

1.0 Sanitary Sewer System

The objective of Sanitary Design Works is to provide sewage systems that:

- Can be sustained by the water resources upon which services rely
- Are financially viable and complies with all regulatory requirements
- Protects human health and the natural environment
- Improves efficiency in the City's existing sanitary system network
- Are in accordance with the City of Quinte West Official Plan and Zoning By-law

2.0 General

This document will be subject to revisions from time to time. The City of Quinte West reserves the right to make revisions having due regard for applications already in the review process. Individuals or groups affected accordingly will be notified by the City of Quinte West, and revisions will become effective on the date of notification.

(Contents of this document are subject to change without further notice)

3.0 References

In addition to the standards specified in this manual, sanitary sewer designs shall follow current standards and in conformance with the following standards, specifications or publications:

Publications

- Ontario Provincial Standard Specifications
- Guidelines for the Design of Sanitary Sewer Works, Storm Sewers, Water Distribution Systems
- Municipal Engineers Association Design Manual
- City of Quinte West Official Plan and Zoning By-law

Standards

City of Quinte West Standard Drawings

- Series 900 – Sanitary Sewer Standards

Permits/Approvals

- City of Quinte West Planning Department Site Plan Approval
- City of Quinte West Development Control Policies
- Hastings and Prince Edward Counties Health Unit

4.0 Table of Contents

<u>SECTION</u>	<u>PAGE</u>
5.0 General - All	9-4
5.1 Submission Requirements	9-4
5.2 Prohibitions	9-4
5.3 Sewer Easements	9-4
5.4 Building Connections	9-4
5.4.1 Location	9-4
5.4.2 Cover	9-4
5.4.3 Size	9-5
6.0 Formulas	9-5
7.0 Gravity Sewers Conveying Whole Sewage	9-6
7.1 Mains – Design Criteria	9-6
7.2 Materials	9-6
7.3 Maintenance Holes	9-7
7.3.1 Spacing	9-7
7.4 Service Connections	9-7
7.4.1 Specifications	9-7
7.5 Testing	9-8
7.5.1 Water Exfiltration Test	9-8
7.5.2 Air Test	9-9
8.0 Sewers Conveying Only the Liquid Portion of Sewage (“Low-Flow Technology”)	9-9
8.1 Mains – Design Criteria	9-9
8.2 Materials	9-10
8.3 Maintenance Holes / Service Cleanouts	9-10
8.4 Service Connections	9-10
8.4.1 Specifications	9-11
8.5 Effluent Sewer System Interceptor Tanks	9-11
8.5.1 Design Criteria	9-11
8.5.2 Materials	9-11
8.5.3 Specifications	9-12
8.6 Testing	9-12
8.6.1 Requirements	9-12

8.6.2 Procedure _____ 9-12

5.0 General - All

5.1 Submission Requirements

Design sheets shall be submitted in a spreadsheet format in accordance with the attached City standard, in both hard copy and digital format.

5.2 Prohibitions

Weeping tile and sump pumps shall not be connected to the sanitary system.

Water and sewer services shall not be connected at the property line until such time that the "Certificate of Substantial Completion of the Underground Infrastructure" or the required inspections and approvals by the City's Building and Water Departments have been issued.

5.3 Sewer Easements

All sewer easements must be a minimum of 6.0 m wide for one sewer. Requirements for additional utilities as determined on a case-by-case basis.

5.4 Building Connections

Separate services shall be provided to each building and each unit of a semi detached or row house residential building.

Building services from adjacent properties shall not be connected to each other.

Sanitary services shall not be connected to a storm main.

5.4.1 Location

Water and sewer services are not permitted in driveways or private sidewalks. If services in a driveway are unavoidable the City requires sewer cleanouts to have a cast iron cleanout and water shutoffs set to grade and clean of asphalt or concrete material.

Unconnected conventional and effluent sanitary laterals shall be brought to the property line, properly capped and clearly marked such that an installer can easily connect when necessary. Caps must withstand air testing of sewer including lateral services to the lot line. Capped services shall be appropriately marked to at least 1.0 meter above finished grade level with a 2" x 4" marker painted green.

5.4.2 Cover

The minimum cover for sanitary services will generally be a minimum of 1.5m from the finished grade. Services of less than 1.5m may be permitted on a case-by-case basis based on a professional engineer's opinion/design. In such cases frost protection must be equivalent to 1.5m cover. Services with less than 1.0m of cover are not permitted.

