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## HARD AND SOFT SOLUTIONS FOR STORMWATER MANAGEMENT

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**A short executive summary:** In light of the recent increase in superstorms causing severe flooding, municipalities, property owners and managers are becoming increasingly aware of the importance of designing sites to reduce the impact of storm events on property damage and municipal infrastructure. With current climate modelling predicting that the intensity and occurrence of superstorms is expected to increase, local governments are adopting more stringent stormwater capture and treatment targets. In less populated areas, stormwater capture is often achieved with stormwater managements ponds which occupy a relatively large area; however stormwater infrastructure in urban areas does not have the luxury of available space for retention ponds, so that unique and creative solutions are often required. Given the multiple stakeholders involved in urban land use projects, input from many professional disciplines is often required. The presentation will describe unique stormwater projects from the University of Ontario Institute of Technology and the Toronto Waterfront Redevelopment. For each project, we will present the innovative stormwater management techniques that were utilized, and discuss the intensive collaboration that was required on the multi-disciplinary design team.

### **Durham College / University of Ontario Institute of Technology (UOIT)**

In the mid-2000's UOIT was Ontario's newest University and the shared Durham College campus was experiencing considerable growth, with several new buildings, outdoor spaces and parking areas. Design solutions were a product of close coordination within the design team. The architect, landscape architect, and civil engineers were brought to the table early in the process and worked closely with the university.. Through the master planning process, large, technically simple and cost effective design solutions were identified that created a strong identity for the new campus and exceeded the local conservation authority's requirement for water quality treatment. The cost effective designs also considered building phasing which enabled development without significant 'throw-away' costs.

While the campus includes some student housing, most students, professors and support staff commute to campus by car, therefore parking needs are significant. The large footprint of parking areas allowed for some design creativity, whereby parking lots were graded toward curb inlets that directed water to vegetated swales. A dual system was implemented that consisted of a primary perforated pipe system that brought water to one of two storm ponds. A secondary system of raised manholes managed larger storm events that caused the swales to be inundated. The storm ponds included a forebay with a specially designed weir wall with scuppers. A reinforced turf access path leading to a maintenance deck allowed for maintenance access. Larger polishing ponds that received the forebay water were designed with naturalized edges and tree planting. Both the north and south ponds created signature waterscapes, and walking trails and bridges quickly followed to enhance the campus design.

On the west side of the central quad, which incorporated a grid of thermal boreholes to heat and cool adjacent buildings, a linear wetland was integrated with a covered promenade. Trench drains collected water from around the quad and directed flows to the linear wetland cells, which included plant material to treat water quality. This integrated design adjacent to the quad space, often used for graduation ceremonies, contributed to the iconic branding of the UOIT / Durham College campus.

### **Toronto Waterfront Redevelopment**

The City of Toronto (the City) released Wet Weather Flow Management Guidelines (WWFMG) in 2006 as a continuation of the Wet Weather Flow Management Policy that the City adopted in 2003. These guidelines provide general guidance for handling, storage and treatment of rainwater and establish principles and standards for runoff handling, with the long term goal of improving discharges to the lake and reducing beach closures.

The waterfront revitalization project involves 800 ha of former industrial lands, with the creation of 40,000 residential units over a period of 25 years and with \$30 billion in private and public investment. It is the largest urban renewal project in Canada and one of the largest waterfront projects in the world.

The City of Toronto WWFMG guidelines apply to new developments, and as such the development of the Toronto waterfront has resulted in innovative stormwater management solutions to manage the adverse effects of runoff and improve the ecosystem and the health of the watersheds. The guidelines also require that new developments capture up to the 2 year storm flow, which puts some of the onus on private developments to play an active role in stormwater management, and has resulted in innovative water re-use applications in this area.

West Don Lands: Prior to redevelopment, the West Don Lands topography was prone to flooding, due to its proximity to the Don River. To allow the development to proceed, the lands had to be protected from flooding by the Don River. A flood protection landform was constructed for this purpose. Construction of the landform blocked the land drainage that was previously directed to the river, requiring regrading of the site and a new outfall to the river at the Keating Channel. With the risk of flooding from the Don River mitigated with the landform, the next task was to capture and treat the stormwater that would be falling directly on the precinct, and any overland flow that would flow into it from neighbourhoods to the north. Rainfall event modelling indicated that a 2,000 m<sup>3</sup> tank, along with a conveyance system of tunnels, would be needed to achieve the WWFMG capture and treatment requirements. The design of the tank and tunnel system required intensive work with existing municipal and transportation infrastructure while providing opportunities for future developments. The challenges of implementing a functional solution to capturing and treating relatively large storm flows, with a firm construction end date, were daunting, but with exceptional teamwork on the part of all stakeholders, the end goal was achieved.

East Bayfront: The East Bayfront precinct is a 22 hectare development bordering Lake Ontario, in downtown Toronto, with both high density residential and commercial properties. It was initially proposed that it would have a dedicated stormwater treatment facility, however a feasibility study concluded that a centralized treatment facility located in the West Don Lands would be preferable. With treatment being located in the West Don Lands, the East Bayfront infrastructure required for stormwater capture and conveyance was somewhat simplified, yet still required an 1800 m<sup>3</sup> attenuation tank and a pumping station. The intensive public realm requirements such as soil cells for trees, unit pavers, granite curbs, street furniture, narrow road width and wider sidewalks, for this high-profile area were such that extensive collaboration was required between the landscape architects, engineers, and stakeholders to elegantly integrate the stormwater infrastructure into the surrounding environment. The bulk of the East Bayfront stormwater infrastructure is located below grade, adjacent to the award-winning Water's Edge Promenade.