**This section was approved by Laurie A. Anderson P. E. , Director Department of Environment and Engineering on 4-21-2004 under City Code Section 110.005**

# SECTION 5: WASTEWATER COLLECTION SYSTEM DESIGN CRITERIA

## 5.1 General

This chapter presents criteria, standards and regulations related to the design of wastewater collection system facilities for general development within the City of San Marcos wastewater service area. The material is directed to the competent design professional and is not intended as a detailed design handbook or technical specifications.

Designs for wastewater system construction and improvements shall conform to the most recent edition of 30 TAC Chapter 317.2 of the Texas Commission on Environmental Quality (TCEQ) and also Chapter 213 for development in the Edwards Aquifer Zone. San Marcos submittal requirements for approval of wastewater system plans are provided in the Land Development Code, Article 3: Development Applications and Checklists, Division 18: Public Improvements Construction Plans, with supplemental requirements as presented in Section 5.12 herein.

## 5.2 Wastewater Line Designations

Collection system wastewater line designations are as follows:

(a) Interceptors or trunk mains are gravity sewer mains generally 15-inches and larger.
(b) Collector lines are gravity sewer mains generally 12-inches and smaller.
(c) Service laterals are stubouts extending from a collector main to the right-of-way line or edge of easement to provide customer service. The City is responsible for the service laterals in right-of-way or easements.
(d) Customer laterals are service lines on private property and are the responsibility of the customer.
(e) Force mains are pipes carrying lift station discharge under pressure.
(f) Inverted siphons are gravity mains flowing full under pressure due to a sag designed into the pipe profile between the inlet and outlet.

## 5.3 Wastewater Design Flows

The design flow for new wastewater lines shall be the peak wet weather flow (PWWF), which consists of the peak dry weather flow (PDWF) plus an allowance for wet weather inflow/infiltration (I/I) due to storm events. The peak dry weather flow is the average dry weather flow (ADWF) times a peaking factor (PF). Therefore, PWWF = ADWF * PF + I/I.

The average dry weather flow (ADWF) shall be based on the following wastewater unit flow rates:

(a) Single-family residential land use – 75 gal/day/capita; 225 gal/day/dwelling unit
(b) Multi-family residential land use – 75 gal/day/capita; 112 gal/day/dwelling unit
(c) Retail land use (wastewater generation generally related to transient clientele) – 225 gal/day per 1000 square feet of building floor space.
(d) Office land use (wastewater generation generally related to stable daytime occupancy) – 65 gal/day per 1000 square feet of building floor space.
(e) Other land use (industrial, educational, medical, etc.) – Wastewater flows will be evaluated on a case-by-case basis where more specific development plans are available

These wastewater unit flow rates are based on analysis of flow monitoring and land use data documented in the City of Austin's "Planning Study Report for the Robert E. Lee Road Relief Interceptor Study" (Espey, Huston & Associates, 1996). Additional or alternative unit flow rates and supporting data may be submitted to the City for consideration.

The wastewater peaking factor (PF) shall be calculated as follows, where F is the average wastewater flow in gal/min based on 75 gal/day/capita for the service population:

$$PF = (18 + 0.139 * F^{½}) / ( 4 + 0.139 * F^{½})$$

Peak dry weather flow: PDWF = ADWF * PF

Inflow/infiltration (I/I component of PWWF): Calculating extraneous wet weather flows for the purpose of sizing new wastewater lines shall be based on 750 gal/day per acre of new sewered development. If the overall service area for new wastewater lines includes older collection system lines, the I/I unit flow rate should be determined in consultation with the Director of Environment and Engineering.

Collection system design data should identify potential service area that is beyond the limits of the proposed development that could generate additional flows for proposed sewer improvements. The City will consider the need for oversizing in such cases. Impacts of collection system extensions on existing downstream facilities will be evaluated by the City.

## 5.4 Determination of Pipe Size and Slope

The minimum pipe size for new wastewater mains shall be 8-inch diameter, with the exception that a waiver may be granted for service to twelve (12) dwelling units or less with a 6-inch pipe at a minimum slope of 1.0 percent.

