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**PART III - MINIMUM DESIGN STANDARDS
SECTION 115**

WATER DISTRIBUTION SYSTEM

115.1 GENERAL

Distribution and/or lateral mains and service lines conveying water from transmission lines to fire protection systems and customers shall be laid out and designed according to the following minimum standards. Pipe and fittings shall be those specified in Part II Section 30, Table 30.1 of these Specifications. When installed, the top of distribution and lateral lines shall be buried a minimum of 4 feet under compacted backfill, below finished grade. These Specifications shall apply to all new construction within the City of Arvada.

115.2 SIZING LINES

All lines shall be sized large enough to provide for domestic, commercial, irrigation, and fire protection flows to the area to be served.

The maximum acceptable head loss for eight (8) inches and larger mains is two (2) feet per 1000 feet of main at peak hour flows. The Hazen Williams friction coefficient of C-100 is to be used when sizing distribution lines sixteen (16) inches and larger. The velocity at maximum flow in any main shall not exceed ten (10) feet per second.

The proposed water system shall be analyzed for whichever is greater of the following:

- A. Peak day plus fire flow demand
- B. Peak hour demand

Pressure requirements to the area being served shall be between 250 feet (108 psi) and 100 feet (43 psi) static head. The system shall maintain a 20 psi minimum residual pressure at the second floor elevation of the highest unit proposed during peak day plus fire flow demand or peak hour demand, whichever demand is greater, and a 43 psi minimum residual pressure during the peak hour demand. The maximum pressure fluctuation at any location in the distribution system between peak hour demand and minimum hour demand shall not exceed 30 psi.

Average demand flow shall be based on:

- A. 175 gpd/capita in residential areas.
(Single Family: 3.3 persons/DU, Duplex: 2.5 persons/DU, MultiFamily: 2.0 persons/DU)

Peak Day Factor: 2.5
Peak Hour Factor: 4.0
- B. 1000 gpd/acre for commercial and professional buildings.

Peak Day Factor: 2.5
Peak Hour Factor: 4.0
- C. 1500 gpd/acre for industrial applications.

Peak Day Factor: 2.5
 Peak Hour Factor: 4.0

Fire flow may be calculated from more than one hydrant providing the hydrants used are directly accessible to all possible fire locations in the area served. Minimum fire flow shall be as shown on the following table:

DESCRIPTION	FAMILY UNITS			NON RESIDENTIAL
	DETACHED	MULTI		
Unit Separation (ft)	15'	5'-14.8'	0-5'	
<u>FIRE FLOW (GPM)</u>				
Minimum	1500	2000	2500	1500
Intermediate	*	*	*	*
Maximum	3500	3500	3500	3500

*Fire flow to be determined by Governing Fire District.

The City reserves the right to size mains to provide service for future needs.

Developers are responsible to design new construction, located in previously established areas, such that the total demand fire flow does not exceed the available fire flow. This may require the developer to oversize existing or install additional mains to serve his project.

115.3 DISTRIBUTION SYSTEM

115.3.1 Layout

Distribution and lateral mains shall be installed in dedicated easements and public right-of-way. Pipe alignment shall be parallel to property lines and located five (5) feet north or east of the street centerline or in the easement. Water mains shall extend to the extremities of the subdivision served. A main serving one (1) lot shall extend across the entire frontage of the lot.

Distribution mains, sized 16 inches and larger in diameter, shall be grid spaced at one mile intervals. No service line taps nor any taps less than six inches in diameter shall be made to distribution mains sized 16" and larger. Exceptions to this will be for air and vacuum release valves only. All connections to distribution mains shall be valved at the connection. If the connection is 16 inches or larger in diameter, there shall be a minimum of two valves for tee connections and three valves at cross connections.

Secondary distribution mains, sized 12 inches to 14 inches in diameter, shall be intermediately spaced at one half (1/2) mile intervals and connected at each end to the larger distribution main. All waterlines shall be looped. No dead-end lines, except lines extending into cul-de-sacs serving not more than 12 single-family residential units will be permitted.

Lateral lines, sized 8 inches to 10 inches in diameter, shall be looped to the distribution

mains and used to deliver water to fire hydrants and the individual customer service and fire protection lines.

Lateral lines, sized 6 inches in diameter: Conditions under which six (6) inch secondary branch laterals will be approved to serve single family detached residences are where:

- A. A six (6) inch branch lateral interconnects between two (2) eight (8) or ten (10) inch lateral lines no more than 600 feet apart.
- B. A six (6) inch branch lateral ends in a cul-de-sac at a fire hydrant no more than 300 feet from its point of connection with an eight (8) inch or larger lateral.
- C. A six (6) inch branch lateral ends in a cul-de-sac not more than 150 feet from its point of connection with an eight (8) inch or larger lateral and serves four (4) or less single family residences.

