Water and Sanitary Sewer Design Manual



SECTION 4 – DESIGN CRITERIA FOR WATER FACILITIES

4.1. General

The following are the minimum requirements that must be met for all water line connections and any improvements or extensions of the City's public water system. Distances shall be measured from the centerline of a pipe, unless otherwise noted.

The following references should be adhered to in conjunction with these requirements:

- Waco Development Guide, latest edition
- City of Waco Code of Ordinances, latest edition
- City of Waco Standard Specifications for Construction, latest edition
- City of Waco Manual of Standard Details, latest edition
- Texas Administrative Code (TAC), Title 30, Chapter 290, Subchapter D: Rules and Regulations for Public Water Systems
- International Building Code (IBC), latest adopted
- International Fire Code (IFC), latest adopted
- International Plumbing Code (IPC), latest adopted
- National Electric Code (NEC), latest adopted

4.2. Typical Location of Water Lines within Public Right-of-Way and Easements

A. <u>Right-of-Way:</u>

- 1. New water distribution lines (≤ 16-inch) shall generally be placed in the center of the outermost lane of traffic, in the northern or eastern portion of the right-of-way.
- 2. Horizontal alignment (distance from ROW, curb, or edge of pavement) shall be maintained, to the greatest extent possible, throughout project.
- 3. Street and major utility crossings shall be installed 90 degrees, plus or minus 10 degrees, to the centerline of the roadway/utility.
- Location of new water transmission main (≥ 16-inch) shall be coordinated with the WUSD.
- 5. Water lines shall not be placed any closer than 5 feet from any right-of-way line.

B. Easements:

- 1. New water lines shall be placed in the center of designated water line easements. Refer to *Section 3 Easement Requirements*.
- 2. If a shared easement is used that contains water and wastewater utilities, refer to *Section 4.3*, below, for required separation distances.

4.3. Horizontal and Vertical Alignments of Water Lines and Separation Distances

A. Horizontal Alignments:

The horizontal alignment of proposed water lines should be laid as straight as practical and follow right-of-way, easement or roadway centerlines.

- 1. <u>Curves:</u> In rights-of-way, easements or centerline alignment curves, the minimum radius of curve and maximum deflection angle of pipe joints will be restricted to 50% of the manufacturer's recommendation, after which, the use of horizontal or vertical fittings will be required. <u>No deflection (bending) of pipe sections is allowed.</u>
- <u>Bends:</u> All bends shall be 45° or less, and consist of standard fittings (45°, 22.5°, and 11.25°), and include blocking per the City's *Manual of Standard Details, Detail W-3A, W-3B & W-3C*. Non-standard bends shall consist of a combination of standard fittings and allowable deflections at the joint. Exceptions may be allowed for larger diameter water lines with specially constructed fittings, on a case-by-case basis, and as preapproved by the WUSD.
- 3. <u>Fittings:</u> Crosses are not permitted. Deflections at fittings shall be restricted to 50% of the manufacturer's recommendation.

B. <u>Vertical Alignments:</u>

The vertical alignment of proposed water lines should follow the existing, or proposed ground surface as closely as practical.

- 1. Depth of Cover:
 - a. 12-inch diameter and smaller water lines shall be designed for a minimum FINAL cover of 42 inches, measured from the top of surface to the top of pipe.
 - b. 16-inch diameter and larger water lines shall be designed for a minimum FINAL cover of 60 inches, measured from the top of surface to the top of pipe. To accommodate water line appurtenances requiring vaults, depths exceeding 60 inches may be necessary.
- 2. <u>Restrained Joints</u>: All vertical and horizontal fittings and valves shall be designed with restrained joints in addition to concrete thrust blocking per the City's *Manual of Standard Details, Detail W-3A, W-3B, W-3C, W-3D, W-3E & W-4*.

C. <u>Clearance Requirements (separation distance):</u>

1. Sanitary Sewer Lines:

As per Texas Administrative Code (TAC), Title 30, Chapter 217.53 (d) and 290.44 (e)(4):

- Wherever possible, a collection system pipe must be located below a water supply pipe. If a collection system pipe cannot be located below a water supply pipe, the owner must justify in the engineering report why it is not possible to locate the collection system pipe below the public water supply pipe.
- Wherever possible, collection system pipes and manholes must be located at least nine feet from all water supply pipes. If a collection system pipe or manhole cannot be located at least nine feet away from a water supply pipe,

the owner must justify in the engineering report why it is not possible to provide at least nine feet of separation.

• Collection system pipes must be installed in trenches separate from water supply trenches.

If a collection system pipe cannot be located at least nine feet away from a water supply pipe:

	Wastewater Main above Drinking Water Line	Drinking Water Line above Wastewater Main
Parallel	Encase wastewater main in casing pipe, maintaining a minimum distance of 5 ft horizontally	Encase wastewater main in casing pipe, maintaining a minimum distance of 5 ft horizontally OR use pressure pipe for wastewater main*, maintaining a minimum distance of 2 ft vertically and 4 ft horizontally
Crossing	Water line to be perpendicular to wastewater main	Water line to be perpendicular to wastewater main
	AND	AND
	water line to be centered over wastewater main with joints at least 9 feet horizontally from the centerline of both crossing pipes	water line to be centered over wastewater main with joints at least 9 feet horizontally from the centerline of both crossing pipes
	AND	AND
	maintain at least 1 ft of vertical separation between water line and wastewater main AND	maintain at least 6 in of vertical separation, measured from outer surface of pressure pipe or casing (when casing is used) when
	One of the following options:	wastewater main is new and 2 ft when wastewater main is an existing non-pressure rated main
	 2. Use ductile iron or steel pipe 	AND
	for waterline with mechanical or welded joints as appropriate	The wastewater pipe shall have a minimum pipe stiffness of 115 psi at 5.0% deflection.*
	AND	AND
	 One of the following options: 1. Encase wastewater main 2. use pressure pipe for wastewater main 	The wastewater main shall be embedded in cement stabilized sand for the total length of one pipe segment plus 12 inches beyond the joint on each end.*
		AND
		One of the following additional requirements:*
		 Encase wastewater main use pressure pipe for wastewater

*: Exception - If an existing wastewater main is not disturbed and a PE determines that it is not leaking, the wastewater main does not have to improved.

