WATER DISTRIBUTION SYSTEM DESIGN GUIDELINES

PART 1 GENERAL

1.1 GENERAL GUIDELINES

A. The following water system design guidelines are based on Federal, State and local health requirements and Berkeley County Water & Sanitation engineering design criteria.

B. Design criteria not indicated herein shall comply with “Ten States Standards” where applicable.

C. All installations are to meet the bacteriological and chemical quality standards of the South Carolina Department of Health and Environmental Control (SCDHEC).

D. No line extension shall be made from an existing line when the existing line does not meet the minimum pressure and flow requirements outlined in this section.

E. Water services and plumbing must conform to relevant local plumbing codes or the National Plumbing Code.

F. Individual home booster pumps are not allowed to meet the 25-psi minimum pressure at the service connection.

G. These design guidelines are applicable to all developments including but not limited to residential, commercial and industrial developments, subdivisions, and/or parks requiring water service from BCWS.

1.2 SYSTEM DESIGN CRITERIA

A. Distribution main size: minimum 4" diameter unless otherwise approved by BCWS. Water mains providing fire service shall be a minimum of 6" unless otherwise approved by BCWS. Larger size mains shall be required if necessary to allow the withdrawal of the required fire flow while maintaining the minimum required residual pressure. Water mains not designed for fire flows of 500 gpm shall not have hydrants.

B. When a variance to the minimum water main diameter of 4 inches is approved, small dead end lines shall not exceed the following lengths:
   1. 1-inch diameter: 150 feet
   2. 1 ¼-inch diameter: 200 feet
   3. 1 ½-inch diameter: 300 feet
   4. 2-inch diameter: 1,500 feet

C. Comply with all application requirements of Federal, State, and local regulations.

D. Hazen and Williams design coefficient:
   1. Ductile iron pipe: C = 120
   2. PVC pipe: C = 140

E. When a design is being considered for a project, a main depth of between 3'-5' below finish grade will be used to establish main and branch line profiles. Main line profiles regardless of line size are to be shown on both the construction and record drawing plans for review and approval by BCWS. When main line is installed temporary line/profile markers (2" PVC Pipe typical) shall be placed every 100' minimum in sub-divisions, 200' minimum in rural areas for surveying purposes to assist with plan and profile shots.

F. Where standard four to six inch diameter hydrants are proposed, the design flow shall not be less than 500 gpm over and above peak hourly flow. Standard hydrants shall not be placed on systems using only hydro pneumatic storage, unless standby power is provided and the pumping capacity from wells or ground storage exceeds the fire flow demand with the largest well or pump out of service. Standard hydrants shall not be connected to lines not designed to carry fire flows.

1.3 BCWS MASTER PLAN

A. Design system to comply and be compatible with BCWS' Water System Master Plan.

1.4 SIZING OF LINES

A. Size pipe 6" and larger based on the following criteria: (1) System pressures at maximum instantaneous demand (not less than twenty-five (25) pounds per square inch); or (2) fire flow in addition to peak hourly flow (not less than twenty five (25) pounds per square inch) or (3) flushing flow in addition to peak hourly flow (not less than twenty five (25) pounds per square inch), whichever is the worst case. Peak hourly demand shall be calculated by multiplying BCWS' peak hour demand factor of 3.5 by the average daily water usage (225 gpd/res. unit). When fire protection is to be provided, system design should be such that fire flows and facilities are in accordance with the requirements of BCWS and the state Insurance Service Office (ISO). Minimum fire flow shall be 500 gpm with a minimum residual pressure of 25 psi. For existing projects that may have additional phases, the DHEC's minimum requirement of 20 psi may be utilized if no other reasonable alternative exists.

B. Pipe size 4" and smaller: Size piping based on either maximum instantaneous demand or peak hour plus flushing flow, whichever is greater.

C. The maximum instantaneous demand is to be calculated using the Community Water System Source Book by Joseph S. Amen, as reference.

