

**TECHNICAL
SPECIFICATIONS
FOR
WATER DISTRIBUTION
SYSTEM IMPROVEMENTS**



SPARTANBURG WATER SYSTEM

SPARTANBURG, SOUTH CAROLINA

Approved by SCDHEC on March 7, 2019

PREFACE

Where the specifications refer to the Spartanburg Water Engineering Department, this shall include but not be limited to, the Collection and Distribution (C&D) Department.

In an attempt to standardize the water distribution systems being deeded to or constructed for the Spartanburg Water System (SWS), we have developed the following specifications for items that shall be incorporated into the design and construction of all water distribution systems. The basis for these specifications is the SOUTH CAROLINA DEPARTMENT OF HEALTH AND ENVIRONMENTAL CONTROL R.61-58 State Primary Drinking Water Regulations. These specifications shall be followed. If they must be deviated from, you shall contact the Spartanburg Water Engineering Department or the C&D Department that is managing the project, and discuss the reasons for the deviation. We are aware that not all items will work in all situations and must ask for your cooperation in working with SWS to resolve problem areas. If you have any comments concerning these specifications, please feel free to contact us at (864) 585-9142.

These specifications will be updated periodically as deemed necessary. It is your responsibility to contact SWS to verify that the revision you are working with is the most recent. All standards cited in the text refer to the latest revision of that standard under the same specification number or to superseding specifications with a new number.

Please refer to the [Spartanburg Water Developers Manual](#) for a detailed explanation of procedures and requirements that a developer must follow in order to plan, construct, and have SWS accept, a water extension for operation and maintenance.



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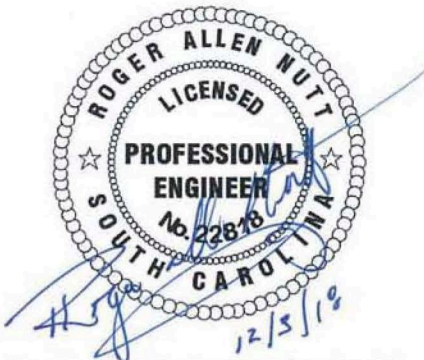
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TABLE OF CONTENTS

	PAGE
<hr/> SECTION 1 GENERAL PROVISIONS <hr/>	
1-01	1-1
1-02	1-2
1-03	1-3
1-04	1-3
1-05	1-4
1-06	1-4
1-07	1-6
<hr/> SECTION 2 RIGHTS-OF-WAY AND EASEMENTS <hr/>	
2-01	2-1
2-02	
2-03	2-1
2-04	2-2
2-05	2-3
<hr/> SECTION 3 MATERIAL SPECIFICATIONS FOR PIPE AND FITTINGS <hr/>	
3-01	3-1
3-02	3-1
3-03	3-2
3-04	3-3
3-05	3-3
3-06	3-3
3-07	3-3
3-08	3-3
<hr/> SECTION 3A DIP <hr/>	
3A-01	3A-1
<hr/> SECTION 3B PVC <hr/>	
3B-01	3B-1
<hr/> SECTION 3C HDPE <hr/>	
3C-01	3C-1
<hr/> SECTION 3D FITTINGS <hr/>	
3D-01	3D-1
3D-02	3D-2
3D-03	3D-2

TABLE OF CONTENTS (CONT'D)

	PAGE
SECTION 4 WATER MAIN INSTALLATION AND TESTING	
4-01 SCOPE	4-1
4-02 DESIGN CRITERIA	4-1
SECTION 4A EXISTING UTILITIES AND STRUCTURES	
4A-01 SCOPE	4A-1
4A-02 GENERAL	4A-1
SECTION 4B CLEARING AND GRUBBING	
4B-01 SCOPE	4B-1
4B-02 GENERAL	4B-1
SECTION 4C TRENCH EXCAVATION	
4C-01 SCOPE	4C-1
4C-02 GENERAL	4C-1
SECTION 4D ASSEMBLING AND JOINTING PIPE AND FITTINGS	
4D-01 SCOPE	4D-1
4D-02 GENERAL	4D-1
4D-03 INSTALLATION OF DUCTILE IRON PIPE	4D-1
4D-04 INSTALLATION OF PVC PIPE	4D-4
4D-05 INSTALLATION OF HDPE PIPE	4D-8
4D-06 INSTALLATION OF TRACER WIRE AND WARNING TAPE	4D-9
SECTION 4E BEDDING OF PIPE AND BACKFILLING OF TRENCHES	
4E-01 SCOPE	4E-1
4E-02 BEDDING OF DUCTILE IRON PIPE	4E-1
4E-03 BEDDING OF PVC PIPE	4E-1
4E-04 BEDDING OF HDPE PIPE	4E-2
4E-05 BACKFILLING TRENCHES	4E-3
4E-06 TEMPORARY SURFACING	4E-5
4E-07 CONCRETE ENCASEMENT OF PIPE	4E-6
SECTION 4F THRUST RESTRAINT	
4F-01 SCOPE	4F-1
4F-02 GENERAL	4F-1
SECTION 4G TESTING AND DISINFECTION	
4G-01 SCOPE	4G-1
4G-02 HYDROSTATIC PRESSURE AND LEAKAGE TEST	4G-1
4G-03 TESTING OF HDPE PIPE	4G-3
4G-04 DISINFECTION	4G-3
4G-05 PLACING IN SERVICE	4G-6

TABLE OF CONTENTS (CONT'D)

	PAGE
SECTION 5 VALVES AND TAPS	
5-01 SCOPE	5-1
5-02 DESIGN CRITERIA	5-1
5-03 GATE VALVES	5-2
5-04 BUTTERFLY VALVES	5-3
5-05 AIR AND VACUUM VALVES	5-4
5-06 MANHOLES	5-5
5-07 BALL VALVES - SWING CHECK VALVES	5-6
5-08 TAPPING SLEEVES	5-6
5-09 LINE STOPS AND VALVE INSERTIONS	5-7
5-10 SERVICE SADDLES AND CORPORATION STOPS	5-8
5-11 VALVE INSTALLATION	5-9
SECTION 6 FIRE HYDRANTS	
6-01 GENERAL	6-1
6-02 MANUFACTURE AND NOMENCLATURE	6-1
6-03 GENERAL CONSTRUCTION	6-1
6-04 MATERIALS AND EQUIPMENT	6-3
6-05 PAINTING	6-4
6-06 INSTALLATION	6-5
SECTION 7 FIRE SERVICES AND METER VAULTS	
7-01 FIRE SERVICES	7-1
7-02 FIRE SERVICE AND METER VAULTS	7-1
SECTION 8 CLASSIFIED EXCAVATION	
8-01 SCOPE	8-1
8-02 ROCK EXCAVATION	8-1
8-03 BLASTING	8-1
SECTION 9 BORING	
9-01 SCOPE	9-1
9-02 GENERAL	9-1
9-03 BORING	9-1
9-04 HORIZONTAL DIRECTIONAL DRILLING	9-6
SECTION 10 AERIAL CROSSINGS	
10-01 PIPE ON PIERS	10-1
10-02 PIPE ATTACHED TO BRIDGES	10-2

TABLE OF CONTENTS (CONT'D)

	PAGE
SECTION 11 PAVEMENT AND SURFACING	
11-01 SCOPE	11-1
11-02 DESIGN CRITERIA	11-1
11-03 CUTTING AND REPLACING PAVEMENT	11-1
11-04 REMOVING AND REPLACING SIDEWALK	11-2
SECTION 12 GRASSING AND EROSION CONTROL	
12-01 SCOPE	12-1
12-02 MATERIALS	12-1
12-03 INSTALLATION OF GRASS AND RELATED MATERIALS	12-5
12-04 TURF MAINTENANCE	12-9
12-05 EROSION CONTROL MEASURES	12-9
12-06 EROSION CONTROL MATERIALS	12-12
12-07 EROSION CONTROL INSTALLATION	12-15
SECTION 13 WARRANTY	
13-01 GENERAL WARRANTY FOR ONE YEAR AFTER COMPLETION	13-1
13-02 MAINTENANCE	13-1

APPENDIX A STANDARD CONSTRUCTION DETAILS

	PAGE
Typical Permanent Blow-off	1
Typical Valve Box	2
Typical Trenching Detail	3
Concrete Thrust Block Detail	4
Typical DIP Concrete Collar Detail	5
Water Main Air Release Valve and Manhole	6
Typical Hydrant Installation With Curb	7
Typical Hydrant Installation Without Curb	8
Typical Hydrant Installation With Water Main in Pavement	9
Carrier Pipe Installation in Casing	10
Pipe Supported on Concrete Piers Detail	11

SECTION 1
GENERAL PROVISIONS

1-01 INTENT AND SCOPE OF PLANS AND SPECIFICATIONS

It is the intent of the plans and specifications that one shall supplement the other, but not necessarily duplicate one another. Any work called for in one and omitted in the other shall be executed as if called for in both in order that the work be fully completed according to the complete design as determined by the Consulting Engineer (Engineer) and approved by the Spartanburg Water System (SWS) Project Manager. Should any discrepancy appear in or between the drawings and specifications, the specifications will govern. It is to be understood that the work described in the specifications and shown on the plans shall be complete in every detail whether every necessary item is particularly mentioned or not and the Contractor shall be held to provide all items of labor and materials necessary for the satisfactory completion of the indicated work. Any provisions contained in the specifications or shown on the standard drawings which are not applicable to the work pertaining to this project shall be disregarded. All testing shall be accomplished in accordance to these specifications and only at the discretion of the SWS shall any portions of the testing be waived.

- A. The Contractor shall check all dimensions, elevations, quantities and instructions shown on the plans or given in the specifications and shall notify the Engineer should any discrepancy of any kind be found in the plans, specifications or conditions at the site. He will not be allowed to take advantage of any discrepancy, error or omissions. If any discrepancy is discovered, the Engineer with Spartanburg Water System's approval will issue full instructions pertaining thereto and the Contractor shall carry out these instructions as if originally specified.
- B. The Specifications are divided into Sections for convenience of reference. The materials, work, etc., mentioned or specified in one part are not intended to be limited to that part only, but shall be applied with equal force to any other part or division of work where such materials, work, equipment, etc., are mentioned or required to properly provide for acceptable work according to the true intent of the drawings and specifications. Reference to standard specifications (ASTM, AWWA, ANSI, etc.), national codes, local or state codes and laws and ordinances shall mean the latest edition of said document in effect at the time of taking bids unless specifically stated otherwise.
- C. Drawings shall be followed in construction of the work and all dimensions and elevations shown on the Plans shall be accurately maintained. Scaled measurements will not be allowed and no work shall be performed when dimensions or elevations are not indicated until such dimensions or elevations are obtained from the Engineer.

1-02 MATERIALS AND WORKMANSHIP

It is the intent of these Specifications that the Contractor shall furnish first-class materials and do all work in a first-class manner so that the completed job shall be thoroughly satisfactory in every respect. To this end, the Contractor shall utilize all of his construction experience and shall consult with the Engineer regarding items in the Plans and Specifications which may be altered to the benefit of the work.

- A. **Materials, Services and Facilities:** It is understood that except as otherwise specifically stated in the specifications, the Contractor shall provide and pay for all materials, labor, tools, equipment, water, light, power, transportation, superintendence, temporary construction of every nature, and all other services and facilities of every nature whatsoever necessary to execute, complete and deliver the work within the specified time.

Materials must be approved for use before being purchased by the Contractor. The Contractor shall submit to the Engineer a list of such materials or products, and the shop drawings, together with such samples as may be necessary for determination of their acceptability and obtain material/product approval. No request for payment will be approved until this list has been received and approved by the SWS Engineering Department. Delay caused by obtaining approvals for substitute materials will not be considered justifiable grounds for an extension of construction time.

- B. **Shop Drawings:** Shop Drawings are original drawings prepared by the Contractor, or a subcontractor or supplier, which illustrate some portion of the work and show fabrication, layout, and setting or erection details. Shop drawings shall also include manufacturer's catalog sheets, brochures, diagrams, schedules, performance charts, illustrations and other standard descriptive data, as required. Shop drawings shall be clearly marked to identify specific materials, finishes, products or models, and shall show all required dimensions and clearances, performance characteristics and capacities, wiring diagrams and controls.
- 1) The Contractor shall review and check all shop drawings for accuracy and conformance with the contract documents. The Contractor's review shall include verifying field measurements, field construction criteria, dimensions, catalog numbers and similar data. Prior to submission to the Engineer, all shop drawings shall be marked, stamped or otherwise certified as approved by the Contractor, dated and signed or initialed. Any shop drawings not so marked will be returned to the Contractor without the Engineer's review.
 - 2) The Contractor shall schedule the submission of shop drawings to allow sufficient time for review by the Engineer and the Spartanburg Water System, corrections and resubmissions by the Contractor, and re-checking by the Engineer/Spartanburg Water System, as necessary. The Engineer

will review shop drawings within two (2) weeks from date received.

- 3) A minimum of six (6) copies of each submittal indicating approval by the Engineer shall be submitted to the Spartanburg Water System.
- 4) Distribution of shop drawings shall be:
 - a) SWS project file – One Copy
 - b) SWS C&D Department – Two Copies
 - c) Contractor – Three Copies
- 5) The Contractor shall not begin fabrication or work which requires submittals until return of submittals with the full approval.

1-03 SOURCE OF SUPPLY AND QUALITY OF MATERIALS

The source of supply of all materials and equipment shall be submitted to the SWS Engineering Department for review before orders are placed. Suppliers of reinforcing steel, fabricated metal work, and metal castings may be required to submit guarantees of conformity with the Drawings and Specifications. If required, representative preliminary samples of the character and quality prescribed shall be submitted by the Contractor or producer for examination and tested in accordance with the methods specified below. Only materials conforming to the requirements of the specifications shall be used in the work. Any materials proposed to be used may be inspected or tested during their preparation and use. If, after inspecting and testing and/or trial, it is found that initial sources of supply do not furnish an acceptable product in conformity with the Specifications, the Contractor shall be required to furnish materials that comply with the specifications. No materials, which after approval have become unfit for use, shall be used in the work or remain on the jobsite.

1-04 SAMPLES AND TESTING OF MATERIALS

Testing and certification of materials may be required by the Engineer if the quality of such materials are in question. In the event the materials do not meet specifications, the Contractor shall pay for the testing and provide materials which meet the specifications. If the materials meet specifications, SWS will pay for the testing. Unless otherwise specified, materials tests shall be made in accordance with the standards of the American Society for Testing and Materials (ASTM), and by a commercial testing laboratory approved by the Engineer. Reports of tests shall promptly be furnished to the Engineer. Test shall be arranged by the Contractor as directed by the Engineer. The cost of all specified inspection and testing of materials shall be paid by the Contractor.

1-05 PRECONSTRUCTION CONFERENCE:

- A. Upon SCDHEC construction permit issuance, the Consulting Engineer shall contact the SWS Project Manager to schedule a preconstruction conference. The conference shall be scheduled no less than 72 hours in advance.
- B. The conference shall be attended by:
 - 1) SWS Project Manager
 - 2) SWS Engineering Field Technician
 - 3) SWS Representative of C&D Department, if applicable
 - 4) Representative of Consulting Engineer
 - 5) Representative of the Contractor and/or the Contractor's Project Foreman (preferred)
 - 6) Representative of any Subcontractors involved with project.
- C. At least two (2) business days prior to the preconstruction conference, the Consulting Engineer shall provide the Spartanburg Water System Project Manager with four sets of plans and specifications stamped "Issued for Construction" for SWS personnel. Additional sets may be needed for Contractor. In lieu of having the printed plans prior to the preconstruction conference, an electronic copy of the "Issued for Construction" plans may be submitted. However, four sets of printed plans marked "Issued for Construction" must be brought to the preconstruction conference. Project cut sheets and applicable shop drawings shall be provided as soon as possible after the preconstruction conference and prior to starting construction.

1-06 INSPECTION

The Engineer shall provide for the inspection of all materials used and all work done under these specifications, by assistants and inspectors under his direction. Such inspection may extend to any or all parts of the work and to the preparation or manufacture of materials used, whether within the limits of the work or at any other place. The Contractor shall furnish the Engineer all information relating to the work and to the materials which the Engineer may deem necessary or pertinent and with such samples of materials as may be required. The Contractor shall, at his own expense, supply labor and assistance as may be necessary in handling material for proper inspection.

- A. The representatives of the Owner, Engineer and any State, Federal or other agency having jurisdiction over the work, shall have access to the work wherever it is in preparation or progress, and the Contractor shall provide proper facilities for such access and inspection.
- B. Spartanburg Water System Engineering Field Technician shall be authorized to

inspect all work done and all materials furnished, including preparation, fabrication and manufacture of the materials to be used. The SWS Engineering Field Technician shall not be authorized to alter or waive requirements of the Drawing and Specifications. The SWS Engineering Field Technician shall call to the attention of the Contractor to failures of the work and/or materials to conform to the Drawings and Specifications. The SWS Engineering Field Technician may reject materials or suspend work until questions at issue can be referred to, and decided by, the Spartanburg Water System Project Manager or designated representative. The presence of the SWS Engineering Field Technician shall in no way lessen the responsibility of the Contractor.

- C. The Contractor shall furnish all necessary facilities and assistance to make any examination of the complete work if such examination is deemed advisable by the Engineer. If any of the work is found defective in any respect, the Contractor shall defray the expense of the examination and satisfactory reconstruction. If the work is found acceptable, the expense of the examination shall be added to the Contractor's final estimate.
- D. Work covered up without consent or approval of the Spartanburg Water System must, if required by the SWS Engineering Field Technician, be uncovered for examination and properly restored at the Contractor's expense.
- E. If the Specifications, the Engineer's instructions, codes, laws, ordinances, or any public authority require any work to be specially tested or approved, the Contractor shall give the Engineer timely notice of its readiness for inspection; and, if the inspection is by an authority other than the Engineer, of the date fixed for such inspection.
- F. Testing: During the course of the project, the SWS Engineering Field Technician will perform and/or witness various testing which is required by SCDHEC or the Spartanburg Water System. The method of performing these tests is outlined in the following sections of this document. The SWS Engineering Field Technician will notify the Contractor of the test results, and whether the results comply with the requirements. The following is a list the testing which is generally required on water main projects:

- 1) Soil Compaction Tests
- 2) Hydrostatic Pressure Tests
- 3) Bacteriological Tests

The installation of special fixtures or materials may require additional, specialized, testing or documentation, which shall be noted on the approved plans. In these cases, the Design Engineer will be responsible for conducting and witnessing the specialized testing.

- G. Final Inspection: Upon notice from the Contractor that work is complete, the Engineer and Spartanburg Water System will make a final inspection, and will notify the Contractor in writing of all defective, incomplete or otherwise unacceptable work revealed by the inspection. The Contractor shall immediately correct all such deficiencies to the satisfaction of the Engineer and Spartanburg Water System. Once all deficiencies have been corrected, and all required testing has passed, the Engineer will then certify the project in writing to SCDHEC, copying the Spartanburg Water System, and request a final regulatory agency inspection.

1-07 EXECUTION OF WORK

- A. Verification of Dimensions and Elevations: Dimensions and elevations indicated on the drawings in reference to existing structures, location of utilities or other information on existing facilities, are the best available data obtainable but are not guaranteed by the Engineer. The Engineer will not be responsible for their accuracy. Before proceeding with any work dependent upon the data involved, the Contractor shall field check and verify all dimensions, grades, inverts, lines, elevations, or other conditions of limitations at the site of the work to avoid construction errors or damage to existing facilities. If any work is performed by the Contractor, or any subcontractors, prior to adequate verification of applicable data, any resultant extra cost for adjustment of work necessary to conform to existing conditions, or damage to existing facilities, shall be assumed by the Contractor without reimbursement or compensation by the Owner.
- B. If the Contractor, in the course of the work, finds any discrepancy between the drawings and the physical conditions of the location, or any errors or omissions in drawings or in the layout as given by survey points and instructions, he shall immediately inform the Engineer, in writing. The Engineer will promptly investigate the reported conditions and, after Spartanburg Water System approval, shall issue such instructions as may be necessary for the proper execution of the work. Any work done after such discovery and prior to receipt of such instructions shall be at the risk of the Contractor.
- C. Care of Existing Facilities: In executing the work, the Contractor shall exert every effort not to damage any existing utilities or the Spartanburg Water System existing facilities. Any damage that is done thereto shall be promptly repaired by the Contractor or by the Owner, at the Owner's option, and at the Contractor's expense. The contractor shall not interrupt or interfere with the operation of existing utilities or facilities during construction except when absolutely necessary. When this is the case, he shall consult with the Engineer, Owner and the utility company as to procedure, and shall be governed by their decision. Any damage done shall be promptly reported to the affected utility for repair. Damage

to SWS existing facilities shall be repaired promptly.

- D. The Engineer does not guarantee that all existing facilities such as buildings, fences, pipelines, electrical lines, conduit, telephone cable, service connections, or other facilities are shown on the plans. It shall be the Contractor's responsibility to locate and protect all such existing facilities prior to beginning construction.
- E. Contractor's Responsibilities. Contractor shall conduct his operations in a manner and sequence which will provide for the continued transportation of wastewater flows during construction of this project. Contractor shall take all actions required to prevent discharge of sewer flow from the system to the ground or any stream. Any construction actions that impede or interrupt flow shall be carefully executed and monitored to prevent surcharging and overflow.
- F. Any existing surface or subsurface improvements, such as pavement, curbs, sidewalks, pipe or utilities, footings, or structures (including portions thereof), trees and shrubbery, not indicated on the drawings or noted in the specifications as being removed or altered shall be protected from damage during construction of the project. Any such improvements damaged during construction of the project shall be restored to a condition equal to that existing at time of award of contract.
- G. Any such improvements damaged during construction of the project shall be restored to a condition equal to that existing at time of award of contract. All repairs to utility services shall be coordinated with the applicable utility company, and shall be made in strict accordance with their requirements.
- H. Connection to Existing Work: It shall be the express responsibility of the Contractor to connect his work to each part of the existing work or work previously installed as required by the drawings and specifications to provide a complete installation. Connections to existing water lines, prior to completion, may be allowed by the SWS on a case by case basis where requested by the Contractor and approved by the Spartanburg Water System Project Manager; otherwise, connections to existing water lines shall be made only after all inspections are completed and all punch list items have been adequately addressed. In certain cases, due to the type of pipe material, certain main transmission and other water mains in the Spartanburg Water system may only be tapped by SWS personnel. The special condition will be noted on the approved project drawings.
- I. Contractor's Work Limits: The Contractor is to perform his work in compliance with all State and Federal safety requirements within the specified public right-of-way or right-of-way as procured by the Spartanburg Water System. The Contractor may make his own arrangements for increased construction right-of-way at no additional cost to the Owner. Any damage caused by the Contractor inside or outside of the specified work limits will be the responsibility of the

Contractor.

- J. Record Drawings: To enable the SWS to prepare record drawings, the Contractor shall keep a complete set with accurate records of changes and/or deviations from the contract documents and shop drawings. It shall show the project as it was actually installed. The Contractor's record set of marked-up drawings, shop drawings and specifications shall be kept at the job site during construction and be available for inspection by the Owner. These marked-up drawings and specifications shall be included in the package of final documentation submittals before final payment is requested.
- K. Contractors Safety Requirements: The Contractor shall conduct the Project in accordance with the applicable federal, state, county and municipal laws, ordinances, and regulations. Safety and health facilities and procedures shall be in accordance with the requirements of the Federal Occupational Safety and Health Act of 1970, as it may be amended from time to time. The Contractor shall comply with the Department of Labor's Safety and Health Regulations for construction promulgated under the Federal Occupational Safety and Health Act of 1970 (P.L. 91-596), latest update to include all appropriate safety regulations, and under Section 107 of the Contract Work Hours and Safety Standards Act (P.L. 87-501). The Contractor is responsible to provide the necessary labor, equipment and material to comply with the regulations and work within the right-of-way provided by the Spartanburg Water System at no additional cost to the Owner.
- L. Order and Sequence of Work: The sequence of the work shall be as provided herein or as approved by the Engineer, which approval, however, shall in no way affect the responsibility of the Contractor. All taps and line draining for connecting lines will be coordinated with the SWS Engineering Department and may not be constructed until approved. The Contractor shall schedule with the SWS any construction work which requires interference with the waterworks operations.
- M. Handling of Materials: Proper and suitable tools and equipment for the safe and convenient handling of pipe and appurtenances are to be used. Special care shall be taken to prevent damage to all pipe, appurtenances and surrounding property while unloading, storing and stringing the pipe.
- N. String of Pipe: Stringing of pipe along the route of work will be allowed to the extent of work which can be completed during a single work day. Unloading and stringing pipe along the entire route is prohibited.

SECTION 2

RIGHTS-OF-WAY AND EASEMENTS

2-01 SCOPE

This section covers the requirements and work pertaining to the rights-of-way and easements necessary for the construction of the project.

2-02 WORK ON RIGHTS-OF-WAY AND EASEMENTS

- A. The Owner will obtain all land and rights-of-way necessary for all work under the project agreement, except for State, County, Town or City public rights-of-way. If all land and rights-of-way are not obtained before construction begins, the Contractor shall start work only upon such land and rights-of-way previously obtained by the Owner, and no claims for damages will be allowed because of such delay. The Contractor shall secure copies of all applicable right-of-way plats to be kept at the job site during construction.

- B. Contractor shall confine his construction operations to the location shown on the plans and in no case shall he encroach beyond the limits of the Owner's property or rights-of-way, without written permission provided to Spartanburg Water System Project Manager from the property owner. The exact location of the rights-of-way limits shall be shown on the rights-of-way plats which will be furnished to the Contractor. He shall place materials, equipment, supplies, etc., so as to cause the least possible damage to property and interference with traffic. Contractor's method of operation and placing of equipment may be subject to the approval of the Owner. Any damage done to property outside the rights-of-way limits shall be the financial responsibility of the Contractor. Any access to right-of-way which crosses private property shall be by written permission of the property owner with copy of same provided to SWS Project Manager and/or SWS Engineering Field Technician.

- C. It shall be the duty of the Contractor to locate the limits of the rights-of-way, or property lines, prior to beginning construction. He shall be solely responsible for any damage to trees, crops or other property outside the boundaries of the rights-of-way and shall make satisfactory settlement for any damage directly with the property owner involved.

2-03 WORK ON STATE AND COUNTY HIGHWAYS OR ROADS, TOWN OR CITY ROADS OR STREETS, RAILROAD AND OTHER UTILITY RIGHTS-OF-WAY

- A. The Contractor shall not begin excavation, grading, fill, storm drainage, paving and any other construction or installations on any property or in any right-of-way of streets, highways, public carrier lines, utility lines (either aerial, surface or

subsurface), etc. until the necessary permits are secured. The Contractor shall conform to all requirements of the authorities having jurisdiction and to the applicable requirements of the specifications. Contractor shall make all necessary arrangements with the proper authorities, including approval of construction methods, etc., and shall pay all costs charged in connection with work. Contractor shall notify the South Carolina Department of Transportation at least 24 hours in advance of any work performed on State roads and shall notify Spartanburg County Roads and Bridges at least 24 hours in advance of any work performed on County roads.

- B. The Contractor shall provide full time flagmen, with required traffic control devices, at all times when work is in progress along highways. Suitable warning and descriptive signs shall be placed at each end of the working area while work is in progress along highways. These signs shall be well tended, and shall be placed at sufficient distances from the work so that ample warning is given to approaching traffic. Signs shall be adequately lighted at night. All traffic control devices and methods shall comply with the latest edition of the Manual on Uniform Traffic Control Devices.
- C. Where pipe is installed in open cut across a highway, the cut shall be immediately backfilled and all work of repairing the pavement completed in accordance with the encroachment/street cut permit. The Contractor shall keep at least one full lane open for traffic at all times. Any subsequent settlement shall be immediately corrected and repaired. Refer to SECTION 11 for paving and surfacing specifications.
- D. Where a pipeline crossing under a highway is installed within encasement pipe, the encasement pipe shall be provided as specified in SECTION 9: BORING.
- E. Unless otherwise indicated, no excavated material shall be placed on the pavement side of the ditch along highways. The least possible amount of ditch shall be left open when work is not in progress, and equipment shall be removed from the pavement and shoulders during shutdown periods. Shoulders of roadways shall be left in good acceptable condition, and all disturbed topsoil and grass shall be replaced.
- F. The Contractor shall not begin work on any property of any Railroad until the all necessary permits have been secured. Contractor shall conform to all requirements of the Railroad, or its authorized representatives, in the construction of this portion of the work. He shall notify the railroad of the time that the work will be done and shall not begin work until authorized by Railroad officials.

2-04 CLEARING AND GRUBBING

See SECTION 4B, CLEARING AND GRUBBING

2-05 RESTORATION OF RIGHTS-OF-WAY

- A. During construction, the Contractor shall maintain the site and adjacent public and private property, including streets and highways, free from accumulations of waste debris, rubbish and dirt caused by his operations. Dry materials and rubbish shall be wet down as necessary to prevent blowing dust.
- B. Immediately after completion of the work, or any substantial unit or portion of it, the Contractor shall remove all unused material, refuse and dirt placed by him in the vicinity of the work and shall leave the premises in a neat and orderly condition, satisfactory to the Engineer.
- C. The right-of-way shall be restored to the original condition. Horizontal benches shall be provided to facilitate access to the site and shall be located where directed by the Engineer and the Spartanburg Water System. Fill material, where required, shall be free of grass, roots, rock and other objectionable material and shall be spread evenly and properly compacted. The entire right-of-way shall be graded, dressed off and cleaned up to the satisfaction of the Engineer, Spartanburg Water System, other agencies having jurisdiction, and property owner, where applicable.
 - 1) Where work is along streets or highways and dirt has been placed on the pavement, the pavement shall be swept clean of all dirt after backfill has been completed.
 - 2) Site: The Contractor shall clean up behind the work as much as is reasonably possible as the work progresses, but in no case shall the pipe laying operation be more than 1000 feet ahead of complete cleanup. Federal regulations require that temporary stabilization measures be implemented within 14 days of the time when construction activities have been completed in an area of a phased project.
 - 3) Upon completion of the work and before acceptance of the Final Payment for the project by the Owner, the Contractor shall remove all his surplus and discarded materials, excavated material and rubbish from the roadways, sidewalks, parking areas, lawns and all adjacent property; shall restore, in an acceptable manner, all property, both public and private, which has been disturbed or damaged during the prosecution of the work; and shall leave the whole site in a neat and presentable condition.
 - 4) Except where specifically directed otherwise by the property owner, the entire construction right-of-way shall be provided with a permanent grass cover within 30 days after backfilling. Topsoil shall be replaced and seed planted, fertilized and watered until a grass cover satisfactory to the Engineer and property owner is obtained. If necessary, a temporary grass cover shall be provided until a permanent cover can be established. Grassing shall be as

specified in SECTION 12. If required by the property owner, shrubbery shall be replaced to the satisfaction of the Engineer and the property owner.

SECTION 3

MATERIAL SPECIFICATIONS FOR PIPE AND FITTINGS

3-01 SCOPE

- A. This section and following subsections contains the current specifications for materials to be used in projects to be integrated into the Spartanburg Water System. The Spartanburg Water System has established specific manufacturers as the standard for various items within its system. Such standardization is for the express purpose of expediting maintenance procedures. All requests for approval of an "or equal" item must be submitted to the Spartanburg Water System in writing. All pipe, fittings, packing, joint materials, valves and fire hydrants shall conform to Section C of the AWWA Standards and SCDHEC R.61-58. All materials or products that contact potable water must be third party certified as meeting the requirements of ANSI/NSF61. Metallic pipe and fittings shall be lead free in accordance with R.61-58.4(F).
- B. The following pipe materials are specifically prohibited from installation, as part of the Spartanburg Water System, for the purpose of distributing potable water:
- 1) Asbestos Cement "AC" Pipe
 - 2) Thermoplastic Pipe in above-grade applications.

3-02 DESIGN CRITERIA

Reference Standards of the American National Standards Institute (ANSI) and American Waterworks Association (AWWA)

A21.4/AWWA C104 Cement-Mortar Lining for Cast-Iron and Ductile-Iron Pipe and Fittings for Water

A21.5/AWWA C105 Polyethylene Encasement for Gray and Ductile Cast-Iron Piping for Water and Other Liquids.

A21.10/AWWA C110 Gray-Iron and Ductile-Iron fittings, 3" through 48" Inches for Water and Other Liquids.

A21.11/AWWA C111 Rubber Gasket Joints for Cast-Iron and Ductile-Iron Pressure Pipe and Fittings.

A21.15/AWWA C115 Flanged Cast-Iron and Ductile-Iron Pipe With Threaded Flanges.

A21.16/AWWA C116 Fusion-Bonded Epoxy Coatings.

A21.50/AWWA C150 Thickness Design of Ductile-Iron Pipe.

A21.51/AWWA C151 Ductile-Iron Pipe Centrifugally Cast, In Metal Molds or Sand-Lined Molds, for Water or Other Liquids.

A21.53/AWWA C153 Ductile-Iron Compact Fittings for 3" thru 48".

B16.1 Cast-Iron Pipe Flanges and Flanged Fittings, Class 25, 125, 250, and 800.
Reference Standards of the American Water Works Association (AWWA)
B300 AWWA Standard for Hypochlorites
C111 Rubber-gasket Joints for Ductile Iron Pressure Pipe and Fittings
C200 Steel Water Pipe
C600 Installation of Ductile-Iron Water Mains and Appurtenances.
C651 Disinfecting Water Mains.
C900, C905 Polyvinyl Chloride (PVC) Pipe
C901, C906 High Density Polyethylene (HDPE) Pipe

3-03 GENERAL

A. Lead Ban

- 1) Any pipe, solder, or flux which is used in the installation or repair of any public water system shall be lead free.
- 2) Any pipe, solder, or flux which is used in any plumbing in a residential or nonresidential facility which provides water, through connection to a public water system, for human consumption shall be lead free.
- 3) Lead free shall be defined, when used with respect to solders and flux, as those containing not more than 0.2 percent lead and not more than a weighted average of 0.25 percent lead when used with respect to the wetted surfaces of pipes, pipe fittings, plumbing fittings, and fixtures
- 4) Lead free shall be defined, when used with respect to pipes and pipe fittings, as those containing not more than 8.0 percent lead.
- 5) Leaded joints necessary for the repair of cast iron pipes shall be exempt from the lead free requirement.
- 6) No person may import, manufacture, process, or distribute in commerce a new plumbing fitting or fixture, intended by the manufacturer to dispense water for human ingestion, that contains more than four (4) percent lead by dry weight.

