Stormwater Criteria – MOE Guidelines

CVA/TRCA Stormwater Management Criteria Workshop
April 26, 2012

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Purpose

To present an overview of the current MOE Stormwater Management Guidelines.

Focus of Presentation:
- Chapter 2 and references/supporting documents
  - Emphasizes that criteria derived from watershed studies are preferable

- Chapter 3 and references/supporting documents
  - Guidance for development in the absence watershed studies (i.e. Table 3.2).

- Both chapters discuss the importance of preserving the pre-development hydrologic regime, and that lot level and conveyance controls (aka low impact development) are currently the best means of achieving water balance objectives

- Briefly discuss maintenance
Stormwater Management Planning and Design Manual

March 2003

Ontario

Ministry of the Environment
Chapter 2
Environmental Planning

A process designed to assist agencies and practitioners in working together to balance social, environmental and economic needs, using an ecosystem approach.

Provides overview of the scale and degree of detail for:

- Watershed studies
- Subwatershed studies
- Environmental management plans; and,
- Environmental/stormwater management reports
**Subwatershed Planning**

June 1993

**Integrating Water Management Objectives into Municipal Planning Documents**

June 1993

- Watershed Plan
- Upper Tier Municipal Plan
- Local Official Plan & by-laws
- Subwatershed Plan
- Official Plan Amendments
- Plan of Subdivision
- Stormwater Management & other Site Management Plans

**Watershed Management on a Watershed Basis:**

Implementing an Ecosystem Approach

June 1993
An integrated plan will guide local/regional governments in planning future land use, infrastructure, resource development; at the same time protecting and enhancing the environment. To include measures that will integrate:

Aquatics: the ecology and biology of aquatic systems and communities;

Water Quality: the physical, biological and chemical characteristics of surface waters;

Hydrology: the surface water flows in a watershed and influences on flows;

Stream Morphology: erosion, transfer and deposition of sediment;

Groundwater: the sub-surface water, its occurrence, movement, chemistry, factors that influence it including interactions with surface flow systems;

Terrestrial: the ecology and biology of terrestrial systems and communities, and connections to other systems outside the watershed;

Social: social values & structures, local knowledge, demographics, cultural heritage, resource use, etc;

Economics: the economic impacts of activities or plans on values;
Comprehensive Management Strategy

Consists of multiple elements that influence watershed conditions - stormwater management does not make up the entire strategy. Components include:

- Preserve terrestrial features for habitat conditions, vegetation and to protect hydrologic processes.
- Preserve surficial topography and geologic properties to maintain surface water and groundwater flow conditions.
- Preserve stream corridors for aquatic, hydrologic processes and water quality.
- Preserve and restore selected headwater systems - important to the stream corridor functions (hydrologic, geomorphology, aquatic, and terrestrial).
- Identify rehabilitation and stewardship opportunities - resiliency of the stream system.
- Protect flow conditions (base flow, bankfull flow, flood flows) and water quality.
- Minimize the threat to life, property and natural resources from flooding and erosion.
Chapter 3
Environmental Design Criteria

“Urban development without watershed/ subwatershed planning is discouraged…”

“…there will be cases where a development will be allowed to proceed without a subwatershed plan.” In general it will occur when:

• Proposed development is small
• The overall level of watershed development (imperviousness) is limited
• The receiving stream is not overly sensitive in terms of aquatics, geomorphology, or flooding
• The receiving stream has good water quality
Specific stormwater management criteria

Water Balance
Water Quantity
Erosion Control/Geomorphology
Water Quality

“Although most of the discussion is focussed on end-of-pipe facilities, lot level and conveyance controls should be utilized to the extent possible....”
VOLUME CONTROLS

Source controls which reduce the amount of impervious area or restrict the discharge of stormwater to sewers should be used first to achieve specified volume controls. Vegetative and structural best management practices which enhance infiltration are gaining agency and public acceptance. Stormwater quality ponds should be considered as the last line of defence and applied only after all opportunities for infiltration of stormwater have been exhausted.
Water Balance

Maintain groundwater infiltration to prevent reduction in baseflow and recharge and avoid:

- Impairment of aquatic and terrestrial habitats
- Shortage of water for agricultural, domestic or other uses

Water Balance Approach:

- Evaluate pre and post development infiltration
- Determine amount of water to infiltrate to compensate for post development impervious areas or changes to vegetation
Water Quantity

Post development, we often contend with greater volume of runoff, rapid conveyance to the stream, and increased peak flows.

Typically, peak flow rates controlled to pre-development values for storms with return periods ranging from 2 to 100 years.

