

**SECTION 5
WASTEWATER COLLECTION SYSTEM**

5.1 Design Criteria

5.1.1 SUBMISSIONS:

1. Wastewater Collection System Public Improvement Plans: The Public improvement plans shall describe the proposed wastewater collection system in adequate detail so as to serve as construction drawings as well as satisfying the requirements of this section.
2. Wastewater Collection System Report: A wastewater collection system report shall be submitted with the final plat describing the basis for the design of the wastewater collection system and shall include but not be limited to:
 - a. Computations indicating flow depths and velocities at minimum, average and peak daily waste flows.
 - b. Design capacity for wastewater lift stations when required.
 - c. Anticipated peak daily wastewater water flow from the subdivision.

5.1.2 METHOD: The design of the wastewater collection system shall be based on standard design practices and design criteria contained in this section.

5.1.3 CRITERIA: The design of the wastewater collection system shall be based on the following:

1. **Flow:** The system shall be designed for the estimated ultimate tributary population. Minimum average flow rate for residential areas shall be 100 gallons per capita per day. Residential peak flow rates are given in Table 5-1. These residential flow rates include normal infiltration. Additional allowances shall be made where inflow or excessive infiltration conditions exist.

<u>Line</u>	<u>TABLE 5-1</u> <u>Residential Peak Flow</u> (gal/capita/day)
Lateral	400
Trunk	250

Minimum residential population density shall be figured on a basis of 3.5 persons per house, 4.0 houses per acre, and 70 percent of total land area developed as residential. Institutional, commercial and industrial sewage contribution estimates shall be reviewed with the Town Engineer. Sewers 10 inches in diameter and smaller shall carry the peak flow at a maximum flow depth of three quarters (75%) of the pipe diameter. Trunk sewers 12 inches in diameter and larger may be designed to flow full at the peak flow rate. The minimum velocity at the peak flow rate shall be 2.0 feet per

second. Where actual flow will be much below normal for several **years**, the minimum velocity shall be achieved by suitable grades at the partial design flow rate. Care shall be taken to design invert elevations at manholes in such a manner that the energy gradient is consistently falling in the direction of flow. Maximum allowable velocity shall not exceed 15 ft./sec. without making special provisions to protect against pipe displacement by erosion or shock.

2. Wastewater Collection System Layout:

- a. **Location:** Sanitary sewer mains are to be in local or collector streets 6 feet west or south of the street centerline as shown in figure 5-1. Mains that are installed in easements or alleys shall ordinarily be located in the center of the easement or alley. When sanitary sewer mains are placed along back lot lines, they shall be located in a manner that provides access for maintenance crews.
- b. **Alignment:** Between manholes sewer **lines** shall be straight, both in line and grade.
- c. **Cul-de-sacs:** Sewer lines into cul-de-sacs shall extend so that the maximum distance from the sewer line to the curb at the closed end of the cul-de-sac shall not exceed 10 feet as shown in Figure 5-1. Sewer lines shall terminate with a cleanout or a manhole.
- d. **Slope:** The following are the minimum sewer line slopes which are acceptable:

<u>PIPE SIZE</u>	<u>MINIMUM SLOPE IN FEET PER 100 FEET</u>
8 inches	0.40
10 inches	0.28
12 inches	0.22
14 inches	0.17
15 inches	0.15
16 inches	0.14
18 inches	0.12

Sewers on 20 percent slope or greater shall be anchored securely. Anchor spacing shall be as follows:

- (1) Not over 36 feet center to center on grades from 20 percent to 35 percent.
 - (2) Not over 24 feet center to center on grades from 35 percent to 50 percent.
- e. Separation of water mains, storm-sewer lines, and sanitary-sewer lines shall be as specified in the General Specifications, Section 7.

