

CITY OF FORT SMITH
WATER MINIMUM DESIGN STANDARDS

March 2022

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1. SCOPE AND AUTHORITY

This document identifies the City of Fort Smith’s minimum design requirements for public water infrastructure as defined by the State of Arkansas and the City of Fort Smith Municipal Code. While this document details the minimum design requirements for any improvements to the City of Fort Smith’s public water infrastructure, it does not relieve the design engineer from providing sound professional judgement. All design documents shall conform to accepted engineering and surveying standards and safeguard the life, health, property, and welfare of the public as identified in Article 20 – Ethics and Rules of Professional Conduct from the Arkansas Board of Licensure for Professional Engineers and Professional Surveyors. The following referenced sections give authority to the City of Fort Smith to construct, maintain, and operate a water system along with associated ability to provide design and construction standards.

1.1 – A.C.A. § 14-234-203 – Authority of Municipalities

Municipalities are authorized to purchase or construct a waterworks system or any integral part thereof and to purchase and hold title to, lease, or rent in connection therewith any land, lake, watercourse, or water supply either inside or outside the limits of the municipality or inside or outside the limits of the county in which the municipality is located.

1.2 – A.C.A. § 20-7-109 – Authority to Regulate Public Health

Power is conferred on the State Board of Health to make all necessary and reasonable rules of a general nature for the protection of the public health and safety; the general amelioration of the sanitary and hygienic conditions within the state; the suppression and prevention of infectious, contagious, and communicable diseases; the proper enforcement of quarantine, isolation, and control of such diseases; and the proper control of chemical exposures that may result in adverse health effects to the public.

1.3 – Arkansas State Board of Health – Rules Pertaining to General Sanitation (ADH-GS Section XII)

In the event that water or wastewater infrastructure improvements (hereinafter “infrastructure”), including those within an improvement district, are proposed to be constructed within the adopted territorial jurisdiction of a municipality under A.C.A. 14-56-413 or its designated utility service area, said municipality shall be provided notice of such a proposal prior to the commencement of any work, assessment, or indebtedness associated with same.

No infrastructure shall be connected to or serviced by a municipal utility unless and until same is expressly granted by the municipality, subject to the municipality’s connection and/or extension policy, if any. Any infrastructure improvements, including those within an improvement district, proposed to be constructed within the adopted territorial jurisdiction of a municipality under A.C.A. 14-56-413 or its designated utility service area, regardless of whether same is to be connected to or serviced by a municipal utility, must be built according to the standard utility construction specifications, if existing, of that municipality and in compliance with the piping sizes required by the municipal utility. The municipal utility shall be granted access during all phases of construction in order to inspect and verify substantial compliance with their construction standards, specifications, and pipe size requirements during and following construction of the infrastructure improvements.

1.4 – CFS: Section 27-507-1 – City of Fort Smith Design Requirement and Approval

1. Applicability.

No water improvement facilities shall be constructed, altered, extended or reconstructed within the City of Fort Smith or the planning jurisdiction of the City of Fort Smith without first having the approval of the City of Fort Smith Utility Department and any required state agencies. All such construction shall meet the requirements included herein.

2. General Requirements and Design Criteria.

Potable water systems shall comply with the City of Fort Smith, Minimum Water Design Standards, which document is hereby incorporated by reference and made a part of this chapter.

Note: All designs shall conform to the most stringent requirement of any adopted code, ordinance, or standard from other governing agencies.

2. GENERAL DESIGN REQUIREMENTS AND PLANNING

2.1 – Licensure Requirements

All designs, plans, and specifications submitted to the City for approval for the construction of public utility improvements as required herein shall be prepared under the direction of a professional engineer, licensed in the State of Arkansas, and shall meet the minimum standards specified. (A.C.A. 17-30)

2.2 – Basis of Design Requirements

The required water facilities shall be of sufficient size to serve the entire project area in which the water facilities are to be constructed with consideration for future expansion beyond the area being developed. The basis of design report shall contain supporting design information for the proposed water facilities to be constructed, a drawing detailing the size, boundaries, and zoning of the initial development. All drawings should contain appropriate locational elements such as north arrow, scale, section lines, street names, etc.

Computations should be presented in a tabular form for each segment of the system. Commentary shall be presented that details how design flows and peaking factors were developed. A summary of the design criteria that shall be submitted with the basis of design are detailed below. Additional items may be requested at the time of review.

Design Criteria:

1. Pipe segment identification detailed on a plan view exhibit
2. Inside pipe diameter and material of each segment
3. Average daily demand
4. Maximum daily demand, peaking factor used, and velocity
5. Maximum hourly demand, peaking factor used, and velocity
6. Fire flow calculations
7. Design flow and velocity at each segment

2.3 – Design Period

In general, the water improvements shall be designed for the estimated ultimate tributary population. Consideration shall also be given to the maximum anticipated demand of uses such as institutions, industrial parks, and fire flows.

2.4 – Design Factors

In determining the required capacities of water mains, the following factors shall be considered:

1. Determine the Average Daily Demand (Q_{avg})
2. Determine the Maximum Daily Demand ($Q_{max(day)}$)
3. Determine the Maximum Hourly Demand ($Q_{max(hour)}$)
4. Determine the required fire flow (Q_{fire})
5. Select an appropriate design flow based on previous determinations (Q_{design})
6. Evaluate and design the piping system using the design flow so that design pressures and velocities are within acceptable limits.

2.5 – Design Flow Requirements

2.5.1 – Design Flow Definitions and Equations

Water distribution systems shall be designed based on *Design Flow*. The distribution system must be designed to maintain a minimum pressure of 20 psi at all points in the system under all conditions of *Design Flow*. (AWWA M31) (AFPC 2012 B102.1)

Design Flow (Q_{design}) – The greater of either the *Maximum Hourly Demand* or the *Maximum Daily Demand* plus the fire flow required. Fire flow requirements can be found in **Section 2.5.6 – Fire Flows**.

Average Daily Demand (Q_{avg}) – The average of the total amount of water used each day during a one-year period.

