

Standard Specification Cover Sheet

The following specifications have been created as go-by specifications for City of Columbia projects. The Design-Build Contractor's Engineer-of-Record shall take full responsibility for the final products' applicability, entire contents of the specification section, and for concordance with the other project documents. Engineer-of-Record must sign and seal all specifications (these standard specifications have not been approved as 'standard specifications' by SCDHEC).

These specifications may be modified or added to if approved in advance by the City of Columbia. Deviations or changes from these standards should be clearly put forward to the City for review and comment/acceptance as early as possible. This is not intended to be a complete or exhaustive list of specifications. Additional content may be needed to successfully complete the project and coordinate with other associated work.

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SECTION 02011
TEST PITS

PART 1 GENERAL

1.01 SCOPE OF WORK

- A. The Work specified in this Section includes the excavation of exploratory test pits to determine or verify underground utility or structure locations or other purposes.
- B. Test pit excavation under this Section shall be made where indicated on the Contract Drawings or as ordered by the City of Columbia (Owner). The Work shall include all necessary excavating, disposing of excavated material, backfilling and compaction, paving, and all incidental Work required. Any test pit performed by the Contractor at locations not shown, or not as directed by the Owner, or for his own convenience shall be at no additional cost to Owner.
- C. This Item of Work is not intended for the general use of the Contractor to verify the location of underground utilities, structures or service connections. The cost of any such Work shall be included in the appropriate Bid Item for permanent Work.

1.02 RELATED WORK

- A. Section 02221 – Trenching Backfill and Compaction
- B. Section 02230 - Granular Fill Materials

1.03 SUBMITTALS

- A. Submit plans showing locations, schedule of completion, and any required traffic impacts and control measures to be implemented for each test pit to be completed.
- B. The Contractor shall submit field sketches and digital photographs (close up and some distance away to show relative location) of each Test Pit completed. Field Sketches shall contain elevations of pipe, conduits, and duct bank inverts and/or crowns, elevations (top and bottom), sizes, locations (horizontal and vertical) from a known point (curb, etc.) and materials of all observed utilities or other obstructions within the trench limit. Test Pits shall be numbered and kept on file with as-built drawings. All test holes must be certified by a SC licensed Engineer or Surveyor. All elevations shall be tied to the project datum and shall include Northing and Easting coordinates.

PART 2 PRODUCTS

2.01 TRENCH REFILL MATERIALS

- A. Refer to Section 02230.

2.02 PAVEMENT

- A. Refer to SCDOT Specifications.

PART 3 EXECUTION

3.01 GENERAL

- A. Test pits for the purpose of identifying any conflicts with underground pipelines or structures shall be excavated in advance of the actual construction at locations shown on the Contract Drawings and as ordered by the Owner and as specified below.
- B. If the test pit is located in the trench limits, temporary pavement is required. If the test pit is located outside the trench limits, permanent restoration is required, including permanent pavement.
- C. The existing pavement and/or sidewalks to be removed shall be carefully saw cut to leave a smooth, straight and vertical edge. Test pits are to be as small as possible while maintaining worker safety. Test pits are to be backfilled and compacted immediately after their purpose has been satisfied and the surface restored and maintained in a manner satisfactory to the Owner.
- D. Material shall be carefully excavated so that the underground utility or structure being searched for, or any other utility or structure, will not be damaged or destroyed. Excavation shall be with a hand shovel if conditions so warrant and hand excavation will be required within two (2) feet of any utility. Any utility or structure damaged or destroyed shall be replaced or repaired at no additional cost to the Owner.
- E. Support of the excavation and dewatering shall be sufficient to accomplish the purpose of the test pit and be in conformance, where required, with other applicable Sections of these Specifications.
- F. The Contractor shall be responsible for having all utilities marked in the area prior to digging a test pit.
- G. The test pit shall be backfilled in accordance with the requirements of Section 02221. If the test pit is within paved areas, it shall be repaved in accordance with SCDOT Standards immediately.

3.02 SERVICE CONNECTION OR UTILITY VERIFICATION

- A. Test pits may be carried out to verify the location and type of service connections or utilities or for other purposes as requested by the Owner.

END OF SECTION

SECTION 02050
DEMOLITION, ABANDONMENT AND SALVAGE

PART 1 - GENERAL

1.01 SCOPE OF WORK

- A. The Work specified in this Section includes furnishing all labor, materials, equipment and incidentals required to demolish, abandon, modify, remove, salvage, and dispose of Work shown on the Contract Drawings and as specified herein.
- B. Included, but not limited to, are demolition, modifications, abandonment, and removal of existing materials, equipment or Work necessary to install the new Work as shown on the Contract Drawings and as specified herein and to connect with existing Work in approved manner.
- C. Demolition, modifications and removals which may be specified under other Sections shall conform to requirements of this Section.
- D. All items designated on the Contract Documents to be removed and salvaged shall be turned over the City of Columbia (Owner) and delivered to a site within the City of Columbia as directed by the Owner. All items indicated for demolition but not indicated for salvage shall be disposed of by the Contractor.
- E. Blasting and the use of explosives will not be permitted for any demolition Work.

1.02 RELATED WORK

- A. Section 02100 - Site Preparation
- B. Section 02221 – Trenching Backfill and Compaction

1.03 SUBMITTALS

- A. Submit to the Owner proposed methods and operations of demolition of the structures and modifications prior to the start of Work. Include the coordination of shutoff, capping and continuation of utility service as required.
- B. Furnish a detailed sequence of demolition and removal of Work to ensure the uninterrupted progress of the Owner's operations.
- C. Before commencing demolition Work, all modifications necessary to bypass the affected structure or utility shall be completed. Actual Work shall not begin until the Owner has inspected and approved the modifications and authorized commencement of the demolition Work in writing.

- D. The Contractor shall remain responsible for any specialty permits required to complete the demolition work and disposal operations.

1.04 JOB CONDITIONS

A. Protection

1. Execute the demolition and removal Work to prevent damage or injury to structures, occupants thereof and adjacent features which might result from falling debris or other causes, and so as not to interfere with the use, and free and safe passage to and from adjacent structures.
2. Closing or obstructing of roadways, sidewalks and passageways adjacent to the Work by the placement or storage of materials will not be permitted and all operations shall be conducted with a minimum interference to traffic on these ways.
3. Erect and maintain all barriers, lights, sidewalk sheds and other required protective devices as required by OSHA and other permitting agencies.

B. Scheduling

1. Carry out operations so as to avoid interference with operations and Work in existing facilities.

C. Notifications

1. At least two weeks prior to commencement of any demolition or removal, confirm with the Owner in writing of proposed schedule therefor. Prior to commencement of any demolition activities, Owner shall inspect the existing equipment and identify and mark those Items which are to remain the property of the Owner. No removals shall be started without the permission of the Owner.

D. Conditions of Structures

1. The Owner and Owner's Representatives assume no responsibility for the actual condition of the structures to be demolished or modified.
2. Conditions existing at the time of inspection for bidding purposes will be maintained by the Owner insofar as practicable. However, variations within a structure may occur prior to the start of demolition Work.

E. Repairs to Damage

1. Promptly repair damage caused to adjacent facilities by demolition operation when directed by Owner and at no cost to the Owner. Repairs shall be made to a condition at least equal to that which existed prior to construction.

F. Traffic Access

1. Conduct demolition and modification operations and the removal of equipment and debris to ensure minimum interference with roads, streets, walks both onsite and offsite and to ensure minimum interference with occupied or used facilities.
2. Special attention is directed towards maintaining safe and convenient access to the existing facilities by City Operations staff and associated vehicles.
3. Do not close or obstruct streets, walks or other occupied or used facilities without permission from the Owner. Furnish alternate routes around closed or obstructed traffic in access ways.

1.05 RULES AND REGULATIONS

- A. The Building Code of the State of South Carolina shall control the demolition, modification or alteration of the existing buildings or structures.

1.06 DISPOSAL OF MATERIAL

- A. Salvageable material and equipment noted on the Contract Drawings shall remain the property of the Owner at their option, otherwise it becomes property of the Contractor and Contractor will be responsible for proper disposal. Dismantle all such items to a size that can be readily handled and deliver them to a designated storage area as directed by the Owner. Any such material damaged due to improper handling will not be accepted and the replacement value of the material deducted from the payment to the Contractor.
- B. All other material and Items of equipment shall become the Contractor's property and must be removed from the site and be disposed of properly.
- C. The storage or sale of removed Items while on the site will not be allowed.

PART 2 PRODUCTS – NOT USED

PART 3 EXECUTION

3.01 GENERAL

- A. All materials and equipment removed from existing Work, shall become the property of the Contractor, except for those which the Owner has identified and marked for his/her use. All materials and equipment marked by the Owner to remain shall be carefully removed, so as not to be damaged, cleaned, protected and delivered to a place specified by the Owner.
- B. Dispose of all demolition materials, equipment, debris and all other Items not marked by the Owner to remain, off the site and in conformance with all existing applicable laws and regulations. The Owner must approve any plans to reuse the material at another location.

C. Pollution Controls

1. All environmental and pollution controls specified elsewhere in the Contract Documents shall be adhered to during demolition.
2. Use water sprinkling, temporary enclosures and other suitable methods to limit the amount of dust and dirt rising and scattering in the air to the lowest practical level. Comply with governing regulations pertaining to environmental protection.
 - a. Do not use water when it may create hazardous or objectionable conditions such as ice, flooding and pollution.
 - b. Clean and protect adjacent structures, facilities, systems, and general Work area of dust, dirt and debris caused by demolition operations. Return adjacent areas to conditions existing prior to the start of the Work.

3.02 STRUCTURAL REMOVALS

- A. Structures designated for demolition or removal shall be removed to a point 3 feet below existing grade (or as shown on the Drawings), or greater if required to provide clearance for new pipelines or other utilities, including allowance for pipe/utility bedding. The portion of the structure that will remain below grade shall be cleaned of rubble and debris including exposed reinforcing steel, backfilled with common fill material in accordance with specification Section 02230 shall be backfilled and graded to match the existing grade around the structure. All mechanical and electrical equipment and piping shall be removed from those structures prior to backfilling and grading in accordance with Section 02221.
- B. Partial removal of structure walls and slabs shall be to the lines shown unless otherwise directed by the Owner. Where no limits are shown, the limits shall be 4-in outside the Item to be installed. The removal of masonry beyond these limits shall be at the Contractor's expense and these excess removals shall be reconstructed to the satisfaction of the Owner with no additional cost to the Owner.
- C. All concrete, brick, tile, concrete block, roofing materials, reinforcement, structural or miscellaneous metals, plaster, wire mesh and other Items contained in or upon the structure shall be removed and taken from the site, unless otherwise approved by the Owner. Demolished Items shall not be used in backfill.
- D. After removal of parts or all of masonry walls, slabs and like Work which tie into new Work or existing Work, the point of junction shall be neatly repaired so as to leave only finished edges and surface exposed.
- E. Contractor shall notify the Owner if items of historical significance are found (brick pavers, cobble stones streets, etc.) and obtain direction from the Owner on necessary procedures for demolition or salvage.

3.03 ABANDONMENT OF EXISTING PIPING AND MANHOLES

- A. Existing piping and manholes designated for abandonment shall be removed from service, dewatered, and filled with flowable fill as specified in Section 02230. Remove valve boxes on all abandoned utilities. Where it is determined by the SCDOT that the existing pipe must instead be removed and the trench backfilled the Contractor shall perform all work including dewatering, excavation, removal and disposal of the pipe and appurtenances, backfill and compaction per the specifications, site restoration, and all other incidentals to the removal of the pipe. No abandoned pipe may be utilized for thrust restraint of an active pipeline.
- B. Where existing piping and manholes are in active service by the Owner, the Contractor shall coordinate with Owner to ensure all services have been relocated and/or abandoned prior to decommissioning of pipe and/or manhole. All utilities to be abandoned shall be isolated as indicated in the approved shop drawings prior to filling with flowable fill.
- C. Provide the Owner ten (10) days notification prior to abandonment of existing piping and manholes.
- D. All manholes to be abandoned shall be removed completely to at least 3-feet below proposed finished grade.

3.04 ELECTRICAL REMOVALS

- A. Electrical removals shall consist of the removal of existing transformers, distribution switchboards, control panels, motors, conduits and wires, poles and overhead wiring, panelboards, lighting fixtures and miscellaneous electrical equipment all as shown on the Contract Drawings, specified herein, or required to perform the Work.
- B. All existing electrical equipment and fixtures to be removed shall be removed with such care as may be required to prevent unnecessary damage, to keep existing systems in operation and to maintain the integrity of the grounding systems.
- C. Conduits and wires shall be abandoned or removed where shown. All wires in abandoned conduits shall be removed, salvaged and stored at Owners option. Abandoned conduits concealed in floor or ceiling slabs or in walls, shall be cut flush with the slab or wall at the point of entrance. The conduits shall be suitably plugged and the area repaired in a flush, smooth and approved manner. Exposed conduits and their supports shall be disassembled and removed from the site. Repair all areas of Work to prevent rust spots on exposed surfaces.
- D. Where shown or otherwise required, wiring in the underground duct system shall be removed. All such wiring shall be salvaged and stored as specified at owner's option. Verify the function of all wiring before disconnection and removing it. Ducts which are not to be reused shall be plugged where they enter buildings and made watertight.
- E. Where shown, direct-burial cable shall be abandoned. Such cable shall be disconnected at both ends of the run. Where it enters a building or structure the cable shall be cut back to the point of entrance. All opening in buildings for entrance of abandoned direct-burial cable shall be patched and made watertight.

- F. Lighting fixtures and other miscellaneous electrical equipment shall be removed or relocated as shown. Fixtures not relocated shall be removed from the site and delivered to Owner or disposed of properly by the Contractor, at the Owners option. Relocated fixtures shall be carefully removed from their present location and rehung where shown.
- G. Care shall be taken in removing all equipment so as to minimize damage to architectural and structural members. All conduits, electrical switches and/or receptacle boxes shall be plugged to prevent migration of gasses. Any damage incurred shall be repaired by the Contractor at no cost to the Owner.

3.05 CLEAN-UP

- A. Remove from the site all debris resulting from the demolition operations as it accumulates. Upon completion of the Work, all materials, equipment, waste and debris of every sort shall be removed and premises shall be left, clean, neat and orderly.

END OF SECTION

SECTION 02100
SITE PREPARATION

PART 1 - GENERAL

1.01 SCOPE OF WORK

- A. The Work specified in this Section includes furnishing all labor, materials and equipment required and performing all site preparation, complete as shown on the Contract Drawings and as specified herein.
- B. Obtain all permits required for site preparation Work prior to proceeding with the Work, including clearing and tree removal.
- C. The areas to be cleared, grubbed and stripped within public rights-of-way and utility easements shall be minimized to the extent possible for the scope of Work and in consideration of the actual means and methods of construction used. No unnecessary site preparation within these areas shall be performed. No tree shall be removed unless specified, shown on the Contract Drawings or with prior permission of the City of Columbia (Owner).
- D. Contractor shall contact the appropriate regulatory authority and the Owner to review and approve any trees to be cut prior to starting any cutting.

1.02 RELATED WORK

- A. Section 02050 - Demolition, Abandonment and Salvage
- B. Section 02221 – Trenching Backfill and Compaction

1.03 SUBMITTALS

- A. Submit to the Owner copies of all permits required prior to clearing, grubbing, and stripping Work.
- B. The proposed site for the disposal of material and debris from the site preparation shall be submitted for approval to the Owner.

PART 2 PRODUCTS – NOT USED

PART 3 EXECUTION

3.01 GENERAL

- A. Mark the area to be cleared at least 5 days prior to commencing work and communicate that marking is complete to the Owner.
- B. Ensure all required stormwater controls required by the Contract Documents and permit requirements are installed and operational prior to performing any clearing or grubbing operations.

3.02 CLEARING

- A. Cut and remove all timber, trees, stumps, brush, shrubs, roots, grass, weeds, rubbish and any other objectionable material resting on or protruding through the surface of the ground.
- B. Preserve and protect trees and other vegetation designated on the Contract Drawings or directed by the Owner to remain as specified below.

3.03 GRUBBING

- A. Grub and remove all stumps, roots in excess of 1-1/2-in in diameter, matted roots, brush, timber, logs, concrete rubble and other debris encountered to a depth of 18-in below original grade or 18-in beneath the bottom of foundations, whichever is deeper.
- B. Refill all grubbing holes and depressions excavated below the original ground surface with common fill and compact to a density conforming to the surrounding ground surface in accordance with Section 02221 and 02230.

3.04 STRIPPING

- A. Strip topsoil from all areas to be occupied by buildings, structures, and roadways and all areas to be excavated or filled.
- B. Topsoil shall be free from brush, trash, large stones and other extraneous material. Topsoil shall not be mixed with subsoil.
- C. Stockpile and protect topsoil until it is used in landscaping, loaming and seeding operations. Dispose of surplus topsoil after all Work is completed.

3.05 DISPOSAL

- A. Cut tree trunks and limbs exceeding 4-in in diameter shall be cut into 4-ft lengths and stockpiled on site in the area designated on the Contract Drawings or approved by the Owner.

- B. Dispose of material and debris from site preparation operations by hauling such materials and debris to an approved offsite disposal area. No rubbish or debris of any kind shall be buried on the site.
- C. Burning of cleared and grubbed materials or other fires for any reason will not be permitted.

3.06 PROTECTION

- A. Trees and other vegetation designated on the Contract Drawings or directed by the Owner to remain shall be protected from damage by all construction operations by erecting suitable barriers, guards and enclosures, or by other approved means. Conduct clearing operations in a manner to prevent falling trees from damaging trees, vegetation, utilities, and structures designated to remain. Conduct clearing to protect the work being constructed and to provide for the safety of employees and others.
- B. Maintain protection until all Work in the vicinity of the Work being protected has been completed.
- C. Immediately repair any damage to existing tree crowns, trunks, or root systems. Roots exposed and/or damaged during the Work shall immediately be cut off cleanly inside the exposed or damaged area. Treat cut surfaces with an acceptable tree wound paint and topsoil spread over the exposed root area.
- D. When Work is completed, remove all dead and downed trees. Live trees shall be trimmed of all dead and diseased limbs and branches. All cuts shall be cleanly made at their juncture with the trunk or preceding branch without injury to the trunk or remaining branches. Cuts over 1-inch in diameter shall be treated with an acceptable tree wound paint.
- E. Restrict construction activities to those areas within the limits of construction designated on the Contract Drawings, within public rights-of-way, and within easements provided by the Owner. Adjacent properties and improvements thereon, public or private, which become damaged by construction operations, shall be promptly restored to their original condition, to the full satisfaction of the property owner.
- F. Construct as necessary based on the type of equipment to be used during the pipelines installations, an access road within the right of way to facilitate the construction activity.

END OF SECTION

SECTION 02140
DEWATERING AND DRAINAGE

PART 1 GENERAL

1.01 SCOPE OF WORK

- A. The Work specified in this Section includes Designing, furnishing, installing, operating, monitoring, maintaining and removing temporary dewatering and drainage systems as required to lower and control water levels to at least 2 feet below the lowest level of the excavation to permit construction in the dry.
- B. Contractor shall obtain and pay for all permits required for temporary dewatering and drainage systems
- C. Furnish, maintain and remove temporary surface water control measures adequate to drain and remove surface water entering excavations.
- D. Retain the services of a Professional Engineer registered in the State of South Carolina to prepare dewatering and drainage system designs and submittals described herein.
- E. Work shall include the design, furnishing equipment and materials, installation, protection, and monitoring of geotechnical instrumentation required to monitor the performance of the dewatering and drainage system as required herein.
- F. Collect and properly dispose of all discharge water from the dewatering and drainage systems in accordance with the provisions of this Section and Section 01046. Under no circumstances shall water from dewatering systems be discharged into the existing or new sanitary sewer systems.
- G. Obtain and pay for all permits required for dewatering and drainage systems.
- H. Repair damage caused by dewatering and drainage system operations.

1.02 RELATED WORK

- A. Section 02100 - Site Preparation.
- B. Section 02221 – Trenching Backfill and Compaction.
- C. Section 02230 - Granular Fill Materials.

1.03 SUBMITTALS

- A. Dewatering and drainage system designs shall be prepared by a licensed Professional Engineer retained by the Contractor. The Contractor shall submit an original and three copies of the licensed Professional Engineer's certification to the City of Columbia (Owner). The Contractor shall also submit qualifications as required herein.
- B. The Contractor shall submit a dewatering and drainage system design plan. The plan shall include a description of the proposed dewatering system and include the proposed installation

methods to be used for dewatering and drainage system elements and for observation wells. The plan shall include equipment, drilling methods, holes sizes, filter sand placement techniques, sealing materials, development techniques, the number and location of dewatering points and observations wells, etc. Include the dewatering system design calculations in the plan.

- C. The plan shall identify the anticipated area influenced by the dewatering system and address any impacts to adjacent existing and proposed structures. The submittal shall also include detailed plans for pre-construction surveys of existing structures in the vicinity of the dewatering system, settlement monitoring of existing structures during construction, and provisions to address settlement of existing structures resulting from dewatering activities.
- D. Coordinate dewatering and drainage submittals with the excavation and support submittals. The submittal shall show the areas and depths of excavation to be dewatered.
- E. Do not proceed with any excavation or dewatering activities until the dewatering submittals has been reviewed and approved by the Contractor's Engineer and acknowledged by the Owner.
- F. If visible contaminants, odorous waste or any other potentially hazardous material is encountered during the dewatering process, the Contractor shall stop work and store the contaminated water in approved containers. Contractor shall develop and submit a disposal plan in accordance with all the latest regulations, Owner to review and acknowledge. The Contractor shall make every effort to limit the environmental impact of the contaminants.
- G. Preconstruction surveys as specified below.
- H. Monitoring reports as specified below.

1.04 QUALITY ASSURANCE

- A. Regulations: Perform all work in accordance with current applicable regulations and codes of all Federal, State and local agencies.
- B. The Contractor's Engineer shall be registered in the State of South Carolina and have a minimum of 5 years of professional experience in the design and construction of dewatering and drainage systems and shall have completed not less than 5 successful dewatering and drainage projects of equal type, size, and complexity to that require for the work.

1.05 DESIGN REQUIREMENTS

- A. The Contractor is responsible for the proper design and implementation of methods for controlling surface water and groundwater.
- B. The primary purpose of the groundwater control system is to preserve the natural undisturbed condition of the subgrade soils in the areas of the proposed excavations. Prior to excavation, the Contractor shall lower the groundwater to at least 2-ft below the lowest excavation subgrade elevation. Additional groundwater lowering may be necessary beyond the 2-ft requirement, depending on construction methods and equipment used and the prevailing groundwater and soil conditions. The Contractor is responsible for lowering the groundwater as necessary to complete construction in accordance with the plans and specifications at no additional cost to the Owner.

- C. Design deep wells, well points and sumps, and all other groundwater control system components to prevent loss of fines from surrounding soils. Sand filters shall be used with all dewatering installations unless screens are properly sized by the Contractor's Engineer to prevent passage of fines from surrounding soils.
- D. The Contractor shall be responsible for damage to properties, buildings or structures, sewers and other utility installations, pavements and work that may result from dewatering or surface water control operations.
- E. Design review and field monitoring activities by the Owner shall not relieve the Contractor of his/her responsibilities for the work.
- F. The Contractor shall perform pre-conditions surveys of facilities located within 50ft of the work. Pre-condition survey shall be performed to include detailed documentation of facilities to include, but not limited to, buildings, roadways, utilities, asphalt parking lots and driveways. Surveys shall document interior and exterior cracking, settlement and distresses which exist prior to any construction activities. Pre-condition shall be submitted to the Contractor's Engineer and the Owner prior to beginning any construction activity.

1.06 DEFINITIONS

- A. Where the phrase "in-the-dry" is used in this Section, it shall be defined as an excavation subgrade where the groundwater level has been lowered to at least 2-ft below the lowest level of the excavation, is stable with no ponded water, mud, or muck, is able to support construction equipment without rutting or disturbance and is suitable for the placement and compaction of fill material, pipe or concrete foundations.

PART 2 PRODUCTS

2.01 MATERIALS

- A. Piping, wells, pumping equipment and all other materials required to provide control of surface water and groundwater in excavations shall be suitable for the intended purpose.
- B. Standby pumping systems and a source of standby power shall be maintained at all sites.

PART 3 EXECUTION

3.01 GENERAL

- A. Control surface water and groundwater such that excavation to final grade is made in-the-dry, the natural undisturbed condition of the subgrade soils are maintained, and softening and/or instability or disturbance due to the presence or seepage of water does not occur. All construction and backfilling shall proceed in-the-dry and flotation of completed portions of work shall be prohibited.
- B. Methods of groundwater control may include but are not limited to perimeter trenches and sump pumping, perimeter groundwater cutoff, well points, ejectors, deep wells and combinations thereof.

