



SANITARY SEWER DESIGN STANDARDS

DEFINITIONS

Sewage or Wastewater: This is the "used" water that contains human wastes from toilets and water from other sources such as sinks, showers, washing machines, dishwashers, etc. Industrial and commercial wastes are also considered sewage or wastewater.

Sanitary Sewer System, or Wastewater Collection System, or Sewers: These are pipes through which sewage is carried from homes and businesses to a treatment plant. The sanitary sewer system includes the main sewer lines in the streets and the branch lines to individual sewer customers called "sewer laterals."

Sewer systems are generally designed to flow by gravity through sloped pipes until it reaches either the treatment plant or a sewage pumping station (which pumps the sewage up to another higher sewer or a treatment plant).

The term "sanitary sewer" is used because sewer pipes are separate from the pipes used for storm water drainage. This helps protect public health and the environment. In some older cities, such as San Francisco, sewage and rainwater flow through the same pipes. This can cause major environmental and public health problems because untreated or partially treated-sewage may be discharged into streams, rivers, and other water bodies during heavy rain.

Sewer Lateral: This is the sewer pipe that connects a building's plumbing system to the main sewer line in the street. Maintenance and ownership of sewer lateral pipes is the responsibility of the property owner. Sewer laterals are also called "service laterals," "house laterals," or simply "laterals."

Sewer Main: This is the sewer pipe that collects flow from laterals. Mains are typically larger pipes than laterals, and get larger and larger further downstream as more and more flow enters the main. Sewer mains are typically located under public streets and maintained by the City.

Sewer Cleanout: This is a pipe rising from the sewer lateral to the ground surface with a removable cap or plug. It is used to access the sewer lateral to free blockages. A sewer cleanout is usually located just inside the property line. There may be additional sewer cleanouts at various other locations on a property.

Backflow Prevention Device: This is a device that prevents sewage from backing up from a main line into a lateral beyond where it is installed. This forces an overflow outside of a home, through a manhole or cleanout, rather than inside where significant property damage may occur.

Infiltration: This refers to groundwater (water found below the ground surface) that enters sewer pipes through cracks, pipe joints, and other system leaks. Because sewers in coastal areas are typically buried deep, they are often located below the water table. Since most sewer lines do not flow full (under pressure), groundwater "infiltrating" into the sewer line is actually more of a problem than sewage leaking out of the line. Storm events can raise groundwater levels and increase infiltration of groundwater into sewer pipes. The highest infiltration flows are observed during or right after heavy rain. Too much infiltration may overload the sewers and cause spills.

Inflow: This is rainwater that enters the sewer system from sources such as yard and patio drains, roof gutter downspouts, uncapped cleanouts, pond or pool overflow drains, footing drains, cross-connections with storm drains, and even holes in manhole covers. Inflow is greatest during heavy rainfall and like infiltration, can cause excessive flows and sewage spills.

Manholes: Sewer manholes are underground structures used to provide access to underground sewer lines and are usually found in a street, parking area or sidewalk. Access is required to periodically inspect and clean the lines. Sewer manholes typically have heavy round covers with the words "Sanitary Sewer" on the cover.

Sanitary Sewer Overflow: Sewage spills are technically called "sanitary sewer overflows" since it involves the overflow of sewage from the sanitary sewer system. Sewage overflows often occur from sewer manholes in the streets. Sewage can also backup into homes through toilets, showers, and floor drains. Sewage spills are caused by sewage filling the sewer pipes behind the clog to the point where it spills out of an opening in the system (generally the lowest manhole, shower drain or other plumbing fixture).

Average Flows: Average flows are typically dry weather sewer flows over a specific time period and often expressed in gallons per day. Average flows do not account for inflow and infiltration and are therefore not usually the basis for designing a sewer piping system.

Peak Flows: Peak flows are typically average flows multiplied by a peaking factor to account for inflow and infiltration and diurnal fluctuations. Sewer designs are usually based on peak flows, and a typical peaking factor is between three and five.

