

DESIGN CRITERIA

SECTION 4 – WASTEWATER COLLECTION SYSTEMS

4.1 General Requirements

These regulations and standards include, but may not be limited to:

Hampton Roads Sanitation District (HRSD)
<http://www.hrsd.com/>

Hampton Roads Planning District Commission (HRPDC)
<http://www.hrpdcva.gov/>

United States Environmental Protection Agency
<https://www3.epa.gov/>

Virginia Department of Environmental Quality
<http://www.deq.virginia.gov/>

Sewage Collection and Treatment (SCAT) Regulations
Chapter 790, Section 10 - 1000
<https://law.lis.virginia.gov/admincode/title9/agency25/chapter790/>

Regional Technical Standards (RTS)
<http://www.deq.virginia.gov/Portals/0/DEQ/Enforcement/FinalOrders/HRSDandLocality-RTS-Sept262007.pdf>

Sanitary sewers are to be provided solely for the collection and transport of sanitary waste. Under no circumstances shall any roof drains, foundation drains, surface or subsurface drains be either directly or indirectly connected to sanitary sewers.

4.2 Planning Phase Requirements

During the planning phase the sanitary sewer service area will be studied, and the following alternatives will be evaluated:

- Minimizing the use of new sewers greater than 15 feet in depth,
- Redirection of a portion of the flows to an adjacent service area,
- Subdivision of the service area with additional lift station(s),
- Overall effect on downstream City and HRSD facilities and
- Comparison of capital, operating and life cycle costs

The most cost-effective alternative will be recommended unless a more significant criterion applies.

The results of the study will be described in a detailed Preliminary Engineering Report. This report

will be submitted to and approved by the Department prior to the commencement of the design phase. The report shall fully comply with all the requirements listed herein as well as applicable Virginia Department of Health (VDH) requirements. This report will contain a Master Utility Plan and a proposed Phasing Plan.

4.3 Design Phase Requirements

A. Coordination

At the start of the preliminary design phase, the Department will provide the designer with contact information with the Department of Public Works. The designer shall coordinate the project with the Streets and Bridges and Stormwater sections. The designer shall refer to the City Right of Way Excavation and Restoration Manual and design accordingly. Additionally, all CIP (Capital Improvement Project) designs shall include an Erosion and Sediment Control plan that will be enforced by the office of Environmental Services. Similarly, all applicable approvals and permits must be obtained prior to construction.

B. Design Factors

1. Sewage collection systems shall be designed and constructed to achieve total containment of the predicted sewage flows contributed from the established service area and population.
 - a. In general, sewer systems shall be designed for the estimated ultimate tributary population with an upper limit consisting of the 50-year population growth projection, except in cases where capacities of system or parts thereof can be readily increased by future relief, allowing for shorter capacity design life of initial or subsequent lines. Consideration shall be given to land use plans and to other planning documents and to the maximum anticipated capacity of institutions, industrial parks, apartment developments, etc.

Reference: *VDH - Sewage Collection and Treatment (SCAT) Regulations: 9 VAC 25-790-310 Design Factors, B. Basis*

C. Average and Peak Sewage Flow

The design of average and peak sewage flow shall be determined using the HRSD Regional Sewage Flow Projection Data Table, with link below. Design for appropriate size of sewer system will be based off peak sewage flow. Variations from this chart may be considered only with prior approval from the Department of Utilities.

Reference: *VDH - Sewage Collection and Treatment (SCAT) Regulations: 9 VAC 25-790-310 Design Factors, D. Capacity*

Reference: HRSD's Sanitary Sewer Flow Calculations Worksheet.
<https://www.hrsd.com/development-services-forms>

HRSD Sanitary Sewer Flow Calculations Worksheet

Applicants with projects generating sanitary sewer flow must use this worksheet to calculate flows and submit to HRSD Development Services using the email link: developrequest@hrsd.com

Project Name:

Pump Station Replacements - Upgrades - Modifications projects

HRSD shall certify a pump station based on metered data if available. In absence of metered data, water consumption data shall be used instead. If there is a future flow component in the calculations for the catchment, please use the worksheet below.