Temporary Laterals - Mains and laterals shall be interconnected or looped. However, when a main or lateral is allowed to temporarily terminate, such as between filings of a subdivision, a fire hydrant or blow-off shall be installed at the point of termination. Mains and laterals shall be extended to the boundaries of filings and completely across the frontage of individual lots.

Easements and Right-of-Way - The minimum width ROW or easement for City use, in which a water main will be installed, is twenty (20) feet, except as authorized for Planned Unit Developments (PUD).

115.3.2 Planned Unit Developments

In planned unit developments, the City will allow the installation of lateral mains under the following conditions:

- A. The main is installed in a non-exclusive easement which is no less than thirty (30) feet in width and the City is provided unobstructed use of twenty (20) feet thereof, except for right angle utility crossings.
- B. The main is installed in a 45 foot minimum width dedicated street which meets all the requirements for a subdivision filing.
- C. See Section 115.6 below.

115.3.3 Line Valves

Line valves are required at approximately every 600 feet in all distribution and lateral lines. Where City blocks exceed 600 feet in length an intermediate line valve shall be installed such that no more than twenty (20) residential units or more than one (1) commercial or industrial user will be out of service during maintenance.

Four-way and three-way street intersections require four (4) and (3) valves respectively, one on each extended property line. For a succession of short blocks perpendicular to the direction of major feed and without residential or commercial services between, one or more intersections may have the valve omitted in that direction, but should retain the 600 foot distance. Line valves shall also be placed:

- A. Such that no more than one (1) fire hydrant is isolated at any one time.
- B. At each end of a line running through an easement on private Property.
- C. On each side of a major creek or channel crossing.
- D. On each side and at property lines extended, of a service line that feeds a hospital, school or large industrial user.
- E. On fire hydrant laterals.

115.3.4 Combination Air Vacuum Air Release Valves

Combination air vacuum air release valve shall be installed at the crown or high point elevation on both distribution and lateral lines. Valves shall be installed in a manhole or vault specifically designed for the application. The use of a fire hydrant to relieve air from six (6) inch secondary laterals will only be allowed when the fire hydrant is installed at the end of a cul-de-sac which is also the high point in the lateral.

115.3.5 Blow-off Valves

Provision shall be included to allow flushing distribution and lateral lines at the sag or low point in the line, between line valves and at temporary dead ends, when approved. Fire hydrants located such that the pumper nozzle outlet elevation is no less than three (3) feet above and within 75 feet of the low point in the line, may be allowed to serve as a blow-off when installed on side property lines extended.

Blow-off gate valves shall be installed perpendicular to and on the downhill side of the main and drain to the nearest gutter line. See standard drawing W-9.

A temporary blow-off valve, in accordance with standard drawing W-9 is required at the end of any water main which terminates and is anticipated to be extended in the future. When a future main extension is anticipated, the main shall be valved so that only one valve will have to be closed when the main is extended. The valve shall be restrained so when the one valve is closed and the line to be extended is exposed, the valve will not blow off. No service taps shall be made between this valve and the temporary blow-off valve.

115.3.6 Waterline Crossing Over a Sanitary Sewer Line

When there is less than 18 inches of vertical clearance between the water main and the sanitary sewer, the sanitary sewer shall be encased in concrete a minimum of nine feet on each side of the centerline of the crossing.

115.3.7 Sanitary Sewer Line Crossing Over a Waterline

In all cases, regardless of vertical clearance, the sanitary sewer shall be encased in concrete a minimum of nine feet on each side of the centerline of the crossing.

115.3.8 Limits on Vertical Separation

Under no circumstances shall the vertical clearance between any lines involving a waterline, sanitary sewer line, or storm sewer be less than 18 inches without written approval from the City.

115.4 FIRE PROTECTION SYSTEM

115.4.1 Fire Hydrants

Fire hydrants shall be installed within dedicated streets or easements. The number and location of fire hydrants in a given area is determined by the City Engineer or designee and the governing fire protection district. Normal practice is to install fire hydrants on the northeast corner of the street intersections. If fire hydrants are to be installed at other than street intersections, they shall be located on one side of the street right-of-way on lines which are established by extending property lot side lines into the street or in easements.