The design capacity of new sewer mains shall be determined as indicated below using Manning's "n" of 0.013, which takes into consideration fouling of the pipe over time:

(a) For sewer mains 18-inch diameter or larger, the main shall be designed with size and slope so that the pipe capacity flowing full is at least 1.25 times the Peak Wet Weather Flow (i.e., the PWWF design flow will not exceed 80% of the capacity of the pipe flowing full).

(b) For sewer mains smaller than 18-inch diameter, two criteria apply: the main shall be designed so that the pipe capacity flowing full is at least 1.54 times the Peak Dry Weather Flow (i.e., the PDWF design flow will not exceed 65% of the capacity of the pipe flowing full), AND the pipe capacity flowing full is at least 1.18 times the Peak Wet Weather Flow (i.e., the PWWF design flow will not exceed 85% of the capacity of the pipe flowing full). Whichever pipe size is larger shall govern.

The minimum design velocity calculated using the Peak Wet Weather Flow shall not be less than 2.0 ft/sec. The maximum design velocity calculated using the Peak Wet Weather Flow should not exceed 10 ft/sec. Under special conditions where no other options are available for limiting the maximum design velocity to 10 ft/sec, the City may grant a waiver provided the design gives proper consideration to pipe material, turbulence, abrasion, and displacement.

The construction plan and profiles sheets shall show the pipe size and slope, capacity and velocity flowing full, flow rate and velocity for Peak Wet Weather Flow, and, for pipes smaller than 18-inch diameter, flow rate and velocity for Peak Dry Weather Flow.

## 5.5 Pipeline Alignment and Location

Sewer mains shall be designed with straight alignment and uniform grade between manholes. Manholes should be located to facilitate access, inspection, and maintenance of the sewer.

All collection system facilities not intended for private ownership and maintenance shall be located in dedicated public right-of-way or in a wastewater easement dedicated to the City. The standard assignment for wastewater mains in right-of-way is 5 feet from the roadway centerline opposite the water line location. In all cases, the separation distance between wastewater and water facilities shall comply with TCEQ §317.2(a)(7) –Protecting Public Water Supply, and TCEQ §317.13 – Appendix E -Separation Distances.

Minimum easement width for wastewater lines shall be 20 feet. The City may require greater easement width depending on pipe size, depth, and location. New sewer lines shall not be installed in the Critical Water Quality Zone without a waiver from the City. New sewer lines should not be installed along the side slope of a waterway or drainage system facility.

Selection of sewer main alignments should be such as to avoid junction manholes with opposing flows from influent pipes. Such manholes shall be designed to avoid solids deposition and minimize turbulence.

## 5.6 Pipeline Design

Acceptable pipe materials for new sewer mains are as follows:

(a) Polyvinyl Chloride (PVC) Pipe – ASTM D3034. PVC gravity sewer pipe must have a Standard Dimension Ratio (SDR) of 26 or less.
(b) Centrifugally Cast Fiberglass Reinforced Polymer Mortar Pipe (FRPMP) – ASTM D3262
(c) Ductile Iron Pipe (DIP) – ASTM A746. DI pipe and fittings in wastewater applications shall have a corrosion resistant lining and polyethylene encasement.
(d) High Density Polyethylene (HDPE) Pipe. HDPE pipe may be used for rehabilitation of existing sewers but not for new construction except with approval of the City.

Pipeline design shall ensure that the pipe classification and installation conditions together provide the required pipe strength to support the anticipated pipe loading in all locations. The pipe bedding envelope shall extend 6 inches below the bottom of the pipe and 12 inches over the top of the pipe. Trench width for the bedding envelope shall extend at least 6 inches and not more than 12 inches beyond the maximum outside dimensions of the pipe. The width of the pipe embedment zone should be sufficient to allow bedding material to be placed and compacted as needed for the proposed size and type of pipe. Additional requirements are shown in the City's various trench Standard Details. ASTM D2321, "Standard Practice for Underground Installation of Thermoplastic Pipe for Sewers and Other Gravity Applications", should be used for flexible pipes, and the proper pipe stiffness should be for with the specified bedding conditions. Pipe material and installation design shall be in accordance with the manufacture's recommendations and the technical specifications. The trench shall include a 12-inch wide tracer tape on the pipe centerline at the interface between the pipe bedding envelope and the trench backfill material.

