



**THE REGIONAL MUNICIPALITY OF DURHAM**

**DESIGN SPECIFICATIONS FOR  
SANITARY SEWERS**

**WORKS DEPARTMENT**

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## **1. Sewer System By-Law 90-2003**

The Region of Durham's Sewer System By-Law 90-2003 is to be used in-conjunction with the Region of Durham's Design Standards or most recent amendment.

## **2. Design Flow**

Sewage flows shall be calculated on the basis of:

### **2.1 Residential**

1. Average flow of 364 litres (L) per person per day
2. Infiltration
  - 22.5 m<sup>3</sup>/ gross hectare (ha)/ day (0.26 L/ second/ ha) - when foundation drains are not connected to the sanitary sewer.
  - 45.0 m<sup>3</sup>/ gross ha/ day (0.52 L/ second/ ha) - when foundation drains are connected to sanitary sewers (in accordance with Region of Durham policy).

Calculated on the number of gross hectares of residential lands tributary to the sanitary sewer systems.

Design flows shall be calculated on the Region of Durham's Standard Design Sheet (see Appendix).

### **3. Peaking Factor**

$$K_H = 1 + \frac{14}{4 + P^{1/2}}$$

$K_H$  Harmon peaking factor

$P$  Population in thousands

$K_H$  Maximum 3.8

Minimum 1.5

4. Population Density

When lands are zoned for a specific residential use and detailed information is not available, the following population densities shall apply:

<b>Type of Housing</b>	<b>Persons/Hectare</b>
Single Family Dwelling	60
Semi-detached & Duplex	100
Townhouse	125
Apartment - Low Density (62 units per hectare)	150
Apartment - Medium-Low Density (86 units per hectare)	210
Apartment - Medium Density (124 units per hectare)	300
Apartment - High Density (274 units per hectare)	600

When the number and type of housing units within a proposed development are known, the calculation of population for the proposed development shall be based on the following:

<b>Type of Housing</b>	<b>Persons/Unit</b>
Single Family Dwelling, Semi-Detached and Links	3.5
Townhouses/Stacked Townhouses	3.0
Apartment -1 Bedroom or smaller (Bachelor)	1.5
Apartment -2 Bedroom	2.5
Apartment -3 Bedroom	3.5
Apartment -4 Bedroom or larger	4.5

5. Undeveloped Land

Future land use and population shall be based on the Region of Durham Official Plan and Secondary Plans of the Local Municipalities.

2.2 Commercial

1. Design Flow: 180 m<sup>3</sup> /gross floor area ha/ day (2.08 L/ second/ ha) including infiltration and peaking effect.
2. Floor Space Index: 0.50 of gross lot area unless designated otherwise on the approved plan.

2.3 Retirement Residence/Nursing Homes

When calculating the sanitary flows from a retirement residence/ nursing home, the residential one-bedroom apartment rate is to be used when determining the sanitary flow.

2.4 Industrial / Schools & Institutions

1. Design Flow Industrial:
  - 180 m<sup>3</sup>/ gross ha/ day (2.08 L/ second/ ha) including infiltration and peaking effect for local sewers.
  - 90 m<sup>3</sup>/ gross ha/ day (1.04 L/ second/ ha) including infiltration and peaking effect for trunk sewers.
2. Design Flow Schools & Institutions:
  - 112 m<sup>3</sup>/ gross ha/ day including infiltration and peaking effect.

The area is calculated using the number of gross hectares included in the industrial, school, or institutional site. This flow figure will apply unless evidence exists which will require additional treatment or provide additional volume.

### 2.5 Sanitary Drainage Area Plan

The tributary areas used in the evaluation of the design flows shall be shown on a plan to a scale of 1:5000. This plan shall indicate the land use, area, population density or number of units, and the design flow in liters per second (L/ s). For each area entered on the design sheet, the maintenance hole numbers, the size and grade of the sewers, and the plan number of the detailed plan and profile for each section of the sanitary sewer shall also be indicated.

## **3. Sanitary Sewer Design**

### 3.1 Pipe Capacities “Q”

Sewer capacities shall be computed by using Manning's Formula on the basis of sewer pipe flowing full. (see Appendix).

### 3.2 Roughness Coefficients “n”

For all types of pipe a roughness coefficient of  $n=0.013$  shall be used.

### 3.3 Velocity and Grade

Minimum velocity 0.60 metres per second (m/ s) and the minimum grade of 0.5 per cent for all local sewers.

A minimum grade of one per cent for the first upstream leg.

The maximum velocity in any sewer shall be 3.65 metres per second.

