



Design Standards for Water, Sewer, and Pump Stations

City of Hendersonville, NC

October 2021

- I. Purpose**
- II. Plan Format Requirements**
 - General Requirements
 - Water Line Requirements
 - Sewer Line Requirements
- III. Water Design Requirements**
 - Authority
 - Design Requirements
- IV. Sewer Design Requirements**
 - Authority
 - Design Requirements
- V. Water Pump Station Design Requirement**
 - Authority
 - Design Requirements
- VI. Wastewater Lift Station Design Requirements**
 - Authority
 - Design Requirements

I. Purpose

- To provide standard guidelines to the Developer and design engineer/plan preparer for plan submittals and the development review process, construction process and closeout procedures for water and wastewater system extensions projects that will connect to and/or become part of the City of Hendersonville's water and sewer systems.
- To consolidate the various sources of information on policies, procedures, design, construction, specifications, and standard detail drawings used by the Water & Sewer and Engineering Departments of the City of Hendersonville. It is not intended to replace previously adopted codes, ordinances, or statutes, but to clearly establish the processes by which water and sewer extensions and commercial connections will be accepted for ownership and maintenance by the City of Hendersonville Water & Sewer and Engineering Departments.
- These minimum standards have been adopted and compiled from information from several sources such as agencies of the State of North Carolina, current industry standards, and the knowledge and experience of the engineering and operations staff of the City of Hendersonville's Water & Sewer and Engineering Departments.

II. Plan Format Requirements

A. Construction Plans

1. General Requirements

- a. Construction plans shall include:
 - A vicinity map showing property boundaries in relation to existing and proposed streets.
 - 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 City of Hendersonville.
 - If the utilities are to be installed in phases, include an overall plan clearly indicating the phase(s) to be approved.
 - Provide plan and profile sheets for proposed mains. Sheets shall be organized “Plan over Profile”. Each sheet shall at a minimum contain the following:
 - a. Diameter, length, and material of all proposed water and/or sewer main
 - b. All existing utilities and minimum crossing separation requirements
 - c. All proposed water and sewer components and appurtenances
 - d. Proposed service connections
 - e. Private lines, if applicable, shall be clearly labeled as such
 - Plan view shall include all property boundaries, rights-of-way, utility easements, existing utilities etc.
 - Provide detail sheets included Standard City of Hendersonville Details of applicable devices and appurtenances.
 - 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 displayed on the plan.
- b. All construction shall be undertaken in accordance with the City of Hendersonville Standard Specifications for Water and Sewer Utility Construction and coordinated through the City.
- c. All utility crossings/separations are to meet state minimum design standards referenced herein, unless otherwise approved by the City of Hendersonville.

2. Water Line Requirements

- a. Plans will be required on all water main extensions. Mains proposed to be public and private shall be clearly labeled.
- b. A profile is required on all water extension projects. Depth, size, material, and clearance shall be clearly shown for all utilities crossing the water line. Pipe restraint should be shown on the profile. Existing and proposed ground elevation should be shown.
- c. The City of Hendersonville will require calculations of water demand, flow, and pressure in an Engineer’s Report.
- d. Technical Specifications for materials, equipment, workmanship, and test procedures

must be presented in a specifications document. The cover sheet must contain the project name and must be sealed and signed by a Professional Engineer with current registration in North Carolina.

- e. Tapping valves, main valves, hydrant valves, air release valves, service lines, backflow prevention devices, fire connections, meters, hydrants, and all other appurtenances shall be clearly shown on plans and details provided.

3. Sewer Line Requirements

a. Plan view shall include:

- Manhole number and stationing
- Pipe material designation, length, and slope
- Manhole top elevation and proposed invert elevations
- Drop manhole location(s)
- All proposed components and appurtenances
- Building(s) with service lateral location(s)
- Existing infrastructure and other utilities

- 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. Profiles are required for all sewer extensions and at a minimum shall show:

- Existing and proposed ground elevation
- Sanitary sewer pipe material, length, and slope
- Depth, size, material, and separation of all existing or proposed utilities which cross the sanitary sewer
- Manhole invert elevations
- Locations where special structures are required.

