City of Houston

Design Manual

Chapter 8

WASTEWATER COLLECTION SYSTEM DESIGN REQUIREMENTS

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8.01 CHAPTER INCLUDES

A. Criteria for the design of wastewater collection systems.

B. This Chapter addresses the design of the wastewater collection systems within the public Right-Of-Way or a dedicated public easement. Sanitary sewers located on private property that are not in such a dedicated easement, are under the jurisdiction of the Plumbing Code, and will be reviewed by the Code Enforcement Branch.

8.02 REFERENCES

A. Refer to the list of references in Chapter 1, General Requirements.

B. City of Houston Engineering Design Guidelines Manual for Submersible Lift Stations.

C. City of Houston Design Guideline Drawings for Submersible Lift Stations.

D. Uniform Plumbing Code, latest edition adopted by the City.

8.03 DEFINITIONS

A. Public Sewer - A closed conduit which conveys wastewater flow and which is located within the public Right-Of-Way or dedicated public sanitary sewer easement. A public sewer (or public sewer system) is intended to serve more than one residential, commercial, or industrial site.

B. Private Sewer - A closed conduit which conveys wastewater flow and is constructed and maintained by a private entity (i.e. homeowner's association). Private sewers may be located in areas such as a private street or common area. Private sewers are subject to the design and construction requirements of the Plumbing Code and must discharge to a public sewer.

C. Sewer Line -A public sewer located within public Right-Of-Way or Permanent Access Easement (PAE) I Public Utility Easement (PUE) that is maintained and operated by the City.

D. Service Lead - The sewer pipe that connects a building sewer to a sewer line that is wholly located within the public Right-Of-Way or public easement. Such a line shall never exceed 150-feet in length, for lengths greater than 150-feet refer to definition for sewer line. No more than the equivalent of two single-family residences may be served at one time.

E. Building Sewer - The sewer pipe that connects a building to a service lead that is wholly

located within the private property. If routed through another tract of land, it shall be located in a building connection easement. If located within a private easement, the City must be included as a third party in the easement documents. It will be owned and maintained by the owner of the property being served. Design shall adhere to the Design Manual or Plumbing Code, whichever is more stringent.

F. Community sewer - A private sewer that serves more than 2 equivalent houses will adhere to this manual using an 8-inch pipe terminating in a manhole and will have an easement dedicated for the community sewer, which allows a property owner to extend a private sewer or service across adjacent property, or properties, to facilitate connection to a public sewer. If located within a private easement, the City must be included as a third party in the easement documents. It will be owned and maintained by the owner of the property being served by the private sewer.

G. Project Area - The area in the immediate vicinity of a public sewer to be constructed. This includes the entire road Right-Of-Way and any adjoining easements used for the proposed wastewater line construction.

H. Stack - A minimum 6-inch riser pipe, constructed on public sewer or lead, with a maximum of 6-feet of cover on the stack. A stack will be used for connecting service leads to a deep sewer line.

I. Stub-Outs- A minimum 5-feet of sewer pipe extended from the manhole for future expansion and terminated with a sanitary sewer plug.

J. Force Main- A pressure-rated conduit which conveys wastewater from one pump station to one discharge point.

K. Central Business District- Area beginning at the centerline of U.S. 59 and the centerline of I.H. 45; thence in the northwesterly and northerly direction along the centerline of I.H. 45 to its intersection with the centerline of U.S. 59; thence in a southwesterly direction along the centerline of U.S. 59 to its intersection with I.H. 45, the point of beginning.

8.04 DESIGN REQUIREMENTS

A. Drawings to be furnished

1. To obtain a permit for the construction of a proposed sewer line or service lead crossing a public Right-Of-Way to an existing sewer line, a plan -and profile drawing of the proposed sewer shall be prepared and submitted to the City for approval.

B. Drawing/Design Information

1. The detailed drawings will show the exact location of the proposed line in the street, alley, or easement with respect to the edge of the particular Right-Of-Way, the transit base line, any nearby utilities, 100-year flood elevation within the project area, major landscaping, and other structures affecting construction.