- C. Where groundwater levels are above the proposed bottom of excavation level, a pumped dewatering system will be required for pre-drainage of the soils prior to excavation, and for maintaining the lowered groundwater level until construction has been completed to such an extent that the structure, pipeline or fill will not be floated or otherwise damaged.
- D. It is expected that the type of system, spacing of dewatering units and other details of the work will have to be varied depending on soil/water conditions at a particular location.
- E. All work included in this Section shall be done in a manner which will protect adjacent structures and utilities and shall not cause loss of ground or disturbance to the pipe bearing soils or to soils which support overlying or adjacent structures.
- F. Install, monitor and report data from observation wells. Evaluate the collected data relative to groundwater control system performance and modify systems as necessary to dewater the site in accordance with the Contract requirements.
- G. Locate groundwater control system components where they will not interfere with construction activities adjacent to the work area or interfere with the installation and monitoring of geotechnical instrumentation including observation wells. Excavations for sumps or drainage ditches shall not be made within or below 1H:1V slopes extending downward and out from the edges of existing or proposed foundation elements or from the downward vertical footprint of the pipe.
- H. All above ground pumps and/or power units shall be equipped with sound attenuation measures to reduce noise levels to 75-decibels maximum at a 50-foot distance from the equipment during all operation periods or meet other noise requirements governing the location of construction. The most stringent noise requirements must be met at all time.

3.02 SURFACE WATER CONTROL

- A. Construct surface water control measures, including dikes, ditches, sumps and other methods to prevent, as necessary, flow of surface water into excavations and to allow construction to proceed without delay.

3.03 EXCAVATION DEWATERING

- A. At all times during construction, provide and maintain proper equipment and facilities to promptly remove and properly dispose of all water entering excavations. Excavations shall be maintained in-the-dry. Groundwater levels shall be kept at least 2-ft below the lowest excavation level.
- B. Excavation dewatering shall maintain the subgrade in a natural undisturbed condition and until the fill, structure or pipes to be built thereon have been completed to such extent that they will not be floated or otherwise damaged by allowing water levels to return to natural elevations.
- C. Pipe, masonry, and concrete shall not be placed in water or be submerged within 24 hours after being installed. Water shall not flow over new masonry or concrete within four days after placement.
- D. In no event shall water rise to cause unbalanced pressure on structures until the concrete or mortar has set at least 24 hours. Prevent flotation of the pipe by promptly placing backfill.

- E. Dewatering shall at all times be conducted in such a manner as to preserve the natural undisturbed condition of the subgrade soils at the proposed bottom of excavation.
- F. If the subgrade of the trench or excavation bottom becomes disturbed due to inadequate dewatering or drainage, excavate below normal grade as directed by the Contractor's Engineer and refill with structural fill, screened gravel or other material as approved by the Contractor's Engineer and acknowledged by the Owner at no additional cost.
- G. It is expected that the initial dewatering plan may have to be modified to suit the variable soil/water conditions to be encountered during construction. Dewater and excavate, at all times, in a manner which does not cause loss of ground or disturbance to the pipe bearing soil or soil which supports overlying or adjacent structures.
- H. Dewatering units used in the work shall be surrounded by suitable filter sand and no fines shall be removed by pumping. Pumping from the dewatering system shall be continuous until pipe or structure is adequately backfilled. Stand-by pumps shall be provided.
- I. Water entering the excavation from precipitation or surface runoff shall be collected in shallow ditches around the perimeter of the excavation, drained to a sump and pumped from the excavation to maintain a bottom free from standing water.
- J. Drainage shall be disposed of in an approved area as specified in Section 01046. Existing or new sanitary sewers shall not be used to dispose of drainage.

3.04 WELL POINT SYSTEMS

- A. Where necessary, install a vacuum well point system around the excavation to dewater the excavation. Each well point and riser pipe shall be surrounded by a sand or gravel filter. Sand or gravel shall be of such a gradation that, after initial development of the well points, the quantity and size of soil particles discharged shall be negligible. Well point systems shall be capable of operating continuously under the highest possible vacuum.
- B. Installation of well point systems shall be in accordance with the approved submittal and in the presence of the Contractor's Engineer and the Owner.

3.05 DEEP WELLS

- A. Where necessary, install a deep well system around the excavation to dewater or depressurize the excavation. Each well shall be surrounded by a sand or gravel filter with adequate gradation such that after development, the quantity and size of soil particles discharged are negligible. Sufficient number of wells shall be installed to lower or depressurize the groundwater level to allow excavation to proceed in-the-dry.
- B. Installation of deep well shall be in accordance with the approved submittal and in the presence of the Contractor's Engineer and the Owner.

3.06 OBSERVATION WELLS

- A. Install observation wells to monitor groundwater levels beneath and around the excavated area until adjacent structures and pipelines are completed and backfilled.

B. Observation Well Locations and Depths:

1. A minimum of 3 wells (one upstream and two downstream of the groundwater gradient) shall be installed around the excavation area. They shall be located in critical areas with respect to groundwater control to monitor performance of dewatering systems designed by the Contractor's Engineer.
2. Observation wells required shall be installed to a depth of at least 10-ft below the deepest level of excavation, unless otherwise approved by the Contractor's Engineer and acknowledged by the Owner, and to whatever depth is necessary to indicate that the groundwater control system designed by the Contractor's Engineer is performing as intended. Additional observation wells may be required by the Contractor's Engineer if deemed necessary to monitor the performance of the Contractor's groundwater control system.

C. Protect the observation wells at ground surface by providing a lockable box or outer protective casing with lockable top and padlock. Design the surface protection to prevent damage by vandalism or construction operations and to prevent surface water from infiltrating.

1. Provide two copies of keys for each padlock to the Contractor's Engineer for access to each well.
2. Observation wells shall be developed so as to provide a reliable indication of groundwater levels. Wells shall be re-developed if well clogging is observed, in the event of apparent erroneous readings, or as directed by the Contractor's Engineer and acknowledged by the Owner.
3. Submit observation well installation logs, top of casing elevation, and well locations to the Contractor's Engineer and the Owner within 24 hours of completion of well installation.

D. Observation Well Maintenance

1. The Contractor shall maintain each observation well until adjacent structures and pipelines are completed and backfilled. Clean out or replace any observation well which ceases to be operable before adjacent work is completed.
2. It is the Contractor's obligation to maintain observation wells and repair or replace them at no additional cost to the Owner, whether or not the observation wells are damaged by the Contractor's operations or by third parties.

E. Monitoring and Reporting of Observation Well Data

1. The Contractor shall begin daily monitoring of groundwater levels in work areas prior to initial operation of drainage and dewatering system. Daily monitoring in areas where groundwater control is in operation shall continue until the time that adjacent structures and pipelines are completed and backfilled and until the time that groundwater control systems are turned off.
2. The Contractor is responsible for processing and reporting observation well data to the Contractor's Engineer on a daily basis. Data is also to be provided to the Owner daily on a form, which shall include the following information: observation well number, depth to

groundwater, total depth of well, top of casing elevation, groundwater level elevation and date and time of reading.

- F. The groundwater level shall be kept at a minimum of 2-ft below the lowest subgrade level for a given excavation.

3.07 REMOVAL OF SYSTEMS

- A. At the completion of the excavation and backfilling work, and when approved by the Contractor's Engineer and acknowledged by the Owner, all pipe, deep wells, well points, pumps, generators, observation wells, other equipment and accessories used for the groundwater and surface water control systems shall be removed from the site. All materials and equipment shall become the property of the Contractor. All areas disturbed by the installation and removal of groundwater control systems and observation wells shall be restored to their original condition.
- B. Leave in place any casings for deep wells, well points or observation wells located within the plan limits of structures or pipelines or within the zone below 1H:1V planes extending downward and out from the edges of foundation elements or from the downward vertical footprint of the pipe, or where removal would otherwise result in ground movements causing adverse settlement to adjacent ground surface, utilities or existing structures.
- C. Where casings are pulled, holes shall be filled with sand. Where left in place, casings should be filled with cement grout and cut off a minimum of 3-ft below finished ground level or 1-ft below foundation level so as not to interfere with finished structures or pipelines.

END OF SECTION

SECTION 02221
TRENCHING BACKFILL AND COMPACTION

PART 1 - GENERAL

1.01 SCOPE OF WORK

- A. Furnish all labor, materials, equipment and incidentals required and perform all trenching for pipelines and appurtenances, including drainage, filling, backfilling, disposal of surplus material and restoration of trench surfaces and easements.
- B. Excavation shall extend to the width and depth shown on the Drawings or as specified herein and shall provide suitable room for installing pipe, structures and appurtenances.
- C. Furnish and place all sheeting, bracing and supports and remove from the excavation all materials which the City of Columbia (Owner) may deem unsuitable for backfilling. The bottom of the excavation shall be firm, dry and in all respects, acceptable. If conditions warrant, deposit gravel for pipe bedding, or gravel refill for excavation below grade, directly on the bottom of the trench immediately after excavation has reached the proper depth and before the bottom of the trench has become softened or disturbed by any cause whatever. The length of open trench shall be related closely to the rate of pipe laying. All excavation shall be made in open trenches.
- D. All excavation, trenching and related sheeting, bracing, etc., shall comply with the requirements of OSHA excavation safety standards (29 CFR Part 1926 Subpart P).
- E. Whenever a requirement for percent compaction is referred to herein, it shall mean at least that percent of maximum density as determined by ASTM D1557, Method D.

1.02 RELATED WORK

- A. Section 02011 – Test Pits.
- B. Section 02100 – Site Preparation.
- C. Section 02140 – Dewatering and Drainage.
- D. Section 02230 - Granular Fill Materials.

1.03 JOB CONDITIONS

- A. Existing utilities:
 - 1. Approximate location of certain underground lines and structures are shown on the plans for information only, other underground lines or structures may not be shown.
 - 2. Locate these and other possible unknown utility lines using electronic pipe finder, or other approved means.

3. Locate, excavate and expose all existing underground lines in advance of trenching operations.
4. The Contractor will be held responsible for the workmanlike repair of any damage done to any of these utilities in the execution of his work under this Section.
5. The Contractor shall familiarize himself with the existing conditions and be prepared to adequately care for and safeguard himself and the Owner from damage.
6. All Work shall be completed in accordance with the provisions of the contract.

B. Notification of intent to excavate:

1. South Carolina Underground Utility Damage Prevention Act (latest edition) requires persons to ascertain the location of underground public utility property prior to excavation or demolition in certain situations. The Act also requires such persons to give timely notice of intent to excavate or demolish prior to commencing such operations. Failure to comply could subject the violator to a civil penalty of up to one thousand dollars (\$1,000) for each violation of the Act.
2. Notification of intent to excavate may be given by calling this toll-free number: 1-888-721-7877 or locally at 811.

C. Protecting trees, shrubbery and lawns:

1. Trees and shrubbery in developed areas and along the trench line shall not be disturbed unless absolutely necessary, and subject to the approval of the Owner and in accordance with Section 01046. Any such trees and shrubbery necessary to be removed shall be heeled in and replanted.

D. Clearing:

1. Perform all clearing necessary for installation of the complete work in accordance with Section 02100.
2. Clearing shall consist of removing all trees, stumps, roots, brush and debris in the rights-of-way obtained for the Work.
3. All material, including trimmings from above, shall be completely disposed of in a satisfactory manner.

E. Removing and resetting fences:

1. Where existing fences must be removed to permit construction of utilities, remove such fences and reset the fences in their original location and condition or as directed by the Owner as the Work progresses.
2. Provide temporary fencing or other safeguards as required.

F. Restoration of disturbed areas:

1. Restore all areas disturbed by construction activities to their existing or better condition. For existing areas with sod type grasses, replace with new sod of same type as existing. Existing sod may be reused where properly removed and stored and as approved by the Owner.

1.04 SUBMITTALS

- A. Prior to the start of work, submit the proposed method of backfilling and compaction to the Owner for review.
- B. Submit technical product literature for all geotextile products to be used for excavation and backfill.
- C. For any excavations 20 feet deep or deeper, the Contractor shall submit method of bracing/sheeting designed and stamped by a Professional Engineer licensed in the state of South Carolina. Submittal to the Owner shall be for information purposes only.

PART 2 PRODUCTS

2.01 EXCAVATED MATERIALS

- A. Perform all excavation of every description and of whatever substances encountered to depths indicated or specified.
- B. Pile material suitable for backfilling in an orderly manner at safe distance from banks or trenches to avoid overloading and to prevent slides or cave-ins.
- C. Remove and dispose unsuitable or excess materials.

2.02 BACKFILL MATERIALS

- A. Provide backfill material in accordance with Section 02230 and the Contract Drawings.
 1. Select soil material free from organic matter and deleterious substances, containing no rocks or lumps over 2" in greatest dimension for backfill up to 12" above top of utility being covered.
 2. Do not permit rocks larger than 2" in greatest dimension in top 6" of backfill.
- B. Should the quantity of suitable on-site material be insufficient to complete the work, Contractor shall provide suitable borrow material as approved by the Owner at no additional expense to the Owner.

2.03 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 3; AASHTO M 288.
 2. Survivability: As follows
 - a. Grab Tensile Strength: 120 lbf (534 N); ASTM D 4632/ D 4632M.
 - b. Tear Strength: 50 lbf (223 N); ASTM D 4533/D 4533 M.
 - c. Puncture Strength: 310 lbf 1 N); ASTM D 6241.
 3. Apparent Opening Size: No. 70 (0.212-mm) sieve, maximum; ASTM D 4751.
 4. Permittivity: 0.1 per second, minimum; ASTM D 4751.
 5. UV Stability: 70 percent after 500 hours' exposure; ASTM D 4355/D 4355M.
- B. Product: Provide "Mirafi 140N," by TenCate Geosynthetics – Nicolon Corporation, or equal.

PART 3 EXECUTION

3.01 TRENCH EXCAVATION

- A. Trench excavation shall include material of every description and of whatever substance encountered, except rock and boulders. Pavement shall be cut with a saw, wheel or pneumatic chisel along straight lines before excavating.
- B. Strip and stockpile topsoil from grassed areas crossed by trenches. At the Contractor's option, topsoil may be otherwise disposed of and replaced, when required, with approved topsoil of equal quality.
- C. While excavating and backfilling is in progress, traffic shall be maintained, and all utilities and other property protected as specified in other sections of these Contract Documents.
- D. Trenches shall be excavated to the depth indicated on the Drawings and in widths sufficient for laying the pipe, bracing and for pumping and drainage facilities. The bottom of the excavations shall be firm and dry and in all respects acceptable to the Owner. Trench width shall be practical minimum.
- E. Excavation and dewatering shall be accomplished by methods which preserve the undisturbed state of subgrade soils. The trench may be excavated by machinery to, or just below the designated subgrade, provided that material remaining in the bottom of the trench is no more than slightly disturbed. Subgrade soils which become soft, loose, "quick", or otherwise unsatisfactory as a result of inadequate excavation, dewatering or other construction methods shall be removed and replaced by crushed stone fill as required by the Owner at the Contractor's expense.

- F. Clay and organic silt soils are particularly susceptible to disturbance due to construction operations. When excavation is to end in such soils, use a smooth-edge bucket to excavate the last 1-ft of depth.
- G. Where pipe is to be laid in gravel bedding, the trench may be excavated by machinery to the normal depth of the pipe provided that the material remaining in the bottom of the trench is no more than slightly disturbed.
- H. Where pipe is to be laid directly on the trench bottom, final excavation at the bottom of the trench shall be performed manually, providing a flat-bottom true to grade upon undisturbed material. Bell holes shall be made as required.

3.02 DISPOSAL OF MATERIALS

- A. Excavated material shall be stacked without excessive surcharge on the trench bank or obstructing free access to hydrants and other utilities. Inconvenience to traffic and abutters shall be avoided as much as possible. Excavated material shall be segregated for use in backfilling as specified below.
- B. All excavated material not used for backfilling shall be removed from the site of the work and disposed of, except as directed by the Owner. Dispose of such surplus material in approved designated areas.
- C. Should conditions make it impracticable or unsafe to stack material adjacent to the trench, the material shall be hauled and stored at a location approved by the Owner. When required, it shall be re-handled and used in backfilling the trench.

3.03 SHEETING AND BRACING

- A. Furnish, put in place and maintain sheeting and bracing required by Federal, State or local safety requirements to support the sides of the excavation and prevent loss of ground which could endanger personnel, damage or delay the work or endanger adjacent structures. If the Owner is of the opinion that at any point sufficient or proper supports have not been provided, he/she may order additional supports placed at the expense of the Contractor. Compliance with such order shall not relieve the Contractor from his/her responsibility for the sufficiency of such supports. Care shall be taken to prevent voids outside of the sheeting, but if voids are formed, they shall be immediately filled and rammed.
- B. When moveable trench bracing such as trench boxes, moveable sheeting, shoring or plates are used to support the sides of the trench, care shall be taken in placing and moving the boxes or supporting bracing to prevent movement of the pipe, or disturbance of the pipe bedding and the gravel backfill.
 - 1. When installing rigid pipe (R.C., D.I., etc.), any portion of the box extending below mid diameter shall be raised above this point prior to moving the box ahead to install the next pipe. This is to prevent the separation of installed pipe joints due to movement of the box.
 - 2. When installing flexible pipe (PVC, etc.), trench boxes, moveable sheeting, shoring or plates shall not be allowed to extend below mid-diameter of the pipe. As trench boxes, moveable sheeting, shoring or plates are moved, gravel shall be placed to fill any voids

created and the gravel and backfill shall be re-compacted to provide uniform side support for the pipe.

- C. The cost for use of sheeting will be included in the bid items for pipe and shall include full compensation for driving, bracing and later removal of sheeting.
- D. All sheeting and bracing shall be carefully removed in such manner as not to endanger the construction of other structures, utilities, or property, whether public or private. All voids left after withdrawal of sheeting shall be immediately refilled with sand and rammed with tools especially adapted to that purpose, or by watering or otherwise as approved by the Owner.
- E. No payment will be given for sheeting, bracing, etc., during the progress of the work. No payment will be given for sheeting which has actually been left in the trench for the convenience of the Contractor.
- F. Sheetting driven below mid-diameter of any pipe shall remain in place from the driven elevation to at least 1-ft above the top of the pipe.

3.04 TEST PITS

- A. Excavation of test pits may be required for the purpose of locating underground utilities or structures as an aid in establishing the precise location of new work.
- B. Test pits shall be backfilled as soon as the desired information has been obtained. The backfilled surface shall be maintained in a satisfactory condition for travel until resurfaced as specified.
- C. Test pits shall be excavated in accordance with Section 02011.

3.05 EXCAVATION BELOW GRADE AND REFILL

- A. Whatever the nature of unstable material encountered or the groundwater conditions, trench drainage shall be complete and effective.
- B. If the Contractor excavates below grade through error or for the Contractor's own convenience, or through failure to properly dewater the trench, or disturbs the subgrade before dewatering is sufficiently complete, he may be directed by the Owner to excavate below grade as set forth in the following paragraph, in which case the work of excavating below grade and furnishing and placing the refill shall be performed at his own expense.
- C. If the material at the level of trench bottom consists of fine sand, sand and silt or soft earth which may work into the gravel pipe bedding, the subgrade material shall be removed to the extent directed and the excavation refilled with a 6-in layer of coarse sand, or a mixture graded from coarse sand to the fine stone, as approved by the Owner, to form a filter layer preserving the voids in the gravel bed of the pipe. The composition and gradation of gravel shall be approved by the Owner prior to placement. Gravel shall then be placed in 6-in layers thoroughly compacted up to the normal grade of the pipe.
 - 1. Payment for excavation below grade and refill shall be at the unit price bid in the Schedule of Prices for the Over Excavation of Unsuitable Soils and Refill bid Item. Payment shall only be made for removal and replacement of existing unsuitable soils. No payment will

be made for removal and replacement of unsuitable soils resulting from improper excavation, improper dewatering or accidental over-excavation by the Contractor.

- D. Geotextile non-woven filter fabric may be substituted for filter layer if approved by the Owner/.

3.06 BACKFILLING

- A. As soon as practicable after the pipe has been laid and jointed, backfilling shall begin and thereafter be prosecuted expeditiously. Bedding gravel, as specified for the type of pipe installed, shall be placed up to 1-ft over the pipe.
- B. An impervious dam or bulkhead cutoff of clay or other impervious material shall be constructed in the trench as directed, to interrupt the unnatural flow of groundwater after construction is completed. The dam shall be effectively keyed into the trench bottom and sidewalls. Provide at least one clay or other impervious material dam in the pipe bedding every 300-ft or as directed by the Owner.
- C. Where the pipes are laid in streets, the trench shall be backfilled with flowable fill per standard details and SCDOT Accommodations Manual.
- D. Where pipes are laid in State Highways, backfill shall be with flowable fill and as shown on the Drawings and as required by the SC DOT Encroachment permit up to the subbase of the pavement.
1. Approval or inspection prior to placement or following placement may be required by the Owner, SCDOT, or entity having jurisdiction over the work. Contractor to coordinate inspections and be familiar with all placement requirements. Any required rework due to lack of coordination by the Contractor shall be completed at no additional cost to the Owner.
 2. If any material is placed that does not comply with the Contract Documents, that material shall be removed and disposed of and suitable material replaced as backfill all at no additional cost to the Owner.
- E. To prevent longitudinal movement of the pipe, dumping backfill material into the trench and then spreading will not be permitted until selected material or gravel has been placed and compacted to a level 1-ft over the pipe.
- F. Backfill shall be brought up evenly on all sides. Each layer of backfill material shall be thoroughly compacted by rolling, tamping, or vibrating with mechanical compacting equipment or hand tamping, to 95 percent compaction. If rolling is employed, it shall be by use of a suitable roller or tractor, being careful to compact the fill throughout the full width of the trench.
- G. Compaction by puddling or water jetting shall not be permitted.
- H. Compaction in confined areas shall be by use of hand or pneumatic ramming with tools weighing at least 20 lbs. The material shall be spread and compacted in layers not exceeding 6-in thick, uncompacted loose measure thickness.

- I. Backfill around structures shall be granular fill material as specified and as shown on the Drawings. All backfill shall be spread and compacted as specified, especially under and over pipes connected to the structures.
- J. Bituminous paving shall not be placed in backfilling unless specifically permitted, in which case it shall be broken up as directed. Frozen material shall not be used under any circumstances.
- K. All road surfaces shall be broomed and hose-cleaned immediately after backfilling. Dust control measures shall be employed at all times.

3.07 RESTORING TRENCH SURFACE

- A. Where the trench occurs adjacent to paved streets, in shoulders, sidewalks, or in cross-country areas, thoroughly compact the backfill and maintain the surface as the work progresses. If settlement takes place, immediately deposit additional fill to restore the level of the ground.
- B. The surface of any driveway or any other area which is disturbed by the trench excavation and which is not a part of the paved road shall be restored to a condition at least equal to that existing before work began.
- C. In sections where the pipeline passes through grassed areas, and at the Contractor's own expense, remove and replace the sod, or loam and seed the surface to the satisfaction of the Owner.

END OF SECTION

SECTION 02230
GRANULAR FILL MATERIALS

PART 1 - GENERAL

1.01 SCOPE OF WORK

- A. Furnish all labor, materials, equipment and incidentals required and obtain materials for filling and backfilling, grading and miscellaneous site work, for the uses shown on the Drawings and as specified herein.

1.02 RELATED WORK

- A. Section 02100 – Site Preparation.
- B. Section 02221 - Trenching, Backfilling and Compaction .

1.03 SUBMITTALS

- A. Submit, in accordance with Section 01300, complete product data and sieve analysis for all materials specified in this Section.
- B. Certification from the supplier of Flowable Fill that mix design is in accordance with SCDOT Supplemental Technical Specification, SCDOT SC-M-210.

PART 2 PRODUCTS

2.01 MATERIALS

- A. Granular materials shall be free of all organic material, trash, snow, ice, frozen soil, or other objectionable materials which may be compressible or which cannot be properly compacted.
- B. Materials labelled as (wrapped) on the Drawings require geotextile wrap to control the migration of fines into open voids. In all cases, use a geotextile that prevents the transmission of the smallest soil particles present in both the in-situ soil and the soil used for bedding and structural backfill.
- C. Crushed Stone (commonly known as #57 stone) shall be sound, durable stone, angular in shape, and free of any foreign material, structural defects and chemical decay. Crushed stone shall conform to the following gradation limits:

Sieve Size	Percent Fines by Weight
1 1/2-in	100
1-in	95-100
1/2-in	25-60
No. 4	0-10
No. 8	0-5

- D. Crushed Stone may be substituted with SCDOT 305.2.1 Macadam Base upon the Contractor's Engineer's approval. Ensure that aggregate is free from organic matter, sand, lumps or balls of clay and other deleterious material. Macadam Base shall conform to the following gradation limits:

Sieve Size	Percent Fines by Weight
2-in	100
1 1/2-in	95-100
1-in	70-100
1/2 -in	48-75
No. 4	30-60
No. 30	11-30
No. 200*	0-12

*AASHTO T-11 is used to determine the amount passing the No. 200 sieve.