Maximum Daily Demand ($Q_{max(day)}$) – The maximum total amount of water used during any 24-hour period. This number should consider and exclude any unusual and excessive uses of water. *Maximum Daily Demand* shall be two and a half (2.5) times average daily usage per capita plus the *Fire Flow (Q_{fire})* requirement for residential calculations.

$$Eq. 2.5.1(a): \quad Q_{max(day)} = (2.5 \times Q_{avg}) + Q_{fire}$$

(Units: Gallons per Day)

Maximum Hourly Demand ($Q_{max(hour)}$) – The maximum amount of water used in any single hour of any day during the design period. This is typically expressed in gallons per day by multiplying the actual peak hour use by 24 to obtain gallons per day. *Maximum Hourly Demand* shall include a peaking factor of seven (7) shall be multiplied by Average Daily Demand usage per capita for residential calculations.

$$Eq. 2.5.1(b): \quad Q_{hour(max)} = 7.0 \times Q_{avg}$$

(Units: Gallons per Day)

2.5.2 – Forecasting

Forecasting future water demands for a given area is a difficult task. Many references vary on what the average daily residential demand per capita. Some references show demands as low as 56.6 gallons per day per capita while others claim as high as 130 gallons per day per capita with an average indoor use of 58.6 gallons per day and an estimated additional 50 gallons per day for those using irrigation or other outside water uses. These studies vary widely due to variances in indoor uses, outdoor uses, and climate (AWWA-REU)

Specific development information is preferred when available to create a more accurate forecast and help reduce the risk of creating an over or under sized system. If specific development criteria is unavailable, forecasting must be based on the worst case scenario based on zoning classifications of the planning area. See **Section 2.5.3 – Zoning Classifications**, **Section 2.5.4 – Residential Design Flow**, and **Section 2.5.5 – Industrial and Commercial Design Flow** for additional information.

2.5.3 – Zoning Classifications

Zoning District	Maximum Dwelling Units/Acre
Residential Estate Three	0.33
Residential Estate One	1
Single Family - Low Density	3
Single Family - Medium Density	4
Single Family - Medium/High Density	6.7
Single Family - High Density	8.7
Single Family - Row House and Zero Lot Line	17
Single Family - Zero Lot Line	8
Single Family - Duplex Low /Medium Density	4
Single Family - Duplex Medium / High Density	6.7
Single Family - Duplex High Density	8.7
Multi-Family - Low Density	10
Multi-Family - Medium Density	20
Multi-Family - High Density	30
Transitional (Single Family)	3
Transitional (Two-Family)	6
Residential Mixed Density	30

**Referenced from City of Fort Smith Municipality Code (Section 27)*

2.5.4 – Residential Design Flow

Residential zone water requirements shall be designed based on the proposed development. When specific data is not available, residential water distribution systems shall use an Average Daily Demand of 100 gallons per day per capita.

Single-family homes shall be assumed to have an average of 3.5 people per household. Apartments and other multifamily residences shall be assumed to have an average of 1.7 people per one bedroom unit, 2.2 people per two bedroom unit, and 4 people per 3-bedroom unit.

If specific development information is unavailable, the design engineer shall assume that all single family homes shall have three bedrooms, multi-family shall have two bedrooms. See **Section 2.5.3 – Zoning Classifications** to determine the number of dwelling units per acre based on zoning.

All water lines located in residential zones must also be designed for a minimum instantaneous flow of 20 gallons per minute per residence without exceeding maximum flow velocity as detailed in **Section 2.5.8 – Velocities**.

2.5.5 – Commercial and Industrial Design Flow

Commercial and industrial zone water requirements shall be individually designed based on the proposed development. The *Design Flow* shall be no less than 120,000 gallons per day per acre (approximately 16,042 ft³/acre) plus the fire flow requirement. Fire flow requirements can be found in **Section 2.5.6 – Fire Flows (Q_{fire})**.

2.5.6 – Fire Flows (Q_{fire})

Water lines must be designed to meet the following fire flow requirements unless modified by the Fire Marshal. The Fire Marshal is authorized to increase or decrease the following fire flow requirements as detailed in Section B103 AFPC Vol. I. (See **Section 7 – Fire Protection Requirements, Hydrants, and Appurtenances for additional firefighting requirements.**)

Residential Areas

In residential areas with single family and duplex housing, single water lines must be designed to furnish a minimum fire flow of 1000 gpm with a residual pressure of 20 psi must be maintained during all *Design Flow* for one hour. (AWWA M31) (AFPC 2012 B102.1)

Single family homes or duplexes that are 3600 ft² or larger may require greater fire flow demands and durations. (AFPC 2012 B105.1)

Multi-Family Housing Developments

Multi-family housing units greater than duplex (ex. Triplex, quadplex, Apartment Complex) must have a minimum fire flow of 1500 gpm with a minimum duration of two hours. Greater fire flow requirements and durations may be warranted as detailed on *Table B105.1 of AFPC Vol. I*. A residual pressure of 20 psi must be maintained during *Design Flow*.

Commercial, Industrial, and Other Non-Residential Developments

All non-residential buildings must meet the minimum *Fire Flow* of 1500 gpm with a minimum duration of two hours. Greater *Fire Flow* requirements may be warranted as detailed on *Table B105.1 of AFPC Vol. I*. A residual pressure of 20 psi must be maintained during *Design Flow*.

2.5.7 – Design Pressures

The distribution system must be designed to maintain a minimum residual pressure of 20 psi at all points in the system under all conditions of *Design Flow*. (ADH-APWS XIV-B) (AWWA M31) (AFPC 2012 B102.1) *Design Flow* requirements can be found in **Section 2.5 – Design Flow Requirements**. The normal working pressure in the distribution system shall be no less than 35 psi with a preferred range of 60 psi to 80 psi at *Maximum Hourly Demand ($Q_{max(hour)}$)*. (TSSW – 8.2.1)

2.5.8 – Velocities

Water distribution lines shall be sized so that under *Design Flow* conditions, the velocities shall not exceed 14 fps (*DIPRA-CML*). *Maximum Hourly Demand* ($Q_{max(hour)}$) flow velocity shall not exceed 9 fps.