B. 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, valves, or other appurtenances which will expose the material to the water. All gaskets shall be AWWA approved.

3-04 DUCTILE IRON PIPE

See SECTION 3A: DUCTILE IRON PIPE

3-05 PVC PIPE

See SECTION 3B: PVC PIPE

3-06 HDPE PIPE

See SECTION 3C: HIGH DENSITY POLYETHYLENE (HDPE) PIPE

3-07 STEEL PIPE

The existing Spartanburg Water distribution system includes several welded steel main transmission water lines. In general, no new steel water lines shall be installed in the SWS system. However, if the installation of a new steel water main has a clear benefit to the SWS system, the design should be submitted to the SWS Engineering Department for consideration. All steel pipe must be in accordance with AWWA C200 or ASTM A53 or ASTM A120.

3-08 ASBESTOS CEMENT PIPE

- A. No asbestos cement pipe will be allowed to be installed.
- B. If asbestos cement pipe is encountered during any work in the Spartanburg Water system, use whatever methods needed to prevent damage to the pipe and follow all applicable SCDHEC regulations.

SECTION 3A

DUCTILE IRON PIPE

3A-01 GENERAL

- A. Ductile Iron Pipe shall be centrifugally cast and conform to ANSI/AWWA A21.51/C151, latest edition.

The pressure Class, net weight of pipe without lining, length of pipe and name of manufacturer shall be clearly marked on each length of pipe.

- B. Push-on, mechanical joint, and restrained joint pipe shall have a minimum rated working pressure of 150 psi. All buried pipe shall be (minimum) pressure class as follows:

- 1) 4" – 12" Pressure Class 350
- 2) 14" – 20" Pressure Class 250
- 3) 24" Pressure Class 200
- 4) 30" – 64" Pressure Class 150

- C. Flanged pipe shall be Thickness Class 53

- D. The pipe shall be lined in accordance with ANSI/AWWA C104/ A21.4, latest edition. The pipe shall have the standard thickness cement lining inside and bituminous coat outside in accordance with ANSI/AWWA C104/A21.4. The inside cement lining shall be treated with a seal coat of asphaltic material in accordance with ANSI/AWWA C104/A21.4. The seal coat shall have no deleterious effect upon the quality, color, taste or odor of potable water and shall be approved by National Sanitation Foundation (NSF). Approved pipe manufacturers are as follows:

- 1) American Pipe
- 2) U.S. Pipe
- 3) McWane Ductile

NOTE: All ductile iron pipe installed in the Spartanburg Water System shall be of domestic manufacture which is defined as physically manufactured within the limits of the continental United States of America.

- E. Push-on and Mechanical Joints shall conform to ANSI A21.11/AWWA C111. The pipe is to be supplied in minimum 18 foot lengths with either push-on joints or mechanical joints.

- 1) Push-On Joints as supplied by the following manufacturers are approved.
 - a. American Pipe Product "Fastite" joint;
 - b. U.S. Pipe Product "Tyton" joint;

- c. McWane Ductile “Tyton” joint 4” – 24” , “Fastite” joint 30” – 36”
- 2) Mechanical Joints in accordance with ANSI A21.11/AWWA C111
- F. Restrained Joint Pipe shall conform to ANSI A21.11/AWWA C111. Approved pipe manufacturers are as follows:
 - 1) American Pipe Product: Flex Ring
 - 2) U.S. Pipe Product: TR FLEX
 - 3) McWane Ductile Product: TR FLEX
- G. Push-on Joint Restraint rubber gaskets shall conform to ANSI A21.11/AWWA C111 with stainless steel locking segments vulcanized into gasket, and shall be have an operating pressure of 250 psi or greater. The joints shall be capable of being disassembled and are approved for use only on ductile iron pipe, 4” through 12” diameter inclusive.

Manufacturers:

 - 1) American Product: Fast Grip
 - 2) U.S. Pipe Product: Field-Lok
 - 3) McWane Ductile Product: Sure Stop
- H. External Restraint of DIP Bell and Spigot Joints

DIP bell and spigot joints may be restrained by the use of the following external restraint fixtures only if specifically approved by the SWS Engineering Department. In all cases, the installation of these fixtures shall be performed as specified by the manufacturer, shall be shown on the approved plans, and shall be specifically called out on the Record Drawings.

TABLE 3-1: DIP External Restraint Fixtures

Manufacturer	Model #	Notes
EBAA Iron Sales, Inc.	MEGALUG Series 1700 Restraint Harness	DIP Only
Ford	Uni-Flange Series 1300 or 1390	DIP Only
Sigma Corporation	One-Lok SLDH Restraint Harness	DIP Only

- I. Except as specifically listed above, no other unique, proprietary, or other pipe or joint restraint method shall be approved as an “equal” prior to being submitted for review by the SWS Engineering Department.
- J. Flanged Joints shall conform to ANSI A21.11/AWWA C115. Bolts and nuts shall conform to ANSI A21.11/AWWA C111.

SECTION 3B

PVC PIPE

3B-01 GENERAL

- A. PVC pipe shall be 4-inch through 12-inch nominal diameter in accordance with AWWA C900, ASTM D2241 and ANSI/NSF 61. PVC pipe in diameters larger than 12-inch is not approved for use anywhere in the Spartanburg Water System. Unless specifically approved by the SWS Engineering Department, PVC pipe may only be installed as part of distribution systems located within residential subdivisions.
- 1) All PVC pipe shall be designed and manufactured in accordance with AWWA C900, latest revision, from virgin polyvinyl chloride resin meeting Cell Class 12454 as defined in ASTM D1784.
 - a. PVC (as described and specified above) is the only type of "thermoplastic" pipe approved for use in the Spartanburg Water System;
 - b. Thermoplastic PVC pipe is not approved for use in any above-grade application, and all installations of PVC must be installed with the depth of cover specified in SECTION 4C-02 D. of these specifications.
 - 2) PVC pipe shall be pressure class 200 (DR14) furnished in ductile iron pipe equivalent outside diameters and shall be approved by the National Sanitation Foundation (NSF) Standard 61. This requirement does not relieve the design engineer of the responsibility to confirm that, if PVC is specified for a project, the maximum working pressure and maximum surge pressure are not exceeded for this material.
 - 3) Each length of PVC pipe shall bear markings indicating the following information at intervals not to exceed five (5') feet: (1) manufacturer's name or trademark, (2) nominal pipe size and OD base, (3) AWWA material code designation, (4) dimension ratio, (5) AWWA pressure class, (6) AWWA C900 designation, and (7) product record code.
 - 4) All PVC pipe shall be elastomeric-gasket bell-end pipe. One gasket shall be furnished with each length of PVC pipe.
 - 5) The installation of solvent-weld PVC pipe and fittings, of any size, is prohibited in the water distribution system which is owned and operated by the Spartanburg Water System.

- 6) Gaskets and lubricants to be used with PVC pipe shall be made from materials that are compatible with PVC and with each other, but that will not support the growth of bacteria or adversely affect, in any way, the quality of the potable water to be transported.
- 7) Fittings used in the laying of PVC pipe shall be iron fittings (See SECTION 3D: FITTINGS). Fabricated or molded PVC fittings will not be acceptable in any application.

NOTE: All PVC pipe installed in the Spartanburg Water System shall be of domestic manufacture which is defined as physically manufactured within the limits of the continental United States of America.

B. PVC PIPE INSPECTION

- 1) Each pipe shipment shall be inspected with care by the Contractor and the SWS Engineering Field Technician. Any pipe which is warped, cracked, discolored or faded, abraded, misshapen, or otherwise damaged shall be considered unsuitable and shall not be used. Any unsuitable material discovered during the inspection or at any other time shall be removed from the job site.
- 2) If the load shifted during transport, has broken packaging, or shows rough treatment, each pipe length shall be carefully inspected for damage.
- 3) It is assumed that all handling and storage of the PVC pipe by all persons who handle, transport, and/or store, these PVC pipe materials prior to their delivery to the job site is in accordance with the requirements of the Uni-Bell PVC Pipe Association. Any damage resulting from improper handling, transportation, or storage prior to or during the time the pipe material is on the work site shall cause the piping materials to be rejected.

C. SHIPPING, RECEIVING, UNLOADING PVC PIPE

- 1) Shipping: All pipe material shall be shipped in a manner to ensure that the pipe is not damaged.
- 2) Receiving: When receiving the PVC pipe shipment at the job site, the Contractor shall exercise established precautions.
- 3) Unloading: Preferred unloading is in package units using mechanical equipment; however, the pipe can be unloaded individually by hand. Mechanical equipment shall be operated so that it does not strike adjacent pipe and that pipe being moved does not strike anything.

- a. Unloading unpackaged PVC Pipe: PVC pipe may be unloaded and moved individually by hand if not packaged or if mechanical equipment is not available.
- b. Unloading Package Units: When unloading package units, the following instructions shall be carefully followed:
 - (i) Remove restraints from the top unit loads;
 - (ii) If there are boards across the top and down the sides of the load which are not part of pipe packaging, remove them;
 - (iii) Use a fork lift with thin chisel forks, extend forks (or front end loader equipped with forks) to remove each top unit (one at a time) from the truck. Remove back units first. Do not run the forks too far under units as fork ends striking adjacent units may cause damage. Insure forks are fully engaged;
 - (iv) If a fork lift is not available, a spreader bar with fabric straps which are capable of handling the load (with straps spaced approximately 8 feet apart and looped under the load) may be used. Cables may also be used if cushioned with rubber hose sleeves or other material to prevent abrasion of the pipe
 - (v) During the removal and handling, be sure that the units do not strike anything. Severe impact could cause damage, particularly during cold weather;
 - (vi) Do not handle units with individual chains or single cables, even if padded;
 - (vii) Do not attach cables to unit frames or banding for lifting;
 - (viii) Pipe package units shall be placed and stored on level ground;
 - (ix) Package units shall not be stacked more than eight feet high. Units shall be protected by dunnage;
 - (x) To unload lower units, repeat the above unloading process;

- (xi) If unloading equipment is not available, pipe may be unloaded by removing individual pieces by hand. However, care shall be taken to insure that pipe is not dropped or damaged.

D. STORAGE REQUIREMENTS FOR PVC PIPE

- 1) PVC pipe shall be stored, if possible, at the job site in the unit packages provided by the manufacturer. Caution shall be exercised to avoid compression, damage or deformation to the bell ends of the pipe. Pipe shall be stored on level ground.
- 2) If stored as individual pieces, pipe shall be arranged and supported so that there can be no compression, damage or deformation to the bell ends.
- 3) When unit packages of PVC pipe are stacked, insure that the weight of the upper units does not cause deformation to the pipe in lower units.
- 4) PVC pipe unit packages shall be supported by racks or dunnage to prevent damage to the bottom during storage. Supports shall be spaced to prevent pipe bending.
- 5) When exposure to direct sunlight for an extended period is unavoidable, PVC pipe shall be covered with opaque material while permitting adequate air circulation above and around the pipe as required to prevent excessive heat accumulation.
- 6) PVC pipe shall not be stored close to heat sources or hot objects such as heaters, boilers, steam lines, engine exhaust, etc.
- 7) When unit packages of PVC pipe are stacked, insure that the height of the stack does not result in instability which could cause stack collapse, pipe damage or personnel injury.
- 8) The interior as well as all sealing surfaces of pipe, fittings and other accessories shall be kept free from dirt and foreign matter.
- 9) Gaskets shall be protected from exposure to heat, direct sunlight, ozone, oil, and grease.

E. HANDLING REQUIREMENTS FOR PVC PIPE:

- a. When using fork lifts or other handling equipment, prevent damage to PVC pipe.

- b. When handling PVC pipe, avoid impact blows, abrasion damage, and gouging or cutting by metal surfaces or rocks. Avoid stressing bell joints and damage of bevel ends.
- c. Pipe shall be lowered, not dropped, from trucks and into trenches.
- d. In preparation for pipe installation, placement of pipe (stringing) shall be as close to the trench as practical and on the opposite side from the excavated earth. Bell ends shall point in the direction of work progress.
- e. Pipe stringing shall not extend further than 100 feet beyond the installation.
- f. In subfreezing temperatures, extra caution is required in handling PVC pipe to prevent impact damage.

F. RESTRAINT OF PVC BELL AND SPIGOT JOINTS

NOTE: Restraint of PVC bell and spigot joints using “gripper” type gaskets is prohibited within the Spartanburg Water System. Restraint of such joints may only be accomplished by the use of external restraint systems as described below.

PVC bell and spigot joints may be restrained by the use of the following external restraint harnesses only if specifically approved by the SWS Engineering Department. In all cases, the installation of these fixtures shall be performed as specified by the manufacturer, and shall be shown on the approved plans, and shall be specifically called out on the Record Drawings.

TABLE 3B-1: PVC Pipe External Restraint Harness

Manufacturer	Model #	Notes
EBAA Iron Sales, Inc.	Series 1500 Bell Restraint Harness	C-900 PVC
Ford	Uni-Flange Series 1390	DR-14 PVC Only
Sigma Corporation	Series PVP PV-Lok	PVC Only

SECTION 3C

HIGH DENSITY POLYETHYLENE (HDPE) PIPE

3C-01 GENERAL

- A. All HDPE pipe shall be designed and manufactured in accordance with the following standards:

Nominal Size	Designation	Applicable Standard
¾" – 3"	IPS	AWWA C901, ASTM D3035
¾" – 2"	CTS	AWWA C901, ASTM D3035
4" – 65"	IPS	AWWA C906, ASTM F714
4" – 65"	DIPS	AWWA C906, ASTM F714

- 1) All HDPE materials installed in the Spartanburg Water System shall be manufactured from PE4710 resin meeting ASTM D3350 with cell classification 345464C.
- 2) All HDPE pipe shall be marked in accordance with the applicable AWWA standards noted above, and will be supplied with a continuous blue stripe running the full length of the pipe joint or coil.
- 3) Unless specifically approved otherwise by the SWS Engineering Department, HDPE pipe shall be Pressure Class 200 (DR-9) or greater wall thickness.
- 4) The pipe is to be supplied in minimum 20 foot lengths with thermal butt fusion joints in accordance with ASTM D3261.

NOTE: All HDPE pipe installed in the Spartanburg Water System shall be of domestic manufacture which is defined as physically manufactured within the limits of the continental United States of America.

B. INSPECTION

Pipe and fittings shall be carefully examined by the Contractor and the SWS Engineering Field Technician for cracks and other defects immediately before installation, with special attention to pipe ends. All defective pipe and fittings discovered during the inspection or at any other time shall be removed from the job site.

SECTION 3D

FITTINGS

3D-01 FITTINGS

- A. Fittings shall be ductile iron fittings manufactured in accordance with ANSI/AWWA C153/A21.53, latest revision. Where compact fittings are not available, fittings shall be full size iron fittings manufactured in accordance with ANSI/AWWA C110/A21.10 and ANSI/AWWA C111/A21.11, latest revisions. The working pressure rating shall be 350 psi.
- B. Only MJ x MJ (for buried service) or Flange x Flange (for above-ground service) are approved. Push-on or other socket-type joints are not approved in any application, and proprietary restraining methods are not approved except as noted below.
- C. Ductile iron shall be in accordance with ASTM A-536, latest revision, with minimum physical qualities of 70,000 psi tensile strength, 50,000 psi yield strength and 5% elongation.
- D. Approved fitting manufacturers are as follows:
 - 1) Star Pipe Products
 - 2) Tyler Union
 - 3) US Pipe

NOTE: All fittings installed in the Spartanburg Water System shall be of domestic manufacture which is defined as physically manufactured within the limits of the continental United States of America.

- E. Coatings shall be as follows (use of either option is approved):
 - 1) Cement-mortar lining shall be in accordance with ANSI/AWWA C104/A21.4, latest edition. The fitting shall have the standard thickness cement lining inside and bituminous coat outside in accordance with ANSI/AWWA C104/A21.4. The inside cement lining shall be treated with a seal coat of asphaltic material in accordance with ANSI/AWWA C104/A21.4. The seal coat shall have no deleterious effect upon the quality, color, taste or odor of potable water and shall be approved by National Sanitation Foundation (NSF).
 - 2) Fusion bonded epoxy coating shall be coated with in accordance with AWWA C-116 and shall be mechanical joint in accordance with ANSI/AWWA C111/A21.11.

3D-02 RETAINER GLANDS

- A. Restraint of joints at MJ fittings shall be achieved through the installation of an approved restrainer gland with “auto-torque” twist-off heads. See below:

TABLE 3D-1: Approved Restrainer Glands for DIP and PVC with DI Fittings

Manufacturer	Model #	Notes
EBAA Iron Sales, Inc.	MEGALUG Series 1100	DIP Only
EBAA Iron Sales, Inc.	MEGALUG Series 2000PV	PVC Only
Ford	Uni-Flange Series 1400	DIP Only
Ford	Uni-Flange Series 1500	PVC Only
Sigma Corporation	One-Lok D-SLDE	DIP Only
Sigma Corporation	One-Lok D-SLCE	PVC Only

NOTE: The use of a restrained joint at a fitting in no way insures the restraint of the pipe/fitting as a system. The Design Engineer shall be responsible for designing the piping system with proper consideration for all issues related to piping restraint, and the installation must be per the approved design.

3D-03 COUPLINGS AND BELL JOINT CLAMPS

- A. Leaks at bell joints are normally repaired by cutting out the leaking joint, and installing a spool piece with the correct Dresser coupling or solid ductile iron MJ sleeve. If specifically approved by the SWS Engineering Department, the repair of leaking bell joints in cast iron pipes may be accomplished with bell joint clamps using Dresser Style 60 or 60S bell joint clamps. Bell-joint clamps are not approved for use on ductile iron or PVC pipe.
- B. Couplings used for joining cast iron, ductile iron or steel water mains of all sizes shall be Dresser Style 38 or Style 138, or Hymax Couplings. The use of Dresser couplings is only approved for the repair of leaks as noted above, not as a substitute for gasketed bell and spigot joints used in normal pipe laying operations. The use of Hymax Couplings may be used for leaks or anywhere the joining of cast iron to ductile iron is necessary.

SECTION 4

WATER MAIN INSTALLATION AND TESTING

4-01 SCOPE

This section and following subsections contains the current specifications for the installation of pipe, fittings, and all related appurtenances in projects to be integrated into the Spartanburg Water System. All pipe, fittings, packing, joint materials and appurtenances shall conform to and shall be installed in accordance with Section C of the AWWA Standards and SCDHEC R.61-58. All materials or products that contact potable water must be third party certified as meeting the requirements of ANSI/NSF61.

4-02 DESIGN CRITERIA

A. Reference Standards of the American Water Works Association (AWWA) Latest Revisions:

B300 AWWA Standard for Hypochlorites

C111 Rubber-gasket Joints for Ductile Iron Pressure Pipe and Fittings

C200 Steel Water Pipe

C600 Installation of Ductile-Iron Water Mains and Appurtenances.

C605 Underground Installation of Polyvinyl Chloride (PVC) and Molecularly Oriented Polyvinyl Chloride (PVCO) Pressure Pipe and Fittings

C651 Disinfecting Water Mains.

C900 Polyvinyl Chloride (PVC) Pipe

C901-02, C906 High Density Polyethylene (HDPE) Pipe

B. The following requirements of SCDHEC R.61-58 State Primary Drinking Water Regulations shall be met:

1) Flushing - The design shall provide for a readily accessible means of flushing all water lines at a minimum velocity of 2.5 feet per second. This does not apply to service lines.

a. Where dead-end lines occur they shall be provided with a fire hydrant if flow and pressure are sufficient and if justified by line size and fire protection requirements. Otherwise, a readily accessible blow-off valve shall be provided for flushing purposes, except for the following cases:

(i) Lines one and one half (1-1/2) inches in diameter and smaller will not require blow-offs.

(ii) Two inch lines shorter than two hundred (200) feet will not require a blow-off. However, a service connection shall be

installed at the end of the line or another acceptable means of bleeding chlorine through the lines must be provided.

- b. Blow-offs shall be sized to provide a minimum velocity of 2.5 feet per second in the line and maintain a residual pressure of twenty-five (25) pounds per square inch.
 - c. Lines ten (10) inches and larger require flows in excess of five hundred (500) gallons per minute to achieve a two and a half (2.5) feet per second scouring velocity. This would require a standard fire hydrant or other approved blow-off, for flushing which must be designed to provide at least five hundred (500) gallons per minute in excess of peak hourly flow and a minimum residual pressure of twenty (20) pounds per square inch.
 - d. No flushing device shall be directly connected to any sanitary sewer. Blow-offs shall be piped to atmosphere. See Typical Permanent Blow-off Detail in APPENDIX A.
- C. Water Crossings: For all surface water crossings (above the water level) the pipe shall be adequately supported and anchored as shown on the construction drawings in order to protect the pipe from damage and freezing as well as to make the pipe accessible for repair or replacement. For all underwater crossings, a minimum of two (2) feet of cover shall be provided. For water crossings of 15 feet wide or greater, the following shall be provided:
- 1) The pipe material and joints shall be designed appropriately;
 - 2) Valves shall be located so that the section can be isolated for testing or repair; the valves shall be easily accessible, and not subject to flooding; and,
 - 3) A blow-off shall be provided on the side opposite the supply service, sized in accordance with R.61-58.4(D)(7). Blow-offs shall not be directed toward creeks or other water bodies without proper precaution taken to dechlorinate prior to discharge.

Refer to SECTION 9: BORING and SECTION 10: AERIAL CROSSINGS.

D. Cross Connection Control (Backflow Prevention Devices)

- 1) 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.

- 2) No by-passes shall be allowed, unless the bypass is also equipped with an equal, approved back-flow prevention device.
- 3) High hazard category cross-connections shall require an air gap or an approved reduced pressure backflow preventer.
- 4) 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.
- 5) 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 for potable water use. Black steel pipe cannot be used on the inlet side of the device. NOTE: Steel pipe is not approved for installation in the Spartanburg Water System.
- 6) Fire line sprinkler systems and dedicated fire lines, except those in the high hazard category, shall be protected by an approved double check valve assembly. High hazard category fire sprinkler systems shall include, but not be limited to: antifreeze systems, foam systems, systems charged from or tied into ponds, lakes, streams, or any water source other than the approved public water supply. High hazard category fire sprinkler systems shall comply with the requirements of Paragraphs 3 and D above.

SECTION 4A

EXISTING UTILITIES AND STRUCTURES

4A-01 SCOPE

This Section pertains to the coordination with other utilities at the construction site and instructions to prevent damage to other utilities.

4A-02 GENERAL

Care shall be taken to prevent damage to other utilities and structures. Any repairs shall be made at Contractor's expense and in accordance with the particular utilities' requirements.

- A. Existing Utilities: Utilities have been located based on information provided to the Engineer by the utility companies. The Spartanburg Water System cannot guarantee the accuracy of this information. At least 72 hours prior to installation, Contractor shall contact Palmetto Utility Protection Service (PUPS) and any other utility that may be in the area.
- 1) When interruptions of existing utilities occur, temporary service shall be provided as approved by the Engineer and owner of the utility.
 - 2) Underground Utilities and Other Structures: Necessary excavations to determine the location and elevation of existing underground utilities and other structures shall be made prior to the opening of trenches. Contractor shall contact the utility and a representative of the utility shall be present when excavating to locate utilities. When a conflicting utility has been located in the field by the utility's personnel, or when there is direct knowledge of the presence of one of these utilities in an area which will conflict with the construction efforts, then the exact location of the conflicting utility shall be verified by hand digging before any additional construction takes place. If the utility's line is not uncovered in the staked position, then additional hand digging shall be performed until either the utility's line is uncovered or until it can safely be determined that it does not interfere with the proposed construction and is not subject to damage during construction. Only after it is confirmed that the conflicting utility will not be damaged shall the pipeline construction efforts proceed.

3) Separation of Water Mains and Sewers:

The separation of water mains and sanitary sewers shall be in accordance with Section R61-58.4.D(12) of the State Primary Drinking Water Regulations, as outlined herein.

- a. Parallel installation - Water mains shall be laid at least ten (10) feet horizontally from any existing or proposed sewer. The distance shall be measured edge to edge. In cases where it is not practical to maintain a ten foot separation, SCDHEC may allow deviation on a case-by-case basis, if supported by data from the design engineer. Such deviation may allow installation of the water main closer to a sewer, provided that the water main is laid in a separate trench or on an undisturbed earth shelf located on one side of the sewer at such an elevation that the bottom of the water main is at least eighteen (18) inches above the top of the sewer. Any deviations to the 10 feet horizontal distance must be approved by the SWS Engineering Department and SCDHEC.
- b. Crossings - Water mains crossing sewers shall be laid to provide a minimum vertical separation of eighteen (18) inches between the outside of the water main and the outside of the sewer. This shall be the case whether the water main is either above or below the sewer line. Whenever possible, the water main shall be located above the sewer line. Where a new water main crosses a new sewer line, a full length of pipe shall be used for both the water main and sewer line and the crossing shall be arranged so that the joints of each line will be as far as possible from the point of crossing and each other. Where a new water main crosses an existing sewer line, one full length of water pipe shall be located so both joints will be as far from the sewer line as possible. Where a water main crosses under a sewer, adequate structural support shall be provided for the sewer line to prevent damage to the water main.
- c. Force mains - There shall be at least a 10 foot horizontal separation between water mains and sanitary sewer force mains. There shall be an 18 inch vertical separation at crossing as required in Part a. and b. above.
- d. Sewer manholes - No water pipe shall pass through or come in contact with any part of a sewer manhole.
- e. Water lines may come in contact with storm water piping or catch basins if there is no other practical alternative, provided that ductile iron is used, no joints of the water line are within the storm water piping or catch basin and the joints are located as far as possible

from the storm piping or catch basin.

- f. No water line shall be installed within 25 feet horizontally from any portion of a wastewater tile/spray field. Also no water line shall be installed within a contaminated area.
- g. Special Conditions: When it is impossible to obtain the distances specified in a. and b. above, the Contractor shall contact the SWS Engineering Department. Any alternative design must first be approved by the SWS Engineering Department and the South Carolina Department of Health and Environmental Control. Any alternative design shall:
 - (i) maximize the distances between the water main and the sewer line and the joints of each;
 - (ii) use approved water main piping materials for the sewer line; and,
 - (iii) allow enough distance to make repairs to one of the lines without damaging the other.

B. Structures: Adequate temporary support and adequate protection and maintenance of all underground and surface structures, drains, sewers, curbs, and other obstructions encountered in the progress of the work shall be provided. The structures which have been disturbed by the construction operations shall be restored to the satisfaction of the utility involved upon completion of the work. ANY DAMAGES to existing underground utilities shall immediately be reported to the Engineer and to the appropriate utility.

SECTION 4B

CLEARING AND GRUBBING

4B-01 SCOPE

This Section includes the requirements for clearing and grubbing.

4B-02 GENERAL

- A. Contractor shall consult with the SWS Engineering Department and Engineer prior to beginning clearing and a full understanding is to be reached as to procedure. Contractor shall then conduct clearing and grubbing operations in strict accordance with these agreements.
- 1) All operations shall be conducted with full consideration of all proper and legal rights of the Owner, adjacent property owners and the public, and with the least possible amount of inconvenience to them. Care shall be taken to protect adjacent property.
 - 2) Contractor shall perform all clearing and grubbing work required for the installation of the complete work. Clearing shall consist of the removal and disposal of all pavement, stumps, trees, brush, debris, or other such materials in the path of the work.
 - 3) No burying of cleared debris on the right-of-way will be allowed.
 - 4) Any vehicular access to the right-of-way which crosses private property shall be by written permission of the property owner with copy of same provided to the SWS Project Manager and/or SWS Engineering Field Technician.
 - 5) Erosion control measures as shown on the plans, and/or as required by SECTION 12: GRASSING AND EROSION CONTROL, shall be put in place during clearing and grubbing and before trench excavation.
- B. Clearing Along Right Of Way: Where trees, brush, stumps or exposed roots exist within rights-of-way, the full width of the right-of-way shall be completely cleared and grubbed. Stumps shall be removed and roots shall be grubbed at least two (2) feet below the ground surface.
- C. Disposal of Cleared Material shall be in strict accordance with all applicable local, state and federal regulations pertaining to open burning and smoke abatement.

Prior to disposal, approval and where applicable written permits, must be obtained from all applicable agencies.

- D. Minor Structures may exist on the right-of-way. The disposition of the structures shall be so noted as shown on the plans by either; (1) left in place in a condition equal to prior to construction; (2) removed and disposed of by the Contractor; (3) removed for construction and replaced in a condition equal to prior to construction; (4) relocated as shown on the plans. If the Contractor notes structures on the right-of-way that are not shown on the plans or the disposition is not noted on the plans, he shall contact the design engineer who will notify and acquire approval from SWS Engineering Department as to which of the above methods shall be followed.
- E. Removal and Replacement of Fences: Fences shall be removed as required by construction and replaced with materials as good, or better, as that which was removed. Temporary fencing, as required, shall be installed to function in a manner equivalent to the removed fencing and maintained as such throughout the duration of the temporary fencing.
- F. Trees or Shrubbery along the highways, roadways, and streets shall not be disturbed unless absolutely necessary. Approval must be obtained from the SWS Engineering Department prior to any such removal. Any such trees or shrubbery which may be necessary to be removed shall be heeled in and replanted. Heeling in and replanting shall be done under the direction of an experienced nurseryman. Trees or shrubbery that die within twelve (12) months of replacement shall be replaced by the Contractor at no expense to the Spartanburg Water System.
- G. Construction Operations: All work along highways, streets and roadways shall be in accordance with the following sequence of construction operations, so as to least interfere with traffic.
 - 1) Trenching, Laying and Backfilling: It is the intent of these specifications that there shall be minimum interruption to traffic and all traffic control shall be in accordance with the regulations and requirements of the South Carolina Department of Transportation, Spartanburg County and/or the local jurisdiction. By entering into the construction agreement, the Contractor agrees to hold the Spartanburg Water System harmless from and against any and all liabilities and claims of any nature whatsoever relating to or arising from traffic control. The trench shall not be opened any further ahead of pipe laying operations than is necessary for proper laying operations, and trenches shall be progressively backfilled and consolidated, and excess material removed immediately behind laying operations so as not to interfere with traffic.
 - 2) Shaping: Immediately after backfilling operations are complete, any damaged cut and fill slopes, side ditches and ditch lines, shall be reshaped and returned to original level and condition. Topsoil, sod and any other

materials removed from shoulders shall be replaced in accordance with the requirements of, and to the full and complete satisfaction of the South Carolina Department of Transportation, Spartanburg County, the local jurisdiction, and the Spartanburg Water System.

- 3) Grassing: See SECTION 12: GRASSING AND EROSION CONTROL.
- 4) Capability: When installing pipelines and appurtenances, sufficient personnel and equipment will be provided so as to simultaneously carry out all of the above operations.

SECTION 4C

TRENCH EXCAVATION

4C-01 SCOPE

This section includes the requirements for the excavation of pipeline trenches.

4C-02 GENERAL

All excavation and grading shall be confined to the right-of-way or easement area as shown on the plans, and shall be done in an approved manner with proper equipment. Excavation, filling and grading work shall be suspended during rain and inclement weather, or when unsatisfactory field conditions are encountered, unless otherwise directed by the SWS Engineering Department. At all times during construction, Contractor shall maintain proper drainage in the construction area, and shall take all measures necessary for erosion and sediment control as required in SECTION 12: GRASSING AND EROSION CONTROL, and as specified in applicable permits.

- A. Classification of Earthwork: Excavation shall be classified as either "common excavation" or "rock excavation." "Rock excavation" shall be such materials which cannot be removed by means other than by blasting or with a pneumatic or hydraulic hammer. "Common excavation" shall include all types of materials that do not fall into the category of "rock excavation" as defined above. Classification of excavation shall be determined by the Engineer. It shall be the Contractor's responsibility to notify the Engineer when rock excavation is encountered. The Contractor will not be credited for any rock quantities excavated before such notice is given.
- B. Excavation and Preparation: Trenches shall be excavated true to line and grade so that the pipe can be installed to the alignment and depth required. The trench shall not be opened any further ahead of pipe laying operations than is necessary for proper laying and backfilling operations and as approved by the SWS Engineering Department. Trenches shall be progressively backfilled within 100 feet of the pipe laying and installation operations unless otherwise approved by the SWS Engineering Field Technician. No trenches may be left open overnight without the approval of the SWS Engineering Department. When approved, proper traffic protection, lighting and signs in accordance with requirements of South Carolina Department of Transportation shall be provided by Contractor.

- C. Trench Width: The minimum clear width of the trench, sheeted or unsheeted, measure at the spring line of the pipe shall not be less than one foot greater than the outside diameter of the pipe to allow backfill material to be installed in the haunching area. The width of the trench shall be ample to permit the pipe to be laid and jointed properly. If the trench width is exceeded, pipe zone haunching shall be compacted on each side of the pipe to the trench walls. Allowable widths of trenches are as follows:

<u>PIPE SIZE</u>	<u>TRENCH WIDTH</u> <u>(min/max)</u>	<u>PIPE SIZE</u>	<u>TRENCH WIDTH</u> <u>(min/max)</u>
3" or Under	6"/12"	20"	40"/44"
4"	18"/24"	24"	44"/48"
6"	24"/30"	30"	50"/54"
8"	24"/30"	36"	56"/60"
10"	24"/36"	42"	62"/66"
12"	24"/36"	48"	68"/72"
16"	30"/40"		

Trenches shall be of such extra width, when required, to permit the placing of timber supports, sheeting and bracing.