Minimum cover over top of pipe shall be 42 inches for sewer mains installed in natural ground not within existing or planned streets or other traffic areas. Sewer mains to be installed in proposed streets shall have at least 48 inches of cover below subgrade. Sewer mains to be installed in existing streets or other traffic areas shall have a minimum cover of 66 inches below finish grade. Where minimum cover requirements cannot be met, the pipe embedment zone shall have a 2000 psi concrete trench cap at least 6 inches thick with welded wire fabric reinforcement and extending laterally 6 inches on both sides of the pipe zone onto undisturbed soil.

In accordance with state law, whenever trench excavation exceeds a depth of 5 feet, trench safety systems that meet current federal standards of the Occupational Safety and Health Administration (OSHA) shall be provided.

When necessary, sewer mains shall be installed using trenchless boring and/or jacking techniques to avoid disturbance to surface features. All carrier pipes installed by boring or

jacking shall be placed in an encasement pipe. The casing shall be steel pipe conforming to ASTM 134 with a minimum thickness of 3/8 inches. Casing spacers shall be provided on the carrier pipe for all boring/jacking operations. The size, length, number, and location of the spacers shall be per the manufacturer's recommendation. The annular space outside the casing shall be filled by pressure grouting for the entire bore length before the carrier pipe is set in place. Each end of the encasement shall be sealed with an approved boot and seal wrap or grouting to prevent migration of adjacent backfill and water into the encasement pipe.

Testing of sewer mains shall be in accordance with the requirements of the City's Technical Manual and a project's technical specifications.

## 5.7 Manhole Design

Manholes are required at the following locations:

(a) a change in sewer main alignment, slope, pipe size, or pipe material;
(b) sewer main junctions, including the point of force main discharge to a gravity main; and
(c) the ends of sewer lines that may be extended in the future, although a wastewater access device (see City standard detail) instead of a manhole may be used at ends of lines with no future extension.

Maximum manhole spacing shall be as follows:

(a) 500 ft for pipes 15-inch and smaller;
(b) 800 ft for pipes 18- to 30-inch; and
(c) 1,000 ft for pipes over 30-inch.

Manholes shall have the following minimum sizing:

(a) 48-inch diameter for pipe connections 15-inch and smaller;
(b) 60-inch diameter for 18 to 24-inch mains;
(c) 72-inch diameter for 30 to 36-inch mains; and
(d) 84-inch diameter for mains larger than 36-inch.

Manholes larger than the indicated minimum size or cast-in-place junction structures may be required to accommodate multiple pipe connections. Manholes larger than 60-inch diameter shall have eccentric cone sections.

Manhole construction shall be pre-cast concrete or cast-in-place concrete with a corrosion resistant lining. Fiberglass manholes may be used only in locations approved by the City. Manholes shall have resilient watertight pipe connections. Bolted watertight covers are required for manholes located in the 100-year flood plain. Reference the City's Standard Manhole detail for additional requirements.

The manhole base shall have a "U"-shaped channel to provide for a smooth flow of water and to carry the pipe slope through the manhole. For connecting pipes of the same size, an invert drop of 0.1-ft across the manhole is desired. Connecting pipes of different size should

have a crown elevation match. In situations where conservation of available head is critical for pipeline design, a waiver from these requirements may be granted to allow pipe invert elevations that provide an energy grade line match, as supported by calculations using the sizes, slopes, and design flows for the connecting pipes.

A drop manhole is required when the upstream pipe is more than 24 inches higher than the manhole invert. The drop pipe must be outside the manhole. The vertical drop shall not exceed 8 feet. Where the difference in elevation between the incoming sewer and the manhole invert is less than 24 inches, the invert should be filleted to prevent solids deposition. Reference the City's Manhole with Drop Inlet standard detail for additional requirements.

