

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 County as being in accord with these requirements and all construction shall be in accord with approved plans.

In addition to County approval, Virginia Department of Health (VDOH) approval is required for any projects involving pumps, storage or contact tanks or water lines over 12 inches in diameter.

Water mains shall be located within public rights-of-way or "waterline easements" and shall be located no closer than ten (10) feet from the edge of the "waterline easement" or right-of-way line unless otherwise authorized by the County. "Waterline Easements" shall provide sufficient space for both installation and maintenance with a minimum width of 25 feet. Additional easement width may be required by the County when it is deemed necessary for proper maintenance of the facilities. No other utility line shall be laid within a vertical area which is parallel to and within 12" of a waterline. A "public utility easement" shall not be combined with or located within a "waterline easement".

Water supply systems as described above shall be designed by a Professional Engineer, licensed in 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. Domestic fire flows shall be analyzed and presented separately and pipes shall be sized to meet the calculated requirements of simultaneous peak daily domestic and fire flow.

100.1

These specifications, approved by the Botetourt County Board of Supervisors, shall be followed unless specified deviation therefore is authorized, in writing, by the County. When such deviations affect fire protection, Botetourt County Ordinances will be followed. All standards referenced in this Section shall refer to the latest revision or revised edition of the referenced manual.

101.0 WATERLINE DESIGN

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

- A. In residential areas six (6) inch line shall be the minimum acceptable diameter.

- B. In commercial and industrial areas eight (8) inch line shall be the minimum acceptable diameter
- C. No plantings or erection of other obstructions shall be made within six (6) feet of any fire hydrant. The surface shall be level within this same radius.
- D. For the last 200 feet of pipe located beyond the last fire hydrant on cul-de-sacs for streets on which the water line cannot be extended, and with no more than four (4) connections, two (2) inch pipe (either ductile iron or SDR-21) may be used when approved by the County.
- E. 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.

101.2 Fire hydrants shall be located as follows:

- A. In residential areas, at street intersections and at intermediate locations where necessary, as determined by the Engineering or Utility Department. In no case shall the distance between fire hydrants, measured along the center line of accessible streets be greater than one thousand (1000) feet.
- B. Within one hundred (100) feet 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 attached dwellings only.	

- D. All hydrants shall be a minimum of fifty (50) feet 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.

101.3 Water systems shall be so designed to adequately supply the 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 fire flows listed below, for a minimum of two (2) hours, with a residual pressure of not less than twenty (20) pounds per square inch at the meter to 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 thirty (30) psi at point of connection of the supplying system.

A. Peaking Factors and Demands for Design:

1. Peak Hour Factor: 4
2. Maximum Day Factor: 2.5
3. Average Day Factor: 1
4. Residential Demand per ERC: 0.5 gpm
5. Industrial or Commercial Demands shall be based on Best Engineering Judgment.

B. Fire flow requirements for various land uses.

1. Residential Areas as follows:
 - a. Normal residential property with over fifty (50) feet between buildings-500 GPM.
 - b. Normal residential property with less than fifty (50) feet between buildings-750
2. High Value Areas:
 - a. Apartments, townhouses, PUD's, up to 2 1/2 stories-1000 GPM.
 - b. Minor mercantile and congested apartments-1000 GPM.
 - c. High value industrial, shopping centers, and mercantile districts-1000 GPM.

The fire flows indicated above are for new development. Where the size and scope of the development exceeds these requirements, additional fire flow shall be provided in accordance with ISO (Insurance Services Organization) requirements.

101.4 Valves shall be set and adjusted so that the covers are set as shown in the Water Detail Drawing. If street surfaces are renewed or replaced by the developer or owner after the water system has been approved and accepted by the County but while such streets are still the obligation of the developer or owner, the valve boxes therein shall be readjusted to proper location relative to the new street surfacing and set according to Water Detail Drawing. Valve boxes located in sodded or other off-street areas shall be so set and adjusted that the covers are set as shown on Water Detail Drawing. All valves five (5) feet or deeper shall be installed with American Flow Control Trench Adapter as shown on the Water Detail Drawing.

101.5 Where a water main that can be extended is terminated beyond a gate valve in that main, one joint of pipe shall be installed and capped, beyond the valve. Pipe shall be plugged and a concrete thrust block poured behind it. In no case shall the end of a pipeline terminate in a paved area.

No water line shall terminate under a concrete valley gutter. Whenever possible to avoid, no gate valve shall be located under a concrete valley gutter.

No services or fire hydrant shall be installed between the gate valve and end of line that can be extended.

101.6 All pipe shall be laid to a minimum depth of thirty-six (36) inches from established final grade to the top of the pipe. Water pipe shall not be laid at depths exceeding ten (10) feet unless specifically approved by the County.

101.7 Valves shall be installed at the intersection of water lines. Generally, four (4) valves will be installed at crosses and three (3) will be installed at tees. A valve shall also be installed at least every one thousand (1000) feet on distribution mains. A valve will be installed between the last service and the terminus of any water main that can be extended in the future.

