

CHAPTER SEVEN

WATER SYSTEM DESIGN

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CHAPTER SEVEN - Water System Design

Section 7.01 General Information

A. Compliance

1. All additions or modifications to the Town of Johnstown water distribution system shall be designed in accordance with the criteria set forth in this Chapter, other applicable Sections of the STANDARDS, and applicable provisions of the Town's Municipal Code.
2. The criteria set forth by these Standards is not intended to be inclusive of all situations and the Design Professional may be required to use additional engineering judgment to meet the overall design intent for constructability and long-term operations and maintenance.
3. Additional criteria may be established by the Town for the overall hydraulics of the water distribution system.
4. These STANDARDS apply to pipe sizes up to and including 12 inches in diameter. Design requirements for pipe sizes larger than 12 inches shall be as determined on a project-by-project basis by the Town.

B. New Development

1. Development projects are required to provide an analysis of the existing distribution system capacity and the condition of the water main and appurtenances in the vicinity of the project. (reference Utility Report Requirements in Chapter 5).
2. In areas where the distribution system does not conform to these STANDARDS or meet the needs of the proposed development, the Town may require off-site improvements to existing Town infrastructure to bring the water main or appurtenances into compliance with these STANDARDS.

C. Town Utility System Ownership

1. The utility system consists of the Town's (Public) water distribution system (and sewer collection system); and includes all pipes and appurtenant facilities of these systems under the complete control of the Town up to the point where the customer's (Private) system begins.
2. The Town's water distribution system includes the network of conduits used for the delivery of water from the source to the point of the beginning of the customer's system at the curb stop.
 - i. Source facilities are owned and operated by the Town of Johnstown. The source facilities include all components of the facilities utilized in the production, treatment, storage, and delivery of water to the distribution systems.
 - ii. The customer system shall include those parts of the facilities beyond the termination of the distribution system, which are utilized in conveying Town delivered domestic water to points of use. From the curb stop to the building is the customer's responsibility (see Standard Detail 103 for clarification).
3. See Section 7.06 (H) Services and 7.06 (I) Meters, for additional information.

Section 7.02 Water Demand Calculation

A. Single-Family and Multi-Family

1. Water demand for single-family or multi-family units shall be calculated for the Town of Johnstown based on Table 7-1: Residential Water Demand Calculations.

TABLE 7-1: RESIDENTIAL WATER DEMAND CALCULATIONS			
AVERAGE DAILY DEMAND (gpd)	MAX. DAILY DEMAND (gpd)	MAX. DAILY DEMAND (gpm)	PEAK HOUR DEMAND (gpm)
Average Daily Demand assumes 3.0 people per dwelling unit (150 gal/day/capita)	2 x Average Daily Demand	Maximum Daily Demand in gpd / 1440	1.5 x Maximum Daily Demand

B. Commercial

- Water demand for commercial use shall be determined using Table 7-2: Commercial Water Demand. Note that average daily demand and peak hour demand are based on 1000 square feet of building area—adjust accordingly based on square footage proposed.

C. Water Demand Calculations

- Water demand calculations shall be included in the Utility Report, and summarized on the Town's Water and Wastewater Worksheet.

TABLE 7-2: COMMERCIAL WATER DEMAND (PER 1000 SQUARE FEET OF BUILDING AREA)			
USE	AVERAGE DAILY DEMAND (gpm)	MAX. DAILY DEMAND (gpm)	PEAK HOUR DEMAND (gpm)
Office Building	0.14	0.28	0.6
Restaurant	0.35	0.70	1.5
Small Businesses	0.14	0.28	0.6
Supermarket/Grocery	0.14	0.28	0.6
Department Store	0.14	0.28	0.6
Laundry Dry Cleaning	0.70	1.40	2.9
Service Station (no car wash)	0.02	0.04	0.08
Car Wash	1.32	2.64	5.5
Hotel/Motel	0.24	0.48	1.0
Warehouse (non-industrial)	0.07	0.14	0.3

Section 7.03 Hydraulic Guidelines

A. Pressure Requirements

1. The water distribution system shall be designed to supply, at any point in the system: The Peak Hour flow system demand (PHD) with a residual pressure of no less than 40 psi. The Maximum Day System demand (MDD) plus fire flow demand (FFD) with a residual pressure of no less than 20 psi.
2. All areas shall be designed to provide a maximum static head of two hundred ninety (290) feet (one hundred twenty-five [125] psi) and a minimum static head of one hundred (100) feet (forty-three [43] psi).
3. The maximum pressure drop from static head to either fire flow or peak residential flow shall not exceed thirty- (30) psi.
4. If system target pressures cannot be met additional appurtenances may be required.
5. Looping between pressure zones is dependent on master plan and modeling. Where looping between pressure zones is permitted, the Applicant shall be responsible for providing any necessary pressure reducing valving and facilities.
6. A copy of the Town's pressure zone map is available on request.

B. Fire Flow

1. The minimum fire flow shall be 1500 gpm for single-family and duplex residences under 3600 square feet.
2. The required minimum fire flow for single-family and duplex residences over 3600 square feet and for all multi-family residences and commercial or industrial buildings shall be as specified by the applicable Fire District requirements, based on the current Fire District and Town adopted International Fire Code.
3. At the discretion of the Town and Fire District, the fire flow for certain structures may be required to be increased to be greater than the minimum requirements.

C. Velocity

1. The velocity in water mains shall not exceed five (5) feet per second during peak hour demands or ten (10) feet per second during maximum day demands plus fire flow.
2. Fire lines (including fire hydrant leads) shall be sized to meet the NFPA standard maximum flow velocity of 15 feet per second for systems requiring fire pumps and 20 feet per second for systems without fire pumps.

Section 7.04 Water System Modeling

A. General

1. A scientific water system model will be required for all new subdivisions and site development projects. This model must provide a hydrant-by-hydrant analysis of the proposed system to assure that the pressure and flow requirements outlined in these STANDARDS are met.
 - i. Both a digital copy and a PDF copy of the model, with input and output files along with a copy of the proposed water system plans, must be provided to the Town for review.
 - ii. The Town may update the Town's water system model with the development's modeling information to confirm the developments modeling results and/or to evaluate the overall Town water system's response to the proposed development system demands.
 - iii. The scientific water system model must be provided in a format that can be easily imported and integrated into the Town's overall system model.