Absolute minimum horizontal distance of a water supply line to a sanitary sewer manhole is five feet. Manhole within nine feet of a water supply pipe:

 Must have no measurable leakage during a leakage test conducted according to the requirements in Texas Administrative Code (TAC), Title 30, Chapter 217.58; or

Be encased in cement-stabilized sand

All distances in this section are measured from outside wall of the pipe or manhole.

Where pressure pipe is called for by the TAC, the sewer main/line pipe and gaskets shall have a minimum pressure rating of 150 psi.

- 2. Other Water Lines:
 - a. <u>Horizontal Separation:</u> If two or more water lines are located parallel to one another, a minimum horizontal clearance of 5 feet shall be required, as measured from the outermost edge of each line.
 - b. <u>Vertical Separation:</u> Where two water lines cross one another (e.g. at ring connections), the minimum vertical separation shall be 6 inches, as measured from the outermost edge of each line.
- 3. <u>Storm Drains and Franchise Utilities:</u>
 - a. <u>Horizontal Separation:</u> If a storm drain or underground franchise utility is located parallel to a proposed water line, a minimum horizontal clearance of 5 feet shall be required, as measured from the outside diameter of each line.
 - b. <u>Vertical Separation</u>: When a water line is proposed to cross a storm drain or underground franchise utility, the minimum vertical separation shall be 2 feet, as measured from the outermost edge of each line. When a water line is placed underneath a storm drain, one full water line joint (minimum 18 feet long) shall be centered on the storm drain. Provide a concrete cap which extends 4-feet beyond the outermost edge of the storm drain.
- 4. <u>Coordination with Permitting Authorities:</u> Where proposed water lines are required to be placed within easements or the right-of-way of a permitting authority (e.g. TxDOT or Railroad), the Engineer is responsible for adhering to the permitting requirements with such entity and shall coordinate that future expansions from the entity will not impact the proposed water line. Provide a copy of ALL coordination documents to the WUSD.

4.4. Water Line Sizing

A. Residential and Commercial:

Water line mains shall be a minimum of 8-inches, or larger, as directed by the WUSD. <u>Note:</u> A smaller water line may be permitted to loop a distribution system in order to avoid a dead end (Refer to *4.8 Dead-end Water Lines*).

B. Industrial:

Water lines shall be a minimum of 12-inches, or larger, as directed by the WUSD.

C. Standard Sizes:

New water transmission and distribution lines shall consist of the following diameters (in inches): 8, 12, 16, 24, 30, 36, and multiples of 6-inch thereafter.

D. System Expansions:

Depending upon the size of the proposed development or subdivision, and the capacity of the existing water distribution system, the City will require a water study be performed to determine if there is adequate supply to support the proposed water demand. At a minimum, all water lines must be sized in accordance with any approved master plan established for the area. If a master plan size is not available, the water line(s) size(s) shall be based on engineering analysis of initial and future demands of the area(s) to be served.

E. Water Demand Estimation:

Water transmission and distribution lines must be sized to meet the estimated maximum day flows plus fire flows, or peak hour flows, whichever is greater.

- 1. Average Day flow:
 - a. <u>General:</u> Average day (AD) flow is the total annual volume of water delivered to the water distribution system divided by the number of days in the year. Per the data contained within the *Waco Comprehensive Plan 2040*, the forecasted AD flow for the City of Waco is 235 gpcd (gallons/capita/day), not including wholesale customers.
 - b. <u>Per Zoning:</u> Refer to the following Table 4.4.1 for determining the minimum AD flow based on zoning.

Land Use⁵	Zoning	Average Day Flow (gpd)	
Rural Residential	R-E	200 per person	
Suburban Basidantial	R-1A	200 per person	
Suburban Residentia	Non-residential use	40 per 400 sf ¹	
Urban Regidential	R-1B, R-1C, R-2	180 per person	
Ofball Residential	Non-residential use	40 per 400 sf ¹	
Medium Density	R-2, R-3A, R-3B, R-3C	180 per person	
Residential	O-1, O-3	40 per 400 sf ¹	
Office Flex	Restaurants	15 per meal ²	
	O-1, O-2, O-3, C-1, C-2	40 per 400 sf ¹	
.Office Industrial Flex	Hospitals	450 per bed ³	
	M-1 ⁴	40 per 400 sf ¹	
	R-3C, R-3D, R-3E	180 per person	
	Non-residential use	40 mar 400 of	
Mixed Use Flex	O-1, O-2, O-3, C-1, C-2	40 per 400 SI	
	Hospitals	450 per bed ³	
	Restaurants	15 per meal ²	
Mixed Llee Core	R-3D, R-3E	180 per person	
	Non-residential use	40 per 400 sf ¹	

Table 4.4.1 Water Demand per Capita Based on Zoning

	O-2, C-2, C-4	
	Hospitals	450 per bed ³
	Restaurants	15 per meal ²
Industrial	M-2 ⁴	40 per 400 sf ¹
Institutional	O-2	50 per 400 sf ¹
Open Space	R-E	40 per 400 sf ¹

¹ Square footage (sf) equals building square footage x # of floors.

