

## CHAPTER 12

### LOW PRESSURE SANITARY SEWERS

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# **PART 1 - GENERAL**

## **1.1 SUMMARY**

### **A. Section Includes:**

1. PVC Pipe and Fittings
2. HDPE Pipe and Fittings
3. Ductile-iron Pipe and Fittings
4. Valves
5. Service Boxes and Lids

## **1.2 RELATED DOCUMENTS**

- ### **A.**
- Charlotte Water Water and Sewer Design and Construction Standards and Standard Details.

## **1.3 DEFINITIONS AND ABBREVIATIONS**

- ### **A.**
- See Sections iii and iv of the Charlotte Water Water and Sewer Design and Construction Standards for common abbreviations and definitions.

## **1.4 SUBMITTALS**

### **A.**

Required submittals for product approval include, but are not limited to, the following:

1. Product brochures
2. Catalog cut sheets
3. Shop drawings including dimensions and part/material lists
4. Certification of compliance
5. Prior product acceptance test reports
6. Reference contact data
7. Shipping tickets and purchase invoices

### **B.**

Provide product data for the following:

1. PVC Pipe and fittings
2. HDPE Pipe and Fittings
3. Ductile Iron Pipe and Fittings
4. Valves
5. Service Boxes and Lids

### **C.**

Shop Drawings:

- ### **D.**
- Pre-excavation Photographs or Videotape: Show existing conditions of adjoining construction and site improvements, including finish surfaces that might be misconstrued

as damage caused by earth-moving operations. For Donated Projects, these requirements apply to existing road rights-of-way only. Submit before earth moving begins.

E. Product Certificates: Required for all products.

F. Qualification Data: For qualified testing agency.

G. Material Test Reports: For each on-site and borrow soil material proposed for fill and backfill as follows:

1. Classification according to ASTM D 2487.

2. Laboratory compaction curve according to ASTM D 698.

## **1.5 DELIVERY, STORAGE, AND HANDLING**

A. Do not store plastic pipe and fittings in direct sunlight. All pipe must be in brand new factory condition, and no more than one year old from manufacturer date to installation. Pipe manufacturer must provide letter regarding exposure requirements.

B. Valves must be stored such that they are protected from freezing.

C. Protect pipe, pipe fittings, and seals from dirt and damage.

D. All PVC and HDPE pipe will be shipped, stored, and strung at the project in such a manner as to be protected from total accumulated exposure to sunlight and possible ultraviolet radiation of no more than two (2) weeks. Pipe must be installed within one year from the manufacturer date printed on the pipe wall.

E. The Contractor shall be responsible for the safe storage of materials furnished by or to them, and accepted by them and intended for the work, until they have been incorporated in the completed project. Handling and storage of all project materials are to be in compliance with the manufacturer's recommendations for handling and storage. The interior of all pipe, manholes and other accessories shall be kept free from dirt and foreign materials at all times.

F. Transportation of Materials and Equipment: The Contractor and their Suppliers are directed to contact the North Carolina Department of Transportation to verify axle load limits on State maintained roads (and bridges) which would be used for hauling of equipment and materials for this project. The Contractor and their Suppliers shall do all that is necessary to satisfy the Department of Transportation requirements and will be responsible for any damage to said roads which may be attributed to this project. All materials required to construct this project shall be furnished by the Contractor and shall be delivered and distributed at the site by the Contractor or their material supplier.

G. Loading and Unloading Materials: Pipe and pipe accessories shall be loaded and unloaded by lifting with hoists or skidding so as to avoid shock or damage. Pipe and precast manholes will be 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.

H. Responsibility for Materials on Site: 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. Each piece shall be redundantly chocked at each end to prevent movement or rolling. Pedestrian or vehicular traffic shall not be unduly inconvenienced in placing of material along the streets or right-of-way, as applicable.

The Contractor will string in advance no more than the amount of pipe and material that can be installed within two (2) weeks unless approved by the Engineer. All the materials shall be placed in such a manner as not to hinder access, endanger or impede traffic, create a public nuisance or endanger the public.

Materials strung through residential areas (or any area with maintained lawns) shall be placed in such a manner as not to restrict normal lawn maintenance and must either be installed within two (2) weeks or removed to an approved storage yard, as required by the Engineer.

- I. Material and Equipment Storage Sites: Unless otherwise shown on the plans, the Contractor will be responsible for locating and providing storage areas for construction materials and equipment. Unless prior written consent from the owner of the proposed storage area is received by Charlotte Water, the Contractor will be required to store all equipment and materials within the limits of the project site, or the limits of the sanitary sewer 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 right-of-way if approved by the controlling agency. Bulk storage of stacked materials shall not be permitted in or along road rights-of-way.

Storage sites shall be fenced with adequate protection to reasonably prevent the public from entering the site. The Contractor shall be responsible for the safeguarding of materials and equipment against fire, theft, and vandalism and in a manner which does not place the public at risk and shall not hold the City responsible in any way for the occurrence of same.

- J. Care of Coatings and Linings: Pre-cast manholes, pipe and fittings, including frames and covers, steps, straps, etc., shall be so handled such that the coating or lining will not be damaged. If, however, any part of the coating or lining is damaged, the repair shall be made by the Contractor at their expense in a manner satisfactory to the Engineer.

## **1.6 FIELD CONDITIONS**

- A. Interruption of Existing Sanitary Sewerage Service: Do not interrupt service to facilities occupied by Owner or others unless permitted and then only after arranging to provide temporary service according to written requirements by Charlotte Water.

## **PART 2 - PRODUCTS**

### **2.1 PIPE, GENERAL**

- A. Unless superseded or modified by a Special Provision; all materials, apparatus, supplies, methods of manufacture, or construction shall conform to the specifications for same contained in this Section. National material standards (ASTM, ANSI, etc.) referred to herein shall be considered to be the latest revisions only.
- B. The Engineer may waive certain requirements of these Material and Installation specifications, provided that the Contractor requests such waiver in writing and provided that the function of the material is not impaired. The Contractor may request to substitute for a material that has been specified. The Engineer, in writing only, may accept or reject such request.

- 1 C. Unless amended on the Construction Drawings, or approved by Charlotte Water, all  
2 piping shall be Poly Vinyl Chloride (PVC) or High-Density Polyethylene (HDPE), as  
3 specified herein.
- 4 D. Unless amended on the Construction Drawings, or approved by Charlotte Water, all  
5 piping shall have a maximum diameter of 4-inches, as specified herein.

