MONTGOMERY COUNTY PUBLIC SERVICE AUTHORITY
WATER AND SEWER DESIGN & COSTRUCTION STANDARDS
THIRD EDITION
JULY 2012

SECTION THREE - SPECIFICATIONS

SPECIFICATION SECTION 01300 – SUBMITTALS AND SUBSTITUTIONS

SPECIFICATION SECTION 02110 – CLEARING AND GRUBBING

SPECIFICATION SECTION 02230 – ROCK EXCAVATION

SPECIFICATION SECTION 02270 – EROSION AND SEDIMENT CONTROL

SPECIFICATION SECTION 02310 – STREAM AND/OR HIGHWAY CROSSINGS

SPECIFICATION SECTION 02605 – CONDUCTIVE TRACE WIRE

SPECIFICATION SECTION 02665 – WATER DISTRIBUTION LINES

SPECIFICATION SECTION 02670 – INSTALLATION OF WATER LINES AND SANITARY SEWER LINES BY HORIZONTAL DIRECTIONAL DRILLING (HDD) METHOD

SPECIFICATION SECTION 02731 – SANITARY SEWER COLLECTOR LINES AND FORCE MAIN

SPECIFICATION SECTION 02900 – SEEDING AND MULCHING

SECTION 01300

SUBMITTALS AND SUBSTITUTIONS

PART ONE - GENERAL

1.1 DESCRIPTION

A. Work included:

1. Submission of all materials to the OWNER as required in Subparagraph 2.1 of this Specification, for his review of substitutions to the items listed on the Bid Form.

2. Submission of all materials after Award of Contract to OWNER, including, but not limited to, CONTRACTOR'S Drawings, shop drawings, Certificates of Compliance, material samples, guarantees, etc., according to Submittal Schedule.

3. Make all submittals required by the Contract Documents, according to the Submittal Schedule, and revise and resubmit, it as necessary to establish compliance with the specified requirements.

1.2 QUALITY ASSURANCE

A. General: Wherever possible throughout the Contract Documents, the minimum acceptable quality of workmanship and materials have been:

1. Defined by manufacturers' names and catalog numbers.

2. Referenced to recognized industrial and government standards.

3. Defined by a description of required attributes and performance.

B. Coordination of submittals: Prior to each submittal, carefully review, label and coordinate all aspects of each item being submitted and verify that each item and the submittal for it conforms in all respects with the requirements of the Contract Documents. By affixing CONTRACTOR'S signature to each submittal, certify that this coordination has been performed.

C. Certificates of Compliance:

1. Certify that all materials used in the Work comply with all specified provisions thereof. Certification shall not be construed as relieving the CONTRACTOR from furnishing satisfactory materials if, after tests are performed on selected samples, the material is found not to meet specified requirements.

2. Show on each certification the name and location of the Work, name and address of CONTRACTOR, quantity and date or dates of shipment or delivery to which the certificate applies, and name of the manufacturing or fabricating company. Certification shall be in the form of letters or company-standard forms containing all required data. Certificates shall be signed by an officer of the manufacturing or fabricating company.

3. In addition to the above information, all laboratory test reports submitted with Certificates of Compliance shall show the date or dates of testing, the specified requirements for which testing was performed, and results of the test or tests.

1.3 SUBMITTALS

A. Approval of equipment and material substitutions: For all materials requiring approval of substitutions after bid opening, CONTRACTOR shall furnish the required information specified in Paragraph 1.4,B. below.

B. All submittals required by this Section shall be addressed and labeled as follows:

Montgomery County Public Service Authority
755 Roanoke Road, Suite 2-I
Christiansburg, Virginia 24073

Attention: Mr. Robert C. Fronk, P.E.
PSA Director

C. Submittal schedule: Within two (2) weeks after issuance of the Award of Contract, and before any items are submitted for approval, submit to the OWNER two copies of the schedule described in Paragraph 2.1 of this Section.

D. Certificates of Compliance: Two copies of the Certificates of Compliance shall be submitted to the OWNER for his review within 48 hours of their completion by the CONTRACTOR.

E. Procedures: Make submittals in strict accordance with the provisions of this Section.

1.4 SUBSTITUTIONS

A. General: Acceptance of substitute equipment and materials shall not exempt the CONTRACTOR from meeting the Specifications. The Specifications shall be the final authority for acceptance of the equipment. Approval of substitute equipment and materials does not eliminate the need for Shop Drawing submittals and approvals during construction. The OWNER reserves the right to reject any equipment or material items during the Shop Drawing review process should it become apparent that the equipment or material cannot meet the Specifications. The CONTRACTOR shall then be required to install the specified equipment or an acceptable substitute at the same price given in the Bid Form.

B. Substitution of equipment and materials: After execution of the Contract, substitutions of equipment and material other than those specifically named in the Contract Documents may be approved by the OWNER under the following conditions:

1. Where a product, item of material or equipment is specified or noted on the Drawings giving the manufacturer's name, model number or similar identification, it shall be understood that the OWNER has selected this product, material or equipment item after careful evaluation of its quality, design and detail to meet the requirements of this project. Other manufacturers' equipment or material of equal quality, design, and detail may be substituted subject to OWNER's approval.

2. CONTRACTOR shall when requesting permission to make a substitution for a product; material or equipment item specified, submit proper identification of the item giving complete specification, catalog cuts, samples, test data and clearly state the total difference in cost to contract.

3. The CONTRACTOR warrants to the OWNER that all materials and equipment furnished under this Contract will be new unless otherwise specified, and that all Work will be of good quality, free from faults and defects and in conformance with the Contract Documents. All Work not conforming to these requirements, including substitutions not properly approved and authorized may be considered defective. If required by the OWNER, the CONTRACTOR shall furnish satisfactory evidence as to the kind and quality of materials and equipment.

C. Substitutions requiring redesign: When considering equipment or materials proposed or approved as a substitute, it shall be the responsibility of the CONTRACTOR to complete any redesign which may be required as a result. Engineering shall be accomplished by an engineering firm acceptable to the OWNER. The CONTRACTOR shall NOT be allowed any time extensions for delays caused by redesign.

PART TWO - PRODUCTS

2.1 SUBMITTAL SCHEDULE

A. General: Compile a complete and comprehensive schedule of all submittals, including dates, anticipated to be made during progress of the Work. Include a list of each type of item for which CONTRACTOR'S drawings, shop drawings, Certificates of compliance, material samples, guarantees, operation and maintenance manuals, or other types of submittals are required and shall include date CONTRACTOR intends to submit said items. Upon approval by the OWNER, this schedule will become part of the Contract and the CONTRACTOR shall be required to adhere to the schedule except when specifically otherwise permitted.

B. Coordination: Coordinate the schedule with all necessary subcontractors and material suppliers to ensure their understanding of the importance of adhering to the approved schedule and their ability to so adhere. Coordinate as required to ensure the grouping of submittals as described in Paragraph 3.2 below.

C. Revisions: Revise and update the schedule on a monthly basis or as necessary to reflect conditions and sequences. Promptly submit revised schedules to the OWNER for review, comment and approval.

2.2 SHOP DRAWINGS

A. Scale and measurements: Make all shop drawings accurately to a scale sufficiently large to show all pertinent aspects of the item and its method of connection to Work.

B. Type of prints required: Submit the number of copies, which are required to be returned (minimum of one copy) plus five copies which shall be retained by OWNER.

C. Number of copies required: Submit the number of copies, which are required to be returned (minimum of one copy) plus three copies which shall be retained by the OWNER.

2.3 MANUFACTURER'S LITERATURE

A. General: Where contents of submitted literature from manufacturers include data not pertinent to the submittal, clearly indicate which portion of the contents is being submitted for review.

B. Number of copies required: Submit the number of copies, which are required to be returned (minimum of one copy) plus three copies which shall be retained by the OWNER.

C. Operation and maintenance manuals: The OWNER reserves the right to use any portion of manufacturer's literature submitted for review in operation and maintenance instructions and manuals.

2.4 SAMPLES

A. Accuracy of samples: Samples shall be of the precise article proposed to be furnished.

B. Number of samples required: Unless otherwise specified, submit all samples in the quantity which is required to be returned plus one which shall be retained by the OWNER.

C. Reuse of samples: In situations specifically so approved by the OWNER, the OWNER's retained sample may be used in the construction as one of the installed items.

PART THREE - EXECUTION

3.1 IDENTIFICATION OF SUBMITTALS

A. General: Consecutively number all submittals. Accompany each submittal with a letter of transmittal containing all pertinent information required for identification and checking of submittals.

B. Internal identification: On at least the first page of each copy of each submittal, and elsewhere as required for positive identification, clearly indicate the submittal number in which the item was included. Additionally, each component of the submittal shall be specifically marked and identified, e.g., catalog cuts, assembly drawings, shop drawings, or O&M manuals. Failure to identify each component shall be sufficient reason for rejection of the submittal.

C. Resubmittals: When material is resubmitted for any reason, transmit under a new letter of transmittal and with a new submittal number.

D. Submittal log: Maintain an accurate submittal log for the duration of the Contract, showing current status of all submittals at all times. Make the submittal log available for the OWNER's review upon request.

3.2 COORDINATION OF SUBMITTALS

A. General: Prior to submittal for approval, use all means necessary to fully coordinate all materials. These means shall include, but not be limited to, requirements necessary to:

1. Determine and verify all interface conditions, catalog numbers, and similar data.

2. Coordinate with other trades as required.

3. Clearly indicate all deviations from requirements of Contract Documents.

B. Grouping of submittals: Unless otherwise specified, make all submittals in groups containing all associated items to ensure that information is available for checking each item when received. Partial submittals may be rejected as not complying with provisions of the Contract Documents and CONTRACTOR shall be strictly liable for all delays so occasioned.

3.3 TIMING OF SUBMITTALS

A. General: Make all submittals in advance of scheduled dates for installation to provide all time required for reviews, for securing necessary approvals, for possible revisions and resubmittals, and for placing orders and securing delivery. Date of

submission should be considered as the day the document is delivered to OWNERs.

B. OWNER's review time: In scheduling, allow at least 14 calendar days for review by the OWNER following his receipt of the submittal.

C. Delays: Delays caused by tardiness in receipt of submittals shall not be an acceptable basis for extension of the Contract completion date.

3.4 OWNER'S REVIEW

A. General: Review by OWNER shall not be construed as a complete check, but only that the general method of construction and detailing is satisfactory. Review shall not relieve CONTRACTOR from responsibility for errors, which may exist. CONTRACTOR shall revise returned shop drawings as required and resubmit until final approval is obtained. If a resubmittal is not approvable, future submittals will be reviewed by the OWNER at the CONTRACTOR's expense. Changes which have been made, other than those requested by the OWNER, shall be indicated on returned drawings. Do not install materials or equipment which require submittals until return of submittals with OWNER's stamp and initials or signature indicating approval.

B. Authority to proceed: The notations "Reviewed, No Exceptions Taken" or "Reviewed, Make Corrections Noted" authorize the CONTRACTOR to proceed with fabrication, purchase, or both, of the items so noted, subject to the revisions, if any required by the OWNER'S review comments. Review shall be as defined in Paragraph 3.4, A. above.

C. Revisions: Make all revisions required by the OWNER. If the CONTRACTOR considers any required revision to be a change, he shall so notify the OWNER as provided for under "Changes in the Work" in the General Conditions. Show each drawing revision by number, date, and subject in a revision block on the drawing. Make only those revisions directed or approved by the OWNER.

D. Revisions after approval: When a submittal has been reviewed by OWNER, resubmittal for substitution of materials or equipment shall not be considered unless accompanied by an acceptable explanation as to why the substitution is necessary.

END OF SECTION

SECTION 02110

CLEARING AND GRUBBING

PART ONE - GENERAL

1.1 DESCRIPTION

A. Work included: Perform all clearing and grubbing as specified herein. Such work includes but is not limited to the following:

1. Perform all clearing and grubbing necessary and required
2. Site Clearing
3. Tree and shrub removal and/or replacement

B. Related work specified elsewhere:

1. Erosion and Sediment Control – Section 02270
2. Rock Excavation – Section 02230
2. Conductive Trace Wire for Nonmetallic Pipe Installation – Section 02605
3. Water Distribution Lines - Section 02665
4. Sanitary Sewer Collector Lines and Force Main - Section 02731
5. Seeding and Mulching - Section 02900

1.2 PROTECTION

Streets, roads, adjacent property and other works to remain shall be protected throughout the work as defined in the General Conditions.

1.3 REQUIREMENTS OF REGULATORY AGENCIES

State and local code requirements shall control the disposal of trees and shrubs.

PART TWO - PRODUCTS

2.1 MATERIALS

Materials shall be at the CONTRACTOR'S option.

PART 3 - EXECUTION

3.1 CLEARING

A. CONTRACTOR is requested to limit his clearing to the area actually needed for construction and wherever possible to avoid clearing large trees.

B. Limits of clearing shall be within the right-of-way, or easements obtained by the OWNER.

C. Individual trees, groups of trees and other vegetation, which may be designated to be salvaged shall be left standing and uninjured.

D. Remove trees, saplings, shrubs, bushes, vines and undergrowth within the limits of clearing to the heights above ground given in the following table:

1. Trees over 6-inches in diameter: 12 inches
2. Shrubs, bushes and trees under 6-inches in diameter: 3 inches
3. Vines and undergrowth: 2 inches

3.2 GRUBBING

A. Limits of grubbing shall coincide with the limits of clearing.

B. Remove all stumps, roots over 4-inches in diameter, and matted roots within the limits of grubbing to a depth of 24-inches below existing ground surface. Engineering requirements shall control removal of stumps smaller than 4-inches in diameter under fills, foundations, or any construction in contact with the stumps.

3.3 TRIMMING OF TREES

When required, with the ENGINEER'S approval, trees shall be trimmed to remove branches or roots, which interfere with construction or traffic. Branches and roots shall be cut flush with the main tree trunk. Paint all cut branches and roots.

3.4 SALVAGE

A. It shall be understood and agreed upon by the CONTRACTOR that only those trees, which directly interfere with the construction of this Project shall be removed. Within the limits of clearing all trees 4-inches in diameter and smaller may be removed. No tree 5-inches or larger in diameter, which does not directly interfere with the construction of this Project shall be removed without the express written approval of the ENGINEER.

B. Material which is to be salvaged, as a result of the CONTRACTOR'S clearing operations, shall include the following items which are to be turned over to the property Owner if the OWNER so desires:

1. Logs over 12-inches, butt diameter
2. Branches over 6-inches, butt diameter
3. Parts suitable for use as mulch
4. Live plants suitable for replanting

C. All ornamental trees and shrubs within temporary construction easements shall be carefully uprooted, stored, and replanted after construction is complete, unless

otherwise directed. Ornamental trees and shrubs, which do not survive for a period of at least one (1) year, shall be replaced at the Contractor's expense. Unless clearly indicated on the plan, CONTRACTOR should only clear trees necessary to perform the work within the easement noted. Trees should not be removed from the temporary easement area unless it is necessary for performance of the work or when the root structure of the tree would be damaged by the work.

D. All salvageable material not desired by the property owner shall be removed at CONTRACTOR'S expense. Any desirable top-soil should be stock piled for possible use during Seeding and Mulching.

3.5 DISPOSAL

A. Burning: Burning of materials on the site by the CONTRACTOR will not be permitted until all applicable permits have been obtained and copies of all permits are filed with the ENGINEER.

B. Removal:

1. Material to be removed shall be removed from the site daily as it accumulates.

2. Should the CONTRACTOR elect to continue work beyond normal working hours, material to be removed shall not be allowed to accumulate for more than 48-hours.

3. Prior to depositing surplus material at any off site location, the CONTRACTOR shall obtain a written agreement with the Owner of the property on which the disposal is proposed. The agreement shall state that the Owner of the property gives permission for the CONTRACTOR to enter and deposit the material at no expense to the OWNER. A copy of the agreement shall be furnished to the OWNER.

3.6 MEASUREMENT AND PAYMENT

No separate measurement and payment will be made for clearing and grubbing as they are considered incidental items to the work to which they are related and the costs, therefore, shall be included in the values bid for the appropriate items.

- END OF SECTION -

SECTION 02230

ROCK EXCAVATION

PART ONE - GENERAL

1.1 DESCRIPTION

A. Work included: Furnish all labor, material and equipment to excavate and dispose of rock as specified herein.

B. Related work specified elsewhere:

1. Erosion and Sediment Control - Section 02110
2. Stream and/or Highway Crossings – Section 02310
3. Conductive Trace Wire for Nonmetallic Pipe Installation – Section 02605
4. Water Distribution Lines – Section 02665
5. Sanitary Sewer Collector Lines and Force Main – Section 02731

1.2 DEFINITION

A. The word "rock," wherever used as the name of excavated material or material to be excavated, shall mean boulders and pieces of concrete or masonry exceeding 1/2 cubic yard in volume; or solid ledge rock which, in the opinion of the OWNER, requires, for its removal drilling and blasting, wedging, sledging, barring, or breaking up with power-operated tools.

B. No soft or disintegrated rock which can be removed with a hand pick or power-operated excavator and/or loader; no loose, shaken, or broken stone in rock fillings or elsewhere; no frozen earth or existing paving; and no rock exterior to the maximum limits of measurement allowed, which may fall into the excavation, will be measured or allowed.

1.3 REQUIREMENTS OF REGULATORY AGENCIES

A. Observe all municipal ordinances and State and Federal laws relating to the transportation, storage, handling and use of explosives.

B. The licensed blaster(s) shall at all times have his license on the work site and shall permit examination thereof by officials having jurisdiction.

PART TWO - MATERIALS

2.1 EXPLOSIVES

A. Where blasting is permitted, explosives shall be kept on the site only in such quantity as may be needed for the work under way and only during such times as they are being used.

B. Explosives shall be stored in a secure manner, separate from all tools and flammable substances.

C. Caps or detonators shall be safely stored at least a distance of 100-feet from explosives.

D. When need for explosives has ended, all such materials remaining at site shall be promptly removed from the premises.

PART THREE - EXECUTION

3.1 GENERAL

A. Excavate rock (as defined above), if encountered, to the lines and grades indicated on the Drawings or as required and dispose of the excavated material.

B. Rock in pipe trenches shall be excavated so as to be not less than 6-inches from the invert of the pipe.

C. Rock in structure excavations shall be excavated to the bottom of the foundation.

3.2 BLASTING

A. All operations involving explosives shall be conducted by experienced personnel only, with all possible care to avoid injury to persons and damage to property.

B. Blasting shall be done only with such quantities and strengths of explosives and in such manner as will break the rock approximately to the intended line and grades and yet will leave the rock not to be excavated in an unshattered condition.

C. Care shall be taken to avoid excessive cracking of the rock upon or against which any structure will be built, and to prevent damage to existing pipes or other structures and property above or below ground. The responsibility for accurately locating and for the complete protection of such items in the event of blasting for rock excavation and all repair to and/or replacement of same shall be the full obligation of the CONTRACTOR. In all cases of blasting, the prepared blast shall be carefully covered with an approved blasting mat so placed that the area affected by the explosion is positively confined.

D. Rock shall be well covered with logs, blasting mats, or both, where required.

E. Sufficient warning shall be given to all persons in the vicinity of the work before a charge is exploded. Flagmen shall be employed to direct traffic as required.

F. Seismograph equipment shall be provided and installed by the CONTRACTOR when blasting is to be done in close proximity to buildings or other features or as directed by the OWNER.

3.3 MEASUREMENT FOR PAYMENT

All rock excavation shall be paid for as an incidental part of the item on which the work is done except where a separate, unqualified item for rock excavation is indicated in the proposal or where rock excavation is ORDERED as an EXTRA by the OWNER, by WRITTEN ORDER. Where payment for rock excavation is established by the proposal or ORDERED as an EXTRA by the OWNER, CONTRACTOR shall be paid only for the quantity of rock removed, measured as follows:

A. For all masonry structures such as buildings, tanks, vaults, catch basins, manholes and the like, the horizontal rock measurement shall be made to include 2-1/2 feet from the outside face of finished vertical sidewall of such structure and the vertical rock measurement shall be made from the top elevation of the rock, before disturbed or removed, to the elevation of the under or lower side of the bottom concrete slab of the structure. Any projection below the bottom slab of any structure required for sump, well, or other pertinent construction shall be measured separately.

B. For installation of pipe lines and fittings the horizontal rock measurement shall be the nominal outside diameter of the pertinent pipe plus 16-inches, except, however, that no horizontal measurement shall be considered to be less than 27-inches; the vertical rock measurement shall be made from the top elevation of the rock, before disturbance or removal, to an elevation of 9-inches below the bottom outside surface of the pipe for pipe having a diameter of 8-inches through 24-inches, and to an elevation of 12-inches below the bottom outside surface of the pipe for all pipe having a diameter greater than 24-inches.

3.4 EXCESS ROCK EXCAVATION

If rock excavated beyond the limits of payment indicated on the Drawings, specified, or authorized in writing by the OWNER, the excess excavation whether resulting from overbreakage or other causes, shall be backfilled, by and at the expense of the CONTRACTOR, as specified below:

A. In pipe trenches, excess excavation above and below the elevation of the pipe bedding shall be filled with earth as specified in Section 02731 - SANITARY SEWER COLLECTION LINES.

B. In excavations for structures, excess excavation in rock beneath foundations shall be filled with concrete, which shall be Class A or B, at CONTRACTOR'S option.

C. Quantity of rock for which payment will be made for installation of each fire hydrant will be limited to a rectangular area, top of which is upper surface of the rock, bottom of which is 2-feet below bottom-most point of the hydrant, in place, and of a square measurement of 3-feet on each of the four sides. Rock section excavation required for installation of fire hydrants shall not be less than stipulated above.

