



WATER SYSTEM STANDARDS

AND

SPECIFICATIONS

PREPARED BY:

PLANNING/ENGINEERING DIVISION

GRAND STRAND WATER AND SEWER AUTHORITY

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JULY 2019

**WATER SPECIFICATIONS
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CHAPTER 1

DEFINITIONS, ABBREVIATIONS, AND GENERAL

1.1 INTERPRETATION OF CERTAIN TERMS OR WORDS

Except as specifically defined herein, all words used in these standards have their customary dictionary definitions. For the purposes of this policy, certain words or terms used herein are defined as follows:

1.1.1 Words used in the present tense include the future tense. Words used in the singular include the plural and words used in the plural include the singular.

1.1.2 The work “**shall**” is always mandatory.

1.1.3 The word “**may**” is permissive.

1.1.4 The work “**lot**” includes the work “**plat**” or “**parcel**”.

1.1.5 The work “**person**” includes a firm, association, organization, partnership, trust company, or corporation as well as an individual.

1.2 DEFINITIONS

1.2.1 AUTHORITY

The Board of Directors of the Grand Strand Water and Sewer Authority is the governing Authority.

1.2.2 DHEC

Department of Health and Environmental Control of the State of South Carolina.

1.2.3 LOT

A part of a subdivision, or parcel of land used as a building site or intended for such use, immediate or future.

1.2.4 UTILITY RIGHT-OF-WAY/EASEMENT

Private right-of-ways or easements for Authority utilities shall not be deemed dedicated to the Authority but for use of the authority’s utilities.

1.2.5 PUBLIC RIGHT-OF-WAY/EASEMENT

Public Right-of-Way or Easement's are considered to mean street right-of-ways or any other public right-of-ways.

1.2.6 ENGINEER

A person registered as a Professional Engineer in good standing with the South Carolina Board of Engineering Examiners.

1.2.7 LAND SURVEYOR

A person registered as a Land Surveyor by the South Carolina Board of Engineering Examiners.

1.2.8 SUBDIVISION

The division of a tract of land into two or more lots for the purpose, whether immediate or future, of sale, legacy, or development. This includes all division of land involving a new street or a change in the arrangement of streets and includes any re-subdivision of land. Subdivision shall also refer to uses of land not ordinarily considered a subdivision but requiring utility installations. Examples of these non-subdivision uses are mobile home parks, multifamily projects, townhouses, and planned unit developments.

1.2.9 DEVELOPER

Any person, firm, corporation, or other legal entity improving property for commercial, industrial, or residential purposes.

1.2.10 PLAT

A map or drawing upon which the development plan is presented for approval.

1.2.11 CONTRACTOR

A person or entity authorized to perform construction by the State of South Carolina Licensing board for contractors. A contractor may not perform work outside of his licensed capacity, this includes well drillers,

water and sewer lines, pump station, and electrical contractors. Where required, all sub-contractors must be certified. The authority reserves the right to accept or reject any contractor or sub-contractor selected to perform work on the systems to be conveyed to the Authority.

1.2.12 DESIGN

The design of water systems shall be done only by persons properly registered under the Professional Engineer's Act of the Business and Professions Code of South Carolina.

All calculations requested by the Authority to verify the design of any portion of the water system shall be submitted to the Authority for their use. Calculations shall be based on rational methods generally accepted by the engineering profession and shall be neatly and legibly done in such form as to enable them to be readily checked.

1.2.13 STANDARD DRAWINGS

Standard drawings, the latest revisions thereof, approved by the Authority for water system construction purposes shall be considered a part of these standards and shall be used in conjunction with these Standards for all subdivision and extension of water system installations. Construction by methods differing from the Standard Drawings which will give equivalent or better results may be approved by the Authority if prior approval or such methods is obtained.

1.2.14 CONFLICTS

In case of conflict between plans, specifications, these Standards or Standard Drawings, precedence shall be given in the following order: (1) Standard Drawings, (2) These Standards, (3) Plans, and (4) Specifications. However, a deviation from the Standard Drawings of these Standards will be approved if a specific note regarding the particular deviation is included on the Plans and Specifications.

1.2.15 CUSTOMER

Customer means any person, firm, association, or governmental agency supplied or entitled to be supplied with sewer service.

1.2.16 OTHER SPECIFICATIONS

Whenever in these Standards other specifications are mentioned, it shall be understood that the materials or methods mentioned shall conform to all requirements of the latest revision of the specifications so mentioned.

1.2.17 PAVED SURFACE

Paved surface includes any pavement used on any street in the county, whether such pavement is composed of concrete, asphalt, oil, gravel, crushed rock or any combination of said forms of pavement.

1.2.18 P.S.I.G.

P.S.I.G. means pounds per square inch, gauge.

1.2.19 PLANS

Plans means all plans, profiles, maps or drawings which show the location, character, dimensions, and details of the work which has been approved for construction by the Engineer.

1.2.20 SERVICE LATERAL

Service lateral means a connection between a water main and user house service.

1.2.21 PUMP STATION

Pump station means a structure and/or pumping facility to facilitate the further transmission of water through the use of pumps and periodic minimal storage.

Those specifications approved by the Engineer for work covered by these specifications.

1.2.22 THESE STANDARDS

These Standards shall mean the standards contained herein.

1.2.23 USER CONNECTION

User connection means the point of connection a user's piping to the Authority's service lateral.

1.2.24 WATER MAIN

Water main means any pipe or conduit that is part of a transmission system and is used to transport or is intended to be able to transport water flow to more than one user connection.

1.2.25 WATER SYSTEM

Water system means the source, facilities, and transmission system and shall include all those facilities of the water system under the control of the Authority up to the customer's connection.

1.2.26 USE OF WATER

Connection of house services to service laterals and subsequent use of water either temporarily or permanently, shall not be allowed prior to acceptance of the water system by the Authority.

1.3 ABBREVIATIONS

Whenever in these standards the following abbreviations are used, the intent and meaning shall be interpreted as follows:

AA	Aluminum Association
AAMA	Architectural Aluminum Manufacturer's Association
AASHTO	American Association of State Highway and Transportation Office.
ACI	American Concrete Institute
AFBMA	Anti-Friction Bearing Manufacturers' Association
AGA	American Gas Association
AGMA	American Gear Manufacturer's Association
AISC	American Institute of Steel Construction
AISI	American Iron and Steel Institute

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AITC	American Institute of Timber Construction
AMCA	Air Moving and Conditioning Association
ANSI	American National Standards Institute
APA	American Plywood Association
API	American Petroleum Institute
AREA	American Railway Engineering Association
ASAE	American Society of Agriculture Engineers
ASCE	American Society of Civil Engineers
ASHRAE	American Society of Heating, Refrigerating and Air Conditioning Engineers, Inc.
ASME	American Society of Mechanical Engineers
ASTE	American Society of Transportation Engineers
ASTM	American Society of Testing and Materials
AWI	American Welding Society
AWPA	American Wood Preservers' Association
AWPB	American Wood Preservers' Bureau
AWWA	American Water Works Association
BHMA	Builders Hardware Manufacturers' Association
CBMA	Certified Ballast Manufacturers' Association
CDA	Copper Development Association
CISPI	Cast Iron Soil Pipe Institute
CMAA	Crane Manufacturers' Association of America
CRSI	Concrete Reinforcing Steel Institute
FED SPEC	Federal Specifications

HI	Hydraulic Institute
HMI	Hoist Manufacturers' Institute
ICBO	International Conference of Building Officials
IEEE	Institute of Electrical and Electronics Engineers
ICEA	Insulated Cable Engineers' Association
JIC	Joint Industry Conferences of Hydraulic Manufacturers'
MMA	Monorail Manufacturers' Association
NBHA	National Builders' Hardware Association
NEC	National Electrical Code
NEMA	National Electrical Manufacturers' Association
NESC	National Electrical Safety Code
NFPA	National Fire Protection Association
NLMA	National Lumber Manufacturers' Association
NWMA	National Woodwork Manufacturers' Association
OECI	Overhead Electrical Crane Institute
OSHA	Occupational Safety and Health Act (both federal and state)
PS	Product Standards Section - US Department of Commerce
RLM	RLM Standards Institute, Inc.
RMA	Rubber Manufacturers' Association
SAE	Society of Automotive Engineers
SDI	Steel Door Institute
SSPC	Steel Structures Painting Council
TEMA	Tubular Exchanger Manufactures' Association
TCA	Title Council of America

UBC	Uniform Building Code
UL	Underwriters' Laboratories, Inc.
WWPA	Western Wood Products Association
SCDOT	SC Department of Highways and Public Transportation

Unless a particular issue is designated, all references to the above specifications, standards, or methods shall, in each instance, be understood to refer to the issue in effect (including all amendments).

1.4 GENERAL CONTRACTOR REQUIREMENTS

1.4.1 COORDINATION

Contractors shall cooperate in the coordination of their separate activities in a manner that will provide the least interference with the Owner's or Authority's operations and other contractors and utility companies working in the area, and in the interfacing and utility companies working in the area, and in the interfacing and connection of separate elements of any overall project work.

If any difficulty or dispute should arise in the accomplishments of the above, the problem shall be brought immediately to the attention of the Engineer.

All contractors working on site are subject to this requirement for cooperation, and all shall abide by the Engineer's or Authority's decision in resolving project coordination problems without additional cost to the Engineer, Owner or Authority.

1.4.2 SHUTDOWN OF EXISTING OPERATIONS OR UTILITIES

Continuous operation of the Authority's or the Owner's existing services or utilities, or for other work that requires the temporary shutdown of any existing operations or utilities shall be planned in detail with appropriate scheduling of the work and coordinated with the Engineer and the Authority.

All materials and equipment (including emergency equipment) necessary to expedite a tie-in shall be on hand prior to the shutdown of existing services or utilities.

1.4.3 OPERATION OF EXISTING SYSTEM

At no time is it allowed to close off any water lines or take any other action which would affect the operation of the existing system, except as specifically required by the drawing and specifications and after prior approval has been granted by the Authority. Request approval a minimum of five working days in advance of the time that interruption of the existing system is required, and comply with the authority's shut down policy.

1.4.4 SCHEDULING

Plan the work and carry it out with minimum interference to the operation of the existing facilities. Prior to starting the work, confer with the Engineer, the Authority and the Owner's representative to develop an approved work schedule which will permit the facilities to function as normal as practical. A pre-construction conference shall be conducted per Authority Developer Policy in effect. It may be necessary to do certain parts of the construction work outside normal working hours in order to avoid undesirable conditions. The Contractor shall do this work at such times, and at no additional cost to the Authority or Owner. Do not make inspection and test have been completed on the new work and it is found to conform in all respects to the requirements.

Work on existing structures and facilities shall be performed no schedule and in a manner that will permit the existing facility to operate continuously.

1.4.5 EQUIPMENT MAINTENANCE DURING CONSTRUCTION

All equipment installed shall be provided with the manufacturers' recommended oil and lubricants by the Contractor and shall be maintained and operated by the Contractor until final acceptance by the Owner or Authority; however, approval to operate specific equipment on temporary basis until final acceptance is achieved may be obtained from the Authority. Said special circumstances and equipment must be substantially complete and written request and approval by the Engineer of work must be submitted for the Authority's review and approval or denial.

1.4.6 EQUIPMENT AND SYSTEM TESTING

Functional (or run) testing, in the presence of the manufacturers' representative and/or Engineer, will be required for each item of equipment following installation. Functional testing is defined as that testing necessary to determine if installed equipment and system will operate as intended.

In addition to the functional test, specific performance testing of installed equipment and systems shall be conducted by the Contractor as required in the section specifying the equipment or system.

The Contractor shall furnish all labor, materials, tools, equipment, instruments, and services necessary to perform the functional and performance testing.

1.4.7 PROGRESS OF PIPELINE CONSTRUCTION

The work shall proceed in a systematic manner so that a minimum of inconvenience will result to the public in the course of construction. It is, therefore, necessary to confine operations to as small a length of work area per crew as is practical. Normally, the trenching equipment shall not be farther than 200 feet ahead of each pipe-laying crew or such distance as necessary to provide maximum safety. Backfill the trench so no section of approved pipe is left open longer than is absolutely necessary.

1.4.8 SAFETY

The Contractor will be completely responsible for the safety conditions of the job site including compliance with all applicable laws. Safety conditions will include, but is not limited to, pipe construction, trenching, chemicals, electrical, blasting and other construction procedures or items utilized for the project.

1.4.9 SHOP DRAWINGS AND SUBMITTALS

The Contractor will provide the Authority with two (2) sets of shop drawings for all applicable items.

CHAPTER 2

WATER SYSTEM INSTALLATIONS

2.1 GENERAL

The Contractor shall be responsible for complying with the current South Carolina Department of Health and Environmental Control Office of Ocean and Coastal Resource Management (OCRM) regulations and requirements.

The Contractor shall perform all work necessary for or incidental to the performance and completion of water system installations. This work shall be completed as shown on the latest revisions of the standard drawings and as may be specified in contract documents. This work shall include the furnishing of all labor, materials and equipment necessary for a complete and operational system. The Contractor shall be responsible for coordinating the work to assure that the work is completed in an orderly manner.

Although such work may not be specifically shown or specified, all supplementary or miscellaneous items, appurtenances and devices incidental to or necessary for a sound, secure and complete water system installation shall be furnished and installed as part of the work.

2.1.1 EXISTING UTILITIES, STRUCTURES, AND OTHER ITEMS

The Contractor will take precautions to prevent any unnecessary damage to existing utilities, structures, property and other items in the work area. Any work resulting in damage to utilities, structures or other items as a direct or indirect result of the Contractor's work shall be the responsibility of the Contractor.

Any liabilities, fines or penalties to the Authority resulting from damage caused by the Contractor or from negligence of the Contractor shall be reimbursed by the Contractor.

The Contractor will be responsible for verifying the location and existence of all underground utilities. Location of utilities on the plans, whether fully and correctly located or partially and/or incorrectly located or omitted will not relieve the Contractor of the responsibility or liability for damage to the utilities. The contractor will be responsible for contacting local utilities for assistance in locating utilities. The Contractor must fully comply with the south Carolina Underground Utilities Damage Prevention Act, General Statutes 58-35 Sections 20 through 120 and all applicable statues and state approved requirements.

The Contractor shall replace and/or repair any drainage culverts necessary to be removed or that have been damaged during work performed. All drainage from ditches or culverts shall be maintained during progression of the work so that any damage to the property, public or private will not result from lack of or diversion of existing drainage courses. At completion of the project, all drainage ditches and culverts will be completely opened and natural drainage restored. It will be the responsibility of the Contractor to replace property corners to proper locations if damaged or destroyed as a result of the Contractor's work.

The Contractor shall be responsible for obtaining a letter of release from SCDOT for work performed on state right-of-ways or from Horry County Public Works for work performed within county right-of-ways. Final release of retainage shall not occur until all letters of release are provided to the Engineer.

Mail Boxes:

Where mail boxes are encountered during the installation of lines, the mail boxes and posts may be carefully removed temporarily only and shall be replaced immediately after backfilling and pipe laying has passed the box location. Said box shall be replaced for use the same day as removed and shall be restored as may be needed to conform to its prior condition with the exception that the distance from the bottom of the box to ground level shall be 43". Any and all necessary replacements of posts and/or boxes needed to conform to this requirement are considered as a part of the overall cost for pipe installation work and no additional compensation will apply.

2.1.2 DEBRIS REMOVAL

All material and debris resulting from clearing operations shall be disposed of by the Contractor as directed by the Engineer and/or Authority.