101.8 A means to provide a blow-off at dead-end lines shall be provided as indicated in the standard details. Fire Hydrants shall not be used as a means to provide blow-off.

101.9 Automatic air release valves shall be placed at strategic high points in the system to provide for the release of trapped air. Fire Hydrants shall not be used for air release.

101.10 All transmission mains will be provided with blow-off valves at strategic low points in the line. The point of connection to the water main shall be rotated downward to facilitate removal of accumulated solids.

101.11 Cross connections and backflow prevention connections shall be designed and reviewed to insure compliance with the Botetourt County Code.

101.12 Water mains may be installed on private property if a waterline easement of a minimum of twenty-five (25) feet in width is duly recorded. The easement width may be reduced in certain areas with written approval of the County when the twenty-five (25) foot easement would constitute a significant hardship for the development. No other utilities shall be allowed within the waterline easement.

Increased easement widths may be required by the County 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 the water purveyor the right of access to the water service connection and the water meter for the purpose of maintenance and operation. Access easements may be required to allow access for maintenance purposes to the water mains that are not located adjacent to a public right-of-way.

No permanent structure, including fences, trees or other shrubbery, shall be placed or constructed within an easement. Additional easements shall be provided across property under the owner/developer's control that may be required to extend water facilities in the future or to provide convenient access to easements for construction and maintenance purposes.

101.13 AWWA STANDARDS

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 County will determine which standard shall apply. In general, the Standard that gives a final product that is in the best interest of the County will be selected. The applicant shall provide the County with Manufacturers 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 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" or larger).

C506 Standard for back-flow 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 their appurtenances.

C602 Standard for cement-mortar lining of water pipe lines.

C651 Standard for disinfecting water mains.

C652 Standard for disinfection of water storage facilities.

C909 Standard for Molecularly Oriented Polyvinyl Chloride (PVCO) Pressure Pipe: 4 in. through 12 in.

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.

102.0 WATER LINE CONSTRUCTION

102.1 General:

Except as specifically modified below, water line construction shall meet the requirements of AWWA C600, latest edition standards. Pipe, fittings, valves, hydrants, and accessories shall be loaded and unloaded by lifting with hoists or skidding so as

to avoid shock or damage. Under no circumstances shall such materials be dropped. Pipe should be so handled that any coating or lining is not damaged.

The water main shall be laid and maintained to the required lines and grades with fittings, valves, hydrants and accessories set at the required locations as indicated on the approved plans for the project. All valve and hydrant stems shall be set plumb. Whenever obstructions not shown on the plans are encountered during progress of the work and interfere to such an extent that alteration in plans is required, the County, or its authorized representative, shall be advised and their approval given before such alterations are put into effect. Any such alternative design shall be designed or approved by the Engineer of record for the original design.

102.2 Excavation, Bedding and Backfill

The trench shall be dug so that the pipe can be laid to the alignment and depth required and it shall be excavated not more than five hundred (500) feet in advance of the completed pipe laying operation. The width of the trench shall be ample to permit the pipe to be placed, backfilled and thoroughly compacted in accordance with the requirements of these specifications. Trenches shall be of such extra widths as will permit the convenient placing of timber supports, sheeting and bracing and handling of special fittings or appurtenances when required.

The trench shall be excavated to the depth required so as to provide a uniform and continuous bearing and support for the pipe on solid and undisturbed ground at every point between bell holes; except that it will be permissible to disturb and otherwise damage the finished surface over a maximum length of eighteen (18) inches near the middle of each length of pipe by the withdrawal of pipe slings or other lifting tackle. The damaged area shall be refinished as near as possible to original quality. The part of the bottom of the trench excavated below the specified grade shall be backfilled with approved materials and be thoroughly compacted. The finished subgrade shall be prepared accurately by means of hand tools.

Bedding as indicated by the standard details shall be placed as required by the pipe manufacturers' written instructions.

Where excavation is made in fractured rock, boulders or other unsuitable material, the subgrade shall be made by backfilling with a minimum of four (4) inch compacted depth of gravel or clean selected soil which shall be thoroughly compacted.

Bell holes shall be provided at each joint to permit the jointing to be made properly and to permit maximum bedding length.

Ledge rock, boulders and large stones shall be removed to provide a clearance of at least six (6) inches below and on each side of the pipe and appurtenances being laid and any part, projection or joint of such rock stone.

No pipe shall be laid in water or when, in the opinion of the County or their authorized representative, trench conditions are unsuitable.

Backfill shall be placed in two (2) equal depth layers to the top of the pipe and each layer shall be thoroughly tamped to ninety-five (95) percent of the maximum theoretical density as determined by ASTM D698 Standard Proctor Test. The

remainder of the backfill shall be placed in a maximum of two (2) foot layers mechanically tamped. Backfill material shall be free of perishable material, frozen clods, sticky masses of clay and other unsuitable matter. Rock pieces larger than two (2) inches shall not be used in the backfill which is within two (2) feet of the pipe. Backfill within existing or proposed roads shall meet the requirements established and required by the Virginia Department of Transportation.