- ² Meals equals the number of meals served per day.
- ³ Beds equals the number of patient hospital beds.
- ⁴ Additional processes and maximum operating rate shall be incorporated in the water study/modeling.
- ⁵ Water demand rates for non-standard land use shall be approved by the city.
- c. <u>Persons per Residential Connection:</u>
 - i. Single Family: 2.7 per residence/service
 - ii. Multi-family: 2.5 per residence/service
- d. <u>Alternative Analysis:</u> The WUSD maintains a water use database. Developers or their engineers SHALL utilize City of Waco historical water use records to estimate proposed water demands. Use of comparative data sourcing shall be preapproved by WUSD.
- 2. Maximum Day flow:
 - a. <u>General:</u> Maximum day (MD) flow is the maximum quantity of water used on any day of the year. Per the *Waco Comprehensive Plan 2040*, the forecasted MD flow is 1.70 x (235 gpcd) = 400 gpcd, not including wholesale customers.
 - b. <u>Per Zoning</u>: To calculate the MD per zoning (Refer to Table 4.4.1), the calculated AD shall be multiplied by 2.25.
- 3. <u>Peak Hour flow:</u> Peak hour (PH) flow is the highest hourly rate of water use during the maximum day flow period. For PH flow, multiply the MD flow by 1.75.
- 4. <u>Fire Flow:</u> Fire flows vary depending on the land use types per current Fire Code requirements. Minimum fire flow requirements are as follows:
 - a. One and two-family dwellings and townhomes:
 - i. 1,000 gallons per minute (GPM) in one and two-family dwellings and townhomes for proposed dwellings smaller than 3,600 square feet.
 - ii. 1,500 GPM if dwelling's square footage is greater than 3,600 square feet.
 - iii. The minimum fire flow duration is 1 hour.
 - b. Other than one and two-family dwellings and townhomes:
 - i. 1,500 GPM minimum or per current International Fire Code requirements whichever is higher.
 - ii. The minimum fire flow duration is 2 hours.
 - F. Flow Velocity:

- 1. The velocity in a distribution line (< 16-inch) shall be maintained between 5 and 8 feet per second (fps) during the MD flow.
- 2. The velocity in a distribution line shall not exceed 6 fps during the AD flow.
- 3. The velocity in a distribution line shall not exceed 10 fps during the PH flow.
- 4. The velocity in a transmission main (> 16-inch) shall not exceed 4 fps during the MD flow.
- 5. Flow velocities shall not create a head loss greater than 1 foot/1000 feet using a Hazen-Williams C value coefficient of 100 for existing water lines and 120 for proposed water lines.

G. Working Pressure:

- 1. Normal working conditions: Design for 150 psi service. A minimum of 35 psi operating pressure at any point in the affected pressure zone using peak hour flow.
- 2. Emergency conditions: A minimum of 20 psi operating pressure at any point in the affected pressure zone using MD and fire flow(s).

H. Fire Lines:

- 1. Fire lines must be a minimum of one standard pipe size smaller than the size of the public line at the connection point.
- 2. Fire pumps are not allowed to connect directly to the public system, unless pre-approved by the WUSD, see APPENDIX F.

I. Surge Pressure:

1. The engineer shall include surge control measures to manage pressure due to water hammer that may exceed the design pressure of the water main.

4.5. Water Line Materials

Allowable water line materials, joints, and fittings shall be in accordance with the City's *Standard Specifications for Construction, Materials and Construction Methods, Section 4.7: Piping Materials*, and as follows:

A. Polyvinyl Chloride (PVC) Water Pipe:

- 1. <u>4-inch through 12-inch, AWWA C900:</u> DR18, default unless otherwise approved by the WUSD. (In service areas where the pressure is over 100 psi, DR14 is required).
- 2. <u>16-inch through 24-inch, AWWA C900:</u> Pressure rating to be specified by Design Engineer, 150 psi minimum, and approved by the WUSD.
- 3. <u>Greater than 24-inch</u>: Shall be approved by WUSD.
- 4. <u>Joints:</u> Gasketed or restrained gasket.

B. Ductile Iron (DI) Water Pipe:

4-inch through 60-inch shall conform to AWWA Standard C150 (ANSI A21.50) and AWWA Standard C151 (ANSI A21.51).

- 1. <u>4-inch through 12-inch:</u> Pressure Class 350
- 2. <u>16-inch:</u> Pressure Class 250

- 3. <u>24-inch:</u> Pressure Class 200
- 4. <u>30-inch through 64-inch:</u> As approved by the WUSD
- 5. Joints: As designated in the plans or bid proposal.
- a. Push-on (AWWA C111)
- b. Mechanical Joint (AWWA C111)
- c. Flanged Ends (AWWA C110)
- 6. Corrosion Protection:
 - a. All ductile iron pipe and fittings shall be wrapped with an 8 mils (0.008") thick polyethylene encasement tube (V-Bio® or approved equal) and secured with 2" wide, 10 mils (0.010") thick plastic backed adhesive tape (Polyken 900, Scotchwrap 50, or approved equal) in accordance with the Ductile Iron Pipe Research Association (DIPRA) MODIFIED "A" INSTALLATION.
 - b. A detailed study shall be performed by a certified corrosion specialist (not affiliated with a corrosion protection system supplier) to identify potential corrosion concerns in accordance with technical standards, test methods and recommended practices of NACE International, ASTM and AWWA. The corrosion study shall be prepared and submitted to the WUSD for acceptance. The corrosion protection system and monitoring recommendations are to be designed by a NACE International certified professional engineer with experience in corrosion engineering and incorporated into the construction plans and specifications.

C. High Density Polyethylene (HDPE) Pipe:

- 1. <u>1-inch through 3-inch, AWWA C901:</u> PE4710 Pressure Class 250, Ductile Iron Pipe Size (DIPS) DR9
- 2. 4-inch through 12-inch, AWWA C906: PE4710 Pressure Class 250, (DIPS) DR9
- 3. <u>16-inch through 24-inch, AWWA C906:</u> PE4710 Pressure Class 200, (DIPS) DR11, or as specified by Design Engineer and approved by the WUSD.
- 4. Joints: Butt heat fusion (ASTM F2620)
- 5. <u>HDPE flow capacity:</u> When HDPE water line is utilized, nominal sizing must be increased to meet minimum water line sizing requirements and to accommodate an equivalent flow capacity compared to PVC or DI pipe material.

