

**CITY OF TUCSON, WATER DEPARTMENT
DESIGN STANDARD NO. 8-08
WATER PIPELINE DESIGN STANDARDS**

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8-08.2.0	Water Pipeline Design Requirements
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8-08.0.0 WATER PIPELINE DESIGN STANDARDS

8-08.1.0 General

1.1 Purpose

This section describes the design standards and requirements for public water pipeline projects.

1.2 Definitions

Section 8-18 contains a list of definitions, abbreviations, and acronyms.

1.3 Applicability

The design standards and requirements listed herein apply to and are applicable to all projects including potable (drinking water), nonpotable (reclaimed water), system modification (other public agency), and developer-financed.

8-08.2.0 Water Pipeline Design Requirements

The requirements described below are based, in part, on ADEQ Engineering Bulletin No. 10, Chapter 7, Distribution Systems.

This subsection contains the following major topics:

- Pipeline Pressure Rating
- Detailed Pipeline Design
- Anchorage
- Utility Separation Requirements
- Crossing Requirements

2.1 Pipeline Pressure Rating

A. Water Pressure Zones

All water pipelines in a water service area with a single or double water pressure zone shall be designed for a minimum internal pressure of 200 pounds per square inch. This includes appropriate allowances for water hammer, which is 40% of the operating pressure in the water service area.

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B. Higher Pressure Zones

In water service areas that may experience water pressures higher than described in paragraph A, i.e., if a water service area experiences water pressure of 170 pounds per square inch, the allowance for water hammer would be 40% or 68 pounds per square inch which would require a pipe of a minimum rating of 238 pounds per square inch.

2.2 Detailed Pipeline Design

This subsection contains the following major topics:

- Material Selection Considerations
- Pipeline Location
- Pipeline Location and Length
- Development Boundary
- Looped Connection
- Pipeline Depth
- Grade Breaks and Horizontal Deflections
- Transmission Main Tees
- Abandoned Mains
- Thermal Contraction/Expansion of Pipelines

A. Material Selection Considerations

Selection of pipeline material for a particular use shall include the following considerations:

- Tucson Water's approved material list. Refer to the Tucson Water Standard Specifications and Details.
- Ability of the material to withstand internal loads (pressures), temperatures (reclaimed water), and external loads
- Ease of installation of the material
- Resistance to corrosion of the material
- Availability of the material
- Durability of the material
- Water industry application and experience with the material
- Compatibility of material with backfill and bedding materials
- Ease of tapping the material for service connections

B. Pipeline Location

1. Standard Location

Water pipelines shall be ten feet south or west of right of way centerline, or in a dedicated utility corridor where possible.

2. Utility Coordinator Location

Water pipelines located in a right of way shall be designed in the location authorized by the applicable city or county utility coordinator, unless the location is precluded by the existence of other extenuating circumstances.

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3. Location Considerations

Pipeline location shall include the following considerations:

- Paving moratoriums
- Utility congestion
- Geotechnical data
- Native plant vegetation and undisturbed areas
- Environmental clearance (archaeology, endangered species)
- Service interruptions
- Traffic disturbance
- Future operations and maintenance working space
- Constructibility
- Future development

C. Pipeline Location and Length

All water pipeline extensions shall be installed in the adjacent street, alley, or easement, the entire length of the property to be served.

D. Development Boundary

The developer's engineer will design water pipelines, service connections, valves, fittings, and appurtenances within the boundary and the streets bounding the development.

E. Looped Connection

The developer shall design and construct all offsite water pipelines as necessary to complete a looped connection to existing mains and provide the required water flows to the development.

F. Pipeline Depth

Sufficient cover, distance from top of pipe to final grade, is necessary to give protection against traffic live and dead loads and provide anchorage for normal sections of straight pipe.