- E. Crusher run shall be sound, durable stone, angular in shape, and free of any foreign material, structural defects and chemical decay. Crusher run shall conform to the following gradation limits:

Sieve Size	Percent Fines by Weight
1-in	100
3/4-in	90
1/2-in	60
1/4-in	25

- F. Common fill shall be free of any foreign material, structural defects and chemical decay. Common fill shall also be free from organic material and muck. Material shall be screened mixed in order to distributed any large pieces of clay. Materials shall have a maximum dry density not less than 100 lbs/ft³ at optimum moisture when tested in accordance with SC-T-29.
- G. Sand shall consist of hard, sharp, angular grains of quartz or other durable rock, free from excessive quantities of clay or other deleterious substances, and containing not more than 10.0% total material passing the No. 200 sieve with a maximum of 6.0% clay. Use sand that is free of clay balls, and if it has any clay contained within it, the clay is uniformly dispersed throughout the material. Excavated, blend, and stockpile the sand so that a uniform product is provided.

Gravel shall be composed of hard durable particles of clean stone, free from an excess of thin or elongated pieces, vegetable matter, or other deleterious substances. Gravel shall conform to the following gradation limits:

Sieve Size	Percent Fines by Weight
2-in	100
1 1/2-in	95-100
1-in	70-100
1/2-in	35 - 65
No. 4	10 - 40

- H. Structural fill shall be sound, durable stone free of any foreign material structural defects and chemical decay. Structural fill shall consist of the following soil types, as defined by AASHTO M 145: Well Graded A-1 soils, Screenings meeting A-1, Macadam Graded aggregate base, Uniformly graded coarse sand A-3 soils (wrapped), Uniformly graded angular stone as large as #5 stone (wrapped).
- I. Flowable Fill shall be easily excavated, consisting of a mixture of Portland cement, fly ash, fine aggregate, air entraining admixture, and water. Flowable Fill shall meet the requirements of the latest edition of SCDOT SC-M-210.
 - 1. The Contractor shall utilize flowable fill as identified in the Contract Drawings, the SCDOT Encroachment Permit, or other applicable permits.
 - 2. The materials and equipment used to produce, transport, and place flowable fill shall be in compliance with the requirements set forth by the SCDOT Standard Specifications for Highway Construction, latest edition. Sampling and testing of flowable fill and materials used to produce it may be required at the discretion of the City of Columbia (Owner) at no additional cost.
 - 3. The Contractor shall be responsible for providing the Owner with certification from the supplier that mix design is in accordance with SCDOT Standard Specification for Highway Construction, latest edition, SCDOT SC-M-210. The Contractor shall use all necessary construction techniques to assure that the finished material will perform as intended. Anticipated unconfined compressive strength for the mixtures shall be as specified in SCDOT SC-M-210.
 - 4. Flowable fill will harden sufficiently to allow full traffic within 8 to 20 hours, depending upon placement conditions. If necessary to return traffic in less than 8 hours or if there is concern that traffic flow will cause damage to the fill or any structure below, steel plates shall be used to bridge over the hardening flowable fill as directed by the Owner.

PART 3 EXECUTION (NOT USED)

END OF SECTION

SECTION 02290
PIPE JACKING

PART 1 GENERAL

1.01 SCOPE OF WORK

- A. Furnish all labor, materials, equipment, supplies, and incidentals required and install casing pipe and carrier pipe by jacking at the locations shown on the Drawings and as specified herein.
- B. Work shall be done in strict accordance with the details shown on the Drawings and as specified herein and in accordance with all South Carolina Department of Transportation (SCDOT) requirements and other applicable permit requirements.
- C. The work shall include, but not be limited to, the following: steel casing pipe, excavation within casing, contact grouting of annular space outside of casing, carrier pipe, casing spacers, casing seals, filling annular void between casing and carrier pipe, coatings, location markers, vents and miscellaneous appurtenances as required to complete the installation.
- D. Furnish special insurance, traffic control, flaggers, and any other requirements imposed by all permitting agencies.

1.02 RELATED WORK

- A. Section 02100 - Site Preparation.
- B. Section 02140 - Dewatering and Drainage.
- C. Section 02221 - Trenching Backfill and Compaction.
- A. Section 02610 - Sewer Testing and Cleaning.
- B. Section 02612 – Cleaning Testing and Disinfection of Water Lines.
- C. Section 02615 - Ductile Iron Pipe for Buried Sewer Service.
- D. Section 02509 – Ductile Iron Pipe for Buried Water Service.

1.03 SUBMITTALS

- A. Submit complete shop drawings and product data for casing pipe, carrier pipe, fittings and related appurtenances. Submit a lay schedule showing stationing, elevations, pipe classes and class coding.
- B. At least 30 days prior to the scheduled start of any jacking operations, submit the proposed methods of jacking. Review will be for information only.

- C. Contractor shall remain responsible for adequacy and safety of construction means, methods, and techniques. Submittals shall consist of design drawings, calculations and related supplemental information describing in detail the design concept for all jacking operations. Submittals shall include, as a minimum, the following:
 - 1. Detailed descriptions of equipment, materials, sequence, and procedures for jacking steel sleeve with shield including provisions for standby and backup equipment.
 - 2. Revisions to shop drawings, as necessary, to accommodate field conditions and/or compliance as specified herein.

1.04 REFERENCE STANDARDS

- A. American Society for Testing and Materials (ASTM)
 - 1. ASTM A36 — Standard Specification for Carbon Structural Steel.
 - 2. ASTM A53 — Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless.
 - 3. ASTM A139 — Standard Specification for Electric-Fusion (Arc) Welded Steel Pipe (NPS 4-inches and over).
 - 4. ASTM C144 — Standard Specification for Aggregate for Masonry Mortar.
 - 5. ASTM C150 — Standard Specification for Portland Cement.
 - 6. ASTM C207 — Standard Specification for Hydrated Lime for Masonry Purposes.
- B. American Water Works Association (AWWA)
 - 1. AWWA C200 — Steel Water Pipe — 6-in (150 mm) and Larger.
 - 2. AWWA C203 — Coal-Tar Protective Coatings and Linings for Steel Water Pipelines — Enamel and Tape — Hot-Applied.
 - 3. AWWA C206 — Field Welding of Steel Water Pipe.
- C. Where reference is made to one of the above standards, the revision in effect at the time of bid opening shall apply.

1.05 QUALITY ASSURANCE

- A. Steel casing pipe shall be the product of a single manufacturer. Pipe shall be tested and inspected at the foundry as required by the standard specifications to which the material is manufactured. Submit sworn certificates of such tests, results and satisfactory approvals.
- B. All pipe to be installed under this Contract may be inspected at the site of manufacture for compliance with this Section by an independent laboratory selected by the City of Columbia (Owner). The manufacturer's cooperation shall be required in these inspections. The cost of any

inspection requested by the Owner of all pipe approved for this Contract shall be borne by the Owner.

- C. Welders shall be certified in accordance with standards of AWS. Submit current certifications prior to the start of field work.

1.06 SYSTEM DESCRIPTION

- A. The completed installation shall be suitable in all respects for transporting water/sewage without affecting the stability and integrity of the overlying roadways/structures.

1.07 DELIVERY, STORAGE, AND HANDLING

- A. Care shall be taken in loading, transporting, and unloading to prevent injury to the pipe or coatings. Pipe shall not be dropped. Any damage to the pipe coatings shall be repaired as recommended by the manufacturer and as approved by the Owner.
- B. All pipe shall be subjected to careful inspection prior to being installed. If any pipe fails to meet the requirements specified herein, it shall be removed and replaced with satisfactory pipe.

1.08 PROJECT/SITE REQUIREMENTS

- A. Discharge from dewatering operations shall be directed into approved receiving basins in accordance with all applicable regulatory requirements
- B. Furnish all maintenance of traffic and establish and maintain all safety procedures on adjacent highways during the jacking operation in accordance with all permitting agency requirements.
- C. Inspect the locations where jacking operations will be conducted and the casing pipe is to be installed, verify the conditions under which the work will be performed, and provide all necessary details, whether shown or specified on the Drawings or not, for the orderly prosecution of the work.
- D. Be prepared to work at night and on weekends, if required, to complete the work. Request and obtain written authorization in accordance with the General Conditions prior to working nights and weekends.
- E. Jacking operations shall not result in measurable settlement, movement, or cracking of roadways or adjacent structures. If any measurable movement or settlement occurs which causes or might cause damage to roadways or structures over, along, or adjacent to the work, jacking operations shall stop immediately except for those activities which will assist in making the work secure and prevent further movement, settlement, or damage. Jacking operations may resume only after all necessary precautions have been taken to prevent further movement, settlement, or damage.
- F. Roadways and structures damaged by jacking operations shall be repaired or replaced as necessary to restore them to their condition prior to beginning jacking operations.

- G. Locate all existing utilities that cross jacking operations and determine elevations prior to submitting lay schedule. Coordinate with appropriate utilities prior to performing jacking operations.

1.09 DEFINITIONS

- A. Casing pipe shall mean the outer sleeve that is installed by the bore and jack method.
- B. Carrier pipe shall mean the pipe inserted within the casing pipe and which acts as the conveyor of liquid.
- C. Launch shaft shall mean the shaft in which the pipe jacking equipment is installed and from which both the casing pipe and carrier pipe are launched.
- D. Exit shaft shall mean the shaft located at the end of the casing pipe remote from the launch shaft at the point where the carrier pipe emerges from the casing pipe.

PART 2 PRODUCTS

2.01 GENERAL

- A. The use of a manufacturer's name and model or catalog number is for the purpose of establishing the standard of quality and general configuration desired.

2.02 MATERIALS

A. Steel Casing Pipe

1. Steel casings shall be of leakproof construction and shall conform to the requirements of ASTM A53 (ASTM A139 Grade "B") and shall be protected inside and outside by a black bituminous coating a minimum of 5-mils thick. Steel casing pipe shall have a minimum yield strength of 35,000 psi, shall be equipped with grout holes as specified herein and shall be designed to withstand H-20 traffic loading.
2. The inside diameter of the casing pipe shall be at least 4-inches greater than the largest outside diameter of the carrier pipe, joints, or couplings. It shall, in all cases, be large enough to allow the carrier pipe to be removed subsequently without disturbing the casing pipe or roadway subgrade.

Casing pipes shall have a minimum wall thickness as follows or larger if required by permitting authority:

Nominal Diameter (inches)	Minimum Nominal Thickness (inches)
24 and 26	0.375
28 and 30	0.406
32	0.438
34 and 36	0.469
Greater than 36	0.50

3. Steel casing thickness shall be increased as necessary by the Contractor to accommodate thrust loads due to jacking to advance the shield and casings.

B. Carrier Pipe

1. All carrier pipe joints within the casing pipe shall be restrained.
2. All pipe and fittings shall be as shown on the Drawings
3. Ductile iron carrier pipe for sewers shall be as specified in Section 02615.
4. Ductile iron carrier pipe for water service shall be as specified in Section 02509.

- C. Casing spacers shall be plastic Model PE as manufactured by Pipeline Seal and Insulator, Inc., or approved equal.

2.03 MIXES

- A. Cement grout shall consist of a mixture of about one-part cement to six parts sand. The amount of cement may be increased or decreased as necessary and as permitted to provide good flowing characteristics.

2.04 SURFACE PREPARATION AND SHOP COATINGS

- A. Steel casing pipe shall be protected inside and outside by a black bituminous coating with a minimum thickness of 5-mils.

PART 3 EXECUTION

3.01 PREPARATION

- A. Notify Owner at least seven days in advance of the planned start of work within the permitting agency right-of-way.
- B. Launch shaft subgrades shall be kept continuously free from ground and surface waters during jacking operations. Additional groundwater controls may be ordered on short notice and shall be implemented as directed. Observed water levels prior to construction are to be below the invert elevation of the launch shafts. Groundwater control along and at the face of the jacking casing shall include chemical grout stabilization as required.

3.02 INSTALLATION

- A. Excavate launch shaft and provide excavation supports as required. Excavation support shall extend a sufficient depth below the invert of the steel casing pipe to resist any pressure developed by the soil outside the launch shaft. Excavation support shall extend at least 3 foot – 6- inches above existing grade.
- B. Furnish, install and remove, to the extent required, thrust blocks or such other provisions as may be required in driving the casing pipe or carrier pipe forward.

- C. Maintain proper alignment and elevation of the casing pipe consistently throughout the jacking operation.
- D. Tolerances for installation of the casing pipe shall be as follows:
 - 1. Pressurized pipes:
 - a. Elevation: to grade or a maximum of 6-inches below grade.
 - b. Plan Location: plus or minus 6-inches.
 - 2. Gravity dependent pipes:
 - a. Elevation and grade of carrier pipe to be achieved.
 - b. Plan Location: plus or minus 6-inches.
- E. Jacking operations for the casing pipe shall be continuous and precautions shall be taken to avoid the pipe to "freeze" in place.
- F. Carrier pipe shall be supported within the casing pipe so that pipe bells do not rest directly on the casing. The load of the carrier pipe shall be distributed along the casing by the method of support as shown on the Drawings and as specified herein.
- G. Dewatering through the casing pipe during construction will not be permitted.
- H. Steel casing pipe sections shall have beveled ends with a single v-groove and shall be full penetration butt welded on the outside of the casing in accordance with the applicable portions of AWWA C206 and AWS D7.0 for field welded water pipe joints. All joints of the steel casing shall be butt welded prior to being subjected to the jacking operation. The welded joints shall be wire brushed and painted with bitumastic enamel coating in accordance with AWWA C203.
- I. Jacking shall be performed in a manner to prevent voids from developing outside the jacking sleeve. A jacking shield shall be used to minimize the amount of voids produced during excavating in the forward end of the jacking sleeve. Voids which occur shall be filled with cement grout.
- J. Furnish and install, and later remove to the extent required, thrust blocks or other provisions for backing up the jacks employed in driving the casing pipe forward.
- K. Immediately following the jacking operation, pressure grout the jacked section to fill all voids existing outside of the jacked casing. Grouting shall be from the interior of the casing through the grouting holes.
- L. After the casing pipe has been completely installed, thoroughly clean the interior of the casing pipe and remove all excess material leaving a smooth interior throughout.
- M. The exit shaft shall be excavated up to the casing pipe. Excavation support shall be provided as required. Sufficient room shall be provided to continue installation of carrier pipe, fittings, and all necessary connections to the system.
- N. The carrier pipe shall be installed within the casing using spacers as specified above. Carrier pipe shall be installed from the jacking pit end of the casing. Each joint shall be thoroughly checked prior to being inserted into the casing.

- O. Upon completion of installation of the carrier pipe inside the casing pipe, provide suitable caps or plugs at each end and hydrostatically test the carrier pipe in accordance with Section 02610 (if a sewer pipe) or Section 02612 (if a water pipe). If a water pipe, disinfect carrier pipe in accordance with Section 02612.
- P. Furnish masonry seal or end seal as specified by Contractor's Engineer and approved by the Owner after the carrier pipe has been installed and successfully hydrostatically tested. Furnish wood backstop to masonry as required by the construction plans.

3.03 SITE RESTORATION

- A. At the conclusion of all jacking operations, remove excavation support systems for jacking pits. If withdrawal should damage or disturb the roadway subgrade, leave supports in place and cut off 36-inches below finished grade.
- B. All areas disturbed by construction shall be restored to existing or better condition and prepared, seeded, and maintained until accepted by the Owner, and permitting agency.

END OF SECTION

SECTION 02509
DUCTILE IRON PIPE FOR BURIED WATER SERVICE

PART 1 GENERAL

1.01 SCOPE OF WORK

- A. The Work specified in this Section includes the installation of buried ductile iron pipe for buried pressure water service as indicated on the Contract Drawings and as herein specified. This section includes furnishing and installing all required pipe, fittings, and appurtenances.
- B. The Contractor shall furnish and install piping and service connection piping to the lines and grades and in the locations indicated on the Contract Drawings and/or as ordered by the City of Columbia (Owner)/.
- C. Piping shall be located substantially as shown on the Drawings. The Owner reserves the right to make such modifications in locations as may be found desirable to avoid interference between pipes or for other reasons. Pipe fitting notation is for the Contractor's convenience and does not relieve him/her from installing and jointing different or additional items where required to achieve a complete piping system.
- D. Where the word "pipe" is used it shall refer to pipe, fittings, or appurtenances unless otherwise noted.

1.02 RELATED WORK

- A. Section 02140 - Dewatering and Drainage
- B. Section 02221 - Trenching, Backfill and Compaction
- C. Section 02230 - Granular Fill Materials
- D. Section 02317 - Underground Utility Warning Tape
- E. Section 02512 – Water Distribution Valves
- F. Section 02513 – Fire Hydrants
- G. Section 02612 – Cleaning, Testing and Disinfection of Water lines

1.03 SUBMITTALS

- A. Submit shop drawings and product data, including piping layouts, design calculations, warranty information, and test reports, in accordance with the referenced standards.
- B. Submit the name of the pipe and fitting suppliers and a list of materials to be furnished.

- C. Submit certified copies of mill tests confirming the type of materials used in the pipe, and shop testing of pipe to show compliance with the requirements of the applicable standards, along with a sworn affidavit of compliance that the pipe complies with the referenced standards, shall be submitted.
- D. Submit copies of all shop tests, including hydrostatic tests.
- E. Submit anticipated delivery schedule.
- F. Submit a certified affidavit of compliance from the manufacturer stating that the pipe, fittings, gaskets, linings and exterior coatings for this project have been manufactured and tested in accordance with AWWA and ASTM standards and requirements specified herein.
- G. Test results from an independent testing agency certifying that the V-Bio polyethylene encasement meets all criteria established by AWWA C105, current edition. In general, samples shall be submitted and include test results in accordance with the AWWA standard associated with tensile strength, elongation, dielectric strength, impact resistance, and propagation tear resistance.
- H. Submit handling procedures for all phases from finished fabrication through delivery including storage, transportation, loading, and unloading. This will include storage at the project site and required protection following installation prior to startup.
- I. Submit detailed procedures of acceptance testing procedures and disinfection operations. Upon completion of testing, submit all test results.
- J. Submit certified statement that inspection and all specified tests have been performed.

1.04 REFERENCES

- A. The following standards based on the latest edition form a part of this specification as referenced:
 - 1. AWWA C105 Polyethylene Encasement for Ductile Iron Pipe Systems
 - 2. AWWA C110 Ductile Iron Full Body Fittings, 3 in. through 64 in.
 - 3. AWWA C111 Rubber-Gasket Joints for Ductile Iron Pressure Pipe and Fittings
 - 4. AWWA C115 Flanged Ductile Iron Pipe with Threaded Flanges
 - 5. AWWA C151 Ductile Iron Pipe, Centrifugally Cast, for Water or Other Liquids
 - 6. AWWA C150 Thickness Design of Ductile Iron Pipe
 - 7. AWWA C153 Ductile Iron Compact Fittings, 3 in. through 64 in. for Water Service
 - 8. AWWA C600 Installation of Ductile Iron Water Mains and their Appurtenances
 - 9. AWWA C104 Cement Mortar Lining for Ductile Iron Pipe

1.05 QUALITY ASSURANCE

- A. It is a requirement of these Contract Documents to have all of the ductile iron pipe and fittings under this section be designed and supplied by a single supplier rather than have selection and supply of these items by a number of different suppliers.
- B. All pipe and fittings shall be inspected and tested at the foundry as required by the standard specifications by which the material is manufactured.
- C. All pipe and fittings shall be subject to inspection by the Owner after delivery to the job site and may also be subject to inspection at the foundry by a representative of the Owner.
- D. In addition, the Owner reserves the right to have any or all pipe, fittings, and special castings inspected and/or tested by an independent service at either the manufacturer's plant or elsewhere.
- E. All pipe and fittings shall be marked in accordance with all applicable AWWA standards. Legibly and permanently mark all pipe, fittings, specials and appurtenances to be consistent with the laying schedule and marking drawings (if required) with the following information:
 - 1. Manufacturer, date.
 - 2. Size, type, class, or wall thickness.
 - 3. AWWA Standard(s) produced to.

PART 2 PRODUCTS

2.01 PIPE

- A. Provide ductile iron pipe and fittings from American Cast Iron Pipe Co., US Pipe and Foundry, Griffin Pipe Products, McWane Company, or approved equal which must be a member of the Ductile Iron Pipe Research Association (DIPRA).
- B. Ductile iron gravity and pressure pipe shall conform to the current ASTM A746, and AWWA C111 and C151 (ANSI A21.51) standard. All pipe shall be new, and shall have the AWWA or ASTM designation, pressure class and size of pipe stamped on the outside of each joint.
- C. Thickness design shall be per AWWA C150, latest standard, with minimum Pressure Class 350 for piping 12-in and smaller, minimum Pressure Class 250 for 18-in piping, minimum Pressure Class 200 for 20-inch and 24-inch piping, and minimum Pressure Class 150 for piping 30 to 64-in.
 - 1. Pipe shall be designed for minimum of 150 psi internal pressure, safety factor of 2 with an additional surge allowance pressure of 100 psi.
 - 2. Provide high service discharge piping with a minimum design pressure of 250 psi internal pressure, safety factor of 2 with an additional surge allowance pressure of 100 psi.

- D. Pipe to be shipped per AWWA C600 and in accordance with the pipe manufacturer's recommendations and stored in a manner that the pipe is not damaged. The Contractor will replace damaged piping at no additional cost to the Owner.
- E. No 10-inch or 14-inch ductile iron pipe will be accepted for any portion of the work, except at existing connections if encountered.

2.02 JOINTS AND GASKETS

- A. Unless otherwise noted, all ductile iron pipe/fitting joints shall be push-on rubber gasket type or rubber gasket mechanical joint type per AWWA C111 in unrestrained areas.
- B. In restrained areas as indicated on the Drawings, both pipe and fitting joints shall be push on rubber gasket, locking ring type restrained joints per the manufacturer' standard, except where flange joints are shown on the Drawings.
 - 1. Restrained push on joints shall be by one of the following or an approved equal
 - a. Amarillo Fast-Grip gasket, Flex Ring, Field Flex Ring, and LOK Ring by American Cast Iron Pipe
 - b. Red Field Lok gasket, TR Flex by US Pipe
 - c. Snap Lok by Griffin Pipe Products.
 - d. Superlok by Clow Water Systems Company.
 - e. or approved equal
 - 2. Restrained joint gaskets shall be colored, non-black. The color shall be consistent throughout the entire cross section of the gasket and not be attained by surface coating; the color shall be inherent within the rubber. Gaskets shall meet applicable requirements of AWWA/ANSI C111/A21.11 and shall be ANSI/NSF Standard 61 certified. Restrained joints shall be rated at a minimum as follows:
 - a. 350 psi for 4"- 12" diameter
 - b. 250 psi for 18" diameter
 - c. 200 psi for 20"- 24" diameter
 - d. 150 psi for 30"-64" diameter
- C. Mechanical joint restraint systems that utilize a wedge style gripping system or a gland/ring positive restraint system will be considered acceptable on a case by case basis as approved by the Owner.
 - 1. The optional mechanical joint restraint shall be incorporated in the design of a follower gland. The gland shall be manufactured of ductile iron per ASTM A536. Dimensions of the gland must be such that it can be used with the standard mechanical joint bell and tee-headed bolts, as specified with the pipe.
 - 2. Restraint Mechanism:
 - a. Individually activated gripping surfaces maximizing restraint capability.
 - b. Wedges designed to spread the bearing surfaces on the pipe.
 - c. Torque limiting twist-off nuts. When the nut is sheared off, standard hex nut shall remain.

3. Restraint Device for mechanical joint Ductile Iron Pipe: EBAA Iron Megalug Series 1100 or approved equal.

D. Threaded ductile iron flanges for ductile iron pipe shall be used only where shown on the Drawings and shall be fabricated per AWWA C115 and sealed during installation with a special high pressure, full face gasket per AWWA C111. At the pipe manufacturer's option, the use of 250 lb. pattern flanges, which are faced and drilled in accordance with ANSI B16.1 may be substituted in order to match valves or other equipment and/or to meet the required working pressure requirements. All flanges shall be rated for the same pressure as the adjacent pipe in all cases. Compatibility of the flanges with 250 lb. class and higher special class AWWA valves will be the responsibility of the Contractor.