PS No:				
PS Name:				
Pump Station Catchment Basin				
Avg. Dry Weather Flow		Wet Weather Flow		
gpd	gpm	gpd	gpm	
Enter Metered	→	0.00	0	0.00
OR Water Consumption Flow	→	0.00	0	0.00
Sub-totals:		0	0.00	0 0.00

Proposed Development

Please use the table below to calculate sanitary sewer flows for your project

Land Use	Contributing Unit Type	Flow (gpd/Unit)	Flow Duration (hours)	Peak Factor
Residential				
Single Family Homes, Trailers, Apartments, Condos, Townhomes, Duplexes	Residential Dwelling	310	24	2.5
Medical Facilities				
Hospitals	Medical Bed	300	24	3
Nursing Homes & Assisted Living		160	24	3
Funeral Homes	Gross SF	0.25	12	3
Medical Office Building	Gross SF	0.25	12	3
Tourism Facilities				
Hotels & Motels	Room	130	24	3
Educational Facilities				
High School (w/ showers)	Student / Faculty	15	8	3
Elementary & Middle School		10	8	3
College/University Campus & Day Care		10	12	3
Boarding Schools		75	16	3
Recreational Facilities				
Picnic Areas, Parks & Amusement Parks	Person	5	12	3
Movie Theater	Seat	2.5	12	3
Religious Assembly		2.5	6	3
Campground / Cabins	Camping site	100	24	3
Dining / Eatery Facilities				
Restaurants	Seat	30	16	3
Service & Retail Facilities				
Shopping Mall & Retail Shops	Gross SF	0.2	12	3
Convenient Store		0.3	24	3
Office Building, Storage Units/Office		0.1	12	3
Fitness Center		0.1	16	3
Service Stations		0.4	16	3
Laundromats	Machine	500	16	3
Industrial Facilities				
Heavy Industrial	Gross SF	0.35	16	3
Light Industrial		0.1	16	3
Warehouse		0.05	24	3

Enter No. of Units	Avg. Flow (gpd)	Avg. Flow (gpm)	Peak Flow (gpd)	Peak Flow (gpm)
	0	0.00	0	0.00
	0	0.00	0	0.00
	0	0.00	0	0.00
	0	0.00	0	0.00
	0	0.00	0	0.00
	0	0.00	0	0.00
	0	0.00	0	0.00
	0	0.00	0	0.00
	0	0.00	0	0.00
	0	0.00	0	0.00
	0	0.00	0	0.00
	0	0.00	0	0.00
	0	0.00	0	0.00
	0	0.00	0	0.00
	0	0.00	0	0.00
	0	0.00	0	0.00
	0	0.00	0	0.00
	0	0.00	0	0.00
	0	0.00	0	0.00
	0	0.00	0	0.00
Sub-Totals:	0	0.00	0	0.00

Future Growth Flow Calculations

Land use	Contributing Unit Type	Enter Flow (gpd/Unit)	Flow Duration (hrs)	Peak Factor
Residential				
Single Family Homes, Trailers, Apartments, Condos, Townhomes, Duplexes	Residential Dwelling	310	24	2.5
Commercial				
Medical, Tourism, Educational, Recreational, Dining, Service & Retail Facilities	Acres	1,000.00	24	3
Industrial				
Heavy & Light Industrial, Manufacturing, Warehouses	Acres	1,000.00	24	3

Enter No. of Units	Avg. Flow (gpd)	Avg. Flow (gpm)	Peak Flow (gpd)	Peak Flow (gpm)
	0	0.00	0	0.00
	0	0.00	0	0.00
	0	0.00	0	0.00
	0	0.00	0	0.00
	0	0.00	0	0.00
	0	0.00	0	0.00
	0	0.00	0	0.00
	0	0.00	0	0.00
	0	0.00	0	0.00
	0	0.00	0	0.00
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	0	0.00	0	0.00
	0	0.00	0	0.00
	0	0.00	0	0.00
	0	0.00	0	0.00
	0	0.00	0	0.00
	0	0.00	0	0.00
	0	0.00	0	0.00
	0	0.00	0	0.00
	0	0.00	0	0.00
	0	0.00	0	0.00
	0	0.00	0	0.00
	0	0.00	0	0.00
	0	0.00	0	0.00
Sub-totals:	0	0	0	0
Grand Totals:	0	0.00	0	0.00

NOTE: Enter the number of units as indicated in the appropriate land use to calculate project design flows. Under the Future Growth Flow Calculations section, you may edit the default values for the flow factor (gpd/Unit) based on best engineering practices.