3.5 SHATTERED ROCK

If rock below normal depth is shattered due to drilling or blasting operations and such shattered rock is unfit for foundations, the shattered rock shall be removed and the excavation shall be backfilled as described above in EXCESS ROCK EXCAVATION. All such removal and backfilling shall be done at the expense of the CONTRACTOR.

3.6 BLASTING RECORDS

Keep and submit to the OWNER an accurate record of each blast. The record shall show the general location of the blast, the depth and number of drill-holes, the kind and quantity of explosive used, seismograph reports, and other data required for a complete record.

3.7 PROTECTION OF EXISTING UTILITIES AND STRUCTURES

Attention of CONTRACTOR is specifically called to the fact that certain sections of the sewer line extension in this Project may be constructed in close proximity to existing buildings, storm sewers, gas lines, underground telephone cables, and private water mains. The responsibility for accurately locating and for the complete protection of such items in the event of blasting for rock excavation and all repair to and/or replacement of same shall be the full obligation of the CONTRACTOR. In all cases of blasting, the prepared blast shall be carefully covered with an approved blasting mat so placed that the area affected by the explosion is positively confined.

END OF SECTION

SECTION 02270
EROSION AND SEDIMENT CONTROL

PART ONE - GENERAL

1.1 DESCRIPTION

A. Work included: Provide all material, equipment and labor necessary to install erosion and sediment control elements as shown on Drawings and in accordance with this Specification. Prior to commencing work, CONTRACTOR shall obtain an erosion and sediment control permit for the project from the local controlling jurisdiction (if required). All costs for permit application shall be borne by the CONTRACTOR. Any permits required by the CONTRACTOR shall be available at the site at all times.

B. Related work specified elsewhere:

1. Clearing and Grubbing - Section 02110
2. Rock Excavation – Section 02230
3. Conductive Trace Wire for Nonmetallic Pipe Installation – Section 02605
4. Water Distribution Lines - Section 02665
5. Sanitary Sewer Collector Lines and Force Main - Section 02731
6. Seeding and Restoration - Section 02900

C. All erosion control measures must be in accordance with State Minimum Criteria, as described in latest edition of the Virginia Erosion and Sediment Control Handbook.

D. Measurement and Payment: No separate item is provided for erosion and sedimentation controls, therefore the CONTRACTOR must include the cost for such items in the unit prices to which the erosion controls pertain, or the cost must be included in the lump sum price of the Contract, wherever applicable.

PART TWO - PRODUCTS

2.1 STRAW BALES

All straw bales shall be securely tied. Moldy, musty or decayed bales are unacceptable.

2.2 SILT FENCING

A. Burlap: Burlap shall be 10 oz. per yd.^{2} fabric.

B. Posts: Posts for silt fences shall be either 1" x 2" wooden stakes or equivalent metal stakes with a minimum length of 3 feet. Steel posts shall have projections for fastening wire to them.

C. Synthetic filter fabric shall be a pervious sheet of propylene, nylon, polyester or

ethylene yarn and shall be certified by manufacturer or supplier as conforming to the following requirements:

PHYSICAL PROPERTY	TEST	REQUIREMENTS
Grab tensile	ASTM-D-4632	175 lbs. (min. warp)
Grab elongation	ASTM-D-4632	25% (max.)
Mullen burst	ASTM-3786	300 psi.(min.)
Trapezoidal tear	ASTM-D-4533	50 lbs. (min.)
Puncture	ASTM-3787(mod.)	80 lbs. (min.)
U.V. resistance	ASTM-4355	70% (min.)
Equivalent opening size	U.S. sieve #	30/50
Filtering efficiency	VTM-51	75% (minimum)

Synthetic filter fabric shall contain ultraviolet ray inhibitors and stabilizers to provide a minimum of 6 months of expected usable construction life at a temperature range of 0° F to 120° F. Silt fence shall be Amoco 1380 Silt Stop, Exxon GTF100S-105S silt fence, Mirafi Envirofence, or approved equal.

D. Other materials: Select all other materials not specifically described but required for compliance with the erosion and sediment control plan, subject to approval by the ENGINEER.

PART THREE - EXECUTION

3.1 GENERAL

A. CONTRACTOR shall familiarize himself with all the stipulations and requirements of the erosion and sediment control permit along with all applicable local and state government requirements/codes. CONTRACTOR shall be held responsible for strict adherence to these regulations and shall work closely with the administrating authority when under their jurisdiction. CONTRACTOR shall be deemed liable for any negligence or infringement, which results in non-compliance with this permit.

B. The location of all sediment and erosion control measures shall be left to the CONTRACTOR'S discretion unless otherwise shown on the Drawings or required by the permit. Should there be no requirement of an erosion control plan, then CONTRACTOR shall be required to provide such measures necessary to prevent the formation of gullies or the spread of mud and debris across roads, into waterways or other areas where it may be considered a nuisance.

3.2 PLANNING OF CONSTRUCTION

A. Planning and coordination of the construction is needed to minimize sediment pollution. Clearing shall be kept to shortest distance possible ahead of construction. Cleared areas shall be kept to minimum required to facilitate construction.

B. Restoration work shall be performed as the Project progresses. and not be left until

the end of the Project. No areas shall be left unprotected for longer than 10 days without some form of temporary seeding or, if during a non-growing season, some other form of stabilization, such as mulch.

3.3 EXCAVATION AND BACKFILL

Excavation shall be closely controlled. The material removed from the excavation shall be selectively stockpiled in areas where a minimum of sediment will be generated and where other damage will not result from piled earth. Drainageways shall be protected at all times and the piling of soil in drainageways shall not be allowed. Backfilling operations shall be performed in such a manner such that remaining trees are not damaged. Temporary repaving shall be placed promptly following completion of backfilling and compaction in improved areas.

3.4 STOCKPILES

A. Stockpile areas shall be selected and maintained by on-site personnel. Site selection and stockpile design shall incorporate sediment and erosion control considerations to prevent the potential direct production and delivery of sediment to waterways, damage to vegetation, and the destruction of trees selected for preservation. Temporary stabilization of stockpiles shall be promptly instituted. The existence of critical slopes on stockpiles shall be avoided. Stockpiling in or immediately adjacent to diversion channels shall not be allowed. If a stockpile is to remain for over sixty (60) days, it shall be stabilized by soil stabilizing chemicals, temporary vegetation, interim structures or other approved practices.

B. Temporary vegetative measures planned for implementation on stockpiles shall be established immediately after stockpile completion. Proper mulching and soil stabilization in conjunction with these seeding operations shall also be carried out.

3.5 STREAM PROTECTION

A. Where construction is close to existing streams and other waterways, construction shall be performed in a manner which will not contribute to stream pollution. Construction practices shall include the following:

1. Construction debris, excavated materials, brush, rocks, refuse and topsoil shall be kept as distant as possible from nearby waterways.

2. Stream crossings and machinery operation in the stream shall occur only as required for construction of the project, and shall be kept to a minimum. Under no circumstances shall a stream bed be permitted to become a highway for machinery traffic.

3.6 PUMP WATER

Pump water management shall be practiced by CONTRACTOR to minimize production

and transport of sediment. Pumped water shall be discharged onto stabilized surfaces and then allowed to be filtered by existing vegetation or other temporary measures as appropriate. Since ditches may be required to transport pumped water away from construction areas, they shall be given the same consideration as other waterways and shall be stabilized in a manner satisfactory to the ENGINEER/OWNER.

3.7 TEMPORARY STRAW BALE BARRIERS

A. Place bales in a single row, lengthwise, on the contour and embedded 3" into the soil. In lieu of embedment, a 3" high shoulder of suitable soil may be compacted against the base of the straw bales.

B. Securely anchor straw bales in place by means of wooden stake or steel rebar driven through the bales.

3.8 SILT FENCES

Place silt fences in a continuous row, parallel to the slope, waterway, roadway or other area being protected. Anchor the silt fence fabric to posts set at a minimum of 10 ft. apart. Embed the bottom of the fabric a minimum of 4" deep and backfill and compact soil over the embedded portion. Replace or repair any sections of fence, which collapse or are washed out during the construction period as soon as reasonably possible.

3.9 CLEAN UP

A. Upon project completion, remove all temporary erosion and sediment control devices. Remove from job site all excess materials, debris, surplus tools and equipment. Leave site in a neat and orderly condition acceptable to the ENGINEER/OWNER.

B. Upon removal of temporary erosion and sediment control devices, perform all required finish grading, seeding, and mulching as specified under Section 02900.

END OF SECTION

SECTION 02310

STREAM AND/OR HIGHWAY CROSSINGS

PART ONE - GENERAL

1.1 DESCRIPTION

A. Work included: Perform all labor, material and equipment to install steel casing pipe for stream and/or highway crossings in accordance with the Drawings and as specified herein.

B. Related work specified elsewhere:

1. Erosion and Sediment Control – Section 02270
2. Rock Excavation – Section 02230
3. Conductive Trace Wire for Nonmetallic Pipe Installation – Section 02605
4. Water Distribution Lines - Section 02665
5. Sanitary Sewer Collector Lines and Force Main - Section 02731
6. Seeding and Mulching - Section 02900

1.2 PROTECTION

Streets, roads, adjacent property and other works to remain shall be protected throughout the work as defined in the General Conditions.

PART TWO - PRODUCTS

2.1 MATERIALS

A. Steel casing pipe shall be smooth wall steel pipe as indicated with a minimum wall thickness of 0.25 inches conforming to the materials standards of ASTM A 252, grade 2. Joints of steel pipe shall be butt welded, watertight, in accordance with the American Welding Society's recommended procedures. The construction plan indicates the minimum thickness of casing pipe.

B. Carrier pipe shall be ductile iron, class 52 or 54, cement lined, bituminous coated AWWA C 151, restrained joint pipe or HDPE pipe as indicated on the plan.

C. Pressure injected grout shall be a sand and cement grout mixture, consisting of 1.0 part cement, 2 parts sand (100 percent passing the No. 3/8 sieve and 94 to 100 percent passing a No. 4 sieve). Dry grout mix shall be combined with the minimum amount of water to achieve the necessary consistency and containing 3 to 7 percent entrained air. Maximum grouting pressure shall be 30 psi.

PART 3 - EXECUTION

3.1 STREAM CROSSING

Unless directed otherwise by permits issued by applicable Federal and/or State agencies, the following procedure shall be utilized:

A. Contractor shall construct crossings of streams in the "dry" by providing a temporary cofferdam or bulkhead of non-erodible material. Cofferdam or bulkhead shall not obstruct more than one-half of water surface at any time and shall not extend more than three (3) feet above the normal water surface. Contractor shall not be allowed to operate construction equipment on the native stream bottom, except during removal of the cofferdam. Contractor shall be advised that the level in the stream(s) can increase rapidly due to rainfall in the upstream watershed.

B. Non-erodible shall be defined as #1 coarse aggregate as defined in the Virginia Department of Transportation "Road and Bridge Specifications" Most Current Edition. An earth core for the cofferdam may be constructed over the proposed excavation; however, the non-erodible material shall be in place prior to placement of the earth, so that the erodible earth does not come in contact with the flowing water.

C. Contractor shall construct crossings as indicated in the details and shall then completely remove cofferdam, bulkhead, or whatever equipment or material that was used to construct the crossing. Bottom of the stream in the construction area shall be restored to its original cross section. All disturbed areas on the banks of streams shall be seeded and mulched as specified hereinafter in paragraph "Seeding."

D. River/Stream crossing permits required from Virginia Marine Resource Commission and/or US Army Corps of Engineers have been obtained by the OWNER and are made part of the CONTRACT DOCUMENTS. Requirements of these permits are considered Special Conditions of the CONTRACT DOCUMENTS.

3.2 HIGHWAY CROSSING - BORE & JACK METHOD

A. Pipeline crossing under highways shall be installed in a steel casing pipe installed by the "drive casing as you go" boring and jacking method unless otherwise indicated. Lengths of steel pipe shall be welded to preceding length installed. Voids between exterior of casing pipe and the ground shall be filled with pressure injected grout. Carrier pipe shall be protected on pipe protection saddles spaced at two (2) per length of pipe. Ends of casing pipe shall be plugged with sacking prior to backfilling. If trench is allowed to be open cut, casing pipe shall be provided unless otherwise directed by the ENGINEER and trench shall be backfilled and pavement

restored within one (1) day of placing casing pipe.

B. The jacking operation shall be carried on in such a manner that settlement of the ground or the highway above the pipeline will not occur. The use of water or other fluids in connection with the boring and jacking operation shall not be allowed. Excavation shall not precede the jacking operation more than is necessary. The Contractor shall repair or replace, as directed by the Engineer, at the Contractor's expense, casing pipe which is damaged during the jacking operation.

C. After installation of casing pipe and grout, if required, carrier pipe shall be installed. Carrier pipes shall be supported by steel saddles strapped to the pipe with steel straps, as specified.

D. All operations of the Contractor shall be subordinate to the free and unobstructed use of the highway right-of-way for passage of traffic without delay or danger to life, equipment or property. Contractor shall provide all necessary flagging, warning devices, flagmen, bracing, bulkheads, and shields to ensure complete safety to all traffic at all times. Contractor shall notify the appropriate Police, Fire and/or Rescue Departments when restricting traffic to one lane.

E. Any highway crossing permits required for a PSA project have been obtained by the OWNER. These permits and the requirements of the permit are made a part of the Special Conditions of the CONTRACT DOCUMENTS.

3.3 HIGHWAY CROSSING - OPEN CUT METHOD

A. Any crossing that is made using the open cut method shall be performed in accordance with Virginia Department of Transportation standards.

B. Any highway crossing permits required for a PSA project shall be obtained by the CONTRACTOR unless otherwise indicated in the CONTRACT DOCUMENTS. These permits and the requirements of the permit are made a part of the Special Conditions of the CONTRACT DOCUMENTS.

C. CONTRACTOR shall adhere to all current VDOT work zone requirements including Erosion and Sediment Control requirements.

3.4 MEASUREMENT AND PAYMENT

Measurement and payment for stream and/or highway crossings shall be made per lineal foot of casing pipe installed for each casing size as specified or indicated on the Drawings. Unit Price shall reflect complete installation of respective casing pipe.

- END OF SECTION -

SECTION 02605

CONDUCTIVE TRACE WIRE FOR NONMETALLIC PIPE INSTALLATION

PART ONE - GENERAL

1.1 DESCRIPTION

A. Work included: Furnish all labor, material and equipment for installation of conductive trace wire with nonmetallic pipe.

B. Related work specified elsewhere:

1. Stream and/or Highway Crossings – Section 02310
2. Water Distribution Lines – Section 02665
3. Installation of Water Lines and Sanitary Sewer Lines by Horizontal Directional Drilling (HDD) Methodology – Section 02670
4. Sanitary Sewer Collector Lines and Force Main – Section 02731

1.2 DEFINITION

Installation of electrically continuous trace wire with identified access points to be used for locating nonmetallic water, sanitary sewer force mains and gravity sanitary sewer pipes including service lines using an electric pipe locator after installation of the pipe.

1.3 SUBMITTALS

Submit shop drawings or manufacturer's "cuts" of all trace wire materials and connectors in accordance with Section 01300 - SUBMITTALS AND SUBSTITUTIONS.

PART TWO - MATERIALS

2.1 TRACE WIRE AND CONNECTORS

A. Trace wire shall be minimum number twelve (12) gauge solid copper or copper clad steel (CCS) wire with high density polyethylene (HDPE), cross-linked polyethylene (XLPE) or high molecular weight polyethylene (HMWPE) jacket specifically recommended for direct burial.

B. A minimum of two number eight (8) gauge trace wires shall be included with non-metallic pipe installed using horizontal directional drilling (HDD), boring or augering.

C. Direct bury wire nuts specifically recommended for use with trace wire installation such King Innovation DryConn Direct Bury Wire Nut, 3M DBR-6 or DBY-6 or approved equal shall be used for end of wire connections to provide watertight connections and electrical continuity.

D. Direct bury wire lug connectors specifically recommended to provide watertight connections and electrical continuity for use with trace wire installation such as King Innovation DryConn Direct Bury Lug-Aqua or approved equal shall be used for branch connections.

PART THREE - EXECUTION

3.1 GENERAL

A. Trace wire shall be installed in the same trench, inside bore/drill holes and casings in contact with all nonmetallic pipes during installation. Trace wire shall be placed along the pipe at the three o'clock position and secured to the pipe every 10 feet by several wraps of adhesive tape to insure that the wire is directly adjacent to the pipe. Trace wire shall be loose and not pulled taut during installation to prevent stretching.

B. Trace wire shall be securely bonded at all wire joints using an approved watertight connector to provide electrical continuity and tensile strength equal to unbroken trace wire. Trace wire shall be continuous and without splices between valves, fire hydrants, manholes or other access points along the main pipe. Branch connections to the trace wire for service lateral trace wire shall be made by approved lug connections.

C. Ends of wire shall be secured against separation by 2 overhand knots in addition to approved connectors.

D. Trace wire shall be protected from damage during excavation or backfilling of pipe to prevent breaks in the wire jacket. Trace wire shall not be installed between service saddles or other fittings and the pipe.

E. Wire jacket shall be stripped the length required for the electrical connector using an approved wire-stripping tool without nicks or scores on the wire. The approved connector shall be installed over the exposed wire. Connections shall be snug and without any section of wire exposed.

F. Trace wire shall be accessible at all valves, water meters, air release valves, fire hydrants, sewer manholes, sewer cleanouts and other locations identified on the plans. Trace wire shall be installed on the inside of vaults or boxes. At manholes, the wire shall be installed from the exterior of the manhole to the interior by installing the wire underneath the manhole frame. Adequate trace wire shall be installed at all access points to provide a five (5) foot length of wire above the ground level.

G. Trace wire shall be installed to the first valve or other vault past the point of connection of nonmetallic pipe to metallic pipe.

H. Where pipes are greater than six (6) feet in depth, wire shall be brought to the surface every one hundred (100) feet and placed in a standard water meter box or approved junction box. The lid of the meter or junction box shall not have any writing or message on it.

3.2 MEASUREMENT FOR PAYMENT

All trace wire shall be included as an incidental part of the pipe installation.

3.3 TESTING

CONTRACTOR shall perform continuity test on all trace wire in the presence of and at the direction of OWNER'S representative.

3.4 REPAIRS TO TRACE WIRE

Repairs to trace wire shall be made using approved materials and connector. Repaired sections shall be tested to insure quality of repair.

END OF SECTION

SECTION 02665

WATER DISTRIBUTION LINES

PART ONE - GENERAL

1.1 DESCRIPTION

A. Work included: Provide all labor, material and equipment to excavate pipe trenches and backfill after the installation of the pipe, all in accordance with the Drawings and as specified herein.

B. Related work specified elsewhere

1. Site Preparation - Section 02110
2. Rock Excavation – Section 2230
3. Erosion and Sediment Control – Section 02270
4. Stream and/or Highway Crossings – Section 02310
5. Conductive Trace Wire for Nonmetallic Pipe Installation – Section 02605
6. Installation of Water Lines and Sanitary Sewer Lines by Horizontal Directional Drilling (HDD) Methodology – Section 02670
7. Seeding and Mulching – Section 02900

1.2 LINES AND GRADES

A. Pipes shall be laid true to the lines and grades as shown on the Drawings except as authorized by the OWNER/ENGINEER. The grade shown on the profile is the invert to which the work must conform. Work not conforming to the grade shall be corrected by the CONTRACTOR at his own expense in a manner acceptable to the ENGINEER.

B. Locations of water mains:

1. The locations of the proposed lines are shown on the Drawings.

2. Contours shown on the Drawings are for bidding and construction estimate only. The OWNER/ENGINEER does not guarantee the contours.

3. The OWNER/ENGINEER reserves the right to make changes in lines and grades of pipe lines; and in locations of pipes and/or appurtenances when such changes may be necessary or advantageous.

1.3 SUBMITTALS

Submit shop drawings or manufacturer's "cuts" of all pipe materials and appurtenances in accordance with Section 01300 - SUBMITTALS AND SUBSTITUTIONS.

1.4 ALTERNATIVES

Type of pipe material used in construction of the specified water pipeline shall be at CONTRACTOR'S option unless a specific type of pipe is required by note on the Drawings.

1.5 APPLICABLE AWWA STANDARDS

The following AWWA Standards (latest revision) are hereby incorporated by reference. Where a conflict exists between these written standards, and the standards incorporated by reference, the PSA Director will determine which standard shall apply. In general, the PSA Director will select the Standard that gives a final product that is in best interest of the PSA. Applicant shall provide PSA with manufacturer's certification that materials meet these standards.