Table 1 - Maximum Instantaneous Flows for Residential Areas

Number of Residences Served	Flow per Residence in GPM
1 (First)	15.0
2 – 10*	5.0
11 – 20**	4.0
21 - 30	3.8
31 - 40	3.4
41 - 50	3.2
51 - 60	2.7
61 - 70	2.5
71 - 80	2.2
81 - 90	2.1
91 - 100	2.0
101 - 125	1.8
126 - 150	1.6
151 - 175	1.4
176 - 200	1.3
201 - 300	1.2
301 - 400	1.0
401 - 500	0.8
501 - 750	0.7
751 - 1,000	0.5

*Second, third, etc., through tenth residence served.
**Eleventh, twelfth, etc., through twentieth residence served.

Table 2 – Maximum Instantaneous Flows for Commercial Areas

Type of Business	GPM on Basis Shown
Barber Shop	3.0 gpm per chair
Beauty Shop	3.0 gpm per chair
Dentist Office	4.0 gpm per chair
Department Store*	1.0 – 2.0 – 3.0 gpm per employee
Drug Store	5.0 gpm
With Fountain Service	add 6.0 gpm per fountain area
Serving Meals	add 2.0 gpm per seat
Industrial Plants**	4.0 gpm plus 1.0 gpm per employee
Laundry	30.0 gpm per 1,000 pounds clothes
Launderette	8.0 gpm per unit
Meat Market, Super Market	6.0 gpm per 2,500 sq. ft. floor area

Motel, Hotel	4.0 gpm per unit
Office Building	0.5 gpm per 100 sq. ft. floor area or 2.0 gpm per employee
Physicians Office	3.0 gpm per examining room
Restaurant	2.0 gpm per seat
Single Service	6.0 to 20.0 gpm total
Drive-in	2.0 to 7.0 gpm total
Service Station	10.0 gpm per wash rack
Theater	0.2 gpm per seat
Drive-in	0.2 gpm per car space
Other Establishments***	Estimate at 4.0 gpm each

*Including customer service.
**Not including process water
***Non-water using establishments

Table 3 – Maximum Instantaneous Flows for Institutions

Type of Institution	Basis of Flow, GPM
Boarding Schools, Colleges	2.0 gpm per student
Churches	0.4 gpm per member
Clubs: Country, Civic	0.6 gpm per member
Hospitals	4.0 gpm per bed
Nursing Homes	2.0 gpm per bed
Prisons	3.0 gpm per inmate
Rooming Houses	Same as Residential*
Schools: Day, Elementary, Junior, Senior High	
Number of Students	GPM Per Student
0 - 50	2.00
100	1.90
200	1.88
300	1.80
400	1.72
500	1.64
600	1.56
700	1.44
800	1.38
900	1.32
1,000	1.2
1,200	1.04
1,400	0.86
1,600	0.70
1,800	0.54
2,000	0.40

*Each unit of an apartment building should be considered as an individual residence.

D. Design for flushing velocity per SCDHEC regulations.

E. All water mains, including those not designed to provide fire protection, shall be sized using a hydraulic analysis based on flow demands and pressure requirements. The minimum pressure in all public water mains under conditions of maximum instantaneous demand shall be twenty-five (25) pounds per square inch at every customer's tap. Twenty (20) pounds per square inch will be acceptable at any tap when fire flows are provided in excess of maximum peak hourly flow [R61-58.4(D)(4)(a)]. The normal working pressure in the distribution system should be approximately 50 – 80 psi and not less than 30 psi.

F. The Developer's Design Engineer is to determine available static and residual pressures at the delivery point for the water to a new development. The data is to be obtained under the direction of an engineer who is registered in the State of South Carolina.

G. Flow test results, conducted in the past 12 months, are required at a location near the proposed connection to the existing system. The results should include: static pressure and residual pressure at a known flow, time and date of test, existing pipe size, type of pipe, and the elevation and distance between the test point and connection. The known flow must be in excess of the demand for the extension.

1.5. VALVES

A. Provide three (3) valves for a tee intersection.

B. Sufficient valves shall be provided on water mains so that inconvenience and sanitary hazards will be minimized during repairs. Valves should be located at not more than 1000 foot intervals in commercial districts and at not more than one block or 2000 foot intervals in other districts. Valves should be placed to minimize the number of BCWS customers out of service due to a main break and/or any maintenance operation. BCWS reserves the right to require additional valves if it is deemed in the best interest of current and future BCWS customers.

