Edwards Gardens Parking Lot Retrofit

CASE STUDY

Low Impact Development Series

Featured practices:

- Bioretention (aka biofilters)
- Infiltration trenches
- Permeable pavement
- Rainwater harvesting
- Green roof
- Swales
- Innovative stormwater management
- LEED® Silver rated building

Groups involved:

- Toronto Parks
- Schollen & Company Inc.
- Mopal Constructions
- Toronto Botanical Gardens
- R.V. Anderson Associates Limited
- Moon-Matz
- GeoTerre

Edwards Gardens is a botanical garden located at 777 Lawrence Avenue East in Toronto, Ontario. Owned by the City of Toronto it has the largest parking lot in Toronto's park system with a total area of 15,045 m^2. The parking lot provides access to Wilket Creek Park, as well as the Toronto Botanical Garden (TBG), which is one of the City's premier attractions. In Spring 2012 the parking lot was transformed into a green parking lot. This retrofit is designed to address stormwater management concerns and complement the TBGs existing LEED® Silver certified building. Prior to the retrofit, the parking lot was a major source of urban runoff to Wilket Creek during storm events, contributing to erosion, elevating flooding risk, and degrading downstream water quality and aquatic habitat. The Wilket Creek Valley has been subject to considerable erosion, resulting in adverse impacts to the valleyland ecosystem and damage to birdges, trails and park amenities. This is not the first stormwater management initiative constructed to provide runoff quantity and quality control in the area. In 1997 a swale and perforated pipe infiltration stormwater system was constructed north west of this site in Toronto's Bridle Path neighbourhood. Together these two practices - the perforated pipe infiltration system and the new green parking lot - will result in substantial reductions in total runoff and peak flow rates, removal of contaminants through infiltration and soil storage, and increased groundwater recharge.

The stormwater biofilters used on this site differ from the design of most bioretention areas in that they consist of stone inlets and clear stone trenches below the plantings.

STUDY SITE

The retrofit of the Edwards Gardens parking lot introduces several new technologies to add to the existing Low Impact Development (LID) practices onsite – an extensive green roof and a rainwater harvesting system. The 223 m^3 sloped green roof located atop the George and Kathy Dembroski Centre for Horticulture is planted with low growing sedums which require little maintenance or irrigation. It reduces stormwater runoff by retaining water and facilitating evapotranspiration and attenuates peak flows by absorbing water and releasing it slowly. A rainwater harvesting system installed in the same building collects and stores runoff from the roof and the courtyard, which is then used to irrigate the gardens on the property. The combination of the rainwater harvesting system and the site's low-flow plumbing fixtures and drip irrigation system result in an annual potable water consumption that is 21% less than the Ontario Building Code's water efficiency requirement.

Figure 1. Study site location

For the parking lot retrofit – which is the main subject of this case study – the design features bioretention areas with native plantings in the traffic islands and permeable pavement in the parking areas and pedestrian paths. This innovative project serves as a model of green parking lot design in accordance with the Toronto Green Standard, and demonstrates that stormwater management goals can be achieved without sacrificing functional or aesthetic value. Although the cost to resurface the existing parking lot would have been lower in the short term, it would not include any stormwater management control to improve conditions in Wilket Creek. Long term costs associated with ongoing repair of erosion and flood damages would likely exceed initial cost savings.

The retrofit was successful in meeting project objectives and has received positive feedback from all partners and the public. What was once a deteriorated parking lot has been revived to a beautiful space that complements the gardens and provides safe passenger drop offs, a bus lane and bike parking. The lessons learned from this project help to promote other green initiatives in the future by providing baseline pricing and cost estimates.

Project Objectives

- Transform a deteriorated parking lot into an updated sustainable design while maintaining the original parking capacity.
- Meet the TBG's sustainability objectives and complement programming offered by the organization.
- Significantly reduce the amount of stormwater run-off being released to the Wilket Creek subwatershed by implementing a suite of LID practices which promote attenuation and infiltration of surface runoff and amelioration of water quality.
- Enhance urban biodiversity and tree canopy through native tree, shrub and grass plantings.
- Upgrade pedestrian and cyclist infrastructure to provide an improved visitor experience and promote sustainable transportation.