5.4.3 Size

Building sewer services shall be sized to meet the Ontario Building Code.

6.0 **Formulas**

Formula	Equation	Criteria
<u>Kutter Formula</u>	$C = \frac{k_1 + \frac{k_2}{S} + \frac{k_3}{n}}{1 + \frac{n}{\sqrt{R}} \cdot \left(k_1 + \frac{k_2}{S} \right)}$	C = Chezy's roughness coefficient (m ^{1/2} /sec) S = Friction slope (m/m) R = Hydraulic radius (m) n = Kutter's roughness (unitless) k ₁ = Constant 23.0 k ₂ = Constant 0.00155 k ₃ = Constant 1.0
<u>Babbitt Peaking Formula</u>	$PF = \frac{5}{P^{0.2}}$	P = Population (thousands)
<u>Harmon Peaking Factor</u>	$M = 1 + \left(\frac{14}{4 + P^{0.5}} \right)$	P = Population (population in thousands)
<u>Peak Sanitary Flow</u>	[Number of People] * [Average Flow Per Person (L/s)] * [Peaking Factor (L/s)] + Infiltration (L/s)	
<u>Capacity Flow</u>	$Q_{cap.} = \left(\frac{\left[\frac{D}{1000} \right]^{2.667} \cdot \left[\frac{S}{100} \right]^{0.5}}{0.211 \cdot n} \right) * 1000(L/s)$	D = Pipe size (mm) S = Slope (grade) of pipe (%) n = Roughness coefficient
<u>Manning Equation</u>	$V = \frac{1}{n} R^{\frac{2}{3}} S^{\frac{1}{2}}$	V = Velocity in meters per second (m/s) n = Manning roughness coefficient (n = 0.013 for smoothed walled pipe) R = Hydraulic radius in meters (m) S = Hydraulic gradient in meters per meter (m/m)
<u>Headloss Across Manholes</u>	$H = \frac{k(V_2^2 - V_1^2)}{2g}$	H = Headloss in meters (m) k = Coefficient V ₁ = Entrance velocity in meters per second (m/s) V ₂ = Exit velocity in meters per second (m/s) g = Acceleration due to gravity in meters per second (m/s)

7.0 Gravity Sewers Conveying Whole Sewage

7.1 Mains – Design Criteria

No decrease in pipe size downstream shall be allowed unless otherwise approved by the City's Public Works Department.

Population design density based on gross population per hectare will be provided by Development Review. Contributing industrial, commercial and institutional design flows shall be considered on a case-by-case basis.

Criteria	Size / Condition	Minimum	Maximum
Pipe Size	HDPE / PVC	200mm	
Velocity (Full Flow)		0.6 m/s	3.0 m/s
Pipe Slopes	First 25 Upstream Dwelling Units	1.0%	
	Top reach (MH to MH)	1.0%	
	200mm	0.4%	
	250mm	0.3%	
	300mm and larger	MOE Guidelines	
Cover		1.5m from the finished grade	
Peaking Factors	Determined by Harmon's equation	4.0	2.75
Average Daily Domestic Flow	Plus Infiltration		450 liters per person per day

Additional Criteria:

Manning's Roughness Coefficient Shall meet the manufacturer's specification and MOE guidelines (typically $n=0.013$)

Infiltration Rate 0.00014m³ per second per hectare of contributing area.

7.2 Materials

Criteria	Size / Condition	Specification	Required Standard
Pipe	PVC	Polyvinyl Chloride (PVC) pipe conforming to OPSS 1841.02. Minimum outer diameter to wall thickness ratio of SDR 35	CAN/CSA B182.4
	HDPE	Minimum outer diameter to wall thickness ratio of SDR 11	CAN/CSA-B182.8
Bedding		Bedding and cover shall conform to Granular 'A' as set forth in OPSS.	OPSD 802 series.

7.3 Maintenance Holes

All manholes shall conform to OPSD 700 standards.
 Precast Drop Structures as per OPSD.

Where pipe of different sizes are connected to a MH, the crowns of the inlet pipe(s) shall not be lower than the crown of the outlet. The difference in invert elevations between inlets and outlets shall be as indicated in MOE Guidelines.

