



# STANDARD WATER SPECIFICATIONS

FOR THE  
CITY OF ROCK HILL



June 2018



City of Rock Hill  
Water/Sewer Utilities  
P.O. Box 11706  
Rock Hill, SC 29731-1706  
803-329-5500





June 14, 2018

ROCK HILL CITY OF  
PO BOX 11706  
ROCK HILL SC 29731-1706

RE: Standard Specifications for Water System  
ROCK HILL CITY OF  
Approval Number SS-002145

This office has reviewed the water system specifications submitted to this office on 03/08/2018, revised on 6/14/2018 for consideration of becoming Standard Specifications. Based on our review this letter may serve as your approval of these Standard Specifications.

For further submittals of projects, please indicate on the application for permit to construct that your specifications have been approved as Standard Specifications and that no additional copies will be necessary.

If you have any questions, please call me at 803-898-1941.

Sincerely,

A handwritten signature in black ink, appearing to read "Maia Milenkova".

Maia P Milenkova  
Construction Permitting Section  
Bureau of Water

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# STANDARD SPECIFICATIONS FOR WATER SYSTEM FACILITIES CONSTRUCTION

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# I. Purpose and General Information

A. **PURPOSE & APPLICATION:** This document was created and assembled for use in planning, designing, and constructing potable water facilities which will be owned and operated by the City of Rock Hill. In addition to the information contained herein, rules and regulations set forth by the South Carolina Department of Health and Environmental Control (SCDHEC) and the US Environmental Protection Agency (EPA) apply to the permitting and construction of these facilities. This information applies to both existing and new facilities construction.

B. **SCOPE OF WORK:** All materials, labor, and equipment necessary for potable water construction and placing in operation water infrastructure and appurtenances within the City of Rock Hill water service territory or to be served by the City of Rock Hill shall be provided in accordance with the following specifications and City of Rock Hill Standard Details.

1. The work shall include all clearing, grubbing, trenching, shoring [in accordance with Occupational Safety & Health Administration (OSHA) regulations], dewatering, installing water infrastructure (i.e., valves, hydrants, piping and other appurtenances) shown and specified, backfilling and consolidating the backfill material, as well as other work as may be necessary to complete the work.

2. Construction Drawings shall be prepared under the direction of a Professional Engineer licensed to practice in the state of South Carolina.

3. The Contractor shall furnish all materials, equipment and labor required to construct the project as outlined in these specifications and Construction Drawings.

C. **ORDER OF WORK:** The Order of Work shall be determined by the Contractor, subject to approval by the City Engineer.

D. **MATERIAL INSPECTION:** All materials and workmanship shall be subject to inspection by the City Engineer or his or her designee and representatives of SCDHEC or SCDOT or any other entity having permitting authority over the project. Work and/or materials not conforming to these specifications or any applicable permit shall be corrected immediately. The Engineer shall have the right to label materials not meeting the specifications and/or the Contractor shall segregate said materials to distinguish them as such.

E. **ORGANIZATION OF WORK AND NOTIFICATIONS:**

1. The Contractor shall so organize his work that backfilling of open trenches and or excavations and associated cleanup of the construction site shall closely follow pipe laying operations and manhole construction. The City Engineer or his designee shall have the authority to determine if the contractor is negligent in complying with this provision. The City shall have the authority to stop work if needed to bring the site into a respectable level of maintenance.

2. All planned road closures shall be reported to the following entities a minimum of 72 hours prior to closing any street.

a) The City of Rock Hill's Homeland Security Director's office at 803-326-3810; and

b) The York County Public Safety Communications office at 803-329-1110.

3. The Public Safety Communications office will notify the appropriate emergency services responders (i.e., EMS, Fire Department, etc.) of the planned road closure(s). Lane closures, where a minimum of one lane is left open to traffic, do not require notification to either office – City of Rock Hill’s Homeland Security Director’s office or York County’s Public Safety Communications office.

4. Traffic control, signage and barricades for road and lane closures and work inside the road rights-of-way shall be in accordance with applicable encroachment permits and the Federal Highway Administration’s (FHWA), Manual on Uniform Traffic Control Devices.

5. Failure on the part of the Contractor to comply with the above provisions in a reasonable manner, in the opinion of the Engineer, shall be sufficient cause for the Engineer to order a temporary shut-down of trenching and pipe laying operations until the provisions have been met.

6. Contractor shall notify each property owner affected by a planned interruption of existing services at least 72 hours prior to the loss of service. For emergency interruption of services, the Contractor shall notify the property owner as soon as practical

F. **LEAD-FREE REQUIREMENTS:** Lead-free pipes, plumbing fittings/fixtures, and solder/flux shall meet the Reduction of Lead in Drinking Water Act (P.L. 111-380). Any pipe, solder, or flux which is used in the installation or repair of any public water system, or used in any plumbing which provides water through connection to a public water system for human consumption, shall be lead-free. Lead-free for solder and flux means those containing not more than 0.2 percent lead. Lead-free for pipes and pipe fittings means those containing not more than 8.0 percent lead. Leaded joints necessary for the repair of CIP shall be exempt from the above lead-free requirements.

G. **SPECIFICATIONS:** Unless superseded or modified herein or in the Standard Details, all materials apparatus, supplies, methods of manufacture, or construction shall conform to the specifications contained herein and to AWWA specifications. All materials/products that contact potable water must be third party certified as meeting the specifications of ANSI/NSF Standard 61. National standards (ASTM, ANSI, AWWA, etc.) referenced herein shall be considered to be the latest revisions only.

#### H. ABBREVIATIONS

1. A list for reference purposes is as follows:

AASHTO	American Association of State Highway and Transportation Officials
AC	Asbestos cement
ACI	American Concrete Institute
AMS	Aerospace Material Specification
ASME	American Society of Mechanical Engineers
ASTM	American Society for Testing and Materials
ANSI	American National Standards Institute
ARV	Air release valve
AWS	American Welding Society
AWWA	American Water Works Association

BPD	Backflow Prevention Device
°C	Degrees Celsius
CIP	Cast iron pipe
DIP	Ductile iron pipe
EPA	US Environmental Protection Agency
°F	Degrees Fahrenheit
FHWA	Federal Highway Administration
FM	Factory Mutual
fps	Feet per second
gph	Gallons per hour
gpm	Gallons per minute
g/m <sup>2</sup>	grams per square meter
ISO	International Organization for Standardization
LF	Linear feet
MJ	Mechanical joint
MSS	Manufacturers Standardization Society of the Valve and Fittings Industry
MUTCD	Manual on Uniform Traffic Control Devices
NFPA	National Fire Protection Association
NPT	National Pipe Thread
NSF	National Sanitation Foundation
NST	National Standard Thread
OSHA	Occupational Safety and Health Administration
ppm	Parts per million
psi	Pounds per square inch
psig	Pounds per square inch – gauge
PVC	Polyvinyl Chloride
SC811	South Carolina 811
SCDHEC	South Carolina Department of Health and Environmental Control
SCDOT	South Carolina Department of Transportation
SDR	Standard Dimension Ratio
SDWA	Safe Drinking Water Act
UL	Underwriters Laboratory
UNS	Unified Numbering System
USDOT	United States Department of Transportation

## II. Material Specifications

### A. GENERAL

1. **STANDARDS:** All material or products which come in contact with drinking water shall be third party certified as meeting the specifications of the NSF/ANSI Standard 61, "Drinking Water System Components – Health Effects". The certifying party shall be accredited by ANSI. Pipe, fittings, packing, jointing materials, valves and fire hydrants shall conform to AWWA Standards, Section C. In the absence of AWWA Standards, materials meeting applicable Product Standards and with prior approval from the Utilities Department may be selected.

2. **USED MATERIALS:** Water mains which have been used previously for conveying potable water may be reused provided they meet the above standards and have been thoroughly cleaned, restored, pressure and bacteriological tested practically to their original condition, unless otherwise stated in these specifications.

3. **GASKETS AND JOINTS:** Gaskets, O-rings, and other products used for material to the water system shall comply with the requirements of SCDHEC, and shall not be made of natural rubber or any other material which will support microbiological growth. Lubricants which will support microbiological growth shall not be used for slip-on joints. The use of vegetable shortening to lubricate joints is prohibited.

#### a) LINE SIZING:

(1) **Pressure** - The minimum pressure in all public water mains under conditions of maximum instantaneous demand shall be 25 psi at every customer's tap. At any tap when fire flows or flushing flows are provided in excess of maximum peak hourly flow, 20 psi will be acceptable.

(2) **Diameter** - The minimum size of water mains for providing fire protection and serving fire hydrants shall be six (6) inches in diameter. Larger size mains will be required if necessary to allow the withdrawal of the required fire flow while maintaining the minimum residual pressure specified in the State Primary Drinking Water Regulation.

4. **NO LINE EXTENSION** shall be made off an existing line when the existing line does not meet the minimum pressure and flow requirements.

#### 5. DEAD ENDS:

a) Dead ends shall be minimized by looping of all mains whenever practical.

b) The lengths of small dead end lines shall not exceed the following:

2-inch diameter	1500 ft.
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c) Conditions may warrant having less than the above maximum lengths in order to meet the minimum pressure requirements.

### B. ASBESTOS CEMENT PIPE: Asbestos cement pipe shall not be used in potable water systems

except in the repair of existing asbestos cement lines.

### c. DUCTILE IRON PIPE AND FITTINGS

1. PIPE: Ductile-iron pipe shall be centrifugally cast and shall conform to the requirements of AWWA C150/ANSI A21.50 and AWWA C151/ANSI A21.51. All ductile iron pipe shall be domestically manufactured in the United States. Push-on and restrained joint pipe shall have a minimum rated working pressure of 150 psi in accordance with AWWA. Pipe larger than 16 inches in diameter shall be as recommended by Engineer and approved by City Engineer; pipe 16 inches in diameter and smaller shall be a Pressure Class 350. Pipe shall have mechanical or push-on joints as outlined in ANSI A21.11 with laying lengths of at least 18 feet.

2. QUALITY ASSURANCE: Require submitted evidence that the ductile iron pipe and fitting manufacturer has a minimum of ten years' experience in material production of diameters noted on the Construction Drawings and specifications. All ductile iron pipe shall be manufactured in the United States. All pipe material suppliers shall be ISO registered or provide the services of an independent inspection agency. Prior to the start of manufacturing, any manufacturer not meeting the ISO registration requirements shall submit to the owner and owner's engineer the names of an independent inspection agency for approval. The independent inspection agency shall be responsible for sample monitoring of chemical and mechanical test, sample visual inspection of quality assurance tests performed on in-process pipe and fittings, and a sample visual and dimensional inspection of finished product for this project. A certified inspection report from the independent inspection agency of all witnessed tests shall be supplied to the owner or owner's engineers within ten (10) days of completion of pipe manufacturing. Chemical samples shall be taken from each ladle of iron and the manufacturers' chemical control limits shall be maintained for at least the following elements: carbon, sulfur, phosphorus, silicon, magnesium, chromium, manganese, tin, aluminum, cerium, copper, and lead. When chemical values fall outside the manufacturer's control limits, additional mechanical property tests shall be performed to assure minimum mechanical properties are met.

3. FITTINGS: Fittings shall be cast from ductile iron and shall conform to AWWA C110/ANSI A21.10 for Pressure Class 250 or AWWA C153 for Pressure Class 350 Compact Fittings. All fittings shall have standard mechanical joints or as shown. For sizes greater than 14-inches, fittings shall be full-bodied. All pipe joints and fittings (including glands and bolts) shall have a minimum working pressure rating as follows:

- a) 350 psi for 4-inch through 16-inch diameters
- b) 250 psi for greater than 16-inch diameters

4. JOINTS: Joints for DIP shall meet the following requirements:

- a) FLANGE JOINTS AND ACCESSORIES: Flanges for pipe, fittings, and valves shall be furnished in accordance with AWWA C115/ANSI A21.15 and shall be faced and drilled identical to ANSI B16.1, Class 125 flanges with full-face rubber gaskets 1/8" thickness. Bolts and nuts for flanges shall be in accordance with ANSI/AWWA Standards.
- b) MECHANICAL JOINTS AND ACCESSORIES: Bolts and gaskets for mechanical joint pipe and fittings shall be furnished by the pipe/fitting manufacturer and shall conform to

AWWA C111/ANSI A21.11

c) **PUSH-ON JOINT MATERIAL:** Gaskets for push-on pipe shall be furnished by the pipe manufacturer. Gaskets and gasket lubricant shall meet the requirements of AWWA C111/ANSI A21.11.

d) **RESTRAINED JOINTS:** Flexible restrained joints shall be supplied by the pipe manufacturer. Gaskets with vulcanized internal stainless steel locking segments may be used for 6-inch through 12-inch DIP, if approved by the City Engineer and not in lieu of concrete blocking. The following manufacturers are approved: U.S. Pipe and Field Lock Gasket. Only designs using a welded retainer ring on the spigot will be allowed for 16-inch and larger diameter pipe. Push-on or mechanical joint designs may be used for the pipe and associated fittings. The restrained joint shall be rated for a minimum 250 psi working pressure with a 2:1 safety factor. The following manufacturer's products are approved: American Lok Ring, American Lok Fast, Griffin Snap Lok, Griffin Bolt Lok, and U.S. Pipe TR Flex.

5. **MARKINGS AND WEIGHTS:** Markings and weights of pipe and fittings shall conform to the requirements of AWWA Specifications.

6. **LININGS AND COATING:** Pipe and fittings shall be cement-mortar lined in accordance with AWWA C104/ANSI A21.4. The interior cement lining shall be approved for contact with potable water. The pipe's interior and exterior is to be of bituminous coating with a minimum thickness of one mil.

a) **ZINC COATING:** Zinc-coated ductile iron pipe conforming to ISO 8179 standards may be installed as an alternative in corrosive soils and other special conditions as approved by the City Engineer. The exterior zinc coating shall be factory-installed using a thermal arc spray process. The zinc layer shall have a mass of 200 grams per square meter ( $\text{g/m}^2$ ) of pipe surface area. A finish layer of bituminous coating shall be placed over the zinc in accordance with AWWA C104, and the pipe shall be marked with the word "zinc".

7. **CERTIFICATION:** The manufacturer of iron pipe and fittings shall be prepared to furnish both the City and the Contractor with certified reports stating that inspection and specified tests have been made and that the results thereof comply with the applicable ANSI Specifications.

8. **QUALITY AND INSPECTION:** Latitudes in workmanship and finish allowed by ASTM notwithstanding, all pipe shall have smooth exterior and interior surfaces; be first quality, be free from cracks, blisters and other imperfections, and be true to theoretical shapes and forms throughout each length. Pipe that does not conform will be so marked by the Engineer, and shall not be used in the work. On-the-job repairing of rejected pipe will not be permitted.