1. Minimum Depth

- a. The depth of cover to the top of the pipe shall not be less than forty-four inches unless adequate structural protection is provided and justified by the design engineer, and approved by Tucson Water. If the design engineer directs that more cover is needed, it shall be noted on the plans.
- b. Within a non-final grade right of way such as in undeveloped areas, mains shall be installed with a minimum of sixty inches of cover from the existing grade which shall also be noted and shown on the profile plans.
- c. Final grade shall be defined as an existing or proposed roadway that includes permanent curbs.
- d. All transmission mains (sixteen-inch or larger) shall have a minimum of sixty inches of cover from final grade.

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2. Calculated Depth

Under certain conditions and pipe materials, the depth of cover must be calculated to provide distribution of external stress from superimposed loads. These include static and dynamic forces.

- Static forces may include overlying material, such as earth fill and the weight of traffic over a deeply buried pipeline.

- Dynamic forces may include traffic impact loads due to moving vehicles on highways and railways.

G. Grade Breaks and Horizontal Deflections

1. PVC Pipe

Grade breaks and horizontal deflection in PVC pipe design is not permissible at joints. PVC pipe design deflections shall be accomplished in the pipe longitudinal bending in accordance with the manufacturer's recommendations. Otherwise, fittings shall be used for grade breaks or horizontal deflections.

2. Ductile Iron Pipe

Grade breaks and horizontal deflection in ductile iron pipe design may be accomplished at joints. Pipe design deflections shall be in accordance with the manufacturer's recommendations. Otherwise, fittings shall be used for breaks or deflections.

H. Transmission Main Tees

Tees in a transmission main are provided to permit distribution system lateral tie-ins to parallel or crossing mains. Tees in a transmission main normally shall be no closer together than 1,320 feet, unless approved by Tucson Water. See also Section 8-04.

There shall be the smallest number of tees consistent with providing a proper water source to that portion of the distribution system served as defined in standard 8-06, Water Source Minimums.

The smallest tee in a transmission main shall be six-inches in diameter. The smallest tee for air relief valve and drain valve appurtenances may be a minimum of four-inches in diameter, with Tucson Water approval.

I. Abandoned Mains

Mains intended to be taken out of service due to the design of new mains will be left in place and are considered abandoned mains (see Tucson Water SD-350, System Abandonment).

If removal or grout filling of abandoned mains is required by the agency having jurisdictional authority over the right-of-way, removal shall be in accordance with Tucson Water Standard Specification

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Section 0204. Grout filling will be in accordance with the requirements of jurisdictional authority.

J. Thermal Contraction/Expansion of Pipelines

In certain fixed and rigid pipeline circumstances, the design engineer shall consider thermal movement of pipeline materials, and provide provisions in the pipeline design to compensate for thermal contraction and expansion.

2.3 Anchorage

Because an internal thrust force occurs in a pipeline under pressure and acts to separate the joints of the pipe, an external force is required to counteract this force. This counter force is called anchorage.

Sections of straight pipe are usually not a concern because anchorage is provided by the soil around the pipe, which keeps the axis of the pipe aligned from section to section. Pipe hung on bridges is anchored by straps to keep it in place.

Changes in direction of flow and changes in velocity of the water require additional anchorage. This occurs at bends, tees, valves being closed, pumps turning off or on, reducers, closed valves and dead-ends.

This subsection contains the following major topics:

- New Pipeline Design/Construction
- Existing Pipeline Modification/Construction
- Thrust Blocks
- Anchor Blocks Design Requirements
- Restrained Joint Length Requirements

A. New Pipeline Design/Construction

1. For new pipe, tension joints shall be used in place of thrust and anchor blocks where required.
2. A pipe with tension joints, usually referred to as restrained joints, normally does not need additional forms of anchorage. A qualified engineer shall provide design requirements, not the contractor nor the inspector.

