



Engineering Standards

Chapter 6 Sanitary Sewer

| <u>Section</u> | <u>Description</u> |
|----------------|---------------------------------|
| 6-01 | General Requirements |
| 6-02 | Sanitary Sewer Design |
| 6-03 | Main Lines |
| 6-04 | Manholes |
| 6-05 | Pipe Class – Protection – Cover |
| 6-06 | Clearances – Other Utilities |
| 6-07 | Connections to Existing System |
| 6-08 | Fats, Oils, Grease, Separation |
| 6-09 | Easements |
| 6-10 | Side Sewers |
| 6-11 | Sewer Materials |
| 6-12 | Sewer Cleaning |
| 6-13 | Testing Gravity Sewers |
| 6-14 | Video Inspection |

6-01 General Requirements

These Engineering Standards set forth minimum standards for the design and construction of public and private sanitary sewer collection facilities.

Reference the Washington State Department of Ecology Criteria for Sewage Works Design and WSDOT Standard Specifications for Road, Bridge and Municipal Construction.

6-02 Sanitary Sewer Design

Type of Collection System

- All sanitary sewer collection systems shall be gravity fed.

Serve to Extreme of Property

- Ensure adjacent properties can be provided sewer service (extend to extreme of developable portion of property and design for the ultimate development of the tributary areas).

Private Sanitary Sewage Pumps

The Public Works Director, in his sole discretion, may allow isolated, topographically constrained areas within specific developments to be served by private, onsite sanitary sewer pump systems. Each system shall be designed and engineered by a qualified professional and shall comply with the Uniform Plumbing Code, Department of Ecology Sewer Design Standards as well as the Department of Labor and Industries (L&I).

If allowed, the system's maintenance and operations standards are subject to City approval and conditions related to the pump system will be placed on the development as necessary.

Public Sanitary Sewage Pumps

When approved, Public Sanitary sewer pump stations shall be designed on a case-by-case basis to serve extended areas. All pump stations must be designed by a licensed Engineer to meet City standards.

6-03 Main Lines

Minimum Pipe Size

- Minimum pipe size shall be 8 inches.

Pipe Slope

- a. All sewers shall be designed and constructed to provide a design velocity, of not less than 2.0 fps [feet per second], for anticipated maximum flows. For minimum pipe slopes refer to the criteria from Sewage Works Designs – DOE.
- b. Maximum main line slope shall not induce velocities greater than 10 fps under daily peak flows.

Table C1-1. Minimum Slope of Sewers, by size (Assuming Full Flow)

| Sewer Size (inches) | Minimum Slope (feet per 100 feet) |
|---------------------|-----------------------------------|
| 8 | 0.40 |
| 10 | 0.28 |
| 12 | 0.22 |
| 14 | 0.17 |
| 15 | 0.15 |
| 16 | 0.14 |
| 18 | 0.12 |
| 21 | 0.10 |
| 24 | 0.08 |
| 27 | 0.07 |
| 30 | 0.06 |
| 36 | 0.05 |

- c. Pipe anchor blocks shall be placed where pipe slope exceeds 20% as per Sewage Works Designs - DOE.
- d. Pipe slope tolerance shall be per WSDOT Standard Specifications 7-08.03 Section (2) B - Allowable Variables.

6-04 Manholes

Note: Manholes ring and cover shall conform to WSDOT Standard Plans and the City of Mount Vernon Standards. All manholes shall contain no knockouts.

- a. Maximum distance between manholes shall be 400 feet.
- b. All manhole covers shall be set flush with ground surface, except where otherwise designated by the City of Mount Vernon. All manholes shall have locking covers.
- c. Only approved concrete adjustment rings will be allowed.

d. Existing and Terminal Manholes:

When connecting to an existing manhole, the design shall call-out all necessary revisions to the existing manhole, or if the existing manhole cannot be modified to meet the standards, the manhole shall be removed and replaced with a conforming structure unless otherwise approved. All sewer mains shall terminate with a manhole.

e. Side sewer connections are not allowed into manholes unless otherwise approved.

f. Terminal manholes shall not be channeled. Slope manhole inside bottom to provide positive drainage toward pipe, use 3,000 PSI cement concrete.

g. Maximum allowable drop in invert elevation across the manhole shall be 1.0 ft. The minimum shall be 1/10th of a foot.

h. Manhole Sizing:

48" manhole:

1. 2 connecting pipes, 8" dia. to 12" dia.
2. 3 connecting pipes, 8" dia. to 10" dia.