The maximum spacing between fire hydrants, when measured along the street curb line or directly from the hydrant to the unit, for types of structure use and maximum floor areas being served shall not exceed the distances shown below:

STRUCTURE TYPE	FAMILY UNIT			MFG/IND/OFFICE	
	DETACHED	MULTI		MULTI STORY	SINGLE STORY
Unit Separation	15'+	0-15'			
Hydrant Spacing					
Along Curb	500'	350'	300'	300'	
From Unit	250'	225'	210'	180'	
From Exit Doors					200'
Fire Flow Range					
GPM (Minimum)	1500	2000	2500	*	*
GPM	1750	2500	3500	3500	3500

* Determined by Fire Marshall and/or City Engineer or designee.

Fire hydrants shall be provided at not less than 1,000 ft. intervals, to provide for transportation hazards, along streets where hydrants are not needed for protection of structures.

Fire hydrants shall be connected to a valve in the main supply line with six (6) inch diameter Class 200 AWWA C900 PVC pipe lateral, perpendicular to the valve, and anchored with retainer glands and/or harness rods. The fire hydrant lateral lines shall be set at 90 degrees to mains. The fire hydrant lateral line shall be no more than 70 feet in length from the main. No horizontal bends or offsets shall be used in fire hydrant lateral lines. Under no circumstances shall any tap be made on a fire hydrant lateral line.

115.4.2 Fire Sprinkler Lines

Fire sprinkler lines shall be installed at right angles to the distribution main or lateral and be extended directly to the property line. No horizontal bends, off-sets or taps are to be installed in these lines. The size of the fire sprinkler lines shall be determined by the governing fire protection district that is served. A valve must be installed in the City right-of-way or easement.

115.4.3 Residential Standby Fire Protection

Single tap combination domestic water service and standby fire protection to a single family residence, may be used when the following conditions are met:

- A. The combination system is approved by both the Arvada Fire Protection District and the Building Inspection Division.
- B. The line is one continuous length of type "K" copper extending perpendicular from the corporation stop in the main to a curb-stop and box, located on the property side of the vertical curb or sidewalk.
- C. The residential domestic service line is teed off the fire line, one (1) foot downstream of the curb stop.
- D. A single meter and pit is installed at the property line to meter both the domestic and fire flow. The meter shall be sized for the maximum flow. The meter shall be the same size as tap and service line. The combined system shall be approved by the Utilities Department.
- E. The fire protection service line shall be equipped with rubber faced check valve or backflow prevention devices.

115.5 **SERVICE LINES**

Service lines with appurtenances to convey water from a distribution or lateral main in a street or easement to a structure shall conform to the following minimum standards.

The corporation stop, the meter, and that portion of the service pipe between the meter and the corporation stop on the main, shall all be of the same size. This portion of the service line must be installed in public right of way or an easement and will be maintained by the City.

115.5.1 Sizing Services

Service lines shall be adequate to supply the requirements of the property being served. The minimum size allowed for a water service line is 3/4".

The size of a service line from the City water main to any unit being served shall be selected such that the following design criteria are not exceeded during total peak demand flow:

- A. Eighty (80) percent of the manufacturer's maximum meter capacity.
- B. Service line pipe flow velocity does not exceed fifteen (15) fps.
- C. The pressure drop from the City water main to any unit being served shall not be greater than 30 psi and the minimum residual pressure at the foundation at any unit shall not be less than 30 psi.

The water requirements of the property being served shall be defined as "total peak demand flow." Peak domestic water requirements shall be as calculated in the latest edition of the Uniform Plumbing Code.

The irrigation demand flow and continuous load demands (when applicable) shall be added to the peak domestic flow to obtain the total peak demand flow. The service lines and meter

shall be designed on the basis of the total peak demand flow. Consideration should be given to metering domestic and irrigation demand flows separately in some instances.

Peak demand flows for commercial, industrial or professional properties are to be approved by the City prior to sizing their service lines.

115.5.2 Layout of Service Line

That portion of the service pipe between the main and the property line shall be one continuous length of copper pipe, installed perpendicular from the main to a meter or curb stop and box at property line.

Service lines shall be installed at least ten (10) feet laterally, on the uphill side from any foreign non-potable conduit and a minimum of five (5) feet from the side property line of the lot being served.

When serving lots at the end of a cul-de-sac, the length of service line between the main and the meter at property line shall not exceed 50 feet. Meters and/or curb stops with boxes shall not be installed in driveways or sidewalks. In instances where this requirement cannot be met, the curb stop/meter pit and lid must be of ductile iron as approved by the City Engineer or designee.

When approved by Utility Department, a meter may be installed inside a building or structure. Provisions must be made for the installation of a remote read meter with curb stop and box at property line.