1. Flanges shall be pre-drilled and then faced after being screwed onto the pipe, with flanges true to 90 degrees of the pipe axis and shall be flush with the end of the pipe.
2. Gaskets shall be full face rubber, 1/8" thick SBR material manufactured by American Toruseal Gasket, or approved equal. Special material ring gaskets manufactured by Garlock or approved equal may be required for pressures exceeding 250 for ANSI rated and custom flanges.
3. Flanged joints shall be supplied with bolts and nuts on one end, bolt studs with a nut at each end, or studs with nuts on one end where the flange is tapped. The number and size of bolts shall comply with the same standard as the flange. Bolts and nuts shall, except as otherwise specified or noted in the Specifications or on the Drawings, comply with ASTM A193, grade B7.
4. Blind flanges shall mate with regular flanges.
5. Filler flanges and beveled flange fillers shall be furnished faced and drilled complete with extra length bolts.

2.03 FITTINGS

- A. Fittings for ductile iron pipe shall be of ductile iron, and shall conform to AWWA C153 or AWWA C110.
- B. Pipe fittings shall be ductile iron with the same pressure rating of the connecting pipe.

2.04 COUPLINGS AND ADAPTERS

- A. Sleeve type couplings shall be mechanical joint solid sleeve type. Dresser Style 38, 138 or equal by Ford Meter Box Co. Shall be used only when approved by the Owner.

2.05 EXTERIOR COATING

- A. All buried pipe shall be installed with an external bituminous coating in accordance with AWWA C151 and C110 respectively.
- B. All ductile iron pipe located within 100 LF of an active cathodic protection system, such as that on steel gas lines, shall be protected by installing polyethylene encasement. When used

polyethylene encasement shall be V-Bio and meet all the requirements for ANSI/AWWA C105/A21.5, Polyethylene Encasement for Ductile Iron Pipe Systems.

1. V-Bio polyethylene encasement shall consist of three layers of co-extruded linear low-density polyethylene (LLDPE), have a minimum thickness of 8 mils and meet or exceed the minimum standards established by AWWA C105, current edition. Polyethylene encasement shall meet minimum size requirements per TABLE 3 of section 2.15 of DIPRA's Installation Guide for Ductile Iron Pipe.
2. The inside surface of the polyethylene wrap to be in contact with the pipe exterior shall be infused with a blend of anti-microbial biocide to mitigate microbiologically influenced corrosion and a volatile corrosion inhibitor to control galvanic corrosion. Ductile iron pipe and the polyethylene encasement used to protect it shall be installed in accordance with AWWA C600 and ANSI/AWWA C105/A21.5 and also in accordance with all recommendations and practices of the AWWA M41, Manual of Water Supply Practices.
3. A 2-inch wide plastic adhesive tape, manufactured by Calpico Vinyl, Polyken, U.P.C. Tape, or approved equal, shall be used for sealing seams, cuts, or tears in polyethylene encasement. Duct tape shall not be allowed.

2.06 INTERIOR LINING

- A. All ductile iron pipe and fittings shall have cement mortar lining (double thickness) per AWWA C104.

PART 3 EXECUTION

3.01 GENERAL

- A. Care shall be taken in loading, transporting and unloading to prevent injury to the pipe, lining or coatings. Pipe and fittings shall not be dropped or skidded against each other. Slings, hooks or pipe tongs shall be used for pipe handling. All pipe and fittings shall be examined before laying and no piece shall be installed which is found to be defective. Any damage to the pipe, lining or coatings shall be repaired per manufacturer's recommendations. Handling and laying of pipe and fittings shall be in accordance with manufacturer's instruction and as specified herein.
- B. If any defective pipe is discovered after it has been laid, it shall be removed and replaced with a sound pipe in a satisfactory manner at no additional cost to the Owner. All pipe and fittings shall be thoroughly cleaned before laying, shall be kept clean until they are used in the work and when installed or laid, shall conform to the lines and grades required.
- C. Materials, if stored, shall be kept safe from damage and stored in accordance with the manufacturer's requirements. The interior of all pipe, fittings and other appurtenances shall be kept free from dirt, excessive corrosion or foreign matter at all times.
- D. Pipe shall not be stacked higher than the limits recommended by its manufacturer. The bottom tier shall be kept off the ground on timbers, rails, or concrete. Stacking shall conform to manufacturer's recommendations and/or AWWA C600.

- E. Gaskets for push-on joints to be stored shall be placed in a cool location out of direct sunlight. Gaskets shall not come in contact with petroleum products. Gaskets shall be used on a first-in, first-out basis.
- F. Piping underneath structures shall be encased.

3.02 INSTALLING DUCTILE IRON PIPE AND FITTINGS

- A. Ductile iron pipe and fittings shall be installed in accordance with requirements of AWWA C600, except as otherwise specified herein. Pipe shall be bedded per details shown on the Drawings. Unless approved at specific locations, blocking will not be permitted. If any defective pipe or fitting is discovered after it has been laid, it shall be removed and replaced with a sound pipe or fitting in a satisfactory manner by the Contractor, at his/her own expense.
 - 1. All pipe and fittings shall be kept clean until they are used in the work and shall be sound and thoroughly cleaned before laying. When laid, the pipe and fittings shall perform to the lines and grades required. When laying is not in progress, open ends of the pipe shall be closed by a watertight plug or other approved means. Sufficient backfill shall be placed to prevent flotation. The deflection at joints shall not exceed that recommended by the manufacturer.
 - 2. All ductile iron pipe laid underground and not in SCDOT right-of-way shall have a minimum of 3 feet of cover for pipes 12-inches and less and 4 feet of cover for pipes greater than 12-inches unless otherwise shown on the Drawings or as specified herein. Pipe shall be laid to the invert elevations shown on the Drawings. All ductile iron pipe laid underground within SCDOT right-of-way shall have a minimum of 4 feet of cover for all diameters or as otherwise required by the SCDOT Utility Accommodations Manual.
 - 3. Fittings, in addition to those shown on the Drawings, shall be provided by the Contractor where required in crossing utilities which may be encountered upon opening the trench. Solid sleeve closures shall be installed at locations approved by the Owner.
 - 4. The pipe interior shall be maintained dry and broom clean throughout the construction period.
 - 5. When field cutting the pipe is required, the cutting shall be done by machine, leaving a smooth cut at right angles to the axis of the pipe. The end of the cut pipe shall be beveled to conform to the manufacturer's recommendations for the spigot end. Any coating removed from the cut end shall be repaired according to manufacturer's recommendation. Cutting of restrained joint pipe will not be allowed, unless approved at specific joints in conjunction with the use of restrainer glands by EBAA Iron or field adaptable restrained joints. Where field cuts are permitted, the pipe to be cut shall be supplied by the factory as "gauged full length". Should full length gauged pipe be unavailable, the pipe to be cut shall be field gauged at the location of the new spigot using a measuring tape, or other means approved by the manufacturer, to verify that the diameter is within the tolerances permitted in Table 1 of AWWA C151.
- B. Jointing Ductile-Iron Pipe
 - 1. Push-on joints shall be made in strict accordance with manufacturer's instructions, AWWA C600 and Appendix B of AWWA C111. If there is conflict, the manufacturer's instructions

shall take precedence. Pipe shall be laid with bell ends looking ahead. A rubber gasket shall be inserted in the groove of the bell end of the pipe. The joint surfaces shall be cleaned and lubricated per the manufacture's recommendations and the plain end of the pipe shall be aligned with the bell of the pipe to which it is to be joined and pushed home. After joining the pipe, a metal feeler shall be used to make certain that the rubber gasket is properly seated.

2. Bolts in restrained joints shall be tightened alternately and evenly.
 3. Restrained joints shall be installed according to pipe manufacturer's instructions.
 4. Flanged joints (not to be used for buried service) shall be assembled in strict accordance with the manufacturer's instructions and Appendix C of AWWA C111. If there is conflict, the manufacturer's instructions shall take precedence. Extreme care shall be taken to ensure that there is no restraint on opposite ends of pipe or fitting, which would prevent uniform gasket compression, cause unnecessary stress, bending or torsional strains, or distortion of flanges or flanged fittings. Adjoining push on joints shall not be assembled until flanged joints have been tightened. Flange bolts shall be tightened uniformly to compress the gasket uniformly and obtain a seal. Flange bolts shall be left with approximately 1/2-inch projection beyond the face of the nut after tightening. After installation bolts and nuts shall be encapsulated using wax sealing tape per AWWA Standard C217.
 5. Mechanical joint solid sleeve couplings shall only be installed for closure or as shown on the Drawings. Couplings shall not be assembled until adjoining joints have been assembled. After installation, bolts and nuts shall be encapsulated using wax sealing tape per AWWA Standard C217, and install protective wrap recommended by the manufacturer or as required herein.
- C. Install V-Bio polyethylene encasement around ductile iron pipe to limits shown on the Drawings and in accordance with pipe manufacturer's recommendations.
1. Polyethylene encasement shall be installed per ANSI/ AWWA C105/A21.5, Method 'A' in accordance with section 2.15 of DIPRA's Installation Guide for Ductile Iron Pipe.
 2. A fabric type or padded sling shall be used when handling polyethylene encased pipe to prevent damage to the polyethylene encasement.
 3. All seams in the polyethylene encasement shall be sealed completely with approved 2-inch wide plastic adhesive tape.
 4. Extreme care shall be taken to ensure that all rips or tears in the polyethylene encasement are properly repaired with additional tape and film as described in ANSI/AWWA C105/A21.5
 5. Extreme care shall be taken when backfilling to avoid damaging the polyethylene encasement

3.03 CONNECTIONS TO STRUCTURES

- A. Wherever a pipe 3-in in diameter or larger passes from a concrete wall to earth horizontally, two flexible joints spaced from 2 to 4-ft apart depending on pipe size shall be installed, within 2-ft of the exterior face of the wall, whether or not shown on the Drawings.
- B. Unless otherwise specified, all pipes passing through a wall will utilize a wall sleeve designed to pass the thrust through the wall via restrained piping.

3.04 HYDROSTATIC TESTING, CLEANING AND DISINFECTION

- A. Cleaning, testing and disinfection of all ductile iron water lines, services, and valves shall be in accordance with Section 02612.

3.05 UNDERGROUND UTILITY MARKING

- A. The underground utility tape shall be provided and installed in accordance with Section 02317.

END OF SECTION

SECTION 02511
WATER SERVICE CONNECTIONS

PART 1 GENERAL

1.01 SCOPE OF WORK

- A. The Work specified in this Section includes furnishing all labor, materials, equipment, and incidentals as shown on the Contract Drawings herein as required to install the following:
 - 1. Pipe and fittings for all $\frac{3}{4}$ -inch and larger water service connections to properties.
 - 2. Corporation stop assembly.
 - 3. Curb stop assembly.
 - 4. Water meters
 - 5. Backflow preventers.
 - 6. Precast concrete vaults.
- B. The Contractor shall furnish and install all water connections at the locations indicated on the Contract Drawings.
- C. Contractor shall be required to use a City approved contractor to make any and all taps on existing City of Columbia owned water lines.
- D. All Water Connections shall be located substantially as shown on the Drawings. The City of Columbia (Owner) reserves the right to make such modifications in locations as may be found desirable to avoid interference with other utilities or for other reasons.
- E. Coordinate Work of this Section with City of Columbia in compliance with applicable permitting agencies.

1.02 RELATED WORK

- A. Section 02221 - Trenching, Backfill, and Compaction.
- B. Section 02509 – Ductile Iron Pipe for Buried Water Service
- C. Section 02607 - Precast Concrete Valve Vaults and Meter Boxes.
- D. Section 02612 - Cleaning and Disinfection of Water Distribution Systems

1.03 REFERENCE STANDARDS

- A. AWWA C800 – Underground Service Line Valves and Fittings,
- B. AWWA C901 – Polyethylene Pressure Pipe and Tubing, for Water Service

- C. AWWA M6 – Water Meters – Selection, Installation, Testing and Maintenance.

1.04 SUBMITTALS

- A. Product Data: Submit manufacturer's latest published literature for all pipe, fittings, corporation stops, curb stops, meter setting equipment, water meters (if not provided by the Owner), backflow preventers, meter boxes and accessories.
- B. Shop Drawings: Must indicate details showing vault and accessories.
- C. Manufacturer's Certificate: Certify that any products that come into contact with the potable water supply meet or exceed specified requirements in accordance with the latest requirements of U.S. Federal Safe Drinking Water Act.

1.05 QUALITY ASSURANCE

- A. Perform Work in accordance with City of Columbia and all applicable permitting agencies.
- B. The Contractor shall allow and facilitate the inspection of each Water Service Connection by the Owner or Owner's Representative. Any service connection, or part thereof, that does not conform to the requirements of the Owner shall be rejected and immediately removed by the Contractor and replaced with the appropriate item meeting all requirements of this specification.

1.06 DELIVERY, STORAGE, AND HANDLING

- A. All items shall be packaged in such a manner as to provide adequate protection during transportation to the site. Any items damaged in shipment shall be replaced as directed by the Owner.
- B. All Water Service Connection piping and accessories shall handled in such a manner as to minimize the possibility of damage prior to installation. All materials shall be stored at the construction site to prevent damage and to assure they are kept as clean prior to installation.

PART 2 PRODUCTS

2.01 WATER PIPING AND FITTINGS

- A. Copper Tubing (3/4" and 1" only):
 - 1. Comply with ASTM B88.
 - 2. Type K Soft Copper.
 - 3. Fittings: None allowed.
 - 4. Joints: Flared only.
- B. High-Density Polyethylene Pipe (3/4" to 2" only):
 - 1. Comply with AWWA C901, PE3406, DR 9, Class 160, CTS.
 - 2. Fittings: Comply with AWWA C901, molded.

3. Joints: Butt fusion.
4. Name and trademark of the manufacturer shall be stamped along the pipe
- C. Ductile Iron (Use 4-inch pipe fitting and reduce to 3-inch at service connection):
 1. Comply with Section 02509 -Ductile Iron Pipe for Buried Water Service.

2.02 CORPORATION STOP ASSEMBLIES

- A. Manufacturers:
 1. Corporation Stops $\frac{3}{4}$ " through 2-inch: Approved manufacturers shall be Mueller P-25008N, McDonald 74701B-22 or 74704B-22, or approved equal with a minimum pressure rating of 250 psig.
- B. Design:
 1. Must comply with ASTM B62.
 2. Body: Brass or red brass alloy and certified NSF 61.
 3. Inlet end: Threaded for tapping according to AWWA C800.
 4. Outlet end: Suitable for specified service pipe material.
- C. Service Saddles:
 1. Type: Double strap.
 2. Designed to hold minimum 200 psi.
 3. Approved manufacturers:
 - a. Smith Blair
 - b. Romac Industries
 - c. JCM Industries
 - d. Or approved equal.

2.03 CURB STOP ASSEMBLIES

- A. Manufacturers:
 1. Curb Stops $\frac{3}{4}$ " through 2-inch approved manufacturers shall be:
 - a. Mueller Company
 - b. McDonald Company
 - c. Ford Meter Box Company
 - d. or approved equal.
- B. Design:
 1. Body: Brass or red brass alloy and certified NSF 61.

2. Comply with AWWA C800 and ASTM B62.
3. Valve type: Compression ball.
4. Sealing: Positive pressure.
5. Working pressure: 300 psig maximum.

C. Curb Stop Box and Cover:

1. Cast Iron Body, Stretch Type or Buffalo Type
2. Minneapolis or Arch Pattern Base.
3. Lid with 'WATER' inscribed and Pentagon Plug.

2.04 WATER METERS

- A. Contractor shall obtain water meter specifications from the City of Columbia. The City of Columbia will provide the water meter to the Contractor for installation by a "City approved Contractor". All costs for installation shall be the responsibility of the Contractor. All meters shall be installed as directed by the Owner on private property. Meter boxes and lids shall be located off of the main travel way and include the following:
1. Be Model DFWQ36C or DFW37D by DFW Plastics Inc. or approved equal.
 2. Be heavy duty type for incidental traffic constructed of a polypropylene body and HDPE lid. The box and lid shall be either oval or rectangular shaped with a 12-inch minimum depth of the body.

2.05 BACKFLOW PREVENTION DEVICES

- A. Manufacturers: All approved backflow prevention devices must be listed on the latest version of SCDHEC's Notice of Approved Backflow Prevention Assemblies for South Carolina, and approval by City of Columbia.
- B. Device must be installed on customer's private property and in accordance with the City of Columbia's Engineering Department Design Manual standards.

PART 3 EXECUTION

3.01 GENERAL

- A. Excavate for meter box and pipe trench in accordance with Section 02221 for Work of this Section.
- B. Prevent foreign material from entering valve body while it is installed. During installation, no debris, lifting straps/chains, tools, clothing, or other materials shall be placed in the valve body.

3.02 PREPARATION

- A. Cut pipe ends square, ream pipe and tube ends to full pipe diameter, and remove burrs.
- B. Remove scale and dirt from inside and outside of piping before assembly.
- C. Prepare pipe connections to equipment with flanges or unions.

3.03 INSTALLATION

A. Corporation Stop Assemblies:

- 1. Make connection for each different kind of water main using suitable materials, equipment, and methods as approved by Owner.
- 2. Provide tapping saddles or mains constructed of materials other than cast iron or ductile iron.
- 3. Location:
 - a. Locate and stagger corporation stops at least 18 inches apart longitudinally.
- 4. Plastic Pipe Mains:
 - a. Provide full support for service clamp for full circumference of pipe, with minimum 2 inches width of bearing area.
 - b. Exercise care against crushing or causing other damage to mains at time of tapping or installation of service clamp or corporation stop.
- 5. Use proper seals or other devices such that no leaks are present in mains at points of tapping.
- 6. Do not backfill and cover service connections until installation is approved by Owner.

B. Curb Stop Assemblies:

- 1. Set curb stops on compacted soil.
- 2. Boxes:
 - a. Center and plumb curb boxes over curb stops.
 - b. Set box cover flush with finished grade.

3.04 HYDROSTATIC TESTING, CLEANING AND DISINFECTION

- A. Cleaning, testing and disinfection of all water lines, services, and valves shall be in accordance with Section 02612.

3.05 UNDERGROUND UTILITY MARKING

- A. The underground utility tape shall be provided and installed in accordance with Section 02317.

- B. Install a continuous #12 gauge blue insulated copper wire, approved by the manufacturer for direct burial, in the trench and taped to the top of the service pipe with 2-inch duct tape. The tracer wire shall terminate at each valve and meter and be arranged to allow connection of equipment for tracking pipe and prevent interference of operating the valve or meter. Tracer wire shall also be installed to the ends of the service lines. Underground waterproof connectors must be used on all splices. All connectors must be thoroughly wrapped in electrical tape.

END OF SECTION

SECTION 02512
WATER VALVES

PART 1 GENERAL

1.01 SCOPE OF WORK

- A. The Work specified in this Section includes furnishing all labor, materials, equipment, supplies, and incidentals required and install all Gate Valves, Butterfly Valves and Air Release Valves complete as shown on the Contract Drawings and as specified herein.
- B. The Contractor shall furnish and install all valves at the locations indicated on the Contract Drawings.
- C. Valves shall be located substantially as shown on the Drawings. The City of Columbia (Owner) reserves the right to make such modifications in locations as may be found desirable to avoid interference with other utilities or for other reasons.
- D. Coordinate Work of this Section with City of Columbia in compliance with other applicable permitting agencies.

1.02 RELATED WORK

- A. Section 02221 - Trenching, Backfill, and Compaction.
- B. Section 02230 - Granular Fill Materials
- C. Section 02612 - Cleaning Testing and Disinfection of Water Lines
- D. Section 02509 - Ductile Iron Pipe for Buried Water Service

1.03 SUBMITTALS

- A. Product Data: Submit manufacturer's latest published literature including product illustrations, installation and maintenance instructions, storage and handling procedures, and recommended spare parts lists.
- B. Shop Drawings: Submit description of proposed installation.
- C. Manufacturer's Certificate: Submit manufacturer's affidavit that specified valves conform to stated requirements of AWWA C500, AWWA C509 and AWWA C515, and this Section, and that they have been tested in the United States in accordance with said AWWA Specifications.
- D. Record actual locations of all valves and submit record drawings in accordance with Section 01720 Record Drawings.
- E. Submit all required Operation and Maintenance data for valves in accordance with Section 01730 Record Drawings.

1.04 QUALITY ASSURANCE

- A. Perform Work in accordance with City of Columbia standards.
- B. Manufacturer's name and pressure rating shall be marked on valve body.
- C. The Contractor shall furnish all labor necessary to assist the Owner in inspecting valves. All valves shall be inspected upon delivery. Any valve that does not conform to the requirements of this Contract shall be rejected and immediately removed by the Contractor.

1.05 DELIVERY, STORAGE, AND HANDLING

- A. All items shall be packaged in such a manner as to provide adequate protection of the products during transportation to the site. Any valves damaged in shipment shall be replaced as directed by the Owner.
- B. Valves and accessories shall be loaded and unloaded or otherwise handled in such a manner as to minimize the possibility of damage prior to installation. All materials shall be stored at the construction site in such a way as to prevent damage and to assure they are kept as clean as possible prior to installation.

PART 2 PRODUCTS

2.01 GATE VALVES

- A. 4-In. to 12-In. in diameter: Open left, non-directional, standard-wall resilient seated (AWWA C509 or AWWA C515), 200 psi pressure rating, bronze mounting, push-on bell ends with rubber joint rings, and nut-operated unless otherwise specified. Provide approved standard-wall resilient seated valves. Comply with following requirements unless otherwise specified in Drawings:
 - 1. Gate valves shall be American Flow Control – Series 2500 Resilient Wedge Gate Valve or Resilient Wedge Gate Valve by Mueller & Company, US Pipe Inc. or other approved equal.
 - 2. Design: Fully encapsulated rubber wedge or rubber seat ring mechanically attached with minimum 304 stainless-steel fasteners or screws; threaded connection isolated from water by compressed rubber around opening.
 - 3. Body: Cast or ductile iron, flange bonnet and stuffing box together with ASTM A 307 Grade B bolts. Manufacturer's initials, pressure rating, and year manufactured shall be cast in body.
 - 4. Bronze: Valve components in waterway to contain not more than 15 percent zinc and not more than 2 percent aluminum.
 - 5. Stems: ASTM B 763 bronze, alloy number-995 minimum yield strength of 40,000 psi; minimum elongation in 2-In. of 12 percent, non-rising.

6. O-rings: For AWWA C 509, Sections 2.2.6 and 4.8.2. 6. Stem Seals Consist of three O-rings, two above and one below thrust collar with anti- friction washer located above thrust collar for operating torque.
7. Stem Nut: Independent or integrally cast of ASTM B 62 bronze.
8. Resilient Wedge: Molded, synthetic rubber, vulcanized and bonded to cast or ductile iron wedge or attached with 304 stainless steel screws tested to meet or exceed ASTM D 429 Method B; seat against epoxy-coated surface in valve body.
9. Bolts: AWWA C 509 Section 4.4; stainless steel; cadmium plated, or zinc coated.

B. Gate Valve Box and Protector Ring

1. All gate valves shall be equipped with cast iron valve boxes and covers of the adjustable or extension type.
2. All valve boxes to be installed with a valve box protector ring as specified in Detail.

C. Gate Valve Extension Stem

1. There shall be a maximum 48" depth to valve operator nut. The Contractor must use extension stems, if necessary, to raise operator nut within 48" of the final grade. Extensions must be securely attached to the operating nut so the shaft will not pull off of the operator.
2. Upper end of extension stem shall terminate in square wrench nut no deeper than 4-ft. from finished grade or as shown on Drawings.
3. Support extension stem with an arm attached to wall of manhole or structure that loosely holds extension stem and allows rotation in the axial direction only.

D. Valve Restraint/Blocking:

1. Install restraint/blocking utilizing method as indicated on Drawings.

2.02 BUTTERFLY VALVES

- A. All valves 16-in. in diameter and larger shall be Butterfly Valves, Open left, mechanical joint, flanged, push-on and furnished with manual operators as specified in the Drawings, meeting all requirements of AWWA C504, or latest revision, and in accordance with the following specifications:
1. Approved manufacturers shall be Henry Pratt Co., Dezurik, Mueller or approved equal.
 2. Design: Buna-N rubber seats which are recess mounted and securely fastened to the valve body or to the valve disc. Seating surfaces shall be stainless steel. Valves shall be rated for 250-psi pressure (Class 250B) and shall be satisfactory for applications involving valve operation after long periods of inactivity. Valve discs shall rotate 90-degrees from the fully open position to the tight closed position. Valves shall meet the full structural requirements

of the application class of AWWA C504 and shall be mounted with all stainless-steel nuts and bolts.

