

SECTION 2 Water Systems

2.1 GENERAL

This section sets forth the general requirements for design, installation and testing of water distribution systems for potable service. Additional information can be found in the General Conditions, Section 4 (Standard Drawings), and Section 5 (Standard Plan Notes) and Section 7 (Technical Specifications). LCPW does not guarantee flows or fire flows.

2.2 SYSTEM DESIGN

The Engineer shall comply with the design and installation requirements as specified by LCPW, the North Carolina Department of Environment and Natural Resources and North Carolina Department of Transportation and any other relevant state and local regulatory agencies..

A. Flow Demands

Flow demands for design shall be calculated on the basis of full development as known or projected. The average daily flow shall be calculated using the criteria set forth in North Carolina Administrative Code (15A NCAC 18C.0409).

B. System Size Computation

The minimum design for water distribution systems shall provide for at least 100% of the combined average day demand rate times the peak factor at 2.5 plus the required fire flow. The allowable minimum service pressure under such design conditions shall be 20 psi. Design computations shall be by the Hardy-Cross procedure, if done manually, or through the use of WaterCad Version 7.0, or other LCPW approved model, if done by computer. WaterCad Version 7.0 shall be the preferred method in all cases with Hardy-Cross only being accepted for small system analysis. All design data and computer printouts or data disks shall be subject to review and approval by LCPW. All water mains shall be sufficiently looped and in no case shall water mains be less than 6" in diameter unless specifically approved by LCPW.

LCPW will allow 2" water mains on cul-de-sacs less than 500' in length.

Unless specifically approved by LCPW for all dead end water mains 6" in diameter and larger a fire hydrant and fully restrained valve must be provided at the end of the main in lieu of a blow-off assembly.

C. Relations of Water Mains to Sewers

When installing water mains in close proximity to sanitary and/or storm sewer the following regulations from 15A NCAC 18C .906 from the NCDEQ Rules Governing Public Water Supplies will apply. LCPW will require a minimum vertical separation of 12” regardless of pipe material specified.

15A NCAC 18C .906

(a) Lateral Separation of Sewers and Water Mains. Water mains shall be laid at least 10 feet laterally from existing or proposed sewers, unless local conditions or barriers prevent a 10-foot lateral separation--in which case:

(1) The water main is laid in a separate trench, with the elevation of the bottom of the water main at least 18 inches above the top of the sewer; or

(2) The water main is laid in the same trench as the sewer with the water main located at one side on a bench of undisturbed earth, and with the elevation of the bottom of the water main at least 18 inches above the top of the sewer.

(b) Crossing a Water Main Over a Sewer. Whenever it is necessary for a water main to cross over a sewer, the water main shall be laid at such an elevation that the bottom of the water main is at least 18 inches above the top of the sewer, unless local conditions or barriers prevent an 18 inch vertical separation--in which case both the water main and sewer shall be constructed of ferrous materials and with joints that are equivalent to water main standards for a distance of 10 feet on each side of the point of crossing.

(c) Crossing a Water Main Under a Sewer. Whenever it is necessary for a water main to cross under a sewer, both the water main and the sewer shall be constructed of ferrous materials and with joints equivalent to water main standards for a distance of 10 feet on each side of the point of crossing. A section of water main pipe shall be centered at the point of crossing.

D. Fire Flows

Fire protection and public water systems shall be independent systems, designed by a North Carolina Registered, Professional Engineer and constructed in accordance with county, state, and federal standards, including satisfaction of the domestic requirements established by the appropriate state agency and the fire protection requirements established by the Uniform Fire Code and the Lincoln County Land Development Code as amended from time to time.

E. Connection to Existing System

All connections to existing mains shall be made as authorized by the Owners of the existing system. Valves separating the mains being installed from existing mains shall be operated by or under the direction of LCPW. The cost of the work in making the connections shall be paid for by the Contractor. A representative of LCPW must be present at all tie-ins and wet taps.

In the event the proposed main is to be connected to a main which has one or more active services between the point of connection and the first existing line valve, a temporary plug or cap shall be installed on the new main until the pressure tests and disinfecting are complete. Upon satisfactory completion, the cap or plug shall be removed from both

mains and the connection made with pipe, which has been swabbed out with a minimum of 50-PPM chlorine solution. The connection shall be made as swiftly as possible and any water in the ditch shall be kept below the level of the pipe.