102.3 Installation of Pipe, Joints, Fittings and Appurtenances

When installing pipe in the trench proper implements, tools, and facilities satisfactory to the County and as recommended by the material manufacturer shall be provided and used by the contractor for the safe and convenient prosecution of the work. All pipe, valves, fittings, hydrants, and accessories shall be carefully lowered into the trench, piece by piece, by means of a derrick, ropes, slings or other suitable tools or equipment in such a manner as to prevent damage to the water main material and any protective coatings and linings. Under no circumstances shall water main material be dropped or dumped into the trench. The pipe and fittings shall be inspected for defects, and while suspended above grade, be rung with a light hammer to detect cracks.

All lumps, blisters and excess coal tar coatings shall be removed from the ends of ductile iron pipe and the outside of the spigot and the inside of the bell shall be wiped clean, dry and free from oil and greases before the pipe is laid.

Every precaution shall be taken to prevent foreign material including non-potable water from entering the pipe while it is being placed in the line. If the pipe-laying crew cannot put the pipe into the trench and in place without getting earth into, a heavy tightly woven canvas bag of suitable size shall be placed over each end and left there until the connection is to be made to the adjacent pipe. During laying operations no debris, tools, clothing, or other materials shall be placed in the pipe. At the end of each day a clean watertight plug shall be placed in the end of all pipe openings.

After placing a length of pipe in the trench, the spigot end shall be centered in the open bell of the pipeline and the pipe pushed home so that the face of the spigot is in close contact with the shoulder of the bell. Water pipe shall be laid with the bell facing the direction of the laying.

No stub of any water main shall terminate with a capped or plugged valve. Where a valve is required to be installed near a stub end, one joint of pipe shall be installed after the valve. The pipe shall be plugged and a concrete kick block poured behind it.

The cutting of pipe for inserting valves, fittings, or closure pieces shall be done in a neat and workmanlike manner without damage to the pipe or cement lining and so as to leave a smooth end at right angles to the axis of the pipe.

When machine cutting is not available for cutting metal pipe twenty (20) inches in diameter or larger, the electric-arc cutting method will be permitted using a carbon or steel rod. Only qualified and experienced workmen shall be used for this work. The flame cutting of metal pipe by means of oxyacetylene torch will not be permitted.

Whenever it is necessary to deflect pipe from a straight line, either in the vertical or horizontal plane, to avoid obstructions or plumb stems, or where long-radius curves

are approved, the amount of deflection allowed shall not exceed the minimum required, for satisfactory jointing of the pipe, as specified in this manual. The maximum deflection permitted pre joint shall be in accordance with AWWA C600 Table 4 for push-on joint and Table 5 for mechanical joint pipe.

All tees, bends, plugs, caps and fire hydrants shall be substantially braced, blocked and/or trapped to prevent any movements by providing adequate reaction backing and/or tie rods. Reaction backing shall be designed and installed as indicated in the standard details.

When installing PVC C909 water pipe, leak detection & location access points shall be installed at approximately 200 lf. intervals along the main waterline. (See Detail)

Hydrants shall be set to finished grade as follows:

1. Bottom of the four and one-half (4 1/2) inch nozzle shall be between eighteen (18) inches and twenty-four (24) inches above finish elevation of the edge of the shoulder on streets without curb and gutter and between eighteen (18) inches and twenty-four (24) inches above the elevation of the curb on streets with curb and gutter as indicated on the standard details.
2. The two and one-half (2 1/2) inch hose connections shall have a minimum of six (6) feet clearance on all sides.
3. Surface shall be approximately level within a six (6) foot radius of the hydrant.

Fire hydrant and blow-off hydrant drains that are not plugged shall be drained to the ground surface or to dry wells provided exclusively for this purpose. If during construction the seasonal water table is noted to be above the drain outlets of the proposed hydrant, the county engineer shall be notified immediately so that the fire hydrant can be relocated to a suitable location or deleted.

102.4 Testing

All new water mains shall be tested, after backfilling to a hydrostatic pressure of not less than 100 psi above design water pressure for the system or 150 psi. whichever is greater. Allowable leakage shall be calculated by the following formula:

$$L = \frac{SDP^{1/2}}{133,200} \quad \text{Where:}$$

L = allowable leakage in gallons per hour
S = length of pipe tested in feet
D = nominal diameter of pipe in inches
P = average test pressure during leakage test in psi

Allowable leakage is shown in columnar form in Table 6.

No water line shall be placed in service until the leakage is less than the allowable leakage as indicated above. Testing of water mains shall only be done after installation of all valves, taps and service laterals are complete. All portions of the water system, including hydrants and service lines, shall be subject to the hydrostatic pressure during the leakage test. Testing of water mains shall be observed and documented by a County Inspector.