B. Existing Pipeline Modification/Construction

1. Generally, the use of thrust blocks is not permissible.
2. In the event thrust and anchor blocks are unavoidable, placement of the blocks must not cover or encase the fitting or pipe joints. Joints and end caps must remain functional.
3. A qualified engineer, not the contractor nor the inspector, shall make the determination of whether or not a given section of

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existing pipeline that is to be modified needs thrust blocks or other means of anchorage. If the design engineer directs that it is needed, it shall be noted on the plans, or in a contract supplemental agreement.

C. Thrust Blocks

A thrust block transfers force from the fitting to a wider load bearing soil surface and is used to counteract downward vertical thrusts and horizontal thrusts, but not for upward thrusts. In the event thrust and anchor blocks are unavoidable:

1. Tucson Water SD-610, Concrete Thrust Blocking. The information furnished in Tucson Water SD-610, Concrete Thrust Blocking, Tucson Water Standard Specifications and Details, is based on very limited design parameters and these are listed in the detail.
2. Variances from Tucson Water SD-610. When project specific conditions vary from the design parameters listed in Tucson Water SD-610, such as when the pressure may exceed 200 pounds per square inch (including surges) or when the pipe is larger than twelve inch, additional information and calculations are needed. In such a case, the practices found in the Manual of Water Supply Practices – M9, Concrete Pressure Pipe, by the American Water Works Association, shall be followed.
3. Allowable Soil Bearing Capacity. The allowable bearing capacity is taken as the ultimate bearing capacity divided by a safety factor against shear failure or excessive settlement.
4. Factor of Safety. The factor of safety is 2.0 for cohesion-less soils (sands), 3.0 for cohesive soils (clays).
5. Undisturbed Soil. When approved by Tucson Water, thrust block designs of sufficient size to reduce the pressure on the soil to the allowable bearing capacity of the undisturbed soil shall be provided to resist downward vertical thrust and horizontal thrusts.
6. Disturbed Soil. In the event of disturbed soils, an aggregate base course backfill material and compaction complying with Standard Specifications for Public Improvements, most current Edition, City of Tucson/Pima Co., Section 303 shall be provided to resist vertical and horizontal thrusts. A qualified engineer, not the contractor nor the inspector, shall determine this.

D. Anchor Blocks Design Requirements

1. For upward vertical thrusts, anchor blocks are needed at valves and vertical direction changes.
2. Anchor blocks may be needed on slopes that exceed twenty degrees since pipelines have a tendency to creep downhill.

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3. When using weight calculations, the weight of the anchor block shall be considered as submerged (i.e., buoyant) due to a leak.
4. Tie bars are used to connect the anchor block to the fitting or pipe. The diameter of tie bars placed against the fitting or pipe should be large enough to prevent point loading on the fitting or pipe.
5. The concrete surface of the anchor block placed against the fitting or pipe should be large enough to prevent point loading.

E. Restrained Joint Length Requirements

A restrained joint is a tension joint that provides the force required counteracting internal thrust forces.

1. Tucson Water SD-600, Restrained Joints. Designers of small pipe, less than twelve inches, may utilize Tucson Water SD-600, Restrained Joints, rather than provide design lengths.

The information furnished in Tucson Water SD-600, Restrained Joints, Tucson Water Standard Specifications and Details, is based on design parameters listed in the detail.

2. Variances from Tucson Water SD-600

When project specific conditions vary from the design parameters listed in Tucson Water SD-600, such as when the pressure may exceed 200 pounds per square inch (including surges), or when the pipe is larger than twelve inches, additional information and calculations shall be provided.

In such a case, the restrained joint length design practices found in the specific pipe material manuals, i.e., Manual of Water Supply Practices – M9, Concrete Pressure Pipe, by the American Water Works Association for concrete pipe, or DIPRA and M41 for ductile iron pipe, or another method approved by industry standards, shall be followed.

3. Allowable Soil Friction Resistance

- a. Allowable friction resistance between soil and the pipe is taken as the ultimate friction resistance divided by a safety factor.
- b. The factor of safety is 2.0 for cohesion-less soils (sands), 3.0 for cohesive soils (clays).
- c. The restrained joint length shall be sufficient to reduce the friction to the allowable soil friction resistance. A qualified engineer, not a contractor nor inspector shall determine this.