2. Sewers and manholes shall be identified by number, letter, combination of, or other identification and shown on the sanitary sewer layout sheet.

3. Where sewers are to be placed between existing pavement and the street Right-Of-Way line (or interior easement line) show the existing ground line at both sides (or the closest side for sewers near the edge) of the Right-Of-Way or adjacent sewer easement. Prior approval will be required if proposed sewers are to be placed under existing pavements or toppings.

4. For connection to the City sanitary sewer system include one of the following: a copy of the City's Wastewater Capacity Reservation (WCR) letter or, a copy of the City's Wastewater short form, and a Wastewater Impact Fee Receipt for any proposed wastewater design.

C. Drawing Requirements

1. All sewers and connections must be shown in both plan-and-profile views.

2. The profile shall show other underground and surface utilities and facilities, both in parallel and at crossings; the size, grade of the proposed line, the elevations of the proposed line to hundredths of a foot at manholes, changes of grade and dead ends; and the proposed finished grade over the sewer. It shall show the actual ground line as it exists prior to construction of the sewer. Where proposed fill or cut is contemplated, the proposed new ground line shall be shown as a separate line from the actual ground line (label both lines and use contrasting line types to identify each). Type of pipe and bedding shall comply with City of Houston Standard Specifications and Standard Details.

3. Commercial sanitary sewer layout sheets for large areas and with a scale of 400 feet or more per inch must have an additional set of layout sheets at not more than 200 feet per inch, with match lines and a small index map showing which portion of the overall layout that the layout of each sheet represents.

4. A scale of not more than 200-feet per inch on the layout sheet will provide the following information:

   a. All easements containing or adjoining sanitary sewers are shown and labeled (including recording information),

   b. Label locations where pipe size or material change,

   c. Identify manhole by letter and/or number,

   d. The sewer alignment shall accurately reflect the relative location of the sewer as shown on the detailed plan view,

   e. Service leads that cross street pavement or serve adjacent property are to be shown on the layout. The detail plans and profiles shall show the flow lines of

service leads at the street or easement Right-Of-Way, as well as at manholes where private sewer connections are allowed or required,

f. The number and size of the lots depicted on both the overall sewer layout sheet and the individual plan-and-profile drawings shall match the number and size of the lots depicted on the final plat after recordation,

g. The size and direction of flow for existing and proposed sewers shall be shown on the overall sanitary sewer layout sheet,

h. The location of the proposed sewer within the public Right-Of-Way, easement adjacent to the public Right-Of-Way, or side lot easement (if allowed by the City), and

i. The overall sanitary sewer layout sheet shall show the area, in acres, which the proposed sewer is designed to serve. Include a location map which references the acreage to nearby major thoroughfares and boulevard streets. The scale used for the project area location map shall be: 1" = 2000' or less and shall be shown on the map.

5. The plan view shall show, at a minimum, the following information for the project area:
   a. Topographical features,

   b. Stationing for the proposed sewers,

   c. Existing buried and overhead utilities (i.e. gas, electric, telecom, etc),

   d. Any significant landscaping or other structures which might impact construction or construction-related activities,

   e. The width and type of existing and proposed easements,

   f. Proposed service leads,

   g. The limits of the proposed bore or tunnel,

   h. Locations where pressure pipe is to be installed for water line crossings, and

   i. Terrain changes, retaining walls, overhangs, buildings, billboards and any other structure within 25 feet of the proposed line.