1.6 INDUSTRIAL OR SPECIAL DESIGN CONDITIONS

A. Design of water systems for industrial or other systems not covered under this section shall be approved on a special case basis only. Special requests need to be made to BCWS.

1.7 DEAD ENDS

A. Minimize dead ends by looping of all mains.

B. Where dead ends occur provide a fire hydrant on lines 6" and larger and a blow off on lines 4" in diameter and smaller. BCWS permits installation of post hydrants for the purposes of flushing so long as the line is capable of providing a flow of 250 gpm. Flushing devices should be sized to provide flows which will give a velocity of at least 2.5 feet per second in the water main being flushed.

C. Do not connect any flushing device to any sanitary sewer.

D. For new construction, all new phases shall end with a main line valve with the properly installed flushing device to prevent disruption to customers on connecting phases of construction.

1.8 SEPARATION OF WATER MAINS AND SEWERS

A. Where possible, locate water line at least ten (10) feet away, horizontally, from sewer pipes. The distance shall be measured edge to edge.

B. Should ten (10) foot separation not be practical, then the water main may be located closer provided:
   1. It is laid in a separate trench.
   2. It is laid in the same trench with the sewer main located at one side on a bench of undistributed earth.
   3. In either of the above cases, crown elevation of the sewer shall be at least 18" below invert elevation of water line.

C. Where water lines cross over sewers, maintain 18" minimum vertical distance between the outside of the water main and the outside of the sewer. This shall be the case where the water main is either above or below the sewer. At crossings, one full length of water pipe shall be located so both joints will be as far from the sewer as possible. Mechanical joints will be used for the transition in the sewer line. Fernco couplings **shall not** be allowed. Special structural support for the water and sewer pipes may be required.
   1. Special Cases:
      a. Water mains may not be placed in contaminated areas unless piping material is adequate to protect the water quality [R.61-58.4(D)(11)(h)].
      b. Water mains may not be less than 25 feet from any waste water tile field or spray field [R.61-58.4(D)(12)(f)].
      c. There may not be any connection between the distribution system and any pipes, pumps, hydrants, or tanks whereby unsafe water or

other contaminated materials may be discharged or drawn into the system [R.61-58.4(D)(14)(a)].

d. Neither steam condensate nor cooling water from jackets or other heat exchange devices may be returned to the potable water supply [R.61-58.4(D)(14)(b)].

1.9 SEWER AND STORM DRAINAGE SYSTEM INTERFERENCE

A. No water pipe shall pass through or come in contact with any part of a sewer manhole or storm drainage pipe or structure. 24” minimum is required when sewer passes under or over storm water piping regardless of drainage pipe size and DIP shall be used. Anything less will require steel casing. Absolute minimum separation between steel casing and storm water piping shall be no less than 6”. See Potable Water Mains Appendix G 02665 for casing requirements.

1.10 EXCEPTION

A. BCWS must specifically approve any variance from any requirements when it is impossible to obtain the specified distances.

1.11 SURFACE WATER AND WETLANDS CROSSINGS

A. Surface water and wetland crossing, whether over or under water, present special problems. BCWS should be consulted before plans are prepared. Water mains crossing surface waters must be adequately supported and anchored, protected from damage and freezing, and be accessible for repair or replacement [R.61-58.4(D)(13)(a)]. Any support or anchoring system should be designed to be corrosion resistant using concrete or 316 stainless steel. Water mains crossing under water must maintain a minimum cover of 3 feet. When crossing water courses which are greater than 15 feet in width, the following must be provided.

1. The pipe material and joints shall be designed appropriately [R.61-58.4(D)(13)(b)(I)].
2. Valves must be located so that the section can be isolated for testing or repair; the valves must be easily accessible, and not subject to flooding [R.61-58.4(D)(13)(b)(ii)].
3. A blow-off must be provided on the side opposite the supply service, sized in accordance with R.61-58.4(D)(7)[R.61-58.4(D)(13)(b)(iii)].

1.12 THRUST BLOCK DESIGN

A. BCWS will approve the use of thrust blocking on a case by case basis.

B. Maximum soil pressure: 1000 lbs/sq ft. Minimize the use of thrust blocking by installing thrust restraint fittings when possible.