54" manhole:

1. 2 connecting pipes, 15" dia. to 21" dia.
2. 3 connecting pipes, 10" dia. to 15" dia.
3. 4 connecting pipes, 8" dia. to 12" dia.

72" manhole:

1. 2 connecting pipes, 21" dia. to 24" dia.
2. 3 connecting pipes, 15" dia.
3. 4 connecting pipes, 15" dia.

i. For other pipe configurations, the size of the manhole will be determined on a case-by-case basis.

j. The minimum angle between the incoming and the outgoing pipe shall be 90 degrees; pipe shall be radial with the center of manhole unless otherwise approved.

k. The above configurations shall provide adequate shelves and room for maintenance and performing video inspections.

l. Channels shall be centered in manhole.

m. Ladder rungs shall be placed on side of manhole with largest shelf.

- n. All manholes shall be provided with an eccentric cone, unless otherwise approved.
- o. Minimum manhole depths (invert to top of rim) shall be 8 ft. unless otherwise approved by the Engineering Services Manager during plan review.
- p. Drop Connection:
 - Minimum height of drop is 2.5'
 - Maximum height of drop is 20'.
 - Outside drop structure is required, unless otherwise approved.

q. Pipe Connections to Manholes:

Unless otherwise approved, flexible connectors are required at pipe connections to manhole, in accordance with WSDOT/APWA Specifications Section 7-05.3. The type of connector shall be an A-LOK flexible connector, KOR-N-SEAL by NPC, INC., or suitable equivalent.

6-05 Pipe Class – Protection – Cover

a. Polyvinyl Chloride (PVC) pipe class designation:

- All sewer pipe shall be SDR 35 PVC conforming to ASTM D3034, unless otherwise approved.
- Depth of cover over SDR35 PVC pipe shall be three feet minimum and twenty feet maximum. Pipe depths outside this range will require use of pressure class PVC conforming to AWWA C900 (dimension ratio 18 or less).

b. All buried metal pipe shall be encased in 8-mil polyethylene per AWWA C-105.

c. Building setback requirements for sewer mains:

- 10' minimum from buildings and retaining walls, or equal to depth of pipe, whichever is greater.
- 20' minimum easement shall be provided between buildings, on multi-family and commercial sites.
- When passing between any two existing buildings (residential or commercial, etc.) which are 15' apart or less, the easement width shall extend the full width between the buildings, and the depth of the sewer line shall not exceed 10'.

6-06 Clearances – Other Utilities (Call for Locates)

- a. All clearances below are from edge-to-edge of each pipe.
- b. Water services and sewer stubs shall have at least 5' horizontal clearance.
- c. Check for crossing or parallel utilities. Maintain minimum vertical and horizontal clearances. Avoid crossings at highly acute angles (the smallest angle measure between utilities should be between 45 and 90 degrees).
- d. Horizontal clearances from sanitary sewer mains:

| | |
|------------------------|-----|
| Cable TV | 5' |
| Gas | 5' |
| Power | 10' |
| Storm | 5' |
| Telephone, Fiber Optic | 10' |
| Water | 10' |
- e. Vertical clearances from sanitary sewer mains:

| | |
|------------------------|----|
| Cable TV | 1' |
| Gas | 1' |
| Power | 1' |
| Storm | 1' |
| Telephone, Fiber Optic | 1' |
| Water | 2' |
- f. Where sewer crosses water main, one full length of sewer pipe shall be used with the pipe centered for maximum joint separation. Washington Department of Ecology Criteria will also apply.

6-07 Sewer Main Connections to Existing System

- a. New sewer mains shall connect to existing sewer main at manholes.
- b. When connecting to an existing manhole, opening shall be core-drilled, fitted with an approved connecting device and manhole base rechanneled.
- c. When connecting to an existing manhole which has access less than 24" in diameter, the manhole shall be upgraded to current standards unless otherwise approved.
- d. Connections to end of existing pipe:
 - If end of pipe is known to have a bell, and new pipe is the same material as existing, plans can specify connection by inserting spigot of new pipe into existing bell end, with an O-ring gasket.

