

SECTION 4 - DESIGN STANDARDS FOR WATER DISTRIBUTION FACILITIES

4.1. General Requirements

- 4.1.01 Water and fire protection distribution facilities are to be provided solely for the purpose of supplying potable water and fire protection. Under no circumstances shall cross-connections be allowed to unapproved water facilities. The following design parameters should be used in the design of water distribution facilities. Water transmission facility design parameters are not included herein and such criteria will be established on a case by case basis.
- 4.1.02 Prior to submitting plans for new water distribution facilities or extensions to existing facilities, the designer shall coordinate with the Department and determine the available flow and pressure from the existing system.
- 4.1.03 Where irrigation systems are installed on systems connecting to public water lines, they shall be provided with backflow devices, rain sensors and other devices to prevent unnecessary usage.

4.2 Technical Design

4.2.01 System Layout

- A. The overall layout and general design shall conform to the parameters set forth in the approved Engineering Report. Generally, all water mains shall be located, where practical, in:
- (1) Legally established road rights-of-way.
 - (2) Legally established permanent easements for such purpose and immediately adjacent to legally established road rights-of-way or paved areas, either existing or as proposed by the designer in accordance with Section 1.3. - "Easement Requirements" of these Standards.

Parallel installation of waterlines under pavement shall not be allowed unless it can be demonstrated that it is the only feasible option. If water lines are installed under pavement, they shall be constructed of Class 52 DI pipe. The Department reserves the right to require that water lines be installed under pavement when it deems this to be in its best interest and these water lines shall be constructed of CL52 DI pipe.

Generally, water lines in well-spaced single family development shall be out of pavement, while water lines in high density single family or in multifamily development shall in pavement

Generally, water lines shall be located behind the curb or 1 foot off the edge of the pavement when a ditch is present.

- B. Construction shall generally be parallel to the center line of roads or easements. The same offset shall be used throughout except when existing utilities dictate a change in offset along the proposed line.
- C. Water mains shall be installed a minimum of 10 feet from any part of any structure.
- D. In general, main line valves are required at intervals of 1000 feet and at tees and crosses to allow adequate control of the system without major system shutdowns. At a minimum, two valves shall be provided at all tees with one on the branch side and three valves shall be provided at all crosses. All valves 16" and larger shall be butterfly valves.
- E. In general, water lines shall be installed above storm sewer lines. Exceptions may be granted when the depth of the storm sewer is such that the waterline passing under the storm sewer will have no more than 6.5' of cover at any point. Waterlines crossing under storm sewers shall have a minimum of 18" of clearance between the storm sewer and water line, shall be constructed of Class 52 restrained ductile iron for a minimum of one joint each side of the crossing, and shall not have any fittings or joints placed under the storm sewer. When waterlines cross over storm sewer lines, a minimum clearance of 12" shall be provided for PVC waterlines. A minimum clearance of 6" may be provided if the water line is constructed of Class 52 ductile iron.

4.2.02 System Design

- A. The proposed facilities together with the pertinent existing facilities shall be evaluated based on the hydraulic design, demand design and fire protection design requirements contained herein.
- B. The Design Engineer shall submit to the Department a neat and orderly set of design calculations to illustrate normal and fire flows, pipe size selection and fire protection requirements.
- C. Conduits of non-ferrous material buried underground shall have a marking tape and tracing wire buried in the trench. Marking tape shall be installed approximately 18" above the pipe, but no less than 24" below grade. Tracing wire shall be taped directly on the pipe in a manner that a continuous tract results.
- D. Dead end lines shall be minimized by looping mains. Where looping is required the minimum size pipe shall be 8".
- E. At least two supply points shall be provided for subdivisions containing more than 50 lots. Phased developments may develop up to 50 lots without a second supply

point. At the time that more than 50 lots are approved, a second supply point must be provided unless the Department has approved a waiver from this requirement.