All high points and service lines in the portion of the system under test shall be vented and all air shall be expelled from the system prior to beginning the test. All fittings and hydrants shall be properly braced or blocked before applying pressure. Where concrete thrust blocks are used, they shall have attained their final set prior to testing.

After the portion of the system under the test has reached the required pressure as stated herein, said pressure shall be maintained for two (2) hours. At the conclusion of the pressure test, the volume of makeup water required to refill the pipeline shall be determined by measurement with a displacement meter or by pumping from a vessel of known volume.

All joints or fittings at which leakage occurs shall be re-worked to insure tightness. All visible leaks shall be repaired regardless of amount of leakage. If the measured amount of leakage exceeds the valves for the appropriate size as found in AWWA Specifications C600, Hydrostatic Testing (Table 6), the pipe-line shall be repaired and re-tested until leakage is within the limit set by the referenced specification. Methods of repair prior to re-testing will be done upon the County's approval and inspection. Repairs of new construction will be by adjustment or replacement of material only. The use of repair clamps or bell clamps will not be acceptable.

INSTALLATION OF DUCTILE-IRON WATER MAINS

TABLE 4

Maximum Joint Deflection* Full Length Pipe – Push On Type Joint

Nominal Pipe Size (in.)	Deflection Angle 0 degrees.	Maximum Offset – S [^] in. (m)		Approx. Radius of Curve – R [^] Produced by Succession of Joints- ft.(m)	
		18 ft. (5.5m) L [^]	20 ft. (6.1 m) L [^]	18 ft. (5.5 m) L [^]	20 ft. (6.1 m) L [^]
3	5	19 (0.48)	21 (0.53)	205 (62)	230 (70)
4	5	19 (0.48)	21 (0.53)	205 (62)	230 (70)
6	5	19 (0.48)	21 (0.53)	205 (62)	230 (70)
8	5	19 (0.48)	21 (0.53)	205 (62)	230 (70)
10	5	19 (0.48)	21 (0.53)	205 (62)	230 (70)
12	5	19 (0.48)	21 (0.53)	205 (62)	230 (70)
14	3*	11 (0.28)	12 (0.30)	340 (104)	380 (115)
16	3*	11 (0.28)	12 (0.30)	340 (104)	380 (115)
18	3*	11 (0.28)	12 (0.30)	340 (104)	380 (115)
20	3*	11 (0.28)	12 (0.30)	340 (104)	380 (115)
24	3*	11 (0.28)	12 (0.30)	340 (104)	380 (115)
30	3*	11 (0.28)	12 (0.30)	340 (104)	380 (115)
36	3*	11 (0.28)	12 (0.30)	340 (104)	380 (115)
42	2*	7 ½ (0.19)	8 (0.20)	510 (155)	570 (174)
48	2*	7 ½ (0.19)	8 (0.20)	510 (155)	570 (174)
54	1 ½*	5 ½ (0.14)	6 (0.15)	680 (207)	760 (232)

*For 14-in and larger push-on joints maximum deflection angle may e larger than shown above. Consult manufacturer.

INSTALLATION OF DUCTILE-IRON WATER MAINS

TABLE 5

Maximum Joint Deflection* Full Length Pipe - Mechanical Joint Pipe

Nominal Pipe Size (in.)	Deflection Angle 0 degrees.	Maximum Offset – S* in. (m)		Approx. Radius of Curve – R* Produced by Succession of Joints- ft.(m)	
		18 ft. (5.5m) L*	20 ft. (6.1 m) L*	18 ft. (5.5 m) L*	20 ft. (6.1 m) L*
3	8-18	31 (0.79)	31 (0.89)	125 (38)	140 (43)
4	8-18	31 (0.79)	35 (0.89)	125 (38)	140 (43)
6	7-07	27 (0.69)	30 (0.76)	145 (44)	160 (49)
8	5-21	20 (0.51)	22 (0.56)	195 (59)	220 (67)
10	5-21	20 (0.51)	22 (0.56)	195 (59)	220 (67)
12	5-21	20 (0.51)	22 (0.56)	195 (59)	220 (67)
14	3-35	13 ½ (0.34))	15 (0.38)	285 (87)	320 (98)
16	3-35	13 ½ (0.34))	15 (0.38)	285 (87)	320 (98)
18	3-00	11 (0.28)	12 (0.30)	340 (104)	380 (116)
20	3-00	11 (0.28)	12 (0.30)	340 (104)	380 (116)
24	2-23	9 (0.23)	10 (0.25)	450 (137)	500 (152)
30	2-23	9 (0.23)	10 (0.25)	450 (137)	500 (152)
36	2-05	8 (0.20)	9 (0.23)	500 (152)	550 (167)
42	2-00	7 ½ (0.19)	8 (0.20)	510 (155)	570 (174)
48	2-00	7 ½ (0.19)	8 (0.20)	510 (155)	570 (174)