- f. General excavation, trenching, backfill, and compaction requirements are specified in the General Specifications, Section 7.
 - g. Wherever the sewer main crosses under an open ditch, canal or creek, an approved cut-off wall shall be constructed on the lower side of the crossing to prevent water from following the sewer trench. See Figure 5-2.
3. **Inverted Siphons:** Inverted siphons shall have not less than 2 barrels with minimum pipe size of 8 inches. The minimum design velocity for average flow is three (3.0) feet per second. The inlet and outlet shall be designed to permit the diversion of normal flow into either barrel so that either barrel may be out of service for maintenance.
4. **Manholes:** Manholes shall be installed at the end of each line; at all changes in grade, size, or **alignment**; at all intersections, and at distances not greater than 400 feet for lines 15 inches or smaller or 450 feet for lines 18 inches or larger. Cleanouts may be provided instead of a manhole at dead ends if the total length above the last manhole is less than 100 feet and a maximum of four residential connections are to be made upstream of the last manhole. Minimum manhole diameter shall be four (4) feet. Manholes shall be stubbed out with suitable size pipe and plugged wherever future lateral extension of the sewer is anticipated. Where drains are to be constructed under sewer mains, cleanouts shall be provided at each manhole for the underdrain.
5. **Cover:** A minimum of 4 ½ feet of cover from the top of the pipe to finished grade is required.
6. **Sewage Lift/Pumping:**
- a. Every effort shall be made in the design of the sewage collection system to minimize the need for sewage pumping stations. In those areas where a pumping station has been tentatively approved, the following information must be provided before the final design approval will be given:
 - 1. Complete manufacturer's specifications.
 - 2. Capacity's as based on estimated peak wastewater flow.
 - 3. Stations shall provide 200% of firm (reserve) capacity of estimated peak flows.
 - 4. Rated horsepower
 - b. Lift stations shall utilize a centrifugal pumping unit of the wet well/dry well type. At least two units shall be provided in each pumping station with each unit supplying 100% back-up capacity. The equipment shall be designed to operate on 3-phase power. The electrical controls shall provide for automatic alteration of equipment and automatic start up of the additional units if the first unit should fail to start. Electric connections for Town stand-by power unit shall be provided.

- c. Facilities shall be provided for the removal of pumps and motors.
 - d. Pumps shall be non-clog type capable of passing a sphere of at least three inches in diameter. Pump suction and discharge opening shall be at least four inches in diameter.
 - e. Adequate positive air displacement for ventilation shall be provided for vaults and dry wells. The ventilation should provide at least 30 complete air changes per hour.
 - f. Wet wells shall have a minimum holding capacity of 2 hours of design flow as based on estimated peak wastewater flow.
 - g. Telemetric alarm systems shall be provided and shall activate in case of power failure, pump failure, or pump station malfunction and shall be connected to a monitor station the location of which shall be designated by the Town Engineer.
 - h. Vaults shall have gas detection equipment monitoring holes provide access without entering vault. Safe and suitable means of access shall be provided to all areas which have mechanical and electrical equipment which must be inspected and maintained. Vaults shall also be equipped with a dehumidifier and a sump pump located at the low point of the vault floor.
- 7. Force Mains:**
- a. At design average flow, a cleansing velocity of at least two feet per second shall be maintained.
 - b. Air relief valves shall be placed a high points in the force main.
 - c. Force mains shall enter the gravity sewer system at a point not more than two feet above the flow line of the receiving manhole.
 - d. All force mains shall be constructed of approved C-900 water pipe with the tracing wire.
- 8. Service Connections:** Wyes shall be provided in the sewer main for service connections at each lot or building site and shall be shown on the plans. These fittings shall ordinarily be located 5-feet from the centerline of the lot and at least 10 feet horizontally from any water service line. Service connection shall not be made at manholes.

5.2 SPECIFICATIONS

- 5.2.1 SCOPE:** The work covered by these specifications concerns the furnishing of all labor, equipment and materials and performing all operations for the construction of the wastewater collection system including sewer lines, manholes and lift

stations in accordance with these specifications and Standard Design Drawings in paragraph 5.5.

5.2.2 GENERAL REQUIREMENTS: The wastewater collection system shall be constructed in accordance with engineered construction plans for the work, prepared under the direction of a professional engineer and approved by the Town Engineer.

5.2.3 MATERIALS:

1. Sewer line Piping:

a. Polyvinyl Chloride Pipe: PVC: All PVC sewer pipe shall be unplasticized polyvinyl chloride plastic gravity sewer pipe “J-M Ring-Tite PVC Sewer Pipe” by Johns-Manville or approved equal with integral bell and spigot joints. Pipe shall be made from clean virgin approved Class 11332-B PVC compound conforming to ASTM resin specification D1784. The pipe shall be suitable for use in gravity sewer conduit with provisions made for contraction and expansion at each joint with rubber ring. The bell shall consist of an integral wall section stiffened with two (2) PVC retainer rings which securely lock the solid cross section rubber ring into position. Standard lengths shall be twelve and one-half (12 ½) feet. The minimum wall thickness of the eight (8) inch pipe shall be 0.24 inches and for the twelve (12) inch pipe shall be 0.36 inches. The pipe stiffness at five (5) percent deflection shall be forty-five (45) when calculated in accordance with ASTM Designation D, 2412 “External Loading Properties of Plastic Pipe by Parallel-Plate Loading.” Joint tightness shall be subject to an internal hydrostatic pressure of twenty-five (25) psi for one (1) hour.