In the event any existing customers will be without water while a connection is being made; the Contractor shall notify them two (2) weeks in advance of when the water will be turned off and when he estimates service will be resumed. These connections shall be made at night unless an alternate tie-in time is approved by LCPW. No customer shall be without water service for more than 4 hours unless specifically approved in writing by LCPW.

F. Tapping Sleeves

Tapping sleeves are used to make "wet" taps into existing mains without loss of water or interruption of service. Sleeves shall be either a stainless steel tapping sleeve and shall conform to AWWA C223 or the cast iron split repair type which shall conform to AWWA C110 suitable for 250 psi working pressure. The cast iron split repair type shall be used for any size on size connection to existing water lines. All tapping sleeves shall be installed per manufacturer's recommendations and shall comply with all current applicable AWWA Standards. Joints shall be suitable for the intended use. Valves shall be the same construction as standard AWWA gate valves, complete with operating nut and suitable for 250 psi working pressure. Tapping valves to be Mueller T-2360-16 or approved equal. All Tapping Sleeves shall be hydrostatically pressure tested to 200 psi or 1.5 times the operating pressure for a minimum of 1 hour prior to conducting a tap on existing water lines. LCPW and the ENGINEER of Record shall be notified 72 hours in advance of any tap on existing water lines.

G. Fire Hydrants

Fire hydrants serving one or more buildings located on private property and or behind a fence or other barrier in which 24 hour access is not provided, LCPW may require the installation of a reduced pressure zone assembly (RPZ) to be located at the right of way line. The fire hydrant(s), water main and all related appurtenances located behind the first O.S. & Y. valve of the reduced pressure zone assembly (RPZ) will be considered private. It shall be the responsibility of the property owner to adequately maintain all private facilities.

In all cases fire hydrants shall be installed so that the 4 ½" streamer connection is no less than 18" and no more than 24" above finished grade.

Fire hydrants shall be spaced at intervals no greater than 1,000 feet apart. All hydrant spacing shall meet the national fire code requirements.

Hydrants shall be connected to 6" and greater water mains only. No hydrants are to be connected to any size water main less than 6".

Hydrant barrels shall be painted AWWA Safety Yellow. They shall be designed for a working pressure of 250 psi and will conform to AWWA Standard C502, "Fire Hydrants for Ordinary Water

Acceptable brands of fire hydrants are:

- Muller Super Centurion 250
- Kennedy K-81D

Refer to Section 4 for additional fire hydrant detail.

H. Hydrants (See Technical Specifications)

I. Hydrant Guard Posts/Bollards

The location of guard posts/bollards for hydrants shall be required in areas subject to traffic flow and maneuvering and approved by LCPW and the Engineer of Record. Guard posts/bollard shall be constructed of 6" diameter, Class 50, Ductile Iron Pipe 6' long buried, 3' below finished grade, filled with 2500 PSI concrete and painted AWWA safety yellow, (refer to detail in Section 4).

J. Valves and Valve Locations

Fully restrained, resilient seated gate valves shall be utilized on all water mains. Water main valves 20" or larger, except tapping valves, shall be direct bury butterfly valves with mechanical joint ends conforming to all requirements of AWWA C504 with reduction gears required on valves larger than 12". Unless otherwise shown on the construction plans, all butterfly valves shall be Class 250B.

Valves shall be provided at pipe terminations, all intersecting water mains, fire hydrants, on both sides of all stream crossings, railroad crossing, bridge crossing and all other locations necessary to provide an operable, easily maintained and repaired water distribution system. Maximum length of water main between valves which can be used for shutting down the main for repair work shall not exceed 1,000 feet in commercial and industrial areas. All inline valves shall be installed next to hydrant tees.

The maximum length of pipe shutdown between valves, which can be used for shutdown for repair work in residential areas, shall not exceed 1,000 feet. All valves shall be tied by stationing for easy identification by field personnel.

Fire hydrants shall be installed with a valve at the connection to the main line. If the pipeline run for the fire hydrant, (fire lines), exceeds 100', a second fully restrained valve shall be required within 2.5' of the hydrant base.