Occasionally, over control (rates less than pre-development) may be required:

- Flows result in destabilized streambanks
- Coincidence of peaks result in flooding
Urbanization and Runoff

Natural Ground Cover
- 40% evapotranspiration
- 10% runoff
- 25% shallow infiltration
- 25% deep infiltration

10%-20% Impervious Surface
- 38% evapotranspiration
- 20% runoff
- 21% shallow infiltration
- 21% deep infiltration

35%-50% Impervious Surface
- 35% evapotranspiration
- 30% runoff
- 20% shallow infiltration
- 15% deep infiltration

75%-100% Impervious Surface
- 30% evapotranspiration
- 55% runoff
- 10% shallow infiltration
- 5% deep infiltration

Ontario
Erosion Control/Geomorphology

“…approaches for the design of end-of-pipe SWM facilities for the control of in-stream erosion potential.”

“…preservation or enhancement of a “stable”, sustainable fluvial system and its associated habitat, aesthetic value and education-recreation potential while accommodating development needs.”

- Appendix B: Proposed Protocol for Detailed Design Approach
- Appendix C: Simplified Design Approach
- Appendix D: Distributed Runoff Control (DRC) Approach

Combination of targets for
- Volume control
- Rate control
Typo on page 3-14 - reference to “figure 1.1” should be “figure 1.3”
Figure referred to on page H-9 (SWMP Sample Calculations) is figure 4.6 in 1994 Manual.
Water Quality

“…the levels of protection should be chosen to maintain or enhance the existing aquatic habitat.”

“…the level of protection should be based on site-specific conditions determined through quantification of pre-development suspended solid loadings to receiving waters and the sediment characteristics of the receiving waters.”
1994 Manual: Levels of Protection (4)

Water quality criteria for various Levels of Protection were first described in 1994 manual with the caveat:

“These water quality criteria are not intended to supersede those in the Blue Book (Water Management, Goals, Policies, Objectives and Implementation Procedures of the Ministry of the Environment)”
Table 3.2 Water Quality Storage Requirements based on Receiving Waters\(^1\)\(^2\)

<table>
<thead>
<tr>
<th>Protection Level</th>
<th>SWMP Type</th>
<th>Storage Volume (m(^3)/ha) for Impervious Level</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>35%</td>
</tr>
<tr>
<td>Enhanced 80% long-term S.S. removal</td>
<td>Infiltration</td>
<td>25</td>
</tr>
<tr>
<td></td>
<td>Wetlands</td>
<td>80</td>
</tr>
<tr>
<td></td>
<td>Hybrid Wet Pond/Wetland</td>
<td>110</td>
</tr>
<tr>
<td></td>
<td>Wet Pond</td>
<td>140</td>
</tr>
<tr>
<td>Normal 70% long-term S.S. removal</td>
<td>Infiltration</td>
<td>20</td>
</tr>
<tr>
<td></td>
<td>Wetlands</td>
<td>60</td>
</tr>
<tr>
<td></td>
<td>Hybrid Wet Pond/Wetland</td>
<td>75</td>
</tr>
<tr>
<td></td>
<td>Wet Pond</td>
<td>90</td>
</tr>
<tr>
<td>Basic 60% long-term S.S. removal</td>
<td>Infiltration</td>
<td>20</td>
</tr>
<tr>
<td></td>
<td>Wetlands</td>
<td>60</td>
</tr>
<tr>
<td></td>
<td>Hybrid Wet Pond/Wetland</td>
<td>60</td>
</tr>
<tr>
<td></td>
<td>Wet Pond</td>
<td>60</td>
</tr>
<tr>
<td></td>
<td>Dry Pond (Continuous Flow)</td>
<td>90</td>
</tr>
</tbody>
</table>

\(^1\)Table 3.2 does not include every available SWMP type. Any SWMP type that can be demonstrated to the approval agencies to meet the required long-term suspended solids removal for the selected protection levels under the conditions of the site is acceptable for water quality objectives. The sizing for these SWMP types is to be determined based on performance results that have been peer-reviewed. The designer and those who review the design should be fully aware of the assumptions and sampling methodologies used in formulating performance predictions and their implications for the design.

\(^2\)Hybrid Wet Pond/Wetland systems have 50-60% of their permanent pool volume in deeper portions of the facility (e.g., forebay, wet pond).
Footnote to Table 3.2

¹Table 3.2 does not include every available SWMP type. Any SWMP type that can be demonstrated to the approval agencies to meet the required long-term suspended solids removal for the selected protection levels under the conditions of the site is acceptable for water quality objectives. The sizing for these SWMP types is to be determined based on performance results that have been peer-reviewed. The designer and those who review the design should be fully aware of the assumptions and sampling methodologies used in formulating performance predictions and their implications for the design.
Chapter 4
Stormwater Management Plan and SWMP Design

Treatment train approach

Premised on providing control at the lot level and in conveyance followed by end-of-pipe controls. Required to meet the multiple objectives of water balance, water quality, and erosion and flood control in an overall stormwater management strategy.

- Lot level and conveyance controls can reduce end-of-pipe storage requirements for erosion control and are the best means of achieving water balance objectives.
- Water quality improvement and quantity control for small storms are secondary benefits.
- End-of-pipe controls are required to meet water quality, and erosion and flood control objectives in most circumstances.