A100 Standard for water wells.
C104 Standard for cement-mortar lined for ductile-iron and gray-iron pipe and fittings.
C110 Standard for ductile-iron and gray-iron fittings.
C111 Standard for rubber gasket joints for ductile-iron and gray-iron pipe and fittings.
C115 Standard for flanged ductile-iron and gray-iron pipe with threaded flanges.
C150 Standard for thickness design of ductile-iron pipe
(Class 52 minimum to be considered for 12" diameter or less)
C151 Standard for ductile-iron pipe
C502 Standard for dry-barrel fire hydrants
C504 Standard for rubber-seated butterfly valves
(approved for 14 inch or larger)
C506 Standard for backflow prevention devices
C508 Standard for swing-check valves
C509 Standard for resilient-seated gate valves
C512 Standard for air release, air/vacuum and combination valves
C550 Standard for protective interior coatings for valves and hydrants
C600 Standard for installation and testing of ductile-iron
water mains and their appurtenances
C602 Standard for cement-mortar lining of water pipe lines
C605 Standard for installation of polyvinyl chloride (PVC) pressure pipe
C651 Standard for disinfecting water mains
C652 Standard for disinfection of water storage facilities
C700 Standard for displacement type water meter
C701 Standard for turbine type water meter
C702 Standard for compound type water meter
C703 Standard for fire service type water meter
C900 Polyvinyl chloride (PVC) pressure pipe, for water (DR-14 minimum class to be considered).
C906 Polyethylene (PE) pressure pipe, for water (DR-11 minimum class to be considered).
C909 Molecularly oriented polyvinyl chloride (PVCO) pressure pipe, for water (Minimum class 200 to be considered).
D100 Standard for welded steel tanks for water storage

D102 Standard for painting steel water storage tanks
D103 Standard for factory-coated bolted water storage tanks

PART TWO – PRODUCTS

2.1 WATER PIPE AND APPURTENANCES

A. General:

1. Ductile cast iron pressure pipe of the push-on joint or "mechanical joint" variety, conforming to AWWA C151, latest revision. Pressure class 350 or thickness class 52 shall be used for all pipe twelve inches (12") in diameter or less. Water mains larger than 12" diameter in size, shall have thickness class as determined by thickness design of ductile-iron pipe AWWA C150, or;

2. Polyvinyl chloride (PVC) conforming to AWWA C900 with ductile iron O. D. Dimension Ratio (DR) 14 shall be minimum for PVC pipe. (SDR PVC pipe shall not be used as part of any water system). Water mains larger than 12-inch diameter in size, shall meet requirements, Uni-Bell-B-11 for DR-18, PR 235 and have integral bell with bonded in ring and spigot joint. On specific authorization of the PSA Director, transmission lines may be PVC meeting Uni-Bell-B-11 with DR-25, PR-165 rating, or:

3. Polyethylene (PE) conforming to AWWA C906, with outside dimension Ratio (DR) 11 shall be minimum for PE pipe. PE pipe shall be assembled and joined using the butt-fusion method in strict compliance with the manufacturer's recommendations, or:

4. Molecularly oriented polyvinyl chloride (PVCO) conforming to AWWA C909 with class 200 shall be minimum for PVCO pipe. This material is only acceptable for water mains up to 12-inch diameter in size.

B. Ductile Cast Iron Standard Mechanical Joint Pipe:

1. All ductile cast iron standard mechanical joint water pipe shall conform to AWWA C104 and ANSI Specification A21.51 and shall be lined with cement mortar and have a protective exterior coating. Linings and protective coatings equal to "Enameline" with tar coating in the exterior will be considered as a satisfactory lining for water pipe, however, any substitution in pipe lining and/or coating from ANSI A21.4 shall be specifically approved by the PSA Director. Joints of standard mechanical joint pipe shall conform to ANSI Specifications A21.11.

2. High strength cast iron tee head bolts, hex nuts, cast or ductile iron glands and rubber gaskets shall be as furnished by the pipe manufacturer. All tee bolts and nuts shall be constructed of same size and type material as head bolts and hex nuts.

3. In making connections of ductile cast iron pipe using standard mechanical joint, the gland followed by the rubber gasket shall be placed over plain end of the pipe, which shall be carefully inserted and aligned into socket end of pipe line. Gasket shall then be pushed into position so that it is evenly seated in the socket. Gland shall then be moved into position against face of the gasket, bolts inserted and made finger tight. Bolts shall then be tightened in accordance with AWWA C600 Table 3 (75-90 FT-LB Torque for pipe size 4-12"). All other requirements concerning bedding, alignment, and cleaning of pipe before making joint shall be followed.

C. Ductile Cast Iron Pipe - "Push-On Joint".

1. All "push-on" or "slip" joint pipe shall conform to requirements of standard mechanical joint pipe in regard to strength, class, protective coatings, etc.

D. Restrained Joint Pipe Systems:

1. Approved restrained joint pipe systems shall include the following:

a. Mechanical joint pipe with use of joint restraint gland such as EBAA Iron "Mega-Lug", Ford "Uni-Flange", Romac Industries "Grip Ring" or other restraint gland as approved by the PSA Director.

b. Ductile iron pipe push-on joint with use of U. S. Pipe "Field LOK" gaskets.

c. Restrained joint pipe such as U. S. Pipe "TR FLEX" pipe, Griffin Pipe "Snap-LOK" pipe or other restraint joint pipe as approved by the PSA Director.

d. Ductile iron, PE, or PVC pipe push-on joint with use of Mueller Company "AquaGrip" system.

E. PVC Plastic Bell and Spigot Joint:

1. PVC pipe meeting the AWWA Specification C900 for dimension ratio (DR) 14, pressure Class 200, may be used for water lines. DR-18 or DR-25 may be used as noted above for pressure pipe larger than 12" in diameter.

2. PVC pipe shall be installed, embedded and backfilled according to the manufacturer's written instructions and AWWA Specification C605. box or approved junction box.

3. All service line connections to PVC pipe shall be made using a stainless steel service saddle and full port, teflon coated ball valve corporation stop. Service saddle shall be of the extra wide or double-band type and manufactured specifically for PVC pipe. No direct tap to PVC pipe shall be permitted.

4. Only bell and spigot with elastomeric gasket joints shall be used. Solvent-cement joints or use of couplings shall not be allowed.

5. To facilitate future locating of PVC water pipe, trace wire shall be installed meeting Conductive Trace Wire for Nonmetallic Pipe Installation – Section 02605.

F. PE Pipe:

1. PE pipe shall be high density polyethylene meeting the AWWA Specification C906 for dimension ratio (DR) 11 and applicable requirements of ASTM D3550, may be used for water lines.

2. PE pipe shall be installed, embedded and backfilled according to the manufacturer's written instructions.

3. All service line connections to PE pipe shall be made using a fused service saddle and full port, teflon coated ball valve corporation stop. No direct tap to PE pipe shall be permitted.

4. PE pipe shall be assembled and joined at the site using the butt-fusion method to provide a leak proof joint. Threaded or solvent-cement joints and connections shall not be permitted. All equipment and procedures used shall be used in strict compliance with the manufacturer's recommendations.

5. Butt-fused joint shall be true alignment and shall have uniform roll-back beads resulting from the use of proper temperature and pressure. Joint shall be allowed adequate cooling time before removal of pressure. Fused joint shall be watertight and shall have tensile strength equal to that of the pipe. All joints shall be subject to acceptance by the OWNER and/or his representative prior to insertion. All defective joints shall be cut out and replaced at no cost to OWNER. Any section of the pipe with a gash, blister, abrasion, nick, scar, or other deleterious fault greater in depth than ten percent (10%) of the wall thickness, shall not be used and must be removed from the site. However, a defective area of the pipe may be cut out and the joint fused in accordance with the procedures stated above. In addition, any section of pipe having other defects such as concentrated ridges, discoloration, excessive spot roughness, pitting, variable wall thickness or any other defect of manufacturing or handling as determined by the OWNER and/or his representative shall be discarded and not used.

6. Terminal sections of pipe that are joined within the insertion pit shall be connected with a full circle pipe repair clamp or equal. Butt gap between pipe ends shall not exceed one-half (½) inch. Also Unicore Plastic Fusion System, unicore can be used to butt fuse the pipe material.

7. To facilitate future locating of PE water pipe, trace wire shall be installed meeting Conductive Trace Wire for Nonmetallic Pipe Installation – Section 02605.

G. PVCO Plastic Bell and Spigot Joint:

1. PVCO pipe meeting the AWWA Specification C909 for pressure Class 200, may be used for water lines up to 12" in diameter.

2. PVCO pipe shall be installed, embedded and backfilled according to the manufacturer's written instructions.

3. All service line connections to PVCO pipe shall be made using a stainless steel service saddle and full port, teflon coated ball valve corporation stop. Service saddle shall be of the extra wide or double-band type and manufactured specifically for PVCO pipe. No direct tap to PVCO pipe shall be permitted.

4. Only bell and spigot with electrometric gasket joints shall be used. Solvent-cement joints or use of couplings shall not be allowed.

5. To facilitate future locating of PVCO water pipe, trace wire shall be installed meeting Conductive Trace Wire for Nonmetallic Pipe Installation – Section 02605.

H. Ductile Cast Iron Pipe Fittings:

1. Fittings for all water pipes shall be ductile iron in accordance with AWWA Specifications C110, latest revision, with a minimum pressure rating of 250 PSI. All ductile iron water pipe fittings shall conform to ANSI Specifications A-21.10 and A-21.11 and shall have same type of connection, lining and coating as pipe. Ductile iron water pipe fittings in conformance with ANSI/AWWA C-153/A-21.53 Specs. for ductile iron compact fittings shall be considered as meeting the requirements of this Specification.

2. One Bolt, Incorporated "One Bolt" fittings may be used for ductile iron and PVC pipe.

3. Infact Corporation's "Foster Adaptor" may be used to connect between mechanical joint fittings, valves and hydrant connections.

I. Gate Valve:

1. All gate valves shall be of superior quality iron body with resilient seat and full bronze mount. All gate valves shall withstand a working pressure of 250 psi and shall be in strict conformance to applicable AWWA Standards. Wrench nut shall turn to the left (counterclockwise) to open valve. Valves shall be so arranged to fit into pipe lines having standardized mechanical

joints or slip joints. All gate valves shall be resilient seat type valves meeting AWWA C509 latest revision Standards with stainless steel or other extra strength stems.

2. On valves fourteen inches (14") or larger, butterfly valves conforming to AWWA C504 may be used.

3. Infact Corporation's "Foster Adaptor" may be used to connect between mechanical joint fittings, valves and hydrant connections.

4. Valve stem risers shall be provided when valves are installed at depth of 4 feet and greater. The top of the stem risers shall not be more than 3 feet from the surface. Stem risers shall be permanently fixed to the gate valve operating nut.

J. Fire Hydrants:

1. Hydrants shall be traffic model, dry-barrel type, meeting AWWA C502 latest revision standard; AVK Model 2780 or approved equal.

2. Hydrants shall be of compression type with main valve openings not less than four and one-half inches (4-1/2") in diameter. Hydrants shall have cast or ductile iron body with full, bronze trim, and shall withstand a hydrostatic test pressure of 300 psi. Hydrants shall have a six-inch (6") connection base for setting with a minimum of thirty-six inch (36") cover on connection pipe. Hydrants shall be equipped with hose connections as follows:
Two each 2-1/2", N.S.T. hose connections
One each 4-1/2", N.S.T. pumper connections

3. Hydrant shall be operated by a National Standard 1-1/2 inch (1-1/2") pentagon shaped, operating nut, opening counterclockwise. Direction of opening shall be clearly marked by an arrow cast on outside of hydrant. Hydrants shall be connected to the main with a six-inch (6") pipe and shall be controlled by an independent six-inch (6") gate valve. Six-inch (6") gate valve shall be located as near to service main as practical, and connected to the tee with tie rods. A gravel dry well shall be provided for hydrant drain.

4. All hydrant barrels and all 2-1/2 and 4-1/2 inch caps of the hydrant shall be painted with red reflective paint. Paint shall be lead free Sherwin Williams KEM 400 Enamel or approved and applied at a minimum thickness of 4 mils.

5. Hydrant assembly shall be restrained from connection to distribution main to hydrant. Approved restraint methods shall include threaded "Corten" rodding between hydrant, hydrant valve and connection to water distribution main with concrete thrust blocks behind hydrant and distribution main tee fitting. Approved mechanical joint gland restraint ("Mega-Lug", "Grip Ring" or "Uni-Flange") may be used in lieu of concrete thrust blocking.

6. Infact Corporation's "Foster Adaptor" may be used to connect between mechanical joint valves, fittings and hydrant connections.

7. A round "Out of Service" marker of black plastic with white lettering shall be placed on the 4 1/2" nozzle behind the end cap. Plastic bags shall not used to indicate out of service fire hydrants.

K. Valve Vaults:

1. Valve vaults shall be used for all main line valves unless otherwise approved in writing by the PSA Director. All vaults shall be precast manhole cone sections with water manhole covers as shown in the Detail Drawings.

L. Valve Boxes:

1. All valve boxes, base extensions, head and cover shall be of cast or ductile iron meeting AASHTO Designation M306-05. Valve boxes shall be of the Mueller sliding type, round head marked "Water". Shaft diameter shall not be less than five inches (5"). Valve boxes shall have a minimum range of extension to fit two inch (2") to twelve inch (12") valves inclusive, placed on mains at depths of three feet, (3') to five feet (5') of cover in order that cover of the valve box is set to finished grade. Valve boxes shall be two piece. Valve boxes shall be centered over valve screw and set plumb. Valve boxes shall only be allowed on fire hydrant valves or on other installations approved in writing by PSA Director.

M. Water Service Connection – Type "A":

1. Type "A" meter connection shall be installed when main line pressure is less than 80 PSI.

2. Water meter box and accessories therein necessary for Type "A" meter installation shall be furnished and installed by CONTRACTOR just within right-of-way/easement at the property line as shown on construction plans. Water meter box and meter setter shall be furnished and installed as shown in the Detail Drawings. All meter setters shall be equipped with an integral lockable valve and check valve.

3. All water services pipe from main connections to the meter box assembly shall be Endot SDR-9 200 psi CTS Polyethylene (PE) or "K" type copper. All connections shall use approved compression, pack-joint type fittings. The minimum size service connection shall be 1 inch (1") I.D. for both single and double setters. Fittings for service lines shall meet AWWA Specification C800. Solder connection shall not be used for underground service.

N. Water Service Connection – Type "B":

1. Type "B" meter connection shall be installed when main line pressure is 80 to 120 PSI. Type "B" connection incorporates an individual ¾-inch pressure reducing valve, Wilkins Model 600 LU or equal installed in a standard meter setter and box situated on the customer side of the meter.

2. Water meter box and accessories therein necessary for Type "B" meter installation shall be furnished and installed by CONTRACTOR just within right-of-way/easement at the property line as shown on construction plans. Water meter box and meter setter shall be furnished and installed as shown in the Detail Drawings. All meter setters shall be equipped with an integral lockable valve and check valve.

3. Pressure reducing valve and accessories shall be furnished and installed by CONTRACTOR on private property side of pressure reducing valve box and valve setter shall be furnished and installed as shown in the Detail Drawings. All meter setters shall be equipped with an integral lockable valve and check valve.

4. All water services pipe from main connections to the meter box assembly shall be Endot SDR-9 200 psi CTS Polyethylene (PE) or "K" type copper. All connections shall use approved compression, pack-joint type fittings. The minimum size service connection shall be 1 inch (1") I.D. for both single and double setters. Fittings for service lines shall meet AWWA Specification C800. Solder connection shall not be used for underground service.

O. Water Service Connection – Type "C":

1. Type "C" meter connection shall be installed when main line pressure is greater than 120 PSI. Type "C" connection incorporates installation of water meter and individual ¾-inch pressure reducing valve with integral pressure relief valve, Wilkins Model BR4EC or equal in a standard double meter setter and box situated on the public water system side of the meter.

2. Water meter, ¾-inch pressure reducing valve, connecting S-bar with integral pressure relief valve and accessories therein necessary for Type "C" meter installation shall be furnished and installed by CONTRACTOR just within right-of-way/easement at the property line as shown on construction plans. Water meter box and double meter setter shall be furnished and installed as shown in the Detail Drawings. All meter setters shall be equipped with an integral lockable valve and check valve.

3. All water services pipe from main connections to the meter box assembly shall be Endot SDR-9 200 psi CTS Polyethylene (PE) or "K" type copper. All connections shall use approved compression, pack-joint type fittings. The minimum size service connection shall be 1 inch (1") I.D. for both

single and double setters. Fittings for service lines shall meet AWWA Specification C800. Solder connection shall not be used for underground service.

P. 1" to 3" Water Services: All service pipe from 1" to 3" in diameter shall be Endot SDR-9 200 psi CTS Polyethylene (PE) or "K" type copper.

Meters shall be placed in a lockable bypass setter. Larger water meters shall be installed in a concrete vault. Concrete vaults shall be provided with drain line. Drain line should drain to surface if practical. Drain line shall be provided with a gate valve.

Q. Water Meters: All residential 5/8" x 3/4" and 1" water meters shall be installed or supplied by the PSA per the current Basic Connection Fee schedule. Water meters shall conform to applicable AWWA standards as listed in 02665 Section 1.5 and current PSA Standards. Larger water meters shall be reviewed and approved during the plan review process.

R. Wet Taps: All taps to PSA water system shall be made or coordinated by PSA at customer's expense. Tapping sleeve shall be stainless steel. Tapping sleeve and tapping valve shall be rated for 250 pounds per square inch (psi). Wet taps shall be hydrostatically tested at a minimum of 250 pounds per square inch (psi) for 15 minutes without loss.

S. Pipeline Bedding Materials: Where pipeline installation requires granular bedding materials, they shall meet requirements of VDOT gradation 21-A, No. 57 or No. 68.

T. Surface Water Crossings:

1. Surface water crossings, both over and under water, present special problems and should be discussed with the PSA Director before final plans are prepared.

2. Above Water Crossings - The pipe above water crossings shall be:

   a. Adequately supported;
   b. Protected from damage from freezing;
   c. Accessible for repair or replacement; and
   d. Above 100 year flood level.

3. Under Water Crossing:

   a. Pipe shall be of special construction, having flexible watertight joints; i.e. ball and socket, lock-joint, and shall be Class 54 or 55 DI. DR-9 HDPE may be used for under water crossings. In lieu of the above, Class 52 DI pipe may be used with a minimum of one foot on all sides being concrete encased within the one hundred (100) year flood way limits.

b. Pipe shall be provided with a minimum of one foot of cover over the concrete encasement from bottom of the stream bed where in rock and three of cover in other material. The trench and stream banks shall be adequately protected with concrete and/or riprap to prevent erosion.

c. Valves shall be provided at both ends of the water crossing so that the section can be isolated for tests or repair; the valves shall be easily accessible and not subject to flooding by the 100-year storm flood level.

d. Permanent sample taps shall be installed on each end of the crossing and at reasonable distance from each side of the crossing to facilitate testing.

U. Special Conditions: PSA Director may require special material and/or construction be used where normal water pressure exceeds pressure rating used in these standards and where design will not permit reducing pressures to acceptable levels.

2.2 EXCAVATION CLASSIFICATIONS

A. All excavated material shall be classified as either rock or earth excavation. The estimated quantity indicated for Rock Excavation in the Bid Form, if included, shall be the amount of rock expected to be encountered by the Contractor. The remainder of the excavation shall be assumed to be Earth Excavation, which shall be included in the unit price for installing the pipe complete-in-place.

B. Rock excavation, if included in Bid Form, shall include boulders measuring three-quarter (3/4) cubic yards or more in volume and weighing more than eight hundred (800) pounds. Also included are solid ledges, bedded deposits, unstratified masses and conglomerations of materials so firmly cemented as to possess characteristics of solid rock, which cannot be removed without systematic drilling and blasting. Sidewalk, curb and gutter, paving and structures to be removed shall not be classified as rock.

PART THREE - EXECUTION

3.1 WATER LINE CONSTRUCTION

A. General:

1. Except as specifically modified below, water line construction shall meet requirements of AWWA C600 and/or C605 latest edition Standards. Pipe, fittings, valves, hydrants and accessories shall be loaded and unloaded by lifting with hoists or skidding so as to avoid shock or damage. Under no circumstances shall such materials be dropped. Pipe shall be so handled that

any coating or lining is not damaged.

2. The water main shall be laid and maintained to the required lines and grades with fittings, valves, hydrants and accessories set at the required locations as indicated on the approved plans for the project. All valve and hydrant stems shall be set plumb. Whenever obstructions not shown on the plans are encountered during progress of the work and interfere to such an extent that alteration in plans is required, the PSA Director or his authorized representative shall be advised and the PSA Director's approval given before such alterations are put into effect. Any such alternative design shall be designed or approved by the Engineer of record for the original design.

B. Excavation, Bedding and Backfill:

1. Trench shall be dug so that pipe can be laid to the alignment and depth required and it shall be excavated not more than one hundred fifty feet (150') in advance of completed pipe laying operation. Trenches are not to be left open overnight unless adequate safety precautions are taken. Width of trench shall be ample to permit pipe to be placed, backfill and thoroughly compacted in accordance with requirements of these specifications. Trenches shall be of such extra widths as will permit convenient placing of timber supports, sheeting and bracing and handling of special fittings or appurtenances when required. Where consistent with safety and space considerations, excavated material is to be placed on uphill side of trenches. Trenches are to be adequately dewatered in a manner that will not adversely affect flowing streams, drainage systems, or off-site property. Pipe shall not be strung along trench in excess of that which can be installed each day.

2. Contractor shall do all sheeting, bracing and shoring necessary to perform the work, protect existing structure, and protect all excavations as required for safety, in conformance with all local, state and federal safety regulations.

3. Trench shall be excavated to depth required so as to provide a uniform and continuous bearing support for pipe on solid and undisturbed ground at every point between bell holes, except that it will be permissible to disturb and otherwise damage finished surface over a maximum length of eighteen inches (18") near middle of each length of pipe by withdrawal of pipe slings or other lifting tackle. Damaged area shall be refinished as near as possible. Any part of bottom of trench excavated below specified grade, shall be backfilled with approved materials, and be thoroughly compacted. Finished subgrade shall be prepared accurately by means of hand tools.

4. Bedding shall be placed as required by the pipe manufacturer's written installation instructions.

5. Where excavation is made in fractured rock, boulders, or other unsuitable material, subgrade shall be made by backfilling with a minimum four inch (4") compacted depth of gravel or clean selected soil which shall be

thoroughly compacted.