D. Other:

Additional water line materials may be considered for use with large public transmission mains or trenchless rehabilitations. Materials may include: RCCP, Steel, FRP, CIPP, etc. Engineer shall coordinate the use of these water line materials and obtain use preapproval by the WUSD.

4.6. Embedment and Backfill Requirements for Water Lines

A. Embedment (or Pipe Bedding Material):

Embedment requirements for water lines shall meet the requirements for Type "A" backfill as defined in the City's *Standard Specifications for Construction, Materials and*

Construction Methods, Section 4.2, Part 2.A.2 and Part 2.A.3 and the City's Manual of Standard Details, Detail G-8.

- 1. <u>Standard:</u> Standard embedment is utilized in ALL areas, unless an alternative embedment is approved by the WUSD <u>AND</u> the City Engineer.
- 2. <u>Concrete Encasement:</u> Concrete Encasement is required in lieu of standard embedment at <u>ALL</u> utility crossings where the vertical separation distance is less than 2 feet and any other location shown on the construction drawings. Concrete encase the lower utility, unless otherwise approved by WUSD.
- 3. <u>Pea Gravel:</u> Pea gravel is <u>not</u> permitted.
- 4. <u>Flowable Fill:</u> Flowable fill may be utilized as an alternate to standard embedment. Flowable fill shall be excavatable cement stabilized sand or lean concrete with compressive strength of 150 to 200 psi. ALL utility pipe lines that are to be encased with flowable fill shall be encased with 8 mil polyethylene encasement. Request to utilize flowable fill shall be approved by the WUSD on a case by case basis.

B. Backfill:

Backfill requirements for water lines shall meet the requirements for Type "A" backfill as defined in the City's *Standard Specifications for Construction, Materials and Construction Methods, Section 4.2, Part 2.A.3* and the City's *Manual of Standard Details, Detail G-10.*

- 1. <u>Standard Trench:</u> Gravel backfill is required for <u>ALL</u> areas subject to the influence of traffic, including right-of-ways, alleyways and parking areas.
- 2. <u>Off-street Trench:</u> In areas not influenced by traffic, select fill may be used in lieu of Type "A" backfill.
- 3. <u>Excavated Material:</u> Native material which has been excavated may only be utilized as backfill should it meet City of Waco Standard Specifications for Construction, or if preapproved by the WUSD or City Engineer.

4.7. Connection to Existing Water Lines

A. Service Connections:

- 1. <u>Residential:</u> All service taps and meter installations must be performed under the direct supervision of a designated City WUSD inspector.
- 2. <u>Commercial:</u>
 - a. Water service taps must be installed under the direct supervision of a designated City WUSD inspector.
 - b. Water service connections are only allowed on public water lines that front the property being served.
 - c. Water service taps should be perpendicular to the public water line and not contain bends or deflections to the property line/meter.

B. Cut-in Tees:

1. Water system service interruptions shall be prescheduled with the City of Waco Engineering Department. Cut-in connections are to be made at any location where existing valves can be closed to isolate the connection point, while keeping as much of the surrounding system in service as possible. All affected water service customers must be notified a minimum of 48 hours prior to any service disruptions. Such notification shall be made by the contractor and should be in written form, on company letter head. Provide the City Inspector a copy of the notice for distribution preapproval a minimum of 24 hours prior to distribution. Connections to large diameter water lines or water lines deemed critical by the WUSD (near: schools, commercial areas, hospitals, etc.) may need to be test killed and/or scheduled for shut down with significant advance notice. The City of Waco will not be liable for project delays due to water system connection scheduling or shutdowns.

- 2. Existing gate valves that are required to be closed in order to isolate the connection to an existing water line shall be identified in the construction drawings.
- 3. If known, the size, depth, and pipe material of the existing water line shall be identified in the construction drawings.

C. Tapping Sleeves and Valves:

- 1. Tapping sleeves and valves are <u>NOT</u> allowed for public water line main connections. Cut-in tees and valves are required, except as detailed in 4.7.C.2.
- 2. Services Connections: Tapping sleeves and valves are allowed for 4-inch service taps if both sleeve and hardware are made of stainless steel (grade 304 or 316).
- 3. Steel cylinder water line connections require WUSD material and scheduling preapproval.

D. Extensions:

Any extensions or tangential connections to an existing water line shall identify both the existing and proposed pipe materials and include the type of connection, adapter and isolation kit, as required.

4.8. Subsurface Utility Engineering (SUE):

SUE services, performed in accordance with ASCE 38-02, Standard Guideline for the Collection and Depiction of Existing Subsurface Utility Data, shall be utilized during the design phase as follows:

a. <u>Quality Level D:</u> All existing public infrastructure.

"Quality Level D. QL-D is the most basic level of information for utility locations. It comes solely from existing utility records or verbal recollections, both typically unreliable sources. It may provide an overall "feel" for the congestion of utilities, but is often highly limited in terms of comprehensiveness and accuracy. QL-D is useful primarily for project planning and route selection activities."

b. <u>Quality Level C:</u> All existing public utilities.

"Quality Level C. QL-C is probably the most commonly used level of information. It involves surveying visible utility facilities (e.g., manholes, valve boxes, etc.) and correlating this information with existing utility records (QL-D information). When using this information, it is not unusual to find that many underground utilities have been either omitted or erroneously plotted. Its usefulness, therefore, is primarily on rural projects where utilities are not prevalent, or are not too expensive to repair or relocate."

c. <u>Quality Level B:</u> All existing franchise utilities, or as deemed necessary by the Engineer.

