SECTION 2
SANITARY SEWER DESIGN AND CONSTRUCTION REQUIREMENTS

2-1 INTRODUCTION

The City of Battle Ground's Engineering Department provides technical management, comprehensive planning, and sound engineering to expand and maintain sewer collection and conveyance systems for service to residential, commercial, and industrial customers in a safe, environmentally protective manner.

As of December 2006, the City has nearly 53 miles of piping dedicated to the collection of wastewater within the City's sewer area. Sanitary sewers are designed to collect the domestic sewage and industrial wastewater from residential and commercial sewer customers. They also deliver the collected wastewater to the Salmon Creek Wastewater Treatment Plant. These systems are not designed to handle flows from street or roof drainage.

Materials and construction methods shall be in conformance with the most current version of the Standard Specifications for Road, Bridge & Municipal Construction as prepared by Washington State Department of Transportation.

City-approved Engineering plans, stamped by a qualified engineer licensed in the State of Washington, will be required for sewer improvements:

If a public sewer main extension is required, or

If the City of Battle Ground Engineering Department determines public sewer service requires special approval and inspection.

Developing properties must extend utility lines to the site, across the frontage and through the property, to allow connection and provide for future extensions for the development of adjacent parcels consistent with the General Sewer Plan. Proposed sewer main sizes, elevations, alignments and capacities must be designed in accordance with the latest General Sewer Plan or other appropriate master plans as determined by the City staff for overall system development.

2-2 GRAVITY SEWER

2-2.01 *Location*

Whenever possible, public sewers shall be extended in public right-of-ways. The standard and, desired location of sewer mains in the public right-of-way is 7 feet south or west of center line. When a property cannot be served by gravity sewer extended in an existing or proposed public right-of-way (due to pipe cover restrictions for example), the sewer shall be extended in an easement dedicated to the City of Battle Ground.

2-2.02 *Easements*

Public sewer facilities that are not in the public right-of-way must be in an easement dedicated to the City of Battle Ground. The easement is intended to allow access for maintenance by City staff, and to prevent any structure or tree from interfering with the facility or hindering access to it. The easement shall be of a standard form, provided by the Community Development Department. The applicant shall record document after review by staff. All questions regarding easements can be directed to the Engineering Counter.

Sewer facilities that require easements on private property include, but are not limited to, sewer mains, manholes and clean-outs. Pump stations require property ownership by the City. Sewer lines shall be installed in right-of-way unless otherwise approved by the Engineering Department.

Easements shall be 20 feet wide unless otherwise approved by the City Engineer. Shared utility easements with sanitary sewer and one other utility such as water or storm water shall be a minimum of 20 feet wide with no exceptions. Shared utility easements with sewer and two other utilities shall be a minimum of 25 feet wide with no exceptions. Wider easements may be required depending on the depth and size of utilities. Easements shall have no structures on them, and shall be paved or covered with approved landscaping (not to include trees). The easements shall extend at least 5 feet past the end of the main. Easements shall be located entirely on one lot or parcel. Straddling lot lines will not be allowed. Sewer mains shall be located at least 5 feet inside the edge of the easement.

2-2.03 *Capacity*

The flow capacity of a sewer main is calculated from Manning's formula for open channel (atmospheric pressure at the fluid surface) flow.

$$Q = (1.49/n)AR^{2/3}S^{1/2}$$

Where: Q = discharge in cubic feet per second, CFS
n = coefficient of roughness, 0.013 is used for sewer main design
A = cross-sectional area of flow in square feet
R = hydraulic radius of flow: "A" divided by "wetted perimeter of flow", in feet.
S = the slope of the hydraulic gradient in feet per foot

For sloped, circular-cross-section sewer mains, acting under the force of gravity, the peak discharge occurs when the fluid level is about 93 percent of the maximum inside diameter of the sewer main. The discharge for a full pipe is about 80 percent of the peak discharge. Flow capacity calculations are based upon full pipe conditions.

Discharge units for sewer are commonly expressed in million gallons per day (MGD). The conversion formula for cubic feet per second (CFS) to MGD is: MGD = CFS x 0.6463.

Table SS-1: Sanitary Sewer Pipe Capacity and Minimum Slopes

Inside Diameter of Pipe (inches)	Minimum Pipe Slope		Capacity at minimum Design Flow (MGD)
	Design	As-Built	
8	.0045	.0040	0.50
10	.0033	.0028	0.75
12	.0027	.0022	1.1
15	.0020	.0015	1.6
18	.0017	.0012	2.4

2-2.04 *Slope*

Table SS-1 above shows minimum pipe slope requirements. The first column lists common nominal pipe diameters. The second column shows the corresponding minimum design slopes and allowable as-built slopes. Design grades for larger pipes will be determined on a case-by-case basis.

