UNIVERSITY ENDOWMENT LANDS
Stormwater Management Policy

Purpose:
This policy describes the required performance criteria and design procedure for on-site stormwater management, as originally defined in the Works and Services Bylaw and mirroring similar requirements in the City of Vancouver.

Stormwater Management Requirements: On-Site Stormwater Management
On-site measures include stormwater management systems that serve the individual development site. These stormwater management systems will be designed by the developer to meet the UEL's development requirements. Their purpose is to manage rainwater runoff from the developed site to resemble runoff from the same site when it was in its pre-developed, natural state, thereby contributing to the protection of the health of salmon-bearing creeks downstream.

Each development is to implement and maintain an on-site storm water management system that captures and infiltrates (or re-uses) the runoff from 24 mm/day rainfall and provide safe conveyance to the UEL's infrastructure when the rainfall event exceeds the 24 mm/day threshold. The performance criteria are based on the extent of impervious surfaces on the development site and may be satisfied by installing absorbent landscaping, green roofs, permeable pavers, a detention and infiltration system, or other applicable strategies.

Required Elements
1. The design of on-site detention and infiltration facilities shall be based on the size of the Effective Impervious Areas (EIA) of the development site (lot). EIAs are defined as fully impervious areas with direct hydraulic connection to the storm drainage system of the site. Fully impervious areas include building roofs and impermeable pavements. Fully pervious areas must have at least 1 metre of permeable soil below. Partially pervious areas are those with permeability but with less than 1 metre of soil.
2. Design and construct a stormwater storage system for a minimum of 24 m3 of storage per 1000 square meters of impervious area.
3. Design and construct the storage facility to include an infiltration facility that would release a minimum of 2.4 L/s/ha of EIA to the natural soil except in Area B where there are slope stability concerns. In Area B a geotechnical assessment must be completed to determine if and how much infiltration is allowed. For some properties, detention may be the only measure allowed.
4. The rate of discharge is controlled at the outlet of the storage tank into the infiltration facility. The control device must be a "passive" control, where the rate of release could not be adjusted by the operators.
5. Design and construct an overflow system to convey stormwater originating on the site to the UEL storm drainage system from rainfall events exceeding capacity of the on-site detention and infiltration system.
6. Provide a stormwater management facility maintenance manual to be implemented on-

going by property owners.

Required Practices for the Design of Infiltration Facilities.

- To facilitate the dispersal of the infiltrated stormwater, the infiltration facilities should be located on the lowest section of the property, downstream from the building drain tile.
- The infiltration facilities should be installed at an elevation below the building's perimeter drain. If the infiltration facility is located above the perimeter drain, an impermeable layer needs to be placed between the infiltration facility and the perimeter drain to prevent short-circuiting the infiltrated water into the storm drain.
- Infiltration facilities (surface and sub-surface) are to be placed over a minimum of 1-meter-deep permeable soil layer with a minimum of 12 mm/hr infiltration capacity to maximize infiltration.
- The infiltration facilities should utilize multiple measures of stormwater control systems, including, but not limited to, green roofs, bioswales, deep soil planters, infiltration trenches, etc.
- Compaction and sedimentation of infiltration areas must be avoided. Sediment ponds and infiltration basins should never be combined in the same facility.

Encouraged Practices for Design of Storm Water Facilities

The design of the on-site stormwater detention and infiltration facilities is based on the Effective Impervious Area (EIA) draining to the facilities. The EIA of the site may be reduced by applying permeable surface cover, such as absorbent landscape soil over impervious surfaces, or by ensuring that there is 1 metre of permeable material under landscaped areas.

The effectiveness of these practices is dependent on the porosity, infiltration capacity, and depth of the soil layer, as well as the physical properties of the underlying subsoil. Together, these factors combine to create a permeable credit, which is used to calculate the sites detention and infiltration requirements. Ten percent permeable credit may be obtained for each 100 mm depth of soil with a minimum of 12 mm/hr infiltration capacity placed over bedrock or other impervious surfaces.

