Storm Water and Rain Water Design Guidelines

The following guidelines are provided to supplement the information contained in the Municipality's Engineering Standards. They are focused primarily on residential developments, but the objectives are also applicable to commercial, industrial and institutional projects. The intention is to ensure that drainage systems are designed to handle significant storm events in accordance with conventional storm water management principles, while also implementing alternative rain water management approaches to deal with the smaller, more frequent rainfall events in an environmentally responsible way. These guidelines are meant to be a working document. As the area of storm water and rain water management continues to evolve, we look forward to your input and suggestions.

Storm Water Management – Design Guidelines

Objectives

- Primary purpose is to limit damage to the community and the environment from significant storm events.
- Focus is on larger storm events ie. 2 yr, 5 yr, 10 yr, 25 yr, 200 yr. Smaller rainfall events are to be handled by Rain Water Management (Source Control) measures.
- Need to ensure that flows from storm events can be handled onsite and offsite by municipal infrastructure and natural systems so as to limit impacts to the community and the environment.
- For typical residential development, water quality objectives are to be met through Rain Water Management measures. For commercial, industrial, institutional and high density residential development, additional water quality treatment measures may be required.

Design Criteria

- Limit post-development peak flow rate to pre-development peak flow rate for the 5 yr event, unless downstream conditions require additional flow control.
- Design detention ponds for the 5 yr event, unless downstream conditions require additional flow control. Provide overflow capacity for the 200 yr event. Refer to MOE/DFO Land Development Guidelines, Section 4, for pond construction details.
- Review downstream capacity and flood risk for 10, 25 and 200 yr events. If necessary, upgrade downstream works and/or provide additional detention and flow control.
- Include drainage from upstream tributary areas, assuming full development as indicated by the OCP, unless otherwise directed.
- Design minor drainage system (pipes, swales, ditches) for 10 yr event peak flows. For pipes 600mm and larger, design for 25 yr event.
- Design major drainage system (overland flow routes) for 200 yr event.

- Size culverts for 10 yr event with HW/D=1.0 (no surcharge), and 200 yr event with maximum surcharge of HW/D = 2.0 (surcharge of one pipe diameter) if site conditions permit; otherwise size for 200 yr event with HW/D=1.0.
- Use the Rational Method to calculate peak flows to size pipes and culverts for basic conveyance systems for drainage areas 20 ha. or less. Refer to DNC Engineering Standards for details. For larger drainage areas use Hydrograph methods.
- Rainfall Intensity Formula Based On Std Dwg D12:
  I =104.0*(Tc^-0.45)*RPIF (only used to develop ORIGINAL IDF curves)
  Rainfall Intensity Formula + 20% for climate change:
  I =124.8*(Tc^-0.45)*RPIF (use for calculating rainfall intensities for design and analyses)
  Where: I = Intensity in mm/hr
  Tc = Time of concentration in minutes
  RPIF = Return Period Intensity Factor below

Return Period (years)	2	5	10	25	50	100	200
Intensity Factor	0.6	0.8	1.0	1.2	1.3	1.4	1.6

- On residential sites where Rain Water Management/Source Control measures have been implemented as outlined below, the Rational Method runoff coefficient "C" may be adjusted as follows:

Land Use (Assumes composite "C" for site)	"C" without Source Control	"C" with Source Control
Residential (>700m^2)	0.5	0.45
Small Lot Residential (<700m^2)	0.6	0.55
Multi-family Residential	0.7	0.65

- On sites with extensive impervious areas (i.e. commercial sites) where Source Control measures are implemented, the minimum enter time, Te, may be increased from 10 minutes to 15 minutes when calculating the time of concentration for areas tributary to the Source Controls.
- Use Hydrograph methods to:
  - analyze large or complex drainage areas.
  - calculate pre and post development flows to size detention facilities.
  - assess downstream capacity and flood risk for various storm events.
  - Refer to MMCD Design Guideline Manual for additional information.
- Provide site specific Storm Water Management Plan in accordance with MMCD Design Guideline Manual, Section 4.3, as directed.
- For commercial, industrial, institutional and high density residential development, design water quality treatment works to meet the following:
  - treat 90% of the annual runoff volume of the catchment area.
  - meet removal targets of 80% TSS and 95% oil.