D. **PLASTIC PIPE AND FITTINGS**

1. **PIPE:** All plastic pressure pipes (sizes 4"-12") shall meet all requirements of AWWA C900 and be made from blue-pigmented virgin materials. Polyvinyl Chloride (PVC) water pipe shall be bell and spigot pipe, shall be in lengths not exceeding 20 feet laying lengths, and shall have minimum wall thickness conforming to SDR18 Class 150 dimensions. Pipe shall be NSF approved. Alternative plastic pipe (sizes 4"-12"), other than C900, shall meet all requirements of ASTM



D1785 (Sch. 40) or ASTM D2241 (SDR26 Class 160 and SDR21 Class 200), but its use shall be subject to the approval of the City Engineer. All plastic pipes (sizes 14"-48") shall also meet all requirements of AWWA C905. Use of plastic pipes 12" and larger shall be subject to the approval of the City Engineer. New mains shall be 6" diameter or larger unless otherwise approved by the City Engineer for a service on a cul-de-sac or other dead-end line. Thermoplastic pipe shall not be used above grade.

2. **FITTINGS:** PVC pressure pipe fittings for 6-, 8-, and 12- inch PVC pipe shall utilize Class 350 ductile-iron fittings in accordance with AWWA C110/ANSI A21.10 or AWWA C153 (Compact Fittings) up to 12" diameter pipe. Fittings shall be in accordance with ductile iron pipe requirements. Fittings for 2-inch PVC pipe shall be push-on joint PVC or threaded malleable iron. Malleable iron fittings shall be furnished with threaded PVC adapters to connect the fittings to the push-on joint pipe. Elastomeric joints for PVC adapters and PVC fittings with push-on joints shall conform to ASTM D3139. PVC adapters and fittings shall have a minimum pressure of 200 psi and shall, except for threaded area on adapters, have a SDR of 13.5.

3. **JOINTS:** All pipes shall have elastomeric joints with an integral belled gasket coupler. Rubber gaskets shall comply with the physical requirements specified in ASTM F477. Joints shall meet the requirements specified in ASTM D3139 for 2-inch pipe and to AWWA C900 and C111 for 6-inch, 8-inch and 12-inch pipe. The use of solvent-weld PVC pipe and fittings in water mains 4 inches and larger is prohibited. If the waterline pipe is required to be cased for any reason, the pipe shall be restrained joint ductile iron pipe.

4. **MARKINGS:** PVC pipe shall be marked at intervals of 5 feet or less with information regarding the Manufacturer's Name or Trade Mark, Plant Code, Date of Manufacture, Nominal Pipe Size, PVC Cell Classification and Legend, in accordance with AWWA C900, that will remain legible during normal handling, storage and installation and which have been applied in a manner that will not reduce the strength of or otherwise damage the pipe or coupling.

## E. WATER SERVICE PIPE

1. **COPPER WATER TUBE:** Copper water tube shall conform to ASTM B88. Tubing located aboveground, in vaults and structures shall be Type K, drawn temper (hard). Buried tubing shall be Type K, annealed temper (soft), except 3-inch tube shall be Type K, drawn temper (hard). Continuous pipe run to be installed between water main and water meter, i.e. no joints in pipe.

2. **PIPE AND NIPPLES:** Pipe and short threaded nipples shall be brass conforming to ASTM B43 or copper conforming to ASTM B42, regular wall thickness, except that pipe and nipples of sizes 1-inch and smaller shall be extra strong. Threads shall conform to ASME B1.20.1, NPT.

### 3. SOLDER-JOINT FITTINGS

a) Use solder-joint fittings for working pressures of 300 psi or less.

b) Wrought copper solder-joint seamless fittings shall be designed for use with copper water tube and conform to ASTM B75 and ASME B16.22. Material shall be UNS C10200, C12000, or C12200.

c) Cast copper solder-joint pressure fittings shall be designed for use with copper

water tube and conform to ASME B16.18.

4. **THREADED FITTINGS:** Cast bronze threaded fittings shall be designed for use with brass or copper pipe and nipples and conform to ASME B16.15, Class 125 and 250. Use Class 125 fittings for working pressures of 200 psi or less. Use Class 250 fittings for working pressures greater than 200 psi, but less than 400 psi.
5. **FLANGES AND FLANGED FITTINGS:** Cast bronze pipe flanges and flanged fittings shall conform to ASME B16.24, Class 150 or Class 300. Use Class 150 flanged fittings for working pressures of 225 psi or less. Use Class 300 flanged fittings for working pressures greater than 225 psi, but less than 500 psi. Provide flat-faced flanges. Use solder-joint or threaded end companion flanges. Companion flanges with solder-joint or threaded end shall be limited to the pressure rating of the pipe connection and not the flanged joint.
6. **SOLDER AND FLUX:** Solder shall be 95/5 (95-percent tin and 5-percent antimony) conforming to ASTM B32, Alloy Grade Sb5 or silver solder conforming to AMS 4773C. Do not use lead or cored solder. Soldering flux shall comply with ASTM B813.

#### F. HYDRANT ASSEMBLIES

1. **GENERAL:** Hydrants shall be furnished as indicated on approved Construction Drawings and as specified herein. All fire hydrants shall meet the requirements of AWWA C502 at a minimum. Hydrants shall be compressive type, self-oiling, non-freezing, and provided with a safety flange and coupling (See Standard Detail). Post-type hydrants are not allowed. Where standard 6-inch diameter hydrants are proposed, the design flow shall not be less than 500 gpm over and above peak hourly flow. Hydrants shall be capable of a working pressure of 150 psi with a test pressure of 300 psi. Hydrants shall be painted silver by the manufacturer.
2. **HYDRANT LEADS:** The hydrant leads shall be a minimum of six (6) inches in diameter. Auxiliary gate valves shall be installed in all hydrant leads.
3. **DRAINAGE:** A gravel pocket or dry well shall be provided unless the natural soils will provide adequate drainage. Hydrant drains shall not be connected to or located within ten (10) feet of sanitary sewers.
4. **VALVE OPENING:** Valve opening shall be not less than 4 ½". Hydrants shall open by turning counter-clockwise.
5. **HOSE AND PUMPER CONNECTION:** Hose nozzles shall be two (2) in number and 2-½ inches in size. A 4-½ inch pumper connection with Storz connector shall be provided. Hose connections shall be threaded and locked in place, or breech-locked into the hydrant barrel. The operating nut shall be 1 ¼ inch and pentagon in shape. Any extensions required shall be as recommended and supplied by the manufacturer.
6. **CONNECTION TO SYSTEM:** Standard hydrants shall not be placed on systems using only hydro-pneumatic storage, unless standby power is provided and the pumping capacity from wells or ground storage exceeds the fire flow demand with the largest well or pump out of service. Standard hydrants shall not be connected to lines not designed to carry fire flows.

a) Shoe connection shall be 6 inch furnished with mechanical joint for connection to spigot of mechanical joint hydrant pipe lead.

7. SEAT RINGS: Seat rings shall be shaped and arranged as to be readily removable. Seat rings shall be bronze and shall screw into a bronze bushing in the shoe. An O-ring seal between the shoe and seat ring shall provide a watertight non-wearing, permanent seat between shoe and seat ring. This seal shall always come out with main valve removal.

8. THRUST BLOCKING: Thrust blocking should not block weep holes.

## G. WATER METERS AND METER BOXES

1. METER BOXES: Meter boxes for service connections shall be located 5 feet from the center of the lots with 10-foot minimum separation from the sewer service. Meter boxes shall not be located in driveways or sidewalks. Meters shall be placed in landscaped areas on the property-owner side of any sidewalk and as shown in the Standard Details. Meter boxes shall be prominently marked in the field a by blue stake to prevent damage during or after construction operations. Meter boxes shall be installed with the service pipe at a depth of 9 inches below grade.

2. WATER METERS: The City of Rock Hill shall be responsible for purchasing all meters. The City shall install Badger or Hersey meters, unless otherwise contacted and approved by the City Engineer. Mueller System FM3 fire service meters may be used for customer services with fire loops. Load data sheets shall be submitted for review in order that the appropriately-sized commercial/industrial meter may be installed. Dedicated fire lines to buildings shall not be metered.

3. BACK FLOW PREVENTION DEVICES: Backflow Prevention Devices (BPD) shall be in accordance with the City's Cross-Connection Control Policy and in accordance with the SCDHEC Backflow Prevention Manual.

## H. VALVES, BLOW-OFFS AND CHAMBERS

1. AIR RELIEF VALVES – Combination air relief valves (ARV) shall be provided in accordance with sound engineering practice at high points in water mains or along extended runs as required. Automatic air relief valves shall not be used in situations where flooding of the manhole or chamber may occur. ARVs shall be furnished and installed as shown on approved Construction Drawings and as specified herein. The combination ARV shall have a cast iron body and stainless steel float. A  $\frac{3}{4}$ " valve capable of 200 psi pressure shall be installed on the service line to the air valve in order to facilitate testing. Other internal parts shall be stainless steel or bronze. The combination ARV shall be in accordance with the Standard Details.

a) ARV PIPING - The open end of an air relief pipe from automatic valves or from a manually operated valve shall be extended to the top of the pit and provided with a screened downward facing elbow.

2. BUTTERFLY VALVES

a) **GENERAL:** Butterfly valves shall be furnished with valve operators and accessories as indicated on the approved Construction Drawings or as specified herein. Valves shall be furnished as manufactured by Mueller, or approved equal. All valves shall comply with AWWA C504, for tight-closing, rubber-seated valves. Butterfly valves shall be Class 150 designed for 16 fps maximum velocity unless otherwise shown. 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. All valves in road shoulder shall have a concrete valve protector ring. (See Standard Detail)

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. The valve body shall have mechanical joint ends meeting the requirements of ANSI 21.11 with necessary nuts, bolts, glands and gaskets. 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 forces resulting from the thrust of the operating mechanism. Trunnion boxes 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 may consist of a one-piece unit or may be the “stub-shaft” type. Valve shafts shall be turned, ground and polished. Valve shafts shall be constructed of 18-8 Type 304 stainless steel conforming to ASTM A276. Shaft diameters shall meet requirements established by AWWA C504 or service required. Valve shafts shall be securely attached to the valve disc by means of taper pins. Taper pins shall be mechanically secured.

d) **VALVE DISC:** Valve discs 20 inches and smaller shall be constructed of alloy cast iron ASTM A436, Type 1 (Ni-Resist); ductile iron ASTM A536, Class 65-45-12; or cast iron ASTM A48. Valve discs 24 inches and larger shall be constructed of ductile iron ASTM A536, Class 65-45-12 or cast iron ASTM A48 with 18-8, Type 304, with stainless steel seating edges. 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 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 316 stainless steel.

e) **VALVE SEATS:** Valve seats shall be natural rubber or Buna “N” rubber designed for tight shutoff in both directions with 150 psi upstream and 0 psi downstream pressure. Rubber seats in the valve body shall be retained by 18-8 Type 304 stainless steel mechanical means, or bonded, without retaining hardware in the flow stream. Rubber seats attached to the disc shall be retained with an 18-8 Type 304 stainless steel clamp ring and stainless steel bolting. Retaining ring cap screws shall pass through the rubber seat and be self-locking. Mating seat surfaces for resilient seats shall be 18-8 Type 304 stainless steel. Seats shall be a full 360-degrees without interruption. Valve seats shall be designed to permit removal and replacement in the field for valves 30 inches in diameter 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 compressive strength of the bearing or shaft material. Bearing material must have coefficient of friction no greater than 0.25, which must be maintained regardless of wear.

g) VALVE OPERATORS: Valve operator shall conform to AWWA C504, and shall be equipped with adjustable mechanical stop-limiting devices to prevent over travel of the disc in the open and closed positions. All valves shall open counter-clockwise. The manual operator shall be the enclosed type, suitable for buried service, fully gasketed, grease packed or oil lubricated and designed to withstand submersion in water to 10 psi. The manual operator for valves size 20 inches and smaller shall be the traveling-nut type with threaded-steel reach-rods and bronze or ductile-iron nut with internal threads. The manual operator for valves size 24 inches and larger shall be the worm-gear type having a self-locking worm gear

h) VALVE TESTING: Performance, leakage and hydrostatic tests shall be conducted in strict accordance with AWWA C504. The manufacturer shall provide the City, upon request, with an "Affidavit of Compliance" as per AWWA C504 upon completion of manufacture.

i) EXTENSION STEMS: Extension stems for the butterfly valves shall be furnished and installed with position indicators.

3. CHECK VALVES: Check valves shall be iron body, bronze mounted, with outside lever and spring, and meet ANSI B16.1, Class 125 flanges and drilling. Iron body valves shall be fusion-bonded, epoxy coated and include 316 top cover bolts. Operating mechanism shall be by internal weight of linkage and spring, and shall be all bronze or stainless steel. Valves shall have rubber faced clapper and bronze seat. Valves shall have two tapped bosses on each side to permit installation of a metered bypass. Valves shall be UL listed/FM approved. Provisions for removing trapped air shall be made.

#### 4. RESILIENT-SEAT GATE VALVES

a) GENERAL: Gate valves shall be furnished as indicated on the approved Construction Drawings and as specified herein.

(1) Gate valves shall be used for 6-, 8- and 12-inch diameter lines. Butterfly valves shall be used for all lines 16-inch diameter and larger.

(2) Metal seated gate valves shall meet all requirements for AWWA C500, but its use shall be subject to the approval of the City Engineer. Resilient-Seat Gate valves shall conform to AWWA C509 or C515, with "O" ring packing. Resilient seated gate valves shall be furnished with durable, opaque end-shields to prevent ultraviolet damage to the rubber discs. Valves shall be furnished as manufactured by Mueller or approved equal.

(3) Working pressure for valves shall be 200 psi.

(4) Gate valves shall embody the best class of workmanship and finish, and shall open and close freely and easily. With discs raised, each valve shall have a clear waterway of the full nominal diameter of the valve. If guides or guide lugs

are used, the design shall be such that corrosion in the guide area does not affect sealing. Resilient seats may be applied to the body or gate and shall seat against a corrosion-resistant surface. The surface may be either metallic or non-metallic. Resilient seats shall be bonded or mechanically attached to either the gate or valve body. The mating surface of the resilient seat shall be machined to a smooth, even finish.

(5) All stems shall be forged bronze stems.

(6) Valve ends shall have mechanical joints.