- iv. Submittal of GIS shapefiles, as noted in **Chapter 5, Section 5.04** may be acceptable, and will be considered on a case-by-case basis.
2. The Town may require additional modeling scenarios, and/or revisions to the model (such as adjustments to the fire flow placement, reservoir elevations, existing system connections, revisions to the pipe and node schematic layout, and other model modifications) as necessary to verify that the proposed potable water system will meet the design requirements and potable water demands of the development and the Town as a whole.
 - i. This may include modeling the existing or future potable water system beyond the limits of the proposed development.
3. Hydrant flow testing at the closest appropriate hydrant to the development site shall be performed to obtain existing system information. (Note that hydrant testing must be coordinated through and observed by the Town)

B. Phasing

1. Water modeling shall be required for each proposed planned development phase of the system (as indicated on the Construction Drawings Phasing Plans), and for the full build-out scenario.
2. The modeling must demonstrate required residual pressures and flows can be met for each interim phased condition.
3. If construction phasing changes during construction to differ from the phases modeled in the approved Utility Report, the Town must be notified immediately. An amended model and Utility Report may be required.

C. Modeling Scenarios

1. Static:
 - i. The static scenario shall establish the available water pressure for the site with no demands on the system and serves to check that pressure requirements are maintained
2. Max Day Demand:
 - i. The max day demand scenario shall establish the available water pressure for the site during max day demand on the system and serves to check that pressure requirements are maintained.
3. Peak hour demand plus fire flow:
 - i. This scenario shall include peak hour domestic water use demands plus fire flow.
 - ii. The modeling results must include hydrant by hydrant modeling output for each hydrant within the development site/subdivision flowing at 1500 gpm and demonstrating that the pressure requirements are met for each hydrant flowing condition.
 - iii. In conditions where required Fire Flow exceeds 1500 gpm, two or more adjacent hydrants flowing concurrently must be modeled. The "pairs" would then be modeled appropriately throughout the development of the water system.
 - iv. Fire flow shall be inclusive of fire hydrant and fire sprinkler flow. Residential, commercial, or industrial developments requiring fire sprinkler systems shall have fire sprinkler demands in addition to hydrant fire flows, placed in the hydraulic water model at appropriate node locations.

Section 7.05 Water System Design and Layout

A. General

1. All improvements proposed to the Town's public water utility system shall conform with the goals, policies, and standards adopted in the Town's Water Master Plan (as amended).
2. New developments are required to provide a minimum of two (2) points of connection to the public water system.

3. All new water main systems shall be designed to create a looped system.
4. Developers are required to extend water main stub-outs to adjacent property line(s) to enable connections for future development(s).
5. In areas where the existing water main does not conform to these STANDARDS and/or does not meet the future needs of the Town or proposed development, the Town may require off-site improvements to existing Town infrastructure to bring the water main and/or appurtenances into compliance with Town STANDARDS.
6. Improvements to the Town's water distribution system shall be designed for a 50-year service life.

B. Main sizing (Diameter)

1. Minimum size of a public water main shall be eight (8) inches.
2. Minimum twelve (12) inch water mains are required on all section lines and minimum ten (10) inch water mains on all half section lines.
3. Larger diameter water mains may be required as determined by the Town.
4. Hydrant branch shall be a minimum inside diameter of six (6) inches.
5. Fire line diameters are determined by the development needs based on proposed use, and shall be designed in accordance with the Town's adopted fire and building codes.

C. Alignment (Horizontal)

1. All water mains shall be placed in public ROW to either the north or east of the street centerline.
2. Water distribution mains shall be located within the public right-of-way at a minimum offset distance of five (5) feet from the face of curb to the outside diameter (OD) of the pipe.
3. The northing and easting and "top of water main" elevation at the valve of all valves shall be provided on the Construction Drawings (CDs).
4. A minimum separation of ten (10) feet shall be maintained between the water main and other utilities, as measured from the outside diameter (OD) of the pipe(s).
5. Where a water main cannot be located within the public right-of-way, a Town approved easement will be required. The water main easement must include the water main, all fire hydrants and hydrant branches to a minimum five (5) feet beyond the hydrant. Refer to Chapter 2, Section 2.02, and Table 2-1: Minimum Easement Design Criteria for specific easement requirements.
6. Ninety-degree bends shall be avoided on the public system. Additional fittings (two forty-five-degree bends, or other fittings -with Town approval) shall be added as needed to avoid ninety-degree bends.
7. Fittings shall be separated by a minimum distance of two (2) feet or directly connected between fittings.
8. Joint deflections shall be a maximum of $\frac{1}{2}$ the manufacturer's recommendation and must be clearly noted on the plan and profile drawings at each point of deflection (e.g., on each joint where deflection is proposed). If the pipe deflection exceeds $\frac{1}{2}$ the manufacturer's recommendation during pipe install, then a mechanical fitting is required.

D. Grade (Vertical)

1. All water mains, hydrant branches, fire lines, and services shall have a minimum cover of four and one-half (4.5) feet.
2. Water mains shall be placed to maintain four and one-half (4.5) feet to five and one-half (5.5) feet of cover. The maximum depth of the water main shall be five and one-half (5.5) feet, as measured from the top of the pipe to the finished ground surface.