- F. All dead ends shall be provided with a fire hydrant.
- G. For large diameter lines (16" or larger) or for "spine" lines that extend long distances without having looped connections, air release only and/or combination valves shall be provided at all high points. Consideration may be given to extra depth of bury to avoid air release valves, but in no case shall the depth exceed 6.5' of cover. The County reserves the right to require air valves on smaller diameter lines or loop lines if, in its judgment, such valves would be needed to protect the system.

4.2.03 Hydraulic Design

- A. Hydraulic design shall be accomplished by use of the Hardy-Cross Network Analysis Method or similar method acceptable to the Department. A Hazen-Williams coefficient of friction equal to 120 shall be used for purposes of design unless the Department has data to indicate a lesser coefficient should be used for existing lines.

4.2.04 Demand Design

- A. Maximum rates of water consumption shall be calculated and used as a basis of hydraulic design. Average daily water consumption rate values for the number and type of consumers anticipated to be served shall be based on those contained in the State of Virginia "Waterworks Regulations." Any such rates not given or any deviations from tabulated rates shall be estimated and justified by the Design Engineer and approved by the Department. The average annual daily water consumption rates shall be adjusted by a multiplier to arrive at the maximum daily water consumption rate by the application of a multiplier, expressed as follows:

$$\text{Average Maximum Daily Demand} = 2.5 \times \text{Average Daily Demand}$$

$$\text{Peak Hourly Demand} = 4.38 \times \text{Average Daily Demand}$$

- B. Any water system shall be designed to provide effective equalization storage and fire protection storage. Equalization storage shall be calculated as 20% of the Peak Hourly Demand as defined above. Fire protection storage shall be defined by the maximum specified fire design for the users in the system. For purpose of residential development, such storage shall be provided using a volume of 120,000 gallons (based on a 1000 gpm fire flow for a 2-hour duration). No discounts for pumping capacity from wells or booster stations shall be considered for purposes of "discounting" from this requirement. Systems that contain commercial development or small systems where providing the storage as required would create water quality conditions via lack of turnover shall be evaluated on a case-by-case

basis.

- C. If the development is connecting to an existing County water system, it shall be the developer's responsibility to upgrade any water system storage, pumping, well, line(s) or any other system component that does not meet the design criteria at the developer's expense, unless the County requires oversizing of such components.

4.2.05 Fire Protection

- A. General

Rates of flow for fire protection shall be estimated based on the International Building Code (IBC) Appendix B – Fire Flow Requirements for Buildings.

- B. Single Family and Duplex Residential Structures

All single family and duplex residential structures up to 3,600 ft² shall be provided a minimum hose stream flow of 1000 gpm from each hydrant. Structures in excess of 3,600 ft² shall comply with the rules for multi-family, commercial, and residential structures. The Fire Department shall have the right to require additional flow in cases where they deem it to be appropriate. Flow reduction may be achieved by the installation of sprinklers (see E below).

- C. Multi Family Residential, Commercial, or Industrial Structures

All multi family residential, commercial, and industrial structures shall be provided with sufficient number of hydrants and flows as appropriate relative to building construction, use, and square footage per appropriate ISO, IBC, and NFPA standards. IBC Table B105.1 shall be the general guideline used to determine required flows. All flows are to be approved by the Fire Department. Flow reduction may be achieved by the installation of sprinklers (see E below) but in no case shall the minimum fire flows for such structures shall be less than 1500 gpm.

- D. Minimum System Pressures

The minimum residual pressure at all points in the distribution system during a flow event shall be 20 psi. Residual pressures are to be verified by hydraulic calculations (preferably computer flow modeling). Fire flow calculations shall be performed assuming maximum day domestic demand in addition to the fire flow and shall assume minimum normal working system pressure and tank levels. Flow calculations shall demonstrate that all hydrants can achieve the required flows without depleting the system residual pressure below 20 psi.