(7) Valve markers are required for water lines and valves not within road rights-of-way. All valves in road shoulder shall have a concrete valve protector ring.

b) **OPERATION:** All valves shall open counter-clockwise. A 2-inch square operating nut with an extension stem will be required for manual operation. The operating nut shall have an arrow cast, indicating the direction for opening the valve.

c) **JOINTING:** All valves shall be furnished with mechanical joints and necessary bolts, glands and gaskets unless otherwise shown on the approved Construction Drawings or specified herein.

d) **MARKINGS:** Each valve shall be plainly marked with the manufacturer's name or particular mark, the year of manufacture, the size of the valve, and designation indicating working pressure, all cast on the bonnet or body.

e) **PAINTING:** All surfaces of the valve shall be clean, dry and free from grease before painting. The interior and exterior valve surfaces except for disc, seating and finished portions shall receive two coats of asphalt varnish.

5. **VALVE BOXES:** The Contractor shall furnish and install valve boxes for butterfly and gate valves and by-pass valves. Valve boxes shall be heavy roadway type. The valve boxes shall be cast-iron, two-piece, slide-type with drop covers. The valve box cover shall have the word "WATER" cast into the cover. The bottom section of the box may be 6-inch diameter ductile iron pipe. The ductile iron pipe or valve box covers shall not be placed directly on the valve. The box must be placed on concrete blocks. Concrete valve rings shall be used on all valves not located in paved surfaces.

6. **EXTENSION STEMS:** In all locations where the valve operating nut is 4 feet or more beneath the ground surface, an extension stem for the valve to terminate at 1.5 feet beneath the ground surface.

7. **BLOW-OFF ASSEMBLY:** Blow-off assemblies for typical use shall be Kupferle Foundry TF-500, which fits in a standard 5 ¼-inch valve box. (See detail.) The orifice should be provided on the fixed piping, in the valve box. Blow-offs should not be directed toward roads or so that the water will flow into creeks, etc. At stream crossings, direct away from streams over ground.

a) Orifices should be sized as follows:

<u>Pipe Diameter</u>	<u>Minimum Flow Required</u>	<u>Orifice Size</u>
2 inch	25 gpm	0.75 inch
4 inch	100 gpm	1.5 inch
6 inch	220 gpm	2 inch
8 inch	400 gpm	2 inch
12 inch	882 gpm	2 inch
16 inch	1570 gpm	2 inch

8. CHAMBERS/VAULTS/PITS/MANHOLES - Chambers, vaults, pits or manholes containing valves, blow-off, meters, air release valves, or other such appurtenances to a water distribution system, shall not be connected directly to any storm drain or sanitary sewer.

a) Chambers, vaults, pits or manholes within rights-of-way shall be designed for AASHTO H-20 traffic loadings and may be adjusted using standard size clay or concrete brick.

## I. CONNECTIONS

1. SERVICE TAPS: All service taps shall be made in accordance with the Standard Details using epoxy coated cast iron service saddles with double stainless steel straps, and ¾" Mueller #H-15000 series corporation stops or approved equal. The service line shall be Type "K" copper. Copper services shall conform to AWWA C800.

a) Fire/Domestic Service Piping: Domestic service piping can branch off dedicated fire line piping to avoid having two service taps to the main and two separate service lines in the public right-of-way or easement. Piping from the main to the vault or right-of-way or easement line is to be maintained by the City and must be constructed of ductile iron pipe. On-site piping may be PVC meeting applicable codes. No 3-inch piping is allowed on domestic line – must be either 2-inch (or smaller) Type K" copper or 4-inch (or larger) ductile iron pipe.

2. SERVICE SADDLES: All corporation stops for services or air releases on pipe, as well as ¾-inch and larger corporations installed on ductile iron pipe, shall be installed with service saddles having threads to acceptable AWWA standards. Service saddles shall be as shown on the Standard Details. Doubled banded complete stainless steel straps must be performed by the manufacturer to the specified outside diameters of the pipe.

3. CORPORATION STOPS: Corporation stops shall comply with AWWA C800 and shall be high pressure rated at 150 psi. All corporations installed on C900 PVC pipe, as well as ¾-inch and larger corporations installed on ductile iron pipe, shall require a tapping saddle/service clamp.

4. TAPPING SLEEVES AND VALVES: Tapping Sleeves and Valves for connection into existing pipelines shall be furnished and installed as indicated on approved Construction Drawings or as specified herein. Unless otherwise indicated, tapping sleeves shall be constructed of stainless steel and include stainless steel bolts, testing plug and stainless steel flange (ductile iron flange may be substituted). Prior approval by the Utility Department is needed before ductile iron mechanical joint sleeves may be used. All tapping sleeves shall be tested for leaks and approved by the City Engineer before the tap is made. The hydraulic pressure test shall be timed for a minimum of 5 minutes at 150 psi.

- a) MATERIALS: Tapping sleeve shall be stainless steel as indicated above or ductile iron, mechanical joint furnished complete with joint accessories, including split glands, split end gaskets, bolts, etc.
- b) BODY: Mechanical joint watermain fittings and accessories, 2-inch through 48-inch shall be produced of ductile iron in accordance with and meet AWWA C110/ANSI A21.10 and AWWA C111/ANSI A21.11. Ductile iron, mechanical joint fittings 3-inch through 24-inch shall be rated for 350 psi working pressure.
- c) OUTLET FLANGE: Carbon Steel per ASTM A36 in accordance with AWWA C207 and ASME B16.1 Class 125. Compatible with approved tapping valve. Recessed for tapping valve per MSS SP-60.
- d) FLANGED ENDS: Flanged ends shall meet the requirements of AWWA C115 or AWWA C207, depending on pipe material.
- e) FINISH: Finish shall be fusion bonded epoxy coating to an average 12 mil thickness. Fusion applied per AWWA C213. Coatings must be NSF-61 approved and conform to AWWA C104.
- f) TEST PLUG: A ¾ inch NPT carbon steel test plug with square head and fusion-bonded epoxy coating shall be used.

#### J. REPAIR/TIE-IN SLEEVES/CLAMPS

- 1. SLEEVES: Solid cast iron mechanical joint sleeves (long pattern) shall be used where indicated for tie-ins between new mains and existing mains and when replacing defective sections of pipe with new pipe.
- 2. REPAIR CLAMPS: Repair clamps or split sleeves will not be allowed on new construction. These may be used to repair existing mains if specifically directed by the Engineer.

#### K. CONCRETE WORK

- 1. GENERAL: Concrete of the respective classes for structures, bedding, blocking, headwalls, piers and other miscellaneous structures shall be as called for in the work to which they pertain.
- 2. CEMENT: Cement shall satisfy the requirements of ASTM C150, Type I or Type II.
- 3. AGGREGATE: Aggregate shall satisfy the requirements of ASTM C33.
  - a) COURSE AGGREGATE: Course aggregate shall be uniformly and evenly graded for each application in accordance with ACI Standard 318. Unless otherwise approved, aggregates shall be sound, crushed, angular granitic stone. Smooth or rounded stone (river rock) shall not be acceptable.
  - b) FINE AGGREGATE: Fine aggregate shall consist of natural sand, manufactured sand or a combination thereof, and shall be graded to meet the requirements of SCDOT



size number FA-10 and 67, as appropriate.

4. **WATER:** Water shall be fresh, clean and free from injurious amounts of oil, acid, alkali, and organic materials.

5. **MIXING:** Mixing shall be accomplished at a central mix plant unless prior approval is given by the Engineer for mixing on the job site.

6. **CENTRAL MIX PLANT:** Concrete supplied from a central mix plant shall have 28-day compressive strengths not less than those listed below.

- (1) Class "A" - 3,000 psi
- (2) Class "B" - 2,200 psi
- (3) Class "C" - 1,500 psi

7. **JOB SITE MIX:** Concrete mixed on the job site shall have 28-day compressive strengths as above and shall contain not less than the following quantities of cement per cubic yard.

- (1) Class "A" - 564 lbs. (6 bags)
- (2) Class "B" - 470 lbs. (5 bags)
- (3) Class "C" - 376 lbs. (4 bags)

8. **GROUTS:** All grouts shall be of a non-shrink nature (as may be achieved through additives or proportioning) and depending upon application, range from plastic to flowable cement water paste. Testing as specified above for concrete may be required for acceptance of grouts to include frequent checks for consistency by a time-of-flow measurement.

a) Expansion grouts shall be either Gilco premixed or Supreme non-metallic grout as manufactured by Gifford-Hill and Company, Inc. or Embeco 636 grout as manufactured by Master Builders, or approved equal.

b) Grouts shall be mixed (if applicable) and placed in accordance with the manufacturer's recommendations, for each specific application.

9. **FLOWABLE FILL:** Flowable fill shall be controlled, self-leveling, non-shrink, low-strength material consisting of a fluid mixture of cement, aggregate, water and with admixtures as necessary to provide workable properties. Long-term hardened strength shall be between 75 psi and 150 psi at 56 days as determined based on an average of three tests for the same placement.

a) Fly ash shall not be used in flowable fill adjacent to ductile iron pipe and fittings. Protect pipe and fittings by covering with polyethylene.

10. **THRUST BLOCKING:** All tees, bends, plugs and hydrants on lines 2-1/2 inches in diameter and larger shall be provided with reaction blocking, tie roads, or other approved method of restraint. Reaction blocking dimensions should be as shown on the Construction Drawings.

Dimensions will depend on field conditions.

11. **CONCRETE CYLINDERS:** Concrete cylinders for testing purposes shall be made in accordance with the procedure described in ASTM C31. Compression tests shall be made at the age of 7 days and 28 days by the testing laboratory as per ASTM C39. Testing shall be done by a laboratory approved by the Engineer. Each test shall consist of at least four (4) specimens; two (2) for field control and two (2) for laboratory control. One (1) initial test will be required and then one (1) test for each one hundred (100) yards thereafter.

## L. MISCELLANEOUS STEEL

1. **STEEL PIER MATERIAL:** Steel piles, cross braces, cradles, etc., shall consist of structural steel shapes of the section required in the Construction Drawings based on the Engineer's design for the specific needs of the project and approved by the City Engineer. The steel shall conform to specifications for ASTM A36.

a) All bolts and nuts shall conform to ASTM A325 for 7/8-inch and ASTM A490 for 1-inch and larger.

b) The Contractor shall handle and store steel members above ground on platforms, skids or other supports. Members shall be free of dirt, grease, and other foreign material and protected against corrosion.

c) Coal tar epoxy coating Carboline Koppers No. 300M, Amercoat No. 78, Carboline Carbomastic No. 14, or approved equal shall be applied to all specified surfaces of the steel pier.

d) Welding Electrodes shall conform to the following:

(1) Shielded Metal-arc: AWS A5.1 or AWS 5.5, E70XX

(2) Submerged-arc: AWS A5.17, F70X-EXXX

(3) Gas Metal-arc: AWS A5.18, E70S-X or E70U-1

(4) Flux Cored-arc: AWS A5.20, E70T-X (except 2 and 3)

2. **STEEL ENCASEMENT PIPE:** Steel pipe shall be welded or seamless, smooth wall or spiral weld, consisting of Grade "B" steel as specified in ASTM A139. Encasement pipe must be approved by the appropriate controlling agency (i.e. SCDOT, railway corporation, etc.) and the City Engineer prior to ordering.

a) Minimum yield strength shall be 35,000 psi; and pipe thickness shall be as specified for each individual job.

b) All pipe shall be furnished with beveled ends prepared for field welding of circumferential joints. All burrs at pipe ends shall be removed.

3. **STRUCTURAL STEEL TUNNEL LINER PLATES:** The tunnel liner plates shall be either the four (4) flanged type (as approved for use within SCDOT rights-of-way) or the lap seam type (as

approved for use within railroad rights-of-way) and fabricated to permit assembly of a continuous steel support system as the tunnel is excavated as specified by the design Engineer. Tunnel liner plates shall be fabricated from hot rolled, carbon steel sheets or plates conforming to the specifications of ASTM A569 and must be approved by the appropriate controlling agency (i.e. SCDOT, railway corporation, etc.) and the City Engineer prior to ordering.

4. **STEEL REINFORCING FOR CONCRETE**

a) **BARS:** All reinforcement bars shall conform to ASTM A615. All bars shall be deformed and of structural grade 60. All splices shall be lapped 24 diameters unless otherwise noted.

b) **WIRE:** All reinforcement wire fabric shall conform to ASTM A185.

M. **STONE AND BRICK**

1. **BRICK:** All brick used to construct or adjust manholes, frames, vaults, or boxes shall be made from concrete, shall be solid only, and shall be of standard building size. All brick shall meet or exceed the compressive strength and water absorption properties as specified in ASTM C139.

2. **GRANULAR BEDDING MATERIAL:** All bedding material shall be angular, clean washed crushed stone graded in accordance with Size #67 in ASTM D448 or SCDOT Standard Size #67. Bedding material will be used only as instructed in the specifications and/or as specifically directed by the Engineer.

3. **RIP RAP:** All rip rap shall consist of clean, field stone or rough unhewn quarry stone, resistant to the action of air and water, varying in weight from 25 to 250 pounds with 60% weighing a minimum of 100 pounds each and no more than 5% weighing less than 50 pounds each (SCDOT Class 2 Rip Rap). Rip rap will be placed from a minimum of 4.0 feet below the toe of the bank to top of the bank in areas determined by field conditions. Rip rap thickness shall be 1-1/2 times the diameter of the largest stones used, or as directed by the Construction Drawings.

4. **SILT CHECK DAM MATERIAL:** Material shall be coarse angular, clean washed, crushed stone, gravel or rock, well-graded, and ranging in size from 2-inches to 6-inches, or SCDOT stone for erosion control, Class A.

5. **STONE STABILIZATION MATERIAL:** All stone stabilization material shall be angular, clean washed crushed stone graded in accordance with standard sizes #67 in ASTM D448 or SCDOT Standard Size #67. Stabilization material will be used only as instructed in the specifications and/or as specifically directed by the Engineer.

N. **DEFECTIVE MATERIALS AND WORKMANSHIP:** Any cracked or broken material, such as pipe, fittings, valves or hydrants, shall be removed and replaced with sound pieces, at the expense of the Contractor. Joints that leak shall be carefully remade. Remade joints and replaced material shall be retested under the same conditions of operation. If joints or materials are then found to be defective, they shall be remade and replaced until the line passes the required test.

### III. CONSTRUCTION SPECIFICATIONS

#### A. ABANDONMENT

1. **GENERAL:** The following requirements shall apply for proposed abandonment of existing facilities, unless otherwise shown on the Construction Drawings or approved by the Engineer. All areas disturbed by abandonment will be restored.
2. **PIPE:** Piping to be abandoned-in-place shall be cut and plugged on the ends and completely filled with flowable fill as indicated on the Construction Drawings. If existing pipe to be abandoned is less than 8 inches in diameter and has less than 5-feet of cover, then the pipe shall be removed and the trench backfilled with suitable material, unless otherwise approved by the City Engineer.
3. **APPURTENANCES:** Valves, hydrants, meters, services, and other water main appurtenances to be abandoned shall be removed and the excavations backfilled with suitable material.
4. **FLOWABLE FILL:** Placement of flowable fill may be by grouting techniques in pipelines or other restricted areas, or as mass placement by chutes or tremie methods in unrestricted locations with open access.
5. **BACKGROUTING:** Backgrouting is secondary stage pressure grouting to ensure that voids have been filled within abandoned pipes. Backgrouting will only be required at critical locations indicated on the Construction Drawings or if there is evidence of incomplete flowable fill placements.

