Chapter 9

Sanitary Sewers

Chapter 9
Sanitary Sewers

Chapter 9
Sanitary Sewers

9.1 General Requirements

9.1.1 Design.

The design for sanitary facilities shall be in conformance with current versions of the following:

1. City of Sioux Falls Design Standards, Standard Specifications, and Standard Plates.
2. Requirements and Standards of the South Dakota Department of Environment and Natural Resources.
3. Recommended Standards for Wastewater Facilities Great Lakes—Upper Mississippi River Board of State Public Health and Environmental Managers Edition (Ten State Standards).
4. South Dakota State Plumbing Code.
5. *Uniform Plumbing Code* of International Association of Plumbing and Mechanical Officials.
6. Conflict—In case of a conflict between the above design standards, the most restrictive requirement shall apply.

9.1.2 Construction Standards.

Construction standards shall be the current version of the City of Sioux Falls Standard Specifications and Standard Plates together with the latest addenda. All details, materials, and sewer appurtenances shall conform to these standards.

9.2 Plan Submittals

9.2.1 Subdivision Plan Submittals.

See Chapter 13 for Subdivision Plan Submittal requirements.

9.2.2 Capital Improvement Project Plan Submittals.

See Chapter 13 for Capital Improvement Project Plan Submittal requirements.

9.3 Determination of Flow

9.3.1 Lateral Sewers.

1. Discharge (QA) Average Daily Flow (gpd).

Equation 1: Area x Area Density x Unit Density x Rate = Average Daily Flow.

Equation 2: Number of Units x Unit Density x Rate = Average Daily Flow.

Density for multiple dwelling units shall not be less than 2.5 persons/unit. Density for single-family dwelling units shall not be less than 3.5 persons per unit.

2. Discharge (QP) Peak Lateral Sewer Flow (gpm).

   Average Daily Flow x 400% = Peak Lateral Sewer Flow.

3. Design Density and Rate—(See paragraph 9.3.5).

9.3.2 Trunk Sewers.

1. Discharge (QA) Average Daily Flow (gpm).

   Equation 1: Area x Area Density x Unit Density x Rate = Average Daily Flow.

   Equation 2: Number of Units x Unit Density x Rate = Average Daily Flow.

2. Discharge (QP) Peak Trunk Flow (gpm).

   Average Daily Flow x 250% = Peak Trunk Sewer Flow.

3. Design Density and Rate—(See paragraph 9.3.5).

9.3.3 Area.

Gross area shall be used in determining design flows and shall include streets and alleys but exclude parks, school grounds, and similar dedicated open space.

9.3.4 Special Design Densities.

Special design densities shall be subject to approval by the City Engineer based on methodology provided by the design professional.

9.3.5 Density Design Table.

Land Use	Area Density	Unit Density	Rate*
Low Density Residential	6 units/acre	3 people/unit	100 gpcd
Med. Density Residential	12 units/acre	2 people/unit	100 gpcd
High Density Residential	25 units/acre	2 people/unit	100 gpcd

Office and Institutional	Special Design Density—dependent on water use.
Commercial	Special Design Density—dependent on water use.
Industrial	Special Design Density—dependent on water use.

*gpcd—gallons per capita per day

9.4 Facility Design

9.4.1 Capacity of Pipe.

The Manning Equation shall be used to determine pipe capacities. The design Manning's (n) for all Pipe Materials.

"n" = 0.013

9.4.2 Velocity within Pipe.

Max. at peak flow = 14 feet per second (fps).

The following are the minimum slopes that shall be provided unless the City Engineer allows an exception; however, slopes greater than these are desirable.

Pipe Size (in)	Slope (%)
8	0.400
10	0.280
12	0.220
14	0.170
15	0.150
16	0.140
18	0.120
21	0.100
24	0.080

Gravity sanitary sewer pipe slopes entering manholes shall not exceed 9%.

9.4.3 Approved Pipe Materials.

Refer to Standard Specifications.