Water transmission lines, as defined in **Section 3.7.3 – Transmission Lines**, shall be sized so that maximum velocity shall not be greater than 5 fps under *Design Flow*. All velocities shall be calculated with the Hazen-Williams equation. The roughness coefficients to be used for design with the Hazen-Williams equation can be found below in **Table 2.5.8 – Hazen-Williams Coefficient Values**.

(Table 2.5.8)	
Hazen-Williams Coefficient Values	
Material Type	Roughness Coefficient
	"C"
Concrete ¹	140
Ductile Iron ²	140
PVC ³	150
Steel ⁴	140

**Note: Values applicable for pipes 48" and less*

¹ AWWA-M09 - Chapter 3, ² *DIRPA-CML*,

³ *PVC - Section 9.3.1*, ⁴ AWWA-M11 - Chapter 3

2.5.9 – Available Water Supply

If the Utility Department determines that the *Design Flow* exceeds the available water supply to a development site, the Utility Department may request changes or decline to approve the proposed development.

3. DETAILS OF DESIGN

3.1 – Materials

All materials including pipe, fittings, valves, fire hydrants and other appurtenances shall conform to the latest revision of the City of Fort Smith Standard Specifications and Arkansas Department of Health.

3.2 – Tracer Wire

All water lines must have tracer wire installed to meet the requirements of the State of Arkansas. (A.C.A. 14-271-111)

All tracer wire must terminate in a tracer wire box. Tracer wire boxes shall be located on design plans at intervals not exceeding 500 feet. Design plans shall show a tracer wire box to be located within five feet of every fire hydrant. If any additional tracer wire boxes are needed due to interval spacing requirements, tracer wire boxes shall be located near other water line appurtenances such as valve boxes. If no water line appurtenances are nearby, tracer wire boxes shall be located near street intersections or other easily accessible area.

3.3 – Integrity of Water Distribution Network

Pipes shall have sufficient structural strength and shall be properly supported and reinforced where necessary to guard against structural failures and resulting sanitary hazards. (ADH-APWS XIV)

Pipe shall be selected based on the following considerations:

1. Internal Pressures (design pressure, working pressure)
2. Surge Pressure
3. Material Yield Strength
4. Trench Load
5. Deflection
6. Casting Allowance
7. Vacuum
8. Geotechnical and Environmental Conditions

(Additional Depth requirements are discussed in Section 3.9 – Alignment and Profile)

3.4 – Geotechnical Considerations

3.4.1 – Corrosive Soil Environments

Protection from corrosive soil environments must be considered when proposed water line is to be located in areas found to have corrosive soils. Water line protective wraps and coatings must be designed in accordance with City of Fort Smith Standard Specifications and the latest revisions of the applicable AWWA standards. Ductile iron pipe, fittings, and valves shall be encapsulated with polyethylene. Corrosion surveys shall be performed in accordance with the latest requirements from *AWWA M11*, *AWWA M41*, or *DIPRA-DDM*. The Utility Department may require additional protection or testing during review.

Regardless of soil type, all ductile iron pipe shall be encased in polyethylene wrapping. Appropriate measures should be taken to protect the valves, bolts, nuts, and other appurtenances against corrosion. These items shall be encapsulated with polyethylene wrapping unless approved otherwise. (*AWWA M44*) (*DIPRA-CCPE*)

3.4.2 – Geotextile Encapsulation

All water lines located within the 100-year flood plain or areas with significant groundwater flow must be designed so that the entire pipe zone will be enveloped by a non-woven geotextile (filter fabric) to prevent soil migration. Filter fabric encapsulation of pipe zone shall be considered by the engineer for all transmission lines for all locations.

3.4.3 – Permeation (Petroleum Product & Organic Solvents)

Documented research has shown that pipe materials (such as polyethylene and polyvinyl chloride) and elastomers, such as those used in jointing gaskets and packing glands, are subject to permeation by low-molecular-weight organic solvents or petroleum products. If a water facility must be installed in such a contaminated area or an area subject to contamination, the design engineer must consult with material manufacturer regarding permeation and provide the manufacture's recommendation to the Utility Department for review. (*AWWA C111*)

The Arkansas Department of Health has stated that PVC pipe should not be installed where soils are or will be exposed to solvents, gasoline, petroleum products, etc. (*ADH-PVC*)

Consideration must be given to the type of gaskets being used in areas that are or will be exposed to similar soil contaminations. This consideration must be given to all gaskets regardless of pipe type.

3.5 – Restrained Joints and Thrust Blocking

Restrained joints or thrust blocking must be provided as necessary to prevent movement of pipe or appurtenances in response to thrust. All thrust restraint system calculations shall be provided by design engineer during review. Thrust restraint calculations shall conform to the latest AWWA recommendation. Restrained joints are preferred and shall be used when practical. Thrust blocking will be allowed in other circumstances.

Thrust restraint is required at the follow locations:

- Changes direction (i.e. bends, elbows, and crosses)
- Changes size (i.e. reducers)
- Dead ends
- Valves and hydrants

The type and size of thrust restraint depends on the following:

- Maximum system operating pressure
- Pipe size
- Appurtenance size
- Type of fitting or appurtenance
- Water line profile (horizontal or vertical bends)
- Soil strength

3.6 – Water Line Encasement

3.6.1 – Encasement Details

Casings shall have a minimum of 36 inches cover from the top of the casing to the bottom of the ditch line or native ground or 42 inches below the top of the roadway subgrade, whichever gives the greater cover.

Casings shall, as a minimum, extend six feet beyond the flow line of the parallel ditches; toe of slope, or back of curb as applicable for the roadway section. Bores shall be paid for per unit foot of bore with the water line inside encasement being paid for separately.

Casings must be designed to accommodate approved spacers and joint restraint. The casing diameter shall be a minimum of two times the diameter of the carrier pipe unless otherwise approved in writing by the Utility Department.

Casings may be required to be placed deeper based on permitting requirements from other agencies or as engineering judgement may require. Casings must be designed and installed in accordance with the latest revision of the City of Fort Smith Standard Specification and City of Fort Smith Standard Drawings. Casing Spacers will be required and spaced in accordance to the pipe manufactures recommendations.