"Quality Level B. QL-B involves the application of appropriate surface geophysical methods to determine the existence and horizontal position of virtually all utilities within the project limits. This activity is called "designating". The information obtained in this manner is surveyed to project control. It addresses problems caused by inaccurate utility records, abandoned or unrecorded facilities, and lost references. The proper selection and application of surface geophysical techniques for achieving QL-B data is critical. Information provided by QL-B can enable the accomplishment of preliminary engineering goals. Decisions regarding location of storm drainage systems, footers, foundations and other design features can be made to successfully avoid conflicts with existing utilities. Slight adjustments in design can produce substantial cost savings by eliminating utility relocations."

d. <u>Quality Level A:</u> All existing utilities 16-inch and larger, or any utility as deemed necessary by the Engineer, City Engineer, or WUSD.

"Quality Level A. QL-A, also known as "locating", is the highest level of accuracy presently available and involves the full use of the subsurface utility engineering services. It provides information for the precise plan and profile mapping of underground utilities through the nondestructive exposure of underground utilities, and also provides the type, size, condition, material and other characteristics of underground features."

4.9. Dead-end Water Lines

- A. Dead-end water lines shall be avoided since they are known to cause taste, odor and low chlorine residual problems, and require flushing and maintenance. A temporary dead-end water line may only be proposed where the looped or interconnected system is part of a documented future phase.
- B. In order to avoid dead-end water lines within residential areas, the City may allow two standard sized water lines to be looped via a line smaller than the minimum requirement (e.g. 2-inch). ALL nonstandard loop designs shall be approved via a variance request. Smaller diameter loops are not permitted in industrial or commercial areas.
- C. The design of a phased water distribution system within the limits of a development should include the opportunity for future looping or interconnects for any approved or proposed dead-end line.
- D. All approved dead-end water lines must include an automatic flushing valve in accordance with the City's *Manual of Standard Details, Detail W-26.*

4.10. Fire Hydrants

A. Public Fire Hydrants:

1. Fire hydrants shall be designed in accordance with the City's *Standard Specifications for Construction* and *Manual of Standard Details.*

- 2. Public fire hydrants shall be painted green and gold to differentiate from private hydrants.
- 3. Fire hydrants must be located within a public right-of-way or a public water line easement.
- 4. Fire hydrants shall be located between 2'-6" (min.) and 7'-6" (max.) from the back of curbs. Where no curb is present, the min. distance shall be 4'-6". Where a roadside ditch is present, the fire hydrant shall be placed a min. of 2'-0" from the top of bank (backside of ditch).
- 5. Clear Space:
 - a. A minimum clear space of 36-inches shall be maintained around the circumference of fire hydrants.
 - b. A minimum clear space of not less than 60-inches shall be provided in front of the fire hydrant pumper outlet.
- 6. Fire hydrants shall be located primarily at the curb return of intersections, where practical, and as to not interfere with ADA ramps. Where a mid-block fire hydrant is required, the fire hydrant shall be located along the projection of a property line.
- 7. <u>Fire Hydrant Spacing and Separation</u>: The following design criteria shall be utilized for fire hydrant locations within the City of Waco:
 - a. <u>One and Two-Family Residences:</u> For all one and two-family residences, fire hydrants must be installed with a maximum spacing of 500 ft., with no more than 300 ft. hose length along the most direct route considering all physical impediments.
 - b. <u>Other Land Uses</u>: For all other land uses, fire hydrants must be installed within 400 ft. (hose length) of each portion of a facility or building. <u>Exception</u>: If the building is fully sprinklered, the hose lay length may be 600 ft. Refer to the *International Fire Code* for access road and spacing requirements.
 - c. <u>Cul-de-sacs</u>: Streets longer than 200 feet that end in a cul-de-sac, must have a fire hydrant in the cul-de-sac. When the cul-de-sac is less than 200 feet from the center of the connecting street intersection, a fire hydrant at the connecting street intersection is acceptable, if located at the curb return of the cul-de-sac street.

B. Private Fire Hydrants:

- 1. Private fire hydrants shall be designed and tested in accordance with the latest adopted *International Fire Code*, NFPA guidelines and approved by the City of Waco Fire Services (254) 750-1740.
- 2. Private fire hydrants must be located on private property.
- 3. Private fire hydrants shall be painted RED to differentiate from public fire hydrants.

4.11. Gate Valves

A. <u>Sizes:</u>

Valves up to 24-inch shall be *vertical* resilient seated gate valves. Valves greater than 24-inch shall be approved by the WUSD.

B. <u>Spacing:</u>

Spacing between gate valves on 12-inch or smaller water lines shall be a maximum of 1,000 feet. Spacing between valves for water lines 16-inch and larger shall be a maximum of 2,000 feet.

C. Locations:

- 1. Valves shall generally be located prior to or just outside of street intersections at projected, transverse right-of-way lines.
- 2. Intermediate valves, not located on the projection of a right-of-way line, shall be located on lot lines or 5 feet from fire hydrants, but not located within drive entrances.
- 3. The **minimum** total number of valves at any water line intersection should equal one less than the number of legs at the intersection (e.g. 1 tee = 3 legs = 2 valves, minimum).
- 4. Proposed connections to existing water lines shall have an isolation valve placed on the new line near the connection. Valves located near reducers shall be located on the larger diameter water line.
- 5. Valves may not be placed within accessible ramps or within a curb line.
- 6. Valves boxes located outside of paved areas and valve boxes within asphalt paving shall include a concrete collar in accordance with the City's *Manual of Standard Details, Detail W-6.*
- 7. Valves located more than 10 feet from a paved area shall include a delineator post in accordance with the City's *Manual of Standard Details, Detail G-12*.
- 8. Where intersections contain four connected water lines, via two tees, an isolation valve shall be located between the two tees (e.g. 2 tees = 4 legs = 4 valves, minimum).
- 9. Additional valves will be required to ensure dual services to facilities deemed critical by the WUSD. (e.g. schools, hospitals, industrial facilities, etc. will require in-line valves on each side of a domestic and fire service)
- 10. Additional valves may be required to facilitate utility construction and prevent extended customer outages.