6. The profile view shall show, at a minimum, the following information for the project area:

   a. Underground and surface utilities/facilities which are either parallel to the proposed sewer or cross the proposed sewer,

b. The proposed sewer's diameter, grade and length for each manhole section,

c. The flow line elevation for sanitary sewers and service leads at each manhole,

d. The rim elevation of existing and proposed manholes,

e. The flow line elevation at each sheet match line (i.e., from one sheet to another),

f. Type of pipe bedding and backfill shall be included in the Standard Details,

g. The finished grade for proposed and existing pavement. Where cut and fill are proposed, the proposed new ground line should be shown as a separate line from the existing ground line (label both lines and use contrasting line types to identify each),

h. The existing ground line for the near side of the public Right-Of-Way where a sewer is to be placed between the edge of existing pavement and the edge of the public Right-Of-Way,

i. The existing ground line at the centerline of the proposed sanitary sewer where a sanitary sewer is to be placed within an easement. Show any proposed cut and fill as described above. Show the finished grade of any proposed and existing pavement,

j. The flow line elevation of service leads where the service lead crosses the edge of the public Right-Of-Way or the dedicated easement adjacent to the public Right-Of-Way,

k. Locations where pressure pipe and/or casing is to be installed for water line crossings or special conditions (i.e. limited clearance, special protection requirements, etc.),

l. The limits of special backfill and proposed stacks shall be identified by stations indicated on the design plans, and

m. Vertical elevation breaks in profiles shall not be used without clearly identifying breaks on each sheet and dimension the break line elevation difference.

7. Drawings for single-family residential subdivisions shall show the proposed location, by stations, of all service leads, and stacks.

D. Service Leads

1. Service leads shall be located either at the side property line between two adjoining lots, or as directed by the City. A single 6-inch service lead located at the property line between two adjoining lots would serve two single-family residences with a wyes

placed at the end of the service lead. Do not extend the wyes beyond the edge of either the public Right-Of-Way or dedicated public easement.

2. Service leads measuring more than 50-feet in length and parallel to the street Right-Of-Way or public sewer easement shall be treated as a public sewer line having both a starting and ending manhole, except for cul-de-sac(s)'.

3. Service leads for single-family developments shall not connect to a manhole unless otherwise stated in this manual. Private sewers from developments with more than 5000 gallons-per-day flow shall discharge into a proposed or existing manhole. Where the flow line of the private sewer is 24-inches or greater above the flow line of the manhole, provide a standard City of Houston outside drop to the manhole. Some design exceptions or additional requirements may be made for flow connections to large (36-inch and larger ID sewers) or deep (>20 feet flow line depth) sewer lines, depending on the individual circumstances.

   a. Service leads shall be provided to serve every lot within a proposed development, whether inside the city limits or in the ETJ. Provide detail(s) for all typical near-side and far-side sewer connections, including 1-side or 2-sided stacks.

   b. Service leads shall be 6-inches in diameter (minimum). If the length of a service lead exceeds 100-feet or the width of the public Right-Of-Way by more than 20-feet, the minimum diameter shall be 8-inches and a manhole shall be utilized for connection to the public sewer. Service leads exceeding 150-feet in length shall be designed as a sewer line.

   c. Service leads with a diameter of 6-inches shall utilize full body fittings (extruded or factory-fabricated) for connection to a proposed public sewer or an approved saddle-type connector for connection to an existing public sewer.

   d. Saddle-type connectors shall be installed with the stub oriented between the spring line (3 o'clock and 9 o'clock positions) and 45 degrees from the spring line (1:30 and 10:30 positions). Full body fittings used to connect a service lead to a proposed public sewer shall be oriented in the same manner.

   e. The service lead shall be designed to minimize the use of bends as conditions permit.

   f. Service leads exceeding the limits defined in Paragraph 8.04.D.2 shall have a manhole at each end; as well as a plan-and-profile drawing for each Right-Of-Way crossing. All or part of these service leads which are located in a public Right-Of-Way, alley or dedicated sanitary sewer or public utility easement(s) may be treated as a public sewer; depending upon the location of the terminal manhole and any intermediate manholes.

g. For existing lots (which are not served in accordance with these guidelines) that requests a sewer connection and the distance to the nearest existing sewer is less than 50 feet, as measured parallel to the street Right-Of-Way, the sewer connection is under the jurisdiction of the Uniform Plumbing Code, (latest edition) provided that: a road bore is not required or a major thoroughfare (or collector) road is not being cut, both of which require City approval and an engineering drawing.

h. The location where the service lead crosses the property line shall be shown on the plans and marked in the field. Provide a typical detail of the durable marker to be placed where the service lead crosses the property line.

i. All private sewers, private force mains, and appurtenances, thereto, that is intended to be located inside the public Right-Of-Way must have an encroachment permit with plan and profile sheets.