3. Bodies: Shall be constructed of cast iron ASTM A126, Class B and shall have integrally cast mechanical joint ends. Two trunnions for shaft bearings shall be integral with each valve body. Body thickness shall be strictly in accordance with AWWA C504. Valve shafts shall be constructed of 18-8 stainless steel or of approved construction.
4. Discs: Shall be constructed of any material described in AWWA C504, Section 4.5.4.1. All disc seating edges shall be smooth and polished. Valve shafts shall be a one-piece unit extending full size through the valve disc and bearings or a two-piece unit (stub-shaft type). Disc mounted seats shall be mechanically retained; body mounted seats shall be bonded to the valve body. Bonded-in seats must be simultaneously molded in, vulcanized and bonded to the body and the seat. Bearings shall be corrosion resistant and self-lubricating.
5. Stem nut: Operator shall be the traveling nut type, AWWA C504, Class 250.
6. All operators shall be fully gasketed and grease packed and designed to withstand submersion in water to 10 psi. Operator shall be equipped for buried service.
7. All surfaces of the valve shall be clean, dry and free from grease before painting. An epoxy coating conforming to AWWA C550 shall be factory applied to the interior and exterior ferrous surfaces of the valve except for finished or seating surfaces.
8. Butterfly valves installed in the ground shall have the operator nut in a vertical position for use in a roadway type valve box.
9. There shall be a maximum 48" depth to valve operator nut. The Contractor must use extension stems, if necessary, to raise operator nut within 48" of the final grade. Extensions must be securely attached to the operating nut so the shaft will not pull off of the operator.
10. Accessories: Manufactured/cast in U.S.A., unless excepted by the Owner.

B. Butterfly Valve Box and Protector Ring

1. All valves shall be equipped with cast iron valve boxes and covers of the adjustable or extension type. 5 1/4 inch diameter screw type, No. 564S recommended (or others for varying depth)
 1. All valve boxes to be installed with a valve box protector ring and have "WATER" cast in valve box covers.

C. Valve Restraint/Blocking:

1. Install restraint/blocking utilizing method as indicated on Drawings.

2.03 AIR RELEASE VALVES

- A. Approved manufacturers: Crispin type 'N', Model No. P10 with 1/4" orifice, APCO Model No. 200A with 1/4" orifice, or Val-Matic Model No. 38 with 3/16" orifice or approved equal. Orifice size shall be as listed above unless otherwise indicated on the Drawings.
- B. Materials: body and cover, ASTM A 48, Class 30, cast iron; float and leverage mechanism, ASTM A 240 or A276 stainless steel; orifice and seat, stainless steel against Buna-N or Viton mechanically retained with hex head nut and bolt; other valve internals, stainless steel or bronze. Provide inlet and outlet connections, and orifice as shown on Plans.
- C. Shall have approved working pressure of 0 to 150 psi, and a 1" NPT connection. Valve shall be attached to the pipeline by means of a 1-inch corporation stop, 1-inch type K copper tubing or polyethylene tubing, 1-inch curb stop and shall be housed in a cast iron meter box or as shown on the Drawings.
- D. Contractor to coordinate air valve locations to ensure they are located at the actual high points along the water main as installed and not simply at locations designated on the Drawings.
- E. Automatic air release valves shall not be used in locations where flooding of the valve box may occur.

PART 3 EXECUTION

3.01 GENERAL

- A. Excavate pipe trench in accordance with Section 02221 for Work of this Section.
- B. No pipe or valving shall be installed when the Owner, or Contractor has determined that the trench conditions are unsuitable.
- C. Carefully lower valves and fittings into trench in such a manner as to prevent damage to the water main materials and protective coatings and linings.
- D. Prevent foreign material from entering valve body while it is installed. During installation, no debris, lifting straps/chains, tools, clothing, or other materials shall be placed in the valve body.
- E. Mechanical Joint Fittings:
 - 1. Install valves per manufacturer's standards.
 - 2. There shall be a minimum of 18 inches of pipe between all valves and fittings.
 - 3. No flanged fittings shall be utilized in a direct bury installation.
- F. Valves shall be designed to be restrained:

3.02 HYDROSTATIC TESTING, CLEANING AND DISINFECTION

- A. Cleaning, testing and disinfection of all ductile iron water lines, services, and valves shall be in accordance with Section 02612.

3.03 UNDERGROUND UTILITY MARKING

- A. The underground utility tape shall be provided and installed in accordance with Section 02317.

END OF SECTION

SECTION 02513
FIRE HYDRANTS

PART 1 GENERAL

1.01 SCOPE OF WORK

- A. The Work specified in this Section includes the furnishing and installation of fire hydrant and related appurtenances as indicated on the Contract Drawings and as herein specified.
- B. Fire Hydrants shall be located as shown on the Drawings. The Contractor shall design the locations of fire hydrants to avoid interference between pipes and all other appurtenances. Any field adjustment of fire hydrants must first be approved by the Owner.
- C. Coordinate Work of this Section with City of Columbia and SCDOT standards and utilities within construction area.

1.02 RELATED WORK

- A. Section 02230 - Granular Fill Materials
- B. Section 02221 - Trenching, Backfill, and Compaction.
- C. Section 01300 – Submittals.
- D. Section 02509 – Ductile Iron Pipe for Buried Water Service
- E. Section 02612 - Cleaning Testing and Disinfection of Water Lines
- F. Section 03300 – Cast-in-Place Concrete

1.03 SUBMITTALS

- A. Product Data: Submit manufacturer's latest published literature including product illustrations, installation and maintenance instructions, storage and handling procedures, and recommended spare parts lists.
- B. Shop Drawings: Submit description of proposed installation.
- C. Manufacturer's Certificate: Certify that fire hydrant meets C502-54: AWWA Standard Specifications for Fire Hydrants for Ordinary Water Works Service.
- D. Indicate and submit results of Contractor-furnished tests and inspections.
- E. Submit manufacturer's approval of installer.
- F. Record actual locations of fire hydrants and service valves and include on and submit with record drawings..

- G. Submit all required Operation and Maintenance data for hydrants with the record drawings.

1.04 QUALITY ASSURANCE

- A. Perform Work according to C502-54: AWWA Standard Specifications for Fire Hydrants for Ordinary Water Works Service standards.

1.05 DELIVERY, STORAGE, AND HANDLING

- A. Prepare hydrants and accessories for shipment according to AWWA standards and seal hydrant and ends to prevent entry of foreign matter.
- B. Inspection: Accept materials on Site in manufacturer's original packaging and inspect for damage.
- C. Store materials in areas protected from weather, moisture, or potential damage. Do not store materials directly on ground.
- D. Handle materials in a way that prevents damage to interior and exterior surfaces.

PART 2 PRODUCTS

2.01 FIRE HYDRANTS

- A. Acceptable Fire Hydrant models are as follows:

1. Mueller – Super Centurion 250 A423
2. M&H - Style 929 Reliant (Epoxy shoe only)
3. Clow Medallion
4. American-Darling B-84-B-5
5. No substitutions will be permitted.

- B. Dry-Barrel Breakaway Type:

1. Comply with AWWA C502 and rated for 250 psi minimum working pressure.
2. Body: Cast iron.
3. Valve: Compression type.
4. Burial Depth: As indicated on Drawings.
5. Inlet Connection Size: 6 inches.
6. Valve Opening: 5-1/4 inches in diameter.
7. End Connections: Mechanical joint.

8. Bolts and Nuts: Stainless steel.
9. Hydrant operating nut shall be AWWA Standard pentagonal type measuring 1-1/2-in point to flat.
10. Interior Coating: Comply with AWWA C550.
11. Direction of Opening: Clockwise (right) unless otherwise indicated.

C. Hose Connections:

1. One 4-1/2-in pumper, two 2-1/2-in hose nozzles.
2. Thread type shall be National Standard.
3. Attach nozzle caps by separate chains.
4. Each hydrant shall be able to deliver 500 gallons minimum through its two 2-1/2-in hose nozzles when opened together with a loss of not more than 2 psi in the hydrant.
5. Hydrants shall be furnished with caps, double galvanized steel hose cap chain, galvanized steel pumper hose cap chain, a galvanized steel chain holder and any other hooks and/or appurtenances required for proper use.

D. Finishes:

1. Primer and two coats of enamel.
2. Color: Factory red primer. Fire department to color code bonnet according to system flows.

2.02 ACCESSORIES

- A. Concrete for Thrust Restraints and barrel collars shall be as specified in Section 03300 - Cast-in-Place Concrete.
- B. Aggregate for hydrant drainage as specified in Section 02230 – Granular Fill Materials.

PART 3 EXECUTION

3.01 GENERAL

- A. Verify exact location and size of hydrants from Drawings. Verify that invert elevations of existing work are as indicated on Drawings prior to excavation and installation of fire hydrants.
- B. Conduct operations not to interfere with, interrupt, damage, destroy, or endanger integrity of surface or subsurface structures, utilities, and landscape in immediate or adjacent areas.
- C. Do not interrupt existing utilities without permission and without making arrangements to provide temporary utility services. Notify Owner not less than 7 days in advance of proposed utility interruption. Do not proceed without written permission from Owner.

3.02 INSTALLATION

- A. Perform trench excavation, backfilling, and compaction as specified in Section 02221 – Trenching, Backfill and Compaction.
- B. Hydrants shall be so arranged that the direction of outlets may be turned 90 degrees without interference with the drain mechanism or obstructing the discharge from any outlet.
- C. During backfilling, additional screened gravel shall be brought up around and 6-in over the drain port. Each hydrant shall be set in true vertical alignment and properly braced.
- D. Concrete thrust blocks shall be placed between the back of the hydrant inlet and undisturbed soil at the end of the trench. Minimum bearing area shall be as shown on the Drawings. Care shall be taken to ensure that concrete does not plug the drain ports.
- E. The hydrant shall be tied to the pipe with approved thrust restraint system. Hydrant paint shall be touched up as required after installation.
- F. Set fire hydrants plumb with pumper nozzle facing roadway.
- G. Set fire hydrants with centerline of pumper nozzle 18 inches above finished grade, and with safety flange not more than 6 inches nor less than 2 inches above grade.

3.03 CLEANING, TESTING AND DISINFECTION OF SYSTEM

- A. Clean, flush and disinfect system as specified in Section 02612 – Cleaning Testing and Disinfection of Water Lines.

END OF SECTION

SECTION 02317
UNDERGROUND UTILITY WARNING TAPE

PART 1 GENERAL

1.01 SCOPE OF WORK

- A. Underground detectable warning tape shall be furnished and installed for all main line (gravity and pressure) sewer, water and drain pipes, regardless of pipe material.

1.02 SUBMITTALS

- A. Submit in accordance with Contract.
- B. Submit manufacturers literature identifying all materials of construction, conformance with applicable reference standards, dimensions, specified material properties, colors and wording.

PART 2 PRODUCTS

2.01 MATERIALS

- A. The detectable warning tape shall include a solid core that provides detectability utilizing either the inductive or conductive modes using a pipe and cable locator.
- B. The detectable warning tape shall be polyethylene tape manufactured in accordance with the following technical data:

<u>PROPERTIES</u>	<u>TEST METHOD</u>	<u>VALUE</u>
Thickness	ASTM 02103	0.006" (6 mils)
Elongation	ASTM D882-75B	80%
Tensile Strength	ASTM 0882	70 lbs/foot

- C. Tape shall be 6 inches wide.
- D. The warning tape shall be heavy gauge 0.006-inch polyethylene and shall be resistant to acids, alkalis and other soil components. It shall be highly visible in the following colors with the associated phrases stamped in black letters and repeated at a maximum interval of 40 inches.

Type of Utility	Color	Warning Message
Sanitary Sewer	Green	Caution – Sanitary Sewer Buried Below
Storm Drain	Green	Caution – Storm Drain Buried Below
Water	Blue	Caution – Water Line Buried Below

- E. The tape shall be of the type specifically manufactured for marking and locating utilities.
- F. Tape shall be Terra Tape, Sentry Line Detectable warning tape as manufactured by Reef Industries Houston, Texas or approved equal.

PART 3 EXECUTION

3.01 INSTALLATION

- A. All buried pipe and fittings shall be installed with detectible underground warning tape located approximately 12-inches above the pipe, but no more than 36 inches below the finished grade surface.
- B. Printed side of the tape shall be installed facing up.

END OF SECTION

SECTION 02605
PRECAST CONCRETE MANHOLES

PART 1 GENERAL

1.01 SCOPE OF WORK

- A. Furnish all labor, materials and equipment required to install precast concrete manholes, frames and covers, and appurtenances as shown on the Drawings and as specified herein.

1.02 RELATED WORK

- A. Section 02221 - Trenching, Backfilling, and Compaction.
- B. Section 02230 - Granular fill materials.
- C. Section 02615 - Ductile Iron Pipe for Buried Sewer Service.
- D. Section 02622 - Polyvinyl Chloride Gravity Sewer Pipe.

1.03 SUBMITTALS

- A. Submit to the City of Columbia (Owner) shop drawings, product data, materials and details of construction, reinforcing and joint details. Submittals shall include at least the following:
 - 1. Base sections, riser sections, eccentric and concentric conical top sections, flat slab tops, grade rings with notarized certificate indicating compliance with ASTM C478.
 - 2. Pipe connections to each manhole including pipe elevations and sizes, pipe angles, knock-out panel sizes and elevations, etc.
 - 3. Manhole frames and covers with notarized certificate indicating compliance with the specified ASTM standard and Class designation.
 - 4. Manhole style, height, and top style (hatch or frame and cover) shall be based on the City standard preference chart. Final manhole style to be approved by Owner.
 - 5. Method of repair for minor damage to precast concrete sections.
 - 6. Sewer brick with notarized certificate indicating compliance with ASTM C32, Grade SS.
 - 7. Sectional plans and elevations showing dimensions and reinforcing steel placement.
 - 8. Structural calculations including assumptions.
 - 9. Concrete design mix.
 - 10. Concrete test cylinder reports from an approved testing laboratory certifying conformance with this Section.

11. Results of leakage tests.

1.04 REFERENCE STANDARDS

A. ASTM International

1. ASTM A48 - Standard Specification for Gray Iron Castings.
2. ASTM C32 - Standard Specification for Sewer and Manhole Brick (Made from Clay or Shale).
3. ASTM C33 - Standard Specification for Concrete Aggregates.
4. ASTM C62 - Standard Specification for Building Brick (Solid Masonry Units Made from Clay or Shale)
5. ASTM C150 - Standard Specification for Portland Cement
6. ASTM C207 - Standard Specification for Hydrated Lime for Masonry Purposes
7. ASTM C443 - Standard Specification for Joints for Circular Concrete Sewer and Culvert Pipe, Using Rubber Gaskets
8. ASTM C478 - Standard Specification for Precast Reinforced Concrete Manhole Sections
9. ASTM C990 - Standard Specification for Joints for Concrete Pipe, Manholes, and Precast Box Sections using Preformed Flexible Joint Sealant.

B. American Concrete Institute (ACI)

1. ACI 318 - Building Code Requirements for Structural Concrete
2. ACI 350 - Code Requirements for Environmental Engineering Concrete Structures

C. American Association of State Highway and Transportation Officials (AASHTO)

1. Standard Specifications for Highway Bridges

D. Occupational Safety and Health Administration (OSHA)

- E. Where reference is made to one of the above standards, the revision in effect at the time of bid opening shall apply.

1.05 QUALITY ASSURANCE

- A. All material shall be new and unused.
- B. Materials' quality, manufacturing process and finished sections are subject to inspection and approval by Owner or Owner's representative. Inspection may be made at place of manufacture, at work site following delivery, or both.

- C. Materials will be examined for compliance with ASTM standards, this Section and approved manufacturer's drawings. Additional inspection criteria shall include: appearance, dimensions, blisters, cracks and soundness.
- D. Materials shall be rejected for failure to meet any requirements specified herein. Rejection may occur at place of manufacture, at work site, or following installation. Mark for identification rejected materials and remove from work site immediately. Rejected materials shall be replaced at no cost to Owner.
- E. Repair minor damage to precast concrete sections by approved method, if repair is authorized by Owner. Epoxy mortar may be utilized for repairs subject to the approval of the Owner.

PART 2 PRODUCTS

2.01 GENERAL

- A. Reference to a manufacturer's name and model or catalog number is for the purpose of establishing the standard of quality and general configuration desired.
- B. Like items of materials/equipment shall be the end products of one manufacturer in order to provide standardization for appearance, operation, maintenance, spare parts and manufacturer's service.
- C. Provide no less than 2 lifting lugs or holes in each precast section for proper handling.
- D. Cement shall conform to ASTM C150, Type II cement or equal.
- E. Precast concrete sections shall be properly cured prior to shipping. Precast concrete sections shall not be shipped before concrete has attained 3,000 psi compressive strength.
- F. Mark date of manufacture, name and trademark of manufacturer on the inside of each precast section.
- G. Precast manhole sections shall be manufactured by Tindall Concrete Products, Inc. or approved equal.

2.02 PRECAST CONCRETE MANHOLE SECTIONS

- A. Precast concrete base sections, riser sections, transition top sections, flat slab tops and grade rings shall conform to ASTM C478 and meet the following requirements:
 - 1. Design precast concrete base and flat slab top for their own weight, weight of soil at 130 pcf, and a live load equal to AASHTO H-20 truck loading applied at finished grade.
 - 2. The wall thickness shall not be less than 5-in for 48-in diameter reinforced barrel sections, 6-in for 60-in diameter reinforced barrel sections and 7-in for 72-in diameter reinforced barrel sections.
 - 3. Bottom slab thickness shall be no less than the riser wall thickness.
 - 4. Construct precast concrete bases as shown on the Drawings.

5. Base, riser and transition top sections shall have tongue and groove joints.
6. Top section shall be eccentric cone where cover over pipe exceeds 4-ft. Top section shall be a flat slab where cover over top of pipe is 4-ft or less or where top elevation of manhole is to be set above grade in a flood prone area as indicated on the Drawings.
7. Provide integrally cast knock-out panels in precast concrete manhole sections at locations, and with sizes shown on Drawings. Knock-out panels shall have no steel reinforcing.

2.03 BRICK MASONRY

- A. Bricks shall be sound, hard, uniformly burned, regular and uniform in shape and size. Underburned or salmon brick shall not be acceptable. Only whole brick shall be used.
 1. Bricks for channels and shelves shall conform to ASTM C32, Grade SS except that the mean of five tests for absorption shall not exceed 8 percent and no individual brick exceed 11 percent.
 2. Bricks for raising manhole frames to finished grade shall conform to ASTM C62.
- B. Mortar shall be composed of 1-part Portland cement, 2-parts sand, and hydrated lime not to exceed 10-lbs to each bag of cement. Portland cement shall be ASTM C150, Type II; hydrated lime shall conform to ASTM C207.
- C. Sand shall be washed, cleaned, screened, well graded with all particles passing a No. 4 sieve and conform to ASTM C33.

2.04 MANHOLE FRAME AND COVER

- A. Manhole frames and covers shall be of good quality, strong, tough, even grained cast iron, smooth, free from scale, lumps, blisters, sand holes and defects of any kind which render them unfit for the service for which they are intended. Manhole covers and frame seats shall be machined to a true surface. Castings shall be thoroughly cleaned and subject to hammer inspection. Cast iron shall conform to ASTM A48, Class 30.
- B. Manhole covers shall have a 24-in. clear opening and a diamond pattern with blind pick holes
 1. The words "City of Columbia" and "Sanitary Sewer" shall be cast in 3-in letters into each sanitary cover.
 2. The words "City of Columbia" and "Drain" shall be cast in 3-in letters into each drain cover.
- C. All standard manhole frames and covers shall be Neenah Foundry model R-1642, East Jordan Iron Works, Inc. model #1045 frame and #1040A cover, US Foundry model #755-NC, or equal.
- D. All water tight manhole frames and covers shall be Neenah Foundry model Lift Mate, East Jordan Iron Works, Inc. model #1033 Hingeco, US Foundry model #750-KI, or equal.

2.05 MANHOLE HATCHES

- A. All flat slab tops installed above grade at elevations above the flood plain, as indicated on the drawings shall include an aluminum access hatch rather than a cast-iron manhole frame and cover.
1. Access doors shall provide a minimum of a 30-inch by 30-inch clear opening.
 2. The access door shall have a 1/4" (7mm) thick, mill finish, extruded aluminum channel frame, incorporating a continuous concrete anchor. A 1-1/2-inch (38mm) drainage coupling shall be located in the front left corner of the channel frame. The entire frame must be supported by a full bed of Class A concrete.
 3. The access door panels shall be 1/4" (7mm) aluminum diamond plate reinforced to withstand a H-20 uniform live load with a maximum allowable deflection of 1/150 of the span, and shall not protrude into the channel frame when in the open position.
 4. The access doors shall open to 90 degrees and automatically lock with a T-316 stainless steel hold open. The doors shall incorporate enclosed stainless-steel compression spring assists. Doors shall close flush with the frame. Hinges and all fastening hardware shall be T-316 stainless steel. Unit shall lock with a T-316 stainless steel slam lock with removable key and have a non-corrosive handle. Unit shall have a hinged aluminum grate fall-through protection system.
 5. The access hatch shall be installed in accordance with the Drawings and the manufacturer's recommendations.
 6. Hatches shall be Halliday H1R3030, as manufactured by Halliday Products Orlando, Florida, or approved equal or size and type as shown on the Drawings.

2.06 MANHOLE RUNGS

- A. There shall be no manhole rungs.

2.07 JOINTING PRECAST MANHOLE SECTIONS

- A. Seal tongue and groove joints of precast manhole sections with either rubber O-ring gasket or preformed flexible joint sealant. O-ring gasket shall conform to ASTM C443. Preformed flexible joint sealant shall be Kent Seal No. 2 by Hamilton-Kent; Ram-Nek by K.T. Snyder Company or equal.
- B. Completed joint shall withstand 15 psi internal water pressure without leakage or displacement of gasket or sealant.

2.08 PIPE CONNECTIONS TO MANHOLES

- A. Connect pipe to manholes in the following ways:
1. Flexible sleeve - Integrally cast sleeve in precast manhole section or install sleeve in a formed or cored opening. Fasten pipe in sleeve with stainless steel clamp(s). Coat stainless steel clamp(s) with bituminous or asphaltic damp-proofing material to protect from

corrosion. Flexible sleeve shall be Lock Joint Flexible Manhole Sleeve; Kor-N-Seal connector; PRX Press-Seal Gasket or equal.

2. Compression gasket - Integrally cast compression gasket in precast manhole section. Insert pipe into compression gasket. Compression gasket shall be A-Lok or equal.
3. At the discretion of the Owner the following procedure may be allowed: Grout in place - Precast manhole section shall have a formed, tapered circular opening larger than the pipe outside diameter. Grout shall be non-shrink and waterproof equal to Hallemite, Waterplug or Embeco. Plastic pipe shall have a waterstop gasket secured to pipe with a stainless-steel clamp prior to grouting.

2.09 DAMPPROOFING

- A. Two coats of bituminous waterproofing material applied to the exterior surfaces of sanitary sewer manholes, precast joints, exterior of grade rings, and frame and covers by brush or spray and in accordance with the manufacturer's recommendations. Damp-proofing shall be Hydrocide 648 by Sonneborn Building Products; Dehydratine 4 by A.C. Horn Inc; RIW Marine Liquid by Toch Brothers or equal.
- B. There shall be no waterproofing applied to the exterior surface of drain manholes.

PART 3 EXECUTION

3.01 INSTALLATION

- A. Manhole Installation.
 1. Manholes shall be constructed to the dimensions shown on the Drawings and as specified herein. Protect all work against flooding and floatation.
 2. Place manhole on a bed of 12-in gravel as specified and shown on the Drawings. Set manhole base grade so that a maximum grade adjustment of 12-in is required to bring the manhole frame and cover to final grade.
 - a. Use precast concrete grade rings or brick and non-shrink mortar to adjust manhole frame and cover to final grade.
 3. Set precast concrete barrel sections plumb with a 1/4-in maximum out of plumb tolerance allowed. Seal joints of precast barrel sections with either a rubber O-ring set in a recess or preformed flexible joint sealant in sufficient quantity to fill 75 percent of the joint cavity. Fill the outside and inside joint with non-shrink mortar and finished flush with the adjoining surfaces. Caulk the inside of any leaking barrel section joint with lead wool or non-shrink grout to the satisfaction of the Owner.
 4. Allow joints to set for 14 hours before backfilling unless the Owner specifically approves a shorter period.
 5. Plug holes in the concrete barrel sections required for handling with a non-shrinking grout or non-shrinking grout in combination with concrete plugs. Finish flush on the inside.

6. Backfill carefully and evenly around manhole sections and in accordance with Section 02221.

B. Manhole Pipe Connections

1. Construct manhole pipe connections, including pipe stubs, as specified herein and in accordance with the manufacturer's recommendations.
2. Close or seal pipe stubs for future connections with a gasketed watertight plug.

