CATARAQUI REGION
CONSERVATION AUTHORITY

Appendix 'F': Guidelines for Stormwater Management

This guideline should be read in conjunction with Section 3.6 of the CRCA Planning Policy, as well as municipal stormwater guidelines where they have been prepared.

Stormwater management is a very important aspect of any site *development*. Where it is implemented correctly, it minimizes downstream hazards such as *flooding* and *erosion*, and maintains and improves water quality by capturing site pollutants before they reach receiving *waterbodies* such as lakes and streams.

The need for stormwater management is established by the legislation and policies of all three levels of government, including the Canada Fisheries Act (protection of fish habitat), the Ontario Lakes and Rivers Improvement Act (in-stream works), the Ontario Water Resources Act (water quality and hydrologic performance), and the Ontario Planning Act and the associated Provincial Policy Statement (water quantity and quality). Conservation Authorities provide input on stormwater management requirements, and also apply regulations under the Ontario Conservation Authorities Act regarding work within, and near, waterbodies. Additionally, the riparian rights doctrine of common law requires consideration of impacts to downstream users.

The Ministry of Environment has prepared the Stormwater Management Planning and Design Manual (SWMPDM) (2003), which contains useful information to assist with design and construction of stormwater management. Some municipalities in the Cataraqui region have stormwater management design standards against which development plans are also reviewed.

The following outlines the guidelines of the Cataraqui Region Conservation Authority for stormwater management in the region. CRCA staff encourage pre-consultation early in the design process, coordinated through our Planning Office.

1.0 GENERAL GUIDELINES

The goals of stormwater management are:

(1) to protect waterways from increasing/excess erosion, flow and flooding, water takings and diversions. This is implemented by ensuring that the *pre-development* condition hydrograph is matched by the post-*development* condition hydrograph.

(2) to maintain the water balance and groundwater recharge.

(3) to maintain or improve water quality.

1.1 Quantity

While the rational method and the matching of pre and post development peak flows at various event return periods have been used together as an estimation tool for hydrograph matching, they should not be used as the sole method of analysis. The rational method was developed in the 19th century as a method for sizing storm sewers, and is not preferred for pond design use. The use of the rational method is discouraged for all sites, but may be considered adequate for some.

A hydrologic/hydraulic model is the best way to compare undeveloped and developed site runoff characteristics, and pre-development and post-development hydrographs should also be examined in an attempt to provide a match. While hydrograph matching is generally not possible due to an increase in the volume of water in the post-development condition, the goal is to match as closely as possible to protect streams from increased flow, erosion and flooding.

If the development proponent proposes post-development peak flows which exceed pre-development peak flows, then the proponent will be responsible for conducting all necessary hydrologic and hydraulic studies to prove that the post peak flows can be released from the site without any adverse upstream or downstream impacts on flood risk or watercourse erosion. These studies must show this to the satisfaction of regulatory authorities including the local municipality and the CRCA. Prior to making any such submission, the proponent should consult with the CRCA to determine the specific technical analyses that will be required to support higher site release flows.

1.2 Quality

Quality controls should be provided as per the SWMPDM Table 3.2 (MOE, 2003), usually to normal protection standards. Some receiving waterbodies that are coldwater streams or lakes, wetlands, the Bay of Quinte, or other environmentally-sensitive waterbodies will require more stringent protection. Consult with the CRCA for the level of protection necessary for the receiving waterbody

Further, storage should be designed to provide 24 hours of detention, and provide a sediment forebay to collect sediment.

1.3 Other

The CRCA encourages master drainage planning for all *development* areas. However, it should be noted that these plans need to be reviewed and updated to reflect current standards on a regular basis. A master drainage plan is considered to be in need of updating five (5) years after its creation.

All stormwater management plans should be consistent with existing Watershed Plans, Subwatershed Plans or Master Drainage Plans. The development proponent is responsible for checking with the local municpality and with the CRCA to determine if any such plans exist. If so, then the development proponent is required to demonstrate that the proposed development's drainage system is consistent with those plans.

Treatment options should be considered, in order of preference, by lot-level and conveyance control, site control, and end-of-pipe treatment.

Best management practices (BMPs) are a stand alone stormwater management option for small sites, and are encouraged for all sites. Some BMP options include:

- grassed swales;
- vegetative buffer strips;
- infiltration pits/trenches/basins;
- sand filters; and
- pervious pipe systems.