6. Bell holes shall be provided at each joint to permit the jointing to be made properly and to permit maximum bedding length.

7. Ledge rock, boulders, and large stones shall be removed to provide a clearance of at least six inches (6") below and at least twelve inches (12") on each side of pipe and appurtenances being laid and any part or projection of such rock, or stone.

8. No pipe shall be laid in water or when, in the opinion of the PSA Director, trench conditions are unsuitable. If the PSA is of the opinion that trench bottom consists of wet, washable material or is otherwise incapable of properly supporting the pipe or structures, such material shall be removed and replaced with proper bedding material in addition to the standard bedding required.

9. Backfill shall be placed in two (2) equal depth layers to the top of the pipe and each layer shall be thoroughly tamped to ninety-five percent (95%) of the maximum theoretical density as determined by a standard proctor test, the remainder of the backfill shall be placed in a maximum of two foot (2') layers mechanically tamped. Backfill material shall be free of perishable material, frozen clods, sticky masses of clay and other unsuitable matter. Rock pieces larger than two inches (2") shall not be used in backfill, which is within two feet (2') of pipe.

10. Backfill in areas not subjected to vehicular traffic shall be compacted to such a degree that any subsidence will not be objectionable or detrimental to normal use. Backfill and replacement in existing or proposed roads shall be executed in full accordance with requirements of the Virginia Department of Transportation Standards. All materials excavated, but not used in backfilling, shall be properly removed and disposed of by the Contractor in an approved location provided by the contractor. No stone or rock larger than five (5) inches in its greatest dimension shall be used in the backfilling of any water or sewer facility.

C. Blasting

1. The PSA may prohibit blasting whenever it is felt that the protection provided is inadequate. Extreme care shall be used whenever blasting for the removal of hard materials is necessary.

2. Blasting shall be prohibited on Sundays, Holidays, and between the hours of 7:00 p.m. and 7:00 a.m., unless previously approved in writing by the OWNER.

3. Only persons experienced in the handling and use of blasting materials shall perform this work. All licenses and blasting permits shall be kept on the job

site at all times blasting is performed.

4. Only the quantity and strength of explosives necessary for proper trench excavation shall be used. All explosives shall be detonated by an approved electric blasting device. Under no circumstances shall electric current from batteries, telephone or power lines be used for detonation.

5. No blasting shall take place until all persons in the vicinity have been warned and had sufficient time to reach safety.

6. All blasting shots shall be covered with blasting mats or other approved material such that all structures, persons, and property are protected from injury. A pre-blast survey may be required if blasting is required in close proximity to structures.

7. Contractor shall take into consideration location of existing utilities, or other structures when blasting. Contractor shall be responsible for taking all necessary precautions during blasting and general construction activities such that existing structures and facilities are protected from damage and will not be affected by construction activities.

8. Contractor shall be responsible for notifying and coordinating with the proper authorities, utility companies, and potentially affected parties prior to and during all blasting activities.

9. When rock is encountered, Contractor shall notify the Construction Inspector in order that the quantities can be measured.

D. Installation of Pipe and Fittings:

1. When installing pipe in trench, proper implements, tools, and facilities satisfactory to the PSA Director and as recommended by material manufacturer shall be provided and used by contractor for safe and convenient prosecution of the work. All pipe, valves, fittings, hydrants and accessories shall be carefully lowered into trench, piece by piece, by means of a derrick, ropes, slings or other suitable tools or equipment in such a manner as to prevent damage to water main material and any protective coatings and linings. Under no circumstances shall water main materials be dropped or dumped into trench. Pipe and fittings shall be inspected for defects, and while suspended above grade, be rung with a light hammer to detect cracks.

2. All lumps, blisters and excess coal tar coatings shall be removed from ends of ductile iron pipe, and outside of the spigot and inside of the bell shall be wiped clean and dry and free from oil and greases before the pipe is laid.

3. Every precaution shall be taken to prevent foreign material including

nonpotable water from entering the pipe while it is being placed in the line. If the pipe-laying crew cannot put the pipe into the trench and in place without getting earth into it, a heavy tightly woven canvas bag of suitable size shall be placed over each end and left there until the connection is to be made to the adjacent pipe. During laying operations, no debris, tools, clothing, or other materials shall be placed in the pipe. At the end of each day a watertight plug shall be placed in the end of all pipe openings.

4. After placing a length of pipe in the trench, the spigot end shall be centered in the open bell of the pipe line and the pipe pushed home so that the face of the spigot is in close contact with the shoulder of the bell. Water pipe shall be laid with the bell facing the direction of the laying.

5. No stub of any water main shall terminate with a capped or plugged valve. Where a valve is required to be installed near a stub end, not less than 36 feet of pipe shall be installed between valve and plugged stub end of pipe for adequate anchoring.

6. Cutting of pipe for inserting valves, fittings, or closure pieces shall be done in a neat and workmanlike manner without damage to the pipe or cement lining and so as to leave a smooth end at right angles to axis of the pipe.

7. When machine cutting is not available for cutting metal pipe twenty inches (20") in diameter or larger, the electric-arc cutting method will be permitted using a carbon or steel rod. Only qualified and experienced workmen shall be used for this work. Flame cutting of metal pipe by means of oxyacetylene torch will not be allowed.

8. Whenever it is necessary to deflect pipe from a straight line, either in vertical or horizontal plane, to avoid obstructions or plumb stems, or where long-radius curves are approved, the amount of deflection allowed shall not exceed the maximum required, for satisfactory joining of the pipe, as specified in this manual. Maximum deflection permitted per joint shall be in accordance AWWA C600 Table 4 for push-on joint and Table 5 for mechanical joint pipe. C900 PVC pipe deflection may not exceed 75% of manufacturer's recommendation.

9. All pipes shall be laid to a minimum depth of thirty-six inches (36") from established final grade to the top of the pipe. Water pipe shall not be laid at depths exceeding five (5') feet unless specifically approved by the PSA Director.

INSTALLATION OF DUCTILE-IRON WATER MAINS
TABLE 4

Maximum Joint Deflection Full-Length Pipe – Push-On Type Joint

		Maximum Offset – S Inches (Meters)		Approximate Radius of Curve – R* Produced by Succession of Joints	
Nominal Pipe Size (Inches)	Deflection Angle	Joint Length 18-Feet (5.5 Meters)	Joint Length 20-Feet (6.1 Meters)	Joint Length 18-Feet (5.5 Meters)	Joint Length 20-Feet (6.1 Meters)
3	5°	19 (0.48)	21 (0.53)	205 (62)	230 (70)
4	5°	19 (0.48)	21 (0.53)	205 (62)	230 (70)
6	5°	19 (0.48)	21 (0.53)	205 (62)	230 (70)
8	5°	19 (0.48)	21 (0.53)	205 (62)	230 (70)
10	5°	19 (0.48)	21 (0.53)	205 (62)	230 (70)
12	5°	19 (0.48)	21 (0.53)	205 (62)	230 (70)
14	3°	11 (0.28)	12 (0.30)	340 (104)	380 (115)
16	3°	11 (0.28)	12 (0.30)	340 (104)	380 (115)
18	3°	11 (0.28)	12 (0.30)	340 (104)	380 (115)
20	3°	11 (0.28)	12 (0.30)	340 (104)	380 (115)
24	3°	11 (0.28)	12 (0.30)	340 (104)	380 (115)
30	3°	11 (0.28)	12 (0.30)	340 (104)	380 (115)

* For 14-in. and larger push-on joints, maximum deflection angle may be larger than shown above. Consult manufacturer.

TABLE 5
Maximum Joint Deflection Full-Length Pipe -- Mechanical Joint Pipe

		Maximum Offset – S Inches (Meters)		Approximate Radius of Curve – R* Produced by Succession of Joints	
Nominal Pipe Size (Inches)	Deflection Angle	Joint Length 18-Feet (5.5 Meters)	Joint Length 20-Feet (6.1 Meters)	Joint Length 18-Feet (5.5 Meters)	Joint Length 20-Feet (6.1 Meters)
3	8° - 18"	31 (0.79)	31 (0.89)	125 (38)	140 (43)
4	8° - 18"	31 (0.79)	31 (0.89)	125 (38)	140 (43)
6	7° - 07"	27 (0.69)	30 (0.76)	145 (44)	160 (49)
8	5° - 21"	20 (0.51)	22 (0.56)	195 (59)	220 (67)
10	5° - 21"	20 (0.51)	22 (0.56)	195 (59)	220 (67)
12	5° - 21"	20 (0.51)	22 (0.56)	195 (59)	220 (67)
16	3° - 35"	13½ (0.34)	15 (0.38)	285 (87)	320 (98)
18	3° - 00"	11 (0.28)	12 (0.30)	340 (104)	380 (116)
24	2° - 23"	9 (0.23)	10 (0.25)	450 (137)	500 (152)
30	2° - 23"	9 (0.23)	10 (0.25)	450 (137)	500 (152)

9. All tees, bends, plugs, caps, and fire hydrants shall be substantially braced, blocked and/or strapped to prevent any movements by providing adequate reaction backing and/or tie rods. Reaction backing shall be designed and installed as indicated in the Detail Drawings. Hydrants shall be set to established finished grade as follows:

   a. Bottom of the four and one-half inch (4-1/2") nozzle shall be between eighteen inches (18") and twenty-four inches (24") above finish elevation, or at the edge of the shoulder on streets without curb and gutter and between eighteen and twenty-four inches (18")-(24") above elevation of the curb on streets with curb and gutter as indicated in the Detail Drawings.

   b. Two and one-half inch (2-1/2") hose connections shall have a minimum of four feet zero inches (4'0") clearance on all sides.

   c. Surface shall be approximately level within a four-foot (4') radius of the hydrant.

   d. Fire hydrant drains shall be plugged if seasonal water level is noted above drain outlet. The Engineer and PSA Director shall be immediately notified so that the fire hydrant can be properly relocated.

   e. A round "Out of Service" marker of black plastic with white lettering shall be placed on the 4 1/2" nozzle behind the end cap. Plastic bags shall not used to note out of service fire hydrants.

10. Water lines installed on slopes greater than 20% shall be secured by anchor blocks in conformance with Detail Drawing S-19. Restrained joint pipe per section 02665 Part 2, 2.1. D. shall be used if the pipe bells are installed on the downhill end of the pipe section. The PSA Director may require restrained joint pipe systems per Section 02665 Part 2.1 D. on grades exceeding 20% where deemed necessary due to trench, subsurface, slope or surface conditions.

E. Installation of Valves, Air Relief Assemblies and Blow-Off Chambers

1. During construction, air and sediment accumulations may be removed through a standard fire hydrant. Compressed air and/or pumping may be used for dewatering mains through hydrants.

2. Chambers or pits containing valves, blow-offs, meters or other such appurtenances to a distribution system shall not be connected directly to any storm drain or sanitary sewer, nor shall blow-offs or air relief valves be connected directly to any sewer.

3. Such chambers or pits shall be drained to the surface of the ground where they are not subject to flooding by surface water, or to absorption pits underground in areas with a sufficiently deep water table.

3.2 RELATION OF SEWERS TO WATER MAINS

A. General:

1. The following factors shall be considered in providing adequate water and sewer line separation.

   a. Materials and types of joints for water and sewer pipe;
   b. Soil conditions;
   c. Service branch connections into the water line and sewer lines;
   d. Compensating variations in the horizontal and vertical separations;
   f. Offsetting of pipes around manholes.

B. Parallel Installation:

1. Normal Conditions - Water lines shall be laid at least ten feet (10') horizontally from sewer lines whenever possible with distance measured edge-to-edge unless determined by PSA Director to be unusual conditions.

2. Unusual Conditions - When local conditions prevent horizontal separation described above, the following construction shall be used:

   a. The bottom (invert) of the water main shall be at least eighteen inches (18") above the top of the (crown) of the sewer.

   b. Where this vertical separation cannot be obtained, sewer shall be constructed of AWWA approved water pipe, hydrostatically pressure tested in place without leakage prior to backfilling. Pressure test shall be 30 psi.

   c. Sewer manhole shall be made 100% water-tight construction and vacuum tested in place without leakage for 30 minutes.

C. Crossing Installation:

1. Normal conditions - water lines crossing over sewers shall be laid to provide a separation of at least eighteen inches (18") between the bottom of the water line and the top of the sewer whenever possible.

2. Unusual conditions - when local conditions prevent a vertical separation as described above, the following construction shall be used:

a. Sewers passing over or under water lines shall be constructed of AWWA approved water pipe, hydrostatically pressure tested in place without leakage prior to backfill. Pressure test shall be 30 PSI.

b. Length of sewer pipe shall be centered at the point of the crossing so that joints shall be equidistant and as far as possible from water line.

3. Water lines passing under sewers shall also be protected by providing:

a. A vertical separation of at least eighteen inches (18") between the bottom of the sewer and the top of the water line. Sewer line shall be encased along its length where it is within 10' of the water line.

b. Adequate structural support for the sewers to prevent excessive deflection of joints and settling on and breaking of the water line.

c. The length of water line be centered at the point of the crossing so that joints shall be equidistant and as far as possible from the sewer.

D. Sewers or Sewer Manholes:

No water pipes shall pass through or come in contact with any part of a sewer manhole.

E. Other Utilities:

1. When other underground utilities (storm drains, gas, electrical, etc.) cross within twelve inches (12") above or below water lines, adequate structural support of the utilities shall be provided.

2. Parallel installations of other utilities shall be a minimum of 24" offset edge to edge from water lines.

3. Water lines shall be placed over storm drains wherever practical.

3.3 HYDROSTATIC TESTS FOR LEAKAGE

A. General:

1. All new water mains shall be tested, after backfilling to a hydrostatic pressure of not less than 100 psi above design water pressure for the system or 150 psi, whichever is greater. Allowable leakage shall be calculated by the following formula and is shown in columnar form in Table 6:

$$L = \frac{SD\sqrt{P}}{133{,}200}$$

Where:
L = allowable leakage in gallons per hour
S = length of pipe tested in feet
D = nominal diameter of pipe in inches
P = average test pressure during leakage test in psi

TABLE 6
Allowable Leakage per 1,000 ft. (305 m) of Pipeline*--gph^

Average Test Pressure PSI (Bars)	NOMINAL PIPE DIAMETER - Inches							
	3"	4"	6"	8"	10"	12"	14"	16"
300 (21)	0.39	0.52	0.78	1.04	1.30	1.56	1.82	2.08
275 (19)	0.37	0.50	0.75	1.00	1.24	1.49	1.74	1.99
250 (17)	0.36	0.47	0.71	0.95	1.19	1.42	1.66	1.90
225 (16)	0.34	0.45	0.68	0.90	1.13	1.35	1.58	1.80
200 (14)	0.32	0.43	0.64	0.85	1.06	1.28	1.48	1.70
175 (12)	0.30	0.40	0.59	0.80	0.99	1.19	1.39	1.59
150 (10)	0.28	0.37	0.55	0.74	0.92	1.10	1.29	1.47
125 (9)	0.25	0.34	0.50	0.67	0.84	1.01	1.18	1.34
100 (7)	0.23	0.30	0.45	0.60	0.75	0.90	1.05	1.20

* If the pipeline under test contains sections of various diameters, the allowable leakage will be the sum of the computed leakage for each size.

^ To obtain leakage in liters/hour, multiply the values in the table by 3.785.

B. No water line shall be placed in service until the leakage is less than the allowable leakage as indicated above. Testing of water mains shall only be done after installation of all valves, taps and service laterals are complete. All portions of the water system, including hydrants and service lines, shall be subject to hydrostatic pressure during the leakage test. Testing shall be limited to sections of water main of 2,000 feet or less. Testing of water mains shall be observed and documented by PSA Inspector/Engineer.

C. All high points and service lines in portion of system under test shall be vented and all air expelled from system prior to beginning test. All fittings and hydrants shall be properly braced or blocked before applying pressure. Where concrete thrust blocks are used, they shall have attained their final set prior to testing.

D. After section of system under test has reached required pressure as stated above, said pressure shall be maintained for two (2) hours. At conclusion of pressure test, volume of makeup water required to refill pipeline shall be determined by measurement with displacement meter or by pumping from vessel of known volume.

E. All joints or fittings at which leakage occurs shall be reworked to insure tightness. All visible leaks shall be repaired regardless of amount of leakage. If measured amount of leakage exceeds values for the appropriate size as found in AWWA Specification C600, AWWA Specification C605 or Hydrostatic Testing (Table 6), pipeline shall be repaired and retested until leakage is within limit set by the referenced specification. Methods of repair prior to retesting will be done with PSA Director's approval and inspection. Repairs of new construction will be by adjustment or replacement of material only. The use of repair clamps or bell clamps will not be acceptable.

3.4 DISINFECTION OF WATER MAINS

A. General - After testing and before final inspection of the completed systems, water mains and service laterals shall be flushed and disinfected in accordance with AWWA Specification C651 latest revision. Flushing shall be accomplished at a flow velocity of not less than 2.5 feet per second.

B. Disinfection Procedures:

1. Disinfection as described in AWWA C651 - "Placing of calcium hypochlorite tablets" shall be used. Five-gram (5g) calcium hypochlorite tablets with 3.25 gram available chlorine per tablet shall be attached at the inside top of the pipe by an adhesive such as Permute No. 2 or equal. The following number of tablets for the given pipe size shall be used for an initial dose of twenty-five (25 mg/1 (ppm) chlorine:

Pipe Diameter	Number Tablets Per 18-20 Ft. Pipe Section
6"	1
8"	2
10"	3
12"	4
16"	7

or the number of tablets equal to $0.0012d^2L$ rounded to the next higher integer, where d is the inside diameter, in inches, and L is the length of the pipe section, in feet. Use of the continuous feed or slug method of disinfecting may only be used to re-chlorinate a water pipe after the initial disinfection or in other specific cases approved by the PSA Director.

2. Disinfection solution shall remain in pipe line for not less than twenty-four (24) hours, after which time a chlorine residual of 10 ppm at all parts of line shall be required.

3. Pipe shall be re-disinfected by injection of gas or liquid chlorine, if pipe is drained for repairs.

4. Following chlorination, piping shall be thoroughly flushed. Water shall be adequately de-chlorinated prior to discharging to the surface.

5. Water in the new main shall be proven comparable in quality, by testing, to the existing public water supply prior to collection of bacteriological samples. The Virginia Waterworks Regulations require at least two consecutive satisfactory bacteriological samples from distribution system for every 2,000 feet of pipe before system can be placed in service. Bacteriological sample results shall only be valid for 30 days and shall be re-tested if the water main is not taken over and placed into service by the PSA.

6. Developer/Contractor shall pay all costs associated with flushing,

disinfection, testing of installed facilities and any additional bacteriological samples required after first set.

3.5 CONDUCTIVE TRACE (LOCATOR) WIRE CONTINUITY TEST

A. All locator wire shall be tested for proper installation and service upon completion of hydrostatic leak testing. Testing shall be performed to verify that wire is without breaks and suitable for its intended purpose. Any breaks in the wire shall be repaired using proper materials and procedures.

3.6 CARE AND RESTORATION OF PROPERTY

A. Excavating machinery and cranes shall be operated with care to prevent damage to existing structures and/or wires.

B. On paved surfaces, the CONTRACTOR shall not use or operate tractors, bulldozers, or other power-operated equipment and treads or wheels which are so shaped as to cut or otherwise damage such surfaces.

C. All surfaces, which have been damaged by CONTRACTOR'S operations shall be restored to a condition at least equal to that in which they were found immediately prior to beginning of operations. Suitable materials and methods shall be used for such restoration.

D. CONTRACTOR shall replace and repair all lawns, terraces, shrubs, trees, plants, fences, sidewalks, curbs, cross walks, gutters, driveways, or pavements, and repair and make good all other damage, that may occur during construction work. CONTRACTOR will be held responsible for all damage that may occur after pipeline is constructed and which may be directly or indirectly attributed to operations as they are carried out. CONTRACTOR shall not operate equipment or store materials on private property without first having obtained written consent of property owner.

- END OF SECTION -

SECTION 02670

INSTALLATION OF WATER LINES AND SANITARY SEWER LINES BY HORIZONTAL DIRECTIONAL DRILLING (HDD) METHODOLOGY

PART ONE - GENERAL

1.1 DESCRIPTION

A. Work included: Furnish all labor, materials, tools and equipment necessary to provide for installation of HDPE and/or restrained joint C900 PVC water pipe line and gravity sewer pipe line using current horizontal directional drilling technology in accordance with the Drawings and as specified herein.

B. General: This specification defines the approved method and material for the installation of water lines, sewer force mains and gravity sewer lines utilizing horizontal directional drilling technology.

C. Definition: Horizontal directional drilling (HDD) involves utilization of an electronically tracked bore-head to guide the borehole to a pre-designed configuration. The HDD process begins with boring a small, horizontal pilot hole with a continuous string of steel drill rod. When the bore-head and rod emerge on the opposite end of the crossing, a back reamer is attached to the drill rod string and pulled back through the pilot hole. The reamer serves to enlarge the pilot hole to allow the HDPE or restrained joint PVC pipe to be pulled through from the opposite end of the borehole. The size of the drilling equipment and required support equipment shall be determined by the CONTRACTOR based on the diameter and length of pipe to be installed.

1.2 QUALITY ASSURANCE

A. Qualifications of manufacturers: Products used in this Work shall be produced by manufacturers regularly engaged in the manufacture of similar items and with a history of quality production acceptable to the OWNER.

B. Contractor Certification: CONTRACTOR shall be certified by the particular horizontal directional drilling manufacturer that CONTRACTOR is a fully trained user of the drilling equipment.