K. Pipe Depth

The standard minimum cover for water distribution systems shall be 36" from the top of pipe to finished grade. Should this design not be possible, alternate methods must be submitted to and approved by LCPW. Where possible the maximum cover for water

mains shall not exceed 48" for pipes smaller than 16" in diameter. Pipes 16" in diameter and larger will require a minimum cover of 48.

L. Air Venting

Where the water main profile is such that air pockets or entrapment occur which could result in flow blockage, automatic air release valves shall be provided per NCDEQ specifications. **Fire hydrants or service laterals are not an appropriate means of air venting.** At critical points on major mains automatic air release assemblies shall be installed **per LCPW Standard Detail WS-06. At a minimum automatic air release valves shall be installed at all high points where the water main profile has an elevation change of $\geq 10'$.** All dead-end water mains, whether temporary or permanent, shall be equipped with a manually operated blow-off assembly at the terminal end.

M. Joint Restraining

Pressure pipe fittings and other appurtenances requiring restraint shall install joint restraint devices, manufactured restrained joint pipe and fittings or braced with thrust blocks. Joint restraining systems shall be designed for the maximum pressure condition and the safe bearing load for horizontal and vertical thrust. At a minimum, the thrust restraining system shall have a working pressure equal to or greater than the pipe material maximum pressure rating. The Design Engineer in specifying all restraining devices shall determine a reasonable safety factor. All restrained fittings and joints shall be shown on the plan and profile and must be included on the record drawings. Refer to Section 4 for the minimum restraint schedule required by LCPW.

A joint restraining schedule shall be the responsibility of the Design Engineer and shall be included in the design package. The restraining schedule shall be an integral part of the package submitted for approval by LCPW and the permit agencies.

N. Electrolysis Prevention

All systems shall be designed to best avoid electrolytic action through the contact of dissimilar metals. Preventative action, if required, may consist of installing insulating or dielectric couplings between the two materials.

O. Dead End Lines

Dead end lines will not be allowed unless justified by the Engineer and specifically approved by LCPW.

P. Water Main Location

Water main extensions are to conform to the existing water main design layout. Water mains are to be installed on the same side of the road as the existing main unless otherwise approved by LCPW.

2.3 MATERIALS

A. Pipe

1. Ductile Iron Pipe

All water mains larger than 12” shall be constructed of Ductile Iron Pipe. **Restrained Joint** Ductile Iron Pipe shall be used for all vertical deflections ditch crossings, subaqueous crossings, and all paved surfaces unless otherwise approved by LCPW.

Ductile Iron Pipe between 3” and 4” shall be a minimum of Class 51 meeting AWWA C151. Ductile Iron Pipe 6” and larger shall be a minimum of Class 50. Ductile Iron Pipe shall conform to the requirements of ANSI/AWWA C151, and shall be cement lined and conform to the requirements of ANSI Standard C104. Fittings for Ductile Iron Pipe shall conform to the requirements of ANSI/AWWA C153/A21.53 or ANSI/AWWA C110/A21.10. Mechanical and push-on joints shall conform to ANSI/AWWA C111/A21.11 and flanged joints shall conform to ANSI/AWWA 115/a21.51.

All aboveground pipe shall be painted blue. The pipe wall thickness shall not be less than that required by a working pressure of 250 psi in laying condition Type 4 "B" with 5-foot cover in conformance with ANSI Standard A21.50. Gaskets shall be a Buna N, Neoprene, or a Nitril-based rubber product approved by the County. Gaskets shall have clean tips unless otherwise specified. Elastomeric gaskets conforming to ASTM F-477 shall also be acceptable.

2. Polyvinyl Chloride Pipe (PVC)

Unless otherwise specified and approved by LCPW, all 4" through 12" diameter PVC pipe shall be rated per AWWA, C900, DR14, Class 200. Water mains larger than 12" shall be constructed of Ductile Iron Pipe. (See Section 5.3, A.1.) All PVC pipe less than 4" in diameter shall be a pressure rating of 200 psi (SDR 21) meeting ASTM D-2241.