- d. All sewer lines within the FEMA mapped Special Flood Hazard Area (SFHA) shall show 100-year flood elevations on the profile.

B. Project Closeout Requirements

As-built drawings and other closeout items shall be provided prior to the final acceptance of the infrastructure.

III. Water Design Requirements

A. Authority

All water designs shall meet, at a minimum, the design requirements of the North Carolina Department of Environmental Quality (NCDEQ) *15A NCAC 18C*, in addition to the criteria developed by the City of Hendersonville, as outlined in this document. All water mains shall be extended in accordance with the City of Hendersonville's Extension Policy.

B. Design Requirements

1. General

- a. Water systems shall be designed to provide adequate flow and pressure for both domestic supply and fire protection. The Engineer shall submit calculations of water demands, fire flow requirements and corresponding pressures. The City of Hendersonville shall determine, in accordance with recognized standards and accepted engineering practice if adequate flows and pressures are met. In general, the following requirements shall be met:
 - Pressure shall not exceed 250 psi static
 - Minimum 40 psi during maximum average daily domestic demands
 - Minimum 30 psi during peak hour domestic demands
 - Minimum 20 psi during peak domestic demand plus fire flow demand
- b. The City does not guarantee water flows and residual pressures for proposed new development. In the event the Public Water System does not meet the Developer's water requirements, either for domestic use or fire protection, it is the responsibility of the Developer to reduce the water requirements through building or development design modifications or by completing any necessary improvements to the existing Public Water System to meet the water requirements. These improvements shall be in accordance with this design manual and be reviewed and approved by the City.

2. Sizing

- a. All water mains shall be sized in accordance with the City's most recent Water Master Plan. In locations where water infrastructure is not specified in the Water Master Plan, the minimum size water main shall be a minimum of six inches in diameter, and eight inches in diameter for commercial projects or in areas with commercial or industrial zoning.
- b. In localized areas of the distribution system where the extent of present and future demands can be fully defined, adequate residual water pressure and volume can be maintained during peak demands and fire flow demands, and the Water Master Plan does not specify otherwise, an exception to the minimum pipe size requirement in accordance with current and accepted engineering practices may be granted.
- c. When the required pipe size for a development project extension is equal to or greater than the City minimum but smaller in diameter than is determined to be required for the betterment of the water distribution system according to the most recent version of the City Water Master Plan or at the determination of the Utilities

Director, City Engineer, or their designee(s), the City may pay the cost of oversizing lines by paying the difference between the size required for development and the oversized diameter as outlined in the “Additional Capacity Reimbursement” section of the City’s Extension Policy.

3. Placement and Installation

- a. All water extensions shall be installed within public or private road rights-of-way, whenever feasible, as determined by the City of Hendersonville. Where water mains are installed outside of these areas, a 12-foot wide, gravel utility access road shall be provided at a minimum.
- b. Each lot or parcel proposed to be served shall have frontage to a public water main.
- c. 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.
- d. Looped feeds may be required to ensure water quality and adequate fire flow protection, as determined by the City.
- e. Water mains shall be located outside paved or otherwise improved surfaces, where feasible, in areas free from trees, bushes and/or above ground structures. Waterlines are to be installed on the cut side of slopes where possible. When waterlines are installed under privately owned roads, sidewalks or similar hardscaped areas, the City will not be liable for road, sidewalk repairs or any other surface improvement repairs necessitated by any water operation or water maintenance activity.
- f. All fittings, bends, tees, crosses, and valves shall be adequately restrained utilizing approved mechanical restraint materials in accordance with manufacturer’s recommendations, City Standard Details, or otherwise approved by the City. Use of poured concrete thrust blocks will be permitted only where connections are made to existing water lines or where use of mechanical restraint is not feasible. Pre-cast concrete thrust blocks are not permitted.
- g. Water mains shall be installed with a standard minimum ground cover of three feet and not greater than five feet, as measured from the top of pipe to finished grade, unless site conditions, such as utility conflicts or stream crossings, warrant otherwise as approved on a case-by-case basis by the City.
- h. Water mains shall have a minimum of ten 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.
- i. Water mains shall not be installed at grades exceeding 18%.
- j. To prevent future cuts in paved streets, tapping connections (stub-outs) shall be extended to each lot, where practical, at the time of installation whether the lot is improved or not.