Examples:

- An extensive green roof with 100 mm absorbent soil layer would receive 10% permeable credit for an EIA=90% design value.
- An intensive green roof with 300 mm absorbent soil layer would receive 30% permeable credit for an EIA=70% design value.
- A landscape area with 300mm absorbent soil over a minimum of 700 mm subsoil with a minimum of 12 mm/hr infiltration capacity would receive 100% permeable credit for an EIA=0% design value.
- Further permeable credit may be received by discharging stormwater runoff from impervious surfaces onto permeable areas. Permeable areas may receive stormwater runoff from impervious areas of equal size. Impervious areas that discharge to fully permeable areas of at least equal size will receive fifty percent permeable credit for an EIA=50% design value.
- Impervious areas which discharge to less than fully permeable areas of at least equal size will receive a credit equal to fifty percent of the permeable credit of the receiving permeable

area. For example, an impervious roof with a roof leader to a landscaped area of equal area with 300mm absorbent soil with a minimum of 12 mm/ hr infiltration capacity would receive a credit equal to 50% x 30% = EIA = 15%.

- Impervious areas that are directly connected to the storm drainage system will receive no permeable credit, EIA=100%

Effective Impervious Area Calculation Examples

Mixed Use/Multi-residential Example

The following example demonstrates the processes of reducing the EIA on the development site by applying various alternative surface treatments for stormwater management benefits. We have assumed the infiltration facility has percolation rates of 25 mm/hr.

EFFECTIVE IMPERVIOUS AREA CALCULATIONS MULTI-FAMILY EXAMPLE

Surface Type	**Area (m^2)**	**Impervious (%)**	**EIA (m^2)**
Impervious Areas			
Directly connected to storm drains (impermeable roof)	2,406	100	2,406
Pervious Areas			
Walkway pavers – draining to 300 mm absorbent landscape	229	70	160
450 mm absorbent soil area	885	55	487
Areas with 300 mm absorbent soil over 700 mm subsoil	380	0	0
Total	**3,900**		**3,053**
DRAINAGE FACILITY SIZING			
Detention storage capacity required *(24m3* EIA/ 1000m2)*	24m3 * 3,053m2 /1000m2		73 m3
Minimum discharge rate to infiltration facility *(2.4 L/s/ha * EIA/10,000 m2/ha)*	2.4 L/s/ha * 3,053m2 /10,000 m2/ha		0.7 L/s
Required surface of infiltration facility *(storage required*1000 / (percolation rate in mm/hr*24 hr)*	(73m3 * 1000mm/m) / (25 mm/hr * 24 hr)		122 m2

Percolation tests are to be performed on each development parcel, at the proposed location and at the depth of the bottom of the infiltration facilities, to characterize the "hydraulic conductivity" of the soil. At the time of the test confirm that the depth of the permeable soil underneath the infiltration facility is at least one meter.

Residential Example

The following example demonstrates the processes of reducing the EIA on the residential (single family) development site by applying various alternative surface treatments for stormwater management benefits. We have assumed the infiltration facility has percolation rates of 20 mm/hr.

EFFECTIVE IMPERVIOUS AREA CALCULATION RESIDENTIAL EXAMPLE

Surface Type	**Area (m^2)**	**Impervious (%)**	**EIA (m^2)**
Impervious Areas			
Directly connected to storm drains (impermeable roof)	350	100	350
Hardscape area (asphalt) with lead directly into infiltration tank	150	100	150
Pervious Areas			
Permeable pavers – draining to 300 mm absorbent landscape	100	70	70
Impermeable hardscape sloping/ draining to equal or larger area of 100% permeable area	100	50	50
Landscape areas with 450 mm absorbent soil over 550 mm subsoil	600	0	0
Total	**1,300**		**620**
DRAINAGE FACILITY SIZING			
Detention storage capacity required *(24m3* EIA/ 1000m2)*	24m3 * 620m2/ 1000 m2		15 m3
Minimum discharge rate to infiltration facility *(2.4L/s/ha * EIA/10,000 m2/ha)*	2.4 L/s/ha * 620m2/ 10,000 m2/ha		0.15 L/s
Required surface of infiltration facility *(storage required*1000 / (percolation rate in mm/hr * 24 hr))*	(15m3 *1000mm/m) / (20 mm/hr * 24 hr)		31 m2

Appendix 1 illustrates the residential example calculations provided in the example above.

Advisements: This information is provided for clarification purposes only and is not in substitution of any applicable Bylaws or Provincial or Federal Codes or laws. In the case of any contradictions, legislative Codes, laws or Bylaws take precedence.

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Appendix 1: Residential SWMP example