

DESIGN AND CONSTRUCTION STANDARDS FOR WATER FACILITIES

100.00 GENERAL REQUIREMENTS:

All water supply systems, other than individual, including mains, valves, hydrants, and appurtenances shall be planned and constructed according to the specifications and standards set forth herein as minimum requirements. Before construction is commenced, plans, profiles, details, and specifications shall be reviewed and approved by the PSA Director as being in accord with these requirements and all construction shall be in accord with approved plans.

Water mains shall be located within public rights-of-way or dedicated public water line easements and shall be located no closer than five (5) feet from the edge of the easement or right-of-way line unless otherwise authorized by the PSA Director. Easements shall provide sufficient space for both installation and maintenance with a minimum width of 20 feet. When it is deemed necessary for proper maintenance of the facilities, additional easement width may be required by the PSA Director.

In planned developments (residential, commercial, industrial, etc.), water lines shall be placed in the road right-of-way outside of pavement and public utility easements for all other utilities (gas, electric, cable TV, telephone, etc.) shall be placed on the opposite side of the roadway to prevent conflicts of other utilities with water lines.

Water supply systems, as described above, shall be designed by a Professional Engineer, licensed by the Commonwealth of Virginia whose seal and signature shall be placed on each plan sheet. A Land Surveyor licensed by the Commonwealth of Virginia may design such portions of a water supply system as provided by the Code of Virginia, Title 54, Section 54-17.1, 3(b).

Systems shall be designed to provide adequate flow and pressure, both for domestic supply and fire flow, based on sound hydraulic analysis and good engineering practice. Hydraulic analysis shall be developed using readily available software. Domestic and fire flows shall be analyzed and presented separately and pipes shall be sized to meet the calculated requirements of simultaneous peak domestic and fire flow. Model output runs shall be presented in tabular form and include the following as a minimum: narrative defining various assumptions and various output runs, map showing all elements and labels easily referenced to site plans, static pressures, residual pressures, available fire flows, pipe velocities, pump conditions, control valve (PRV, etc.) conditions, storage tank conditions, and condition of any other applicable system element.

In order to properly evaluate water systems and hydraulic conditions, all submitted plans shall be based upon actual USGS datum.

Authority, of which these specifications are a part, approved by the Board shall be followed unless specified deviation therefore is authorized, in writing, by the PSA Director. When such deviations effect fire protection concurrent authorization by the Emergency Services Coordinator shall also be obtained. All standards referenced in this Section shall refer to the latest revision or revised edition of the referenced manual.

101.00 WATER LINE DESIGN:

101.01 The minimum size of water line shall be as follows:

- A. In residential districts, eight-inch (8"); six inch (6") may be used only when it completes a good grid system, and only, in blocks six hundred feet (600') or less in length.
- B. In other areas, 12-inch (12") and 8-inch (8"); 8-inch may be used only when it completes a good grid system and 12-inch for lines not interconnected.
- C. Fire hydrants shall not be installed on lines less than eight inches (8") in diameter, except that fire hydrants may be installed on a six-inch (6") line that is part of good grid system. Unless specifically approved by the Emergency Services Coordinator, no plantings or erection of other obstructions shall be made within a four-foot (4') radius of any fire hydrant. The surface shall be level within this same radius.
- D. For the last 450 feet of pipe located beyond last fire hydrant on streets which water line cannot be extended, 6-inch pipe may be used, when approved by PSA Director.
- E. In lieu of the above, and for residential districts only, detailed design calculations may be submitted for review and concurrence by the PSA Director to substantiate line sizes other than those specified above. In any case, the minimum line size acceptable shall be six-inch (6"). For all design, the published "C" factor shall be reduced to new pipe "C" factor minus 10. This reduced "C" factor shall be used so as to reflect more accurately the future flow in aged pipe.
- F. Dead-end water lines shall be eliminated wherever possible by looping of all water mains. Generally, ends of water lines within 500 feet or less shall be connected.
- G. Long water service lines shall not be allowed in lieu of water main extensions, where a water main extension would serve other customers or areas. Where allowed, the water meter shall be installed at the right-of-way or easement line perpendicular to and at the shortest point from the public water main. Private water service lines shall not be located within the public right-of-way or easement parallel to the water main. The property owner shall be responsible to obtain private easement(s) for any crossing of private property.