C. Brickwork

1. Mix mortar only in such quantity as may be required for immediate use. Use mortar before initial set has taken place. Mortar shall be used within 1-1/2 hours and shall be constantly worked with hoe or shovel until used. Anti-freeze mixtures shall not be included in the mortar. Install masonry when the outside temperature is above 40 degrees F unless provisions are made to protect the mortar, bricks and finished work from frost by heating and enclosing the work with tarpaulins or other suitable material. Owner's decision regarding the adequacy of protection against freezing shall be final.
2. Construct channels and shelves of brick and concrete as shown on the Drawings. Brick lined channels shall correspond in shape with the lower half of the pipe. Set shelf elevation at crown of highest pipe and slope 1-in/ft to drain toward the flow through channel. Construct brick surfaces exposed to sewage flow with nominal 2-in by 8-in face exposed (i.e., bricks on edge).

D. Setting Manhole Frame and Cover

1. Set manhole covers and frames in a full mortar bed. Utilize bricks or precast concrete grade rings, a maximum of 12-in thick, to assure frame and cover are set to the finished grade. Set manhole frame and cover to final grade prior to placement of permanent paving.

E. Setting Access Hatches

1. Install in accordance with the manufacturer's recommendations.

F. Damp-proofing

1. Paint outer surfaces of precast sanitary sewer manholes exterior, precast joints, exterior of grade rings, and frames and covers with two coats of bituminous damp-proofing at the rate of 30 to 60 sq. ft. per gallon, in accordance with manufacturer's instructions.

3.02 CLEANING

- A. Thoroughly clean all new manholes of all silt, debris and foreign matter of any kind, prior to final inspections.

END OF SECTION

SECTION 02607
PRECAST CONCRETE VALVE VAULTS

PART 1 GENERAL

1.01 SCOPE OF WORK

- A. Furnish all labor materials, equipment and incidentals required to install precast concrete valve vaults complete as shown on the Drawings and specified herein.

1.02 RELATED WORK

- A. Section 02221 – Trenching Backfill and Compaction
- B. Section 02230 – Granular Fill Materials.
- C. Section 02509 – Ductile Iron Pipe for Buried Water Service
- D. Section 02512 – Water Valves

1.03 SUBMITTALS

- A. Submit cut sheets with dimensions of base sections, riser sections, eccentric and concentric conical top sections, flat slab tops, and grade rings. Indicate location, orientation size and elevation of finished inverts for penetrations for each structure.
- B. Submit notarized certificate indicating compliance with ASTM C 478.
- C. Submit concrete test cylinder reports from an approved testing laboratory certifying conformance with this Section.
- D. Submit manufacturer Instructions: Submit special procedures for precast concrete valve vaults and meter boxes installation and method of repair for minor damage to precast concrete sections.
- E. Submit cut sheets for each structure frame and cover, access hatch, rungs and or ladders.
- F. Submit concrete mix design for each different mix.
- G. Submit signed and sealed Shop Drawings with design calculations and assumptions for custom fabrications of each valve vault or meter box. Sectional plans and elevations showing dimensions and reinforcing steel placement shall be submitted.

1.04 QUALITY ASSURANCE

- A. Products shall meet all requirements of the State of South Carolina Department of Transportation, the City of Columbia, South Carolina Water Department and all applicable permitting agencies.

- B. Perform structural design according to ACI 318.
- C. Perform Work in a plant certified by NPCA – National Precast Concrete Association.
- D. Perform welding according to following:
 - 1. Structural Welding Code - Steel: AWS D1.1
 - 2. Structural Welding Code -Reinforcing Steel AWS D1.4
- E. The quality of all materials, the process of manufacture, and the finished sections shall be subject to inspection and approval by the City of Columbia (Owner). Such inspection may be made at the place of manufacture, or on the work after delivery, or at both places and the materials shall be subject to rejection at any time on account of failure to meet any of the requirements specified herein; even though samples may have been accepted as satisfactory at the place of manufacture. Material rejected after delivery to the job shall be marked for identification and shall be removed from the job at once. All materials which have been damaged after delivery will be rejected, and if already installed, shall be acceptably repaired, if permitted, or removed and replaced.
- F. At the time of inspection, the materials will be carefully examined for compliance with the ASTM standard specified below and this Section and with the approved manufacturer's drawings. All sections shall be inspected for general appearance, dimension, "scratch strength", blisters, cracks, roughness, soundness, etc. The surface shall be dense and close textured.
- G. Imperfections in sections may be repaired, subject to the approval of the Owner, after demonstration by the manufacturer that strong and permanent repairs result. Repairs shall be carefully inspected before final approval. Cement mortar used for repairs shall have a minimum compressive strength of 4000 psi at 7 days and 5000 psi at 28 days, when tested in 3 by 6-inch cylinders stored in the standard manner. Epoxy mortar may be utilized for repairs subject to the approval of the Owner.
- H. All work shall be completed by a manufacturer specializing in manufacturing products specified in this Section with minimum three years' documented experience.
- I. All installation shall be by a company specializing in performing Work of this Section with minimum three years documented experience and approved by manufacturer.
- J. Design professional qualifications are required for design of custom fabrications. A Licensed Professional Engineer in the State of South Carolina with a minimum of three years experienced in design of specified Work shall be used.

1.05 DELIVERY, STORAGE, AND HANDLING

- A. Do not deliver products until concrete has cured 5 days or has attained minimum 75 percent of specified 28-day compressive strength.
- B. Accept materials on Site in manufacturer's original packaging and inspect for damage.
- C. Comply with precast concrete manufacturer instructions for unloading, storing, and moving precast structures.

- D. Transport and handle precast concrete units with equipment designed to protect units from damage. Lift structures from designated lifting points.
- E. Store precast concrete valve vaults and meter boxes according to manufacturer instructions.
- F. Do not place concrete units in position to cause overstress, warping, or twisting.
- G. Repair property damaged from materials storage.

PART 2 PRODUCTS

2.01 DESIGN REQUIREMENTS

- A. A16: equivalent to AASHTO HS20 - 16-kip wheel.
- B. Minimum 28-Day Compressive Strength: 5,000 psi.
- C. Honeycombed or re-tempered concrete is not permitted.

2.02 PRECAST CONCRETE VALVE VAULTS

- A. Precast valve vaults shall be manufactured by Tindall Concrete Products, Inc. or approved equal.
- B. Valve Vaults with ductile iron frame and covers shall be:
 - 1. ASTM A536, Standard Specification for Ductile Iron Casting.
 - 2. Contact Surfaces: Machined and matched.
 - 3. Cast cover inscription with pipeline service and City of Columbia.
- C. Valve vaults with aluminum access hatches shall be:
 - 1. Access doors shall provide a minimum of a 30-inch by 30-inch clear opening or as shown on the Drawings.
 - 2. The access door shall have a 1/4" (7mm) thick, mill finish, extruded aluminum channel frame, incorporating a continuous concrete anchor. A 1-1/2-inch (38mm) drainage coupling shall be located in the front left corner of the channel frame. The entire frame must be supported by a full bed of Class A concrete.
 - 3. The access door panels shall be 1/4" (7mm) aluminum diamond plate reinforced to withstand a H-20 uniform live load with a maximum allowable deflection of 1/150 of the span, and shall not protrude into the channel frame when in the open position.
 - 4. The access doors shall open to 90 degrees and automatically lock with a T-316 stainless steel hold open. The doors shall incorporate enclosed stainless-steel compression spring assists. Doors shall close flush with the frame. Hinges and all fastening hardware shall be T-316 stainless steel. Unit shall lock with a T-316 stainless steel slam lock with removable key and have a non-corrosive handle. Unit shall have a hinged aluminum grate fall-through protection system.

5. The access hatch shall be installed in accordance with the Drawings and the manufacturer's recommendations.
6. Hatches shall be Halliday H1R3030, as manufactured by Halliday Products Orlando, Florida, or approved equal or size and type as shown on the Drawings.

2.03 MATERIALS

- A. Portland Cement shall comply with ASTM C150 Standard Specification for Portland Cement: Type II.
- B. Coarse Aggregates shall comply with ASTM C33 Standard Specification for Concrete Aggregates. Graded 1 inch to No. 4 sieve.
- C. Sand shall comply with ASTM C33 Standard Specification for Concrete Aggregates. Fineness Modulus: 2.35.
- D. Water shall be potable and be clean and free of injurious amounts of acids, alkalis, salts, organic materials, and substances incompatible with concrete or steel.
- E. Air-Entraining Admixtures shall comply with ASTM C260 Standard Specification for Air-Entraining Admixtures for Concrete.

2.04 REINFORCING STEEL

- A. For Galvanized Finish: Comply with ASTM A767, Standard Specification for Zinc-Coating (Galvanized) Steel Bars for Concrete Reinforcement, Class I.
- B. For Epoxy Coating Finish: Comply with ASTM A775 Standard Specification for Epoxy-Coated Steel Reinforcing Bars).
- C. Deformed Bars: ASTM A615 Standard Specification for Deformed and Plain Carbon-Steel Bars for Concrete Reinforcement: Grade 60.
- D. Welded Wire Fabric: ASTM A185 Standard Specification for Steel Welded Wire Reinforcement, Plain, for Concrete.

2.05 JOINT SEALANT

- A. Gasket Joints shall comply with ASTM C443 Standard Specification for Joints for Concrete Pipe and Manholes, Using Rubber Gaskets.
- B. External Sealing Bands shall comply with ASTM C877 Standard Specification for External Sealing Bands for Concrete Pipe, Manholes, and Precast Box Sections
- C. Preformed Joint Sealants shall comply with ASTM C990, Standard Specification for Joints for Concrete Pipe, Manholes, and Precast Box Sections Using Preformed Flexible Joint Sealants.
- D. Elastomeric Joint Sealants shall comply with ASTM C920 Standard Specification for Elastomeric Joint Sealants.

2.06 GROUT

- A. Cement Grout: Portland cement, sand, and water mixture with stiff consistency to suit intended purpose.
- B. Non-Shrink Grout: Premixed compound consisting of non-metallic aggregate, cement, and water-reducing and plasticizing agents. Conform to ASTM C1107, Standard Specification for Packaged Dry, Hydraulic-Cement Grout (Non-shrink). Minimum Compressive Strength: 2,400 psi in 48 hours, and 7,000 psi in 28 days.

2.07 FABRICATION

- A. Fabricate precast reinforced concrete structures according to ASTM C913 – Standard Specification for Precast Concrete Water and Wastewater Structures, to dimensions indicated on Drawings, and to specified design criteria.
- B. Construct forms to provide uniform precast concrete units with consistent dimensions.
- C. Clean forms after each use.
- D. Install reinforcement by tying or welding to form rigid assemblies. The minimum cover per ASTM C913 is 1" for water bearing structures and ¾" for other structures.
- E. Position reinforcement to maintain minimum ½-inch cover.
- F. Secure reinforcement to prevent displacement while placing concrete.
- G. Position and secure embedded items to prevent displacement while placing concrete.
- H. Deposit concrete in forms and consolidate concrete without segregating aggregate.
- I. Provide initial curing by retaining moisture using one of following methods:
 - 1. Cover with polyethylene sheets.
 - 2. Cover with burlap or other absorptive material and keep continually moist.
 - 3. Apply curing compound according to manufacturer instructions.
- J. Provide final curing according to manufacturer's standard.
- K. Remove forms without damaging concrete.

2.08 SOURCE QUALITY CONTROL

- A. Manufacturer shall perform the following tests for each 150-cu. yd. of concrete placed with minimum one set of tests each week:
 - 1. Slump: Comply with ASTM C143 Standard Test Method for Slump of Hydraulic Cement Concrete.

2. Compressive Strength: ASTM C31 Standard Practice for Making and Curing Concrete Test Specimens in the Field
 3. Air Content: Comply with ASTM C231 Standard Test Method for Air Content of Freshly Mixed Concrete by the Pressure Method
 4. Unit Weight: Comply with ASTM C138 Standard Test Method for Density (Unit Weight), Yield, and Air Content (Gravimetric) of Concrete
- B. Make test results available to Owner upon request.
- C. Visually inspect completed precast structures for defects. Repair defects on surfaces exposed to view to achieve uniform appearance. Repair honeycomb by removing loose material and applying grout to produce smooth surface flush with adjacent surface.

PART 3 EXECUTION

3.01 GENERAL

- A. Installation shall be in accordance with manufacturers recommendations and applicable permitting agencies.
- B. Excavation and Bedding shall be in accordance with Section 02221.

3.02 INSTALLATION

- A. Hand trim excavation for accurate placement of vaults to elevations indicated.
- B. Place bedding material level in one continuous layer not exceeding 6 inches compacted depth and compact to 95 percent maximum density.
- C. Backfill around sides of vaults, tamp in place, and compact to 95 percent maximum density.
- D. Maintain optimum moisture content of bedding material to attain required compaction density.
- E. Lower each section into excavation. Clean all joint surfaces. Install watertight joint seals according to manufacturer instructions
- F. If applicable, remove knockouts or cut structure to receive piping without creating openings larger than required to fit pipe; fill annular space with grout.
- G. Connect pipe to structure and seal watertight.
- H. Grout inside of structure to achieve slope to drain.
- I. Paint interior with two coats of bituminous interior coating at rate of 120 sq. ft. per gal. for each coat.
- J. Install Frame and Cover or Access Hatch by setting level, without tipping, to elevations as indicated on Drawings. Set cover and access hatches 2 inches above finished grade for structures located within unpaved areas to allow area to be graded away from cover.

END OF SECTION

SECTION 02610
SEWER TESTING AND CLEANING

PART 1 GENERAL

1.01 SCOPE OF WORK

- A. Furnish all labor, materials, equipment and incidentals required and test and clean all new sewer pipelines installed under this Contract as specified herein. This section does not apply to water pipelines.

1.02 RELATED WORK

- A. Section 02615 - Ductile Iron Pipe for Buried Sewer Service.
- B. Section 02622 – Polyvinyl Chloride Gravity Sewer Pipe
- C. Section 02605 - Precast Concrete Manholes

1.03 SUBMITTALS

- A. Submit a testing plan including detailed procedures and methods and equipment that will be used for pipeline testing at least 10 days before starting the testing for City of Columbia's (Owner)'s review. All tests shall be conducted in the presence of the Owner. Furnish all necessary equipment and labor for carrying out the specified tests.
- B. Results of all infiltration, exfiltration, low pressure air, and hydrostatic pressure tests shall be submitted to the Owner. All rates of infiltration/exfiltration shall be clearly indicated along with sections of pipelines tested, and durations of the test.
- C. Any pipe not meeting the testing requirements of this section shall be repaired and/or replaced, retested and new test results submitted to the Owner for approval.

PART 2 PRODUCTS (NOT USED)

PART 3 EXECUTION

3.01 GENERAL

- A. Furnish all necessary equipment and labor for cleaning and testing all new sewer pipelines. The procedures and methods shall be approved by the Owner.
- B. Make any taps and furnish all necessary caps, plugs, etc., as required in conjunction with testing pipelines. Furnish a test pump, gauges and any other equipment required in conjunction with carrying out the hydrostatic tests specified herein.

3.02 CLEANING PIPELINES

- A. As pipe laying progresses and at the conclusion of the work thoroughly clean all new pipelines by flushing with water or other means to remove all dirt, stones, pieces of wood or other material which may have entered during the construction period. If, after this cleaning, obstructions remain, they shall be removed by other means by the Contractor as approved by the Owner.

3.03 TESTING GRAVITY SEWER PIPELINES

- A. All sanitary gravity pipelines including ductile iron, PVC, and Centrifugally Cast Fiberglass Reinforced pipe shall be tested for leakage by an infiltration or exfiltration test. Buried piping shall be tested by an infiltration test if the groundwater is more than 2-ft above the crown of the pipe for the full length of the section to be tested. Air testing may be used in lieu of an exfiltration test subject to approval of the Owner.
- B. Exfiltration Test
 - 1. Leakage tests by exfiltration shall be made by creating a head in the pipeline to be tested by filling the line and either a manhole or temporary riser on one end of the line with water. The length of pipe to be tested shall be such that the head over the crown at the upstream end is not less than 2-ft and the head over the downstream crown is not more than 6-ft. The pipe shall be plugged by pneumatic bags or mechanical plugs in such a manner that the air can be released from the pipe while it is being filled with water. Before any measurements are made, the pipe shall be kept full of water long enough to allow absorption and the escape of any trapped air to take place. Following this, a test period of at least one hour shall begin. Provisions shall be made for measuring the amount of water required to maintain the water at a constant level during the test period.
 - 2. If any joint shows an appreciable amount of leakage, the jointing material shall be removed and the joint repaired. If any pipe is defective, it shall be removed and replaced. If the quantity of water required to maintain a constant head in the pipe does not exceed 1.9 gallons per inch of diameter per day per 100-ft of pipe and if all the leakage is not confined to a few joints, workmanship shall be considered satisfactory.
- C. Infiltration Test
 - 1. Pipe shall be tested for infiltration after the backfill has been placed and the ground water allowed to return to normal elevation. The length of line to be tested shall be not less than the length between adjacent manholes and not more than the total length of each size of pipe. The allowable infiltration shall be 1.9 gallons per inch of diameter per day per 100-ft of pipe in each section tested. There shall be no gushing or spurting leaks.
 - 2. If an inspection of the completed pipeline or any part thereof shows pipes or joints which allow noticeable infiltration of water, the defective work or material shall be replaced or repaired as directed.
 - 3. Rates of infiltration shall be determined by means of V-notch weirs, pipe spigots, or by plugs in the end of the pipe installed in an approved manner and at such times and locations as may be directed by the Contractor's Engineer.

D. Low Pressure Air Test

1. Low-pressure air tests shall be made with equipment specifically designed and manufactured for the purpose of testing pipelines using low-pressure air. The equipment shall be provided with an air regulator valve or air safety valve so set that the internal air pressure in the pipeline cannot exceed 8 psig. Pneumatic plugs shall have a sealing length equal to or greater than the diameter of the pipe to be tested. All air used shall pass through a single control panel.
2. Install plugs at manholes. Brace plugs securely as required for safety and allow no one in the manholes while pressurizing the line or during the test.
3. Low-pressure air shall be introduced into the sealed line until the internal air pressure reaches 4 psig. The internal air pressure in the sealed line shall not be allowed to exceed 8 psig. At least 2 minutes shall be allowed for the air pressure to stabilize in the section under test. After the stabilization period, the low-pressure air supply hose shall be quickly disconnected from the control panel. The time required in minutes for the pressure in the section under test to decrease from 3.5 to 2.5 psig shall not be less than that shown in Table 1 of ASTM F1417.
4. If the pipe section does not pass the air test, sectionalize the section tested to determine the location of the leak. Once the leak has been located, repair and retest.

3.04 TESTING PRESSURE SEWER PIPELINES

1. All pressure pipelines shall be pressure and leakage tested. Pipelines shall be subjected to a hydrostatic pressure of 150 pounds per square inch or 1.5 times the operating pressure, whichever is greater, as determined by the Owner. This test pressure shall be maintained for at least 2 hours. The test pump and water supply shall be arranged to allow accurate measurement of the water required to maintain the test pressure. Where applicable, hydrant branch gate valves shall remain open during this test.
2. The amount of leakage which will be permitted shall be in accordance with AWWA C600.

3.05 LEAKAGE TESTS FOR SANITARY MANHOLES

- A. Sewer pipelines shall be tested as specified in Section 02610.
- B. Test each sewer manhole for leakage. Owner shall observe each test. Perform exfiltration test as described below:
- C. Assemble manhole in place; fill and point all lifting holes and exterior joints within 6-ft of the ground surface with an approved non-shrinking mortar. Test prior to placing the shelf and invert and before filling and pointing the horizontal joints below 6-ft of depth. Lower ground water table below bottom of the manhole for the duration of the test. Plug all pipes and other openings into the manhole and brace to prevent blow out.
- D. Fill manhole with water to the top of the cone section. If the excavation has not been backfilled and no water is observed moving down the surface of the manhole, the manhole is satisfactorily watertight. If the test, as described above is unsatisfactory as determined by the Owner, or if the manhole excavation has been backfilled, continue the test. A period of time may be permitted to

allow for absorption. Following this period, refill manhole to the top of the cone, if necessary and allow at least 8 hours to pass. At the end of the test period, refill the manhole to the top of the cone again, measuring the volume of water added. Extrapolate the refill amount to a 24-hour leakage rate. The leakage for each manhole shall not exceed one gallon per vertical foot for a 24-hour period. If the manhole fails this requirement, but the leakage does not exceed three gallons per vertical foot per day, repairs by approved methods may be made as directed by the Owner. If leakage due to a defective section of joint exceeds three gallons per vertical foot per day, the manhole shall be rejected. Uncover the rejected manhole as necessary and disassemble, reconstruct or replace it as directed by the Owner. Retest the manhole and, if satisfactory, fill and paint the interior joints.

- E. No adjustment in the leakage allowance will be made for unknown causes such as leaking plugs, absorptions, etc. It will be assumed that all loss of water during the test is a result of leaks through the joints or through the concrete.
- F. An infiltration test may be substituted for an exfiltration test if the ground water table is above the highest joint in the manhole. If there is no leakage into the manhole as determined by the Owner, the manhole will be considered watertight. If the Owner is not satisfied, testing shall be performed as previously described.

3.06 DEFLECTION TESTING

- A. All PVC and Centrifugally Cast Fiberglass Reinforced pipes shall be tested for deflection as follows:
 - 1. Pipe deflection shall be measured not less than 90 days after the backfill has been completed and shall not exceed 5 percent. Deflection shall be computed by multiplying the amount of deflection (nominal diameter less minimum diameter when measured) by 100 and dividing by the nominal diameter of the pipe.
 - 2. Deflection shall be measured with a rigid mandrel (Go/No Go) device cylindrical in shape and constructed with a minimum of nine evenly spaced arms or prongs. Drawings of the mandrel with complete dimensions shall be submitted to the Owner for each diameter of pipe to be tested. The mandrel shall be hand pulled through all sewer lines.
 - 3. Any section of sewer not passing the mandrel shall be uncovered at no additional cost to the Owner and the bedding and backfill replaced to prevent excessive deflection. Repaired pipe shall be retested at no additional cost to the Owner. Retested pipe shall not deflect more than 4 percent.

END OF SECTION

SECTION 02612
CLEANING TESTING AND DISINFECTION OF WATER LINES

PART 1 GENERAL

1.01 SCOPE OF WORK

- A. Furnish all labor, materials, equipment and incidentals required to clean, test and disinfect all new water pipelines installed under this Contract as specified herein. This section does not apply to sewer pipelines.

1.02 RELATED WORK

- A. Section 02509 - Ductile Iron Pipe for Buried Water Service.
- B. Section 02512 –Water Valves
- C. Section 02513 – Fire Hydrants

1.03 SUBMITTALS

- A. Submit a testing plan including detailed procedures and methods and equipment that will be used for pipeline testing at least 10 days before starting the testing for the City of Columbia's (Owner)'s review. All tests shall be conducted in the presence of the Owner. Furnish all necessary equipment and labor for carrying out the specified tests.
- B. Results of all tests shall be submitted to the Owner.

1.04 REFERENCE STANDARDS

- A. AWWA C600 – Installation of Ductile Iron Mains and their Appurtenances
- B. AWWA C651 – Disinfecting Water Mains
- C. AAWA C655 – Field De-chlorination

PART 2 PRODUCTS (NOT USED)

PART 3 EXECUTION

3.01 GENERAL

- A. Furnish all necessary equipment and labor for cleaning, testing and disinfection of all new water pipelines. The procedures and methods shall be approved by the Owner.
- B. Make any taps and furnish all necessary caps, plugs, etc., as required in conjunction with testing and disinfection of pipelines. Furnish a test pump, gauges and any other equipment required in conjunction with carrying out the hydrostatic tests specified herein.

- C. Any pipe not meeting the testing requirements of this section shall be repaired and/or replaced, retested and new test results submitted to the Owner for approval.

3.02 CLEANING PIPELINES

- A. As pipe laying progresses and at the conclusion of the work thoroughly clean all new pipelines by flushing with water or other means to remove all dirt, stones, pieces of wood or other material which may have entered during the construction period. If, after this cleaning, obstructions remain, they shall be removed by other means by the Contractor as approved by the Owner.

3.03 HYDROSTATIC TESTING OF PIPELINES

- A. All water pipelines shall be pressure and leakage tested. Furnish all necessary equipment and labor for testing all pipelines.
- B. Submit detailed test procedures and methods per AWWA C600 for review by Owner at least 10 days prior to testing.
- C. Pipelines shall be subjected to a hydrostatic pressure of 150 pounds per square inch or 1.5 times the operating pressure, whichever is greater, as determined by the Owner. This test shall be maintained for at least 2 hours. The test pump and water supply shall be arranged to allow accurate measurement of the water required to maintain the test pressure. Where applicable, hydrant branch gate valves shall remain open during this test.
- D. The amount of leakage which will be permitted shall be in accordance with AWWA C600, latest edition. Repair all evident leaks and repair all lines failing to meet tests. Retest as necessary until test requirements are met. Remove and replace all defective materials.

