THE REGIONAL MUNICIPALITY OF DURHAM

DESIGN SPECIFICATIONS FOR STORM DRAINAGE

WORKS DEPARTMENT

April 2025

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1. Culverts and Bridges

The sizing of road crossing culverts and bridges shall be in accordance with Ontario Ministry of Transportation (MTO) Highway Drainage Design Standards (2008), with regulatory agency inputs and additional considerations as noted in the following paragraphs.

To improve the resilience of culverts and bridges against current and future flood risks, Durham Transportation Master Plan has identified emphasis areas and recommendations to consider as applicable in the planning and design of Durham roads. The Region has completed the flood risk assessment within the Toronto and Region Conservation Authority (TRCA) and Central Lake Ontario Conservation Authority (CLOCA) watersheds of the region and identified water crossings and road segments that are at risk for the present and future flood scenarios. The recommendations of the above studies shall be considered in the planning and design of culverts, bridges and road segments that are exposed to flood risk.

The recommended minimum size for circular road crossing culverts is 700 millimetre diameter. Road crossing culverts shall be embedded below the bottom of the ditch by at least 10 per cent of the pipe diameter (or 100 millimetres for pipes smaller than 1000 millimetre). Consult with the Region's Project Manager regarding locations with limited cover.

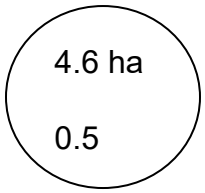
The length of culvert shall be determined using the depth of ditch and 4:1 side slopes (desirable). Culverts shall be designed to accommodate a minimum of highway (CHBDC CL-625) loading and soil conditions. Culverts are to be installed by open cut construction.

The overtopping design criteria used for the different design storms shall be calculated and submitted to the Region for review and acceptance. The criteria for flooding hazards and the control of flows over the roadway are detailed in Ministry of Natural Resources and Forestry's Technical Guide – River & Stream Systems: Flooding Hazard Limit (latest version) and the Ministry of Transportation of Ontario (MTO) Highway Drainage Design Standards (WC-13). When overtopping affects the centre two lanes of a Regional Road, culvert re-sizing, so that surcharged culvert capacity eliminates overtopping, shall be considered. Design Flows and Watershed Area

The watershed area shall be determined from contour plans and shall include all areas that naturally drain into the system and shall also consider all lot grading plans for proposed developments.

A plan of the watershed area shall be prepared for submission to the Region of Durham and shall include all affected streets, lots, and watercourses. The proposed storm sewer system shall be shown on this plan including each maintenance hole and catch basin. Maintenance holes or catch basins shall be provided at every change of pipe size, grade, and alignment.

The watershed area outlet tributary point to each maintenance hole and catch basin shall be clearly outlined on the storm drainage area plan with the area in hectares (to the nearest tenth) and runoff coefficient both shown in a circle of 15 millimetre diameter.

Thus 

In cases where areas of different runoff coefficients are tributary to one maintenance hole or catch basin, the areas tributary to the maintenance hole or catch basin shall be individually outlined. The tributary area and runoff coefficient for each area shall be shown as set out above.

In determining tributary areas to maintenance holes and catch basins, the proposed grading of lots must be considered and taken into account in order to maintain consistency in design.

In the case of large tributary areas under single ownership, such as shopping centres, apartment developments, schools, etc., the design shall be prepared on the basis of the whole area being tributary to a maintenance hole or catch basin in an abutting storm sewer. When more than one storm sewer connection will be necessary to serve the property in question, the appropriate area tributary to each storm sewer connection shall be clearly shown and taken into account in the design of the storm sewer.

In lieu of precise information on development of the whole or any part of a watershed area, the latest approved zoning by-law and plans, including requirements for on-site stormwater management, shall be used to select the correct values of the runoff

coefficients to be used in the design and to determine the specific areas where they will apply.

2. Major – Minor System and Overland Flows

Storm drainage design shall follow the principles of minor flows being accommodated in gutters and piped systems, where installed, and roadside ditches elsewhere. The major system, consisting of overland flow routes, including surface flow along roadways, shall also be designed and confirmed to be adequate for all storm runoff events.

Where feasible, to facilitate safer passage of emergency vehicles and accommodate evacuation routes, it is desirable to confine overland flow to outside lanes on regional roads such that one lane in each direction is maintained during the 100 year rainfall event. Where two regional roads intersect, overland flow routing should avoid crossing through the intersection. Sometimes this necessitates intersection pavement elevation adjustments or 100 year inlets and piping.