PLANNING AND REGULATION

The City of Toronto and the landscape design consultant, Schollen and Company Inc., applied in March 2011 for a permit to reconstruct the parking lot. The planned work was scheduled to take place from September 2011 to May 2012. The proposal complied with Section 4.3, Infrastructure and Servicing, of Toronto and Region Conservation Authority's (TRCA) Valley and Stream Corridor Management Program and the permit was approved by TRCA in June 2011. Additional approvals were required for the planting plan, the removal of several existing trees, and the Toronto Ravine Protection By-law, which were all secured internally by the City of Toronto Parks, Forestry and Recreation Division. Toronto Water reviewed and approved the stormwater management design.

DESIGN

The retrofit was designed to capture stormwater runoff and convey it through stormwater biofilters (combined bioretention and infiltration trenches). Permeable pavers were also implemented to promote infiltration. These practices have been implemented to reduce the volume and improve the quality of runoff discharged to Wilket Creek. For specific information on individual LID practices please refer to the LID Planning and Design Guide (TRCA and CVC, 2010).

Figure 2. Bifilter design schematic (Image courtesy of Schollen and Company Inc.)

Swales

A swale lined with rip rap was constructed to convey flows from the parking lot to an existing stormwater outet that discharges to Wilket Creek.

Stormwater biofilters

Situated in traffic islands, a network of stormwater biofilters totaling 880 m^2 capture, infiltrate and convey runoff. Water enters the biofilters through gravel inlets. When the system reaches its storage capacity, excess water is directed to an outfall via the perforated exfiltration pipe.

Native plantings

The stormwater biofilters are landscaped using a diverse selection of native trees, shrubs, and grasses selected following an extensive consultation process with TRCA and TBG staff. Selection criteria included drought tolerance, contribution to biodiversity, and consistency with established botanical planting themes at the TBG. The native plantings provide several additional benefits, including: (i) increased evapotranspiration, (ii) reduction of the urban heat island effect of the parking lot, (iii) provision of habitat for local birds and wildlife, (iv) reduction of the visual scale of the parking lot, and (v) opportunities for education and an improved visitor experience. TBG staff have observed many different species of birds, butterflies, bees and other insects feeding on the plant material.

Figure 3. Native plants in the bioretention

Permeable pavement

Permeable pavement in the form of AquaPave precast pavers is installed within selected parking areas and pedestrian footpaths. A subdrain pipe carries surplus water to biofilter exfiltration trenches where water infiltrates into the native soils or is conveyed to Wilket Creek when the trenches are full. Permeable pavement pads are strategically located to intercept and infiltrate runoff from impervious areas, complementing the function of the stormwater biofilters.

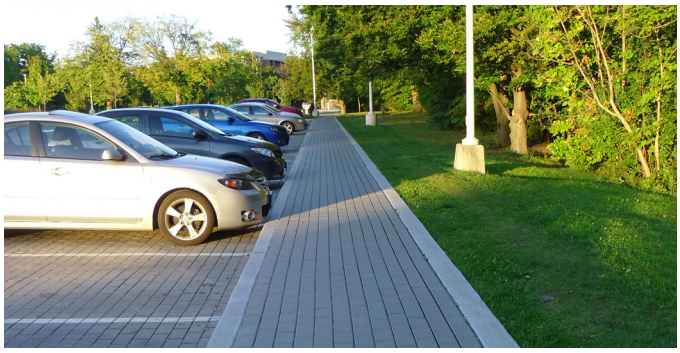

Figure 4. Permeable pavement parking spaces and pedestrian walkways

Enhanced visitor experience

The design of the parking lot encourages the use of alternative modes of transportation and improves visitor experience and safety. Ample parking is provided for motorcycles, and circulation is improved through a network of pedestrian walkways constructed from permeable pavement. There is a visitor drop-off area and an onsite lay-by for buses to reduce traffic congestion on adjacent residential streets (buses had previously been required to park on nearby streets to load and unload passengers).