2.1.3 UNCLASSIFIED EXCAVATION

All excavated material removed for water system installations shall be considered unclassified material.

2.1.4 EXCESS MATERIALS

All excess materials will be disposed of by the contractor at a location or in a manner approved by the Engineer and/or the Authority.

2.1.5 ACCESS

The Contractor during the course of the work will maintain a full access to public or private properties including but not limited to driveways, sidewalks, fire hydrants and streets. The contractor is responsible for coordinating work to minimize any inconvenience to the public as a result of the construction work under this contract. The length of trench open per crew at any one time will not exceed 200 linear feet unless otherwise approved by the Engineer and no section of trench will be left open any longer than is absolutely necessary. Failure to comply with these provisions may necessitate shutdown of the entire project until backfilling of open trenches is performed. The Contractor will be responsible for the safety conditions of the open trench.

2.1.6 WATER SYSTEMS PROTECTION FROM CONTAMINATION

a. Separation from Sewer Systems

Construction shall be in accordance with the South Carolina STATE PRIMARY DRINKING WATER REGULATIONS (R.61-58). In particular R. 61-58.40 (12) addresses separation requirements between water and sewer mains. Refer to Section 4.5.3 of these specifications for further information on this subject.

b. Construction in Contaminated Areas

If a water main must pass through a contaminated site, the construction materials must be suitable to protect the water system from contamination. Also provisions are to be made for suitable disposing of spoil materials in accordance with all applicable local, state, and federal requirements.

During the course of construction if a contaminated area is encountered, this information shall be brought to the engineer's attention so that an evaluation can be made to determine the best course of action to either avoid the area or to make provision for appropriate materials and disposal of spoil. Approval by the Authority and SCDHEC must be outlined before implementing a course of action for such a situation.

c. Material in Contact with Water Mains

All materials and products which come into contact with drinking water must be certified as meeting the specifications of the American National Standards Institute/National Sanitation Foundation. (ANSI/NSF) Standard 61. Drinking Water System Components - Health Effects.

2.1.7 CROSS CONNECTION CONTROL (BACKFLOW PREVENTION DEVICES):

- a. There shall be no connection between the distribution system and any pipes, pumps hydrants, or tanks whereby unsafe water or other contamination materials may be discharged or drawn into the system. *(R.61-58.4.D.(14)(a))*
- b. No by-passes shall be allowed, unless the bypass is also equipped with an equal, approved back-flow prevention device. *(R.61-58.4.D.(14)(a))*
- c. High hazard category cross connections shall require an air gap separation or an approved reduced pressure backflow preventer. *(R.61-58.7.F(4))*
- d. Reduced pressure principal backflow prevention assemblies shall not be installed in any area location subject to possible flooding. This includes pits or vaults which are not provided with a gravity drain to the ground's surface that is capable of exceeding the discharge rate of the relief valve. Generally, if installed in a pit, the drain line shall be 2 times the size of the line entering the backflow prevention device. The drain cannot empty into any type of ditch, storm drain, or sewer, which could flood water back into the pit. *(R.61-58.7.F.(5))*
- e. All piping up to the inlet of the backflow prevention device must be suitable for potable water. The pipe must be AWWA or NSF approved. Black steel pipe cannot be used on the inlet side of the device.
- f. Fire line sprinkler systems and dedicated fire lines, except those in the high hazard category shall be protected by an approved double detector check valve assembly. *(R.61-58.7F.(6))*

2.2 PIPELINE TRENCHING

2.2.1 TRENCHING, GENERAL

- a. Trenches will be excavated by the open cut method to a depth shown on the plans and necessary to accommodate the work including bedding. The Contractor shall take precaution to avoid excavating below the

necessary depth in order to maintain existing firm conditions. In the event of over excavation, the trench will be backfilled with approved materials and thoroughly compacted in six (6) inch lifts.

- b. Trench widths will be limited to provide ample room for workmen. Trench widths at the top of the pipe will not exceed the total width of the outside diameter of the pipe plus eighteen (18) inches for pipes with outside diameters of thirty-three (33) inches and less, and the total width of the outside diameter of the pipe plus twenty-four (24) inches for pipes with outside diameters greater than thirty-three (33) inches. When sheeting is necessary the allowable trench width will be increased by the thickness of the sheeting.
- c. Trench walls shall be cut vertically from the trench bottom to the top of the pipe. Top of trench width shall not exceed a width brought about by a one and one-half (1 1/2) horizontal to one (1) vertical slope from the top of the pipe to the surface of the ground. The maximum allowable top of trench width will be fifteen (15) feet. Any damage to any item, including pavement, as a result of exceeding the allowable trench width, and any liability thereof, will be considered the responsibility of the Contractor.

2.2.2 TRENCHING METHODS

- a. Trench excavation shall be made in open cut and true to the lines and grades shown on the plans, unless boring is necessary or required. Banks of the trenches shall be cut in vertical, parallel planes equi-distant from the pipe center line. The horizontal distance between such planes, or the overall width of trench, shall vary with the size of the pipe to be installed. The overall width of trench shall be as recommended by manufacturer. When vertical banks for trench excavation are not practical to construct or create dangerous conditions to workmen, the banks may be sloped provided that such excavation does not damage adjacent structures. When trench banks are sloped, such banks shall be cut to vertical planes as specified above for that part of the ditch below the level of 12 inches above the type of the pipeline. The bottom of the trench shall be level in cross section and shall be cut true to the required grade of the pipe and the pipe embedment materials.
- b. Bell holes for bell-and-spigot pipe shall be excavated at proper intervals so that the barrel of the pipe will rest for its entire length upon the bottom of

the trench. Bell holes shall be large enough to permit proper joint installation in the pipe.

- c. When muck, quicksand, soft clay, swampy or other material unsuitable for foundations or sub-grade are encountered such material shall be removed and replaced with approved pipe foundation material consisting of gravel or crushed stone of a maximum diameter of 3/4". Cost of approved pipe foundation material shall be included in unit cost of pipe installation.
- d. If required by the Engineer, after excavation, the space below the ultimate pipe grade shall be filled with pipe embedment materials consisting of gravel or crushed stone of maximum diameter of 3/4". Embedment shall be a minimum thickness of 4" below piping and up to the springboard of pipe (centerline). Embedment shall extend the full width of trench and be compacted to proper grade and made ready for pipe laying.
- e. Debris encountered in trench excavation for water and other pipelines shall be removed for the overall width of trench which shall be as shown on the plans. It shall be removed to a depth of six (6) inches below the bottom of the pipe for pipes smaller than twenty-four (24) inches in size; eight (8) inches below the bottom of the pipe for pipes twenty-four (24) inches to thirty-six (36) inches in size and twelve (12) inches below the bottom of the pipe for pipes larger than thirty-six (36) inches in size, if debris extends to such depth.
- f. Bracing and sheeting will be provided as necessary to comply with trench width requirements of OSHA and other federal, state, and local requirements. The use of drag boxes or similar items may be acceptable provided subsequent moving of the box does not result in cave-ins. Sheeting shall be left in place until the pipe has been placed and back filled in the area of the pipe. Shoring and sheeting if removed must be done in a manner that will not upset pipe construction including creating unacceptable voids in the backfill.
- g. The Contractor must take precautions in controlling the width of the trench to prevent unnecessary damage to adjacent roads, utilities and structures and to protect workmen and the public. The Contractor will be responsible for repairs or compensation due to such damage without additional compensation from the Owner.

- h. Trenches shall be kept free of water during installation of the pipes. Water shall be disposed of in a manner so as not to damage adjoining private or public properties or in a manner as to be a detriment to public health. Payment for de-watering will be included in the unit price item for the pipe laid.
- i. Pipes shall be kept free from any water, trench material or debris from entering the pipe during the pipe laying operation. Pipes shall be plugged with approved pipe plugs at all times to prevent foreign material and contaminated water from entering the pipe when the Contractor's personnel are not in attendance.

2.2.3 SITE GRADING, BACKFILLING, AND COMPACTING

- a. The Contractor will stake out and establish proposed elevations of all items including structures, sidewalks, parking areas and utilities and any other layout work necessary for construction of the project. Grading work will be completed in accordance with the plans. Grading operations will be performed only under acceptable weather conditions and soil moisture contents. Final grades of proposed disturbed area will be brought to existing easements, pavement, curb, grassed, water, or other area grades in a manner acceptable to the Engineer's representative even if minor adjustments from plan grades are required.
- b. During grading operations, the Contractor will be responsible for maintaining proper drainage and minimizing erosion. The Contractor will be responsible for re-establishing grades due to washout, settlement or other manner prior to acceptance.
- c. The Contractor shall use only suitable backfill materials which shall be free from any deleterious materials and as approved by the Engineer and/or the Authority. Backfill will be hand or pneumatic tamped under and around the pipe in six (6) inch lifts up to twenty-four (24) inches above the top of the pipe. Backfill to the top of ground will be in eight (8) inch loose thickness lifts compacted as specified. Any pipe displaced or broken during back filling or compaction will be replaced at the Contractor's expense.
- d. Compaction will be to a density of 95 percent of maximum dry density as determined by ASTM-D 698 or AASHTO Method T 99 for paved, concrete, parking or other unpaved areas common to traffic. In other areas of

Department of Highways and Public Transportation right-of-ways, the backfill must be compacted to ninety-five (95) percent of maximum dry density or to a density equal to that prior to the area's disturbances whichever is less. For all other areas, trench backfill will be compacted to a minimum ninety (90) percent of maximum dry density as determined by ASTM - D 698 and AASHTO Method T 99. Maximum dry density will be as determined by the Standard Proctor test.

- e. When required by the Engineer, or the Authority, moisture density tests will be performed through a recognized testing laboratory. Should the compacted backfill fail the moisture density tests, the Contractor will uncover backfill until additional tests show adequate density exists. Additional tests at a site of initially failed testing will be paid for by the Contractor. Additional back filling and compaction requirements and bedding requirements are discussed in sections on Pressure Piping and Gravity Piping and are shown on the trench detail drawings.
- f. Said work as above described shall be considered as a part of the unit cost items and unless otherwise described no additional compensation will be allowed.

2.3 CONSTRUCTION IN PUBLIC RIGHT-OF-WAY AND EASEMENTS

2.3.1 GENERAL

The Contractor shall perform all work necessary for or incidental to the performance and the completion of construction in all public right-of-ways and easements including but not limited to furnishing all labor, materials, and equipment. This work shall be completed as shown on the drawings and as specified in the contract documents. The Contractor shall be responsible for coordinating the work to assure that the work is completed in a timely and orderly manner.

Attention is directed to the plans for the removal and/or replacement of existing landscaping, shrubs, plantings, miscellaneous storage buildings, fences and lawn areas that might be in conflict with the work or may have been damaged. The Contractor shall replace any and all damaged or removed items with equivalent materials and conditions all to the satisfaction of the property owner and GSWSA.

Although such work may not be specifically shown or specified, all supplementary or miscellaneous items, removed and replaced items, appurtenances and devices incidental to or necessary for a sound, secure and complete installation shall be furnished and installed as part of this work. Said work as above described shall be considered as a part of the unit cost items and unless otherwise described no additional compensation will be allowed.

2.3.2 ENCROACHMENT PERMITS

The Contractor will not proceed with construction along any South Carolina Department of Transportation (SCDOT) or other local county or municipal right-of-way or easement without approved encroachment permits from the appropriate agency having jurisdiction. The Contractor will keep a copy of approved encroachment permits at the project site at all times during the construction. The Contractors will be responsible for notifying and obtaining through the Engineer necessary encroachments permits from the appropriate agency, SCDOT, the county or municipality prior to initiating construction on any public right-of-way or easement. All work performed in SCDOT right-of-way will be in full accordance with the approved encroachment permits including any "Special Provisions" and SCDOT's "A Policy for Accommodating Utilities on Highway Right-of-Ways," latest edition and these specifications. Contractor shall be responsible for obtaining a letter of release from the appropriate agency stating their acceptance of reconstruction subject to normal warranty periods.

2.3.3 MATERIALS

All materials used within SCDOT right-of-ways will be SCDOT approved and are to be in accordance with SCDOT Standard Specifications for Highway Construction, latest edition. Base course material will be select aggregate base course (SABC) material from approved aggregate pits. Asphaltic concrete will be mix Type 3 (within the range of 6.0 and 6.5 percent liquid asphalt content) and will be mixed in approved batch plant. Asphaltic concrete will weigh a minimum of one hundred and ten (110) pounds per square yard per inch depth of asphalt placed.

2.3.4 PAVEMENT CUT AND PATCH

- a. Any pavement cut or damaged during course of construction will be the responsibility of the Contractor and will be repaired by the Contractor. The Contractor must take due caution in controlling pavement damage during necessary pavement cuts as discussed in other sections of these specifications. After back filling of the trench required, for pavement cut,

the Contractor will backfill and compact base material in accordance with Section 306 of the SCDOT Standard Specifications from ten (10) inches below the existing pavement surface to the point flush with the pavement. The Contractor will maintain the cut in good order until such time as the patching is completed. Immediately prior to patching, the Contractor will remove the back filled stone from the point flush with the pavement to the proposed two (2) inch depth of pavement. The Contractor will then trim pavement and cut edges to true line. The pavement will be trimmed an additional six (6) inches beyond the trench edge to provide firm support on undisturbed material for the patch

- b. After removal of the stone and trimming of the edges, an asphalt primer will be applied at .25 to .45 gallons per square yard over the entire surface of the stone in the cut and allowed to set. Existing asphalt surfaces contacted with the new asphalt will have applied a thin coat of hot asphalt cement or asphalt thinned with naphtha immediately prior to placing of the asphalt. Asphalt joints shall be cut back to form a bond with freshly mixed asphalt and chilled asphalt. For asphalt thickness greater than three (3) inches, the asphalt will be placed in two lifts. The depth of the asphaltic concrete patch will be placed in a minimum of two (2) inches lifts and placed flush with the existing asphalt surface
- c. For longitudinal cuts in pavement, the cut will be patched and the entire width of the roadway will be resurfaced for the longitudinal length of the cut. The depth of the resurfacing will be one (1) inch
- d. Damage to pavement as a result of exceeding trench width regulations discussed in other sections or in the opinion of the Engineer or the Authority, as a result of Contractor carelessness during construction operations outside the immediate pavement area, will be the responsibility of the Contractor and will be repaired by the Contractor at no cost to the Owner or the Authority
- e. All pavement and/or driveway cut and patch shall conform to the standard trench detail adopted by Grand Strand Water and Sewer Authority, SC DOT and Horry County Road Department.

2.3.5 MAINTENANCE OF EXISTING DRAINAGE

- a. The Contractor will be responsible for maintaining drainage in all project areas during the course of construction. The contractor will be responsible for damage due to flooding as a result of construction practices. The contractor will take precautions to minimize erosion during construction.
- b. The Contractor will be responsible for back filling, re-establishing turf, and restoring all properties including swales, ditches, culverts, etc. to a condition equal to or better than the original, to facilitate drainage.
- c. For lines installed under culverts, the Contractor will provide 2,000 psi concrete arch encasement from the spring line of the proposed pipe to four (4) inches above the bottom of the culvert or use D.I.P. as directed by the Engineer or Authority representative. If the minimum distance between the top of the proposed pipe and the bottom of the culvert exceeds the radius of the culvert, the contractor will compact soil around and above the line to 95 percent of the maximum density (modified Proctor) and place 2,000 psi concrete from four (4) inches below the bottom of the culvert to a depth equal to the culvert radius or use D.I.P.