E. General Requirements

1. Connect service leads to stacks, wyes or tees as shown on the City's Geographic Information Mapping System (GIMS). Where none are shown, a licensed plumber is responsible for placing a City approved saddle for connection to the public sewer and the City Inspector is responsible for determining that the saddle is watertight and properly installed.

2. Materials and construction shall conform to latest City of Houston Standard Specifications, including standard leak test.

3. Unless noted otherwise, all public sewers and service leads shall be embedded in cement-stabilized sand from 6-inches below the pipe to 12-inches above the pipe and for the full trench width. All such bedding shall be compacted to the density required by Standard Specifications. Cement-stabilized sand shall have a 48-hour compressive strength of 100 psi minimum. The cross-section described in this paragraph is defined as the pipe embedment zone.

4. Backfill excavated areas and trenches under or within one foot of existing or proposed pavement with cement-stabilized sand from the top of the pipe embedment zone up to one foot below the paving sub-grade. Cement-stabilized sand must develop 100 psi minimum compression at 48 hours. Backfill shall be compacted to 95 percent standard Proctor density.

5. The actual location of all special backfill and of proposed stacks shall be shown by stations on the drawings.

6. Public sewers and force mains shall be located in either the public Right-Of-Way or easements. Side lot easements may be used only with special approval. Back lot easements shall not be utilized except in the case of preexisting conditions or as approved by the City Engineer.

7. Generally, the location of the public sewer within a dedicated easement shall be along the centerline of the easement. However, in those instances where the easement is adjacent to the public Right-Of-Way, the location of the sanitary sewer and its manholes shall be approved on a case-by-case basis by the Director of Houston Public Works, or his designee. Required easement widths are addressed in Chapter 5, Easement Requirements. Additional information regarding the location of sanitary sewers is contained in Chapter 6, Utility Locations.

8. The final determination as to that portion of a street, alley, or sanitary sewer easement to be occupied by a proposed sewer or force main rests with the City. The Director or designee will take into consideration existing, planned and proposed facilities such as manholes, pavement, pipes/conduits, along with existing trees and shrubs, or other unique surface conditions when arriving at a decision.

9. There shall be no closed-end easements for public sanitary sewers and force mains.

10. The drawings for the sewer shall show the location of any pipe, duct, other structure(s), hazardous obstacles and/or protected vegetation known to exist that might interfere with the construction of the sewer and call to the attention of the City any known obstacles that might be encountered in constructing the sewer in any location under consideration. The Professional Engineer of Record shall determine the existence of pipes, ducts, and any above stated obstacles by visually inspecting the site, researching all available public and private records, and conducting subsurface investigations when necessary.

11. Manholes located within the 100-year floodplain shall be sealed and vented per TCEQ requirements. Engineering judgment and aesthetics should be considered.

12. Manholes located within driveways shall be sealed and vented per TCEQ requirements.

13. New manholes shall not be located between the top of banks for ditches or swales, unless approved by the City.

14. Wastewater lines along State Right-of-Way shall be installed outside of the right-of-way in a separate contiguous easement; width of easement shall be as provided in Chapter 5.

F. Line Size

1. The minimum pipe diameter for a public sanitary sewer shall be 8-inches.

2. Service leads 4-inches in diameter shall be confined to the limits of the lot which they serve and shall serve only the equivalent of one single-family lot. No 4-inch sewer shall be laid in any street, alley, dedicated sewer easement or Right-Of-Way.

3. Service leads 6-inches in diameter shall not serve more than the equivalent of 2 single-family lots or other types of small land tracts.

4. Service leads of 6-inch and 8-inch diameter for single-family residential lots shall have a minimum grades as shown in table 8.1.