## 6 **2.2 PVC SERVICE PIPE AND FITTINGS**

- 7 A. 4-inch diameter and smaller pipe: All 4-inch diameter and smaller pressure sewer pipe  
8 may be manufactured and tested in accordance with ASTM D-2241 for iron pipe size  
9 (IPS) dimensions and shall be Pressure Class 315 with an SDR of 13.5 or less (pressure  
10 rating equal to 315 psi) and shall be PVC 1120 pipe. PVC pressure pipe shall be made  
11 from materials whose Cell Classifications are Class 12454 and shall be furnished in  
12 lengths of 20 feet. Lesser lengths will be accepted to allow the proper placement of  
13 fittings, valves, etc. Pipe color shall be green unless otherwise approved by the Engineer.
- 14 B. Pipe markings shall meet the following minimum requirements:
- 15 1. Manufacturer
  - 16 2. Manufacturer Number (identifies factory, location, date manufactured, shift and  
17 sequence)
  - 18 3. Nominal diameter
  - 19 4. Beam load
  - 20 5. Laying length
  - 21 6. ASTM designation
- 22 C. All pipe joints shall be by ELASTOMERIC GASKET JOINTS only, conforming to ASTM  
23 standard D-3139. Pipe Bells for all pipes shall be integral to the pipe; sleeve couplings  
24 are not allowed.
- 25 D. Fittings: PVC fittings for pressure sewer pipe 4-inch diameter and smaller shall be  
26 Schedule 80 fittings manufactured in accordance with ASTM D-2467 with solvent weld  
27 joints installed according to ASTM D-2855. Fitting color shall be grey. Schedule 80 PVC  
28 solvent weld by threaded adapters shall be provided to join pipe to 2-inch threaded main  
29 line iron bodied plug valves. 3 and 4-inch pipe shall connect to main line iron bodied plug  
30 valves with mechanical joint transition gaskets.
- 31 E. Gaskets: ASTM F 477, elastomeric seals. The lubricant used for assembly shall be as  
32 recommended by the manufacturer and shall have no detrimental effect on either the pipe  
33 or the rubbergasket.
- 34 F. Solvent Cement: ASTM F943, low VOC emissions, heavy bodied, medium setting, high-  
35 strength PVC solvent cement formulated for PVC sewer piping. Solvent cement shall not  
36 be used without prior application of the primer.
- 37 G. Primer: ASTM F 656; Weld-on 729, or equal.
- 38 H. Whenever a PVC pressure sewer crosses over or within 1.5 feet below a water main, the  
39 PVC pipe shall be installed within a length of 3-inch, 4-inch, or 6-inch diameter Ductile  
40 Iron Pipe. The ductile iron pipe shall extend not less than 10 feet on each side of the  
41 water main. The ductile iron pipe shall be standard Pressure Class 350 cement lined  
42 pipe.

I. Manufacturers:

1. PVC pipe shall be as furnished by the following or pre-approved equal:
  - a. North American Pipe Corporation, NAPCO
  - b. JM Eagle
  - c. Diamond Plastics
  - d. National Pipe
  - e. Sanderson Pipe
  - f. Jetstream (by Pipelife)
2. PVC fittings shall be as furnished by the following or pre-approved equal:
  - a. North American Pipe Corporation, NAPCO
  - b. IPEX

J. PVC Solid Wall Sewer Pipe for Service Laterals:

1. Solid wall schedule 80 PVC service laterals shall be in accordance with ASTM D-2665, NSF 14, and D-1785. Fittings shall be socket type in accordance with ASTM D-2466. PVC material shall be PVC 1120. Joining shall be through solvent cement and primer in accordance with ASTM D-2564. Pipe color shall be grey unless otherwise approved by the Engineer.
2. The pipe shall contain all product markings required by ASTM D-1785, or ASTM D-2665. The minimum pipe markings shall include manufacturer's name or trademark, ASTM designation "ASTM D-1785 or D-2665", nominal pipe size, type of plastic material such as "PVC1120 pipe", Schedule 80 as applicable, and production code including year, month, day, shift, plant and extruder. Markings shall be at intervals of not more than 5 feet.
3. The fittings shall contain all product markings required by ASTM D-1785, or ASTM D-2665. The minimum markings on fittings shall include manufacturer's name or trademark, and the pipe material "PVC". Markings shall be on the body or the hub.
4. PVC pipe and fittings shall be manufactured within the North American Continent. An officer of the manufacturing company shall certify that all pipe and fittings were manufactured in North America.
5. Product shall be manufactured at a facility that has a Registered ISO 9001:2000 Quality Management System. Copy of current ISO 9001:2000 registration shall be submitted with product submittals.
6. Required submittals for product approval include, but are not limited to, product brochure, catalog cuts or shop drawings including dimensions and part/material list, certification of compliance, prior product acceptance test reports, and reference contact data.

## **2.3 HIGH DENSITY POLYETHYLENE (HDPE) PIPE AND FITTINGS**

- A. High Density Polyethylene (HDPE) pipe and fittings shall meet the requirements of AWWA C901 (3-inch diameter and smaller pipe) and AWWA C906 (4-inch diameter pipe).
- B. HDPE must meet or exceed the minimum wall thickness for HDPE IPS Pressure Pipe PE4710 Dimension Ratio: SDR 9.
- C. The outside diameter of the pipe shall be based upon the Iron Pipe Size (IPS) sizing system.
- D. Polyethylene pipe shall be made from HDPE material having a material designation code of PE4710 or higher.
- E. The material shall meet the requirements of ASTM D 3350 and shall have a minimum cell classification of PE445474C.
- F. Pressure Pipe shall be approved by the Underwriter's Laboratory (UL) or Factory Mutual (FM).
- G. Pipe Markings:
  - 1. Meet the minimum requirements of AWWA C901 and C906. Minimum pipe markings shall be as follows:
    - a. Manufacturer's Name or Trademark and production record
    - b. Nominal pipe size
    - c. IPS
    - d. Dimension Ratio (SDR 9)
    - e. AWWA C901 or C906
    - f. Seal of testing agency that verified the suitability of the pipe
    - g. Resin type (PE4710)
  - 2. Color identification to identify pipe service is required:
    - a. Conform to ASME A13.1.
      - 1) Color: Sewer/wastewater – green.
      - 2) For pipes 4-inches and larger in diameter: Stripes or colored exterior pipe product shall be green.
        - a. Permanent identification of piping shall be provided by co-extruding multiple equally spaced color stripes into the pipe outside surface or by solid colored pipe shell.
        - b. The striping material shall be the same material as the pipe material except for the color.
      - 3) Pipe interior shall be gray for visual inspection.
      - 4) Plain Black HDPE Pipe without color code markings may not be used.
- H. Only smooth wall HDPE will be permitted.
- I. Fittings: Fittings for HDPE pipe shall be as specified in Charlotte Water's standard specification for High Density Polyethylene (HDPE) Sanitary Sewer Piping.

1. 3 and 4-inch pipe shall connect to main line iron bodied plug valves with HDPE butt fusion mechanical joint adaptor fittings. 2-inch and smaller pipe shall connect to iron bodied main line plug valves and PVC service valves with a SDR 9 HDPE socket fusion stainless steel threaded adaptor, as manufactured by DriscoPlex, Integrity Fusion Products, Georg Fischer Central Plastics, or approved equal.
  2. Reducers: For reducers to pipes 2-inches and smaller reducers shall be socket fusion fittings conforming to ASTM 1056 and larger than 2-inches shall be butt fusion conforming to ASTM F 2620.
- J. Acceptable manufacturers of HDPE piping and fittings shall be as specified in Charlotte Water's standard specification for High Density Polyethylene (HDPE) Sanitary Sewer Piping.
- K. HDPE Laterals:
1. HDPE laterals shall be in accordance with ASTM D-2239 and shall meet or exceed the minimum wall thickness for HDPE IPS Pressure Pipe PE4710 SDR 9.
  2. Connections to a new HDPE main shall be performed using electrofusion and or butt fusion. Fittings shall be made of polyethylene pipe compound that meets the requirements of ASTM D1248, Class C and suitable for fusion welding to polyethylene pipe.
  3. New service connections to existing active mains Connections to an existing sewer house connection pipe shall be made using sleeved stainless-steel couplings on each side of a new service cut-in wye.
- L. Pipe Manufacturers: Performance Pipe, GF Piping Systems, JM Eagle, Driscoplex, WL Plastics or approved equal.
- M. Butt Fusion Fittings Manufacturers: ISCO, IPEX, Georg Fisher, or approved equal.
- N. Electrofusion Fittings Manufacturers: Agru America, GF Piping Systems, Integrity Fusion Products, IPEX, MT Deason Company, NUPI Americas Inc, or approved equal.