Minimum Design Slopes: Engineers shall design systems using the minimum design slopes in most cases. In general, slopes greater than those shown are desirable and are particularly recommended where the main will not be extended further and there are few connections. Reaches which will not be extended should be laid at a slope of 0.008 when possible to provide more flow velocity.

Minimum As-Built Slopes: Are based on slopes required to produce a mean velocity, when flowing full or half full, of at least 2 feet per second (fps), based upon Manning's "n", the coefficient of roughness, and valued at not less than 0.013.

The differences between design slopes and as-built slopes in Table SS-1 represent an allowable tolerance of 0.0005. Mains installed flatter than the as-built minimum shall be reinstalled by the contractor.

Exceptions: The City reserves the right to require design slopes flatter than those listed in table SS-1. Minimum as-built slopes may be allowed as design slopes when flatter slopes are required to serve the basin, and the City determines that the use of a larger pipe size is detrimental to the system. In such cases, the construction tolerance of 0.0005 (8 inch to 18 inch pipe) will still be allowed.

Slopes slightly less than those shown in Table SS-1 may be considered if substantial justification can be demonstrated by the applicant's engineer. In cases where flatter slopes are considered for sanitary sewer pipes of less than 15 inch inside diameter, there must be enough live sewer interceptions to ensure that the average depth of sewage flow will not be less than 0.3 of the pipe inside diameter. Use of larger pipe for the sole reason of laying a pipe at a lesser slope shall not be allowed when there is inadequate flow to flush the pipe.

Maximum Allowable Slope: Maximum pipe slope shall be governed by terrain and available fall between manholes. Maximum velocity in the pipes shall not exceed 8 fps, unless specifically approved by the city. In some cases it may be necessary to use outside drop connections to reduce slope and velocities.

2-2.05 ***Design Flows***

Design flow calculations typically include estimates of average, maximum and minimum daily flows. The submission of design calculations will not ordinarily be required, but engineers should be prepared to substantiate pipe sizes, layout, population estimates, land uses, fixture units or other design assumptions. Engineers wishing to know if design calculations will be required may request a determination when submitting a development application.

The sanitary sewer must be designed with the capacity to handle peak flows and also to transport suspended solids during minimum flows. The following factors are often considered in determining design flows:

1. Drainage basin characteristics
2. Population densities
3. Per capita wastewater contribution rates
4. Land use within the area to be served
5. Commercial, industrial, or institutional users to be served.

To determine the pipe capacity for peak flows the following formula is used:

Required Pipe Capacity = Average flow * PF + I&I
Where: PF = Peak Flow Factor
I&I = Infiltration and Inflow

Notes: In the absence of flow data or other reliable information, the following table may be used to estimate the design flows.

Table SS-2: Sanitary Sewer Contribution Rates

Land Use		Assumed Unit Flow (gpad)
Residential:	R3	732
	R5	1,220
	R7	1,708
	R10	2,440
	R12	2,928
	R16	3,904
	R20	4,880
Mixed Use Residential (MU-R)		1,285
Commercial/Industrial Uses		750
Mixed Use Employment (MU-E)		928
Airpark		200
Infiltration and Storm Water Inflow		1,000 gpd per acre

Apply peak flow factor (PF) to average flow using the following formula:

$14/(4+\sqrt{p})+1$ p=population in thousands

Infiltration & Inflow (I&I): Groundwater and storm related drainage may enter sanitary sewers through faulty pipe joints, broken pipes, cracks or openings in manholes, and other faults in the system. Capacity designs therefore, must include an estimate of I&I as it can result in increased pipe sizing or even supplemental sewers.

An analysis of I&I in the City is included in the General Sewer Plan. It was determined that 1,000 gallons per day per acre shall be used for I&I in determining the capacity of sewer mains.

2-2.06 ***Pipe Materials***

Specifications for all materials and construction shall be in conformance with the "most current version of the Standard Specifications for Road, Bridge & Municipal Construction." The following table lists approved pipe materials and their specifications for permanent sanitary sewers.