Wherever adequate sewer ventilation is not provided by means of a sufficient number of lateral and service connections within a 1500-ft reach of main, sewer ventilation shall be provided by means of gooseneck vents at manholes. Vent discharge elevation shall be at least 2 feet above the estimated 100-year flood elevation at that point. Vent assemblies shall be 4-inch ductile iron pipe with two flanged 90$^{o}$ bends for the downturn with insect screen between flanges. The subsurface portion of the vent to the manhole cone connection shall be concrete encased.

Testing of sewer manholes shall be in accordance with the requirements of the City's Technical Manual.

## 5.8 Service Lines

The service line from the main to the property line shall be 4-inch minimum size for a single residential customer and 6-inch minimum size for dual service connections and commercial customers. The service line shall not be smaller than the diameter of the private service lateral.

A cleanout is required at the property line per the City's Single Service Connection and Dual Service Connection standard details. A sampling port is required for commercial customers per the City's Sample Ports standard detail. The standard location for the service and cleanout is an offset of 3 feet from the common property line between adjacent lots.

The minimum slope allowed for service lines is 1.0% (1/8-inch per linear foot). Grade breaks should be made with standard fittings and not exceed 45 degrees. Minimum service line depth of cover at the curb line is 36 inches.

Service line connections to proposed mains shall be made with wye or tee fittings. Service line taps to existing mains shall be made using a saddle type connection designed to join the types of pipe that are to be connected. Service taps shall be watertight and shall not protrude into the sewer main.

Service connections are not allowed on sewer mains larger than 15-inch diameter.

## 5.9 Force Mains

Design details for proposed force mains shall be included in a technical report for lift station design submitted to the City's Water and Wastewater Department. The technical report should include derivation of design flows based on criteria in Section 5.3 herein. Pumping capacity for the design flows should produce force main velocity between 3.0 and 6.0 ft/sec. The design report should include calculations of system head based on the force main size, length, and profile and for pumping head based on proposed pumps, with operating points indicated for both single and multiple pump operation where applicable. The design report should include a drawing of the complete force main pipe profile and the hydraulic grade line profile(s) at the design flow(s). For details of lift station requirements, refer to technical specifications prepared by the Water and Wastewater Department.

## 5.10 Inverted Siphons

The use of inverted siphons is discouraged due to high maintenance requirements. A minimum of two flow barrels is allowed for a new inverted siphon for substantial existing flows. A minimum of three flow barrels is required when initial flows are substantially lower than future flows. The inverted siphon shall have an air flow barrel between the siphon inlet and outlet structures with a minimum size of one-half the diameter of the upstream pipe. The air jumper design shall provide for removal of condensation.

The smallest barrel should have a minimum velocity of 3.0 ft/sec at initial Peak Dry Weather Flow. The complete inverted siphon shall have capacity for future Peak Wet Weather Flow. Under all flow conditions the siphon should be designed so that head loss does not cause backwater or surcharging in the upstream sewer. Engineering calculations shall be submitted showing the head, flow, and velocity for each barrel at initial and future design flows.

The siphon inlet and outlet structures should be located with convenient access. Weirs at the siphon inlet to control flow splits between barrels shall have provisions for height adjustment. The siphon outlet structure should be designed to facilitate hydraulic and mechanical cleaning of the siphon barrels. The pipe profiles shall be designed with smooth curves to allow passage of cleaning equipment. Corrosion resistant materials and coatings shall be used for inverted siphon structures and pipes.

## 5.11 Construction Plans

The following information should be provided on the construction plans in addition to the general requirements for information required as listed in the Land Development Code, Development Applications, Division 18: Public Improvements Construction Plans:

(a) manhole and benchmark coordinates on the City's GIS coordinate system

(b) distance and bearing of each pipe segment, or alignment deflection angles at manholes
(c) station numbers and pipe invert elevations at manholes, curve starting and ending points, and at even n+00 station numbers
(d) pipe profile for all force mains with appropriate air/vacuum values at necessary locations

END OF SECTION