Supporting sizing calculations are to be included in the design reports where these or other types of controls are proposed.

New developments should be designed to incorporate all reasonable and practical means of minimizing direct surface runoff, including:

- Minimizing the amount of impervious area
- Maximizing the amount of existing vegetated area (treed areas, grassed areas) that is retained within the development design, to help maximize opportunity for infiltration of surface water
- Roof drainage should be diverted on vegetated areas to give the water opportunity to soak into the ground.

The CRCA encourages, and is open to, new and innovative ideas where they are shown to be reasonable, effective and environmentally sound.

2.0 REPORT CONTENT

The CRCA reviews stormwater management reports with respect to the regulations identified above. The following requirements have been identified for SWM reports. Reports which do not meet the basic CRCA requirements for breadth of content may not be reviewed until modifications have been made to fulfill these requirements. All reports should be typed, clearly legible, use SI (metric) measurements, and include applicable, legible maps and plans with sufficient, identified scales appropriate for review.
Stormwater management reports shall include the following:

Title Page

- *Development* name and name of proponent
- Date of issue and revision number
- Consultant contact information

Introduction

- *Development* location (with key map), municipality (existing and geographic), Lot, Concession, civic address
- Size of property (ha)
- Size of *development* (ha)
- Type of *development*
- Existence, date of creation, and phase of development in a Master Drainage Plan, where applicable
- Proposed *development* phasing, and its impact on the system as a whole

Background

- Site history
- Information on existing *development*/land use
- Plan layout of existing, and proposed site
- Areal extent and description of all types of pervious and impervious surfaces present including:
  - Buildings,
  - Asphalt,
  - Gravel,
  - Landscapes including lawn, long grass, trees, etc
  - Ponds,
  - Waterways
- Runoff coefficients (Average or weighted are acceptable for large residential sites)
- Site constraints
- Receiving waterbodies: identification, location relative to the site, existing condition/issues
- Any geotechnical properties of the local soil including permeability, depth to bedrock, water table levels

Analyses

Quantity Control Analyses

- Quantity control provided for the minor through regulatory (2 year through 100 year) return periods.
- Hydrologic/hydraulic matches assessed so that post-*development* runoff equals *pre-development* runoff.
- Appropriate calculations and tables. These should be sufficient for CRCA review and should conform to the guidelines outlined by the municipality.
- Equations, assumptions and units used.
- For stormwater management reports that are prepared in support of the redevelopment of a site, an assessment of runoff for the state of the land prior to any *development*, and also for the state of the land with existing *development*.
- The method of control (e.g., BMPs, dry pond, wet pond, wetland, infiltration, enhanced catch basin)

- Calculations to support open channel, flow control, and major flow path designs.
- Examination of the impact of the control method on groundwater recharge

Quality Control Analyses
- Quality control for the 25 mm storm held for 24 hours, with Normal Protection (MOE 2003) generally required. Some locations on coldwater streams or lakes, wetlands, waterbodies draining toward the Bay of Quinte, or other environmentally-sensitive waterbodies will require more stringent protection. Consult with the CRCA for the level of protection necessary for the receiving waterbody
- Appropriate storm, runoff coefficients, assumptions and equations that conform to the guidelines outlined by the CRCA and the municipality.
- An examination of more than one storm distribution including a worst-case scenario
- Sample calculations for each equation used
- All variables, constants, units and equations.
- The method of control

Controls

- Stage-storage-discharge table
- Detailed drawings, plan view, elevation view, cross-section through outlet structure
- Minimum freeboard of 0.3 m at regulatory event must be used.
- Outlet(s) location are to be shown
- Emergency overflow outlet to convey major event flow if normal outlet becomes blocked
- Sediment forebay(s)
- Planting plan--native, non-cultivar species appropriate for frequency of inundation are to be used whenever possible
- Safety concerns
- Extent of parking lot and roadway storage at 5 year and regulatory (100 year) return period events
- Snow storage location
- Maintenance access
- Maintenance and operations plan - inspection and cleanout frequency
- Method of conveyance/outlet between site controls and receiving waterbodies to demonstrate that sufficient capacity exists
- Conveyance details: longitudinal slope, cross-section, subsurface drainage, rock check dams, etc.

