# SECTION 6900 - WATER MAINS

# CITY OF LEE'S SUMMIT, MISSOURI
# DESIGN CRITERIA

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A. General

1. The design standards presented in the City of Lee's Summit Design Criteria are the minimum standards to be followed in the design and construction of the Lee's Summit water distribution system. These standards are not intended to be used as a substitute for actual construction specifications and design computations.
2. Minimum pipe size: No public water main shall be less than 8 inches in diameter unless otherwise specified in this section.
3. Where water mains are extended into the interior of a lot, the water main shall not be considered a public water main.
4. Main Designations
   - Transmission Mains. Transmission mains are classified as mains transporting water from a water source to a pumping station or reservoir. Transmission mains shall be 16 inches in diameter or larger, and are as shown in the City's currently-adopted Master Plan. Transmission mains shall not be tapped.
   - Major Distribution Mains. Major distribution mains are classified as mains transporting water from a transmission main to a minor distribution main. Major distribution mains shall be all other mains16 inches in diameter or larger, and are as shown in the City's currently adopted Master Plan. Major distribution mains shall only be tapped by minor distribution mains. Connections to major distribution mains shall be made at intervals not less than 1,000 feet.
   - Minor Distribution Mains. Minor distribution mains are classified as water mains 6 to 12 inches in diameter. Six-inch water mains can only be provided at dead end water mains that will not be extended in the future.
5. Grid System: Mains shall be laid on a loop or grid system with mains cross connected not more than 1,000 feet apart. Cross mains to be installed as part of a subdivision or platted lot shall be a minimum of 8 inches in diameter.

B. Capacity

1. The water distribution system and any extension thereof shall have adequate capacity to:
   a. Supply the peak hour demands at maximum day demand (estimated at 0.67 GPM/customer) of all customers, domestic, public, commercial and industrial while maintaining a pressure of not less than 40 pounds per square inch at all points of delivery, without reducing the service to any customer below these requirements.

b. For residential fire protection, the system must be capable of providing adequate fire protection on the day of maximum customer demand (estimated at 0.44 GPM/customer) with a residual pressure of not less than 20 pounds per square inch to at least one point within 300 feet of each building to be served or proposed to be served by such system and extension for residential. For residential buildings in excess of 3,600 square feet ($ft^2$), the currently-adopted Fire Code shall be followed.

c. For other than residential fire protection, currently-adopted Fire Code shall be followed. Coordinate with the LS Fire Department.

d. The City will evaluate development based on a worst case scenario and how it will impact the systems design.

C. Criteria for Estimating Demand

1. The following criteria will be used in estimating the average day demand, maximum day demand, and peak hour demand incident to the determination of future water main sizes.

   a. Residential population = N = number of dwelling units x 2.78 people/dwelling unit.

   b. Average daily water demand of residential population [gallons per day (gpd)] = R = N x 125 gallons/person.

   c. Average daily commercial and industrial water demand (gpd) = C = number of commercial and industrial employees x 100 gallons/person, plus additional water demand as required for the specific facility.

   d. Average daily school water demand (gpd) = S = number of staff employees and students x 20 gallons/person.

   e. Average daily water demand (gpd) = A = R + C + S.

   f. Maximum daily water demand (gpd) = M = A * Y (Y = The Maximum Day to Average Day ratio as indicated in the City's currently adopted Water Master Plan). The minimum value of the maximum day to average day ratio shall be 2.1.

   g. Peak hour demand (gpd) = P = 2 * M. Gallons per minute (gpm) = P/1440).

2. Required Fire Flows

   a. In general, the following fire flows will be used to evaluate development proposals using the City's water model:

      i. Residential: 1,000 gpm for structures up to 3,600 $ft^2$

      ii. Commercial (including churches and schools): 1,500 gpm minimum

   b. The Fire Department may require increased fire flows, depending on the building's type of construction, square footage, and use.

3. If determined by City staff that hydraulic modeling is required to determine the effect of new development on the existing water distribution system, then the latest version of the water model adopted by the City of Lee's Summit shall be used. The Design Engineer shall provide data as required for the City to run the model. The Design Engineer/Developer shall be responsible for any costs associated with the hydraulic analysis.

