



# Standards for Water and Sewer Design

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## **I. Plan Format Requirements**

### **A. Construction Plans**

- 1. General Requirements
  - a. Construction plans shall include:
    - 1. A vicinity map showing property boundaries in relation to existing and proposed streets.
    - 2. An overall site plan clearly indicating existing and proposed utilities. Existing and proposed topography on the overall site plan at scales of 100 feet or less and where directed by the Water Resources Department.
    - 3. If the project is to be done in phases, include a master plan clearly indicating the phase(s) to be approved.
    - 4. Provide a plan and profile sheet for proposed mains. Lines which will be public (i.e. in public easements or right-of-ways) must be on City of Greensboro format mylar. Private lines shall be labeled as such and shall not be drawn on City of Greensboro format mylar.

5. All plans shall be stamped and signed by a Professional Engineer with a valid North Carolina license and denoted as “Preliminary-Do Not Use for Construction” or “For Construction”. The Engineer’s contact information (address and phone) shall be on the plan.
  6. No plan submitted for public extensions should be larger than 24 inch x 36 inch.
  7. Scale for public lines shall be to the following specifications: 1”=40’ horizontal, 1”= 4’ vertical.
- b. All construction shall be undertaken in accordance to the City of Greensboro Standard Specifications for Water and Sewer Utility Construction.
  - c. Profile and label all proposed and existing utility crossings.
  - d. All utility crossings/separations are to meet state minimum design standards referenced herein, unless otherwise directed by the Water Resources Department.
2. Water Line Requirements
- a. Plans will be required on all water lines up to the building. Construction inspections will normally stop at the meter, unless 3 inches or larger lines are used past the meter. Construction inspections will continue to the building in these instances.
  - b. A profile is required on water, if pipe cover deviates from a 4 feet minimum or if potential conflicts with other utilities exist. A profile is required on all water mains 12 inches and larger. Size, material and clearance shall be clearly shown for all utilities crossing the water line.
  - c. The Water Resources Department may require calculations of water flow and pressure.
  - d. Tapping valves, sprinkler main valves, hydrant valves, backflow prevention devices, fire department connections, meters, and all other appurtenances shall be shown on plans.
3. Sewer Line Requirements
- a. Plan view shall include:
    1. Manhole number or station
    2. Pipe material designation
    3. Manhole top elevation
    4. Drop manhole location
    5. Building(s) with lateral location(s)
  - b. A profile shall be provided for any existing sewer line that may be affected by a project. Existing and proposed ground elevation should be shown.
  - c. Profile should show:
    1. Existing and proposed ground elevation
    2. Depth, size, material, and clearance of all lines which cross the path of the sanitary sewer
    3. Manhole invert in and out elevations
    4. Locations where special structures or ductile iron pipe are required

- d. All sewer lines within the FEMA mapped Special Flood Hazard Area (SFHA) shall show 100-year flood elevations on the profile.
- e. A detail showing pier design shall be included on plans, along with pipe deflection calculations, where required.
- f. Groundwater wells within 200 feet of improvements shall be located and shown on plans with 25 and 100 feet radii around, to ensure that minimum separation has been met.

## II. Water Design Requirements

### A. Authority

All water designs shall meet, at a minimum, the design requirements of the North Carolina Department of Environmental and Natural Resources *15A NCAC 18C.0900*, in addition to the criteria developed by the City of Greensboro Water Resources Department, as outlined in this document.

This document is intended for design guidance of water mains and general City of Greensboro requirements. Water Resources reserves the right to uphold additional design criteria that is good engineering practice and protects the water utility, as well as the public.

### B. Design Requirements

#### 1. Sizing

- a. Minimum main size in non-residential areas shall be 8 inches, unless otherwise directed by the Water Resources Department.
- b. Minimum main size for a fire pump shall be 8 inches, unless otherwise directed by the Fire and/or Water Resources Departments.
- c. Water mains must be sized for adequate fire protection or provide for adequate looping for fire protection.