## **2.4 DUCTILE-IRON PIPE AND FITTINGS**

- A. All materials furnished in accordance with these specifications shall be new and unused, unless otherwise specified in the project Special Provisions. Unless superseded or modified by a Special Provision, all materials, apparatus, supplies, methods of manufacture, or construction shall conform to the specification for same contained in this Section. National material standards (ASTM, ANSI, etc.) referred to herein shall be considered to be the latest revisions only.
- B. Pipe: At a minimum, all Ductile Iron Pipe shall conform to the requirements of AWWA C151/A21.51, and ASTM A-746, pressure class 350, with Protecto 401 lining or approved equal.
1. The pipe class selection for all diameters shall be based on the installation conditions and existing or proposed depth of cover. Special thickness class pipe up to and including thickness class 56 shall be required when specified, based on installation conditions and depth of cover.
  2. The pipe shall contain all product markings required by ASTM A-746 and AWWA C-151. The minimum pipe markings shall include the weight, class or nominal thickness, casting date. The manufacturer's mark, the country where cast, the



production year, and the letters “DI” or “DUCTILE” shall be cast or metal stamped on the pipe, and on pipe sizes 14-inch and larger shall not be less than ½-inch in height. All markings shall be clear and legible, and all cast or metal-stamped marks shall be on or near the bell.

C. Compact Fittings: AWWA C153/A21.53, with Protecto 401, Tnemec Perma-Shield PL Series 431, or approved equal lining in accordance with AWWA.

1. The fittings shall contain all product markings required by AWWA C-153 as applicable. The minimum markings on each fitting shall include the identity of the AWWA standard, the pressure rating, nominal diameters, manufacturer’s identification, the county where cast, the letters “DI” or “DUCTILE”, and the angle of all bends. The markings shall be distinctly cast raised or in relief on the outside of the fitting body.

D. Gaskets: AWWA C111/A21.11, Styrene Butadiene Rubber (SBR or EPDM), of shape matching pipe and fittings.

E. Manufacturers:

1. DIP pipe shall be as furnished by the following or pre-approved equal:
  - a. American Cast Iron Pipe
  - b. McWane Cast Iron Pipe
  - c. US Pipe Company
2. DIP fittings shall be as furnished by the following or pre-approved equal:
  - a. American Cast Iron Pipe
  - b. McWane Cast Iron Pipe
  - c. Star Pipe Products
  - d. Sigma Corporation
  - e. SIP Industries
  - f. Tyler Union Pipe
  - g. US Pipe Company

F. HDPE to Ductile Iron Transition Assembly:

1. Transition between DIP and HDPE shall be fully restrained joint pipe. Provide a male HDPE MJ adaptor on the outer ends of the pipe such that it is fully restrained.
2. 3-inch DIP: Use DI mechanical joint Long Pattern Solid Sleeve with IPS transition Gasket, on each end of the DIP. Use male HDPE MJ adaptor on the outer ends of the LPSS's such that the connection is fully restrained. Alternatively, use EBAA Iron Series 2000PV mechanical joint restraint on the HDPE side of the long pattern solid sleeve. Contractor to follow all installation instructions, including requirement to remove the spacer on each restraint screw, prior to assembly.
3. 4-inch and larger DIP: Use DI mechanical joint Long Pattern Solid Sleeve with IPS transition Gasket, on each end of the DIP. Use male HDPE MJ adaptor on the outer ends of the LPSS's such that the connection is fully restrained. Alternatively, use EBAA Iron Series 2000PV mechanical joint restraint on the HDPE side of the

long pattern solid sleeve. Contractor to follow all installation instructions, including requirement to remove the spacer on each restraint screw, prior to assembly.

G. PVC to Ductile Iron Transition Assembly:

1. 3-inch DIP – use DI mechanical joint reducer with IPS transition gasket, on each end of the DIP.
2. 4-inch and larger DIP - use DI mechanical joint long pattern solid sleeve with IPS transition gasket on each end of the DIP.

## 2.5 VALVES

A. All valves on pressure sewer mains shall be plug or ball valves as specified below. Valve operation shall be open left. All direct bury valves shall require valve extension stems.

B. Plug Valves: All valves on pressure sewer mains shall be eccentric plug valves and shall confirm to all requirements of AWWA C-517 and as specified below:

1. Plug valves shall be non-lubricated, with a plug facing of a material specifically recommended by the valve manufacturer for the indicated service and shall have stainless steel permanently lubricated upper and lower plug stem bearings. Valve seats shall be nickel. Valves shall be designed with adjustable seals which are replaceable without removing the bonnet. The bearing and seal area shall be protected with grit seals. Valve bodies shall be Gray Cast Iron or Ductile Iron.
2. Area of port opening for all 3 inch and larger valves shall be no less than 100% of full pipe area. Area of port opening for all 2-inch valves shall be no less than 81% of full pipe area.
3. All valves shall be rated at 175 psi and shall be Bi-Directional.
4. Buried valves 2-inch in diameter and smaller shall have schedule 80 threaded ends and shall be connected to the pressure main by schedule 80 PVC threaded by socket adapters on PVC pipe and with a DR 9 HDPE butt fusion by stainless steel threaded adaptor, as manufactured by DriscoPlex, Integrity Fusion Products, Georg Fischer Central Plastics, or approved equal on HDPE pipe.
5. Buried plug valves shall have 2-inch operating nuts within 10- inches to 15-inches below finish grade. Maximum operating torque shall be limited to 150 Ft.-Lbs. Enclosed gearing/actuator shall be required as recommended by the manufacturer.
6. Extension stems, stem guides, actuators, operating levers, and other miscellaneous items required for a complete installation shall be provided in accordance with the requirements and recommendations of the manufacturer.
7. Buried plug valves shall be provided with adjustable valve boxes. Valves boxes shall be cast iron conforming to ASTM A- 48, Class 35. Valve box castings shall be fully bituminous seal coated. Valve box shall be in accordance with the Charlotte Water Standard Detail.
8. Buried valves 3-inch and 4-inch and other valves specifically indicated shall have mechanical joint ends conforming to ANSI A21.11.
9. MJ valve connections shall be fully restrained to the HDPE pipe using a male MJ SDR 9 HDPE adaptor, with stainless steel pipe inserts.

10. Manufacturers:

- a. Plug valves shall be as manufactured by Dezurik Corporation, Milliken Valve Co., Keystone Valve, or approved equal.
- C. Thermoplastic ball valves: Thermoplastic ball valves shall be used at each service connection and shall be made of PVC Thermoplastic. The valves shall be furnished with teflon seats and true union ends. The handle shall be capable of being locked in the open and closed positions using a barrel lock or pad lock. Thermoplastic ball valves shall be as manufactured by Hayward, Incorporated or approved equal.
- D. Thermoplastic ball check valves: Thermoplastic ball check valves shall be used at each service connection and shall be made of PVC Thermoplastic. The valves shall be furnished with elastomeric seats and true union ends. Thermoplastic ball check valves shall be as manufactured by Hayward, Incorporated or approved equal.
- E. Iron body plug valves: Iron body plug valves shall be used at air releases and cleanouts.