- If existing pipe is plain end, or must be cut, plans should specify use of an approved coupling to connect new and existing lines.

e. Approved couplings for use on sanitary sewer systems:

- Ductile iron mechanical couplings (equal to ROMAC) on ductile iron, concrete, vitrified clay, or pipes with differing materials or diameters.
- On PVC or HDPE mains, PVC or HDPE couplings with compatible dimension ratio and gaskets to connect new and existing pipes shall be used.
- When a section of existing PVC pipe is replaced by “dropping-in” a new section of PVC pipe, the connections to existing pipe shall be made with PVC closure couplings (slip couplings).

6-08 Oil / Water Separation, Grease Interceptor

Oil/Water Separator

Industrial or Commercial Businesses that regularly wash vehicle/equipment exterior surfaces or engage in engine cleaning and other cleaning operations that use acids, caustics, or other metal brighteners as part of their integral maintenance operations, must use closed loop water recycling systems, that have zero discharge. Sludge accumulations from these systems can usually be disposed of in a landfill. Check with Skagit County Health Department for details regarding the disposal.

- a. Evaporator type systems meeting Air Pollution Authority requirements are also permissible.
- b. Contractors must submit the maintenance and operation plan for these systems for the City’s approval.
- c. Miscellaneous floor drains within these businesses may discharge to the sanitary sewer system following pre-treatment for oil removal.
- d. Maintain free access to the separator at all times for inspection and compliance determination sampling. A sampling tee must be located on the outlet with a minimum 18-inch drop below invert.

Whenever an industrial or commercial business generates mineral/petroleum oils exceeding 100 milligrams per liter to be discharged to the sanitary sewer, pre-treatment is required. An oil/water separation device shall be installed by the property owner as specified in the appropriate standard drawings. Selection and sizing of an oil/water separator shall be subject to approval by the Utility. Water discharged from any oil/water separator to the sanitary sewer system shall not contain in excess of 100 milligrams per

liter of petroleum oil, non-biodegradable cutting oil or mineral products, and shall be in compliance with the City of Mount Vernon regulations for discharge to the sanitary sewer.

- a. Sizing of a separator facility shall be based upon maximum available flow to the separator and provision of a forty-five minute retention time in the separator at that flow, with a minimum capacity of at least 100 gallons.
- b. The oil/water separator shall be covered with removable sections. Access and inspection covers, weighing not more than 30 lbs. and with suitable handholds, are to be provided directly above inspection “tee” and oil/grit collection compartments.
- c. Only waste water from floor drains and covered parking areas shall drain to the separator. The location and design shall minimize or eliminate the possibility of storm water reaching the separator – **Area over two hundred square feet open to rainfall shall not drain to the separator.** Sewage from restrooms and shower facilities shall not drain to the separator.
- d. Allowable materials for construction are as follows:
 - Tank – concrete
 - Baffles – concrete, steel plate
 - Or as approved by Engineering Services Manager during plan review
- e. The separator shall be located within 20 feet of drive for access by maintenance vehicle.
- f. A sampling tee shall be located on the outlet with a minimum 18-inch drop below the invert. Access to the separator shall be maintained free for inspection and compliance determination sampling at all times.
- g. The effluent discharged from any oil/water separator to the sanitary sewer shall not exceed 100 milligrams per liter total oil.
- h. When pre-treatment is no longer required, the inlet and outlet pipes shall be permanently plugged, the separation chambers pumped out, and the vault removed, or filled with an approved structural fill or controlled density fill.
- i. Vehicle fueling stations that regularly engage in the filling of vehicle fuel tanks must have a dead end sump, closed tank system to contain accidental and miscellaneous spills that occur at the fueling area during the fueling operations. The City must approve the capacity of the tank. The contaminated reservoir contents must be disposed of according to Department of Ecology standards. Discharge to the sanitary sewer will not be allowed.