- E. Sprinklers

Fire flow requirements under B and C above may be reduced by the installation of

approved automatic sprinkler systems. Amount of flow reduction shall be as determined by the Fire Department and the IBC. Structures protected by automatic sprinkler systems require installation of a double detector check, dedicated fire hydrant, and a siamese connection. Siamese connections must be located within 50 feet of the dedicated hydrant. Double detector checks shall be located in vaults adjacent to rights of way or edges of easements per New Kent County DPU Standard Details.

F. Minimum Line Size

The minimum size water line used for fire protection to single family or duplex residential properties shall be 8" in size. Exceptions may be granted in cases where an entire subdivision is provided with sprinkler systems and it can be demonstrated that reduced line sizes can achieve the required hose stream flow at minimum residual pressure. In no case shall lines less than 6" be installed.

The minimum size water line used for fire protection to multi-family residential, commercial, or industrial properties shall be 8" in size.

The minimum sized fire service lines shall be looped to provide feed from at least two directions. The sizing of minimum-sized fire service lines and larger than minimum fire service lines shall be determined by Sections 4.2.03 and 4.2.05 - "Hydraulic Design" and "Fire Protection." No fire hydrants shall be installed on a 6" dead end line except in cases of single family or duplex residential development where sprinklers are provided and the system can provide the required flows while maintaining minimum residual system pressure.

G. Hydrant Location & Spacing

Fire hydrants shall be located no further from edge of roadway shoulder than 10'0"

.Fire hydrants shall be placed on legal rights-of-way and shall generally be placed in line with street intersections. This shall be deemed to be the P.T. of the returns on the rights-of-way. Where long block lengths require the use of intermediate fire hydrants, they shall be placed in line with the property boundary between adjacent lots or parcels of land. Fire hydrants on cul-de-sac dead end lines shall be located at the intersection of the cul-de-sac with the feeder road. In cases where an additional hydrant is required on the cul-de-sac due to spacing, the hydrant shall be located as near as practical to the middle of the cul-de-sac.

Fire hydrant spacing for properties zoned agricultural or with single family or duplex residential development shall not exceed 900 feet or require a hose lay of over 650 feet from the hydrant to any part of any structure to be protected.

Fire hydrant spacing for properties zoned or with multi-family residential, commercial or industrial development shall not exceed 500 feet or require a hose

lay of over 350 feet from the hydrant to any part of any structure to be protected. Where multiple fire hydrants are needed to supply the required fire flow, all necessary hydrants must be located within the specified hose lay. Notwithstanding the above, hydrants shall be evenly spaced around such structures to provide adequate coverage as determine by the Fire Department.

No fire hydrant shall be placed closer than 50 feet from the face or overhang of any building to be protected.

The above criteria for spacing fire hydrants may be modified by the County Fire Chief to improve fire hydrant accessibility for fire fighting purposes.

4.2.06 Structural Design

- A. Structural requirements must be considered in the design of all water mains and appurtenances.
- B. The proper strengths shall be specified for the pipe material being specified. Strength shall be based on operating pressures, depth of bury, trench width and foundation conditions. This is an engineering matter and not subject to generalization.
- C. Proper blocking and restraints must be provided and shown on the drawings.
- D. Proper support shall be provided for aerial or suspended lines.
- E. Any potable waterline crossing above surface water must be:
 - (1) Adequately supported.
 - (2) Protected from freeze damage.
 - (3) Accessible for repair or replacement.
 - (4) Above the 100-year flood plain elevation.
 - (5) Constructed of Class 53 flanged ductile iron.
- F. Any potable waterline crossing under surface water must meet the following requirements:
 - (1) The pipe shall be of special construction having flexible watertight joints.

- (2) Valves shall be provided at both ends of the water crossing so that the section can be isolated for test or repair; the valves shall be easily accessible and not subject to flooding.
 - (3) Permanent sample taps shall be available at each end of the crossing and at a reasonable distance from each side of the crossing, for the purpose of testing the section of line crossing the surface water, and for locating leaks in that section.
 - (4) Minimum cover over the pipe during crossing shall be 3 feet.
 - (5) The water line shall be constructed of Class 53 ductile iron. PVC and HDPE may be used for directional drilling with Department approval.
- G. Waterlines located in fill material shall be constructed of restrained Class 52 ductile iron.
- H. All waterlines, including service lines, shall conform to the specifications in Section 02665.