#### B. HANDLING AND STORAGE OF MATERIALS

1. **GENERAL:** The Contractor shall be responsible for the safe storage of materials furnished by or to him, and accepted by him, and intended for the Work, until they have been incorporated into the completed project. The interior of all pipe, valves and other accessories shall be kept free from dirt and foreign materials at all times. The City Inspector has the right to reject any and all material based on its storage and handling.
2. **TRANSPORTATION OF MATERIALS AND EQUIPMENT:** All materials furnished by the Contractor shall be delivered and distributed at the site by the Contractor or his material supplier. The Contractor and his Supplier are directed to contact the SCDOT to verify axle load limits on State-maintained roads (and bridges) which would be used for hauling of equipment and materials for the Project. The Contractor and his Suppliers shall do all that is necessary to satisfy the SCDOT requirements and will be responsible for any damage to said roads which may be attributed to this project.
3. **HANDLING:** Proper and suitable tools and equipment shall be used for the safe and convenient handling and laying of pipe. Pipe, fittings and other materials shall be carefully handled so as to prevent breakage and as to prevent damage to the interior lining and coatings on the pipe and fittings. Pipe shall not be unloaded by rolling or dropping off of trucks or cars, but shall be handled by carefully lifting and lowering into position, using approved slings or clamps

which shall be provided by the Contractor or material manufacturer for the purpose. Pipes and fittings shall be carefully examined for cracks, broken lining and 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 sound material at the expense of the Contractor. If any part of the coating or lining is damaged; the repair shall be made by the Contractor at his expense in a manner satisfactory to the Engineer. All pipe and fittings shall be thoroughly cleaned before being laid and shall be kept clean until accepted as completed work.

4. **LOADING AND UNLOADING:** Personnel and equipment for unloading, transporting, distributing and storing materials shall be furnished by the Contractor. The Contractor is responsible for the coordination of material deliveries and for providing appropriate staging and or lay-down areas. Ductile iron pipe and cast iron accessories shall be loaded and unloaded by lifting with hoists or skidding so as to avoid shock or damage. Other pipe and materials shall be loaded and unloaded with hoists and/or as recommended by the respective manufacturers. Under no circumstances shall such materials be dropped. Pipe handled on skidways shall not be skidded or rolled against pipe already on the ground.

5. **DISTRIBUTING:** Materials shall be distributed and placed so as to least interfere with traffic. The Contractor shall furnish and maintain proper warning signs and lights for the protection of traffic along highways, streets and roadways upon which material is distributed. No distributed materials shall be placed in drainage ditches.

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

b) Contractor will string in advance no more than the amount of pipe and material that can be installed within four (4) weeks or less, as approved by the Engineer. All materials shall be placed in such a manner as not to hinder access, endanger or impede traffic, or create a public nuisance. Materials strung through residential areas (or any area with maintained lawns) shall be placed in such a manner as not to restrict normal maintenance of established lawns, and must either be installed within two (2) weeks or removed to an approved storage yard, as required by the Engineer.

6. **STORAGE:** All pipe, fittings and other materials that cannot be distributed safely along the route of the work shall be stored for subsequent use when needed. The Contractor shall make his own arrangements for the use of storage areas. Unless prior written consent from the owner of the proposed storage area is received by the City Engineer, the Contractor will be required to store all equipment and materials within the limits of the right-of-way, permanent easement, and temporary construction easement provided. The materials and equipment storage shall comply with all local and state ordinances throughout the construction period. Material and equipment may only be stored within road rights-of-way if approved by the controlling agency. PVC pipe shall not be exposed to direct sunlight for inordinate periods of time.

**C. WATER SYSTEM INSTALLATION:** The Contractor shall assemble, joint and lay all ductile iron pipe and fittings in accordance with the following:

1. **GENERAL:** Installation of all water lines and appurtenances shall be conducted in accordance with the requirements of AWWA Section C and/or manufacturer's recommended

installation procedures. All installation practices shall be in accordance with the State Primary Drinking Water Regulations unless as noted.

a) PIPE shall be laid in a workmanlike manner, true to line and grade. Any water pipe with less than 4 feet of cover to finished grade shall be ductile iron with a minimum cover of three feet. Additionally, any water pipe laid with 12 feet to 18 feet of cover shall be ductile iron. No water line shall be installed with more than 18 feet of cover. All pipe laid outside the road right-of-way shall be ductile iron. Pipe laid within the roadway may be PVC.

b) OVERNIGHT COVER: During construction all vault, hydrant or other ground openings shall be covered at the end of each day. For sidewalls, use wing-nut type plugs to secure openings. Trenches shall be covered or backfilled at the end of each working day.

c) CONTAMINATED AREAS: All water mains shall be located outside contaminated areas. Re-route line if possible. If the main must run through a contaminated site, the main material must protect the water system from being contaminated (e.g. Ductile Iron Pipe with chemical resistant gaskets).

d) EASEMENTS/RIGHTS-Of-Way: Pipe shall be installed in dedicated easements or public rights-of-way. The minimum easement width for water main shall be 20 feet; however, this may be increased to accommodate large-diameter pipe or burial greater than standard depth. See City Standard Details for additional information.

e) UTILITY CROSSINGS: All crossings with other utilities shall be made with ductile iron pipe.

2. LOCATION AND GRADE: The line and grade of the water main and appurtenances will be given by the Engineer. The location shall be in agreement with approved Construction Drawings. Any substantial deviation shall be subject to approval by the City Engineer.

a) The water main shall be laid and maintained to the required lines and grades with fittings, valves and hydrants at the required locations; spigots centered in bells; and all valves and hydrant stems plumb. Necessary lines, levels and grades will be given by the Engineer but the Contractor shall be responsible for accurately transferring such lines and grades to the work. This work by the Contractor shall be subject to frequent checking by the Engineer and City personnel.

b) All water mains shall be provided with a minimum forty-eight (48) inches of cover. Where this is not possible, pipe shall be ductile iron or other approved material and method approved by the Engineer, and, when necessary, insulated to prevent freezing. The Contractor may be required to vary the depth of pipe to achieve minimum clearance from existing utilities while maintaining the minimum cover specified, whether or not the existing pipelines, conduits, cables, mains, etc. are shown on the Construction Drawings. Water lines in excess of 12 feet of cover shall be ductile iron and shall be subject to approval by the City Engineer.

c) When the water line is constructed in the road right-of-way, it shall be in conformance with the City of Rock Hill Utility Location Plan and applicable encroachment

permits. All pipe laid outside the road right-of-way shall be ductile iron. In some cases depending on soil types and the presence of other utilities with cathodic protection, 16 mil polyethylene pipe wrap, or PVC pipe may be required for use. Metal water lines crossing or within 10 feet of utilities with cathodic protection shall be designed to protect the water line and shall be approved by the City Engineer.

d) Potable water lines shall not be laid less than 25 feet horizontally from any portion of a wastewater tile-field or spray-field, or shall be otherwise protected by an acceptable method approved by SCDHEC.

e) In general, alignment and gradient for pipe shall be straight; however, pipeline may be laid on a curve but must be within the limits of curvature as recommended by the pipe manufacturer, both horizontal and vertical.

f) Blow-offs shall not be directed toward creeks or other water bodies without proper precaution being taken to dechlorinate prior to discharge.

3. **PLACEMENT:** All pipe, fittings, valves and hydrants shall be carefully lowered into the trench piece by piece by means of a backhoe or other suitable means, in such a manner as to prevent damage to protective coatings and linings. Under no circumstance shall water main materials be dropped or dumped into the trench.

4. **REUSING PIPE:** Water mains that have been previously used for conveying potable water may be reused provided they meet applicable criteria from AWWA Section C, ANSI/NSF 61, and ASTM D1785 or D2241. The mains must be thoroughly cleaned and restored practically to their original condition.

5. **DETECTION OF MAINS:** All mains shall be detectable within three (3) feet with electronic locating equipment. Non-metallic pipes shall be installed with solid, UL-approved 14-gage (min) copper tracer wire running along the centerline of the pipe or other means of detection. Wire shall be brought up into the valve boxes and bare wire connected to a valve bolt. Warning tape shall be placed 1-foot over top of water mains.

6. **CREEK CROSSINGS:** Creek crossings and other applications may require a specialized section of pipe (e.g., long-span steel pipe with specialized joint restraint). Each such crossing shall be addressed on a case-by-case basis and approved by the City Engineer.

a) **ABOVE GRADE CROSSINGS:** For pipe crossing above creeks, streams and other bodies of water, pipe shall be adequately supported and anchored, protected from damage and freezing, and accessible for repair or replacement.

b) **BELOW GRADE CROSSINGS:** For pipe crossing under creeks, streams and other bodies of water, a minimum of two feet (2') of cover shall be provided over the pipe. When crossing water courses that are greater than fifteen feet (15') in width, the pipe and material shall be designed appropriately, valves shall be located on both sides of crossing to isolate for testing and repair that are easily accessible and not subject to flooding, a blow-off shall be provided on the side opposite the supply service (directed away from creeks and over ground), and ductile iron pipe with mechanical joints shall be used for any lines being installed in rock.

## D. PIPE INSTALLATION

### 1. DUCTILE IRON PIPE AND IRON FITTINGS

a) GENERAL: The Contractor shall assemble, joint and lay all pipe and fittings in accordance with AWWA C600.

b) CUTTING DUCTILE IRON: Whenever ductile iron pipe or special castings are required to be cut, the cutting shall be done by skilled workmen, using an abrasive wheel cutter. Use of oxyacetylene torch will not be permitted. Pipe that is cut in the field must be ground and beveled before assembly and cut to leave a smooth end at right angles to the axis of the pipe. The plain end shall be beveled; any sharp edges that might damage the gasket shall be removed by means of a file or power grinder.

### 2. PVC PIPE AND IRON FITTINGS

a) GENERAL: The Contractor shall assemble, joint and lay all pipe and fittings in accordance with AWWA C605.

b) CUTTING PVC PIPE: Whenever pipe or special castings are required to be cut, the cutting shall be done by skilled workmen, using an abrasive wheel cutter. Pipe that is cut in the field must be ground and beveled prior to assembly and cut to leave a smooth end at right angles to the axis of the pipe. The plain end shall be beveled; any sharp edges that might damage the gasket shall be removed by means of a file or power grinder.

### 3. COPPER PIPE AND FITTINGS

a) GENERAL: For copper pipe Install pipe and tube without springing, forcing or stressing the pipe, tube, or any connecting valves. Provide pipe hangers and supports for pipe and tube where installed aboveground, in vaults, and structures. Use soldered joints and fittings with copper water tube in buried and exposed service. Use threaded joints and fittings with brass or copper piping in buried and exposed service.

b) INSTALLATION

(1) Cut tubing square and remove burrs. Use a sizing ring on the ends of soft copper tubing and bring to true dimension and roundness.

(2) Joints shall be watertight. Remove foreign matter and dirt from inside the tubing and keep clean during and after laying.

(a) Clean surfaces to be soldered with fine emery cloth, cleaning pads, or special wire brushes. Make soldered joints in accordance with ASTM B828. Solder shall penetrate to the full depth of the cup in joints and fittings.

(b) Clean threaded joints by wire brushing or swabbing. Apply Teflon joint compound or Teflon tape to male pipe threads before mating threaded joint.



- (3) Bends in soft copper tubing shall be long sweep. Shape bends with shaping tools, without flattening, buckling, or thinning the tubing wall.

## E. JOINT AND FITTING INSTALLATION

1. **GENERAL:** The location of bends, joints, and fittings indicated on the Construction Drawings are a guide. The Contractor will be required to furnish additional bends and fittings as needed to complete all installations.
2. **PERMISSIBLE DEFLECTION OF JOINTS:** Where ever it is necessary to deflect pressure pipe from a straight line, either in the vertical or horizontal plane, to avoid obstruction or plumb valve stems, or where long radius curves are permitted, the amount of deflection allowed shall not exceed that required for satisfactory sealing of the joint as recommended by the manufacturer, and shall be approved by the Engineer.
3. **PUSH-ON JOINT PIPE:** The gasket groove and bell socket shall be cleaned and lubricated, and the gasket inserted as specified by the pipe manufacturer. Sterile lubricant, as furnished or specified by the manufacturer shall be applied to the gasket and beveled spigot end of the pipe. The beveled spigot end of pipe shall be pushed straight into bell using either a bar, jack, lever, puller, or backhoe. A timber header will be placed between the jack or backhoe bucket and the pipe to prevent damage to the pipe. At no time will the joint be made by swinging the pipe. The pipe will be deflected, if required, after the joint is made.
4. **MECHANICAL JOINT PIPE AND FITTINGS:** All spigots shall be centrally located in the bell and adequate anchorage shall be provided where abrupt change in direction of dead ends occur. All pipe surfaces with which the rubber gasket seals come into contact will be brushed with a wire brush just prior to assembly in order to remove all loose rust or foreign material and to provide a clean surface of the installation of the gasket. The pipe surface with which the gasket comes into contact will be brushed with soapy water just prior to the installation of the gasket and the making up of the joint. When tightening bolts, the gland will be brought up toward the pipe flange evenly, maintaining approximately the same distance between the gland and the face of the flange at all points around the socket.

## F. CONNECTIONS

1. **CONNECTIONS TO EXISTING PIPELINES:** Connections to existing pipelines shall be made with necessary fittings and valves as indicated on the approved Construction Drawings. The Contractor shall, before opening pipeline trenches, locate the various points of connections to be made into existing pipelines.
  - a) When a tapping sleeve and valve is installed, the coupon from the existing water main shall be submitted to the City. The coupon must be marked indicating the date and time of the tap and the location.
  - b) Only one (1) connection between the existing system and the new extension will be allowed until testing, chlorination, and successful sampling of the new extension is complete.
  - c) Contractor shall verify blocking at existing valves prior to making connections

and will be required to block, rod, or restrain existing and new pipe, fittings and valves as necessary.

d) Coordinate with the City Inspector to be present during exposure and tapping of the existing water main. Contact Inspector and Engineer a minimum of 48 hours prior to exposure.