Table SS-3: Approved Pipe Materials and Specifications

Approved Material		Specifications
Gravity Sewers	Reinforced Concrete Pipe (RCSP),	ASTM C 76, Class III, IV, or V
	Ductile Iron Pipe (DIP); Class 52	ANSI A21.51 or AWWA C151
	Polyvinyl Chloride (PVC)[1] 4" to 15"	ASTM D 3034, SDR 35, or ASTM F789
	PVC Sewer Pipe; 18"	ASTM F 679, Type 1
Force Mains	Ductile Iron Pipe Class 52 minimum	ANSI A21.51, or AWWA C151

Notes:

1. PVC pipe shall be installed in 12 ½-foot maximum laying lengths unless otherwise approved by the city.
2. DIP and RCSP are considered rigid pipe. See rigid pipe bedding details, SS-4.0.
3. PVC is considered flexible pipe. See flexible pipe bedding details, SS-4.1.
4. Transitions between dissimilar pipe materials or sizes, when allowed in special cases, shall be made with approved adaptors such as a Fernco coupler.

Special Construction Materials: Pipe materials for special uses will be considered on a case by case basis. These designs might include materials proposed for temporary construction, bridge crossings, and others. Submit engineering plans detailing proposed material types and specifications for approval through the engineering plan review process.

Pipe materials for special uses such as for liner pipe, temporary construction, stream crossings, bridge crossings, etc., will be considered special design cases. Tees and wyes shall be of the same size and class as the main sewer line. Note that all laterals connecting to ductile iron pipe shall also be constructed of ductile iron.

2-2.07 ***Pipe Diameter***
Mainline sewers shall be a minimum of eight inch inside diameter. Sewers shall not be reduced in diameter when the slope in the downstream section is increased except when approved by the City.

In certain cases, the City may require a sewer main that is larger than needed by the development alone. Theses lines are listed in the General Sewer Plan. Credits are available for force mains and pump stations only, provided all conditions are met. No credits are available for oversized gravity mains, however developers may pursue latecomers' agreements.

2-2.08 ***Installation***
Installation of CSP and PVC pipe shall conform to Sections 7-17.3 and 7-18.3 of the current year *Standard Specifications*. PVC pipe shall also be installed in accordance with UNI-BELL specifications, UNI-PUB-6 (available on the internet at http://www.uni-bell.org/literature.php). Water settling of backfill material is prohibited unless otherwise allowed by city inspector.

2-2.09 ***Depth and Cover***
All public sanitary sewers shall be laid at a depth sufficient to be protected against damage by frost and traffic. Public sewers laid in areas subject to wheel loads shall have a minimum cover of 5 feet measured from top of pipe to finished grade or be otherwise protected from damage by traffic. This minimum cover may be reduced to 3 feet provided ductile iron pipe is used. In addition, if the public sewer main is in a roadway, right of way or other paved area, the ductile iron pipe must be deep enough so that any installed, or future, laterals will have a minimum clearance between the top of the lateral and the bottom of the roadway section of at least 6 inches. Finished floor elevations shall be required on all plans.

Under normal conditions, main line public sanitary sewers in residential areas without basements should be laid at a depth of 8 feet. Services to adjacent properties from such sewers should normally be laid so that the depth of the service lateral at property line is at least 6 feet. Depths are measured from the public sewer or service lateral invert to finished grade directly above the public sewer. Plans with public sewers less than 6 feet deep shall show minimum building finished floor elevations on all adjacent parcels.

Sewer lines that can be extended in the future shall be laid as deep as possible so that they can serve as much area as possible in the future.

In residential areas with basements, public sanitary sewers shall be of sufficient depth to serve existing basements, if possible. Those basements which cannot be reasonably served by gravity sewer shall be clearly indicated on the plans.

2-2.10 ***Separation***
Sanitary sewers shall be a minimum of 50 feet from any well, spring, or other source of domestic water supply. All sanitary sewers or parts thereof which are located within 50 feet from any such source of domestic water supply shall be constructed of cement lined ductile iron pipe with watertight joints. Sanitary sewers and domestic water lines shall not be laid in the same trench.