D. Water Mains

1. Location

a. Within or Adjacent to Right of Way: When water mains are placed in or adjacent to the right-of-way (R/W), water mains shall be located as follows:

i. Water mains shall be located at least 4 feet from back of curb with an embankment slope of 3:1 or flatter.

ii. Street crossings shall be bored under existing streets.

iii. All boring excavations shall be located no closer than 2 feet from back of curb and with a minimum depth not less than 42 inches from the finished grade to the top of the water main.

iv. No parallel utilities may be laid in the same trench as the water main.

v. Where sidewalks will be placed on the same side of the street as the water main, the water main shall be located at least four feet from the sidewalk outside the right of way in a utility easement.

b. Away from Right of Way: When placed away from and outside the right of way, water mains shall be located as follows:

i. Water mains shall be installed in easements with an embankment slope of 3:1 or flatter.

ii. Water mains shall not be located in the rear of the property.

iii. Water mains shall be located in the center of the easement.

c. Separation from Other Pipes:

i. Factors: The following factors should be considered in providing adequate separation:

(a) Materials and type of joints for water and sewer pipes.
(b) Soil conditions.
(c) Service and branch connections into the water main and sanitary sewer main.
(d) Compensating variations in the horizontal and vertical connections.
(e) Space for repair and alterations of water and sewer pipes.
(f) Offsetting of pipes around manholes and other sewer structures.

ii. Parallel Installation: Water mains and appurtenant structures shall be laid at least 10 feet horizontally from any existing or proposed sanitary sewer or force main and at least 10 feet horizontally from any storm sewer. The distance shall be measured edge to edge.

iii. Crossings:

(a) Water mains crossing sanitary or storm sewers shall be designed to provide a minimum vertical clear distance of 18 inches between the outside of the water main and the outside of any sanitary sewer and storm sewer. This shall be the case where the water main is either above or below the sewer.

(b) At crossings, a full length of water pipe shall be located such that both joints will be as far from the sewer as possible.

(c) Where conditions prevent the minimum vertical separation set forth above from being maintained, the following shall be applied:

(i) The water main shall be constructed of mechanical or manufactured restrained joint pipe, fusion welded pipe, or cased in a continuous casing that extends no less than ten feet on both sides of the crossing. Casing pipe must be a material that is approved for use as water main.

(ii) Any exception from the minimum vertical clear distance must be submitted to the Missouri Department of Natural Resources for approval.

(d) For DIP water mains crossing other cathodically protected pipe lines, calculations to determine the need for a cathodic protection system for the water main shall be submitted. Cathodic protection system will be designed as required.

(e) Provide special structural support for the pipes as necessary.

(f) Minimum crossing angle shall be 45 degrees.

d. Separation from Structures:

i. Manholes and Other Utility Structures:

(a) No water main shall be located closer than 10 feet horizontally to any part of sewer main or structure.

(b) No water main shall be located closer than 5 feet to any part of a storm sewer curb inlet, junction box, or other storm sewer structure.

ii. Buildings: Water mains shall be at least 15 feet from any building.

iii. Retaining Walls: Water mains shall be located so that maintenance on the water main will not jeopardize the structural integrity of the wall. Location shall comply with Section 5700.

e. Drainage Courses and Streams:

i. The location of water mains relative to drainage courses and streams shall be designed to comply with Section 5600.

ii. Pipelines crossing drainage courses and streams shall be designed to cross as nearly perpendicular as possible.

iii. Pipelines shall be designed to minimize the number of crossings.

iv. Ductile iron pipe (DIP) with restrained joints shall be used for all drainage courses and stream crossings. The DIP shall extend into the bank a minimum of 20 feet at each end of the crossing.

v. Valves shall be provided at both ends of the drainage course crossing (i.e., a minimum of 20 feet into the bank at each end of the crossing) so that the section

can be isolated for testing or repair. The valves shall be easily accessible and not prone to flooding.

vi. The top of all water mains entering or crossing streams shall be at least 42 inches below the natural bottom of the stream bed to protect the pipeline.

vii. All non-bore crossings shall be encased in concrete.

viii. The use of aerial crossings shall not be allowed.