Design Flows: Design flows are the flows used to design a sewer system. Typically, they are peak flows. For the City of Brisbane's sewer design criteria, design flows are peak flows at build-out conditions, which are average flows multiplied by a peaking factor of three.

SEWER MAINS

Materials

1. New gravity mains shall be polyvinyl chloride (PVC) or high density polyethylene (HDPE) with a maximum standard dimensional ratio (SDR) of 35 for conditions with at least three feet of cover. In cases where the City authorizes less than three feet of cover, alternate SDRs may be required. The City may require alternate pipe materials in cases with less than minimum cover or when other utilities are in close proximity to the sewer main.
2. For sewer main replacements that are five feet or less in length, pipe materials may match existing materials (e.g., when replacing a five-foot section of vitrified clay pipe (VCP), the replacement section can also be VCP). All sewer main replacements of more than five feet shall be PVC pipe.

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Sizing

1. Flow Sizing

- A. Gravity mains shall be a minimum of eight inches (8") in diameter.
- B. Mains shall be designed to carry peak flows at build-out conditions ("design flows"). Average daily flow values shall be computed based on the following table, and multiplied by a peaking factor of five (5) to determine design flows. Calculations for design flow rates shall be submitted to the City Engineer for review.

Land Use	Unit Flow Rate (gallons/day/ acre)	Unit Flow Rate (gallons/day/ dwelling unit)
Brisbane Village Neighborhood Commercial District	500	-
Downtown Brisbane Neighborhood Commercial District	500	
Manufacturing District	500	
Medium Density Apartment District	-	90
Multiple Use Residential District		90
Office District	1500	
Open Space District	0	-
Planned Development District		90
Single Family (20,000 sq. ft. building site)		105
Single Family (5,000 sq. ft. building site)	-	105
Southwest Bayshore Commercial District	500	
Trade Commercial — Crocker Park District	250	

- C. Maximum depth of flow for pipes between eight and ten inches in diameter shall be one-half (1/2) the pipe diameter at design flows. For pipes twelve inches and larger in diameter, the maximum flow depth shall be two-thirds (2/3) the pipe diameter at design flows.
- D. Mains shall be sized using Manning's equation based on design flows, a roughness coefficient ("n") of 0.0135 or the pipe manufacturer's recommendation, whichever is greater, maximum flow depths, and maintaining minimum design slopes.
- E. Miscellaneous head losses at manholes, curves, and junctions shall be estimated and allowed for as follows:
- i) At manholes on straight runs allow head loss = 0.05 feet.
 - ii) 90° turns made inside of manholes, where the radius of turn is less than two pipe diameters, allow $0.50 V^2/2g$. If the radius of turn is greater than two pipe diameters, allow $0.25 V^2/2g$. In no case shall the total allowance be less than 0.05 feet.
 - iii) At transitions and intersections of sewers larger than 24 inches in diameter, allow $0.50 V^2/2g$.

2. Velocity Sizing

- A. Mains shall be designed to transport suspended solids without deposition in the pipe.
- B. Mains shall be designed to maintain minimum cleansing velocities of three (3) feet per second for ten inch and smaller diameter pipes and two (2) feet per second for twelve inch and larger diameter pipes at design flow conditions.
- C. The maximum velocity for all pipe diameters is 10 feet per second.

Alignment

1. Depth

- A. Gravity mains shall be installed at a depth sufficient to provide a minimum of three feet of cover above the crown of the pipe. Installations with lesser amounts of cover are at the City's discretion, and may require alternative pipe material.
- B. Sewers shall be installed at sufficient depth to provide gravity service to properties contiguous to the sewer line. Additional depth may be required to provide service. Generally, house services shall be a minimum of four feet below the top of curb at the property line as measured from the top of curb to the invert of the services.