3. The maximum depth of the water main at all valves and tees/crosses, hydrant connections shall be five and one-half (5.5) feet, as measured from the top of the pipe to the finished ground surface.
4. If the surface grade is raised or lowered above an existing water main, at the Towns discretion the water main shall be relocated to maintain cover between four and one-half (4.5) feet to five and one-half (5.5) feet.
5. The maximum depth of the water main in lowered sections shall not exceed eight (8) feet. Lowered sections shall be designed and constructed as shown on Standard Detail 519. The design engineer shall design valves and connection to the water main outside of a lowering.
6. Clearance:
 - i. Where a water main crosses within 24-inches vertical separation of a storm drain, the water main shall be wrapped with a six (6) inch layer of extruded polystyrene foam (XPS) for a minimum of five (5) feet on either side of the crossing. See Standard Detail 111.
 - ii. Where the water main crosses over and within 18-inches (outside pipe to outside pipe) of sanitary or storm lines, or crosses under sanitary or storm lines at any separation distance, the sanitary or storm drain joints shall be encased per Town requirements to ten (10) feet on either side of the water main. See Standard Detail 110.
7. Fire Hydrants are required at all high points on water mains.
 - i. Air release and vacuum (ARV) valves may be required as determined by the Town.
 - ii. ARV shall be installed in precast manholes or vaults fitted with air vents open to the atmosphere and in accordance with Standard Detail 403.
8. Joint deflections shall be a maximum of $\frac{1}{2}$ the manufacturer's recommendation and must be clearly noted on the plan and profile drawings at each point of deflection (e.g., on each joint where deflection is proposed). If the pipe deflection exceeds $\frac{1}{2}$ the manufacturers recommendation during pipe install, then a mechanical fitting shall be required.

E. Looping and Dead End Water Mains

1. Water mains shall be designed to create a looped water system unless otherwise approved by the Town Engineer.
2. All dead-end mains shall be avoided and shall require approval by the Town Engineer. Under no circumstance shall the length of a dead-end water main exceed 500 feet.
3. The design of all water distribution systems should include a provision for future looping or interconnection of any approved or proposed dead-end line.
4. All dead-end water mains must meet the following criteria:
5. Permanent dead-end mains must terminate with a fire hydrant. The section of main beyond the last service to the fire hydrant would be six (6) inch diameter.
6. Temporary dead-end mains or stub outs may terminate with the following methods subject to approval by the Town:
 - i. FIRE HYDRANT—preferred.
 - ii. 2-INCH MANUAL BLOW-OFF VALVE—considered on a case-by-case basis.
7. The water turnover in dead-end water mains, as calculated in the last 100-foot segment, shall not exceed one day (24-hours) during low flow (winter) conditions.
 - i. Turnover is required to be calculated based on number of taps in the Utility Report for all dead-end mains.

F. Future Connections

1. Where a connection is required for a future water main extension, a valve shall be installed on the extension side of the connection to isolate the water main.
2. The valve shall be adequately restrained to install the extension without isolating (shutting down) a water main other than the extension.
3. Joint restraints shall be required for pressure testing of future connections and for temporary dead end water mains before connection to existing water mains.
4. Restraint may be made by a swivel tee, approved mechanical joint adapter, or the minimum lengths of pipe restraint.
5. Dead-ends and stub outs for future connections must be marked per Standard Detail 115.

Section 7.06 Appurtenances Design and Layout

A. General

1. All fittings, including fittings with thrust blocks, must be wrapped with polyethylene wrap. See Standard Detail 111.
 - i. Other materials will be considered through the Town's Approved Material List process.

B. Thrust Blocks and Joint Restraint

1. Concrete thrust blocks are required for water mains, and for all taps greater than or equal to four (4) inch diameter. Concrete Thrust Blocks shall be placed as noted on Standard Detail 513 and Standard Detail 514.
2. Concrete thrust blocks shall be designed for the internal pipe pressure, surge pressure and the soil bearing capacity.
 - i. The minimum design pressure shall be 150 psi with a safety factor of one and one-half (1.5).
3. The minimum soil bearing capacity shall be 1500 pounds per square foot (psf). The Design Professional is responsible for verifying the actual site conditions and design for greater thrust blocking requirements if necessary.
4. Joint restraint is required in addition to concrete thrust blocks for all bends, tees and dead-ends, and when the water main must be placed into service before concrete thrust blocks have achieved a minimum compressive strength of 70 percent (%) of the 28-day design strength.
5. The length of restrained pipe is measured each way from valves and bends per Table 7-3 and as shown on Detail 514. The Design Professional shall be responsible for verifying the restraint length for the actual site conditions, but in no case shall restraint lengths be less than those shown in the Detail.
6. Joint restraints shall be required for pressure testing of future connections and for temporary dead end water mains before connection to existing water mains.

C. Valves

1. Valves shall be placed with a maximum spacing of five hundred (500) feet. Valves shall also be placed to ensure that only one hydrant will be out of service in the event of a water main break.
2. Valves at water main intersections:
 - i. Tees shall require 3 valves.
 - ii. Crosses shall require 4 valves.
3. Valves shall be restrained to the tee or cross.

4. The Town may reduce the number of valves at its discretion.
5. A valve shall be installed on all hydrant branches within 2 feet of the main.
6. Valves at mechanical joint fittings shall be connected to the fitting with a 24-inch length of pipe between the fitting and the valve.
7. Valves shall not be placed in a water main lowering section.

TABLE 7-3: LENGTH OF RESTRAINED PIPE						
Fitting Type	Pipe Diameter					
	4"	6"	8"	12"	16"	20"
Minimum Restrained Length						
Tee or Valve	30'	46'	61'	90'	116'	141'
Plug for 90° Bend	30'	46'	61'	90'	116'	141'
45° Bend	9'	13'	18'	26'	34'	41'
22½° Bend	2'	3'	5'	7'	9'	11'
11½° Bend	1'	1'	1'	2'	2'	3'

D. Pressure Reducing Valves (PRV's)

1. Pressure Reducing Valves (PRV) are required where identified by the Town to meet pressure zone requirements.
2. Water main PRVs shall be installed in a vault and contain parallel valves for high and low flow ranges. Piping must be ductile iron through the vault walls extending three (3) feet past the vault walls and shall be as shown on Standard Detail 508.
3. The calibration of the PRV shall be the responsibility of the Developer or Contractor installing the valves and completed by a factory trained representative.
 - i. The Town shall be notified prior to scheduling the calibration.
 - ii. The calibration shall be to the satisfaction of the Town.
4. For PRV requirements on private water service lines, see Section 7.06(H).

E. Air Release Valves

1. On water mains 12-inch diameter and larger, a combination air valve, air release valve and air/vacuum valve, (ARV) shall be provided at all high points.
2. ARV placement and design shall use AWWA M-51 design criteria.
3. ARV's shall be placed in manholes or vaults.