2. Dead End Water Mains

   a. Dead end water mains shall not exceed 700 feet in length.

   b. All dead end water mains that are to be extended in the future shall be installed to the limits of the platted subdivision such that extensions to the mains to serve adjacent subdivision plats may be connected at the plat boundary and shall be installed with an inline valve and a temporary fire hydrant that is properly restrained. The valve shall be the same size as the main.

   c. When a subdivision or platted lot abuts or contains a planned water main as depicted in the City's Master Plan and the subdivision or platted lot will benefit from the main, the Contractor/Developer is responsible for the cost of the water main extension to the plat boundary as described above. Such cost shall be limited to that of an 8-inch main unless a larger main is necessary to serve the development.

   d. All dead end water mains that are not to be extended in the future shall be a minimum 6 inches in diameter between the last two fire hydrants.

   e. All dead end water mains serving a cul-de-sac shall be extended around the cul-de-sac sufficiently far so that no service lines need to be bored more than the width of the normal, non-cul-de-sac street R/W.

3. Thrust Restraint Design

   a. Thrust restraint shall be either restraint joint pipe, thrust blocks, or straddle blocks.

   b. Thrust restraint shall be designed to meet the following criteria:

      i. Design pressure of 250 psi (150 psi working pressure plus 100 psi surge allowance).

      ii. Allowable soil bearing capacity of 1500 pounds per square foot (psf).

      iii. Safety factor of 1.0.

      iv. For horizontal thrust blocks, the minimum and maximum bearing areas are 4.0 and 50.0 square feet ($ft^2$), respectively.

      v. For vertical (upward) thrust blocks, the minimum and maximum block sizes are 4.0 and 216.0 cubic feet ($ft^3$), respectively. A unit weight of 140 pounds per cubic foot (pcf) of concrete is assumed.

      vi. For horizontal and vertical thrust restraint details, see the Standard Drawings.

      vii. For water mains 16 inches and larger, straddle blocks shall be used in lieu of thrust blocks. Engineering calculations shall be submitted for approval.

viii. Restrained joint pipe calculations shall comply with the design requirements of the Ductile Iron Pipe Research Association (DIPRA) for ductile iron pipe (DIP) or of the Uni-Bell PVC Pipe Association for polyvinyl chloride (PVC) pipe.

ix. Restrained joint pipe that is designed and manufactured by the same manufacturer as the DIP and PVC pipe shall be used in cul-de-sacs. In the event that the manufacturer of the PVC pipe does not manufacture restrained joint pipe, a joint restraint system acceptable to and approved by the PVC pipe manufacturer shall be used.

c. Temporary Restraint Methods:

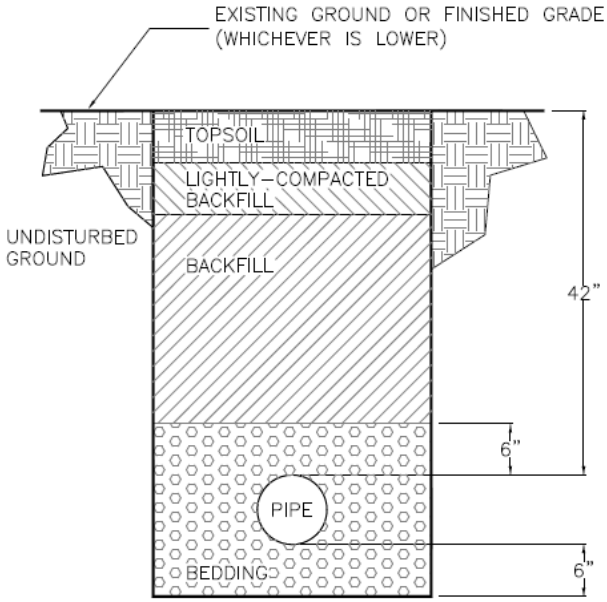
i. Retainer glands (e.g., Megalug, Uni-Flange, etc.), Duc-Lugs and all-thread, set screw collars, and field-welded collars are considered short-term restraint. When it is necessary to put the pipeline into service immediately and concrete blocking is utilized, a retainer gland may be installed to provide short-term restraint while the concrete cures.

ii. Gripper gaskets (e.g., Field-Lok, Fast-Grip, etc.) should only be utilized on one side of fittings where field adjustment becomes necessary or it is not possible to lay pipe from both directions.