101.02 In general, fire hydrants shall be located as follows:

- A. In residential areas, at street intersections and at intermediate locations where necessary, as determined by the Emergency Services Coordinator. In no case shall the distance between fire hydrants, measured along the centerline of accessible streets, be greater than one thousand feet (1,000').
- B. Within one hundred feet (100') of any standpipe or sprinkler system fire department connections, where those systems are required in buildings.
- C. As required by the following schedule as given by use group, the distance shall be measured to the most remote part of the structure the hydrant will serve.

Industrial buildings	250 feet	
School buildings		300 feet
Commercial, Churches & Office Buildings		350 feet
Apartments, Multi-family & Townhouses		250 feet
Single family detached dwellings		500 feet*

* Measured along centerline of street to the center of front property line for single-family detached dwellings only.

- D. All hydrants shall be a minimum of fifty feet (50') away from buildings other than single-family detached dwellings. The location of all new and existing hydrants that are to serve the property shall be shown on the plans.

101.03 Water systems shall be so designed to adequately supply normal and peak demands of all customers, maintaining a pressure of not less than twenty-five (25) pounds per square inch at all points of delivery, without reducing the service to existing customers below the foregoing requirement, and shall have adequate capacity to be capable of delivering not less than the below fire flows, for a minimum of two hours, with a residual pressure of not less than twenty (20) pounds per square inch to at least one (1) point within two hundred fifty feet (250') of each building to be served or proposed to be served by an extension. In those cases where the existing source of supply cannot deliver fire flows at adequate pressures, the developer shall design his water system based on achieving the required fire flows with an assumed residual pressure of 30 psi at point of connection to the supplying system.

- A. Peaking Factors and Demands for Design:
 1. Peak Hour Factor: 3
 2. Maximum Day Factor: 2
 3. Average Day Factor: 1
 4. Residential Demand per ERC: 0.5 gallon per minute (GPM)
 5. Maximum Hour Domestic Demand (less than 1,000 ERC): $Q=11.4 \times N^{0.544}$
 $Q = \text{total GPM}$ $N = \text{total number of residential units}$
 6. Industrial or commercial demands shall be based upon Best Engineering Judgment
 7. Minimum fire flow: 500 GPM.

B. Fire Flow Requirements for Various Land Uses

1. Residential Areas as follows:

- a. Normal residential property with over 100' between buildings - 500 GPM.
- b. Normal residential property with 31'-100' between buildings - 750 GPM.
- c. Normal residential property with 11'-30' between buildings - 1,000 GPM.
- d. Story and one-half residential - 1,000 GPM.
- e. Two-story residential, congested area - 1,500 GPM.
- f. Normal residential property with 10' or less between buildings - 1,500 GPM.

2. High Value Areas:

- a. Apartments, townhouses up to 2-1/2 stories - 1,500 GPM.
- b. Minor mercantile and congested apartments, 2 to 3 stories - 2,000 GPM.
- c. High value industrial, shopping centers, and mercantile districts - 2,500 GPM.

In areas of mixed-use development, higher fire flow shall govern. Fire flows indicated above are for new development. Where size and scope of the development exceeds these requirements, additional flow shall be provided in accordance with ISO (Insurance Services Organization) requirements as reviewed by the Emergency Services Coordinator.

101.4 Valves shall be so set and adjusted such that covers shall be exposed and flush with street surface. Valves may not be installed in a roadway ditch or concrete gutter. If street surfaces are renewed or replaced by developer or owner after water system has been approved and accepted by the PSA but while such streets are still the obligation of the developer or owner, valve boxes/vaults therein shall be readjusted to proper location relative to the new street surfacing. Valve boxes/vaults located in sodded or other off-street areas shall be so set and adjusted that the covers shall be exposed and flush with finished surface elevation.

