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INFLUENTS

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STORMWATER AND SEWER SYSTEMS

PART 2: MANAGEMENT AND TREATMENT TECHNOLOGIES

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HIDING GIANT STORM TANKS IN BEAUTIFUL URBAN SPACES

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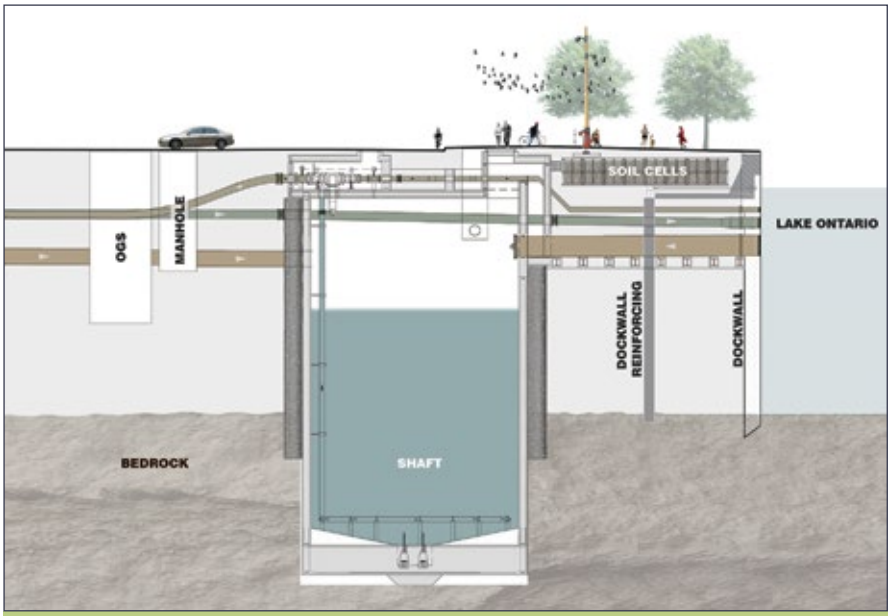
Stormwater management is a concern across all disciplines working within a municipal right-of-way. Stormwater challenges in East Bayfront, Toronto's newest waterfront community with a mandate for high quality public realm design, include flat topography, poor quality soil, aging infrastructure that includes combined sewer overflows (CSO's) and limited routing options. Lake Ontario is also a limiting factor as it is at the lowest point of the stormwater collection system and will ultimately receive the treated water.

With the recent development of the East Bayfront, Toronto Water and Waterfront Toronto were given an opportunity to showcase innovative stormwater techniques encompassed in a new significant precinct. With diminishing industrial uses along the waterfront and Port Lands, Toronto's waterfront has become a gem with prime development opportunities. Progressive urban design and transit planning has positioned this new community to become efficiently connected to Toronto's core. As a result, land values have been raised and development interest is strong.

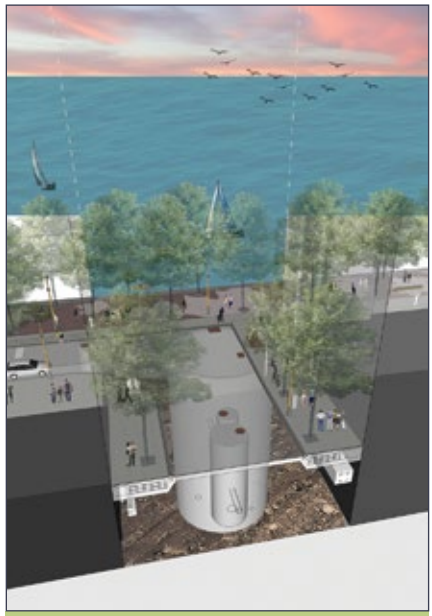
Charged with the strategic development of this land, Waterfront Toronto, a public organization with a mandate to revitalize Toronto's waterfront, has seized the opportunity to heighten interest in the precinct and anchor new community development through high quality parks and urban spaces. New public amenities in the East Bayfront neighbourhood include the Water's Edge Promenade, Sugar Beach and Sherbourne Common. These landmark destinations have a combination of both passive and active uses, as well as the flexibility for future phases that will build on Toronto's legacy of providing waterside public parks.

