Appendix I: Guidelines for Stormwater Management

1 Introduction

This document is Appendix I to the Cataraqui Conservation Environmental Planning Policies (2015). It should be read in conjunction with the Cataraqui Conservation Environmental Planning Policies, as well as municipal stormwater guidelines where they have been prepared. These guidelines will be updated from time to time. Cataraqui Conservation staff encourage consultation early in the design process to determine specific requirements, coordinated through our Planning Office.

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 various legislation and policies, 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 upstream and 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 controls. Some municipalities in the Cataraqui region have stormwater management design standards that are also used to review development plans.

The following outlines the guidelines of the Cataraqui Region Conservation Authority for stormwater management in the region.

2 General Guidelines

The goals of stormwater management are:

1. to protect waterways from increasing/excess erosion, increasing flows and flooding, decreasing flows and drying up, water takings and diversions. This is implemented by attempting to mimic the pre-development condition hydrograph in the post-development condition hydrograph.

2. to maintain the water balance and groundwater recharge.

3. to maintain or improve water quality.

Cataraqui Conservation encourages master drainage planning for all development areas. Master drainage plans are prepared on a subwatershed basis and identify the approach to meet targets for the area, specify methods of stormwater control, and outline the general location and size of stormwater facilities.These plans should be structured so as to account for a variety of implementation scenarios, in terms of: the order and timing of development, the type and form of development, and land tenure. Master drainage plans need to be reviewed and updated to reflect current standards on a regular basis, at least once every five years.

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 municipality and with Cataraqui Conservation 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. If a master drainage plan has been prepared but is no longer considered valid, then the preferred approach is for the master drainage plan to be updated in light of the proposed development.

The size and complexity of a proposed development often decides the size and complexity of the stormwater report.

In general, Cataraqui Conservation will encourage the preparation of master drainage plans and other major stormwater management reports for plans of subdivision (e.g. neighbourhood scale development with multiple landowners) and in support of site plan control for large scale residential, commercial, industrial, or institutional developments.

Standard stormwater management reports will generally be recommended for plans of subdivision, and in support of site plan control for small or medium scale residential, commercial, industrial, or institutional developments.

At the discretion of Cataraqui Conservation staff, an abbreviated (brief) stormwater management report, may be allowed in certain circumstances.

2.1 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 appropriate for pond design. There are drainage area limitations for the rational method, but may be considered adequate in some situations (e.g. - very small sites).

A hydrologic/hydraulic model is the best way to compare undeveloped and developed site runoff characteristics. Pre-development and post-development hydrographs should also be examined in an attempt to provide a match. While exact 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, as well as decreasing flows to the point of drying up the stream.

If the development proponent proposes post-development peak flows which exceed predevelopment 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 planning and regulatory authorities including the local municipality and Cataraqui Conservation. Prior to making any such submission, the proponent should consult with the Cataraqui Conservation to determine the specific technical analyses that will be required to support higher site release flows.

2.2 Quality

In terms of quality control, capturing the more frequent, smaller events and the start of larger events (called the first flush) that typically wash contaminants off the hard surfaces, and holding them for a minimum of 24 hours, has been shown to reduce the volume of sediments and contaminants in the water.

Quality controls need to be based on watershed studies, master drainage plans, or master stormwater management plans, where they exist. Where such plans do not exist, Normal (level 2) protection, as defined by the Ontario Ministry of the Environment, will generally need to be achieved. Some receiving waterbodies that are coldwater streams or lakes, wetlands, the Bay of Quinte, or other environmentally-sensitive waterbodies will require enhanced protection. Consult with Cataraqui Conservation for the level of protection necessary for the receiving waterbody.

Further, quality storage should be designed to provide a minimum of 24 hours of detention for settling of particles, and provide a sediment forebay at the SWM inlet to collect additional sediment.

2.3 Treatment Options

Treatment options should be considered, in order of preference, by lot-level and conveyance control, and end-of-pipe treatment. Low Impact Development (LID) techniques should be considered where suitable conditions exist. Credit Valley Conservation (CVC) and the Toronto Region Conservation Authority (TRCA) have produced a very useful guideline for Low Impact Development Stormwater Design that is available on their websites (http://www.creditvalleyca.ca/ and http://trca.on.ca/).

Best management practices (BMPs) are a stand alone stormwater management option for small sites, and are encouraged for all sites. Some BMPs, which are typical low impact development (LID) techniques, include:

- Reduce lot grading
- Grassed swales
- Vegetative buffer strips
- Infiltration pits/trenches/basins
- Sand filters
- Previous 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
- Diverting roof drainage to vegetated areas to give the water opportunity to soak into the ground

Cataraqui Conservation encourages, and is open to, new and innovative ideas where they are shown (through scientific research and monitoring) to be reasonable, effective and environmentally sound for the Cataraqui Conservation area.

3 Report Content

Cataraqui Conservation reviews stormwater management reports with respect to the legislation and policies identified above. Reports which do not meet the basic Cataraqui Conservation 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 effectiveness of the stormwater 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
- 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, etc.

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 peak flows equal predevelopment peak flows, and in addition that the post-development hydrograph matches the pre-development hydrograph.