Erosion:

Provisions shall be made to prevent erosion and siltration caused by construction. Temporary grassing, hay bales, silt fences or other methods called for on the plans or as may be required, shall be used.

2.3.6 VEGETATION AND GRASSING

The Contractor will take precautions to avoid any unnecessary damage to trees, shrubbery or other vegetation in the right-of-ways. Shoulders, swales, easements, and other similarly disturbed areas will be grassed if required by the Engineer, the Authority or the Owner in accordance with Section 810 "Seeding" of the SC Department of Transportation Standard Specifications for Highway Construction and as follows: The following would apply if required by the Engineer, the Authority, or the Owner.

- a. Seeding schedules will be as specified in SC Department of Transportation Standard Specifications for Highway Construction Section 810 for permanent vegetation - lower state.

- b. Commercial fertilizer following ground preparation will be applied at a rate of 500 lbs. per acre Transportation Standard Specifications for Highway Construction and as follows: The following would apply if required by the Engineer, the Authority, or the Owner.
- c. Seeding shall be uniformly sown in accordance with seeding schedules within 24 hours of application of fertilizers.
- d. When required straw or hay mulch will be uniformly applied at a rate of 2 tons per acre. Emulsified asphalt RS-2 diluted with an equal amount of water will be uniformly applied over the mulch at a rate of .20 gallons per square yard. As an alternate method of seeding, wood cellulose fiber mulch shall be applied at a rate of 1,500 pounds per acre in a mixture of seed and fertilizer with hydraulic equipment in accordance with SC Department of Highways and Public Transportation's Standard Specifications for Highway Construction Section 810.17, Method.
- e. A satisfactory stand of perennial grass as permanent vegetation will be developed.
- f. Restoration and clean-up will follow immediately after backfill operations.

2.3.7 UNPAVED ROADWAYS

Unpaved or gravel highways of SCDOT, county or local municipality will be stabilized within the trench location for the top twelve (12) inches of backfill with crushed stone or SABC (coquina) mixed with binder after back filling in accordance with Section 2.2.3.

Site Grading, Back filling and Compacting flush with the roadway. Any other unpaved road, side road, driveway, or other area presently stabilized by use of rock material will be stabilized with four (4) inches of crushed stone or coquina after back filling, in accordance to Section 2.2.3 Site Grading, Back filling, and Compacting. Cost of restoring roadways shall be included in unit cost of pipe installation. All trench backfill work shall be in accordance with the applicable trench section standard detail adopted for the project.

2.3.8 TRAFFIC MAINTENANCE SAFETY AND CONTROL

The Contractor must maintain at least one lane of traffic at all times and no trenches will be left open over night. The contractor will receive permission from the local SCDOT Maintenance Engineer or the appropriate representative of the county or local municipality having jurisdiction prior to closing of a roadway. Work will be conducted so as to assure the least possible obstruction to traffic. The convenience of the general public and residences adjacent to the property are of prime importance and shall be provided for in an adequate and satisfactory manner.

All obstructions in right-of-ways will be protected by the Contractor providing signs, barricades and lights. Signs and flagmen in the construction area will comply with the 1972 SCDOT Manual of Uniform Traffic Control Devices for Streets and Highways, Rev. 6-1-76 and all subsequent addendums. All trenches which traffic will pass over will be maintained in a condition that will allow normal vehicular traffic to pass over. Temporary access drives will be provided when necessary.

Barricades and Warning Signs

The contractor shall erect, mark and maintain suitable barricades to protect and maintain public safety. Barricades, warning signs and other safety devices shall meet the requirements of OSHA, South Carolina Department of Transportation and GSWSA requirements. No work will commence until the contractor has secured approval for the agency responsible for the right-of-way in which construction is proposed.

2.3.9 ACCEPTANCE OF WORK

Upon completion of the project, a certification of acceptance of work along the public right-of way or easement will be obtained by the Contractor from all authorities having jurisdiction over right-of-way or easement encroached upon during the course of the project and submitted to the Engineer or the Authority prior to final payment.

2.3.10 WARRANTY

The Contractor will guarantee to the Owner or Authority all materials and equipment furnished and work performed for paving, drainage, grassing and other construction in public right-of-ways and easements for a period of one (1) year from the date of the Engineer's certification of work. For work requiring SCDOT

approval on a SCDOT right-of-way the guarantee will be for two (2) year from the date of certification by terms of the applicable specifications

2.3.11 DUST PREVENTION

Disturbed roads in the construction area will be maintained for dust prevention by water or dust preventative treatment. The contractor shall comply with all applicable environmental regulations.

CHAPTER 3

PIPING AND APPURTENANCES FOR POTABLE WATER SYSTEMS

3.1 GENERAL

This section shall include the furnishing of all types of pipe and other incidentals required for the construction of a complete water system as shown on the drawings and as specified herein.

All piping, valves, fittings, packing, joint materials, fire hydrants, and accessories coming in contact with potable water shall conform to Section C of the AWWA Standards (*R.61-58.4D.(1)*) as required by South Carolina Department of Health and Environmental Control regulations as to meeting NSF 14 and 61 and potable drinking water regulations.

Unless otherwise noted, the materials listed below are acceptable to the Owner for use in water distribution systems. Should the Contractor desire to use other materials not listed in these specifications, written permission must be obtained from GSWSA and the Owner's Engineer.

All material shall be free from defects impairing strength and durability and be of the best commercial quality for the purposes specified. It shall have structural properties sufficient to safely sustain or withstand strains and stresses to which is normally subjected and be true to detail.

The South Carolina Department of Health and Environmental Control requires the Authority to insert the following statement:

"All pipe material, solder and flux shall be lead free (less than 0.2 percent lead in solder and flux and less than 8.0 percent in lead in pipes and fittings."

However, it is the policy of the Authority that no piping or appurtenances shall be allowed which contain any measurable lead content.

Asbestos cement pipe shall not be used in potable water systems except in the repair of existing asbestos cement lines. All PVC piping 3" and larger shall be blue in color.

Thermoplastic pipe shall not be used above grade. Natural rubber or other material which will support microbiological growth may not be used for any gaskets, o-rings, and other products used for jointing pipes, setting meters or valves or other appurtenances which will expose the material to the water. Lubricants which support microbiological growth

shall not be used for slip-on joints. The use of solvent-weld PVC pipe and fittings in water mains 4 inches and larger is prohibited.

3.1.1 SUBMITTALS

The Contractor shall submit to the Engineer two (2) copies of all submittal data for review and/or approval. Submittals shall include at a minimum: (1) the manufacturer's name, (2) type of material, (3) ASTM, ANSI, AWWA or other quality standard and (4) pressure class. If the materials do not meet the quality standards specified, the submittals will be rejected and other materials submitted as specified. The contractor must obtain approval of all pipe materials prior to commencing construction.

The Contractor shall submit to the Engineer two (2) copies of a certificate of inspection from the pipe manufacturer that the pipe supplied has been inspected at the plant and meets the requirements of these specifications.

3.1.2 PIPE DELIVERY, STORAGE, AND HANDLING

Truck and shipment units shall be delivered, handled, and maintained in a manner to avoid damage to the pipe. During shipment, piping across the front of the load shall be tarped across the entire front of trailer to prevent contamination by atmospheric conditions or by diesel fumes from truck. Piping found to be partially or wholly shipped uncovered will not be accepted. Pipe found to be contaminated as a result of non-conformance to this requirement will not be accepted for use. The pipe shall be stored in an open area on high, well-drained land not subject to flooding, mud or other means of contamination. Pipe shall not be strung out in ditch areas where contamination will occur. The Contractor shall obtain written permission from the Owner to schedule all pipe and material purchases and deliveries from the suppliers designated for the project. Written permission from property owners selected for pipe storage shall be obtained and approved by GSWSA prior to unloading. This Section 3.1.2 includes PVC, Ductile Iron and HDPE piping purchased for potable water use.

3.2 DUCTILE IRON PIPE

3.2.1 GENERAL

Ductile iron shall conform with the latest revision of ANSI/AWWA C151/A21.51. Each pipe shall be subject to a hydrostatic pressure test of at least 500 psi at the

point of manufacture. Pipe dimensions shall conform to Federal Specifications WW-P-41C, Type II, push-on joints; Type III, mechanical joints. Each joint of pipe shall be conspicuously marked on the outside of the barrel to readily identify it from cast iron. Thickness class shall be as required by ANSI A 21.50, AWWA C150, latest revision.

A. JOINTS

- 1) Mechanical Joints: ANSI Specifications A21.11 (AWWA C-111), latest revision, for three inch pipe and larger, and CEPR Specification 3-54 and 4-54 for two inch pipe. Bolted mechanical joints shall be used at canal crossings, railroad crossings and where specifically called for on the plans or in the Schedule of Bid Items
- 2) Push-on Joints: Single gasket push-on type joints shall conform with ANSI A 21.11(AWWA C-111), latest revisions. Push-on joints may be used where mechanical joints are not specifically called for on plans or specified above
- 3) Flanged Joints: Flanged joints shall be constructed of ductile iron pipe conforming to ANSI/AWWA C115/A 21.15 Class 53 minimum latest revisions.

B. PIPE LINING

Cement mortar lining on the interior shall conform with ANSI A 21.4 (AWWA C-104), latest revision.

C. EXTERIOR COATING

The pipe shall have a standard asphaltic coating on the exterior in accordance with the manufacturer's and AWWA specifications. The final coat shall be continuous and smooth being neither brittle when subjected to low temperatures, nor sticky when exposed to hot sun. The coating shall be strongly adherent to the pipe at all temperatures

3.3 POLYVINYL CHLORIDE (PVC) PIPE (C-900)

3.3.1 GENERAL

For all C900, C905, SDR-PR, PVC piping and in addition to meeting all applicable AWWA and Uni-Bell standards, GSWSA reserves the right to reject any pipe not within the dimensional specification tolerances and may also upon visual inspection reject any pipe found to be not free of blisters, cracks, seams, welds or ripples on the ID and/or OD of the pipe and bell that in the opinion of GSWSA would be in any way detrimental to its intended use and intended purpose of the purchase. All PVC piping shall be blue in color.

PVC Pipe in sizes four (4) inches through (12) inches will be in accordance with the latest edition of AWWA C-900, Class 100 psi, Class 150, and in sizes less than four (4) inches will be in accordance with ASTM D 2241 200 psi SDR 21. PVC pressure piping shall be in accordance with ASTM D 1784 for PVC compounds, ASTM S-3139 for push on joints and ASTM F-477 for rubber gaskets. The pipe furnished will also meet the following specifications.

A. C-900 PVC PIPE WILL BE SDR 25 PRESSURE CLASS 100 OR SDR 18 PRESSURE CLASS 150

All pipe shall meet the requirements of the AWWA C-900, Standard for Polyvinyl Chloride (PVC) Pressure Pipe four (4) inches through twelve (12) inches for water. The pipe will be furnished in twenty (20) foot lengths with smaller lengths comprising no more than fifteen 15 percent of the system installed. The pipe will be cast iron pipe equivalent outside diameters. Joints will be rubber gasket sleeve-type couplings or integral bell (push-on). Pipe bedding requirements will be in accordance with ASTM D 2321 except as modified by these specifications.

Pipe will not fail when tested in accordance with AWWA C-900 for sustained pressure, burst pressure, flattening and extrusion quality. Each section of C-900 must pass a hydrostatic proof test at four times its rated class pressure for a minimum of five seconds

All PVC shall be furnished in factory packaged units and each section of pipe clearly marked with the manufacturer's name pressure class, sizes and appropriate standard. All PVC pipe conveying potable water shall be manufactured with NSF 14 inspection and approval and shall be stamped with the appropriate NSF seal of approval. Pipe not bearing this approval shall be rejected and considered not acceptable.

Tapping C900: C 905 should not be direct tapped. Cutting should be done only with a full circle shell-cutter tool. The shell cutter must have sharp teeth and clean teeth. A full circle tapping sleeve should be used. Hole cut must be circular. Holes cut into PVC C-905 pipes in any method other than above are not acceptable to PVC pipe manufacturers and will void pipe warranty.

Hole cutting by any method other than described above could induce stresses into the pipe wall and even hairline cracks which could cause failure of the pipe under pressure.

B. SDR-PR PVC (3" PVC)

SDR-PR will meet requirements of ASTM D 2241 and will be 200 psi pipe with Standard Dimension Ratio of 21 (SDR-21). Pipe will not fail when tested for the appropriate sustained Pressure Rated PVC pipe will include an encasement of sand six (6) inches thick around the full perimeter of pipe. Payment for sand will be included in the unit price bid per linear foot of PVC pipe.

The pipe will be furnished in twenty 20 foot laying lengths with no more than fifteen (15) percent of the system comprised of lengths less than twenty (20) feet.

All pipes will be furnished in factory packaged units and each section of pipe will be clearly marked with the manufacturer's name, pressure class, size appropriate standard. All PVC pipe conveying potable water shall be manufactured with NSF 14 inspection and approval and shall be stamped with the appropriate NSF seal of approval. Pipe not bearing this approval shall be considered unacceptable.

The pipe shall be plainly marked with the following information: manufacturer's name, size, material (PVC) type and grade or compound, NSF Seal, pressure rating and reference to appropriate product standards.

3.4 POLYVINYL CHLORIDE (PVC) PIPE (C-905)

SDR-PR Thickwall C-905 PVC pipe for large diameters, 14" through 48", shall meet all requirements of AWWA C905-97 first edition. Unless otherwise specified, specifications are for DR25 for PVC transmission pipe with Cast Iron outside diameter. Rubber gaskets with pipe lubricant shall be furnished for all joints. Pipe shall be furnished in cast iron pipe equivalent outside diameters with rubber-gasket separate couplings or push-on joints. Pipe and couplings shall not fail when subjected to the following tests; (1) sustained pressure (2) burst pressure (3) flattening and extrusion quality. Tests shall be conducted as outlined in AWWA specifications. Each length of PVC pipe shall pass a hydrostatic integrity test at the factory to 2 times the pressure class of the pipe for 5 seconds.

Pipe shall be furnished in 20 ft. laying lengths. Random lengths shall be a minimum of 10 feet long and shall comprise no more than 15 percent of the length of the piping system. Pipe shall be furnished in factory packaged units, with each joint plainly marked with the manufacturer's name, pressure class, size, etc.

All PVC shall be furnished in factory packaged units and each section of pipe clearly marked with the manufacturer's name pressure class, sizes and appropriate standard. All PVC pipe conveying potable water shall be manufactured with NSF 14 inspection and approval and shall be stamped with the appropriate NSF seal of approval. Pipe not bearing this approval shall be rejected and considered not acceptable.

Tapping C 905: C-905 shall not be direct tapped. Cutting should be done only with a full circle shell cutter tool. The shell cutter must have sharp teeth and clean teeth. A full circle tapping sleeve should be used. Hole cut must be circular. See 4.6.12 Referenced retrievable coupon.

Holes cut into PVC C-905 pipes in any method other than above are not acceptable to PVC pipe manufacturers and will void pipe warranty.

Hole cutting by any method other than described above could induce stresses into the pipe wall and even hairline cracks which could cause failure of the pipe under pressure.

3.4.1

Third Party Certification:

The manufacturer of all PVC pipe supplied to GSWSA shall be subject to random inspection and evaluation by an independent third party in order to assure the purchaser to full compliance with this specification. The third party shall report all findings to GSWSA upon request. The third party selection shall be subject to the approval of GSWSA and shall be provided at no charge.