## 2.6 SERVICE BOXES AND LIDS

- A. All 1.5-inch diameter service connections and air release/clean outs shall be placed in an appropriately sized box, in accordance with the Standard Details, and shall be as manufactured by Hubbell PenCell Plastics, DFW Plastics, or approved equal.
  - 1. All service connection boxes shall be made of green plastic with the physical dimensions shown in the Standard Details and constructed of standard thermoplastic materials using the structural foam approach, and shall be as manufactured by Hubbell PenCell Plastics, DFW Plastics, or approved equal. The plastic composition shall be uniform and substantially resistant to moderate acid attack, ultraviolet ray action, and weathering as may be encountered in outdoor application and semi-buried service.
  - 2. Plastic lids shall be furnished as needed with "snap lock" tabs and imprinted with the words "CHARLOTTE WATER" or "CLT WATER" and "Pressure Sewer" on the lid.
  - 3. Plastic lids shall have a 3/4-inch diameter prick hole.
- B. All 2-inch through 4-inch diameter service connections shall be installed in precast concrete vaults with steel access doors in accordance with the appropriately sized Standard Details.
  - 1. The steel access door shall be imprinted with the words "CHARLOTTE WATER" or "CLT WATER" and "Pressure Sewer" on the cover. The ERT hanger and slots shown on the Standard Water Details shall be removed for the LPSS door.
  - 2. The service box and lid shall conform to the requirements of ANSI 77 and shall meet the load requirements of Tier15.
- C. Identification
  - 1. Lid: Premise numbers shall be clearly indicated on lid via an adhesive tag. See the Charlotte Water Water and Sewer Design and Construction Standards for requirements.
  - 2. Manifolds: Premise numbers shall be engraved inside the door, on the support rib adjacent to the handle in line with transmitter. Lettering shall be laid out using a 1

1 ¼-inch stencil and engraving shall be with a high-speed rotary tool with a ¼-inch  
2 oval or ball bit.

### 3 **PART 3 - EXECUTION**

#### 4 **3.1 PIPING INSTALLATION GENERAL**

- 5 A. General Locations and Arrangements: Drawing plans and details to indicate general  
6 location and arrangement of underground sanitary sewer piping. Location and  
7 arrangement of piping layout take into account design considerations. Install piping as  
8 indicated, to extent practical. Where specific installation is not indicated, follow piping  
9 manufacturer's written instructions.
- 10 B. In all instances pipe shall be laid in a workmanlike manner, true to line and grade, with  
11 bell ends facing up-grade in the direction of laying. The various pipes referred to herein  
12 shall be handled, belled up and laid in accordance with the manufacturer's requirements  
13 and good engineering practices as defined in the various publications referenced in this  
14 document. The following requirements and/or standards of the Charlotte Water shall  
15 govern this construction unless exceeded by other regulatory bodies.
- 16 C. Install proper size increasers, reducers, wyes, bushings, and couplings where different  
17 sizes or materials of pipes and fittings are connected. Reducing size of piping in direction  
18 of flow is prohibited.
- 19 D. When installing pipe under streets or other obstructions that cannot be disturbed, use  
20 dry bore with encasement, auger without encasement, dry punch/mole or horizontal  
21 directional drilling, as shown on the plans or as approved by the Engineer.
- 22 E. Pipe Bedding: Unless otherwise specified or noted on the Plans the following bedding  
23 classes are commonly required by Charlotte Water. When filter fabric is required to be  
24 placed over the granular bedding and pipe, as shown on the Standard Details, the fabric  
25 shall be Mirafi 140N or approved equal. When granular material embedment is required,  
26 the Contractor will backfill above the granular bedding as specified for Type I bedding to  
27 an elevation one (1) foot above the top of pipe bell.
- 28 1. Type I - Shaped Bottom Bedding: The trench bottom shall be shaped so the  
29 pipe bears uniformly upon undisturbed native earth. Soil shall then be placed by  
30 around the pipe and completely under the pipe haunches in uniform layers not  
31 exceeding six (6) inches in depth up to an elevation one (1) foot above the top  
32 of the pipe bell. Each layer shall be placed and then carefully and uniformly  
33 compacted, so that the pipe is not damaged, nor the alignment disturbed.
- 34 2. Type IA – Granular Shaped Bottom Bedding: The trench bottom shall be  
35 shaped so the pipe bears uniformly upon undisturbed native earth. The pipe  
36 haunches shall be filled with an approved stone to a vertical height of one-fourth  
37 the outside diameter of the pipe bell for the pipe's entire length and for the entire  
38 width of the ditch. Type IA granular shaped bottom bedding may be used in lieu  
39 of Type I shaped bottom bedding. Soil shall then be placed by around the pipe  
40 and completely in uniform layers not exceeding six (6) inches in depth up to an  
41 elevation one (1) foot above the top of the pipe bell. Each layer shall be placed  
42 and then carefully and uniformly compacted, so that the pipe is not damaged,  
43 nor the alignment disturbed.

- 1           3.    Type II - Granular Material Embedment: The trench bottom shall be undercut a  
2                   minimum of six (6) inches below the pipe barrel grade and filled with an approved  
3                   stone to an elevation such that the pipe will be completely and uniformly bedded to  
4                   a vertical height of one-third the outside diameter of the pipe bell for the pipe's  
5                   entire length and for the entire width of the ditch. Depending upon soil and ground  
6                   water conditions, greater depths (undercut) may be required to create a stable  
7                   condition. Type II granular material embedment shall be used as directed by the  
8                   Engineer. When ground water or bedrock is encountered, a minimum bedding of  
9                   Type II is required.
- 10          4.    Type III - Granular Material Embedment: The trench bottom shall be undercut a  
11                   minimum of six (6) inches below the pipe barrel grade and filled with an approved  
12                   stone to an elevation such that the pipe will be completely and uniformly bedded to  
13                   vertical height of one-half the outside diameter of the pipe bell for the pipe's entire  
14                   length and for the entire width of the ditch. Depending upon soil and ground water  
15                   conditions, greater depths (undercut) may be required to create a stable condition.  
16                   Type III granular material embedment shall be used as directed by the Engineer.
- 17          5.    Type IV – Granular Material Embedment: The trench bottom shall be undercut  
18                   a minimum of six (6) inches below the pipe barrel grade and filled with an  
19                   approved stone to an elevation such that the pipe will be completely and  
20                   uniformly bedded to a vertical height equal to the outside diameter of the pipe  
21                   bell for the pipe's entire length and for the entire width of the trench. Depending  
22                   upon soil and ground water conditions, greater depths (undercut) may be  
23                   required to create a stable condition. Type IV granular material embedment  
24                   shall be used as directed by the Engineer.
- 25          6.    Type V – Granular Material Embedment: The trench bottom shall be undercut  
26                   a minimum of six (6) inches below the pipe barrel grade and filled with an  
27                   approved stone to an elevation such that the pipe will be completely and  
28                   uniformly bedded to a vertical height of twelve (12) inches above the outside  
29                   diameter of the pipe bell for the pipe's entire length and for the entire width of  
30                   the trench. Depending upon soil and ground water conditions, greater depths  
31                   (undercut) may be required to create a stable condition. Type V granular  
32                   material embedment shall be used as directed by the Engineer.
- 33          7.    Type VI – Flowable Fill Embedment: The trench bottom shall be undercut a  
34                   minimum of six (6) inches below the pipe barrel grade and filled up to the spring  
35                   line with excavatable flowable fill, for use adjacent to lakes and ponds, when  
36                   the pipe is more than 6 feet below full pond, or when excavation occurs within  
37                   45-degree line sloping out and down from toe of foundation slab. Depending  
38                   upon soil and ground water conditions, wider trenches may be required to  
39                   create a stable condition in poor soils that cannot brace the flowable fill. Type  
40                   VI flowable fill embedment shall be used as directed by the Engineer.
- 41          8.    Stone Stabilization: When the bottom of the trench is not sufficiently stable to prevent  
42                   vertical or lateral displacement of the pipe after installation with Type II or Type III  
43                   bedding, stone stabilization will be required to develop a non- yielding foundation for  
44                   the bedding and pipe. When such conditions are encountered, the trench will be  
45                   excavated to a depth as great as 2.5 feet below the pipe bell, or as determined by  
46                   the Engineer, and #467 or #357 crushed stone, ballast stone or rip rap will be placed  
47                   to an elevation six (6) inches below the bottom of the pipe. The pipe will then be

laid with Type II or Type III bedding as directed by the Engineer. Stabilization techniques utilizing a geotextile fabric may also be permitted or required by the Engineer.