PVC pipe 4" in diameter or larger shall have provisions for expansion and contraction provided in the joints. All joints shall be designed for push-on make-up connections. Push-on joint may be a coupling manufactured as an integral part of the pipe barrel consisting of a thickened section with an expanded bell with a groove to retain a rubber sealing ring of uniform cross section, similar and equal to John's Mannville ring-type and Ethyl Bell Ring or may be made with a separate twin gasketed coupling similar and equal to Certainfeed Fluid-Type.

High Density Polyethylene (HDPE)- LCPW has the option of approving the use of HDPE for water mains, crossings of roadways, ditches, streams, and environmentally sensitive lands. HDPE water mains shall have the same equivalent internal diameter and equivalent pressure class rating as the corresponding PVC pipe, unless otherwise approved by LCPW. HDPE must have at least three equally spaced horizontal blue marking stripes. For all roadway crossings a steel casing pipe must be provided. The Department of Transportation having jurisdiction of said road and right-of-way must grant specific approval.

PVC or HDPE shall not be installed in areas with petroleum contamination.

3. Service Connections

All potable service taps shall be located in open/green areas unless specifically approved by LCPW. Service connections shall be installed at the locations and in the manner shown on the drawings.

Service clamps for PVC mains shall be full-circle bearing types as shown on the details in Section 4 and double-strap tapped saddle service clamps for ductile iron mains. Corporation stops and curb stops shall be fitted with a compression connection outlet with split-lock devices for copper pipe.

On curbed streets the exact location for each installed service shall be marked by etching or cutting a "W" in the concrete curb; where no curb exists or is planned, locations shall be adequately marked by a method approved by LCPW. Service connection shall not be installed on pipeline 16" and larger unless extenuating conditions exist and said connection is approved by LCPW Director or designee.

When practical, in new residential, commercial, or/and industrial subdivisions, the corporation stop shall be located at the intersecting property line or in the center of the lot.

- a. Copper Pipe for 3/4" to 2" service line installations shall be American manufactured, Type K, and conform to the requirements of ASTM designation B88. Brass compression couplings with screw-clamp fittings shall be used with copper pipe

- B. Fittings (See Technical Specifications)
- C. Resilient, Wedge or Gate Valves and Boxes (See Technical Specifications)
- D. Gate Valves and Boxes Greater Than 20" in Diameter (See Technical Specifications)
- E. Check Valves (See Technical Specifications)
- F. Backflow Prevention Devices (See Technical Specifications)
- G. Meter Boxes
 - ¾" meters shall be installed in a Mueller Setter Model 203-RS-15-18-F-S-A-N box with Mueller Lid and Frame #282920.
 - 1" meters shall be installed in a Mueller Setter Model 330-RS-18-24-F-S-A-N box with Mueller Lid and Frame #282921.
 - 2" meters shall be installed in a Mueller Setter Model 550-VB-27-30-F-B-A box with Mueller Lid and Frame #700092/282921.
 - No meter shall be installed in a building unless approved by LCPW. See Section 4 for details.

Meter boxes, lids and frame, which need to be replaced shall be of the same type and kind.

- H. Concrete (See Technical Specifications)
- I. Sand (See Technical Specifications)
- J. Valve Boxes

Cast iron valve boxes shall be provided for all valves installed underground which do not have extended operators such as is required by the plug valves. The valve boxes shall be adjustable to fit the designated depth of each cover over the valve and shall be designed so as to prevent the transmission of surface loads directly to the valve or piping. Valve boxes shall have an interior diameter of not less than 5". The valve boxes shall be provided with covers marked with the word "WATER". The covers shall be so constructed as to prevent tipping or rattling. See Section 4 for details.

- K. Air Release Valves (See Technical Specifications)
- L. Restraining Devices (See Technical Specifications)

- Joint restraint devices for ductile iron mechanical joint pipe and ductile iron mechanical joint fittings to ductile iron pipe shall be EBAA Iron Inc., Series 1100 Megalug (R), Star Pipe Products, L.P., or approved equal.
- Bell joint restraint devices for ductile iron push joint pipe shall be EBAA Iron Inc., Series 1700 Megalug (R) for bell restraint, Star Pipe Products L.P., or approved equal.
- Joint restraint devices for C-900, C905 PVC pipe used with ductile iron mechanical joint fittings shall be EBAA Iron Inc., Series 2000 PV, Uni-Flange 1300, Star Pipe Product, L.P., or approved equal.
- Bell joint restraint devices for PVC push joint pipe shall be EBAA Iron Inc., Series 1600 for C- 900 PVC pipe, Series 2800 for bell restraint on C-905 PVC pipe or Uni-Flange Series 1300, 1360 or 1390 or ROMAC Series 600, Star Pipe Products L.P., or approved equal.
- C-900 or C-905 PVC fittings shall be restrained with EBAA Iron Inc., Series 2500 bell restraint for PVC fittings, Star Pipe Products, L.P., or an approved equal.