Velocity change from the upstream pipe to the downstream pipe in a maintenance hole shall not decrease by more than 0.60 metres per second.

### 3.4 Siphon Design

The minimum velocity for siphon design is 0.90 metres per second (as per Ministry of Environment criteria). Siphon design submissions are to include siphon calculations stamped and signed by an engineer.

### 3.5 Minimum Size of Pipe

Minimum size of pipe shall be 200 millimetre diameter.

### 3.6 Minimum Depth of Pipe

Depth is measured from the final centerline finished road elevation to the top of the sanitary sewer:

1. For residential, commercial, and institutional areas the minimum depth shall be 2.75 metres.
2. For industrial areas, the minimum depth shall be 2.15 metres.

In all cases the proposed sanitary sewers shall be installed at sufficient depth to service lands external to the site as determined by the Region of Durham.

### 3.7 Maintenance Holes

Maintenance holes shall be constructed of poured or precast concrete as detailed on the Standard Drawings.

All new maintenance holes placed within existing, proposed, or future road surface locations shall be integrated frame and cover maintenance hole system, unless directed otherwise by the Region.

The use of precast modular adjustment units will not be permitted within the roadway unless the specific circumstances does not allow the use of an integrated frame and cover maintenance hole system.

Maintenance holes shall be provided at each change in alignment, grade, pipe material and at all junctions, except where radius pipe is used in size 1050 millimetre and over.

Maintenance holes shall be spaced at a maximum of 120 metres for pipe sizes 200 millimetre diameter to 750 millimetre diameter, a maximum of 125 metres for pipe sizes 825 millimetre diameter to 1200 millimetre diameter and a maximum of 155 metres for pipe sizes over 1200 millimetre diameter. Where sewers are installed using trenchless methods, the maximum spacing of maintenance holes will be evaluated on a site-specific basis.

The type and size of maintenance hole shall be specified on the profile and a detail of the benching is to be shown on the plan portion of the engineering drawing for cases when the benching differs from the normal.

Granular bedding shall be 19 millimetre crusher run limestone.

All maintenance hole accesses shall be located outside of the wheel path and multiuse paths (i.e., bike lanes, sidewalks) where possible.

The maximum change in the direction of flow in any sanitary sewer maintenance hole shall be 90 degrees. A change of flow direction at acute interior angles shall not be permitted.

A maximum drop of 0.25 metres will only be allowed if the design of the sewer cannot be modified to reduce the drop or modified to accommodate a drop structure.

If the design of the sewer system is such that there is an elevation difference of at least 0.6 metres between the maintenance hole inlet and outlet, then a drop structure shall be required as per the minimum drop from the “Table of Minimum Dimensions & Maximum Velocities” in S-100.080. Drop structures with an elevation difference greater than five metres shall be individually designed and detailed.

Whenever feasible, sewer systems shall be designed to avoid the use of drop structures.

When pipe size does not change through a maintenance hole and the upstream flow velocity does not exceed 1.5 metres per second, the following allowances shall be made to compensate for hydraulic losses.

For non-pre-benched maintenance holes:

<b>Alignment Change</b>	<b>Drop Required</b>
Straight run	Grade of sewer
15 - 45 degrees	0.03 metres
46 - 90 degrees	0.06 metres
Junctions and Transitions*	See appendices



For pre-benched maintenance holes:

<b>Alignment Change</b>	<b>Drop Required</b>
0 - 45 degrees	0.03 m
46 - 90 degrees	0.06 m
Junctions and Transitions*	See appendices

\*For all junction and transition maintenance holes, and when the upstream flow velocity exceeds 1.5 metres per second; the drop required shall be calculated using the Ministry of the Environment guidelines “Hydraulic Calculations for Junction and Transition Maintenance Holes” (See Appendices).

The obvert(s) on the upstream side of a maintenance hole shall not be lower than the obvert(s) on the downstream side of the maintenance hole.

All maintenance holes shall be benched as detailed on the Standard Drawings for poured and precast maintenance holes. Benching shall meet the following criteria:

1. All benching shall be sloped at two per cent to channel.
2. Alignment of sewer to extend a minimum of 150 millimetres into maintenance hole before a change in alignment begins.

Benching height requirements shall be determined from the chart shown in accordance with OPSD 701.021 (latest revision).

The Standard Drawings provide details for maintenance holes up to certain maximum depths. The Engineer shall analyze individually each application of the standards, related to soil conditions, loading and other pertinent factors, to determine structural suitability. In all cases where the standards are not applicable, maintenance holes shall be individually designed and detailed.