C. Qualifications of Personnel: HDPE pipe jointing shall be performed by personnel trained in the use of butt-fusion equipment and recommended methods for new pipe connections. Personnel directly involved with installing the new pipe shall receive training in the proper methods for handling and installing the HDPE pipe. Training shall be performed by a qualified representative.

1.3 SUBMITTALS

A. General: All submittals shall be made in accordance with these Specifications. CONTRACTOR shall furnish engineering data covering design and installation. Submittal shall be made in a timely manner so that the project schedule can be met.

B. Shop drawings: As a minimum, the following data and shop drawing information shall be submitted to the OWNER for review and approval:

1. Before beginning work, CONTRACTOR shall submit to the OWNER for approval, the Vendor's shop drawings, catalog data and specific manufacturer's technical data showing complete information on material composition, physical properties, and dimensions of new pipe and fittings. Include manufacturer's recommendations for handling, storage, and repair of pipe and fittings, which are damaged.

2. A certificate of "Compliance with Specification" shall be furnished for all materials supplied.

3. CONTRACTOR shall submit certification of workmen training for all personnel involved in installation of pipe.

4. CONTRACTOR shall submit a work plan to the OWNER for acceptance. Work plan shall address preparation steps required for pre-installation.

5. CONTRACTOR shall submit information to the OWNER for approval of the procedure and the steps to be followed for installation of the HDPE or restrained joint PVC pipe utilizing horizontal directional drilling technology, even if the process is named in the specification. Any proposed changes in installation procedures shall require submittal of revised procedures for acceptance by the OWNER.

6. CONTRACTOR shall submit to the OWNER for approval, full details about component materials and their properties, except those protected by trade secrets which may harm their claim to the product.

1.4 RESPONSIBILITY FOR MATERIALS

A. Material furnished by CONTRACTOR: CONTRACTOR shall be responsible for all material furnished by him and shall replace at his own expense all such material found defective in manufacture or damaged in handling after delivery by the manufacturer. This shall include furnishing of all materials and labor required for the replacement of installed material discovered defective prior to the final acceptance of the work.

B. Material furnished by OWNER: CONTRACTOR'S responsibility for material furnished by the OWNER shall begin at the point of delivery to CONTRACTOR. Materials already on site shall become CONTRACTOR'S responsibility on the date of the award of the Contract. CONTRACTOR shall examine all material furnished by the OWNER at the time and place of delivery to him and shall reject all defective material. Any material furnished by OWNER and installed by CONTRACTOR without discovery of such defects will, if found defective prior to final acceptance of

the Work, be replaced with sound material by the OWNER. CONTRACTOR, however, shall at his own expense, furnish all supplies, labor and facilities necessary to remove said defective material and install sound material in a manner satisfactory to the OWNER.

1.5 PRODUCT HANDLING

A. Handling of materials:

1. All materials furnished by the CONTRACTOR shall be delivered and distributed by the CONTRACTOR. Materials furnished by the OWNER shall be picked up by the CONTRACTOR at points designated by the OWNER and hauled to and distributed at the site.

2. Pipe, fittings, etc., shall be loaded and unloaded by lifting with hoists or skidding so as to avoid shock or damage. Under no circumstances shall such materials be dropped. Pipe handled on skidways shall not be skidded or rolled against pipe already on the ground.

3. In distributing the material at the site of work, each piece shall be unloaded opposite or near the place where it is to be laid in the trench.

4. Pipe shall be so handled that no damage shall occur. If any part of the pipe is damaged, CONTRACTOR shall replace damaged material at his expense in a manner satisfactory to OWNER.

B. Storage of Materials: CONTRACTOR shall be responsible for safe storage of material furnished by or to him, and accepted by him, and intended for the Work, until it has been incorporated in completed Project. Interiors of all pipe, fittings and other accessories shall be kept free from dirt and foreign matter at all times.

C. Damaged Material: Any material furnished by OWNER that becomes damaged by CONTRACTOR after acceptance shall be replaced by CONTRACTOR at his expense.

1.6 COMPLIANCE WITH UNDERGROUND UTILITY DAMAGE PROTECTION ACT

CONTRACTOR shall be responsible for notifying "Miss Utility" a minimum of 48 hours prior to any excavating operations. CONTRACTOR shall be aware of and comply with all provisions of the Virginia Underground Utility Damage Protection Act as enforced by the State Corporation Commission.

1.7 COMPLIANCE WITH VA DEPARTMENT OF TRANSPORTATION STANDARDS

CONTRACTOR shall be aware of and comply with all provisions of the Virginia Department of Transportation (VDOT) as contained in the latest editions of the VDOT Road and Bridge Specifications, VDOT Road and Bridge Standards, VA Work Area Protection

Manual and VDOT Land Use Permit Manual.

1.8 WARRANTY

All equipment and materials supplied under this Section shall be warranted to be free from defects in materials and workmanship for a minimum of one (1) year following acceptance by the OWNER.

PART TWO - PRODUCTS

2.1 MATERIALS:

A. HDPE Pipe: Polyethylene plastic pipe shall be high density polyethylene pipe which meets the applicable requirements of ASTM F714 Polyethylene (PE) Plastic Pipe (SDR-PR) based on Outside Diameter, ASTM D1248, ASTM D3550.

1. Sizes of the pipe to be used for installation of water and sewer lines shall be as directed by the OWNER.

2. All pipe shall be made of virgin material. No rework except that obtained from manufacturer's own production of the same formulation shall be used.

3. The pipe shall be homogenous throughout and shall be free of visible cracks, holes, foreign material, blisters, or other deleterious faults.

4. Dimension Ratios: The minimum wall thickness of the polyethylene pipe shall be as follows:

   Gravity sanitary sewer line: SDR 17
   Sanitary sewer force main: DR-11
   Potable water line: DR-11.

5. For sewer installations pipe material color shall be white, black or whatever is specified with interior of pipe having a light reflective color to enhance viewing for television inspection.

6. Installation Method: HDPE pipe shall be continuously joined with a minimum length, which shall be that deemed necessary by the CONTRACTOR to effectively span the required distance from the inlet to the outlet of the respective pipe, unless otherwise specified. CONTRACTOR shall verify the lengths in the field before manufacturing.

7. Pipe Locator Wire: To facilitate future locating of HDPE pipe, trace wire shall be installed meeting Conductive Trace Wire for Nonmetallic Pipe Installation – Section 02605.

B. PVC Restrained Joint Pipe:

1. PVC pipe meeting the AWWA Specification C900 for dimension ratio

(DR) 14, pressure Class 200, shall be used for water lines. DR-25 pipe may be used for gravity sewer pipe installations. SDR-21 or DR-14 pipe may be used for sanitary sewer force mains. Pipe shall be Certa-Lok C900/RJ restrained joint PVC pipe or approved equal. PVC pipe materials shall be furnished by the OWNER and installed by the CONTRACTOR.

2. PVC pipe shall be installed according to the manufacturer's written instructions for installation by horizontal directional drilling. To facilitate future locating of PVC pipe, trace wire shall be installed meeting Conductive Trace Wire for Nonmetallic Pipe Installation – Section 02605.

3. Pipes shall be joined using non-metallic couplings, which have been designed with the pipe as an integral system for maximum reliability and interchangeability. High-strength, flexible thermoplastic splines shall be inserted into mating precision-machined grooves in the pipe and coupling to provide full, 360-degree restraint with evenly distributed loading at the joint. No external pipe-to-pipe restraining devices, which clamp onto or otherwise damage the pipe surface as a result of point loading shall be permitted. Solvent-weld cement joints shall not be allowed.

2.2 EQUIPMENT

A. Directional Drilling Machine:

1. Directional drilling equipment shall be self-powered and self-contained. Equipment shall be designed and manufactured with an electronically tracked bore-head so as to guide the borehole to a desired configuration, both horizontally and vertically.

2. Directional drilling equipment shall generate sufficient torque and thrust/pullback force to drill a pilot hole, enlarge the pilot hole by back reaming and pull the pipeline back through the enlarged hole.

3. CONTRACTOR shall comply with manufacturers specifications as to the machine size requirement for a given diameter and length of pipe, as well as parameters of the required size machine for percentage of upsize allowed.

B. Vacuum Excavation Unit:

1. Directional drilling operations shall be assisted by use of an adequately sized vacuum excavation system mounted on either a trailer or truck body.

2. Vacuum excavation system shall provide sufficient storage tank capacity and power pack to efficiently remove drilling fluid from the insertion pit during horizontal directional drilling operations.

3. Vacuum excavation system shall be equipped with a high-pressure water system designed to assist with "pothole" excavation operations.

C. Drilling Fluid Management System:

1. Directional drilling operations shall be assisted by use of a truck mounted drilling fluid mixing system.

2. Fluid management system shall include two mixing tanks to allow for flexibility in mixing, transferring and delivering drilling fluid.

3. Fluid management system shall have the capability to transfer between tanks while providing drilling fluid to the directional drilling machine.

2.3 SHIPPING & HANDLING

HDPE and/or PVC pipe materials and fittings shall be protected from kinking and gouging during shipping, handling, and storage.

2.4 MATERIAL TESTING

Tests for compliance with this specification shall be made as specific herein and in accordance with the applicable ASTM Specification. A certificate with this specification shall be furnished, upon request, by the manufacturer for all material furnished under this specification. Polyethylene plastic pipe and fittings may be rejected to meet any requirements of this specification.

PART THREE - EXECUTION

3.1 HORIZONTAL DIRECTIONAL DRILLING OPERATION AND PIPE INSTALLATION

A. Access to the project site:

1. Access to the site of the project under construction shall be primarily by respective pipeline easement and/or existing State road rights-of-way. Access through private property will not be permitted without the explicit written permission of the property owner. Two (2) copies of such written permission shall be given to the OWNER for his review and records. At all locations where the CONTRACTOR desires to enter the easement from a state road, an access approach will be constructed. All construction within the State road right-of-way shall conform to the standards and requirements of the Virginia Department of Transportation.

2. Whenever such access approaches are in use, a flagman shall be posted at the State road. Whenever such access approaches are not in use, a barricade, a chain, fence or gate will be installed to prevent unauthorized and accidental entry to the project site.

3. CONTRACTOR shall not employ those portions of the pipeline easement, which have had pipe line construction completed by others, as an access

route, without express permission from the OWNER in writing.

B. Pre-Installation Preparations: CONTRACTOR's work plan shall address the following minimum preparations/steps, unless approved otherwise by the OWNER.

1. **SAFETY**: The CONTRACTOR shall carry out operations under this section in strict accordance with all applicable OSHA Standards. Particular attention is drawn to those safety requirements involving work on an elevated platform and entry into a confined space. It shall be the CONTRACTOR's responsibility to comply with OSHA Standards and Regulations pertaining to all aspects of the work.

2. **DIVERSION PUMPING**: When required for acceptable completion of the directional drilling and pipe installation process, CONTRACTOR shall provide for continuous sewage flow around section(s) of pipe designated for pipe installation.

   a. By-passing of sewage flow shall be accomplished by use of a diversion pump and piping system. Diversion pump and bypass lines shall be of adequate capacity and size to handle the flow. All costs for by-pass pumping required during installation of the pipe shall be paid in conformance with the respective bid item.

   b. CONTRACTOR shall be responsible for continuity of sanitary sewer service to each facility connected to the section of sewer during execution of the work.

   c. If sewage backup occurs and enters buildings, CONTRACTOR shall be responsible for clean-up, repair, property damage cost and claims.

C. Installation Procedures - General: All approved installation instructions and procedures submitted shall be carefully followed during installation. OWNER shall provide all grade profiles and field stakeout required for pipe centerline grade and offsets. Any proposed changes in installation procedures shall require submittal of revised procedures and acceptance by the OWNER.

1. Equipment used to perform the work shall be located as far away from buildings as possible. Provide enclosed, insulated power packs for all mechanical equipment to reduce machine noise, as required to meet local requirements.

2. CONTRACTOR shall install all pulleys, rollers, bumpers, alignment control devices and other equipment required to protect existing structures, and to protect the pipe from damage during installation. Lubrication shall be used as recommended by the manufacturer. Under no circumstances will the pipe be stressed beyond its elastic limit.

D. Pipe Joining of HDPE Pipe:

1. HDPE pipe shall be assembled and joined at the site using either the butt-fusion or electro-fusion method to provide a leak proof joint. Threaded or solvent-cement joints and connections shall not be permitted. All equipment and procedures used shall be used in strict compliance with the manufacturer's recommendations. Fusing shall be accomplished by personnel certified, as fusion technicians, by a manufacturer of polyethylene pipe and/or fusing equipment.

2. Butt-fused joint shall be true alignment and shall have uniform roll-back beads resulting from the use of proper temperature and pressure. Joint shall be allowed adequate cooling time before removal of pressure. Fused joint shall be watertight and shall have tensile strength equal to that of the pipe. All joints shall be subject to acceptance by the OWNER and/or his representative prior to insertion. All defective joints shall be cut out and replaced at no cost to the OWNER. Any section of the pipe with a gash, blister, abrasion, nick, scar, or other deleterious fault greater in depth than ten percent (10%) of the wall thickness, shall not be used and must be removed from the site. However, a defective area of the pipe may be cut out and the joint fused in accordance with the procedures stated above. In addition, any section of pipe having other defects such as concentrated ridges, discoloration, excessive spot roughness, pitting, variable wall thickness or any other defect of manufacturing or handling as determined by the OWNER and/or his representative shall be discarded and not used.

3. Terminal sections of pipe that are joined within the insertion pit shall be connected with a full circle pipe repair clamp or equal. Butt gap between pipe ends shall not exceed one-half (½) inch. Also Unicore Plastic Fusion System, unicore can be used to butt fuse the sewer pipe material.

E. Connection of HDPE Pipe to Fittings: HDPE Pipe shall be joined to ductile iron fittings, valves and fire hydrants in strict compliance with manufacturer's recommendations.

1. HDPE Mechanical Joint adapters shall be either butt-fused or electro-fused to the HDPE pipe to provide a leak proof joint in compliance with Specification Section 02670-3.1-D. Ductile iron fitting, gate valve or fire hydrant shall be bolted to the M.J. adapter in compliance with the manufacturer's recommendations.

2. HDPE pipe may be joined directly to ductile iron fittings, valves and fire hydrants by the use of Mega-Lug joint restraints, or approved equal, in strict compliance with the manufacturer's recommendations. Stainless steel insert pipe stiffeners shall be used with all such connections.

3. Ductile iron fittings, valves and hydrants with integral HDPE stub-outs shall

be either butt-fused or electro-fused directly to the HDPE pipe in compliance with Specification Section 02670-3.1-D. All gate valves with integral HDPE stub-outs of 4" or smaller size shall incorporate an HDPE valve foundation to prevent operating torque being transferred from the valve to the pipe connections.

F. Pipe Joining of Restrained Joint PVC Pipe:

1. Restrained joint PVC shall be assembled and joined at the site using non-metallic couplings designed with the pipe as an integral system. Pipe and coupling shall be restrained using high-strength, flexible thermoplastic splines inserted into mating precision-machined grooves in the pipe and coupling. Threaded or solvent-cement joints and connections shall not be permitted.

G. Field Testing of Sewer Pipe:

1. For sewer pipe installation pipe shall be internally inspected with a television camera and videotape as required. Finished tape shall be continuous over the entire length of the sewer between two manholes to be free from visual defects.

2. Defects, which may affect the integrity or strength of the pipe in the opinion of the OWNER, shall be repaired or the pipe replaced at CONTRACTOR's expense.

3. Service Reconnection:

a. Once installation of sewer pipe has been completed, CONTRACTOR shall reconnect existing live service connections. These services shall be reconnected by one of the approved methods listed in Paragraph D-3e below.

b. All sewer service connections shall be identified and located prior to pipe insertion operations to expedite reconnection. Upon commencement of pipe installation, pipe insertion shall be continuous and without interruption from one manhole to another, except as approved by the OWNER and/or his representative. Upon completion of installation of new sewer pipe, CONTRACTOR shall expedite reconnection of services so as to minimize any inconvenience to customers.

c. Installed pipe shall be allowed manufacturer's recommended amount of time, but not less than four (4) hours, for cooling and relaxation due to tensile stressing prior to any reconnection of service lines, sealing of the annulus or backfilling of the insertion pit. Sufficient excess length of new pipe, but not less than four (4) inches, shall be

allowed to protrude into the manhole to provide for occurrence of pipe relaxation.

d. Following relaxation period, the annular space may be sealed. Sealing shall be made with material approved by the OWNER and/or his representative and shall extend a minimum of eight (8) inches into the manhole wall in such a manner as to form a smooth, uniform, watertight joint.

e. Sewer service connections shall be connected to new pipe by various methods that are compatible with the new HDPE sewer pipe. If a saddle is used, that saddle once secured in place, drill a hole full inside diameter of saddle outlet in pipe liner.

e1.) Mechanical saddles shall be made of polyethylene pipe compound that meets the requirements of ASTM D1248, Class C, have stainless steel straps and fasteners, neoprene gasket and backup plate. Mechanical saddles shall be Strap-On-Saddle Type as manufactured by Driscopipe or approved equal. (800-527-0662).

e2.) Inserta-Tee Connection by Fowler Manufacturing (503) 357-2110 shall also be allowed to be used. Also approved is the Unicore Plastic Fusion System (705) 876-6400 that uses butt-fusion to connect a tee or prefabricated polyethylene saddle or equivalent to sewer pipe material.

4. Finished Pipe

a. Installed sewer pipe shall be continuous along entire length of each pipe segment from manhole to manhole and shall be free from visual defects such as foreign inclusions, concentrated ridges, discoloration, pitting, and other deformities.

b. Pipe with gashes, nicks, abrasions, or any such physical damage, which may have occurred during storage and/or handling and which are larger/deeper than 10 percent (10%) of the wall thickness shall not be used and shall be removed from the construction site.

c. Sewer pipe passing through or terminating in a manhole shall be carefully cut out in a shape and manner approved by the OWNER. Installed sewer pipe shall meet the leakage requirements of the pressure test as specified. HDPE or PVC pipe within the manhole shall be neatly cut off at least a minimum of 4" away from manhole wall. The invert in the manhole shall be a smooth continuation of the pipe(s) and shall be merged with other lines, if any. Channel cross-section shall be U-shaped with a minimum height of half pipe diameter to three-fourths of pipe diameter for fifteen inch and larger.

The side channels shall be built up with mortar/concrete to provide benches at a maximum of 1 in 12 pitch towards the channel.

d. All manholes shall be individually inspected for water migration, cutoffs, benches, and invert works.

5. Process Limitations:

Though installation process may be licensed or proprietary in nature, CONTRACTOR **SHALL NOT** change any material, thickness, design values or procedural matters stated or approved in SUBMITTALS, without OWNER's prior knowledge and pre-approval.

3.2 TESTING OF SEWER PIPE

A. General: Testing will be required after the pipeline has been installed between manholes. Test shall consist of a low-pressure air test of the sewer pipe before any service connections to the new installed pipe have been made. The purpose of this test is to check the integrity of the pipe and to verify that the pipe has not been damaged during operations when pulling it through the borehole space created by directional drilling.

B. Plugging of Test Section: After a manhole-to-manhole section of sewer pipe has been lined, it shall be plugged at each manhole with pneumatic plugs. Design of the plugs shall be such that they will hold against the test pressure without requiring external blocking or bracing. One of the plugs shall have three air hose connections, one for inflation of the plug, one for reading of the pressure into the sealed line and one for introducing air into the sealed line.

C. Low Pressure Test:

1. Test section shall be pressurized to 4 PSI and held above 3.5 PSI for not less than two (2) minutes. Air shall be added if necessary to keep the pressure above 3.5 PSI. At the end of this two (2) minute stabilization period, the pressure shall be noted (must be 3.5 PSI min.) and the time period shall begin. If the pressure drops 0.5 PSI in less time than given in Table 2, the section of pipe shall have failed the test.

2. When prevailing groundwater is above the sewer liner pipe being tested, test pressure shall be increased 0.43 PSI for each foot that the water table is above the invert.

SEWER SIZE (Inches)	**MINIMUM TEST TIME** (Minutes)
8	4
10	5
12	6
15	7.5
18	7.5

3. If the time for the pressure to drop 0.5 PSI is 125% or less of the time given in the table, the line shall immediately be re-pressurized to 3.5 PSI and the test repeated.

4. Pressure gauges used shall be supplied by the CONTRACTOR and have minimum divisions of .010 PSI.

D. Post Televising of Completed Sections: CONTRACTOR shall provide to OWNER a color video tape showing the completed work, including condition of the restored service connection. Video shall be taken by a pan and tilt radial viewing pipe inspection camera, that pans +/-275 degrees and rotates 360 degrees. Camera shall have an accurate footage counter, which shall display on the monitor the exact distance of the camera from the centerline of the starting manhole.

E. Restoration of Project Area: Upon completion of the installation work, testing, and televising, CONTRACTOR shall restore/clear the project area affected by his operations. No trash, rubbish, etc., shall be stored at any site whether the work is in progress or not.

3.3 TELEVISION INSPECTION OF SEWER LINE:

A. General: Television inspection of sewer pipelines shall be performed by experienced personnel trained in locating breaks, obstacles and service connections by closed circuit color television. Television inspection shall include the following:

1. Video tapes (post installation) to be submitted to the OWNER prior to processing of final invoice.

2. Videotapes to remain property of the OWNER; CONTRACTOR to retain second copy for his use.

3. All flows tributary to reach of sewer being inspected are to be completely by-passed around the reach during video inspection, if necessary and/or required by the OWNER.

4. Post construction videotape footage shall be taken upon completion of reconstruction of each reach of sewer with the voice description, as appropriate, and with stationing of service connections indicated. Data and stationing shall be indicated on video.