Erosion and Sediment Control Measures

- Temporary and permanent measures:
  - prior to site construction (grubbing, pre-grading),
  - during construction, and
  - post-construction
- Location plan drawing
- Appropriate Ontario Provincial Specification Drawings (OPSD) included in drawing set
- Monitoring plan addressing monitoring provisions and frequency of monitoring of erosion and sediment control measures

Recommendations and Conclusions

- Recommendations with descriptions, based on the analyses performed
- Long term maintenance and monitoring plan addressing monitoring provisions and frequency of stormwater controls
- Recommended notices to purchasers, or on title, regarding special setback or building freeboard provisions
- Signature
- Professional Engineer's Seal

Appendices

- Computer model input and output files
- Additional drawings
- Full calculation sheets
- Agencies consulted

3.0 DESIGN PARAMETERS

3.1 Applicable Storms

An applicable storm for the Cataraqui Region should be used for modeling purposes. As noted above, the examination of multiple storm distributions and durations should be conducted by consultants, and the most appropriate should be selected. Environment Canada has kept records and completed statistical analyses on historical rainfall events. The text Hydrology of Floods in Canada (Watt, 1989) recommends the Atmospheric Environment Service (AES) or Hydrotek storm distributions for use in Canada. The Chicago distribution is much less suitable. However, care should be taken to ensure that the best design storm is chosen and used properly within the range of its applicability (Marsalek and Watt, 1984).

The storm duration should be greater than the time of concentration of the site, and a variety of durations should be examined to determine the worst case scenario. Time of concentration should be calculated for each site, using the appropriate method.

For urban design, typically the rain event will result in the largest flows, but larger watersheds, and rural watersheds, may experience higher flows due to a combination rain/snowmelt event.

Plans shall be based on climate data from Atmospheric Environment Service (AES) stations that are representative of the subject area or site.

3.2 Ponds

Stormwater management ponds are recommended for quality and quantity control on all new development, with the acknowledgment that some smaller sites and infill sites will be too small to accommodate a pond and will require alternative stormwater control, such as those discussed in Sections 3.3 to 3.6.

All stormwater management ponds are required to provide both quality and quantity control. However, in some cases the removal of the requirement for a quantity control pond may be considered, for instance if a site has direct drainage to Lake Ontario or the St. Lawrence River. Consideration for removal of the quantity control aspect is due to the size of the receiving water

body, and the minimal effect an increase in volume will have on the flood hazard in that water body. It should be noted that even though a site may ultimately drain to a large body of water such as Lake Ontario or the St. Lawrence River, the conveyance path from the site to the water body must be considered from a flood hazard perspective, and the removal of the quantity control pond requirement may not be an option. In all cases, quality control will be required. Calculation of this quantity of initial storm runoff should be discussed with the CRCA Watershed Engineer.

The following list contains a number of other considerations for pond design.

- Quality ponds should be designed to include a sediment forebay and a permanent pool or wetland component. These will serve to increase pollutant removal efficiency.
- All quality control ponds should have sediment forebays (settling basins) located at each inlet into the pond. These should be designed as per the SWMPDM.
- Quantity ponds can take the form of dry extended detention basins, wet ponds, wetlands, etc.
- All pond inlet and outlet orifices should be a minimum diameter of 75 mm (3 in.) To minimize the potential for plugging with sediment and/or debris.
- The bottom of the pond is to be lined with a 0.5 meter clay liner in areas with a high groundwater table, permeable soils or bedrock and/or where infiltration of groundwater is undesirable.
- Upstream drainage not affected by the *development* should bypass any ponds in order to provide maximum pond efficiency, unless the pond is intended to provide control for that upstream area.
- On-line ponds are discouraged, and generally will not be approved due to impacts on fish/wildlife habitat and water temperature.
- Ponds and larger conveyances should have a minimum freeboard of 0.3 m during major events.
- Pond embankments should have a minimum slope of 5:1.
- Ponds should preferably be designed to include plantings of native species of Eastern Ontario stock, especially where adjacent to a receiving waterbody or other natural area.
- Species and proposed planting locations should be considered with respect to moisture tolerance, frequency and duration of inundation.
- Ponds should be an amenity that are integrated into public *open space*; however, designers should also consider the safety aspects of these locations.
- Ponds should be constructed during the first phase of a *development*, and should be ready to accept runoff prior to the issuance of any building permits.
- For areas where more than one phase of *development* has been proposed, the pond outlet should be designed such that it can be modified as the catchment area continues to be developed.
- Infiltration should be explored and used where appropriate, at all levels of control: lot-level, site, and end-of-pipe. Consideration of the potential for groundwater contamination will be required when infiltration is proposed.
- Stormwater Management reports should include maintenance plans, expected cleanout frequency, recommended inspection frequency, etc.