5. For all service leads that requires a street bore, submit a copy of the wastewater capacity letter to establish the required size of the line.

6. For commercial service leads, the minimum size service lead shall be 8-inches in diameter for the Central Business District and 6-inches in diameter elsewhere. Connect all service leads within Central Business District directly to a manhole.

7. Sewer lines shall be laid at a size and depth to conform to designs permitting an orderly expansion of the sewer system of the City and so as to avoid a duplication of lines in the future.

8. The City shall be the final judge as to size and depth required and any exception to service leads as previously defined.

G. Line Depth

1. Sewer line shall be laid with the top of the pipe a minimum of 3-feet below the surface of the natural ground without side ditches.

2. Sewers laid in the street Right-Of-Way with curb and gutter paved streets shall have a minimum cover of 4-feet from the top of the pipe to top of the curb.

3. Sewers laid in street Right-Of-Way with crowned roads and side ditches shall have a minimum cover of 6-feet from the average ground line at the adjacent street Right-Of-Way to the top of pipe.

4. Where the minimum cover as specified in Paragraphs 8.04.G.1, 8.04.G.2, and 8.04.G.3 is not possible, the sewer shall be laid with Class 150 (150 psi) pressure pipe with cement-stabilized sand backfill as shown in Standard Details. Ductile iron pipe shall be lined with a material listed on the City of Houston Approved Product List and applied by either the pipe manufacturer or an approved applicator. Liners shall meet requirements of TCEQ 217.56(c)

5. Maximum depth for 8-inch, through 12-inch diameter collection lines shall be 20-feet from average ground surface of the trench width to pipe invert. Depths greater than 20-feet are subject to approval by the City Engineer if justified for site-specific reasons during the preliminary engineering phase of the project design.

H. Line Grades

1. The following table lists the minimum grades for 6-inch to 27-inch diameter public sewers. (6-in. diameter is for service leads only). The minimum grade is based on a minimum full pipe velocity of 2.3 feet per second (fps). The maximum grade is based on a maximum full pipe velocity of 4.5 fps. In both cases, the Manning Formula has been used with an n coefficient of 0.013. The use of different pipe materials will not alter the use of 0.013 for the purposes of the Design Manual.

Table 8.1
GRADES FOR WASTEWATER LINES

NOMINAL INTERNAL PIPE DIAMETER (INCHES)	MINIMUM GRADE TO DEVELOP V= 2.3 FPS (PERCENT)	MAXIMUM GRADE TO DEVELOP V=4.5 FPS (PERCENT)
6	0.70	2.46
8	0.44	1.73
10	0.33	1.21
12	0.26	0.97
15	0.19	0.72
18	0.15	0.57
21	0.13	0.46
24	0.11	0.38
27	0.09	0.33

2. For sewers larger than 27-inches in diameter, the Professional Engineer of Record shall determine the appropriate grade utilizing the Manning Formula, n = 0.013 and a minimum full pipe velocity of 3.0 fps.

I. Line Alignment

1. Gravity sewers shall be laid in straight alignment with uniform grade between manholes. Deviations from straight alignment shall be justified by complying with the TCEQ requirements and approved by the City. Deviations from uniform grade without manholes shall not be allowed.

J. Manholes

1. Manholes shall be pre-fabricated or precast -, as per Standard Specifications and Details; unless the Professional Engineer of Record submits a cast-in-place manhole design for review and approval by the City. The Professional Engineer of Record shall determine the need for a liner or coating on concrete manholes. Liner or coatings will be as per Standard Specifications. Fiberglass manholes, per Standard

Details, are not allowed within the existing or proposed pavement allowed outside the street Right-of-Way. Precast manholes shall incorporate a boot-type connector for sewer diameters up to 24-inches. For sewer diameters greater than 24-inches, utilize either the boot-type connector (if available) or an integral gasket. Precast manholes shall conform to the latest ASTM requirements. Manhole covers shall be 32-inches as shown in the Standard Details.