- k. Existing water infrastructure affected by a development are to be improved to City of Hendersonville and NCDEQ standards by the Developer.
 - l. Storm water infrastructure or Best Management Practices (BMP's) are not allowed to be constructed or installed over any water line unless specifically approved by the City of Hendersonville.
4. Connections to Existing Infrastructure
- a. Same size wet taps are generally not permitted. Same size connections (i.e. 6-inch x 6-inch, or 8-inch x 8-inch etc.) shall be made by cutting in a fitting, at the determination of the City.
 - b. Connections to the existing water system may only occur after all inspection, testing, and disinfection have occurred and certifications have been provided.
5. Meters
- a. Connections shall be made in accordance with the City's Metering and Connection Policy.
 - b. Determination of meter size is the responsibility of the Developer.
 - c. Meters boxes or vaults generally shall be located at the edge of public or private right-of-way or utility easement abutting the property receiving service and shall not be located in drives, walks or within drainage areas.
 - d. Sub-metering or resale 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.) Proposed water piping that connects to a sub-metering, resale, or master metered water system shall be considered an extension of the City's Public Water System.
6. Backflow Prevention
- a. All non-residential development shall be reviewed and assessed for cross-connection risk and may require backflow prevention at the determination of the City of Hendersonville.
 - b. All Backflow devices shall be approved by the City's Environmental Compliance Coordinator and must be installed in place before a water meter will be installed.
 - c. Backflow devices shall be installed on the property outside of the street right-of-way directly behind the water meter.
 - d. Materials on the property or private side of the meter and backflow device shall meet all plumbing code requirements.
 - e. 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.
 - f. All backflow prevention devices shall be installed above grade in a horizontal position within a heated enclosure, unless otherwise approved by the City of Hendersonville.

- g. The following standards have been established pertaining to uses that require a Reduced Pressure Zone Backflow Prevention Device (RPZ):
 - All RPZs are required to be located directly behind the water meter in an approved above ground enclosure, unless otherwise directed by the City of Hendersonville.
 - An RPZ is required on all new non-residential service connections and any existing service connection where a plumbing permit is issued for improvements or there is a change of use at the property.
 - An RPZ shall be installed on all irrigation systems and fire protection lines.
 - All master-metered lines/systems will be required to have an RPZ installed directly behind the meter in an approved above ground enclosure.

7. Fire Hydrants

- a. All fire hydrants shall meet or exceed the requirements of AWWA C-502, be listed by Underwriters Laboratories, Inc. and have Factory Mutual Research approval.
- b. Hydrants shall be rated 250 psi working pressure minimum unless static water pressures exceed 200 psi or otherwise required by the City of Hendersonville. In these locations, Hydrants shall be rated 350 psi working pressure.
- c. Specific fire flow requirements are determined by the appropriate jurisdiction's Fire Official. The City of Hendersonville Water & Sewer Department does not guarantee the water distribution system's capability to deliver the Fire Official's required fire flow and residual pressure. It is the responsibility of the developer or their representative to determine the governing Fire Official in their project area and document that the project's fire protection and hydrant design has been reviewed and approved by that Official.
- d. Hydrant spacing for public water mains shall not exceed 500 feet and shall be located at street intersections and at dead-end mains where possible. These distances would be measured the way fire hose would be laid or dropped from a driven fire truck.
- e. Hydrants must be spaced at a minimum of 5 feet from the driveway apron for a residential property, and at a minimum of 10 feet from the driveway apron and/or curve radius of a commercial and/or industrial drive entrance.
- f. Hydrants must be spaced at a minimum of 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/developer's expense, as directed by either the City of Hendersonville and/or Fire Official.
- h. All fire hydrants shall be installed in accordance with the Standard Detail and Specification.