3.04 DISINFECTION OF PIPELINES

- A. General
 - 1. Should initial treatment fail to meet results specified, repeat procedures until satisfactory results are obtained, at no additional cost to the Owner.
 - 2. Disinfect all pipelines per AWWA C651 and in accordance with all requirements of the South Carolina Department of Health and Environmental Control (SCDHEC) and the City of Columbia Plant Laboratory.
 - 3. The Contractor shall provide a minimum of two ¾-inch sampling ports in the pipe to be disinfected along with all feeders, feed taps, chemicals, etc. Sample locations shall be at tie-in location of new and existing water lines, at the end of all dead-end lines, and at intervals of no more than 1,200 linear feet.
 - 4. Newly laid valves or other appurtenances shall be operated several times while line is filled with chlorinating agent.
 - 5. All sample locations are to be given an identifying label and are to be included on the record drawings indicating location.

B. Procedure

1. Flush line to extent possible with available pressure and outlets, prior to installation. Hydrant openings required to produce proper flushing velocity at 40 psi are:

<u>Pipe Size (inches)</u>	<u>Hydrant Openings</u>
4" – 12"	1 – 2-1/2"
Greater than 12"	Refer to Contractor Engineer's design

2. Apply chlorine as liquid chlorine or chlorine compound such as calcium hypochlorite with known chlorine content.
3. Apply through corporation cock in top of main at beginning of section being disinfected.
4. Use proper feeder and flow regulator to introduce chlorinating agent.
5. Application rate shall be not less than 50 ppm.
6. Retain chlorinated water in main not less than 24 hours.
7. At end of retention period, at least 10 ppm of chlorine residual shall remain in the water at the extreme end of section.
8. Flush line thoroughly.

C. De-chlorination

1. Dechlorinate the chlorinated water used for disinfecting water lines in accordance with AWWA C655.
2. Apply dechlorinating agent as liquid sulfur dioxide or sodium bisulfite solution.
3. Prepare a mixing chamber using a 55-gallon tank or similar vessel as approved by the Owner. Feed the discharge and dechlorinating agent at the bottom of the tank with overflow at the top.
4. Discharge total chlorine residual to be less than 0.5 milligrams per liter and in compliance with Federal, State and local standards.

D. Acceptance:

1. City of Columbia laboratory staff to collect 1st and 2nd samples during a 24-hour period for testing at the City's laboratory. Testing shall include both coliform and non-coliform growth.
 - a. The sample results shall include the free chlorine residual at the at the time the samples were collected.

- b. Chlorination of pipelines shall continue uninterrupted until approval by the Owner.
- c. Notify the City of Columbia to take a 3rd sample if necessary. Additional City of Columbia testing for lines not passing shall be billed to the Contractor for payment.
- d. Acceptance shall be in accordance with AWWA C651.

END OF SECTION

SECTION 02615
DUCTILE IRON PIPE FOR BURIED SEWER SERVICE

PART 1 GENERAL

1.01 SCOPE OF WORK

- A. The Work specified in this Section includes the installation of buried ductile iron pipe for gravity and pressure sanitary sewer service as indicated on the Contract Drawings and as herein specified.
- B. The Contractor shall furnish and install sewer piping and service connection piping to the lines and grades and in the locations indicated on the Contract Drawings and/or as ordered by the City of Columbia (Owner).
- C. Piping shall be located substantially as shown on the Drawings. The Owner reserves the right to make such modifications in locations as may be found desirable to avoid interference between pipes or for other reasons. Pipe fitting notation is for the Contractor's convenience and does not relieve him/her from installing and jointing different or additional items where required to achieve a complete piping system.
- D. Where the word "pipe" is used it shall refer to pipe, fittings, or appurtenances unless otherwise noted.

1.02 RELATED WORK

- A. Section 02140 - Dewatering and Drainage
- B. Section 02221 - Trenching, Backfill and Compaction
- C. Section 02230 - Granular Fill Materials
- D. Section 02610 - Sewer Testing and Cleaning
- E. Section 02605 - Precast Concrete Manholes
- F. Section 02317 - Underground Utility Warning Tape

1.03 SUBMITTALS

- A. Submit shop drawings and product data, including piping layouts, design calculations, warranty information, and test reports and the referenced standards.
- B. Submit the name of the pipe and fitting suppliers and a list of materials to be furnished.
- C. Submit certified copies of mill tests confirming the type of materials used in the pipe, and shop testing of pipe to show compliance with the requirements of the applicable standards, along

with a sworn affidavit of compliance that the pipe complies with the referenced standards, shall be submitted.

- D. Submit copies of all shop tests, including hydrostatic tests.
- E. Submit anticipated delivery schedule.
- F. Submit a certified affidavit of compliance from the manufacturer stating that the pipe, fittings, gaskets, linings and exterior coatings for this project have been manufactured and tested in accordance with AWWA and ASTM standards and requirements specified herein.
- G. The Applicator of the interior lining shall submit a certified affidavit of compliance with manufacturer's instructions and requirements specified herein.
- H. Submit handling procedures for all phases from finished fabrication through delivery including storage, transportation, loading, and unloading. This will include storage at the project site and required protection following installation prior to startup.
- I. Submit certified statement that inspection and all specified tests have been performed.

1.04 REFERENCES

- A. The following standards based on the latest edition form a part of this specification as referenced:
 - 1. ASTM A746 Standard Specifications for Ductile Iron Gravity Sewer Pipe
 - 2. AWWA C105 Polyethylene Encasement for Ductile Iron Pipe Systems
 - 3. AWWA C110 Ductile Iron Full Body Fittings, 3 in. through 64 in.
 - 4. AWWA C111 Rubber-Gasket Joints for Ductile Iron Pressure Pipe and Fittings
 - 5. AWWA C115 Flanged Ductile Iron Pipe with Threaded Flanges
 - 6. AWWA C151 Ductile Iron Pipe, Centrifugally Cast, for Water or Other Liquids
 - 7. AWWA C150 Thickness Design of Ductile Iron Pipe
 - 8. AWWA C153 Ductile Iron Compact Fittings, 3 in. through 64 in. for Water Service
 - 9. AWWA C600 Installation of Ductile Iron Water Mains and their Appurtenances

1.05 QUALITY ASSURANCE

- A. It is a requirement of these Contract Documents to have all of the ductile iron pipe under this section be designed and supplied by a single supplier rather than have selection and supply of these items by a number of different suppliers.
- B. All pipe and fittings shall be inspected and tested at the foundry as required by the standard specifications by which the material is manufactured.

- C. All pipe and fittings shall be subject to inspection by the Owner after delivery to the job site and may also be subject to inspection at the foundry by a representative of the Owner.
- D. In addition, the Owner reserves the right to have any or all pipe, fittings, and special castings inspected and/or tested by an independent service at either the manufacturer's plant or elsewhere.
- E. All pipe and fittings shall be marked in accordance with all applicable AWWA standards. Legibly and permanently mark all pipe, fittings, specials and appurtenances to be consistent with the laying schedule and marking drawings (if required) with the following information:
 - 1. Manufacturer, date.
 - 2. Size, type, class, or wall thickness.
 - 3. AWWA Standard(s) produced to.

PART 2 PRODUCTS

2.01 PIPE

- A. Provide ductile iron pipe and fitting from American Cast Iron Pipe Co., US Pipe and Foundry, Griffin Pipe Products, McWane Company, or approved equal which must be a member of the Ductile Iron Pipe Research Association (DIPRA).
- B. Ductile iron gravity and pressure pipe shall conform to the current ASTM A746, and AWWA C111 and C151 (ANSI A21.51) standard. All pipe shall be new, and shall have the AWWA or ASTM designation, pressure class and size of pipe stamped on the outside of each joint.
- C. Thickness design shall be per AWWA C150, latest standard, with minimum Pressure Class 350 for piping 12-in and smaller, minimum Pressure Class 250 for piping from 14 to 20-in, minimum Pressure Class 200 for 24-inch piping, and minimum Pressure Class 150 for piping 30 to 64-in.
- D. Pipe to be shipped per AWWA C600 and in accordance with the pipe manufacturer's recommendations and stored in a manner that the pipe is not damaged. The Contractor will replace damaged piping at no additional cost to the Owner.

2.02 JOINTS AND GASKETS

- A. Unless otherwise noted, all ductile iron pipe/fitting joints shall be push-on rubber gasket type or rubber gasket mechanical joint type per AWWA C111 in unrestrained areas.
- B. In restrained areas as indicated on the Drawings, both pipe and fitting joints shall be push on rubber gasket, locking ring type restrained joints per the manufacturer' standard, except where flange joints are shown on the Drawings.
 - 1. Restrained push on joints shall be by one of the following or an approved equal
 - a. Amarillo Fast-Grip gasket, Flex Ring, Field Flex Ring, and LOK Ring by American Cast Iron Pipe

- b. Red Field Lok gasket, TR Flex by US Pipe
 - c. Snap Lok by Griffin Pipe Products
 - d. Superlok by Clow Water Systems Company
 - e. Or Equal
 2. Restrained joint gaskets shall be colored, non-black. The color shall be consistent throughout the entire cross section of the gasket and not be attained by surface coating; the color shall be inherent within the rubber. Gaskets shall meet applicable requirements of AWWA/ANSI C111/A21.11 and shall be ANSI/NSF Standard 61 certified. Restrained joints shall be rated at a minimum as follows:
 - a. 350 psi for 4"-18" diameter
 - b. 250 psi for 20"-24" diameter
 - c. 150 psi for 30"-64" diameter
- C. Mechanical joint restraint systems that utilize a wedge style gripping system or a gland/ring positive restraint system will be considered acceptable on a case by case basis as approved by the Owner.
 1. The optional mechanical joint restraint shall be incorporated in the design of a follower gland. The gland shall be manufactured of ductile iron per ASTM A536. Dimensions of the gland must be such that it can be used with the standard mechanical joint bell and tee-headed bolts, as specified with the pipe.
 2. Restraint Mechanism:
 - a. Individually activated gripping surfaces maximizing restraint capability.
 - b. Wedges designed to spread the bearing surfaces on the pipe.
 - c. Torque limiting twist-off nuts. When the nut is sheared off, standard hex nut shall remain.
 3. Restraint Device for mechanical joint Ductile Iron Pipe: EBAA Iron Megalug Series 1100 or approved equal.
- D. Threaded ductile iron flanges for ductile iron pipe shall be used only where shown on the Drawings and shall be fabricated per AWWA C115 and sealed during installation with a special high pressure, full face gasket per AWWA C111. At the pipe manufacturer's option, the use of 250 lb. pattern flanges, which are faced and drilled in accordance with ANSI B16.1 may be substituted in order to match valves or other equipment and/or to meet the required working pressure requirements. All flanges shall be rated for the same pressure as the adjacent pipe in all cases. Compatibility of the flanges with 250 lb. class and higher special class AWWA valves will be the responsibility of the Contractor.
 1. Flanges shall be pre-drilled and then faced after being screwed onto the pipe, with flanges true to 90 degrees of the pipe axis and shall be flush with the end of the pipe.
 2. Gaskets shall be full face rubber, 1/8" thick SBR material. Such as American Toruseal Gasket, or approved equal. Special material ring gaskets such as those by Garlock or approved equal may be required for pressures exceeding 250 for ANSI rated and custom flanges.

3. Flanged joints shall be supplied with bolts and nuts on one end, bolt studs with a nut at each end, or studs with nuts on one end where the flange is tapped. The number and size of bolts shall comply with the same standard as the flange. Bolts and nuts shall, except as otherwise specified or noted in the Specifications or on the Drawings, comply with ASTM A193, grade B7.
 4. Blind flanges shall mate with regular flanges.
- 2.03 FILLER FLANGES AND BEVELED FLANGE FILLERS SHALL BE FURNISHED FACED AND DRILLED COMPLETE WITH EXTRA LENGTH BOLTS.FITTINGS
- A. Fittings for ductile iron pipe shall be of ductile iron, and shall conform to AWWA C153 or AWWA C110.
 - B. Fittings shall have the same pressure rating, as a minimum, of the connecting pipe.
- 2.04 COUPLINGS AND ADAPTERS
- A. Sleeve type couplings shall be mechanical joint solid sleeve type. Dresser Style 38, 138 or equal by Ford Meter Box Co. shall be used only when approved by the Owner.
- 2.05 EXTERIOR COATING
- A. All buried pipe shall be installed with an external bituminous coating in accordance with AWWA C151 and C110 respectively.
 - B. All ductile iron pipe located within 100 LF of an active cathodic protection system, such as that on steel gas lines, shall be protected by installing polyethylene encasement. When used polyethylene encasement shall be V-Bio, or approved equal, and meet all the requirements for ANSI/AWWA C105/A21.5, Polyethylene Encasement for Ductile Iron Pipe Systems.
 1. V-Bio polyethylene encasement shall consist of three layers of co-extruded linear low-density polyethylene (LLDPE), have a minimum thickness of 8 mils and meet or exceed the minimum standards established by AWWA C105, current edition. Polyethylene encasement shall meet minimum size requirements per TABLE 3 of section 2.15 of DIPRA's Installation Guide for Ductile Iron Pipe.
 2. The inside surface of the polyethylene wrap to be in contact with the pipe exterior shall be infused with a blend of anti-microbial biocide to mitigate microbiologically influenced corrosion and a volatile corrosion inhibitor to control galvanic corrosion. Ductile iron pipe and the polyethylene encasement used to protect it shall be installed in accordance with AWWA C600 and ANSI/AWWA C105/A21.5 and also in accordance with all recommendations and practices of the AWWA M41, Manual of Water Supply Practices.
 3. A 2-inch wide plastic adhesive tape, manufactured by Calpico Vinyl, Polyken, U.P.C. Tape, or approved equal, shall be used for sealing seams, cuts, or tears in polyethylene encasement. Duct tape shall not be allowed.

2.06 INTERIOR LINING

- A. For sanitary sewer, ductile iron pipe and fittings shall be lined with a ceramic-filled amine-cured epoxy, Protecto 401 by Induron, or equal. The lining thickness shall be 40 mils minimum. Application shall be performed by an applicator approved by the coating manufacturer, in accordance with manufacturer's instructions and under controlled conditions at the applicator's shop or the pipe manufacturer's plant.
 - 1. Interior lining shall cover all exposed surfaces of the pipe and fittings. The lining shall extend from the spigot end through the socket to the edge of the gasket sealing the recess for pipe using push-on joints. The lining shall also cover the exterior of the spigot end from the end of the pipe to beyond the gasket sealing area.

PART 3 EXECUTION

3.01 GENERAL

- A. Care shall be taken in loading, transporting and unloading to prevent injury to the pipe, lining or coatings. Pipe and fittings shall not be dropped or skidded against each other. Slings, hooks or pipe tongs shall be used for pipe handling. All pipe and fittings shall be examined before laying and no piece shall be installed which is found to be defective. Any damage to the pipe, lining or coatings shall be repaired per manufacturer's recommendations. Handling and laying of pipe and fittings shall be in accordance with manufacturer's instruction and as specified herein.
- B. If any defective pipe is discovered after it has been laid, it shall be removed and replaced with a sound pipe in a satisfactory manner at no additional cost to the Owner. All pipe and fittings shall be thoroughly cleaned before laying, shall be kept clean until they are used in the work and when installed or laid, shall conform to the lines and grades required.
- C. Materials, if stored, shall be kept safe from damage and stored in accordance with the manufacturer's requirements. The interior of all pipe, fittings and other appurtenances shall be kept free from dirt, excessive corrosion or foreign matter at all times.
- D. Pipe shall not be stacked higher than the limits recommended by its manufacturer. The bottom tier shall be kept off the ground on timbers, rails, or concrete. Stacking shall conform to manufacturer's recommendations and/or AWWA C600.
- E. Gaskets for push-on joints to be stored shall be placed in a cool location out of direct sunlight. Gaskets shall not come in contact with petroleum products. Gaskets shall be used on a first-in, first-out basis.
- F. Piping underneath structures shall be encased.

3.02 INSTALLING DUCTILE IRON PIPE AND FITTINGS

- A. Ductile iron pipe and fittings shall be installed in accordance with requirements of AWWA C600, except as otherwise specified herein. Pipe shall be bedded per details shown on the Drawings. Unless approved at specific locations, blocking will not be permitted. If any defective pipe or fitting is discovered after it has been laid, it shall be removed and replaced with a sound pipe or fitting in a satisfactory manner by the Contractor, at his/her own expense.

1. All pipe and fittings shall be kept clean until they are used in the work and shall be sound and thoroughly cleaned before laying. When laid, the pipe and fittings shall perform to the lines and grades required. When laying is not in progress, open ends of the pipe shall be closed by a watertight plug or other approved means. Sufficient backfill shall be placed to prevent flotation. The deflection at joints shall not exceed that recommended by the manufacturer.
2. All ductile iron pipe laid underground and not in SCDOT right-of-way shall have a minimum of 3 feet of cover for pipes 12-inches and less and 4 feet of cover for pipes greater than 12-inches unless otherwise shown on the Drawings or as specified herein. Pipe shall be laid to the invert elevations shown on the Drawings. All ductile iron pipe laid underground within SCDOT right-of-way shall have a minimum of 4 feet of cover for all diameters or as otherwise required by the SCDOT Utility Accommodations Manual.
3. Fittings, in addition to those shown on the Drawings, shall be provided by the Contractor where required in crossing utilities which may be encountered upon opening the trench. Solid sleeve closures shall be installed at locations approved by the Owner.
4. The pipe interior shall be maintained dry and broom clean throughout the construction period.
5. When field cutting the pipe is required, the cutting shall be done by machine, leaving a smooth cut at right angles to the axis of the pipe. The end of the cut pipe shall be beveled to conform to the manufacturer's recommendations for the spigot end. Any coating removed from the cut end shall be repaired according to manufacturer's recommendation. Cutting of restrained joint pipe will not be allowed, unless approved at specific joints in conjunction with the use of restrainer glands by EBAA Iron or field adaptable restrained joints. Where field cuts are permitted, the pipe to be cut shall be supplied by the factory as "gauged full length". Should full length gauged pipe be unavailable, the pipe to be cut shall be field gauged at the location of the new spigot using a measuring tape, or other means approved by the manufacturer, to verify that the diameter is within the tolerances permitted in Table 1 of AWWA C151.

B. Jointing Ductile-Iron Pipe

1. Push-on joints shall be made in strict accordance with manufacturer's instructions, AWWA C600 and Appendix B of AWWA C111. If there is conflict, the manufacturer's instructions shall take precedence. Pipe shall be laid with bell ends looking ahead. A rubber gasket shall be inserted in the groove of the bell end of the pipe. The joint surfaces shall be cleaned and lubricated per manufacturers recommendations and the plain end of the pipe shall be aligned with the bell of the pipe to which it is to be joined and pushed home. After joining the pipe, a metal feeler shall be used to make certain that the rubber gasket is properly seated.
2. Bolts in restrained joints shall be tightened alternately and evenly.
3. Restrained joints shall be installed according to pipe manufacturer's instructions.
4. Flanged joints (not to be used for buried service) shall be assembled in strict accordance with the manufacturer's instructions and Appendix C of AWWA C111. If there is conflict, the manufacturer's instructions shall take precedence. Extreme care shall be taken to ensure

that there is no restraint on opposite ends of pipe or fitting, which would prevent uniform gasket compression, cause unnecessary stress, bending or torsional strains, or distortion of flanges or flanged fittings. Adjoining push on joints shall not be assembled until flanged joints have been tightened. Flange bolts shall be tightened uniformly to compress the gasket uniformly and obtain a seal. Flange bolts shall be left with approximately 1/2-inch projection beyond the face of the nut after tightening. After installation bolts and nuts shall be encapsulated using wax sealing tape per AWWA Standard C217.

5. Mechanical joint solid sleeve couplings shall only be installed for closure or as shown on the Drawings. Couplings shall not be assembled until adjoining joints have been assembled. After installation, bolts and nuts shall be encapsulated using wax sealing tape per AWWA Standard C217, and install protective wrap recommended by the manufacturer or as required herein.
- C. Install V-Bio polyethylene encasement around ductile iron pipe to limits shown on the Drawings and in accordance with pipe manufacturer's recommendations.
1. Polyethylene encasement shall be installed per ANSI/ AWWA C105/A21.5, Method 'A' in accordance with section 2.15 of DIPRA's Installation Guide for Ductile Iron Pipe.
 2. A fabric type or padded sling shall be used when handling polyethylene encased pipe to prevent damage to the polyethylene encasement.
 3. All seams in the polyethylene encasement shall be sealed completely with approved 2-inch wide plastic adhesive tape.
 4. Extreme care shall be taken to ensure that all rips or tears in the polyethylene encasement are properly repaired with additional tape and film as described in ANSI/AWWA C105/A21.5
 5. Extreme care shall be taken when backfilling to avoid damaging the polyethylene encasement

3.03 CONNECTIONS TO STRUCTURES

- A. Wherever a pipe 3-in in diameter or larger passes from a concrete wall to earth horizontally, two flexible joints spaced from 2 to 4-ft apart depending on pipe size shall be installed, within 2-ft of the exterior face of the wall, whether or not shown on the Drawings.
- B. Unless otherwise specified, all pipes passing through a wall will utilize a wall sleeve designed to pass the thrust through the wall via restrained piping.

3.04 TESTING AND CLEANING

- A. All gravity and pressure testing of sewer pipe is included in Section 02610.

3.05 UNDERGROUND UTILITY MARKING

- A. The underground utility warning tape shall be provided and installed in accordance with Section 02317.

END OF SECTION

SECTION 02622
POLYVINYL CHLORIDE GRAVITY SEWER PIPE

PART 1 GENERAL

1.01 SCOPE OF WORK

- A. The Work specified in this Section includes furnishing all labor, materials, equipment and incidentals required to install and test polyvinyl chloride (PVC) sewer pipe and fittings, complete as shown on the Contract Drawings and as specified herein.
- B. The Contractor shall furnish and install sewer piping to the lines and grades and in the locations indicated on the Contract Drawings and/or as ordered by the City of Columbia (Owner).
- C. Piping shall be located substantially as shown on the Drawings. The Owner reserves the right to make such modifications in locations as may be found desirable to avoid interference between pipes or for other reasons. Pipe fitting notation is for the Contractor's convenience and does not relieve him/her from installing and jointing different or additional items where required to achieve a complete piping system.
- D. Where the word "pipe" is used it shall refer to pipe, fittings, or appurtenances unless otherwise noted.

1.02 RELATED WORK

- A. Section 02140 - Dewatering and Drainage
- B. Section 02221 - Trenching, Backfill and Compaction
- C. Section 02230 - Granular Fill Materials
- D. Section 02610 - Sewer Testing and Cleaning
- E. Section 02605 - Precast Concrete Manholes
- F. Section 02317 - Underground Utility Warning Tape.

1.03 SUBMITTALS

- A. The Contractor shall furnish, prior to use of the materials, satisfactory written certification of his compliance with the manufacturer's standards for all materials, conformance with the methods of the manufacturer, and accordance with all standards.
- B. Submit to the Owner, within 30 days of the effective date of the Contract, the name of the PVC pipe supplier and a list of materials to be furnished.

- C. Prior to each shipment of PVC pipe, submit certified test reports that the PVC pipe for this Contract was manufactured and tested in accordance with all ASTM Standards specified and referenced herein.
- D. Submit to the Owner detailed shop drawings and product data for all pipe, fittings, and appurtenances specified in this Section. Product data submittals shall include the following as a minimum: details of the proposed pipe; properties and strengths of the pipe; joint details; instructions on storage, handling, transporting, and installation; standard catalog sheets; and material certifications.
- E. Submit handling procedures for all phases from finished fabrication through delivery including storage, transportation, loading, and unloading. This will include storage at the project site and required protection following installation prior to startup.
- F. Submit pipe testing plan including detailed procedures and methods and equipment that will be used for pipeline testing as specified herein and in Section 02610.