#### 2. Placement

- a. Water mains shall be extended across the entire frontage of a property. Corner properties, which have water existing on one side, will be required to extend water on the adjacent side.
- b. Loop feeds may be required to ensure water quality and adequate fire flow protection, as directed by the Water Resources Department.
- c. A minimum 4 feet of cover shall be provided, unless otherwise directed by the Water Resources Department.
- d. Water mains shall have a minimum of 10 feet horizontal separation from proposed and existing sanitary sewer mains. When this separation cannot be met, both water and sanitary sewer mains shall be ductile iron pipe.
- e. Water and sewer utilities affected by a development are to be adjusted to City of Greensboro and NCDENR standards by the developer.

- f. Storm water infrastructure or Stormwater Control Measures (SCM's) are not allowed to be constructed or installed over any water line unless specifically approved by the Water Resources Department.
  - g. Subdivision and/or recombination requires extension of water and/or sewer to City of Greensboro standards or as directed by Water Resources.
  - h. Construction of public roadways requires extension of water and/or sewer across entire frontage to City of Greensboro Standards or as directed by Water Resources.
3. Meters
- a. Meters boxes or vaults cannot be located in drives or walks unless traffic bearing models built to City of Greensboro Standard Specifications are provided.
  - b. Meters 4" and larger that are outside of an existing or proposed drive shall have a minimum 14' wide access drive with a minimum 30'x 50' setup area with 95% or greater compaction. The access drive and setup area shall have a minimum 6" layer of fresh clean ABC stone with proper drainage. All access drive and setup areas shall have a dedicated access easement dedicated to the City of Greensboro. Requirements for 4" and smaller meters in these areas will be determined on a case by case basis.
  - c. Sub metering of any water usage must follow all applicable rules and regulations as set forth by the North Carolina Utilities Commission (NCUC Docket No. WR-100, Sub 5, 08/01/04, 01/20/05.)
4. Backflow Protection
- a. If the meter is installed within the street right-of-way, the backflow device shall be installed at the property line outside of the street right-of-way.
  - b. If the meter is installed outside of the street right-of-way, the backflow device shall be installed on the outlet side of the meter and within 10 feet of the meter.
  - c. Materials on the property side of the meter and backflow device shall meet plumbing code requirements.
  - d. A tandem backflow device or bypass with equal backflow device is required if multiple users are served by the same connection or the service cannot be interrupted for testing.
  - e. All backflow prevention devices shall be installed at or above grade in a horizontal position, unless otherwise approved by the Water Resources Department.
  - f. A backflow prevention device is required for any main greater than 150 feet in length that doesn't have any type of a continuous usage connection.
  - g. The following standards have been established, pertaining to uses that require a Reduced Pressure Zone Backflow Prevention Device (RPZ):
    - 1. All RPZ's are required to be located outside the building in an approved above ground enclosure, unless otherwise directed by the Water Resources Department.

2. An RPZ shall be installed on a residential service connection when a backflow prevention device is required.
3. An RPZ is required on all new non-residential service connections and any existing service connection where a plumbing permit is issued for improvements.
4. An RPZ shall be installed on all irrigation systems.
5. All master metered lines/systems will be required to have a RPZ installed on the outlet side of the meter in an approved above ground enclosure.