4.2.07 Miscellaneous Considerations

- A. The minimum size water line pipe to be used for normal domestic water shall be 8".
- B. Air, air/vacuum or pressure reducing valves and related fittings shall be provided as required. The type, size, etc., shall be specified in Section 02665.
- C. The minimum depth of cover for water mains shall be 3½ feet. Additional depth shall be provided where required for thrust restraint or to clear underground obstructions. Where water lines cross under roadside ditches, minimum cover may be reduced to no less than 3 feet but in no case shall depths less than 3 ½ feet be allowed for a horizontal distance of less than 5 feet along the pipe axis.
- D. The profile of water services at ditch lines shall be shown on plans and have a minimum of 24" cover at the ditch invert.
- E. Service lines larger than ¾", with meters larger than ⅝" shall be sized in accordance with AWWA Manual M-22 "Sizing Water Service Lines and Meters" except as follows:
 - (1) Use constant pressure factor of 1.
 - (2) Include all outside hose bibs in combined fixture value total.

- (3) Irrigation systems shall be excluded from domestic meter sizing criteria. If metered separately, the irrigation meter shall be sized based on demand criteria furnished by the Engineer.
- (4) For non-residential facilities with flush-valve fixtures, the meter will be sized as follows:

METER SIZE – INCHES*	COMBINED FIXTURE VALUE TOTAL
1	41-100
1½	101-400
2	401-1200

- (5) For residential facilities and office buildings with tank type water closets, the meter will be sized as follows:

METER SIZE - INCHES	COMBINED FIXTURE VALUE TOTAL
5/8	0-40
1	41-400
1½	401-5500

- (6) Plumbing Fixtures Values shall be shown in AWWA No. M-22 for 35 PSI.
 - (7) Meter installations requiring a flow of greater than 160 gpm or greater than the total fixture values indicated above shall be reviewed and/or approved on a case by case basis in accordance with AWWA Manual M-22.
 - (8) Steel casing pipe shall be sized in accordance with Paragraph 3.2.01S.
 - (9) A 5/8" meter may be used for non-residential facilities with tank type water closets and a combined fixture value total of 0-40.
- F. Where water lines are subject to extreme variations in temperature (i.e., attached to bridges or box culverts) consideration shall be given to expansion and contraction of pipe materials and the freezing of the line contents.
 - G. Cathodic Protection - Design Engineer shall consider ground conditions in the case of metallic conduits and provide suitable cathodic protection where necessary.
 - H. No flushing device shall be directly connected to a sewer.

4.3. Drawings

4.3.01 In addition to the requirements of Section 1.2. - "Drawings Organization and Format" of these Standards, the drawings shall incorporate the following features:

- A. Drawings for water lines shall show stationing, pipe size, pipe material, bearings, deflection angles and curve data.
- B. The drawings shall also show all fire hydrant and water service connections. Fire hydrants and water services over $\frac{3}{4}$ " in size shall be shown in plan and profile views which are labeled by stations.
- C. Profiles shall be provided for all water lines. Grades shall be calculated and shown on the profiles. Profiles shall also show all fittings, air, air/vacuum relief valves, and fire hydrants.
- D. Water lines shall be referenced by distances from right-of-way lines, buildings and other utilities.
- E. Blocking and/or restraint details.
- F. Current New Kent County Sewer and Water Notes, where applicable, see Section 6 – Standard Forms and Notes, F-3.
- G. All drawings for water mains, crossing sewers, force mains, storm sewers, or other utilities, shall show points where crossings occur. Crossings shall be shown in both Plan and Profile. The Profile shall clearly indicate vertical clearance between utilities.
- H. Meter sizing form, backflow prevention details and ISO calculations shall be shown on the plans.
- I. All fittings to include valves, bends, tees, etc. shall be shown on the plan and profile.

END OF SECTION