Testing:

GSWSA shall have free access to that part(s) of the manufacturer's plant involved in work perform to meet requirements of this recommended standard. The manufacturer shall afford the inspector, at no charge, reasonable facilities needed to determine if the pipe meets the requirements of this recommended standard. GSWSA shall have the right to plant inspection for witness testing and conformance to all specifications; all costs including transportation and lodging and meals is to be borne by the manufacturer.

3.5 POLYETHYLENE PIPE FOR WATER MAINS

3.5.1 General

The pipe supplied under this specification shall be SDR 17 (unless specified otherwise) high density polyethylene pipe, and shall conform to ASTM F 714 and ASTM D 1248 (Type III C, Class C, Category 5, P34). Minimum cell classification values shall be 345434C as referenced in ASTM D 3350 - latest edition. The fittings supplied in this specification shall be molded or manufactured from a polyethylene compound having a cell classification equal to or exceeding the compound used in the pipe. To insure compatibility of polyethylene resins, all fittings supplied under this specification shall be of the same manufacture as the pipe being supplied. Polyethylene pipe and fittings shall conform to the latest edition of ANSI/AWWA C901 or C904 for ½" – 3" water service laterals and C906 for 4" – 63" water distribution mains. Material used in manufacture of polyethylene pipe or fittings shall conform to the PE standard code PE 4710.

The pipe shall conform to the physical properties as described herein.

All pipe shall be color coded and/or striped blue (for water) unless otherwise specifically approved. All pipe shall have the manufactured stamped AWWA and have the SDR clearly designated on it.

**PIPING AND APPURTENANCES FOR POTABLE WATER SYSTEMS
CHAPTER THREE**

A. Typical Pipe Physical Properties

PROPERTY	TEST METHOD	UNIT	VALUE
Density	ASTM Method	gms/cc	0.955
Melt Index	ASTM D 1238	gms/10	0.11
	(190/2.16)	min.	
Environmental Stress Cracking Resistance:			
Condition A,B, & C, F-O	ASTM D 1693	hrs.	>5000**
Compressed Ring, F-50	ASTM F 1248	hrs.	>1000
Tensile Strength, Yield	ASTM D 638	psi	3200
Type IV Specimen	(2"/min.)		
Elongation at Break	ASTM 638	%	>750
Type IV Specimen	(2"/min.)		
Vicate Softening Temp.	ASTM D 1525	°F	257
Brittleness Temp.	ASTM D 746	°F	<-180
Flexural Modulus	ASTM D 3350	psi	135,000
Modulus of Elasticity	ASTM D 638	psi	130,000
Hardness	ASTM D 2240	Shore D	65
Coefficient of linear Thermal Expansion:			
Molded Specimen	ASTM D 696	in./in./deg	8.3x10-5
Extruded Pipe			1.2x10-4

Thermal Conductivity	Dynatech-Colora BTU,In./ Thermoconductor ft./2 hrs./deg.F		2.7
Long term Strength:			
73°F	ASTM D 2837	psi	1600
14°F		psi	800
Material Cell			
Classification	ASTM D 3350		345464 C
Material Designation	PPI Recommendation		PE 4710

B. Quality Control

The resin used for manufacturer of the pipe shall be manufactured by the pipe manufacturer, thus maintaining complete control of the pipe quality. The pipe shall contain no recycled compound except that generated in the manufacturer’s own plant from resin of the same specification from the same raw material. The pipe shall be homogenous throughout and free of visible cracks, holes, foreign inclusions, or other deleterious defects and shall be identical in color, density, melt index, and other physical properties. GSWSA may request, as part of the quality control records submittal, certification that the pipe produced is represented by the quality assurance testing. Additionally, test results from manufacturer’s testing or random sampling by the engineer that do not meet appropriate ASTM standards or manufacturer’s representation, may be cause for rejection of pipe represented by the testing. These tests may include density and flow rate measurements from samples taken at selected locations within the pipe wall and thermal stability determinations according to ASTM D 3350, 10.1.9.

GSWSA may request certified lab data to verify the physical properties of the materials supplied under this specification or may take random samples and have them tested by an independent laboratory. Approved manufactures are Plexco, Driscopipe, CSR, or Authority approved equal.

C. Pipe Delivery, Storage and Handling:

Truck and shipment units shall be delivered, handled and maintained in a manner to avoid damage to the pipe. During shipment, piping across the front of the load shall be tarped across the entire front of trailer to prevent contamination by atmospheric conditions or by diesel fumes from truck. Piping found to be partially or wholly shipped uncovered will not be accepted. Pipe found to be contaminated as a result of non-conformance to this requirement will not be accepted for use. The pipe shall be stored in an open area on high, well-drained land not subject to flooding, mud or other means of contamination. Pipe shall not be strung out in ditch areas where contamination will occur. The Contractor shall obtain written permission from the Owner to schedule all pipe and material purchases and deliveries from the suppliers designated for the project. Written permission from property owners selected for pipe storage shall be obtained and approved by GSWSA prior to unloading. This Section 3.1.2 includes, PVC, Ductile Iron and HDPE piping purchased for potable water use.

D. Rejection:

GSWSA reserves the right to reject any polyethylene pipe and fittings failing to meet any of the requirements of this specification. Per the manufacturer's recommendations, the following apply to all handling and preservation of the pipe: Shipping, hauling, unloading, stringing and installing HDPE should be done with the care necessary to prevent damage to the pipe. Since all plastics are softer than steel, poor handling can result in abrasions, cuts, gouges, punctures and are causes for rejection.

All pipe shall be carefully examined before installation and damaged pipe removed. Damage that results in reduction of the wall thickness by more than approximately 10% should be cut out and discarded as it may impair long-term service life.

Damaged pipe will be repaired by butt fusion only.

E. Pipe Dimensions:

Pipe supplied under this specification shall have a nominal IPS (Iron Pipe Size) O.D. unless otherwise specified. The pipe size and SDR (Standard Dimension Ratio) of the pipe supplied shall be as specified by GSWSA

3.5.2 Construction Practices

A. Handling of Pipe

Pipe shall be stored on clean, level ground to prevent undue scratching or gouging of the pipe. If the pipe must be stacked for storage, such stacking should be done in accordance with the pipe manufacturer's recommendations. The handling of the pipe should be done in such a manner that it is not damaged by dragging over sharp objects or cut by chokers or lifting equipment.

B. Repair of Damaged Sections

Segments of pipe having cuts or gouges in excess of 10% of the wall thickness of the pipe should be cut out and removed. The undamaged portions of the pipe shall be rejoined using the butt fashion joining method and as per the specification.

C. Pipe Joining and Directional Boring

Sections of polyethylene pipe should be joined into continuous lengths on the job site above ground. All shavings and cuttings resulting from the fusion operation shall be collected from the on job fusion/cutting site and properly removed off and disposed of from the project site. The joining method shall be the butt fusion method and shall be performed by the manufacturer's trained and certified technicians and in strict accordance with the pipe manufacturer's recommendations. The butt fusion equipment used in the joining procedures should be capable of meeting all conditions recommended by the pipe manufacturer, including, but not limited to, temperature requirements, alignment, and fusion pressures. Prior approval of fusion equipment and personnel shall be obtained from GSWSA before fusion begins. The contractor shall furnish prior written evidence that the thermal fusion shall be conducted by personnel that have received approved and proper training in the use of fusion equipment according to the recommendations of the pipe supplier and the fusion equipment supplier. The installing contractor shall maintain on file with the Authority a certification of training of personnel operating the approved equipment for fusion and installation work. The Authority reserves the right to reject at any time the contractors proposed or being used, equipment and personnel as applicable to pipe joining and directional boring. The drilling-boring contractor shall receive prior approval of what manufacturer and product the drillers mud is proposed

to be used. The size of the Auger Head shall be approved by the Authority prior to its use.

D. END CONNECTIONS

Special mechanical joint ends will be required for each end. See standard drawings developed for polyethylene installation for special end conditions. This HDPE MJ adapter to be size on size. Any required change in pipe diameter shall be made using DI MJ fittings with restraints. HDPE reducers are not allowed. The HDPE MJ transition adapter DR must match the DR of the HDPE bore pipe being installed.

E. HANDLING OF FUSED PIPE

Fused segments of pipe shall be handled so as to avoid damage to the pipe. When lifting fused sections of pipe, chains or cable type chokers should be avoided. Nylon slings are preferred. Spreader bars should be used when lifting long fused sections. Care should be exercised to avoid cutting or gouging the pipe.

F. INSTALLATION

Trenching, installing, backfilling and testing shall be in accordance with GSWSA specifications and drawings and special method of installation developed for this specific project. An electronically generated profile and plan shall be provided as a part of the overall project as-built for each directional bore where installed. See Standard Drawing WS 4.

3.5.3 FINAL TESTING

After polyethylene piping is installed, back filled and all air removed, the contractor shall apply a hydrostatic pressure of 150 psi or 1.5 times the working pressure as determined by the Authority to the pipe. The test pressure shall be allowed to stand without make-up pressure for a period of time as required by the pipe manufacturer and approved by the engineer to allow for diameter expansion or pipe stretching to stabilize. This stabilization time is approximately 24 hours and will vary depending on field conditions. After the required equilibrium period the test section shall be returned to the original test pressure. All final testing shall be in conformance with GSWSA specifications.

3.6 WROUGHT PIPING

3.6.1 GENERAL

Wrought steel pipe shall conform to ASTM A-53. Wrought iron pipe shall conform to ASTM A-72. All wrought piping shall be standard strength schedule 40 and shall be galvanized inside and outside

3.7 PIPE FITTINGS

For all pipe three (3) inches in diameter and greater, fittings will be ductile iron in accordance with AWWA C110/ANSI A 21.10 latest revisions. Ductile iron fittings will be cement mortar lined in accordance with AWWA C104/ANSI 21.4 with an outside coating. The coating will be of bituminous material approximately one (1) mil thick and will be continuous and smooth and strongly adherent to the fittings. Fittings will be Class 350 up to twenty-four (24) inches and Class 250 for sizes greater than twenty-four (24) inches. Fittings will be marked in accordance with ANSI 21.10. Mechanical joints will be in accordance with ANSI 21.11. Payment weight will be as listed in ANSI 21.10 or AWWA C-110-71. Fittings weights will be without accessories. Fittings shall be American Cast Iron Pipe Company, Tyler Union, Sigma, or approved equal.

The Authority reserves the right to require special interior and/or exterior coating as applicable to certain applications of usage. All coated fittings must meet requirements of NSF-61.

All bends and fittings may be of the compact size in accordance with AWWA C153/A21.53 latest revisions. The fitting manufacturer must be approved prior to placement of any order.

Fittings for pipe less than three (3) inches in diameter will be in accordance with ASTM D 2467 for Schedule 80 fittings

The Authority reserves the right upon inspection of delivered bends and fittings to reject any item not in full conformance to the specifications and that have been damaged (linings or exterior) and/or found to be out of round.

3.8 PIPE INSTALLATION

3.8.1 GENERAL

Pipe shall be installed in accordance with the manufacturer's recommendations and as specified in Chapter 4 of these specifications. Disinfection and pressure testing shall meet the requirements in Sections 4.4 and 4.5

3.8.2 METHOD OF MEASUREMENT

Pipe shall be measured from the bell or connection at the beginning to the bell or connection to the end, per linear foot, complete in place and accepted, including the furnishing of all labor, tools, materials, and equipment necessary for trenching, laying, jointing, testing, sterilizing, back filling, connections to existing mains, and all other necessary

CHAPTER 4

WATER MAIN CONSTRUCTION METHODS

4.1 GENERAL

This section shall include furnishing all labor, tools, equipment and other incidentals required for the construction of the water distribution system as shown on the drawings and as specified herein

The work shall include laying pipe and installing fittings, valves, hydrants, and services, pressure testing, installation of tracer wire, and sterilization of the water distribution system

Materials shall be as specified in previous sections of these specifications.

4.1.1 SHOP DRAWINGS

The Contractor will submit shop drawings as may be specified by the Engineer and the Authority for all pipe and appurtenant items. For piping, the Contractor will submit a notarized sworn statement from the manufacturers stating that inspections and all specified tests have been made and the results comply with the appropriate standards set forth in these specifications

4.2 PIPE AND FITTINGS

Pipe and fittings shall be laid as directed by the engineer, and located as shown on the drawings. No additional payment will be made due to location changes directed in the field by the engineer

Pipe laying for pressure piping will be in accordance with AWWA Standards and manufacturers recommendations and these specifications for delivering, protecting, handling, storing, laying and use of the pipe to be installed.

4.2.1 TRENCHING

The trench shall be dug to the required alignment and depth as shown on the plans or directed by the engineer, and only so far in advance of the pipe laying as the engineer shall permit. The width of the trench shall be kept at a minimum. The depth of the trench shall generally be sufficient to allow a minimum of three feet of cover over the top of the pipe. The bottom of the trench shall be shaped by hand and shall support the pipe for the entire length. It shall be the responsibility of the Contractor to provide adequate bearing for all pipe lines laid in uncertain

soil conditions. If the trench bottom should be softened by flooding, rain or other causes, the unsuitable material shall be removed and replaced with suitable material properly shaped and tamped to grade. The use of timber or other material to support the pipe shall not be accepted.

4.2.2 PIPE LAYING

Water pipe shall be laid in conformance with the standards set forth by AWWA C-600, latest revision. All water pipe shall be laid by experienced workmen with straight lines, even grades, and all joints shall be perfectly fitted. All pipe fittings, valves, hydrants, and accessories shall be carefully lowered into the trench with suitable equipment in a manner that will prevent damage to pipe fittings. Under no circumstances shall pipe or accessories be dropped or dumped into the trench. Pipe and accessories shall be inspected for defects prior to their being lowered into the trench. Any defective, damaged or unsound material shall be repaired or replaced as directed by the Engineer. All foreign matter or dirt shall be removed from the interior and machined ends of pipe and accessories before it is lowered into position in the trench. Pipe shall be kept clean by means approved by the engineers, during and after laying.

Pipe will be laid on true lines as according to the plans without any unnecessary bending or wandering of the pipe along the right-of-way. Minimum nominal lengths of eighteen (18) feet for ductile iron and (20) feet for PVC C900 of pipe sections will be used and installed with a minimum of (36") inches of cover for PVC C900. Ductile iron minimum depth shall be eighteen (18") of cover.

The trench bottom will be leveled so as to provide a firm, stable, uniform support. Bell holes will be excavated at each joint to assure support is provided along the barrel of the pipe and to permit proper assembly of the joint. Ledge rock, boulders and large stones will be removed within six (6) inches of all sides of the pipe

Joints shall be fitted to insure watertight joints and shall be in conformance with manufacturer recommendations. Transition couplings manufactured per AWWA Standards will be used for joining different type pipes.

4.2.2.1 TRACER WIRE:

Where PVC or Polyethylene pipe is used in water main construction, a continuous #12 gauge blue insulated solid copper tracer wire, approved by the manufacturer for direct burial, shall be installed and taped to the top of the water line. The tracer wire shall terminate at each valve or meter and be arranged to allow connection of equipment for tracking pipe and to prevent interference of operating the valve or meter. Standard underground type electrical wire connectors are to be used where splicing is required. All terminals are to be taped for corrosion and underground deterioration protection. Tracer wire shall be as manufactured by Baron, # 12 AWG, UL, UF, 600V or prior approved equal.

As an alternate, PRO-TRACE copper clad steel conductor tracer wire or prior approved equal may be used. Conductor shall be #12 AWG, blue in color, RoHS compliant and rated for direct burial use at 30 volts.