2.4 Utility Separation Requirements

This subsection contains the following major topics:

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- Sewer Separation Requirements
 - Other Utility Separation Requirements
 - Joint-Use Trench Separation Requirements
 - Storm Drain Separation Requirements
- A. Sewer Separation Requirements
Installation of water pipes near sewer mains shall comply with the following to prevent potential cross connection issues:
1. State of Arizona Criteria.
 - a. AAC R18-5-502.C, Minimum Design Criteria, Water and Sewer Mains, includes requirements for separation of facilities, materials, types of joints and encasement. For additional detail, refer to Tucson Water SD-106.
 - b. All public water and sewer line invert elevations shall be shown on the design drawings and the record drawings at each crossing to verify the separation requirements.
 2. Tucson Water Standard
All the requirements of Tucson Water SD-106, Sewer/Water Crossing Details, Tucson Water Standard Specifications and Details, must be met.
 3. Fire Hydrant and Service Connections Not Allowed
Where extra protection is needed near sewer mains as required by AAC R18-5-502.C, Minimum Design Criteria, Water and Sewer Mains, no fire hydrants or customer water service connections shall be installed.
 4. Reclaimed Water Pipes
Reclaimed water pipes located adjacent to potable water pipes shall comply with the separation criteria established for pressure sanitary sewer lines. Where reclaimed water pipes are installed in the vicinity of sanitary sewer lines, the reclaimed water pipes shall be considered potable with respect to clearances.
- B. Other Utility Separation Requirements
Other utilities are defined as electric, natural gas, fiber optic, telephone and cable television lines, conduits or structures.

Water main installation shall conform to the following separation requirements concerning other utilities:

1. Horizontal and Vertical Separation
Water mains shall not be designed for placement within a five foot horizontal distance of parallel utility lines. The minimum vertical separation, at any location, shall be twelve inches.

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2. Property Corners

Customer water services and fire hydrants shall not be installed at the same property corner as electrical or communications pedestals or transformers. This will minimize the risk of damage during installation and facilitate water system maintenance.

If this requirement absolutely cannot be met, there shall be a minimum horizontal distance of ten feet between the other utility's structures and the water mains and waterworks structures.

C. Joint-Use Trench Separation Requirements

When other utilities are laid parallel to water facilities, they shall not be installed with less than five feet horizontal clearance from the water main unless the system has been approved for Joint-Use Trench. In these cases, the joint-use trench detail (Tucson Water SD-108) must be shown on the plans.

D. Storm Drain Separation Requirements

The requirements stated in this section are in addition to the requirements in Tucson Water SD-107, Drainage Facilities Crossing Details, Tucson Water Standard Specifications and Details.

1. Water Pipe Below Structure

When the water main can be installed below a storm drain structure, the minimum vertical separation shall be in accordance with Tucson Water SD-107.

2. Water Pipe Above Structure

When installing water mains over a storm drain structure and minimum cover cannot be achieved, the contractor, with the approval of the Tucson Water engineer, may install the water main with less than the minimum cover under the following conditions:

- a. The water pipe material shall be ductile iron.
- b. Separation between the water main and the top of the storm drain structure shall be no less than twelve inches.
- c. Under no circumstances shall the pipeline have less than twenty-four inches of cover to final grade.

2.5 Crossing Requirements

This subsection contains the following major topics:

- Surface Water Crossing Requirements
- Utility and Transportation Crossing Requirements

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A. Surface Water Crossing Requirements

This subsection contains the following major topics:

- Above Surface Water Crossings
- Below Surface Water Crossings
- Pipelines Parallel to Surface Water Crossings

A surface water crossing includes a river, stream, or wash (dry or wet). It does not include a local, unimproved drainage ditch that experiences no scour.