- Bolts and nuts shall be Ductile Iron or 300 Series Stainless Steel, T-Head type with hexagonal nuts. Bolts and nuts shall be machines through and nuts shall be tapped at right angles to a smooth bearing surface.

2.4 EXCAVATION, TRENCHING, BACKFILLING AND RESTORATION

A. General

The provisions set forth in this Section shall be applicable to all underground water piping installations regardless of location. Special design considerations shall require approval from LCPW.

B. Materials

All Materials shall be in accordance with AWWA standards and manufactures specifications. See Section 7 Technical Specifications for details.

C. Workmanship (See Technical Specifications)

All Workmanship shall meet AWWA standards and manufactures specifications. See Section 7 Technical Specifications for details.

2.5 ADDITIONAL INSTALLATION REQUIREMENTS (See Technical Specifications)

A. Flush Out Connections

Flush out connections shall be installed on all dead end water mains at the locations and in accordance with the details shown in Section 4.

B. Casing Installations

1. General

The provisions of this section shall represent the minimum standards for the installation of casing pipe for water main pipeline. Water mains to be placed under all NCDOT roadways shall be installed in a casing. The steel casing and procedures shall conform to the requirements of NCDOT and any supplements thereto. All work and materials shall be subject to inspection by NCDOT. The NCDOT property and surface conditions shall be restored to the original condition in keeping with the NCDOT specifications and standards.

In general, all underground water lines crossing all existing or proposed North Carolina State Highways and railroads shall be installed under these traffic ways within steel casing pipe. Specific crossing requirements shall be obtained in advance from the authority having jurisdiction.

It shall be the responsibility of the developer or engineer to submit the necessary permit documents and data to the appropriate authority and receive approval thereof. The Contractor shall maintain traffic on the roadway and shall keep all workmen and equipment clear of the travelway during the work. All safety regulations of the Department and any permit(s) shall be complied with.

2. Casing Pipe Material and Installation

Casing pipes crossing under NCDOT roadways shall be located at suitable approved alignments in order to eliminate possible conflict with existing or future utilities and structures with a minimum 36" depth of cover between the top of the casing pipe and the surface of the roadway. Casings shall be prime steel pipe conforming to the requirements of ASTM Designation A-139. Unless otherwise approved by NCDOT, the minimum casing pipe size and wall thickness shall be as shown in the following table, for the water carrier pipe size indicated. For sizes not included therein, or for special design considerations, approval shall be obtained from LCPW. PVC shall be an acceptable casing material for service lines.

For PVC and DIP Pressure Carrier Pipes

Carrier Pipe Casing Pipe Casing Pipe

CARRIER PIPE	Casing Pipe	Wall Thickness		Recommended Min. Tunnel
		DOT	RR	
6" Ductile Iron	12"	0.250"	0.281"	48"
8" Ductile Iron	16"	0.250"	0.312"	48"
10" Ductile Iron	16"	0.250"	0.344"	48"
12" Ductile Iron	20"	0.250"	0.375"	48"
16" Ductile Iron	24"	0.312"	0.469"	48"
18" Ductile Iron	30"	0.312"	0.469"	48"
20" Ductile Iron	30"	0.375"	0.501"	48"
24" Ductile Iron	36"	0.375"	0.532"	48"

3. Carrier Pipe

Water main carrier pipes to be installed within the casings shall be Restrained Joint Ductile Iron in accordance with the requirements of the installation permit. Pipe and fittings shall comply with the applicable provisions of these Standards. Special supporting of the carrier pipe within the casing shall be required with a design approved by LCPW.

