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TORONTO PIONEERS UNDERGROUND BIORETENTION

stormwater “proof of concept” Silva Cell installation

Perforated distribution pipes are placed throughout the system

The Silva Cell has primarily been used as a system to provide large volumes of un-compacted planting soil for trees in dense urban centers. Lesser known, but equally important, is the system’s complementary ability to manage stormwater runoff as the source control.

Toronto Water, the city’s water authority, wanted to test the Silva Cells’ capacity to manage surface runoff. In conjunction with Ryerson University and Deep Root Canada Corp., the city installed a proof-of-concept installation on the Queensway, a commercial area between Moynes and Berl Avenue on the North side. Pave-Al, the contractor, excavated two trenches for two Silva Cell systems, each two frames deep and with spots for two tree openings, that straddled the sidewalk area and the parking bays.

The Silva Cells were filled with a bioretention soil mix (80% sand, 20% soil) that has a 20% water holding capacity. All of the rainwater runoff is collected in the city’s standard stormwater catch basin. In effect, the Silva Cell is being used to create a giant bioretention swale underneath the sidewalks and parking bays. A bio-swale can keep the surface runoff out of the stormwater system for 24 hours and filter out pollutants from the water. A typical rain event in Toronto is 0.09-0.12” (2-3 mm) in 24 hours, and 50% of Toronto’s annual precipitation events are less than .19” (5 mm). The Silva Cell system was sized and laid out to manage the runoff from a 2” (5 cm) rain event in 24 hours.

The system captures all of the run-off from the crown of the street to the building face and from one end of the block to the other. All of this water is cleaned, retained and detained by the bioretention soil. The system also meets AASHTO H-20 loading requirements to support parking. The entire installation took 3 days, with a crew of 5 workers, and provided a total of almost 600 ft^3 (16 m^3) of bioretention soil per tree.

An 8” (20 cm) PVC pipe runs from the street catch basin into the top layer of the Silva Cell system, delivering all of the surface runoff from the roadway and adjacent sidewalk into the bioretention soil. A perforated PVC pipe then distributes the surface runoff evenly throughout the soil and the water infiltrates through the soil until it reaches the bottom of the system. At the bottom of the trench is a perforated drain line that will carry any excess overflow into the existing stormwater system. Depending on the site, the runoff that percolates to the bottom of the Silva Cell system can be infiltrated into the

Asphalt covers the parking bay and pavers cover the sidewalk.

Two Catchment Areas (Paired with One Silva Cell Group)

Storm Size (inches)	Storm Duration (hours)	Watershed Area (sq. ft.)	(sq. m.)	Length of Delay (hours)	Volume of Water Toward Catch Basin (cu. ft)	(cu. m.)	Volume of Runoff (cu. ft)	(cu. m.)	Volume Infiltrated (cu. ft.)	(cu. m.)	Overflow Drainage to Sewer (cu. ft.)	(cu. m.)	Volume Retained in Soil (cu. ft.)	(cu. m.)	Percent of Infiltrated Volume Retained in Soil
0.5	24	8288	770	8	328	9.29	82.5	2.34	245.5	6.95	63.8	1.81	181.7	5.15	74.01%
1	24	8288	770	4.8	656	18.58	269	8.18	387	10.39	125.3	3.55	241.8	6.85	85.89%
2*	24	8288	770	2.7	1312	37.15	812	22.99	500	14.16	204.5	5.79	295.7	8.37	59.14%

*Note that the model is not accurate for these measurements. The quantites shown are estimated.

One Catchment Area (Paired with One Silva Cell Group)

Storm Size (inches)	Storm Duration (hours)	Watershed Area (sq. ft.)	(sq. m.)	Length of Delay (hours)	Volume of Water Toward Catch Basin (cu. ft)	(cu. m.)	Volume of Runoff (cu. ft)	(cu. m.)	Volume Infiltrated (cu. ft.)	(cu. m.)	Overflow Drainage to Sewer (cu. ft.)	(cu. m.)	Volume Retained in Soil (cu. ft.)	(cu. m.)	Percent of Infiltrated Volume Retained in Soil
0.5	24	4144	385	11.3	164	4.64	1.3	0.04	162.7	4.61	30.9	0.87	131.8	3.73	81.01%
1	24	4144	385	8	328	9.29	82.5	2.34	245.5	6.95	63.8	1.81	181.7	5.15	74.01%
2	24	4144	385	4.8	656	18.58	269	8.18	387	10.39	125.3	3.55	241.8	6.85	85.89%

Silva Cell system performance modelling based on bioretention performance standards

subsoil to help replenish the aquifer. As the two trees in each of the trenches mature they strengthen the efficiency of the stormwater management, evapotranspirating large volumes of rainwater out of the soil through their roots systems, and interdicting and evaporating much of the rainfall with their canopies.

The City, with assistance from Ryerson, is installing the monitoring equipment to track the flow qaulity of infiltration and quality of water in and out of the Silva Cells. Toronto Water will continue to monitor the installation's ability to manage stormwater and in 10 to 20 years fully expects to see the Silva Cells continuing to nurture large, mature trees and supporting an effective and more ecological stormwater system.

Installation Summary:
Total bioretention soil per tree: 688 ft^3 (19.5 m^3)
Number of Silva Cells: 260 frames, 130 decks
Installation date: October 2008
Installation type: Trees and stormwater
Water volume treated: 656 ft^3 (18.5 m^3)*
Watershed area treated: 8,288 ft^2 (770 m^3)
Project designers: Toronto Water and Kestrel Design Group
Client: City of Toronto

**Based on a 2" (5 cm) storm event*

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