F. Blow Off Valves

1. On water mains 12-inch diameter and larger, in-line blow-off valves shall generally be placed at severe low points, lowering's and/or at crossings.
2. Two (2) inch temporary construction blow-offs can be used for stubs at phase lines which have no services.
 - i. The main between the temporary blow-off and the nearest inline valve shall be emptied of water after final testing and acceptance.
 - ii. A 2-inch tap with a 90 degree vertical bend may be made directly into the cap of the main. The bend should be connected to a short section of 2-inch diameter pipe with a 2-inch curb stop valve. This valve shall be closed after the blow has been completed.
 - iii. All fittings for temporary 2-inch blow-offs shall be brass.
 - iv. An adequately sized concrete thrust block shall be poured behind the stub.
 - v. The blow off may be buried after completion. The location of blow off shall be marked with a tee post.

G. Fire Hydrants

1. The Applicant or Developer shall consult with the appropriate Fire District to determine and include in the water system design all Fire District requirements that must be addressed in the design of the water distribution system .
2. Fire hydrant spacing shall be determined based on the more restrictive Fire District standards or Town adopted International Fire Code as follows:
 - i. One or two family attached Residential Areas – No more than 500 feet between hydrants starting at street intersections or more than 600 feet to any residence.
 - ii. Multiple Family Dwellings – No more than 350 feet between hydrants and not more than 200 feet from the end of a required emergency access.
 - iii. Commercial, Industrial, Storage Areas – No more than 500 feet between hydrants and not more than 200 feet from the end of a required emergency access.
3. No hydrant branch shall be connected to less than 8 inch water main or to a "dead end" water main unless the hydrant can deliver a minimum of 1500 gpm during maximum day demand (MDD) of the system with minimum 20 psi residual pressure.
4. All fire hydrants shall have a restrained connection directly to the tee off the main. See Standard Detail 509.
5. Hydrant branches shall be C900 Polyvinyl Chloride Pipe (PVC) pipe (Specify pressure class), with swivel tees.

H. Services

1. General
 - i. Water service lines shall be of the size that is adequate to supply the requirements of the property being served. The minimum size allowable for a service line shall be $\frac{3}{4}$ inch.
 - ii. Each subdivided commercial or single-family residential lot must have its own water service connection.
 - iii. The point of connection to the public water system, service alignment and meter location shall be represented on the Construction Drawings. Proposed Northing & Easting, or Stationing and offset for each tap and meter location shall be provided.
 - iv. All service lines shall have a curb stop or gate valve installed outside of the structure and an isolation valve installed inside of the structure.
 - v. The service line may only be increased one standard size to the next approved larger diameter beginning 5 feet downstream of pit or vault.
 - vi. Service line shall be installed such that the meter pit is not located under paved driveway or service road.
 - vii. No service lines shall be laid parallel to or within three (3) feet of any bearing wall.
 - viii. The tap, corporation stop, and the portion of the service line between the corporation stop and 5-feet past the meter shall be the same size.

2. Location Requirements (Horizontal and Vertical)
 - i. Water service lines shall be located to take the shortest, most direct route from the water main to the building.
 - ii. Service lines shall be laid at uniform grade and in straight alignment perpendicular to the water main.
 - iii. All water service line locations shall be marked on the curb with a "W" symbol where services cross under the curb.
 - iv. Water service shall be in a separate trench and shall be a minimum of 10 feet from the sewer service line. The water service line shall be a minimum of 18 inches above any sanitary sewer crossing.
 - v. All service lines shall be stubbed into the lot either 10 feet beyond the back of walk or 5 feet past any utility easement, whichever is greater, and shall be marked at the end of the water service with a 2 inch x4 inch marker painted blue.
 - vi. The water service line at the curb stop shall be no deeper than 5.5 feet.
 - vii. The water service line shall be a minimum of 2 feet into the lot from the property line.
3. Ownership
 - i. If a curb stop exists, the Town shall be responsible from the curb stop back to the water main and for the water meter only.
 - ii. If no curb stop exists and the meter is in the right-of-way, the Town shall be responsible from the property side of the water meter to the water main.
 - iii. If no curb stop exists and the meter is inside the house, the Town shall be responsible for the water service in the right-of-way back to the water main.
 - iv. Property owners shall maintain curb boxes and lids therefor in good and unbroken condition and in readiness for emergency connect and/or disconnect, and shall keep curb box lids unobstructed and visible at all times.
4. Connections
 - i. The main is required to be fully tested prior to tap install for services.
 - ii. Tapping for service lines shall be conducted with a wet tap using a stainless-steel tapping sleeve and valve, if the existing main can be isolated at the tap location, a standard tee with gate valves on all branches shall be cut in.
 - iii. All taps shall be at least 18 inches from any joint, fitting, valve or other tap unless approved otherwise by Town Engineer.
 - iv. Compound taps (more than one property connected to a single water or fire service line) are generally prohibited. Compound Taps will be considered on a case by case basis, only for residential condominiums or townhomes in the Town, and only if:
 - a. The owner of the realty projected for this type of development (residential condominium or residential townhome), records with the Plat, a Declaration containing a covenant running with the land and binding upon the owner's heirs, successor and assigns legally binding a homeowner's association consisting of the owners of each residential condominium or residential townhome unit to be jointly and severally responsible of the water service line repairs, rents and rates attributable to the development.
 - b. Services lines must extend out from the building to a common service line located at least five feet (5') horizontally from the outside foundation of the building structure, and shall not be connected underneath or through one building into the next.
 - c. Backflow prevention for residential and commercial connections to the Town's distribution system shall meet all State Standards on compound taps.
5. Installation
 - i. All service lines 2 inches and smaller shall be soft Type K copper. Services larger than or equal to 3 inches shall be C900 or Ductile Iron.
 - ii. Two couplings/splices in the service line are allowed every 100 feet.
 - iii. Connections are prohibited on the service line ahead of any meter or backflow prevention device located at the point of delivery to the customer's water system. Refer to Standard Details 520 and 521.