9.4.4 Force Main Minimum and Maximum Velocity.

The minimum force main velocity shall be 2 feet per second.

Suction and discharging piping for lift stations shall be sized so that the maximum velocities do not exceed 5 feet per second and 8 feet per second, respectively.

Dual force mains will be required if the initial force main velocities cannot meet the minimum velocity standards or if odor problems are anticipated.

9.4.5 Size of Sewer Pipe.

The minimum gravity sewer size for public or private sanitary sewer collection systems shall be 8-inch diameter.

9.4.6 Depth of Sewer.

Gravity sewers shall have a minimum depth of 7 feet to the invert where practical. Insulation shall be placed above the sanitary sewer where the dimension from the finished grade elevation to the top of the pipe is 5 feet or less (see the Standard Plates for pipe insulation details). The maximum sanitary sewer depth to the invert at manholes shall be 15 feet.

9.4.7 Alignment of Sewers.

Sewers shall be installed in a straight line between manholes. In subdivisions where street layouts are such that a straight alignment is not practical, sewers may be curved. All sanitary sewers on curved streets shall be located in the center of the street. Where it is not possible to maintain the centerline location on a curved street (ex: road centerline radius of curvature less than 200 feet), the sanitary sewer shall be located as close to the centerline as possible and at a distance of at least 10 feet from the back of curb. The following table shows the minimum pipe radius.

Pipe Size (inches)	Minimum Radius (feet)
8	200
10	250
12	300

The recommendation for 15-inch through 36-inch diameter sewer pipe is that the angular deflection at the joint is a maximum of 1.5 degrees. This will produce an offset in a 20-foot section of approximately 6.25 inches. The pipe manufacturer's recommended minimum curvature shall not be exceeded.

9.4.8 Physical Requirements.

1. **Minimum Manhole Diameter**—48 inches when the influent or effluent piping is less than 18 inches. Manholes are to have a minimum diameter of 60 inches when either the influent or effluent pipes are 18 inches and greater. In all cases, the manufacturer's recommended minimum spacing between pipes shall be followed.

2. **Maximum Manhole Spacing**

Diameter of Sewer	Distance
All sanitary sewer pipe diameters	400 feet

Note: Exceptions will be permitted within a development; however, said exceptions shall not be for more than 5 percent of the manholes in the development. Said exceptions shall not exceed 6 percent of the above distances.

3. **Manhole Locations.** Manholes shall be installed at the following locations:

   a. At the end of each sewer line. "Dead end" manholes on line segments shall be extended beyond the midpoint of the last serviced lot.

   b. At all changes in pipe size, grade, or alignment.

   c. At all sewer pipe intersections.

   d. Manholes located within the pavement at the end of cul-de-sacs shall be located 5 to 10 feet from the back of curb and gutter.

   e. All manholes located on trunk sewers or lines 10 inches and greater shall be constructed with a corrosion-resistant liner.

   f. Sanitary sewer lines ending at development phase boundaries that do not terminate with a manhole shall be ended with a bell end section of pipe and watertight plug. A 1-foot or less section of pipe with a glued-on cap inserted into the bell end of the pipe will be allowable as a watertight plug. Couplings will not be allowed for this type of connection unless there is a change in pipe material. The sewer shall not be put in service until a manhole on the dead end line is installed.

   g. Shall be placed outside the 100-year floodplain. Exceptions will require approval from the City Engineer and shall include placing the rim elevation a minimum of 1-foot above the 100-year base flood elevation.

4. **Minimum Manhole Drop**

   Same pipe size—0.10 feet.

   Change in pipe size—match 0.8 depth point of all lines as a minimum and match tops of pipes whenever possible.

5. **Maximum Manhole Drop**

   The designer shall remove drop manholes of less than 4 feet by increasing the pipe slope as long as velocity requirements are not exceeded. When the drop is less than 1.5 feet, the manhole invert shall be constructed to form a uniform slope from the incoming pipes to the outgoing pipe.