D. Orientation/Operation:

- 1. All valves shall be installed in the vertical direction.
- 2. Valves must be placed perpendicular to the existing/proposed ground elevation.
- 3. ALL valves shall open to the left (counter-clockwise).

E. Ring Connections:

Ring connections and valves should be provided for water lines 16-inch and larger in accordance with the City's *Manual of Standard Details, Detail W-5.*

4.12. Air Release Valves

All Air Release Valves shall be Combination Air Valves that are designed to serve the function of Air Release and Air/Vacuum Valves.

A. <u>Size:</u>

Air Release Valves shall be sized in accordance with the current edition of the *AWWA Manual M51*. Refer to the following Table 4.11.1 for the <u>minimum</u> allowable sizes.

Water Line Size	Min. Air Release Size	Air Release Type
≤ 16-inch	2-inch	Single Body
24-inch to 30-inch	4-inch	Dual Body
36-inch to 42-inch	6-inch	Dual Body
≥ 48-inch	8-inch	Dual Body

Table 4.11.1 Combination Air Release Valves

B. Location:

At the high points of all 16-inch and greater water lines and additional locations as determined by the design Engineer or the WUSD.

- 1. Off-street: In accordance with the City's Manual of Standard Details, Detail W-22.
- 2. In-street: In accordance with the City's Manual of Standard Details, Detail W-23.
- 3. Air release valves located more than 10 feet from a paved area shall include a delineator post in accordance with the City's *Manual of Standard Details, Detail G-12*.
- 4. All air release valve standpipes shall terminate at least 2 feet above the 100 year floodplain.

4.13. Blow-off Assemblies

Blow-off valve assemblies are required at the low points of 16-inch and greater water transmission lines in accordance with the City's *Manual of Standard Details, Detail W-27A, W-27B, W-28A and W-28B*.

<u>Note</u>: If site conditions require the blow-off enclosure to be a vault, it shall be designed as a water-containment vault with watertight hatch. Blow-off assemblies located more than 10 feet from a paved area shall include a delineator post in accordance with the City's *Manual of Standard Details, Detail G-12*.

A. <u>Size:</u>

- 1. \leq 24-inch water line (6" valve)
- 2. > 24-inch water line (8" valve), or as otherwise directed by the WUSD.

4.14. Water Sampling Stations

Public water sampling stations may be required at designated locations by the WUSD in order to test and assure water quality requirements. Water sampling stations located more than 10 feet from a paved area shall include a delineator post in accordance with the City's *Manual of Standard Details, Detail G-12*.

4.15. Fire Lines, Service Lines and Water Meter Requirements

A. Fire Lines:

- 1. All fire lines are required, at a minimum, to have a double detector check assembly. The double detector check assembly and vault, if applicable, shall be located on private property at the property line and within 150 feet of the fire system stand pipe. Alternatively, the check assembly can be in a building if the building is within 150 ft of the water main.
- 2. Fire lines are considered Private after the fire line valve located at the public main, the fire line shall be owned and maintained in good working condition by the property owner.
- 3. Fire lines shall be aligned straight and perpendicular to the water distribution line and should avoid conflicts with existing/proposed utilities.
- 4. No horizontal bending of fire lines is allowed within public right-of-way.
- 5. Fire lines shall not contain branches or tees prior to the backflow assembly.
- 6. Fire lines ≥8-inch shall be profiled to ensure adequate separation from other utilities.
- 7. Fire lines shall not provide domestic water service.

B. <u>Service Lines:</u>

- 1. Service lines from the distribution line tap to the meter must be located within public right-of-way or a public water line easement and shall be owned and maintained by the City.
- 2. Service lines from the meter to the point of use are considered Private and shall be owned and maintained in good working condition by the property owner.
- 3. Service lines shall be aligned straight and perpendicular to the water distribution line and should avoid conflicts with existing/proposed utilities.
- 4. No horizontal bending or splicing of service lines is allowed.
- 5. Services within cul-de-sacs shall be placed perpendicular to the water line, unless otherwise approved by the WUSD.
- 6. Domestic water service taps shall not be shared, split, or bullheaded unless for irrigation to serve the same lot, unless the owner seeks a variance and is approved by WUSD.
- 7. Factory service taps shall have a minimum of 18 inches of separation between fittings.
- Service lines ≥ 8-inch should be profiled to ensure adequate separation from other utilities.
- Water line services that traverse a TxDOT roadway shall be installed within a casing pipe. Service lines 2" and smaller shall be installed in an approved 4-inch casing pipe.
- 10. Service lines crossing under a utility (single or multiple barrel) that are >36-inches wide shall be installed within a casing pipe. Service lines 2" and smaller shall be installed in an approved 4-inch casing pipe.
 - C. <u>Typical Residential Service Lines and Water Meters:</u>

- 1. The minimum size water service line for new residential development shall be 1-inch.
- 2. All water services shall be located in the middle two thirds of the lot being served.
- 3. Water meters and boxes shall be located within public right-of-way or a public water line easement and shall be owned and maintained by the City.
- 4. Water meters shall be located outside of existing and proposed paving improvements (e.g. driveways, sidewalks, and ramps).
- 5. Water services should be in accordance with the City's *Manual of Standard Details, Detail W-9.*

D. Commercial and Large Residential Service Lines and Water Meters:

- 1. The minimum size water service line shall be 2-inch.
- 2. 2-inch service lines may be bullheaded to serve both domestic and sprinkler service to a <u>single</u> lot.
- 3. Water meters and boxes shall be located within public right-of-way or a public water line easement and shall be owned and maintained by the City.
- 4. Water meters shall be located outside of existing and proposed paving improvements (e.g. driveways, sidewalks, and ramps). Vaults within traffic areas are not allowed.
- 5. Water services should be in accordance with the City's *Manual of Standard Details, Detail W-12*.