TABLE 6

Allowable Leakage per 1,000 ft. (305 m) of Pipeline* -- gph[^]

Average Test Pressure psi (Bar)	Nominal Pipe Diameter - inches															
	3	4	6	8	10	12	14	16	18	20	24	30	36	42	48	54
450 (31)	0.48	0.64	0.95	1.27	1.59	1.91	2.23	2.55	2.87	3.18	3.82	4.78	5.73	6.69	7.64	8.60
400 (28)	0.45	0.60	0.90	1.20	1.50	1.80	2.10	2.40	2.70	3.00	3.60	4.50	5.41	6.31	7.21	8.11
350 (24)	0.42	0.56	0.84	1.12	1.40	1.69	1.97	2.25	2.53	2.81	3.37	4.21	5.06	5.90	6.74	7.58
300 (21)	0.39	0.52	0.78	1.04	1.30	1.56	1.82	2.08	2.34	2.60	3.12	3.90	4.68	5.46	6.24	7.02
275 (19)	0.37	0.50	0.75	1.00	1.24	1.49	1.74	1.99	2.24	2.49	2.99	3.73	4.48	5.23	5.98	6.72
250 (17)	0.36	0.47	0.71	0.95	1.19	1.42	1.66	1.90	2.14	2.37	2.85	3.56	4.27	4.99	5.70	6.41
225 (16)	0.34	0.45	0.68	0.90	1.13	1.35	1.58	1.80	2.03	2.25	2.70	3.38	4.05	4.73	5.41	6.03
200 (14)	0.32	0.43	0.64	0.85	1.06	1.28	1.48	1.70	1.91	2.12	2.55	3.19	3.82	4.46	5.09	5.73
175 (12)	0.30	0.40	0.59	0.80	0.99	1.19	1.39	1.59	1.79	1.98	2.38	2.98	3.58	4.17	4.77	5.36
150 (10)	0.28	0.37	0.55	0.74	0.92	1.10	1.29	1.47	1.66	1.84	2.21	2.76	3.31	3.86	4.41	4.97
125 (9)	0.25	0.34	0.50	0.67	0.84	1.01	1.18	1.34	1.51	1.68	2.01	2.52	3.02	3.53	4.03	4.53
100 (7)	0.23	0.30	0.45	0.60	0.75	0.90	1.05	1.20	1.35	1.50	1.80	2.25	2.70	3.15	3.60	4.05

*If the pipeline under test contains sections of various diameters, the allowable leakage will be the sum of the computed leakage for each size.

[^]To obtain leakage in liters/hour, multiply the values in the table by 3.785.

103.0 WATERLINE PIPE, FITTINGS, AND ACCESSORIES

All pipe for water main construction shall be either ductile cast iron pressure pipe of the push-on joint or mechanical joint variety, conforming to AWWA C151, latest revision. Thickness class shall be Class 52 for all pipe twelve (12) inches in diameter or less. Water mains larger than twelve (12) inches diameter in size shall have thickness class as determined by thickness design of ductile-iron pipe AWWA C150 or ;

Molecularly Oriented Polyvinyl Chloride (PVCO) pressure pipe conforming to AWWA C909, dimension Ratio (DR) 18, shall be minimum for water pipe. SDR-21 in two (2) inch size only may also be used where approved by County.

103.1 Ductile Cast Iron Standard Mechanical Joint Pipe

All ductile cast iron standard mechanical joint water pipe shall conform to ANSI Specification A21.51 and shall be lined with cement mortar and have a protective exterior coating. The linings and protective coatings equal to "Enamline" with tar coating in the exterior will be considered as a satisfactory lining for the water pipe, however, any substitution in pipe lining and/or coating from ANSI A21.4 shall be specifically approved by the County. Joints of standard mechanical joint pipe shall conform to ANSI Specifications A21.11.

High strength cast iron tee head bolts, hex nuts, cats or ductile iron glands and rubber gaskets shall be as furnished by the pipe manufacturer. All tie bolts and nuts shall be constructed of the same size and type material as head bolts and hex nuts.

In making connections of ductile cast iron pipe using the standard mechanical joint the gland followed by the rubber gasket shall be placed over the plain end of the pipe which shall be carefully inserted and aligned into the socket end of the pipe. Gasket shall then be pushed into position so that it is evenly seated in the socket. The gland shall then be moved into position against the face of the gasket, bolts, inserted and made finger tight. Bolts shall then be tightened in accordance with AWWA C600 Table 3 (75-90 ft-lb torque for pipe size 4-12"). All other requirements concerning bedding, alignment , and cleaning of the pipe before making the joint shall be followed.

103.2 Ductile Cast Iron Pipe-Push on Joint

All push-on or 'slip' joint pipe shall conform to the requirements of standard mechanical joint pipe in regard to strength, class, protective coatings, etc.