2. Slope

- A. Ten-inch and smaller diameter mains shall have a minimum slope of 0.0036. Twelve-inch and larger diameter mains shall have a minimum slope of 0.0024.
- B. Slopes shall be adjusted based on ground level gradient and maintaining minimum cleansing velocities. Minimum slopes shall only be used when topography and existing sewer depth make greater slopes impossible or when anticipated flows are such that scouring velocity is achieved on a regular basis. Increasing pipe size to allow lesser slopes will be at the City's discretion.

3. Curvature

- A. Horizontal and vertical curves are not recommended, but in cases where justification can be shown, limited use of such designs will be considered. A design report shall be submitted from the design engineer justifying a curved alignment. In no case shall horizontal or vertical curves exceed 1/32 bend (11.25 degrees). Complete and accurate details shall be furnished, including: exact location of such curved sewers, length of curve, degree of curve (or radius), and stationing of curve points.
- B. Where curved alignments are utilized, the City may require the following:
 - i) Slope greater than minimum slope for the size of pipe.

- ii) Manhole spacing of less than 300 feet.
- iii) Provide a licensed professional land surveyor or engineer to continuously monitor installation of the curved pipe during construction.
- iv) Video inspection prior to final acceptance.

4. Placement in street/easement

- A. Under normal conditions, sewers shall be constructed in straight lines from manhole to manhole in public rights-of-way or private roads. When practical, sewers shall be installed on the opposite side of the right-of-way from water and storm drain lines.
- B. Sewer trenches shall not extend under the edge of gutters.
- C. When necessary to locate sewers in public easements, such easement shall have a width equal to twice the depth of the sewer main, or 15 feet, whichever is greater. Sewers 24 inches in diameter or larger, or over 12 feet in depth, may require wider easements. All easements shall allow for year-round vehicular access to all manholes and cleanouts.

Clearances to other utilities/structures

1. Sewer mains shall be installed a minimum of 10 feet horizontally from all structures and existing or proposed water mains. In situations where it is not feasible to maintain a 10-foot separation, the distance may be reduced at the City's discretion.
2. Sewer mains shall have a minimum one foot clearance to all other utilities. Installations with lesser clearances are at the City's discretion and may require alternate pipe materials.
3. Sewer mains shall be installed beneath water lines and storm drain lines by at least 18 inches (crown of sewer line to invert of water or storm drain line). Crossings shall be arranged so sewer line joints will be equidistant and as far as possible from the water main (-10 feet).
4. Sewer mains shall be installed at least five feet horizontally from all trees, where practical.

Cover/trench requirements

1. Minimum cover over gravity sewer mains shall be three feet.
2. Plastic detection tape shall be installed one foot above the crown of all gravity sewer mains.
3. Sewer main trenches shall be backfilled with four inches of compacted fill sand prior to laying pipe. Once pipe is installed, it shall be backfilled to twelve inches above the crown with compacted fill sand, followed by native material (with rocks over two inches removed) compacted to 90% relative compaction. Native material shall extend to finished grade in unimproved areas. In existing or new streets, backfill and street section above the pipe shall

be in accordance with the City's Street Standards.

Maximum run between and connections to manholes

1. The maximum run between manholes shall be no more than 300 feet.
2. Connection to existing manholes shall be made with a concrete core saw and neoprene adapter boot. Exceptions to this requirement are at the City's discretion. New connections to existing manholes shall be fitted with a temporary plug until the entire project has been accepted. Connections to structures other than manholes shall be specifically detailed on the plans for approval by the City.

Cleanouts

Terminal cleanout structures are acceptable at the end of sewer lines if located no more than 100 feet to the downstream manhole.

LATERALS

Materials

Sewer laterals shall be SDR 35 PVC or HDPE pipe with a minimum of three feet of cover. In situations where cover is between 18 inches and three feet, SDR 26 is required. The City may require alternative pipe materials if minimum cover cannot be achieved.