4.2.2.2 JOINTING MECHANICAL JOINT PIPE

- 1) Joining Existing Bell and Spigot to New Mechanical Joint: Due to the difficulty that may be encountered in attempts to make such a connection of this type, an adapter having a fitting bell and M.J. socket may be used by the Contractor.

- 2) Cleaning and Assembling Joints: Clean last 8" outside the spigot, and the inside of the bell of mechanical joint pipe to remove oil, grit, tar (other than standard coating) and other foreign matter from the joint and then paint area clean with an AWWA approved standard lubricant. The ductile iron gland shall then be slipped on the spigot end of the pipe with the extension of the gland toward the socket or bell end. The rubber gasket shall be painted with the standard lubricant and placed on the spigot end with thick edge toward the gland.

- 3) Bolting of Joints: Push entire section of pipe forward to seat spigot end in the bell. Press gasket into place within the bell, being careful to have the gasket evenly located around the entire joint. Move ductile iron gland along the pipe into position for bolting insert all bolts, and screw nuts up tightly with fingers. Tighten all nuts with a suitable (preferably torque-limiting) in order to produce equal pressure on all parts of the gland.

4.2.2.3 JOINTING RUBBER GASKET PIPE (BELL TITE, TYTON, OR EQUIVALENT)

- 1) **Cleaning Joint Gasket:** Clean gasket, spigot and inside of bell thoroughly to remove all dirt and other foreign matter
- 2) **Inserting Gasket:** Insert gasket furnished by the pipe manufacturer into the gasket seat in the bell. Gasket shall be properly seated in the grooves provided in the pipe bell.
- 3) **Lubricating Gasket and Pipe Spigot:** Using a non-toxic vegetable soap, apply a film by hand to the inside surface of the gasket that comes into contact with the entering pipe and to the first 1" of the spigot end of the entering pipe. Use only lubricant specified by the pipe manufacturer.
- 4) **Final Assembling of Joint:** Align entering pipe with the bell to which it is to be joined. Enter the spigot end into the bell until it just makes contact with the gasket. Apply sufficient pressure to force the spigot end past the gasket up to solid contact with the bell.
- 5) **Field Cutting Pipe:** When it is necessary to field cut pipe with rubber gaskets, chamfer the cut end 1/8 inch X 30 degrees before inserting into a rubber gasket bell.
- 6) **Fittings:** Fittings shall be installed where and as shown on the plans or as directed by the Engineer. All bends (1/16 to 1/4), y-branches, plugs and all other fittings requiring such shall be sufficiently restrained, backed, blocked, or braced to preclude the possibility of their leaking or blowing off the main.
- 7) **Bell joint restraints** shall be used on each side of a bend, valve and/or fitting. See Detail Drawing for minimum number to be installed on each side.

4.2.3 MECHANICAL THRUST RESTRAINTS

All turns, fittings, etc., that induce pressure which would cause separation of pipe, breakage, etc., shall be mechanically restrained in such a manner that the pressure to be exerted at the point of restraint is transferred to the pipeline for a distance sufficient to prevent separation, breakage, etc., MJ fittings shall be restrained with restraints such as Romac Grip Ring or Ebaa Iron 2000PV Megalug restraints for PVC

pipe and Series 1100 Megalug for DI pipe or approved equal. Pipe joints shall be restrained with harness or bell restraints such as Ebaa Iron Series 1700 for DI slip joint pipe or Series 1500 or Series 1100 HV for PVC, Romac Grip Ring, JCM Series 600 fusion epoxy coated or, Ford Uni Flange restraints or approved equal. Specialized PVC and DIP restraints are to be used as recommended by the manufacture for each type of pipe being used. See Standard Detail Drawing WS3 for required restraints. All installations shall be in conformance to the manufacturer's requirements and no deviation will be allowed. Two bell restraints shall be required on the two joints either side of a directional bore.

4.2.4 CONCRETE BLOCKING

Concrete thrust blocking shall only be used if approved by GSWSA or mechanical restraints are not feasible. Where mechanical restraints are not feasible, all turns, fittings, etc., that induce pressure which would cause separation of pipe, breakage, etc., shall be blocked with 3,000 lb. concrete. Blocking shall be formed and placed in such a manner that the pressure to be exerted at the point of blocking shall be transferred to firm, undisturbed earth at a maximum load of 2,000 lbs., per square foot. The Contractor shall insure that blocking at all tees, bends, plugs, etc., shall be sufficient to contain all pressure exerted by the pipe up to a pressure of 200 lbs., per square inch hydraulic pressure within the pipe, i.e., pressure at plug = 200 X (area of pipe in inches). Blocking shall be constructed as shown on the detail sheet contained in these specifications. The Contractor shall also be responsible for any damage or repairs caused by blowouts of any insufficiently blocked pipe.

4.2.5 METHOD OF MEASUREMENT

The cost of laying pipe including connection of existing mains, pressure testing, sterilization, and bacteriological testing shall be included in the unit price per foot of pipe measured as previously specified. The cost of setting valves, fittings, water services, etc., shall be included in the cost per unit of the respective item measured as specified.

Blocking for fittings shall be measured by the cubic yard of concrete. This item shall include all labor, equipment, and incidentals necessary to properly block all fittings and bends according to the detailed drawings contained herein.

4.3 BORING UNDER HIGHWAYS AND RAILROADS

4.3.1 GENERAL

This section shall include furnishing all labor, tools, equipment and other incidentals required to bore casing pipe under highways or railroads.

Before starting boring operations, the Contractor shall submit to the Engineer an experience record of the proposed boring sub-contractor. Such record shall include a list of equipment and personnel to be used, and a list of at least five previous successful similar installations under highways or railroads within the past five years. Failure to submit an experience record or submittal of a record not meeting these requirements will be cause for rejection of the boring subcontractor.

4.3.2 BORING

Procedures for boring shall be in accordance with the best accepted methods of the construction and as shown on the plans and specified and detailed in these specifications.

- A. Boring under Highways: Lines installed under highways shall be bored as shown on the detail drawings contained in these specifications. Casings will be installed of the type, size, and thickness as specified herein or on the detail drawings. The Contractor shall be responsible for notifying the South Carolina Department of Transportation at least five days prior to any contemplated work and for securing any required permits for performing the work. All work shall be accomplished under the supervision of the Engineer and the District Engineer of the Department of Transportation or his authorized representative.
- 1) Carrier Pipe: Carrier pipe used under highways shall be of an approved material and installed to the satisfaction of the District Engineer of the Department of Transportation. Carrier pipe shall be of the same material specified for water main construction unless otherwise noted. The carrier pipe shall be restrained at each end with pipe meg-a-lugs and rods welded to the casing per GSWSA standard details. All carrier pipe shall be restrained at each joint within the casing pipe.
 - 2) Casing pipe: The inside diameter of the casing pipe shall not be less than 2 inches greater than the largest outside diameter of the joints and couplings for carrier pipe less than 6" o.d., and 4"

greater for carrier pipe 6" or larger. It shall, in all cases, be great enough to easily remove carrier pipe without disturbing the casing pipe.

- a. Pipe Size 8" and Smaller: Schedule 40 wrought steel or wrought iron pipe having a wall thickness as shown below.

Diameter of Pipe (in.)	Schedule 40 Wrought Steel Wall Thickness (in.)	Wrought Iron Wall Thickness (in.)
2	0.203	0.208
4	0.237	0.242
6	0.280	0.286
8	0.322	0.329

- b. Pipe Sizes Larger than 8": Steel pipe casings larger than 8" shall be manufactured from steel than 8" having a minimum yield strength of 35,000 psi with the minimum wall thickness as shown below

Diameter (in.)	Minimum Wall Thickness (in.)
10	0.188
12	0.188
16	0.250
18	0.250

20	0.250
24	0.250
30	0.312
32	0.375
36	0.375

- 3) Installation: The depth from the roadway surface to the top of the casing pipe at its closest point shall be minimum three feet. The casing pipe ends shall be protected from the entrance of foreign material. The casing pipe shall extend from ditch line to ditch line or toe to toe of till unless otherwise noted on the plans or specified herein. Carrier pipe shall be supported with casing spacers.

Contractors should provide shoring of boring pits and trenches more than 5 feet deep in accordance with the South Carolina Department of Transportation and Federal Occupational Health and Safety Act.

- 4) Casing Spacers: Casing spacers shall be prefabricated steel with polyethylene insulators capable of being securely fastened to the carrier piping by bolting methods. Casing spacers shall be Cascade, Advance Products, CMI Boyd's Spider Manufacturer or approved equal. A minimum of three spacers shall be used per pipe. See standard GSWSA detail. Submittals for approval shall be made for the use of casing spacers.

- B. Borings under Railroads: All work on railroads rights of way shall be done under the supervision of the Chief Engineer of the railroad, or his authorized representative, who shall be notified at least 15 days before construction is begun. In addition, this work shall only be done in the presence of the authorized representative of the Chief Engineer, and no methods shall be use that, in the opinion of the representative, could be hazardous to the railway.

- 1) Carrier Pipe: Carrier line pipe and joints shall be of the material shown on the details of the railroad encroachment agreements. Carrier pipe shall be of the same material specified for water main construction unless otherwise noted. The carrier pipe shall be restrained at each end with pipe meg-a-lugs and rods welded to the casing per standard details. All carrier piping shall be restrained at each joint within the casing pipe.

- 2) Casing Pipe: The inside diameter of the casing pipe shall not be less than 2 inches greater than the largest outside diameter of the joints and couplings for the carrier pipe less than 6" o.d. and 4" greater for carrier pipe 6" and larger. It shall, in all cases, be great enough to easily remove carrier pipe without disturbing the casing pipe.

Steel pipe manufactured from steel having a minimum yield strength of 35,000 psi and having a minimum permissible wall thickness as listed below shall be used as casing pipe.

Diameter of Casing Pipe (in.)	Minimum Wall Thickness (in.)
10	0.188
12	0.188
16	0.219
18	0.250
20	0.281
24	0.344
30	0.406
32	0.438
36	0.469

- 3) Installation: The depth from the base of the railway rail to the top of the casing at the closest point shall not be less than 5'. Also, there should not be less than 3 feet from the bottom of the side ditches to the top of the casing pipe. The casing pipe ends shall be protected from the entrance of foreign materials. The casing shall extend 25 feet either side of the centerline of the railroad track unless otherwise noted on the plans or specified herein. Carrier pipe shall be supported with casing spacers. Contractors shall be required to shore all pits used for boring if it is over 5 feet deep.

- 4) Casing Spacers: Casing spacers shall be prefabricated steel with polyethylene insulators capable of being securely fastened to the carrier piping by bolting methods. Casing spacers shall be Cascade, Advance Products, CMI Boyd's or approved equal. A minimum of three spacers shall be used per pipe. See standard GSWSA details. Submittals shall be made for the use of casing spacers.

4.3.3 METHOD OF MEASUREMENT

Bores shall be measured in linear feet from end to end of casing pipe installed and accepted. This item shall include casing pipe and other materials, tools, equipment, labor and incidentals required to bore and install casing as shown on the details and as directed by the highway or railroad district engineer and/or resident engineer.

4.3.4 AS-BUILTS REQUIREMENTS

The Contractor shall provide within 14 days of completion of all bores (jack and bores as well as horizontal directional drills) the following:

- A. Plan review of bore that shows:
 - 1) Project name, project #, bore # and bore description
 - 2) Start location of bore labeled "Start of Bore" with corresponding plan station and measurements to permanent features (edge of pavement, centerline of road, telephone pedestals, power poles, RCP ends, etc.).

- 3) End of location of bore labeled "End of Bore" with corresponding plan station number and measurement to permanent features (edge of pavement, centerline of road, telephone pedestals, power poles, RCP ends, etc.).
- B. Profile view of bore that shows:
- 1) Project name, project #, bore # and bore description
 - 2) Vertical depths from existing ground plotted beginning with the "Start of Bore" continuing at 10' intervals until the "End of Bore"
 - 3) Vertical separations shown between bore and all existing utilities (water, sewer, telephone, electric, TV, gas, storm drainage, etc.).

4.4 PRESSURE AND LEAKAGE TESTS

4.4.1 GENERAL

All sections of pressure pipe laid under this contract will be subjected to pressure and leakage testing in accordance with all sections of AWWA C900 and C905 and/or C605 and any and all AWWA latest editions, except as modified in these specifications. The main shall be subjected to a hydrostatic pressure test of 150 pounds per square inch for a period of two hours minimum or a minimum of two times the system working pressure. The test pressure to be used is to be 150 psi unless otherwise approved.

After installation and back filling, the lines will be flushed clean and all air expelled from the lines. The Contractor will provide for at his cost and as may be needed additional and/or new ARV's and outlets for air removal at all high points in the line to accomplish a complete air free hydrostatic test. Temporary taps may be required to be provided for in order to achieve a complete flush and air removal. Additional permanent and/or temporary air release points that may be required are to be provided for by the contractor and no additional compensation will be provided. The hydrostatic test pressure at the lowest point in the line will be equal to the rated working pressure of the pipe unless otherwise specified under Section I "Special Conditions". The Contractor will be responsible for providing all pumps, connections and any other apparatus including gauges for the proper completion of the testing.

The Contractor will conduct all pressure and leakage tests in the presence of the Engineer's representative and a representative of the Authority. Each section of line between valves will be tested in order to check the tightness of valves for a

period of fifteen (15) minutes. After the first section of line has been tested, the valve will be opened and the second section and valve(s) tested.

The test will proceed in this manner until an entire area is under pressure. Pressure will be maintained over the entire area for a period of two (2) hours. Allowable leakage in the two (2) hour period will be in accordance with the following table:

Allowable Leakage*

(in gallons per hour per 1,000 L.F.)

Pipe Size	Test Pressure			
	50	100	150	200
2"	0.11	0.15	0.18	0.21
3"	0.16	0.23	0.28	0.32
4"	0.21	0.30	0.37	0.42
6"	0.32	0.45	0.55	0.64
8"	0.42	0.60	0.74	0.85
10"	0.53	0.75	0.92	1.06
12"	0.64	0.90	1.10	1.27

* For lengths of 18 feet. For lengths of 20 feet multiply allowable leakage by a factor of 0.9. For line sizes not shown in table, the Authority will provide the allowable valve.

Water for testing will be provided by the Authority for line flushing and testing in conformance with the Authority's latest Extension Policy. Water loss due to improper workmanship will be paid for by the Contractor.

4.5 FLUSHING AND DISINFECTION PROCEDURES

4.5.1 FLUSHING NEW WATERLINES

In line with DHEC standards, two pipes full of water are required to pressure test and sterilize the line. This volume of water as metered by the GSWSA, as outlined in the Authority's Extension Policy.

NOTE: TAP VALVES BETWEEN EXISTING LINES AND CONTRACTORS LINES SHALL REMAIN CLOSED AT ALL TIMES. THIS VALVE SHALL BE OPENED ONLY BY REPRESENTATIVES OF THE GSWSA AT THE TIME OF FINAL ACCEPTANCE.

The GSWSA Water Department must monitor this volume of water and measure all water used. No water may be used for this purpose without proper notification and authorization of the GSWSA and proper monitoring of the usage. Metering may be done via hydrant meters installed and controlled by the GSWSA. Meters have the capacity to measure up to 750 GPM will normally be used. Lines requiring larger flows may require 2 or more – metering points.

All systems will be designed to allow for measurements of flushing water via locating fire hydrants and post hydrants at the end of all lines. All water will be billed to the contractor or the owner of the system at the normal rates in effect at the time the water is used.