101.05 Valves shall be installed at the intersection of water lines. Generally, three (3) valves will be used at crosses and two (2) valves at tees. A valve shall also be installed at least every one thousand feet (1,000') on distribution mains and adjacent to fire hydrant tees if practical. A valve shall be installed between the last service and the terminus of any water main that can be extended in the future.

- 101.06** Where a water main that can be extended is terminated beyond a gate valve on that main, the minimum length of pipeline between valve and end of the line shall be thirty-six feet (36'). Additional length shall be required to insure future extension with minimum surface destruction. In no case shall the end of a pipeline terminate in a paved area. No services or fire hydrant shall be installed between gate valve and end of line that can be extended.
- 101.07** No water line shall terminate under a concrete valley gutter or roadway ditch. Whenever possible to avoid, no gate valve shall be located under a concrete valley gutter. Water lines shall be laid with a minimum parallel offset of 3 feet from centerline of the pipe to either face of concrete curbing.
- 101.08** A blow-off at dead-end lines shall be provided as indicated in the details drawings.
- 101.09** All pipes shall be laid to a minimum depth of thirty-six inches (36") from established final grade to the top of the pipe. Water pipe shall not be laid at depths exceeding eight (8') feet unless specifically approved by the PSA Director.
- 101.10** Automatic air release valves shall be placed at all high points in the system to provide for the release of trapped air. Fire hydrants may only be used at high points for release of trapped air when approved by the PSA Director. Automatic air/vacuum release valves shall be installed when required by the PSA Director to mitigate potential vacuum conditions.
- 101.11** All water mains shall be provided with blow-off valves at strategic low points in the line. Fire hydrants may be used at low points in place of blowoffs where it is demonstrated that a minimum flushing velocity of 4 feet per second is provided. The point of connection to the water main shall be rotated downward to facilitate removal of accumulated solids.
- 101.12** Cross connections and backflow prevention connections shall be designed and reviewed to insure compliance with the adopted cross-connection and backflow ordinance.
- 101.13** Water mains may be installed on private property if a public water line easement of a minimum of twenty feet (20') in width is duly recorded. The easement width may be reduced in certain areas with written approval of the PSA Director when the twenty-foot (20') easement would constitute a significant hardship for the development.

Increased easement widths may be required by the PSA Director when determined necessary due to large mains or excessive depths which will require special trench excavation in order to comply with applicable State and Federal safety regulations. Easement instruments denoting water line easements shall include a note giving water purveyor the right of access to water service connection and water meter for the purpose of maintenance and operation.

No permanent structure, including fences, trees or shrubbery, shall be placed or constructed within an easement. Additional easements shall be provided across property under the owners/developers control that may be required to extend water facilities in

the future or to provide convenient access to easements for construction and maintenance purposes. Grade within existing easements shall not be changed without written approval from the PSA Director.

101.14 AWWA STANDARDS

101.15

The following AWWA Standards (latest revision) are hereby incorporated by reference. Where a conflict exists between these written standards, and the standards incorporated by reference, the PSA Director will determine which standard shall apply. In general, PSA Director will select Standard that gives a final product that is in the best interest of the PSA. Applicant shall provide PSA with manufacturer's certification that materials meet these standards.

- A100 Standard for water wells.
- C104 Standard for cement-mortar lined for ductile-iron and gray-iron pipe and fittings.
- C110 Standard for ductile-iron and gray-iron fittings.
- C111 Standard for rubber gasket joints for ductile-iron and gray-iron pipe and fittings.
- C115 Standard for flanged ductile-iron and gray-iron pipe with threaded flanges.
- C150 Standard for thickness design of ductile-iron pipe
(Class 52 minimum to be considered for 12" diameter or less)
- C151 Standard for ductile-iron pipe
- C502 Standard for dry-barrel fire hydrants
- C504 Standard for rubber-seated butterfly valves (approved for 14 inch or larger)
- C506 Standard for backflow prevention devices
- C508 Standard for swing-check valves
- C509 Standard for resilient-seated gate valves
- C550 Standard for protective interior coatings for valves and hydrants
- C600 Standard for installation and testing of ductile-iron water mains and appurtenances
- C651 Standard for disinfecting water mains
- C602 Standard for cement-mortar lining of water pipe lines
- C652 Standard for disinfection of water storage facilities
- C900 Polyvinyl chloride (PVC) pressure pipe, (DR-14 minimum class for water).
- D100 Standard for welded steel tanks for water storage
- D102 Standard for painting steel water storage tanks
- D103 Standard for factory-coated bolted water storage tanks