1.04 REFERENCES

- A. The following standards based on the latest edition form a part of this specification as referenced:
- B. American Society for Testing and Materials (ASTM) Publications
 - 1. D3034 – Standard Specification for Type PSM Poly (Vinyl Chloride) (PVC) Sewer Pipe and Fittings.
 - 2. F679 - Specification for Poly (vinyl chloride) (PVC) Large - Diameter Plastic Gravity Sewer Pipe and Fittings.
 - 3. F477 - Standard Specification for Elastomeric Seals (Gaskets) for Joining Plastic Pipe.
 - 4. D 3212 - Standard Specification for Joints for Drain and Sewer Plastic Pipes Using Flexible Elastomeric Seals.
 - 5. F794 - Standard Specification Poly (vinyl chloride) (PVC) Profile Gravity Sewer Pipe and Fittings Based on Controlled Inside Diameter. (Only closed profile gravity sewer pipe will be considered based on this ASTM specification.)
 - 6. F1803 - Standard Specification Poly (vinyl) (chloride) (PVC) Closed Profile Gravity Sewer Pipe.
 - 7. D2321 – Standard Practice for Underground Installation of Thermoplastic Pipe for Sewers and Other Gravity-Flow Applications.
 - 8. D1784 – Standard Specification for Rigid Poly (Vinyl Chloride) (PVC) Compounds and Chlorinated Poly (Vinyl Chloride) (CPVC) Compounds.
 - 9. F949 – Standard Specification for Poly (Vinyl Chloride) (PVC) Corrugated Sewer Pipe with a Smooth Interior and Fittings.

1.05 QUALITY ASSURANCE

- A. All pipe delivered to the job site shall be accompanied by test reports certifying that the pipe and fittings conform to the herein-mentioned ASTM specifications. In addition, the pipe shall be subject to thorough inspection and tests, the right being reserved for the Owner to apply such tests as they deem necessary.
- B. All tests shall be made in accordance with the methods prescribed by the herein mentioned ASTM specifications, and the acceptance or rejection shall be based on the test results.
- C. The Contractor shall furnish all labor necessary to assist the Owner in inspecting the pipe. Pipe will be inspected upon delivery, and such as does not conform to the requirements of this Contract shall be rejected and shall immediately be removed by the Contractor.

1.06 DELIVERY, STORAGE AND HANDLING

- A. All items shall be bundled or packaged in such a manner as to provide adequate protection of the ends during transportation to the site. Any pipe damaged in shipment shall be replaced as directed by the Owner.
- B. PVC items deteriorate in sunlight and are slightly brittle, especially at lower temperatures, so care shall be taken in loading, transporting and unloading items to prevent injury to the items. All items shall be examined before installation and no piece shall be installed which is found to be defective. Handling and installation of pipe and fittings shall be in accordance with the manufacturer's instructions, referenced standards and as specified herein.
- C. Any pipe or fitting showing a crack or which has received a blow that may have caused an incident fracture, even though no such fracture can be seen, shall be marked as rejected and removed at once from the work.
- D. While stored, pipe shall be adequately supported from below at not more than 3-ft intervals to prevent deformation. The pipe shall be stored in stacks no higher than that given in the following table:

<u>Pipe Diameter (inches)</u>	<u>Max. No. of Rows Stacked</u>
8 or less	5
12 to 21	4
24 to 27	3

- E. Pipe and fittings shall be stored in a manner which will keep them at ambient outdoor temperatures and out of the sunlight or delivered to the site so that no pipe is exposed to sunlight for more than 30 days. Temporary shading as required to meet this requirement shall be provided. Simple covering of the pipe and fittings which allows temperature buildup or direct or indirect sunlight will not be permitted.
- F. If any defective item is discovered after it has been installed, it shall be removed and replaced with an exact replacement item in a satisfactory manner by the Contractor, at the Contractor's own expense. All pipe and fittings shall be thoroughly cleaned before installation and the interior shall be kept clean until testing.

- G. In handling the items, use special devices and methods as required to achieve the results specified herein. No un-cushioned devices shall be used in handling the item.

PART 2 PRODUCTS

2.01 PIPE AND FITTINGS, AND SPECIALS

- A. The polyvinyl chloride pipe and fittings, including also those required for stubs, shall conform to one of the following:
 - 1. ASTM D3034 for diameters 4-inch through 15-inch.
 - 2. ASTM F679 (Wall thickness T- 1) for diameters 18-inch through 27-inch.
- B. The pipe shall have pipe diameter to wall thickness ratio (SDR) of a maximum of 26, as manufactured by Diamond, Ipex USA, National Pipe, North American Pipe Corporation, Royal Pipe Systems or equal.
- C. Straight pipe shall be furnished in lengths of 14 or 20 feet, and Y-branches shall be furnished in lengths of not more than 3 feet, unless otherwise permitted by the Owner. Saddle Y-branches will not be allowed.
- D. Fittings and special pipe pieces shall conform to the specifications for straight pipe insofar as applicable.

2.02 JOINTS

- A. Joints for the polyvinyl chloride pipe shall be push-on bell and spigot joints using elastomeric ring gaskets conforming to ASTM F477. The gaskets shall be securely fixed into place in the bells so that they cannot be dislodged during joint assembly. The gaskets shall be of a composition and texture which is resistant to common ingredients of sewage and industrial wastes, including oils and groundwater, and which will endure permanently under the conditions of the proposed use. The joints shall conform to ASTM D3212.

PART 3 EXECUTION

3.01 GENERAL

- A. No single piece of pipe shall be laid unless it is straight. The centerline of the pipe shall not deviate from a straight line drawn between the centers of the openings at the ends of the pipe by more than 1/16-in per foot of length. If a piece of pipe fails to meet this requirement check for straightness, it shall be rejected and removed from the site. Laying instructions of the manufacturer shall be explicitly followed.
- B. If any defective pipe is discovered after it has been installed, it shall be removed and replaced with a sound pipe in a satisfactory manner at no additional cost to the Owner. All pipe and fittings shall be thoroughly cleaned before installation, shall be kept clean until they are used in the work and when laid, shall conform to the lines and grades required. PVC pipe and fittings shall be installed in accordance with requirements of the manufacturer and/or as otherwise provided herein.

- C. As soon as the excavation is complete to normal grade of the bottom of the trench, bedding shall be placed, compacted and graded to provide firm, uniform and continuous support for the pipe. Bell holes shall be excavated so that only the barrel of the pipe bears upon the bedding. The pipe shall be laid accurately to the lines and grades indicated on the Drawings. Blocking under the pipe will not be permitted. Bedding shall be placed evenly on each side of the pipe to mid-diameter and hand tools shall be used to force the bedding under the haunches of the pipe and into the bell holes to give firm continuous support for the pipe. Bedding shall then be placed to 12-in above the top of the pipe. The initial 3-ft of backfill above the bedding shall be placed in 1-ft layers and carefully compacted. Compaction shall be done evenly on each side of the pipe and compaction equipment shall not be operated directly over the pipe until sufficient backfill has been placed to ensure that such compaction equipment will not have a damaging effect on the pipe. Equipment used in compacting the initial 3-ft of backfill shall be approved by the pipe manufacturer's representative prior to use.
- D. All piping shall be sound and clean before installation. When installation is not in progress, including lunchtime, the open ends of the pipe shall be closed by watertight plug or other approved means. Good alignment shall be preserved during installation. The deflection at joints shall not exceed that recommended by manufacturer. Fittings, in addition to those shown on the Drawings, shall be provided, if required, in crossing utilities which may be encountered upon opening the trench.
- E. When cutting pipe is required, the cutting shall be done by machine, leaving a smooth cut at right angles to the axis of the pipe. Cut ends of pipe to be used with a bell shall be beveled to conform to the manufactured spigot end.
- F. The Owner may examine each bell and spigot end to determine whether any preformed joint has been damaged prior to installation. Any pipe having defective joint surfaces shall be rejected, marked as such and immediately removed from the job site.
- G. Each length of the pipe shall have the assembly mark aligned with the pipe previously laid and held securely until enough backfill has been placed to hold the pipe in place. Joints shall not be "pulled" or "cramped".
- H. Before any joint is made, the pipe shall be checked to assure that a close joint with the next adjoining pipe has been maintained and that the inverts are matched and conform to the required grade. The pipe shall not be driven down to grade by striking it.
- I. Precautions shall be taken to prevent flotation of the pipe in the trench.
- J. When moveable trench bracing such as trench boxes, moveable sheeting, shoring or plates are used to support the sides of the trench, care shall be taken in placing and moving the boxes or supporting bracing to prevent movement of the pipe, or disturbance of the pipe bedding and the backfill. Trench boxes, moveable sheeting, shoring or plates shall not be allowed to extend below top of the pipe. If trench boxes, moveable sheeting, shoring or plates have been installed below the top of the pipe, they shall be moved slowly taking care not to disturb pipe, bedding or backfill. As trench boxes, moveable sheeting, shoring or plates are moved, pipe bedding shall be placed to fill any voids created and the backfill shall be recompacted to provide uniform side support for the pipe.
- K. Install a continuous #12-gauge blue insulated copper wire, approved by the manufacturer for direct burial, in the trench and taped to the top of the pipe with 2-inch duct tape. Tracer wire

shall also be installed to the ends of the service lines and terminate in a meter box. Underground waterproof connectors must be used on all splices. All connectors must be thoroughly wrapped in electrical tape.

3.02 JOINTING PVC PIPE (PUSH-ON TYPE)

- A. Joints shall be made in strict accordance with the manufacturer's instructions. Pipe shall be laid with bell ends looking ahead. The rubber gasket shall be cleaned and lubricated and all joint surfaces cleaned thoroughly. The plain end of the pipe to be entered shall then be inserted in alignment with the bell of the pipe to which it is to be joined and pushed home with a come-along or by other means. Check that the reference mark on the spigot end is flush with the end of the bell.
- B. All manhole connections shall be as shown on the Drawings and as specified in Section 02605. All concrete and mortared connections shall be equipped with an integral O-ring, or other sealant, such that a positive watertight seal is established as specified in Section 02605.

3.03 WYE BRANCHES, CHIMNEYS AND STUBS

- A. All fittings shall be furnished by the same manufacturer that furnishes the pipe.
- B. Wye branches shall be furnished and installed and capped as shown on the Drawings or in locations directed by the Owner.
- C. If applicable, PVC chimneys shall be installed according to the detail on the Drawings at locations to be determined by the Owner. Concrete shall be as specified in Division 3. No backfill shall be placed over concrete within 16 hours of placing.
- D. Ample time shall be given to the Owner to obtain the exact location of each wye branch and chimney before it is covered. Wye branches and chimneys, which are covered before the Owner has had time to obtain their location, shall be exposed at no additional cost so that location measurements can be taken.
- E. PVC inside manhole drops shall be installed as shown on the Drawings. anchoring of PVC drops shall be as shown on the Drawings..
- F. Pipe stubs for manhole connections shall not exceed 3.25-ft in length unless directed otherwise by the Owner. Install caps where required.

3.04 SERVICE CONNECTIONS AND CLEANOUT

- A. Service connections shall be installed at a minimum slope of 2 percent at the locations shown on the Drawings and/or to the limits determined by the Owner in the field. In each case, the end shall be capped and backed with a 2-in by 4-in wood post extending to 3-ft below the finished ground surface.
- B. Service connections shall be 6-in minimum diameter unless otherwise shown on the Drawings.
- C. Cleanouts as shown on the Drawings shall be installed at the edge of the right-of-way or easement line, brought up to grade and capped.

3.05 TESTING AND CLEANING (GRAVITY PIPELINES)

- A. Exfiltration and infiltration testing shall be completed on all PVC gravity pipelines and shall be as specified in Section 02610.
- B. All PVC gravity pipelines shall be tested for deflection as specified in Section 02610.

3.06 UNDERGROUND UTILITY MARKING

- A. The underground utility warning tape shall be provided and installed in accordance with Section 02317.

END OF SECTION

SECTION 02767
SANITARY SEWER FLOW CONTROL

PART 1 - GENERAL

1.01 SCOPE OF WORK

- A. This Section includes all materials, labor, and equipment required to provide bypass flow control for new sanitary sewer line construction, upgrades or rehabilitation. This section also includes all materials, labor, and equipment required to provide bypass flow control for conducting proper PACP CCTV inspection of sewers.
- B. The Contractor shall be responsible for maintaining wastewater flow in all public and private pipes during construction. All bypass pumping systems shall be manned by the Contractor during non-working hours, seven (7) days per week as necessary. During the installation and/or rehabilitation of sections of the sewer system, it is required that the Contractor maintain sewage flows in the system and from all abutting properties at all times. No sanitary service shall be interrupted by the Contractor except as absolutely necessary and then for only very short periods of time of no more than thirty (30) minutes and then only when coordinated with the affected property owner and the City of Columbia (Owner). During main line cured-in-place pipe lining operations, interruption at the street tie-in will be allowed for up to twenty-four (24) hours, when coordinated, by the Contractor, with the affected property Owner.
- C. The Contractor is required to furnish all power, maintenance, etc. to implement the bypass flow control system necessary to divert the existing flow around the work area for the work's duration. The design, installation, and operation for the temporary bypass pumping system shall be solely the Contractor's responsibility. Bypass pumping is required to adequately control the flow as listed in Paragraph 3.01.
- D. The Contractor shall exhaust all attempts with other methods of flow control (i.e. work in low flow times, plugs, dams, blocking, etc.) prior to recommending bypass pumping. If bypass pumping is determined to be needed, concurrence from the Owner is required before proceeding.
- E. If access to private property is required to perform the work, the contractor must obtain written permission prior to starting any work. Clearing and other costs related to gaining access (including restoration) should be included in contractor's bid pricing. Contractor to assume bid responsibility for coordination of and relocation of sheds if such relocation is required to perform work. The final location of the shed will be determined on a case by case basis in consultation with the Owner and the property owner.
- F. If fence removal is required, fences shall be replaced in kind and a gate should be placed along any easements to allow future access by Owner forces and equipment. Each of these will be determined on a case by case basis directly with the Property Owner.
- G. Contractor shall include site restoration including irrigation line repairs, driveway restoration, shrubbery replacement, etc. when choosing a route for bypass equipment.

- H. Contractor is solely responsible for any damages resulting from his/her operations.
- I. Contractor is required to obtain any and all required permits necessary to implement his proposed bypass pumping operation.
- J. The Contractor shall meet with the City to understand the requirements of the Sanitary Sewer Overflow Response Plan (SORP). Contractor staff shall be trained on the plan's requirements and the Contractor shall be required to implement preventative measures in accordance with the SORP throughout the bypass pumping operations.

1.02 RELATED WORK

- A. Section 02615 - Ductile Iron Pipe for Buried Sewer Service.
- B. Section 02622 - Polyvinyl Chloride Gravity Sewer Pipe.

1.03 SUBMITTALS:

- A. Submit a statement indicating that the Contractor is familiar with the requirements of the SORP and that his staff shall implement applicable requirements throughout the bypass pumping operations.
- B. Submit the following to Owner prior to commencing work for review and approval.
 - 1. Bypass Sewage Pumping Plan. Plan shall contain, at minimum, the following:
 - a. Staging areas for pumps.
 - b. Sewer plugging method and types of plugs.
 - c. Number, size, material, location and method of installation of suction piping.
 - d. Number, size, material, method of installation and location of installation of discharge piping.
 - e. Calculations of bypass pump sizes, capacity, number of each size to be on site and power requirements. Pump sizing shall clearly indicate compliance with requirements of this Specification.
 - f. Calculations of static lift, friction losses, and flow velocity (pump curves showing pump operating range shall be submitted).
 - g. Standby power generator size and location and spill prevention and control measures.
 - h. Downstream discharge plan along with method of protecting discharge manholes or structures from erosion and damage.
 - i. Thrust and restraint block sizes and locations.
 - j. Sections and plans showing suction and discharge pipe location, depth, embedment, select fill and special backfill.
 - k. Method of noise control for each pump and/or generator.
 - l. Any temporary pipe supports and anchoring required.
 - m. Schedule for installation of and maintenance of bypass pumping lines.
 - n. Plan indicating monitoring locations.

- o. All items related to testing, inspection, maintenance, and monitoring as described in these section.
 - p. All other incidental items necessary and/or required to ensure facilities are properly protected including protecting the access and bypass pumping locations from damage due to the discharge flows, and compliance with the requirements and permit conditions specified in the Contract Documents.
 - q. For sewer rehabilitation by lining methods, generic plans may be developed for typical situations and various sizes to be implemented.
- C. Submit a list of emergency contact phone numbers for staff that are available to respond to emergencies 24-hours per day 7-days-per-week. The phone numbers must be maintained throughout the duration of the bypass operations.
- D. Submit a plan that addresses emergency measures that could be implemented to increase bypass flow if needed during an unforeseen wet-weather condition. The plan shall include addition of pumps, pipes, generators, and appurtenances necessary and the additional flows that could be pumped if such a plan were implemented. Implementation of such a plan would only be required when directed by the Owner.
- E. Submit daily checklists of field quality control as required by Paragraph 3.04.

PART 2 PRODUCTS

2.01 BYPASS EQUIPMENT

- A. All equipment utilized for bypass pumping shall be specifically designed for intended purpose. All piping, pumps, etc. in contact with sanitary sewage shall be manufactured with materials designed for use in a sewage environment.
- B. All pumps used shall be fully automatic self-priming units which do not require foot valves or vacuum pumps in the priming system.
- C. The pumps shall be electric, hydraulic, or diesel powered.
- D. All pumps used shall be constructed to allow dry running for long time periods to accommodate cyclical flows.
- E. Above ground pumps and/or power units shall be located inside a temporary portable berm to contain any fuel or sewage that may spill during the normal course of operation.
- F. Hard discharge piping shall be butt-welded HDPE with a minimum pressure rating of 2.5 times the total dynamic pump head.
- G. Under no circumstances will irrigation type piping or glued PVC pipe be allowed.

- H. Discharge hose may be allowed on rehabilitation projects for short-term setups (less than or equal to 48 hours) on short sections with approval from the Owner. Hoses shall have no leaks, and all couplings shall be quick connecting with gaskets. Quick connect shall be tape wrapped or secured by other means and approved by Owner.
- I. The multiple pump header system shall have check valves, isolation valves and air release valves to facilitate pump removal, service, and/or replacement while the system remains operational.
- J. All above ground pumps and/or power units shall be equipped with sound attenuation measures to reduce noise levels to 75-decibels maximum at a 50-foot distance from the equipment during all operation periods or meet other noise requirements governing the location of construction. The most stringent noise requirements must be met at all time.
- K. Include 100% mechanical redundancy installed online with a float or ultrasonic type system to switch to the standby system automatically if the primary system fails.
- L. The discharge location (the point where the bypass main reenters the gravity sewer system) shall be to existing manholes and constructed with adequate sealant materials to minimize sewer gas and odor release to the maximum extent possible.
- M. The Contractor shall install a minimum 12-inch by 24-inch sign at all bypass pumping locations indicating that the equipment is a temporary wastewater pumping operation, identifying the Contractor as the responsible party, and include an emergency contact phone number.

PART 3 EXECUTION

3.01 FLOW REQUIREMENTS

- A. Provide bypass sewage pumping, as required, around the area of work is being performed. Bypass pumping shall be the full responsibility of the Contractor.
- B. For television inspection, bypass pumping should be utilized if the depth of wastewater flow within the sewer mains to be inspected exceed the following:

6" – 10" pipe:	20% of pipe's diameter
12" – 24" pipe:	25% of pipe's diameter
24" pipe:	30% of pipe's diameter

If Contractor has exhausted all other means for flow control (plugs, nighttime work, etc.), the depth of wastewater flow within the sewer mains to be inspected may be allowed up to 50% of pipe diameter with approval from the Owner.

- C. For complete bypass required for new construction and pipe rehabilitation, the bypass system shall be a sufficient capacity to handle full pipe capacity for the pipeline section being bypassed

times 1.25 and shall provide and maintain sufficient flow at all times to prevent any backwater flooding due to obstructions caused by the construction. Prior to starting work, the Contractor shall submit required information as described in this specification to the Owner for review and approval. No work shall commence until the Owner provides approval.

3.02 GENERAL REQUIREMENTS

- A. If at any time the Contractor is unable to properly bypass pump the sewage, construction will be stopped until the Contractor is able to continue work in an acceptable manner. The Contractor will not receive additional contract time for delays caused by improper equipment, labor, or breakdowns.
- B. Discharge of sewage to the ground, creeks, and/or storm sewers shall be prohibited. Any violation shall be corrected immediately. If the Owner is required to alleviate any prohibited discharges, the Contractor shall be charged two times the Owner's cost of labor, equipment and materials. All costs shall be deducted from the Contract Amount.
- C. Service shall be maintained at all times. Surcharges due to plugging the sewer line for bypass pumping shall be maintained to prevent backups in services and overflows at any point in the system. Contractor is fully responsible for any backups or overflows caused by bypass pumping operations or any associated work.
- D. Bypass pumping systems are required to be operated continuously 24-hours per day.
- E. All suction and discharge piping shall be free of leaks and designed to carry the required pumped sewage. Any leaks shall be repaired immediately. If the piping used is inadequate in size, amount of hose on site, or condition, the Contractor shall be required to replace the hose as directed by the Owner's Representative.
- F. The use of a partial plug may be considered if approved by the Owner.

3.03 PERFORMANCE REQUIREMENTS

- A. It is essential that the system operate uninterrupted throughout the project's duration. Provide, maintain, and operate all bypass facilities such as dams, plugs, pumping equipment (primary and backup units as required), conduits, all necessary power equipment, and all other labor and equipment necessary to intercept the incoming flow before it reaches the point where it would interfere with the work, carry it past the work area, and return it to the existing system downstream of the work.
- B. In the case of emergencies such as failure of the bypass pumping equipment or other aspects of the system, the Contractor shall provide an immediate response within 2 hours of notification, 7 days per week 24 hours per day. The Contractor shall respond with adequate manpower, and work around the clock as necessary to ensure an expeditious repair of the failed system or part.
- C. The temporary pumping system's design, installation, and operation shall be the Contractor's responsibility. The bypass system shall meet all codes and requirements for regulatory agencies having jurisdiction.

- D. Provide all necessary means to safely convey the sewage past the work area. The Contractor will not be permitted to stop or impede the sewer main flows under any circumstances.
- E. No flow diversion around the work area shall be performed in a manner that will cause damage to or surcharging of Owner system. The diversion shall protect public and private property from damage and flooding.

3.04 FIELD QUALITY CONTROL AND MAINTENANCE

- A. Testing: Prior to actual operation, test the complete bypass pumping system for leaks and pressure using clean water. Bypass piping shall be hydrostatically tested following each setup and prior to flow diversion to a minimum pressure 2.5 times the pump(s) total dynamic head. The Owner shall be given a 24-hour notice prior to testing.
- B. Inspection: Inspect the bypass pumping system on a continuous basis to ensure the system is working properly. A daily checklist for the entire system shall be developed and maintained. The checklist shall contain all bypass pumping system components, and shall be specifically developed to address all aspects for the individual project. The daily checklist shall be submitted to the Owner daily. The completed daily checklists shall be maintained, available for review, and on-site for the project's duration.
- C. Maintenance Service: Ensure the temporary bypass pumping system is properly maintained, and a responsible operator shall be readily available at all times when pumps are operating.
- D. Monitoring:
 - 1. During bypass pumping, continuously monitor all bypass pumping system components.
 - 2. A telemetry system or designated personnel to maintain 24-hour onsite monitoring shall be required to alert the Contractor to system malfunctions or high liquid levels in manholes.
- E. Additional Materials:
 - 1. Spare parts for pumps and piping shall be kept on site as required. Adequate hoisting equipment for each pump and accessories shall be maintained on site.
 - 2. Keep an HDPE fusion machine on site and accessible for the duration of bypass pumping operation, or at a minimum, have a machine available within a 2-hour window to facilitate immediate repairs to hard piping.
- F. Preparations and Precautions:
 - 1. Locate any existing utilities in the area selected for the bypass pipelines. Locate the bypass pipelines to minimize any disturbance to existing utilities, and obtain approval for the pipeline locations. Pay all costs associated with relocating utilities and obtaining all approvals.
 - 2. During all bypass pumping operations, protect the Owner site and system (pumping station, conveyance system, etc.) as applicable from damage inflicted by any equipment.

The Contractor is responsible for all physical damage to the system caused by human or mechanical failure.

G. Installation and Removal:

1. When plugging or blocking is no longer needed for work performance, it is to be removed in a manner that permits the sewage flow to slowly return to normal without surge flows to prevent surcharging or causing other major disturbances downstream.
2. When working inside manholes, sewers, or force mains, exercise caution and comply with all applicable OSHA requirements.
3. Bypass pipeline installation is prohibited in all wetland areas. The pipeline shall be located, if possible, off streets and sidewalks and on road shoulders. If in easements, the bypass pipeline shall be within the easement area acquired for the project.
4. When the bypass pipeline crosses local streets and private driveways, place the bypass pipelines in trenches and cover with temporary pavement. Obtain any property owner or municipal approvals before placing the temporary pipeline.

3.05 CLEAN-UP

- A. Upon acceptance of the work, the Contractor shall restore the project area affected by the operations to a condition at least equal to that existing prior to the work.

END OF SECTION