The exact time the flushing will be allowed will be at the GSWSA's discretion. The Water Department will coordinate with the Inspections Department.

The Water Department will notify the Contractor of the time he will be allowed to flush the system. Flushing during other times will be considered in violation of these procedures and the Contractor may be charged for any water or flushing not authorized and fined according to the Authority's Developer Policy.

Any contractor failing to contact the Inspection Department for coordination and measurement of flushing may also be assessed a fine plus the cost of the estimated volume of water consumed.

All fines and/or water charges so levied in accordance with this procedure must be paid prior to receiving Service Authorization and acceptance of the system by the GSWSA.

The following data is provided as a guide to calculate the flow and volume needed to properly flush a system; minimum velocity is 2.5 ft. per second:

Pipe Size (in.)	Gallons/Ft	Minimum Flow for Flushing (GPM)
3"	0.37	55
6"	1.47	220
8"	2.61	380
10"	4.08	620
12"	5.86	860
16"	10.45	1575

Any deficiencies in the system will be repaired and/or replaced and retested at no cost to the Owner or the Authority.

4.5.2 DISINFECTION

After pressure and leakage tests, all sections of line will be disinfected in accordance with AWWA 651, latest edition, except as modified in these specifications.

NOTE: DISCHARGE OF HIGHLY CHLORINATED WATER INTO WETLANDS OR OTHER SENSITIVE AREAS WILL NOT BE ALLOWED.

The lines will be thoroughly flushed prior to disinfection at a velocity sufficient to clean the lines. The Contractor must take precautions to assure that proper drainage is achieved where flushing water is discharged. No flushing device may be directly connected to any sewer.

Under the supervision of the Authority's Water Department Representative, the contractor will be instructed to open the metered tap valve between the existing and new water lines slightly to allow a constant rate of water to slowly fill the new line. Chlorine will be pumped by continuous feed methods into the line in sufficient quantities to provide a minimum chlorine residual throughout the system of fifty (50) parts per million (ppm). The new line will then be isolated from the existing system for a period of twenty-four (24) hours. All valves and hydrants shall be operated within this period to disinfect the appurtenances. After twenty-

four (24) hours, the treated water will contain no less than 25 mg/l of free chlorine residual through the lines tested. The lines will again be opened after the twenty-four (24) hour period and thoroughly flushed until no chlorine exists as determined by the DPD test administered by the Authority's Water Department Representative.

The contractor or owner shall collect a minimum of two (2) samples from each sampling site for total coliform analysis. The number of sites depends on the amount of new construction but must include all dead-end lines, be representative of the water in the newly constructed mains, and shall be collected a minimum of every 1,200 linear feet. A tap will be placed prior to disinfection on the top of the pipe at predetermined locations based on the previous guidelines and will be used by the Authority's Water Department Representative to collect samples for bacteriological quality. No hoses or hydrants will be used in collecting samples. After flushing of the chlorine from the system, the Contractor will provide sterilized bottles and the Authority's Water Department Representative shall take a minimum of two samples with the second sample taken twenty-four (24) hours after the first sample. The sample analysis Department Representative will measure and report the chlorine residual.

The sample results must show the absence of coliform bacteria. If the membrane filter method of analysis is used for the coliform analysis, non-coliform growth must also be reported. If the non-coliform growth is greater than eighty (80) colonies per one hundred (100) milliliters, the sample result is invalid and must be repeated. Should the analysis show bacteria present, the Contractor is responsible for repeating the disinfection and analysis procedures. The number of sampling points required will be as directed by the Engineer. Once suitable back-to-back bacteriological samples are obtained, the Engineer will be responsible for notifying the South Carolina Department of Health and Environmental Control (DHEC) so that the department can obtain samples necessary to confirm the absence of bacteria. DHEC testing is required prior to placing the lines in service. Disinfection will be required on potable water lines only and not on sewer force mains. The Contractor will be responsible for the cost of water as outlined in the Authority's latest Developer Policy.

4.5.3 WATERLINE AND FORCE MAIN/GRAVITY SEWER LINE SEPARATION

Water line passing over force main or gravity sewer line shall have a minimum clearance of eighteen (18) inches between the outside of the water main and

outside of the sewer line. Where the eighteen (18) inch separation is not possible, both water and force main or gravity sewer lines shall be ductile iron pipe each with a minimum section of eighteen (18) linear feet of pipe centered at the crossing. Suitable bedding of the sewer lines will be provided to the spring line of the water line for a distance of two (2) feet each side of each pipe at the center of the crossing.

Water line passing beneath force main or gravity sewer line shall have a minimum clearance of eighteen (18) inches between the outside of the water main and outside of the sewer main. In addition, both water and force main or gravity sewer lines shall be ductile iron pipe each with a minimum of eighteen (18) linear feet of pipe centered at the crossing. Suitable bedding material shall be provided from the bedding of the water line to the spring line of the sewer line for a distance of two (2) feet each side of each pipe at the crossing.

Horizontal separation between water line and force main or gravity sewer line shall be a minimum of ten (10) feet from the inner edges of each pipe unless otherwise approved by the Authority. Where it is not practical to provide ten (10) feet of horizontal separation, the bottom of the water line shall be placed a minimum of eighteen (18) inches above the top of the force main or gravity sewer line in a separate trench. Where neither the ten (10) feet nor eighteen (18) inches of clearance are practical the water line shall be placed as far as practical horizontally and as high as practical above the force main or gravity sewer line while providing minimum cover and shall consist of ductile iron pipe. Any deviations from the minimal standards for separation and pipe material selection shall be approved by the engineer of work, DHEC and the Authority.

Special Conditions: When it is impossible to obtain the distances specified in SCDHEC *R.61-58.4(D)(12)(a) and (b)* GSWSA may allow an alternative design. Any alternative design shall:

- Maximize the distances between the water main and sewer line and the joints of each;
- Use materials which meet the requirements SCDHEC *R.61-58.4(D)(1)* for the sewer line; and
- Allow enough distance to make repairs to one of the lines without damaging the other.

Drain-fields and Spray-fields: Potable water lines shall not be laid less than 25 feet horizontally from any portion of a waste water tile-field or spray-field, or shall be otherwise protected by an acceptable method approved by SCDHEC.

4.5.4 PAYMENT

Payment when required for pressure pipe will be based on a unit price per linear foot. The unit price will include the furnishing and installation of materials, excavation, bedding, back filling, gaskets, transition couplings, unloading, hauling and placing of the pipe. The unit price will also include tie-ins (wet or dry) to the existing system, valves and other appurtenant items unless otherwise specifically shown as a separate item on the Bid Form. Pipe will be measured for payment along the centerline of the pipe as installed.

4.6 VALVES AND TAPPING SLEEVES

4.6.1 GENERAL

Valves 8" and smaller shall be provided with special support consisting of a sufficiently tamped trench bottom and crushed stone. Valves 10" and larger shall be supported by concrete pads unless otherwise directed by the Engineer. Crushed stone shall be used to encase the valve up to the height of the valve nut. The bid item unit cost for valves shall include the valve, valve box, valve box collar, concrete markers, testing, bedding and any associated appurtenance necessary for a complete, functional installation.

All valve bonnets and stuffing box bolts, studs, washers and nuts shall be "316 stainless steel". This is applicable to all size valves.

4.6.2 VALVE EXTENSIONS AND MARKERS

Any valve installed at a depth greater than 5' shall have a nut extension installed to within 2' of the surface. Concrete markers shall be installed for all bends, valves and buried facilities. The number of markers required per location shall be determined by the inspector and O&M department.

4.6.3 DOUBLE DISC VALVES

Double Disc Parallel Seat Gate Valves (AWWA). Double disc parallel seat gate valves will be manufactured in accordance with AWWA C-500, latest revision. Valves shall be non-rising stems (NRS) with 2" square operating nut for buried service installations, or outside screw and yoke (OS & T) if noted on plans. Valves shall be manufactured with O-ring stem seals. Valves will be designed for a working pressure of 200 psi for sizes 2" through 12", and 150 psi for valves 14" and larger. Double Disc valves 16" and larger shall be equipped with bypass valves to equalize pressure on both sides of gate. All valves 24" and larger shall be equipped with gearing, rollers, tracks, and scrapers as needed for horizontal installation. Valves bodies will be of heavy cast iron with corrosion resistant parts and coatings, high tensile manganese bronze stems and bronze disc rings. Flanged valves shall be in conformance with ANSI B 16.1, Class 125. Tapping valves shall have flanged inlet end with centering ring and a mechanical joint outlet end. All buried service gate valves shall be fitted with cast iron valve boxes and cover with fully adjustable tops. Double disc gate valves shall be, Mueller, American Flow Control, M & H, Clow, or approved equal.

4.6.4 RESILIENT SEAT OR WEDGE GATE VALVES

Resilient seat gate valves shall be either cast iron or ductile iron body, bonnet, and stuffing box and comply with AWWA C-509 latest revision. External parts will consist of corrosion resistant materials or be protected by corrosion resistant coatings (fusion bonded epoxy) in compliance with AWWA C550. The wedge type valve disc will be cast iron or ductile iron with bronze stem nut and bronze stem, and shall be fully EPDM rubber encapsulated including stem nut area and guides. The operating mechanism shall be equipped with O-ring seals above and below the thrust collar to prevent entrance of contaminants. The stem shall be lubricated in the space between the seals, and shall utilize anti-friction washer above and below the thrust collar. The use of seal cartridges shall not be allowed. Above ground installations shall be mechanical joint with restraints, or, flanged with hand wheels, or as noted on plans. Buried service valves shall be mechanical joint or threaded with 2" square operating nuts. All valves shall be non-rising stems (NRS) and shall open counter-clockwise. Stems shall be bronze in conformance with AWWA C-509 standards. Body to bonnet fastening shall be by hex head nuts and bolts only.

Resilient seat gate valves will be for use in sizes 4" through 12. When open, the valve will provide smooth unobstructed flow with a diameter equal to the nominal

diameter of the valve. The valves will be subject to two hydrostatic tests. The first test will check for leakage across the seat at 200 psi, and the second in the open position for leakage at flanges, body, O-rings at 400 psi. Valves shall be American Flow Control, Mueller, Clow or approved equal.

4.6.5 BUTTERFLY VALVES

All butterfly valves, except as herein otherwise noted, shall conform to AWWA C-504, latest revision. All valve shafts shall be connected to operators by the use of keys and keyways. The use of compression or friction connections is not acceptable.

The seat on disc valve shall be continuous around the periphery of the disc and shall not be penetrated by the valve shaft.

Standard service butterfly valves shall be short body type, Class 150B. Valve disc shall be contoured ASTM A 48, Class 40 cast iron or ASTM A536, Grade 65-45-12 ductile iron. Valve shaft shall be Type 304 stainless steel with self-lubricating, corrosion-resistant sleeve type bearings. Valve seat shall be attached to either the valve body or the disc and shall be of EPDM rubber. Valves shall be equipped with totally enclosed geared operator. Valves shall be flanged with 125 pound full faced flanges drilled in accordance with ANSI B 16.1.

Buried service butterfly valves shall have ANSI/AWWA C111/A21.11 integrally cast mechanical joint ends, and shall be Class 150B. Valves shall be equipped with totally enclosed geared operator. Valves shall have ASTM A126, Class B cast iron body. Valve disc shall be contoured ASTM A 48, Class 40 cast iron or ASTM A536, Grade 65-45-12 ductile iron. Valve shaft shall be Type 304 stainless steel with self-lubricating, corrosion-resistant sleeve type bearings. Valve seats shall be attached to either the valve body or the disc and shall be of EPDM rubber.

Operators shall be equipped with a 2" square operating nut, open left, and have sealed grease case operator to withstand an external groundwater pressure of 10 psi minimum. Valves shall be Henry Pratt, Mueller LineSeal III, Clow, Dezuick, American Flow Control, M & H, or approved equal with manufacturers standard geared operator. Approval of submittals must be obtained prior to purchasing for installation.

4.6.6 RESILIENT SEATED GATE VALVES 14" THROUGH 24"

Valves may be completely ductile bodied, lightweight with compact wall, and shall conform with applicable AWWA standards. The valve shall be 250 psi rated, and 500 psi shell tested, and shall have a ductile iron gate completely encapsulated in EPDM rubber including stem nut area and guides. Shall be capable of horizontal installation where needed for ground line clearance through the use of manufacturers enclosed bevel gear operator mounted directly to the valve by the manufacturer. Valve shall have a fusion bonded epoxy coating inside and out conforming to AWWA C-550. When open the valve shall have a smooth port with no obstructions or cavities to collect debris. Valve body to bonnet shall be fastened by hex head bolts and nuts only. Valve shall be American Flow Control Series 2500, Mueller, M & H, or approved equal. Approval of submittals must be obtained prior to placement of order.

4.6.7 SWING CHECK VALVES

The Contractor will furnish and install swing check valves as shown on the plans which meet the requirements of AWWA C508. For valves four (4) inches and larger, bodies and bonnets will consist of cast iron or cast steel and will be designed to allow removal of the clapper arm and sic assembly through the bonnet opening without requiring removal of the valve from the line. Disc will be of cast iron or cast steel with bronze or alloy disc rings machined into the disc. The seat ring will be bronze or stainless steel and will be threaded for removal with the valve body in line. Clappe arms will be bronze bushed ductile iron. Clapper arm shafts will be manufactured of bronze or high tensile aluminum bronze, will be extended through the body for attachment of the weight or spring and will be capable of being field adjusted. Flanged ends will be faced and drilled in accordance with ANSI B 16.1 Class 125. Valves twelve (12) inches and smaller will have a minimum working pressure rating of 175 psi and 350 psi hydrostatic test pressure and valves larger than twelve (12) will have a corresponding pressure of 150 psi and 300 psi. The valves may be operated by lever and weight or lever and spring as directed by the Engineer.

Check valves for fire systems shall be UL and FM approved detector double check type. External levers are not allowed in UL or FM installations.

4.6.8 BALL CHECK VALVE

The contractor shall furnish and install ball check valves of the type and size indicated on the drawings which meet the requirements of AWWA C507. The

valves shall consist of a gray cast iron Class 35 body and cover and a hollow steel ball with a vulcanized nitride rubber exterior. The ball check valve will have one moving part. The design of the valve shall be such that it keeps solids, stringy material, grit, rags, etc. moving without the need for back flushing. The ball shall clear the waterway providing "full flow" equal to the nominal size. It shall be non-clog. There shall be no outside levers, weights, springs, dash pots or other accessories required for a swing (clapper) type check valve. The ball shall be resistant to grease, petroleum products, animal and vegetable fats, diluted concentration of acids and alkalinize (ph 4-10), tearing and abrasion. Flange drilling shall be according to ANSI B 16.1, Class 125. The ball check valve will be installed in a horizontal or vertical position as shown on the plans. If shown, the valve shall be of the type shown on the plans.

4.6.9 VALVE BOXES

Gate valves will be fitted with cast iron valve boxes and covers with fully screw type adjustable top for all buried installations. Cast iron valve boxes shall be provided for all valves installed underground. The boxes shall be adjustable to fit the depth of earth cover over the valve and shall be designed so as to prevent the transmission of surface loads directly to the valve or piping and concrete around the outside per standard drawings. Valve boxes shall have "WATER" clearly marked on top cover.