Stainless steel carriers with Teflon skids being on center and restrained shall be the preferred method for installing the carrier pipe. There shall be a minimum of 2 spacers per joint of pipe or spaced according to manufactures recommendations. After the carrier pipe has been tested for leakage, the casing shall have the ends blocked with either a 8"

wall of brick masonry with a weep hole installed near the bottom of each wall or Cascade Model CCES End Seals with stainless steel bands.

C. Testing and Disinfection

1. Flushing

All water mains shall be flushed to remove all sand and other foreign matter. The velocity of the flushing water shall be at least 2 fps. Flushing shall be terminated at the direction of the Engineer or LCPW designee. The Contractor shall dispose of the flushing water without causing a nuisance or property damage, and meet all regulatory requirements for the protection of the environment.

2. Hydrostatic Testing

The Contractor shall perform hydrostatic testing of all water distribution system as set forth in the following, and shall conduct said tests in the presence of representatives from the County and other authorized agencies, with 72 hours advance notice provided. Piping and appurtenances to be tested shall be within sections between valves unless alternate methods have received prior approval from the County. Testing shall not proceed until concrete thrust blocks are in place and cured, or other restraining devices installed. All piping shall be thoroughly cleaned and flushed prior to testing to clear the lines of all foreign matter. While the piping is being filled with water, care shall be exercised to permit the escape of air from extremities of the test section, with additional release cocks provided if required.

Hydrostatic testing shall be performed with a sustained pressure for a minimum of two (2) hours at 200 psi pressure or 1-1/2 times working pressure, whichever is higher, unless otherwise approved by LCPW, for a period of not less than two (2) hours.

Testing and passing results shall be in accordance with the applicable provisions as set forth in the most recent edition of AWWA Standard C600. The allowable rate of leakage shall be less than the number of gallons per hour determined by the following formula:

$$L = \frac{SD(P)^{0.5}}{133,200}$$

L = Allowable leakage in gallons per hour;

S = Length of pipe tested in feet;

D = Nominal diameter of the pipe in inches;

P = Average test pressure maintained during the leakage
test in pounds per square inch

The testing procedure shall include the continued application of the specified pressure to the test system, for the two (2) hour period, by way of a pump taking supply from a container suitable for measuring water loss. The amount of loss shall be determined by measuring the volume displaced from said container.

Should the test fail, necessary repairs shall be accomplished by the Contractor and the test repeated until results are within the established limits. The Contractor shall furnish the necessary labor, water, pumps, and gauges at specified location and number and all other items required to conduct the required water distribution system testing and perform necessary repairs at no cost to LCPW.

Pressure gage shall be in good working order and have a range of 0-300 psi.

3. Disinfection

Following acceptable pressure testing, the Contractor shall disinfect all sections of the water distribution system and receive approval thereof from the appropriate agencies, prior to placing in service. Advance notice of 24 hours shall be provided to the County before disinfecting procedures start. The disinfection shall be accomplished in accordance with the applicable provisions of AWWA Standard C601, "Disinfecting Water Main" and all appropriate approval agencies.

The disinfecting agent shall be free chlorine in aqueous solution with sustained concentration for 72 hours or more of not less than 50 parts per million. Chlorine may be derived from Chlorine gas, or 70% (high-test) calcium hypochlorite (HTH or Perchloron, or equal). Commercial liquid bleach is **not** allowed.

Administration may be by any of the several methods described in AWWA Standard C601 as proposed by the Contractor and approved by the Engineer. Proposals as to method must be made prior to commencement of the disinfection process.

Following contact with chlorine solution, the system shall be thoroughly flushed out. Samples shall then be taken using sterile containers. Samples shall be taken by the Contractor and delivered by him to an approved laboratory for analysis. Chlorine residual shall be below 2 ppm.

If samples do not demonstrate satisfactory results, the disinfection procedure shall be repeated until one series of satisfactory samples are obtained, the period between such series of samples to be a minimum of 24 hours.

2.6 CROSS CONNECTION CONTROL POLICY

All projects must be designed to comply with the LCPW Cross Connection Control Ordinance as amended from time to time.

At no time will water mains under construction be allowed to connect to existing active water mains without an approved temporary construction connection (See Section 4 Details). In addition, water mains under construction will not be made active prior to receiving NCDEQ final certification approval.