115.6 **PLANNED UNIT DEVELOPMENT TOWNHOME COMPLEX**

Each building, regardless of the number of units contained therein, in a P.U.D. shall be metered and the service line from the meter tapped directly to a main located in public right-of-way or to a lateral supply line in the common area. The service line to the meter shall be one continuous section of copper pipe installed perpendicular to the main or lateral supply line. Meter shall be installed at property line or at a point in the common area that is easily accessible and void of vehicular traffic at all times. The location of lateral supply lines and meter, to be installed in common areas; easements must be approved by the City Engineer or designee.

In a townhome complex, each townhome unit shall have its own separate meter. The service line from each meter shall be directly tapped to a supply line, as set forth above for a P.U.D. building. In addition, the service line shall only cross the common area and the unit lot of the townhome being served. See section 115.3-2 of these Specifications.

115.7 **COMMERCIAL STANDBY FIRE PROTECTION LINE**

A property requiring both a fire line and a domestic service line cannot be served from a single tap. The fire protection service line shall extend perpendicular from the main to the property line and shall have a gate valve located within two (2) feet from and on the street side of the property line. A separate tap shall be placed on the water main to serve a separate domestic service line. A domestic service tee may not be placed on an existing fire line.

115.8 COMMON TRENCH

Service lines shall be separated laterally from a foreign conduit by a minimum of ten (10) feet and shall not be installed in trenches containing any substance other than potable water, except when the following conditions are met:

- A. The service line is one continuous length of copper pipe.
- B. The foreign pipe is polyvinyl chloride (PVC) pipe in 20 foot sections with concrete encased joints.
- C. The bottom of the service pipe is at least twelve (12) inches above the top of the foreign pipe and placed on a shelf excavation on one side of the common trench.
- D. Specifically approved by the City in writing.

115.9 BACKFLOW PREVENTION DEVICES

115.9.1 General

An approved backflow prevention assembly shall be installed at the service connection to any premises where there are existing cross connections or where potential cross connections exist or where it is expected that the consumer may make piping or equipment changes which would result in the installation of cross connections. Installation of the assemblies shall be inspected and approved by the City of Arvada.

115.9.2 Degree of Hazard

The type of backflow prevention assembly required must be consistent with the "degree of hazard" existing in the facility. The term "degree of hazard" shall be derived from the evaluation of conditions within a system which can be classified as either a "pollutional" (non-health) or a "contamination" (health) hazard. The "degree of hazard" shall be determined by the City based on the following.

- A. A Health Hazard is an actual or potential threat of contamination of a physical or toxic nature to the public potable water system or the consumer's potable water system that would be a danger to health. A health hazard requires the installation of an approved reduced pressure principle backflow assembly or an air gap.
- B. An Aesthetically Objectionable Hazard is an actual or potential threat to the physical properties of the public or the consumer's potable water system or a pollution or contamination which would have a protracted effect on the quality of the potable water in the system. An aesthetically objectionable hazard requires as a minimum the installation of an approved double check valve assembly.

115.9.3 Approved Models

Only those models (FEBCO:825Y-BV sprinkler line or 825 Y-BY building service line) that have met completely the laboratory and field performance specifications of the Foundation for Cross Connection Control and Hydraulic Research, of the University of Southern California, will be permitted by the City. In addition, the design for installation of backflow prevention assemblies shall, where applicable, address the following:

- A. Water service size and location; meter size and location; backflow prevention assembly size, type, and location.
- B. Backflow prevention assemblies shall be installed in the horizontal plane and inside a building.
- C. Vertical clearance between floor and the lowest point of the device shall be no less than twelve (12) inches or no more than thirty (30) inches.
- D. Horizontal clearance between any wall and the device shall be no less than twenty-four (24) inches on the test cock side and no less than twelve (12) inches on the opposite side.
- E. An underground drain line shall be provided to dispose of waste fluids developed during regular use and testing of the device. An air gap, no less than twice the diameter of the drain line, shall be provided between the relief valve outlet and the drain line.
- F. Continuous service systems shall be provided with parallel backflow prevention assemblies. One device shall be operable while the other is being tested.
- G. No installation of a backflow prevention device will be allowed above electrical or other equipment, where water could cause a hazard.
- H. Backflow prevention devices are required on all sprinkler systems. A pressure vacuum breaker shall only be used where the device is never subjected to back pressure and installed a minimum of twelve (12) inches above the highest piping or outlet downstream of the device in a manner to preclude back pressure. An atmospheric vacuum breaker shall be used only where the device is: never subjected to continuous flow, installed on the discharge side of the last control valve and above the point of usage, and installed with the air inlet in a level position and a minimum of six (6) inches above the highest piping on the outlet it is protecting.
- I. Backflow prevention assemblies, connecting lines, and drains shall be protected from freezing and thawing cycles.