Comments:

Applicant's Name:
 Phone No:
 Email:

**This Table includes Inflow & Infiltration (I & I).
 Groundwater infiltration is accounted for in peak factors**

1. Population Density

Population density shall be in accordance with the Comprehensive Plan for the City of Norfolk projected by the Department of Planning and Codes Administration, or actual count or character of proposed development, whichever is greatest.

2. System Layout

- a. The overall layout and general design shall conform to the parameters set forth in the approved Preliminary Engineering Report
 - i. All sanitary sewers must be accessible for operation and maintenance:
 - ii. Locate all sanitary sewer in legally established road rights-of-way. Underneath the roadway is the standard location.
 - iii. Sewers shall be located outside of jurisdictional wetland areas, whenever possible. In the event that this is impractical, the Design Engineer must obtain required permits.
 - iv. Stormwater BMPs shall not encroach within 10 feet of the sanitary sewer.
- b. Construction shall be along the center line of rights-of-way or easements except when this location has been previously used by another utility, or when the width of a road right-of-way justifies the use of two sewer lines.
- c. All sewers shall be on continuous grade and straight alignment between manholes
- d. All sewer lines shall be designed with the entry into the manhole by the proposed sewer lines at an angle of 90° or greater to the downstream line. In the event that this is impractical, the Design Engineer must satisfy the Department that adequate losses have been provided in the hydraulic analysis as shown in Section 4.3 above.
- e. Where sewer depth is 10 feet or less, sewers and manholes shall be located a minimum of 15 feet horizontally, measured from edge to edge, from any part of a building, structure, or its foundation. Where the depth of sewer is greater than 10 feet, the sewers and manholes shall be located a minimum of 20 feet from any part of a building, structure, or its foundation.
- f. Siphons are to be avoided and will only be considered on special occasions. The Design Engineer shall submit justification and calculations demonstrating the need for siphons. Siphons may only be installed with prior approval from the Department.

3. Capacity Design

- a. Determine flow quantities as described in 4.3 below.
- b. The hydraulic grade line for all conditions of flow shall be below the crown of the sewer.
- c. Hydraulic computations for all sewers shall be provided. Computations shall be accompanied by an Overall (System Layout) Plan. Map(s) shall show the entire service area involved, location(s) of line(s) in the system, and the points of entry

of flows, including any flows being received from other areas. Computations and maps shall be submitted to the Department for approval.

D. Hydraulic Design – Sewers

1. Minimum slopes shall be as specified in the latest edition of the *VDH - Sewage Collection and Treatment (SCAT) Regulations*. Pipe sizes shall not be arbitrarily increased in order to take advantage of a flatter grade. Use of slopes less than those specified shall be justified by the designer and will be subject to approval by the Department and DEQ.
2. The minimum size pipe to be used in sewer systems shall be eight (8) inches.
3. Computations for velocity of flows in new pipe shall be included with every design. They shall be based upon the following minimum values of "n" as used in the Manning formula for velocity of flow, as stated below:
 - a. Ductile iron pipe all sizes: "n" equals 0.013
 - b. PVC pipe all sizes: "n" can be no lower than 0.012.
4. In cases where the calculated depth of flow is less than pipe flowing full, the velocity at actual depth of flow shall be computed.
5. For sewage flow depth less than 1/4 full, an allowance shall be made for increased value of "n" and in no case shall velocities of less than 1.3 feet per second be permitted. The improved velocities shall be accomplished by steeper grades and not by changing pipe diameter.
6. New sewer services requiring service laterals of 8 inches or greater shall connect to the main at a manhole, and shall include a manhole at the property line or edge of easement. Sewer services for single residential connections shall be a minimum of 4 inches and shall include a cleanout at the property line or edge of easement. Sewer services for connections with greater than 4 residential units shall be a minimum of 6 inches and shall include a cleanout at the property line or edge of easement. Sewer services for commercial connections shall be a minimum of 6 inches and shall include a cleanout at the property line or edge of easement. Calculations based on peak sewer demand will be provided by the Design Engineer to determine commercial size lateral (Reference 4.2.01.1). Services shall be at an angle of 90° to the main, as practical, with the actual connection to the main at 45° in the direction of flow. 4-inch Connections shall be installed at a minimum grade of 1/8 inch per 1 foot (1% slope).
7. Miscellaneous head losses at manholes and curves shall be computed in accordance with the following. Junctions of more than two (2) pipes will require special consideration.
 - a. Manholes where radius of turn is less than 2 pipe diameters:
$$H = .50(\text{angle}/90^\circ)^.5(V^2/2g)$$