The state of Washington, Department of Ecology, Criteria for Sewage Works Design (publication #98-37WQ available on the internet at Ecology's website, http://www.ecy.wa.gov/pubs/9837/cl.pdf) shall be followed regarding the separation of sewer and water mains (Section C1-9.1). Some of these criteria are repeated and/or discussed as follows:

Parallel Pipes: A minimum horizontal separation of 10 feet between gravity sanitary sewers and any existing potable water lines shall be maintained, whenever possible. The sewer shall also be a minimum of 18 inches below the water main. The distance shall be measured edge to edge. When physical conditions render this spacing impossible or impractical, a gravity sewer may be laid closer than 10 feet, but in no case closer than 5 feet, provided the elevation of the crown of the gravity sewer is a least 18 inches below the invert of the water line and the sewer line is constructed to water line standards, including passing water line testing, per the table below:

Table SS-4: Water Main Standard Pipe Material

	AWWA (ASTM) Standard		
Type Of Pipe	**Pipe**	**Joint**	**Fittings**
Ductile Iron	C 151 and C 104	C 111	C 110
Polyvinyl-Chloride	C 900*	(D 3139 and F 477)	C 110

* Pipe over 12 inches shall be C 905

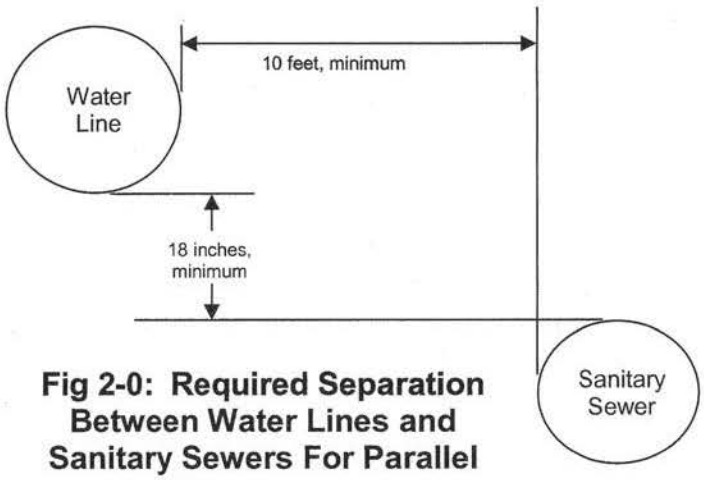


Fig 2-0: Required Separation Between Water Lines and Sanitary Sewers For Parallel

Perpendicular Pipes: Sewer lines crossing water lines shall be laid below the water lines to provide a separation of at least 18 inches between the invert of the water pipe and the crown of the sewer, whenever possible. If this is not possible then one of the following methods are required:

1. The sewer main shall be constructed of ductile iron pipe (C 151) or polyvinyl-chloride (C 900 up to 12 inches and C 905 over 12 inches) with a standard length of pipe (minimum 18 feet) centered on the water main to maximize joint separation.
2. The sewer pipe shall be incased in concrete per detail SS-4.3 or in a ¼ inch steel casing with the voids pressure grouted. The length of sewer pipe shall be centered at the point of crossing so that the joints will be equidistant and as far as possible from the water line. The sewer pipe shall be the longest standard length available from the manufacturer.

Refer to the State of Washington, Dept. of Ecology, *Criteria for Sewage Works Design*, Dec. 1998, Section C1-9.1.4 for any additional requirements. http://www.ecy.wa.gov/pubs/9837/c1.pdf

Sewer laterals without the proper clearance from water mains, as shown in Fig. 2-0, shall be constructed of ductile iron pipe. In cases where the sewer line is above the water main, there must be a minimum of 18 inches of clearance in addition to the above requirements. Separation requirements are for the normal conditions found with sewage and water systems. These basic requirements apply to sewers of 24 inch diameter or less. Larger sewers may create special hazards because of flow volumes and joint types. More stringent requirements may be necessary in areas of high ground water, unstable soil conditions, etc.

Separation requirements for private on-site utilities are outlines in the Washington State Administration Code, WAC 246-272B-09501.

2-2.11 *Pipe Joints*

All pipe joints must be constructed watertight. Rubber rings or other approved joint sealing material shall be used. Joint deflections shall be controlled such that the watertight integrity of the joint is maintained. See *Standard Specifications*, Section 7-08.3(2)E for specific requirements.

2-2.12 *Anchor Walls*

Sewers on slopes of twenty percent (20%) or more shall be secured by anchor walls. Anchor walls shall be constructed per detail SS-4.3. Allowable anchorage spacing is as follows:

1. Not over 36 feet center to center on slopes 20 percent and up to 35 percent.
2. Not over 24 feet center to center on slopes 35 percent and up to 50 percent.
3. Not over 16 feet center to center on slopes 50 percent and over.