7.3.1 Spacing

Maximum Spacing:	
Sewers 200mm to 450mm	- 120 m
Sewers 525mm or greater	- 150 m

7.4 Service Connections

The crown of the main at the point where the service is connected shall be a minimum of 1.0m below the lowest floor grade of the buildings being serviced except where connection is by a pumped sewage connection with back flow prevention installed to protect the building being connected.

The first 40 building services connected to 200mm main shall be set above the spring line of the sewer main with proper "Y" fittings and with long radius bends. Building sewers connected to larger mains may be by a tee connection with the side of the tee rotated at between 22 ½ degrees and 45 degrees above horizontal.

7.4.1 Specifications

Criteria	Specification
Pipe	Polyvinyl Chloride (PVC) pipe, SDR 28, CSA B182.2 125 mm diameter for building connections to conventional sewer mains (the color shall be green)
Connections	Shop pre-manufactured tee connections shall be used for building sewer connections. Cleanouts are to be installed on the property line of each building. Cleanouts are not permitted in driveways. Building services shall not be connected directly to maintenance holes unless authorized by the City's Public Works Department.
Cleanouts	Municipal cleanouts at property line are required on all connections. Clean outs shall have metal caps 100mm below finished grade.

7.5 Testing

The City Inspector shall be given 48 hours notice of all tests.

Testing of gravity sewers and manholes shall be done by either a Water Exfiltration Test or an Air Test.

Sewers shall be flushed immediately prior to the closed circuit TV inspection.

7.5.1 Water Exfiltration Test

Unless the water table is 0.6 m (2 ft.) or more above the top of the pipe, exfiltration tests shall be used.

Extent The complete sewer system including house connections and manholes shall be tested in accordance with OPS Specifications.

Procedure Any visible leak must be repaired.

The test section shall be sealed at its lower extremity by means of a water tight plug. The test section shall be filled with water to the specified level in a manner to allow for the displacement of air in the line.

The minimum head measured from the crown of the pipe at the high end of the section under test shall be 0.6 m (2ft.), provided that maximum head on the line is not more than 4.752 m (15ft.).

The test shall stand completely full for 24 hours before test measurements are commenced. The duration of the test shall be two (2) hours.

Manholes shall be tested independent of the sewer pipe for leakage by filling the chamber to the underside of the roof slab with water. The test duration shall be a minimum of three hours. No leakage shall be permitted in manholes.

Maximum allowable leakage of any test in gravity sewer:

$$\text{Allowable leakage in litres} = \frac{HDL}{5200}$$

Where: H = Duration of test in hours
 D = Inside diameter of the pipe in millimeters
 L = Length of pipe in test section in meters

7.5.2 Air Test

Shall not be used with concrete sewers.

Extent The complete sewer system including house connections and manholes shall be tested in accordance with OPS Specifications.

Procedure Based on OPSS 410, modified so that the pressure drop does not exceed 3.5 kPa over a time in minutes equal to the volume in cubic metres multiplied by 1.25.

8.0 Sewers Conveying Only the Liquid Portion of Sewage (“Low-Flow Technology”)

8.1 Mains – Design Criteria

No decrease in pipe size downstream shall be allowed unless otherwise approved by the Public Works and Environmental Services Department.

Population design density based on gross population per hectare will be provided by Development Review. Contributing industrial, commercial and institutional design flows shall be considered on a case-by-case basis. Sealed systems shall be designed for an inflow/infiltration rate of zero.

Criteria	Size / Condition	Minimum	Maximum
Pipe Size*	If proven by a HGL analysis to the City's satisfaction	75mm	
Velocity	Minimum design velocity can be less than the stated value if good engineering principles are used to meet the minimum scouring velocity necessary to create self-cleaning conditions once daily, upon approval of the City	0.15 m/s	3.0 m/s
Pipe Slope	If proven by a HGL analysis to the City's satisfaction	0%	
Cover	Acceptable Fill	1.5m from the finished grade	
Peaking Factors	Substantiated peaking factor attenuation data from existing system installations will qualify.	4.0	2.75
Average Daily Domestic Flow	Zero infiltration		225 liters per person per day

Additional Criteria:

Manning's Roughness Coefficient

Shall meet the manufacturer's specification and MOE guidelines (typically n=0.013)

*Pipe Sizing

All main sizes must be approved by the City's Public Works and Environmental Services Department if good engineering principles are used and the designer can demonstrate that local contractors have existing equipment to facilitate the cleaning of such diameter piping.