2. Location: For public sewers, manholes shall be placed at changes in alignment, changes in grade, junction points, and either at street, alley, or easement intersections as designs may require.

   a. Sewers laid in easements shall have a manhole in each street crossed by the sewer.

   b. The maximum distance between manholes shall be determined from the following table for 8-inch to 48-inch pipe diameters. Spacing for manholes on mains with diameters larger than 48-inches installed by tunneling methods or open-cut methods shall be determined on an individual project basis.

Table 8.2
MAXIMUM DISTANCE BETWEEN SANITARY SEWER MANHOLES

PIPE DIAMETER (I.D.) IN INCHES	MANHOLE MAXIMUM SPACING IN FEET
8-15	400
18-48	800
Greater than 48	As approved by the City

   c. A design objective is to have sewers with the same, or approximately the same, flow line elevation intersect each other at a 90-degree angle. However, where a true perpendicular intersection cannot be obtained, and where the entering sewer intersects the receiving sewer at, or about, the same flow line elevation, one or more manholes shall be located so that a minimum angle of 80 degrees at the point of intersection can be achieved for the sewer line. When the entering sewer is on the upstream side of the manhole, the minimum angle between the sewers may be reduced to a 45-degree angle provided:

      (1) A distinct flow channel can be maintained within the manhole when the flow line elevations of the sewers are at or within one pipe diameter of the smaller pipe; or

      (2) The flow line elevation of the entering pipe is above the crown of the primary sewer and clearance can be provided between the sewers.

(3) The design is in compliance with City of Houston Standard Details (02082N-02 & 03)

d. Place manholes at the terminal (most upstream) end of all public sewer lines. Clean-outs will not be utilized except at the end of each service lead.

e. Existing manholes located within the city limit shall be identified by the alphanumeric system established by the Department. Refer to Department's "GIMS" map's "Wastewater Manholes" data layer for the 8-digit ID #s. If the manhole has no ID #, use the manhole's "Feature ID #" from the "Identify" query-generated pop-up database box.

f. Criteria for Connections to and Utilization of Manholes:

(1) Connections between public sewers at the manhole shall adhere to the following criteria when possible:

(a) The elevation of the crown of the discharging sewer shall either match the elevation of the crown of the receiving sewer or be approved as a special case by the City.
(b) A standard outside drop connection as shown in City of Houston Standard Details is required when the difference in elevation between discharging sewer flow line and receiving sewer flow line is greater than 24-inches.

(2) The routing of a service connection directly to an existing manhole will be allowed only if:

(a) The flow line elevation of the existing sanitary sewer is more than 10 feet below grade and there is no available stack and the lot to be so connected is a single-family, owner-occupied, single lot residence connection to an existing manhole; or
(b) The lot to be so connected is a single-family, single lot connecting to a manhole in a cul-de-sac.
(c) Satisfies discharge requirements of service leads requiring manholes (see Paragraph 8.04.D.3).

(3) When routing an approved service lead to a manhole the wall penetration shall not be greater than 10-inches in diameter and shall be sealed using approved water stop and grout, see Paragraph 8.04.J.2.f.(2).

(4) When routing an approved service lead to an existing manhole with invert elevation more than 24-inches lower, the connections shall utilize an outside drop and shall adhere to the following criteria, see Paragraph 8.04.J.2.f.(3):
(a) The manhole wall penetration shall not be greater than 10-inches in diameter,

(b) The outside drop shall be a minimum of 6-inches in diameter and shall be constructed of SDR 26 PVC pipe (ASTM D 3034),

(c) The outside drop shall be located 45-degrees from the upstream side of the sewer line,

(d) Usage of an internal drop will be reviewed on a case-by-case basis. A minimum of 48-inches of clear space shall be maintained inside the manhole between the drop and the opposing manhole wall. The drop pipe shall be firmly and frequently affixed to the manhole wall utilizing stainless steel bands and anchor bolts. All existing coatings shall be repaired per manufacturers recommendations upon completion,

(e) An internal drop shall terminate with a 45-degree bend. The 45-degree bend shall not extend below the top-of-pipe elevation of receiving sanitary sewer, and

(f) The wall penetration shall be sealed using an approved water stop and grout.