- iv. No soldered joints will be allowed underground. Compression coupling or approved equal shall be the only acceptable joints. No joints are allowed between the main and the curb stop.
6. Fire Lines
- i. All fire lines shall be designed and constructed per the more restrictive of the Fire District or Town adopted codes.
 - ii. Fire lines for internal fire suppression systems shall require a valve on the fire line at the water main. The valve shall be restrained back to the water main.
 - iii. Valve box lids for fire lines shall be cast on the cover with FIRE.
 - iv. The use of any private fire line to supply more than 1 lot is prohibited.
 - v. Fire lines shall be electrically insulated from the water main if the water main is metallic pipe.
 - vi. All fire lines shall be installed with a backflow prevention device, the location of the backflow shall be identified on the plans.
 - vii. Domestic service taps are not allowed to be placed on a fire service line.
7. Control Valves
- i. Service lines shall include a control valve (curb stop or gate valve) located at the property line with easy access to the Town.
 - ii. The curb stop or gate valve shall be located in an utility easement or in ROW depending on the type of installation.
 - iii. Curb stops installed must conform to AWWA C800 for service lines up to and including two (2) inches in diameter. For all service lines greater than 2 inches in diameter, a gate valve shall be installed.
 - iv. Acceptable curb stop box information is located in the Approved Materials List.
8. Pressure Reducing Valves
- i. Pressure reducing valves (PRV) shall be installed on all domestic services.
 - ii. The PRV shall be downstream from the meter on the private system.
 - iii. PRV's shall be located inside the building (where the service comes into the building) and shall be readily accessible.

I. Meters

1. General
- i. All service lines must be metered with the exception of services that only provide fire protection.
 - ii. All meters shall be purchased from and installed by a Town representative.
 - iii. The Town requires at least three (3) feet of unobstructed access to the meter pit and at least five (5) feet of vertical clearance above the meter pit.
2. Ownership
- i. Town ownership of water meters extends only to the body and register of the meter.
 - ii. Water meters installed at a premise shall remain with that premise and are not transferable.
 - iii. All meters must be located in the public right-of-way or an easement, in a meter pit or vault (outdoors, in a landscaped area) where they will not be exposed to vehicular traffic, with the following exceptions:
 - a. Commercial and Industrial meters may be located inside a utility room attached to the building. The Town must be provided access to this space.
 - iv. It shall be the builder/contractor responsibility to protect the meter from freezing or other physical damage during construction. After acceptance by the owner, it shall be the owner's responsibility to protect the meter from freezing or other physical damage.
3. Installation
- i. The Town of Johnstown requires that water meters are set inside a meter pit or vault (refer to Standard Details 523-526) as follows:
 - a. $\frac{3}{4}$ " and 1" domestic taps shall be installed in a meter pit located outside, without a bypass.
 - b. 1 $\frac{1}{2}$ " or larger shall be installed in a vault with a bypass.
 - c. Irrigation meter installs are not allowed to have a bypass.

- ii. If ground is not to final grade at the time of installation of the meter, the meter pit or vault shall be raised or lowered when the final grade is established. The top of the meter pit or vault lid must be a minimum of 2 inches above finish grade if no sod or other landscape covering is in place at the time of final inspection. The meter pit or vault lid shall be flush with the sod or finished ground service with the completion of the landscaping.
- iii. The service line through and on both sides of the meter pit or vault must be of the same material.
- iv. Meters are not typically size on size and a step down from the service line size.
- v. Materials shall be in accordance with the Approved Materials List.

J. Backflow Prevention Assemblies

1. General

- i. All backflow prevention and cross-connection controls shall meet the requirements of Town Code and the State of Colorado Regulation 11.39.
- ii. An approved backflow prevention assembly (assembly) used for protection by containment is required on any water service line whenever there is an actual or potential situation when backflow due to backpressure and/or back siphonage can occur.
- iii. All backflow prevention assemblies have to be periodically tested and certified, most of them annually. The property owner shall take whatever measures are necessary for providing this periodic access to the assembly for the purposes of testing and certification.
- iv. Only properly trained and certified cross-connection control personnel are permitted to install, repair, replace, relocate, maintain, test, certify, modify, or otherwise affect the internal workings of a backflow prevention assembly.
- v. The location of the backflow prevention device must be clearly depicted on the submitted Construction Drawings.

2. Ownership

- i. Backflow prevention assemblies shall be privately owned and maintained by the property owner.
- ii. Backflow prevention assemblies are not transferable to another premise, property, area, or street address.

3. Installation

- i. In all new commercial, industrial, multi-family, fire and irrigation service lines directly connected to the Town's water system, the Town requires a reduced pressure zone backflow assembly to be installed unless otherwise identified below
- ii. Backflow prevention assemblies shall be installed above ground in a climate controlled space that is accessible for inspection, testing and maintenance without removal of the device.
- iii. Pit and vault installations are prohibited.
- iv. All assembly installations require installation of isolation valves, before and after the assembly, for testing, repair and maintenance.
- v. An adequate drainage area for the assembly must be provided in the event that water is released.
- vi. All assemblies shall be installed within the user's potable water system between the service connection and the first branch line leading off the service line.
- vii. Backflow protection may be required on temporary and compound service meters. The type of assembly shall be commensurate with the degree of hazard and shall be determined on a case-by-case basis by the Town.
- viii. For installation of backflow devices on non-residential properties see Standard Details 520 and 521.
 - a. A minimum vertical distance of 12 inches shall exist between the ground or floor and the lowest point on the assembly, including the air gap funnel on RPZ backflow prevention assemblies.
 - b. The lowest point on the assembly shall not exceed 30 inches above the floor, ground, or a firm, permanent footing surface.
 - c. For assemblies two (2) inches and smaller, the closest side of the assembly shall not be less than two (2) inches from any wall or obstruction and shall be at least four (4) inches from any surface which is subjected to freezing temperatures on its other side. Assemblies larger than two (2) inches in diameter which require companion flanges for installation shall have a minimum clearance of 12 inches from the closest wall or obstruction.