- b. Manholes where radius of turn is greater than 2 pipe diameters:

$$H = 0.25(\text{angle}/90^\circ)^5(V^2/2g)$$
 - c. Where angle is horizontal deflection angle $V^2/2g$ is velocity head of effluent pipe
8. Loss for straight run manhole shall be 0.1 feet. Where this is not achievable, Design Engineer shall submit calculations and justification.
 9. Where pipe diameters increase at manholes in direction of flow, the effluent invert shall be lowered below influent elevation as follows:

Change in invert elevation equals $0.8 (D_1 - D_2)$ Where:

D_1 equals downstream diameter, feet

D_2 equals upstream diameter, feet

This adjustment shall be in addition to computed head loss.

10. In general, average flow velocities greater than ten feet per second shall not be permitted. Outside drop manholes shall be provided where required to eliminate steep slopes and to reduce high velocities to a limit of eight feet per second or less. Where it is impractical to limit velocities below eight feet per second, reasonable effort must be made not to exceed ten feet per second.
11. A statement must be included in the design documents and on the construction drawings that identify all single private sewer laterals or mains that serve two or more individually owned or occupied units within one building.

E. Structural Design and Location

1. Structural requirements must be considered in the design of all sewers and appurtenances.
2. The proper strengths shall be determined and indicated for sewer pipe materials being specified. Strength shall be based upon pipe size, proposed depth, width of trench, bedding conditions, existing ground conditions, etc. The proper strength of sewer pipe is a matter of detail design not subject to simple generalizations.
3. In deep cuts, it is generally preferable to change pipe strengths to obtain proper design rather than vary bedding conditions. However, pipe strength or class shall be shown on plans with stations to indicate the location. For lines 3' to 10' deep, a minimum of Class 52 ductile iron (with SewperCoat or Protecto 401 lining), or PVC SDR-26 shall be used. For sewer lines greater than 10' deep, a minimum of Class 52 ductile iron (with SewperCoat or Protecto 401 lining), PVC C-900 (DR 25, 18), or PVC C-905 (DR 25, 18) shall be used.
4. No change in pipe strength or material shall be made between manholes. Laterals to be the same material as the sewer main it will connect to.

5. The minimum manhole diameter shall be 48-inches when the total depth is less than 12 feet. The minimum manhole diameter shall be increased to 60-inches when the total depth equals or exceeds 12 feet (RIM to deepest invert).
6. All pipes and manholes shall be protected against hydrogen sulfide. This shall be accomplished by the use of acid-resistant pipe (PVC or lined ductile iron) and lined manholes. The Department shall approve the materials and design for the conditions at each individual location. Current approved linings are referenced on the current Approved Products List.
7. Only ductile iron pipe coated with SewperCoat or Protecto 401 lining shall be used for the following conditions:
 - a. Where sewer lines enter or cross streams, estuaries, lakes or reservoirs.
 - b. Where sewer lines cross jurisdictional wetland areas.
 - c. As a carrier pipe within any bore or tunnel crossing.
 - d. In subdivisions where sewer lines are installed in an easement along the property line between buildable areas.
 - e. In easements where, in the opinion of the Department, the sanitary sewer is not accessible from a street, parking lot, or driveway.
8. Corrosive conditions will require additional consideration.
9. Reuse of Existing Sanitary Sewer Laterals:
 - a. To determine the condition of an existing sanitary sewer lateral, Closed Circuit Television (CCTV) shall occur for inspection of the existing sanitary sewer lateral. CCTV Inspections shall be conducted in accordance with the *National Association of Sewer Service Companies (NASSCO) standards*. Standard NASSCO report to be submitted. The following definitions shall apply.
 - i. Light Cleaning – Removal of all debris and removal of deposits settled in the existing sanitary sewer pipe. The work includes up to three passes of a hydraulic flusher.
 - ii. Heavy Cleaning – Removal of all debris, obstructions, deposits settled and deposits attached by grease by rotating nozzle or other mechanical means but excluding saws or cutters. The work includes greater than three passes and up to ten passes by high velocity hydro-cleaning equipment.
 - b. If the existing sanitary sewer lateral is determined to be serviceable by the City, then connection to the City sewer system may occur.
 - c. If the existing sanitary sewer lateral is determined to be past its useful life and deemed unserviceable (by the City), then connection to the City sewer system must occur through a new sanitary sewer lateral, installed at the cost of the City. Exclusion of cost will occur, if the location of the new lateral is located within an ongoing Norfolk Utilities CIP project, currently under construction.