6. **Manhole Covers, Manhole External Joint Seals, and Manhole Markers.** Refer to Standard Specifications for materials and construction requirements.

7. **Access to Manholes.** Manholes outside the street right-of-way shall be subject to the acceptance of the City Engineer. Manholes located outside of the street rights-of-way must be located in areas that allow direct access by maintenance vehicles. In parking areas, there shall be no parking within 10 feet of a manhole rim.

8. **Industrial Sewer Monitoring Facility.** Any new building constructed or proposed to be constructed in an industrially zoned area with a floor space of greater than 5,000 square feet, and with a water meter size of greater than 3/4 inch and projected process wastewater flow greater than 5,000 gallons per day, or if otherwise required by the Director of Public Works, shall install a sewer monitoring facility prior to final building inspection approval. The monitoring facility shall normally be situated outside of the building on the user's premises. If the industrial user's service line ties into an existing City manhole and such manhole allows for safe sampling and isolation of the industrial user's discharge, the Director of Public Works may allow said manhole to serve as the industrial user's monitoring facility.

9. **Crossings.** Sanitary sewer crossings of storm sewers shall have no less than 6 inches of clearance. Special structural support and insulation will be required if there is less than 18 inches clearance (see the Standard Plates for insulation details). Clearance refers to the distance from the outside of the sewer pipe to the outside of the storm sewer pipe.

   Sewer systems shall be designed to minimize the number of open channel drainage crossings. Sanitary sewer crossings of open channel drainage features shall be designed as nearly perpendicular as possible and shall be on a constant grade. Special structural support and

insulation will be required if less than 3 feet of cover is provided within the stream bed.

Sanitary sewer crossings of other utilities shall be done in accordance with the South Dakota Department of Environment and Natural Resources, the City Standard Specifications, and the City Standard Plates.

10. **Standard Plates.** See Supplemental Standard Specifications and Standard Plates for such details as manholes, drop connections, risers, and other appurtenances.

9.4.9 Sewer Services.

9.4.9.1 Connections to Manholes.

Individual services may not be connected into manholes.

9.4.9.2 Regular Services.

1. Each structure shall be served by a separate service line connected to a public or private sanitary lateral sewer. The service should be perpendicular to the lateral sewer line in the public right-of-way. Single-family attached housing (twin homes, duplexes, etc.) will be required to have separate services for each living unit. The service for each living unit shall not be located under the property of the adjacent living unit.

2. Sewer services must meet all the requirements of the Supplemental Standard Specifications and Standard Plates.

3. All platted lots of a proposed subdivision are to front on and have a separate sewer service to a public sanitary sewer main without crossing adjacent properties. Additional sewer services will be required for each additional principal structure on a given lot.

4. Sewer services across one lot to provide service to an adjacent lot in a proposed subdivision may be approved, provided that all of the following conditions are met:

    a. Proposed subdivision does not exceed two lots.

    b. A private utility easement 20 feet in width is provided across the burdened lot (to be occupied by sewer service only).

    c. The City Engineer's Office determines that a sewer main extension will not be necessary to perpetuate the system

and in all likelihood no future development of abutting properties will benefit from a main extension.

5. Minimum size of building sanitary sewer stub outs shall be 4-inch diameter. All sanitary sewer services other than single-family residential units (example: commercial, industrial, office, multifamily, etc.) shall be a minimum of 6-inch diameter. No private lateral sewer shall be less than 6 inches in diameter; however, 8-inch diameter sewers are recommended.

6. Service lines shall be designed with a 2 percent grade (absolute minimum of 1 percent upon approval of the City Engineer).

7. Whenever possible, the building sewer shall be brought to the building at an elevation below the basement floor. In all buildings in which any building drain is too low to permit gravity flow to the public sewer, sanitary wastewater carried by the building drain shall be lifted by an approved means and discharged to the building sewer at the owner's expense.