All water lines that have been bored must be encased. Exceptions may be given for directional drilling in certain circumstances by the Utility Department. Water line encasement requirement may be removed with approval from the Utility Department.

Roadway crossings shall be perpendicular unless otherwise approved in writing by the Utility Department.

3.6.2 – Locations Requiring Encasement

Water Lines must be bored and encased in the following locations:

1. Railroad crossings in accordance with approved railroad permit.
2. Stream crossings. Boring requirement may be waived based on approved permits.
3. ArDOT maintained roadways in accordance with approved ArDOT permit.
4. All public roadway crossings.

Exception to Public Roadway Crossings:

- a. Water lines under a “Residential Street” as classified by the City of Fort Smith Master Street Plan with a surface older than two years or prior to roadway construction may be installed by an open cut method without the need to be encased. Encasement is still required when bored.
5. Service Line Crossings (See **Section 6 – Water Services** for additional details)
 6. Areas of Possible Cross Connection (See **Section 4 – Protection of Water Supplies** for additional details)

3.7 – Water Line Sizes

3.7.1 – Minimum Water Line Size

Distribution piping must be sized to meet *Design Flow*. No public water line shall be less than 8-inches in diameter except for the following cases:

1. 6-inch water lines may be allowed for looped connections where future development and fire flow requirements are able to be satisfied without exceeding velocities detailed in **Section 2.5.8 – Velocities** during *Design Flow*.
2. 4-inch dead-end water lines may be allowed where no future extension of the line is possible, and the water lines will not be required to carry fire flows. *Design Flow* for 4-inch water lines must include domestic and irrigation demands for all tracts being served by 4-inch water lines and must meet the instantaneous service flow requirement detailed in **Section 2.5.4 – Residential Design Flow**. All residential units must maintain a minimum pressure as detailed in **Section 2.5.7 – Design Pressures**. In addition to the previous requirements, all properties being served by 4-inch water lines must be within the required radius of a fire hydrant on a main of adequate size. See **Section 3.8.2 – Dead End Lines** for additional information on dead end lines.

3.7.2 – Line Size for Fire Flow

The minimum size of water line to provide fire protection and serve fire hydrants is 6-inches in diameter. (*TSSW – Sec. 8.2.2*) Larger water lines may be necessary to achieve required fire flow and maintain the minimum residual pressure specified in **Section 2.5.6 – Fire Flows** and not exceed max velocities as specified **Section 2.5.8 – Velocities**.

3.7.3 – Transmission Lines

All water lines greater than 12-inches are considered transmission lines. No service taps will be allowed on transmission lines without written approval from the Utility Department. Service taps are highly discouraged in order to help maintain the integrity of water transmission lines.

3.8 – System Design

3.8.1 – Layout

Consideration should be given to future needs. The water system should be designed to serve not only the current project area but also shall be compatible with an overall master plan as determined by the Utility Department. Water lines shall be extended across property frontages to allow for future development when future development is possible as determined by the Utility Department. Water systems must be designed wherever possible in a gridiron configuration to assure adequate continuous supplies and promote circulation. Dead-end lines must be avoided wherever possible. Water lines shall be extended across property frontages to allow for future development when practical as determined by the Utility Department.

3.8.2 – Dead-End Lines

Dead-end lines must be avoided when possible in order to increase reliability of service and reduce issues related to water quality. Dead end mains must be equipped with a means to provide adequate flushing as detailed in the latest revision of the City of Fort Smith Standard Specifications. See **Section 5.3 – Water Line Flushing Devices** for additional details. Any dead-end segments with a length greater than two feet, including pipe or valve, shall be equipped with a flushing device located at the end of the segment that is capable of flushing the segment at a velocity of 3.0 fps.

3.8.3 – Flushing & Disinfection of Water Lines

All public water lines must be designed in such a way to allow all segments of the proposed system to be disinfected and flushed in a manner outlined in the latest revision of AWWA C651. (*ADH-APWS XIV*). All injection and flushing and sampling points must be detailed on the plan set.

3.9 – Alignment and Profile

3.9.1 – Alignments

Water lines must be designed in such a way to minimize the amount of bends in an alignment as practical. All horizontal alignment changes must be accomplished by the use of fittings, pipe joint deflections, or approved longitudinal bending. See **Section 3.10 – Joint Deflection and Longitudinal Bending** for additional details. When possible, water lines alignment shall not be designed to run longitudinally under a road.

3.9.2 – Profiles

Water lines must be designed for a minimum cover of 30 inches. Water lines must not be located more than 6-feet below finished grade without written approval from the Utility Department. While water line profiles will naturally follow the normal contours of the finish grade, water lines must be designed in such a way to minimize the number of high points. All vertical alignment changes must be accomplished by the use of fittings, pipe joint deflections, or approved longitudinal bending. See **Section 3.10 – Joint Deflection and Longitudinal Bending** for additional details.

3.10 – Joint Deflection and Longitudinal Bending

3.10.1 – Joint Deflections (Joint Offset)

The maximum joint deflection angle used for design purposes must be 80% of the designed maximum deflection angle as detailed in the latest AWWA standards or manufacturer specifications, whichever is less. Ductile iron pipe push-on joint deflections are detailed in AWWA C600 and typically range from 3° to 5° for push on type joints. PVC deflections are detailed in AWWA Manual M23 and found in manufacturer's specification and typically range from 1/3° to 5°. Other joint types may have differing joint deflection allowances. A copy of the document used to determine deflection angles may be requested during review.

3.10.2 – Longitudinal Bending

Longitudinal bending of pipe will not be allowed with the following exception:

1. 4-inch PVC water lines used in cul-de-sacs shall have no less than a 100 foot radius using a combination of joint deflection and longitudinal bending. Longitudinal bending must be approved in writing from the Utility Department.