Sizing

Laterals shall be a minimum of four inches (4") in diameter for single family residences and six inches (6") for multiple units, apartments, local retail, and commercial, and eight inches (8") or larger as required for manufacturing and industrial, and should be sized to accommodate anticipated flow.

Connections per building/unit

For new construction, service laterals shall be provided to every parcel being served as part of the project. Each individual building or dwelling unit requires a separate service lateral, with separate connection to the sewer main. Connections for multi-unit buildings will be at the City's direction. For existing construction, if the City determines individual buildings or dwelling units are served by a joint lateral, the City may require property owners to install separate laterals for each building or dwelling unit and establish appropriate private easement agreements as necessary, or may require upgrades to existing joint laterals if installation of separate laterals is infeasible.

Alignment

1. Depth

Laterals shall be placed a minimum of three feet (3') below finished grade. This shall extend all the way to the building connection. Therefore, in general, the minimum depth for sewer to serve a given residential property shall be three feet plus 2% times the length of the house lateral (the distance from the sewer to the center of the house). Less than minimum cover is at the City's discretion and may require alternative pipe material.

2. Slope

Laterals shall have a minimum two percent (2%) slope. Lesser slopes are at the City's discretion.

3. Cover/trench requirements

Sewer lateral trenches shall be backfilled with four inches of compacted fill sand prior to laying pipe. Once pipe is installed, it shall be backfilled to twelve inches above the crown with compacted fill sand, followed by native material (with rocks over two inches removed) compacted to 90% relative compaction. Native material shall extend to finished grade in unimproved areas. In existing or new streets, native material shall be followed by asphalt concrete/aggregate base lifts in accordance with the City's Street Standards.

Clearances to other utilities/structures

Laterals shall be installed with a ten-foot minimum horizontal separation to water service lines. Cleanouts

Each lateral shall have an approved cleanout. Cleanouts shall be located approximately six inches (6") from the property line on private property (at the right-of-way or easement line).

Backflow prevention devices

Backflow prevention devices shall be incorporated as part of the cleanout on all new lateral installations. Backflow prevention devices shall be installed on existing laterals during remodeling or if new plumbing fixtures are added to a home.

Connection to mains

1. No sewer laterals smaller than eight inches shall be connected to manholes.
2. Lateral connections to existing mains may be made by tapping the existing main only when the lateral diameter is less than or equal to three-fourths (0.75) the main line size. If this ratio is exceeded, the connection shall be made by removing a section of the main line and installing a properly sized wye fitting. Laterals eight inches in diameter and larger shall connect to the mainline at a manhole.

3. Laterals shall be constructed perpendicular to the main line and shall intersect the property line a minimum of five feet from the property corners. Exceptions will be made in the case of cul-de-sacs where perpendicular service lines are not practical.

PRESSURE SYSTEMS

Materials

All pressure systems shall utilize heat-fused high density polyethylene (**HDPE**) pipe meeting Specification Section 15066, or PVC pipe meeting American Water Works Association (AWWA)'s C900 specifications with appropriate couplings.

Sizing

Pressure mains shall be sized to accommodate anticipated peak flow rates based on hydraulic calculations for downstream pump sizing. Hydraulic calculations showing pump and pipeline sizing shall be submitted to the City Engineer for approval.

Alignment

1. Depth

Pressure mains shall be installed with a minimum of three feet of cover. Installation at shallower depths shall be at the discretion of the City Engineer and may require alternate pipe material.

2. Slope

Pressure mains shall be installed to avoid bellies.

3. Cover/trench requirements

Minimum cover over pressure mains shall be three feet.

Clearances to other utilities/structures

1. Pressure mains shall be installed a minimum of 10 feet horizontally from all structures.
2. Pressure mains shall have a minimum one foot clearance to all other utilities. Installations with lesser clearances are at the City's discretion and may require alternate pipe materials.
3. Pressure mains shall be installed beneath water lines and storm drain lines by a minimum of 18 inches (crown of sewer line to invert of water or storm drain line).