8. Risers on service stub outs shall be provided for sewers greater than 12 feet deep as measured at the main line sanitary sewer (see the Standard Plates for riser details).

9. Private sewer service clean-outs will not be allowed in the public right-of-way. All clean-outs shall be protected with approved cover protection (see Standard Plates).

9.4.9.3 Lateral Extension.

1. The sanitary sewer collection system shall be considered "public," if the following conditions exist:

   a. The sanitary sewer serves upstream properties outside of the development.

   b. Sanitary sewer serves more than one lot.

2. The sanitary sewer collection system shall be considered "private" if the following condition exists:

   a. The sanitary sewer is extended to a single private lot to serve a building(s) and/or dwelling unit(s), which are not platted separately and/or are not separated by a two-hour fire wall (identified by the International Building Code or City of Sioux Falls Ordinance). Appropriate private sanitary sewer easements shall be placed over

the center line of the lateral or service extension meeting the width requirement for public sanitary sewer lines.

b. Shared public and private utility easements will not be allowed.

c. Private maintenance agreements—refer to subdivision ordinance for private maintenance agreements.

9.4.10 Sewage Lift Stations.

The Design Standards and Standard Details for sewage lift stations shall be used for all stations unless a separate design is determined necessary by the City Engineer. Example specifications and drawings can be obtained from the City Engineer's Office for reference. Each pumping station shall be provided with a minimum of two pumps, each having a capacity sufficient to pump the peak design flow. Submersible pumps will not be allowed.

Temporary lift stations with reduced design requirements may be considered by the City Engineer where future trunk sewers are planned to eliminate the need for the station within five years from the installation date of the lift station. Temporary pump stations and force mains shall only be used if the criteria in the "Policy on Temporary Pump Stations and Force Mains" established by City Council resolution are met.

No sanitary sewage shall be allowed to be discharged into a newly constructed lift station wet well until final completion is made and notification is made by the City assuring operation responsibilities.

9.4.10.1 Specific Equipment Required.

The sewage lift station shall be supplied with, but not be limited to, the following specific items:

Separate dry well and wet well.

Flow meter.

Secondary power supply—engine generator system.

Automatic transfer switch for the secondary power supply.

Programmable logic controller to control and monitor the lift station remotely and locally.

Man lift for all stations greater than 20 feet in depth (the depth shall be defined as the dimension from the top of the dry well entrance tube to the floor of the dry well).

Variable Frequency Drive (VFD) for all motors greater than 30 horsepower—the requirement for VFDs may be deleted if it is determined unnecessary by the City Engineer.

9.4.10.2 Wet Well Design.

The wet well design shall be coordinated with pump sizing in order to avoid frequent on/off cycling of the pumps. To prevent septicity, wet well detention time at average daily flow (QA) should not exceed 30 minutes.

Cycle time is the total time between starts of an individual pump and can be determined by comparing the volume between the “on” and “off” levels in the wet well with the pump capacity. Cycle time is computed as follows:

Where:

CT = Cycle Time (minutes);

V = Wet Well Volume between On and Off Levels (gallons);

D = Rated Pump Capacity (gallons per minute); and

(QP) = Peak Hourly Lateral Sewer Flow (gallons per minute).

$CT = V/(D- QP) + V/ QP$

With a given wet well volume and pumps of uniform pumping rate, minimum cycle time will occur when the rate of inflow is equal to one-half of the discharge rate of the individual pump under consideration and the formula for cycle time simplifies to $CT = 2V/ QP = 4V/D$. An effective wet well volume of at least 2.5 times the discharge rate of the pump is required.

The operating volume of the wet well shall be designed to provide the following maximum motor starting times at the design pumping rates.

Motor Size, hp	Maximum Motor Starting Times
0–25	6 starts per hour
26–35	5 starts per hour
36–60	4 starts per hour

9.4.10.3 Pump Design.

The operating speed of the pumps shall not exceed 1,800 rpm. The test sphere minimum diameter shall be no less than 3 inches in diameter. The minimum suction and discharge diameter shall be no less than 4 inches in diameter.