2-3 MANHOLES AND CLEANOUTS

2-3.01 *Location*

Manholes are required at the following locations:

1. At every change in slope or alignment of sewer
2. At every point of change in size of sewer or pipe material
3. At each intersection or junction of sewer
4. At the upper end of all sanitary main extensions greater than 150 feet and with service lateral connections
5. At intervals of 400 feet or less in developed areas, unless otherwise approved by the City
6. At future roadway extensions

2-3.02 *Construction*

Construction shall be watertight. If groundwater or surface drainage can be expected to flood the top of a sanitary manhole, a watertight frame and cover shall be used. A 100-year-recurrence-interval storm shall be used in determining flooding elevations.

The manhole joints and the manhole frame shall be sealed with manufactured seals such as the external "Seal Wrap" system (Infi-Shield), Wrapid Seal, or approved equal.

Manholes located in easements outside of paved areas shall have a locking frame and cover. See Standard Detail SS-2.3. This requirement may be waived for manholes located in paved easements.

2-3.03 *Design Considerations*

The key consideration in designing and constructing a manhole is that it will provide convenient access to the sewer for observations and maintenance operations and will result in minimum interference with sewer hydraulics. Manholes will be circular with inside dimensions sufficient to perform inspections and maintenance when necessary. The minimum inside diameter for a manhole is 48 inches.

Provide a 0.2 foot minimum and 0.4 foot maximum drop in flow line elevation through manholes. Where slopes are considered critical, the design engineer may request a waiver. In such cases, the drop may be reduced to 0.1 foot for straight through manholes, or to no drop if the pipe is laid through the manhole.

Where a smaller sewer joins a larger one at a manhole, the invert of the larger sewer should be lowered sufficiently to maintain the same energy gradient. Approximate methods for securing these results are to 1) place the 0.8 depth point of both sewers at the same elevation, and 2) to match the elevations of the pipe crowns.

Manholes built over large diameter sewers require special construction. Contact the Engineering Department for standard plans. See also the current year *Standard Specifications* section 7-05.

2-3.04 *Drop Manholes*

Special approval for all drop assemblies is required from the Engineering Department. When approved, outside drop assemblies shall be provided for new manhole construction for pipes 12 inches in diameter and smaller when entering a manhole at a distance of more than 24 inches above the invert of the manhole. Pipes between 0.4' and 2' shall use a "beaver slide". Larger pipe should be introduced into the manhole at the manhole invert. See Standard Detail SS-2.6.

Inside drop assemblies for eight inch pipes will be considered in cases involving connections to existing manholes. Requests for inside drops for private service laterals will also be considered. See the current year *Standard Specifications* Section 7-05.3(4) and Standard Detail SS-2.5.

2-3.05 *Connections*

Connections to sewer lines, manholes, and cleanouts, whether existing or new construction, shall be designed and constructed to provide a smooth transition of flows, and have minimum interference with sewer hydraulics.

Laterals connecting to a beginning manhole shall enter the manhole at bench elevation, and transition to the flow line.

2-3.06 *Frames, Covers and Steps*

Frames, covers, and steps shall meet the requirements of the *Standard Specifications for Road, Bridge & Municipal Construction* as prepared by Washington State Department of Transportation, Section 7-05. Grade adjustments should be made with concrete riser rings located below the frame, not with metal risers set on the frames.

Cover type shall be as follows:

1. Standard, used in public right of way
2. Locking frame and cover shall be used on all sanitary manholes located in easements outside of paved areas
3. Watertight frame and cover assemblies are required for sanitary sewer manholes installed within the 100-year flood or where periodic flooding may occur

Rainguards are required on all manholes. Steps shall be wide enough for a worker to place both feet on a step and should be designed with some type of slip prevention. They are generally spaced at vertical intervals of 12 inch to 16 inch. Standard Plan SS-2.4 details the requirements for steps and Standard Plan SS-2.3 gives specifications for frames and covers. Cones, frames, and covers shall be rotated to avoid anticipated wheel traffic.

2-3.07 *Pipe Stubs*

Sewer main stubs are short sewer mains extended from manholes to serve future development. Sewer main stubs shall be extended from the manhole, parallel to the centerline of the road, and extended to past

the end of the road improvements. Stubs less than 150 feet in length shall have a cleanout at the end. All other stubs shall end with a manhole.

2-3.08 *Cleanouts*

Cleanouts will not normally be approved as substitutes for manholes, except at the upper end of sewers 150 feet or less in length when the downstream manhole is accessible. Cleanout details are shown on City of Battle Ground Standard Detail No. SS-2.7. See also the current year *Standard Specifications* section 7-19.