4. PROTECTION OF WATER SUPPLIES

4.1 – Cross Connections

Every precaution must be taken against the possibility of sewage contamination of the water in the distribution system. Water mains and sanitary sewers must be constructed as far apart as practicable, and must be separated by undisturbed and compacted earth. (*ADH-APWS XIV*)

There must be no physical connection between any water supply system and any storm or sanitary sewer system, or any appurtenance, thereto which would permit the passage of polluted water into the potable supply. (*ADH-APWS XVI*)

All designs must conform to the minimum requirements as detailed in City of Fort Smith Ordinance 25-166 (*CFS 25-166*) and from the Arkansas Department of Health.

Fire hydrant drains shall not be connected to or located within 10 feet of sanitary sewers, storm sewers, or storm drains. (*TSSW – 8.4.4*)

4.2 – Horizontal Separation From Sanitary Sewers

A minimum horizontal distance of ten feet should be maintained between water lines and sewer lines or other sources of contamination. Water lines and sewers must not be laid in the same trench except on the written approval of the Arkansas Department of Health and the City of Fort Smith Utility Department. (*ADH-APWS XIV*)

4.3 – Crossing and Vertical Separation From Sanitary Sewers

Water mains necessarily in close proximity to sewers must be placed so that the bottom of the water line will be at least 18 inches above the top of the sewer line at its highest point. If this distance must unavoidably be reduced, the water line or the sewer line must be encased in watertight pipe with sealed watertight ends extending at least ten feet either side of the crossing. Any joint in the encasement pipe is to be mechanically restrained. The encasement pipe may be vented to the surface if carrying water or sewer under pressure. Where a water line must unavoidably pass beneath the sewer line, at least 18 inches of separation must be maintained between the outside of the two pipes in addition to the preceding encasement requirement. Exceptions to this must be approved in writing by the Arkansas Department of Health and the City of Fort Smith Utility Department. (*ADH-APWS XIV*)

4.4 – Crossing and Vertical Separation From Storm Sewers

Storm sewer lines that are 24 inches in diameter, or equivalent cross-sectional area of flow, and greater shall be treated the same as sanitary sewer lines with respect to their interaction with water lines. Therefore, water lines necessarily in close proximity to storm sewer lines that are 24 inches and greater shall be designed with the same protections as required for water lines in close proximity to sanitary sewer lines.

4.5 – Separation From Other Utilities

A minimum horizontal distance of three feet must be maintained between water lines and other underground utilities of a non-sanitary nature (gas, electric, etc.). Exceptions to this must be approved in writing by the Arkansas Department of Health and Human Services and the City of Fort Smith Utility Department. (*ADH-APWS XIV*)

A minimum vertical distance of 18 inches must be maintained between water lines and other underground utilities of a non-sanitary nature.

Any utility that may cause a sanitary hazard will be required to follow the same guidelines set forth for sanitary sewers in **Section 4.2 – Horizontal Separations From Sanitary Sewers** and **4.3 – Crossing and Vertical Separations From Sanitary Sewers**.

5. VALVES AND OTHER APPURTENANCES

5.1 – Valves

A sufficient number of valves must be provided on water mains to minimize inconvenience and sanitary hazards during repairs. Valves should be located at not more than 500 foot intervals in commercial and industrial zones and at not more than one block or 800 foot intervals in other districts. Where systems serve widely scattered customers and where future development is not expected, the valve spacing may be greater with written permission of the City of Fort Smith Utility Department. At no point should valve spacing exceed one mile. (*TSSW – 8.3*)

Generally, valves should be placed near roadway intersections to allow for easy access. An adequate number of valves must also be located at crosses and tees to allow for proper isolation. Additional valves may be required during City of Fort Smith Utility Department review. When possible valves shall not be located within roadways. Water line profiles shall be designed in such a way that valves may be able to be installed in a plumb orientation.

A valve box or vault shall be provided for each valve installed. The valve box or vault shall be designed so that surface loading will not be transmitted to the valve, valve actuator, or water line. Unless otherwise required, the valve box or vault shall be of proper height to allow these components to be flush with the final grade or roadway.

5.2 – Air Valves

Pockets of air are difficult to detect with in the distribution system and can reduce the overall system efficiency while also potentially contributing to water hammer problems, pipe breaks, system noise, and pipe corrosion and can cause erratic operation of control valves, meters, and equipment. Studies have shown that small pockets of air within a system can cause or intensify pressure surges. (*AWWA M51*)

5.2.1 – Air Pocket Scouring Within Pipelines

The velocity of the flow of water past a pocket of air may be sufficient to scour air from the pipeline. The *AWWA M51 (Second Edition) – Table 1-1* has been reference below for convenience. Air valves may be eliminated from design if it can be shown that normal flows will meet or exceed the air pocket scouring velocity as detail in the reference **Table 5.2.1 – Velocities Required to Scour Air and Wastewater Gases from Pipelines** (next page).

Slope Pipe Size	Negative slopes				
	0° (0%)	2.9° (5%)	14° (25%)	45° (50%)	90° Vertical
4"	2.7 ft/sec	2.9 ft/sec	3.1 ft/sec	3.4 ft/sec	3.5 ft/sec
8"	3.8 ft/sec	4.1 ft/sec	4.4 ft/sec	4.8 ft/sec	5.0 ft/sec
12"	4.7 ft/sec	5.0 ft/sec	5.4 ft/sec	5.9 ft/sec	6.1 ft/sec
24"	6.6 ft/sec	7.1 ft/sec	7.6 ft/sec	8.3 ft/sec	8.6 ft/sec
36"	8.1 ft/sec	8.7 ft/sec	9.3 ft/sec	10.2 ft/sec	10.6 ft/sec

Source: AWWA M51 (Second Edition)

5.2.2 – Location of Air Valves

The proper location of air-release, air/vacuum, and combination air valves is as important as the proper sizing of the air valve. An improper location can render the valve ineffective.