- d. The following reference includes information for sanitary sewer connections, associated connection costs, and authority for the determination of material condition; Reference: *Code of the City of Norfolk, VA 1979, Chapter 39.1-7. – Sewer connection charges, Chapter 39.1-17 – Inspections and repairs*

10. Sanitary Sewer Connections for CIP Projects

- a. No service connections will be installed for vacant lots with the following conditions:
 - i. Where the sewer main invert is less than or equal to 12 feet in depth from the finished grade
 - OR
 - ii. The street frontage lot is greater than or equal to 160 feet.
- b. Service connections to be installed for vacant lots with the following conditions:
 - i. Where the sewer main invert is greater than 12 feet in depth from the finished grade, service connections will be installed for vacant lots with street frontages as follows:
 - 1. Street frontage lot greater than or equal to 40 feet and less than 80 feet; install one main line wye, one 4-inch service lateral, one 4-inch service wye and one 4-inch property line cleanout.
 - 2. Street frontage lot size greater than or equal to 80 feet and less than 120 feet; install one main line wye, one 6-inch service lateral, one 6-inch service wye and one 4-inch property line cleanout.
 - 3. Street frontage lot size greater than or equal to 120 feet and less than 160 feet; contact property owner & offer installation of maximum of three 4-inch services. Install three 4-inch services or the number of services requested by the property owner.

11. Sanitary Sewer Connections for Developer Projects

- a. Sanitary sewer connections for vacant lots shall be installed in accordance with the Standard Detail CS 10.
- b. Sanitary sewer connections to be installed at the Developer's expense.

12. Septic Tanks

- a. If City sewer is available within two hundred feet of the property line, then no septic tank system is permitted.
Reference: *Code of the City of Norfolk, VA 1979, Chapter 39.1-5. – Mandatory sewer connections*

13. Oil-Water Separators subject to storm water and roof drains are prohibited from discharging into the wastewater system.

F. Manholes

1. Standard and drop manholes shall be constructed in accordance with Standard Details.
2. Manholes shall be installed at the end of each line, at all grade, size, material or alignment changes; at all sewer line intersections and at a maximum interval spacing of 300 feet.
3. Flow channels shall be shaped and formed in each manhole to provide a smooth transition of flow from all inlets to the outlet. The flow line shall be formed to the crown of inlet and outlet pipes to form a “U” as shown in the Standard Details.
4. Sewer lines shall be protected from a 100-year flood by either raising manhole tops above flood plain or by the use of watertight frames and covers. Where watertight frames and covers are used, unventilated length of sewer cannot exceed 1000 feet. When feasible, manhole covers shall be no more than 30 inches above ground level. Only 316 stainless steel watertight manhole inserts shall be used.
5. Note to be added to each CIP project on the contract construction plans that states the 100-year flood elevation in the specified project area.
6. Where possible in unpaved areas, manholes are to be flush with existing grade and sealed with a stainless steel watertight insert.
7. Sewer services connections will connect to the sewer main. No service connections into manholes.
8. Manholes shall not have bricked-up or partially scored openings for future sewers.
9. A manhole at the property line or edge of easement shall be required for all sewer service laterals that are 8-inch or greater. A manhole shall also be required where 8-inch services connect to the main line.
10. No conflict manholes will be allowed.