4. Locating Underground Utilities: Utility marker tape shall be installed above each water main.

5. Trench Design

a. Minimum Cover: A minimum of 42 inches of cover shall be over the top of the pipe. This minimum of cover shall be from the top of the pipe to the finished grade, as shown below:




b. Maximum Cover: The maximum cover allowed is 7 feet.

c. Bedding: Bedding aggregate shall be placed from a level 6 inches below the bottom of the pipe to a level 6 inches above the top of the pipe as shown above.

d. Backfill

i. See Paragraph 2102.2.C.2.

ii. Backfill of all pipes under roadways, curb and gutter and all other paved areas within the right of way shall consist of flowable backfill as specified in Section 2602.2.H Mix Design Type A. The flowable fill shall extend to 2 feet from back of curb to 2 feet back of curb, up to 18 inches below finished grade. For existing roadways flowable shall be extend up to the base of pavement.

e. Topsoil: See Paragraph 2102.7.

f. Trench Checks:

iii. Impervious trench checks shall consist of flowable backfill as specified in Paragraph 3901.G, and shall be placed at a maximum spacing of 500 feet. If valves are closer than 500 feet apart on the main so that the section can be isolated, trench checks may be omitted.

iv. Trench check shall extend 12 inches below the bottom of the pipe. Length shall be a minimum of 12 inches and width shall be the width of the trench. The height of the trench check shall extend to 12 inches above the top of the pipe.

g. Conduits: No conduits, pipes or other utilities shall be located in water main trenches.

6. Straddle Blocks

a. Straddle blocks shall be provided as required to restrain piping.

b. Straddle blocks shall also be provided in accordance with the following table:

| Percent of Grade | Center to Center Max. Spacing (ft) |
|---|---|
| 20 ≤ Slope < 35 | 36 |
| 35 ≤ Slope <50 | 24 |
| 50 ≤ Slope | 16 |

c. The design criteria for straddle blocks shall be as shown for thrust restraint (see Paragraph 6901.D.3.).

d. Straddle blocks at shorter intervals may be required under extreme conditions as determined by the City Engineer.

e. For straddle block detail, see the Standard Drawings.

7. Pipe Encasement: Pipe encasement, when required and/or permitted, is intended to provide maximum support for pipe in locations where standard embedment may be insufficient. For pipe encasement detail, see the Standard Drawings.

E. Valves

1. Location
   a. Valves on transmission and major distribution mains shall be installed as follows: three valves at every tee, four valves at every cross, and an in-line valve every 1,000 feet as a minimum.
   b. Valves on minor distribution mains shall be installed as follows: two valves at every tee on opposite lines, three valves at every cross, and an in-line valve every 1,000 feet as a minimum.
   c. Valves shall be placed at or near the ends of mains in such a manner that a shutdown can be made for a future main extension without causing loss of service on the existing main.
2. Where fire lines are connected to City water mains, one valve shall be installed on the fire line at the tee. No valves shall be placed on the main when an existing valve in either direction is within 500 feet of the tee. If there are no valves on the main within 500 feet of the tee, then one valve shall be placed on the main on either side of the tee.
3. One valve shall be installed on a single branch fire hydrant unless otherwise required by the City Engineer to improve the ability to isolate an area of the water distribution system in the event of a water main break.
4. The type, size, and location of valves shall be as designated on the approved Engineering Plans.
5. Butterfly Valves:
   a. Butterfly valves shall be provided for all mains 12 inches or larger.
   b. Valves shall be subjected to and pass a one-time pressure test of 192.5 psi prior to delivery. Valves shall be clearly marked to that effect, and the manufacturer shall provide for certification upon delivery of the valves to the site. Certification shall be given to the Inspector.
6. Air release valves shall be provided on all water mains 12 inches and larger. At a minimum, placement shall be at high points and on straight runs at intervals as determined by the Design Engineer. The size and type of the air release valves (combination air valves) shall be as determined by the Design Engineer, meeting the requirement of this manual. Air release valves shall not be connected directly or indirectly to any storm drain, storm sewer, sanitary sewer, or service lateral.

F. Tapping Sleeves and Valves

1. The use of a tapping sleeve and valve is to be minimized and will only be allowed on a case-by-case basis.
2. Design Engineer shall provide justification when proposing the use of a tapping sleeve and valve.
3. Thrust blocks shall be used behind all tapping sleeves and valves.