5. Should any portion of the inspection tapes be of inadequate quality or coverage, as determined by the OWNER, CONTRACTOR shall have the portion reinspected and video taped at no additional expense to the OWNER.

3.4 HYDROSTATIC TESTS FOR LEAKAGE

A. General:

1. All new water mains shall be tested, after backfilling to a hydrostatic pressure of not less than 100 psi above design water pressure for the system or 150 psi, whichever is greater. Allowable leakage shall be calculated by the following formula and is shown in columnar form in Table 6:

$$L = \frac{SD\sqrt{P}}{133{,}200}$$

Where:
L = allowable leakage in gallons per hour
S = length of pipe tested in feet
D = nominal diameter of pipe in inches
P = average test pressure during leakage test in psi

TABLE 6

Allowable Leakage per 1,000 ft. (305 m) of Pipeline*--gph^

Average Test Pressure PSI (Bars)	NOMINAL PIPE DIAMETER - Inches							
	3"	4"	6"	8"	10"	12"	14"	16"
200 (14)	0.32	0.43	0.64	0.85	1.06	1.28	1.48	1.70
175 (12)	0.30	0.40	0.59	0.80	0.99	1.19	1.39	1.59
150 (10)	0.28	0.37	0.55	0.74	0.92	1.10	1.29	1.47
125 (9)	0.25	0.34	0.50	0.67	0.84	1.01	1.18	1.34
100 (7)	0.23	0.30	0.45	0.60	0.75	0.90	1.05	1.20

*If the pipeline under test contains sections of various diameters, the allowable leakage will be the sum of the computed leakage for each size.

^To obtain leakage in liters/hour, multiply the values in the table by 3.785.

B. No water line shall be placed in service until the leakage is less than the allowable leakage as indicated above. Testing of water mains shall only be done after installation of all valves, taps and service laterals are complete. All portions of the water system, including hydrants and service lines, shall be subject to hydrostatic pressure during the leakage test. Testing shall be limited to sections of water main of 2,000 feet or less. Testing of water mains shall be observed and documented by the Inspector/Engineer.

C. All high points and service lines in portion of system under test shall be vented and all air expelled from system prior to beginning test. All fittings and hydrants shall be properly braced or blocked before applying pressure. Where concrete thrust blocks are used, they shall have attained their final set prior to testing.

D. After section of system under test has reached required pressure as stated above, said pressure shall be maintained for two (2) hours. At conclusion of pressure test, volume of makeup water required to refill pipeline shall be determined by measurement with displacement meter or by pumping from a vessel of known volume.

E. All joints or fittings at which leakage occurs shall be reworked to insure tightness. All visible leaks shall be repaired regardless of amount of leakage. If measured amount of leakage exceeds values for the appropriate size as found in AWWA Specification C600, Hydrostatic Testing (Table 6), pipeline shall be repaired and retested until leakage is within limit set by the referenced specification. Methods of repair prior to retesting will be done with PSA Director's approval and inspection. Repairs of new construction will be by adjustment or replacement of material only. The use of repair clamps or bell clamps will not be acceptable.

3.4 DISINFECTION OF WATER MAINS

A. General - After testing and before final inspection of the completed systems, water mains and service laterals shall be flushed and disinfected in accordance with AWWA Specification C651 latest revision. Flushing shall be accomplished at a flow velocity of not less than 2.5 feet per second.

B. Disinfection Procedures:

1. Disinfection as described in AWWA C651 - "Placing of calcium hypochlorite tablets" shall be used. Five gram (5g) calcium hypochlorite tablets with 3.25 gram available chlorine per tablet shall be attached at the inside top of the pipe by an adhesive such as Permatex No. 2 or equal. The following number of tablets for the given pipe size shall be used for an initial dose of twenty-five (25 mg/1 (ppm) chlorine:

Pipe Diameter	Number Tablets Per 18-20 Ft. Pipe Section
6"	1
8"	2
10"	3
12"	4

or the number of tablets equal to $0.0012d^2L$ rounded to the next higher integer, where d is the inside diameter, in inches, and L is the length of the pipe section, in feet. Use of the continuous feed or slug method of disinfecting may only be used to re-chlorinate a water pipe after the initial disinfection or in other specific cases approved by the PSA Director.

2. Disinfection solution shall remain in pipe line for not less than twenty-four (24) hours, after which time a chlorine residual of 10 ppm at all parts of line shall be required.

3. Pipe shall be re-disinfected by injection of gas or liquid chlorine, if pipe is drained for repairs.

4. Following chlorination, piping shall be thoroughly flushed. Water shall be adequately de-chlorinated prior to discharging to the surface.

5. Water in the new main shall be proven comparable in quality, by testing, to the existing public water supply prior to collection of bacteriological samples. The Virginia Waterworks Regulations require at least two consecutive satisfactory bacteriological samples from distribution system for every 2,000 feet of pipe before system can be placed in service. Bacteriological sample results shall only be valid for 30 days and shall be re-tested if the water main is not taken over and placed into service by the PSA.

6. Developer/Contractor shall pay all costs associated with flushing, disinfection, testing of installed facilities and any additional bacteriological samples required after first set.

3.5 CARE AND RESTORATION OF PROPERTY

A. All heavy equipment shall be operated with care to prevent damage to existing structures and/or wires.

B. On paved surfaces, the CONTRACTOR shall not use or operate tractors, bulldozers, or other power-operated equipment the treads or wheels of which are so shaped as to cut or otherwise damage such surfaces.

C. All surfaces which have been damaged by the CONTRACTOR'S operations shall be restored to a condition at least equal to that in which they were found immediately prior to the beginning of operations. Suitable materials and methods shall be used for such restoration.

D. Restoration of existing property or structures shall be done as promptly as practicable and shall not be left until the end of the construction period.

3.6 PROTECTION OF EXISTING STRUCTURES, PRIVATE PROPERTY, AND RIGHTS-OF-WAY

A. All existing pipes, poles, wires, fences, curbing, property-line markers, and other structures which, in the opinion of OWNER must be preserved in place without being temporarily or permanently relocated, shall be carefully supported and protected from injury by CONTRACTOR, and in case of injury, CONTRACTOR shall notify the appropriate party so that proper steps may be taken to repair any and all damage done. When the owners do not wish to make the repairs themselves, all damage shall be repaired by CONTRACTOR, or, if not promptly done by him, OWNER may have the repairs made at expense of CONTRACTOR.

B. The CONTRACTOR shall consult the OWNER or his representatives prior to removing or disturbing any tree, shrub, bush, fence, sidewalk, building structure, or improvement that may be encountered in the line of the sewer line or in the path of the easement, or right-of-way secured by the OWNER. Immediately upon

completion of sewer line rehabilitation through each piece of private property, the CONTRACTOR shall replace the sod, lawns, bushes, shrubs, or whatever else may have been removed, disturbed or altered during the progress of the work.

3.7 PAYMENT

A. The installed pipe shall be paid for per linear foot of the size pipe specified and shall include all pipe bedding, backfill material, annulus sealing material and launching pits. Locating and reconstruction of services and all reconnections of services shall be paid for per each connection made, including fittings and pipe.

1. The work performed as prescribed by this item will be paid at the hourly rates for labor and equipment required to install water or sanitary sewer pipe installed by horizontal directional drilling for the specified pipe diameter and location, which price shall be full compensation for installation of the new pipe, placing of all materials, labor, tools, equipment, cleaning, and any other operations necessary to complete the project.

B. All costs for testing, television inspection and by-pass pumping the pipe after installation shall be considered incidental to the cost of the project.

C. All other payments shall be made as per bid items. No payment shall be made for work considered incidental or complimentary to a pay item already in bid. The contractor shall clarify, for his own benefit, all work required for any item, incidental or otherwise, prior to bidding.

- END OF SECTION -

SECTION 02731

SANITARY SEWER COLLECTOR LINES AND FORCE MAIN

PART ONE - GENERAL

1.1 DESCRIPTION

A. Work included: Furnish all labor, materials, tools and equipment necessary to install, backfill and test all sanitary sewer collector lines and associated structures in accordance with the Drawings and as specified herein.

B. Related work specified elsewhere:

1. Clearing and Grubbing - SECTION 02110
2. Rock Excavation - SECTION 02230
3. Erosion and Sediment Control - SECTION 02270
4. Stream and/or Highway Crossings – SECTION 2310
5. Conductive Trace Wire for Nonmetallic Pipe Installation – Section 02605
6. Installation of Water Lines and Sanitary Sewer Lines by Horizontal Directional Drilling (HDD) Methodology – SECTION 02670
7. Seeding and Mulching - SECTION 02900

1.2 QUALITY ASSURANCE

A. Qualifications of manufacturers: Products used in this Work shall be produced by manufacturers regularly engaged in the manufacture of similar items and with a history of quality production acceptable to the OWNER.

B. Qualifications of installers: Use experienced workmen to ensure proper installation of the products specified herein. In the acceptance or rejection of installed Work, no allowance shall be made for the lack of experience on the part of the workmen.

1.3 SUBMITTALS

A. Shop drawings: As a minimum, the following shop drawing information shall be submitted to the OWNER for review and approval:

1. Complete bill of materials to be provided for the work described under this Section.

2. Manufacturer's catalog cuts for all materials to be provided under this Section.

1.4 RESPONSIBILITY FOR MATERIALS

A. Material furnished by CONTRACTOR: The CONTRACTOR shall be responsible for all material furnished by him and shall replace at his own expense all such

material found defective in manufacture or damaged in handling after delivery by the manufacturer. This shall include the furnishing of all materials and labor required for the replacement of installed material discovered defective prior to the final acceptance of the work.

B. Material furnished by OWNER: The CONTRACTOR'S responsibility for material furnished by the OWNER shall begin at the point of delivery to CONTRACTOR. Materials already on the site shall become the CONTRACTOR'S responsibility on the date of the award of the Contract. The CONTRACTOR shall examine all material furnished by the OWNER at the time and place of delivery to him and shall reject all defective material. Any material furnished by the OWNER and installed by the CONTRACTOR without discovery of such defects will, if found defective prior to final acceptance of the Work, be replaced with sound material by the OWNER. The CONTRACTOR, however, shall, at his own expense, furnish all supplies, labor and facilities necessary to remove said defective material and install the sound material in a manner satisfactory to the OWNER.

1.5 PRODUCT HANDLING

A. Handling of materials:

1. All materials furnished by the CONTRACTOR shall be delivered and distributed by the CONTRACTOR. Materials furnished by the OWNER shall be picked up by the CONTRACTOR at points designated by the OWNER and hauled to and distributed at the site.

2. Pipe, manholes, etc., shall be loaded and unloaded by lifting with hoists or skidding so as to avoid shock or damage. Under no circumstances shall such materials be dropped. Pipe handled on skidways shall not be skidded or rolled against pipe already on the ground.

3. In distributing the material at the site of work, each piece shall be unloaded opposite or near the place where it is to be laid in the trench.

4. Pipe shall be so handled that any coating and lining shall not be damaged. If, however, any part of coating or lining is damaged, repair shall be made by CONTRACTOR at his expense in a manner satisfactory to the OWNER.

B. Storage of materials: The CONTRACTOR shall be responsible for the safe storage of material furnished by or to him, and accepted by him, and intended for the Work, until it has been incorporated in the completed Project. The interior of all pipes, fittings and other accessories shall be kept free from dirt and foreign matter at all times.

C. Damaged material: Any material furnished by OWNER, that becomes damaged by the CONTRACTOR after acceptance, shall be replaced by CONTRACTOR at his expense.

1.6 WARRANTY

All equipment and materials supplied under this Section shall be warranted to be free from defects in materials and workmanship for a minimum of one (1) year following acceptance by the OWNER.

PART TWO - PRODUCTS

2.1 STRUCTURAL REQUIREMENTS

A. Structural Design of Sewers: Structural design of sewers shall conform to the methods given in the ASCE Manual Number 37 - "Design and Construction of Sanitary and Storm Sewers". In the use of this manual, backfill weight shall equal 130 pounds per cubic feet and K_u shall be 0.130. The live load for sewers subject to traffic effect shall be determined from a minimum wheel load equivalent to an H-20 loading (16,000 pound wheel load). An allowance of fifty percent (50%) of the design wheel load shall be added for impact. A minimum wheel load of 10,000 pounds per wheel shall be applied to all other sewers not subject to traffic load. Ultimate lengths of rigid pipe shall be measured in terms of ultimate three-edge bearing strength divided by a safety factor of 1.5. Allowable load shall be working strength times a 2.5 load factor for concrete cradle or arch bedding and times a 1.9 load factor for Class B gravel bedding condition.

2.2 SEWER PIPE AND MATERIALS

A. General: All sanitary sewer pipe installed on this project shall conform to the type, classification, and sizes as shown on the Drawings and as described in the Specifications. The pipe materials listed below have been approved for use. However, the acceptability of specific pipe material for use within a specific soil type or condition shall be determined by the PSA Director on an individual basis at the time of design review of the Contract Documents. The type or types of pipe allowed for use on any specific project shall be shown on the approved construction drawings.

1. One type and class of pipe shall be used from manhole to manhole unless approved in writing by the PSA Director. Any changes in size, kind, type and class of pipe being installed shall be made at manholes only.

2. Pipe plugs shall be of the same material as the pipe. The cost of furnishing and placing pipe plugs shall be included in the unit prices bid for furnishing and installation of pipe and pipe stubs.

3. To facilitate future locating of sanitary sewer pipe, trace wire shall be installed meeting Conductive Trace Wire for Nonmetallic Pipe Installation – Section 02605.

B. Pipe Material:

1. Ductile Iron Pipe: Ductile iron pipe shall be centrifugally cast manufactured in accordance with ANSI Specification A21.51, latest revision, and shall be internally lined with material specifically designed for use with sanitary sewer applications. Slip joint or mechanical joint pipe shall be used for gravity sewers. Slip joint pipe shall be designed in accordance with ANSI standard A21-50 and specified according to ANSI standard A21-11. Class 51 pipe shall be minimum strength used in all sewer applications. May only be used upon approval of PSA Director. Gaskets shall be furnished by the manufacturer and installed in accordance with his recommendations. Ductile iron pipe shall be used in exposed pipe installations, and where approved by the PSA Director when other pipe materials are subject to crushing.

2. Polyvinyl Chloride (PVC): PVC sewer pipe shall be manufactured in accordance with ASTM Designation 3034-77 (SDR 35). Gravity sewer pipe shall be unplasticized polyvinyl chloride with integral rubber ring wall bell and spigot joints furnished in 12.5' and 20' nominal lengths. Installation of PVC gravity sewer pipe and fittings shall be in accordance with ASTM Designation 2321 and manufacturer's recommendations.

   a. PVC sewer pipe shall be stored in accordance with manufacturer's recommendations on flat, even surfaces and shall remain racked on the pallets as delivered to the job site until such time as the trench is ready for placement of the pipe; i.e., PVC pipe shall not be strung out on the job site in excess of one day's work.

   b. The PSA Director may require additional strength PVC pipe including SDR-26, SDR-21, DR-18 or concrete encasement of SDR-35, or both where depth exceeds twelve feet (12') and where additional protection is required for the pipe.

   c. To facilitate future locating of sanitary sewer pipe, trace wire shall be installed meeting Conductive Trace Wire for Nonmetallic Pipe Installation – Section 02605.

3. PVC (Ribbed Pipe): Ultra-Rib pipe meeting ASTM F-794 with a stiffness factor of 46 may be used. Installation of both shall be in strict compliance with manufacturer's written instructions. All fittings used shall be designed specifically for pipe used and be approved for use by same manufacturer of pipe. Connections to manholes shall be made by manufacturer's recommended methods and approved by PSA Director.

   a. To facilitate future locating of sanitary sewer pipe, trace wire shall be installed meeting Conductive Trace Wire for Nonmetallic Pipe Installation – Section 02605.

4. PE Pipe: Polyethylene plastic pipe shall be high density polyethylene pipe

which meets the applicable requirements of ASTM F714 Polyethylene (PE) Plastic Pipe (SDR-PR) based on Outside Diameter, ASTM D1248, ASTM D3550.

a. All pipe shall be made of virgin material. No rework except that obtained from manufacturer's own production of the same formulation shall be used.

b. The pipe shall be homogenous throughout and shall be free of visible cracks, holes, foreign material, blisters, or other deleterious faults.

c. Dimension Ratios: The minimum wall thickness of the PE pipe used as gravity sewer line shall be a minimum of SDR 17. Additional strength pipe material may be required for deep sewer lines.

d. For sewer installations pipe material color shall be white, black or whatever is specified with interior of pipe having a light reflective color to enhance viewing for television inspection.

e. PE pipe for sewer installations of four inch (4") diameter or larger shall be straight pipe sections of 40' or shorter. Rolled pipe is not approved for use in PSA systems.

f. All service line connections to PE pipe shall be made using a fused service saddle. No direct tap to PE pipe shall be permitted.

g. PE pipe shall be assembled and joined at the site using the butt-fusion method to provide a leak proof joint. Threaded or solvent-cement joints and connections shall not be permitted. All equipment and procedures used shall be used in strict compliance with the manufacturer's recommendations.

h. Butt-fused joint shall be true alignment and shall have uniform roll-back beads resulting from the use of proper temperature and pressure. Joint shall be allowed adequate cooling time before removal of pressure. Fused joint shall be watertight and shall have tensile strength equal to that of the pipe. All joints shall be subject to acceptance by the OWNER and/or his representative prior to insertion. All defective joints shall be cut out and replaced at no cost to the OWNER. Any section of the pipe with a gash, blister, abrasion, nick, scar, or other deleterious fault greater in depth than ten percent (10%) of the wall thickness, shall not be used and must be removed from the site. However, a defective area of the pipe may be cut out and the joint fused in accordance with the procedures stated above. In addition, any section of pipe having other defects such as concentrated ridges, discoloration, excessive spot roughness, pitting, variable wall thickness or any other defect of manufacturing or handling as determined by the OWNER and/or his representative

shall be discarded and not used.

i. To facilitate future locating of sanitary sewer pipe, trace wire shall be installed meeting Conductive Trace Wire for Nonmetallic Pipe Installation – Section 02605.

5. Sanitary Sewer Force Main: Sanitary sewer force main shall be constructed of SDR-21 PVC pipe, AWWA C900 DR-14 PVC pipe or Class 51 ductile iron pipe with sewer specific lining and joined with push-on joints as indicated on Drawings. High-density polyethylene (HDPE) DR-11 pipe is also acceptable for sewer force mains. HDPE pipe joints shall be connected using heat fusion, electrofusion, thermal welding and flanges in conformance with manufacturer's recommendations.

a. To facilitate future locating of sanitary sewer pipe, trace wire shall be installed meeting Conductive Trace Wire for Nonmetallic Pipe Installation – Section 02605.

b. All valves, fittings, and other related appurtenances shall be rated for a minimum working pressure of 150 lbs. per square inch (PSI). Sewer force mains using PVC pipe shall be C900 D-18 PVC for four inches (4") and larger in diameter and SDR-21 PVC pipe for force mains two and three inches (2" & 3") in diameter.

c. All pipes shall be laid to a minimum depth of thirty-six inches (36") from established final grade to the top of the pipe. Sewer force mains shall not be laid at depths exceeding five (5') feet unless specifically approved by the PSA Director.

C. Air Release Valve: Force main Universal, Combination or vacuum/air release valve shall be Crispin Model S20 or equal with a 1/2" orifice and 2-inch screened inlet furnished with backflushing attachment.

D. Bedding: Bedding, haunching, and initial backfill construction shall be in accordance with the manufacturer's recommendation. All PVC pipe shall be bedded in compacted granular material. Haunching of pipe shall be accomplished with compacted granular bedding, which shall extend at minimum to the spring line of the pipe barrel. Granular material shall be well-graded, crushed stone meeting the requirements of VDOT gradation 57 or 68 stone.

E. Service Connections: Polyvinyl chloride (PVC) sewer pipe conforming to ASTM Designation 3034-77 (SDR-35); or Schedule 40 PVC pipe conforming to ASTM Designation 1785-76 shall be used between the sewer main and the cleanout. SDR-21 PVC pipe shall be used where additional strength pipe is required.

1. The PVC SDR 35 joints shall be made with bonded-in-bell elastomeric seal. Schedule 40 PVC joints shall be made with a solvent weld bell and spigot joint using PVC pipe cleaner and glue as supplied by the manufacturer.

2. No-hub pipe shall not be permitted.

3. There shall be no bends in service line from main to cleanout except as indicated on approved PSA Sewer Detail Drawings.

4. Branch sewer force main (service or public force main) connections to a primary force main (public force main) shall include an isolation valve and check valve on the branch sewer force main.

5. All sewer service lines in the public easement or public road right-of-way that will be maintained by the PSA shall be a minimum of six inches (6") in diameter.

6. To facilitate future locating of sanitary sewer service connections, trace wire shall be installed meeting Conductive Trace Wire for Nonmetallic Pipe Installation – Section 02605.

F. Hydraulic Cement Mortar and Gravel: Cement mortar and grout shall consist of a mixture of hydraulic cement, fine aggregate, water and admixture.

1. Cement shall be Portland Cement Type I or II.

2. Fine Aggregate Grade C shall be used.

3. Water used with cement or lime shall be clean, clear, and free of oil, acid, salt, alkali, organic matter or other deleterious substances.

