

DESIGN CRITERIA FOR
SANITARY SEWERS AND APPURTENANCES

- A. DESIGN FACTORS. Sanitary sewers should be designed for the ultimate tributary population. Due consideration should be given to current zoning regulations and approved planning and zoning reports where applicable. Sewer capacities should be adequate to handle the anticipated maximum hourly quantities of sewerage and industrial waste together with reasonable consideration given to infiltration/inflow.

Construction, installation, expansion or modification of any collection system or wastewater treatment facility is prohibited until a construction permit is issued by the department, per 10 CSR 20-6.010(4)(A).

- B. SEWER DESIGN. Sewers shall be designed for the total tributary area using the following minimum criteria:

Interceptors and trunk lines	0.01 CFS/Acre
Laterals and sub-mains	0.02 CFS/Acre

Using this criteria all pipes are to be sized flowing full.

- C. MAXIMUM SIZE. The diameter of sewers proposed shall not exceed the diameter of the existing or proposed outlet; whichever is applicable, unless otherwise approved by the City Engineer.
- D. MINIMUM SIZE. No public sewer shall be less than eight (8) inches in diameter. Stublines for service connections shall not be less than four (4) inches in diameter and shall be extended at a 90 degree angle to the main sewer line.
- E. MATERIALS OF CONSTRUCTION. Sanitary sewers shall be constructed of pipe material resistant to or protected from bacterial degradation, acid and alkaline solutions, normal sewer temperature variation, abrasion, and industrial wastes or other materials that may be transmitted by the collection system.

The following types of commercial pipe are approved for gravity sanitary sewer systems constructed in the City of Liberty:

High Density Polyethylene (HDPE) Pipe	ASTM F714; ASTM D-1248; ASTM D-3550; shall be marked with a green stripe to signify its use for sanitary sewer facilities.
Ductile Iron Pipe	ANSI A21.51; ASTM A536, Grade60-42-10; thickness Class 50, unless otherwise required by the City Engineer.
PVC Pipe	ASTM D3034, Type PSM Polyvinyl (Chloride), SDR 35; PVC Material shall conform to ASTM D1784 and shall have a cell classification of 12454-B, 12454-C, 12364-C or 13364-B. The minimum

pipe stiffness for pipe used for stublines shall be SDR 26.

For PVC Pipe the minimum stiffness allowed for depths of:

- SDR 35, for less than 15 feet below finish grade;
- SDR 26, for 15 feet to 20 feet below finish grade;
- SDR 21, for 20 feet to 25 feet below finish grade;
- DIP, for greater than 25 feet below finish grade.

F. MINIMUM SLOPE. All sewers shall be designed to give mean velocities when flowing full of not less than 2.0 feet per second.

All velocity and flow calculations shall be based on the Manning Formula using an "n" value of 0.013. The following slopes shall be minimum for the size indicated.

<u>SEWER SIZE</u>	<u>MINIMUM SLOPE IN PERCENT FULL AND HALF FULL FLOW</u>
8"	0.60
10"	0.28
12"	0.22
15"	0.15
18"	0.12
21"	0.10
24"	0.08

Exceptions to these minimum slopes shall be made at the upper end of the lateral sewers serving under thirty (30) houses and more than ten (10) houses. Said sewers shall have a minimum slope of 0.76%.

Where lateral sewers serve less than ten (10) houses, the minimum slope shall not be less than 1% unless otherwise approved by the City Engineer.

Minimum basement floor (MBF) elevations shall be shown on the plans for each proposed lot, calculated as the flowline at the stub, plus the length of the stubline to the right-of-way line times 2%, plus 3.5 feet. Include all stublines in a Sanitary service line summary table containing station, length, size, flowline elevation at the main, and MBF elevation for each service line.

G. INCREASING PIPE SIZE. When a sewer joins a larger one, the invert of the larger sewer should be lowered sufficiently to maintain a continuous energy gradient.

H. HIGH VELOCITY PROTECTION. In situations where flow is continuous and grit is a problem, and where velocities greater than 10 feet per second are possible, special provisions shall be made to protect against abrasion damage to the pipe. Such protection may be attained utilizing ductile iron pipe. Where velocities greater than fifteen feet (15')

per second (4.6 m/s) are attained, special provision shall be made to protect against displacement by erosion and impact.