Grease Interceptor

Whenever a commercial and/or retail food preparation operation, regardless of size, generates animal/vegetable fats, oils or grease (F.O.G) waste, which causes a visible sheen or accumulations in the effluent, to be discharged to the sanitary sewer, pre-treatment is required. A grease interception device-and/or other biological, chemical, or other pre-treatment approved by the City of Mount Vernon, shall be installed by the owner. Effluent discharged from any grease interceptor shall not contain a visible sheen or accumulations of F.O.G. and shall be in compliance with the City of Mount Vernon regulations for discharge to the sanitary sewer.

- a. Size and design of the grease interceptor shall conform to the Uniform Plumbing Code, Appendix H standards, and shall be 600 gallons except as noted by the City of Mount Vernon.
- b. Fixtures in the kitchen area which discharge waste-water containing grease are to be connected to the grease interceptor. Such fixtures include dishwashers, pot sinks, range woks, janitor's sinks, floor sinks, and rotoclones. Toilets, urinals, and wash basins shall not flow through the interceptor.
- c. The interceptor shall be located outside the building within 20-feet of the access drive for maintenance vehicles.
- d. The interceptor shall be filled with clean water prior to start-up of system.
- e. Allowable materials for construction are:
 - Tank – concrete
 - Baffles – concrete, steel plate
 - Or as approved by Engineering Services Manager during plan review
- f. Access to the interceptor shall be maintained free for inspection and compliance determination sampling at all times.
- g. When pre-treatment is no longer required, the inlet and outlet pipes shall be permanently plugged, the separation chambers pumped out, and the vault removed, or filled with an approved structural fill or controlled density fill.
- h. Grease Interceptors shall be cleaned every six months and an invoice shall be provided to the Public Works Department. A City of Mount Vernon approved maintenance program must be posted in the kitchen area.

6-09 Easements

- a. All easements shall be a minimum of 20' in width, or twice the depth of pipe, whichever is greater. Locate sewer main 10 feet from edge of easement facing interior lot, to ensure setback from building.
- b. Show easements on plans and identify width.
- c. All easements with public utilities shall be granted to the City of Mount Vernon
- d. Storm and sanitary facility access. Unless otherwise approved by the Public Works Director, all public storm and sanitary catch basins and manholes not constructed in the street section, must have an all-weather drivable surface constructed to each catch basin and manhole. The all-weather drivable surface must be of adequate grade, width and surfacing to allow access by maintenance vehicles.

6-10 Side Sewers

- a. Side sewer stub shall extend from main line to minimum 10' past edge of property line, with above grade cleanout outside of the dry utility easement.
- b. The end of each sanitary sewer stub shall be marked with pressure treated 2x4 painted green, or a PVC pipe. All side sewers must have locator tape or locator wire buried with the pipe.
- c. 4" minimum pipe diameter shall be used for single-family residential side sewers.
- d. For multi-family and commercial developments, side sewers shall be sized according to the intended use with a minimum of 6" in diameter.
- e. Side sewers shall connect to new main sewer lines with an approved fitting. Side sewer stubs shall run perpendicular to the sewer main in the right-of-way. Indicate station of side sewer tee from nearest downstream manhole. Also indicate the length of side sewer stub from main to clean-out and the cap at end of lateral. Call out invert at clean-out and provide finish floor elevation.
- f. Minimum side sewer slope shall be 2%.
- g. All side sewer clean-outs on commercial and multi-family projects shall include traffic rated enclosures for clean-outs within driving surfaces.
- h. Maximum distance between side sewer clean-outs shall be 100 feet.
- i. Connections to existing side sewers shall be made with pre-approved devices.
- j. All side sewers shall be pressured tested. Hydrostatic Testing is preferred.

6-11 Sewer Materials

General

All materials not specifically referenced shall comply with applicable sections of ASTM, AWWA or WSDOT Standard Specifications.

Pressure Sewer Pipe

PVC pressure pipe shall conform to AWWA C900 pressure class 100 (DR 25) unless otherwise approved. Joints shall be constructed as recommended by the pipe manufacturer for pressure pipe.

PVC fittings compatible with AWWA C900 pipe, or ductile iron fittings, when allowed, shall conform to these specifications.

Fittings

All fittings shall be of the same material as the pipe unless otherwise approved.