G. Valves Boxes

1. Valve boxes shall be provided for buried valves.

a. In paved areas these shall be the adjustable screw-type ferrous metal valve boxes.

b. In grassed areas, these valve boxes may be made of AWWA C900 PVC pipe or equivalent.

H. Backflow Prevention

1. Backflow prevention devices (BFPDs) are required on all fire lines, commercial buildings, pump stations, excess flow holding basins, and irrigation systems in accordance with the following table:

| Location | Type of BFPD |
|---|---|
| Fire Line | Double check detector assembly (If chemical additives will be introduced into the fire line, then a reduced pressure principle detector assembly shall be installed unless the chemical additive is isolated by a reduced pressure principle assembly.) |
| Commercial Building, Pump Station, and Excess Flow Holding Basins | Reduced pressure principle assembly |
| Irrigation System | Double check valve assembly (If chemical additives will be introduced into the irrigation system, then a reduced pressure principle assembly shall be installed.) |

2. On buildings, the backflow prevention systems shall be designed to comply with the City's currently-adopted Plumbing Code, latest edition.

3. When BFPDs are to be installed in a vault, the following considerations apply:

a. The location of the vault shall be such that the pit is located outside of the R/W and easement lines and not in the lowest area. The ground surrounding the vault shall be graded to drain away from the vault.

b. Wall penetrations shall be designed to be as watertight as possible.

c. Steps shall be cast into the wall of the vault.

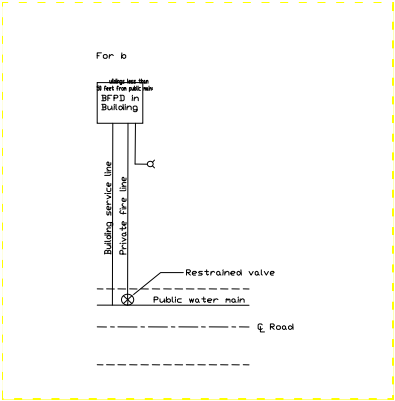
d. The minimum wall and lid thickness of the vault shall be designed to withstand an AASHTO H-20 loading.

e. The size of the top opening into the vault shall be geared to the size of BFPD used. On larger BFPDs, use a rectangular lid to allow ease of BFPD removal. Opening shall be directly over BFPD.

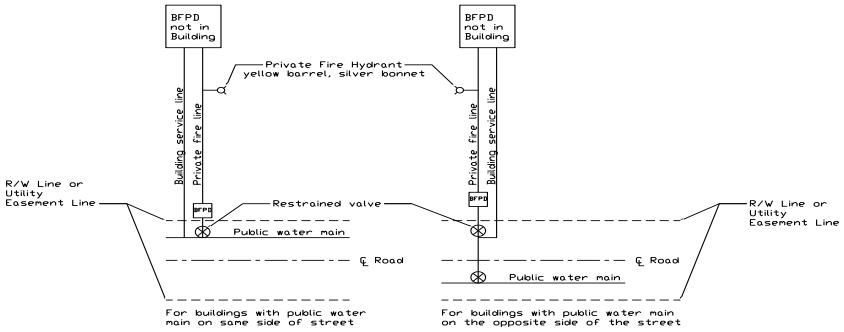
I. Fire Lines

# WATER MAINS

1. Ownership: Where fire lines are installed, a restrained valve shall be installed at the point where the fire line connects to the public water main, which is a water main located within the R/W or public easement. This valve denotes the end of Water Utilities (WU) Operations maintenance and is considered to be publicly owned.
2. When the BFPD is to be installed inside the building, the following apply (see figure below):
   a. The building shall be located no more than 50 feet from the public water main.
   b. The water main from the restrained valve at the public water main to the BFPD shall be considered a private fire line.
   c. The building service line shall not be tapped off the private fire line.
   d. Private fire hydrants shall be installed after the building's BFPD.
   e. Private fire hydrants shall be factory-painted in compliance with Paragraph 3901.P.
   f. The property owner shall be required to maintain the fire line and BFPD.
   g. No private fire line shall be less than four inches in diameter.