9.4.10.4 Engine Generator Design.

The engine generator shall be designed to operate each pump simultaneously but start each pump separately. If more than two pumps are used, the engine generator shall be designed to start the pumps necessary for the firm pumping capacity of the station simultaneously. It shall be at the City Engineer's discretion to change the generator sizing requirements when the size of the lift station warrants it. The engine generator system shall be a four-cycle water-cooled type. The generator shall be supplied with an automatic transfer switch. An enclosure for the automatic transfer switch shall be supplied and sized large enough to contain the station on/off switches, telephone termination boxes, and other necessary controls. The generator shall be enclosed in a sound attenuation enclosure and supplied with all accessories which make it a complete operating system.

9.4.10.5 Power Supply.

The power supply shall be 240 volt, 60 Hz, 3-phase unless 480-volt power supply is required and/or available.

9.4.10.6 Access Road to the Lift Station.

An access into the lift station will be required and shall be shown on the construction drawings. The access road shall meet minimum thickness and materials standards for streets. The surfacing used shall be asphalt or concrete.

9.4.10.7 Lift Station Site Fencing.

A fence shall be required and constructed around the perimeter of the lift station generator. The City Engineer shall determine if a fence is required around the entire site. The fence shall be as detailed and specified in the Standard Plates.

9.4.10.8 Site Landscaping.

The Contractor shall maintain the grass areas by watering, fertilizing, reseeding, mulching, and mowing until the grass has established a 2-inch catch of grass. The Contractor shall immediately reseed and mulch areas which show bare spots at no additional cost.

9.4.10.9 Odor Control.

Odor control shall be provided at the lift station and/or the force main discharge where it is determined to be a detectable problem or shown through a design analysis. The design engineer shall perform an analysis showing the modeled results of the odor

control analysis. Odor control will be required at the lift station and force main discharge point if it is found to be a detectable problem in the analysis or in the field as determined by the City Engineer within the two-year warranty period.

9.4.10.10 Flooding.

Wastewater pumping station structures and electrical and mechanical equipment shall be protected from physical damage by the 100-year flood and shall remain fully accessible during the 100-year flood.

9.5 Sanitary Sewer Easements

Sanitary sewer easements shall be obtained for all sanitary sewers located on private and public property. In addition, temporary easements may be required for construction.

Sanitary sewer easements shall be accessible for City maintenance vehicles to drive on to maintain the sanitary sewer. All manholes shall be accessible to City maintenance vehicles. If determined necessary by the City Engineer, the area over the sanitary sewer shall be benched to provide an access trail along the line and/or to the manholes.

The current version of the sanitary sewer easement forms shall be used and obtained from the City Engineer's Office.

The following Table 9.5 lists the minimum easement widths for sanitary sewer with a pipe diameter of 30 inches or less. The minimum easement widths shall be used when preparing plans. Easements shall be shown on the Preliminary Plans, Development Engineering Plans, and CIP Plans. Plans are to show the easement dimensioned from the centerline of the pipe to the outside edge of the easement and labeled "Sanitary Sewer Easement." The easement widths may be required to be wider depending upon specific site conditions.

Easement shall be provided over lots where sewer crosses, but no Development Plan has been submitted. The minimum horizontal clear distance between pipes shall be half the necessary sanitary sewer easement width. Water and storm easements can overlap 10 feet max when running parallel.

Table 9.5
Minimum Required Easement Width for Sanitary Sewer
(for 30-inch pipe and smaller)

Pipe Depth (feet)	Minimum Easement Width Required (feet)
8	20
9	20
10	20
11	22
12	24
13	28
14	30
15	34
16	36
17	40
18	42
19	46
20	48
21	52
22	54
23	58
24	60
25	64
26	66
27	70
28	72
29	76
30	78