2. SERVICE CONNECTIONS: Once service connections are approved and all fees paid to the City of Rock Hill, connections for water service can be made.

a) Service lines will be made perpendicular to the water main unless otherwise approved. All taps will be made substantially as shown on the Standard Details. Service connections shall be installed prior to pressure testing and sterilization of the main. Allowance for joints in service connection will be included when computing the allowable leakage. The contractor shall flush each connection after testing and sterilization is complete.

b) Service lines will be installed with a minimum depth of cover of 24 inches and a maximum depth of cover of 30 inches.

c) Multiple service taps shall have a minimum of 24 inches of separation between taps and shall be located on planes at least 12 inches offset.

d) Service connections to the main piping shall be made by using tapping saddles threaded to accept corporation stops.

e) Meter boxes and locations shall be as shown on the Standard Details. In areas with sidewalks or proposed sidewalks, the meter boxes are to be set outside the sidewalk area on the property-owner side of the sidewalk. Meter boxes shall not be set in driveway locations.

f) The location of the services will be identified by the letter "W" imprinted into the curb adjacent to the service. Where a service is moved or removed, the "W" will be removed from the curb or grouted over.

g) For services 3-inches and larger, the Contractor shall consult with the City Inspector to determine the location of meter vaults prior to the installation.

h) The City requires the property owner or developer to perform the tap to the main. There are no tap fees associated with this work. Contractors performing taps to the City's main(s) must contact the City's Planning and Development Services Engineer to schedule an inspection and witness pressure testing of the tapping sleeve and valve.

3. INTERCONNECTIONS AND CROSS CONNECTIONS

a) INTERCONNECTIONS: The approval of SCDHEC shall be obtained for interconnections between potable water supplies.

b) **CROSS CONNECTIONS:** There shall be no connection between the water distribution system and any pipes, pumps, hydrants, or tanks whereby unsafe water or other contamination materials may be discharged or drawn into the system.

c) **DEVICES:** Backflow Prevention Devices (BPD) shall be installed in accordance with the SCDHEC Backflow Prevention Manual. All piping up to the inlet of the BPD must be suitable for potable water. The pipe must be AWWA or NSF approved. Black steel pipe cannot be used on the inlet side of the device.

(1) No by-passes shall be allowed, unless the bypass is equipped with an equal, approved BPD.

(2) High-hazard category cross-connections shall require an air gap separation or an approved reduced pressure principal (RPP) backflow preventer.

(3) RPP 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 BPD. The drain cannot empty into any ditch or sewer, which could flood water back into the pit.

(4) 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. Double Check Valve Assembly (DCVA) can be located in the building's mechanical/riser room or in a vault. If installed in a vault, the installation shall be in accordance with the City's Standard Detail.

d) **COOLING WATER:** Neither steam condensate nor cooling water from engine jackets or other heat exchange devices shall be returned to the potable water supply.

e) **WATER LOADING STATIONS:** To prevent contamination of the public supply, the following criteria shall be met:

(1) Air Gap - A device shall be installed on the fill line to provide an air break and prevent a submerged discharge line.

(2) Hose length - The fill hose and cross connection control device must be constructed so that when hanging freely it will terminate at least two (2) feet above the ground surface.

(3) Fill line terminus - The discharge end of the fill line must be unthreaded

4. **INTERRUPTION OF SERVICE:** Connections to existing pipelines shall be made only at such times and in such manner as will meet operating requirements. No cut shall be made in existing lines until the permission of the City Engineer has been obtained as to time and manner of making the cuts and connections. All existing valves shall be operated only by authorized representatives of the City. If connections to existing mains will necessitate an interruption of service, the Contractor will schedule the connection for a time that is most convenient to the affected customers as determined by the Engineer. Adequate notice will be provided to those customers

who will be put out of service by the connection. When such interruption of service is approved, the Contractor will have all required labor, material and equipment at the site before beginning any work and the service interruption will be kept to an absolute minimum.

5. JUMPER CONNECTION: Contractor shall use a jumper connection as shown in the Standard Details for the purpose of filling a newly constructed line with water to prepare it for testing and disinfection.

## G. FIRE HYDRANT ASSEMBLIES

1. COVER: Hydrants shall have a 3-foot depth of cover over the leader pipe. However, if the hydrant is located so as to require additional cover, extension sections shall be furnished and installed.

### 2. GENERAL CONSTRUCTION

a) Hydrant assemblies shall be installed plumb and in accordance with the Standard Details at locations shown of the Construction Drawings and/or as directed by the Engineer.

b) The operating nut shall be totally sealed away from the hydrant barrel and all working parts shall be continuously and automatically lubricated from a large oil reservoir and packing gland. Drain mechanism shall be simple, positive, and automatic in operation.

c) 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 construction of the flange and coupling shall be such as to permit rapid and inexpensive replacement. They shall be located above the ground line. The force of the impact of a traffic accident shall break the flange and spread the coupling. Hydrant shall be constructed as to permit facing nozzles in any direction at any time without digging up the hydrant or cutting off the water. This shall be accomplished by removing safety flange bolts and rotating the head.

d) All working parts, including the seat ring shall be removable and through the top without digging.

e) Hydrants shall be set to grade such that a wrench may turn the hose connection covers in any direction, at any time, without impacting the ground.

f) Each hydrant installation shall include a drainage bed of clean washed stone approximately 1 cubic foot in size at the "weep hole." Piping from the main to the hydrant shall be 6-inch (minimum size) DIP.

H. VALVES AND VALVE BOXES: Sufficient valves shall be provided on water mains so that customer inconvenience and sanitary hazards will be minimized during repairs. No valve is required at the right-of-way or easement line if a valve is provided at the main tap location. Valves located within a street shall be located outside the wheel travel paths. At intersections, valves shall be located on the side of the less traveled street.

1. **AIR RELIEF VALVES (ARV):** Air relief valves shall be installed at the high points shown on approved Construction Drawings on 12-inch and larger mains. The installation shall include the corporation stop, necessary piping, valve vault with manhole frame and cover and appurtenances. All valves shall be tested in accordance with AWWA Standards.
2. **RESILIENT-SEAT GATE VALVES:** Valves shall be for vertical installation only, with square operating nut and non-rising stem.
3. **VALVE BOXES**
  - a) A valve box conforming to the Standard Details shall be installed for every gate valve. The valve box shall not transmit shock or stress to the valve and shall be centered plumb over the operating nut, with the box cover flush with the surface of the pavement or other existing surface.
  - b) Where the box is not set in a paved surface, the top section shall be anchored by a concrete pad, set flush with the existing terrain. The top section will be grouted into the concrete pad. The location of valves will be identified by the letter "V" imprinted into the curb adjacent to the mainline or hydrant valve.

I. **BLOCKING/RESTRAINTS:**

1. **BLOCKING:** All tees, bends, plugs and hydrants on lines 2 ½ inches in diameter and larger shall be provided with reaction blocking, tie rods or other approved restraining methods to prevent movement.
2. **VALVE BLOCKING:** All end of line valves 12-inch and smaller installed on PVC or ductile iron water mains and all 12-inch valves installed along PVC water mains shall be securely wedge blocked with concrete bearing against, and cut into the excavated sides of the trench. Care shall be taken in forming and pouring the "wedge" blocking so the fitting joints will be accessible for repair and/or valve extraction.
3. **BLOCKING/RESTRAINT FITTINGS:** Thrust blocking or mechanical restraints must be specified for all plugs, caps, tees, and bends deflecting 11-1/4 degrees or greater on lines 2 ½ inches in diameter and larger, for all post hydrants on lines 3 inches in diameter and larger, and for all hydrants on lines 6 inches in diameter and larger. Blocking and/or restraints must be placed as shown on the Construction Drawings and/or as directed by the Engineer. Blocking shall consist, of ready mix concrete having a compressive strength of not less than 3,000 psi at 28 days.
  - a) Bagged mix concrete may be used for blocking, anchorage, concrete valve pads, etc. on water mains and valves 12-inch and smaller, when less than ½ yard is required.
  - b) Blocking shall be placed between solid ground and the fittings to be anchored. The area of bearing on the pipe and on the ground in each instance shall be that shown or directed by the Engineer. The blocking shall be placed that the pipe and fittings will be accessible for repair.
  - c) Restrained joints shall be installed where shown on the Construction Drawings, Standard Details, or when approved by the Engineer, and may be installed in lieu of

blocking. Installation shall be per manufacturer's recommendations, as shown on the Construction Drawings, special provisions, and/or as directed by the Engineer. Restrained joints will not be allowed on PVC pipe.

## J. CLEANING, FLUSHING AND DISINFECTION

1. **CLEANING:** All dirt and foreign material must be cleaned from each joint of pipe or fitting while it is suspended, before it is lowered into the trench. The Contractor shall also, before the system is accepted, thoroughly clean all lines.

2. **FLUSHING:** The design shall provide for a readily accessible means of flushing all water lines at a minimum velocity of 2.5 fps. 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, or a readily accessible blow-off valve in a box for flushing purposes, except for the following cases and also must have prior approval from the Engineer:

b) Lines 1-inch diameter and smaller will not require blow-offs. Lines 2 inches in diameter and shorter than 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.

c) 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 25 psi.

d) Design head loss calculations, including elevation changes shall show 25 psi minimum residual when instantaneous demand occurs or 20 psi minimum residual when either fire flow or flushing flow in excess of peak hourly flow occurs, whichever is greater.

e) Lines 10 inches and larger require flows in excess of 500 gpm to achieve a 2.5 fps scouring velocity. This would require a standard fire hydrant or other approved blow-off, for flushing which must be designed to provide at least 500 gpm in excess of peak hourly flow and a minimum residual pressure of 20 psi.

f) No flushing device shall be directly connected to any sewer.

3. **DISINFECTION**

a) **GENERAL:** All pipelines and appurtenances, both existing and newly constructed which have been exposed to contamination by reason of construction, shall be sterilized after testing and flushing of the lines has been completed. The Contractor shall notify the City before chlorination to ensure that precautions are taken to not allow the backflow of water into the existing system.

b) Disinfection of all new water mains shall be in accordance with AWWA C651 and ANSI/NSF Standard 60 for the disinfection of water mains.

c) A BPD shall be utilized to supply water from the City's water system to the new

water line extension. Lines shall be filled and flushed to clear the lines of any debris. Lines shall then be filled with fresh water containing 50 parts per million of chlorine and allowed to stand for a period of 24 hours. 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 10 ppm free chlorine, or the procedure must be repeated. Lines shall then be flushed slowly and uniformly at a controlled rate, at which time a sample shall be collected for bacteriological examination. No flushing device shall be directly connected to any sewer.

d) The Contractor shall collect a minimum of two (2) samples from each sampling site for total coliform analysis. The number of sites depends on the amount of new construction but must include all dead-end lines, be representative of the water in the newly constructed mains, and shall be collected a minimum of every 1,200 linear feet. Prior to sampling, the chlorine residual must be reduced to normal system residual levels or be non-detectable in those systems not chlorinating. These samples must be collected at least twenty-four (24) hours apart and must show the water line to be absent of total coliform bacteria. The chlorine residual must also be measured and reported. All samples must be analyzed by a State certified laboratory.

e) No line shall be placed into service without the consent of the City Engineer and SCDHEC.

#### K. PROXIMITY TO SEWER INFRASTRUCTURE

1. GENERAL: All installation practices shall be in accordance with Section R61-58.4D of the State Primary Drinking Water Regulations when installing water supply infrastructure in the vicinity of sanitary sewer.

2. PARALLEL INSTALLATION: Water mains shall be laid at least ten (10) feet horizontally from any existing or proposed sewer (gravity or force main). The distance shall be measured edge to edge. In cases where it is not practical to maintain a ten foot separation, any deviation shall be authorized by SCDHEC 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. If these condition are not able to be met or an alternative design is not feasible, the sewer pipe shall be replaced and the water line laid such that the distances between joints of water and sewer pipe is maximized and the sewer pipe shall be replaced with ductile iron pipe.

a) There shall be no physical connection(s) between a public or private potable water supply and a sanitary sewer collection system.

b) Sanitary sewer service lateral piping shall be installed no closer than 10 feet as measured horizontally from water service piping.

3. 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.

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

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

5. FORCE MAINS: There shall be at least a ten (10) foot horizontal separation between water mains and sanitary sewer force mains. There shall be an eighteen (18) inch vertical separation at crossing as required in R.61-58.4(D).

6. SEWER MANHOLES: No water pipe shall pass through or come in contact with any part of a sewer manhole. Water lines may come in contact with storm sewers 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 sewer or catch basin and the joints are located as far as possible from the storm sewer or catch basin.

7. DRAIN-FIELDS AND SPRAY-FIELDS: Potable water lines shall not be laid less than twenty-five (25) feet horizontally from any portion of a waste-water tile-field or spray-field, or shall be otherwise protected by an acceptable method approved by SCDHEC.

L. PROTECTION OF OTHER UTILITIES AND STRUCTURES: Before beginning any excavation for installing water infrastructure, the Contractor shall locate or cause to have located any water, sewer, gas or other utilities as necessary to avoid conflicts. The Contractor shall excavate and expose existing underground utilities in advance of trenching operations to determine the precise location of the utilities or other underground obstructions shown on the Construction Drawings. Such location and excavations shall be at least 500 feet ahead of the construction, unless otherwise noted. Conflicts with existing utilities shall be reported to the Engineer and conflicting utility's owner for resolution. Changes to the alignment and/or grade of the water piping shall be submitted to the City Engineer for review and approval.

1. All utility owners will be notified prior to excavation as required by the 1985 Underground Damage Prevention Act. To aid in the location of existing utilities, Contractor shall contact the South Carolina Utility Protection Service (PUPS) by telephone or posting a utility location requires on the PUPS website. The following information is provided by PUPS.

- a) "South Carolina State Law requires the excavator, when planning any activity that results in the movement or removal of earth, rock, or other materials in or on the ground to contact South Carolina 811 and any non-member company with adequate information regarding the excavation.



b) At least 3 full working day notice at 11:59 pm (not including the day of the call) prior to digging, call SC 811 by dialing 811 or (888) 721-7877. A SC811 representative will record the location of the digging site and notify member companies of your intent to dig. Each member company will then send either one of their employees or a contract locator to your dig site to mark the location of their underground facilities lines.

c) Once the lines have been marked, you may begin carefully to dig, keeping in mind the 2 feet allowance on either side of the markings. [(a) if the diameter of the facility is known, the distance of one-half of the know diameter plus twenty-four inches on either side of the designated center line; (b) if the diameter of the facility is not marked, twenty-four inches on either side of the outside edge of the mark indicating a facility; or (c) for subaqueous facilities, a clearance of fifteen feet on either side of the indicated facility}. Not all utilities are members with SC811. If a utility is not named, please contact them directly.

d) Remember: Call 811, wait the required time, respect the marks, and dig with care!”