Air valves shall be installed at the following locations in accordance with *AWWA M51 (Second Edition)*:

- *High Points* – Combination air valves should be considered at system high points to provide venting while the system is being filled, during normal operation of the system, and for air inflow to provide vacuum protection while the pipe is draining. A high point is defined by the higher end of any pipe segment that slopes upward toward the hydraulic gradient or runs horizontal to it, followed immediately by a down sloping segment.
- *Mainline Valves* – Air/vacuum valves or combination air valves should be considered on the downstream side of mainline valves to facilitate draining of the system or a segment of the system from its isolating valve to the draining valve. An air-release valve should be considered on the pressurized side of a mainline valve to facilitate venting of air during the initial filling or testing of a pipeline segment.
- *Increased Downslope* – A combination air valve should be considered at abrupt increases in downslope.
- *Decreased Upslope* – An air/vacuum valve or a combination air valve should be considered at abrupt decreases in upslope.
- *Long Ascents* – An air/vacuum valve or combination air valve should be considered at intervals of ¼ mile to ½ mile along ascending sections.
- *Long Descents* – An air-release valve or combination air valve should be considered at intervals of ¼ a mile to ½ mile along descending sections.

- *Horizontal Runs* – Combination air valves should be considered at the beginning and end of long horizontal sections, and air-release valves or combination air valves should be considered at intervals of ¼ mile to ½ mile along horizontal sections of pipe. It is difficult to evacuate air and wastewater gases from a long horizontal piping system at low-flow velocities.
- *Transient Locations* – Other locations may be identified by a transient analysis mathematical model of the distribution system such as identifying the anticipated location of potential column separations. Air valves used to mitigate the effects of column separation should be equipped with slow-closing devices, or vacuum breakers equipped with air-release valves should be considered.
- *Flowmeters* – Air release valves should be considered upstream of flowmeters to mitigate measurement inaccuracies caused by entrapped air.
- *Deep-Well and Vertical Turbine Pumps* – Air/vacuum or combination air valves should be considered on the discharge side of deep-well and vertical turbine pumps to exhaust the air and wastewater gases in the pump column during pump startup and to allow air back into the line after pump shutdown. Air valves mounted on these types of pumps may require slow-closing devices or throttling devices owing to the violent changes in flow rate during pump cycling. Air-release valves can also be considered for use with time-delayed, power-actuated check valves to release the air and wastewater gases in the pump column slowly under full pump pressure.

5.3 – Water Line Flushing Devices

Flushing devices should be sized to provide flows which will produce a velocity of at least 3 feet per second in the water main being flushed (*AWWA C651*). A blow off hydrant as detailed in the City of Fort Smith Standard Specifications shall be used on water lines smaller than 6 inches. A fire hydrant shall be used on lines 6-inch to 12-inch. Appropriate sized “Goose Neck” blow off assemblies must be used on water lines greater than 12-inches. The flow from any water line flushing activities must not be allowed to enter any sanitary sewer.

5.4 – Flooding

Air valves, vacuum valves, relief valves, and blow off devices must be located in areas accessible and not subject to damage in the 100-year return storm (*TSSW 8.6*). Exceptions to this requirement must be approved by the City of Fort Smith Utility Department in writing. Where practical, fire hydrants and water line valves shall be placed at locations above the 100-year return storm elevation.

6. WATER SERVICES

6.1 – Water Services Connection Limitations

Each building structure must have separate water service from the point of the utility source and in no case be interconnected with the plumbing system of another privately owned property. (APC 603.2.3)

A maximum of five domestic water service taps will be allowed per tract of land. A minimum of 24 inches of clearance must be maintained between water line taps. Master meters will be required for properties requiring more than five domestic water service taps. All sub-metered properties must comply with the *ADH - Policy on Regulatory Compliance for a Sub-metered Property (August 2008)*.

6.2 – Service Lines Sizes

The smallest service line that will be installed from the water main line to the meter box will be 1-inch.

6.3 – Service Lines Installation

All service lines under roadways must be installed in a conduit. Single 1-inch water service lines must be installed in a 2-inch diameter conduit. Two 1-inch water service lines may be installed in a 4-inch diameter conduit. All 4-inch conduits that are installed with the intention of serving two separate properties shall be installed at the lot line separating the two properties that are to be served. In industrial and commercial areas, the method of serving each lot will be determined on an individual basis. Each lot must have the ability to receive water service. Service taps shall not be located under a roadway without approval from the City of Fort Smith Utility Department.

6.4 – Meter Boxes and Vaults

Water services that are 1-inch and 2-inch shall use meter boxes that are specified in the City of Fort Smith Standard Specifications. Water services that are greater than 2-inches must be installed in a meter vault. Location and size of any bypass loops or instrumentation should be accounted for when sizing a water meter vault. Bypass loops may be allowed with written approval from the City of Fort Smith Utility Department. All bypass loops must be metered.

7. FIRE PROTECTION REQUIREMENTS, HYDRANTS, AND APPURTENANCES

7.1 – General Requirements

The City of Fort Smith has adopted the 2012 edition of the Arkansas Fire Prevention Code (AFPC) Volumes I, II, III. More specifically the City has adopted and removed appendices in each volume. The ordinances referenced below should be reviewed to obtain additional details:

1. AFPC Volume I (Adopted CFS Section 10-31)
2. AFPC Volume II (Adopted CFS Section 6-26)
3. AFPC Volume III (Adopted CFS Section 6-2)

7.2 – Fire Hydrant Locations

Fire hydrants should be provided at each street intersection, at intermediate points between intersections, and within 400 feet of dead end streets. Generally, fire hydrants must not exceed a spacing of 400 feet between hydrants. A 600-foot spacing may be authorized if building(s) within the increased spacing are equipped with approved automatic sprinkler system(s). (*AFPC Vol. I - 507.5.1*)

Where new water mains are extended along streets where hydrants are not needed for protection of structures or similar fire problems, fire hydrants shall be provided at spacing not to exceed 1000 feet to provide for transportation hazards. (*AFPC Vol. I Table C105.1 Note C*)

Fire hydrant drains shall not be connector or located within 10 feet of sanitary sewers, storm sewers, or storm drains. (*TSSW – 8.4.4*) Final determination and approval of fire hydrant locations will reside with the Fire Marshal.

7.3 – Hydrant Types

All hydrants must conform to the latest revision of the City of Fort Smith Standard specifications.