- D. Depth of Cover: All pipe shall have a minimum cover of 48 inches. If 48 inches of cover cannot be obtained (i. e. bridge crossings) ductile iron pipe shall be required and adequate insulation shall be provided to prevent freezing. Any deviations from minimum cover shall be approved by SWS Engineering Department.
- E. Excavation to Grade: The trench shall be excavated to the depth required so as to provide a UNIFORM AND CONTINUOUS ditch bottom between the bell holes. Ledge rock, boulders and large stones must be removed to provide not less than 6 inches of soil cushion on all sides of the pipe and appurtenances. Any part of the bottom of the trench excavated below the specified grade shall be corrected by adding approved material and compacted to not less than 95% of the maximum dry density as determined by a Standard Proctor Test (ASTM D698). The finished subgrade shall be prepared accurately by means of hand tools.
- F. Bell Holes: Bell holes shall be provided at each pipe joint to permit the jointing to be properly made. Bell holes shall be excavated to sufficient depth and width, approximately one (1") inch, to allow the pipe to rest uniformly on the bedding material and to allow the joint to be properly made. The pipe bell shall not be used to support the pipe.
- G. Excavation in Soil: Where the bottom of the trench at subgrade is found to be unstable or to include ashes, cinders, refuse, vegetable, or other organic material

which, in the opinion of the SWS Engineering Field Technician should be removed, then the material shall be removed to the width and depth required. Before the pipe is laid, the subgrade shall be prepared by backfilling with an approved material in three (3") inch uncompacted layers. Each layer shall then be thoroughly compacted, as specified below in order to provide a uniform and continuous firm bearing and support for the pipe at every point between bell holes.

- H. Crushed Stone Stabilization: Wherever, in the opinion of the SWS Engineering Field Technician, the subgrade is by nature too soft or mucky for the proper installation of the pipe, the trench shall be excavated as directed by the Engineer, and backfilled with No. 67 Stone (3/4" and less) and brought to the grade required and compacted.
- I. Excavated Material: All surface materials which are suitable for reuse in restoring the surface shall be kept separate from the general excavated materials.
 - 1) Storage of Excavated Material: All excavated material shall be stored in a manner that will not endanger the work and which will avoid obstructing sidewalks, driveways, or traffic. Fire hydrants under pressure, valve pit covers, valve boxes, curb stop boxes, fire and police call boxes or other utility controls shall be left unobstructed and accessible until the work is completed. Gutters shall be kept clear or other satisfactory provisions made for street drainage, and natural water courses shall not be obstructed. Rural mail boxes shall be left unobstructed and accessible when possible.
- J. Trench Bracing: The Contractor is responsible for the safety of the site. This is to include complying with all safety regulations concerning trench bracing to State and Federal requirements.
- K. Dewatering: An adequate dewatering system shall be provided, if required by the SWS Engineering Field Technician. If a well-point system is used, the Contractor shall submit plans to the SWS Engineering Department for approval. The system shall be capable of removing any water that accumulates in the excavation and maintaining the excavation in a dry condition while construction is in progress. Dirt placed on the surface of the ground shall be sloped away from the excavation. If necessary, piping shall be provided to prevent surface water from entering the excavation. Disposal of water from the dewatering operation shall be done in a manner that does not interfere with normal drainage, and does not cause damage to any portion of the work or adjacent property. All drains, culverts, storm sewers and inlets subject to the dewatering operation shall be kept clean and open for normal surface drainage. The dewatering system shall be maintained until backfilling is complete or as otherwise directed by the SWS Engineering Field Technician. All damage resulting from the dewatering operation shall be repaired by the Contractor to the satisfaction of the SWS Engineering Field Technician and at no cost to the Spartanburg Water System.

- L. Underground Utilities: The Contractor is responsible for locating and protecting all existing underground utilities as required in Section 4A: EXISTING UTILITIES AND STRUCTURES.

SECTION 4D

ASSEMBLING AND JOINTING PIPE AND FITTINGS

4D-01 SCOPE

This section includes the requirements for assembling and jointing ductile iron, PVC and HDPE pipes and fittings

4D-02 GENERAL

- A. All pipe and fittings shall be assembled and joined in accordance with the instructions in this Section and shall accurately conform to the lines and grades established by the plans.
- B. Sequence of Work: Excavation, cleaning, laying, jointing, and backfilling shall be kept up as closely as is possible so as to progress in a uniform, workmanlike manner. In no case shall pipe be left in the trench overnight, without completing the joint. The completed pipeline shall not be left exposed in the trench unnecessarily. The trench shall be backfilled and compacted as soon as possible after laying and jointing is completed. If necessary, exposed ends of pipe shall be properly plugged during laying to prevent dirt and other materials entering the line. Each day at the close of work, and at all times when laying is not in progress the exposed end of the pipeline in the trench shall be closed by the use of an approved temporary water tight plug. If, at any time, it becomes necessary to cover the ends of the uncompleted line with backfill, the end of such pipeline shall be plugged with a water tight plug.

4D-03 INSTALLATION OF DUCTILE IRON PIPE

- A. Handling: Proper and suitable tools and equipment for the safe and convenient handling and laying of pipe shall be used. Care shall be taken to prevent the pipe or fittings coating from being damaged, particularly the cement lining on the interior of the iron pipe. All pipe and fittings shall be carefully examined for cracks, broken lining or other defects. No pipe or fitting shall be laid which is known to be defective. If any pipe or fitting is discovered to be cracked, broken or defective, after being laid, it shall be removed and replaced with acceptable new pipe or fittings at no additional cost. All pipe and fittings shall be thoroughly cleaned before being laid and shall be kept clean until accepted in the completed work.
- B. Cleaning Pipe and Fittings: All lumps, blisters and excess tar coating shall be removed from the bell and spigot, and the inside of the bells shall be wire brushed and wiped clean and dry and free from oil and grease or other foreign material before the pipe is laid. If the interior of the pipe is not clean, the entire length of

pipe shall be SWABBED clean by the use of a circular cloth swab having a diameter equal to the inside diameter of the pipe.

- C. Placing in Ditch: Every precaution shall be taken to prevent foreign material from entering the pipe while it is being placed in the trench. If the pipe laying crew cannot place the pipe into the trench and in place without getting earth into it, a heavy tightly woven canvas bag of suitable size shall be placed over each end before lowering the pipe into the trench and left in place until the connection is to be made. During laying operations, no debris, tools, clothing or other material shall be placed in the pipe.
- D. Whenever pipe laying is stopped, the open end of the line shall be closed with a tight-fitting, inflatable, plug to keep out sand, earth, and water. An MJ cap (with restrainer gland) may be used as an alternate if the pipe terminates in a plain end. Any standing water shall be removed from the trench before the plug or cap is removed. The plug should be tied off to prevent movement under the influence of standing water in the ditch which may be present after a heavy rain. Any dirt or foreign matter found in the pipe shall be thoroughly removed before joining occurs.
- E. In the event that the cap or plug fails to prevent the entry of standing water and/or debris into the pipe, the pipe laying operation shall not commence until the interior of the pipe has been cleaned to the satisfaction of the SWS Engineering Field Technician.
- F. Permissible Deflection: Whenever it is necessary to deflect the pipe from a straight line, either in the horizontal or vertical plane the maximum amount of deflection allowed shall be per the pipe manufacturers recommendation for the pipe and joint type being installed. Joints shall be pushed home straight before deflecting. For mechanical joint pipe, the bolts shall be partially tightened before the length of pipe is deflected.
- G. Cutting Pipe: The cutting of pipe for installing valves, fittings or nipple pieces shall be done in a neat and workmanlike manner without damage to the pipe or lining and so as to leave a smooth end at right angles to the axis of the pipe. Prior to cutting, the exact location of the cut shall be carefully marked by chalk or some other means around the entire circumference of the pipe. The cut shall be made following this mark. The edge of the cut spigot shall be beveled a minimum of 1/4-inch when "push-on" joints are involved.
 - 1) A pipe saw shall be used for cutting all pipe. Any other method must be approved by the SWS Engineering Department prior to construction.
 - 2) The flame cutting of any pipe by any means will not be allowed.
 - 3) The minimum nipple length allowed without approval from the SWS Engineering Field Technician is two feet (2').

- H. Push-On Joints ("Tyton", Fastite): Jointing of compression ("Push-on") joint pipe shall be made by experienced workers. Sockets, spigots, and gaskets shall be thoroughly cleaned in accordance with AWWA C111 before the gasket is inserted into the socket recess. At a minimum, the sockets and spigots shall be cleaned with a wire brush. If the gaskets and spigots require additional cleaning and lubrication, this shall be provided via an NSF approved soapy water solution or an approved lubricant. However the lubricant cannot be vegetable shortening nor can it support microbiological growth. Any lubrication shall be in accordance with manufacturer's recommendation. Care must be taken in the use and storage of the joint lubricant provided. Lubricant contaminated by dirt or other material shall be discarded. The gasket shall be carefully placed into the socket recess by hand, and evenly seated. A thin film of lubricant supplied by the pipe supplier shall be applied to the inside of the gasket and outside of the spigot end of the pipe to permit easy entry of the pipe into the socket. The spigot ends of cut pipe shall be dressed and tapered with a coarse file or approved beveling device in a manner that will protect the gasket from damage, permit the proper centering of pipe in the bell, provide uniform compression of the gasket, and easy entry of spigot into socket. The spigot end of the pipe shall be pushed "HOME" by the use of a large bar ratchet type assembly tool, or jack, or other approved methods. Care must be taken in the use and storage of the joint lubricant provided. Lubricant contaminated by dirt or other material shall be discarded. During assembly of the next joint of pipe in the ditch, the joint being installed must be kept straight and in line with the previous joint installed. Pipe may be deflected if necessary but only after the assembly is completed.
- I. Mechanical Joints: Joints for mechanical joint pipe shall be made by experienced workers. Gaskets, sockets and spigots shall be cleaned and lubricated as stated in paragraph "B" above. The spigot shall be pushed into position and seated evenly in the socket. The gland shall be pushed into position for compressing the gasket. All bolts and nuts shall be tightened to a uniform permanent tightness to the required torque as shown in Table 4-1. Bolts shall be tightened beginning with the bottom bolt, then the bolt directly opposite and proceeding around the joint using this alternating procedure to provide uniform tightness around the pipe. Care shall be taken to keep the gland square with the socket. The glands and bolts shall be kept clean and sockets, spigots, and gaskets shall be kept clean until such joint has been completed. Any joint which leaks shall be reassembled.
- J. Restrained Joint Pipe: Where restrained joint pipe is called for on the plans, or is otherwise required and approved by the Engineer, it shall be assembled and installed in accordance with the manufacturers published instructions and recommendations.

4D-04 INSTALLATION OF PVC PIPE

- A. All pipe and fittings shall be assembled and jointed in accordance with the manufacturer's instructions and with this section. When gaskets are color coded, refer to the PVC pipe manufacturer's literature for significance.
- B. Handling: Proper and suitable tools and equipment for the safe and convenient handling and laying of PVC pipe shall be used. Care shall be taken to prevent the pipe or fittings from being damaged, particularly the lining on the interior of the iron fittings. All pipe and fittings shall be carefully examined for cracks, broken lining or other defects. No pipe or fitting shall be laid which is known to be defective. If any pipe or fitting is discovered to be cracked, broken or defective, after being laid, it shall be removed and replaced with acceptable new pipe or fittings. All pipe and fittings shall be thoroughly cleaned before being laid and shall be kept clean until accepted in the completed work.
- C. Cleaning Pipe and Fittings: In all cases, clean the gasket, the bell or coupling interior, especially the groove area (except when the gasket is permanently installed) and the spigot area with a rag, brush or paper towel to remove any dirt or foreign material before assembling. If, in the opinion of the SWS Engineering Field Technician, the interior of the pipe is not clean, the entire length of pipe shall be SWABBED clean by the use of a circular cloth swab having a diameter equal to the inside diameter of the pipe.
- D. Inspection of Pipe: Inspect the gasket, pipe spigot bevel, gasket groove and sealing surfaces for damage or deformation. When gaskets are not permanently installed in the pipe, use only gaskets which are designed for and supplied with the pipe. Insert them as recommended by the pipe manufacturer.
- E. Placing in Ditch:
 - 1) Proper tools and equipment shall be used for careful placement of PVC pipe in the trench to prevent damage. Under no circumstances shall pipe or accessories be dropped into the ditch.
 - 2) Every precaution shall be taken to prevent foreign material from entering the pipe while it is being placed in the trench. If the pipe laying crew cannot place the pipe into the trench without getting earth into it, a heavy, tightly woven canvas bag of suitable size shall be placed over each end before lowering the pipe into the trench and left in place until the connection is to be made. During laying operations, no debris, tools, clothing or other material shall be placed in the pipe. When pipe laying is not in progress, open ends of installed pipe shall be plugged with SWS approved plugs to prevent the entrance of trench water, dirt, or other foreign matter. Any dirt or foreign matter which is found in the pipe shall be removed before joining occurs.

- 3) Lubrication: Lubricant shall be applied as specified by the pipe manufacturer. Bacterial growth, damage to the gaskets or the pipe may be caused by use of non-approved lubricants. Use only lubricant supplied by the pipe manufacturer for use with the pipe provided and in potable water systems. Lubricants which will support microbiological growth shall not be used for slip-on joints. Care must be taken in the use and storage of the joint lubricant provided. Lubricant contaminated by dirt or other material shall be discarded. Any lubricant must be ANSI/NSF approved.
- 4) The socket (except when gasket is permanently installed), gasket, and spigot shall be thoroughly cleaned with a rag, brush, or paper towel before the gasket is inserted into the socket recess. Insert gasket as recommended by manufacturer.
- 5) Good alignment of the pipe is essential for ease of assembly. Align the spigot to the bell and insert the spigot into the bell until it contacts the gasket uniformly. Apply firm steady pressure either by hand or by use of a bar and block assembly, until the spigot easily slips through the gasket.
- 6) Do not suspend the pipe and swing it into the bell. The use of a backhoe to push the pipe will not be allowed. The use of other construction machinery will be allowed only if recommended by the pipe manufacturer and approved in advance by the SWS Engineer.
- 7) The spigot end of the PVC pipe is marked by the pipe manufacturer to indicate the proper depth of insertion. Care shall be taken to insure that the spigot end is inserted to this mark. **PIPE SHALL NOT BE OVER-INSERTED.**
- 8) Care must be taken to assure that previously assembled pipe joints are not disturbed or over-inserted as a result of force applied to subsequent joints.
- 9) When pipe installation is performed in cold weather gasket materials should be kept warm until jointing is to occur to aid in the ease of assembly.
- 10) If undue resistance to insertion of the pipe end is encountered or if the reference mark does not position properly, the joint shall be disassembled and the position of the gasket checked. If the gasket is twisted or out of place, the components shall be inspected and damaged items repaired or replaced. Components shall then be cleaned and reassembled making sure both pipe lengths are in concentric alignment. If the gasket is not out of position, verify proper location of the reference mark. The SWS Engineering Field Technician may relocate the reference mark if it is out of position.

- 11) During assembly of the next joint of pipe in the ditch, the joint being installed must be kept straight and in line with the previous joint installed.
- F. Permissible Joint Deflection and Longitudinal Bending: Pipe may be deflected if necessary but only after the assembly is completed and only if the manufacturer's literature states that this is allowable. Whenever it is necessary to deflect the pipe from a straight line, either in the horizontal or vertical plane to avoid obstructions, or to properly locate valve stems, or where long radius curves are required; this may be accomplished by longitudinal bending only if the pipe is designed to allow this. If so, the manufacturer's recommendations for shall be followed and not exceeded.
- G. Cutting Pipe:
- 1) The field cutting of pipe for installing valves, fittings, or nipple pieces shall be done in a neat and workmanlike manner without damage to the pipe and so as to leave a smooth end at right angles to the axis of the pipe. Prior to cutting, the exact location of the cut shall be carefully marked around the entire circumference of the pipe. The cut shall be made following this mark. A square cut is essential for proper assembly.
 - 2) A hacksaw, handsaw or a power handsaw with a steel blade or abrasive disc shall be used for cutting PVC pipe.
 - 3) A factory-finished beveled end shall be used as a guide to ensure proper bevel angle and depth and proper insertion reference mark when assembling to PVC pipe bells. For installation of PVC pipe in iron fittings, all but 1/4-inch of the factory bevel on the spigot end shall be removed.
 - 4) The end may be beveled by using wood rasp or a pipe beveling tool which will cut the correct taper. A portable sander or abrasive disc may also be used. All sharp edges on the bevel shall be rounded off with a knife or a file.
 - 5) The minimum nipple length allowed without the approval of the SWS Engineering Field Technician is 2' – 0".
- H. Excavation, cleaning, laying, jointing, and backfilling shall be kept up as closely as is possible so as to progress in a uniform, workmanlike manner. In no case shall pipe be left in the trench overnight, without completing the joint. The completed pipeline shall not be left exposed in the trench unnecessarily. The trench shall be backfilled and compacted as soon as possible after laying and jointing is completed. If necessary, exposed ends of pipe shall be properly plugged during laying to prevent dirt and other materials entering the line.
- 1) Whenever pipe laying is stopped, the open end of the line shall be closed with a tight-fitting, inflatable, plug to keep out sand, earth, and water. An

MJ cap (with restrainer gland) may be used as an alternate if the pipe terminates in a plain end. Any standing water shall be removed from the trench before the plug or cap is removed. The plug should be tied off to prevent movement under the influence of standing water in the ditch which may be present after a heavy rain. Any dirt or foreign matter found in the pipe shall be thoroughly removed before joining occurs.

- 2) In the event that the cap or plug fails to prevent the entry of standing water and/or debris into the pipe, the pipe laying operation shall not commence until the interior of the pipe has been cleaned to the satisfaction of the SWS Engineering Field Tech.

I. Mechanical Joint Fittings: Joints with mechanical joint fittings shall be made by experienced workers.

- 1) All but 1/4-inch of the factory bevel on the spigot end of a length of PVC pipe shall be removed before installation of this spigot end into an iron fitting. This shall be removed following the procedures in paragraph G of this section.
- 2) Gaskets, sockets and spigots shall be thoroughly cleaned with a rag, brush, or paper towel before slipping the gland and gasket over the spigot end of the pipe.
- 3) The spigot shall be pushed into position and seated evenly in the socket. The gland shall be pushed into position for compressing the gasket. All bolts and nuts shall be tightened to a uniform permanent tightness in accordance with manufacturers recommendations. Bolts shall be tightened beginning with the bottom bolt, then the bolt directly opposite and proceeding around the joint using this alternating procedure to provide uniform tightness around the pipe. Care shall be taken to keep the gland square with the socket.
- 4) The glands and bolts shall be kept clean and sockets, spigots, and gaskets shall be kept clean until such joint has been completed. Any joint which leaks shall be reassembled.

J. Thrust restraint shall be installed as shown on the approved plans and as required in the applicable section of these SPECIFICATIONS.

- 1) For external restraint of bell and spigot joints refer to SECTION 3B-01, Paragraph F.
- 2) For restraint of iron fittings refer to SECTION 3D-02.

I. Dead-end Lines: Where a line is to terminate in a plug, the last joint of pipe shall

be one full length of mechanical joint ductile iron pipe (AWWA C151) with a restrained joint plug (AWWA C153). The pipeline shall be restrained as required in SECTION 4F: THRUST RESTRAINT.

4D-05 INSTALLATION OF HDPE PIPE

- A. Pipe shall be protected from lateral displacement by pipe embedment in trench material installed as specified in SECTION 4E-04. Pipe shall not be laid in water or under unsuitable weather or trench conditions and shall be protected against entry of foreign matter. If the pipe laying crew cannot place the pipe into the trench and in place without getting earth into it, a heavy, tightly woven canvas bag of suitable size shall be placed over each end before lowering the pipe into the trench and left in place until the connection is to be made.
- B. During freezing weather, particular care shall be taken in handling and laying pipe to prevent damage by impact.
- C. Whenever pipe laying is stopped, the open end of the line shall be closed with a tight-fitting, inflatable, plug to keep out sand, earth, and water. Any standing water shall be removed from the trench before the plug or cap is removed. The plug should be tied off to prevent movement under the influence of standing water in the ditch which may be present after a heavy rain. Any dirt or foreign matter found in the pipe shall be thoroughly removed before joining occurs.
 - 1) In the event that the cap or plug fails to prevent the entry of standing water and/or debris into the pipe, the pipe laying operation shall not commence until the interior of the pipe has been cleaned to the satisfaction of the SWS Engineering Field Tech.
- D. Pipe shall be protected from exposure to sunlight, shall be kept as cool as possible during installation, and shall be covered with backfill immediately after installation.
- E. Cleaning. The interior of all pipe and fittings shall be thoroughly cleaned before installation and shall be kept clean until the work has been accepted.
- F. Alignment: Piping shall be laid to the lines and grades indicated on the drawings. Pipelines or runs intended to be straight shall be laid straight. Deflections from a straight line or grade shall not exceed the maximum deflection specified by the manufacturer.
- G. Unless otherwise specified or indicated in the drawings either shorter pipe sections or fittings shall installed as required to maintain the indicated pipeline alignment or grade.
- H. Cutting Pipe: Cutting shall be in accordance with the pipe manufacturer's recommendations. Cuts shall be smooth, straight, and at right angles to the pipe

axis. After cutting, the end of the pipe shall be dressed to remove all roughness and sharp corners and shall be beveled in accordance with the manufacturer's instructions.

- I. Butt-fusion: Jointing shall be done in accordance with the instructions and recommendations of the pipe manufacturer.
 - 1) Joints between plain end pipes and fittings shall be made by thermal butt fusion method in accordance with the pipe manufacturer's recommendations. Socket fusion and extrusion welding or hot gas welding will not be acceptable.
 - 2) The equipment used to prepare and complete the butt fusion shall include a datalogger which will record the fusion conditions. These conditions shall be, as a minimum, the elapsed time, the temperature, and the pressure exerted during the fusion operation.
 - 3) The butt fusion operation shall not occur unless the fusing machine and all pipe which is in the process of being fused are completely free of any moisture which would effect the integrity of the fusion.
- J. Polyethylene pipe and fittings may be joined together or to other materials by means of flanged connections, mechanical couplings designed for joining polyethylene pipe or for joining polyethylene pipe to another material, mechanical joint adapters, or electrofusion. When joining by other means, the installation instructions of the joining device manufacturer shall be observed. The Engineer who is responsible for the design of projects which involved transitions from HDPE to other materials must be experienced and knowledgeable of the specific issues related to this type of installation.
- K. Connections between new work and existing piping shall be made using suitable fittings. Each connection with an existing pipe shall be made at a time and under conditions which will least interfere with service to customers, and as authorized by SWS. Facilities shall be provided for proper dewatering and for disposal of all water removed from the dewatered lines and excavations without damage to adjacent property.

4D-06 INSTALLATION OF TRACER WIRE AND WARNING TAPE

Wherever PVC or HDPE pipe is installed, tracer wire and warning tape shall be installed to facilitate future locating of the pipe line.

- A. Materials:
 - 1) For open-trench pipe installation, tracer wire shall be #14 AWG copper-clad-steel (CCS) wire or #12 AWG gauge solid copper with minimum

30mil (0.03”) thick HDPE insulation.

- 2) For directional drill installation, tracer wire shall be #12 AWG copper-clad-steel (CCS) wire or #8 AWG gauge solid copper with minimum 45mil (0.045”) thick HDPE insulation.
- 3) For pipe bursting installation, proposed tracer wire shall be submitted for review and approval to the SWS Engineering Department.
- 4) Warning tape shall be 100% virgin, pigmented, polyolefin film with a printed message on one side, and specifically designed for use to protect, identify and locate underground utilities.
- 5) Warning tape and tracer wire insulation shall be color colored in accordance with APWA Uniform Color Code.
- 6) Test boxes shall be the Glenn 4 Test Station (4-inch diameter, 18-inch length) with a locking cover and 4-terminal terminal board as manufactured by C. P. Test Services, Inc., or equal. Test box shall be 4-inch ID plastic with cast iron cover and collar. The cover shall be painted blue.

B. Installation:

- 1) Tracer wire shall be taped to the top of the pipe (“12-o’clock position”) using strips of duct tape or other suitable adhesive tape spaced a minimum of every 5 feet along the entire length of the pipe.
- 2) Tracer wire shall be looped up into valve boxes on in-line valves. The tracer wire shall pass through the gap between the upper and lower sections of a standard valve box. A loop shall be made in the wire to prevent it from falling down around the valve operating nut. Refer to Typical Valve Box Detail in APPENDIX A, which shows the tracer wire.
- 3) Tracer wires shall begin and terminate in the test boxes. Test boxes shall be installed at each location as shown on the plans, spaced at intervals not to exceed 500 feet. Test boxes shall not be installed in streets or driveways.
- 4) Tracer wire between boxes shall be continuous, unbroken lengths. The tracer wire shall not be installed in tension, but neither shall there be "coils" in the wire. The ends of the tracer wires shall be installed in the test boxes. The length of each tracer wire in each box shall be long enough to extend no less than one foot and no greater than two feet above ground level and shall be attached to the terminal board.
- 5) Splicing and repair of breaks shall be made by the installation of direct-bury wire nuts. When connecting tracer wire ends together, strip 5/8” of

insulation from both wire ends. Insert the bare wire ends into the direct-bury wire nut. Twist the direct-bury wire nut clockwise while pushing the wires firmly into the wire nut. Confirm that the open end of the wire nut is completely sealed with the silicone grease and that there is no bare wire visible protruding from the open end of the wire nut. Tie the two wires in a knot approximately 6" from the wire nut so that no strain on the wire is transferred to the wire nut.

- 6) Connections of tracer wire at tees, crosses, and at locations where the tracer wire will be brought to the surface shall be conducted by the installation of a direct-bury lug. Install the direct-bury lug in accordance with the manufacturer's instructions and insure that no bare wire is visible protruding from the lug.
- 7) Prior to backfilling, all tracer wire splice connections, whether made with a direct-bury wire nut or direct-bury lug must be inspected and approved by the SWS Engineering Field Technician.
- 8) Warning tape shall be buried in the backfill approximately one foot below grade, directly over the top of the PVC or HDPE pipeline. Tape shall be laid in continuous lengths. Any breaks or tears shall be repaired before proceeding with the backfilling operations.

C. Testing: After construction and backfilling is complete, but before final inspection, the SWS Engineering Field Technician will test the tracer wire with standard SWS locating equipment. If the SWS Engineering Field Technician determines that the tracer is not operating properly, the Contractor shall locate and correct the problem. The pipelines will not be accepted and placed in operation until the tracer system is acceptable

SECTION 4E

BEDDING OF PIPE AND BACKFILLING OF TRENCHES

4E-01 SCOPE

This section shall include specifications for bedding of pipe and backfilling of trenches.

4E-02 BEDDING OF DUCTILE IRON PIPE

- A. All ductile iron pipe 3-inch through 20-inch diameter shall be bedded on a flat trench bottom or on select material as described in B.1) below. All ductile iron pipe 24-inch through 42-inch diameter shall be bedded on a 4-inch thick bed of angular material as described in B.2) below. All pipe bedding shall be continuous and uniform, have adequate support, and no stones within six (6) inches of the pipe.
- B. Bedding Materials: Materials for pipe bedding shall be as indicated on the typical trench section (See Typical Trenching Detail in APPENDIX A), or as specified herein.
 - 1) Select material shall be used from the angular material to the top of trench. It shall be suitable material from the excavation free of large stones, hard lumps of debris and other objectionable materials. If select material is not available from the excavation, it shall be hauled to the site.
 - 2) Angular material shall be crushed stone conforming to ASTM C33, Size No. 67 with a size not larger than 3/4-inch. Size No. 57 stone, which is frequently more-readily available, may be used as a substitute.
- C. Trench Earth Dams: Where pipe bedding is angular material, earth dams, consisting of a minimum ten (10) foot trench length of select compacted backfill to replace angular bedding, shall be installed every 200 feet of pipe to prevent groundwater movement in angular bedding material. Compacted backfill 95% Standard Proctor shall replace angular bedding.

4E-03 BEDDING OF PVC PIPE

- A. Trench Bottom: Before the pipe is laid, the trench bottom shall be constructed to provide a firm, stable, and uniform longitudinal support for the full length of the pipe.
- B. Pipe Bedding: PVC Pipe shall be installed with proper bedding providing uniform

longitudinal support under the pipe.

- C. Bedding material shall be worked under the sides of the pipe to provide satisfactory haunching from the trench bottom to the spring-line of the pipe. This material shall be selected and placed carefully, avoiding stones, frozen lumps and debris and shall be compacted to 95% Standard Proctor.
- D. Bedding Materials: Materials for pipe bedding shall be as indicated on the typical trench detail in APPENDIX A, or as specified herein.
- E. Select material shall be suitable material from the excavation free of large stones, hard lumps of debris and other objectionable materials. If select material is not available from the excavation, it shall be hauled to the site.
- F. Angular material shall be crushed stone conforming to ASTM C33, Size No. 67 with a size not larger than 3/4-inch. Size No. 57 stone, which is frequently more-readily available, may be used as a substitute.
- G. Trench Earth Dams: Where pipe bedding is angular material, earth dams, consisting of a minimum ten (10) foot trench length of select compacted backfill to replace angular bedding, shall be installed every 200 feet of pipe to prevent groundwater movement in angular bedding material. Compacted backfill 95% Standard Proctor shall replace angular bedding.

4E-04 BEDDING OF HDPE PIPE

- A. Trench Bottom: Before the pipe is laid, the trench bottom shall be constructed to provide a firm, stable, and uniform longitudinal support for the full length of the pipe.
- B. Pipe Bedding: HDPE Pipe shall be installed with proper bedding providing uniform longitudinal support under the pipe.
- C. Bedding material shall be worked under the sides of the pipe to provide satisfactory haunching from the trench bottom to the spring-line of the pipe. This material shall be selected and placed carefully, avoiding stones, frozen lumps and debris and shall be compacted to 95% Standard Proctor.
- D. Bedding Materials: Materials for pipe bedding shall be as indicated on the typical trench detail in APPENDIX A, or as specified herein.
- E. Select material shall be suitable material from the excavation free of large stones, hard lumps of debris and other objectionable materials. If select material is not available from the excavation, it shall be hauled to the site.

- F. Angular material shall be crushed stone conforming to ASTM C33, Size No. 67 with a size not larger than 3/4-inch. Size No. 57 stone, which is frequently more-readily available, may be used as a substitute.
- G. Trench Earth Dams: Where pipe bedding is angular material, earth dams, consisting of a minimum ten (10) foot trench length of select compacted backfill to replace angular bedding, shall be installed every 200 feet of pipe to prevent groundwater movement in angular bedding material. Compacted backfill 95% Standard Proctor shall replace angular bedding.

4E-05 BACKFILLING TRENCHES

A. GENERAL

All trenches shall be backfilled immediately after the pipe is laid in the trench and bedding is complete, unless otherwise directed by the SWS Engineering Field Technician. All opened trench shall be properly backfilled before the end of the working day unless the SWS Engineering Department specifically approves leaving the trench open.

B. BACKFILLING OF DUCTILE IRON PIPE

The backfilling of pipe trenches shall be as stated below according to the pipe diameter.

- 1) Ductile iron pipe 4-inch to 12-inch diameter: The trench shall have a lightly consolidated backfill (80% Standard Proctor) placed around the barrel of the pipe, with fine material, free of large stones, hard lumps of debris and other objectionable material, up to the top of pipe. Backfilling shall be carried up evenly on both sides of the pipe. The remaining backfill may be placed in layers of up to 12-inches for mechanical tamps, (18-inches if a mobile tamp is used) and each layer shall be compacted to 95% standard proctor by using one of the approved tamping devices listed in paragraph 5) below. The tamping equipment shall make no less than four (4) passes. One compaction run up the trench and back down the trench is considered one pass.
- 2) Ductile iron pipe 14-inch to 42-inch diameter: The trench shall be backfilled to the top of the pipe with select material compacted to 95% standard proctor by a narrow footed air tamp or narrow footed mechanical tamp. Remaining backfill may be placed in layers of up to 12 inches. From the top of the pipe to the top of ditch the backfill shall be compacted by using one of the approved tamping devices listed in paragraph E below. All backfill shall be compacted to 95% maximum Standard Proctor (ASTM

D698). The tamping equipment shall make no less than four (4) passes; more if necessary to obtain the required compaction. One compaction run up the trench and back down the trench is considered one pass. Compaction shall be such as to prevent future settlement. The entire cross-section of the trench (from side to side of trench and entire length) shall be compacted. No space in the trench shall be left uncompacted.

C. BACKFILLING OF PVC PIPE

- 1) All trenches shall be backfilled immediately after the pipe is laid in the trench and bedding is complete, unless otherwise directed by the SWS Engineering Field Technician. All opened trench shall be property backfilled before the end of the working day unless the SWS Engineering Department specifically approves leaving the trench open.
- 2) Initial backfill material shall be placed to a satisfactory height over the top of the pipe (minimum 12-inches) for impact protection during the initial backfill. No mechanical tamps shall be used until this depth has been achieved.
- 3) Bedding and backfill up to 12 inches over the top of the pipe shall be placed as required above. Backfilling shall be carried up evenly on both sides of the pipe. The remaining backfill may be placed in layers of up to 12-inches for mechanical tamps, (18-inches if a mobile tamp is used) and each layer shall be compacted to 95% Standard Proctor by using one of the approved tamping devices listed in Paragraph E below. The tamping equipment shall make no less than four (4) passes. One compaction run up the trench and back down the trench is considered one pass. Refer to Typical Trenching Detail in APPENDIX A.

D. BACKFILLING OF HDPE PIPE

- 1) All trenches shall be backfilled immediately after the pipe is laid in the trench and bedding is complete, unless otherwise directed by the SWS Engineering Field Technician. All opened trench shall be property backfilled before the end of the working day unless the SWS Engineering Department specifically approves leaving the trench open.
- 2) Initial backfill material shall be placed to a satisfactory height over the top of the pipe (minimum 12-inches) for impact protection during the final backfill. No mechanical tamps shall be used until this depth has been achieved.

