City of Estevan

Storm Drainage Design Guidelines

Revised April 16, 2001

1. Minor Drainage System

1.1 Storm Sewers

Standard level of service for storm sewers shall be the conveyance of run-off from a 5 year recurrence interval storm at an overall run-off co-efficient (rational method) of 0.40 at post developed conditions.

Should run-off exceed the computed standard service level or should capacity in an existing storm sewer be less than the run-off from a 5 year recurrence interval storm at post-developed conditions, on–site detention facilities shall be provided at the project proponent's own expense, prior to discharge of run-off into the publicly owned storm sewer system.

The following standards shall be adhered to:

a) Storm Sewers:

- Sewer materials permitted are PVC sewer pipe (where it can be demonstrated that flammable materials will not gain entry into the system), ASTM C76 concrete pipe. (Corrugated steel pipe shall only be used at driveway crossings of road ditches or channels.)
- Manholes and catchbasins as per standard specifications and drawings.
- Manhole spacing to be 120 m maximum or at all junctions and changes in direction.
- Minimum depth of cover to pipe crown = 1.25 meters (sewer and catchbasin leads).
- Catchbasins shall be provided at regular intervals along roadways at a maximum spacing of 150 m and at intersections.
- Minimum catchbasin lead diameter shall be 200 mm except that 150 mm diameter may be used to regulate discharge from an on-site detention systems.
- Type 33 or K2 inlets at rolled curb locations,
- Type 35 or Type 50 (Type K) inlets at barrier curb locations;
- Area-type inlets may only be used where adequate inlet capacity can be demonstrated without excessive ponding depths (over 200 mm depths are considered excessive during major storm events).
- Minimum CB lead slope to be 1%, unless shallower grades can be verified by submission of supporting calculations.
- Velocities of flow in storm sewers shall be 0.6 m/second minimum and 3.0 m/second maximum. Where velocities exceed 3.0 m/second, drop structures, anchor blocks, and energy dissipaters to be used to prevent erosion and preserve integrity of pipes and structure.
- Mannings roughness coefficient (n) for pipes shall be 0.010 (PVC), 0.013 (concrete) and 0.024 (CSP).

- Design criteria for use with the rational method to be as follows:

i)

Run off Coefficients (c)	5 Year Frequency
Pavement & roofs	0.90
Lawns, parks, cemeteries	0.10
Playgrounds	0.25
Gravel roads & lanes	0.50
Schools & multiple residential (detached)	0.50-0.70 *
Multiple family residential	0.40
Multiple residential (attached)	0.65-0.85 *
Apartments	0.70-0.90 *
Commercial & Industrial	0.70-0.90 *

* Lumped run-off co-efficient shall be the weighted average of coefficients for sub-areas based upon condition of imperviousness of each sub-area.

Run-off coefficients shall be modified by the following antecedent precipitation constants (**λ**):

Storm Frequency	**λ**
2-10 years	1.00
25	1.10
50	1.20
100	1.25

(ii) Inlet times and times of concentration shall be computed using:

- minimum inlet time = 10 minutes (for flow along public roadways) and 5-7 minutes (for flow into on-site detention systems)
- time of concentration shall be composite of inlet and computed flow times.

The Kirpich or Sealey formulae shall be used to obtain overland flow times. Any other method shall require prior approval of the Engineering Department.

Kirpich Formula $t_c = 7.8 \times 10^{-3} L^{0.77}/S^{0.385}$

Sealey Formula $t_c = (2 \times L \times n/[3 \times S^{0.5}])^{0.467}$

t_c - minutes
L - distance of travel in feet
n - mannings roughness
s - slope in %

(iii) Rainfall intensity shall be computed using the formula:

$$i \text{ (mm/hr)} = \frac{A}{(t_c + B)^c}$$

where t_c = time of concentration in minutes and constants as follows:

Return Frequency

Years	A	B	C
2	814.65	9.0	0.857
5	1976.73	14.0	0.933
50	4889.25	18.0	0.991
100	5575.99	18.0	0.994

Q (run-off in Litres/sec) = 2.78 c*i*A
where A = catchment area in hectares.

(iv) Inlet and Outlet Structures:

- shall be provided with rip rap or other approved energy dissipating structures for discharge velocities grater than 1.5 m/sec.
- shall be provided with a tamper-proof safety grillage at the outlet of every storm sewer or the inlet into every culvert exceeding 600 mm diameter.