(5) When the line is more than 20-feet below grade or the line is greater than 36-inch in diameter a site-specific design is required.

3. Benches and Inverts: The bottom of the manhole shall be provided with a "U" shaped channel that is a smooth continuation of the inlet and outlet pipes. The depth of the "U" shaped channel shall be at least equal to the largest pipe diameter. In manholes with pipes of different sizes, the tops of the pipes shall be placed at the same elevation and flow channels in the invert sloped on an even slope from pipe to pipe. The bench provided above the channel shall be smooth and uniformly sloped at a minimum of 1-inch per foot to a maximum of 1.5-inches per foot, from the wall to the top of the invert channel.

4. Large manholes: All manholes connecting pipes larger than 36-inch and junction boxes shall have the lower corners filleted to prevent solids deposition.

K. Lift Stations

1. Lift station design shall comply with the City of Houston Engineering Design Guidelines Manual for Submersible Lift Stations and Design Guideline Drawings for Submersible Lift Stations, latest revision. The designer shall submit a Final Design Submittal Checklist (available from the City), signed and sealed by the Design Engineer, to ensure that the lift station is designed in compliance with the requirements of applicable codes and regulations. Include a copy of the Engineering Design Report satisfying TCEQ criteria.

L. Metro Solutions - Guided Rapid Transit

1. Location of Sanitary Sewer Lines

a. Sanitary sewer lines crossing under tracks shall be in steel casing, with minimum pipe size of 10-inches.

b. Sanitary service lines (building connections) shall not cross under tracks.

c. Extend the sanitary sewer stub for a minimum of "depth of sanitary sewer cover + 5 feet" beyond pavement limits.

d. Relocate existing sanitary sewer lines for a minimum of 15 feet from centerline of the nearest proposed track.

e. SDR 35 PVC pipe is not allowed.

f. Minimum cover of the pipe shall be determined by the Guided Rapid Transit Load Distribution calculations, use the greater of the calculated live or dead loads.

8.05 UNSERVED SITES REQUIRING ON-SITE SEWAGE FACILITIES (OSSF) (SEPTIC TANKS)

A. Engineer shall conform to applicable County criteria.

8.06 SUBMITTALS

A. Preliminary Design - Submit the following for review and comment:

1. Copies of any documents, which show approval or exceptions to the City design criteria.

2. Design calculations for line sizes and grades.

3. Contour map for overall area.

4. Plan-and-profile sheets showing proposed improvements (City projects only).

5. Geotechnical soils report for the project (City projects only).

B. Final Design - Submit the following for approval:

1. Final documents of the above plus plan-and-profile sheets and geotechnical soils reports for non-City projects.

2. Review prints.

3. Original drawings.

4. Complete copy of project specifications.

5. A final engineering design report shall be developed following the latest edition of TCEQ Chapter 217 and submitted to the City for each project. This report shall bear the signed and dated seal of a Professional Engineer registered in the State of Texas who is responsible for the design.

8.07 QUALITY ASSURANCE

A. Prepare calculations and construction drawings under the supervision of a Professional Engineer trained and licensed under the disciplines required by the drawings. The final construction drawings must be sealed, signed, and dated by the Professional Engineer responsible for the development of the drawings.

8.08 RESEARCH REQUIREMENTS

A. Discuss project concepts outlining proposed features and usage with City of Houston, Department of Houston Public Works.

B. Research existing utility and Right-Of-Way information.

C. Verify that no restrictions exist that will deny approval of the project concept.

8.09 DESIGN ANALYSIS

A. A calculation of design flows for the complete development project.

B. Calculations for design of any treatment plant required for the development.

C. Calculations for effect of the 25-year storm outfall from any proposed treatment plant.

8.10 DRAWINGS

A. Drawings shall include layout sheets with contours, plan-and-profile sheets, and detail sheets for special items and treatment plants.

END OF CHAPTER