3. Stormwater Management

The design of Stormwater drainage and Storm Sewers shall be in accordance with MTO Highway Drainage Design Standards (latest version), with regulatory agency inputs and additional considerations as noted in the following paragraphs.

Specific requirements for quantity control and quality control of drainage system runoff will vary depending on watershed study findings and impact of the proposed regional road project. Where feasible, it is preferable to discharge runoff to existing municipal stormwater management ponds. Drainage from outside the regional road allowance are to be directed to the local municipality’s storm sewers, where possible. Linear storage systems and water quality methodologies, such as oil-grit separators, flat bottom ditches and infiltration trenches should be selected and designed with maintenance and operations as a key consideration.

4. Storm Sewer Design

4.1 Runoff Quantity

The design of the Regional storm sewers shall be computed on the Region of Durham's Standard Storm Sewer Design Sheets (see Appendix) or similar sheets.

All storm sewers shall be designed according to the Rational Formula where:

$Q = 2.78\ (A \times i \times R)$ $\qquad i = \frac{3454}{Tc+20}$

A = Area, hectares

I = Average rainfall intensity, millimetres/ hour

R = Runoff coefficient

Q = Runoff quantity, litres/second

Tc= Time of concentration, minutes

The values of the rainfall intensity "i" shall be determined using approved Rainfall Intensity - Duration Curve and a storm frequency of 1:10 years. Where a new storm sewer system discharges into an existing system, an evaluation of the impacts to the existing system shall be completed, with regards to peak flow and hydraulic grade line. Values for the runoff coefficient "R" shall be as approved by the Engineer. The design storms for events other than ten-year storm shall be based on the local area municipality's' Rainfall Intensity-Duration Curves or design storms approved for the respective watershed plans by the Conservation Authority.

In urban areas the value of the runoff coefficient will be increased for high magnitude storms. For the 25, 50, and 100-year events the runoff coefficient "C" should be multiplied by the corresponding Antecedent Precipitation Index (Ca) listed below.

Antecedent Precipitation Index (Ca) – Multiply the C value by Ca for a given storm event:

- 25-year storm = 1.10
- 50-year storm = 1.20
- 100-year storm = 1.25

The maximum value of Ca x C is 1.00.

A minimum 15-minute Tc for entry time shall generally be allowed at the head of the system. Smaller times of concentration may be considered for individual situations. Other approved methods may be used for the design of storm sewers where it is considered expedient, however, design flow values shall not be less than those calculated using the Rational Formula.

4.2 Pipe Capacity “Q”

Manning's Formula (see Appendix) shall be used to compute both capacity and velocity of storm sewers. This formula shall be used in conjunction with the Region of Durham storm sewer design sheet. Storm sewers shall be designed to convey the 10-year peak flows at a maximum 80% capacity flowing in a subcritical condition.

4.3 Roughness Coefficient “n”

The roughness coefficient to be used for storm sewer pipes shall be:

1. Concrete
    - n = 0.013 for all size of pipes
2. Polyvinyl Chloride
    - n = 0.013 for all size of pipes
3. High Density Polyethylene
    - n = 0.013 for all size of pipes
4. Corrugated Steel
    - n = manufacturers specifications

4.4 Velocity

The velocity in storm sewers shall be limited to a minimum of 0.75 metres per second and a maximum of five metres per second.

Velocity change from one pipe to another in a maintenance hole shall not exceed 0.60 metres per second.

Minimum Pipe Grade shall be 0.5 per cent, unless otherwise approved by the Region's Project Manager.

4.5 Minimum Sizes of Pipe

Sewer mains shall be 300 millimetre diameter.

Catch basin connections shall be 250 millimetre diameter for single catch basins and 300 millimetre diameter for double catch basins.

4.6 Minimum Depth of Pipe

The minimum cover from finished grade to the top of pipe shall be 1.20 metres.

4.7 Maintenance Holes

Maintenance holes shall be provided at each change in alignment, grade, pipe size and pipe material.

Maintenance holes shall be spaced at a maximum of 120 metres for pipe sizes 300 millimetre diameter to 1200 millimetre diameter and a maximum of 150 metres for pipe sizes greater than 1200 millimetre diameter.

Maintenance holes are to be located out of the road surface where possible on regional roads. Where the maintenance hole must be located within the road, the chamber opening shall be located outside of the wheel path.

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

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 hole chamber openings shall be located towards the road unless otherwise specified.

Maintenance hole sizing based on pipe opening and benching (if required) shall be determined from the chart shown in accordance with OPSD 701.021 (latest revision).

Maintenance hole tees may be built on concrete storm sewer pipe from 1200 to 3000 millimetre diameter as shown in accordance with OPSD 707.010 (latest revision).