All surface water crossings of “Navigable Waters of the United States” will require review and approval from the appropriate government agencies, including:

- City of Tucson Floodplain Section,
- Pima County Flood Control District, and
- EPA (404 Permit, Nationwide Permit 12 administrated by Army Corp of Engineers).

1. Above Surface Water Crossings

Above surface water crossings occur on bridges or on a suspended cable, and are not acceptable without approval.

2. Below Surface Water Crossings

a. A design evaluation shall be performed, if required by Tucson Water, and shall include the following tasks:

- Prepare all hydrologic reports that may be required, including a scour analysis.
- Review records and projections of storm water runoff and flood events affecting the project area.
- Determine magnitude of flood events and the constraints that they may impose during and after construction.
- Determine the extent of flood limits.
- A final report shall include the results of all the required tasks, and shall show elevations of the streambed with normal and extreme low and high water levels.

b. Crossing Minimum Requirements

The design of the pipeline and any other support structures shall include restrained joints within the flood limits.

Additionally, a Floodplain Use Permit Application shall be filed with the permitting agencies.

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ADEQ Engineering Bulletin No. 10 contains the following additional requirements:

- The water pipeline shall be located a minimum of two feet below the scour depth.
- There shall be two valves, one at each side of the crossing, which are accessible and not subject to flooding.
- Pipe taps shall be provided on each side of the crossing for water quality sampling, pressure testing, and applying compressed air, all located between the valves.

3. Pipelines Parallel to Surface Water Crossings

Extra protection shall be considered for pipelines parallel to a river, stream, or wash that has a history of bank erosion or appears likely to be subjected to future erosion.

B. Utility and Transportation Crossing Requirements

1. Utilities Crossing Requirements

The companies of the following utilities shall be contacted for the latest crossing requirements:

- natural gas pipelines
- gasoline pipelines (petroleum products)
- telephone lines,
- military installations,
- irrigation lines or canals.
- communications cables or conduits
- electric lines, or conduits,
- fiber optic cables or conduits

2. Transportation Crossings Requirements

A transportation crossing includes a highway or railroad crossing that may cause vibrations to the pipeline.

a. Design Evaluation

A design evaluation shall be performed, if required by Tucson Water, and shall include the following tasks:

- Prepare all reports that may be required.
- Review records and projections of traffic loads and frequency affecting the project area.
- Determine magnitude of loadings and the constraints that they may impose during and after construction.
- Determine the extent of vibration effects.
- A final report shall include the results of the required tasks.

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b. Crossing Minimum Requirements

The design of the pipeline and any other water support structures shall include the following minimum requirements for transportation crossings:

- Restraint joints shall be used within the determined length of vibration effects.
- A sleeve or casing shall be used to jack and bore beneath the crossing to avoid disturbance of the traffic system.
- The wall thickness of the sleeve or casing shall be sized to withstand H-20 traffic loading and or transportation agency specifications.
- The sleeve or casing shall be designed to reduce the vibration effects to the water pipeline.
- A sleeve or casing shall be designed to permit drainage for water pipeline leaks or pipe rupture.
- A sleeve or casing shall be supported and allow easily removable of the pipeline for repair.
- There shall be two valves, one at each side of the crossing. The designer shall locate the valves out of the flood plain and minimize the number of customers that would be out of service.

c. Jacking and Boring

Calculations are required for the design of steel jack and bore casing diameter and thickness sizing, and design shall be pursuant to Tucson Water SD-800. The carrier pipe shall be restrained beyond the ends of the casing for a minimum of 18-inches or equal to one-half times the carrier pipe diameter, whichever is greater. A second gasket joint shall be a minimum of two times the carrier pipe diameter beyond the casing.