Installation of PVC pipe and fittings shall be in accordance with ASTM Designation D-2321-67 and these specifications.

Type M or O rubber gaskets shall be placed around the OD of the pipe where the line enters or leaves any structure or encasement which rigidly holds the pipe (manholes, cut-off walls, etc.). Gaskets shall be placed ± 4 ” back from each face of the encasement to act as a water stop and compensate for differential shrinkage.

Special care shall be taken to place a pipe joint within 4 feet of each side of any structure or encasement which rigidly holds the pipe.

b. Concrete Sewer Pipe: All concrete sewer pipe shall be reinforced concrete pipe conforming to ASTM C-76-76 with rubber gasketed joints in conformance with ASTM C443-76. Internal pipe walls shall be reasonably smooth and free of defects. Pipe that is rough and/or uneven shall be reworked or removed from the job site.

- c. **Cast Iron Pipe:** Cast Iron pipe, shall conform to ASA 21.6-1962 or A21.8-1962 Specifications. Joints shall be of the bell and spigot type, rubber gasketed and conform to ASA Designations A21.11-1964. Joints between cast iron and other types of pipe herein designated shall be water tight and structurally sound, with a smooth continuous invert.

2. **Manholes:**

- a. **Precast Reinforced Manhole Sections:** Precast manhole sections shall conform to ASTM Designation C478-70 except as modified here and in Figure 5-3 of paragraph 5.5.
Concrete: shall have a minimum 28-day compressive strength of 3500 psi, and be placed with a slump not to exceed five (5) inches.

Minimum wall thickness shall be 5" to and including 60" diameter manholes. 72" diameter manholes shall have a 6" minimum wall thickness.

Flat covers, where called for in the plans, shall have a minimum thickness of 8 inches, reinforced with a double mat of steel. Openings in flat slabs shall be additionally reinforced. Straight rods used to reinforce openings shall have a minimum length equal to the diameter of the opening plus 2 inches.

Precut sections shall be set in mortar of ramneck so as to provide a water-tight joint.

- b. **Manhole Foundation:** Bases for manholes shall be a minimum of 8" thick and made of Portland Cement Concrete with a minimum 28-day compressive strength of 3500 psi and having a slump not to exceed 3 inches at a time of placement. Pre-cast sections set on the foundation shall be set in mortar or ramneck so as to provide a water-tight seal at the manhole base.
- c. **Manhole Steps:** Steps shall be an aluminum magnesium silicide type alloy conforming to Federal Specification QQ-A-200/8. Steps shall be non-skid COMCO FOUNDRY, INC. #12653B or approved equal, non-staggered and installed on 15" vertical centers.
- d. **Manhole Rings and Covers:** manhole rings and covers shall be gray cast iron conforming to ASTM Designation A-48 free from cracks, holes, swells, cold shutes and having a smooth workmanlike finish. Rings and covers shall be COMCO FOUNDRY, INC. #C-1161 or approved equal, having machined metal bearing surfaces and the word "sewer" imprinted.

3. **Mortar:** Mortar shall be composed of one (1) part Type II cement to two (2) parts sand, thoroughly mixed dry and then having only that amount of water added and mixed to form a paste of workable consistency. Mortar shall be freshly made and no re-tempered mortar nor mortar that has obtained its initial set shall be used.
4. **Plugs:** a water tight compression plug, as recommended by the manufacturer, shall be installed to seal all dead ends and wyes.

NOTE: At all ends and wyes, the contractor shall attach a 9-gauge steel wire to the plug and extend the wire vertically to within 12" of finish grade, where the wire shall be attached to the equivalent of 2" x 4" x 24" section of timber.

5.3 **CONSTRUCTION**

5.3.1 GENERAL REQUIREMENTS: Section 7, General Specifications shall be followed except as modified in paragraph 5.3.2.

5.3.2 SPECIFIC REQUIREMENTS: The following specific requirements shall apply in the construction of the wastewater collection system:

1. **Trench Depth:**
 - a. Pressured Sewer lines: The trench shall be of sufficient depth to provide a minimum of 4 ½ feet of cover over the top of the pipe, at subgrade. Street to be at subgrade elevation prior to installation of any sewer line.
 - b. Gravity Sewer lines: Depth determined by engineered drawings.
2. **Pipe Installation:** Sewer lines shall be constructed continuously upgrade from the lowest point, with the spigot ends pointing in the direction of the flow. Special care shall be taken to lay sewer pipe to exact line and grade. Pipe bedding material shall be placed in the trench bottom, to the thickness specified, to provide a uniform and continuous bearing support for the pipe at every point between bell holes. Preparatory to making pipe joints, all surfaces of the joint shall be clean and dry. Lubricants, primers, etc., shall be used as recommended by the manufacturer. The pipe shall be set in position and checked for line and grade using care to keep the joint absolutely free of dirt. When final grade is established, the joint shall be carefully pushed home using appropriate methods of leverage. Care shall be taken so that the bell end of the pipe will not be deflected to the extent that the gasket is pinched or rolled. Adjustment in line or grade may then be made by working the bedding material in around the pipe.

If O-ring gaskets are used, immediately after completing the joint, the seating of the gasket shall be checked around the entire circumference of the pipe, by visual and finger inspection. The pipe shall be secured in place by installation

of the bedding material tamped under and along the pipe barrel up to spring line.

All sewers shall be kept thoroughly clean and free from gravel, dirt and debris. Whenever work ceases for any reason, the unfinished end of the pipe shall be securely closed with a temporary tight fitting plug.

The Town Inspector shall be notified at least twenty-four hours in advance of when pipe is to be laid in any trench. No pipes shall be covered until they have been inspected by the Town Inspector. The entire wastewater collection system must be installed and inspected prior to the tie-in to the existing system.

3. **Manholes and Cleanouts:** Manholes and cleanouts shall be constructed in accordance with Figure 5-3 and Figure 5-4. Manhole bases shall be constructed with flow through channels made to conform in shape and slope to that of the sewers. Sewer lines will not be permitted to be laid through the manhole. Precast manhole sections shall not be placed on the foundations until after it has reached sufficient strength to provide support without damage. The top of the bench shall be thoroughly cleaned and wetted with water. While the bench is still moist, a full mortar bed at least 1 inch in thickness shall be applied to the pre-cast section bearing seat. The first precast section shall be carefully lowered onto the bench so that the mortar bed will be forced out from under the section evenly on all sides. Each succeeding precast section shall be jointed in a similar manner and smoothly finished, inside and out. All lifting holes and other imperfections in the interior surface of the manhole shall be filled with cement mortar. Ramneck may be used in the joints in lieu of mortar.

The influent and effluent lines in a manhole shall have a rubber stop placed around the pipe. The rubber stop shall consist of a rubber ring and stainless band as manufactured by Armco Steel Corp. or approved equal.

Manhole cover rings shall be installed on a minimum of two courses and a maximum of six courses of brick above the precast lid or cone or top of the brick taper section. Manhole rings shall be set in a full bed of mortar to the grade called for on the plans. In areas where a bituminous wearing surface is to be laid, the manhole lids and covers, or clean-out covers, shall be laid to base course elevation raised to finished grade elevation after bituminous surfacing has been completed. Bituminous material removed for raising shall be replaced with Portland cement concrete and protected for seven (7) days from any loading or freezing.

4. **Connection to Existing Manholes:** Sewer pipe connections to existing manholes, where there is not existing pipe stubbed out, shall be made in such a manner that the finished work will conform as nearly as practicable to the essential requirements specified for new manholes. The contractor shall

break out as small an opening in the existing manhole as necessary to insert the new sewer pipe. The existing concrete foundation bench shall be chipped to the cross-section of the new pipe in order to form a smooth continuous invert similar to that which would be formed in a new concrete base. Cement grout shall be used as necessary to smoothly finish the new invert and to seal the new line so the junction is watertight.