Multi-component approach

In the multi-component approach, a series of, for example, stormwater quality practices are used to meet water quality objectives.
<table>
<thead>
<tr>
<th>SWMP</th>
<th>Topography</th>
<th>Soils</th>
<th>Bedrock</th>
<th>Groundwater</th>
<th>Area</th>
</tr>
</thead>
<tbody>
<tr>
<td>wet pond</td>
<td>none</td>
<td>none</td>
<td>none</td>
<td>none</td>
<td>&gt; 5 ha</td>
</tr>
<tr>
<td>dry pond</td>
<td>none</td>
<td>none</td>
<td>none</td>
<td>none</td>
<td>&gt; 5 ha</td>
</tr>
<tr>
<td>wetland</td>
<td>none</td>
<td>none</td>
<td>none</td>
<td>none</td>
<td>&gt; 5 ha</td>
</tr>
<tr>
<td>infiltration basin</td>
<td>none</td>
<td>loam (min. inf. rate ≥ 60 mm/h)</td>
<td>&gt; 1 m below bottom</td>
<td>&gt; 1 m below bottom</td>
<td>&lt; 5 ha</td>
</tr>
<tr>
<td>infiltration trench</td>
<td>none</td>
<td>loam (min. inf. rate ≥ 15 mm/h)</td>
<td>&gt; 1 m below bottom</td>
<td>&gt; 1 m below bottom</td>
<td>&lt; 2 ha</td>
</tr>
<tr>
<td>reduced lot grading</td>
<td>&lt; 5%</td>
<td>loam (min. inf. rate ≥ 15 mm/h)</td>
<td>none</td>
<td>none</td>
<td>none</td>
</tr>
<tr>
<td>soakaway pit</td>
<td>none</td>
<td>loam (min. inf. rate ≥ 15 mm/h)</td>
<td>&gt; 1 m below bottom</td>
<td>&gt; 1 m below bottom</td>
<td>&lt; 0.5 ha</td>
</tr>
<tr>
<td>rear yard ponding</td>
<td>&lt; 2%</td>
<td>loam (min. inf. rate ≥ 15 mm/h)</td>
<td>&gt; 1 m below bottom</td>
<td>&gt; 1 m below bottom</td>
<td>&lt; 0.5 ha</td>
</tr>
<tr>
<td>grassed swales</td>
<td>&lt; 5%</td>
<td>none</td>
<td>none</td>
<td>none</td>
<td>&lt; 2 ha</td>
</tr>
<tr>
<td>pervious pipes</td>
<td>none</td>
<td>loam (min. inf. rate ≥ 15 mm/h)</td>
<td>&gt; 1 m below bottom</td>
<td>&gt; 1 m below bottom</td>
<td>none</td>
</tr>
<tr>
<td>vegetated filter strips</td>
<td>&lt; 10%</td>
<td>none</td>
<td>none</td>
<td>&gt; 0.5 m below bottom</td>
<td>&lt; 2 ha</td>
</tr>
<tr>
<td>sand filters</td>
<td>none</td>
<td>none</td>
<td>none</td>
<td>&gt; 0.5 m below bottom</td>
<td>&lt; 5 ha</td>
</tr>
<tr>
<td>oil/grit separators</td>
<td>none</td>
<td>none</td>
<td>none</td>
<td>none</td>
<td>&lt; 2 ha</td>
</tr>
</tbody>
</table>
Example Environmental Compliance Approval

Features:
- 5.7 ha Bioswale
- Oil and Grit Separators
- Grass Swales
- Rain Gardens
- Perforated Storm Sewers and Infiltration Trenches
- Permeable Pavement
- Extra Topsoil in Landscaped Areas
Example Environmental Compliance Approval

Features:

3.9 ha
Exfiltration System
Maintenance

Maintenance is a necessary and important aspect of urban SWMPs design.

One of the main reasons for SWMP failures and/or poor performance is lack of maintenance.

Designers should give thought to future, long-term maintenance during the design of SWMPs.
LSRCA Pond Study Results

• Of the 114 SWP 90 (79%) were Level 1,

• In 2010, only 39 SWP (40%) remain at Level 1,

• A total of 51 SWP now at lower design Level
  • 26 dropped 1 level
  • 11 dropped 2 levels
  • 2 dropped 3 levels
  • 12 no longer provide any quality benefit

D. Lembcke, B. Ginn, S. Lynn, R. Bolton
http://www.lsrca.on.ca/pdf/reports/stormwater_maintenance.pdf
Figure 1: Design of a three-chamber OGS

PERFORMANCE ASSESSMENT OF TWO TYPES OF OIL & GRIT SEPARATOR FOR STORMWATER MANAGEMENT IN PARKING LOT APPLICATIONS
Summary

• Criteria derived from watershed studies are preferable
• Urban development without watershed/subwatershed planning is discouraged because cumulative effects may not be identified and addressed
• Lot level and conveyance controls (low impact development) should be utilized to the extent possible
• More effort on water balance and erosion control is needed
• Maintenance is required for all stormwater management facilities