9. Stone Foundation: When the bottom of the trench is not sufficiently stable to prevent vertical or lateral displacement of the pipe after installation of feet of stabilization stone material, stone foundation materials will be required to develop a non-yielding foundation for the stone stabilization, bedding and pipe. When such conditions are encountered, the trench will be excavated to a depth, as determined by the Engineer. Class A, B, 1, or 2 stone foundation materials will be placed to an elevation determined by the Engineer. Layering of several classes of stone foundation materials may be required by the Engineer. Stabilization stone shall be used between the stone foundation materials and the bedding stone as determined by the Engineer. The pipe will then be laid with Type II through Type VI (6) bedding as directed by the Engineer. Should the Engineer determine that the stone foundation material is not capable of providing a non-yielding foundation, then concrete cradles or piers shall be required as specified below. Excavation and disposal of undercut materials necessary for installation of stone foundation material is included as part of stone foundation.
10. Concrete Encasement and Cradles: Shall be as designed for each individual case and will be noted on the Plans and in the Special Provisions when applicable.

### **3.2 INSTALLATION OF PVC LOW PRESSURE SEWER PIPE AND FITTINGS**

- A. Clear interior of piping of dirt and superfluous material as work progresses. Maintain swab or drag in piping and pull past each joint as it is completed. Place watertight plug-in end of incomplete piping at end of day and when work stops.
- B. PVC Pipe: PVC pressure sewer main shall be installed substantially in accordance with the Standard Recommended Practices for UNDERGROUND INSTALLATION OF FLEXIBLE THERMOPLASTIC SEWER PIPE, ASTM D-2321.
- C. Valves and Fittings: Valves and fittings shall be installed in the manner specified for cleaning, laying and jointing pipe. Valves shall be installed at locations shown on the Plans and/or as directed by the Engineer.
- D. Valve Boxes: A valve box shall be installed at every buried plug valve. The valve box shall not transmit shock or stress to the valve and shall be centered and plumb over the operating nut, with the box cover flush with the pavement or other existing surface. Where the box is not in pavement or sidewalk, the top section shall be anchored by an 24" diameter pre-cast concrete pad, or cast in place concrete pad, set flush with the existing terrain. The top section of the valve box will be grouted into the pre-cast concrete pad, with the full annular space filled with grout. The location of the valve will be identified by the letter "PSV" imprinted onto the curb adjacent to the pressure sewer valve, with the "PSV" pointing at the valve location.
- E. Blocking Fittings: All plugs, caps, tees, wyes, bends, and valves on pressure mains shall be provided with thrust blocking, placed as shown on the plans, standard details, and/or as directed by the Engineer, and consisting of ready-mix concrete having a compressive strength of not less than 3,600 LBS per square inches at 28 days. Bagged mix concrete may be used for blocking, anchorage, etc. on sewer mains and valves. 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 valve, fitting, etc. shall be wrapped with 2 layers of polyethene wrap to prevent bonding between the concrete and the fitting. The blocking shall be so placed that the pipe and fittings will be accessible for repair.

F. Alignment and Grade: The curb must be in place and backfilled, and the area between curb and street right-of-way line graded smooth and to finished grade before the pressure sewer mains are installed. The pressure sewer mains shall be installed on the opposite side of the road from the water main and typically five feet behind the curb except as shown on the approved plans or as directed by the Engineer. The pressure sewer shall be laid and maintained at the required lines and grades with fittings and valves at the required locations, spigots centered in bells, and all valve stems plumb.

G. The location and depth of the pressure sewer main and valves, etc., will be checked for conformance to Charlotte Water standards. Any deficiencies will be corrected to the satisfaction of the Engineer prior to testing and activation of the mains.

H. Depth of Pipe Installation: Unless otherwise indicated on the Plans, or required by existing utility location, all pipes shall be installed with the top of the pipe at least 5.0' below the edge of the adjacent roadway pavement or 5.0' below the ground, whichever requires the lower pipe elevation. The Contractor is instructed to check construction plans and blow-up views for additional requirements.

I. The Contractor may be required to vary the depth of the 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 plans. PVC pressure sewer shall be installed with 18-inches clearance above other utilities or 18-inches clearance below other utilities.

### **3.3 INSTALLATION OF HIGH DENSITY POLYETHYLENE (HDPE) LOW PRESSURE SEWER PIPE AND FITTINGS**

A. Clear interior of piping of dirt and superfluous material as work progresses. Maintain swab or drag in piping and pull past each joint as it is completed. Place watertight plug in end of incomplete piping at end of day and when work stops.

B. Installers

1. Only formally trained and certified fusion technicians may conduct fusions. Qualification of the fusion technician shall be demonstrated by certification in fusion training within the past year for the type of fusion, and size of the pipe, and on the specific equipment to be used on this project. Provide documentation showing current and up-to-date qualification of training obtained to fuse PE pipe in the appropriate sizes.

2. Training in accordance with ASTM 2620 for butt fusion.

3. Training in accordance with ASTM F 1055 and F1290 for electrofusion.

4. Fusion joints shall be made by qualified technicians per PPI TN-42.

5. Qualified technician has documented prior experience in performing HDPE pipe installations, head fusion procedures, and testing methods.

C. Joining Methods

1. Butt Fusion: Butt fusion shall be done in accordance with ASTM F 2620, Plastic Pipe Institute (PPI) TR-33 and PPI TN-13. All fusion joints shall be made in compliance with the pipe or fitting manufacturer's recommendations.
2. Saddle fusion: Saddle fusion shall be done in accordance with ASTM F 2620 PPI TR-41 and PPI TN-13. All saddle fusion joints shall be made in compliance with the pipe or fitting manufacturer's recommendations.
3. Electrofusion: Electrofusion joining shall be done in accordance with the manufacturers recommended procedure. Other sources of electrofusion joining information are ASTM F 1290 and PPI TN 34. The process of electrofusion requires an electric source, a transformer, commonly called an electrofusion box that has wire leads, a method to read electronically (by laser) or otherwise input the barcode of the fitting, and a fitting that is compatible with the type of electrofusion box used. The electrofusion box must be capable of reading and storing the input parameters and the fusion results for later download to a record file.
4. Socket Fusion: Socket fusion shall be done in accordance with ASTM 1056 and PPI TN-13. All socket fusion joints shall be made in compliance with the pipe or fitting manufacturer's recommendations. Socket fusion made be used for pipes smaller than 2-inches in diameter.

D. Mechanical

1. Mechanical connection of HDPE to auxiliary equipment such as valves, and fittings shall use restrained joint mechanical joint HDPE adapters and other devices in conformance with the PPI Handbook of Polyethylene Pipe, Chapter 9 and AWWA Manual of Practice M55, Chapter 6.
2. Unless specified by the fitting manufacturer, a restraint harness or concrete anchor is recommended with mechanical couplings to prevent pullout.
3. Mechanical coupling shall be made by qualified technicians.

E. Joint Recording

1. Butt Fusion: The butt fusion equipment must be capable of reading and storing the input parameters and the fusion results for later download to a record file.
2. Saddle Fusion: The saddle fusion equipment must be capable of reading and storing the input parameters and the fusion results for later download to a record file.
3. Electrofusion: The electrofusion equipment must be capable of reading and storing the input parameters and the fusion results for later download to a record file.
4. Socket fusion: The socket fusion equipment must be capable of reading and storing the input parameters and the fusion results for later download to a record file.
5. The critical parameters of each fusion joint, as required by the manufacturer and these specifications, shall be recorded by an electronic data logging device. All fusion joint data shall be included in the fusion technician's joint report.