C. Minimum water pressure: 150 psi.

D. Safety factor: 2

E. Concrete: 3000 psi.

1.13 COVER

A. Provide suitable cover on all distribution mains. Minimal cover depth as follows:
   1. 4" - 12" diameter: 36".
   2. 16" diameter and larger: 48".
   3. All piping located within the right-of-way of the South Carolina Department of Transportation and Berkeley County Public Works shall have a minimum cover of 48" below the crown of the road when installed within the limits of the paved roadway, 36" cover when installed in the shoulder of right-of-way and a minimum of 24" separation under the design invert of drainage structures. The greater dimension of the above shall dictate minimum depth where applicable.
   4. Special conditions other than those listed above may be approved if requested in writing from BCWS.
   5. Water lines crossing open ditches shall have a minimum of 36” of cover from bottom of ditch invert to top of pipe and carrier pipe material shall be DIP. If this is not possible, install a joint of the appropriate size RCP as approved by the governing agency, over the pipe to protect the water line.

1.14 DUCTILE IRON PIPE LOCATIONS

A. Where new water mains cross beneath new sewer mains, the water main shall transition to ductile iron pipe and the length of pipe shall be centered on the sewer main so that joints will be equidistant. The transition between PVC and DIP shall be made with mechanical joint sleeves or molded fittings. The use of Fernco couplings shall not be allowed. All DIP pipe and fittings shall be wrapped in blue poly encasement.

B. Ductile iron pipe with mechanical joints shall be used for any water mains being installed in rock and shall be wrapped in blue poly encasement.

C. Ductile iron pipe with mechanical joints shall be used for any water mains under roadways. DIP shall be used at all piped or open drainage crossings. At minimum, a full stick of DIP shall be centered over/under storm drainage location with minimum separation requirements met as called out on Detail Water Panel 12 and Detail CP4 Sanitary Sewer and Storm Drain/Water Line Crossing. On road crossings, DIP shall extend

minimum 2’ outside pavement/curbing. Other locations may require DIP piping as required by BCWS.

1.15 TAP SIZE IN RELATION TO MAIN SIZE

A. All water service taps shall be a minimum of two sizes smaller than the water main and cannot be larger than the main being tapped. Water main valve tie-ins utilizing wet tap method with tapping saddle shall also be at least two sizes smaller than the water main being tapped unless specified and approved by BCWS prior to construction. BCWS reserves the right to stipulate the maximum size tap available off of any water main regardless of the main size and configuration, if it is deemed in BCWS’ best interest to do so.

1.16 AIR RELEASE VALVES

A. Mains shall be designed to minimize high points. At high points in water mains where air can accumulate, provisions shall be made to remove the air by means of an air release valve. Automatic air release valves shall not be used in situations where flooding of the manhole or chamber may occur. Air valves should be sized based on the size of the water main. Air valves should be detailed on the design drawings and approved by BCWS. Air release valves must incorporate an open end of an air relief pipe from automatic valves and must be extended to the top of the pit and provided with a screened downward facing elbow [R.61.58.4D(10)(b)]. Where ARV manholes are installed, a dummy valve box shall be installed within 3’ of manhole for safe tracer wire access.

1.17 BLOW OFF CHAMBERS

A. General
   1. Post-type hydrants are acceptable for flushing on lines four to eight inches in diameter and can be used on 3-inch diameter lines where the design flow is increased to 100gpm in excess of the peak hourly flow.
   2. Where post-type hydrants are proposed, they must meet the flow requirements for blow-offs. Post hydrants shall not be used on water lines smaller than 3-inches in diameter.
   3. All 4" dead-end water mains shall be designed to include a 2-inch blow-off hydrant. Fire hydrants may be used as blow-offs on 6" mains and larger. Lines 6" and larger require a fire hydrant and 500 gpm to achieve a 2.5 fps scouring velocity. This would require a standard fire hydrant or other approved blow-off for flushing which must be designed to provide at least 500 gpm in excess of peak hourly flow and a minimum residual pressure of 20 psi. [R.61-58.4(7)(e)].
   4. Where pipe size changes on a water main, a flushing device is required at the transition, unless the design engineer can demonstrate

that there is adequate pressure to flush the lines. Plans should specify the size and type of the flushing device. Dead end lines shall be provided with a fire hydrant (if flow and pressure are sufficient), a post hydrant, or a blow-off valve in a box for flushing purposes, except for lines:

a. 1 ½ inches in diameter and less will not require blow-offs but will require a service connection.
b. 200 feet or less in length will not require blow-offs, unless specifically required by SCDHEC.