Backwater Valve

Backwater check valve installed on side sewers shall be rubber flapper swing type check valve. Flapper shall be constructed from steel reinforced rubber with 45-durometer standard rubber hardness. Valve seat shall be at 45° angle to direction of flow. Flow area through valve shall equal full pipe area. Valve body shall be cast iron with flanged ends and bolted over to allow removal of flapper without removing valve from line.

Trench Bedding and Backfill

Gravel backfill for pipe zone bedding shall be per WSDOT standard plans and specifications.

Trench backfill shall be gravel borrow as per WSDOT Standard Specifications.

6-12 Sewer Cleaning

General

All new sewer mains between manholes must be cleaned and inspected by video prior to acceptance by the City. It is the responsibility of the developer to provide the necessary cleaning, inspection and reports.

The following standards are intended to regulate the activities of independent contractors, when working on newly installed sewer. All pipe cleaning and video inspection work will be as specified by the most current NASSCO-PACP Standards and the following:

Sewer Line Cleaning

a. Intent:

- The intent of sewer line cleaning is to remove foreign materials from the lines and restore the sewer to a maximum carrying capacity. The contractor shall be solely responsible for all injuries and property damage resulting from the cleaning activities.

b. Cleaning Equipment:

- High-Velocity Jet (Hydro cleaning) Equipment: All high-velocity sewer cleaning equipment shall be constructed for ease and safety of operation. The equipment shall have a selection of two or more high-velocity nozzles. The nozzles shall be capable of producing a scouring action from 15 to 45 degrees in all size lines designated to be cleaned. Equipment shall also include a high-velocity gun for washing and scouring manhole walls and floor. The gun shall be capable of producing flows from a fine spray to a solid stream. The equipment shall carry its own water tank, auxiliary engines, pumps, and hydraulically driven hose reel. The NASSCO Jetter Code of Practice shall be consulted as a guide for the selection of different type nozzles and recommended pressure applications for various cleaning requirements.

Material removal: Material shall be removed from the pipe at the downstream manhole and not allowed to continue downstream.

c. Cleaning Precautions:

- During sewer cleaning operations, satisfactory precautions shall be taken in the use of cleaning equipment. When hydraulically propelled cleaning tools (which depend upon water pressure to provide their cleaning force) or tools which retard the flow in the sewer line are used, precautions shall be taken to insure that the water pressure created does not damage or cause flooding of public or private property being served by the sewer. The developer must obtain permission from the Skagit County PUD and the City of Mount Vernon Fire Dept. prior to fire hydrant use.

d. Sewer Cleaning:

- Sewer cleaning shall be performed using combination vacuum/jetter units. No manhole entry will be allowed except in extenuating circumstances and following OSHA confined space entry requirements. The equipment and methods selected shall be satisfactory to the Owner's representative. When cleaning is complete, the pipe shall be free of all dirt, grease, rocks, sand, and other debris and materials.

6-13 Testing of Gravity Sewers

Immediately following the pipe cleaning, or as directed by City Inspector, the sewer pipe installation shall be tested with low-pressure air. As per WSDOT Standards Specifications, air shall be slowly supplied to the plugged pipe sections until the internal air pressure reaches 4 pounds per square inch. The internal pressure shall be held for 4 minutes.

The City, at any time may require proof of calibration of gauges and any other instrumentation that is used as part of the testing equipment.

For side sewer testing see Section 6-10

6-14 Video Inspection

- a. After installing, replacing, repairing or cleaning a portion of the public sewer the manhole/pipe sections shall be visually inspected and recorded with digital video. A representative of the City may monitor the inspections.
 - The City shall be notified a minimum of five (5) working days in advance of the inspection.
 - All repair, replacement, or alterations made to the pipe after the initial television inspection will require the contractor to provide a new inspection at the contractor's expense.
 - If, in the opinion of the City's representative, debris and or damage from the contractor's activities have affected additional manhole/pipe sections, the contractor shall provide additional inspection video at the contractor's expense.
- b. The video camera used for the inspection shall be one specifically designed and constructed for such inspection.
 - The camera shall be 100% digital.
 - Any analog or NTSC video camera will be deemed unacceptable.
 - Lighting for the camera shall be suitable to allow a clear picture of the entire periphery of the pipe.
 - The camera shall be operative in 100% humidity conditions.
 - The camera, monitor, and other components of the video system shall be capable of producing picture quality sufficient to determine condition of the pipes being inspected.
 - The camera used for television inspection shall be self-propelled, crawler-type units having 360° pan and tilt capabilities.
 - No hand winching units shall be allowed.