F. Installation

1. HDPE pipe shall be installed with a minimum of 5.0 feet of cover and a maximum of 25 feet of cover. HDPE pipe and fittings shall be installed in accordance with



ASTM D2321 or ASTM D2774 for pressure systems and AWWA Manual of Practice M55 Chapter 7.

2. Trenching:

a. Trench Length: The length of open trench required for fused pipe sections should be such that bending and lowering the pipe into the ditch does not exceed the manufacturer's minimum recommended bending radius and result in kinking.

b. Trench Width: The trench width at pipe grades for pipes less than 24-inches diameter shall be equal to the pipe outer diameter plus 12-inches.

3. Lay pipe with green stripe within 45-degrees either side of crown, if pipe has green stripe.

4. Pipe embedment - Embedment material shall be fine aggregate defined as:

a. Granular and free flowing

b. Generally meets or exceeds the limits on deleterious substances per Table 1 for fine aggregate according to ASTM C 33.

c. Reasonably free of organic material.

d. Gradation:

Embedment Material	
Sieve Size	Percent Retained
1 inch	0
3/8 inch	0-10
#40	20-60
#100	95

5. Compact backfill per ASTM D 698 and AASHTO T-99 as modified by NCDOT to 85% of maximum density or 95% maximum density within a road right-of-way. Compact the top 12-inches below the road sub-grade to 100% of maximum density within a road right-of-way.

6. Valves and Fittings: Valves and fittings shall be installed in the manner specified for cleaning, laying and jointing pipe. Valves shall be installed at locations shown on the Plans and/or as directed by the Engineer.

7. Valve Boxes: A valve box shall be installed at every buried plug valve. The valve box shall not transmit shock or stress to the valve and shall be centered and plumb over the operating nut, with the box cover flush with the pavement or other existing surface. Where the box is not in pavement, the top section shall be anchored by an 24" diameter precast concrete pad, set flush with the existing terrain. The top section will be grouted into the precast concrete pad. The location of pressure sewer valves will be identified by the letters "P.S.V." imprinted onto the curb adjacent to the pressure sewer valve.

- 1           8.    Alignment and Grade: The curb must be in place and backfilled, and the area  
2           between curb and street right-of-way line graded smooth and to finished grade  
3           before the pressure sewer mains are installed. The pressure sewer mains shall be  
4           installed on the opposite side of the road from the water main and five feet behind  
5           the curb except as shown on the approved plans or as directed by the Engineer.  
6           The pressure sewer shall be laid and maintained at the required lines and grades  
7           with fittings and valves at the required locations, spigots centered in bells, and all  
8           valve stems plumb.

### 9    **3.4    CONNECTIONS TO EXISTING SEWERS**

- 10       A.    Tie-ins to existing activated sewer lines will be allowed when proper precautions are taken  
11       to protect the existing main. Tie-ins to existing unactivated sewer lines not installed under  
12       the same contract will not be allowed without written approval from all parties involved  
13       (Charlotte Water, contractors, contract holders, etc.). If the proposed sewer does not begin  
14       at an existing manhole, a straddle type manhole as shown on the Standard Details will be  
15       constructed over (and around) the undisturbed existing pipeline. The existing pipeline will  
16       not be cut out and the new invert formed until all testing has been successfully completed.
- 17       1.    Pre-Cast Manhole Tie-In: Any connection at an existing precast manhole will  
18       require the Contractor to core the necessary opening through the manhole wall.  
19       Connections to existing pre-cast manholes shall require rehabilitation with coating  
20       per Charlotte Water standard specifications. Jackhammer or sledgehammer  
21       break-in to the manhole is not permitted.
- 22       2.    Brick Manhole Tie-In: Connections to existing brick manholes may be cored or  
23       sawed for all pipe diameters. Depending on the condition of the existing manhole,  
24       Charlotte Water may require replacement of the manhole. Connections to existing  
25       brick manholes shall require rehabilitation with coating per Charlotte Water  
26       standard specifications.
- 27       3.    Temporary Watertight Plugs: The Contractor shall install temporary watertight plugs  
28       in the proposed sewer line, at the open end of the pipeline prior to leaving the job  
29       site daily, during lunch breaks, and elsewhere as dictated by good engineering and  
30       construction practices. All installed pipe shall be backfilled or otherwise securely tied  
31       down to prevent flotation in the event water enters or rises in the trench. The pipe  
32       system shall be watertight during any absence of the Contractor from the project site.  
33       The plugs as installed shall prevent infiltration or the introduction of any foreign  
34       material into either the existing or proposed systems. The City will not accept any  
35       pipeline or manhole which contains any silt, sedimentation or other foreign material,  
36       within. The Contractor shall at their own expense flush, or otherwise cause the line  
37       to be cleaned out without any discharge into the existing system. Upon completion  
38       of all construction, the Contractor will be responsible for the complete removal of all  
39       watertight plugs, in the sequence necessary to allow testing and subsequent  
40       activation, all under the review of the Engineer.
- 41       4.    Scheduling: When the flow of an existing sewer must be interrupted and/or  
42       bypassed, the Contractor shall, before beginning any construction, submit a work  
43       schedule which will minimize the interruption and/or bypassing of wastewater flow  
44       during construction. This schedule must be approved by the appropriate controlling  
45       agencies and Engineer and may require night, holiday, and/or weekend work.  
46       Existing low pressure sewer customers impacted by the interruption of service must  
47       be notified when the private pump stations must be turned off and must also be

1 notified when the work is complete and the private pump stations can be turned back  
2 on. Advance notifications shall be made in writing using door hangers or US mail or  
3 in person hand delivery. Advance notifications must be completed a minimum of 48  
4 hours prior to the scheduled tie-ins. Notification that private pump stations may be  
5 returned to service shall be made in writing by in person delivery, or by doorhangers  
6 when the customer does not come to the door.

- 7 5. 1.5-inch Service Connections to PVC Mains: On 4-inch and smaller mains, the 1.5"  
8 laterals shall be connected to the street main with schedule 80 PVC solvent weld  
9 wyes. The 1.5" service lateral shall be completed to the property line using  
10 Schedule 80 solvent weld PVC pipe and fittings as detailed in the Standard Details.  
11 The service connection meter box shall be installed one foot outside the road right  
12 of way, and shall not be located in a driveway, or sidewalk. The service box shall  
13 include a true union ball valve, a ¾ inch brass hose bib/air release, true union ball  
14 check valve, and true union property lineball valve. All fittings shall connect to the  
15 schedule 80 pipe with solvent welds. The service connection shall be in  
16 accordance with the Standard Details. An "S" shall be cut into the top of the curb  
17 in line with the service box.
- 18 6. 1.5-inch through 4-inch Service Connections to HDPE Mains: On 4-inch and  
19 smaller mains, the 1.5" laterals shall be connected to the existing low pressure  
20 sewer main with SDR 9 HDPE fused wyes. The 1.5" service lateral shall be  
21 completed to the first true union ball valve in the service connection vault using  
22 SDR 9 HDPE fused pipe adaptor with stainless steel threaded end. The buried  
23 true union ball valve on the roadside of the service connection vault shall connect  
24 to the HDPE pipe with union by female threaded ends. The pipe shall be SDR 9  
25 HDPE by stainless steel male threaded adaptor. The pipe between the buried ball  
26 valve and the first ball valve in the service connection vault shall be SDR 9 HDPE  
27 pipe. All remaining pipe from the ball valve to the property line cap shall be  
28 schedule 80 PVC pipe with solvent welds/flanges, as detailed in the Standard  
29 Details. The service connection vault/box shall be installed one foot outside the  
30 road right of way, and shall not be located in a driveway, pavement, or sidewalk.  
31 The service vault/box shall include a true union ball valve, a ¾ inch brass ball  
32 valve, hose bib/air release, true union ball check valve, and true union property  
33 lineball valve. All 1.5-inch diameter fittings shall connect to the schedule 80 PVC  
34 pipe with solvent welds. All 2-inch and larger diameter fittings shall connect to the  
35 schedule 80 PVC pipe with flanges as shown on the standard details. The service  
36 connection shall be in accordance with the Standard Details. An "S" shall be cut  
37 into the top of the curb in line with the service box.
- 38 7. Buried Valve Magnet: A PVC encapsulated magnet shall be attached near all the  
39 buried service valves on the front side of the meter box, and at the property line  
40 service tailpiece cap for magnetic locating purposes.