- d. At least one side of the assembly shall be open to ready and easy access.
- e. The piping side of all unions and companion flanges shall allow sufficient room to introduce bolts, nuts, and use usual tools. In no case shall the piping side of a union or companion flange be closer than four (4) inches to a wall, floor, or other obstruction.
- f. There shall be at least 12 inches of clearance between the test cocks and any adjacent wall, fixture, or ceiling.
- g. No assembly set shall be installed in or above a ceiling.
- h. No assembly shall be located such that any vented or dumped water cannot be safely carried away without damaging property.
- i. No assembly, including any air gap funnel, shall be located such that it is likely to be submerged in the water it vents or dumps, in ground water, or in other water or liquids which may be present.
- j. No assembly shall be located either above or below a hazardous location, such as a chemical mixing tank, electrical apparatus, electronic equipment, or a storage site for chemicals or other hazardous materials.
- k. All assemblies shall be located such that they are protected against vandalism, mischief, and deterioration due to atmospheric conditions.

4. Fire Service Lines

- i. All newly constructed or modified fire suppression systems using potable water from the Town's water distribution system shall be required to have an approved backflow prevention assembly installed.
- ii. All fire suppression lines shall be protected with a double check backflow prevention assembly except as follows:
 - a. Reduced Pressure Zone (RPZ) backflow prevention assemblies shall be installed whenever any chemical additive, pump, injection, or other means of producing backpressure is present.
 - b. RPZ backflow prevention assemblies shall be installed in any situation where a second source of water is utilized or may be utilized.
- iii. Where a single water service line is used for supplying domestic water and fire suppression water, both the portion of the piping system supplying the domestic water and the portion supplying fire suppression water shall have installed the appropriate backflow prevention assemblies.
- iv. Installation of a double check valve assembly (DCVA) or RPZ backflow assembly shall be installed in a dedicated utility room. The utility room shall be temperature controlled. If access to the building utility room is limited, the utility room shall have an external building access door.

5. Reduced Pressure Zone or Reduced Pressure Detector Check Assemblies

- i. An RPZ or Reduced Pressure Detector Check (RPDC) backflow prevention assembly shall be installed for protection by containment and shall meet the following:
- ii. When installed horizontally, they shall be in an upright position, essentially plumb, and with the relief valve pointed down. RPZ and RPDC assemblies larger than two (2) inches in size must be installed horizontally. RPZ devices two (2) inches and smaller may be installed in a vertical position provided the water flow will be in an upward direction through the assembly. Such installations require the addition of a vent elbow such that the outlet of the air gap funnel will be pointing down. RPZ and RPDC assemblies shall be installed per the manufacturer's recommendations.
- iii. RPZ assemblies two (2) inches and smaller shall be equipped with full port/quarter turn ball isolating valves.
- iv. RPZ and RPDC assemblies sized two and one-half (2-1/2) inch and larger are normally provided with resilient seat butterfly type isolating valves.
 - a. Outside screw and yoke (OS&Y) type gate valves can be substituted for the butterfly valves when the assembly is to be used in a fire suppression water line.
- v. RPZ and RPDC assemblies shall be protected against frost and freeze damage.

- vi. RPZ and RPDC assemblies installed inside structures may have a drainage line through an exterior wall to daylight provided any dumped or vented water exiting the drain line will not pose a hazard to the public. Such drain line shall be equipped with a non-corrodible screen at the discharge opening.
 - vii. RPZ and RPDC assemblies may have drain lines connected to a sewer system, provided a building permit is obtained and a City Inspector approves the sewer system connection.
6. Double Check Valve Assemblies
- i. A double check valve (DCV) assembly for fire service lines shall conform to the following:
 - a. When installed horizontally, DCV assemblies shall be in an upright position and essentially plumb.
 - b. DCV assemblies may be installed vertically, provided, the water flow is in an upward direction through the assembly.
 - c. DCV assemblies two (2) inches and smaller shall be equipped with full port/quarter turn ball isolating valves.
 - d. DCV assemblies sized 2-1/2 inches and larger are normally provided with resilient seat butterfly type isolating valves. OS & Y type gate valves can be substituted for the butterfly valves when the assembly is to be used in a fire suppression water line.
 - e. DCV assemblies shall be protected against frost and freeze damage.
 - f. DCV assemblies shall not be installed in underground vaults, either alone or in conjunction with water meters.
 - g. Installation of a DCV assembly above ground in a small enclosure is acceptable, provided that the enclosure provides the necessary frost protection and conditions of access.
 - ii. The Town may elect to remove the operators or handles from the isolating valves or to chain them together to prevent unauthorized operation of the isolating valves.

Section 7.07 Operational Provisions

A. Operation of Valves

1. No person other than a duly authorized employee of the Town shall open or turn on any Town water valve or curb stop regulating the flow of water from the Town water mains to any premises, lot, building or house for any reason.
2. Contractors shall notify the Town at least 48 hours prior to needing any valve operated.

B. Connection to Existing System

1. At locations where connections to existing water mains are to be installed, the Contractor shall locate the existing mains both vertically and horizontally and verify their exact size and material in advance of the time scheduled for making the connections.
2. Prior to connecting to existing water mains, the Contractor shall have all personnel, materials, and equipment ready to connect the fitting to the existing main, so as to keep the shutoff time to a minimum. As soon as possible after making the connections, the Contractor shall flush the connection so as to prevent contamination of the existing facilities. The Contractor shall take every precaution necessary to prevent dirt or debris from entering the water main.
3. Connections to the existing water system shall be completed in a proper, neat and workmanlike manner. The Town shall be notified at least 48 hours in advance and be present at all times during the construction of the connection. The connection is subject to approval by the Town Engineer. Under no circumstances shall a non-disinfected water main, which cannot be isolated, be connected to an existing disinfected water main.
4. The Town does not guarantee the water tightness of existing valves on existing facilities. If existing valves leak, the Town shall assist in reducing the influx of water, but the Contractor is responsible to use methods at their own disposal to dewater the trench and to complete any required testing or disinfection of the water line.

5. All connections shall be valved to separate new construction from the existing system. Only one connection to the existing system will be allowed until the new system has been completely tested.