8-08.3.0 Water Pipeline Appurtenance Requirements

This subsection contains the following major topics:

- Valve Requirements
- Fire Hydrant and Stub-out Location
- Pipeline Access Manways and Manholes

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3.1 Valve Requirements

In this manual, valves are classified according to function rather than application, motion or port size. The functional classification of valves can be categorized into three areas:

- shutoff and isolation valves, which allow either flow and pressure to pass, or block flow and pressure;
- non-return valves, which allow flow and pressure to travel in one direction only;
- throttling valves, which allow regulation of flow or pressure by varying the valve stroke between fully opened to fully closed. Thus, they can also act as on-off valves.

A. Shutoff Valves

Types of shutoff valves include gate, ball, and corporation stops.

1. Shutoff Valves in Water Distribution Mains

Generally, a water distribution main (sixteen-inch diameter and smaller) includes any pipe if direct water service to an individual customer is provided from that pipe.

- The shutoff valves are used to divert flow around an area or distribution section needing maintenance or repair while minimizing customer service interruptions.
- Special consideration shall be given to minimize the number of fire hydrants taken out of service.
- The valves in a new distribution system shall be located so as to require no more than four valves to shut down a water main. A project for a new pipeline may have to add new valves to the existing water system to meet this requirement.

2. Distribution Main Connection to Transmission Main

When connecting a distribution main to a transmission main (42-inch and larger), the designer shall apply the “double block and bleed” OSHA criteria, which requires two consecutive valves for isolation of the distribution main.

- The “double block and bleed” OSHA criteria is applied for safety during installation and for subsequent use by operation and maintenance personnel.
- To minimize cost, an existing valve in the distribution main shall be used as one of the "consecutive valves" as long as no customer water service connections are present between this valve and the transmission main.

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B. Shutoff Valve Location

Within the distribution piping (sixteen-inch diameter, if there are water service connections, and smaller), shutoff valves are required in:

- commercial areas – every 500 feet or no more than from intersection to intersection,
- all other areas – every 660 feet or between intersections.

C. Intersections in Distribution Mains

The number of shutoff valves at distribution main intersections is one less than the number of radiating pipes. One valve will be omitted from the pipeline that principally supplies flow to the intersection.

D. Fire Hydrant Branch

One shutoff valve is required on each fire hydrant branch. Refer to Tucson Water SD-500.

E. Gate Valve (Bonnet) Cover Minimum

The gate valve bonnet shall have a three-foot minimum cover distance from top of bonnet to the roadway subgrade.

F. Isolation Valves in Transmission Mains

Isolation valves used in transmission mains (twenty-four-inch diameter and larger, sixteen-inch if no water service connections) are the butterfly valve type.

1. Location of Isolation Valves

At pipeline intersections, isolation valves shall be located upstream of the determined predominant flow pattern so that, when closed, there will be the least disruption of service to the water customer and shall permit the necessary shut down of transmission mains for maintenance or repair.

2. Separation of Isolation Valves

Although each project's valve placement will be evaluated separately and will be dependent upon the location of the tees/welded outlets for distribution system lateral tie-ins to parallel or crossing mains, in-line isolation valves are generally located:

- Every 1,320 feet for sixteen-inch pipe,
- Every 2,640 feet for sixteen-inch and no more than thirty-six-inch diameter pipe,
- Every 5,280 feet (maximum) for larger than thirty-six-inch pipe.

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3. Downsizing Valves on Large Pipe

- Downsizing is not allowed on fifty-four-inch and smaller pipe.
- Valve downsizing on pipes greater than fifty-four-inch shall be considered by Tucson Water on a case by case application and following a cost benefit evaluation.

G. Flushing Devices

Flushing devices take on various names depending on the intended use or purpose. These include blow-off valve assemblies, drain valve assemblies, and fire hydrants.

- In the potable drinking water system, in large pipelines (thirty-six-inches and above), the location of drain valve assemblies shall be at low points along the transmission main, as determined by Tucson Water, so that the discharged water can be disposed of easily. This also permits the draining of the pipeline to allow for repairs or discharging of stagnant water to improve water quality.
- For particulate removal, such as sand, a properly designed flushing device shall to attain the velocity (2.5 feet per second) needed to perform this function. Refer to ADEQ Bulletin No. 8.
- All dead-end potable pipelines shall have a blow-off valve assembly type flushing device. These devices shall not be located in washes, detention/retention areas, sidewalks or driveways.