2-4 BUILDING CONNECTIONS

2-4.01 *Service Laterals*

Sanitary service laterals extend from the public sewer main to the property line to serve individual parcels and/or buildings. Each building on a parcel shall be served by a separate service lateral. Connection, ownership, and responsibilities for service laterals are outlined in BGMC 13.120. On-site plumbing from the property line to the building are private and discussed in section 3-4.02.

Sanitary service lateral connections to the public sewer main shall be installed according to City of Battle Ground Standard Plan SS-3.0 and SS-3.1. Lateral construction shall conform to the same standards as for main sewer construction. All laterals connecting to ductile iron pipe shall also be constructed of ductile iron.

Sanitary service laterals in the public right-of way or public easement shall typically be a minimum of 6-inches in diameter and a minimum slope of 1% shall be provided. In the case of a single family residence a minimum 4-inch diameter is acceptable and a minimum slope of 2% shall be provided.

Service laterals may be connected to manholes if such placement does not interfere with other present or future connections to the manhole.

The following service lateral connections and/or locations require special approval by The City of Battle Ground's Engineering Department.

- Lateral connections (taps) to mains larger than 15 inches in diameter
- Laterals connecting to manholes on large mains may be placed in the same easement as the sanitary interceptor where necessary

2-4.02 *On-site Plumbing*

On-site plumbing shall meet the requirements of the current adopted version of the Uniform Building Code (UBC) with Washington Amendments, the Uniform Plumbing Code (UPC) and general local and state requirements. Connection of on-site plumbing to laterals must be watertight.

Roof, surface, foundation, or other storm water drain lines are prohibited from being connected to the public sanitary sewer. Approved private sewer collection systems may be allowed for *single* non-residential, industrial, or commercial establishments, provided that the sewer main extension is not required to serve other parcels. A manhole is required at the point of connection of a private sewer system to a public system.

Commercial and industrial complexes serving multiple owners or tenants, and multiple residential dwelling facilities (such as apartments and condominiums) are required to install public sanitary sewers as indicated in WAC 173-240-104.

2-5 OTHER DESIGN/CONSTRUCTION CONSIDERATIONS

2-5.01 *Phase and Contingent Development*

To approve a plan for a sewer main extension that is submitted contingent on development of a downstream connecting sewer main, the City must have Final Acceptance of the downstream connecting sewer. If Final Acceptance has not been granted, the applicant must include with their plan set for the proposed development, a complete set of plans for all related downstream connecting sewers.

2-5.02 *Decommissioning Sanitary Sewer Mains and Appurtenances*

In most cases, sanitary sewer mains, manholes, service laterals, and cleanouts that are no longer in service shall be removed from the ground and disposed of according to Federal, State and local health regulations or as directed by the City of Battle Ground.

In some cases, however, the City may allow sanitary sewer appurtenances to be left in place if it is shown that they will be properly decommissioned.

Sewer mains shall be decommissioned by plugging the ends with Portland Cement Concrete after they are flushed. The concrete plugs shall extend into the pipe from the pipe ends a minimum distance of three times the inside diameter of the pipe. The Portland Cement concrete shall meet the requirements for Commercial Concrete, WSDOT/APWA, and the current year *Standard Specifications* for Road, Bridge and Municipal Construction, Section 6-02.3(2)B. In some cases, the space between the plugged ends of the abandoned main will be required to be filled with sand or the entire abandoned main will be required to be completely filled with a pumpable, flowable cement slurry.

Manholes shall be decommissioned by removing the cover, frame, riser rings, cone or flat slab, and filling the manhole with compacted sand. The parts removed from the manhole shall be disposed of according to Federal, State and local health regulations or as directed by the City of Battle Ground. The sand shall meet the grading requirements for backfill for sand drains, WSDOT/APWA, and the current year *Standard Specifications* for Road, Bridge and Municipal Construction, Section 9-03.13. The sand shall be compacted to at least 95 percent of the maximum density value determined according to Section 2-03.3(14)D. The remainder of the hole, from the top of the compacted sand to finished grade, shall be backfilled, paved and/or landscaped, as directed by the City, to match the surrounding pavement or landscaping

Service laterals shall be decommissioned by installing a mechanical plug at the tee or wye, on the sewer main, or by installing a watertight patch on the main at the lateral-to-main connection point. Alternatively, when directed by the City of Battle Ground, the service lateral may be stopped with a mechanical plug at an undamaged service lateral joint near the edge of the public sewer easement or public right-of-way.