8. Fire Connections

- a. A fire 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.

9. Pipe Materials

- a. All water pipe shall be ductile iron pipe (DIP) per the City of Hendersonville Standard Specifications.

10. Valves

- a. Valves must be installed underground with mechanical joint connections and have a square two-inch operating wrench nut within three feet of the top of the valve box.
- b. Gate valves are required for water mains 12 inches and smaller spaced at a maximum distance of 1000 feet.
- c. Butterfly valves are required for water mains greater than 12 inches. Valve spacing for water mains greater than 12 inches shall be determined by the City.
- d. Valves should be installed at the following locations:
 - All pipe intersections, tees, crosses
 - Change in pipe diameter and material
 - Hydrants – valve on all hydrant legs
 - Locations otherwise required by the City for proper operation and maintenance of the infrastructure

11. Service Laterals

- a. Services shall be installed in accordance with the Standard Detail. Service laterals shall be independently connected. “Split services”, or multiple customers served from a common service lateral, are not permitted.
- b. No connections (domestic, irrigation, and/or fire sprinkler) shall be installed on any public fire hydrant leg.
- c. Abandon any unused or existing water services back to the water main at corporation, unless otherwise directed by the City.

12. Water Main Easements

- a. The width of utility easements exclusive to the City of Hendersonville shall be a minimum width of 20 feet. The City may require additional easement width depending on main size, depth of main or other factors necessary for the proper maintenance and operation of the infrastructure.
- b. Temporary construction easements will be a minimum of 40 feet unless otherwise indicated. These easements may vary depending on size, depth, and project conditions.
- c. It is the developer’s sole responsibility to obtain any utility easements required.
- d. The City may require additional utility easement area for future, orderly expansion of the water system.

IV. 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,” most recent version, in addition to the criteria developed by the City of Hendersonville, as outlined in this document.

B. Design Requirements

1. Sizing

- a. The minimum size sewer main shall be pipe not less than eight inches in diameter.
- b. At a minimum, all gravity sewer mains shall be designed and sized to serve the 85% buildout of a sewer drainage basin.
- c. When the required pipe size for a development project extension is equal to or greater than the minimum but smaller in diameter than is determined to be required for the betterment of the sewer collection system according to the most recent versions of the City Sewer Master Plan or at the determination of the Utilities Director, City Engineer, or their designee(s), the City may pay the cost of oversizing lines by paying the difference between the size required for development and the oversized diameter as outlined in the “Additional Capacity Reimbursement” section of the City’s Extension Policy.

2. Depth

- a. Sewer mains shall be installed at adequate depth to allow for gravity service connections where feasible and allow for reasonable future extension at the discretion of the City.
- b. Maximum sewer main depth is not to exceed 20 feet without prior approval.
- c. Maximum service lateral depth is not to exceed 12 feet without prior approval.
- d. No services will be allowed on mains deeper than 12 feet without prior approval.

3. Slope

- a. Minimum slope is 0.4 percent for all 8-inch diameter sewer main.
- b. Maximum slope is 10 percent. The City 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 and Installation

- a. All sewer extensions shall be installed within public or private maintained street rights-of-way, whenever feasible, as determined by the City of Hendersonville. Where sewer mains are installed outside of these areas, a 12-foot wide, gravel utility access road shall be provided at a minimum.
- b. Sewer mains shall not be installed within 30 feet of a stream bank, unless otherwise directed by the City. Sewer mains should cross creeks at near 90 degrees and have adequate cover. Creek crossings should be minimized in the design layout of a sewer

extension.

- 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 uppermost point of the property or to any other point which can provide reasonable service to adjacent property or properties where feasible.
- d. Each lot or parcel proposed to be served shall have frontage to a public sewer main.
- e. Stormwater infrastructure or Best Management Practices (BMP's) are not allowed to be constructed or installed over any sewer line unless specifically approved by the City.