7.4 – Hydrant Connections

Hydrants must be connected to the water main with a ductile iron pipe (fire hydrant lead line) of not less than 6 inches in diameter. A gate valve must be installed on all lines connecting the hydrants to the water main. Fire hydrant lead lines longer than 25 feet must have a second gate valve (watch valve) in accordance with the Standard Drawings.

7.5 – Obstruction and Physical Protection of Fire Hydrants and Appurtenances

Unobstructed access to fire hydrants shall be maintained at all times. The fire department shall not be deterred or hindered from gaining immediate access to fire protection equipment or fire hydrants.

A 3 foot clear space shall be maintained around the circumference of fire hydrants. Where fire hydrants are subject to impact by a motor vehicle, guard post or other approved means shall comply with Section 312 of AFPC Vol I. (*AFPC Vol I. 507.5.4 - 6*)

7.6 – Private Fire Services

Private fire services shall be designed and constructed to the same standards as public fire services. In addition, private fire services are subject to all testing and maintenance requirements as detailed in the latest City ordinances, Arkansas Fire Prevention Code, and any other requirements of governmental authority. (*AFPC Vol 1. 507.5.3*)

8. EASEMENTS

8.1 – Easements for Water Lines and Appurtenances

All water lines not located in a public right-of-way shall be located in a water easement with a width no less than 15 feet wide or a width 2.5 times the depth of the line, whichever is greater. Greater widths may be required due to the size of line or to accommodate appurtenances. Any exceptions must be approved by the Utility Department in writing. Easements that run parallel to a property line must not straddle said property line but instead be located wholly on one property.

Where alleys are not provided, adequate easements shall be provided where necessary for use by utilities. Utility easements shall be separated from drainage easements except for necessary crossings. (*CFS 27-504-1A*)

All water and sewer easements shall be of such dimensions as to provide access for the construction, and maintenance of the facilities within the easements and according to the applicable design standard. (*CFS 27-504-1B*)

All easements acquired, developed through platting, or used by the project shall have easement type and dimensions detailed on plan set. The recorded book and page or recorded plat location shall be detailed on record plan set.

8.2 – Easements and Landscaping

All landscaping located within any easement containing a water or sanitary sewer line must be installed in accordance with the latest revision of the Utility Landscaping Development Policy.

No trees other than those in the small tree category on the recommended trees list may be planted under or within ten lateral feet of any overhead utility wire, or over or within five lateral feet of any underground water line, sewer line, transmission line or other utility in city parks, public grounds, or public rights-of-way on city park property. (*CFS 18-154-b.9*)

9. PRIVATE DEVELOPMENTS

The following options were created to address the development of large residential complexes, neighborhoods, and new developments requiring public water and sewer access on private property. The Utility Department reserves the right to individually review new developments and specify requirements that protect the integrity and operation of the public infrastructure as required beyond the scope of this document.

9.1 – General Requirements for Private Developments

The following requirements shall be met for all developments, regardless of whether the utilities are public or private beyond the property line:

1. All water taps to a public main must be performed by city personnel or designated representative.
2. All domestic and irrigation water connections to a public water main will be metered.
3. Water lines and sub-meters downstream of any public meter(s) shall be privately owned and maintained.
4. Sewer connections to public main shall be minimized. The number of sewer connections to public mains shall be justified by demonstration of slope calculations and engineering drawings.
5. All water and sewer utilities will be designed and constructed to current utility department standards.
6. Any water meters that services a fire hydrant, fire suppression system, or equivalent must have a fire rated meter installed.
7. Irrigation and fire lines shall comply with all requirements within the City of Fort Smith requirements, including the Cross Connection Control Program.
8. All other applicable AWWA Standards, City requirements, and State requirements must be met.

9.2 – Private Utilities with Private Access

1. All meters and sanitary sewer clean-outs shall be located at a point immediately outside of the private access area and within a utility easement or public Right-of-Way (ROW).
2. If an irrigation line, fire line, or fire hydrant are to be connected to a private domestic water line, a backflow prevention device shall be installed immediately beyond the public easement or ROW, in accordance with the City of Fort Smith Cross Connection Control Program.
3. If two water service lines are required, both water service taps shall have separate meters and backflow prevention devices in accordance with the City of Fort Smith Cross Connection Control Program.
4. Fire Hydrant locations must be designed and installed in accordance with the City of Fort Smith minimum design standards and standard specifications.
5. Fire Hydrants shall be privately owned and maintained. All private fire hydrants must have an approved permit from the City of Fort Smith, in accordance with the City of Fort Smith Cross Connection Control Program.

9.3 – Public Utilities with Private Access

1. The City of Fort Smith Utility Department must be able to access public facilities at all times (i.e. a gate code).
2. Access easement for private roadway must meet requirements set forth in Section 27-504 of the City of Fort Smith Municipal code.
3. Access easement shall have one access point connecting to a public ROW that shall be a minimum of 12 ft. wide to allow for heavy equipment access.
4. Sewer easements width shall be at least 2.5 feet for every 1 foot of pipe depth. A minimum of 15 foot width with the sewer line centered within the easement. Additional easement width may be required.
5. Water easements shall be a minimum of 15 foot width with the water line centered within the easement. Additional easement width may be required.
6. Water and Sewer Easements shall be exclusive.
7. All crossings under private roadway shall be considered private.
8. Fire Hydrants shall be public.
9. Fire Hydrants shall follow City spacing specifications.
10. Irrigation lines and fire lines shall have separate taps on the public main, and shall not be connected to domestic water service lines.
11. No permanent structures will be allowed within the water or sanitary sewer easements.

10. PLANS & SPECIFICATIONS

10.1 – Plan Specifications

All designs, plan and specifications submitted to the City for approval for the construction of public utility infrastructures (water and sewer) shall be prepared by a registered professional engineer, licensed in the State of Arkansas. All design and construction techniques shall conform to the City of Fort Smith's Standard Specifications. Any changes or special details will need to be specifically approved by the City of Fort Smith Utility Department.