3. For buildings more than 50 feet from the public water main, a BFPD shall be located in a buried vault installed within 5 feet of the R/W line, or utility easement line (if a utility easement line is present), on the private side (see figure below). See Paragraph 6901.H.3.
   a. If the public water main is on the same side of the street as the building, the building service line shall be tapped off the public main.
   b. If the public water main is across the street from the building, the building service line may be tapped off the public main after it crosses the road and before the restrained valve and BFPD on the public side of the R/W or utility easement line.
   c. A public water main shall be constructed of materials as specified in Section 3900 within the R/W. The restrained valve shall be installed at the edge of the R/W or utility easement.




4. Private Fire Lines. Private fire lines, valves, hydrants and BFPD are owned by and are to be maintained by the property owner. For dead end private fire lines, it may be necessary to locate hydrants closer to the building than the existing public hydrants will allow.
5. Post indicator valves (PIV) shall be installed as required by the Fire Department.
   a. All accessible valves on a fire suppression system shall be electronically supervised or secured and locked.
   b. The PIV shall be secured with a suitable, break-away padlock, supplied and accessible by the property owner. A Knox lock box padlock is not required, except in certain circumstances as required by the Fire Chief.

J. Fire Hydrants

1. In water systems and extensions serving one-family and/or two-family residential subdivisions, fire hydrants shall be installed at such locations that there will be at least one fire hydrant within 600 feet hose length (as measured on a drivable surface) to the nearest wall of any building, existing or future. Minimum street length between fire hydrants shall not exceed 500 feet. Hydrants on adjacent streets will not be considered in meeting the above requirements.
2. In commercial, industrial, and apartment house areas, fire hydrants shall be provided so that in no case shall more than 300 feet of fire hose, using an approved route, be required to reach any point at the base of any exterior building wall from the nearest fire hydrant to supply the stipulated fire flow.
3. For public water mains, not more than one fire hydrant shall be located on any 6-inch dead end main. For private fire lines, the size of fire line and number of hydrants shall be designed by a qualified engineer and approved by the City's Fire Department.
4. Fire hydrants shall be located a minimum of 20 feet from the points of curvature of the curb return.
5. To the extent practicable, fire hydrants should be located at property lines between lots.

6. Fire hydrants shall be factory painted in accordance with the colors shown in Paragraph 3901.P.
7. For public water mains along streets without curbs, the fire hydrants shall either be placed within one foot of the R/W line or the fire hydrant should not be more than 10 feet from the edge of pavement. No fire hydrant shall be placed in the bottom of a ditch.

K. Service Lines

1. Service lines extending from the water main to the water meter are public. Service lines extending from the water meter to the building are private. Service lines shall be at least 10 feet from sanitary sewer manholes and at least 5 feet from storm sewer structures.
2. The service line from the water main to the water meter should be ¾, 1, 2, or 3 inch diameter.
3. Services shall be connected with corporation stops for 2-inch and smaller service lines and with a cut-in tee and appropriate valving for larger sizes.
4. An irrigation sprinkler system and its required BFPD shall be tied to the service line outside of the meter well on the customer's side of the meter. Alternatively, a sprinkler system and its required BFPD may be tapped to the public water main. However, this requires payment of a separate tap fee and installation of a separate meter.
5. No splices or fittings (e.g., flared copper coupling, pack joint coupling, 3-part union/coupling, etc.) shall be allowed between the water main and the meter.
6. Any splices between the meter and the customer shall comply with the City's currently-adopted Plumbing Code, latest edition.
7. Each individual residential or business unit, except apartments, shall have separate meters and service lines. The number of connections shall comply with the City's Code of Ordinances, Section 32-61, Paragraph A.
8. Service lines shall not be laid parallel to the R/W or run continuously within the R/W.
9. Soft type "K" copper service line (diameter in accordance with the City standard details) shall extend a minimum of 10 feet beyond the meter well (between the meter and the private customer).