4. Admixtures shall conform to Section 217 of VDOT Specifications.

5. Hydraulic cement mortar and grout shall contain from 3 to 7 percent entrained air. Air entrained cement may be used in lieu of plain cement and air entraining admixture. Mortar and grout shall be mixed with a minimum amount of water necessary to obtain required consistency. Mortar and grout shall be properly cured and protected for not less than three (3) days.

a. **Cement Mortar** shall consist of one part hydraulic cement, 2 1/2 parts fine aggregate by weight and sufficient water to produce a stiff mix. Grade C Fine Aggregate shall be used.

b. **Non-Shrink Mortar** shall consist of one part hydraulic cement, 2 1/2 parts fine aggregate by weight, a set retardant or other admixture which will reduce the amount of required mixing water and sufficient water to produce a stiff mix. Grade C Fine Aggregate shall be used.

c. **Cement Grout** shall consist of one part hydraulic cement, 2 parts

fine aggregate by weight and sufficient water to produce a free flowing mix. Grade A fine aggregate shall be used.

d. **High Strength Grout and Mortar** shall consist of a prepackaged, non-shrink hydraulic cement mixture with a 7-day compressive strength of at least 4,000 psi when tested in accordance with ASTM C109 and with a 7-day bond strength of at least 1,000 psi when tested in accordance with VTM-41, except that epoxy will not be used to develop the bond.

PART THREE - EXECUTION

3.1 GENERAL REQUIREMENTS

A. Contractor shall provide all labor, equipment and material and perform all work required for installation of sewer lines, manholes and appurtenances as outlined on Drawings and on Specifications, all of which become part of the Contract Documents.

B. All construction of sanitary sewer mains and appurtenances in PSA systems shall be in strict accordance with plans and specifications prepared as part of the Contract Documents and as approved by the PSA Director. All materials shall be new and unused. Prior to construction of the approved sanitary sewer, Contractor shall provide field stakeout including adequate line and grade stakes in order that sanitary sewer and appurtenances may be constructed in accordance with Contract Drawings.

C. Engineer or surveyor shall prepare legible cut sheets at all manholes and midpoints of pipe between manholes indicating all pertinent construction data to include sewer service connection locations, concrete encasement or cradle, manhole invert and top (frame and cover elevations). Three sets of all cut sheets shall be submitted to the PSA for review.

D. If any deviation is contemplated in location or line grade of any sewer, structure or appurtenance as shown on the Contract Drawings, a revision of the Drawings showing the proposed deviation shall be submitted to the PSA Director for review and approval before any changes are constructed. Design Engineer of Record must concur in any revision of drawings. Minor field changes may be made with approval of PSA field inspector.

E. Contractor shall contact Miss Utility by telephoning 811 at least 48 hours prior to any excavating operations. Contractor shall be responsible for determining exact location and depth of all underground utilities, which are shown on the Drawings or marked on the ground. Contractor shall exercise care in determining the location of any underground utility to avoid damaging or disrupting utility service. If Contractor inadvertently damages any utility line or cable, he shall be responsible for immediately contacting the affected utility company and repair, or have repaired, the damage at his expense. Contractor shall at all times be subject to the provisions of

the Virginia Underground Utility Damage Prevention Act.

F. Should Contractor discover and/or damage any underground utility facilities, which are not shown on Drawings and/or marked on the ground, Contractor shall promptly notify utility owner and Owner's project representative. Relocation of any utilities shall be approved and coordinated with the appropriate utility owner.

3.2 EXCAVATION

A. Excavation shall conform to the lines and grades shown on the plans. The width of excavation for trenches shall be a minimum of 24" plus the outside diameter of the pipe. Excavation shall not be carried below the established grades and any excavation below the required level shall be backfilled with suitable, thoroughly compacted granular bedding material. Contractor shall install all sheeting, bracing, and shoring necessary to perform the work, to protect existing structures and all excavations as required under Virginia OSHA Regulations. Compliance with provisions of the Overhead High Voltage Line Safety Act is required.

B. Dewatering equipment shall be sized to maintain the trench in a satisfactory de-watered condition suitable for pipe laying and backfilling. Pipe laying will be permitted only where the depth of water is maintained below the bedding material. Bedding material shall not be placed on unstable trench material.

C. Not more than one hundred fifty feet (150') of trench shall be opened in advance of the completed pipe laying. Trench walls shall be protected in accordance with current OSHA regulations. Excavation at manholes and similar structures shall provide a minimum clearance of eighteen inches (18") between the outer surface of the structure and the embankment or sheeting.

D. Rock excavation: Rock excavation, when needed, shall be defined and performed in accordance with Section 02230 - ROCK EXCAVATION. All blasting operations shall be in accordance with existing ordinances and regulations. Where excavation is made in fractured rock or boulders, no rock shall remain nearer than six inches (6") to any part of the sewer pipe when laid, nor shall rock project beyond the lines and grades of masonry structures. No blasting shall be performed within forty feet (40') of a tested or completed sewer. The ends of sewers adjacent to blasting shall be covered to avoid receiving debris.

E. Wherever foundation material is unsuitable, it shall be excavated until a stable foundation is achieved. Granular material, VDOT stone type 21A, shall then be placed in six inch (6") layers and compacted until the trench bottom has been stabilized. Standard granular pipe bedding material shall be placed in accordance with Section 2.2-D of these Specifications.

3.3 BACKFILL

A. Backfill shall begin at the top of the standard granular bedding and shall be placed in six inch (6") layers for the initial one foot over the pipe and shall be thoroughly

tamped to ninety-five percent (95%) of the maximum theoretical compaction density as determined by a standard proctor on the material. Remainder of the backfill shall be in two foot (2') layers properly tamped.

B. Backfill material shall be free of perishable material, frozen clods, sticky masses of clay and other unsuitable matter. Rock pieces larger than one inch (1") shall not be used in the backfill which is within two feet (2') of the pipe. No rock over five inches (5") in its greatest dimension shall be used in any backfill. Manholes and cleanouts shall be backfilled in same manner as the sewer pipe. Backfill material shall not be dropped directly on the pipe from a height greater than three feet (3').

C. Backfill in areas not subject to vehicular traffic shall be compacted to such a degree that any subsidence will not be objectionable or detrimental to normal use. Backfill and replacement in existing or proposed roads shall be executed in full accordance with the requirements of the Virginia Department of Transportation Standards. All surplus materials excavated, but not used in backfill, shall be disposed of in approved areas provided by the Contractor.

3.4 PIPE INSTALLATION

A. All gravity sewer mains, service laterals and force mains shall have a minimum cover of three feet (3') as measured from top of pipe to finish grade. The PSA Director may require additional cover as needed for pipe protection. Sewers, which have a depth of cover less than three feet (3'), shall be approved and installed as per PSA Director's written instructions.

B. All pipe and fittings shall be carefully handled with non-metallic slings or other approved devices to prevent damage to protective coatings or joints. Lifting equipment shall be satisfactorily rated to handle the pipe sizes used. Pipe shall not be dumped or dropped into trench. Each section of pipe shall be thoroughly inspected for defects before being lowered into the trench.

C. Pipe shall be laid true to line and grade with bells upstream and shall be jointed together such that the completed pipe will have a smooth invert. Pipe shall be pushed home by hand. The use of equipment (i.e. backhoe) shall not be permitted. Cutting of pipe shall be performed by sawing. Standard bedding shall be shaped to the curvature of both the bell and barrel of the pipe. The trench shall be kept free of water while the work is in progress. The ends of the pipe shall be cleaned so that proper joints can be made. As the work progresses, the interior of the pipe shall be cleared of dirt, cement, or other deleterious material.

D. Except as required for use of a laser level, exposed end of all pipe and fittings shall be fully closed to prevent earth, water or other substances from entering pipe. Trench shall be completely backfilled at end of each workday. When new pipe is tied into an existing manhole, new pipe shall be plugged with a standard sewer plug and shall remain plugged until all new line(s) that will flow to existing manhole have been completed, tested, and accepted.

3.5 BY-PASS PUMPING DURING SEWER LINE INSTALLATION

A. Contractor shall be responsible at all times for maintaining sewer flows during project to include any required by-pass pumping of wastewater between manholes during installation of sewer lines and/or manholes. By-pass pumping system shall provide continuous full conveyance and containment of wastewater present during the work and shall not surcharge the upstream (suction) manhole by more than two (2) feet above the manhole invert.

B. Contractor shall furnish all pumps, pipe, fittings, plugs, etc. required to perform by-pass pumping operation. Backup or replacement pumping equipment shall be available to the project site to ensure that continuous by-pass pumping can be provided. All pumping equipment shall be provided with sufficient mufflers to prevent excessive noise.

C. Authorization from the ENGINEER shall be required to utilize by-pass pumping overnight or during the weekends. In the event it is not possible to temporarily reconnect sewer lines at the end of the work day or over week-ends, Contractor shall be responsible for continuous attendance, operating and maintaining by-pass pump operations around the clock to insure continued conveyance of existing wastewater flows.

D. By-pass pumping shall not be diverted to another sanitary sewer system without the approval of the ENGINEER.

E. A by-pass pumping plan shall be submitted for approval prior to beginning the work. This plan shall outline the by-pass pumping procedures and include the capacity and components of all by-pass pumping equipment.

3.6 TRENCH DEWATERING DURING SEWER LINE INSTALLATION

A. All ground water which may be found in the trenches and any water which may get into them from any cause whatsoever shall be pumped or bailed out so that the trench shall be dry during the pipe laying period. No water shall be permitted to reach concrete until it has set sufficiently. All water pumped from the trenches shall be disposed of in a manner satisfactory to the OWNER. CONTRACTOR shall provide at least two (2) pumps for each trench opened in wet ground and at the same time, he shall have one (1) pump in reserve.

B. If, during any time that CONTRACTOR is permitted to lay pipe in a trench containing unavoidable trench water and construction is interrupted for any reason, the open ends of pipe shall be closed by watertight plugs or caps, or other means approved by the OWNER. In any case, such protection shall be provided when work is suspended overnight or on weekends and holidays, regardless of the condition of the trench with respect to water at the time that the work is suspended.

C. CONTRACTOR shall be responsible for the protection of all structures, including pipes and manholes, against any tendency to float under conditions of high water,

whether due to high ground water or flood conditions on the project site. It shall be the responsibility of the CONTRACTOR to take whatever steps may be required, including the installation and operation of pumps and pumping systems, well points or relief devices, to prevent any structure from floating during construction.

D. Cost of the necessary pumps, well points or other appurtenances required to prevent flotation shall be included in the unit prices bid in the Proposal for the various bid items, and no extra compensation shall be allowed for such work. Any damage which may occur to any part of the work as the result of the flotation effect of ground or flood waters shall be repaired in a manner fully satisfactory to the OWNER, at no additional cost to the OWNER.

E. CONTRACTOR shall provide and place all necessary flumes or other channels of adequate size to carry temporarily all streams, brooks, stormwater or other water, which may flow along or across the lines of the pipe line. All flumes or channels thus utilized shall be tight so as to prevent leakage into the trenches. Water pumped from trenches shall be led to natural watercourses. Existing sewers shall not be employed as a drain for the removal of dewatering wastes.

3.7 SEPARATION OF WATER LINES AND SANITARY SEWERS

A. General - The following factors shall be considered to provide adequate separation:

1. Materials and types of joints for water and sewer pipe;
2. Soil conditions;
3. Service branch connections into the water line and sewer lines;
4. Compensating variations in the horizontal and vertical separations;
5. Offsetting of pipes around manholes.

B. Parallel Installation

1. Normal Conditions - Water lines shall be laid at least ten feet (10') horizontally from a sewer line whenever possible, distance shall be measured edge-to-edge unless determined by PSA Director to be unusual conditions.

2. Unusual Conditions - When local conditions prevent a horizontal separation described above, the following construction shall be used:

a. Bottom (invert) of water main shall be at least eighteen inches (18") above top (crown) of sewer.

b. Where this vertical separation cannot be obtained, sewer shall be constructed of AWWA approved water pipe, hydrostatically pressure tested in place without leakage prior to backfilling. Pressure test shall be 30 psi.

c. Sewer manhole shall be made 100% water-tight construction and

tested in place by vacuum testing to top of manhole cover frame without leakage for 30 minutes.

C. Crossing

1. Normal conditions - water lines crossing over sewers shall be laid to provide a separation of at least eighteen inches (18") between the bottom of the water line and the top of the sewer whenever possible.

2. Unusual conditions - when local conditions prevent a vertical separation as described above, the following construction shall be used:

   a. Sewers passing over or under water lines shall be constructed of AWWA approved water pipe, hydrostatically pressure tested in place without leakage prior to backfill. Pressure test shall be 30 psi.

   b. Length of sewer pipe shall be centered at the point of the crossing so that joints shall be equidistant and as far as possible from water line.

3. Water lines passing under sewers shall, in addition, be protected by providing:

   a. Vertical separation of at least eighteen inches (18") between invert of sewer and crown of water line. Sewer shall be encased along its length where it is within 10' of water line.

   b. Adequate structural support for sewers to prevent excessive deflection of joints and settling on and breaking of the water line.

   c. Length of water line shall be centered at the point of the crossing so that joints shall be equidistant and as far as possible from sewer.

D. Sewers or Sewer Manholes. No water pipes shall pass through or come in contact with any part of a sewer manhole.

3.8 SERVICE CONNECTIONS

A. SDR 35 and schedule 40 PVC pipe lateral service connections to the sewer main shall be made by means of a commercially manufactured tee, wye, or wye branch. Service laterals may also be connected to the sewer system at a manhole using inside drop connection. A sewer cleanout the same size as the service line shall be installed in accordance with the Detail Drawings. Pipe material shall be of the same type to and including the cleanout stack.

B. All taps to an existing manhole or pipe shall be supervised or performed by the PSA. A minimum of 48 hours notification is required by the PSA when scheduling sewer taps.

C. Sewer service line shall be a minimum of six inches (6") for residential service and non-residential service. Sewer cleanouts shall be same size as service line and shall be installed per Sewer Detail drawing. Additional sections of pipe shall be installed behind cleanout as indicated on detail drawings to prevent conflict with other utilities generally located in this area.

D. Sewer service connections from manhole or sewer main to the cleanout shall be installed with the same care as the sewer main. Proper excavation, slope of pipe and standard granular bedding shall be provided throughout. All gravity sewer mains and service laterals shall be air tested. For air testing procedures see Section 3.13-C.

E. No connection shall be made to the vertical portion of a cleanout except for private force main. Refer to Sewer Detail Drawings for specific requirements including the use of Schedule 40 material.

F. All sewer service connections or portions of sewer service connections outside of the public right-of-way or sewer easement shall be privately owned and maintained.

G. A sampling manhole, which conforms to Detail Drawings, shall be installed on sewer service lateral for all non-residential facilities. Manholes may be installed at property line in lieu of cleanout or between cleanout at the property line and the facility. Sampling manholes shall be tested by either vacuum method or exfiltration.

3.9 TRAPS/SEPARATORS

A. Grease traps, volatile liquid separators, or other such devices may be required by the PSA Director on non-residential facilities where, due to the nature of their operation, it is deemed necessary.

B. Grease trap or volatile liquid separator is to be located externally in a manner so that all discharges from the kitchen plumbing except garbage grinders, pass through the grease trap or volatile liquid separator prior to entering the sanitary sewer; all other domestic waste water shall by-pass the grease trap.

C. Grease trap or volatile liquid separator designs shall be reviewed on an individual basis during the plan review process. A minimum capacity of 500 gallons or 30 minutes of peak flow storage shall be provided per each grease trap.

D. Adequate access for inspection and maintenance of grease trap or volatile liquid separator is to be provided. Owner of facility served by a grease trap or volatile liquid separator shall be responsible for proper operation and maintenance.

3.10 MANHOLES

A. Only precast manhole sections shall be used. Manholes shall be constructed with manhole frames, covers and steps. Frames and covers shall be East Jordan Models 1045Z and 1040AGS or equivalent per Detail Drawings. Covers for use in areas subject to flooding and/or sewer surcharging shall have "cam bolt" locking system

to secure the cover to the frame. All covers shall have a minimum of two cored pickbars for ease of lifting per Detail Drawing.

B. Casting shall be best quality tough, gray iron, free from defects, blow holes, and other imperfections and shall meet the requirements of AASHTO Designation 306-05. The castings shall be sound, free to form and thickness, cleaned by means of sand blast and neatly finished. The material bearing surfaces shall be machine ground and finished to insure satisfactory seating. Covers shall have the words "Sanitary Sewer" cast into the top. Castings shall receive one coat of black asphaltum paint at the factory.

C. Covers shall be furnished with means of lifting. Covers that rock under normal load, will be rejected. Frames shall be bolt-down type, with butyl mastic sealer placed between frame and manhole. Mortar shall not be permitted. Frames shall have a nut and washer installed on top and bottom to facilitate minor elevation adjustments. The adjustment space between the bottom of the frame and the top of the manhole section shall be formed and filled with 3000 psi concrete.

D. Steps for manholes shall be made of fiberglass construction, cast iron, or steel and shall have a plastic coating. Steps shall be spaced a maximum of 16 inches (16") and a minimum of 12 inches (12") apart. The bottom step shall be within 24 inches (24") of the bottom of the manhole.

E. Precast concrete manholes shall consist of precast reinforced concrete sections, an eccentric conical section and a standard base section with poured uniform bottom inverts. Flat top manholes can be used only with approval of PSA Director. Where soil conditions dictate their use, expanded base section, extending a minimum of four inches (4") and a maximum of eight inches (8") beyond the outside vertical wall (riser section) of the manhole shall be used. Manhole shall be installed with steps vertically aligned over manhole bench. Access hole in flat top manhole section shall be centered over manhole steps.

F. Manholes shall have a minimum inside diameter of four feet (4'). Manholes over fifteen feet (15') in total depth (lowest invert to top of cover) shall be 5' in diameter. Larger diameter manholes shall be provided for inside drop connections and where required by the PSA Director. Manholes larger than 5' in diameter shall have the reducing slab or reducing cone installed just below the frame or standard cone section. Manholes deeper than 20 feet shall have safety slabs installed every 10 feet.

G. Precast base section shall be installed on a compacted stabilized foundation of bedding material foundation prepared similar to that required for the proper installation of the adjacent sewer pipe as described elsewhere in these Specifications.

H. Precast manhole sections shall be manufactured in accordance with ASTM Designation C478, latest revision. Each section shall have not more than two (2) holes for the purpose of handling and setting. These holes shall be tapered and shall be plugged up with rubber stoppers and an approved non-shrink grout after

installation. Exterior surfaces of all concrete manhole sections shall have two coats (minimum 16 dry mils) of coal tar epoxy, Koppers Co. Bitumastic 300-M or equal.

I. A cold applied butyl mastic joint sealer manufactured specifically for the purpose shall be used to make a watertight joint between manhole sections and/or grade rings. Mortared joints are not permitted. All new manholes shall be pre-cast concrete inverts except straddle manhole. All straddle manhole and all field-constructed inverts shall be with ready mix (3000 psi) concrete and shall only be used with approval of PSA Director.

J. Standard manhole drop connections shall be installed where indicated on the drawings. Drop connections shall conform to the Detail Drawings.

K. The invert channels of the manhole shall be smooth and semi-circular in shape conforming to the inside of the adjacent sewer section. Changes in direction of flow shall be made with a smooth curve of as large a radius as the size of the manhole will permit. Invert benches shall be constructed of ready mix concrete (3,000 psi) over the entire existing bench. Inverts for extra strength pipe sections shall be specifically constructed for the pipe to insure smooth flow transitions.

L. The invert channel shall be at least 0.75 times the diameter of the pipe in depth. The minimum difference in elevation of inverts of incoming and outgoing pipes shall be 0.10 feet.

M. Where grade rings are required to meet specified grade, the maximum height/thickness and minimum number of rings shall be used. Cone sections and grade rings may be predrilled with matching holes to accept threaded rod installation or drilled in the field. Refer to Detail Drawings.

N. Manhole vents shall be installed at intervals of no more than 1,000 feet in all sections of sanitary sewers with watertight covers. See Detail Drawings for configuration and materials.

3.12 PIPE CONNECTION AT MANHOLES

A. All new manholes shall be supplied with an approved flexible boot connection suitable for specified pipe and manhole. All rubber boots for 8 inch (8") pipe shall have a maximum flexibility of 24° in any direction from center. Boot flexibility for pipe sizes larger than 8 inch (8") shall be per the manufacturer's recommendations. Twenty inch (20") and larger pipe connections shall have the first joint located four feet (4') from the inside face of the manhole. Flexible joint manhole connection shall be as manufactured by Pres-Seal Gasket Corporation, Fort Wayne, IN; or approved equal.

B. Manhole to pipe installation procedures shall be as follows:

1. After manhole has been set to line and grade, inspect flexible connector boot

for damage and clean out inside of boot. Clean surface of pipe barrel to be installed.

2. Insert pipe into connector boot until end of pipe breaks plane of manhole wall and flush with manhole invert. Position pipe in center of connector.

3. Install take-up clamp(s) in groove(s) at pipe receiving end of boot and tighten clamps to 60 in/lbs. of torque **PRIOR** to adjusting pipe to desired angle of deflection.

4. After desired deflection angle of pipe has been achieved, install bedding and backfill material in accordance with these Specifications.

5. Grout, cement or concrete **SHALL NOT** be placed in the inside or outside of the manhole boot section. The manhole boot must provide a flexible connection.

C. Precast manhole sections shall be manufactured for the specified size, angle and number of pipe connections required. Specialty cast manhole pipe opening and boots shall be provided when the pipe slope exceeds twelve percent (12%). Field modification or abandonment of any part of a precast manhole will not be permitted without written approval of the PSA Director. Any approved field modification(s) or repairs shall be performed by a qualified person(s) approved by the manufacturer.

D. Inside of manholes (walls, steps, invert, pipe connections, benches) and frame and cover shall be kept clean and free of dirt, stone, mastic, trash and construction materials. Manholes shall be cleaned prior to testing.