5. Fire Hydrants

- a. Hydrant spacing for public water mains is not to exceed 500 feet.
- b. Hydrant spacing for private on-site developments requires a hydrant to be within 500 feet of every portion of a building, provided no sprinkler system will be installed. If a sprinkler system will be installed, a hydrant will be required to be within 600 feet of every portion of the building, as measured around that building. These distances would be measured the way fire hose would be laid or dropped from a driven fire truck.
- c. A fire hydrant is required within 150 feet of a fire department connection. A double check valve or reduced pressure zone backflow prevention device shall be located between the fire department connection and the hydrant source.
- d. Fire hydrants must be no closer than 40 feet to all buildings, unless additional fire hydrants are providing overlapping fire coverage or as otherwise directed by the Water Resources Department and/or Fire Department.
- e. Hydrants must be spaced a minimum 5 feet from the driveway apron for a residential property, and a minimum 10 feet from the driveway apron and/or curve radius of a commercial and/or industrial drive entrance.
- f. Hydrants must be spaced a minimum 10 feet from the curve radius of a public and/or private street intersection.
- g. Additional fire hydrants may be required to be installed at the owner/developers expense, as directed by either the Water Resources Department and/or Fire Department.
- h. All fire hydrants shall have a guard valve restrained back to the main.
- i. Entirety of building pads on 'flag lots' shall be within 500 feet of a hydrant for fire coverage.

6. Fire Sprinkler Connections

- a. A sprinkler connection shall not be a larger size than the water main.
- b. The installation of a fire pump may be restricted if starting or stopping of the pump will introduce undesirable changes at any point within the water system. All fire pumps will require the submission of calculations and pump curves, in addition to plans, to ensure that the water system will not be adversely affected.
- c. There must be a backflow prevention device installed on the sprinkler system, per Water Resources Department backflow and meter installation drawings. This device must be

installed on the property, outside of the street right-of-way or water line easements. The Double Check Assembly (DCA) can be installed inside the building, if the domestic connection is within 10 feet of the building and no other dead-end fire line is proposed.

- d. If changes or improvements are made to an existing sprinkler system, the entire system, including the existing portion, has to be brought up to current City of Greensboro design standards.
  - e. The Fire Department Connection (FDC) must have a minimum height of 18” with a maximum height not to exceed 48”. The FDC must have a 4” storz connection with a 30 degree downturn as approved by the Fire Department.
  - f. The following standards have been established, pertaining to the location and type of device:
    1. A DCA may be used on any fire sprinkler system where a health hazard does not exist.
    2. An RPZ is required on any fire sprinkler system where a potential health hazard may exist, such as an anti-freeze solution or other chemicals that are introduced to the sprinkler system.
    3. An RPZ is required to be installed if a fire pump is installed on a sprinkler system, which must be installed on the city side of the pump.
    4. An RPZ is required on fire sprinkler systems if the building exceeds three stories in height.
    5. If the domestic service line is not connected to the sprinkler line or if the domestic service is connected to the sprinkler line within the street right-of-way or easement, a backflow prevention device must be installed at the property line.
    6. If the backflow prevention device is installed at a point on the property, the domestic service must be installed within 10 feet. The backflow prevention device must be installed on the building side of the domestic connection point.
7. Materials
- a. All pipe material, structures, and construction methods shall meet the requirements of the City of Greensboro Standard Specifications for Water and Sewer Utility Construction.
  - b. The City of Greensboro Water Resources Department reserves the right to specify the pipe material based on system knowledge.
  - c. All pipe installed in the street right-of-way or water line easement shall be ductile iron per the City of Greensboro Standard Specifications for Water and Sewer Utility Construction.
  - d. All un-metered waterlines 4 inches and larger shall be ductile iron pipe. All un-metered service laterals 2 inches and 3 inches in size can be either Type K copper pipe or ductile iron pipe.
  - e. Materials used from the meter to a point a minimum of 2 feet past the backflow device shall be Type K copper for lines up to 3 inches and ductile iron for lines 3 inches and larger.