E. Boxes and Vaults:

- 6. Meters up to $1 \frac{1}{2}$ " shall be placed within an approved meter box.
- 7. 2-inch and larger water meters shall be installed in a concrete vault in accordance with the City's *Manual of Standard Details, Detail W-19 and W20.*
- 8. 2-inch and larger water meters shall include a lockable bypass line.
- 9. Water meters and vaults shall be located within public right-of-way or a public water line easement and shall be owned and maintained by the City.
- 10. Water meter vaults should be located outside of existing and proposed paving improvements (e.g. driveways, sidewalks, and ramps). Vaults within traffic areas are not allowed.

F. Sub-metering Requirements:

- 11. Owners shall comply with private sub-metering requirements established by TCEQ and *Plumbing Code* requirements
- 12. Water service to a single lot that has multi-unit facilities, including condominiums, apartments, manufactured home rental communities, and multiple use facilities, may be provided through a master meter or may be a group of manifolded individual meters.
 - a. Sub-meters and plumbing after the master meter will be installed and maintained at the customer's expense.
 - b. Sub-meters must conform to current AWWA Standard C700.

4.16. Pressure Reducing Valves

A. Public System:

Pressure Reducing Valve (PRV) assemblies are NOT permitted.

B. Private System:

In areas where service pressures may exceed 80 psi, property owners shall provide for private pressure reducing devices to be installed in accordance with the City's currently adopted *Plumbing Code*. All private PRV's shall be located on private property and shall be maintained by the customer.

4.17. Backflow Protection

A. <u>General</u>

In order to protect the health, safety, and welfare of the general public, all connections to the City's potable water system that have a *potential* for contaminating or polluting the potable water system shall include the installation, maintenance, and operation of a privately owned, City approved, backflow prevention device that meets the requirements set forth by the current adopted *Plumbing Code* and *City Code of Ordinances, Chapter 26 - Utilities, Article VII. - Cross Connection [Backflow] Protection.*

B. Circumstances Requiring Backflow Protection:

- 1. When the nature and extent of any activity at a premise, the materials used in connection with any activity at a premise, or materials stored at a premise could contaminate or pollute the potable water supply.
- 2. When a premise has one or more cross connections and the cross connections are protected by an atmospheric vacuum breaker device (AVB).
- 3. When internal cross connections are present that are not correctable.
- 4. When intricate plumbing arrangements are present which make it impractical to ascertain whether cross connections exist.
- 5. When there is unduly restricted entry so that inspections for cross connections cannot be made with sufficient frequency to ensure that cross connections do not exist.
- 6. When the installation of an approved backflow prevention assembly is deemed to be necessary to accomplish the purpose of these regulations in the judgment of the City.
- 7. When an appropriate cross connection survey report form has not been filed with the City's WUSD upon request of the City.
- 8. When a fire suppression system is connected to the City's water system.
- 9. All new construction, if deemed necessary by the City during the customer service inspection. The type of assembly required will be determined by the degree of potential hazard.
- 10. Any used water return system.
- 11. When a point-of-use assembly has not had the testing or repair done as required by this article, a premises isolation assembly will be required.

- 12. When it is determined that additions or alterations have been made to the plumbing system without obtaining proper permits, premises isolation may be required.
- 13. All multistory buildings or any building with a booster pump or elevated storage tank.
- 14. When retrofitting will be required on all high hazard connections and wherever else the City deems necessary to retrofit.
- 15. Where the potable water system is connected to any auxiliary supply.
- 16. When any premise has multiple service connections.

C. Backflow Prevention Requirements:

- 1. Assemblies shall be located on private property, as close to the City's meter as possible.
- 2. Assemblies shall be installed at a location approved by the City.
- 3. Assemblies shall be of a type and model approved by the City.
- 4. Assemblies shall not include bypass lines or fittings that could be used for circumventing the device or any other activity.
- 5. All facilities that require continuous, uninterrupted water service and are required to have a backflow assembly must make provisions for the parallel installation of assemblies of the same type so that device testing, repair, and maintenance can be performed without interruption of service.
- 6. Initial certified test results are to be filed with the City.

4.18. Cathodic Protection

If water line materials other than PVC, HDPE, or FRP are utilized, the City will require a cathodic protection analysis be performed by a corrosion protection specialist. In the event the analysis indicates that corrosion protection of the proposed utility is warranted, construction plans and specifications shall include corrosion protection provisions that are sealed by a licensed Texas engineer that is qualified to perform corrosion protection work. All metallic fittings shall be wrapped in poly encasement in accordance with City of Waco Standard Specifications for Construction.

4.19. Removal and Abandonment of Water Lines and Appurtenances

A. <u>Removal:</u>

- 1. Existing water lines and appurtenances shall be removed and properly disposed of or salvaged if a proposed water line is within 3' of the existing line or if the existing line is within the trench excavation of the new utility.
- 2. Existing water lines shall be removed if in conflict with any proposed improvements.
- 3. In the event that removal of an existing water line or appurtenance creates a temporary disruption in service that lasts longer than eight (8) hours, provisions to provide temporary water service to each affected customer shall be provided.
- 4. Water line appurtenances are to be removed and/or salvaged as follows:

- a. Gate Valves: Remove and salvage (deliver to City).
- b. Fire Hydrants: Remove and salvage (deliver to City).
- c. <u>Vaults:</u>
 - i. Remove and salvage vault lid and valves (deliver to City)
 - ii. Remove and properly dispose of piping and other materials.
 - iii. Demolish, remove, and dispose of the entire vault. Backfill and compact in accordance with the City's *Manual of Standard Details, Detail G-8.*
- 5. Service Taps:
 - a. All existing service taps 1-inch and smaller that are no longer required shall be removed from the water main and the main shall be clamped with an approved stainless steel repair clamp.
 - b. All service taps larger than 1" shall be cut and capped just beyond the isolation valve. Valve boxes shall be removed.