2. Prior to final acceptance by the City of the water utility being constructed, the developer/owner shall be responsible for the integrity of the utility and for locating the utility until final acceptance by the City. Final acceptance shall include written documentation, permits to operate, copies of record drawings, and other requirements so listed by the City.

3. Crossings:

a) Whenever a water main crosses under other utility lines (gas, telephone conduit, storm drain, etc.), there shall be 2-feet clearance between the top of the water and the bottom of the affected utility. Stone bedding shall be used from 6-inches below the water to 12-inches above the water from one foot outside the utility trench. If this clearance is not possible, the water line shall be ductile iron pipe 1-foot outside the utility trench, with a minimum length of 10 feet.

b) Whenever a water main crosses over other utility lines (gas, telephone conduit, storm drain, etc.), there shall be one foot clearance from the top of the utility to the bottom of the water for PVC water lines. If this clearance is not possible, the water line shall be ductile iron pipe from 1-foot outside the utility trench, with a minimum length of 10 feet.

4. The Contractor shall be solely responsible for the repair and payment of penalties for any damage made to existing utilities as a result of the work.

## M. SYSTEM TESTING

1. GENERAL: All required testing of pipelines and valves shall be done under the direct supervision of the City Inspector and must be conducted in accordance with AWWA C600 and C605. Field testing shall not negate the requirements for material certifications as contained in these specifications unless otherwise directed by the Engineer. All testing and disinfection shall be completed prior to connection to any existing line. Contractor shall be responsible for providing all equipment, personnel, and ventilation necessary to comply with OSHA confined space regulations.

2. TESTING AND CLEANING: When a length of pipe is deemed adequate for testing, the line shall be filled and thoroughly exhausted of air and a leakage test made. The Contractor shall furnish all labor, materials and equipment for carrying out these tests. Wherever conditions will permit, pipelines shall be tested before the trench is backfilled. All joints then shall be examined during open trench test and all leaks entirely stopped. The Contractor shall furnish a test pump, a means for accurate measurement, of water introduced into a line during testing, and shall furnish and install corporation stops at all high points in the line and at the test pump location as required for exhausting the air.

3. TEMPORARY BULKHEADS: The Contractor shall furnish, install and remove all temporary bulkheads, flanges or plugs, to permit the required pressure tests, and shall furnish all equipment and labor to properly carry out such tests and to replace defective material. City Inspector shall be present during installation of bulkheads and during the removal of the bulkheads.

4. TEST PRESSURE AND LEAKAGE: The Contractor shall give the City Inspector a 48-hour notice before starting test. On completion of the line or sections of the lines, connections and appurtenances, the line shall be filled and hydrostatically tested. All air shall be released from the system prior to testing. Test pressure shall be 1.5 times the maximum working pressure in the system (i.e. 150 psig) and 150 psig minimum as measured at the lowest point of elevation of the section of line being tested. Testing time shall be a minimum two (2) hours. Leakage shall not exceed the allowable leakage shown AWWA C600 and C605 or calculated by the formula:

For Ductile Iron Pipe:

$$G = \{S * D * (P^{1.5})\} / 148,000$$

Where: L = allowable leakage, in gallons per hour  
 S = length of pipe tested, in feet  
 D = nominal diameter of pipe, in inches  
 P = average test pressure (psig) = 150 psig

For PVC Pipe:

$$L = \{N * D * (P^{1/2})\} / 7,400$$

Where: L = allowable leakage, in gallons per hour  
 N = # of joints of pipeline being tested  
 D = nominal diameter of pipe, in inches  
 P = average test pressure (psig) = 150 psig

Note: Add 0.0043 gph for each ¾-inch service and 0.0057 gph for each 1-inch service.

All visible leaks shall be repaired regardless of the amount of leakage, and test will be repeated until it passes.

N. GENERAL CONSTRUCTION

1. CLEARING & GRUBBING: The Contractor shall perform all clearing necessary for installation of the complete work. Clearing shall consist of removing all trees, stumps, roots, brush and debris in the way of the work. Temporary Construction easements shall be selectively cleared with specimen trees left standing.

2. **DISPOSAL:** All excess and waste material shall be legally disposed in a satisfactory manner. Burning shall be in accordance with City Fire Department regulations and SCDHEC Regulations. When burning is allowed, the Contractor shall obtain a Burning Permit from the office of the City Fire Chief prior to any burning operations.

3. **REMOVAL OF PRIVATE OR PUBLIC FACILITIES:** Any private or public facilities, including fences, mailboxes, etc., removed for construction purposes shall be promptly replaced of the same material in the same or better condition than prior to construction. Trees or shrubbery along highways, roadways and streets shall not be disturbed unless absolutely necessary. Tree removal is subject to the approval of the City Engineer. Planting such trees or shrubs that are to be removed and replaced may be heeled in and replanted. Heeling and replanting shall be done under the direction of an experienced nurseryman and City Forester.

**o. CONSTRUCTION ALONG HIGHWAYS, STREETS AND ROADWAYS**

1. **GENERAL:** The Contractor shall install pipelines and appurtenances along publicly owned and maintained highways, streets and roadways in accordance with all applicable encroachment permits and City and SCDOT regulations, with reference to construction operations and requirements, safety, traffic control, road maintenance and repair.

2. **PROTECTION OF TRAFFIC:** The Contractor shall provide suitable signs, barricades and lights for protection of traffic, in locations where traffic may be endangered by construction operations. All highway signs removed by reason of construction shall be replaced as soon as the conditions that necessitated such removal have been cleared. No highways, streets or roadways shall be closed without first obtaining permission from the proper authorities. Before any roadway is blocked, the Contractor shall notify the City Engineer's office.

3. **CLOSURES:** In general, not more than one block of a street or roadway shall be closed for construction at any one time. Before proceeding with trenching operations in a succeeding block, the preceding section shall be backfilled, cleaned completely and the street opened to traffic. All planned road closures shall be reported in accordance with these specifications prior to closing any street, or for unplanned roadway closings, as soon as possible after the roadway has been closed.

4. **MAINTAINING HIGHWAYS, STREETS, ROADWAYS, AND DRIVEWAYS:** The Contractor shall furnish adequate personnel and proper construction equipment, which shall be available for use at all times, for maintaining highways, streets and roadways upon which work is being performed. All such highways, streets and roadways shall be maintained in suitable condition for movement of traffic until completion and final acceptance of the work. For temporary drive closures, the contractor is to coordinate the closure(s) with applicable property owner(s). The Contractor shall immediately repair all driveways that are cut or damaged and shall maintain them in a suitable condition for use until completion and final acceptance of the work.

5. **CONSTRUCTION OPERATIONS:** The Contractor shall construct all work along roadways using the sequence of construction operations, as to least interfere with traffic.

6. **REMOVING PAVEMENT:** The Contractor shall remove pavement as necessary for installing the new piping and appurtenances and for making connections to existing pipelines. Care shall be taken by the Contractor to avoid damage to pavement adjoining pavement removal

areas. If damaged, the Contractor shall remove the damaged pavement and shall replace it with new pavement at his own expense.

a) There may be instances where the City requires additional pavement removal and repair based on the condition of the road. In these areas, the City will contract with and negotiate the price with the Contractor for the damaged pavement removal and associated repair work to be completed. Should a portion of this work be completed by City forces, the Contractor shall work with the City in coordinating the work as the applicable Encroachment Permit allows.

7. **MARKING & CUTTING:** Before removing any pavement, the pavement shall be marked for cuts neatly paralleling pipelines and existing street lines taking into consideration existing pavement conditions. Pavement shall be saw-cut prior to removal to form a clean transition edge. Asphalt pavement shall be broken along the marked cuts by use of a jackhammer or other suitable tool. Concrete pavement and asphalt pavement on concrete base shall be scored to a depth of approximately 2" below the surface of the concrete along the marked cuts. Scoring shall be done by use of a rotary saw, after which the pavement may be broken below the scoring by use of a jackhammer or other suitable tool.

8. **STRIPPING:** Where the pipeline is laid along road shoulders, all sod, topsoil and other materials suitable for shoulder restoration shall be stripped and stockpiled for replacement.

9. **EXCAVATED MATERIAL:** Excavated Material shall not be placed along highways, streets and roadways in such a manner as to obstruct traffic. No scattered excavated material shall be allowed to remain on the pavement. All such material shall be kept swept away.

10. **PAVERS OR CURB:** The Contractor shall remove and replace or tunnel or bore under any paver areas or concrete/stone curb encountered along the project route. In any case, protection of the pavers' and curb and gutter's supporting foundation is the responsibility of the Contractor.

11. **MACHINE PULLING:** No pavement shall be machine pulled until completely broken and separated along the marked cuts.

12. **DRAINAGE STRUCTURES:** All side ditches, culverts, cross drains and other drainage structures shall be kept clear of excavated material and be free to drain at all times.

## P. EARTHWORK

1. **GENERAL:** The Contractor shall excavate, install piping and backfill and consolidate the trench backfill as quickly as possible to maintain safety within the construction site. Trenches 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. Backfill material and material consolidation shall meet SCDOT specifications, but in no case shall the consolidation be less than 95% maximum dry density for each layer of soil material-in-place as determined by ASTM D698 (Standard Proctor) test procedures. The Contractor shall so organize his work that backfilling and cleanup shall closely follow pipe laying operations and construction.

a) Excavations within street rights-of-way shall be backfilled when left unattended

for more than 1 hour, unless otherwise approved by the controlling agency.

b) Excavations within water rights-of-way/easement shall be backfilled, fenced, or otherwise protected when left unattended for more than 1 hour.

2. **TRENCH EXCAVATION:** Trench excavation shall include the removal of material necessary for the installation of the piping infrastructure and associated fittings and structures. Excavated materials that are not suitable for backfill material shall be removed from and legally disposed offsite.

a) **DEPTH OF TRENCHES:** The minimum cover over the top of the pipe shall be 3 feet, unless otherwise directed by the City Engineer and/or shown on approved Construction Drawings. If the minimum cover is not achieved, the pipe shall be made of ductile iron and meet the requirements of these specifications. Where obstructions are encountered, minimum depth may be changed to avoid interference. Where necessary to increase the depth of cover to avoid interference with underground utilities, obstructions and utilities services, the Contractor shall furnish all construction equipment and shall perform all labor required for additional trench depth.

b) **LENGTH OF OPEN TRENCH:** A maximum trench of  $\pm 100$  LF shall be open in advance of the pipe laying than is necessary to expedite the work, unless prior approval is given by the Engineer. Ground conditions and/or location requirements shall govern the amount of trench open at any one time as determined by the Engineer.

c) **WIDTH OF TRENCHES:** Trenches shall be excavated sufficiently wider than the infrastructure to be installed to allow for personnel and the preparation of the infrastructure foundation, installation of infrastructure and associated bedding, and to properly consolidate the backfill material including the pipe support bedding located under the pipe's haunches. In any case, the width of the trench is not to be narrower than 24 inches plus the outside diameter of the pipe.

3. **GENERAL EXCAVATION**

a) **BELL HOLES:** The trench bottom shall be true and even with bell holes at each joint to provide the barrel of the pipe with soil and/or granular (as applicable) support for its full length. If stone bedding of sufficient depth is not provided, the Contractor shall over-excavate the locations where the pipe bells rest so the entire length of the pipe will be uniformly supported.

b) **EARTH EXCAVATION:** Earth excavation shall include all excavation of whatever substance encountered, except rock excavation, as further provided in these specifications. The area excavated shall be limited to no more than is necessary to allow the proper installation of the structure as determined by the Engineer, and the excavation shall be made to the lines, grades and elevations shown on the Construction Drawings. In locations where pipe is to be bedded in earth excavated trenches and no stone is used for bedding the pipe, the bottoms of such trenches shall be fine graded to allow for a firm and uniform bearing for the bottom of the pipe. Where any part of the trench has been excavated below the engineered grade for the pipe, the part excavated below such grade shall be backfilled with sand and compacted at the Contractor's expense.

c) **BORE PITS:** Bore pit excavations shall be controlled by the limits of the existing rights-of-way and shall not exceed these without prior written approval of the property owner. The excavation shall be made to the proper elevation, line and grade as required to install the casing pipe as shown on the Construction Drawings. The pit bottom shall be true and even with adequate stabilization to maintain proper elevation and grade on the boring rig for the duration of the bore.

d) **ROCK EXCAVATION IN TRENCHES AND PITS** includes removal and disposal of materials and obstructions encountered which cannot be excavated with a 1.0 cubic yard (heaped) capacity, 42 inch wide bucket on track-mounted power excavator equivalent to Caterpillar Model 215, rates as not less than 90 HP flywheel power and 30,000 lb drawbar pull. Rock excavation shall comprise solid rock in the original bed, or in well-defined ledges, the removal of which in the opinion of the City Engineer requires drilling, blasting, or the use of jackhammers or bull-points, and shall also include boulders or detached pieces of rock 8 cubic feet or more in content. Trenches in excess of 10 feet in width and pits in excess of 30 feet in either length or width are classified as open excavations. Rock removal shall extend to be a minimum of 6 inches vertically and 12 inches horizontally from the piping to be installed.

#### 4. MATERIALS

a) Satisfactory soil materials are defined as those complying with ASTM D2487 soil classification groups GW, GP, GM, SM, SW, GC, SC, CL, ML and SP.

b) Unsatisfactory soil materials are defined as those complying with ASTM D2487 soil classification groups MH, CH, OL, OH, and PT.

5. **SHORING AND BRACING:** All shoring and bracing shall conform to all OSHA regulations. The specific type of shoring and bracing used shall be determined by the Contractor as to prevent caving of trench banks and to provide safe excavation.

6. **DEWATERING:** The Contractor shall at all times provide and maintain ample means and equipment with which to remove and properly dispose of any and all water entering the excavation or other parts of the work, and keep all excavation dry until such time as pipe laying and grading is completed and structures to be build therein are completed.

a) No water shall be allowed to rise around the pipe in unbackfilled trenches nor shall it be allowed to rise over masonry until the concrete or mortar has set (minimum 24 hours). All water pumped or drained from the Work shall be disposed in such a manner as to prevent siltation and erosion to adjacent property or other construction.

7. **BACKFILL:** All backfill shall be of non-plastic nature free from roots, vegetative matter, waste, construction material, rock larger than  $\frac{3}{4}$  cubic foot, or other objectionable material. Backfill material shall be capable of being tamped by mechanical tamps using relatively low velocity and heavy blows. Material deemed by Engineer to be unsuitable for backfill purposes shall be removed from the job site before backfilling operations begin and replaced with satisfactory soil materials as approved by the Engineer or directed by the permitting agency.

a) Continuous and uniform bedding shall be provided in the trench for all buried pipe. Backfill material shall be tamped in layers around the pipe and to a sufficient height

above the pipe to adequately support and protect the pipe. Stones, other than crushed bedding, shall not come in contact with the pipes and shall not be within 6-inches of the pipe.