102.00 SURFACE WATER CROSSING

Surface water crossings, both over and under water, present special problems and should be discussed with the PSA Director before final plans are prepared.

A. Above Water Crossings - The pipe above water crossings shall be:

1. Adequately supported;
2. Protected from damage from freezing;
3. Accessible for repair or replacement; and
4. Above 100 year flood level.

B. Under Water Crossing:

1. Pipe shall be of special construction, having flexible watertight joints; i.e. ball and socket, lock-joint, and shall be Class 54 or 55 DI. DR-9 HDPE may be used for under water crossings. In lieu of the above, Class 52 DI pipe may be used with a minimum of one foot on all sides being concrete encased within the one hundred (100) year flood way limits;
2. Valves shall be provided at both ends of the water crossing so that the section can be isolated for tests or repair; the valves shall be easily accessible and not subject to flooding by the 100-year storm flood level;
3. Permanent sample taps shall be installed on each end of the crossing and at reasonable distance from each side of the crossing to facilitate testing.

103.00 WATER STORAGE FACILITIES

Water storage facilities shall be designed and constructed to meet the requirements of AWWA D100 for "Welded Steel Tanks" or AWWA D103 for "Factory Coated Bolted Steel Tanks" for water storage, latest edition Standard except as hereafter specified otherwise. Water storage facilities shall be designed and constructed to meet Virginia Department of Health (VDH) standards and PSA requirements. All water storage facility design plans and specifications shall be reviewed and approved by the VDH and PSA.

Precast concrete water storage reservoirs may be required by the PSA Director under specific conditions that require below ground reservoirs. All precast concrete water storage reservoirs will be designed by PSA using applicable standards.

Water storage tanks shall be located on a dedicated water storage tank lot with a all-weather access road. Minimum lot size shall be 150 feet by 150 feet and minimum access road width shall be 15 feet.

A. Steel Standpipe, Reservoirs and Accessories

1. Supplemental Information to both AWWA D100 and AWWA D103.
 - a. Earthquake Design: Seismic Zone 2 using fixed percentage method of 5%.
 - b. Electric Power: Developer/Contractor's obligation
 - c. Compressed Air: Developer/Contractor's obligation
 - d. Concrete Work: Comply with all requirements of ACI 301.
2. Supplemental Information to AWWA D100.

- a. Corrosion Allowances: 1/16-inch for parts in contact with water.
 - b. Submit written report certifying work inspected as set forth in AWWA D100, Sec. 11.2.1. Mill and shop inspection by commercial inspection agency is required.
 - c. Submit details of all welded joints referenced on design drawings in accordance with AWWA D100, Sec. 1.4.
 - d. Mill Scale: Completely remove by blast cleaning or pickling. (SSPC-SP10 or SSPC-SP8)
 - e. Butt-joint welds subject to secondary stress where thickness is greater than 3/8 inch (3/8") shall have complete joint penetration welds.
 - f. Radiographic tests shall be required and film shall become property of the PSA.
 - g. Protective Coatings:
 - g1. Surface preparation for both inside and outside shall be in accordance with SSPC-SP10. (Steel Structures Painting Council - Surface Preparation 10)
 - g2. First anniversary inspection in compliance with AWWA D102 will be required.
 - g3. Outside Paint System: Aliphatic Polyurethane 5.5 to 8.0 total dry mils. Outside paint shall be Tnemec 70/71-3, Pennsbury Coatings, Water Tank System No. 10 or equal as approved by PSA Director.
 - g4. Inside Paint System: Two-Coat Epoxy Polyamide, 7.0 to 11.0 total dry mils meeting NSF Standard 61. The inside paint shall be Tnemec 20-1 (Poto-Pox) or equal as approved by the PSA Director.
 - g5. Paint Color shall be as selected by the PSA Director from the manufacturers available colors.
3. Supplemental Information to AWWA D103.
- a. Tank Bottom: Concrete slab and steel base setting ring is required.
 - b. Full five (5) year manufacturers warranty on factory coating is required.