5. **Restoration and Cleanup:** The Contractor shall restore or replace all removed or damaged paving, curbing, sidewalks, gutters, sod shrubbery, fences, irrigation ditches, pipe or other structures or surfaces to a condition equal to that before the work began and to the satisfaction of the Town Inspector. The construction site shall be left clean and orderly at the end of each work day.
6. **Sewer Service Line Connections:** In all new developments, the sewer main shall be installed with wye services or tees for each plotted lot prior to installation of curb and gutter. Locations shall be marked with a #20 copper wire with yellow insulation run from the plugged end up 12 inches below the ground surface and teed off to a 24-inch piece of 2-inch by 4-inch lumber. As-built measurements shall be made by the Contractor to reference the wye or riser connection to the nearest manhole before backfilling.
 - a. The service line shall be laid in bedding and cover similar to the sewer main along its entire length.
 - b. The Service line from the main to the building cast iron footing stub shall be one type of materials such as all plastic, not portions of each.
 - c. Services for service stations, car washes, food processing establishments, etc. shall have a grease and/or sand trap installed on their service lines. The trap shall be constructed to the standards as defined in Chapter 7 of the Uniform Plumbing Code.
 - d. The minimum grade of the sewer service line shall be one-eighth (1/8) inch drop per foot for lines 6" and larger. Minimum grades for 4" diameter lines shall be one-fourth (1/4) inch per foot.
 - e. Sewer service lines shall not be laid closer than 10' from and water service lines. In those locations, i.e., cul-de-sacs, where it is not possible to meet this requirement, benching will be permitted provided that such benching meets the requirements as set forth in the Uniform Plumbing Code or the sewer service line may be encased in concrete in accordance with Section 7.
 - f. In most cases, sewer services will not be permitted to be laid under driveways. In those instances where this requirement cannot be met, the final location will be determined by the city Inspector.

5.4 **TESTING**

- 5.4.1 **COMPACTION TEST:** Compaction tests to verify specified trench compaction shall be performed as required in Section 7 of this manual.

5.4.2 INFILTRATION AND EXFILTRATION: Infiltration and exfiltration shall not exceed 200 gallons/inch diameter/5280 LF/24 hours for the entire wastewater collection system.

Tests for water tightness shall be conducted by the contractor at his own expense and in the presence of the Town Inspector on all new sewer construction prior to final acceptance: in the following manner:

- a. Manhole: (applicable test should be determined by the Town Inspector)
 - (1) Water Test: fill to 5 feet over sewer pipe for 2 hours; maximum lost ¼”.
 - (2) Vacuum test: plug and brace all penetrations; install pipe 5-psig rated plugs beyond boot seals; secure vacuum apparatus; start vacuum. If leaks are evident; locate, excavate seal retest and re-backfill; attain a vacuum of 10” hg; time pressure drop to 9” Hg; release vacuum. Refer to chart for minimum test times.

Table 1. Minimum test times for various manhole diameters (ASTM C1244-93).

Depth (ft.)	Diameter (in.)									
	30	33	36	42	48	54	60	66	72	
	Times (s)									
8	11	12	14	17	20	23	26	29	33	
10	14	15	18	21	25	29	33	36	41	
12	17	18	21	25	30	35	39	43	49	
14	20	21	25	30	35	41	46	51	57	
16	22	24	29	34	40	46	52	58	67	
18	25	27	32	38	45	52	59	65	73	
20	28	30	35	42	50	57	65	72	81	
22	31	33	39	46	55	64	72	79	89	
24	33	35	42	51	59	68	78	87	97	
26	36	39	46	55	64	75	85	94	105	
28	39	42	49	59	69	81	91	101	113	
30	42	45	53	65	74	87	98	108	121	

- b. Sewer line air test: The section of sewer line to be tested must be pressurized to a minimum of 4# psi. The sewer line cannot exceed loss of 0.6 psi in 4 minutes.

Infiltration or exfiltration tests shall also be conducted whenever, during the course of construction, infiltration appears to be greater than the maximum allowed or the quality of workmanship is questionable. Whenever the rate of infiltration or exfiltration is found to exceed the prescribed amount, the Contractor shall stop all construction. The Contractor shall make appropriate repairs by methods approved by the Town Engineer and shall continue to test the conduit until it is satisfactory.

5.4.3 VISUAL TEST: All lines shall be jetted and camera tested with standard video equipment and the video tapes released to the Town Inspector prior to acceptance of the improvement. All lines are subject to being lapped and a sewer ball of appropriate diameter may be required to be forced through the line by water at the discretion of the Town Inspector. The Town Inspector must be given 24 hours notice prior to the process. The Contractor shall remedy, at his own expense, any poor alignment or any other defects in workmanship or

materials as found by the Town Inspector. Final acceptance will be based on re-inspection of the sewer after the appropriate repairs and corrections are completed.

5.5 STANDARD DESIGN DRAWINGS

- Figure 5-1 Main Location in Thru Streets and Cul-de-sacs**
- Figure 5-2 Cut-off Wall Details For Ditch & River Crossings**
- Figure 5-3 Standard Manhole Details**
- Figure 5-4 Sewer Clean Out Details**
- Figure 5-5 Typical Sewer Service Line Installation**
- Figure 5-6 Combination Oil, Grease & Sand Integrator**

ADDITIONAL NOTES:

Date: _____ **Comments:**

Town Admin Approval:

Date: _____ **Comments**

Town Admin Approval:

