Creating and Utilizing Mature Trees for On-Site Stormwater Management in Ultra Urban Sites

deeproot

I. Introduction -Inspirational Projects
II. Sizing
III. Projects
IV. Stormwater
V. Q&A

Requirements to grow a healthy tree

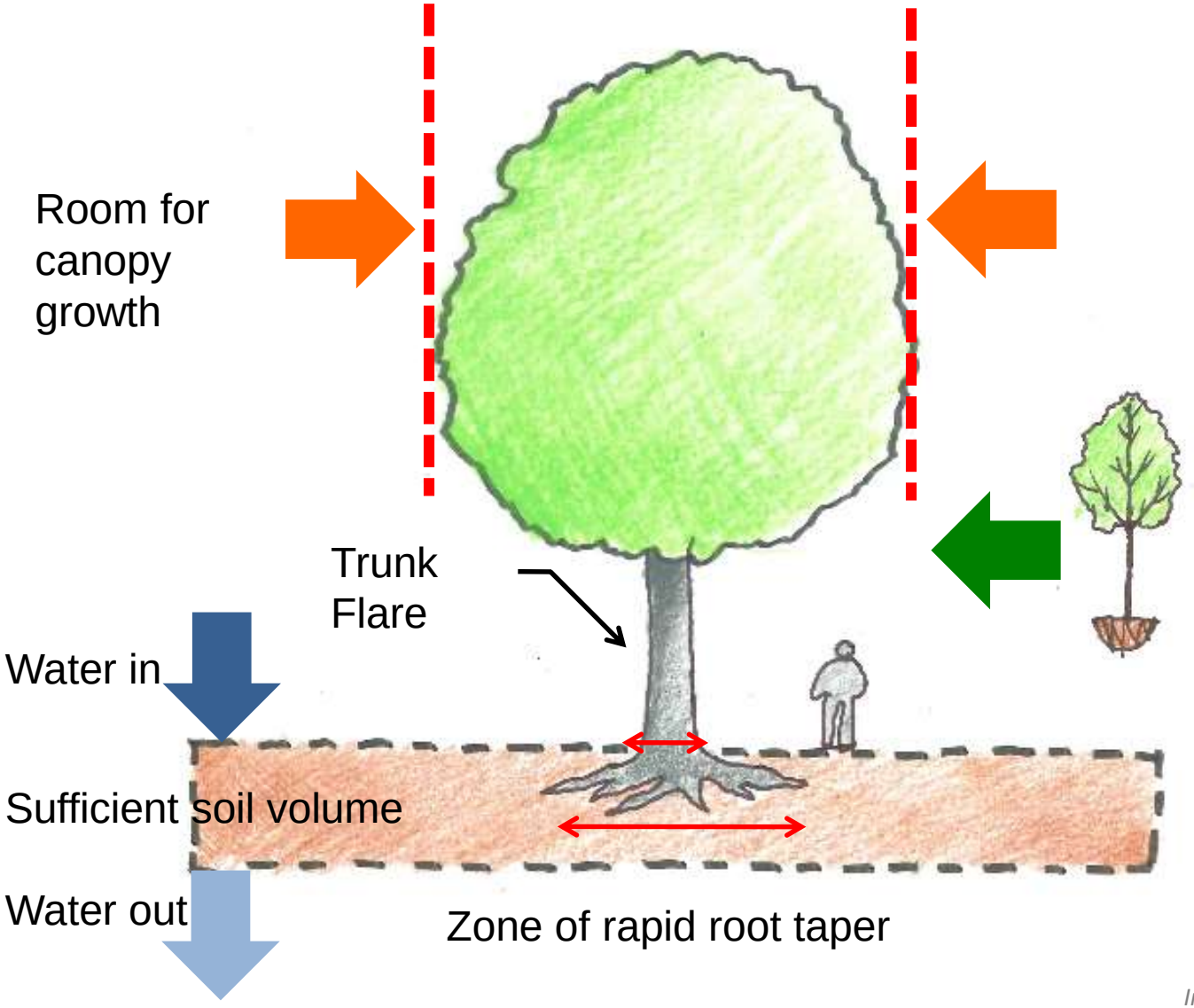


Image: James Urban

The Most Valuable Benefit?

MEDIUM-SIZE OFFICE BUILDING

The figures below present the key office building assumptions, the proposed green infrastructure property improvements, and the resulting benefits.

GREEN INFRASTRUCTURE IMPROVEMENTS

Energy savings due to reduced demand for heating and cooling	**$1,630** Annually
Avoided costs for conventional roof replacement	**$271,970** present value over 40-year analysis period
Tax credit	**$67,130** one-time credit in year of installation
Increased **rental income**	**$72,150** annually (assuming no vacancies)
Stormwater **fee reduction**	**$3,490** Annually (projected to increase 6% per year)
Total present value benefits (over 40-year analysis period)	**$1,863,000 +**

Source: NRDC: The Green Edge-How Commercial Property Investment in Green Infrastructure creates value

What's missing from this picture?

"**The undervaluing of soils** is one of the singular failings of the conventional development approach."
*Sustainable Sites Initiative – Guidelines a**nd** **Performance Benchmark Draft 2008 (ASLA, 2008)***

Photo courtesy of James Urban

What is suspended pavement?

Traditional planting

Design for maturity

Image: James Urban

Custom system:
Christian Science Center

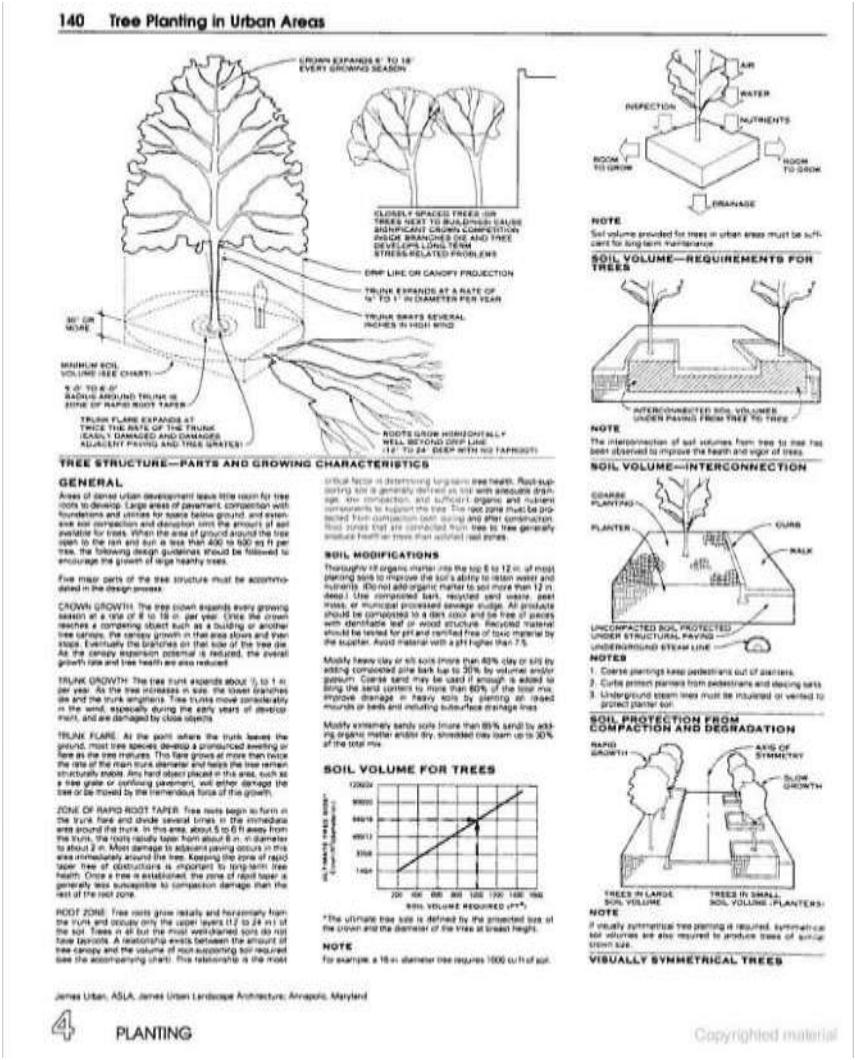
Trees planted in 1968 in a custom system.
Approximately 800 cubic feet of soil per tree

How to size a Suspended Pavement System?

Landscape Architectural Graphics Standards, 2006.

By James Urban FASLA

Edited by Leonard J. Hopper, FASLA



140 Tree Planting in Urban Areas

TREE STRUCTURE—PARTS AND GROWING CHARACTERISTICS

GENERAL

SOIL MODIFICATIONS

SOIL VOLUME FOR TREES

SOIL VOLUME—REQUIREMENTS FOR TREES

SOIL VOLUME—INTERCONNECTION

SOIL PROTECTION FROM COMPACTION AND DEGRADATION

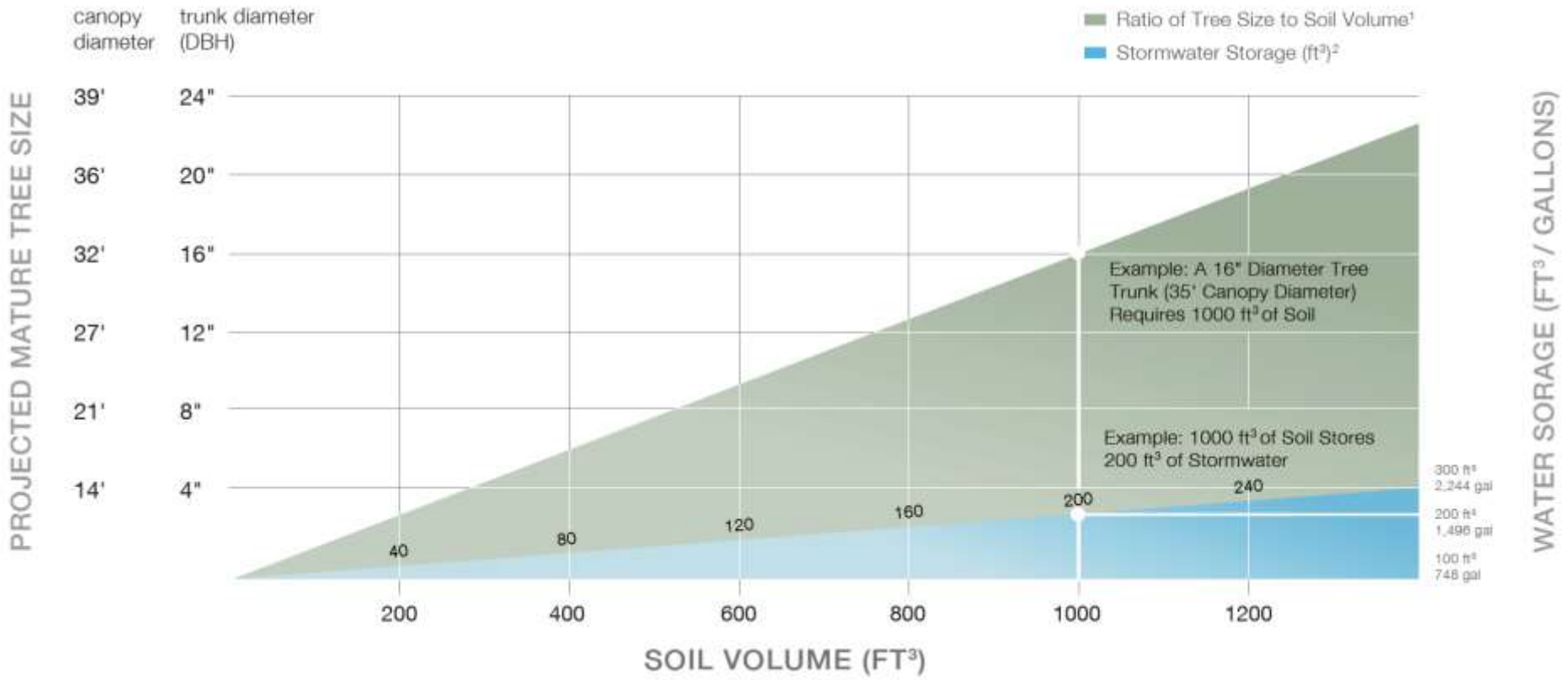
VISUALLY SYMMETRICAL TREES

James Urban, ASLA, James Urban Landscape Architecture, Annapolis, Maryland

4 PLANTING

How Much Soil to Grow a Big Tree?

How Much Water Can be held in the Soil?



Lincoln Center Bosque, New York City

In April of 2009, 970 Silva Cell frames and 620 Silva Cell decks were installed at the Lincoln Center Bosque (Barclay Capital Grove) in New York City, New York to support 30 new trees that were planted that spring. Each tree receives a total of 450 cubic feet (12.7 cubic meters) of soil. The project site, formerly known as the North Plaza, rests entirely on a parking garage.

Approx Cost:
$7,500.00/tree

Sundance Square, Fort Worth, TX

The trees of Sundance Square plaza after three growing seasons. In October of 2013, 960 Silva Cell frames and 480 Silva Cell decks were installed beneath the Sundance Square Plaza in Fort Worth Texas to support the 18 Cedar Elm trees that were planted later that autumn. Each tree receives 800 cubic feet of soil, and water efficient irrigation techniques were employed in the design to ensure that the trees would thrive in the often arid desert climate.

Approx Cost:
$12,000.00/tree

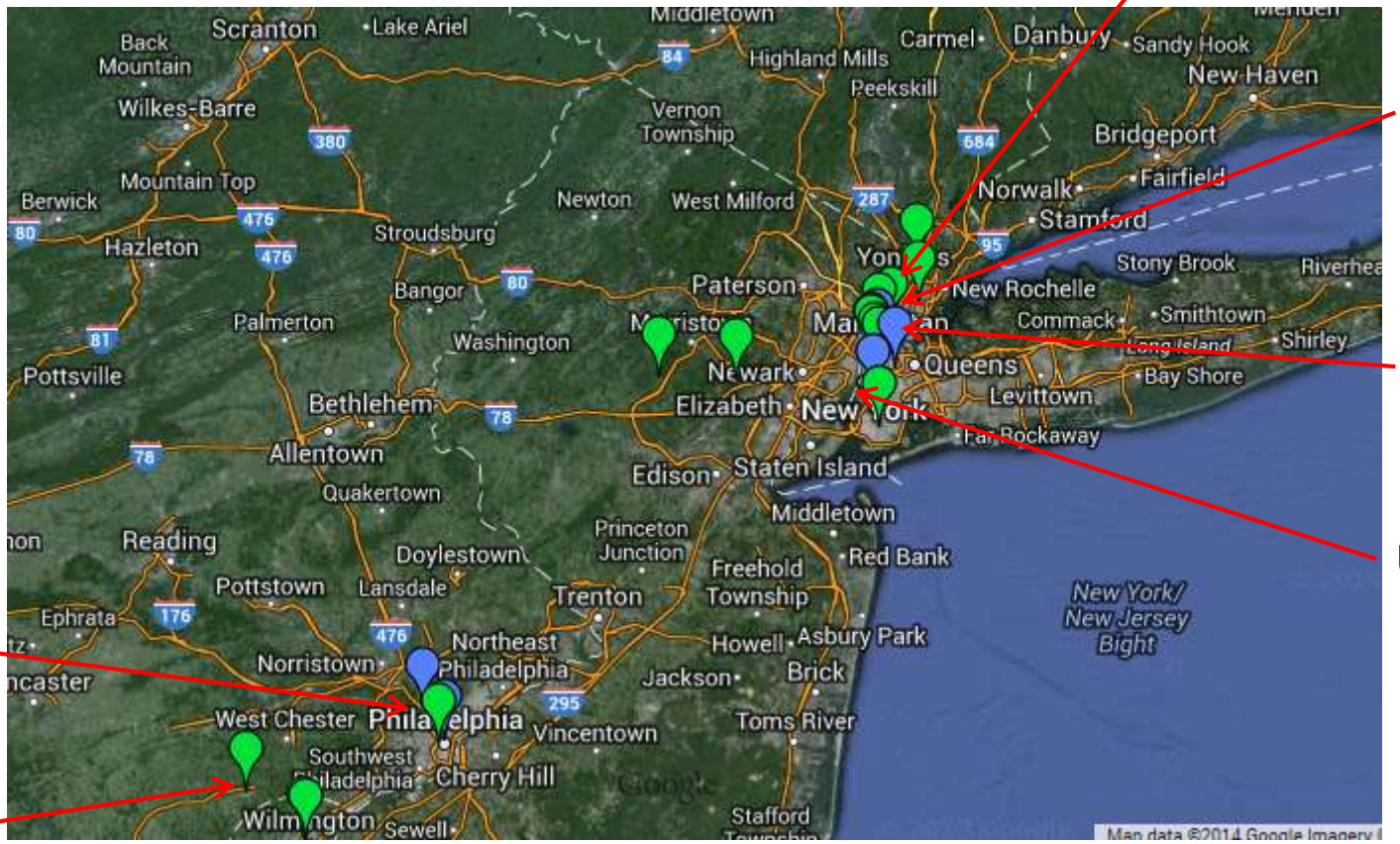
Sugar Beach Toronto, ON

The trees at Sugar Beach in Toronto, Ontario after 5 growing seasons. These trees are supported by 3,150 Silva Cell frames and 1,960 Silva Cell decks, which help them to receive over 1,236 cubic feet (35 cubic meters) of soil each. The Silva Cell system was installed in winter 2010, and the trees planted in spring 2010 as part of the Waterfront Toronto revitalization project.

Approx Cost: $18,000.00/tree (US$)

2007-2017 We have data on over 1200 installations

20+ Project in the Tristate



Metropolitan Museum

Yankee Stadium

Lincoln Center

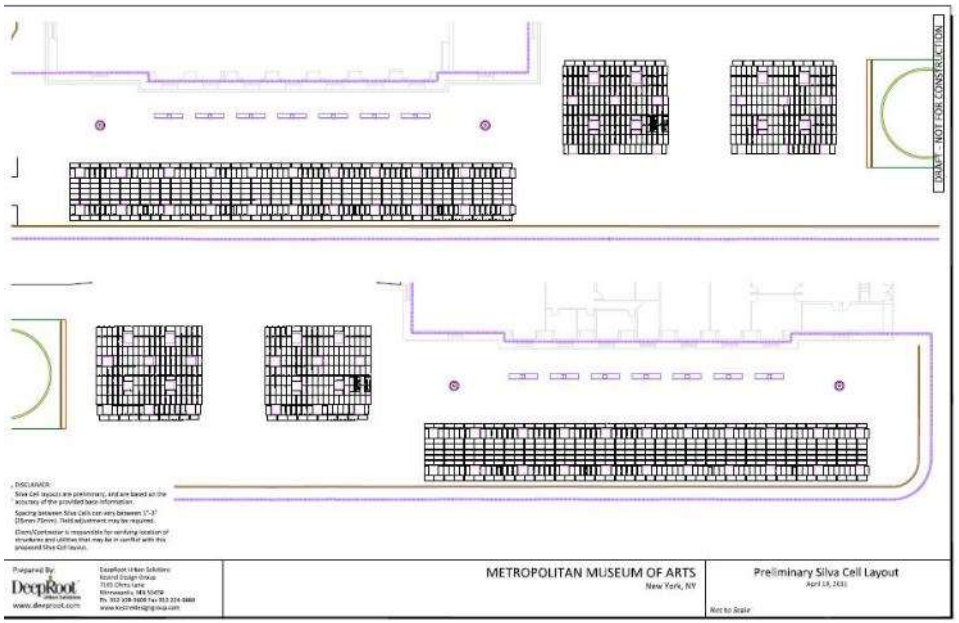
Julliard School

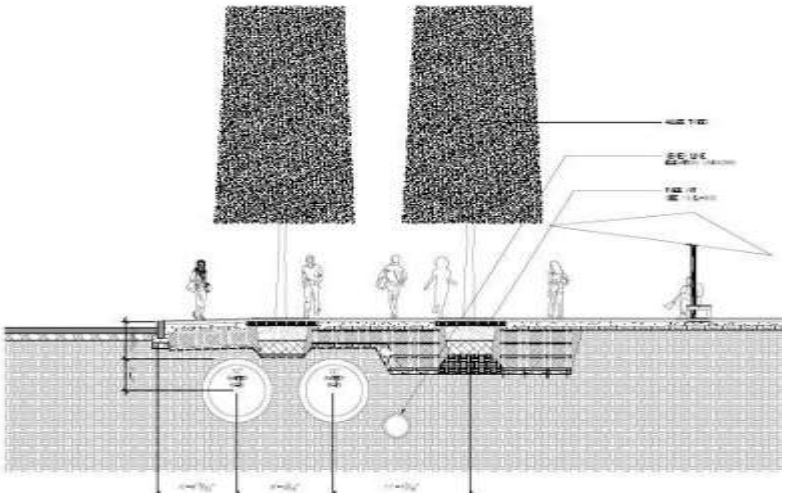
USTA

Venice Island PWD

Rodney Sq. Longwood

Metropolitan Museum of Art (New York, NY)
OLIN Studio





Metropolitan Museum of Art- 2014 Bosques

Metropolitan Museum of Art- 2016 Bosques

Metropolitan Museum of Art (New York, NY)

OLIN Studio May 2014

Metropolitan Museum of Art (New York, NY) OLIN Studio June 2016

Suspended Pavement- A Rain Garden beneath

Traditional Bio Swale

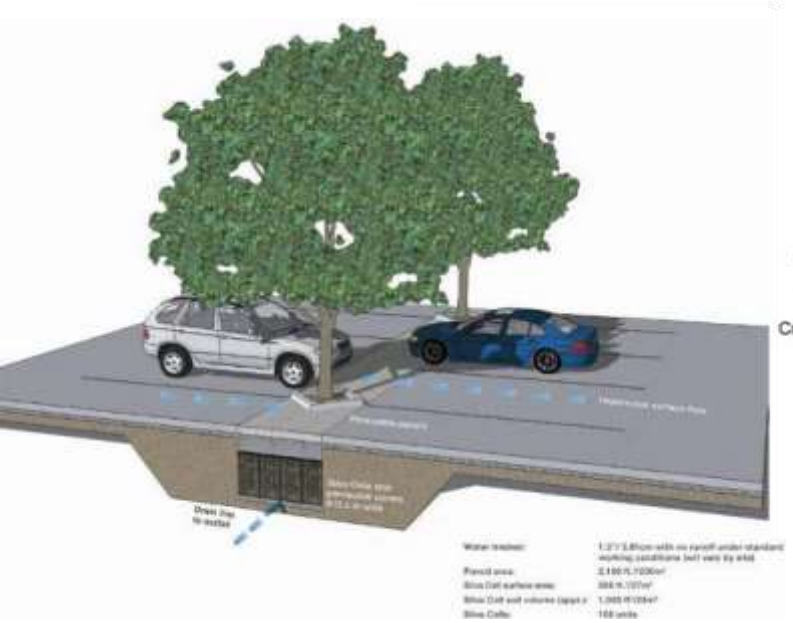
- Uses a lot of land
- Collect garbage
- High Maintenance cost

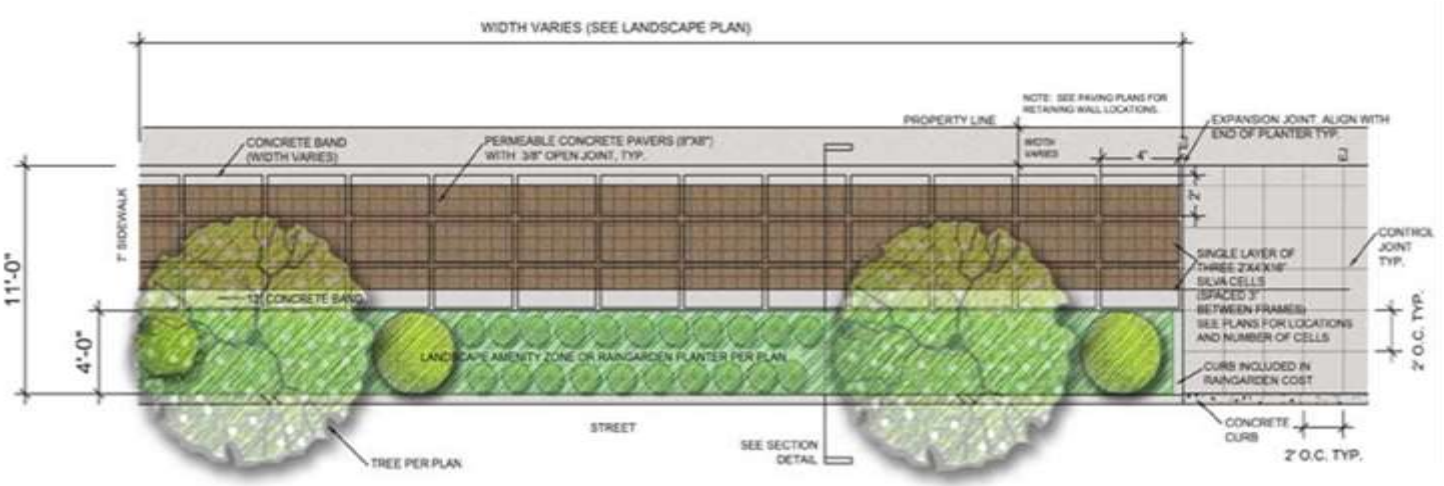
Swales are under sized-Trees do not play a significant role

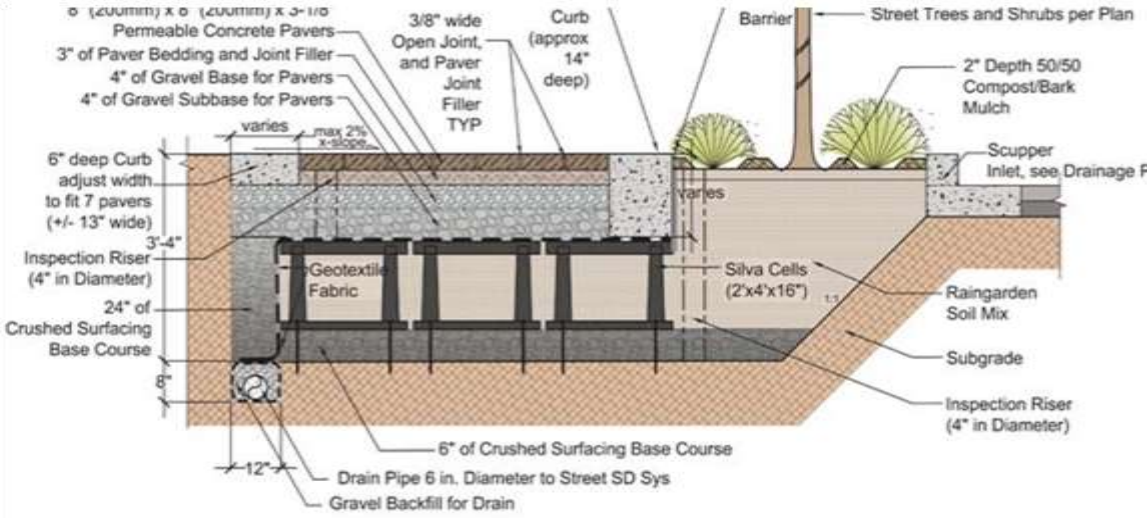
SW 12th Avenue Green Street
by Kevin Robert Perry, *ASLA*
ASLA General Design Award of Honor 2006

(Photo: James Urban)

The Suspended Pavement expands the ecosystem service.