103.3 Molecularly Oriented Polyvinyl Chloride (PVCO) pressure pipe

PVCO pipe meeting the AWWA Specification C909 for DR 18, pressure class 150 may be used for water lines.

- A. PVC pipe shall be installed, embedded and backfilled according to the manufacturer's written instructions. To facilitate future locating of PVC water pipe, a continuous copper wire, size 10, shall be laid with the pipe and in contact with all fittings and valves as shown on the Water Detail Drawing. When installing PVC water pipe, leak detection & location access points shall be installed at approximately 200 lf. intervals along the waterline. (See Detail)
- B. All service line connections to PVC pipe shall be made using a service saddle and corporation stop. Service saddle shall be of a type specifically manufactured for PVC pipe and shall be extra wide or double-band type. No direct tap to PVC pipe will be permitted.
- C. Only bell and spigot with elastomeric gasket joints shall be used. Solvent-cement joints or pipe requiring couplings shall be used.
- D. SDR-21 shall be used for all pipe sized two (2) inch.
- E. For lines five (5) foot or deeper, a monument (as shown on the Water Detail Drawing) shall be installed every five-hundred (500) feet of water line installed.

103.4 Cast Iron Pipe Fittings

Fittings for all water pipes shall be ductile iron or gray cast iron in accordance with AWWA Specification C110, latest revision, with a minimum pressure rating of 250 psi.

103.5 Gate Valve

All gate valves shall be of superior quality thick-walled, ductile iron valves, manufactured by American Flow Control. The valves shall be resilient seat, epoxy coated bronze mount type. All gate valves shall withstand a working pressure of 200 psi and shall be in strict conformance to all applicable AWWA Standards. Wrench nut shall turn to the left (counterclockwise) to open the valve. Valves shall be so arranged to fit into pipe lines having standardized mechanical joints or slip joints. All gate valves shall be resilient seat type valves meeting AWWA C509, latest revision standards.

On valves fourteen (14) inches or larger, butterfly valves conforming to AWWA C504 may be used.

103.6 Control Valves

The main valve shall be hydraulically operated, diaphragm actuated in globe or angle pattern. The main valve body and cover shall be made from 300 series stainless steel. The valve shall be similar in all respects to the Ames Model 900 Double Chambered Valve.

103.7 Fire Hydrants

All hydrants shall be traffic model, Dry-barrel type, meeting AWWA C502, latest revision standard; American Darling B-84B. Hydrants shall be of the compression type with main valve openings not less than four and one-half (4 1/2) inches in diameter.

Hydrants shall have a cast or ductile iron body with full bronze trim and shall withstand a hydrostatic test pressure of 300 psi. Hydrants shall have a six (6) inch connection base for setting with a minimum of thirty-six (36) inch cover on connection pipe. Hydrants shall be equipped with hose connections as follows:

Two (2) each, 2 1/2" N.S.T. hose connections

One (1) each, 4 1/2" N.S.T. pumper connection

Hydrant shall be operated by a National Standard one and one-half (1 1/2) inch pentagon shaped operating nut, opening counterclockwise. The direction of opening shall be clearly marked by an arrow cast on the outside of the hydrant. Hydrants shall be connected to the main with a six (6) inch pipe and shall be controlled by an independent six (6) inch gate valve. The six (6) inch gate valve shall be located as near to the service main as practical and connected to the tee with tie rods.

All hydrant barrels and caps shall be painted red.

103.8 Valve Boxes

All valve boxes, base extensions, lid and cover shall be of cast or ductile iron. Valve boxes shall be of the American Flow Control sliding type, round head marked "Water." The shaft diameter shall be not less than five (5) inches. The valve boxes shall have a minimum range of extension to fit two (2) inch to twelve (12) inch valves inclusive, placed on mains at depths of three (3) feet to five (5) feet of cover in order that the cover of the valve box is set to finished grade as shown in the Water Detail Drawing. For valves five (5) feet or deeper an American Flow Control Adjustable Trench Adapter shall be used with the cover of the valve box set to finished grade as shown in the Water Detail Drawing.

103.9 Water Service Connections

The water meter box and accessories therein necessary for meter installation shall be furnished and installed by the developer just within the right-of-way/easement at the property line as shown on the approved subdivision or other property plat. Water meter box and meter setter shall be furnished and installed as shown on standard Water Detail Drawing. Water meter box and setter shall be DFW Round Meter Pit with Ford Electronic Read Lid and Ford 70 Series Coppersetter, respectively. All meter setters shall be equipped with integral lockable valves on both sides of the meter connections.

All water service pipe from main connections to the meter box assembly shall be black roll polyethylene (200 PSI). All connections shall be made by compression type fittings. The minimum size service connection shall be three-quarter (3/4) inch I.D. for a single setter, and one (1) inch I.D. for double setter. Fittings for service lines shall meet all applicable AWWA Standards, latest revision. Solder connections shall not be used.

103.10 Water Meters

Meters shall be Sensus SR II or Hersey Model 430 IIS w/Model 520R MXU.