8. **COMPACTION CONSOLIDATION REQUIREMENTS:** Compaction of the trench backfill is to conform to the more stringent requirements of the permit issuing authority and requirements herein. Contractor shall be responsible for ensuring the material is adequately compacted. Compaction shall be in accordance with the Standard Detail as determined by ASTM D698 (Standard Proctor) test procedures.

9. **CRUSHED STONE STABILIZATION AND BEDDING:** Crushed stone material shall conform to ASTM C33, as amended to date, gradation #67 (ASTM #67), varying in sizes 1/4" through 3/4". Stabilization and bedding material shall be placed in the trench and thoroughly compacted to grade by tamping. Compacted bedding material shall be carried up the sides of the pipe to the heights shown on the Standard Details.

a) Wherever the sub grade is by nature too soft or mucky, in the opinion of the City Engineer, for the proper installation of the pipe, the Contractor may be ordered to undercut the trench and backfill with crushed stone or gravel.

b) Crushed stone bedding material shall conform to ASTM C33, gradation #67 (ASTM #67), varying in sizes 1/4" through 3/4". Bedding material shall be placed in the trench and thoroughly compacted by tamping to the grade required for the particular location. Compacted bedding material shall be carried up the sides of the pipe to the heights necessary for the various classes of bedding.

10. **SHAPING:** The Contractor, immediately after completing backfilling operations shall re-shape any damaged cut and fill, slopes, side ditches and ditch lines, and shall replace topsoil, sod and any other materials removed from shoulders. When installing pipelines and appurtenances, the Contractor will be required to provide sufficient personnel and equipment so as to simultaneously carry out all of the above operations.

## Q. CONCRETE CONSTRUCTION

1. **PLACING OF CONCRETE:** Placing of concrete shall be in daylight hours. Concrete mixed at a central plant shall be transported to the job site as per ASTM C94 and placed within 90 minutes of the dispatch time. Concrete shall be deposited in such a manner so as to prevent contamination by foreign material and segregation due to re-handling or flowing. Free fall shall not exceed 3-feet. Concrete when placed shall be compacted with mechanical, internal-vibrating equipment and/or with hand spading with a slicing rod. Temperature shall be above 35 degrees Fahrenheit and rising by 10:00 AM for the placement of concrete. Depositing shall cease when the descending air temperature in the shade falls below 40 degrees Fahrenheit. If the temperature drops below 35 degrees after concrete is placed the Contractor shall enclose, heat and protect the concrete or Contractor shall replace the concrete at his own expense. Earth fill shall not be placed on concrete until concrete has been allowed to set for 24 hours. Exposed concrete shall have 3/4" chamfered corners.

2. **FORMWORK:** Formwork, where required, shall be built to conform to the shape, lines and dimensions of the concrete work as shown. Forms may be made of wood, plywood, metal or any

other material approved by the Engineer. Forms shall be mortar tight, of materials strong enough to resist noticeable deflection or bulging between supports, and the interior dimensions of the forms shall be such that the finished concrete shall be of the form and dimensions shown on the Construction Drawings. The design of the forms shall take into account the effect of the vibration of the concrete as it is placed and also the rate of speed at which the forms will be filled.

a) Mechanical vibrators of an approved type, and continuous spading and/or rodding of concrete shall be used to produce proper contact of concrete with forms and reinforcing steel in piers and with forms and pipe in monolithic inverts insuring a compact, dense, and impervious artificial stone of uniform texture.

3. **SETTING FORMS:** Forms shall be set to line and grade, and shall be braced, tied, and secured in a manner which will withstand placing of the concrete, and which will maintain shape and position. Forms shall be tight, and be substantially assembled to prevent bulging and the leaking of concrete. Joints shall be arranged vertically or horizontally. Temporary openings shall be arranged, where required, at the bottoms of wall forms and elsewhere, to facilitate cleaning and inspecting. Lumber used once in forms shall have nails removed and surfaces in contact with concrete work thoroughly cleaned before reuse. Wall sleeves, inserts, and openings required in concrete work shall be properly set in formwork. Chamfer strips shall be placed in forms for all exterior corners.

4. **CURING:** All concrete will be cured after placement according to the following procedures.

a) Forms will normally be left in place for the entire curing period. Exposed surfaces not covered by forms will be kept moist continuously for the entire seven day period or will be cured through use of an approved curing compound which will be applied after all surface water has disappeared.

b) All form marks exposed to view shall be rubbed off with a stone.

5. **REMOVING FORMS:** Under normal conditions, the time elapsing before the forms may be stripped shall not be less than the following:

- |     |       |         |
|-----|-------|---------|
| (1) | Slabs | 14 days |
| (2) | Piers | 7 days  |
| (3) | Walls | 2 days  |

6. **FINISHING:** All exposed concrete work shall be kept wetted with water, and shall be rubbed with a carborundum stone of medium fineness, or other equally as good abrasive, to bring the surface to a smooth texture and to remove all form and other marks. The paste formed by the rubbing may be rubbed down by floating with a canvas, carpet-faced, or cork float, or may be rubbed down with dry burlap.

7. **TESTING:** The following test may be performed by the City to ensure the concrete quality.

a) **Compressive Strength** – Compressive strength testing shall be conducted in accordance with ASTM C31 and ASTM C39. Test cylinders which are formed in the field



will be left in the field until compression testing is completed.

b) Slump – Slump testing shall be in accordance with ASTM C143.

c) Air Content Test – The test for air content in the mixture will be in accordance with either ASTM C173 or ASTM C231.

8. **ACCEPTANCE:** Concrete shall be accepted on the basis of its meeting the requirements listed under the Material Specifications and Detail specification Section of this contract. The Inspector will accept no ready mix concrete without the plant dispatch ticket.

a) The Engineer shall require any test as he deems necessary to insure that the concrete meets specifications. The Engineer may require the test to be performed by an independent testing laboratory at the Contractor’s expense.

b) Segregated concrete and/or concrete containing foreign material will not be accepted.

9. **BLOCKING INSTALLATION:** Concrete blocking shall be formed and poured at the backs of fittings, including elbows, tees, fire hydrants and other fittings to the dimensions shown on approved detailed Construction Drawings. Unless otherwise noted, concrete shall be 3,000 psi with a four-inch (4”) slump. Blocking shall be poured against undisturbed earth. If existing soil conditions will not support concrete blocking, it is the Engineer’s responsibility to recommend proper restraining devices in order to prevent movement of the pipe. Concrete of the respective classes for thrust blocking, bedding, blocking, headwalls, piers and other miscellaneous structures shall be as called for in the work to which they pertain.

**R. BORES, TUNNELS, AND CASINGS:**

1. **BORE PITS (OR TUNNEL PITS):** Bore or tunnel pits shall be safed-up, shore, well-marked, lighted, and not left unattended except as approved by the controlling agency. Requirements of stabilization and dewatering of bore pits shall be as herein before specified. The angle of repose method (sloping pit walls) for creating a safe working area shall not be used.

2. **SIZING:** Carrier pipe shall be Restrained Joint DIP. Casing is to extend beyond the edge of pavement or control structure at least as far out as it is deep and clearance of 25 feet beyond the casing shall be granted for future removal of the carrier pipe. Spiders shall be used on all water lines installed within steel casing. The minimum size and thickness standards for casing pipe and tunnels for various sewer line sizes and types are as follows:

Carrier Pipe (inch diameter)	Casing Pipe (inches)	Thickness (inches)		Recommended * Tunnel (inches min.)
		DOT	RR	
8" DIP	18"	0.250"	0.312"	48"
10" DIP	20"	0.250"	0.344"	48"
12" DIP	24"	.0.250"	0.406"	48"
16" DIP	30"	0.312"	0.469"	48"
18" DIP	30"	0.312"	0.469"	48"
24" DIP	36"	0.375"	0.562"	48"
30" DIP	48"	0.500"	0.750"	60"

- Gauge to be determined by controlling agency and/or by depth of installation

3. **INSTALLATION:** Smooth wall or spiral weld steel pipe may be jacked through dry bores slightly larger than the pipe, bored progressively ahead of the leading edge of the advancing pipe as soil is mucked by the auger back through the pipe. As dry boring operation progresses, each new section of encasement pipe shall be butt welded to the section previously jacked into place. Continuous checks shall be made as to the elevation, grade and alignment of each successive section of encasement, as well as the tracks (rails) upon which the boring rig travels. Continuous checks shall be made as to the elevation, grade and alignment of each successive section of encasement, as well as the tracks (rails) upon which the boring rig travels.

a) Installation shall be such to prevent the formation of a waterway under the road or rail bed. If voids are encountered or occur outside the encasement pipe, grout holes shall be installed in the top section of the encasement pipe at ten (10) foot centers and the voids filled with 1:3 Portland cement grout at sufficient pressure to prevent settlement in the roadway/railway.

b) Boring operations shall be continuous to their completion, and unnecessary or prolonged stoppages shall not be allowed.

c) In the event an obstruction is encountered during the boring and jacking operations, the auger is to be withdrawn and the excess pipe is to be cut off, capped, and filled with 1:3 Portland cement grout at sufficient pressure to fill all voids before reapplying to the controlling agency for permission to open cut, bore at an alternative location, or install a tunnel.

d) Installation shall be to the limits specified by the controlling agency and/or as delineated in their encroachment permit issued. The controlling agency shall have full authority to require remedial measures and/or to stop all work if, in its opinion, said work will cause any damage to the roadway/railway section or endanger traffic. In all instances the controlling agencies reserve the right to sample, test, and approve all materials and methods used.

e) The Contractor shall notify the controlling agency through the Engineer and an acknowledgement shall be received a minimum of five (5) working days prior to beginning any work within the roadway or railway rights-of-way. If required, 24-hour notice will be given prior to completion.

4. **GUARANTEED CASING INSTALLATION:** The casing shall be installed by jacking, with simultaneous removal of spoil. The spoil removal shall not proceed more than 18-inches ahead of the casing. The diameter of the excavated hole shall be no larger than necessary to keep the casing moving freely and lubricant may be used to reduce the jacking forces. Casing sections shall be joined by butt weld.

a) After casing is jacked in place, 2-inch grout holes shall be used to pump a 1:3 Portland cement grout to fill the void outside the casing. Sufficient pressure should be applied to force grout out the adjacent grout hole. Grout holes shall be a maximum of 10 feet apart at the top of the casing.

5. **TUNNELS USING STEEL LINER PLATES:** All structural steel liner plates for tunnels shall

be formed to provide circumferential-flanged joints. Longitudinal joints may be flanged or offset lap seam type. All plates shall be punched for bolting on both the longitudinal and circumferential seams or joints. Bolt spacing in circumferential flanges shall be in accordance with the manufacturer's standard spacing and shall be multiples of the plate length so that plates having the same curvature shall be interchangeable to permit staggering of the longitudinal seam. Bolt spacing at flanged longitudinal seams shall be in accordance with the manufacture's standard spacing. For lapped longitudinal seams, bolt size and spacing shall be in accordance with the manufacturer's standard, but not less than that required to meet the longitudinal seam strength requirements of the design specifications. All liner plates for the full length of a specified tunnel shall be either the flange or the lapped seam type. The two types shall not be mixed in the same tunnel.

a) Liner plates shall be assembled in accordance with the manufacturer's instructions. Galvanized and coated plates shall be handled in such a manner as to prevent bruising, scaling, or breaking of the coating. Any plates that are damaged during the handling or placing shall be replaced, except that small areas with minor damage may be repaired to the satisfaction of the Engineer or his representative.

b) Galvanized surfaces shall be repaired by thoroughly wire brushing the damaged areas and removed all loose, cracked coating, after which the cleaned areas shall be painted with two (2) coats of zinc rich paint as approved and an acceptable bituminous coating restored.

c) When tunneling has proceeded in a distance sufficient for placing one section of the tunnel liner, that section of liner will be placed before excavating further. Excavation shall be controlled so that the space outside the liner plate shall be held to a minimum. All voids between the liner plate and tunnel wall shall be filled with 1:3 Portland cement grout, containing no more water than necessary, placed under sufficient pressure to fill all voids. Grout shall be placed through the grout holes provided in the top of the tunnel liner plates. Grout holes 2" in diameter shall be provided at no more than 4.5-foot center or every third ring of plates to permit grouting as the erection of the tunnel liner progresses. At no time will the grouting operations be further than 10 feet from the front end or head of the tunnel construction.

d) At the end of each day's operations, the voids outside installed liner plates shall be grouted whether 10-feet or less. Grout will be forced into each grout hole. If the grout from one hole should flow along the liner plates so as to plug the next holed, the plug shall be opened by punching through the grout so that each hole may be used for grouting. The grouting operation will be continued at each hole until all spaces outside the liner plates are filled and no grout will flow.

e) The tunnel shall be constructed to the limits, grade and alignment shown on the Construction Drawings. Excavation, without the use of jetting, shall be done in such a manner as to protect public and/or private property from damage. Prior to beginning any construction, the Contractor shall submit pit shoring and tunnel liner details for approval and no tunneling may begin prior to approval of these details by the appropriate controlling agency. After approval of tunnel liner and pit shoring details, a five (5) day notice to the Controlling Agency, through the Engineer shall be provided as previously specified.

f) No blasting will be done without prior written approval of the controlling agency

and then only in strict accordance with all Federal, State, and Local laws, ordinances, rules or regulations governing the storage and use of explosives. Where blasting is required, only small controlled charges or 40% dynamite or plastic explosives shall be used. The depths of the holes for these charges shall not exceed the depth necessary to clear an area sufficient to place one section of tunnel liner.

g) The charges for the initial series of blasts should be placed in the triangle method. The second series should be placed in the radial method a minimum distance from the desired diameter of the tunnel. The triangular charges shall be set to go off first, with the radial charges to go off following a short interval or using the time-lag method.

h) Where rock is encountered before approaching the shoulder or pavement, the first four series of charges will be used in determining the amount of controlled blasting to be used before beginning any blasting beneath the railway or shoulders or pavement of the highway as applicable. If rock is encountered after tunneling progresses beneath the pavement or railway, charges will initially be set at very low levels and increased in small increments until the proper amount of charged is determined. In no case will an overshoot be permitted. If a boulder is encountered and removed by blasting or by other methods, a bulkhead will be formed immediately after removal of the boulder and the area filled with grout before proceeding with the tunneling operations.

i) If there is any indication of a vertical split in the rock formation, or any indication of settlement of the roadway or railway fill, all operations shall be stopped and the controlling agency notified immediately. If the vertical split is not determined to be out too great a magnitude or too close to the rails/pavement, the split shall be filled with grout at a pressure specified by the controlling agency, allowed to set and tunneling operations may be continued.

j) If it is determined that the vertical split is too great of a magnitude or too close to the pavement or railway, the Controlling Agency shall determine the method to be used to correct the split. If settlement of the roadway or railway occurs, the Controlling Agency will advise the Owner and his Contractor of the proper steps to be taken to correct the settlement. If deemed necessary by the Controlling Agency, adequate warning devices (signs, flasher, etc.) accompanied by responsible flagmen shall be placed at a distance allowing any and all traffic time to stop safely before reaching the questionable area. At the option of the Controlling Agency, it may provide the necessary flagmen, warning devices, etc., at the Contractor's expense. Traffic shall be allowed over the questionable area, only as directed by the Controlling Agency.

k) The completed liner shall consist of a series of structural steel liner plates assembled with staggered longitudinal joints. Liner plates shall have been fabricated to fit the cross-section of the tunnel. All plates shall be connected by bolts on both longitudinal and circumferential seams or joints.

l) After tunneling operations have been completed, the Contractor will install the carrier pipe in a manner approved by the Engineer. Concrete fill (1:3 Portland cement grout) will then be placed after completing installation of the water pipe within the tunnel liner as directed by the Engineer and end enclosure walls installed as shown on the Construction Drawings or Standard Details. Ends of the tunnel liner will be sealed with an 8-inch masonry wall on the lower end and a 12-inch masonry wall on the higher end.