When any dimension of a maintenance hole exceeds those on the Standard Drawings, the maintenance hole shall be individually designed and detailed.

A safety platform shall be required in all maintenance holes greater than 5.0 metres in depth.

Whenever practical, a safety platform shall be located 0.5 metres below the drop structure inlet pipe.

Consideration should be given to FRP ladders (with Stainless steel hardware) in maintenance holes with drop structures with potential for Hydrogen Sulfide (H<sub>2</sub>S).

All maintenance holes located on easements in parks, in playgrounds or in other locations as deemed necessary shall be equipped with a locking watertight maintenance hole cover.

A one metre minimum 50 millimetre circular asphalt collar shall be installed around a maintenance hole located in a gravel shoulder according to Region of Durham Standard Drawing S-101.030.

Lifting holes in precast sections shall be completely filled with three parts sand, one part cement mortar prior to backfilling.

For maintenance holes located outside the roadway, concrete adjustment units shall be set in three parts sand, one part mortar or using Moduloc tape. The adjustment units shall be parged on the outside with 15 millimetre of three parts sand, one part mortar and sealed with two coats of bituminous paint.

### 3.8 Pipe

The class and type of pipe and the type of pipe bedding shall be shown on the profile for each section of sewer.

The use of radius pipe or deflected pipe will be permitted to achieve changes in horizontal alignment for sewer sizes 1050 millimetre diameter and larger. The minimum radius allowed for various pipe diameters shall be as detailed in the manufacturer specifications. When pipes are deflected at the joints, the angle of joint displacement shall not exceed three degrees.

No decrease of pipe size from a larger size upstream to a smaller size downstream shall be allowed regardless of increase in grade.

Pipe bedding and class of pipe shall be designed to suit ultimate loading conditions.

No sanitary service connections shall be permitted to sanitary sewers exceeding 7.60 metres in depth. Depth is measured from the final centre line finished road elevation to the top of the sanitary sewer.

PVC forcemains shall be white or green.

Pipe stub locations and elevations shall be surveyed and accurately tied to permanent structures prior to backfilling.

### 3.9 Connections

All sanitary sewer connections to service private property shall comply with the “Design Specifications for Service Connections”.

### 3.10 Tracer Wire

Tracer wire shall be installed on all forcemains. Tracer wire shall be brought to the surface using 50 millimetre diameter valve boxes spaced at 300 metre intervals along the forcemain for locating purposes.

#### **4. Materials**

For sanitary sewer material refer to the Region of Durham Approved Manufacturers' Product List.

In industrial areas, pipe material will be determined on a site-specific basis with consideration to chemically resistant products.

In non-industrial areas, PVC or reinforced concrete pipe shall be used up to 450 millimetre diameter, reinforced concrete pipe shall be used for greater than 450 millimetre diameter.

The consulting engineer shall support the selection of pipe to be used with reference to applicable OPSD Standards or by providing detailed design calculations.

Where soil conditions and depth of pipe allow, the Region of Durham's standard bedding detail for PVC pipe shall be used. Where the depth of pipe and soil conditions require additional bedding requirements as determined by the design Engineer, detailed design calculations, a geotechnical report and any supplemental drawings shall be submitted to support the additional bedding requirements.

For PVC pipe, the maximum deflection measured not earlier than 24 hours after backfill shall not exceed 5.5 per cent of average inside diameter (ID). The maximum deflection measured after one year of installation, and prior to the end of maintenance period shall not exceed seven per cent of average ID.

Site Specific approval shall be required when using High-Density Polyethylene (HDPE) pipe.

#### **5. Easement Requirements**

For minimum widths of permanent easements refer to Section 6 of Design Specifications for Engineering Submissions.

The locations of sanitary sewers within easements or where deemed necessary by the Region of Durham, shall be indicated with marker sign and post. Contractor shall supply and install marker post, the location and spacing will be determined by the Region of Durham and shown on the contract drawings. Marker signs shall be made available from the Region of Durham at no cost. All costs associated with the installation of marker signs and posts shall be borne by the contractor.

## **6. Camera Inspection of Sanitary Sewers**

Refer to the Region of Durham's "Construction Specifications for Regional Services", General Requirements, Section 01450, Clause 1.07 Camera Inspection, for the correct format.

## **7. Concrete Encasement**

If concrete encasement is necessary for rigid pipe, a detailed design shall be submitted for approval. Concrete encasement shall be designed from maintenance hole to maintenance hole to prevent pipe shear. All concrete encased pipes shall be upsized one size to allow for potential future liners.