4.6.10 VALVE EXTENSIONS AND MARKERS

Any valve installed at a depth greater than 5' shall have a nut extension installed to within 2' of the surface. An extension shall be permanently attached to valve nut and shall be provided with spacers for vertical alignment within the valve box. Concrete markers shall be installed for all bends, air release valves, valves and fire hydrants. A minimum of two concrete valve markers and/or permanent ties shall be approved as part of the as-built dimensioning process. Markers shall be painted blue. The number of markers, their locations and the number required per location shall be determined by the inspector and O&M Division. See standard details for Valves, Boxes, Extensions and Markers.

4.6.11 DOUBLE CHECK VALVE OR REDUCED PRESSURE BACK FLOW PREVENTOR

Double check valve assemblies or reduced pressure back flow preventors shall be installed as shown on the plans to protect the water supply source from contamination. Each valve will operate independently of each other. Springs will

consist of stainless steel. The assembly shall consist of a one-piece bronze sleeve and seat capable of being disassembled and repaired without removing the unit from the line service. Double check valve assemblies or reduced pressure device must be included on the South Carolina Department of Health and Environmental Control's, "List of Approved Back flow Prevention Devices," latest edition. Installation of the assembly shall be in accordance with manufacturer recommendations and Authority standard drawings and shall be in such a manner as to provide adequate access to the assembly for operation and testing. The assembly provided must be capable of operating in the vertical or horizontal position shown on the plans. Each assembly must be tested by a certified tester upon installation and once annually thereafter or after any repairs.

4.6.12 TAPPING SLEEVES

All tapping sleeves and tapping valves are to be air tested and inspected prior to installation of adjoining pipe systems.

All tapped pipe wall sections "cookie" coupons after tapping shall be retrieved and turned over to the Authority inspector. The Contractor shall verify all taps with the Authority inspector.

A. Mechanical Joint Type

Tapping sleeve to be manufactured from gray cast iron meeting or exceeding ASTM A126 Grade B or ductile iron meeting ASTM A536 Grade 65-45-12 (outlet sizes 14" and larger).

Tapping sleeve to be used in conjunction with a mating tapping valve from same manufacturer. Outlet flange of sleeve to be counter-bored per MSS SP-60 for true alignment of tapping valve and tapping machine. Sizes of outlet to be available through equal opening of sleeve diameters up to 24". Sizes 12" and smaller sleeves must be capable of working on Class ABCD Pipe diameters without changing either half of sleeve. Sizes 14" and larger must be specified as to which class size is needed. All sleeves are to include the end joint accessories and split glands necessary to assemble sleeve to pipe. MJ bolts and nuts are to conform to ANSI/AWWA C111.A21.11. No special tools other than standard socket wrench to be required for assembly of sleeve to main.

Cast or ductile sleeves shall be coated with asphaltic varnish per Federal Specification TT-V-51, Military Specification MIL C-450, or approved equal.

B. Single Seal Type and Stainless Steel

Tapping sleeve to be manufactured from gray cast iron meeting or exceeding ASTM A126 Grade B or fabricated T-304 stainless steel including flange in accordance with ANSI/AWWA C-207 Class D ANSI 316.5 CI 150. Sleeve to be of the lightweight compact type with sealing effected by a single rectangular gasket used inside the sleeve. No other auxiliary means of sealing ends of sleeve to be necessary.

Tapping sleeve to be used in conjunction with a mating tapping valve from same manufacturer. Outlet flange of sleeve to be counter-bored per MSS SP-60 for true alignment of tapping valve and tapping machine. Sizes of outlet to be available through equal opening of sleeve diameters.

Maximum bolt torque required to seal sleeve to main shall be 90 ft.-lbs. All bolting used shall be equal to ANSI/AWWA C111/A21.11 specifications. Sleeve shall be capable of fitting to PVC, either cast iron or ductile iron pipe, Class ABCD diameters, without changing either half of sleeve. No special tools other than standard socket wrench to be required for assembly of – sleeve to main.

Cast sleeves shall be coated with asphaltic varnish per Federal Specification TT-V-51, Military Specification MIL C-450, or approved equal.

All stainless steel sleeves shall conform to the following:

- Shell and Lugs: Stainless steel per ASTM A240, type 304 and type 304L.
- Bolts: 5/8" UNC rolled thread, stainless steel per ASTM A 193, type 304. 4" nominal pipe size has 1/2" bolts. Fasteners coated to prevent galling.
- Nuts: Heavy hex, stainless steel per ASTM A194, type 304.
- Washers: Stainless 304 Steel and plastic lubricating washer.
- Gaskets: Virgin SBR per ASTM D2000 MAA 610, compounded for water and sewer service. Other compounds available on request.
- Flange: Stainless steel per ASTM A240, type 304. Approved tapping sleeves are Romac SST No. 3, Smith Bair 665, Mueller H304, JCM 452 or prior approved equal.

4.7 AIR AND VACUUM RELEASE VALVE ASSEMBLIES

4.7.1 GENERAL

This section covers the work necessary for furnishing and installing the air and vacuum release valve assemblies, complete. Air and vacuum relief valves shall be provided in accordance with sound engineering practices at high points in water mains as required. Automatic air and vacuum relief valves shall not be used in situations where flooding of the manhole or chamber may occur. Chambers, pits or manholes containing valves, blow-offs, meters, air relief valves, or other such appurtenances to a distribution system shall not be connected directly to any storm drain or sanitary sewer.

4.7.2 MATERIALS

Main Line connection shall be a wide band single strap service saddle with AWWA thread corporation stop, tap, and neoprene gaskets. Service saddles shall be adequate for use with the size, type, and class of the water pipe and shall be ROMAC No. 101N, Smith Blair 315 or approved equal by GSWSA.

4.7.3 COMBINATION AIR AND VACUUM RELEASE VALVES

The air and release valves shall be designed to operate under working pressures of 150 psi and shall have been tested at a pressure not less than 300 psi, and be 1 inch in size with iron pipe threads on the inlet. Air and vacuum release valves shall have cast iron body and cover. Float guides, bushings, and lever pin shall be stainless steel or bronze.

The air and vacuum release valves shall be ARI combination air release valves, or approved equal by GSWSA.

4.7.4 AIR RELEASE VALVES

Air release valves shall have cast iron body and cover. Float guides, bushings, and lever pin shall be stainless steel or bronze. The air release valves shall be designed to operate at a design pressure of not less than 150 psi. Inlet size shall be 1/2 inch NPT.

The air release valves shall be Val Matic, Crispin or approved equal by GSWSA.

4.7.5 PIPE AND MALLEABLE IRON FITTINGS

The pipe used for the air release valve assemblies shall be Schedule 80 PVC or Schedule 40 stainless steel pipe or approved equal.

4.7.6 WORKMANSHIP

A. Tapping Pipe

On existing waterlines, or waterlines accepted by GSWSA, unless otherwise approved the pipe shall be tapped and service saddle installed by GSWSA Personnel.

B. Testing and Sterilization

Air and vacuum release valve assemblies shall be tested and sterilized in conjunction with the pipeline.

4.8 POTABLE WATER SERVICE CONNECTION

4.8.1 GENERAL

The work covered under this division of the specifications is intended to include the furnishing of all equipment, materials, and labor necessary for or reasonably incidental to the complete installation of the individual house service or building lines including the following items as may be indicated on the plans or specified. Corporation stop, service line, stretch meter box, and double check valve or reduced pressure type back flow preventer. Bid item unit prices for residential service taps shall include tap saddle, tap corporation stop, piping, gaskets, meter box, check valve assembly, and meter setter complete in place. All brass fittings, fixtures and valves coming in contact with potable water shall be made of no lead brass. No-lead brass being defined as a brass product's lead content not exceeding 0.25%, weighted average. All stainless steel fittings shall conform to ASTM A351. Stainless steel nipples shall conform to ASTM A312.

4.8.2 SERVICE CONNECTION SIZE

The location and size of service connection to be installed will be as shown or as directed by the Engineer or the Authority. The water meter will be installed by

the Authority. Services shall consist of the tap, saddle, corporation stop, one (1) inch service line, 1" x 3/4" x 3/4" wye for dual services, and stretch yoke box with dual services.

4.8.3 QUALITY STANDARDS

Quality standards refer to the following standard references with respect to materials, test and physical parameters:

ASTM B88 - Type "K" Copper service line (Only where specifically approved for use.)

AWWA C800 - Threads for all fittings

Commercial Standard Specifications CA-255-63 - Polyethylene Pipe, 200 psi Min. SDR 9 with NFS seal of approval. (See Section 4.8.9)

4.8.4 SUBMITTALS

The Contractor may be required to submit complete shop drawings, cuts, diagrams and charts as necessary, all in accordance with the general conditions and/or special conditions for the project.

4.8.5 METER SETTER

Where meter setters are required the Contractor shall furnish all brass meter setters with connection required to connect to 1 inch service lines on street side of installation and 3/4 inch house connection line on property side of installation. Setters furnished shall raise the meter to point seven inches (7") above run of the service line and shall be equipped with 3/4 brass ground key curb cutoff cock. Connections shall be for 5/8 inch x 3/4 inch meter. Setters furnished shall be similar and equal to that manufactured by Ford Meter Box Company or an equal as may be approved by the Engineer and the Authority.

Meter setters of a different size may be required if designated in the specifications or on the proposal or Project drawings. See Authority Standard Details for turf box and valve on property side of meter.

4.8.6 METER BOXES AND COVERS

Ford 3/4 inch Golden Gate Yoke box No. 241-233-NL with locking lids and angle inlet, straight outlet, as manufactured by Ford Meter Box or approved equal. The

stretch box assembly w/double check valve where required shall be per cities supply for 3/4" and 1" service connections. See standard drawing for applicable installation. Check valve shall be Ford HHC 33-322 or Watts No. 7.

4.8.7 INSTALLATION OF METER BOXES

Meter boxes or vaults shall be installed as shown or as directed by the Engineer or the Authority. Finish grade of completed meter enclosure shall be flush with existing ground or shown otherwise or as directed by the Engineer. Meter boxes or vaults shall be set or constructed plumb with the top set to conform to the slope of the finish grade. Lightly compacted earth backfill shall be placed inside of the meter boxes to depth indicated. Grade adjustment of the meter boxes or vaults shall be by using standard extension sections for the box or vault specified. Backfill around meter vaults as specified for adjoining pipe. Final adjustment to grade of meter box and meter appurtenances is the responsibility of the customer's installing contractor. No meter will be authorized to be set until approval of all appurtenant work and final inspection by the Authority has been received. Meters will be set by Authority personnel.

Meters may be withheld from installation until the entire water system is ready for operation. The remainder of the service connection, excluding the meter and other appurtenances, may be installed at any time during or after construction of the water main. Meters cannot be set until the waterline is first approved by the Authority and received final inspection.

4.8.8 COPPER PIPE (ONLY WHERE SPECIFICALLY APPROVED FOR USE)

Copper pipe used in service entrances shall conform to the requirements for seamless copper service pipe used for underground service connections as specified by ASTM B88, Type "K" for the sizes specified. The copper tubing shall be cut with square ends, reamed, and flared with the proper size flaring tool, cleaned, and made up tightly. Care shall be taken to prevent the tube from kinking or buckling on short radius bends. Kinked or buckled sections of copper tube shall be cut out and the tube spliced with the proper brass fitting at the Contractor's expense.

4.8.9 POLYETHYLENE SERVICE LATERAL PIPING

Where called for on the plans and/or specifications polyethylene or cross linked polyethylene service pipe shall be furnished as approved by the AWWA and the National Sanitary Foundation for 200 psi working pressure. Service pipe shall be

SDR9 (200 psi) polyethylene or cross linked polyethylene, CTS. Pipe shall be marked with the following information: nominal size, manufacturer's name, operating pressure, water service, CTS, NSF, ASTM D 2737 or ASTM F876, material classification and date code. Cross linked polyethylene pipe shall also have a minimum marking of PEXa 3306.

4.8.10 CURB COCKS

Curb cocks furnished shall be a brass ground key curb cock for use with selected service pipe. Curb cocks shall be designed to receive the service pipe connection with straight coupling nut on the street side and an iron pipe thread connection on the opposite side. Curb cocks shall be as manufactured by Mueller, Ford Meter Box Company, or approved equal. See standard drawing for application.

4.8.11 CORPORATION COCKS

Corporation stops. Stops shall be of the same size as the service. Normal house taps shall be 1 inch. Stops shall be CC X CTS (Compression) with an insert if recommended by the manufacturer and shall be Ford, Mueller, Hays or approved equal. See standard drawings for application.

4.9 WATER METERS

4.9.1 COLD WATER METERS - DISPLACEMENT TYPE

The work covered under this division of the specifications is intended to include the furnishing of all equipment, material and labor necessary for or reasonably incidental to the complete installation of the water meters as indicated on the drawings and specified herein.

Water meters shall be installed as shown on the plans. All meters furnished shall comply completely with the latest edition of AWWA C700-71 "AWWA Standards for Cold Water Meters - Displacement Type" 5/8 inch x 3/4 inch Sensus or approved equal shall be used.

4.9.2 COLD WATER METERS - COMPOUND TYPE

The work covered under this division of the specifications is intended to include the furnishing of all equipment, materials and labor necessary for or reasonably incidental to the complete installation of the water meters as indicated on the drawings and specified herein for larger compound type meters.

Water meters shall be installed as shown on the plans. All meters furnished shall comply completely with AWWA C702-70 "AWWA Standard for Cold Water Meters - Compound Type." The Authority shall select the manufacturer and the model meter to be used.

4.10 TAPPING SADDLES

4.10.1 WATER SERVICE LINE TAPPING SADDLES

The Contractor shall furnish and install complete a wide band single strap nylon coated S.S. service saddle or double strap for all taps occurring in pipe mains. Saddles shall be threaded with CC pipe threads. Saddles furnished shall be per the standard drawing for saddles.

Service clamps shall be used on all taps regardless of type main being tapped. Clamp shall have CC outlet and be designed for use of the pipe being tapped. Clamps shall be Romac 101 N, Smith Blair 315, Mueller DEIS or approved equal by GSWSA. All saddles shall meet AWWA standards.

4.10.2 HYDROSTATIC TEST AND LEAKAGE

Test service connections and service connection pipe in conjunction with the main at the test pressure required for the main. Duration of the test shall be in conformance with Chapter 4.

Service connection transfers will be visually inspected for leakage by the Authority under normal system pressure.

4.11 HYDRANT ASSEMBLIES

4.11.1 FIRE HYDRANT SPECIFICATIONS

All fire hydrants shall comply with AWWA Standards C502, the latest revision thereof, and the following design standards.

Fire hydrants shall be of the dry barrel compression type, closing with line pressure, and all operating parts, (including valve seat ring, drain ring upper valve plate, nozzles, etc.) shall be all bronze meeting either of the following: ASTM B61, B62, B98, B150.

Hydrant operating threads shall be contained in an oil or grease reservoir. All threaded and metal to metal bearing surface in bonnet shall be automatically lubricated each time the hydrant is cycled. Maximum operating torque to open or close hydrant shall not exceed 25 ft. lbs. at 50 PSI pressure. Grease and oil shall be USDA food grade.

The main valve shall be of rubber, minimum 4 1/2" diameter. The seat ring shall be bronze and threaded into bronze seat bushing located between lower barrel and shoe, forming an all bronze drain way with a minimum of two drain port openings. Hydrant barrels and shoe shall be cast iron or ductile iron. Bolts securing the lower barrel to the shoe shall be minimum of 3/4" hex head. Distance from bury cast line on lower barrel to center line of nozzles shall be a minimum 18". Lower barrel shall have raised or notched line denoting target ground line. Barrels shall be cast iron or ductile iron and be separated by flat rubber gaskets. Flanges of barrels shall be either snap-ring design so as not to transmit shock waves to underground joints, or integral.