- The camera shall be moved through the line at a rate that allows complete inspection, stopping when necessary to permit proper documentation of the sewer's condition.
 - In no case will the television camera travel at a speed greater than 30 feet per minute.
- c. A device for measuring the depth of standing water shall be visible on the video at all times. The operator shall stop or reduce speed to sufficiently measure the depth of standing water. A contrasting, non-staining dye must be added to each run, prior to being videoed.
- d. Distance Measurement:
- The “zero” point of the inspection shall be the centerline of the manhole where the camera is inserted.
 - The footage counter shall be set accordingly by adding the footage from the centerline of the manhole to the edge of the manhole plus the camera length (or the camera length plus the camera focal length). The importance of accurate distance measurement is emphasized.
 - During any inspection procedure, the video cable shall only be removed from the reel by a motorized system.
 - At no time during the inspection is the cable to be removed manually, by hand.
 - The television cable between the counter and the cameras shall be taught at all times.
 - All cleaning and video inspection reports shall show the recorded distances to within 2 feet of the measured lineal footage.
- e. Documentation of the video inspection results shall be as follows:
- Inspection videos shall be recorded and provided in MPEG format with a frame resolution of at least 640x480 pixels, and a frame rate of at least 29 fps.
 - The video shall provide a clear view free of obstructions and lens obscuring damage or debris.
 - Video recording shall be started after the camera is placed into the manhole and shall end prior to pulling the camera back out.
 - The video shall be free of superfluous “dead space” while the operator makes initial adjustments to equipment.
 - Each individual pipe run must be included in a single file, and shall be named using the following convention:
 - Upstream MHID - - Downstream MHID - - YYYYMMDD. For example, a video of a pipe run from upstream MH#A10 to downstream manhole C25 recorded on July 1 of 2015 would be named “**A10 - - C25 - - 20150701.mpg**”.

- f. The following information must be provided as screen text on the video recording:
- The text should be clearly displayed on a contrasting background (e.g. white text on dark background or black text on white background).
 - This text should be displayed for approximately 15 seconds or for the duration of the start-up narration, whichever is longer.
 - If an inspection is being performed on consecutive pipe runs with the same setup, this information must be provided at the start of each pipe run:
 - Upstream and downstream manhole numbers
 - Pipe size
 - Pipe material
 - Direction of camera travel
 - Name of project
 - Location
 - Date and time of day
 - Contractor name
 - Operator's name
- g. During video, the running screen must include the following information. The display of this information must in no way obscure the central focus of the pipe being inspected.
- Running footage (distance traveled)
 - Upstream and downstream (or "from" and "to") manhole numbers of inspected pipe run.
 - The end point of the inspected pipe run should be indicated with screen text for approximately 15 seconds. The ending screen text should indicate:
 - Ending footage
 - Date and time of day
 - Upstream and downstream manhole numbers of inspected pipe run
- h. Video Inspection Reports shall be provided by the Contractor for each inspected pipe run.
- The reports shall provide a graphic of the pipe and indicate, at a minimum, the pipe location, including the street name, starting and ending manholes, date and time of inspection, direction of inspection, pipe diameter, material, joint length, and final inspected length.
 - The report shall clearly show the distance from the centerline of the starting manhole of each observation and other points of significance such as locations of building sewers or other connections, broken or cracked pipe, separated or offset joints, vertical misalignment (sags), presence of roots, scale, corrosion, exposed aggregates, grease, sediment, debris, or

infiltration, and other discernible features or unusual conditions, using NASSCO-PACP observation codes.

- Comments shall be noted to document atypical conditions not otherwise described by the observation codes.
- A copy of each video inspection report shall be supplied to the City in PDF format in a single report per file.
- The pdf file shall be named in accordance with the same convention as the digital video file as noted in this section.