H. Air and Vacuum Release Valves

Air and vacuum release valves are designed to release accumulated air and for the admission and subsequent release of air during an event such as a power failure.

This valve will prevent the development of a vacuum with induced external pressures that may collapse a pipe made of a flexible material. Accumulated air, sometimes referred to as an air lock or air pocket, can cause resistance to flow and an increase in power cost.

All air and vacuum release valves shall be a combination air/vacuum release type.

Air and vacuum release valves are required at critical high points in all pipelines, in which there are no connections, such as a fire hydrant or a water service connection, that would otherwise permit accumulated air to be released.

When a shut-off valve is also at the high point in a pipeline, air and vacuum release valves shall be provided on each side of the valve.

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I. Above-Grade Venting

In order to prevent intrusion, automatic air and vacuum release valves and similar appurtenances should be designed to have above-grade venting (at least one foot) and be designed to be tamper-proof to avoid deliberate contamination of the water system.

Intrusion refers to the flow of non-potable water into pipelines through leakage points, submerged air and vacuum release valves, faulty seals, or other openings.

Intrusion can occur during low or negative pressure transient events. Pressure transients can be caused by:

- main breaks,
- uncontrolled pump starting or stopping,
- opening and closing of fire hydrants,
- power failures,
- the slamming of an air valve,
- flushing operations,
- fire flow, and
- other conditions including venturi effects.

J. Air Valve Capacity

Pipeline size and profile, together with critical temperature and time considerations, shall be used to establish the capacity required at a given high point. The design engineer should specify air valve capacity and the manufacturer can best determine valve size and number required.

Air valve capacities for a given size vary considerably between manufacturers. Acceptance tests are to be required.

3.2 Fire Hydrant and Stub-out Location

None of the requirements stated in this section shall take precedence over the requirements in Tucson Water SD-500, Fire Hydrant Installation, Tucson Water Standard Specifications and Details.

A. New Fire Hydrants

1. The number of fire hydrants and their location shall be as approved by the local fire suppression authority without violating any other requirement contained herein.
2. Horizontal ninety-degree bends in fire hydrant laterals are undesirable and will be avoided when possible. If unavoidable, a minimum of ten feet of ductile iron pipe will be installed between the bend and the hydrant. Where practicable, the ninety-degree bend shall consist of two forty-five-degree bends.

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B. Fire Hydrant Replacement

Unless otherwise directed by Tucson Water, fire hydrants on substandard mains will be replaced with a new hydrant if:

1. the hydrant is more than ten years old, and
2. the hydrant is in poor visual or recorded substandard condition,
3. but not until the substandard main is replaced.

C. Fire Hydrant Not Allowed

1. Transmission Mains

There shall be no fire hydrant or service connections located directly on transmission mains over twelve-inches.

2. Extra Protection Near Sewer Mains

There shall be no fire hydrant connections located where extra protection is needed near sewer mains as required by AAC R18-5-502.C, Minimum Design Criteria, Water and Sewer Mains. This will reduce any potential risk involving the fire hydrant barrel drain.

3. Limitation of the Available Water Supply

There shall be no fire hydrants installed where there is a limitation of the available water supply to provide the flow implied by the presence of a fire hydrant.

4. Impediment

The hydrant should be located so that it will not impede vehicular or pedestrian traffic, block driveways, take parking space, etc.

3.3 Pipeline Access Manways and Manholes

Forty-eight-inch diameter and larger concrete cylinder pipe and welded steel pipe transmission mains shall be designed with forty-two-inch horizontal, tangential (to the bottom) manways and vertical seventy-two-inch inside diameter manholes. These appurtenances shall be designed at a minimum of 2,640-foot intervals and shall be equally spaced between in-line isolation valves.