G. Depth of Sewers

1. Generally, all sewers shall be of sufficient depth to provide service to the lowest sewer elevation of structure in question, allowing proper service connection grade. The minimum cover depth for all sewer lines shall be 36 inches. Where this is not attainable, lines with less than 36 inches of cover shall be minimum Class 52 ductile iron pipe lined with SewperCoat, Protecto 401 lining, or approved equal.

2. Sanitary sewers crossing under storm sewers shall maintain a minimum separation of 12 inches. Where this separation is not possible, ductile iron pipe lined with SewperCoat, Protecto 401 lining, or approved equal shall be used. Concrete supports may be required for the storm sewer.
3. Sanitary sewers beneath streams shall be at a sufficient depth below the bottom of the stream bed to protect the sewer line. In general, three feet of suitable cover shall be provided. For all stream crossings, ductile iron pipe lined with SewperCoat, Protecto 401 lining, or approved equal shall be used, with all pipe enclosed in a casing pipe.

H. Easements

1. Easements shall be established according to the procedures in Section 8 of these Standards.

I. Protection of Water Supplies

1. Comply with *Virginia Department of Health Waterworks Regulations and Sewerage Regulations* for separation of water mains and sewers.
2. Parallel Installation
 - a. Normal Conditions – Sanitary sewer or sewer manholes shall be constructed at least 10 feet horizontally from water lines whenever possible. The distance shall be measured edge-to-edge.
 - b. Unusual Conditions – When local conditions prevent a horizontal separation of at least 10 feet, the sewer or sewer manhole may be installed closer to a water line provided that:
 - i. The bottom of the water line is at least 18 inches above the top of the sewer.
 - ii. Where this vertical separation cannot be obtained, the sewer shall be constructed of AWWA approved water pipe.
3. Crossing
 - a. Water lines crossing over sewers shall be laid to provide a separation as described in Section 3.2 B.8. The following construction techniques shall be used.
 - i. Sewer passing over or under water lines shall be constructed of the materials described in parallel installation, unusual conditions – Section 3.2 II B.7.

- ii. Water lines passing under sewers shall, in addition, be protected by providing:
 - 1. A vertical separation of at least 18 inches between the bottom of the sewer and the top of the water line.
 - 2. Adequate structural support for the sewers to prevent excessive deflection of the joints and the settling on and breaking of the water line.
 - 3. That the length of the water line segment be centered at the point of the crossings so that joints shall be equidistant and as far as possible from the sewer.
- 4. No water pipes shall pass through or come in contact with any part of a sewer line or sewer manhole.

Reference: *VDH - Sewage Collection and Treatment (SCAT) Regulations:*
9 VAC 25-790-360 *Water quality and public health and welfare protection*

J. Abandonments

- 1. For in-kind redevelopments with reconnection to an existing sewer lateral (i.e. single-family demo and rebuild), the following shall occur:
 - a. The sewer service connection shall be terminated on the private side of the property-line cleanout.
 - b. The existing private-side lateral shall be cut and capped on the influent to the wye using a cap suitable for in-ground use and of the same material as the lateral.
 - c. The property line cleanout and box shall be left in place; a gripper plug or threaded plug shall be installed inside of the cleanout.
 - d. This work will continue to be inspected by the Plumbing Division of Building Construction Services.
- 2. For total abandonments and redevelopments that propose or require installation of a new sewer lateral, the following shall occur:
 - a. The existing sewer service connection shall be terminated on the public side of the property-line cleanout (within 2 feet).
 - b. The existing lateral shall be cut and capped on the influent to the sewer main using a cap suitable for in-ground use and of the same material as the lateral.
 - c. The existing cleanout wye, riser and box shall be removed and the void filled with suitable soil.
 - d. This work will also continue to be inspected by the Plumbing Division of Building Construction Services.
- 3. Prior to the issuance of a demolition permit for an existing structure, the existing sewer service(s) must be terminated using one of the methods described above.

4.4 Permitting Phase Requirements

All applicable federal, state, and local permits and approvals must be obtained prior to plan approval. This includes the requirement to formally obtain a construction permit through the Virginia Department of Health and the Virginia Department of Environmental Quality. If a waiver for formal permit issuance has been granted, proof of the waiver must be presented prior to plan approval.