Weep holes will be provided on the downstream end for drainage.

6. **FINISH WORK:** Once the Contractor has installed the carrier pipe, complete and in-place, the Contractor shall then remove the vertical shoring for pits (if ground conditions allow), surplus spoils, and material from the site. The site shall then be returned to its original condition, seeded, mulched, or restored as specified and left in a neat and satisfactory condition. Shoring material shall be removed in such a manner so as to avoid collapse and to allow proper backfill. The backfill shall be placed in accordance with these Specifications or the requirements of the Controlling Agency

S. **BLASTING:** The Contractor shall not be allowed to blast within any rights-of-way maintained by any agency (SCDOT, railroad, gas, etc.) other than the City without specific approval of the controlling agency and only in accordance with their respective requirements.

1. Prior to commencing any blasting operations, the Contractor shall notify either the City Fire Department – Fire Prevention Section or the County Fire Administrator as applicable, and obtain blasting permits as required. The Contractor must furnish certification of Insurance specifically covering any and all obligations assumed pursuant to the use of explosives. All blasting supplies shall be stored in a place and manner approved by the City, State Fire Marshal and other entities having jurisdiction over blasting operations. In no case shall blasting caps or other igniters or exploders be kept in the vicinity of dynamite or where other explosives are stored.

2. Blasting operations shall be conducted in strict accordance with any and all decrees, rules, regulations, ordinances, and laws as may be imposed by any regulatory body and/or agency having jurisdiction over the Work relative to handling, transporting, use and storage of explosives. Blasting shall be done only by competent, sober, and experienced personnel whose activities shall be conducted in a workmanlike manner. Satisfactory information must be provided to the Engineer that the blaster meets or exceeds the qualifications enumerated in OSHA Regulations Part 1926, Subpart U, Section 1926.901 – Blaster Qualifications. All blasting supplies shall be stored in a place and manner approved by the City. In no case shall caps or other exploders be kept at the place where dynamite or other explosives are stored.

3. All rock, dirt and debris from blasting shall be contained within the excavation by use of weighted mats or undisturbed overburden. The Contractor's blaster shall be fully responsible for determining the method of containment and the weight, size and placement of material required to contain the charge he is using. Charges shall be sized such that no damage to houses, structures, roadways, etc., outside the limits of excavation will occur. Where there is a possibility of such damage, the charge will initially be set at a very low level and increased in small increments until the proper charge is determined. The Contractor shall be held responsible for any and all injury to persons or damage to public or private property. No blasting will be permitted adjacent to existing buildings and structures. Rock at those locations shall be removed with jackhammers and bull-points. A seismic survey and/or a pre-blast survey may be required.

T. **EROSION AND SEDIMENT CONTROL:**

1. **GENERAL:** Erosion and sediment control shall be conducted in accordance with the applicable Erosion and Sediment Control and or NPDES permit. It is the Contractor's responsibility for controlling soil erosion and sediment runoff. The Contractor is to utilize mulches, mattings and or other fabrics, silt fences and other filters, grasses, slope drains, and other erosion control

devices as necessary to control erosion and sediment runoff. Erosion control may include temporary work that must be removed upon achieving construction site surface stabilization.

2. **TEMPORARY EROSION CONTROL:** Temporary erosion control shall consist of planting temporary grass of a quick growing species such as millet, rye grass, or cereal grasses suitable to the area or other approved temporary means. When used, seed, fertilizer, mulch and periodic watering shall be applied in adequate quantities to assure a full, healthy ground cover over the entire disturbed area of construction operations. All materials shall be of first class quality and subject to approval by the governing erosion control authority. All disturbed areas along the pipeline, with exception to a construction access or haul road, shall be grassed as soon as possible after backfilling operations have been completed.

3. **CONSTRUCTION IN STREAMS AND IMPOUNDMENTS:** Unless otherwise approved by the City Engineer, construction operations in streams and impoundments shall be restricted to those areas which must be entered for the construction of temporary or permanent structures. As soon as conditions permit, streams and impoundments shall be promptly cleared of all falsework, piling which are to be removed, debris and other obstructions placed therein or caused by the construction operations. Frequent fording of live streams with construction equipment will not be permitted; therefore, temporary bridges or other structures shall be used wherever an appreciable number of stream crossings area necessary. Unless otherwise approved by the City Engineer, mechanized equipment shall not be operated in live streams except as may be required to construct channel changes and temporary or permanent structures, and to remove temporary structures.

4. **CONSTRUCTION IN EASEMENTS:** Erosion control measures shall be constructed such that they do not discharge onto water or sewer easements, but to the opposite sides of such easements to prevent future erosion of the easement.

5. **LIMIT OF PROGRESS:** The Engineer will limit the area of excavation commensurate with the Contractor's capability and progress in keeping the finish grading, mulching, seeding and other such pollution control measures current in accordance with an accepted schedule. Should seasonal limitations make such coordination unrealistic, special erosion control measures shall be taken immediately to the extent feasible and justified.

6. **SURFACE STABILIZATION: PERMANENT GROUND COVER:** Upon construction completion and upon achieving construction site surface stabilization, the Contractor is to establish a permanent ground cover over any remaining denuded areas, and the Contractor shall remove all temporary erosion and sediment control measures upon achieving a permanent ground cover or satisfactory surface stabilization.

7. **RIGHT TO CORRECT:** In the case of failure on the part of the Contractor to adequately control erosion, pollution, and/or Siltation, the City reserves the right to employ outside assistance or to use his own forces to provide the necessary corrective measures. Such incurred direct costs will be charged to the Contractor.

#### U. RESTORATION OF DISTURBED AREAS

1. **GENERAL:** All surfaces (both public and private) within and adjacent to the construction operations shall be restored to a condition comparable to that existing prior to construction, or

as specified by the Engineer. All surplus materials shall be disposed in a manner acceptable to the Engineer, and the construction area shall be left in a neat condition, with special attention called to proper drainage, smoothness of surface, and general clean-up. No machinery or equipment shall be left or stored on the job site after the project is complete.

2. **STABILIZATION:** Unless otherwise specified, complete restoration is to include fertilizing, seeding, and mulching any and all areas disturbed during the construction within 30 working days following the initial ground disturbing activity.

3. **APPURTENANCES:** Water meters, valve boxes, drain pipes, and other structures encountered shall be reset or re-laid to match or clear surface grade and/or water main pipe grade as applicable.

4. **REFUSE BURIAL:** Timber, rock and other refuse may not be buried within the temporary or permanent water rights-of-way with the exception of rock smaller than  $\frac{3}{4}$  cubic foot.

5. **RIP-RAP:** The Contractor shall place stone rip-rap as specified in those areas subject to severe water action, where directed by the Engineer. Placement of rip-rap as shown on the Construction Drawings shall be considered as a guide only, with final determination made at the time of construction by the Engineer.

a) Stone rip-rap will be placed as indicated on the Standard Details immediately following pipe installation and will be installed no steeper than a 2:1 slope, except when specifically approved by the engineer. Grading will be required as necessary to insure continuous even flow.

b) In locations where a creek bank is eroded near the water line, the Contractor will be required to place compacted fill material along the creek bank in order to maintain 3-feet of cover over the water line in all directions. This is to be done before the rip-rap is placed.

c) The rip-rap installation shall include all earthwork necessary to stabilize the creek bank and to provide cover for the water line.

6. **JUTE NETTING/EROSION BLANKET:** The Contractor shall install jute netting or erosion control blank in areas subject to high runoff velocities, areas subject to concentrated runoff, and on steep slopes as shown on the Construction Drawings or directed by the Engineer.

## V. RESTORATION OF EXISTING PAVED SURFACES

1. **GENERAL:** All removal and restoration of pavement and road surfaces will be in accordance with the specifications approved by the City of Rock Hill Public Works Department or the South Carolina Department of Transportation, whichever applies.

a) All resorted bituminous and concrete pavements shall be placed to existing cross-section and ride quality. Restored pavement will in all instances be flush and level with existing pavement at the sawed edges, and at existing gutter lines where applicable, unless approved by the Engineer. When pavement repairs do not meet the above criteria or are not permitted in a workmanship manner as determined by the Engineer, the City

of Rock Hill Public Works or SCDOT, whichever applies, will remove and re-perform the restoration as specified at the Contractor's expense.

b) When cuts are to be made in street rights-of-way under maintenance by the City of Rock Hill Public Works Department, the Contractor shall contact the Public Works Director or his designated representative before each separate pavement cut is made and secure a permit.

2. **REPLACEMENT:** All areas of existing pavement shall be neatly removed with straight edges. The Contractor shall remove and replace pavement, which in the opinion of the Engineer has been cracked or displaced by the operations of the Contractor. Edges shall be sealed upon completion of the repair.

a) In all pavement cuts either the permanent pavement or a temporary pavement consisting of 1 to 1 ½ inches of black asphaltic concrete (later to be replaced permanently) will be placed immediately upon completion of the subgrade unless otherwise approved by the Engineer.

b) Unless otherwise approved or required, concrete pavement shall be removed to the nearest expansion or contraction joint. The Contractor shall contact the Public Works Director and/or SCDOT's District Engineer for determination of the limits of concrete replacement and location of joints. Work procedures shall be such to prevent damage to surrounding pavement.

c) Bituminous pavement shall be cut in a smooth and straight line. Sawing is required on asphaltic concrete. The width of the pavement left between the edge of the ditch and the existing edge of pavement or the front line of the gutter, shall be at least 2 feet. Residual strips of pavement less than 2 feet in width must be removed and replaced. Existing pavement shall be removed on each side of the trench for at least 12-inches beyond the top of trench.

3. **RESTORATION:** Restoration of the paved surface shall be in accordance with the following specifications:

a) **CONCRETE PAVEMENT:** The concrete used to restore pavement shall have a minimum 28-day compressive strength of 3000 psi. The concrete shall conform to the shape, grade, and finish of the existing pavement and will be 1-inch deeper than the original pavement, including base, but in no instance less than 6 inches.

b) **ASPHALT PAVEMENT:** All material above the sub-base level shall be hot-mix bituminous concrete conforming to the SCDOT Standard Specifications for Roads and Structures for both mix design and placement. The asphalt pavement as placed shall be 1-inch deeper than the original pavement, including base, but in no instance less than 6 inches within City-maintained roadways or eight inches in state-maintained roadways. The asphalt shall be placed in lifts not greater than 4 inches and shall not be hot-mix bituminous concrete binder, Type H. The last 2 inches in either instance shall be bituminous plant mix (Type C – surface course) suitable to the appropriate controlling agency. Type C asphalt pavement surfacing will be placed with paving machines and/or rollers of a size and type currently approved by the SCDDOT for use on resurfacing contracts.



(1) If bituminous surfacing overlays a concrete base, the Contractor, at the option of the Engineer, shall replace the concrete to its original thickness or to a level 2-inches below the finished surface. The Engineer may direct the Contractor to omit all concrete and to replace the pavement with bituminous materials.

(2) Tack coats shall be employed with each lift. Tack coats shall be placed on both horizontal and vertical surfaces (pavement cuts or faces of concrete gutters).

(3) Under normal conditions, asphalt binder will be placed in pavement cuts at the end of each workday. Following completion of pipeline construction along a continuous section of pavement, 1 to 2 inches shall be replaced weekly or within five days. During inclement weather, the Engineer may permit the use of temporary asphalt (cold Mix) to seal the trench until permanent asphalt can be placed.

(4) All pavement markings are to be restored.

4. **DAMAGE TO ADJACENT PAVEMENT:** The pavement adjacent to pipeline trenches must not be disturbed or damaged. If the adjacent pavement is disturbed or damaged, irrespective of cause, the Contractor shall remove the damaged pavement and shall replace with new pavement at his own expense

**W. RECORD/AS-BUILT DRAWINGS:** The Contractor is to keep a set of approved Construction Drawings on site to make notes to facilitate the preparation as-built/record drawing information for the sewer infrastructure being installed. Notes taken during construction shall include but is not limited to field changes to the horizontal alignment or grades of the infrastructure being installed, valves and meter service locations (station along water main), description, size and location (station and elevation(s)) of all underground tees and utility crossings encountered during the construction work, location of bedrock encountered and removed, and other pertinent information.

1. The Contractor shall supply a copy of the field noted drawings to the engineer, along with surveyed as-built/record drawings (signed and sealed by a South Carolina Licensed Surveyor). Surveyed as-built/record drawings shall include the location and elevations of all tees and vaults, locations of valves and meter boxes (station and offset) and calculated pipe grades. Stations and elevations of all utilities encountered during the water installation shall be incorporated in the drawings. If easements or rights-of-way were acquired for the project, a list shall be provided on the record drawings stating the tax identification number and deed book/page number of each recording. Engineer shall provide to City hard set (bond and Mylar) of as-built drawings and digital set (in .pdf and .dwg formats) prior to receiving final approval of the project.

2. Engineer shall prepare individual AutoCAD drawings of each valve in the project, with location and measurements from valve to two or more permanent monuments.

3. Engineer shall flow each hydrant and provide test results to the City. Hydrant flow test results shall include at a minimum, the date of the test, the tester's name, the hydrant location and plan reference number, the static pressure in psi, the residual pressure in psi, and the flow rate in gpm.

X. **WARRANTY:** The Work shall be free of defects in material and workmanship for a full year from the date of acceptance, which is defined as either the date of the signature by the City Engineer on the Final Plat or as referenced in correspondence by the City Engineering Division. If neither date can be identified, the date shall be the issuance date for the SCDHEC Permit to Operate.