4. The following accessories, in addition to those required by either AWWA D100 or AWWA D103, shall be provided and installed.
 - a. Exterior safety cage, rest platform and roof ladder, handrails to accessories in conformance with OSHA. A fall prevention system, which complies with applicable OSHA regulations is also required.
 - b. Overflow to ground, 1,000 GPM minimum, located near roof opening. Provide coarse screen and concrete splash pad and erosion protected channel from overflow to drainage system or natural channel.
 - c. Screen vent against insects, provide special vent to insure fail-safe operation in event insect screens frost over.
 - d. Removable silt stops.
 - e. Separate drain line to drainage system or natural channel with erosion protection.
 - f. Separate fill and discharge lines to provide adequate mixing and minimize short-circuiting.

B. Disinfection

1. After all painting and coating schedules have been completed and the specified drying times have elapsed, the Developer/Contractor shall proceed to disinfect the interior surfaces of the standpipe structure utilizing one of the following disinfection methods.
 - a. Tank shall be filled to overflow level with potable water to which enough chlorine has been added to produce an initial chlorine concentration of 50 mg/l in the full tank. The full tank should stand for 24 hours; however, in no case, shall it stand less than 6 hours. At the end of the holding period, the highly chlorinated water shall be drained to waste, the tank refilled with potable water and tested for bacteriological quality.
 - b. All interior surfaces of the tank shall have applied to them a strong chlorine solution containing at least 200 mg/l of free available chlorine. The chlorine solution shall be applied with either spray equipment or brushes. Any equipment used to apply the chlorine solution shall either be new or previously used only for disinfection purposes. Strong chlorine solution shall remain in contact with tank surfaces for at least 30 minutes. Tank shall then be filled with potable water to overflow level and tested for bacteriological quality.

- c. Potable water containing a free chlorine residual 50 mg/l shall be placed in the tank to such a depth that when the tank is filled, the resulting chlorine concentration in the water will be at least 2 mg/l. The water containing 50 mg/l of chlorine shall stand in the tank for 24 hours. The tank shall then be filled with potable water and allowed to stand for 24 hours. At the end of the second 24-hour period, the chlorine residual shall be at least 2 mg/l. After bacteriological analysis of the water for quality, the tank may be placed in service without draining the water used to disinfect it.
2. Two consecutive bacteriological samples collected at 24-hour intervals shall be obtained from the standpipe structure before the tank is placed into service. The bacteriological test form shall be marked "CONSTRUCTION SAMPLE". Analysis of the samples shall be performed by a laboratory certified by the VA State Health Department. If contamination is indicated in the bacteriological samples, the disinfection procedure shall be repeated at the Developer/Contractor's expense.

104.00 WATER PUMP STATIONS

Water pump stations shall be designed and constructed to meet Virginia Department of Health (VDH) standards and PSA requirements. All water pump station design plans and specifications shall be reviewed and approved by the VDH and PSA. In addition the following requirements shall apply:

- A. All pump stations shall be designed with three pumps, each capable of pumping 50% of the peak day design flow. Hydraulic or electrically actuated pump control valves shall be provided for each pump unless otherwise approved by the PSA Director.
- B. Pumps shall be selected for maximum operating efficiency. The pump operating design point (system curve intersect) shall be between 60 to 120 percent of the gallon per minute (GPM) flowrate (Q) of the pump rate (GPM) at the point of maximum operating efficiency (n) on the manufacturer's pump curve.
- C. Pump stations shall be controlled by pressure devices installed on a separate sensing line at the point of storage. For pump stations not located at storage facilities, pump control information shall be transmitted to pump station via telephone lines or radio transmission.
- D. Pump controllers shall include provisions for alternating plus backup control of pumps.
- E. Low suction pressure cut-off switches shall be provided to prevent/shut down pump operation when suction pressure drops to a preset value to prevent pump damage.
- F. Electrical Requirements:

1. Pumps 5 horsepower and above shall be 3 phase. Where 3 phase is available, pumps larger than 3 horsepower shall be 3 phase. Variable Frequency Drives (VFD) shall be provided for all pumps 5 horsepower or greater where 3 phase power is not available. Three-phase power will be considered available if the supply is within 2,000 feet for overhead service or 1,500 feet for underground service of the sewage pump station.
2. Three phase pumps shall have phase protection on individual phases which also protect when running, as manufactured by Square D, Allen-Bradley or equal as approved by the PSA Director.
3. Three phase pumps shall each have an individual poly-phase starter.
4. All pumps shall be controlled by starters with individual HOA switches.
5. Starters shall be sized one size larger than horsepower required. Heaters shall be sized for actual current load.
6. All control circuits shall be 120 volt.
7. Electrical service shall be provided with lightning arresters.
8. Electrical panel shall have a minimum of 20 circuits.
9. All electrical wiring shall be placed in conduit.
10. Water pump stations shall be considered a wet location for interpretation of the National Electric Code requirements.
11. All receptacles and switches shall have a minimum 20-amp rating.
12. At least one 20-amp circuit equipped with GFI protection shall be provided.
13. All electrical equipment and panels shall be manufactured units with UL listing and shall include the manufacturer's warranty.
14. A non-automatic transfer switch shall be installed on load side of service disconnect. Switch shall be rated same as or higher than service disconnect.
15. On-site standby generators shall be provided for all pump stations.
Generators shall be powered by natural gas (where available) or propane and sized to provide adequate service to start and operate all pumps.

G. Hour run meters shall be required for each pump motor.

- H. Master water meters shall be provided and located to provide maximum accuracy.
- I. All pump stations installed above ground shall be of masonry construction with masonry or frame roof. Exterior shall be brick faced or washed pebble and shall have prefinished fascia, soffit and trim. Pre-hung insulated steel doors with minimum size 3-0 x 6-8 shall be used.
- J. Pump houses shall have adequate insulation to protect equipment and reduce heating cost.
- K. Adequate lighting, heating, ventilation, and drainage shall be provided for pump stations.
- L. Below or in-ground pump stations may be approved by the PSA Director for special application on an individual basis. Such approval will only be given when such design meets all the above requirements and adequate provisions are provided for the prevention of flooding, safe working conditions, efficient access system and adequate area for maintenance and operation of the pump station.
- M. Minimum size structures to house a pump station shall be 8 foot x 10 foot x 8 foot high.
- N. All pump stations shall comply with applicable Building Codes and applicable Montgomery County permits shall be secured.
- O. All pump station piping and fittings shall be flanged copper or ductile iron unless otherwise approved by the PSA Director.
- P. Isolation valves shall be required between the connection to the piping and all gauges and all other smaller diameter taps.
- Q. Bleeder valves (petcocks) shall be provided on all pump discharge lines.
- R. Pump shutoff controls (high level pressure switch) with manual reset is required for each pump when discharge pressure exceeds 85 psi unless otherwise approved by the PSA Director.
- S. Automatic air release valves shall be installed at all high points on pump discharge piping.
- T. A minimum of one automatic air/vacuum valve shall be installed on the pump suction piping.
- U. A spare (not installed) pump shall be provided with each pump station.
- V. Water pump stations shall be located on a dedicated water pump station lot with all-weather access road. Minimum lot size shall be 100 feet by 100 feet.

- END OF SECTION -