Both the municipal right-of-ways and parks in the East Bayfront utilize passive onsite source controls for stormwater management. Collecting stormwater in ponds is a management technique not appropriate for a dense urban setting. Waterfront Toronto and Toronto Water are able to treat a larger quantity of stormwater to achieve 'enhanced protection' as recommended in the current MOE SWM Planning and Design Manual through the use of a new Stormwater Facility and attenuating stormwater shaft, allowing the larger precinct to benefit from an economy of scale.

The City of Toronto's Wet Weather Flow Management Guidelines introduced stormwater quality targets for the capture and treatment of storm flows up to the two-year storm. Using rainfall data from 1991, supplied by the City of Toronto, as a basis for design, the East Bayfront stormwater system was



Illustrated section of the stormwater attenuation shaft, dockwall and adjacent infrastructure.



Illustrated perspective of the stormwater facility.

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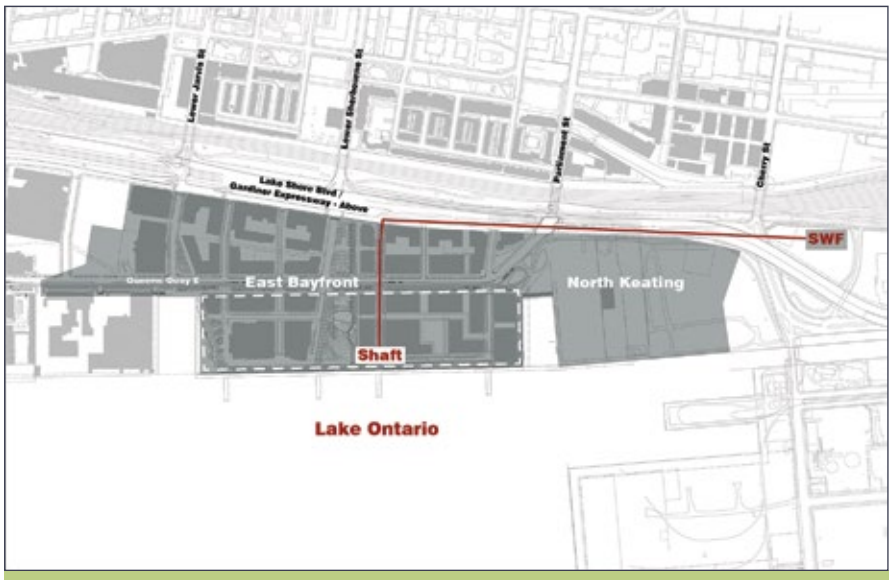

Context map of the East Bayfront precinct and stormwater facility.

Stormwater attenuation shaft under construction(August 2014).

designed to include a stormwater attenuation tank and a stormwater treatment facility at a centralized location.

The project traces the path of the stormwater, from precipitation through to the system outfall. The stormwater falls directly onto the East Bayfront precinct streets and development blocks. The blocks themselves are being developed with built-in storm mitigation measures primarily for attenuation, which means the stormwater eventually finds its way to the stormwater sewer network.

The storm sewer network feeds two large oil grit separators (OGS), which each discharge to a shaft storage tank ('the stormwater attenuation tank'), located within the municipal right-of-way. The purpose of this storage is to attenuate the storm flows and mitigate the size of the downstream treatment facilities. The tank is operated by emptying after each storm cycle, allowing for maximum storage.

Constructing the stormwater attenuation infrastructure within a dense urban environment is challenging. The stormwater attenuation tank – a vertical storage shaft – is located within the municipal right-of-way, avoiding the need to purchase land. The tank was constructed near an existing dock wall which made construction difficult. Another complexity, not often encountered in traditional wastewater treatment projects, was locating civil services and infrastructure within a matrix of soil cells, required for the promenade trees. It would have been easy to simply eliminate the soil cells in question, however the trees were a key component of the public realm design and to the success of this innovative precinct.

"THE PURPOSE OF THIS STORAGE IS TO ATTENUATE THE STORM FLOWS AND MITIGATE THE SIZE OF THE DOWNSTREAM TREATMENT FACILITIES."