- 3) Bedding and backfill up to 12 inches over the top of the pipe shall be placed as required above. Backfilling shall be carried up evenly on both sides of the pipe. The remaining backfill may be placed in layers of up to 12-inches for mechanical tamps, (18-inches if a mobile tamp is used) and each layer shall be compacted to 95% standard proctor by using one of the approved tamping devices listed in Paragraph 4) below. The tamping equipment shall make no less than four (4) passes. One compaction run up the trench and back down the trench is considered one pass. Refer to Typical Trenching Detail in APPENDIX A.
- E. Tamping Equipment: Mechanical tamps (gasoline driven), pneumatic tamps (air tamp), and sheepsfoot trench rollers are acceptable. "Mobile tamps" and/or "sheepsfoot trench rollers" such as "Rammax P-24EC" or approved equal, are permitted.
 - F. Compaction Test: All backfill for water lines shall be subject to a compaction test by Spartanburg Water System personnel or an independent laboratory approved by the Spartanburg Water System. If compaction fails the test, the Contractor shall remove and replace backfill to the satisfaction of the Spartanburg Water System at no additional cost to SWS.

4E-06 TEMPORARY SURFACING

- A. Temporary Surfacing of Trenches: Where trenches are in streets or across roadways or driveways open to vehicular traffic, the remaining 6 inches of backfill up to the traveled surface shall be made with compacted crushed stone, ASTM C33 Gradation 67 with sufficient fines for compaction. Such surface maintenance of trenches shall continue until permanent replacement of street paving is completed.
- B. Under Pavement, the top of the trench shall be filled with base for pavement as specified in SECTION 11: PAVEMENT AND SURFACING. In unpaved roads and shoulders, the top 6 inches of the trench shall be filled with compacted topsoil.
- C. Contractor shall be responsible for final subsidence of all trenches, and shall leave trenches flush with the original ground after all settlement has taken place. Any settlement of backfill below finish grade shall be promptly corrected. Trenches shall be protected against scour due to surface drainage.

4E-07 CONCRETE ENCASEMENT OF PIPE

- A. Where shown, and where otherwise directed, pipe shall be completely encased with concrete as specified in this paragraph. The trench shall first be excavated not less than six inches (6") below the bell of the pipe and the pipe laid to line and grade on concrete blocking. Concrete shall then be placed to the full width of the trench, but in no case less than six inches (6") from the pipe bell on either side of the trench, and to a height of not less than six inches (6") above the top of the pipe bell. No backfill material shall be placed in the trench for a period of at least twenty four (24) hours after the concrete encasement has been placed. The water main shall be tested before encasing in concrete.

SECTION 4F

THRUST RESTRAINT

4F-01 SCOPE

For lines 2-inches and larger, all plugs, caps, tees, bends, valves, hydrants, and other items as may be indicated on the plans, shall be provided with reaction blocking, tie rods, or other approved restraining methods or as shown on the drawings. This includes fire all hydrants.

4F-02 GENERAL

A. Concrete Blocking and Rodding:

- 1) Concrete used for blocking, collars and "Deadman" type thrust blocks shall have a compressive strength of 3,000 psi at 28 days. High early strength concrete shall be used.
- 2) Concrete shall be poured to the dimensions shown on the plans and formed when directed by the Engineering Field Technician. The large side (backs) of the blocking shall bear against undisturbed, hard, solid earth. Blocking shall be poured to bear against the pipe or fitting and allow sufficient area for repair and the easy removal of nuts and bolts. The pipe or fitting shall be wrapped with 8 mil polyethylene (according to AWWA C-105) for a suitable distance either side of the thrust block to prevent the concrete from bonding to the pipe, fitting, or fasteners. Refer to Concrete Thrust Block Detail in APPENDIX A.
- 3) Backfilling on poured concrete will not be permitted on concrete for 24 hours after pouring, and no water will be permitted in mains for at least 24 hours after concrete blocking is poured.
- 4) Metal Straps and rods shall be made of steel having a tensile strength of 95,000 psi. If required by the Engineer, the Contractor shall supply acceptable certification of tensile strength. All steel components, including rods, straps, nuts, bolts, and clamps shall be coated with 17.5 mils of Thick and Quick Mastic, or equal. Contractor shall supply coating and coat all the tie rods, clamps and miscellaneous steel used for anchoring purposes. Rod couplings are not allowed.
- 5) Concrete Collars poured on the last joint of pipe of a dead end run, shall be poured around a thrust collar which shall be installed according to the

manufacturer's recommendations (unless welded on, which must be done at the factory). This collar shall be installed on the pipe midway between the Mechanical Joint (MJ) bell and the spigot. Pipe manufacturer's shop drawings must be submitted for each size collar to be used indicating that the collar is designed to, at a minimum, restrain the force created by a 250 psi line pressure as listed in the table below. Field welding thrust collars will not be allowed. Refer to Typical DIP Concrete Collar Detail in APPENDIX A.

Pipe Size (in)	Force (lb)	Pipe Size (in)	Force (lb)	Pipe Size (in)	Force (lb)
4	4,500	16	59,400	40	388,800
6	9,300	18	74,700	48	506,700
8	16,100	20	91,600	54	650,500
10	24,200	24	130,700	60	745,300
12	34,200	30	201,100	64	846,800
14	46,000	36	288,000		

*Thrust value represents the force in pounds that will be exerted on a test bulkhead (plug, cap, blind flange, etc.), a closed valve, or the back of a full opening tee by the an internal pressure of 250-psi acting over the pressure area (pipe OD).

- 6) Certain applications require special thrust restraint procedures and designs which should be submitted to the SWS Engineering Department for review and prior approval.

B. Restrained Joint Pipe

- 1) Restrained joint piping materials shall meet the requirements stated in Section 3A, DUCTILE IRON PIPE MATERIALS, and Section 3D FITTINGS, and shall be as those shown on the shop drawings submitted by the Contractor and approved by the Engineer.
- 2) Installation of restrained joint piping shall be as specified in Section 4D, ASSEMBLING AND JOINTING PIPE AND FITTINGS, and as recommended by the manufacturer.

C. Retainer Glands: Thrust restraint devices shall be installed where shown on the plans. Installation shall be as specified in Section 4D, ASSEMBLING AND JOINTING OF PIPE AND FITTINGS, and as recommended by the manufacturer. See Section 3D, FITTINGS for a list of approved manufacturers.

SECTION 4G

TESTING AND DISINFECTION

4G-01 SCOPE

This section contains the requirements for testing, disinfection, clean-up, and placing newly installed water mains into service.

4G-02 HYDROSTATIC PRESSURE AND LEAKAGE TESTING

- A. The hydrostatic pressure test shall be performed in conjunction with the leakage test and shall be in accordance with the requirements of the Spartanburg Water System, and AWWA C600, and the South Carolina Department of Health and Environmental Control R.61-58. All equipment, procedures, and sequences for each test shall be as required by the Spartanburg Water System. Water for testing shall be provided by Spartanburg Water System at no cost to the Contractor.
- 1) Taps: If taps are not available at high points in the pipeline, taps for air release shall be installed. The Contractor shall excavate tap holes, make the taps, and backfill when testing is complete. After the tests have been completed, plugs shall be installed on the taps by the Contractor at his expense. Post hydrants are not allowed.
 - 2) Testing shall be conducted in the following steps:
 - a. The SWS Engineering Field Technician with the assistance of the Contractor shall fill each of the sections of pipe slowly with water and expel all air through air valves or taps. SWS Engineering Field Technicians shall operate all valves in the existing water system. Contractor to operate all blow-offs.
 - b. Before testing, the newly constructed water main shall be thoroughly flushed to remove all dirt and foreign matter. Water shall be flowed in a manner which will create a scouring velocity of not less than 2.5 feet per second in the main being flushed for all ductile iron pipe installations. For all PVC pipe installations, the scouring velocity shall not be less than 3.0 feet per second. Flushing of all lines shall be coordinated by and shall be done at the direction of the SWS Engineering Field Technician after the trench has been backfilled. Flushing will be coordinated by the SWS Engineering Field Technician based upon system operating conditions at the time.

- c. Employ Best Management Practices (BMPs) to prevent erosion from discharge of water during any construction activities including flushing and disinfection in accordance with an approved Storm Water Pollution Prevention Plan (SWPPP)
 - d. Extreme care shall be taken during the flushing operation to ensure that damage is not caused to adjacent property from the discharged water, that the operation is performed in the safest manner possible, and that the nearby system pressure is not adversely affected. If necessary, a pressure gauge shall be installed on a fire hydrant so that the system pressure can be monitored during flushing. Care shall be exercised to prevent the water from entering the trench and/or wetting the backfill material. The Contractor shall be responsible for any damage caused by flushing.
 - e. The Contractor shall provide an approved test pump and a method of measuring water pumped into the pipeline which is acceptable to the SWS Engineering Field Technician
 - f. The SWS Engineering Field Technician shall connect the pressure test recording device to an appropriate pressure tap on the water main, shall operate the device, and shall be present during the entire test.
 - g. The test pressure shall be 1.5 times the working pressure of the line or 150 psi, whichever is greater, as measured at the lowest point in the section of the line being tested, and no less than 1.25 times the working pressure as measured at the highest point in the section.
 - h. The pressure in the line shall be pumped up to the test pressure and be constantly maintained for 96 minutes and recorded on pressure recorders furnished by the Spartanburg Water System. During testing, the pressure must be maintained to within ± 5 psi of the test pressure.
- 3) Leakage is the quantity of water that must be supplied to the newly laid pipe or any closed-valved section to maintain the pressure within the limits stated above.

- 4) The allowable leakage (for DIP and PVC) is defined by the following AWWA formulas:

Ductile Iron Pipe

PVC Pipe

$$L = \frac{SD\sqrt{P}}{148,000}$$

$$Q = \frac{LD\sqrt{P}}{144,800}$$

L = allowable leakage (gallons/hr) Q = quantity of makeup water (gallons/hr)
 S = length of pipe tested (ft) L = length of pipe tested (ft)
 D = nominal diameter of pipe (in) D = nominal diameter of pipe (in)
 P = average test pressure (psi) P = average test pressure (psi)

- 5) If the amount of leakage exceeds the allowable limit, the Contractor shall locate and repair the leaks and shall retest the line using the same test procedures. All visible leaks shall be repaired regardless of the amount of leakage.
- 6) Examination: All exposed pipe, valves, fittings, fire hydrants, etc., shall be carefully examined during the tests. When any visible leakage is detected, joints that are found to be leaking shall immediately be properly adjusted to stop the leakage. Any pipe, valves, fittings, fire hydrants, or other items discovered to be defective during the tests shall be removed and replaced and tests repeated until the results are satisfactory to the SWS Engineering Department.

4G-03 TESTING OF HDPE PIPE

- A. The hydrostatic test procedures for High Density Polyethylene Pipe (HDPE) are different from those used with other pressure pipe. In testing HDPE pipe, the manufacturer's specific procedures shall be used. Prior to scheduling testing with the SWS Engineering Field Technician, the test procedure shall be submitted to the SWS Engineering Department for review and acceptance.

4G-04 DISINFECTION

- A. All water for disinfection shall be furnished at no cost by the Spartanburg Water System. Chemical hoses, pumps and all equipment shall be supplied by the Contractor. Disinfection shall be in accordance with AWWA C651 (latest version) and this section. Disinfection must be done on Monday through Thursday and must be scheduled so that the samples can be collected by SWS laboratory personnel or SWS Engineering Field Technician before 12:00 noon on

Friday. All chemicals or products added to the public water supply must be third party certified as meeting the specifications of ANSI/NSF Standard 60.

- 1) Equipment: All disinfection equipment shall be suitable and approved by the SWS Engineering Department.
- 2) Acceptable Disinfectants
 - a. Sodium hypochlorite [NaOCl] conforming to AWWA B300 Standard for Hypochlorites.
 - b. Calcium hypochlorite [Ca(OCl)₂] granules and tablets conforming to AWWA B300 Standard for Hypochlorites. Calcium hypochlorite intended for use in swimming pools is not permitted.
 - c. Disinfection with pure chlorine gas is not permitted.
- 3) Disinfection Procedure: Before being placed in service, all new mains and repaired portions of, (or repaired existing mains) must be thoroughly flushed and then chlorinated with not less than fifty (50) ppm of available chlorine throughout the length of the water main being disinfected. Water from the existing distribution system should be controlled so as to flow slowly into the newly constructed pipeline during the application of chlorine. The solution shall remain in the main for a minimum period of twenty-four (24) hours. The pressure of the injected chlorination solution in the main must not exceed a pressure of 5 psi less than the static pressure of the supply main. At the end of this 24-hour period, the treated water in all portions of the main must have a residual of not less than ten (10) ppm free chlorine.
- 4) Flushing After: Immediately after the requirements of the above paragraph have been met, the water main shall then be thoroughly flushed with potable water using the same taps and materials as utilized in the previous flushing procedures.
 - a. No flushing device or drain shall be directly connected to any type of sewer.
 - b. Chambers for valves, blow-offs, meters, air release valves are not allowed to be connected directly to storm drains or sewer systems.
 - c. No cross connections between water lines and any pipes, pumps, hydrants, or tanks will be allowed.
 - d. No cross connections between the distribution system and unsafe water or contaminations are allowed.

- 5) Chlorinated water used for disinfection shall be dechlorinated with an approved dechlorination agent. If discharge is not to a watercourse (e.g., flat ground), then total chlorine concentration shall be reduced to less than 1 ppm (part per million). Do not dose neutralizing chemical beyond the minimum required to neutralize the chlorine actually present in discharge. Allowable residual chlorine will vary depending on discharge avenue (watercourse or flat land).
- 6) Acceptable Dechlorination (Neutralizing) Agents
 - a. Sodium thiosulfate (technical grade, prismatic rice) is acceptable for all discharges, except to an active watercourse.
 - b. Vitamin C salt (sodium ascorbate, Vita-D-Chlor brand or equal) must be used when discharging to an active watercourse.
 - c. Sulfur dioxide gas is not permitted.
- 7) Sampling
 - a. Riser pipes for sampling shall be the same size as the tap and shall be made with a minimum of one foot of metal piping material at the end. Riser pipes shall be supplied by and installed by the Contractor. Hydrants shall not be used for sampling.
 - b. After water mains have been tested, disinfected, and flushed, the SWS Engineering Field Technician shall then notify the appropriate Spartanburg Water Laboratory that the main is ready for bacteriological sampling. Contractor shall give the SWS Engineering Field Technician sufficient notice to allow twenty-four (24) hours' notice to the Laboratory.
 - c. The number and location of sampling sites depends on the amount of new construction. As a minimum, the sampling sites:
 - (i) Must include all dead-end lines
 - (ii) Must be representative of the water in the newly constructed mains.
 - (iii) Shall be collected a minimum of every 1,200 linear feet
 - c. Prior to sampling, the chlorine residual must be reduced to normal system residual levels. In the Spartanburg Water System, compliance with this requirement shall be confirmed by measuring the chlorine residual in the "backup" sample, which is taken from a nearby source of supply from the existing system, and comparing this value with the sampling sites on the new main.
 - d. At each site, a minimum of two (2) satisfactory bacteriological

samples taken at least 24 hours apart shall be obtained. Also, at each site, chlorine residual at time of sampling must be measured and reported.

- e. If the sample is positive for total coliform utilizing colilert presence/absence testing procedure, the sample is also tested for E. Coli using UV light. The sample is considered positive and will be recollected.
- f. If the chlorine residual is less than 0.2 ppm, non-coliform growth will be tested. 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.
- g. If the membrane filter method of coliform analysis is used, non-coliform growth must also be reported.
- h. All samples shall be analyzed by the Spartanburg Water System laboratory which is State Certified. If the bacteriological tests are satisfactory, the laboratory will so inform the SWS Engineering Department and the Spartanburg Water Collection and Distribution Department that the sampled water main may then be put into operation. However, if the samples indicate that contamination is still present, the Contractor shall then re-disinfect the water main according to the above procedure until satisfactory samples are obtained from all sampling sites. Water used for re-disinfection shall be paid for by the Contractor, at the rate charged for irrigation water. The volume of water used for re-disinfection shall be estimated by the SWS Engineering Field Technician.
- i. NOTE: The bacteriological sampling results are only valid for 30 days; If the new line has not been accepted by the Spartanburg Water and System placed in operation within 30 days, flushing and sampling must be repeated at no cost to SWS.

4G-05 PLACING IN SERVICE

- A. Placing the new water main in service is conditional upon the following:
 - 1) Installation: The completed installation fully complying with all of the Spartanburg Water System's current requirements, standards and criteria.
 - 2) Hydrostatic Leakage Test: The successful completion of the required Hydrostatic Leakage Test.
 - 3) Disinfection: The meeting of the Spartanburg Water System's standard water quality and bacteriological tests.
 - 4) Discharge of Chlorinated Water: All chlorinated water which is to be

discharged, shall be discharged in a manner which protects fish, wildlife, and vegetation from damage. All State, Federal, and local requirements governing the discharge of chlorine into the environment shall be adhered to.

- 5) Valve Operation: The SWS Engineering Field Technician or authorized SWS Employee is the only person authorized to operate Spartanburg Water System valves. The SWS Engineering Field Technician will verify that all valves within the project are in the "open" position, unless specific instructions to leave a valve "closed" are shown on the plans or ordered by the SWS Engineering Department.
- 6) Pavement Patches: All pavement patches shall be made in accordance with the related encroachment permit for the project and/or as directed by the SWS Engineering Department.

SECTION 5

VALVES AND TAPS

5-01 SCOPE

This section contains the current specifications for materials to be used in projects to be integrated into the Spartanburg Water System. The Spartanburg Water System has established specific manufacturers as the standard for various items within its system. Such standardization is for the express purpose of expediting maintenance procedures. All requests for approval of an "or equal" item must be submitted to the Spartanburg Water System in writing. All valves and miscellaneous appurtenances shall conform to Section C of the AWWA Standards. All materials or products that contact potable water must be third party certified as meeting the requirements of ANSI/NSF61.

5-02 DESIGN CRITERIA

Valves and appurtenances shall be of the type and size shown on the plans. Underground valves shall have standard mechanical joint ends. Valves above ground or installed within structures shall have flanged ends. Flanges shall be Class 125 except where Class 250 is specifically noted. Valves shall be at least the same class as the pipe with which they are used. All valves which will be exposed to the weather shall be shop primed. Valves shall conform to the requirements of AWWA C-504, C-509 or C-515 and ANSI/NSF 61. All horizontal valves shall be set so that the operating nut is vertical.

Reference Standards of the American National Standards Institute

A21.11 Rubber Gasket Joints for Cast-Iron and Ductile Iron Pressure Pipe and Fittings

B16.1 Cast-Iron Pipe Flanges and Flanged Fittings, Class 25, 125, 250, 800

Reference Standards of the American Water Works Association (AWWA)

AWWA C111 Rubber Gasket Joints for Cast-Iron and Ductile-Iron Pressure Pipe and Fittings.

AWWA C223 Fabricated Steel and Stainless Steel Tapping Sleeves

C504 Rubber-Seated Butterfly Valves

C509 Resilient Seated Gate Valves

C515 Reduced-Wall, Resilient Seated Gate Valves

C512 Air-Release, Air/Vacuum and Combination Air Valves for Waterworks Service

C540 Power-Actuating Devices for Valves and Slide Gates

C550 Protective Interior Coating for Valves and Hydrants

C600 Installation of Ductile-Iron Water Mains and Their Appurtenances.

5-03 GATE VALVES:

- A. All valves 2-inch and smaller shall be Ford Ball Valves. The valve is to open left.
- B. Gate valves for water service, 3-inch through 12-inch, shall have a cast iron or ductile iron body, bonnet and gate. The valve shall close to a drop tight shut off by way of resilient seating. Double disc and wedge are not acceptable. The valve stem shall be non-rising construction and supplied with a 2-inch operator unless otherwise specified on the drawings. The stem and stem nut shall be made of bronze. The stem shall have a minimum of two o-rings, one above and one below the stem thrust collar. The valve shall conform to all requirements of AWWA C-509 or AWWA C-515, latest edition, designed for a minimum operating pressure of 200 psi. The valve shall open counter clockwise (open left). Acceptable valve manufacturers are as follows:
 - 1) Mueller
 - 2) Kennedy
 - 3) American-Darling Valve (American Flow Control).
- C. Gate valves for water service 14-inch and larger shall be cast iron or ductile iron body, bronze mounted double disc and wedge, parallel seat type. The valve stem shall be non-rising with a bevel gear or spur gear (as specified by the Design Engineer), weather tight gear case and grease case tracks. The stem is to be sealed with a minimum of two o-rings, where available. The valves for water service shall conform to all requirements of AWWA C-509 latest edition. Acceptable valve manufacturers are: Mueller, Kennedy and American-Darling Valve (American Flow Control).
- D. All gate valves will be furnished with Mechanical Joint and all necessary bolts, nuts, gaskets, glands and other necessary appurtenances. All external valve body bolts shall meet the requirements of ASTM-A307 and shall be hot-dip zinc coated. The bolts and nuts are to have hexagonal heads. The nuts shall be bronze. 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, valves, or other appurtenances which will expose the material to the water. All gaskets shall be AWWA approved.
- E. All valves to be coated in accordance with AWWA C-509 or C-515 latest edition.
- F. Valve stem sizes must meet the minimum standard set by AWWA C-509 or C-515.
- G. Valves 16-inches and larger shall have the number of turns to open stamped on the valve. The minimum number of turns to open shall be as specified in AWWA C-509 or C-515 for all valves.

- H. All valves shall be given an operational test, seal test and a hydrostatic test in accordance to AWWA C-509 or C-515. Certified test results shall be available on request.

5-04 BUTTERFLY VALVES

All valves shall comply with AWWA C504, as amended to date, for tight closing rubber-seated, Class 150B valves, and shall meet the following requirements:

- A. General: Butterfly valves shall be the buried service type. Valves shall be bubble tight at rated pressures and shall be satisfactory for applications involving throttling service and/or frequent operation and for applications involving valve operation after long periods of inactivity. Valve discs shall rotate 90 degrees from full open position to the tight shut position. Wafer type valves are not acceptable.
- B. Valve Body: Valve bodies shall be either of cast iron conforming to ASTM A126, Class B, or ASTM A48, Class 40, or ductile iron conforming to ASTM A536, Grade 65-45-12, as amended to date. Drilled and tapped holes are permitted where required at the body bearing trunnions. The body shall be designed to withstand the internal forces acting directly and the forces resulting from the thrust of the operating mechanism. Trunnion bosses shall be located at diametrically opposite points in the valve body which shall be accurately bored to accept permanently self-lubricated shaft bearing bushings. The trunnion box at the operator end shall be furnished with an integral packing box and the other trunnion shall include a factory set two-way bronze thrust bearing and a cast iron thrust bearing cover.
- C. Valve Shafts: Valve shafts shall be turned, ground and polished. Valve shafts shall be constructed of 18-8 Type 304 Stainless Steel conforming to ASTM A276, as amended to date. Shaft diameters shall meet requirements established by AWWA C504, as amended to date. Valve shafts shall be securely attached to the valve disc by means of stainless steel taper pins. Taper pins shall be mechanically secured.
- D. Valve Disc: Valve discs shall be constructed of ductile iron ASTM A536, Class 65-45-12, or ASTM A48, Class 40, or cast iron ASTM A48. The valve discs shall be designed to withstand bending and bearing loads resulting from the pressure load and operating forces. The faces of the discs shall be smooth and free of external projections. All retaining or pinning hardware in contact with water shall be monel or 316 stainless steel. The disc shall provide 360 degree uninterrupted seating.
- E. Valve Seats: Valve seats shall be Buna-N rubber designed for tight shutoff in both directions. Retaining ring cap screws shall pass through the rubber seat and be self-locking. Mating seat surfaces for resilient seats shall be 18-8 stainless steel. Seats shall provide full 360 degree seating without interruption. Valve seats shall be designed to permit removal and replacement in the field for valves 30-inch in size and larger.

- F. Valve Bearings: The valve shall be fitted with sleeve type bearings. Bearings shall be corrosion resistant and self-lubricating. Bearing load shall not exceed 1/5 of the compressible strength of the bearing or shaft material.
- G. Valve Actuators and Accessories: Valve actuators shall conform to AWWA C504, as amended to date. Operator shall be designed for buried service and employ a traveling nut design and be self-locking without the need for unidirectional sustained force from the valve. Stop-limiting devices shall be provided; the closed position stop will be adjustable externally. All 12" through 24" valve manual operators shall be capable of withstanding 450 foot pounds of input torque either in the open or closed position. The operator nut shall be 2-inches square. Operators shall hold valve disc in any intermediate position between fully open and fully closed without creeping or fluttering.
- H. Coating: All valves are to be coated in accordance with AWWA C-550, latest edition.
- I. Valve Testing: Performance, leakage and hydrostatic tests shall be conducted in strict accordance with AWWA C504, as amended to date. Leakage test shall be performed on each valve after the actuator has been mounted on the valve. The manufacturer shall, upon completion of manufacture, provide the Owner with an "Affidavit of Compliance" as per AWWA C504, as amended to date.
- J. All valves shall be open left (counterclockwise, viewed from the operating nut end of the stem).
- K. End connections shall be mechanical joint and shall be furnished with all necessary bolts, nuts, gaskets and appurtenances.
- L. Butterfly valves furnished shall be the Groundhog as manufactured by Henry Pratt; the Lineseal III as manufactured by Mueller; or the American-Darling Class 150 Butterfly Valve as manufactured by Valmatic.

5-05 AIR AND VACUUM VALVES

- A. Air relief valves shall be provided in accordance with sound engineering practice at high points in water mains as required. Automatic air relief valves shall not be used in situations where flooding of the manhole or chamber may occur.
- B. Air and vacuum valves shall be designed for a minimum working pressure of 150 psi. Valve shall be of the type to vent air when the pipelines are being filled, to close once the line is filled, to remain closed until the line is drained, and then open to allow air to re-enter the line to prevent a vacuum from developing. All air and vacuum valves shall comply with AWWA C-512 latest edition.

- C. Valves shall be A.R.I. Model D-040-C, Combination Air Valves as a combination of an air and vacuum unit and a pressure unit. Valve sizes shall be as specified by the Design Engineer and shall be subject to approval by the SWS Engineering Department.
- D. Where called for on the construction drawings air relief and vacuum valves shall be installed in 5-foot diameter manholes. Air relief valves shall be provided at high points in the water main. The open end of the vent pipe valve shall be extended to the top of the manhole with a screened downward facing elbow. Refer to Water Main Air Release Valve and Manhole detail in APPENDIX A.
- E. Chambers, pits or manholes containing valves, blow-offs, meters, air release valves or other such appurtenances shall not be directly connected to any storm drain or sanitary sewer, and shall not be subject to flooding.
- F. If the location of the water main is such that installation of the air release valve directly on the water main may not be desirable or possible, SWS may consider an alternate design based on the following criteria:
 - 1) The air release valve is remotely mounted in a location which provides adequate security and protection from damage and flooding;
 - 2) The air release valve is connected to the water main with appropriately-sized piping which includes the necessary isolation valves, and the vent piping is not subject to flooding;
 - 3) The entire arrangement is designed by a licensed engineer, complies with SCDHEC R.61-58, and is submitted to SWS for approval.

5-06 MANHOLES

Manholes shall be used for all air valves, and as an alternative to valve vaults where specified on the plans. Shop drawings and related data for manhole material, frames, covers and steps shall be submitted to the Engineer and the SWS Engineering Department for review.

- A. Manhole material shall be precast concrete unless otherwise approved by the Engineer and the Spartanburg Water System. The minimum diameter of all manholes shall be five (5) feet. The minimum wall thickness shall be five (5) inches.
- B. Precast Concrete Manholes shall conform to ASTM C478, and shall consist of precast reinforced concrete riser sections, a monolithic base section, and an eccentric, concentric or flat slab top section as required, all in accordance with the details shown on the plans.

- 1) Minimum compressive strength of concrete for all sections shall be 4000 psi. Maximum allowable absorption of concrete shall be 8 percent of the dry mass. Manhole interior walls, tables and inverts shall be a smooth surface free of voids, depressions, chips, rough edges and high spots. Pipe openings shall be provided in base sections as required. Lifting holes may be provided in each section for ease of handling. Concentric cones may be used for manholes less than five feet in depth.
- 2) Joint sealant shall be butyl rubber ring joint, 1-inch diameter, conforming to Federal Specifications SS-S-00210, Type I. Cement mortar joints will not be acceptable, except that each joint shall be wiped inside the manhole with cement mortar after assembly.
- 3) When depth will not allow cone-shaped tops, a precast cover designed to withstand traffic loads shall be installed.
- 4) Manhole frame and cover shall be Standard Frame and Cover shall be USF-668, KL as manufactured by U.S. Foundry or V-1384 as manufactured by East Jordan Iron Works.

5-07 BALL VALVES - SWING CHECK VALVES

Ball valves (larger than 2”) and swing check valves are typically not allowed to be installed within the Spartanburg Water System, except as part of a back-flow preventer and in a fire service (REFER TO SECTION 7). However, where allowed, these valves shall conform to AWWA C507 and C508.

5-08 TAPPING SLEEVES

- A. Tapping sleeves for main line taps on pipe 12” OD and smaller (except for “size on size” taps) shall be as specified in the list below:

Tapping Sleeves for Wet Taps on Ductile Iron, PVC and Cast Iron Pipe

<u>MANUFACTURER</u>	<u>STYLE</u>	<u>SIZE (O.D.”)</u>
Ford	Stainless Steel Wrap Around	4 – 12 (except size on size)
Romac	Stainless Steel Wrap Around	4 – 12 (except size on size)
Cascade	Stainless Steel Wrap Around	4 – 12 (except size on size)

- B. On main line taps on pipe larger than 12” OD, and for all size on size taps, the Contractor shall submit to the SWS Engineering Department the proposed tapping fixture for approval. The approval of a given tapping fixture, or the requirement of

an alternate method of constructing a branch, will be made based on the best interests of the Spartanburg Water System.

- C. In an effort to maintain the integrity and durability of the distribution system, Spartanburg Water System reserves the right to specify any one (or a combination) of the following alternative methods of installing branches:
 - 1) Installation of a “wet tap” using a full-body, stainless steel, tapping sleeve (on pipe 12” OD and smaller and on other than “size on size” taps)
 - 2) Installation of a “wet tap” using a ductile (or cast) iron tapping sleeve or a full-body, stainless steel, tapping sleeve (on pipe larger than 12” OD and all “size on size” taps)
 - 3) Cutting in a new tee fitting with up to three (3) valves, depending on the area affected. This option will require that a water outage is scheduled and coordinated with the SWS Engineering Department and/or Collection and Distribution Department.

5-09 LINE STOPS AND VALVE INSERTIONS

Spartanburg Water System reserves the right to require specialized techniques to reduce the number of customers affected by a water outage which may be required to install a valve, a branch, or to extend a main line. This may include the installation of a line stop, valve insertion, or other method. Any method used must comply with all current SCDHEC regulations, AWWA Standards, and NSF requirements.

- A. Planned line stops and valve insertions shall always be submitted to the SWS Engineering Department for approval and scheduling.
- B. Preliminary installation of thrust blocks, dead men, or thrust collars may be required prior to the line stop or valve insertion.
- C. For developer projects, all costs associated with the installation of line stops or valve insertions, including dead men, thrust blocks, jumpers, or other appurtenances, whether performed by Spartanburg Water System or its subcontractor, will be paid by the Developer.

5-10 SERVICE SADDLES AND CORPORATION STOPS

- A. All pipe saddles and corporation stops for air relief, flushing and testing and disinfection shall be as specified in the list below. Tapping saddles will be required when the tapping machine is not capable of making a direct tap.

SADDLES FOR DUCTILE IRON PIPE

<u>Manufacturer</u>	<u>3/4"CC Single Strap</u>	<u>1"CC Single Strap</u>	<u>1-1/4"CC Double Strap</u>	<u>1-1/2"CC Double Strap</u>	<u>2"CC Double Strap</u>
Ford	F101	F101	F202	F202	F202
Mueller	DR-1A Series	DR-1A Series	DR-1A Series	DR-1A Series	DR-1A Series
Romac	101	101	202	202	202
Smith/Blair	311	311	313	313	313

SADDLES FOR C-900 PVC

<u>Manufacturer</u>	<u>3/4"CC</u>	<u>1"CC</u>	<u>1-1/4"CC</u>	<u>1-1/2"CC</u>	<u>1-1/2"CC</u>
Ford	FS202	FS202	FS202	FS202	FS202
Mueller	DR15	DR15	DR25	DR25	DR25
Romac	101S	101S	101S	101S	101S
Smith-Blair	317	317	317	317	317

Note: CC Denotes Type Thread

CORPORATION STOPS

<u>Manufacturer</u>	<u>3/4"</u>	<u>1"</u>	<u>1-1/2"</u>	<u>2"</u>
Ford *	F-600	F-600	FB-600	FB-600
Mueller *	H-15000	H-15000	B-25000	B-25000
Ford **	*****	*****	*****	FB-400

* CC Thread Inlet & Flare Copper Outlet

**CC Thread Inlet & Male Iron Pipe Outlet

- B. Certain areas within the Spartanburg Water distribution system may operate at system pressures which are normally higher than in the other pressure zones. In these areas, SWS may specify alternate materials which are more appropriate for the higher operating pressures. Spartanburg Water System reserves the right to specify

alternative materials as needed, but in all cases, these materials shall comply with SCDHEC R.61.58.