### 41 **3.5 TRACER WIRE, PIPE MARKING, AND IDENTIFICATION**

- 42 A. The installation of tracer wire is required on all underground pipe installed. Tracer wire  
43 shall be installed on all wastewater pipe regardless of pipe material. The wire shall begin  
44 at the connections to the existing public mains and shall extend along the entire length  
45 of new pipe installed.
- 46 B. Tracer Wire System: A single conductor AWG No. 12 (12-gauge) solid copper wire with  
47 30 mils green HDPE insulation shall be laid on top of the pipe to aid in locating the pipe

for maintenance purposes. The wire shall extend along the entire length of the new pipe installed. The copper conductor wire shall conform to ASTM B-3.

1. The wire shall be secured to the pipe with zip ties or duct tape (2-inches in width) near every bell and at the midpoint of each pipe joint, or at a minimum, every 10 feet. The wire shall be a single continuous conductor from valve/service box or vault to valve/service box or vault. When the distance between valve/service box or vault exceeds 500 feet, splices will be permitted at 500 feet (or greater) intervals, if needed. The splice shall be made watertight as indicated in the standard detail as approved by the Engineer. Splices shall be isolated from direct tension on the wires in accordance with the Standard Details.
2. When wire splices are required, the splices shall be securely bonded together with an approved industrial connector to provide electrical continuity. Connector shall be copper, and insulation shall be repaired as detailed to seal out moisture and corrosion and shall be installed so as to prevent any uninsulated wire exposure. See Standard Details.
3. At valve/service boxes, vaults or tracer wire termination valve boxes, the wire shall be installed along the outside of the box/vault assembly from the pipe to the top section of the box/vault. The wire shall enter the box/vault assembly, directly below the top section of the box/vault. The wire shall extend through the top section and shall terminate 24 inches above the top section. This excess wire shall be coiled and stored in the top section, directly below the box/vault cover.
4. Contractor shall perform post installation testing of the tracer wire system to confirm conductivity from valve/service box/vault to valve/service box/vault on a daily basis during construction. Immediately prior to, or during the final inspection, the Contractor shall perform post installation testing of the tracer wire system to confirm conductivity from box/vault to box/vault. The test shall consist of applying an alternating High/Low tone voltage to the conductor at one valve box and testing the conductor at the next box/vault with Fluke Networks PRO3000 Tone Generator and Probe Kit or approved equal. Every service line pipe segment shall be tested in addition to all main line pipe segments. Alternate testing methods will be subject to approval by the Engineer. The testing shall be witnessed by the Engineer. The repair or replacement of any defective or improperly installed systems shall be the responsibility of the Contractor. Any and all repairs or replacement of defective or improperly installed tracer wire systems shall be performed by the Contractor and at no cost to the Engineer. Method of repairs or replacement shall be subject to approval of the Engineer. Upon acceptance by the Engineer, the wires in each valve box shall be connected together with a wire-nut wire connector, coiled and stored in the top section, directly below the valve box cover. The official Tracer Wire Conductivity test shall be performed by the contractor at the time of the Final inspection.

- C. Detectable Warning Tape: 6-inch wide green sewer warning tape will be installed 12 inches above the top of the pipe and 24 inches below finish grade.

### **3.6 HYDROSTATIC TESTING**

#### **A. General**

1. Hydrostatic and Makeup Water Tests: On completion of the line or sections of the lines, connections and appurtenances, the line shall be filled and hydrostatically

1 tested. The water for this purpose can be taken from existing lines under the  
2 supervision of the Engineer's Inspector and makeup water will be measured by the  
3 Inspector with an ultrasonic water meter furnished by Charlotte Water. The Owner  
4 will provide water for the first two makeup water tests. If additional tests are  
5 needed, the Contractor is responsible for the cost of the water after the initial two  
6 tests and for any subsequent tests. All leaks and any defective material shall be  
7 repaired or replaced to the satisfaction of the Engineer and the tests repeated until  
8 the requirements of this specification are met. Any special equipment, pumps, etc.  
9 required to make the test shall be furnished and operated by the contractor as  
10 directed by the Inspector.

11 2. The Contractor shall use great care to be sure that all air is expelled from each  
12 section under test. If openings are not available for the purpose of expelling air,  
13 the Contractor shall provide air releases of sufficient size (as determined by the  
14 Engineer) in accordance with Charlotte Water Standard Drawings, at their  
15 expense.

16 3. The water for testing purposes can be taken from the nearest available Charlotte  
17 Water water main, public fire hydrant, air release, or blow off, under the supervision  
18 of the Engineer's Inspector and leakage will be measured by the Inspector with an  
19 ultrasonic water meter furnished by Charlotte Water

20 B. Testing of PVC Low Pressure Sewer Piping

21 1. The test pressure will be 1.5 times the new system operating pressure or 150 PSI,  
22 whichever is greater, at the low point of the section under test.

23 2. Testing requirements and allowable makeup water shall be as specified in Section  
24 9.3, Hydrostatic Testing, of AWWA C-605. See Table 4a of AWWA C-605 for  
25 Makeup Water Allowance.

26 3. Required testing of pipelines and valves shall be done under the direct supervision  
27 of the Project Inspector. Field testing shall not negate the requirements for material  
28 certifications as contained in the material specification section of this contract.  
29 Unless otherwise directed by the Engineer, all testing will be completed prior to  
30 connection to any existing line. The Contractor shall provide open ventilation of  
31 confined spaces. The Contractor shall be responsible for providing all equipment  
32 and personnel necessary to comply with OSHA confined spaces regulations.

33 4. On completion of the line or sections of the lines, connections and appurtenances,  
34 the line shall be filled and hydrostatically tested. All leaks and any defective  
35 material shall be repaired or replaced to the satisfaction of the Engineer and the  
36 tests repeated until the requirements of this specification are met. Any special  
37 equipment, pumps, etc. required to make the test shall be furnished and operated  
38 by the contractor as directed by the Inspector.

39 5. Specific procedures for testing mains are as follows:

40 a. Pressure and leakage tests will be run concurrently and for a duration of two  
41 hours except as modified below.

42 b. The Contractor will pressurize the line and complete a pre-test to verify that  
43 it is within allowable makeup water before the official test is started. All  
44 makeup water shall be measured by a 5/8-inch ultrasonic water meter,  
45 furnished by Charlotte Water. Pressure gauges shall be furnished by the  
46 Contractor. The official test gauge shall be 4.5-inch dial with accuracy of

1 ±0.5% of span per ASME B40.100, Grade 2A with liquid fill, throttle screw  
2 and pulsation damper, or 3-inch digital gauge with accuracy of ±0.25% of  
3 span. The gauge shall be 300 PSI or as approved by the Engineer. The  
4 gauge shall be calibrated within 90 days of the pressure test. Proof of  
5 calibration by a third party testing/lab company shall be provided prior to the  
6 testing. Other observation gauges may be 2.5-inch dials with accuracy of ±3-  
7 2-3% of span (ASME B40.100, Grade B

8 c. During the official test, the Contractor is to maintain the pressure within +/- 5  
9 PSI for the duration of the test period. The contractor will pump the line to  
10 full test pressure at the end of each hour AND when the test pressure drops  
11 5 PSI. The contractor will record the time, meter reading and pressure  
12 reading before and after each pumping occurrence.