10.2 – Plan Set Requirements

All plan sets that propose work in connection with the water or sewer infrastructure shall have the following items detailed:

- A. All easements acquired, developed through platting, or existing easements that are used by the project shall have easement type and dimensions detailed on plan set.
- B. Water lines and sewer lines shall be shown in both in a plan view and a profile view. Material, size, elevations (flow line, existing grade, and finished grade), slopes of each pipe segment, and any appurtenances shall be shown in their proper views. All elevations shall be based upon USGS datum with location of benchmark given.
- C. All coordinates used on plans and specifications shall be based on the City of Fort Smith coordinate system.
- D. All connections, bends, junctions, and manholes shall be coordinately located on the plan set.
- E. A project location sheet shall be provided which details the project location in relation to streets, subdivisions, governing boundary lines, any major geographical features such as streams or bodies of water, and the 100-year flood plain elevation line.
- F. Information such as geotechnical data, environmental data, information on other utilities, or special construction requirements may be required in addition to the previous requirements.

10.3 – Record Drawing Requirements

All public water and sewer improvements shall not be accepted by the City of Fort Smith Utility Department until record drawings have been received and reviewed by the Utility Department. Record drawings shall contain updated information for the item detailed in **Section 10.2 – Plan Set Requirements** based on actual results of construction. All easements acquired, developed through platting, or existing easements used by the project shall have easement type, dimensions, and the recorded book and page or recorded plat location detailed on plan set. Record plan set shall not be sealed by an engineer.

11. REFERENCED CODES AND STANDARDS

1. A.C.A. – Arkansas Code Annotated

- a. A.C.A. § 14-56-413 – *Territorial Jurisdiction*
- b. A.C.A. § 14-234 – *Waterworks and Water Supply*
- c. A.C.A. § 14-271-111 (a) (2) – *Underground Facilities Damage Prevention*
- d. A.C.A. § 14-234-105 – *Alteration Despite Zoning Regulations*
- e. A.C.A. § 17-30 – *Engineers*
- f. A.C.A. § 20-7-109 – *Authority to Regulate Public Health (Board of Health)*

2. ADH – Arkansas Department of Health

- a. ADH-APWS – *Arkansas State Board of Health – Rules and Regulations Pertaining to Public Water Systems (02/24/2014)*
- b. ADH-GS – *Arkansas State Board of Health – Rules Pertaining To General Sanitation*
- c. ADH-PVC – *Arkansas Department of Health – Policy Statement: PVC Pipe (AWWA C900 or ASTM D2241) for Use in Public Water Systems (October 2008)*
- d. ADH-SMP – *Arkansas Department of Health – Policy on Regulatory Compliance for a Sub-metered Property (August 2008)*

3. AFPC - Arkansas Fire Prevention Code Volumes 1-3 – (2012 Edition)

- a. Adopted (Section 10-31) - *Volume I**
- b. Adopted (Section 6-26) - *Volume II**
- c. Adopted (Section 6-2) - *Volume III**

*As Adopted by City of Fort Smith (CFS – 10-31, 6-26, 6-2)

4. APC – Arkansas Plumbing Code - (2006)

- a. Section 603.2.3 – *Individual Water*

5. AWWA – American Water Works Association

- a. C111 – *Rubber Gasket Joints for Ductile-Iron Pressure Pipe and Fittings*
- b. C600 – *Installation of Ductile-Iron Mains and Their Appurtenances*
- c. C651 – *Disinfecting Water Mains*
- d. M09 – *Concrete Pressure Pipe (3rd Edition)*
- e. M11 – *Steel Pipe – A Guide for Design and Installation (5th Edition)*
- f. M23 – *PVC Pipe – Design and Installation (2nd Edition)*
- g. M31 – *Distribution System Requirements for Fire Protection (4th Edition)*
- h. M41 – *Ductile-Iron Pipe and Fittings (3rd Edition)*
- i. M44 – *Distribution Valves: Selection, Installation, Testing, and Maintenance(3rd Edition)*
- j. M51 – *Air Valves: Air-Release, Air/Vacuum & Combination (2nd Edition)*
- k. M68 – *Water Quality in Distribution Systems (1st Edition)*

6. CFS – City of Fort Smith Municipal Code of Ordinances

- a. Section: 6-2 – *Adoption of One- and Two-Family Dwelling Code (Adopts AFPC Vol. 3)*
- b. Section: 6-3 – *Amendments (Amends AFPC Vol. 3)*
- c. Section: 6-26 – *Adopted (Adopts AFPC Vol. 2)*
- d. Section: 6-27 – *Amendments (Amends AFPC Vol. 2)*
- e. Section: 6-238 – *Code Adopted (Fully Adopts APC)*
- f. Section: 10-31 – *Adopted (Adopts AFPC Vol. 1)*
- g. Section: 10-32 – *Amendments (Amends AFPC Vol. 1)*
- h. Section: 18-154-b.9 - *Tree planning, planting, maintenance and removal*
- i. Section: 25-166 – 25-176 – *Cross Connection Control Program*
- j. Section: 27-503-18 – *Fire Protection*
- k. Section: 27-504-1 – *Utility Easements*
- l. Section: 27-505-1 – *Applicability (Sanitary Sewer Approval Required)*
- m. Section: 27-505-2 – *General Requirements and Design Criteria (Sanitary Sewer)*
- n. Section: 27-507-1 – *Applicability (Water Approval Required)*
- o. Section: 27-507-2 – *General Requirements and Design Criteria (Water)*

7. DIPRA – Ductile Iron Pipe Research Association

- a. DIPRA-CML - *Cement-Mortar Linings for Ductile Iron Pipe (March 2017)*
- b. DIPRA-DDM – *Design Decision Model (DIPRA & Corrpro) (May 2018)*
- c. DIPRA-CCPE – *Corrosion Control Polyethylene Encasement (January 2017)*

8. PVC – PVC Pipe Association – Hand Book of PVC Pipe Design and Construction (5th Edition)

- a. Section 9.4 – *Flow*

**9. TSSW – Recommended Standards for Water Works (2012 Edition)
(Also known as Ten States Standards – Water)**

- a. Section 8.2 – *System Design*