C. TAPPING MACHINES

<u>Manufacturer</u>	<u>Type</u>	<u>Tap</u>	<u>Size</u>
Mueller	E-5	Saddle	3/4" - 1"
Mueller	D-5	Saddle	3/4" - 2"
Mueller	B100, B101	Direct	3/4" - 1"
Mueller	Tru-Cut	Saddle	3/4" - 1"
Romac	Tap Mate Too	Saddle	3/4" - 2"

*Note: Tapping Method must be approved by SWS Engineering Department

5-11 VALVE INSTALLATION

- A. Gate valves, in general, shall be installed and jointed as specified in Section 4D, ASSEMBLING AND JOINTING OF PIPE.
- B. Valve markers shall be manufactured of 3,000 psi concrete and provided as required by the SWS Engineering Field Technician, and carefully set to assure the markers are plumb. The letters on the markers shall face the valves. Valve markers shall be marked with revised letters, MV for valves, AV for air or air/vacuum valves or BO for blow-offs.
- C. Valve boxes shall be furnished by the contractor for all underground valves and shall be cast iron, two-piece stack (sliding) type with covers and bases. All boxes shall be gray cast iron in accordance with ASTM #A-48, Class 20. Boxes shall be Bingham and Taylor Figure No. 4908.
- D. A valve box shall be installed on each underground valve. They shall be carefully set, entered exactly over the operating nut and plumbed true. The base shall be set as shown in Typical Valve Box detail in APPENDIX A, arranged so that the weight of the valve box and superimposed loads will bear on the base and not on the valve or pipe. Extension stems shall be installed to assure the operating nut is no more than four feet beneath finished grade. A concrete valve collar shall be used for valves not located in asphalt.
- E. Non-gearred Valves: A cast iron valve box shall be provided for each vertical valve which has no gearing mechanism. The valve box shall not transmit shock or stress to

the valve and shall be centered and plumb over the operating nut of the valve with the box cover flush with the surface of the finished grade.

- F. Geared Valves: A valve vault or manhole shall be provided for each valve which has a geared operating mechanism on all valves 16-inch and larger. The operating nut shall be easily accessible for operation through the opening in the manhole, which shall be set flush with the surface of the finished pavement or such other level as may be directed by the SWS Engineering Department. Valve vaults shall be constructed as to permit minor valve repairs and afford protection to the valves and pipe from impact where they pass through the vault walls.
- G. Valves shall be installed so the operating stem is vertical and plumb. Horizontal valves shall be installed so that the operating nut is vertical and plumb.
- H. Precast concrete valve collars shall be installed, if necessary, around the tops of all valve boxes which are not otherwise installed in pavement.

SECTION 6

FIRE HYDRANTS

6-01 GENERAL

All fire hydrants shall comply fully with AWWA Standard C502, latest revision, ANSI/NSF 61 and 372, and NFPA 1963-2003, for dry barrel hydrants and standards and specifications of the Spartanburg Water System. Where discrepancies exist, the more stringent (in the opinion of the Water System) shall govern. Hydrants shall be the particular model name or number by either of the manufacturers listed in Paragraph 6-02 and shall be modified as specified in this section.

6-02 MANUFACTURE AND NOMENCLATURE

Hydrants shall be any of the following:

- A. Mueller – Centurion
- B. American-Flow Control - Mark 73-5
- C. East Jordan Ironworks CD250

6-03 GENERAL CONSTRUCTION

Hydrants shall be compressive type, self-lubricating, non-freezing, and provided with a safety flange and coupling. The operating unit shall be totally sealed from the barrel and all working parts shall be continuously and automatically lubricated. Drain mechanism shall be simple, positive and automatic in operation. The safety flange on barrel and safety coupling on valve stem shall operate to prevent damage to barrel and stem in case of a traffic accident. The force of the impact shall break the flange and spread the coupling. The ground line shall be marked on the lower barrel and the flange and coupling shall be above the ground line marking and constructed so as to permit rapid and inexpensive replacement. Hydrant shall be constructed to permit rotating nozzles in any direction by loosening safety flange bolts and revolving the upper barrel at any time without digging or cutting off water. All working parts of the hydrant, including the seat ring, shall be removable through the top without digging or removing the hydrant, including the shoe, from its installed location. Seat rings shall be so shaped and arranged as to be readily removable. Hydrants shall have bronze to bronze seating and bronze to bronze threads. 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, valves, or other appurtenances which will expose the material to the water. All gaskets shall be AWWA approved.

Hydrants shall be the type as listed above by any of the manufacturers listed above, but with modifications or features as listed in the remainder of this section.

- A. Hydrants shall be designed for a working pressure of 150 psi and tested to 300 psi. At the time of delivery, the supplier shall furnish written certification that each hydrant has been tested and has passed the test.
- B. Three nozzles shall be provided. Two 2 1/2-inch connectors shall be provided 180 degrees apart and one 4 1/2-inch at 90 degrees to the other nozzles shall be provided. Nozzles shall be all bronze threaded into the barrel, or "locked" to the barrel and sealed with o-ring seat and locked into place with locking device. Locking device shall be inaccessible from outside the hydrant. Threads shall be as specified in the NFPA 1963-2003 Standard for Fire Hose Connections as follows:
 - 1) Fire Hose Connection: 2.5" diameter with 7 ½ threads per inch;
 - 2) Pumper Connection: 4.5" diameter with 4 threads per inch;
 - 3) Caps shall have nuts of the same size as the operating nut specified in Paragraph C below. Caps shall be secured to the barrel with non-linking chain loop on the caps for free turning of the cap during removal.
- C. The operating nut shall be one piece bronze or cast iron construction, pentagon shape, and measure 1 1/4-inch from the point to flat area of the base and shall be the same size as the nozzle cap. An arrow shall be cast into the weather cap or bonnet indicating the direction of opening which shall be counterclockwise (open left). An O-ring seal shall be provided to seal operating nut to the bonnet. Hold down nut shall be all bronze with O-ring seals on the inside sealing against the operating nut and on the outside sealing against the bonnet.
- D. Lubrication system shall be either oil or grease. Oil reservoirs shall have an external filler plug made of brass or stainless steel. Grease fittings shall be brass or stainless steel. Oil and grease reservoirs shall be sealed to a bronze stem sleeve by two (2) O-rings. Bronze stem sleeves shall be O-ring sealed to the stem. All thrust bearing surfaces shall be able to be lubricated without bonnet removal. A thermo set anti-friction washer shall be located between the thrust collar of the operating nut and the hold down nut or plate. Oil filter plug or grease fitting shall permit adding lubricant, filling reservoir, and checking lubricant level without removing bonnet, or weather cap.
- E. Hydrants shall be traffic models having the upper and lower barrels joined approximately 2 inches above the bury line by a traffic flange, breaking ring, or ground-line coupling, providing 360 degree rotation of the upper barrel while hydrant is in service. "Break-away" bolts will not be acceptable. The lowest nozzle shall be a minimum of 18 inches above the ground-line or bury line. A corrosion proof safety coupling shall connect the upper and lower stems. The safety coupling

shall be attached to the stem with either bronze or stainless steel pins, screws or clips. The safety coupling shall be of the torque diverting type and shall be designed such that no pieces fall into the lower barrel when the coupling fractures upon impact and designed to prevent fractures through the screws or pins holding the coupling to the stem.

- F. The upper barrel shall be manufactured of cast iron or ductile iron. The lower barrel and shoe shall be manufactured of cast iron or ductile iron. Interior of shoe shall be coated with epoxy, a total of 4 mils thick, or with two (2) coats of an asphaltic varnish, each coat with a minimum thickness of 1 1/2 mils and a total minimum thickness of 3 mils. Any coating shall meet the requirements of AWWA C502 and shall be suitable for potable water. The brand name, year of manufacture and valve opening size shall be cast on the outside of upper barrel.
- G. Drain holes shall be provided at the lowest possible elevation to assure complete drainage of all water from the hydrant. A minimum of two external drain holes or ports 180 degrees apart shall be provided with a minimum diameter of 1/4-inch. Two internal drain holes shall be provided, each at least 1/4-inch diameter. Hydrant design shall be such that drain ports are flushed with full line pressure each time the hydrant is opened and closed. Drain valve facings shall be mechanically attached to the upper valve plate by means of stainless steel or bronze screws or stainless steel pins. If two drain holes are provided, they shall be 180 degrees apart, and no drain holes shall be at the back base of the shoe where concrete thrust blocks will be poured. Seat rings shall be bronze and shall screw into bronze drain or shoe rings. Seat rings shall be sealed by o-rings. All internal bronze components shall conform to AWWA Standard C502.
- H. Hydrants shall be either for 3'-6" bury or 4'-0" bury (unless otherwise specified by the Spartanburg Water System) when ordered. Bury shall be cast in lower barrel or stenciled in 2-inch painted letters. Hydrants shall be extendable in 6-inch increments by means of extensions. Extensions shall be provided which shall be of the same material as the shoe and lower barrel and shall be complete with one (1) set of all necessary bolts and nuts, safety flange, gaskets, stem couplings and stem extensions and stem pins.

6-04 MATERIALS AND EQUIPMENT

A particular manufacturer of hydrants may not have the exact part described below, which is acceptable. It is the intent of these specifications that a manufacturer will supply this standard hydrant modified or with options supplied as specified.

- A. Hydrants shall be equipped with the following options at the factory prior to shipment.
 - 1) Rubber (Buna N) or cellulose fiber gaskets throughout;

- 2) Travel stop nut or equivalent for position stop;
- 3) Rubber or metal weather shield;
- 4) Bronze to bronze drain arrangement - bronze hydrant seat and bronze o-ring;
- 5) Chains to attach nozzle cap to hydrant;
- 6) "Spartanburg Standard Hydrant" and the supplier's logo shall be stenciled on the lower barrel.

B. Clarification of the materials is as follows:

- 1) Rubber refers to Buna N synthetic rubber. Natural rubber shall not be provided in any parts.
- 2) Stainless steel refers to ASTM 276, Grade 302 or better.

6-05 PAINTING

- A. The interior and exterior parts of the hydrant shall be cleaned in accordance with AWWA Specification C502, latest edition. Interior coatings shall be suitable for potable water.
- B. A primer shall be applied from the ground line up in accordance with the AWWA C502, latest edition.
- C. Interior surfaces shall be coated with two (2) coats of asphalt varnish in accordance with AWWA C502, latest edition. Each coat shall be at least 2 mils thick.
- D. Paint shall be as follows:
 - 1) Chain aluminum paint shall be one of the below.
 - a. Gilman #45-6F Chrome Aluminum
 - b. PPG #6-230 (2-901) Chrome Aluminum
 - c. Sherwin-Williams Chrome Aluminum
 - 2) Body shall be painted with heavy grade, high gloss enamel which shall be one of the following:
 - a. Gilman #57-16F Fire Engine Red

- b. PPG #6-301 Safety Red
 - c. Sherwin-Williams Safety Red
- 3) Spartanburg Water System shall be responsible for painting the fire hydrant components per the NFPA Color Code.

6-06 INSTALLATION

- A. General: Hydrants shall be installed plumb and jointed as specified for pipe and fittings. The installation of hydrants shall include the installation of concrete blocking, rodding and washed crushed stone backfill as shown in and/or as specified herein.
- B. The preferred method of installing a fire hydrant in a new subdivision will be through the use of a “hydrant tee” or “valve restraining” tee in which the hydrant isolation valve is mounted directly on the branch tee. In some cases the use of a hydrant tee will not be possible, in which case the isolation valve shall be installed on the end of a short pipe spool piece which is restrained to a standard MJ tee. See also Section 3D, FITTINGS. Refer to Typical Hydrant Installation details in APPENDIX A.
- C. Fire hydrants shall be located as shown on the plans and shall be field located by the SWS Engineering Field Technician.
- D. All fire hydrants shall be plumbed and shall have the pumper nozzle perpendicular to the curb. Fire hydrants shall be set with the "Bury Line" marker set to the established grade or as directed by the Inspector.
- E. Each fire hydrant shall be connected to the main with a minimum 6-inch branch connection of the same material as the pipeline. Gate valves shall be used on all fire hydrant branches.
- F. The proper length of hydrant extension shall be used, when necessary, to raise the bury line of the hydrant to grade. The use of multiple short extensions when one of longer length is needed will not be permitted (ie, 2 - 6” extensions shall not be installed instead of a single 12” extension). A maximum of two extensions per hydrant will be allowed.
- G. Clean, washed gravel, no larger than #57 stone, shall be placed around the shoe of the fire hydrant, 6" above and for a radius of 18-inches around the weep holes. Hydrants shall be set with stone free of dirt and set to drain freely. Three (3") inches of additional stone (18-inch radius around the weep holes) shall be added for each 6-inch of hydrant extension. Hydrant drains shall not be connected to or located within

ten (10) feet of sewer systems.

- H. The shoe of each fire hydrant shall be well braced against UNDISTURBED earth and at the end of the trench with a poured concrete brace block and it shall be properly restrained, as directed by the SWS Engineering Department and shown on the plans.

SECTION 7

FIRE SERVICES AND METER VAULTS: MATERIALS AND INSTALLATION

7-01 FIRE SERVICES

- A. Fire Services, in general, shall be installed and jointed as specified in Section 4D, ASSEMBLING AND JOINTING OF PIPE AND FITTINGS;
- B. Specific regulations regarding approved back-flow preventers and piping arrangements to be used in fire service pits are covered in the Spartanburg Water System Cross Connection Control Manual and in SECTION 4, Paragraph 4-02, D. of these Specifications. A copy of this document can be obtained by contacting the Spartanburg Water System Water Quality Department at 253-9632 or on the web site at www.SpartanburgWater.org.
- C. The installation of a fire service shall comply with the details provided with the approved construction drawings, all applicable Federal, State and Local regulations, and the requirements presented in these Specifications.

7-02 FIRE SERVICE AND METER VAULTS

- A. Scope: This section contains the current specifications for fire service and meter vaults that are to be built for customers of Spartanburg Water. Spartanburg Water System does not own its customers' fire service vaults. However, Spartanburg Water System will, on occasion, have a need to enter the fire service vaults. It is for this reason that the vault must be constructed in accordance with the minimum specifications as described below.
- B. The vault shall be designed by others. The Spartanburg Water System is not responsible for the structural design of the vault.
- C. The vault can be constructed by a variety of methods.
 - 1) Poured in place reinforced concrete.
 - 2) Precast reinforced concrete.
 - 3) Filled concrete masonry units on reinforced concrete footings.
- D. The vault can either be open bottom with a stone base or closed bottom concrete floor with drain holes in each corner.

E. Access Door

- 1) Door shall be made of aluminum, diamond plated, with a double leaf opening and manufactured for 300 lbs. per square foot live load.
- 2) Doorframe shall be aluminum and all hardware shall be stainless steel.
- 3) Door shall have a slam lock and an automatic “hold open” mechanism shall be part of unit.

F. Ladder/Steps: Vaults shall be equipped with either ladder or steps. Below are the requirements for each

1) Ladder

- a. All ladders shall be made of aluminum and shall be a “ships ladder”. Ladder steps shall be a minimum of 17 inches wide with non-skid rungs that are spaced a maximum of 16 inches apart.
- b. Ladders shall be attached to pit wall or floor with a minimum of 4 stand-offs with holes for anchor bolt and washers.
- c. The first rung of the ladder shall be a maximum of 12 inches below top of vault opening. The bottom rung shall be no more than 12” from the bottom of the vault.

2) Steps

- a. Commercially manufactured steps shall be a minimum of 16 inches wide with non-skid treads.
- b. Angle frame steps shall be made for casting in a poured in place wall.
- c. Steps requiring a core-drilled hole shall have anchoring or non-removable features.
- d. The top step shall be a maximum of 12 inches below the top of the vault opening. The bottom rung shall be no more than 12” from the bottom of the vault.
- e. All subsequent steps shall be spaced a maximum of 16 inches apart.

G. Wall Sleeves, Pipe Openings

- 1) The inside diameter of the sleeve is required to have a critical dimension of 4 inches greater than the nominal pipe size. (i. e. 6-inch pipe requires 10-inch inside diameter sleeve).
- 2) Sleeves cast in place shall be made from steel pipe, ductile iron pipe, or C-900 PVC pipe cut to the length of wall dimension.
- 3) A cast in place or precast wall alternate is a core-drilled hole to the critical inside diameter size.
- 4) All sleeves shall have a smooth surface in order to properly receive the sleeve seals.

H. Sleeve Seals: Commercially manufactured sleeve seals, ie. “Link Seals”, or manhole pipe boot shall be required.

I. Fire Department Riser

- 1) All riser pipes shall be galvanized steel or ductile iron. PVC pipe will not be allowed.
- 2) A wafer type check valve with ball drip meeting all requirements of U. L. and F. M. shall be installed vertically or horizontally to the riser tee.

J. Fire Department Connection

- 1) The local fire authority shall establish requirements for the type of fire department connection. The type FDC will not be specified by SWS; the Contractor shall confirm that the FDC complies with the local jurisdiction.

K. Pipe Piers and Supports

- 1) Pipe piers and supports shall be constructed in accordance with one of the following:
 - a. Commercially manufactured steps shall be a minimum of 16 inches wide with non-skid treads.
 - b. Solid concrete bricks and mortar with dimensions as indicated by the design professional.
 - c. Poured in place reinforced piers.

- d. Precast reinforced concrete.
- 2) All piers must have contact with fitting, valve, etc.
- L. Stone: In instances where stone is required in the bottom of the fire service vault, washed stone grade size #57 (3/4") shall be used.

SECTION 8

CLASSIFIED EXCAVATION

8-01 SCOPE

Classified excavation shall include the removal and disposal of rock or hardpan requiring methods other than conventional excavation equipment.

8-02 ROCK EXCAVATION

- A. "Rock Excavation" shall be the excavation of such material which cannot be removed by means other than by blasting or with a jack hammer or other means approved by the Engineer. "Unclassified" excavation shall include the excavation of all types of materials that do not fall into the category of "rock excavation" as defined above. The classification of excavation shall be determined by the SWS Engineering Department. It shall be the Contractor's responsibility to notify the SWS Engineering Department when he believes that rock excavation is encountered. The Contractor will not be credited for any rock quantities excavated before such notice is given.
- B. Clearance: Ledge rock, boulders and larger stone shall be removed to provide a clearance of at least 6 inches below and on each side of all pipe, valves, and appurtenances. This specified minimum clearance is the minimum clear distance which will be permitted between any part, projection or point of such rock, boulder, or stone and any part of the water main.
- C. Subgrade: Where excavation is made in rock or boulder, the subgrade shall be prepared by backfilling with an approved select material in 6-inch compacted layers and each layer shall then be thoroughly compacted to not less than 95% of the maximum dry density as determined by a Standard Proctor Test (ASTM D698) so as to provide a uniform and CONTINUOUS BEARING and support for the pipe along the entire pipe length between bell holes. The minimum depth of the compacted backfill material shall be 6 inches.

8-03 BLASTING

All blasting, where required, shall be done under the personal supervision of a person duly licensed in the State of South Carolina to engage in the use or storage of explosive materials.

All necessary measures to protect life and property shall be taken. Where in close proximity to buildings, structures, transmission lines, utility lines or other facilities, timber mats or other means of preventing damage from flying debris shall be used. Ample and suitable signals shall be given in proximity to the work before each blast, and flagmen shall be placed on all roads beyond the danger zone in every direction to warn traffic. Contractor shall be

responsible for all damage resulting from blasting.

- A. Procedure: Blasting for excavation will be permitted only after securing the approval of the Spartanburg Water System Engineering Department, only after a South Carolina State Blasting Permit has been obtained and a copy given to the SWS Inspector, and only when proper precautions are taken for the protection of persons and property. The hours of blasting will be fixed by the Contractor and approved by the SWS Engineering Department. Blasting operations and storage of explosives shall be conducted in strict accordance with existing ordinances, regulations, and laws of local, State, and Federal agencies.
- B. Damage Liability: All blasting shall be done with the utmost care so as not to endanger life or property. Whenever directed, the number and size of the charges shall be reduced. All damages or injuries resulting from blasting operations shall be reported immediately to the SWS Engineering Department. Contractor shall be responsible for all damage resulting from blasting and shall supply liability insurance to cover any damage. Certificates of insurance shall be filed with the SWS Engineering Department prior to commencing blasting work. The policy shall cover blasting over the duration of the project.
- C. Limits: Where new water lines are being constructed or connections being made to existing mains, blasting operations shall not be conducted within fifty (50) feet of the end of such mains. The use of explosives shall be limited to a minimum distance of twenty-five (25) feet from any and all utilities or structures or as specified by the Spartanburg Water System.
- D. Operations: Blasting operations shall be conducted in strict accordance with the S.C. Explosives Control Act, all applicable Spartanburg Water System, city, county, state and federal ordinances and regulations. All exposed structures shall be carefully protected from the effects of blast and all blast areas shall be covered with heavy timbers, mats or other suitable protection. The blasting shall be done only by blasting personnel licensed in the State of South Carolina. Very light charges must be used to prevent damages to adjacent structures. In no case shall caps or other explosives be kept at the place where dynamite or any other explosive is stored.
- E. Traffic Controls: Ample and suitable signals shall be given in proximity to the work before each blast, and flagmen and appropriate signs shall be placed on all roads beyond the danger zone in every direction to warn traffic.
- F. Pre and Post-Blast Property Survey Requirements. Spartanburg Water System may require a pre- and post-blast property survey, depending on the proximity of the work to businesses, residences or other structures which may be affected by the ground or atmospheric vibrations which could result from the blasting. The following is a description of the type of survey and the reporting which may be required.
 - 1) Description: The locations of the properties which may be affected shall be

determined by a Contractor's representative qualified in vibration analysis / monitoring and damage assessment associated with blasting. The Contractor shall arrange with property owners affected by the project to obtain the rights-of-entry to their properties in order to engage in a pre-blast and post-blast property damage survey. The Contractor shall submit a Pre- and Post-Blast Property Survey Report to the Engineer to document the investigation of the buildings on these properties.

2) Investigation Methods: the investigation shall consist of visually inspecting and recording all existing defects in the structures. The structures shall be thoroughly inspected from top to bottom, inside and out. The Report shall include names of inspectors, date of inspections, and descriptions and locations of defects. In addition, the Contractor shall mark existing cracks in such a way that future observations would indicate whether cracks continue to open or spread. Photographs shall be used in verifying written descriptions of damaged areas.

a. Pre-blast Survey: The Contractor shall arrange for professional photography capable of producing sharp, grain-free, high-contrast pictures with good shadow details for construction monitoring at the properties. Photographs shall be taken so that details of the buildings will be clear and well defined. The intent is to procure a record of the general physical condition of the buildings. Camera location shall be changed for each of the photographs and shall be varied so that all portions of the buildings' exterior surfaces will be covered by the view.

Each photograph shall contain the following information (if applicable):

Project Title
Project No.:
Property Address:
Building Description:
View
Looking
Date
Photographer

Photographs shall be 8 inches by 10 inches (200 mm by 250 mm), black and white glossy, mounted on paper with a flap for binding.

b. Blast Monitoring: Spartanburg Water System reserves the right to require blast monitoring during the work. Monitoring may include the use of seismographs and other appropriate devices which are capable of storing data in digital form

- c. Post-blast Survey: The Contractor shall conduct a second inspection of each affected property once blasting is complete. The Contractor shall visually inspect and photograph each structure to verify the post-blast condition. The Contractor shall follow the same inspection procedures as previously outlined herein before for the pre-blast survey.
- 3) Reports: Pre and Post-Blast Property Survey Report shall be typed on bond paper in text form with headings, indexes, etc., and shall be submitted within 30 calendar days of the final blasting. An evaluation of the property impacts from the blasting activities shall be included in the Report. Rights for subsequent use shall become the property of the Contracting Authority.

SECTION 9

BORING

9-01 SCOPE

This section contains the current specifications for the installation of pipe by various methods other than conventional “open cut” including boring (jack and bore, impact mole, closed-face bore, micro-tunneling and others) and Horizontal Directional Drilling (HDD).

9-02 GENERAL

- A. The conventional “open cut” method of pipe installation is adequately covered in SECTION 4 of these Specifications. However, plans which incorporate alternative pipe installation methods, which are the subject of this section, must be prepared by engineers specifically trained and experienced in the particular method used. The specifications listed below are not intended to replace or be used as a substitute for the detailed design by a licensed engineer.
- B. The review of plans by the SWS Engineering Department will only serve to insure compliance with SCDHEC and the Spartanburg Water System specifications. The design and use of alternative installation methods include various risks which may not exist with other methods; the Design Engineer and Contractor must accept full responsibility for the liabilities associated with these alternative methods. In situations where substantial risks exist, the Spartanburg Water System reserves the right to require additional liability insurance coverage, and/or extended warranties, beyond that noted in the front end General Conditions (if applicable) and SECTION 13 of these Specifications.

9-03 BORING

Where shown on the approved plans, pipe shall be installed under highways, railroads, or other obstacles by boring. The Contractor shall furnish all labor and materials necessary to complete the bore, install steel casing if required, and install carrier pipe per the approved plans.

- A. All bores under railroads shall be performed as required by railroad specifications. The Design Engineer shall be responsible for compliance with all railroad related permitting and design requirements.
- B. Service line bores under highways may be made without encasement unless otherwise noted on the plans.

C. If steel casing is required, unless otherwise noted on plans, encasement up to and including 48-inches in diameter shall be installed by boring and jacking (either augur or closed-face). Larger encasement shall be by tunneling. Refer to detail for Carrier Pipe Installation in Casing in APPENDIX A.

D. General Requirements

- 1) Authorities: All aspects of crossing construction shall conform to the requirements of the South Carolina Department of Transportation and/or railroads.
- 2) Insurance: It shall be the responsibility of the Contractor and/or his subcontractor to comply with all insurance requirements of the highway or railroad work within their right-of-way if the limits are higher than the limits of the insurance requirements of this contract.
- 3) Inspection: Crossing construction operations shall be subject to inspection by the Owner's representative and by the highway or railroad representative, who shall have full authority to stop work if, in his opinion, it would cause damage to the roadway or railway section, endanger traffic or endanger life.
- 4) Prior to beginning work, the Contractor shall submit to the Engineer a work plan detailing the procedure and schedule to be used to execute the project. The work plan shall include as a minimum:
 - a. a description of all equipment to be used;
 - b. a list of personnel and their qualifications and experience (including back-up personnel in the event that an individual is unavailable);
 - c. list of subcontractors;
 - d. a schedule of work activity;
 - e. a safety plan (including MSDS of any potentially hazardous substances to be used);
 - f. traffic control plan (if applicable);
 - g. an environmental protection plan and contingency plans for possible problems.

The work plan shall be comprehensive, realistic and based on actual working conditions for this particular project. Plan shall document the thoughtful planning required to successfully complete the project.

E. Additional Requirements

- 1) Contractor shall comply with all requirements of the highway or railroad relating to temporary work, inspection, watchmen, flagmen, traffic barriers, protection of personnel and property, work restrictions, work scheduling, insurance and such other requirements. The Contractor shall pay for all costs associated with meeting these requirements, except as otherwise specified.
- 2) Where steel casing is required, it shall be within the limits of the highway or railway right-of-way and shall be installed to the proper line and grade; no open excavation will be allowed within the limits of the steel casing without the Engineer's approval. The steel casing shall be furnished and installed in accordance with additional requirements specified herein.
- 3) All work shall be completed to the full satisfaction of the highway or railroad engineer, or his authorized representative.
- 4) For all work on railroad right-of-way, the Contractor shall notify the railroad division Superintendent at least 72 hours, or as noted in the permit, prior to entering railroad right-of-way to begin construction.

F. Installation by the boring method: Installation of the water main and, the steel pipe casing, where required, shall be by the dry boring method at locations shown on the Drawings. Installation shall include all related work and services such as mobilization, construction and maintenance of work pits, right-of-way maintenance and restoration, traffic maintenance, excavation, dewatering, sheeting, shoring, bracing, bulkhead, clean up, and move out. Installation of steel casing shall be in accordance with the applicable regulations of the South Carolina Department of Transportation, the specific Railroad company; the Detail Drawings and these Specifications. All excavations for pit and bore shall be unclassified. Refer to Carrier Pipe Installation in Casing detail in APPENDIX A.

- 1) Boring Pit
 - a. The boring pit shall be solid sheeted, braced, shored, and dewatered as necessary to provide a safe operation;
 - b. The limits of the bore pit shall be contained on public right-of-way unless prior construction or permanent easements have been secured;
 - c. Provide protection to other utilities and roadways;
 - d. The Contractor shall take all precautions, and shall comply with all requirements as may be necessary to protect private or public property;

- 2) Line and Grade: The Contractor shall set the boring rig so that, after the water main and, the casing pipe, if required on the project, is (are) installed the elevations of the water main shall conform accurately to the grades and alignment fixed or given by the Engineer.
- 3) Boring
 - a. Where encasement is required, the water main diameter and steel casing diameter shall be as noted on the plans. The hole shall be bored and encased through the soil by a cutting head on a continuous auger mounted inside the steel casing.
 - b. The boring of the hole and installation of the steel casing shall be simultaneous. Lengths of casing shall be fully welded to the preceding section in accordance with American Welding Society recommended procedures. The Contractor shall bear the cost of any corrective action required to meet line and grade requirements shown on the plans.
 - c. The distance to which excavation is carried ahead of the casing shall be not more than is absolutely necessary for installation purposes, and will be subject to approval of the Engineer. The work shall be performed so that no voids occur in the earth surrounding the casing and so that ground settlement adjacent to and within the limits of the pipeline crossing is eliminated.
 - d. If voids occur or are encountered outside the pipe, the Contractor shall stop the work and contact the agency having jurisdiction (SCDOT, County, City, etc.). The Contractor shall correct this condition using the method required by the agency. One method of correcting this condition is grout injection as follows:
 - i. holes shall be drilled at 10-foot centers to near the top of the steel casing;
 - ii. the voids filled with a 1:3 Portland cement grout at sufficient pressure to fill voids and prevent embankment settlement.
 - iii. If disruption of traffic will occur during the work, the Contractor shall obtain an approved Traffic Control Plan prior to commencing the work. All traffic control requirements shall be the responsibility of the Contractor.
 - e. If it becomes necessary to abandon an incomplete or unacceptable bore, the abandoned encasement shall be capped and filled completely with 1:3 Portland cement grout. Abandonment

procedures shall be completed prior to moving to another boring location. All costs in connection with an abandoned bore, including the construction cost and capping and filling costs, shall be at the Contractor's expense.

- 4) Steel casing installed by boring and jacking shall be welded steel pipe conforming to ASTM A139, Grade B, and shall be of the sizes shown on the plans. Pipe shall be bituminous coated on the outside. Casing size and minimum wall thickness shall be as follows:

Carrier Pipe Diameter (inches, nominal)	Required Minimum Casing Diameter (inches, nominal)	Casing Thickness (inch)
4"	8	.0188 (3/16)
6"	12	.0188 (3/16)
8	16	0.250 (1/4)
10	18	0.250 (1/4)
12	20	0.281
14	22	0.312
16	24	0.344
20	28	0.406
24	32	0.438
30	38	0.5
36	44	0.5
48	56	0.75
60	68	0.75
Greater than 60	Per Design	Per Design

When steel casing is installed without protective coating or cathodic protection, the wall thickness shall be increased a minimum of 0.063 inch greater than the thickness shown above.

- 5) Boring without encasement shall be bored through the soil and the pipe pushed through the bore hole. The diameter of the bore shall be no larger or more than 4-inches greater than the diameter of the bell of the pipe.

- G. Casing Spacers: All carrier pipe installed inside encasement shall be supported by spacers ("spiders") as called for on the plans. Spacers shall be fabricated from quality ASTM A36/A structural steel with continuous meg welds at each joint. The flanges for the two-piece spacer supports shall be formed with half bands. The legs shall be welded to the bands and the skids welded to the legs. After fabrication, the spacers shall be coated with bituminous dip. Grade 5 bolts with nylon locking nuts shall be used to secure the spacer supports to the carrier pipe. Spacers shall be manufactured by Spider Manufacturing, Inc., Cascade, Inc., or other approved

supplier. The casing spacers must be submitted to the SWS Engineering Department as part of the plan review. Refer to Carrier Pipe Installation in Casing detail in APPENDIX A.

9-04 HORIZONTAL DIRECTIONAL DRILLING (HDD)

A. Scope of Work

This section contains guidelines and specifications applicable to the installation of pipelines using horizontal directional drilling (HDD). It includes minimum requirements for design, materials and equipment used for the horizontal directional drilling for the substantially trenchless construction of pipelines. The section also includes materials, dimensions and other pertinent properties of pipe and required accessories. These properties provide minimum performance requirements for various components including joints.

B. Submittals

- 1) All items listed under paragraph 9-03 D. above shall be submitted for approval
- 2) Specifications on material to be used shall be submitted to Engineer. The material shall include the pipe, fittings, drilling mud, drilling additives and any other item, which is to be an installed component of the project or used during construction.
- 3) Pipe materials will be considered on a case-by-case basis by the Spartanburg Water System. Pipe materials, other than shown on design plans, for HDD project shall be submitted to the SWS Engineering Department for review and approval. SWS makes no commitment regarding the future use of HDD as a pipe installation method, based on previous projects or assumed approvals.

C. General

- 1) The bore path alignment and design for HDD shall be based on the Engineer's plans and other factors. Some factors which must be considered are the acceptable bend radius or maximum deflection capabilities of the joint (if jointed pipe is used)
- 2) Prior to the start of drilling, reaming and pipe placement operations, the Contractor shall properly locate and identify all existing utilities in proximity to the pipeline alignment. The Contractor shall confirm the alignment of all critical utilities, using vacuum excavation or other suitable excavation method, for further detailed confirmations as necessary.

D. Equipment and Expertise

- 1) The Contractor shall have equipment and expertise, appropriate for horizontal directional drilling installations. This includes the preparation and maintenance of the bore path using drilling fluids appropriate for the geology of the soils. The Contractor shall also have experience in safety and dependability installing, in similar geology, similar size and length of piping involved.
- 2) The directional drilling machine shall consist of a hydraulically powered system to rotate, push and pull hollow drill pipe into the ground at variable angles down to 8 degrees above horizontal, while delivering a pressurized fluid mixture to a guidable drill (bore) head. The machine shall have a capacity to adequately complete the drilling and piping installation. The machine shall be anchored to the ground to withstand the pulling, pushing and rotating pressure required to complete the crossing.
- 3) The hydraulic power system shall be self-contained with sufficient pressure and volume to power drilling operations. Hydraulic system shall be free of leaks. Rig shall have a system to monitor the maximum pull-back pressure during the pull-back operation. The rig shall be grounded during drilling and pull-back operations. There shall be a system to detect electrical current from the drill string and an audible alarm, which automatically sounds when an electrical current is detected.
- 4) The drill head shall be a steerable type and shall provide the necessary cutting surfaces and drilling fluid jets. Mud motors shall be adequate power to turn the required drilling tools.
- 5) The equipment shall incorporate a conventional electromagnetic sound walkover system or Magnetic Guidance System (MGS) probe or proven gyroscopic probe and interface shall be used to provide a continuous and accurate determination of the location of the drill head during the drilling operation. The guidance shall be capable of tracking at the maximum depth required and in any soil condition, including hard rock. It shall enable the driller to guide the drill head by providing immediate information to the tool face, azimuth (horizontal direction), and inclination (vertical direction). The guidance system shall be accurate to $\pm 2\%$ of the vertical depth of the borehole at sensing position at depths up to one hundred feet and accurate within 1.5 meters horizontally.
- 6) The Guidance System shall be of a proven type and shall be setup and operated by personnel trained and experienced with this system. The Operator shall be aware of any geo-magnetic anomalies and shall consider

such influences in the operation of the guidance system if using a magnetic system.