Hydrant hardware shall be stainless steel including nuts, bolts and washers.

Maximum pressure loss allowed shall not exceed AWWA standards.

Hydrant shoe and lower valve plate shall be coated with fusion bonded epoxy coating inside and out, meeting AWWA C-550.

Hydrant shall be traffic model with breakable flanges, and stem coupling shall be breakable design with pinned connectors. Hydrant shall be equipped with one 4 1/2" pumper NST threads, and two 2 1/2" hose nozzles NST threads. Hydrant shall open left (counter-clockwise) and shall be rated for 200 PSI and shall meet Underwriters Laboratory and Factory Mutual Insurance rating. All suppliers shall provide data certifying to the above criteria when requested.

Hydrant shall be marked with the name of the manufacturer, year of manufacture, and valve opening size. Approved fire hydrant manufacturers are American-Darling Mark 73 by AFC, Mueller Super Centurion, Clow, M & H or approved equal.

All hydrants shall be red in color and installed on the same side of the road as the water main unless otherwise specifically noted.

4.11.2 POST HYDRANT SPECIFICATIONS

Post hydrants or flushing hydrants shall conform to AWWA Standards C502, the latest revision thereof. Post hydrants shall be dry barrel compression type closing with line pressure. Post hydrants shall have a minimum of one 2-1/2" National Standard hose connection. Post hydrants shall be Eclipse, Clow, M & H, Mueller, or approved equal. Installation is to be per standard detail drawings.

Hydrant hardware shall be stainless steel including nuts, bolts and washers.

All hydrants shall be red in color.

4.12 WATER CROSSINGS

4.12.1 All pipe installations above water crossings shall be adequately supported and anchored, protected from damage and freezing, accessible for repair or replacement.

4.12.2 Under water crossings: A minimum of 2 feet of cover shall be provided over the pipe. When crossing water courses that are greater than 15 feet in width, the following shall be provided:
(R.61-58.4.D.(13)(b)(i)-(iii))

- a. The pipe material and joints shall be designed appropriately.
- b. Valves shall be located so the section can be isolated for testing or repair, the valves (on both sides of crossing) shall be easily accessible and not subject to flooding.
- c. A blow-off shall be provided on the side opposite the supply service sized in accordance with *Section R-61-58.4.(D)(7)*. Direct away from streams, over ground.
- d. Major rivers and water way crossings shall have the minimum required cover as identified in the Corps of Engineering permit conditions.

CHAPTER 5

SITE WORK AND FENCING

5.1 FENCING

5.1.1 GENERAL

The Contractor shall perform all work necessary for or incidental to the performance and completion of fencing, where fencing is required. This work shall be completed as shown on the drawings and as specified. This work shall include the furnishing of all labor, materials and equipment. The contractor shall be responsible for coordinating the work to assure that the work is completed in an orderly manner.

Although such work may not be specifically shown or specified, all supplementary or miscellaneous items, appurtenances and devices incidental to or necessary for a sound, secure and complete installation shall be furnished and installed as part of this work.

5.1.2 CHAIN LINK FENCE MANUFACTURING AND MATERIALS

Chain link fence installed on this project will meet or exceed all applicable standards of the Chain Link Institute. Fencing provided will be of new materials only and all fabric, posts, gates, post tops, tension wire, bars, rails, bands, braces, fittings, fasteners and all other items necessary will be one reputable manufacturer. All items will be hot-dip galvanized steel except fabric which may be aluminum coated. Materials will be fabricated and welded prior to coating. The fencing will consist of the following:

A. Fabric

Fabric will be one piece six (6) feet in width and will consist of No. 9 gauge wire woven in tow (2) diamond mesh with barbed selvages at top and bottom. Fabric will consist of zinc coated steel or aluminum coated steel. Zinc coated will be in accordance with ASTM A 392, Class I "Zinc Coated Steel Chain Link Fence Fabric," and will require 1.2 oz. of coating per square foot (S.F.) of wire surface area. Aluminum coated will be in accordance with ASTM A 491, Class II and will require 0.40 oz. per SF of wire surface area.

B. Posts

1. Line posts will be 2 1/2 inch outside diameter (O.D.) galvanized steel pipe weighing not less than 3.65 lbs. per linear foot (LF); or 2 1/2 inch square tubing or 2 1/4 inch H -Sections weighing not less than 4.1 lbs. per LF.
2. Gate posts will be three (3) inch O.D. galvanized steel pipe weighing not less than 5.79 lbs. per foot for gates up to six (6) feet in width.
3. Corner, pull and end posts or terminal posts will be three (3) inch O.D. galvanized steel pipe or 2 1/2 inch square tube weighing not less than 5.79 lbs. per LF. Corners will be considered as changes in direction of thirty (30) degrees or more. Pull posts will be used at abrupt changes in grade. Posts will be sufficient length to be set in thirty-six (36) inches of concrete as shown on the plans. Steel Pipe will be galvanized in accordance with ASTM A 120 (1.8 oz. zinc per S.F.) Steel, weather-tight post caps will be provided for each post.
4. Bracing rails will consist of 1 5/8 inch O.D. galvanized steel pipe weighing not less than 2.27 lbs. per LF. Bracing will be between terminal posts and adjacent line posts and installed midway between the top rail and the ground level. Pipe will be galvanized in accordance with ASTM A 120 (1.8 oz. zinc per S.F.).
5. Stretcher Bars for attaching fabric to terminal posts will be flat bars of a cross section of 3/16" x 3/4" steel consisting of one piece equal to the height of the fabric. Stretch bar bands will be No. 11 gauge sheet metal spaced at fifteen (15) inches on center and bolted with 3/8 inch diameter bolts. Stretcher bars will be provided at one bar for each gate and end post and two for each corner and pull post. Bars and bands will be galvanized in accordance with ASTM A 120 (1.8 oz. per S.F.).
6. Tension Wire for attaching the fabric to terminal posts will be No. 7 gauge spring rolled steel galvanized with 0.8 oz. of zinc per S.F. of surface and spaced twenty-four (24) inches on center. Fabric bands will be No. 9 gauge wire or straps, galvanized steel or aluminum for attaching fabric to line posts and top rails.

7. Fittings will be of malleable steel, cast iron or pressed steel, rigid and weatherproof and suitable size for strong construction. Included will be a forty-five degree bracket to accommodate three strands of barbed wire.
8. Barbed wire will consist of two (2) strands of No. 12 1/2 gauge wire with 14 gauge 4 point barbs in accordance with ASTM A 121 with Class 3 zinc coating and spaced five (5) inches O.C.
9. Gates. Gate frames will be constructed of galvanized steel pipe not less than 1 7/8 inch in diameter and weighing not less than 2.72 lbs. per LF or square tubing weighing not less than 3.65 lbs per LF. Frames will be bolted, riveted or welded with welds provided with an application of zinc based paint. Fabric will be as previously specified and will be attached with a spacing not exceeding fifteen (15) inches. Gate hinges will be of pressed or forged steel or malleable iron of adequate strength with large bearing surfaces for clamping or bolting in position. Hinges will be off-set to permit 180 degrees gate opening. Hinges will not deform under the action of the gate. Gate latches will be a plunger-bar arranged to engage the center gate stop and for locking with padlocks. Keepers will be provided to engage the gate leaf and hold it open until manually released. A drop rod on the latch with casing set in concrete will be provided. The gates will be capable of being easily opened and closed by one person. A padlock with two keys will be furnished by the Contractor and keyed as specified by the Engineer.
10. All fabric, posts, wires, etc. shall conform to the standard detail approved by GSWSA.

5.1.3 CHAIN LINK FENCE ERECTION

Erection of the fence will be in full accordance with the standards of the Chain Link Institute, ASTM F 567 and manufacturer recommendations and will be by experienced, skilled mechanics.

Final grading of the site will be along straight lines, and set plumb with posts spaced at a maximum distance of ten (10) feet.

Postholes will be drilled in firm, undisturbed or compacted soil. The Contractor is responsible for verifying suitability of soil conditions prior to installation. For posts less than six (6) inches in diameter, holes will be twelve (12) inches in diameter for terminal posts and nine (9) inches for line posts to a depth of forty (40) inches below grade. Posts will be set in a concrete foundation completely filling the hole to a depth of thirty-six inches below grade with four (4) inches of concrete below the bottom of the post. The top of the concrete foundation will be shaped to drain water.

Horizontal brace rails and diagonal truss rods (3/8") brought to proper alignment. Top rails will be installed with expansion couplings providing rigid connections allowing expansion and contraction. Top rails will be anchored to main posts with proper fittings. The fence framework will be firmly fit. Fabric will be installed from two (2) inches above grade at the bottom to the top of fabric at the top rail. The fabric will be stretched tight and fastened to end posts with stretcher bars and clamps and to line posts and top rails with wires or bands. The fabric installed on the security side of the fence. Fabric will be free of sags or bulges and secured to posts at fifteen (15) inches O.C. and to top rails at twenty-four (24) inches O.C.

Three strands of barbed wire will be installed on the brackets of the fence and gate, tightened and fastened on each bracket. Brackets will be angled away from the security side of the fence.

Gates will be erected rigidly without sagging, twisting or loose fittings and hung plumb and level. Hardware will be adjusted to provide smooth opening and closing of the gate.

5.2 GRASSING

5.2.1 GENERAL

The Contractor shall perform all work necessary for or incidental to the performance and completion of grassing, when required for specific projects. This work shall be completed as shown on the drawings and as specified. This work shall include the furnishing of all labor, materials, and equipment. The Contractor shall be responsible for coordinating the work to assure that the work is completed in an orderly manner.

Although such work may not be specifically shown or specified, all supplementary or miscellaneous items, appurtenances, and devices incidental to or necessary for

a sound, secure, and complete installation shall be furnished and installed as part of this work.

5.2.2 SUBMITTALS

The Contractor shall submit data on the suppliers of all materials to be used, germination results, seed content, etc.

5.2.3 SEED SCHEDULE

Grassing shall be in accordance with the latest S.C. Department of Highways and Public Transportation seed schedule.

In all applications, seeded area shall receive an application of mulch at a minimum rate of one (1) bale per 400 SF with 4.5 gallons emulsified asphalt per bale to anchor mulch.

The following procedure shall be utilized in all seeded areas: The topsoil shall be conditioned with limestone incorporated into the full depth of the topsoil by discing, rototilling, or other approved method. The incorporating machine shall pull a drag or other acceptable smoothing device. Following the limestone application, fertilizer shall be applied at the required application rate, evenly spread and incorporated into the top one inch of soil by raking. All debris, stones, etc., over one inch in diameter shall be removed. Finish soil by alternately dragging leveling device and rolling with light-weight (less than 3 1/2 tons) roller until surface is free of high spots and depressions and lightly compacted with positive surface drainage.

Seed shall be sown at the specified rate and mixture within 24 hours following soil conditioning and application of fertilizer. Immediately after seeding, mulch shall be evenly applied at the specified rate. Erosion and displacement of newly laid mulch shall be prevented on all swales and slopes. Displaced mulch shall be applied as necessary to insure grass cover.

Materials used shall meet the following specifications:

5.2.4 LIMESTONE

Ground dolomitic limestone shall be used containing not less than 85 percent total carbonates and 8 percent magnesium. Limestone shall be ground so that 50 percent passes 100 mesh sieve and 90 percent passes 20-mesh sieve. Coarser materials shall be acceptable provided the rate of application is increased over the

specified rates proportionately on the basis of quantities passing 100-mesh sieve. Lime shall conform to the requirements of the South Carolina Department of Agriculture.

5.2.5 FERTILIZER

Commercial fertilizer shall be used containing 5 percent nitrogen, 10 percent available phosphoric acid and 10 percent potash. Fertilizer provided shall conform to all applicable state and federal regulations, conform to the plant nutrients standards of ADAC, be uniform in composition, and be dry and free flowing. Fertilizer shall be delivered to the site in original, unopened, containers bearing manufacturer's guaranteed analysis.

5.2.6 SEED

Seed shall be certified, blue tag, clean, meeting the specified mix requirements. Seed shall be delivered to the site in original, unopened, containers bearing manufacturer's guaranteed analysis. Seed shall be guaranteed 95 percent pure and have a minimum germination rate of 85 percent within one (1) year of application.

5.2.7 MULCH

Mulch shall be threshed straw of oats, wheat, or rye free from seed of nuisance weeds or clean salt hay.

5.2.8 ACCEPTANCE AND PAYMENT

Before acceptance of the grassed areas, the Contractor shall be required to produce a stand of grass sufficient to survive dry periods and winter weather and capable of re-establishment in the spring. Grasses shall be strongly growing of good color, disease free, and of a density sufficient to provide visible evidence of strong resistance to erosion. Stands of grass shall not be satisfactory if the bare spots exceed the following limits: more than 10 percent of any 1,000 square feet area with bare spots larger than six square inches; more than 15 percent of any 1,000 square feet area with bare spots larger than 4 square inches; any bare spots larger than 2 square feet

5.3 CONCRETE WORK

5.3.1 GENERAL

The Contractor shall perform all work necessary for or incidental to the performance and completion of concrete work. This work shall be completed as shown on the drawings and as specified in the contract documents. This work shall include the furnishing of all labor, materials, and equipment. The Contractor shall be responsible for coordinating the work to assure that the work is completed in an orderly manner.

Although such work may not be specifically shown or specified, as a part of water system improvements, all supplementary or miscellaneous items, appurtenances and devices incidental to or necessary for a sound, secure and complete installation of a water system shall be furnished and installed as part of this work.

5.3.2 MATERIALS

The Contractor may be required to submit the names of suppliers of all concrete materials. Materials supplied on the project will meet the requirements of ACI 301-72, "Specifications for Structural Concrete for Buildings. "Concrete will be 3,000 or 4,000 psi standard 28 cylinder strength as shown on the plans with a maximum design slump of four (4) inches. Ready Concrete must meet the requirements of ASTM C 94. Specifications for Ready Mix Concrete". Concrete form-work will meet the requirements of ACI 347 "Recommended Practice for Concrete Form work."

Reinforcing steel bars will be Grade 60 for bars No. 4 and larger and Grade 40 for No. 3 bars. Reinforcement bars will meet the requirements of ASTM A 615 for Billet Steel Bars.

5.3.3 TESTING

Concrete testing will conform with ACI 301-72 Chapter H. Two concrete cylinders will be provided per test with two tested at seven days and two additional cylinders at twenty-eight days. One test (four cylinders) will be required per one hundred (100) cubic yards for each type concrete poured. Concrete failing the strength test will be repaired and/or replaced – and re-tested at the Contractor's expense.

Concrete testing will be conducted by a laboratory selected by the Owner or the Authority. The Contractor will be responsible for notifying the Owner, Engineer and Authority and testing laboratory a minimum of twenty-four (24) hours prior to placement of concrete.

Concrete mix test results may be required to be submitted to the Engineer or the Authority prior to initiating concrete work showing compliance with specifications. Engineer's or Authority's approval of concrete mix does not relieve the Contractor of the responsibility for the performance of the concrete.

5.3.4 INSTALLATION

Concrete will not be placed when the temperature is forty (40) degrees Fahrenheit and falling or when freezing weather is predicted within twenty-four hours. The Contractor may place concrete in cold weather if approved and the requirements of ACI 306, "Recommended Practice for Winter Concreting, " are met. However, accelerator antifreezes and high early strength (Type III) concrete may be required to be utilized.