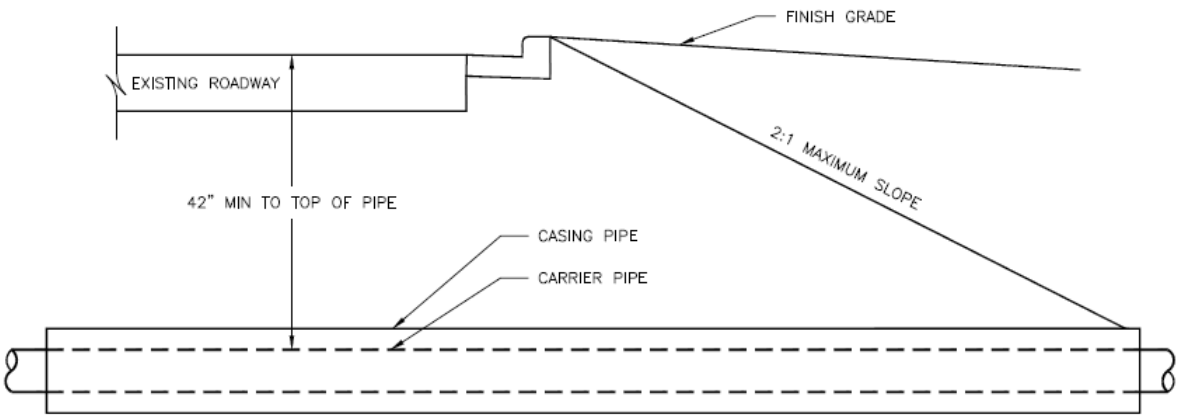
L. Water Meters

1. The water meter shall be located in the R/W or easement within 1 foot of the R/W or easement line.
   a. Two inch and smaller meters shall be set in a minimum 5-foot by 5-foot easement or in the R/W.
   b. Three-inch and larger meters shall be located in a vault. An easement extending at least 10 feet around the vault and including the vault shall be provided. If the vault is not located adjacent to the R/W, a 15-foot wide access easement shall be provided to the easement. Easement shall be sufficiently large to provide parking space for a vehicle.

2. Water meters must be located outside of paved areas, including sidewalks, unless otherwise approved by the City Engineer. In the event that the meter must be installed in a paved area, the Engineer shall submit plans for a traffic-bearing meter well and lid. The Contractor/Developer shall pay for the additional costs associated with traffic-bearing meter well and lid for any meters placed in paved areas.
3. The top of the meter shall be 14-18 inches below the water meter lid.
4. Each individual residential or business unit, except apartments, shall have separate meters and service lines. The number of connections shall comply with the City's Code of Ordinances, Section 32-61, Paragraph A. Double setters are acceptable.

M. Casing Pipe

1. Casing pipe is required on all bores except service lines 2 inches and smaller.
2. Casing Spacers: Stainless steel casing spacers in a centered configuration with manufactured end seals shall be used.
3. Extent: The extent of the casing pipe shall be as shown below. Consideration shall be given for future road widening.




NOTE:
BOTH ENDS OF CASING PIPE SHALL BE PLUGGED USING ONE OF THE METHODS LISTED IN THE STANDARD SPECIFICATIONS

N. Easements

1. Unified Development Ordinance (UDO): Easements shall be provided in accordance with the requirements of the City's UDO, Article 16. In addition, the following guidelines shall be followed:
   a. Easements shall be a minimum of 10 feet wide when adjacent to the R/W.
   b. Easements shall be a minimum of 15 feet wide when detached from the R/W (i.e. between buildings or across undeveloped areas), where the additional 5 feet are needed and additional access necessary to drive equipment in to perform a repair.

c. For deep installations (i.e. greater than 7 feet deep), easements shall be a minimum of 2 feet wide for every foot of trench depth.

d. Easements shall be a minimum of 15 feet wide around the bulb of the cul-de-sac adjacent to the right-of-way.

2. Temporary construction easements shall be acquired as necessary to complete the installation of the project.

3. Legal Descriptions: Legal descriptions shall include drawings indicating the point of commencement, the point of beginning, line bearings, line distances, the ending point, and the area described. The drawings shall be on letter size paper. Legal descriptions and drawings shall be sealed by a Land Surveyor registered in the State of Missouri and meet the filing requirements of Jackson and/or Cass County. All documentation shall be formatted to meet the requirements of the County Recorder. Aerial photographs shall not be used in the background of the drawing.

4. Water Mains Extending beyond Platted Areas: In the event that a water main needs to extend beyond the platted area of a development, proposed easements shall be provided for the main(s) prior to receiving approval of the Engineering Plans.