E. Drilling Fluid (Mud) System

- 1) A self-contained, closed, drilling fluid mixing system shall be of sufficient size to mix and deliver drilling fluid composed of bentonite clay, potable water and appropriate additives. Mixing system shall be able to molecularly shear individual bentonite particles from the dry powder to avoid clumping and ensure thorough mixing. The drilling fluid reservoir tank shall be a minimum of 500 gallons. Mixing system shall continually agitate the drilling fluid during drilling operations.
- 2) Additives to drilling fluid such as drill soap, polymers, etc. shall be “environmentally safe” and be approved for such usage. No diesel fuel shall be used.

F. Other Equipment

- 1) Pipe rollers shall be of sufficient size to fully support the weight of the pipe while being hydro-tested and during pull-back operations. Sufficient number of rollers shall be used to prevent excess sagging of pipe. Rollers shall be used as necessary to assist in pull back operations and in layout/jointing of piping.
- 2) Hydraulic or pneumatic pipe rammers may only be used if necessary and with the authorization of Design Engineer. Other devices or utility placement systems for providing horizontal thrust other than those previously defined in the preceding sections shall not be used unless approved by the Design Engineer prior to commencement of the work. Consideration for approval shall be made on an individual basis for each specified location. The proposed device or system shall be evaluated prior to approval or rejection on its potential ability to complete the utility placement satisfactorily without undue stoppage and to maintain line and grade within the tolerances prescribed by the particular conditions of the project.

G. Additional Requirements

- 1) The Engineering Field Technician must be notified 48 hours in advance of starting work. The Directional Bore shall not begin until the Engineering Field Technician is present at the job site and agrees that proper preparations for the operation have been made. The approval of the Engineering Field Technician for beginning the installation shall in no way relieve the

Contractor of the ultimate responsibility for the satisfactory completion of the work.

- 2) All personnel shall be fully trained in their respective duties as part of the directional drilling crew and in safety. Contractor must show job history and reference list of equal or greater size and length of piping involved. The Supervisor must have at least two years directional drilling experience. A competent and experienced supervisor representing the Drilling Contractor shall be present at all times during the actual drilling operations. A responsible representative who is thoroughly familiar with the equipment and type work to be performed, must be in direct charge and control of the operation at all times.
- 3) Testing and acceptance of water mains installed by HDD shall be as indicated in SECTION 4G of these Specifications.

SECTION 10

AERIAL CROSSINGS

10-01 PIPE ON PIERS

This section addresses the situation in which the water main must cross natural or man-made terrain features, with the pipe exposed above-ground, rather than crossing underground. The guidelines below refer to water mains in the Spartanburg Water distribution system, and may not apply to other aerial installations such as within treatment plants or other isolated facilities. The Engineer shall be responsible for all details associated with the design of pier-supported piping systems. All details related to a planned aerial crossing on piers shall be submitted the SWS Engineering Department with the preliminary plan submittal package.

A. Materials

- 1) Ductile iron pipe shall be used for all aerial crossings, the required wall thickness shall be specified by the Engineer.
- 2) The DIP joint configuration shall be as specified;
- 3) Fittings and appurtenances shall be as specified;
- 4) Long span pipe may be used to reduce the number of joints; this material shall be submitted to the SWS Engineering Department for approval.

B. Design Considerations

- 1) The carrying capacity of the supports themselves,
- 2) The strength of the structure from which a pipe may be suspended
- 3) Unusual or additional loads not in the scope of this section. Such loading may include seismic, frequency or resonance of vibrations, wind, water current, and other special design considerations.
- 4) It is also necessary to ensure a minimum of lateral and vertical stability at the supports for aboveground piping. Deflected pipe joints can result in thrust forces of hydrostatic or hydrodynamic origin, and, if not laterally and vertically restrained, unbalanced forces may result in additional joint deflection and possible failure of the pipeline.
- 5) Thermal expansion of ductile iron pipelines supported above ground is not usually of concern in correctly designed and installed systems because of the nature of the push-on joint. A 50° Celsius change in temperature results in

expansion or contraction of a 6m length of ductile iron pipe of approximately 3.4mm. This is easily accommodated by correctly installed pipe and joints.

- 6) Occasionally, where support structures are expected to have significantly different behavior than the pipeline, special considerations for expansion, contraction, and supports may be necessary;
- 7) Supports should generally be positioned immediately behind the pipe bells. Supports should normally not be placed under spigots adjacent to bells, due to possible undesirable effects on joints.
- 8) Pipe supports should cradle the pipe in a saddle. This cradling, which should follow the contour of the pipe, minimizes stress concentrations at the supports. It is recommended that the saddle angle of the support be between 90° and 120°. Little or no benefit is gained by increasing the saddle angle more than 120°. With angles smaller than 90°, the maximum stress tends to increase rapidly with decreasing saddle angle.
- 9) Supports, piles, and/or foundations should be adequately designed from a structural and soil-engineering standpoint to safely handle any loads transferred from the pipe.
- 10) Refer to Pipe Supported on Concrete Piers detail in APPENDIX A.

NOTE: The construction details provided in these Specifications are suggestions only and do not relieve the Design Engineer from the responsibility and obligation to consider all issues related to the proper design of all structures and systems and compliance with all applicable regulations and standards.

10-02 PIPE ATTACHED TO BRIDGES

- A. Attachment of water mains to bridges or other structures must be approved by the agency with jurisdiction over the structure. It shall be the responsibility of the Design Engineer to obtain written authorization and approval as needed from all agencies including (but not limited to) the following:
 - 1) SCDOT
 - 2) The City of Spartanburg
 - 3) Spartanburg County.
- B. General: All pipe, fittings and appurtenances shall be assembled and joined in accordance with the instructions in this Section and manufacturer's recommendations

and shall accurately conform to the dimensions established. Pipe hanger assemblies shall be the type and size indicated on the plans and shall meet the requirements stated on the plans and stated herein. The pipe hanger shall be either a yoke pipe roll or a clevis. All pipe fittings and appurtenances shall be adequately supported and anchored, protected from damage and freezing, and accessible for repair and replacement.

- 1) Steel Yoke Pipe Roll Hanger: If the hanger is to be a yoke pipe roll type, it shall be a Grinnell "adjustable steel yoke pipe roll," or approved equal. The yoke, roll rod and hex nuts shall be manufactured from carbon steel and the roll shall be cast iron. Each hanger shall have a maximum recommended load of not less than 1200 lbs.
- 2) Pipe Hanger Clevis: If the pipe hanger is to be a clevis type, it shall be a Grinnell "adjustable clevis for cast iron pipe," or approved equal. The clevis shall be manufactured from carbon steel and shall have a maximum recommended load of not less than 1940 lbs.
- 3) Rods: Rods shall be the diameter and length shown on the plans. Rods shall be carbon steel with a minimum yield strength of 60,000 psi. Rods shall be threaded to match the hanger hardware.

C. Existing Bridge: Where a pipeline is to be installed on an existing bridge, it shall be supported by hangers attached to the bridge by anchors drilled and embedded in the bottom of the bridge deck as shown on the construction plans.

- 1) Concrete Anchors: Shall be the Hilti HVA Adhesive Anchor System or approved equal with 7/8-inch diameter and a minimum embedded depth of 6 5/8 inches. Tensile bond strength shall be 28,720 lbs minimum.
- 2) Installation: During assembly, the vertical position of the hanger on the rod shall be adjusted to provide consistent clearance between the pipe and the bridge deck. The hanger rod nuts shall be tightened securely. Each completed hanger assembly shall be coated with 17.5 mils of Koppers Bitumastic 300-M, or equal.

D. New Bridge: Where a pipeline is to be installed on a bridge which is being newly constructed, arrangements will be made by the Spartanburg Water System to have concrete inserts cast in place in the bottom of the bridge deck when it is being formed. The pipeline will be supported by hangers attached to these inserts as shown on the construction plans.

- 1) Concrete Inserts: Concrete inserts shall be the Grinnell "wedge type concrete insert," or approved equal. The inserts shall be manufactured from carbon steel and have a galvanized finish. The nut shall be iron. Maximum recommended load shall be not less than 1,200 lbs. Inserts shall be installed

in place by nailing each insert to the wooden form at the locations shown on the plans before the concrete is poured into the form. Two one foot lengths of 3/8-inch rebar shall be installed in the slots of each insert as shown on the plans and shall be cast in place with the inserts. After the bridge is poured, set and the forms removed, the knockout plate in each insert shall be removed with a screwdriver.

- 2) Installation: The wedge nut should be put on the rod before inserting into the concrete insert body. Insert the nut into the slot and turn rod so the elongated nut lies across the slot. Screw rod through nut until rod is firmly against the top of the recess.
- 3) After assembly of pipe, clevis and rod, the vertical position of the clevis on the rod shall be adjusted to provide consistent clearance between the pipe and the bridge deck. The hanger rod nuts shall be tightened securely. Each completed hanger assembly shall be coated with 17.5 mils of Koppers Bitumastic 300-M, or equal.

SECTION 11

PAVING AND SURFACING

11-01 SCOPE

This section covers cutting and replacing pavement for installation of utilities, as shown on the plans and as specified herein.

11-02 DESIGN CRITERIA

Reference 2007 SCDOT Standard Specifications for Highway Construction
Reference Spartanburg County Standard Specifications for Construction of Roads

11-03 CUTTING AND REPLACING PAVEMENT

- A. Cutting: All pavement shall be neatly cut to a straight edge in advance of trenching, with the method of cutting subject to approval of the Engineer. Cutting pavement shall be sawed with suitable concrete saw cutting equipment. Pavement shall be cut 12 inches wider than the excavated area on each side. Ragged and irregular edges shall be redone.
- B. Trench Backfilling under pavement shall be as specified in SECTION 4E of these Specifications.
- C. Base for pavement shall be crusher run stone for all secondary highways and non-highway streets, and concrete for all primary highways. Base shall be placed in accordance with plan or encroachment permit details. Base width shall be as shown on the plans of encroachment permits for the various types pavement cuts.
 - 1) Crusher run stone shall be graded 1-1/2 inches and down, with fines being added if necessary. Stone shall be well mixed and compacted by tamping and rolling so as to prevent settlement. Crusher run base material shall be placed at the same time that the trench is backfilled. Backfilling to the top of the trench, to be cut out and replaced with base material at a later date, will not be allowed.
 - 2) Base for highway pavement and adjacent drives shall be 8 inches of crusher run stone, stabilized with 5% Portland cement. Base shall be thoroughly mixed prior to compaction.
 - 3) Base for non-highway pavement and adjacent drives shall be 8 inches of crusher run stone, without the addition of cement.

- 4) Concrete base shall consist of 10 inches of concrete. Concrete shall be designed to produce a compressive strength of 3000 psi at 28 days. Design of mix and source of supply shall be subject to approval of the Design Engineer.
- D. Pavement shall be replaced with the same type of pavement that existed prior to cutting, and shall consist of bituminous surfacing, bituminous plant mix pavement. The Contractor shall contact the highway department and obtain the specifications for the mix to be used for any one or group of pavement cuts.
- 1) Pavement shall be repaired within the same week that it is cut. If inclement weather delays pavement replacement, Contractor shall not cut additional pavement until he has notified the Engineer and received specific permission and instructions.
 - 2) For bituminous pavement or surfacing, the entire area to be resurfaced (including edges of existing pavement) shall be primed with an acceptable asphalt prime coat just prior to placing the new pavement.
- E. The requirement of the agency having jurisdiction over the roadway which is being impacted by the work shall govern.
- F. All Work on State Highways, County Highways or Roads, Town or City Street shall be done in strict accordance with requirements of the agency having jurisdiction thereof. It shall be the responsibility of the Contractor to familiarize himself with all such requirements. He shall obtain from the Owner a copy of all required encroachment permits, and shall conform to all requirements and stipulations therein.

11-04 REMOVING AND REPLACING SIDEWALK

Where pipe is to be placed under an existing concrete sidewalk, the concrete shall be removed in construction units unless their length is more than 10 feet, in which case, the concrete shall be cut as specified for pavement. Backfill shall be thoroughly compacted for the entire depth of the trench.

- A. Sidewalk shall be replaced with 3,000 psi concrete 4 inches thick, except for driveways where it shall be 6 inches thick. Concrete shall be placed monolithic and dressed off with a wooden float, brush and edging tool. Where pipe is to be placed under a concrete walk, the Contractor may, with permission of the Engineer, install the pipe by boring instead of removing and replacing the walk.
- B. If pipe is to be placed under curb and gutter, it shall be done by boring.

SECTION 12

GRASSING AND EROSION CONTROL

12-01 SCOPE

This section contains specifications for the materials, equipment, construction, measurement, and payment for the seeding, interseeding, fertilizing, applying nitrogen and lime when specified, and mulching in conformity with the Plans and the Specifications or as directed by the Engineer or Inspector. Interseeding consists of the planting of centipede grass seed within the existing turf.

12-02 MATERIALS

- A. General: At the time of delivery, furnish invoices for materials received in order to determine the application rate of materials.
- B. Seed: Ensure that seed conforms to state laws and the requirements and regulations of the South Carolina Department of Agriculture (SCDA). Provide individually packaged or bagged and tagged varieties of seed that show the name of seed, net weight, origin, percentages of germination and purity, lot number, and other information required by the South Carolina Department of Agriculture. SWS reserves the right to test and reject or approve any or all seed before application of the seed. For mixtures of different types of seed called for in the seeding schedule, weigh and mix in the proper proportions.
- C. Seeding Schedules: Unless otherwise provided, select the type of seeding from the tables shown below for the upper state regions as applicable to the project. The upper state region includes all of Spartanburg, Greenville, Union, and Cherokee Counties. The total seed rate in pounds per acre is the sum total shown for all the varieties of seed opposite the schedule number in the seeding schedules included herein.

Adhere to the following two seeding schedules.

Seeding Schedule for Permanent Vegetation Upper State				
Schedule No.	Common Name of Seed	Pounds/acre ¹		Planting Dates
		Rural	Urban	
1	Common Bermuda (hulled) ³	23	23	March 15 to August 14
	Sericea Lespedeza (scarified) ²	50	50	
	Kentucky 31 Fescue	50	60	
	Weeping Lovegrass ²	10	10	
2	Kentucky 31 Fescue	50	80	August 15 to March 14
	Sericea Lespedeza (unhulled, unscarified) ²	80	80	
	Common Bermuda (unhulled) ³	30	30	
	Weeping Lovegrass ²	10	10	
	Reseeding Crimson Clover ⁴	20	0	
	Annual Rye Grass ⁵	5	15	
	Rye Grain	20	0	
<p>Notes:</p> <p>¹ Includes rural areas adjacent to well-developed lawns.</p> <p>² Not required on shoulders, medians, etc. and on slopes under 5 feet in height.</p> <p>³ Do not use Giant Bermuda seed including NK-37.</p> <p>⁴ Inoculate Reseeding Crimson Clover in accordance with Subsection 810.2.4. Do not plant clover in medians or in rural areas adjacent to well-developed lawns.</p> <p>⁵ The use of Italian Rye Grass is prohibited on all projects.</p>				

Adhere to the following schedule for interseeding.

Interseeding Schedule			
Schedule No.	Common Name of Seed	Pounds per acre	Planting Dates
1	Centipede	10	October 15 to July 15

810.2.3.3 Temporary Vegetation Seeding Schedule

Adhere to the following seeding schedules for temporary vegetation.

Seeding Schedules For Temporary Vegetation Upper and Lower State			
Schedule No.	Common Name of Seed	Pounds per acre	Planting Dates
1	Brown Top Millet	50	April 1 to August 15
2	Rye Grain	55	August 16 to March 31
	Annual Ryegrass ¹	15	
¹ The use of Italian Rye Grass is prohibited on all projects.			

Add oat grain at the rate of 10 pounds per acre to schedules if the seeding date is between March 1 and April 16.

- D. Inoculants: Provide an inoculant for treating reseeding crimson clover seed of a pure culture of nitrogen-fixing bacteria selected for a maximum vitality and ability to transform nitrogen from the air into soluble nitrates and deposit them into the soil. Ensure that inoculants consist of purebred cultures and are not more than one year old.
- E. Commercial Fertilizer: Provide commercial fertilizers that comply with state fertilizer laws. When a fertilizer is required for any grass, use a mixed fertilizer with a designation such as 10-10-10, where the first number represents the minimum percent of nitrogen required, the second number represents the minimum percent of available phosphoric acid required, and the third number represents the minimum percent of water soluble potash required in the fertilizer. For centipede grass, use only 15-0-15 or 16-4-8 fertilizer.
- F. Lime: Ensure that lime is agricultural grade, standard ground limestone conforming to the current *Rules, Regulations, and Standards of the Fertilizer Board of Control*. These rules, regulations, and standards are promulgated and issued by the Fertilizer Board of Control at Clemson University in accordance with Section 16 of the South Carolina Liming Materials Act. Ensure that each bag has affixed in a conspicuous manner a tag or label, or in the case of bulk sales, a delivery slip showing the brand or trade name, calcium carbonate equivalent, percent by weight passing prescribed

U.S. Standard sieves, and other pertinent information to identify lime as agricultural grade, standard ground limestone. The Contractor may substitute liquid lime for ground lime if it meets all requirements for agricultural grade lime specified herein, except percent by weight passing U.S. Standard Sieves, which is waived for liquid lime.

G. Tackifiers as Mulch Binders

- 1) Emulsified Asphalt: If emulsified asphalt is used as a tackifier, ensure that emulsified asphalt is diluted at the manufacturing plant with water, if necessary, to provide a homogenous and satisfactory material for spraying.
- 2) Chemical Tacking Agents: If a chemical tacking agent is used, ensure that it consists of a polymer synthetic resin, polypectate, liquid latex, or other material that gives similar adhesive properties as asphalt emulsion when sprayed on straw and cellulose fiber mulches. Chemical tacking agents require approval by the SWS Engineering Department.

H. Straw Mulch: Use straw mulch material consisting of straw or hay. Use straw that consists of stalks of wheat, rye, barley, oats, or other approved straw. Use hay that consists of Timothy, Peavine, Alfalfa, Coastal Bermuda, or other grasses. Ensure that these materials are reasonably dry and reasonably free from mature seed-bearing stalks, roots, or bulblets of Johnson Grass, Nutgrass, Sandburg, Wild Garlic, Wild Onion, Wild Mustard, Crotolaria, Pigweed, Witchweed, and Cocklebur. Comply with all state and federal domestic plant quarantine regulations.

I. Wood Fiber Hydroseeding Mulch

- 1) Use wood fiber hydroseeding mulch made from wood chip particles manufactured particularly for discharging uniformly on the ground surface when dispersed by a hydraulic water sprayer. Ensure that it remains in uniform suspension in water under agitation and blends with grass seed and fertilizer to form homogeneous slurry. Make certain that the fibers intertwine physically to form a strong moisture-holding mat on the ground surface and allow rainfall to percolate the underlying soil. Use a fiber material that is heat processed and contains no germination or growth-inhibiting factors.
- 2) Use a fiber material dyed (non-toxic) an appropriate color to facilitate the uniform application of material.
- 3) Use suppliers that certify that their product has been laboratory and field tested and meets all of the foregoing requirements based upon such testing. Ensure that the weight specifications from suppliers and for all applications of this material refer only to the absolute air-dry weight of the fiber material. Absolute air-dry weight is based on the normal weight standard of the Technical Association of the Pulp and Paper Industry for wood fiber

hydroseeding mulch and is considered equivalent to 10% moisture. Ensure that the manufacturer marks each package of the wood fiber hydroseeding mulch to show the air-dry weight content.

- J. Cellulose Fiber Hydroseeding Mulch: Use cellulose fiber hydroseeding mulch consisting of recycled magazine stock products shredded into small pieces for application by hydraulic seeding equipment. Ensure that It mixes readily and uniformly under agitation with water and blends with grass seed and fertilizer to form homogeneous slurry. When applied to the ground surface, ensure that the material forms a strong moisture-holding mat, allows rainfall to percolate to the underlying soil, and remains in place until the grass root system is established. Ensure that the material contains no growth inhibiting characteristic or organisms. Obtain mulch from suppliers that certify that their product meets these requirements.

12-03 INSTALLATION OF GRASS AND RELATED MATERIALS

- A. Seeding Dates and Rates of Application: Perform seeding during the periods and at the rates specified in the seeding schedules above. The Contractor may perform seeding work throughout the year using the schedule prescribed for the given period. Do not conduct seeding work when the ground is frozen or excessively wet. Produce a satisfactory stand of grass meeting the requirements of this section, regardless of the period of the year in which the work is performed. Perform interseeding during the periods and at the rates specified in the interseeding schedule. Conduct the interseeding with a no-till drill calibrated to deliver the specified rate of seed per acre.
- B. Preparation of Ground Before Seeding: Ensure that the areas seeded are uniform and conform to the finished grade and cross-section shown on the Plans or as otherwise directed by the Engineer. Perform minor shaping and evening of uneven and rough areas outside the graded section as needed in order to provide for more effective erosion control and ease of subsequent mowing operations. Loosen the seedbed (including cut slopes) to a minimum depth of 3 inches before agricultural lime, fertilizer, or seed is applied. Clear the areas to be seeded of stones larger than 2½ inches in any dimension, roots, and other debris. Temporarily seed slopes to coincide with the embankment work in 10-foot increments. When 10 feet of fill is in place, seed the slope. Track the slopes vertically to help hold the seed in place
- C. Applying Organic Topsoil: At areas to be grassed where the existing seedbed has little or no topsoil, topsoil may be furnished and placed on the seedbed to ensure a good stand of grass
- D. Applying Lime and Fertilizer: When called for in the Contract, spread lime and/or fertilizer uniformly over the designated areas and thoroughly mix with the soil to a depth of approximately 2 inches. Apply fertilizer at the rate of 1000 pounds per acre unless otherwise directed. Apply lime at the rate of 2000 pounds per acre, unless

otherwise specified. Unless otherwise provided, do not apply lime for temporary seeding. Adequately scarify steep slopes, which are inaccessible to power equipment and are subject to slides. Fertilizer may be applied as a mixture of fertilizer and seed by approved mechanical spreaders or by hydraulic methods. When fertilizer is applied in a combination seed and fertilizer drill, no further incorporation is necessary. Apply the fertilizer and seed together when the hydraulic method of seeding is used. Remove all stones larger than 2½ inches in any dimension, larger clods, roots, or other debris brought to the surface. Fertilizer of a different analysis than that specified on the Plans may be substituted if approved by the Engineer. If a different fertilizer is approved, apply the fertilizer at such a rate per acre to give at least the amount of nitrogen, phosphoric acid and potash as would have been accomplished had the originally specified fertilizer been used and applied at the specified rate. If the substitute fertilizer meets the minimum analysis of at least one or more of the three basic ingredients, do not consider the excess in calculating the required quantity of the substituted fertilizer. Payment is made for the number of tons of fertilizer which would have been required if the originally specified fertilizer had been used at the specified rate. For Interseeding, apply fertilizer at the rate of 500 pounds per acre. Use 15-0-15 or 16-4-8 fertilizer

- E. Permanent Vegetation: Produce a satisfactory stand of perennial vegetation with a root system that is developed sufficiently to survive dry periods and winter weather, and is capable of re-establishment in the spring. The perennial vegetative cover must have a minimum coverage density of 70% for the seeded areas. Using the seed specified above, determine the rate of application necessary to produce the required stand of grass and follow the application procedures as specified herein
- F. Temporary Vegetation: Obtain a satisfactory stand of vegetation that is capable of erosion control. Using the seed specified above, determine the rate of application necessary to produce the required results. Ensure that the temporary vegetation provides minimum density coverage of 70% of the seeded area.
- G. Temporary Seeding: Sow seed within 24 hours following the application of fertilizer and preparation of seedbed as specified above. Sow seed at the required rate by hand or by methods as outlined above. Compact or cover the seeded areas as specified above. On small areas inaccessible to machinery, the Contractor may cover the seed by hand rakes or other methods satisfactory to the Engineering Field Technician. Apply fertilizer at the rate of 500 pounds per acre or as directed by the Engineering Field Technician. Lime is not required in temporary seeding unless otherwise specified. No tackifiers or mulches are required for temporary seeding. The Contractor may use temporary seeding in isolated problem areas or, where it is not feasible or practicable to bring an area to final slope, grade and finish so that the permanent seeding can be performed without subsequent serious disturbance by additional grading.

H. Seeding (Unmulched): Ensure seeding without mulch (unmulched) conforms to Method A or B as prescribed below, except do not use Method A in urban areas or in areas adjacent to sidewalk, guardrail, curb, curb and gutter, or concrete median.

1) Method A: Seeding with Emulsified Asphalt Tackifier

Sow seed within 24 hours following the application of fertilizer and lime and preparation of the seedbed as specified above. Uniformly sow seed at the rate specified by the use of approved mechanical seed drills, rotary hand seeders, hydraulic equipment, or any other type of equipment that produces a uniform application of the seed. Except on steep slopes where mechanical equipment cannot operate satisfactorily, compact all seeded areas by means of a cultipacker or light roller. Compaction is not necessary if seeds are planted by mechanical seed drills that perform a compaction procedure. On slopes that are inaccessible to compaction equipment, cover the seed by dragging spiked-chains, by light harrowing, or by other methods satisfactory to the Engineer. Within 24 hours following compaction of the seeded areas, uniformly apply emulsified asphalt, diluted at the manufacturing plant with an equal amount of water, over the seeded areas at a rate of 0.15 to 0.32 gallon of the dilution per square yard. The RCE will determine the exact rate of application. Before spraying emulsified asphalt, cover parts of bridges, culverts, guardrail, signs, sidewalk, curb and gutter, catch basins, pipe ends, and other structures as necessary to prevent discoloration.

2) Method B: Seeding with Wood Fiber Mulch Tackifier

Cellulose Fiber Mulch Tackifier, or Wood/Cellulose Fiber Mix Tackifier
Apply lime and prepare the ground as shown on the Plans or as provided above. Choose one of the following tackifiers: wood fiber tackifier, cellulose fiber tackifier, or wood/cellulose fiber mix tackifier and apply with a mixture of water, seed, and fertilizer at the rate of 1500 pounds per acre. Use hydraulic equipment for the application of slurry of water, fertilizer, seed, fiber, and tackifier. Use equipment with a built-in agitation system and an operating capacity sufficient to agitate, suspend, and homogeneously mix the slurry. Ensure that the slurry distribution lines are large enough to prevent clogs. Equip the discharge line with a set of hydraulic spray nozzles to provide even distribution of the slurry on the various areas seeded. Use a slurry tank with a minimum capacity of 1000 gallons. Combine all of the seed, fertilizer, tackifier, and water into the slurry tank for distribution of all ingredients in one operation by the hydraulic seeding method specified herein. Combine the materials in a manner recommended by the manufacturer. Regulate the slurry mixture so that the amounts and rates of application result in a uniform application of all materials at rates not less than the amounts specified. Using the color of the slurry as a guide, spray the prepared seedbed with a uniform visible coat. Apply the slurry in a sweeping motion in an arched stream falling like rain and allow the slurry to build upon

itself until an even coat is achieved.

- I. Seeding (Mulched): Ensure that seeding with mulch conforms to Method A, B, or C as prescribed below, except do not use Method A in urban areas or in areas adjacent to sidewalk, guardrail, curb, curb and gutter, or concrete median.
- 1) Method A: Seeding with Straw or Hay Mulch

Sow seed as specified in Method A of Section I above. Within 24 hours following covering of the seed, uniformly apply straw or hay mulch material at the rate of 2 tons per acre. Spread mulch by hand, by appropriate mechanical spreaders, or by blowers. Use mulch that allows sunlight to penetrate and air to circulate but also partially shades the ground and conserves soil moisture. Use emulsified asphalt meeting the requirements of Section 12-02 H. above, or other approved tacking agent, to hold the newly laid mulch in place. Ensure that the emulsified asphalt is diluted at the manufacturing plant with an equal amount of water. Uniformly apply the material as a film over the mulch at approximately 0.20 gallon of dilution per square yard. Make certain that the film is sufficient to bond together the mulch particles without giving a heavy coating of the asphalt material. Ensure that the film prevents wind erosion. Other tacking agents may be used and applied at the manufacturer's recommended rate. Replace displaced mulch.
 - 2) Method B: Seeding with Straw and Hydroseeding Mulch

Apply seed as in Method A of Section I above, then cover with straw tacked with the manufacturer's recommended rate of wood, cellulose, or a wood/cellulose mix hydroseeding mulch; or straw tacked with manufacturer's recommended rate of a combination of tacking agent and any of the aforementioned hydroseeding mulches.
 - 3) Method C: Hydroseeding

Hydroseed using 1500 pounds per acre of wood, cellulose, or a wood/cellulose mix hydroseeding mulch with the manufacturer's recommended rate of an approved tacking agent.
- J. Application of Nitrogen: As soon as the plants show satisfactory growth, apply nitrogen evenly at the rate of 48 pounds per acre on the areas designated by the RCE. Unless otherwise permitted, apply the nitrogen in a solid form rather than in a liquid state. Do not apply nitrogen to stands of *sericea lespedeza*. Unless otherwise provided, do not apply nitrogen to temporary vegetation.

12-04 TURF MAINTENANCE

- A. Mowing: Mow areas seeded or sodded , or other areas as necessary, to maintain the project in a satisfactory manner. Perform mowing where directed by the Engineer. Commence mowing within three business days following verbal notification by the Engineer. Failure to comply with the above may be grounds for stopping work on the project (or withholding payment of the next pay estimate if a Capital project).
- B. Maintenance: Perform all maintenance necessary to keep seeded areas in a satisfactory condition until the work is finally accepted. This includes mowing, repairing washes, and additional applications of seed, fertilizer, and mulch to areas where a satisfactory stand of grass has not been achieved.
- C. Stand of Grass: Before acceptance of the seeding performed for the establishment of permanent vegetation, produce a uniform perennial vegetative cover with a density of 70% of the seeded area. Ensure that the root system is developed sufficiently to survive dry periods and winter weather and is capable of reestablishment in the spring. Before acceptance of the seeding performed for the establishment of temporary vegetation, produce a stand of grass sufficient to control erosion for a given area and length of time before the next phase of construction or the establishment of permanent vegetation commences

12-05 EROSION CONTROL MEASURES

Ensure that the equipment necessary for the proper construction of the work is on site, in acceptable working condition, and approved by the Engineering Field Technician as to both type and condition before the start of work under this section. Provide sufficient equipment to enable the work to proceed in accordance with the project schedule and completion of the work in the specified time.

- A. Partial and Temporary Seeding: Coordinate seeding with the construction of cut and fill slopes. Limit the area of erodible material by bringing partially completed slopes to the required slope and perform seeding operations at that time as directed by the Engineering Field Technician. Temporarily seed slopes to coincide with the embankment work.
- B. Erosion Control Measures: In addition to the erosion control measures specified herein and in the Plans and the Special Provisions, the Contractor is advised that all land disturbing activities (clearing and grubbing, excavation, borrow and fill) are subject to the requirements set forth in the following permits and regulations. The party responsible for each requirement will depend upon whether the project is a SWS Capital Project, or a Developer Project:
 - 1) South Carolina Code of Regulations 63-380, Standard Plan for Erosion, Sediment, and Stormwater Runoff Control. The regulation may be viewed at

the following Internet web address:

<http://www.scstatehouse.net/coderegs/c063.htm>

- 2) Erosion and Sediment Reduction Act of 1983 (Title 48, Chapter 18 of the South Carolina Code of Laws of 1983, as amended). Section 70 of this code authorized the South Carolina Department of Health and Environmental Control (SCDHEC) to administer this regulation with respect to lands under the jurisdiction of the South Carolina Department of Transportation. The code may be viewed at the following Internet web address:
<http://www.scstatehouse.net/code/t48c018.htm>
- 3) National Pollutant Discharge Elimination System (NPDES) General Permit Number SCR100000, effective September 1, 2006: The Environmental Protection Agency, in accordance with the Federal Clean Water Act, has granted to the South Carolina Department of Health and Environmental Control (SCDHEC) the authority to administer the Federal NPDES permit program in the State of South Carolina. The permit may be viewed at the following Internet web address:
<http://www.scdhec.net/environment/water/docs/finalcgp.pdf>
- 4) In accordance with the NPDES General Permit, sign a Co-Permittee Agreement and Contractor Certification statement (shown in Part 3.2D of the General Permit) and require all subcontractors performing land-disturbing activities to sign a Co-Permittee Agreement and Contractor Certification statement as part of their subcontract. These certifications are incorporated into the proposal form for the Contract. By signing either form, the Contractor acknowledges that upon award and execution of the Contract, he/she accepts/ understands the terms and conditions of the *Storm Water Pollution Prevention Plan (SWPPP)* as required by the NPDES General Permit and may be legally accountable to SCDHEC for compliance with the terms and conditions of the *SWPPP*. In addition, the Contractor certifies that the NPDES certification statement and/or co-permittee status is made part of all its subcontracts.
- 5) Prepare and submit a *Contractor's Erosion Control Plan (CECP)* to the SWS Engineering Department before the pre-construction conference. Ensure that the plan meets the requirements of the NPDES General Permit. The plan will be reviewed and approved by the Department before commencing any land disturbing activities. Upon approval of the *CECP*, the Engineer will complete and forward a *Notice of Intent (NOI)* to SCDHEC. If SCDHEC does not send a letter within 10 business days of receipt of the *NOI*, authorizing coverage, denying coverage, or advising that a review of the *CECP* will take place, coverage will be automatically granted.
- 6) At the pre-construction conference, with all contactors and subcontractors performing land-disturbing activities present, the *CECP* will be explained

and discussed so that each contractor and subcontractor is made aware of their responsibilities in the *CECP*. Once approved, fully implement the *CECP*. Coordinate the prompt installation of erosion control devices with construction activities to maintain compliance with the above regulations and NPDES General Permit.