Air release/vacuum valves

Air release/vacuum valves shall be installed at all high points along the pressure main alignment.

MANHOLES

Frequency/Location

1. Manholes shall be located at all sewer main intersections, at all changes in vertical or horizontal alignment, pipe size, or grade, where laterals larger than eight inches are connecting to a main, and at the beginning and end of curved sewer sections.
2. Manhole spacing shall be 300 feet, at a maximum. Manholes shall be installed at all terminating sewer mains longer than 100 feet.
3. All manholes shall be located in such a way that maintenance vehicles will have year-round access.
4. Monitoring manholes may be required at commercial/industrial service connections at the direction of the City. A monitoring manhole shall be required on all new construction or renovations or modifications to existing facilities, where the discharge originating in the new, renovated, or modified facility is, or will have the potential to be, non-domestic in nature. All waste from the facility shall flow through the monitoring manhole.

Type

1. Drop manholes are not recommended, but in cases where justification can be shown, limited use of such designs will be considered. Elevation drop through manholes shall be a minimum of 0.2 ft. Inside drops shall have a maximum drop of 2 ft. Drops greater than 2 ft shall be constructed with outside drop structures. Where unequal pipe diameters enter a manhole, crown of pipes shall be at the same elevation.
2. Flat top manholes shall be used where the distance from the invert to the rim is less than six feet. Manholes greater than six feet deep shall be constructed with standard cone sections.

Materials

1. Manholes shall be constructed using Class A concrete.
2. Manhole joints shall be made watertight using neoprene gaskets, subject to City Engineer approval.
3. New connections to existing manholes shall be made with neoprene adapter boots.

Sizing

1. Manholes 48 inches in diameter may be used for sewer mains up to 18 inches in diameter and up to 15 feet deep. Manholes 60 inches in diameter may be used for sewer mains up to 42 inches in diameter and up to 22 feet deep, or where the alignment of the main lines is such

that the distance between openings would be less than 1.5 feet with a smaller manhole.

2. Manhole necks shall be adjusted to finished grade by the use of concrete grade rings with approved sealant between each ring. The maximum height of grade rings shall be 12 inches for new construction and 18 inches for modifications to existing manholes. Adjustments beyond these limits shall be made with full barrel sections.

Covers

1. Manholes located outside of the paved surface shall be fitted with lockdown, watertight covers.
2. Where a manhole is in a sump or other area that is prone to flooding, watertight covers shall be used. Manhole cones shall be rotated to avoid areas of standing water to the extent possible. All manhole rims shall be 6 inches above the 100-year flood elevation, except where the rim would be more than four feet above the existing grade, in which case watertight covers shall be used and manholes set at a height of four feet above final grade.

Lining

Downstream transition manholes originating from a pump station or manholes where turbulence is a factor may be required to be coated with hydrogen sulfide-resistant material.

TESTING AND ACCEPTANCE REQUIREMENTS

General

1. All gravity and pressure sewer pipes and service laterals shall be tested for exfiltration and/or infiltration and deflection.
2. Sanitary sewer systems shall be subjected to an air or water pressure test, as approved by the City Engineer.
3. Sewer lines shall be television-inspected at the City's discretion.
4. Manholes shall be hydrostatically tested for leakage after installation, but prior to being backfilled. Prior to hydrostatic testing, all manholes shall be visually inspected for leaks. All leaks or cracks shall be repaired prior to hydrostatic testing, to the satisfaction of the Public Works Inspector.

MAINTENANCE REQUIREMENTS

The City maintains all public sewer mains and manholes.

Property owners own the lateral from the connection at the structure to the main line. Tree root intrusion, grease buildup, cracks, breaks, etc., are all the responsibility of the property owner. Maintenance of the lateral is the property owner's responsibility.