- Appropriate calculations and tables. These should be sufficient for Cataraqui Conservation review and should conform to the guidelines outlined by the municipality.
- Appropriate storm, runoff coefficients, assumptions and equations that conform to the guidelines outlined by Cataraqui Conservation and the municipality. Intensity Duration Frequency (IDF) curves are available for Kingston and Brockville and should be used.
- An examination of more than one storm distribution (and duration) including a worst-case scenario. The Chicago storm distribution was designed for extreme rainfall in Chicago and surrounding areas of Illinois, it is not appropriate for eastern Ontario. It overestimates peak flows, and thereby does not properly match the pre and post hydrographs, and may result in oversizing of ponds, and oversizing of pond outlet structures. Instead, a storm distribution created from specific Canadian data is more appropriate, such as an AES (Atmospheric Environment Service) or Hydrotek storm distribution.
- The runoff coefficient (C) and time of concentration (t_c) values used in the calculations shall be appropriate for the existing site (or Ontario) and the proposed *development.*
- 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 (predevelopment condition), 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) is 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 Cataraqui Conservation for the level of protection necessary for the receiving waterbody.
- Sample calculations for each equation used.
- Naming of all variables, constants, units and equations.
- The method of control.
- Properly designed sediment forebay to capture sediment at the inlet to the SWM facility.

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 (or larger than major event is received).
- Sediment forebay(s).
- Planting plan: native, non-cultivar species appropriate for frequency of inundation are to be used whenever possible. The use of *persuasive planting* (e.g. rose bushes, hawthorns) shall be preferred over perimeter fencing, especially where the facility has been designed with safety features (i.e. a shallow permanent pool, benching, gentle sideslopes, etc.).
- Safety concerns.
- Extent of parking lot and roadway storage at 5 year and regulatory (100 year) return period events - maximum depth should be 0.25 m.
- Snow storage location(s) for all parking facilities and private (internal) roads. Snow storage areas must be located as far as possible from the intended stormwater outlet and/or an adjacent *waterbody* and/or an identified *groundwater* recharge or discharge area***,*** and be designed so as not to impair the function of stormwater management facilities.
- Maintenance access
- Maintenance and operations plan - including 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
    - 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.
- Removal plan for accumulated sediments.

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

4 Design Parameters

4.1 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. A time of concentration method based on Canadian, or better Ontario, data is the most appropriate option.

For urban design, typically a 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.

4.2 Ponds

Stormwater management ponds are recommended for quality and quantity control on all new development. Planned development should make adequate accommodation for stormwater management facilities. Some sites (e.g. redevelopments and, potentially, infill sites) may be too small to accommodate a pond and will require alternative stormwater control, such as those discussed in Sections 4.3 and 4.6.

All stormwater management ponds are generally required to provide both quality and quantity control. In rare 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 Cataraqui Conservation staff.

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

- Quality ponds should be designed to include a sediment forebay (settling basins) located at each inlet into the pond, and a permanent pool or wetland component. These will serve to increase pollutant removal efficiency. The ponds 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 m 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.
- Ponds and larger conveyances should have a minimum freeboard of 0.3 m during major events.
- Pond embankments should have a maximum 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 amenities that are integrated into public *open space*; however, designers should also consider the safety aspects of these locations.
- Ponds should be fully constructed and ready to accept water **prior** to development.
- 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, conveyance, 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.

4.3 Swales

We recommend that swales be designed as per the Stormwater Pollution Prevention Handbook (MOE, 2001):

- 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 (i.e., unmown vegetation).

The Ministry of Natural Resources Natural Hazards Technical Guides (MNR, 2001, 2002a and 2002b) 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.

4.4 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. Additional information on buffer strips is provided in Appendix ‘F’ to the Cataraqui Conservation Environmental Planning Policies. A riparian buffer minimum of 30 m 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 Cataraqui Conservation 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.

4.5 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 no more than 0.25 m to facilitate safe vehicular access in parking lots.

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

Regular sediment removal from catch basins is very important to the overall water quality protection aspect of this type of SWM control.

4.6 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, in small redevelopment sites or infill projects, or where specific spill-control concerns are raised. Where these facilities are proposed, they should be designed as part of a treatment train approach including lot-level BMPs and conveyance controls.

Enhanced catch basins may be supported for spill control and as the primary method of quality treatment on small urban sites (i.e., generally less than 1.0 ha) such as refuelling stations, especially as part of infill *development* or the redevelopment of a site. On other sites, enhanced catch basins are generally not supported since new planned developments should make adequate accommodation for more natural forms of stormwater management (e.g., lot level, conveyance, and end-of-pipe facilities).

Cataraqui Conservation may support the use of underground storage tanks for quality control if used in conjunction with other proven measures to provide the necessary level of quality protection or where oversight would be provided by the Ministry of the Environment.

4.7 Cleaning, Maintenance and Monitoring

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 include a section on maintenance, cleaning, and monitoring of the SWM facilities for the duration of their operation. It should specify when maintenance is required (e.g. forecast when a SWM pond would be x% full). This information will be included in the Site Plan or Subdivision Agreement, as applicable.

5 Approval Process

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

Cataraqui Conservation will review proposed development plans with respect to drainage and stormwater management requirements set out in these guidelines. Cataraqui Conservation will assess a cost-recovery fee for its review of a stormwater report, based on the approved Plan Review Service Fee Schedule, as amended from time to time. Straightforward reports will typically be reviewed at the staff level. However, depending on scope and complexity, reports may be subject to a peer review, at the expense of the proponent.

Additional approvals may be required depending on the specific design and type of drainage system being proposed, such as a permit under Ontario Regulation 148/06: Development, Interference with Wetlands, and Alterations to Shorelines and Watercourses.

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 Cataraqui Conservation, the local municipality 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 responsible for determining what EA requirements apply to the project.

References

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For More Information

Please contact Cataraqui Conservation at 613-546-4228, info@crca.ca or visit our website at www.cataraquiconservation.ca.