E. Abandonment of manholes and sewer lines shall be performed in accordance with the Detail Drawings.

F. A rubber water stop shall be used around pipe at manhole connection of straddle manhole. Refer to Detail Drawings.

3.13 ACCEPTANCE TESTS

A. General

1. Sewers will be inspected to determine if any deviation from line and grade have occurred. Pipe alignment will be checked by illuminating interior of pipe. If pipe shows poor alignment, displaced pipe, or any defect, including a visible leak, defect shall be corrected before leak testing of the pipe. All sewer lines are subject to internal inspection and testing by closed circuit TV at PSA Director's discretion.

2. Air testing shall be used, test methods and acceptability criteria shall be in accordance with the Uni-Bell low pressure air test. Air testing of gravity

lines shall be required for all types of pipe and materials.

B. Manhole Acceptance Tests

1. Manholes, including frame, shall be tested by vacuum testing from the top of the frame. Inflatable stoppers shall be used to plug all lines into and out of the manhole being tested including any vent line. The stoppers shall be positioned in the lines far enough from the manhole to insure testing to those portions of the lines not air tested. Vacuum tests shall be made with a vacuum of 10" Hg. The time for the vacuum to drop from 10" to 9" of Hg must be greater than 60 seconds.

2. Contractor shall furnish weirs, stand pipes, pipe plugs, water, pressure gauges, stop watches, air compressor, vacuum pump, hose and such materials and assistance as required to perform these tests. All acceptance tests shall be conducted by Contractor in the presence of a PSA Inspector.

3. Acceptance tests shall not be made until sanitary sewer, manholes and proposed sewer service connections, as shown on the approved sewer plans, have been installed, the sewer trenches (including manholes and cleanout stacks) backfilled and compacted to finished sub-grade.

4. Contractor shall schedule all acceptance tests with the project inspector at least forty-eight (48) hours in advance. No sewers or sewer service connections are to be excluded from this testing procedure.

5. Manholes which fail to maintain the stipulated vacuum for the time period specified shall be deemed to have failed the vacuum test and is unsatisfactory for acceptance by the OWNER. Repairs shall be made by replacing the butyl mastic joint sealer between the manhole sections. Coatings of any type **SHALL NOT** be applied on the inside of the manhole. Coatings of the outside of the manhole shall only be allowed upon approval of a waiver request by the PSA Director. Any manhole that fails to pass this test **shall be replaced by the Contractor at his expense**.

C. Sewer Pipe Testing Procedures

1. Whenever it is necessary to construct underdrains or place gravel under pipe lines in order to dewater trench during construction of sewers, acceptance test will not be made until any pumps, which have been used in dewatering process, have been disconnected or drains have been taken out of service.

2. Contractor shall schedule all acceptance tests with PSA Director at least forty-eight (48) hours in advance. Each section of completed sewer shall be tested. Generally, sewers will be tested from manhole to manhole. No sewer or sewer service connection is to be excluded from this testing procedure.

3. Low Pressure Air Testing Procedure - The test procedure shall be conducted in the following manner: (Vacuum test of manholes is generally inverse of low pressure air test of sewer lines)

a. Contractor shall thoroughly clean and remove all debris, silt, earth or other materials from the sewer prior to acceptance testing.

b. Proper test plugs shall be supplied and installed by Contractor. Test gauges used in air test procedure shall have a range of 0-10 psi and shall be calibrated in divisions of 0.10 psi with an accuracy of +/- one percent. Test gauges shall be calibrated at least once a year and the date and results displayed on the equipment including date of calibration. Calibrations shall be certified by an independent testing lab. Test gauges shall be located outside of manhole during testing.

c. If pipe to be tested is expected to be below ground water table, Contractor shall either:

- Install a small diameter perforated vertical pipe from invert elevation of the sewer to the surface prior to backfilling; or
- Insert a pipe probe by boring or driving into the backfilling material adjacent to the invert elevation of the pipe, and determine the depth of the ground water level above the pipe invert immediately prior to acceptance testing the sewer.
- All gauge pressures for test shall be increased by the amount of this back pressure due to ground water over the invert of the pipe.
- In lieu of the above water depth determination, Contractor may add three (3) psi to the gauge pressure in the test.

d. Contractor shall add air slowly to the portion of the pipe under test until the internal air pressure is raised to 4.0 psi gauge plus the ground water pressure.

e. As a safety precaution, no one shall be allowed in manhole after air pressure is increased in the sewer line. If the inspector suspects that the test plug may be leaking, pressure shall first be relieved before any adjustments are made to eliminate air leakage at the plug.

f. Contractor shall allow air temperature to stabilize for at least two (2) minutes with the pipe subjected to an internal pressure of 4.0 psi by adding only the amount of air required to maintain the pressure.

g. After temperature stabilization, the test will begin. If the internal air pressure decreases, the time required for the pressure to drop from

3.5 to 2.5 psi gauge will be observed and recorded. The time interval shall be compared with the established standards in accordance with Detail Drawings for time and length of test section for various diameters of the sewer. All pipes 15 inches or less shall be tested for a pressure drop of 1.0 psi gauge.

h. Pipe which fails to maintain the stipulated pressure for a period equal to or greater than the holding time shown in Table I shall be deemed to have failed the low pressure air test and is unsatisfactory for acceptance by the OWNER. Any sewer that fails to pass this test **shall be replaced by the Contractor at his expense**. A single coupling or pair of repair clamps shall be allowed between manholes to facilitate replacement of defective materials or workmanship. "Fernco" flexible couplings SHALL NOT be used on new sections of sewers except upon approval of a waiver request by the PSA Director.

4. Sewer Force Main Testing Procedure – Sewer force mains shall be hydrostatically tested at 150% of the design operating pressure or a minimum pressure of 50 psi for 30 minutes. Allowable leakage shall be the same as established for water pipe lines in the PSA Water and Sewer Regulations.

3.14 CARE AND RESTORATION OF PROPERTY

A. Excavating machinery and cranes shall be operated with care to prevent damage to existing structures and/or wires.

B. On paved surfaces, the CONTRACTOR shall not use or operate tractors, bulldozers, or other power-operated equipment the treads or wheels of which are so shaped as to cut or otherwise damage such surfaces.

C. All surfaces which have been damaged by the CONTRACTOR'S operations shall be restored to a condition at least equal to that in which they were found immediately prior to the beginning of operations. Suitable materials and methods shall be used for such restoration.

D. CONTRACTOR shall replace and repair all lawns, terraces, shrubs, trees, plants, fences, sidewalks, curbs, cross walks, gutters, driveways, or pavements, and repair and make good all other damage that may occur during construction work. CONTRACTOR will be held responsible for all damage that may occur after pipeline is constructed and that which may be directly or indirectly attributed to operations as they are carried on. CONTRACTOR shall not operate his equipment or store materials on private property without first having obtained written consent of Property Owner.

E. CONTRACTOR'S attention is directed to importance of maintaining closed fences

and/or gates on all property thus protected at present. In the event that fences are encountered in the line of the Project, or along rights-of-way, temporary fences shall be installed by CONTRACTOR before removal of existing fences. Temporary fences shall be installed totally on the Project easement near appropriate boundary of the right-of-way. Such temporary fence shall be of like quality and design as fence being replaced, and shall be maintained by CONTRACTOR in efficient condition until replaced by him with replacement fence. After construction has progressed beyond location of temporary fence, temporary fence shall be removed and permanent replacement fence, of quality and design at least equal to that existing, shall be erected on easement, in same location(s) as before construction.

F. Wherever, with Property Owner's written permission, it is necessary that gates in fenced lands be opened, or used periodically, the CONTRACTOR shall use special caution to prevent the escape of, or damage to, livestock, horses, or other property thus now protected, including the installation of cattle-guard devices, if necessary.

G. Damage to, or loss of, fenced property, real, live or other, shall be totally the responsibility of CONTRACTOR, and CONTRACTOR shall save harmless the OWNER and OWNER from any and all claims arising out of such damage or loss.

H. No additional compensation shall be allowed for temporary fences, the cost of which shall be included in respective unit price bid in proposal for various depths and sizes of pipe installed. Upon completion of the sewer construction, CONTRACTOR shall replace all the permanent fences on the rights-of-way or adjacent private property with fences of comparable type, size and construction as the original fences. No additional compensation shall be allowed for replacement of permanent fences, the cost of which shall be included in respective unit price bid in proposal for various depths and sizes of pipe installed.

I. Compensation for replacement of lawns, ornamental shrubs, etc. and any additional work arising by reason of construction of sewer on private property and right-of-ways shall be included in respective unit price bid for various depths and sizes of pipe and appurtenances installed.

J. Restoration of existing property or structures shall be done as promptly as practicable and shall not be left until the end of the construction period.

3.15 PROTECTION OF EXISTING STRUCTURES, PRIVATE PROPERTY, AND RIGHTS-OF-WAY

A. All existing pipes, poles, wires, fences, curbing, property-line markers, and other structures which, in the opinion of the OWNER must be preserved in place without being temporarily or permanently relocated, shall be carefully supported and protected from injury by CONTRACTOR, and in case of injury, CONTRACTOR shall notify the appropriate party so that proper steps may be taken to repair any and all damage done. When owners do not wish to make the repairs themselves, all damage shall be repaired by CONTRACTOR, or, if not promptly done by him,

OWNER may have repairs made at expense of CONTRACTOR.

B. All utility services shall be supported by suitable means so that the services shall not fail when tamping and settling occurs. The CONTRACTOR must cover same in the unit price bid for sewer line construction.

C. CONTRACTOR shall not be compensated for any additional work involved if utilities or underground structures cross trench line transversely above or below the sewer line.

D. CONTRACTOR shall consult OWNER or his representatives prior to removing or disturbing any tree, shrub, bush, fence, sidewalk, building structure, or improvement that may be encountered in the line of the sewer line or in path of the easement, or right-of-way secured by the OWNER. Immediately upon completion of laying of necessary pipe, fittings, and appurtenances through each piece of private property, CONTRACTOR shall backfill the trench, tamping same in a careful and workmanlike manner, replacing sod, lawns, bushes, shrubs, or whatever else may have been removed, disturbed or altered during progress of the work.

- END OF SECTION -

SECTION 02900

SEEDING AND MULCHING

PART ONE - GENERAL

1.1 DESCRIPTION

A. Work included:

1. Preparation of ground, seeding, protection and cleanup of Work areas designated for grading and seeding operations.

2. Disking and harrowing of ground for seeding purposes where grade is undisturbed by construction unless otherwise specified.

3. Proper protection of seeded, disturbed, or a combination of both, areas from erosion.

B. Areas responsible for:

1. All areas within the construction easement.

2. All areas disturbed by the Contractor and his personnel during construction of project under contract.

C. Related work described elsewhere:

1. Erosion and Sedimentation Control - Section 02270

1.2 QUALITY ASSURANCE

A. Selection of materials:

1. The selection of all materials required from Drawings and Specifications shall be subject to the Engineer's approval.

2. The Engineer shall have the right to reject any and all materials, which do not meet the Specification requirements or are not otherwise satisfactory at any stage of operations.

3. The Contractor shall remove all rejected materials immediately from the site at no additional cost to the Owner.

B. Execution of the Work:

1. The execution of all grading, seeding and other operations required under

Drawings and Specifications shall be subject to Engineer's approval.

2. The Engineer shall have the right to reject any and all methods of operations found unacceptable for the Work required.

PART TWO - PRODUCTS

2.1 FERTILIZER

Grade 10-10-10 fertilizer, uniform in composition, free-flowing, and suitable for application with approved equipment, shall be provided. Deliver fertilizer to the site in bags or other convenient containers, each fully labeled, conforming to applicable commonwealth or state fertilizer laws, and bearing the name, trade name or trademark, and warranty of the producer.

2.2 LIMESTONE

Furnish agricultural-grade limestone ground to pass an 8-mesh sieve with 25% passing a 100-mesh sieve. In addition, calcareous limestone shall contain not less than 50% calcium oxide, and dolomitic limestone shall contain not less than 40% magnesium oxide. Coarser materials may be acceptable provided the specified rates of application are increased proportionately, on the basis of quantities passing the 8- and 100-mesh sieves, but no additional payment shall be made for increased quantity.

2.3 MULCH

Furnish threshed straw of cereal grain such as oats, wheat, barley, rye, rice, etc. or grass hay. Materials that contain objectionable weed seeds or other species that might be detrimental to planting being established or to adjacent farmland shall not be acceptable.

2.4 SEED

A. Furnish seed labeled Virginia CERTIFIED or APPROVED, unless written exception is granted. Furnish seed in sealed, standard containers unless written exception is granted. Seed that is wet or moldy or that has been otherwise damaged in transit or stage shall not be acceptable.

B. Mixtures: Furnish seed of the Kentucky 31 Tall Fescue type. Application rate shall be 220 lbs. per acre or 5 lbs. per 1,000 sq. ft.

2.5 SOIL FOR REPAIRS

For fills and topsoiling areas to be repaired, soil shall be of at least equal quality to existing in areas adjacent to the area to be repaired. Soil used shall be free from roots, stones, and other materials that hinder grading, planting, and maintenance operations and free from objectionable weed seeds and toxic substances.

2.6 TOPSOIL

Topsoil stockpiled under other sections of these Specifications shall be utilized and shall contain no rocks or lumps 2" in greatest dimension. If stockpiled topsoil is unavailable, the Contractor shall import the soil, subject to Engineer's approval.

2.7 WATER

Water shall be free from oil, acid, alkali, salt, and other substances harmful to growth of grass, and shall be from a source approved prior to use by Engineer.

PART THREE - EXECUTION

3.1 GENERAL

A. Area and requirements of Work: All disturbed ground areas within limits of construction shall be graded, topsoiled, tilled, fertilized, limed, seeded, and mulched. For cut and fill areas which consist of primarily rock or rough rock/soil, topsoiling, and tilling shall be waived.

B. Equipment: Provide equipment in good condition for the proper ground preparation and for hauling and placing of materials. Equipment shall be approved before work is started.

3.2 PREPARATION OF GROUND SURFACE

A. Clearing: Prior to grading and tilling, vegetation that may interfere with operations shall be moved and grubbed; remove collected material from site, or when suitable, used material for mulch as approved by Engineer. Clear surface of stumps, roots, cable, wire, rocks or lumps greater than 2", and other materials that might hinder Work or subsequent maintenance.

B. Grading: Maintain previously established grades on the areas to be treated in a true and even condition; make necessary repairs to previously graded areas. Where grades have not been established, grade areas as shown on Drawings, and leave all surfaces in an even and properly compacted condition to prevent formation of depressions. Finished grade shall be such that after subsequent treatments, i.e. tillage, topsoiling, and planting, planted grade shall join 1 inch below adjoining surfaced grade of walks and drives.

C. Tillage: After areas required to be treated have been brought to grades shown, till soil to a depth of at least 3 inches by plowing, disking, harrowing, or other approved operations until condition of soil is acceptable. Perform Work only during periods

when, in Contractor's or Engineer's opinion, beneficial results are likely to be obtained. When drought, excessive moisture, or other unsatisfactory conditions prevail, Work shall be stopped when directed. Level undulations or irregularities in surface before next specified operation.

D. Topsoiling:

1. Distribute topsoil uniformly and spread evenly to a settled thickness of 4 inches. Spread topsoil so that planting can proceed with little additional soil preparation or tillage.

2. Level surface irregularities resulting from topsoiling or other operations to prevent depressions. Adjust grade to assure that planted grade will be 1 inch below adjoining grade of any surfaced area in accordance with requirements of Paragraph 3.2, B.

3. Topsoil shall not be placed when subgrade is frozen, excessively wet, extremely dry, excessively compacted, or in a condition detrimental to proposed planting or grading.

4. Pulverize soil compacted by construction equipment or soil on compacted cut slopes or grades to a minimum depth of 2 inches by disking or plowing before applying topsoil.

E. Fertilizing:

1. Distribute fertilizer uniformly at a rate of 25 pounds per 1,000 square feet over areas to be seeded, and incorporate it into soil to a depth of at least 3 inches by disking, harrowing, or other acceptable methods. Incorporation of fertilizer may be part of operation specified in Paragraph 3.2, C.

2. If liquid fertilizer is used, apply it in amounts sufficient to provide the same value of nutrients per unit of surface area specified for dry fertilizer. If a liquid fertilizer is used in a hydroseeder, apply material on a poundage basis mixed with same volume of water used with dry fertilizer.

3. Use of approved hydraulic equipment or seed drill equipped to sow seed and distribute fertilizer at the same time shall be acceptable.

F. Liming: Immediately following or simultaneously with incorporation of fertilizer, distribute limestone uniformly at a rate of 80 pounds per 1,000 square feet, and incorporate it into soil to a depth at least 3 inches by disking, harrowing, or other acceptable methods. Incorporation of limestone along with fertilizer may be part of the operation specified in paragraph 3.2. C.

G. Leveling: Level surface irregularities resulting from tillage, fertilizing, liming, or other operations before seeding.

3.3 PLANTING SEED

A. General: Sow seed between dates of April 15 and May 30 or August 15 and October 1, unless otherwise directed in writing.

1. Employ a satisfactory method of sowing, using approved mechanical power-drawn drills or seeders, mechanical hand-seeders, hydraulic seeders, or other approved methods. When drills are used, provide markers or other means to ensure that successive seeded strips will overlap or be separated by a space no greater than equipment row spacings.

2. When delays in operations extend Work beyond the most favorable planting season for species designated or when conditions are such by reason of drought, high winds, excessive moisture, or other factors that satisfactory results are not likely to be obtained, halt Work as directed and resume only when conditions are favorable or when approved alternate or corrective measures and procedures have been effected.

3. If inspection during seeding operations or after there is show of green indicates that strips wider than space between rows planted have been left unplanted, or other areas skipped, sow additional seed at no additional cost to Owner.

B. Broadcast seeding: Broadcast seed either by hand or with approved hydraulic seeding equipment, as specified hereinbefore, in combination with fertilizer, or with other approved sowing equipment at the rate shown under Paragraph 2.4, B.

1. Distribute seed uniformly over designated areas.

2. Sow half of seed with sower moving on one direction.

3. Seed shall be covered to an average depth of 1/4" by brush harrow, spike-tooth harrow, chain harrow, cultipacker, hand rake, or other approved device.

4. Seed shall not be broadcast during windy weather.

3.4 COMPACTING

A. Equipment: Immediately after the seeding operation has been completed, the surface shall be compacted by a cultipacker, roller, or other approved equipment weighing 100 to 160 pounds per linear foot of roller.

1. When planting by machine, the roller shall be operated immediately behind the planter unless otherwise directed. Under certain soil conditions, the Engineer may direct that rolling be delayed for 15 to 30 minutes following planting to avoid balling the soil on the roller or squeezing water out of

furrows.

2. If the soil is of such type that a smooth or corrugated roller cannot be operated satisfactorily, a pneumatic-tired roller, not wobble-wheel, shall be used. A roller having tires of sufficient size shall be used, or sufficient passes of the roller shall be made, to cover the soil surface completely.

3.5 MULCHING

A. Conditions: Straw or hay mulch shall be spread uniformly in a continuous blanket, using 100 pounds per 1,000 square feet.

B. Equipment: Mulch shall be spread by hand or by a manure spreader, a blower-type mulch spreader, or other suitable equipment.

C. Method:

1. Mulching shall be started at the windward side of relatively flat areas, or at the upper part of a steep slope, and continued uniformly until the area is covered. The mulch shall not be bunched.

2. Immediately following spreading, the mulch shall be anchored to the soil by a V-type wheel land packer, a scalloped-disk land packer designed to force mulch into the soil surface, or other suitable equipment.

3. The number of passes needed, not to exceed three, shall be determined by the Engineer.

3.6 WATERING

A. Water shall be delivered in a manner that will ensure that the upper 6" of the soil surface is moistened. Distribution shall be at an even rate and in a manner to prevent erosion.

B. Watering equipment of a type that prevents damage to finished surface shall be used.

3.7 ESTABLISHMENT AND MAINTENANCE

A. General: Protection shall be provided against traffic or other use by erecting barricades immediately after treatment is completed, and by placing warning signs, as directed, on various areas. Contractor shall assume responsibility for proper care of seeded areas while grass is becoming established for three months after completion of treatment on the entire project, unless desired cover is established in a shorter period of time and the Engineer shortens the responsibility period. When any portion of the surface becomes gullied or otherwise damaged or treatment is destroyed, the affected portion shall be repaired to re-establish condition and grade of soil and treatment prior to injury, as directed. Repair work required because of

faulty operations or negligence on the part of the Contractor shall be performed without additional cost.

B. Postplanting fertilization: From 40 to 60 days after seeding or planting, Grade 10-10-10 fertilizer shall be applied uniformly at a rate of 15 pounds per 1,000 square feet over areas seeded or planted. Fertilizer conforming to physical condition, packaging, and marking as specified shall be provided. Fertilizer shall be applied when grass blades are dry to minimize burning. When water is available, the planted area shall be irrigated to thoroughly moisten the upper 6" of the soil surface after the fertilizer is applied. Engineer shall designate areas needing further refertilization at least 15 days before application is required.

C. Reseeding: The Engineer shall designate areas requiring reseeding at least 15 days before the period specified for reseeding. Seed specified shall be drilled at 4 pounds per 1,000 square feet, in a manner that will cause minimum disturbance to existing stand of grass, and at an angle of not less than 15 degrees from direction of previously seeded rows.

D. Mulching: Mulched areas shall be maintained until all work or designated portions thereof have been completed and accepted. Any damage shall be repaired, and mulch material that has been removed by wind or other causes shall be replaced and secured.

END OF SECTION