2-5.03 *Stream Crossings and Drainage Facilities*

Sewers entering or crossing streams, drainage ponds or swales shall be constructed of ductile iron pipe or PVC pipe installed in a steel casing. The pipe and joints shall be tested in place and shall not exhibit infiltration. They shall be designed, constructed, and protected against anticipated hydraulic, physical, longitudinal, vertical and horizontal loads, and erosion impacts.

Sewers laid on piers across ravines, streams, drainage ponds or swales shall be allowed only when it can be demonstrated that no other practical alternative exists. Sewers on piers shall be constructed in accordance with the requirements for sewers entering or crossing under streams. Designs shall be submitted for review and approved on a case-by-case basis.

Additional permits may be required for stream crossings and may include shorelines management, state fish and wildlife, and other permits. The developer shall obtain all necessary permits prior to construction. Construction shall meet or exceed the following requirements for these permits.

1. The top of all sewers entering or crossing streams shall be at a sufficient depth below the natural bottom of the stream bed to protect the sewer line. In general, this will be three feet of cover or more.
2. Less cover will be approved only if the proposed sewer crossing will not interfere with the future improvements to the stream channel. Reasons for requesting less cover should be given in the project proposal.
3. Sewers crossing streams should be designed to cross the stream as nearly perpendicular to the stream flow as possible and shall be free from change in grade. Sewer systems shall be designed to minimize the number of stream crossings.
4. The sewer manholes, or other structures, shall be located so they do not interfere with the free discharge of flood flows of the stream.
5. Sewers located along streams shall be located outside of the stream bed and sufficiently removed therefrom to provide for future possible stream widening and to prevent pollution by siltation during construction.
6. Construction methods and materials of construction shall be such that sewers will remain watertight and free from changes in alignment and grade.

2-5.04 *Railroad Crossings*

The developer shall obtain and make full payment for any permits, and easements required from the railroad prior to constructing a sewer under any railroad tracks. All requirements of the permit shall be met prior to acceptance of any construction. Requirements usually include boring under the tracks with a steel casing for installation of the sewer. Easements may be required in lieu of, or in addition to, a permit.

2-5.05 *Modeling and Capacity Simulation*

The City of Battle Ground's Engineering Department maintains a hydraulic model to simulate flows in the wastewater collection system. These model simulations can be used to help predict collection system responses to various flow inputs and piping conditions and arrangements. For example, model simulations might help to compare proposed design alternatives or to prevent long-term collection system capacity stresses.

Many other hydraulic models are readily available for sanitary collection system modeling. In special cases, the City may request model simulations from engineering firms proposing development to help determine potential impacts to the existing collection system. For these special cases, simulation requirements will be specified and the simulation results will be submitted to the City for review as part of the approval process. Engineers wishing to know if modeling will be required may request a determination when submitting plans for review.

2-6 SPECIAL REQUIREMENTS

2-6.01 *Industrial/Commercial Wastewater*

Pretreatment: Pretreatment may be required to remove pollutants from industrial and commercial wastewater. Pretreating a waste stream serves to protect the treatment plant, protect the receiving stream, and protects workers, both in sewer operations and at the plant. An Industrial Pretreatment review may be required to determine whether a pretreatment permit will be issued to authorize the discharge of process wastewater.

Sampling Manholes: All non-residential users are required to provide a sampling manhole. The sampling manhole shall be constructed per detail SS-3.2 or SS-3.3 and shall have a 3 foot straight lateral run on both sides of the manhole.

Grease Traps/Interceptors: Users who operate restaurants, cafes, lunch counters, cafeterias, bars or clubs, hotels, hospitals, sanitariums, factory or school kitchens, or other establishments where grease may be introduced to the sewer system shall have grease traps or interceptors. The City shall approve the sizing, design, and plan for installation in accordance with the Uniform Plumbing Code with a minimum 70 pound grease trap or 1,000 gallon grease interceptor.

Oil/Water Separators: Users who operate automobile and truck repair facilities, steam cleaning facilities for motorized equipment, air compressors, or and other establishment where petroleum-based grease and oil may be introduced to the sewer system shall have pretreatment facilities to prevent the discharge of oil and grease. Pretreatment facilities shall be in accordance with City and Washington State Department of Ecology standards.