The minimum drop across the maintenance hole for all straight runs shall be sufficient to maintain the hydraulic grade line across the maintenance hole.

The obverts on the upstream side of a maintenance hole shall be in no case lower than those on the downstream side.

When the dimensions of a maintenance hole exceed those on Standard Drawings, the maintenance hole shall be individually designed and detailed.

Safety platforms shall be required in all maintenance holes greater than five metres in depth. Safety platforms shall not be more than five metres apart and constructed in accordance with OPSD 404.020 (latest revision).

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.

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 millimetres of three parts sand, one part mortar and sealed with two coats of bituminous paint.

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.

4.8 Catch Basins

Special catch basins and inlet structures shall be fully designed and detailed. Catch basins shall be selected, located and spaced in accordance with conditions of design; the spacing shall not exceed 75 metres. The design for catch basin location and type shall take into consideration the lot areas, lot grades, road widths and road grades. Catch basin spacing will need to be altered for road profile grades over four per cent, for use of side inlet catch basins or where special grates are used. Double catch basins are required at sag locations.

Side inlet catch basins are to be used adjacent to on road bicycle lanes and in medians where necessary (i.e., superelevated sections). Side inlet catch basins should also be used as a first choice over catch basin setbacks.

Spacing of catch basins shall be calculated to ensure capture of minor system flows. Major system overland flow routes need to be considered. Flow spread must leave at least one lane free of water in each direction.

At street intersections, catch basins shall be located immediately upstream of sidewalk or pedestrian crosswalks. Avoid placing catch basins within the intersection curb returns and in front of bus stop pads.

Catch basins and connections shall provide for the expected maximum flow.

OPSD 400.020 (latest revision), Cast Iron, Square Frame, with Square Flat Grate for Catch Basins, Herring Bone Openings shall be used.

For single and double catch basins, the connection pipe shall be laid at one per cent minimum grade.

Catch basin outlet pipes shall be connected directly to the nearest storm maintenance hole, or to the mainline storm sewer using a prefabricated tee.

Subdrains shall be provided on both sides of all catch basins where possible and connected to the catch basin at the downstream end of the subdrain by two metre section of non-perforated corrugated steel pipe. All plastic knockouts shall be entirely removed from catch basins. All catch basin connections shall be mortared on the inside and outside of the catch basin wall, unless rubber boot connection is used.

Concrete adjustment units shall be set in three parts sand, one part mortar or using Moduloc tape. For catch basins located outside the roadway, 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.

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

4.9 Pipe

Pipe length, diameter, percent grade and shall be shown on the profile for all lengths of storm sewer pipe.

Proposed/existing pipe diameters shall be shown both on the plan and profile section of the drawing, as shown on sample drawings.

All storm sewers shall be located as shown on the appropriate road cross-section standard.

Pipe sizes shall not decrease from a larger size upstream to a smaller size downstream regardless of the increase in grade.

Pipe class and bedding shall be designed based on pipe material used to suit a minimum of highway (CHBDC CL-625) loading and soil conditions.

5. Materials

For storm sewer material refer to the Region of Durham Approved Manufacturers' Product List. The consulting engineer shall support the selection of pipe to be used with reference to applicable OPSD Standards or by providing detailed design calculations.

Storm sewers shall be constructed of concrete pipe, polyvinyl chloride pipe, high-density polyethylene pipe or concrete cast in place. Corrugated steel pipe shall not be used as part of an enclosed storm sewer system. Corrugated steel pipe can be used for storm sewer outlets, driveway culverts and road crossing culverts.

6. Easement Requirements

For minimum widths of permanent easements refer to Section 3 of Design Specifications for Engineering Submissions. Consideration of overland flow routing may affect easement size and grading.

The locations of storm sewers within easements or where deemed necessary by the Region of Durham, shall be indicated with marker sign and post. Contractor to 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.

7. Camera Inspection of Storm 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.

8. Reports and Approvals

Design and construction of storm water discharge to creeks, wetlands, storm water management ponds etc. to be in accordance with and approved by Conservation Authority, Ministry of Natural Resources, Department of Fisheries and Oceans and the Ministry of Environment, Conservation and Parks.

Typically, a comprehensive drainage and stormwater management report, outlining existing and proposed drainage conditions, is required to determine the optimum drainage scheme for the road project.

Local Area Municipalities typically have an area wide understanding of storm drainage adjacent to Regional roads and have recommendations for accommodating road runoff. In addition, adjacent property owners may provide input and seek to partner in development of shared facilities to accommodate their needs.