Flanged inspection ports twelve inches in diameter shall be designed in a horizontal orientation on all pipelines twenty-four inches through thirty-six inches in diameter in 2,640-foot intervals.

8-08.4.0 Water Pipeline Miscellaneous Requirements

4.1 Customer Water Service Connections

A water service connection includes the service clamp or saddle, corporation stop, copper pipe, angle meter stop, tracer wire, locator tape, meter box and lid. Please refer to Tucson Water SD-309, 310, 311 and 312 for additional requirements.

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A. Customer Water Service Connections

Each customer water service connection shall be individually metered. The customer shall install and maintain their own shutoff valves in their water service line (a.k.a. private plumbing) between the water meter and the customer structure, and shall be financially responsible for their water service line.

A contractor or Tucson Water shall install the service connection.

B. Customer Water Service Connections, Location

1. For automated meter reading and easy access by vehicles, each water service connection shall be installed within the public right-of-way or an easement (approved by Tucson Water for the project) and adjacent to the property to be served.
2. The water meter will be installed by Tucson Water after the project has been accepted.

C. Main Replacement Water Service Connections

When new water mains replace existing mains, all existing water services shall be connected to the new main by either a water service connection tie-over or a water service renewal. Please refer to Tucson Water SD-316 for additional requirements.

Service renewals will be used in areas that involve an improvement district with definite paving plans or when the service has been acquired from a private water company and the angle meter stops were not installed.

Iron or any unacceptable material used for water service lines shall be replaced with copper pipe all the way to the meter unless an excessive amount of paving will have to be cut. In that event, the connection to the service line is to be made in the shortest distance.

D. Water Service Locations Not Allowed

1. On water pipeline sizes over twelve-inches, there shall be no water service connections.
2. Where extra protection is needed near sewer mains as required by R18-4-502.C, Minimum Design Criteria, Water and Sewer Mains, no customer water service connections shall be installed.

E. Irrigation and Fire Services

For commercial developments, water used for irrigation will be separately metered. Once the potable water enters these systems, it is then defined as nonpotable.

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4.2 Water Loading Stations

Water dispensing facilities, such as those used to load water trucks, present special problems regarding contamination. To prevent contamination of the potable water supply, the requirements described in ADEQ Engineering Bulletin No. 10, Chapter 7, Distribution Systems, Section K., Water Loading Stations, must be met. Contamination may occur when filling non-potable tanks or contaminated vessels.

4.3 Landscape Plantings

This subsection replaces Distribution Design Section Procedure 1-01-005, 02/01/94, Required Spacing Between New Landscape Plantings and Existing Waterlines.

A. Purpose

The requirements in this subsection have been established to protect all Tucson Water facilities after the planting of new landscaping for a water construction project. These facilities include pipelines, sleeves, casings, water mains, water services lines, and water meters. These requirements also apply to reclaimed water system projects.

B. Large Root-Ball Sizes

For trees of fifteen-gallon root-ball size and larger, a horizontal distance of ten feet is to be provided from the outside of the waterline to the outside diameter of the root-ball.

If the ten foot condition cannot be met, then a minimum horizontal distance of five feet should be provided from the outside of the waterline to the outside diameter of the root-ball with the following requirements:

- The contractor is to uncover the existing waterline, exposing its joints for a horizontal distance of ten feet either side of the centerline for the proposed tree well.
- The contractor is to install a polyethylene sheet wrap around the pipe joints for a distance of eighteen inches either side of the joint. The polyethylene wrap shall be in accordance with American Water Works Association C105-88, Class A, with the installation by Method C. The sheet wrap seams are to be sealed to the pipe and itself by the use of watertight, Mylar tape wrap.

C. Medium and Smaller Root-Ball Sizes

For plantings with smaller than fifteen-gallon root-ball sizes, a horizontal distance of five feet is to be provided from the outside of the waterline to the center of the plant root-ball.