Figure 5. Pedestrian crossings in parking lot

CONSTRUCTION AND COMMISSIONING

During the 9 months of construction, efforts were made to reduce as much waste as possible. The asphalt surface of the existing parking lot was pulverized and recycled to form a compacted base material while existing concrete was sent to a recycling depot. Rather than sourcing new fencing materials, the original fencing was restored and incorporated into the new design. Removed tree limbs became

part of an onsite art installation, and brush was used for compost, woodchips, and pathway edgers. The 9 trees removed were replaced with 66 tree species throughout the new parking lot, and 5 small trees were transplated within the site. The protection of existing trees and their root zones was overseen by an arborist and specimen trees were rejuvenated through selective pruning. All lawns were replaced with native vegetation.

Standard erosion and sediment control (ESC) measures (e.g. silt fencing) were installed prior to the start of construction and maintained until the site was stabilized and restored. This prevented the discharge of sediment offsite into Wilket Creek. Straw bale filters and check dams were used during grading operations with the work completed in accordance with the Greater Golden Horseshoe Area Conservation Authorities' ESC Guideline for Urban Construction.

The retrofit construction was planned for the fall to avoid programming conflicts at the TBG, however there was not sufficient time to complete it until spring. While there were no significant construction issues, connecting to the old irrigation system proved to be more difficult than expected.

The $1.8 million project had 3 funding partners, $200,000 from Urban Forestry, $400,000 from Toronto Water and $300,000 from Transportation. The the balance of the funding was paid by the City's Parks Forestry Recreation capital state of good repair.

OPERATION AND MAINTENANCE

Proper maintenance of LID practices is crucial for optimizing performance, cost effectiveness, and aesthetics, especially during the initial establishment of vegetation. It may be necessary to follow-up with the contractor to ensure that the activities specified within the maintenance agreement are taking place.

For specific information on individual LID practices please refer to the LID Stormwater Management Practice Inspection and Maintenance Guide (TRCA, 2016).

For de-icing of the site during the winter, the City of Toronto uses alternative products (e.g. calcium carbonate) in place of salt so that environmental impacts to the adjacent ravine are minimized.

ACHEIVEMENTS

Innovative project. This project is one of the few parking lot retrofits in Ontario to integrate such a variety of LID practices.

Stormwater management benefits. The LID practices implemented onsite help to improve the quality and reduce the volume of runoff discharging to Wilket Creek.

Functional design. The parking lot achieves stormwater management objectives while streamlining pedestrian and vehicle flow, promoting sustainable modes of transportation, and improving visitor experience.

Joint partnership. All partners worked together to ensure the success of this project.

LESSONS LEARNED

- In retrofit projects, construction should be timed to minimize disruptions to facility operations and programming.
- To maintain parking lot capacity, it is important to account for the space occupied by above ground LID practices and make appropriate compensations during the design phase.
- Retrofit projects can be particularly challenging because existing infrastructure must be removed and replaced. It is important to maintain an accurate, up to date site plan to avoid damage to underground utility mains.
- Designs should include a route for stormwater to leave the site safely in case of malfunction or for storms that exceed the design capacity of the system.
- Characterizing site soils early in the project planning process is essential as this will allow any issues or barriers to infiltration to be identified, and the design to be modified to account for them.

REFERENCES

Credit Valley Conservation and Toronto and Region Conservation (CVC & TRCA) (2010) Low Impact Development Stormwater Management Planning and Design Guide. Version 1.0. Toronto, Ontario.
Toronto and Region Conservation (TRCA) (2016) Low Impact Development Stormwater Management Practice Inspection and Maintenance Guide. Toronto, Ontario.

For more information on STEP's other Low Impact Development initiatives, visit us online at www.sustainabletechnologies.ca

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