3.3 Other Types of Controls

Stormwater management methods such as enhanced catch basins (oil/grit separators), underground tanks, etc., will only be considered where there is not enough space to use other, more natural methods of management, for example in small redevelopment sites or infill projects, or where specific spill-control concerns are raised. New *development* should be designed around consideration of natural controls.

3.4 Swales

The Stormwater Pollution Prevention Handbook (2001) provides recommends for swales as follows:

- minimum 0.75 m flat bottom;
- maximum 0.15 m^3/s flow;
- maximum 0.5 m/s velocity;
- maximum 2 ha contributory drainage area;
- minimum 3(h):1(v) side slopes; and
- minimum 15 cm grass length.

The Ministry of Natural Resources Natural Hazards Guidelines (MNR, 2003) recommend a velocity-depth product of less than 0.4 m^2/s (velocity multiplied by water depth), with a maximum depth of 0.8 m, or a maximum velocity of 1.7 m/s; this has been deemed safe for people to traverse. In addition, a freeboard of 0.3 m between the top of bank and the regulatory water level is recommended.

3.5 Buffer Strips

Buffer strips are encouraged for water quality protection, as this has been found to remove a significant portion of suspended sediments and pollutants. Buffer strips are discussed in CRCA Planning Policy Appendix E. A riparian buffer minimum of 30 metres is recommended, with exceptions made for special circumstances. Steeper slopes, less porous soils, or other factors warrant an increase in buffer width. Wetlands are not considered buffers. The CRCA Riparian Buffer Guidelines recommend a buffer for protection not only of water quality, but of the general health of the stream, aquatic species and riparian zone.

3.6 Catch Basins

It is recommended that any catch basins being installed on a site be protected with sediment controls until the site has been stabilized. Examples include surrounding the catch basin with straw bales or placing geotextile underneath the catch basin grate, to keep sediment out of the storm sewer system and the receiving waterbody. Sediment should be removed, and properly disposed of, from around the catch basin once the site is stabilized, and then on a regular basis.

Where pipe/catch basin/parking lot storage is proposed, the maximum depth of ponding is to be less than 0.25 m to facilitate safe vehicular access.

Increases in catch basin sump depth is recommended to increase sediment capture in the storm sewer network.

3.7 Cleaning and Municipal/Client Assumption

Temporary construction sediment and erosion control measures should be installed prior to any site disturbance, checked on a daily basis, remain in good working order until the site is stabilized, and should be cleaned on a regular basis. Once the site has been stabilized and excess sediment removed, these temporary sediment and erosion controls should be removed.

All sediment deposition, catch basins, sediment forebays, sediment fences, etc., should be cleaned prior to the municipality assuming ownership (for public facilities), or prior to the owner paying the final installment to the contractor (for private facilities). All permanent sediment and erosion controls should be in good working order prior to assumption, or final payment.

The stormwater report should also include a section on maintenance, cleaning, and monitoring of the SWM facilities for the duration of their operation. This information will be included in the Site Plan or Subdivision Agreement, as applicable.

4.0 Approval Process

Application for approval of proposed drainage systemes for land developments must be made to the local municipality as part of the overall development approval process administered by the municipality.

The CRCA will review proposed development plans with respect to drainage and stormwater management requirements set out in these guidelines. Additional approvals may be required depending on the specific design and type of drainage system being proposed.

The development proponent is responsible for obtaining any and all necessary approvals related to stormwater management. These approvals will include but are not necessarily limited to: Ontario Ministry of Environment approval (Section 53 approval under Ontario Water Resources Act); Ontario Ministry of Natural Resources approval (Sections 14 and 16 under the Lakes and Rivers Improvement Act); and Fisheries and Oceans Canada approval (Section 35(1) under the Fisheries Act). The development proponent is responsible for determining approval requirements through discussion with the CRCA, the local minicipality and the Ontario Ministry of the Environment.

The development proponent is responsible for completing any necessary environmental assessment (EA) that may be required under the Ontario Environmental Assessment Act or the Canadian Environmental Assessment Act. The development proponent is responsbile for determining what EA requirements apply to the project.

Contact Information:

For more information, please contact the CRCA Watershed Engineer at (613) 546-4228, or via fax at (613) 547-6474.

References:

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Watt, W.E. (Ed.). 1989. *Hydrology of Floods in Canada*.