C. Service Interruptions

1. The Contractor shall notify the Town and the affected Fire District at least four (4) working days in advance of any water shut off.
2. A description of the boundaries of the affected area and the location of all fire hydrants in the area shall be provided to the Town and to the affected Fire District.
3. The Contractor shall schedule disruptions of service with the Town Monday through Thursday 8am to 4pm. Service disruptions are prohibited on Fridays.
4. Contractor is required to complete the service disruption within 4 hours of turning off water.
5. If the Town determines that a customer cannot be out of water service during normal business hours, the Contractor shall work with the Town and Customer to schedule the disruption to mitigate impacts or shall provide an appropriate, alternative means of providing water service to the affected customer during the disruption of service.
6. Planned disruptions may be cancelled at the discretion of the Town and require renotification of impacted Customers, reasons for cancellation may include not being ready to begin the connection at the start of scheduled outage, not having required equipment, materials and labor on hand to make the connection within the scheduled outage time, or if public safety concerns do not permit a water service disruption.

D. Abandonment of Existing Water Lines or Stubs

1. All water mains, fire service lines and water service lines that were installed and will not be used (such as a reflat or a change in building configurations) shall be abandoned at the water main.
2. This shall include excavating the water main and removing any valves on the line to be abandoned and replacing them with a plug.

E. Tapping Authorization

1. The Town's Inspector, or Town's designated representative, is the sole individual authorized to operate valves and supervise tapping on the Town's water mains.
2. All taps shall be wet taps performed by a qualified Contractor.
3. All wet taps shall be at least one nominal pipe size less than the water main that is being tapped. Size on size wet taps are prohibited.
4. The Owner shall apply for the tap and pay all associated tapping fees prior to contacting the Town to schedule the tap.
5. No tap shall be scheduled less than 48 hours, or two (2) working days, from the time the Town is contacted by the Contractor for the tap.
6. The Contractor must sufficiently expose the water main to accommodate the tapping equipment as determined by the Town. The water main shall be exposed a minimum of 48 inches centered over the connection.
7. The Contractor shall be responsible for compliance with all OSHA trench and job site safety requirements. No Town personnel will enter an unsafe job site. If the trench and or job site is determined to be unsafe, the Town personnel will not perform the tap. A new time shall be scheduled by the Contractor and a reinspection fee charged.
8. The Owner shall pay all costs and expenses incident to the installation and connection of water facilities and the building water system. All costs incurred by the City for time lost on the originally scheduled tap may be billed to the Owner.

Section 7.08 Non-Potable Water Systems

A. General Information

1. The minimum standards for the Non-Potable Water System shall be similar to those given for the potable water system with the exception of the additional criteria listed in this section.

B. Design and Sizing of Non-Potable Systems

1. Non-Potable Water Main sizing shall deliver not less than 20 psi dynamic pressure at the Non-Potable Water Main during peak flow rate (demand) conditions.
2. The Non-Potable Water System will not be designed to provide any fire protection flows.
3. All appurtenant fittings must be rated for raw water.
4. Non-Potable Water Mains shall be purple and shall conform to AWWA C900 PVC, Purple Pressure Pipe for Non-Potable water, minimum Pressure Class 235. DR 18.
5. Valve boxes shall be in accordance with Standard Drawing 527. shall have "Non-Pot" cast on the cover.
6. All Non-Potable Water Mains shall be installed with warning tapes and with the warning printed directly onto the Non-Potable Water Main.
7. The warning tape, and printing directly on the Non-Potable Water Main, and shall state: "NON-POTABLE LINE – DO NOT DRINK".
8. The Non-Potable Water Service Line shall not be installed closer than ten feet (10') horizontally to the Water Service Line or Sewer Service Line.
9. Non-Potable Water Service Lines shall not be installed inside a building or within five feet (5') of a building foundation.

C. Construction Water

1. Temporary use of potable water from the Town's water distribution system by means of a temporary water tap, a temporary service line, a fire hydrant, or other devices shall require a permit from the Town, subject to availability. Said permit shall include provisions for payment of water used, installation of a meter, installation of an appropriate backflow prevention device, deposit and daily rental charge.
2. For temporary hydrant water, only Town designated fire hydrants may be used unless otherwise approved on the permit.
3. The Town will require a minimum of two working days advance notice prior to the issuance of any temporary water use permit.
4. At its sole discretion, the Town may suspend temporary water use permits with one (1) week's notice.

Section 7.09 Testing and Disinfection

A. Use of Qualified Laboratory

1. The developer shall employ and the developer will pay for the services of a qualified independent testing laboratory to conduct the tests for:
 - i. Bacteriologic Tests.
2. The Contractor must submit the following qualifications: to the Town for prior approval:
 - i. Name and address of proposed testing laboratory.
 - ii. Qualification of personnel.
 - iii. Description of facilities and equipment.
 - iv. Certificate of calibration of applicable testing equipment made by an accredited calibration agency within 12 months prior to the submittal date.

3. Instruct the testing laboratory to submit, directly to the Town, two copies of all reports of tests or inspections made showing:
 - i. Project identification.
 - ii. Date of test.
 - iii. Location of test in the project.
 - iv. Applicable specification section and standard for compliance.
 - v. Indication of compliance, irregularities or deficiencies.
 - vi. Observations relating to compliance.
 - vii. Name and signature of observer.

B. Contractor Testing and Town Inspector Observed Tests

1. The contractor shall conduct the following tests under the observation of and to the satisfaction of the Town:
 - i. Pipe alignment tests.
 - ii. Pipe deflection tests.
 - iii. Pressure and leakage tests.
2. Inspection will be completed by the Town for all proposed developments under construction. If a problem involving materials or workmanship is encountered, the Town reserves the right to request testing be conducted.
3. The Contractor shall contact both the Town and the Town's water quality lab to arrange for testing at least 48 hours prior to testing.

C. Disinfection

1. Flush and satisfactorily disinfect new water lines prior to placing in service in accordance with AWWA C651-86.
2. Clean and swab the interior of the pipe, fittings, valves, or appurtenances with a 5 percent (50,000 ppm) hypochlorite disinfecting solution if dirt, trench water, or other contaminants enter the pipe or will not be removed by flushing operations.
3. Manipulate valves to prevent the disinfection solution from flowing back into the line supplying the water or into adjacent parts of the in service distribution system.
4. Operate valves and appurtenances while the lines are filled with chlorinated water.