- f. If a water main on private property is master metered, Polyvinyl Chloride (PVC) may be substituted for ductile iron on the portion past the meter.
8. Service Laterals
- a. No connections (domestic, irrigation, and/or fire sprinkler) shall be installed on any public fire hydrant lead.
  - b. Abandon any unused water lines/services back to the main, unless otherwise directed by the Water Resources Department.
9. Water Easements
- a. The width of easements exclusive to the City of Greensboro shall be a minimum width of twenty (20) feet or two times the depth of the easement (as rounded up, in five foot increments) whichever is greater, unless the Water Resources Department determines less width is necessary. The minimum width of non exclusive easements shall be greater to accommodate the location of the other utilities and shall be five (5) feet wider per additional utility unless the Water Resources Department determines less width is necessary.
  - b. Shall have a maximum grade of ten percent (10%) across a permanent water easement.
  - c. Temporary construction easements will be a minimum of 40 feet unless otherwise indicated. These easements may vary depending on size, depth, and project conditions. It is the developer's responsibility to obtain any easements which are required to extend water lines
  - d. Improvements outside the easements that exert loads into the easement at a depth determined by the lowest point of the applicable utility on or within the easement envelope and affected segment shall not be allowed.
  - e. To avoid adverse effects to slopes, those 5 feet and greater shall be outside the area of influence of the easement.

### **III. Sewer Design Requirements**

#### **A. Authority**

All sewer design shall meet, at a minimum, the design requirements of the North Carolina Department of Environment and Natural Resources "Gravity Sewer Minimum Design Criteria", adopted in February 1996, and 15A NCAC 02T.0300, in addition to the criteria developed by the City of Greensboro Water Resources Department, as outlined in this document.

This document is intended for design guidance of sewer mains and general City of Greensboro requirements. Water Resources reserves the right to uphold additional design criteria that is good engineering practice and protects the sewer utility, as well as the public.

#### **B. Design Requirements**

##### 1. Sizing

- a. Sizing of sewer mains shall meet the minimum state requirements of 8-inch public and 6-inch private, unless otherwise directed by the Water Resources Department.

- b. Oversizing of sanitary sewer mains may be required based on location of sanitary sewer and upstream basin size.
2. Depth
- a. Maximum sewer main depth is not to exceed 20 feet without prior approval by the Water Resources Department.
  - b. Maximum service lateral depth is not to exceed 12 feet without prior approval by the Water Resources Department.
  - c. No services will be allowed on mains deeper than 15 feet unless specifically approved by the Water Resources Department.
3. Slope
- a. Minimum slope is 0.5 percent for all 8-inch pipes.
  - b. Maximum slope is 10 percent. The Water Resources Department may allow greater slopes for shorter sections of pipe, in order to avoid deep manholes or drops. Ductile Iron Pipe will be required.
4. Placement
- a. No place along a sewer line should be within 30 feet of a creek bank, unless otherwise directed by the Water Resources Department. Sewer should cross creeks at near 90 degrees. Creek crossings should be minimized.
  - b. Spacing of piers should be  $18/20$  feet or  $36/40$  feet.
  - c. Mains extended in the street to serve a property must be extended across the entire frontage of the property. Projects requiring extensions within a drainage basin must be extended to the upper most point of the property or to any other point which can provide reasonable service to adjacent property or properties.
  - d. Storm water infrastructure or Stormwater Control Measures (SCM's) are not allowed to be constructed or installed over any sewer line unless specifically approved by the Water Resources Department.
  - e. Subdivision and/or recombination requires extension of water and/or sewer to City of Greensboro standards or as directed by Water Resources.
  - f. Construction of public roadways requires extension of water and/or sewer across entire frontage to City of Greensboro Standards or as directed by Water Resources.
5. Infiltration
- a. Infiltration rate shall be limited to 0 gallons per day.
6. Materials
- a. All pipe material, structures, and construction methods shall meet the requirements of the City of Greensboro Standard Specifications for Water and Sewer Utility Construction