5. Materials

- a. Gravity sewer pipe shall be Poly-Vinyl Chloride (PVC). A Standard Dimension Ratio (SDR) of 35 shall be the maximum allowed for pipe supplied under ASTM D-3034, unless otherwise specified in the Drawings or approved by the Engineer. The City of Hendersonville reserves the right to specify the pipe material based on system knowledge.
- b. Ductile iron pipe is required for proposed pipe cover less than three feet, when there is less than 10 feet horizontal separation from water, grades of 10 percent or greater, and at all stream crossings.
- c. A sewer main shall not change material between manholes.
- d. All service laterals and wyes shall be constructed of a single piece of either service weight coated cast iron or Schedule 40 PVC pipe.

6. Service Laterals

- a. All laterals must have a clean out installed at the edge of the property or utility easement boundary abutting the property receiving service, including those tied into manholes, in accordance with the standard detail.
- b. An individual service lateral must be provided for each single-family structure. For townhouses, an individual lateral must be provided for each unit. Manifold lateral configuration should be used to reduce the number of taps along the main in other scenarios, however each structure shall have separate lateral connections. For multi-family structures, all units in one building may be combined into a common 6-inch diameter lateral.
- c. Properly abandon any existing unused sewer laterals to the main, unless otherwise directed by the City.
- d. Pressure service lateral connections to existing force mains are not permitted.

7. Manholes

- a. Pipe diameter changes, material changes, grade changes and angular deflections shall occur only in manholes.
- b. All manholes should be located at least 30 feet from a stream bank.

- c. No more than a total of three incoming lines and one outgoing line will be allowed in any manhole, unless otherwise directed by the City.
 - d. Angle of flow from incoming to outgoing line including service laterals shall not be less than 90 degrees.
 - e. A 0.2-foot drop should be provided through the manhole for all pipe sizes less than 12-inches. 0.1-foot drop shall be provided for pipe sizes greater than 12-inches. For line size changes at manholes or lines tying to existing manholes/outfalls, the crown elevations of the pipes shall match.
 - f. A drop manhole is required where the difference between invert in and out elevation is greater than 2.5 feet. Outside drops are preferred.
8. Sewer Main Easements
- a. The width of utility easements exclusive to the City of Hendersonville shall be a minimum width of 20 feet. The City may require additional easement width depending on main size, depth of main or other factors necessary for the proper maintenance and operation of the infrastructure.
 - b. Temporary construction easements will be a minimum of 40 feet unless otherwise indicated. These easements may vary depending on size, depth, and project conditions.
 - c. It is the developer's responsibility to obtain any easements required.
 - d. The City may require easement area for future expansion of the sewer infrastructure.

V. Water Pump Station Design Requirement

A. Authority

Water pump stations are only permitted with extensions or connections to the Public System where, in the sole opinion of the City, adequate water service is not achievable or is determined to be financially infeasible.

B. Design Requirements

Public Water Pump Stations shall be designed and installed in accordance with the City of Hendersonville Standards for Typical Water Pump Station 2HP to 25 HP, most recent version.

VI. Wastewater Lift Station Design Requirements

A. Authority

Wastewater lift stations are only permitted with extensions or connections to the system where, in the sole opinion of the City, gravity service is not achievable.

Private lift stations are only allowed where gravity sewer exists adjacent to a property, but is not deep enough to serve all of the property. Private lift stations shall not serve more than one property. Private lift stations require specifications and detailed site plans for approval by the City of Hendersonville and must be permitted by the State of North Carolina.

All sanitary sewer lift station designs shall meet, at a minimum, the design requirements of the NCDEQ “Minimum Design Criteria for the Fast-Track Permitting of Pump Stations and Force Mains,” most recent version, in addition to the standard requirements developed by the City of Hendersonville.

B. Design Requirements

Public Lift Stations shall be designed and installed in accordance with the City of Hendersonville Standards for Typical Duplex Submersible Wastewater Pump Stations, 5 HP to 25 HP, most recent version.