Steep slope protection. Sewers on twenty percent (20%) slope or greater shall be anchored securely with concrete anchors or equal, spaced as follows: A. Not over thirty-six feet (36') (11 m) center-to-center on grades twenty percent (20%) and up to thirty-five percent (35%); B. Not over twenty-four feet (24') (7.3 m) center-to-center on grades thirty-five percent (35%) and up to fifty percent (50%); and C. Not over sixteen feet (16') (4.9 m) center-to-center on grades fifty percent (50%) and over.

- I. ALIGNMENT. All sewers shall be laid with straight alignment between manholes. Angles between pipes at manholes shall be shown. Sewers twenty-four inches (24") (61 cm) or less shall be laid with straight alignment between manholes. Straight alignment shall be checked by either using a laser beam or lamping.

Curvilinear alignment of sewers larger than twenty-four inches (24") (61 cm) may be considered on a case-by-case basis provided compression joints are specified and ASTM or specific pipe manufacturers' maximum allowable pipe joint deflection limits are not exceeded. Curvilinear sewers shall be limited to simple curves which start and end at manholes. When curvilinear sewers are proposed, the recommended minimum slopes indicated in paragraph (5)(D)1 of this rule must be increased accordingly to provide a minimum velocity of two feet (2') per second (0.6 m/s) when flowing full.

- J. MANHOLE CONSTRUCTION. Manholes shall be installed at the end of each line; at all changes in grade, size, or alignment; at all intersections; and at a distance not greater than four hundred (400) feet for sewers fifteen (15) inches or less in diameter and not greater than five hundred (500) feet for larger sewers.

- K. MANHOLES. The construction of all manholes shall conform to the details shown on the Standard Drawings.

The minimum horizontal clear distance within the barrel of standard manholes shall not be less than four (4) feet. Manholes with inside drops or connecting pipe diameters greater than 24 inches shall have a minimum inside clear dimension of five (5) feet. Wall sections deeper than 16 feet shall be 5 inches minimum thickness. A minimum access diameter of twenty-two inches (22") (56 cm) shall be provided.

Drop manholes should be avoided as much as possible. Outside drop manholes are not allowed. However, if a drop manhole is necessary, an inside drop shall be used. An inside pipe shall be provided for a sewer entering a manhole at an elevation of twenty-four (24) inches or more above the manhole invert. The inside drop pipe shall be installed and anchored according to the standard detail for inside drop manholes. The drop pipe shall have the same nominal diameter as that of the incoming sewer. When using precast manholes, drop connections must not enter the manhole at a joint.

Without utilizing drop manholes, the difference in elevation between the invert of any incoming sewer and the invert of the outgoing sewer should not exceed twenty-four (24) inches except where required to match crowns. When a sewer joins a larger one, the crown of the smaller sewer shall not be lower than the crown of the larger one. The

minimum drop through manholes shall be 0.2 feet.

Where manholes are to be built in close proximity to streets, the top of manhole elevation shall be set within the following limits:

Minimum Elevation	1/4" per foot rise above top back of curb
Maximum Elevation	2" per foot rise above top back of curb

All other sanitary sewer lines (sewer lines across unplatted land, etc.) shall have the tops of manholes set flush with the existing ground elevation. The top of all manholes shall be located at least one (1) foot above the 100-year flood plain, or employ bolt-down lids.

Each sanitary service line in commercial and industrial developments shall have a sampling manhole.

Corrosion Protection for Manholes. Where corrosive conditions due to septicity or other causes are anticipated, corrosion protection on the interior of the manholes shall be provided.

Any variation from the above top of manhole criteria will require a letter of explanation to be submitted with the drawings and be subject to approval by the City Engineer.

- L. SEWER LOCATIONS. Sanitary sewers shall be located within street or alley rights-of-way (outside pavement limits) unless topography dictates otherwise. When located in easements on private property, access shall be provided to all manholes. A manhole shall be provided at each street or alley crossing.