2-6.02 *Prohibited Discharges*

Prohibitions and regulations of wastewater discharges are addressed in the pretreatment ordinance, BGMC 13.137.

2-7 ALTERNATIVES TO GRAVITY SYSTEMS

2-7.01 *Individual Grinder Pumps*

Although grinder pumps are not usually required, they may be allowed by the City when it is not feasible for the house or building to gravity flow to the sewer main.

If a grinder pump is allowed it shall be connected to a gravity lateral and the connection shall occur outside the right-of-way on private property. Grinder pumps and the force mains connected to them are private systems; maintenance is solely the responsibility of the property owner. Plumbing and connection plans shall be submitted for review by the city prior to installation. Inspections will be required.

2-7.02 *Pump Stations*

Specific approval of lift or pump stations will be required. Pump stations shall only be allowed consistent with the General Sewer Plan or with approval from the Public Works Department when there is no gravity option available. The City of Battle Ground has adopted a submersible lift and pump station as its standard pump station design. Standard specifications and requirements are available in the document: "Wastewater Pump Station and Pressure Sewer Design and Construction Standards ".

2-7.03 *Force Main Design and Construction*

Pumping systems may be necessary to serve low-lying or flat areas within the City's service area. These areas are identified in the City of Battle Ground's General Sewer Plan. Force mains deliver flows from public pump or lift stations via a pressure sewer main, to the gravity system. Table SS-5 lists the accepted pipe materials for pump station pressure sewer construction. Reference the City of Battle Ground's Wastewater Pump Station and Pressure Sewer Design and Construction Standards for further details.

Table SS-5: Force Main Pipe Materials

Material	Specifications
Ductile Iron Pipe; Class 52 min.	ANSI A21.51 or AWWA C151

2-8 RESOURCES

ASCE–Manuals and Reports on Engineering Practice–No. 60 and WPCF—Manual of Practice—No. FD-5, Gravity Sanitary Sewer Design and Construction.

City of Battle Ground, "Battle Ground Municipal Code Title 13: Water and Sewers," available from Battle Ground's website: http://www.cityofbg.org.

City of Battle Ground, "General Sewer Plan", March 2006

City of Battle Ground, "Wastewater Pump Station and Pressure Sewer Design and Construction Standards", May 2006

International Association of Plumbing and Mechanical Officials, Uniform Plumbing Code, 2003 Edition with Washington amendments.

Washington Department of Ecology, Water Quality Program, Publication #98-37 WQ, "Criteria for Sewage Works Design (Orange Book)".

Washington State Department of Transportation, Standard Specifications for Road, Bridge, and Municipal Construction, M41-10, latest version adopted by the City of Battle Ground.

2-9 SANITARY SEWER STANDARD PLAN DETAIL SHEETS

Standard Plan Description and Numbers

Sanitary Sewer General Notes	SS-1.0
Standard Precast Manhole	SS-2.0
Top Slab for Standard Precast manhole	SS-2.1
Standard Manhole Connection Details	SS-2.2
Standard Manhole Frames & Covers	SS-2.3
Manhole Step	SS-2.4
Inside Drop manhole Connection	SS-2.5
Outside Drop Manhole Connection	SS-2.6
Clean Out	SS-2.7
4 inch Lateral Connection	SS-3.0
6 inch Lateral Connection	SS-3.1
Sampling Manhole	SS-3.2
Shallow Sampling Manhole (Future)	SS-3.3
Grease Interceptor	SS-3.4
Standard Oil / Water Separator-Sanitary	SS-3.5
Pipe Bedding (Rigid Pipe)	SS-4.0
Pipe Bedding (Flexible Pipe)	SS-4.1
Typical Trench Backfill	SS-4.2
Concrete Encased Pipe	SS-4.3
Anchor Wall	SS-4.4
Air Vacuum Release Vault with Odor Control Canister	SS-5.0A
Air Vacuum Release Vault with Odor Control Canister	SS-5.0B
Buried Gate Valve	SS-5.1
Typical Pressure Cleanout	SS-5.2
Toning Wire Locate Tape	SS-5.3
Water Sanitary Crossing	SS-5.4
Pig Launch	SS-5.5
Site Plan	SS-6.0
Site Piping Schematic	SS-6.1
RPBA and Yard Hydrant	SS-6.2
Bioxide Feed System	SS-6.3
Typical Control Panel	SS-6.4
Electrical 1	SS-6.5
Electrical 2	SS-6.6
Electrical 3	SS-6.7
Testing Schedule (Future)	SS-7.0