13 d. The Inspector will begin the test and remain at the job for the first hour,  
14 making sure that the test pressure is maintained within +/- 5 PSI. At the end  
15 of the first hour, with the line pumped to full test pressure, they will read the  
16 meter and record the first hour leakage. If the first hour leakage is within  
17 allowable, they will return at the end of the second hour and again read the  
18 meter. If the total leakage for the two hour period does not exceed two times  
19 the first hour leakage, the test will be terminated. If the total leakage exceeds  
20 two times the first hour leakage, but is still within allowable, the test will be  
21 held an additional hour. If the third hour leakage does not exceed the  
22 average hourly leakage for the first two hours, the test will be terminated at  
23 the end of the third hour. Otherwise, the test will be held until the leakage is  
24 non-increasing and within allowable for two consecutive hours.

25 e. The maximum length of pipe tested in one test shall be 5,000 feet or as close  
26 to 5,000 feet as possible depending on valve spacing.

27 f. During the last stages of the test and without any reduction in pressure,  
28 progressing in an orderly manner from the end opposite the test pump, each  
29 main line valve, cleanout/manual air release valve, buried service valves  
30 between the main and the service vault/box will be closed, and pressure  
31 released to determine if it is holding test pressure (minimum 10 minutes per  
32 valve closing). No measurable pressure drop is permitted during each valve  
33 test.

34 C. Testing of High Density Polyethylene (HDPE) Low Pressure Sewer Piping:

35 1. Hydrostatic leakage testing is recommended and shall comply with ASTM F 2164  
36 and AWWA Manual of Practice M55 Chapter 9, and PPI Handbook of Polyethylene  
37 Pipe Chapter 2 (2nd Edition). If the test section fails this test, the Contractor shall  
38 repair or replace all defective materials and/or workmanship at no additional cost  
39 to the Owner.

40 2. Prior to scheduling a test with the inspector, preform a pre-test to confirm  
41 compliance. The contractor shall provide a copy of the pretest results to the project  
42 inspector before the official test is scheduled.

43 3. Contractor shall perform hydrostatic and leakage tests in accordance with North  
44 Carolina state requirements.

45 4. Leak tests of HDPE water system shall be conducted in accordance with ASTM  
46 F2164. The pipeline should be slowly filled with potable water and all trapped air

bled off. The main should undergo a hydrostatic pressure test using pressure at the lowest elevation in the system at 1.5 times the system design pressure, or 150 psi, whichever is greater. The pressure shall be maintained constant for 4-hour period. After 4-hour period is completed, the pressure is then dropped by 10 psi. The pressure shall remain steady within 5% of target test pressure for one hour. If the pressure drops more than 5% during the one hour test, then the pipe has failed the test. Proceed with the depressurization required in Item 5 below. If the pressure drops less than 5% during the one hour test, then the pipe has passed the test. Proceed with testing all the valves as required in item 8 below.

5. The total test time should not exceed 8 hours. If the pipeline has to be retested – the pipe must be depressurized and allowed to “relax” for at least 8 hours before the next testing sequence.
6. In fused polyethylene water piping system, no leakage shall be present. If leakage is observed at a fusion joint, complete rupture may be imminent. The Contractor shall move all personnel away from the joint and depressurize the main. Leaks, failure, or defective construction shall be promptly repaired by the Contractor at the Contractor’s sole expense. Repair methods shall be approved by the Engineer and shall be witnessed by the Charlotte Water Inspector.
7. The maximum length of pipe tested in one test shall be 3,000 feet or as close to 3,000 feet as possible depending on valve spacing.
8. During the last stages of the test and without any reduction in pressure, progressing in an orderly manner from the end opposite the test pump, each main line valve, hydrant guard valves, air release valves, blow off valves, and all service valves, between the main and service vault/box, will be closed and pressure released to determine if it is holding test pressure (minimum 10 minutes per valve closing). No measurable pressure drop is permitted during each valve test.
9. Any visible leakage shall invalidate and stop the test. The pipe shall be repaired in a manor approved by the Engineer. Once repairs have been completed, the line shall be refilled, and the testing process will restart from the beginning of the specified process.

### **3.7 RECORD DRAWINGS**

- A. The Engineer shall provide the Contractor PDFs to use as the Contractor Record Drawings. The Record Drawings shall be annotated using Bluebeam, by the Contractor, to show all changes encountered or made during the construction of proposed facilities. Record Drawings should be submitted to the Engineer upon completion of construction of facilities required by each sheet, but no less often than once a month. Record Drawings shall be subject to approval pending review by the Engineer and Charlotte Water Inspector. Review and approval shall consist of a review for accuracy and completeness, based on the Inspector’s knowledge of the project, and based on the minimum requirements indicated below. Record Drawings which are not approved by the Engineer shall be returned to the Contractor for explanation, revision, or correction as deemed necessary by the Engineer.
- B. Record Drawings shall meet the following minimum requirements and standards:
  1. General to all projects:
    - a. Annotations shall be in red ink only.

- b. Annotations shall be neatly printed and legible.
- c. Add existing facilities encountered but not shown on plans.
- d. Revise existing facilities encountered differently from plans.
- e. Traffic control, erosion control and other temporary facilities shall not be recorded.
- f. Mark through changed stations, bearings, distances, slopes, etc., and print actual station, bearing, distance, slopes, etc.
- g. Mark through "proposed" for items that were actually installed.
- h. Mark completely through items that were proposed but were not installed.
- i. Correct notes, sizes, diameters, dimensions, classes, types, etc. to actual as installed.
- j. Revise profile of proposed facilities to within 0.1 feet of actual vertical and within 1.0 feet of actual horizontal, based on contractor field survey of each pipe joint.
- k. Revise plan view of proposed facilities to within 1.0 feet of actual.
- l. The following sheets are excluded, and do not require updating by the Contractor:
  - m. Cover Sheet, Permit Sheet. Vicinity/Location Map Sheets
  - n. Traffic Control Sheets, Erosion Control Sheets
  - o. Standard Detail Sheets
- 2. General to all new force main projects:
  - a. Indicate pipe manufacturer, type and class of pipe.
  - b. Indicate station for transition in pipe materials.
  - c. Indicate restraint type, manufacturer, and beginning and ending stations in profile, or on plan views without profiles.
  - d. Indicate bedding type and location in profile, or on plan views without profiles.
  - e. Indicate solid ledge rock in profile to within 0.1 feet of actual vertical and within 1.0 feet of actual horizontal, or on plan views without profiles.
  - f. All fittings, valves, air releases, casings, tunnels, etc. shall be stationed.
  - g. Indicate survey grade northing and easting coordinates for all appurtenances and provide GPS locations along the main.
  - h. At air releases, indicate station for tee or plug, control valve and standpipe. Detail required, if not directly adjacent to the main.
  - i. At ALL valves, indicate valve manufacturer, model, and actual number of turns to operate.
  - j. At ALL valves, indicate if valve extension stem was installed, and actual height of extension stem (valve nut to operating nut length, measured to closest 0.1 feet.



- 1
  - 2
  - 3
- k. Indicate Survey grade northing and easting coordinates for all valve box tracer wire terminal points.
- END OF SECTION