5. Chambers, pits, or manholes containing valves, blow-offs, or other such appurtenances to a distribution system shall not be connected directly to any storm drain or sanitary sewer, nor shall blow-offs or air relief valves be connected directly to any sewer. Such chambers or pits shall be drained to the surface of the ground where they are subject to flooding by surface water, or to absorption pits underground, and in the public right-of-way shall be installed at existing grade. Blow-off chambers must include a removable extension to direct the water away from the blow-off box.

Table 4 – Required Blow off Device Orifice Sizes for Different Pipe Diameters

Pipe Diameter (inches)	Orifice Size (inches)	
	Permanent	Temporary
2	Post Hyd.	2.0
4	Post Hyd.	2.0
6	FH	2.0 or FH
8	FH	2.5 or FH
10	FH	FH
12	FH	FH

*A temporary blow-off may be utilized in cases where the main is to be extended.

B. Quality Assurance

1. Reference Standards of the American National Standards Institute (ANSI).
   a. Thrust restraint section (AWWA C600-99 section 3.8).
   b. 21.53 Ductile Iron Compact Fittings, 3" through 16", for Water and Other Liquids (AWWA C153).

C. Materials

1. Permanent blow-off hydrants shall be a non-freezing, self-draining type. All of the working parts shall be of bronze-to-bronze design. The outlet shall be bronze with a 2½" NST.
2. Temporary blow-off devices shall be constructed of brass, stainless or galvanized steel and must include an in-line sized valve reduced to blow off apparatus size and extend above ground at least 2’ above

grade with quarter turn ball valve and a 90 degree elbow fitting installed for above ground operation to direct flow away from street. No PVC piping allowed on temporary blow offs.

1.18 WATER LOADING STATIONS

A. To prevent contamination of the public water supply, the following criteria for water loading stations must be met:
   1. Air Gap – A device must be installed on the fill line to provide an air break and prevent a submerged discharge line.
   2. Hose Length – The fill hose and cross connection control device must be constructed so that when hanging freely it will terminate at least two feet above the ground surface.
   3. Fill Line Terminus – The discharge end of the fill line must be unthreaded and constructed to prevent the attachment of additional hose, piping, or other appurtenances.

1.19 BACKFLOW PREVENTION AND METERING DURING CONSTRUCTION

Any extension to the BCWS water system must be constructed in a manner that eliminates the possibility of back-flow of water from the non-approved system into the active BCWS system and provides the ability to meter water use. To achieve this, the following method shall be used:

1. At the beginning of construction, a temporary backflow preventer and meter (both approved by BCWS) shall be supplied and installed by the Contractor in-line between the tapping valve, or stub-out, and the water extension. BCWS must be present at initial installation to verify connection and take initial construction meter information. Contractor to provide at least 72hr notice prior to installation. The backflow preventer shall be tested and certified by a SCDHEC licensed tester and the test results provided to BCWS prior to being placed into operation. The engineer shall determine the size backflow preventer and meter necessary to achieve 2.5 feet/sec flushing velocity for a given size pipe.
2. Any other connection points to the BCWS system shall be provided with an air gap of (3) feet between the new pipe and the existing stub out, wet tap, or existing valve. All temporary backflow installations shall be inspected and approved by a BCWS inspector prior to being placed into operation.
3. Once the SCDHEC permit to operate has been issued for the new section, the backflow assembly removal can be scheduled with BCWS as well as all remaining air gap connections shall be made at this time. Please provide BCWS at least 72 hour notice to schedule.

4. Of note, this connection to BCWS system until PTO is received is for construction water usage only, and considered non-potable water. BCWS does not guarantee fire protection from these connections.

In the case of a water project that has multiple connection points with the BCWS system, the BCWS Engineering Department will determine the optimum location for a single water-supply connection. Final tie-in to all other connection points shall only be made after the Permit to Operate has been issued by SCDHEC.

END OF SECTION