103.11 Special Conditions

The County may require that special material and/or construction be used where normal water pressure exceeds the pressure rating used in these standards and where the design will not permit reducing these pressures to acceptable levels.

104.0 METER INSTALLATIONS

All Botetourt County owned and maintained water meters shall be installed by the Botetourt County Utility Department.

105.0 DISINFECTION OF WATER MAINS

After testing and before final inspection of the completed systems, water mains and service laterals shall be flushed and disinfected in accordance with AWWA Specification C651 latest revisions. Flushing shall be accomplished at a flow velocity of not less than 2.5 feet per second.

Disinfection as described in AWWA C651 - "Placing of calcium hypochlorite tablets" shall be used. Five (5) gram calcium hypochlorite tablets with 3.25 gram available chlorine per tablet shall be attached at the inside top of the pipe by an adhesive such as Permatex No. 2 or equal. The following number of tablets for the given pipe size shall be used for an initial dose of twenty-five (25 mg/l ppm) chlorine:

<u>Pipe Diameter</u>	<u>Number of Tablets Per 18-20 Ft. Pipe Section</u>
6"	1
8"	2
10"	3
12"	4
16"	7

or the number of tablets equal to $0.0012 d^2L$ rounded to the next higher integer, where d is the inside diameter, in inches, and L is the length of the pipe section, in feet. Use of the continuous feed or slug method of disinfecting may only be used to re-chlorinate a water pipe after the initial disinfection or in other specific cases approved by the County.

The disinfection solution shall remain in the pipe line for not less than twenty-four (24) hours, after which time a chlorine residual of 10 ppm at all parts of the line shall be required. All valves and appurtenances shall be operated while the chlorinated water is in the main.

Following chlorination, piping shall be thoroughly flushed. Water in the new main shall be proven comparable in quality to the existing public water supply. The Virginia Waterworks Regulations require at least two consecutive satisfactory bacteriological samples, collected 24 hours apart, from the distribution system before the system can be placed in service. Samples must be collected at regular intervals not exceeding 2000 feet throughout the length of the main and must be taken to an approved

laboratory for testing and the Developer/Contractor shall pay all costs associated with disinfection and testing of installed facilities and bacteriological samples as required.

106.0 SEPARATION OF WATER LINES AND SANITARY SEWERS

General: the following factors shall be considered in providing adequate separation:

- A. Materials and types of joints for water and sewer pipe
- B. Soil Conditions
- C. Service branch connections into the water line and sewer lines
- D. Compensating variations in the horizontal and vertical separations
- E. Offsetting of pipes around manholes

106.1 Parallel Installation

- A. Normal conditions: water lines shall be laid at least ten (10) feet horizontally from a sewer line whenever possible, the distance shall be measured edge-to-edge unless determined by the County to be unusual conditions.
- B. Unusual conditions: when local conditions prevent a horizontal separation described above, the following construction shall be used:
 - 1. The bottom (invert) of the water main shall be at least eighteen (18) inches above the top (crown) of the sewer.
 - 2. Where this vertical separation cannot be obtained, the sewer shall be constructed of AWWWA approved water pipe, pressure tested in place without leakage prior to backfilling. Pressure test shall be 30 psi.
 - 3. The sewer manhole shall be made 100% water-tight construction and tested in place by Standard vacuum test.

106.2 Crossing

- A. Normal Conditions: water lines crossing over sewers shall be laid to provide a separation of at least eighteen (18) inches between the bottom of the water line and the top of the sewer whenever possible.
- B. Unusual conditions: when local conditions prevent a vertical separation as described above, the following construction shall be used:
 - 1. Sewers passing over or under water lines shall be constructed of AWWWA approved water pipe, pressure tested in place without leakage prior to backfill. Pressure test will be conducted at 30 psi.
 - 2. Water lines passing under sewers shall, in addition, be protected by providing:

- a. A vertical separation of at least eighteen (18) inches between the bottom of the sewer and the top of the water line. Sewer line shall be encased along its length where it is within 10' of the water line.
- b. Adequate structural support for the sewers to prevent excessive deflection of the joints and the settling on and breaking of the water line.
- c. The length of the water line be centered at the point of the crossing so that joints shall be equidistant and as far as possible from the sewer.

106.3 Sewers or Sewer Manholes

No water pipes shall pass through or come in contact with any part of a sewer manhole. Water lines shall be located a minimum of 10 ft. from any manhole.

106.4 Other Utilities

When other underground utilities (storm drains, gas, electrical, phone, etc.) cross within twelve (12) inches above or below water lines adequate structural support of the utilities shall be addressed.

107.0 VALVE, AIR RELIEF, AND BLOW-OFF CHAMBER

During construction only, air and sediment accumulations may be removed through a standard fire hydrant; compressed air and pumping may be used for de-watering mains through hydrants.

Chambers or pits containing valves, blow-offs, meters, or other such appurtenances to a distribution system shall not be connected directly to any storm drain or sanitary sewer.