- b. The City of Greensboro Water Resources Department reserves the right to specify the pipe material based on system knowledge.
  - c. Ductile iron pipe is required for proposed covers of less than 4 feet, when there is less than 10 feet horizontal separation from water, depths greater than 20 feet, grades of 10 percent or greater, sewer lines in fill areas, and at all stream crossings. If minimum covers cannot be maintained, the line shall be protected with casings or concrete.
  - d. A sewer main can change pipe material only once between manholes and a rigid coupling should be used. Pipe change material between manholes will be allowed case by case based on the proposed distance between the manholes. If the distance is minimum, Water Resources may require the entire length of sewer to be the same material.
  - e. Pipe on piers must be ductile iron pipe with approved restrained joints or steel pipe. If steel pipe is used, the wall thickness must be noted on plans and calculations for deflections must be submitted.
  - f. Piers are to be constructed of reinforced concrete.
  - g. All service laterals and wyes shall be constructed of a single piece of either service weight coated cast iron or Schedule 40 PVC pipe.
  - h. Traffic bearing cleanouts shall be used when appropriate, as deemed by site layout.
7. Service Laterals
- a. All laterals must have a clean out set at the easement line, including those tied into manholes.
  - b. An individual lateral must be provided for each building. For townhouses, an individual lateral must be provided for each unit. Manifold lateral configuration should be used in order to reduce the number of taps along the main. For condos, all units in one building may be combined into a common 6 inch line (with a 1 percent minimum slope). More than one building will require a main, which may be 6 inches if private.
  - c. All laterals in excess of 200 feet, or which require more than 3 cleanouts total will be required to be a 6-inch private main with manholes unless otherwise directed by the Water Resources Department.
  - d. Abandon any existing, unused sewer lines/services to the main, unless otherwise directed by the Water Resources Department.
8. Manholes
- a. All manholes should be located at least 30 feet from a creek bank.
  - b. Maximum manhole spacing for public mains shall be 500 feet for lines 15 inches in diameter or less and 600 feet for sewers 18 inches and larger, unless otherwise directed by the Water Resources Department.
  - c. Maximum manhole spacing for private mains shall be 400 feet.

- d. No more than a total of four incoming and/or outgoing lines will be allowed in any manhole, unless otherwise directed by the Water Resources Department.
  - e. Angle of flow from incoming to outgoing line shall not be less than 90 degrees.
  - f. In some cases, due to size and alignment, four lines will not be allowed. A 0.2 foot drop should be provided through the manhole. For lines tying to existing outfalls, the invert into the manhole should be at least in the upper third of the existing lines.
  - g. Sewer alignment and slopes shall be adjusted to prevent drop manholes to the extent practicable. If a difference between inverts in and out is greater than 2 feet, an inside drop will be required. All drop manhole must be approved by the Water Resources Department. Drops will not be allowed for sewer 12" and larger.
9. Sewer Easements
- a. The width of easements exclusive to the City of Greensboro shall be a minimum width of twenty (20) feet or two times the depth of the easement (as rounded up, in five foot increments) whichever is greater, unless the Water Resources Department determines less width is necessary. The minimum width of non exclusive easements shall be greater to accommodate the location of the other utilities and shall be five (5) feet wider per additional utility unless the Water Resources Department determines less width is necessary.
  - b. Shall have a maximum grade of ten percent (10%) across a permanent sewer easement.
  - c. Temporary construction easements will be a minimum of 40 feet unless otherwise indicated. These easements may vary depending on size, depth, and project conditions. It is the developer's responsibility to obtain any easements which are required to extend sewer lines.
  - d. Improvements outside the easements that exert loads into the easement at a depth determined by the lowest point of the applicable utility on or within the easement envelope and affected segment shall not be allowed.
  - e. To avoid adverse affects to slopes, those 5 feet and greater shall be outside the area of influence of the easement.

**Related Documents:**

City of Greensboro Standard Specifications for Water and Sewer Utility Construction

City of Greensboro Water and Sewer Standard Details

City of Greensboro Sewer Lift Station Requirements

North Carolina DEQ (DENR) Minimum Design Criteria for the Permitting of Gravity Sewers

North Carolina DEQ(DENR) Minimum Design Criteria for the Permitting of Pump Stations and Force Mains

NC Subchapter 02T- Waste not Discharged to Surface Waters