The stormwater attenuation tank is a 12 m diameter, 25 m deep shaft, and is equipped with pumps to convey the stormwater to an above grade, centralized stormwater facility. This facility is designed to remove suspended solids, and is sized to accommodate stormwater flows from the West Don Lands and the North Keating portion of the Lower Don Lands. This centralized stormwater treatment facility will be equipped with gravity screens, ballasted flocculation tanks, and UV disinfection units, and following treatment the stormwater would flow by gravity to the outfall at the Keating Channel. Stormwater is also conveyed via a gravity forcemain to the Sherbourne Commons UV treatment facility.

The East Bayfront stormwater attenuation tank feeds the treatment facility via pumps located at the bottom of the storage tank. However, during a very large storm, a portion of the flow would bypass the treatment facility and overflow from the stormwater attenuation tank directly to Lake Ontario via an outfall.

The City of Toronto's Wet Weather Flow Management Guidelines require removal of 80% total suspended solids (TSS) on an annual basis. The storage capacity of the East Bayfront system is such that the Wet Weather Flow Management Guidelines would be met by removing 80% of TSS on an annual basis when taking into account the occasional bypass events. The design is based on 1991 annual rainfall data, provided by the City of Toronto.

Vertical walls of the stormwater attenuation shaft under construction (August 2014).

The hydraulic operation of the system was reviewed with Toronto Water's engineering staff to guarantee proper performance of the pumping system under all possible hydraulic conditions (e.g., different water levels) and fully mitigate harmful operating conditions, such as pump run-out or cavitation. The design team completed a surge analysis. Two surge relief combination air valves were provided to dampen these surges. The first and most critical valve is located near the pumps, while a second valve is located in a valve chamber on the forcemain, approximately 700 m north of the tank.

A duty and standby pumping system was proposed to ensure the system has redundancy in the event that the duty pump is out of service, thus reducing the amount of time upstream sewers are surcharged. The pump discharges each have a check valve and isolation manual valve, prior to combining into a single forcemain. As requested by Toronto Water, each pump is also equipped with a magnetic flowmeter and pressure indicating transmitter for remote pressure and flow monitoring and control. These devices are located in the tank but near ground level and above a service platform so that the operator can access and service this equipment without having to descend to the bottom of the tank. Flexible pipe couplings are provided between the flowmeters and valves for ease of equipment removal.

The tank is designed to be emptied with each pumping/storm cycle. Given that the stormwater has only received OGS treatment, settling of some lighter solids is expected. Therefore for ease of maintenance and operation, a flushing nozzle system was implemented. Flushing nozzles that are fed by the auxiliary forcemain, connected to the lake, open when the stormwater attenuation tank is nearly empty after a storm/pumping cycle. The flushing would resuspend any settled solids. The pumps would continue pumping to the stormwater facility and the solids would ultimately be removed by the treatment equipment. The clean water flushing would continue until the TSS, monitored at the inlet of the treatment facility, shows negligible TSS in the system,

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which would also ensure that the forcemain to the treatment facility has been cleared of excess suspended solids.

The electrical system is comprised of two separate components. A small control panel will be located in the public realm, adjacent to the shaft, and a larger remote control panel and MCC equipment will be located in the adjacent park facility in Sherbourne Common. These two systems allow for all of the required electrical power, quality monitoring, variable frequency drives, and harmonic filters, while drastically minimizing the impact on the public realm.

The design team had collaborated on significant infrastructure projects in the past. There was a mutual respect and trust that all disciplines could collaborate in a supportive environment to achieve the functionality of their design interests, while exploring other concepts to realize all team members' design needs.

The design team and Waterfront Toronto worked closely with Toronto Water over nine working meetings and several drawing reviews, from concept development to final approval. All of Toronto Water's concerns in regard to operation and performance of the system were addressed throughout the design process.

"THERE WAS A MUTUAL RESPECT AND TRUST THAT ALL DISCIPLINES COULD COLLABORATE IN A SUPPORTIVE ENVIRONMENT."

This cooperative environment translated into a strong relationship with both Waterfront Toronto and Toronto Water. The stormwater shaft design and approval was achieved through collaborative internal team meetings, web conference calls that included 3D models, hand sketches, and coordinated CAD drawings.

In summary, the evidence of this successful collaboration is demonstrated in the innovative stormwater treatment capabilities in the East Bayfront, facilitated by the large stormwater shaft within the right-of-way, with minimal and considered impacts on the public realm.

Stormwater attenuation shaft roof slab and access chambers under construction (October 2014).