8.2 Materials

Criteria	Specification
Pipe	Polyvinyl Chloride (PVC) pipe, DR 11 (minimum), CSA B137.3 and B137.2
Connections	Shop pre-manufactured tee connections shall be used for building sewer connections.
Cleanouts	Municipal cleanouts at property line are required on all connections. Specifications as per product manufacturer's requirements and approval by the Public Works and Environmental Services Department.

8.3 Maintenance Holes / Service Cleanouts

Sealed cleanouts shall be at a distance not greater than 150 metres to permit pressure-washing, if required, unless increased spacing can be flushed by existing servicing equipment.

Where required, cleanouts shall have odor control devices attached which will provide additional air flow through the system.

Cleanouts on roadways shall have an approved load bearing casing installed to protect cleanout access piping.

All cleanouts shall be compatible with the City of Quinte West equipment. Verification of compatibility per City of Quinte West requirements shall be the responsibility of the Developer.

8.4 Service Connections

The crown of the main at the point where the service is connected shall be a minimum of 1.0m below the lowest floor grade of the buildings being serviced except where connection is by a pumped sewage connection with back flow prevention installed to protect the building being connected or where a solids-separation tank is employed.

8.4.1 Specifications

Criteria	Specification
Connections	The cleanout is installed off the exit side of the interceptor tank. Each dwelling connected to the effluent sewer must be equipped with a ball valve or check valve which shall be installed between dwelling and interceptor tank. Building sewers from the building line to the main shall be laid at 2% from the building line to the main sewer or interceptor tank.
Materials	100 mm diameter for building connections to interceptor tanks 75mm diameter for gravity discharge from interceptor tanks to sewer mains. 50 mm diameter for pressure discharge from interceptor tanks to mains.

8.5 Effluent Sewer System Interceptor Tanks

8.5.1 Design Criteria

Interceptor tanks shall be installed as recommended by the manufacturer and as follows:

Criteria	Specification
Access	Interceptor tanks shall be equipped with insulated access hatches that extend to the ground surface at both the inlet and outlet locations.
Elevations	The elevation difference between the inlet and outlet should be a minimum of 50mm.
Cover/Insulation	Insulation cover shall be at least 50mm extruded polystyrene Dow Styrofoam HI-40 or equivalent, or as recommended by the geotechnical engineer.
Bedding	All tanks shall be installed on prepared foundation bedding, consisting of a 200mm thick bed of Granular "A" to OPSS 1010, compacted to 95% SPMDD. Native soil backfill shall be approved by the engineer prior to placement.
Filter	For gravity discharge from interceptor tank to sewer main, an effluent filter must be located in the effluent tank.

8.5.2 Materials

All interceptor tanks shall meet the requirements of CSA B-66-05: Design, Material and Manufacturing Requirements for Pre-fabricated Septic and Sewage Holding Tanks.

All concrete reinforcement shall meet the requirements of G30.18 M92 (R2002). Concrete shall be as per CSA A23.4, latest revision and shall be not less than 32 MPa (4,500psi) minimum compressive strength at 28 days with 6-8% air entrainment.

Tanks and connecting fitting shall be certified vacuum tested, resulting in a leak-proof assembly.

8.5.3 Specifications

Volumes for interceptor tanks shall conform to design standard provisions for daily design flow and septic tank capacities as stipulated within Sections 8.2.1.3 and 8.2.2.3 of Part 8 of the Ontario Building Code.

8.6 Testing

The City Inspector shall be given 48 hours notice of all tests.

8.6.1 Requirements

Sealed effluent sanitary collection systems shall be air or water tested to 350kPa (50psi) to ensure there is no system exfiltration.

The Developer shall provide all labor, equipment and materials to carry out the tests, and repair or reconnect services to where necessary. The Developer shall arrange the tests for sections of sewer between cleanouts or manholes.

8.6.2 Procedure

Testing will be carried out from maintenance cleanout to maintenance cleanout including laterals to the interceptor tank, where a pressure cap shall be installed for testing operations.

Air testing is successful when system pressure is maintained within 10% of the 350 kPa (50psi) testing value for 10 minutes. Water results as per AWWA recommendations.

Any sections of sewer which fails to meet the requirement of this section shall be repaired and re-tested.