Such chambers or pits shall be drained to the surface of the ground where they are not subject to flooding by surface water, or to absorption pits underground in areas with sufficiently water table.

The design engineer shall indicate the size of the air relief discharge required on the plan sheet.

108.0 SURFACE WATER CROSSING

Surface water crossings, both over and under water, present special problems and should be discussed with the County 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
 4. Above 100 year flood level

B. Under water crossing:

1. The pipe shall be of special construction, having flexible watertight joints; i.e. ball and socket, lock-joint, and shall be Class 54 or 55. In lieu of the above, Class 52 Ductile Iron pipe may be used with a minimum of 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. Sample taps shall be available at each end of the crossing and at reasonable distance from each side of the crossing
4. Permanent taps shall be made for testing and locating leaks

109.0 WATER STORAGE FACILITIES

Water storage facilities shall be designed and constructed to meet the standards of the Virginia Department of Health and also the requirements of AWWA D 100 for "Welded Steel Tanks" or AWWA D103 for "Factory Coated Bolted Steel Tanks" for water storage, latest edition Standard except as hereafter specified otherwise.

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. One (1) light and one (1) 110 volt outlet
 - d. Concrete work: Comply with all requirements of ACI 301
2. Supplemental Information to AWWA D100
 - a. Corrosion Allowances: one-sixteenth (1/16) inch to parts in contact with water.
 - b. Submit written report certifying work as 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 three-eighths (3/8) inch shall have complete joint penetration welds.
 - f. Radiographic tests will be required and the film shall become property of the County.
 - g. Protective Coatings: All coatings need to be NSF approved (Standard 61)
 - 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 either Tnemec70/71-3 or equal as approved by County.
 - g4. Inside Paint System: Two Coat Epoxy Polyamide, 7.0 to 11.0 total dry mils. The inside paint shall be either Tnemec 20-1 (Poto-Pox), 2 coat high build Epoxy System or equal as approved by County.
 - g5. Paint Color shall be as selected by Botetourt County from the manufacturer's 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 manufacturer's 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 required.
 - b. Overflow to ground, 1000 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 adequately sized to handle the 1000 GPM (or applicable) flow.
 - c. Screen vent against insects, provide special vent to insure fail-safe operation in event insect screens frost over.
 - d. Removable silt stop.
 - e. Separate drain line to drainage system or natural channel with erosion protection.
 5. Disinfection
 - a. 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.
 - 1) The tank shall be filled to the 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 shall stand for 24 hours. At the end of the holding period, the highly chlorinated water shall be acceptably drained to waste, the tank refilled with potable water and tested for bacteriological quality.
 - 2) 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 be new. The strong chlorine solution shall remain in contact with the tank surfaces for a minimum of thirty (30) minutes. The tank shall then be filled with potable water to the overflow level and tested for bacteriological quality.

- 3) 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.
- b. Two (2) 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 "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.

110.0 WATER PUMP STATIONS

Water pump stations shall be designed and constructed to meet the Standards of the Virginia Department of Health, and in addition to meet the following:

- A. Hydraulic or electrically actuated pump control valves shall be provided for all pumps unless otherwise approved by the County
- B. 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 the storage facilities, pump control information shall be transmitted to the pump station via telephone lines or radio transmission.
- C. Pump controllers shall include provision for alternation pumps plus backup control of pumps.
- D. 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.
 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 County.
 3. Three phase pumps shall each have an individual poly-phase starter.

4. All pumps shall be controlled by starters and shall have individual HOA switches.
 5. Starters shall be sized on 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, 200 AMP minimum.
 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 switches shall have a minimum 20 amp rating.
 12. All receptacles shall be GFI protected.
 13. All electrical equipment and panels shall be manufactured units with UL listing and shall include the manufacturer's warranty.
 14. Service disconnect shall be lockable.
- E. Hour run meters shall be required for each pump motor.
- F. Master Water Meter - with flow rate and flow totalizer.
- G. All pump stations installed above ground shall be of masonry construction with masonry or frame roof. Exterior shall be brick faced, split faced block, or washed pebble and shall have prefinished fascia, soffit and trim. Pre-hung insulated steel doors with minimum size 3/6: x 6'8" shall be used.
- H. Pump houses shall have adequate insulation to protect equipment and reduce heating cost.
- I. Adequate lighting, heating, ventilation, and drainage shall be provided for pump stations.
- J. Below or in-ground pump stations may be approved by the County 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.
- K. The minimum size structures to house a pump station shall be 400 square feet.
- L. All pump stations shall comply with applicable BOCA Cods and applicable County permits shall be secured.
- M. Isolation valves shall be required between the connection to the piping and all gauges and all other smaller diameter taps.

- N. Bleeder valves (petcocks) shall be provided on all pump discharge lines.
- O. 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 County.
- P. All plumbing to/away from Water Booster Pump shall be in accordance with written manufacturer's suggestions.