(v) Surcharged Sewers:
Surcharged sewers occurring concurrently with a 5 year return frequency design storm will only be permitted to fill a detention pond. Surcharged sewers shall have the 5 year and 100 year hydraulic grade line shown on the drawings.

(vi) The line assignment of storm sewers on public property or within public rights-of-way shall be confirmed with the City of Estevan, Engineering Department.

2. Major Drainage System

2.1 Culverts:

a) Culverts shall have a minimum diameter of 600 mm.

b) Culverts shall be designed to accommodate overland conveyance of run-off from major (100 year return) events. Surcharging to optimize channel storage is preferred, provided that the backwater profile does not intersect habitable property or a plane 150 mm below the bottom of pavement sub-base.
On collector or local roads, road overtopping from major events will require specific approval of the Engineering Department and only if the occurrence is localized and mitigation provided. Overtopping will only be permitted at specific locations where there is no hazard to traffic or roadway pavement structure. Where road overtopping is anticipated,

scour protection and other approved mitigation measures shall be provided.

2.2 Detention Systems:

a) Run-off detention systems will be required where there is inadequate capacity in an existing storm sewer or where an area is being developed or redeveloped. The run-off to storm sewers shall be restricted to pre-developed conditions. Systems shall be sized for ultimate build-out conditions. The City's Engineering Department shall determine the capacity limits of existing storm sewers and shall specify the pre or post developed conditions that may be considered for discharge into the public drainage system whether underground or overland.

b) Flow control devices shall be installed in public rights-of-way or on public property and accompanied by adequate engineering analysis to demonstrate the effectiveness of such devices.

c) Acceptable methods of detention storage shall be:
1. roof top detention;
2. parking lot storage;
3. dry ponds;
4. wet ponds;
5. underground holding tanks (super pipe).

d) Storage volumes shall be calculated by:
(i) hand methods (for use with catchment areas 5.0 ha or less)
- "Simplified storage Volume Calculation: by K.L. Chua, CAN. J. CIV. Eng. Volume 10, 1983.
- other modified rational methods (APWA Special Report #49 URBAN STOMWATER MANAGEMENT).

(ii) computer simulations using SWMM, OTTHYMO, POND PACK, or other acceptable methods (for areas larger than 5.0 ha).

e) Design Parameters:
- as indicated in "Storm Sewers";
- design storm hyetographs shall be constructed using dimensionless synthetic rainfall depth distribution curves;
  - by Huff (Bulletin 70-71 – median type storms, 50% exceedance probability); or
  - chicago method, adjusted to compensate for excessive peaking; or
  - centre peaking curves using IDF data.
- provisions shall be made for sediment traps prior to discharge into storm sewers or drainage ditches;
- no building to be inundated at its ground line;
- continuity of overland flow routes shall be maintained.

2.3 Channels, Ditches and Major System Elements:

Standard service level for channels, ditches, and the major drainage system elements shall be the conveyance of run-off from a 100 year recurrence interval storm overland. No building shall be inundated at its ground line.

Post disaster facilities such as schools, hospitals, fire halls, police stations, and municipal buildings shall be accessible by collector or arterial routes during major storm events with inundation permitted as follows:

- arterial roads to the facility: at least 2 x 3.75 m wide driving lanes not inundated in a direction parallel to flow and with depth of flow at crossings less than 75 mm;
- collector roads to the facility: at least 1 x 3.75 m wide driving lane not inundated in a direction parallel to flow and with depth of flow at crossings less than 125 mm.
- velocities and depths of flow in other areas accessible to the public to conform to the following:

Water Velocity (m/sec)	Maximum Permissible Depth (m)
0.5	0.6
1.0	0.32
2.0	0.21
3.0	0.09

3. Submission Requirements:

- Detailed calculations showing design parameters used, catchment areas, flows, velocities, capacities, rainfall hyetographs, run-off hydrographs, hydraulic grade lines indicated on drawings, storage volume calculations, stage/discharge relationships, orifice and flow control device sizing calculations, detention storage volumes, maximum ponding depths, operating levels, low water levels, emergency overflow routes, and detailed site grading plan with design contours.
- Verification that basement flooding will not occur.