Rain Water Management – Design Guidelines

Objectives

- Primary purpose is to limit adverse impacts to the environment when land is developed.
- Deals with both water quantity and water quality.
- Focus is on smaller, frequent rainfall events, ie. smaller than 2 yr events.
- Post-development hydrology to mimic pre-development hydrology using small scale, onsite, non-pipe, "low impact" approaches.
- Often called "Source Control", two specific techniques outlined below are infiltration chambers and rain gardens. Other techniques that will be considered on a case by case basis include swales, permeable pavement, absorbent landscaping, increased topsoil and other "low impact", Water Balance Model type approaches.

Design Criteria

- Source control works shall be designed to handle runoff from onsite impervious surfaces, ie. typically roofs, driveways and parking areas. The primary goal is to make use of onsite infiltration to reduce runoff from the site. The secondary goal is to provide detention so as to allow runoff that is not handled by infiltration to be discharged to the storm drainage system at a rate similar to pre-development conditions.

- Source control works shall be installed on all sites regardless of soil conditions, unless otherwise approved. It is recognized that where sites have soils that drain poorly, the effectiveness of infiltration systems will be limited, particularly during winter months. This is acceptable because it mimics the pre-development conditions of sites with soils that drain poorly.

- Design of source control works shall be based on 50% of the Mean Annual Rainfall (MAR) 24 hour event. For the Municipality of North Cowichan, an MAR of 48mm shall be assumed, resulting in a 24 hour design rainfall of 24mm, or an average rate of 1.0mm/hr. The intention is that the source control works shall be designed to handle this rainfall amount through a combination of infiltration and detention over a 48hour period.

- Source control works shall include a detention component sized to provide a minimum storage volume based on 25% of the MAR, or 12mm, over the impermeable areas, assuming no infiltration or outflow. This equates to a storage volume of $1.2m^3$ for every $100m^2$ of impervious area. For a typical residential lot with $200m^2$ of impervious area, the works shall provide a minimum storage volume of $2.4m^3$.

- Unless otherwise approved, a flow controlled outlet shall be provided so that, if necessary, the above storage volume is drained to the piped drainage system over a 24 hour period after the rainfall event. This equates to an outflow rate of 0.50mm/hr X the impervious area, or a rate of 1.4 l/s/ha from the impervious areas. For a typical

residential lot with 200m^2 of impervious area, the discharge rate will be 100 l/hour or 0.028 l/s. Simple orifice type flow control is not recommended for such low flow rates as the orifice diameter would only be about 5mm, which would be susceptible to plugging. As an alternative, flow control may be achieved by using an infiltration layer above an under-drain.

- The requirement for a flow controlled outlet may be waived upon submission of evidence by a Geotechnical Engineer that subsurface soil infiltration rates are adequate to handle the full design flow of 24mm of rainfall from onsite impervious surfaces over a 48 hour period. The basis for this requirement is that during the first 24 hours, half of the rainfall is infiltrated and the other half stored, then during the second 24 hours, the stored rainfall is infiltrated. This equates to an infiltration rate of 0.50mm/hr X the impervious area. For a typical residential lot with 200m^2 of impervious area, 100 l/hr will need to be infiltrated into the soil. For a typical infiltration system with 10m^2 of area, an average infiltration rate of 10mm/hr will need to be sustained over a 48 hour period.

- The above measures should result in a theoretical combined discharge of 1.0 l/s/ha from the permeable and impermeable areas of a typical 600m^2 lot for a 50% MAR event

- Infiltration chambers shall typically occupy an area equal to about 5% of the site impervious area. For a residential lot with 200m^2 of impervious area, the infiltration chamber works will occupy an area of about 10m^2 or 3.0mx3.0m.

- Rain gardens shall typically occupy a minimum area equal to about 10% of the site impervious area. For a residential lot with 200m^2 of impervious area, the rain garden will occupy an area of about 20m^2. To meet the storage requirement outlined above, a ponding depth of 150mm will be typical.

- Alternate designs meeting the requirements outlined above will be considered on a case by case basis.

- Other Considerations:

    - Subsurface infiltration systems are preferred by the Municipality for single family residential lots, as they have lower maintenance requirements and a smaller footprint than surface systems such as rain gardens.

    - Where soil conditions are poor for subsurface infiltration, rain gardens are a good alternative, as their larger area supports lower infiltration rates, and shallow depth is suited to areas with a high water table. The ability to combine rain gardens with site landscaping makes them well suited to many multifamily and commercial sites.