B. Abandonment:

- 1. <u>Existing water lines ≤ 6-inch</u>: Lines to be abandoned in place shall be drained and plugged at all cut and removal locations.
- 2. <u>Existing water lines ≥ 8-inch</u>: Lines to be abandoned in place shall be drained, grouted with flowable fill, and plugged at all cut and removal locations.
- 3. In the event that the abandonment of an existing water line creates a temporary disruption in service that lasts longer than eight (8) hours, provisions to provide temporary water service to each affected customer shall be provided.
- 4. Existing water vaults to be abandoned:
 - a. Remove and salvage vault lid and valves (deliver to City).
 - b. Remove and dispose of piping and other materials and properly dispose.

C. Pressure Caps:

Pressure caps (with blocking) shall be placed at the termination of water lines that are to remain in service.

4.20. Water Line Crossings

A. General:

- 1. Steel Casing:
 - a. Casing shall extend a minimum of 4 feet beyond either side of the conflict.
 - b. At a minimum, casing pipe nominal diameter shall be 12-inches larger than carrier pipe nominal diameter.
 - c. Carrier pipe (water line) shall be restrained joint.
 - d. Casing pipe shall include approved end seals at each end of casing pipe.
 - e. Minimum casing thickness shall be per City's *Manual of Standard Details, Detail W-32*.

f. Metallic casing pipe shall be fully welded and water tight to 150 psi.

B. <u>Texas Department of Transportation (TxDOT) Crossings:</u>

- 1. The design of water lines under or along TxDOT right-of-way must be in compliance with all applicable TxDOT requirements and in accordance with *Texas Administrative Code (TAC), Title 43, Part 1, Chapter 21, Subchapter C: Utility Accommodation.*
- 2. Prior to construction, an approved *TxDOT Utility Installation Permit* must be obtained.
 - a. Engineer of Record shall coordinate with TxDOT and prepare required exhibits.
 - b. City shall file Utility Permit w/TxDOT or provide Engineer of Record with access to file on City's behalf.
- 3. Location:
 - a. Water lines shall be located to avoid or minimize the impact of known future highway projects and improvements.
 - b. Longitudinal installations, if allowed, shall be located on uniform alignments to the right-of-way line and provide space for future highway construction and possible future utility facility installations.
 - c. New water lines crossing a highway shall be installed at approximately 90° to the centerline of the highway.
 - d. All new water lines proposed to cross TxDOT right-of-way shall be installed by boring or tunneling and encased in steel casing pipe from right-of-way to right-of-way. Boring shall be per TxDOT's requirements and the City's *Manual of Standard Details, Detail W-31*.
 - e. All new water line crossings shall include a valve on each side of the highway crossing. No services shall be allowed between the two valves.
 - f. Customer service meters must be placed outside the limits of TxDOT right-ofway and within a public easement. Refer to *Section 3 Easement Requirements*.

C. Railroad Crossings:

- 1. The design of water lines within railroad right-of-way must be in accordance with the requirements of the railroad. The Engineer should obtain the railroad's utility accommodation policies prior to beginning design. These include, but are not limited to, insurance and licensing agreement requirements.
- 2. Prior to construction, an approved railroad crossing Permit or License Agreement must be obtained.
- 3. New water lines crossing a railroad shall be installed at approximately 90° to the centerline of the railroad.
- 4. All new water lines proposed to cross railroad right-of-way shall be designed in accordance with the latest addition of the *American Railway Engineering & Maintenance Association's (AREMA's)* guidelines.
- 5. All new water lines proposed to cross railroad right-of-way shall be installed by boring and shall be encased in steel casing pipe from right-of-way to right-of-way. Boring shall be per railroad requirements and the City's *Manual of Standard Details, Detail W-30*.

6. All new water line crossings shall include a valve on each side of the railroad crossing, outside of the limits of the right-of-way. No services shall be allowed between the two valves.

D. River, Stream and Lake Crossings:

The crossing of rivers, streams, lakes, and other bodies of water is discouraged and must be approved by the WUSD. When there is no other reasonable alternative, crossings shall meet jurisdictional determination and permitting requirements in accordance with the United States Army Corps of Engineers and other regulatory agencies.

1. <u>Trenchless Installation:</u>

- a. Where water lines are proposed under any flowing stream or semi-permanent body of water, such as a marsh or pond, the water line shall be installed in a separate watertight casing pipe and installed with valves on each side of the crossing to allow for isolation and testing of that portion of the water line to determine if there are any leaks in accordance with *Texas Administrative Code* (*TAC*), *Title 30, Chapter 290, Subchapter D, Chapter 290.44(f)(2).*
- b. All new water lines proposed to cross under any existing channel or body of water shall be installed by bore and encased in casing pipe. Bore shall be per the City's *Manual of Standard Details, Detail W-31*.
- 2. <u>Open Cut Installation:</u> Open cut installation shall be avoided. If boring is not practical, open cut installation shall be as approved by the WUSD and in accordance with the United States Army Corps of Engineers and other regulatory agency requirements.
- 3. All new water line crossings shall include a valve on each side of the body of water. No services shall be allowed between the two valves.

E. Elevated Crossings:

Elevated crossings for water lines are NOT permitted.

4.21. Water Line Detection

A. Tracer Wire:

ALL water line shall be installed with approved tracer wire in accordance with City of Waco Standard Specifications for Construction and Manual of Standard Details. Tracer wire shall be a minimum of #12 AWG, solid wire, with blue coating and shall terminate in an approved tracer wire box. Wire termination in valve boxes will not be permitted.

B. <u>Detection Tape:</u>

ALL water line shall be installed with approved detection tape in accordance with City of Waco Standard Specifications for Construction and the Manual of Standard Details.