- 7) Conduct an Erosion and Sediment Control Inspection by an appointed Certified Erosion Prevention and Sediment Control Inspector (CEPSCI) from the Contractor at least every 7-calendar days. Both parties will acknowledge participation in the inspection by signing the inspection report and include their inspector's CEPSCI number on the report. Correct deficiencies noted during these inspections within the assigned priority period. On SWS Capital Projects, if deficiencies are not corrected within this timeframe, the Engineer, Engineering Field Technician, or Owner's Representative will stop all work (except erosion and sediment control measures) until the deficiencies are corrected.
- 8) Give special attention to critical areas within the project limits (i.e., running streams, water bodies, wetlands, etc.). In these areas, the Contractor may be required to undertake immediate corrective action, but in no case allow these deficiencies to remain unresolved more than 7 days or 48 hours in accordance with their assigned priority after being identified during the Erosion and Sediment Control Inspection.
- 9) Closely follow the grading operations with the seeding operations. Shape and prepare the slopes for seeding as the grading progresses. Limit the amount of surface area exposed by land disturbing activities to 750,000 square feet. Commence seeding operations within 7 days following completion of construction activities within an area. Initiate stabilization measures within 7 days for an area where construction activities will be temporarily or permanently ceased for 21 days or longer.
- 10) Coordinate the installation of all other permanent erosion control items with the grading and seeding operations. These items include, but are not limited to, asphalt gutter and riprap. Construct gutter work before or promptly after the seeding is performed. Place riprap at the ends of pipe immediately after the pipe is laid and promptly install riprap ditch checks after ditch work has been performed. Failure to adequately comply with the provisions as detailed above or any other required erosion control measures will result in stoppage of all contract operations (except erosion and sediment control measures) until corrective action has been taken. Additional sanctions may be invoked by the Scheming accordance with their authority.
- 11) Keep the following documents at the Contractor's field office from the start of construction until the site is finally stabilized:

- a) Copy of the *CECP*,
 - b) Copies of all the co-permittee agreements and Contractor certification statements
 - c) Copy of the permit/approved SWPPP
 - d) Letter from DHEC authorizing permit coverage, and A marked-up set of site plans.
- 12) When uniform perennial vegetation achieves a cover density of 70%, submit a Notice of Termination (NOT) to SCDHEC to terminate coverage. Include a signed statement with the NOT certifying that all work on the site has been completed in accordance with the SWPPP and the NPDES General Permit for all sites one acre or greater.

Fines assessed on the Spartanburg Water System by SCDHEC as the result of the Contractor's non-compliance or violation of said permit provisions will be paid by the Department and will subsequently be deducted from any monies due or that may become due to the Contractor. In case no monies are due or available, the fines incurred will be charged against the Contractor's Surety.

12-06 EROSION CONTROL MATERIALS

A. Temporary Erosion and Sedimentation Control Materials:

- 1) Silt Fence
 - a) Silt fence shall be polymer type netting with a built-in cord running throughout the top edge of the fabric. Posts shall be either steel or pressure treated fir, southern pine or hemlock and shall be spaced not more than six feet on center. Silt fence shall be provided with netting to provide reinforcing when necessary. Silt fence fabric shall have an Equivalent Opening Size (EOS) of 40 to 100. Silt fence fabric shall have a maximum permeability of 40 gallons per minute per square foot.
 - b) Silt fence fabric shall be equal to Mirafi 100X, Amoco 1380 or Exxon GTF-100 Series.
- 2) Hay bales shall be clean, seedfree cereal hay type.
- 3) Netting shall be ½-inch, galvanized steel, chicken wire mesh.

- 4) Filter stone shall be coarse aggregate conforming to South Carolina Department of Highways and Public Transportation, Aggregate Number CR-14.
- 5) Concrete block shall be hollow, non-load-bearing type.
- 6) Plywood shall be ¾-inch thick exterior type.

B. Sediment Tubes

C. Rip-Rap

- 1) Use only one method throughout the job.
- 2) Stone Rip Rap: Use sound, tough, durable stones resistant to the action of air and water. Slabby or shaley pieces will not be acceptable. Unless shown or specified otherwise, stone rip rap shall be Type 1 rip rap.
 - a) Type 1 Rip Rap: Stone pieces shall range in weight from a minimum of 25 pounds to a maximum of 250 pounds. At least 60 percent of the stone pieces shall weigh more than 150 pounds. Rip rap shall conform to South Carolina Department of Highways and Public Transportation Standard Specifications 804.04.
 - b) Type 2 Rip Rap: Stone shall vary in size with no pieces weighing more than 150 pounds. At least 20 percent of the stone pieces, excluding spalls, shall weigh more than 60 pounds, and no more than 20 percent of the stone pieces, excluding spalls, shall weigh less than 25 pounds. Rip rap size shall conform to South Carolina Department of Highways and Public Transportation Standard Specifications 804.03.
 - c) 200 Pound Rip Rap: Minimum weight of individual stones shall be 200 pounds.
- 3) Sand-Cement Bag Rip Rap
 - a) The bags shall be of cotton, burlap or fiber reinforced paper capable of containing the sand-cement mixture without leakage during handling and placing. Bags previously used for sugar or any other material which will adversely affect the sand-cement mixture shall

not be used. Capacity shall be not less than 0.75 cubic foot, nor more than two cubic feet.

- b) Sand and Portland cement shall be mixed at the maximum ratio of 5:1 by weight and shall obtain a minimum compressive strength of 500 psi in seven days. For sand-cement bag rip rap, the amount of water used shall be just enough to make up the optimum moisture content of the aggregate and cement, as determined by ASSHTO T 134. When sand-cement rip rap is to be pre-bagged, the sand-cement shall be mixed dry, and after placing each course, the bags shall be wet until sufficient moisture is present for proper cement hydration.

D. Filter Fabric

- 1) The filter fabric for use under rip rap shall be a monofilament, polypropylene woven fabric meeting the specifications as established by Task Force 25 for the Federal Highway Administration. The filter fabric shall have an equivalent opening size (EOS) of 70.
- 2) Filter fabric under rip rap shall be equal to Mirafi, Amoco or Exxon.

E. Concrete

- 1) Concrete shall have a compressive strength of not less than 3,000 psi, with not less than 5.5 bags of cement per cubic yard and a slump between 3 and 5 inches. Ready-mixed concrete shall be mixed and transported in accordance with ASTM C 94. Reinforcing steel shall conform to the requirements of ASTM A 615, Grade 60.
- 2) Provide a concrete mix design for job mixed concrete for the Engineer's approval.

F. Gabions

- 1) Gabions shall be large, multi-celled, rectangular wire mesh boxes filled with rip rap to prevent erosion, scour or sloughing of an embankment. Gabions shall have the following features.
 - a) Hexagonal mesh pattern, which under stress will deform but not break.
 - b) Triple twist, which will make the mesh non-raveling.
 - c) Reinforcing wires woven into each corner, which will increase the strength at the stress points and help the gabion retain its shape, during and after filling.

- d) A diaphragm securely attached to the base, which will prevent the shifting of the stone, and at the same time, reinforce the gabion.
- 2) The wire mesh shall have an opening of approximately 3 x 4-inches and shall be a minimum 12 gauge. Wire mesh shall be galvanized.
- 3) Gabion baskets shall be 12 feet long x 3 feet high with four cells.
- 4) Gabions shall be equal to Maccaferri Gabions, Inc.

12-07 EROSION CONTROL INSTALLATION

A. General

- 1) Standards: Provide all materials and promptly take all actions necessary to achieve effective erosion and sedimentation control in accordance with the standards listed above, local enforcing agency guidelines and these Specifications.
- 2) Implementation: The work shown on the approved plans and working drawings shall be considered a minimum requirement. What is shown shall not relieve the Contractor of the responsibility to actively take all steps necessary to control soil erosion and sedimentation.

B. Temporary Erosion and Sedimentation Control

- 1) Temporary erosion and sedimentation control procedures should be initially directed toward preventing silt and sediment from entering the creeks. The preferred method is to provide an undisturbed natural buffer, extending a minimal 5 feet from the top of the bank, to filter the run-off. Should this buffer prove infeasible due to construction activities being too close to the creek, or if the amount of sediment overwhelms the buffer, the Contractor shall place silt fences to filter the run-off and, if necessary, place permanent rip rap to stabilize the creek banks. When excavation activities disturb the previously stated preventative measures, or if they are not maintained, or whenever the construction activities cross the creeks, check dams shall be installed downstream and within 200 feet of the affected area.
- 2) Silt dams, silt fences, traps, barriers, check dams, appurtenances and other temporary measures and devices shall be installed as indicated on the approved plans and working drawings, shall be maintained until no longer needed, and shall then be removed. Deteriorated hay bales and dislodged filter stone shall be replaced with new materials. Detention ponds, if

constructed, shall be maintained in a condition ensuring that unfiltered water will not leave the pond.

- 3) Where temporary grassing is not appropriate, and where the Contractor's temporary erosion and sedimentation control practices are inadequate, the Engineer may direct the Contractor to provide temporary vegetative cover with fast growing seedings. Such temporary vegetative cover provided by the Contractor in compliance with the Best Management Practices of the Erosion and Sediment Control Practices for Developing Areas, specifically in the selection of species, planting dates and application rates for seedings, fertilizer and mulching, with the exception that kudzu shall not be permitted.
- 4) All erosion and sedimentation control devices, including check dams, shall be inspected by the Contractor at least weekly and after each rainfall occurrence and cleaned out and repaired by the Contractor as necessary.
- 5) Temporary erosion and sedimentation control devices shall be installed and maintained from the initial land disturbance activity until the satisfactory completion and establishment of permanent erosion control measures. At that time, temporary devices shall be removed.

C. Permanent Erosion Control: Permanent erosion control shall include:

- 1) Restoring the work site to its original contours, unless shown otherwise on the Drawings or directed by the Engineer.
- 2) Permanent vegetative cover shall be performed in accordance with "Grassing" below and prior sections 12-02 and 12-03.
- 3) Permanent stabilization of steep slopes and creeks shall be performed in accordance with "Rip Rap" of this Section.
- 4) Permanent erosion control measures shall be implemented as soon as practical after the completion of pipe installation or land disturbance for each segment of the Project. In no event shall implementation be postponed when no further activities related to pipe installation will impact that portion or segment of the Project. Partial payment requests may be withheld for those portions of the Project not complying with this requirement.

D. Grassing

- 1) General
 - a) All references to grassing, unless noted otherwise, shall relate to establishing permanent vegetative cover as specified herein for seeding, fertilizing, mulching, etc.

- b) When final grade has been established, all bare soil, unless otherwise required by the Contract Documents, shall be seeded, fertilized and mulched in an effort to restore to a protected condition. Critical areas shall be sodded as approved or directed by the Engineer.
 - c) Specified permanent grassing shall be performed at the first appropriate season following establishment of final grading in each section of the site.
 - d) Permanent grassing shall be of perennial species.
- 2) Replant grass removed or damaged in residential areas using the same variety of grass and at the first appropriate season. Where sod is removed or damaged, replant such areas using sod of the same species of grass at the first appropriate season. Outside of residential or landscaped areas, grass the entire area disturbed by the work on completion of work in any area. In all areas, promptly establish successful stands of grass.
 - 3) Grassing activities shall comply with the Best Management Practices of the Erosion and Sediment Control Practices for Developing Areas, specifically for the selection of species, with the exception that kudzu shall not be permitted, planting dates and application rates for seeding, fertilizer and mulching. Where permanent vegetative cover (grassing) cannot be immediately established (due to season or other circumstances) the Contractor shall provide temporary vegetative cover.

E. Rip-Rap

- 1) Unless shown otherwise on the Drawings, rip rap shall be placed where ordered by the Engineer, at all points where banks of streams or drainage ditches are disturbed by excavation, or at all points where their natural vegetation is removed. Carefully compact backfill and place rip rap to prevent subsequent settlement and erosion. This requirement applies equally to construction along side of stream or drainage ditch as well as crossing a stream or drainage ditch.
- 2) When trenching across a creek, place rip rap a distance of 10 feet upstream and 10 feet downstream from the top of the trench excavation. Place rip rap across creek bottom, across creek tanks and extend rip rap placement five feet beyond the top of each creek bank.
- 3) Preparation of Foundations: The ground surface upon which the rip rap is to be placed shall be brought in reasonably close conformity to the correct lines and grades before placement is commenced. Where filling of depressions is required, the new material shall be compacted with hand or mechanical

tampers. Unless at creek banks or otherwise shown or specified, rip rap shall begin in a toe ditch constructed in original ground around the toe of the fill or the cut slope. The toe ditch shall be two feet deep in original ground, and the side next to the fill or cut shall have that same slope. After the rip rap is placed, the toe ditch shall be backfilled and the excess dirt spread neatly within the construction easement.

- 4) Placement of Filter Fabric: The surface to receive fabric shall be prepared to a relatively smooth condition free from obstructions, depressions and debris. The fabric shall be placed with the long dimension running up the slope and shall be placed to provide a minimum number of overlaps. The strips shall be placed to provide a minimum width of one foot of overlap for each joint. The filter fabric shall be anchored in place with securing pins of the type recommended by the fabric manufacturer. Pins shall be placed on or within 3-inches of the centerline of the overlap. The fabric shall be placed so that the upstream strip overlaps the downstream strip. The fabric shall be placed loosely so as to give and therefore avoid stretching and tearing during placement of the stones. The stones shall be dropped no more than three feet during construction. The fabric shall be protected at all times during construction. The fabric shall be protected at all times during construction from clogging due to clay, silts, chemicals or other contaminants. Any contaminated fabric or any fabric damaged during its installation or during placement of rip rap shall be removed and replaced with uncontaminated and undamaged fabric at no expense to the Owner.
- 5) Placement of Rip Rap: The rip rap shall be placed on a 6-inch layer of soil, crushed stone or sand overlaying the filter fabric. This 6-inch layer shall be placed to maximize the contact between the soil beneath the filter fabric and the filter fabric. Rip rap shall be placed with its top elevation conforming with the natural slope of the stream bank and stream bottom.
 - a) Stone Rip Rap: Stone rip rap shall be dumped into place to form a uniform surface and to the thickness specified on the Drawings. The thickness tolerance for the course shall be 6-inches and +12-inches. If the Drawings or Bid do not specify a thickness, the course shall be placed to a thickness of not less than 18-inches.
 - b) Sand-Cement Bag Rip Rap: The bags shall be uniformly filled to the maximum capacity which will permit satisfactory tying. The bagged rip rap shall be placed by hand with the tied ends facing the same direction, with close, broken joints. When directed by the Engineer or required by the Drawings, header courses shall be placed. After placing, the bags shall be rammed or packed against one another to produce the required thickness and form a consolidated mass. The top of each bag shall not vary more than 3-inches above or below the required plane.

6) Gabions

- a) Where, in the opinion of the Engineer, the slope of the banks of the stream is too steep to support rip rap, gabions shall be provided in lieu of rip rap.
- b) Gabions shall be assembled according to the manufacturer's recommendations. Laterally adjoining gabions shall be wired together by vertical edges. Vertically adjoining gabions shall be wired together along the front and back edges. Rip rap size for gabion construction shall be large enough not to fall out of gabions, but small enough to form three layers. Gabions shall be placed over a 6-inch layer of soil, crushed stone or sand overlaying a filter fabric. This 6-inch layer shall be placed to maximize the contact between the soil beneath the filter fabric and filter fabric.

SECTION 13

WARRANTY

13-01 GENERAL WARRANTY FOR ONE YEAR AFTER COMPLETION

For a period of at least one year after Spartanburg Water System's Final Inspection, the Contractor warrants the fitness and soundness of all work done and materials and equipment put in place under the contract and neither the final certificate of payment nor any provision in the contract documents nor partial or entire occupancy of the premises by the Owner shall constitute an acceptance of work not done in accordance with the contract documents or relieve the Contractor of liability in respect to any express warranties of responsibility for faulty materials or workmanship. The Contractor shall remedy any defects in the work and pay for any damage to other work resulting therefrom, which shall appear within a period of one year from the date of final acceptance of the work unless a longer period is specified.

A second SWS inspection will be conducted 10 months after the date of acceptance of the project. The Owner will be notified of observed defects after the "10-month" inspection is conducted. The contractor will correct any defects prior to the expiration of the one-year warranty.

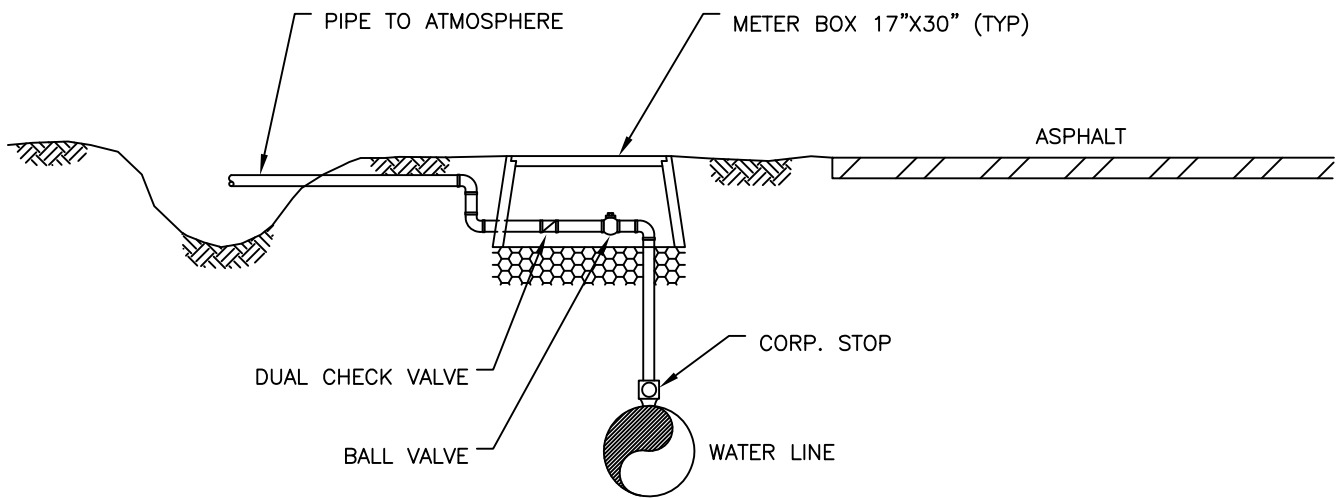
- A. If in fulfilling the requirements of the contract or of any guarantee embraced therein or required thereby, the Contractor disturbs any work guaranteed under another contract, he shall restore such disturbed work to a condition satisfactory to the Engineer, and shall guarantee such restored work to the same extent as it was guaranteed under such other contract.
- B. If the Contractor, after notice, fails to proceed promptly to comply with the terms of the guarantee, the Owner may have the defects corrected and the Contractor and his Surety shall be liable for all expenses incurred.
- C. All special guarantees applicable to definite parts of the work that may be stipulated in the specifications or other papers forming a part of the Contract shall be subject to the terms of this paragraph during the first year of the life of such special guarantee.

13-02 MAINTENANCE

In addition to the guarantee stipulated in the Contract, each Contractor shall fully maintain all work performed under his contract for sixty (60) days after final completion and acceptance of the work. The retained percentage of contract payments shall not be due until after the 60 days maintenance period, except that the Owner may at his discretion release such retainer earlier.

Appendix A

Standard Construction Details



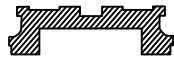
NOTE
 1- SEE WATER SERVICE CONNECTION SECTION OF TECHNICAL SPECIFICATIONS FOR PIPE MATERIAL.

THE INTENT OF THIS DETAIL IS TO CLARIFY AND NOT SUPERSEDE OR MODIFY THE SPECIFIC REQUIREMENTS AS LISTED IN THE SPECIFICATIONS

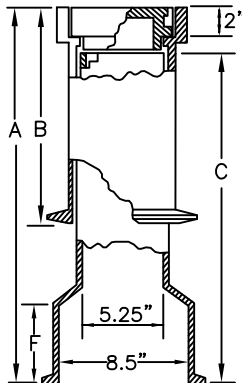


TYPICAL PERMANENT BLOW-OFF

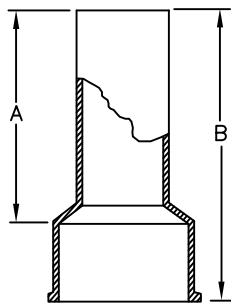
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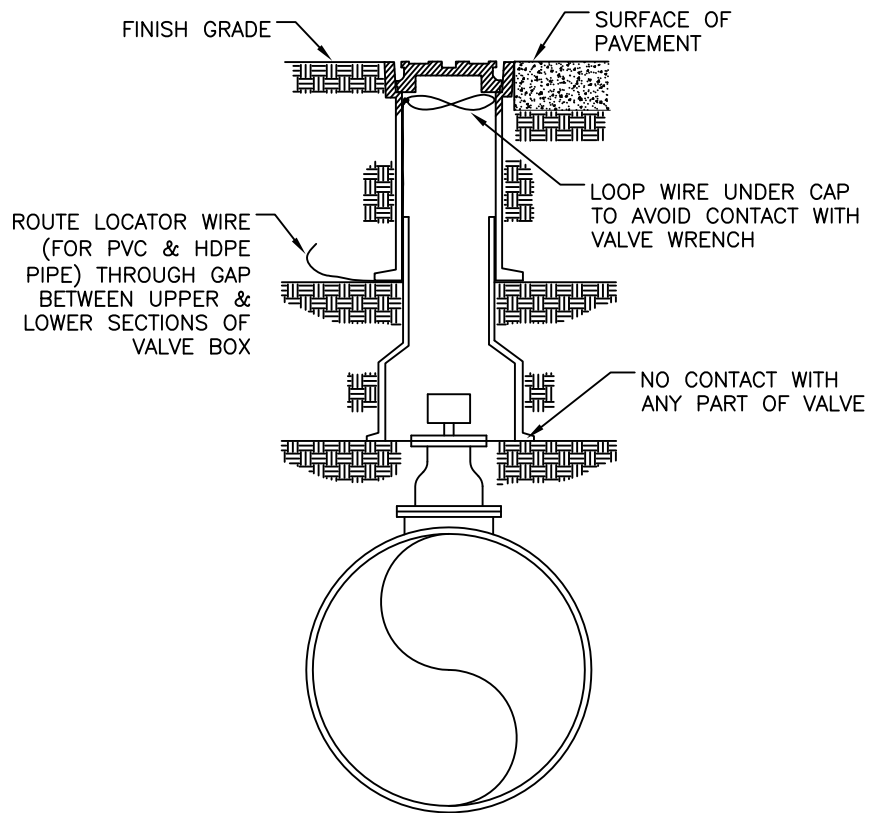
VALVE BOX LID
NTS



VALVE BOX



EXTENSION



VALVE BOX
NTS

VALVE BOX & EXTENSIONS SHALL BE BINGHAM & TAYLOR. SEE CHART BELOW FOR SIZES

Size No.	Extension Range-A	Top Section & Cover			Bottom Section			Height Bell-F	Wt.	
		No.	Dim. B	Wt.	No.	Dim. C	Wt.			
5461-S	18-24	54-S	10.5	35.0	61-S	15.0	24.0	6.5	59.0	
5561-S	23-29	55-S	15.5	42.0	61-S	15.0	24.0	6.5	65.1	
5562-S	27-36	55-S	15.5	42.0	62-S	24.5	33.0	6.5	75.0	
5564-S	39-48	55-S	15.5	42.0	64-S	36.0	46.0	8.5	88.0	
5662-S	38-48	56-S	26.5	57.0	62-S	24.5	33.0	6.5	90.0	
5664-S	39-60	56-S	26.5	57.0	64-S	36.0	46.0	8.5	103.0	
5468-S	63-68	Longer Boxes Made By Adding Extensions to No.5664-S								
5568-S	63-73									
5668-S	63-84									

VALVE BOXES

Size No.	Increases Length A	Overall Length B	Wt.
63-E	9.0	13.0	20.0
64-E	14.0	18.0	23.0
65-E	20.0	24.0	31.5
66-E	24.0	30.0	36.5
67-E	30.0	36.0	46.0

EXTENSIONS

THE INTENT OF THIS DETAIL IS TO CLARIFY AND NOT SUPERSEDE OR MODIFY THE SPECIFIC REQUIREMENTS AS LISTED IN THE SPECIFICATIONS

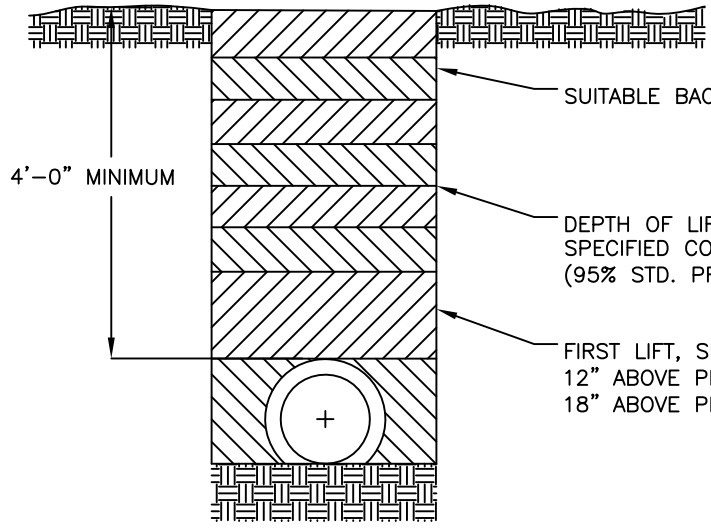


TYPICAL
VALVE BOX

SCALE: NTS

REVISION DATE: 11/07/2016

EXISTING GROUND



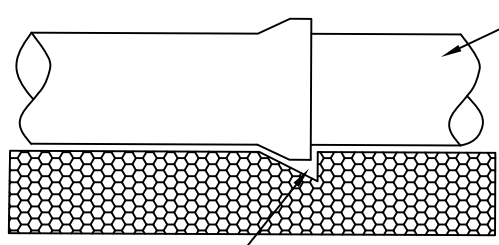
SUITABLE BACKFILL

4'-0" MINIMUM

DEPTH OF LIFTS TO ACHIEVE SPECIFIED COMPACTION (95% STD. PROCTOR, MINIMUM)

FIRST LIFT, SELECTED BACKFILL MINIMUM OF 12" ABOVE PIPE (MECHANICAL TAMP) 18" ABOVE PIPE (MOBILE TAMP)

See Specs for Trench Width Based on Diameter of Pipe



PIPE MAY BE BEDDED DIRECTLY ON NATIVE SOIL UNLESS OVER-EXCAVATION HAS OCCURRED IN WHICH CASE AGGREGATE BEDDING MAY BE REQUIRED.

NATIVE MATERIAL OR #57 STONE AS REQUIRED

BELL HOLES REQUIRED. PIPE TO BE CONTINUOUSLY SUPPORTED ALONG LENGTH OF BARREL EXCEPT AT BELL

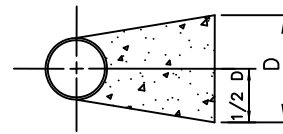
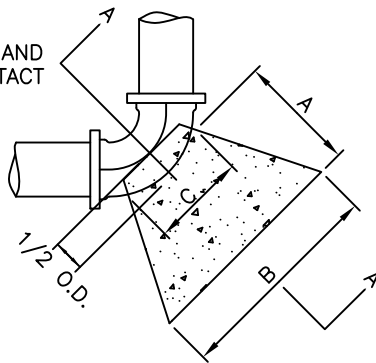
THE INTENT OF THIS DETAIL IS TO CLARIFY AND NOT SUPERSEDE OR MODIFY THE SPECIFIC REQUIREMENTS AS LISTED IN THE SPECIFICATIONS



TYPICAL TRENCHING DETAIL

SCALE: NTS REVISION DATE: 11/07/2016

PROTECT GLANDS AND BOLTS FROM CONTACT WITH CONCRETE



SECTION A-A

MINIMUM DIMENSIONS FOR CONCRETE BLOCKING

BEND	SIZE	A	B	C	D	VOLUME CY
11 1/4°	6"	1'-0"	2'-0"	4"	1'-0"	0.05
	8"	1'-0"	2'-0"	5"	1'-0"	0.05
	10"	1'-0"	2'-0"	6"	1'-0"	0.05
	12"	1'-0"	2'-0"	7"	1'-0"	0.05
	14"	2'-0"	2'-0"	11"	1'-6"	0.16
	16"	1'-0"	2'-0"	1'-0"	2'-0"	0.22
	20"	2'-0"	3'-0"	1'-3"	2'-0"	0.32
	24"	2'-0"	3'-0"	1'-6"	3'-0"	0.50
22 1/2°	6"	1'-0"	2'-0"	6"	1'-0"	0.05
	8"	1'-0"	2'-0"	7"	1'-0"	0.05
	10"	1'-0"	2'-0"	8"	1'-6"	0.08
	12"	1'-0"	2'-0"	10"	2'-0"	0.11
	14"	2'-0"	3'-0"	11"	2'-0"	0.29
	16"	2'-0"	4'-0"	1'-0"	2'-0"	0.37
	20"	2'-0"	4'-0"	1'-3"	3'-0"	0.58
	24"	3'-0"	4'-6"	1'-6"	4'-0"	1.33
45°	6"	1'-0"	2'-0"	6"	1'-0"	0.05
	8"	1'-0"	2'-0"	7"	2'-0"	0.10
	10"	2'-0"	3'-0"	9"	2'-0"	0.28
	12"	2'-0"	3'-0"	11"	3'-0"	0.44
	14"	2'-0"	4'-0"	11"	3'-0"	0.55
	16"	3'-0"	5'-0"	1'-0"	3'-0"	1.00
	20"	4'-0"	6'-0"	1'-3"	4'-0"	2.15
	24"	4'-0"	7'-0"	1'-6"	5'-0"	3.15
90°	6"	1'-0"	2'-0"	1'-0"	2'-0"	0.11
	8"	2'-0"	3'-0"	1'-2"	2'-6"	0.37
	10"	2'-6"	3'-9"	1'-6"	3'-0"	0.72
	12"	2'-0"	4'-0"	2'-0"	4'-0"	0.84
	14"	3'-0"	5'-0"	2'-0"	4'-6"	1.71
	16"	4'-0"	6'-0"	2'-2"	4'-9"	2.84
	20"	4'-0"	7'-0"	2'-8"	6'-4"	4.51
	24"	5'-0"	8'-0"	3'-4"	8'-0"	8.40
TEES & PLUGS	6"	1'-0"	2'-0"	10"	1'-6"	0.08
	8"	1'-9"	2'-6"	1'-1"	2'-0"	0.23
	10"	2'-0"	4'-0"	1'-3"	2'-0"	0.41
	12"	2'-6"	3'-9"	1'-7"	3'-0"	0.75
	14"	3'-0"	5'-0"	2'-0"	3'-0"	1.17
	16"	3'-0"	5'-0"	2'-2"	4'-0"	1.59
	20"	4'-0"	6'-0"	2'-8"	5'-0"	3.21
	24"	6'-0"	9'-0"	3'-4"	5'-0"	6.85

DESIGN DATA:

- DIMENSIONS OF THRUST BLOCK IN FEET BASED ON 2000 POUNDS PER SQUARE FOOT SOIL BEARING PRESSURE AND 200 POUNDS PER SQUARE INCH TEST PRESSURE. ACTUAL INSIDE DIAMETER OF DUCTILE IRON PIPE, CLASS 51 USED AS STANDARD.
- FOR 3" & 4" PIPE, USE 6" SIZES.
- SIZES SHALL BE DETERMINED BY SPARTANBURG WATER ENGINEERING DEPARTMENT FOR PIPES LARGER THAN 24".

NOTE

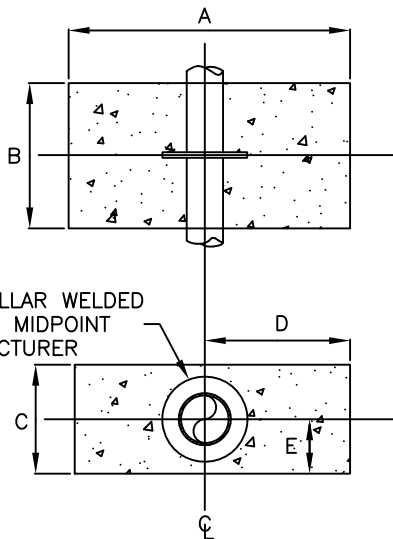
- 1- CONCRETE THRUST BLOCK SHALL BE POURED AGAINST UNDISTURBED SOIL.
- 2- SOIL CONDITIONS SHALL BE VERIFIED BY SPARTANBURG WATER ENGINEERING DEPARTMENT BEFORE DESIGN IS IMPLEMENTED.
- 3- CONCRETE SHALL HAVE A MINIMUM COMPRESSIVE STRENGTH OF 3,000 P.S.I.