D. Flushing

1. Preliminary flushing: Flush pipelines at a minimum velocity of 2.5 ft/sec to remove foreign material prior to disinfection.
2. Do not use preliminary flushing if the tablet method of disinfection is approved by Town Engineer.
3. Final flushing: Flush chlorinated water from the lines after chlorination until the chlorine concentration is no higher than that prevailing in the system, or less than 1 mg/l, whichever is higher.

E. Methods

1. In general, apply chlorine using the continuous feed method.
 - i. Slug method may be used on large diameter pipe where continuous feed is not practical.
 - ii. Tablet method may be used on a short extensions up to 2500 feet of water lines 20 inch and smaller.
2. Continuous Feed Method
 - i. Introduce chlorinated water into the lines at a constant rate so that the chlorine concentration in the water lines is maintained at a minimum of 50-mg/l available chlorine.
 - ii. Fill the entire main with the chlorine solution.
 - iii. Retain the chlorinated water in the main for at least 24 hours at which time the treated water shall contain no less than 25 mg/l chlorine throughout the length of the main.

3. Slug Method
 - i. Introduce chlorinated water into the lines at a constant rate so that the chlorine concentration in the water lines is maintained at a minimum of 300-mg/l available chlorine.
 - ii. Apply for a sufficient period of time to develop a solid column of chlorinated water that will expose all interior surfaces for a period of at least 3 hours.
 - iii. Measure chlorine residual at the upstream end of the line.
4. Tablet Method
 - i. Do not use if trench water or foreign material has entered the line or if the water temperature is below 5° C (41° F).
 - ii. Use only when scrupulous cleanliness has been exercised due to the fact that preliminary flushing is not possible with this method.
 - iii. Place tablets in each section of pipe, hydrants, hydrant leads, and other appurtenances in sufficient number to produce a minimum chlorine concentration of 50 mg/l. Reference Table 4, AWWA C651-86.

F. Hydrostatic Testing

1. Timing of Tests
 - i. Conduct pressure test and leakage test concurrently.
 - ii. Do not test until at least 7 days have elapsed after the 1st concrete thrust restraint has been cast.
 - iii. 36 hours minimum shall elapse if high-early-strength cement is used.
 - iv. Conduct tests in increments not to exceed 2 miles of pipe as construction progresses.
 - v. No allowance shall be made for pressure reductions accomplished by means of pressure reducing valves or other mechanical means.
 - vi. Prior to tests Contractor and Engineer shall inspect valves within the test section to make sure they are fully open.
2. Hydrant Tests
 - i. Test with the hydrant main valve closed and the auxiliary line valve open.
3. Pressure Tests
 - i. Preparation:
 - a. Slowly fill pipe with water.
 - b. Remove all air.
 - c. Install corporation cocks at high points to evacuate the air if permanent air vents are not located there.
 - ii. Leave pipe filled with water at working pressure for a minimum of 24 hours prior to the hydrostatic pressure test.
 - iii. Test Pressure:
 - a. For steel pipe, ductile iron pipe and PVC pipe, use a test pressure of 1½ times the working pressure measured at the lowest elevation of the pipeline test section or the working pressure plus 50 psi, whichever is greater.
 - b. Maintain the test pressure within + 5 psig of the test pressure for at least 2 hours.
4. Leakage Test
 - i. Leakage is the quantity of water that must be added to the pipeline to maintain pressure within 5 psi of the specified test pressure after the air has been expelled and the pipe is filled with water.
 - ii. Maximum allowable leakage:
 - a. For ductile iron pipe and PVC pipe:

$$L = ND (P\frac{1}{2}) H 7400$$

Where:

L = Maximum allowable leakage in gallons.

N = Number of joints in the length of pipeline tested.

D = Nominal pipe diameter in inches.
 P = Average test pressure during the leakage test in psig.
 H = Number of test hours.

- iii. When testing against closed metal-sealed valves, an additional leakage per closed valve of 0.0078 gal/hour/inch of nominal valve size will be allowed.
- iv. Acceptance
 - a. Acceptance shall be on the basis of maximum allowable leakage.
 - b. Locate and repair defective materials and joints if the tests disclose leakage greater than that specified.
 - c. Repeat tests until the leakage is within the permitted allowance.

TABLE 7-4: GALLONS OF ALLOWABLE LEAKAGE PER 100 COUPLINGS PER HOUR*

PIPE DIAMETER	AVERAGE TEST PRESSURE AT LOWEST POINT IN LINE -PSI								
	50	75	100	125	150	175	200	225	250
4	0.71	0.87	1.00	1.12	1.23	1.32	1.42	1.51	1.58
6	1.06	1.29	1.51	1.68	1.84	1.98	2.12	2.25	2.37
8	1.42	1.72	2.00	2.24	2.45	2.64	2.84	3.00	3.16
10	1.77	2.15	2.50	2.79	3.07	3.40	3.54	3.75	3.95
12	2.12	2.58	3.00	3.35	3.68	3.96	4.24	4.52	4.74
14	2.48	3.01	3.50	3.91	4.28	4.62	4.96	5.26	5.50
16	2.83	3.44	4.01	4.47	4.89	5.27	5.68	6.00	6.32
18	3.18	3.87	4.52	5.02	5.52	5.93	6.37	6.75	7.11
20	3.54	4.30	5.00	5.58	6.12	6.58	7.08	7.51	7.90
21	3.73	4.54	5.24	5.88	6.40	6.92	7.42	7.86	8.28
24	4.24	5.16	6.00	6.69	7.34	7.91	8.50	9.01	9.47
27	4.77	5.83	6.74	7.56	8.23	8.90	9.54	10.12	10.66
30	5.30	6.45	7.51	8.37	9.18	9.88	10.62	11.26	11.84
33	5.83	7.13	8.24	9.25	10.06	10.88	11.67	12.36	13.02
36	6.37	7.75	9.01	10.07	11.02	11.88	12.71	13.50	14.22
39	6.88	8.42	9.74	10.83	11.90	12.96	13.79	14.61	15.40
42	7.42	9.08	10.48	11.78	12.82	13.85	14.86	15.74	16.58

* Data is based on 150 psi and represents a leakage of approximately 30 gpd per mile of pipe, per inch of pipe diameter—for pipe placed in 13-foot lengths.

END OF CHAPTER

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