End lines shall be extended to provide access from street or alley rights-of-way where possible. Imposed loading shall be considered in all locations. Not less than eight (8) feet of cover shall be provided over top of pipe in street and alley rights-of-way and five (5) feet in all other areas unless otherwise approved by the City Engineer.

Structures. The sewer outfalls, headwalls, manholes, gateboxes, or other structures shall be located so they do not interfere with the free discharge of flood flows of the stream.

Materials. Sewers entering or crossing streams shall be constructed of ductile iron pipe with mechanical joints; otherwise, they shall be constructed so they will remain watertight and free from changes in alignment or grade. Material used to backfill the trench shall be stone, coarse aggregate, washed gravel, or other materials which will not readily erode, cause siltation, damage pipe during placement, or corrode the pipe.

Siltation and erosion. Construction methods that will minimize siltation and erosion shall be employed. The design engineer shall include in the project specifications the method(s) to be employed in the construction of sewers in or near streams. Such methods shall provide adequate control of siltation and erosion by limiting unnecessary excavation, disturbing or uprooting trees and vegetation, dumping of soil or debris, or pumping siltladen water into the stream. Specifications shall require that clean-up, grading, seeding, planting, or restoration of all work areas shall begin immediately. Exposed areas shall not remain unprotected for more than seven (7) days.

M. CLEANOUTS AND LAMPHOLES. Cleanouts and lampholes will not be permitted on public sanitary sewer mainlines. A two-way cleanout will be required to be installed near the edge of the public right-of-way on proposed private service lines. Service lines shall be stubbed approximately 5 feet beyond the cleanout from the main.

N. PROTECTION OF WATER SUPPLIES. There shall be no physical connection between a public or private potable water supply system and a sewer, or appurtenance thereto, which would permit the passage of any wastewater or polluted water into the potable water supply.

1. Horizontal Separation: Sewer mains shall be laid at least 10 feet horizontally from any existing or proposed water main. The distances shall be measured edge to edge. In cases where it is not practical to maintain a 10-foot separation, the Engineer may allow deviation on a case-by-case sewer closer to a water main, provided that the water main is in a separate trench or on an undisturbed earth shelf located on one side of the sewer at such an elevation that the bottom of the water main is at least 18 inches above the top of the sewer.
2. Crossings: Sewers crossing water mains shall be laid to provide a minimum vertical distance of 18 inches between the outside of the water main and the outside of the sewer. This shall be the case where the water main is either above or below the sewer. The crossing shall be arranged so that the sewer joints will be equidistant and as far as possible from the water main joints. Where a water main crosses under a sewer, adequate structural support shall be provided for the sewer to prevent damage to the water main.
3. Special Conditions: When it is impossible to obtain proper horizontal and vertical separation as stipulated above, the sewer shall be designed and constructed equal to water pipe, and shall be pressure tested to assure water tightness prior to backfilling.

No water pipe shall pass through, or come in contact with, any part of a sewer or a sewer manhole.

O. AERIAL CROSSINGS. Adequate support shall be provided at all joints in pipes utilized for aerial crossings. Only ductile-iron pipe with restrained joints shall be used unless otherwise approved by the City Engineer.

Precautions against freezing, such as insulation and increased slope, shall be provided. Expansion jointing shall be provided between above-ground and below-ground sewers. Where buried sewers change to aerial sewers, special construction techniques shall be used to minimize frost heaving.

For aerial stream crossings, the impact of flood waters and debris shall be considered. The bottom of the pipe should be placed no lower than the elevation of the fifty (50)-year flood.

P. EASEMENTS. Public sanitary sewer mains outside of the public right-of-way shall be encompassed entirely by a public sanitary sewer easement, at least twenty (20) feet minimum width, and centered over the facilities. Excessively deep facilities, or other

special circumstances may require a wider easement as determined by the City Engineer.

- Q. TRACER WIRE PIPE DETECTION SYSTEM. Tracer wire pipe detection shall be installed on private service lines between the mainline and the two-way cleanout within the public right-of-way per Section 9100 Tracer Wire Pipe Detection System.