THE INTENT OF THIS DETAIL IS TO CLARIFY AND NOT SUPERSEDE OR MODIFY THE SPECIFIC REQUIREMENTS AS LISTED IN THE SPECIFICATIONS



CONCRETE
THRUST BLOCK
DETAIL

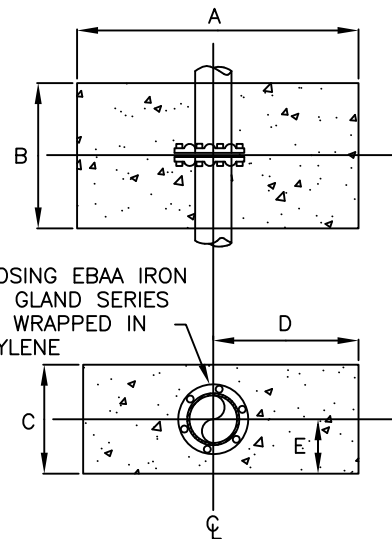
SCALE: NTS REVISION DATE: 11/07/2016



TOP VIEW

FRONT VIEW

DETAIL "A"



(2) OPPOSING EBAA IRON
MEGALUG GLAND SERIES
1100SDB WRAPPED IN
POLYETHYLENE

DETAIL "B"

PIPE SIZE	A	B	C	D	E	CY.	WELDED THRUST COLLAR MINIMUM RATING
4"	3'-0"	2'-0"	1'-6"	1'-6"	0'-8"	0.33	4,500 lbs
6"	4'-0"	2'-0"	1'-6"	2'-0"	0'-9"	0.44	9,300 lbs
8"	4'-6"	2'-0"	2'-0"	2'-3"	1'-0"	0.67	16,000 lbs
12"	6'-0"	2'-0"	3'-0"	3'-0"	1'-6"	1.33	34,000 lbs
16"	6'-6"	2'-0"	4'-6"	3'-3"	2'-3"	2.17	59,000 lbs

NOTE

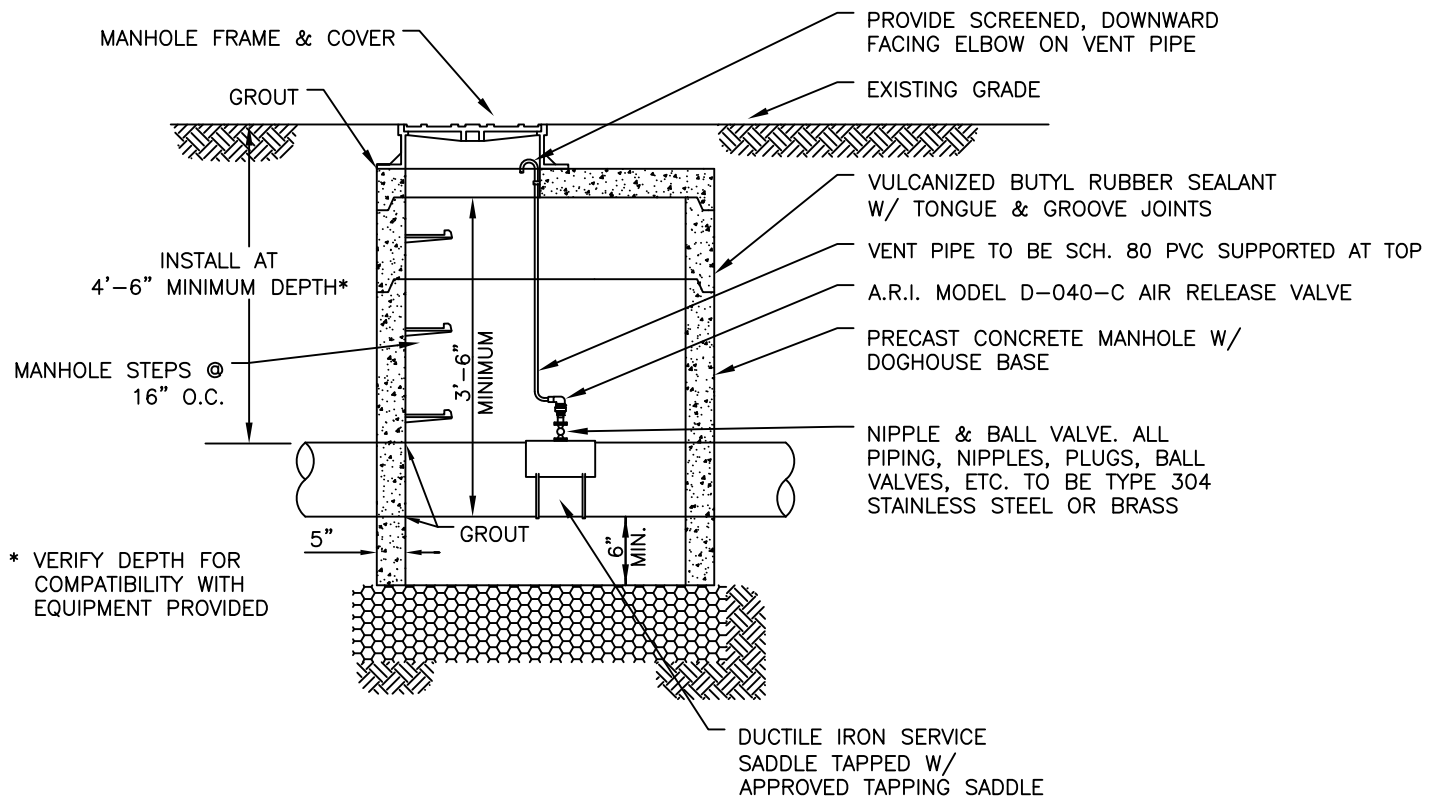
- 1- DIMENSIONS OF CONCRETE COLLARS BASED ON 2000 P.S.F. SOIL BEARING.
- 2- CONCRETE SHALL HAVE A MINIMUM COMPRESSIVE STRENGTH OF 3,000 P.S.I.
- 3- SOIL CONDITIONS SHALL BE VERIFIED BY SPARTANBURG WATER ENGINEERING DEPARTMENT BEFORE DESIGN IS IMPLEMENTED.
- 4- FOR 3" PIPE, USE 4" DIAMETER THRUST RATING.
- 5- NOT TO BE USED ON CAST IRON.

THE INTENT OF THIS DETAIL IS TO CLARIFY AND NOT SUPERSEDE OR MODIFY THE SPECIFIC REQUIREMENTS AS LISTED IN THE SPECIFICATIONS

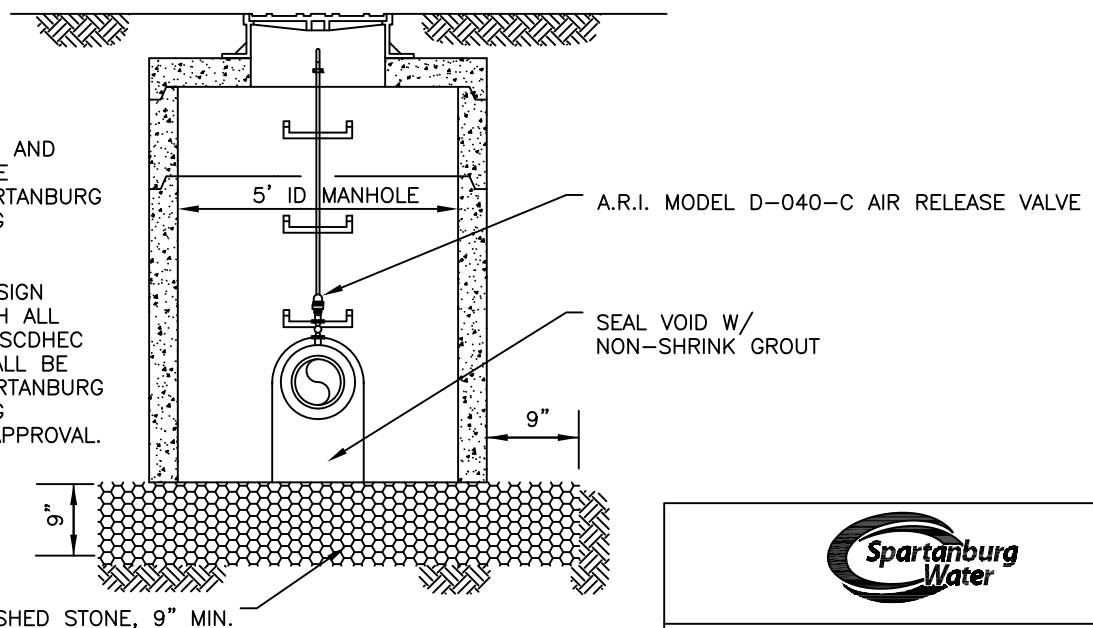


TYPICAL DIP
CONCRETE COLLAR
DETAIL

SCALE: NTS REVISION DATE: 11/07/2016



- NOTE**
- 1- AIR RELEASE VALVE AND PIPING SIZES TO BE APPROVED BY SPARTANBURG WATER ENGINEERING DEPARTMENT.
 - 2- ANY ALTERNATE DESIGN SHALL COMPLY WITH ALL REQUIREMENTS OF SCDHEC R. 61-58 AND SHALL BE SUBMITTED TO SPARTANBURG WATER ENGINEERING DEPARTMENT FOR APPROVAL.

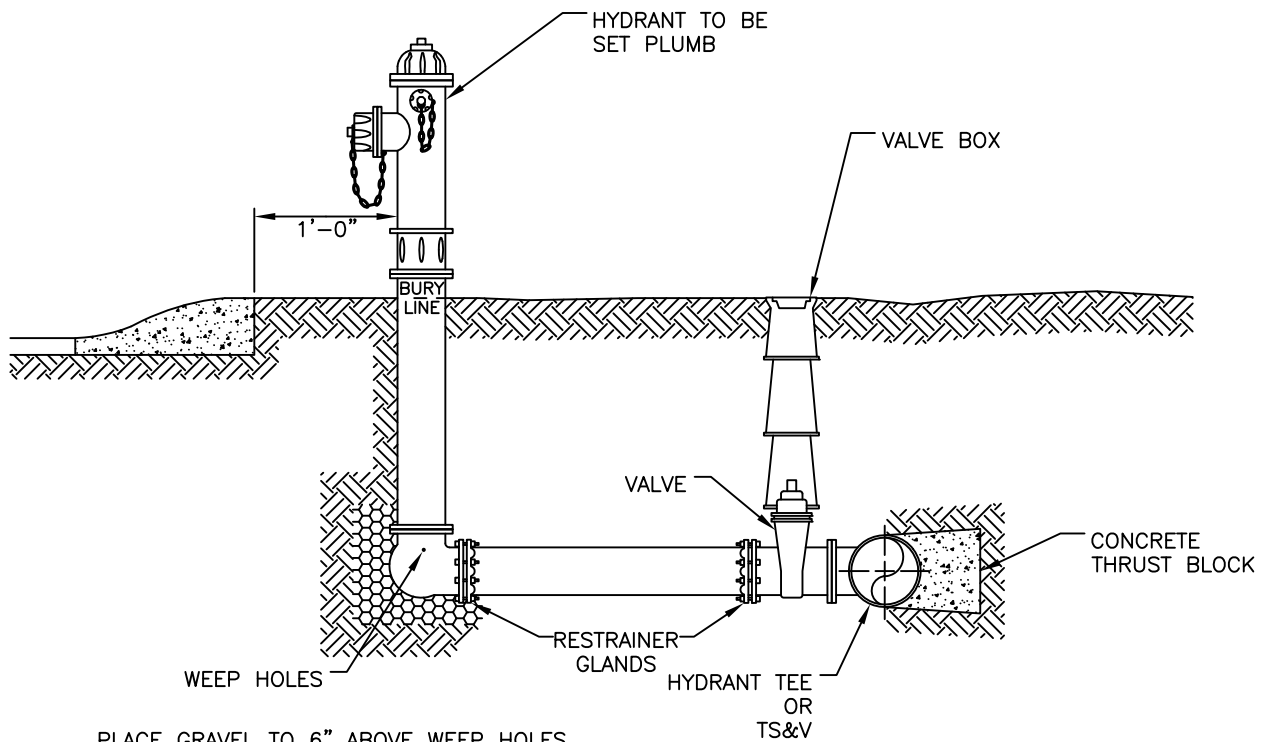


THE INTENT OF THIS DETAIL IS TO CLARIFY AND NOT SUPERSEDE OR MODIFY THE SPECIFIC REQUIREMENTS AS LISTED IN THE SPECIFICATIONS

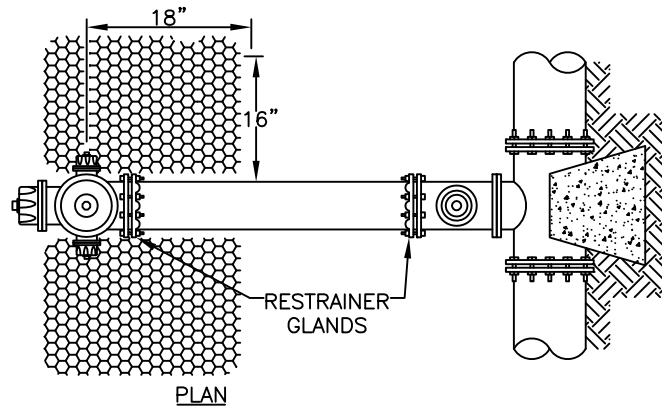


WATER MAIN
AIR RELEASE VALVE
AND MANHOLE

SCALE: NTS REVISION DATE: 11/07/2016



PLACE GRAVEL TO 6" ABOVE WEEP HOLES, 18" BELOW WEEP HOLES AND 18" TOWARDS THE MAIN. ALSO 16" Laterally ON EACH SIDE.



NOTE

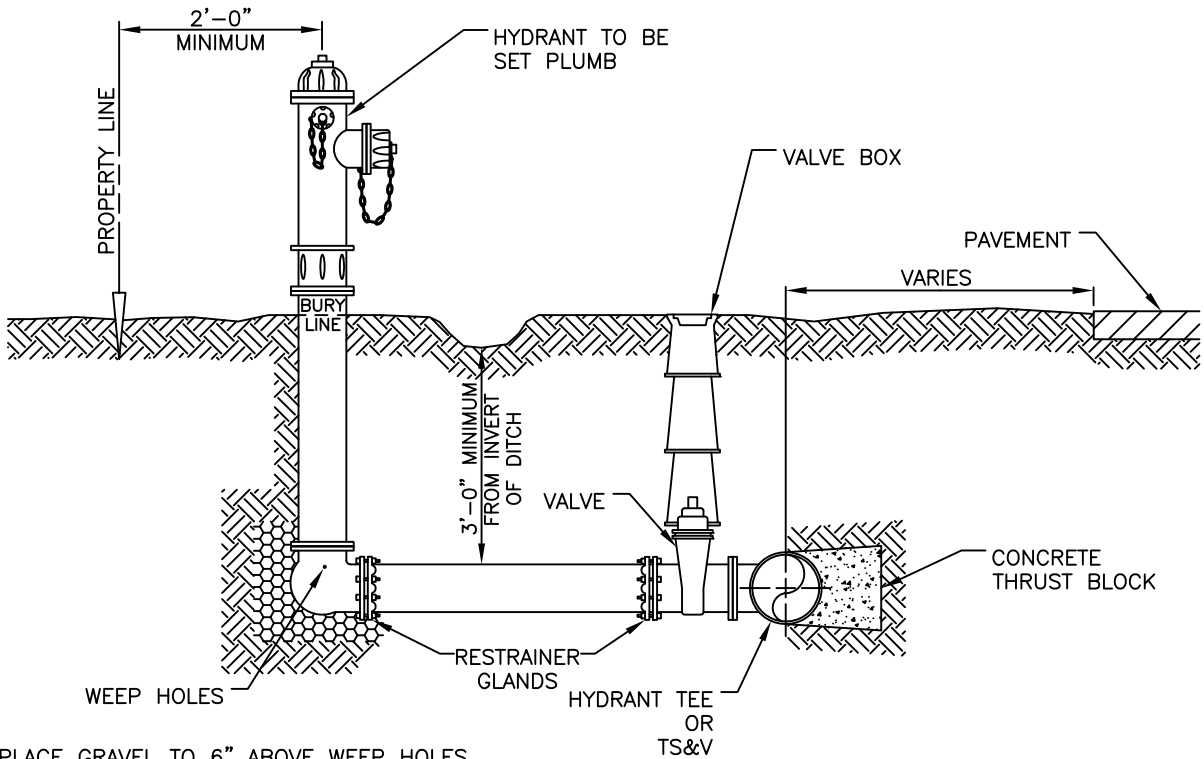
1- RODS AND BLOCKING MAY BE USED IN LIEU OF APPROVED RESTRAINER GLANDS. SEE STANDARD SPECIFICATIONS FOR ROD AND BLOCKING INFORMATION.

THE INTENT OF THIS DETAIL IS TO CLARIFY AND NOT SUPERSEDE OR MODIFY THE SPECIFIC REQUIREMENTS AS LISTED IN THE SPECIFICATIONS

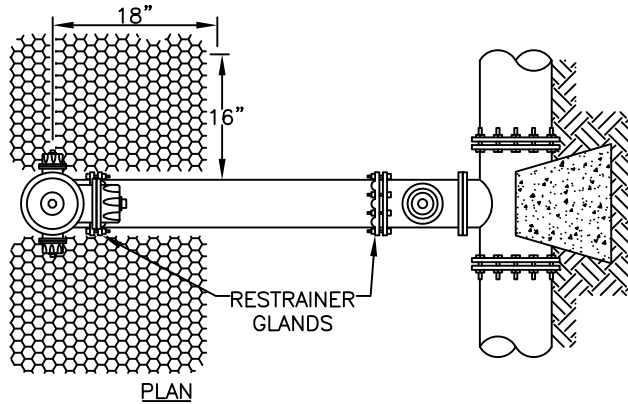


TYPICAL
HYDRANT INSTALLATION
(WITH CURB)

SCALE: NTS REVISION DATE: 11/07/2016



PLACE GRAVEL TO 6" ABOVE WEEP HOLES, 18" BELOW WEEP HOLES AND 18" TOWARDS THE MAIN. ALSO 16" Laterally ON EACH SIDE.



NOTE

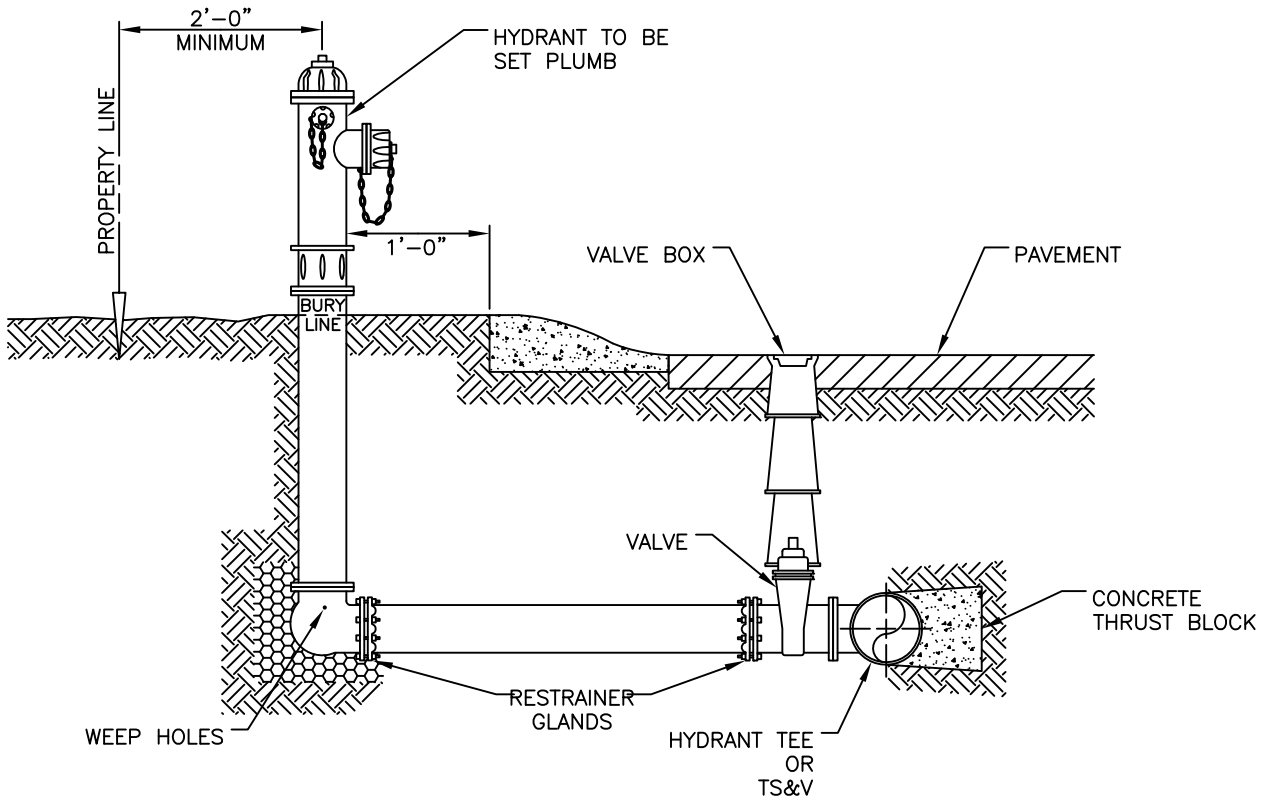
1- RODS AND BLOCKING MAY BE USED IN LIEU OF APPROVED RESTRAINER GLANDS. SEE STANDARD SPECIFICATIONS FOR ROD AND BLOCKING INFORMATION.

THE INTENT OF THIS DETAIL IS TO CLARIFY AND NOT SUPERSEDE OR MODIFY THE SPECIFIC REQUIREMENTS AS LISTED IN THE SPECIFICATIONS

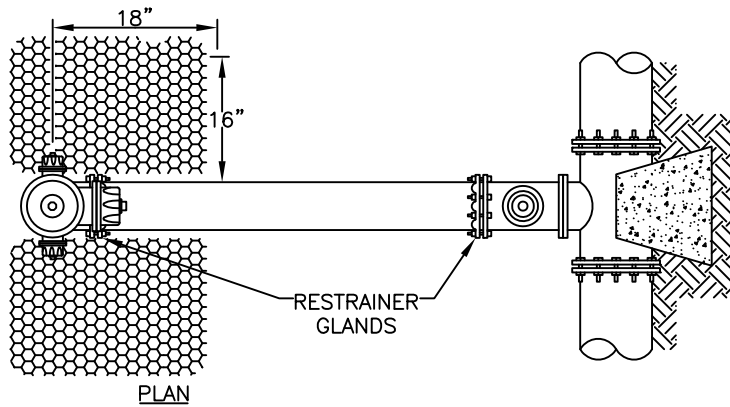


*TYPICAL
HYDRANT INSTALLATION
(WITHOUT CURB)*

SCALE: NTS REVISION DATE: 11/07/2016



PLACE GRAVEL TO 6" ABOVE WEEP HOLES, 18" BELOW WEEP HOLES AND 18" TOWARDS THE MAIN. ALSO 16" Laterally ON EACH SIDE.



NOTE

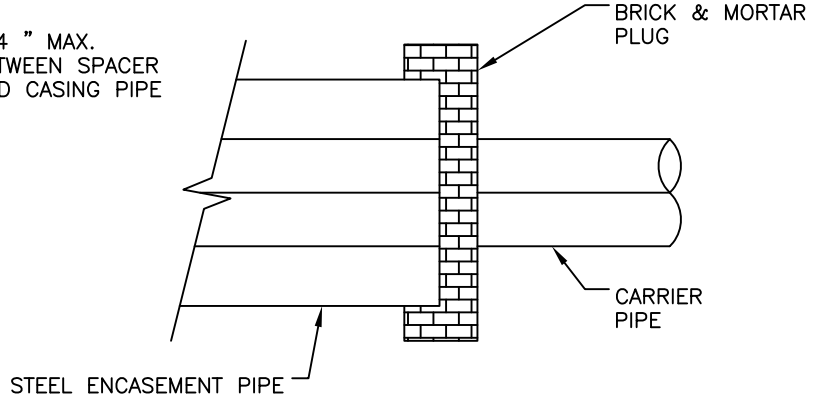
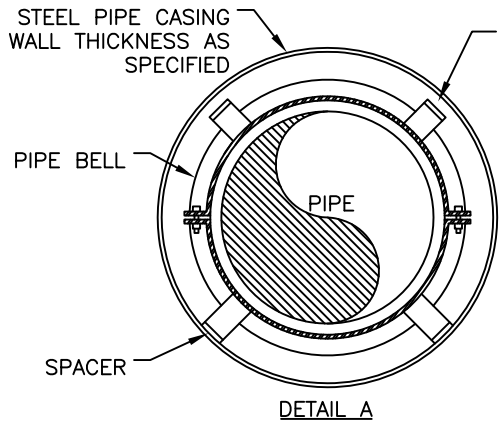
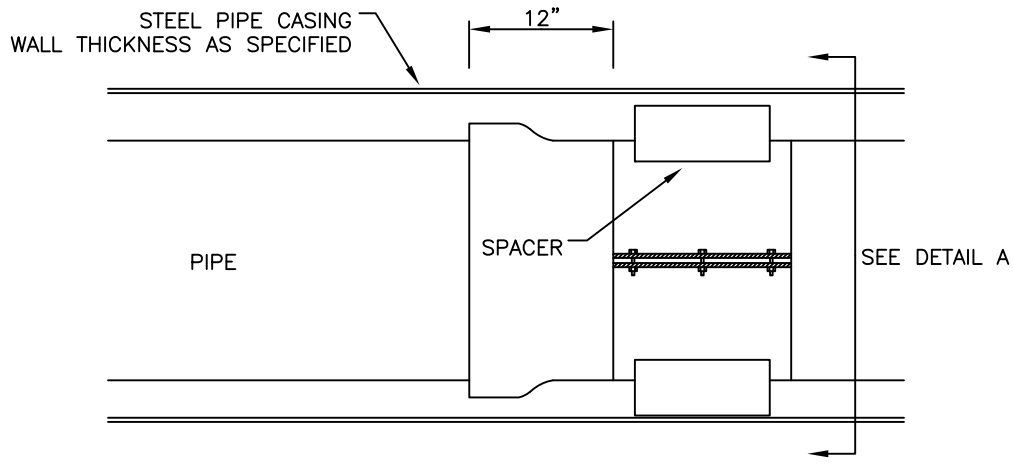
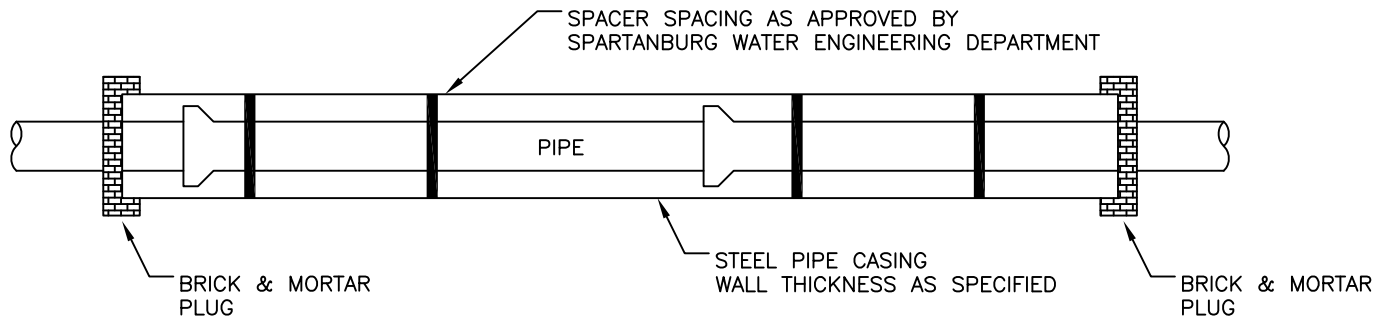
1- RODS AND BLOCKING MAY BE USED IN LIEU OF APPROVED RESTRAINER GLANDS. SEE STANDARD SPECIFICATIONS FOR ROD AND BLOCKING INFORMATION.

THE INTENT OF THIS DETAIL IS TO CLARIFY AND NOT SUPERSEDE OR MODIFY THE SPECIFIC REQUIREMENTS AS LISTED IN THE SPECIFICATIONS



*TYPICAL
HYDRANT INSTALLATION
(WITH WATER MAIN IN PAVEMENT)*

SCALE: NTS REVISION DATE: 11/07/2016



PIPE SIZE	MINIMUM CASING SIZE	MIN. CASING THICKNESS
6"	12"	0.188"
8"	16"	0.250"
12"	20"	0.281"
16"	24"	0.344"
20"	28"	0.406"
24"	32"	0.438"

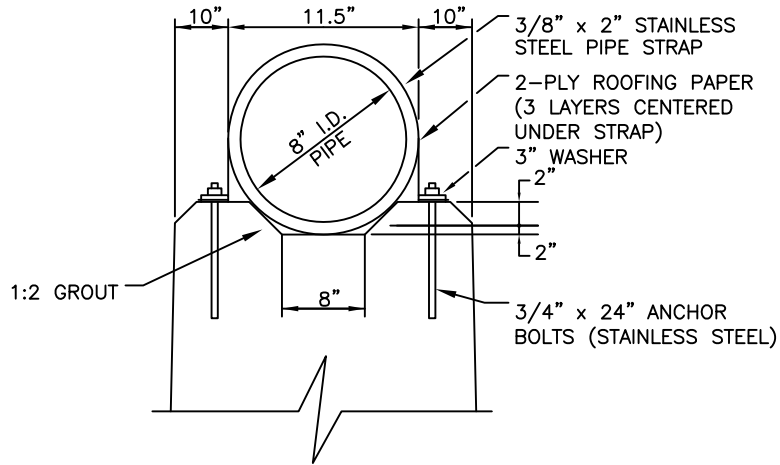
SEE SPECIFICATIONS FOR ADDITIONAL SIZES

THE INTENT OF THIS DETAIL IS TO CLARIFY AND NOT SUPERSEDE OR MODIFY THE SPECIFIC REQUIREMENTS AS LISTED IN THE SPECIFICATIONS

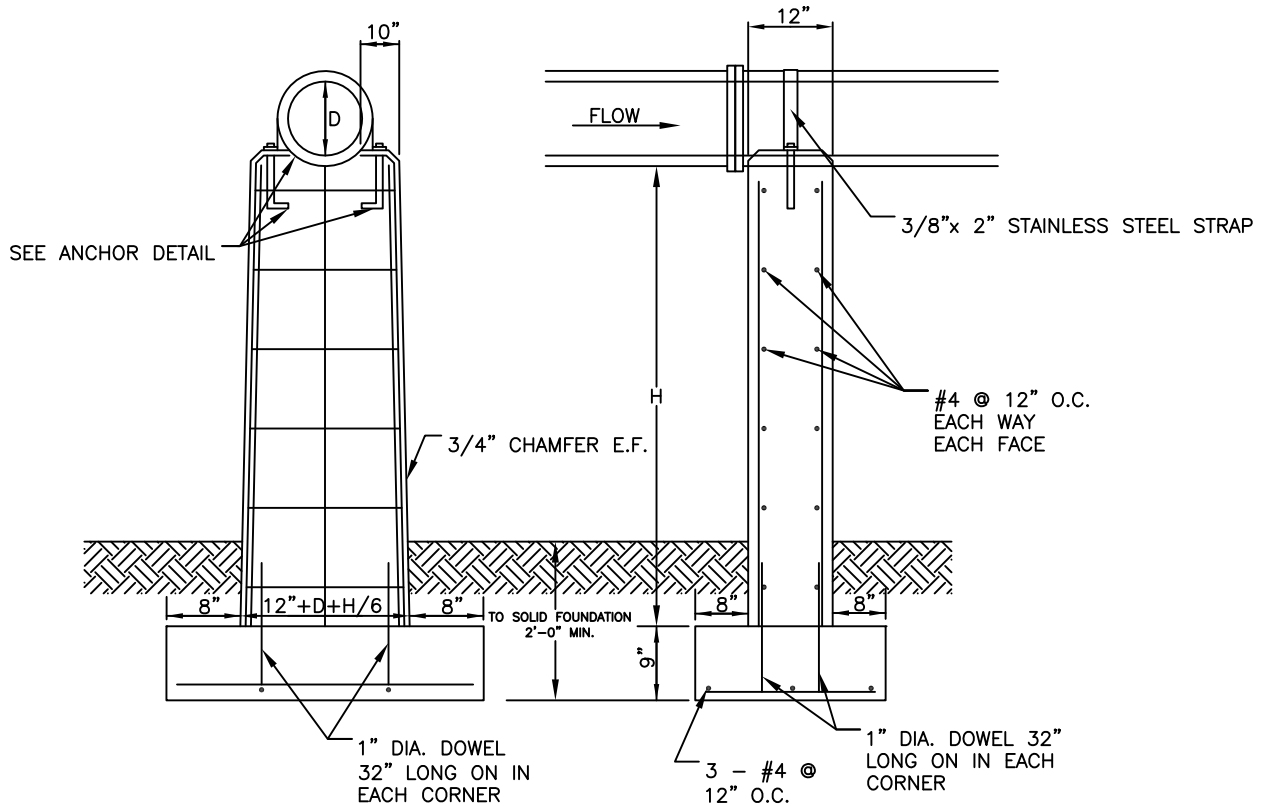


CARRIER PIPE INSTALLATION IN CASING

SCALE: NTS REVISION DATE: 11/07/2016



ANCHOR DETAIL



NOTE

- 1- ALL HARDWARE TO BE HOT DIPPED GALVANIZED
- 2- THIS CONSTRUCTION DETAIL IS A SUGGESTED DESIGN ONLY AND DOES NOT RELIEVE THE DESIGN ENGINEER FROM THE RESPONSIBILITY AND OBLIGATION TO CONSIDER ALL ISSUES RELATED TO THE PROPER DESIGN OF ALL STRUCTURES AND SYSTEMS AND COMPLIANCE WITH ALL APPLICABLE REGULATIONS AND STANDARDS. THE DESIGN ENGINEER SHALL SUBMIT ALL PIER SUPPORTED PIPING SYSTEMS TO THE SPARTANBURG WATER ENGINEERING DEPARTMENT FOR APPROVAL.

THE INTENT OF THIS DETAIL IS TO CLARIFY AND NOT SUPERSEDE OR MODIFY THE SPECIFIC REQUIREMENTS AS LISTED IN THE SPECIFICATIONS



PIPE SUPPORTED
ON
CONCRETE PIERS

SCALE: NTS REVISION DATE: 11/07/2016