NCSU- Modeling Quality and Volume

deeproot

CITY OF WILMINGTON NORTH CAROLINA

NC STATE UNIVERSITY

Bio&Ag ENGINEERING

NCDENR

KestrelDesignGroup

Stormwater Treatment Performance Study Underway

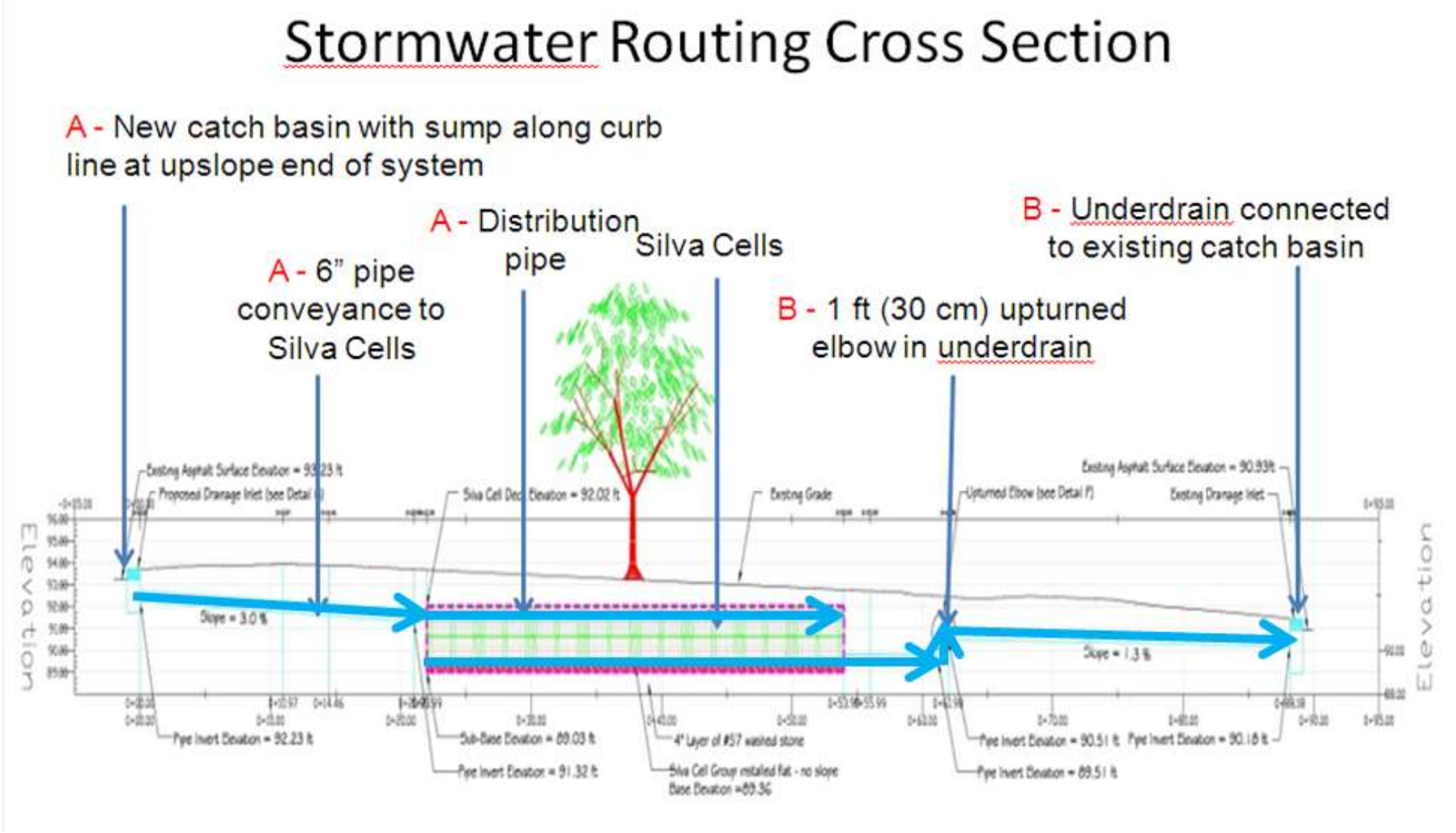
Two Silva Cell Sites Being Monitored in Wilmington, NC

North Carolina State University

Dr. William Hunt's lab in Raleigh, NC,

Ryan Winston,
Jonathan Page
Bill Hunt

NCSU Silva Cell Schematic



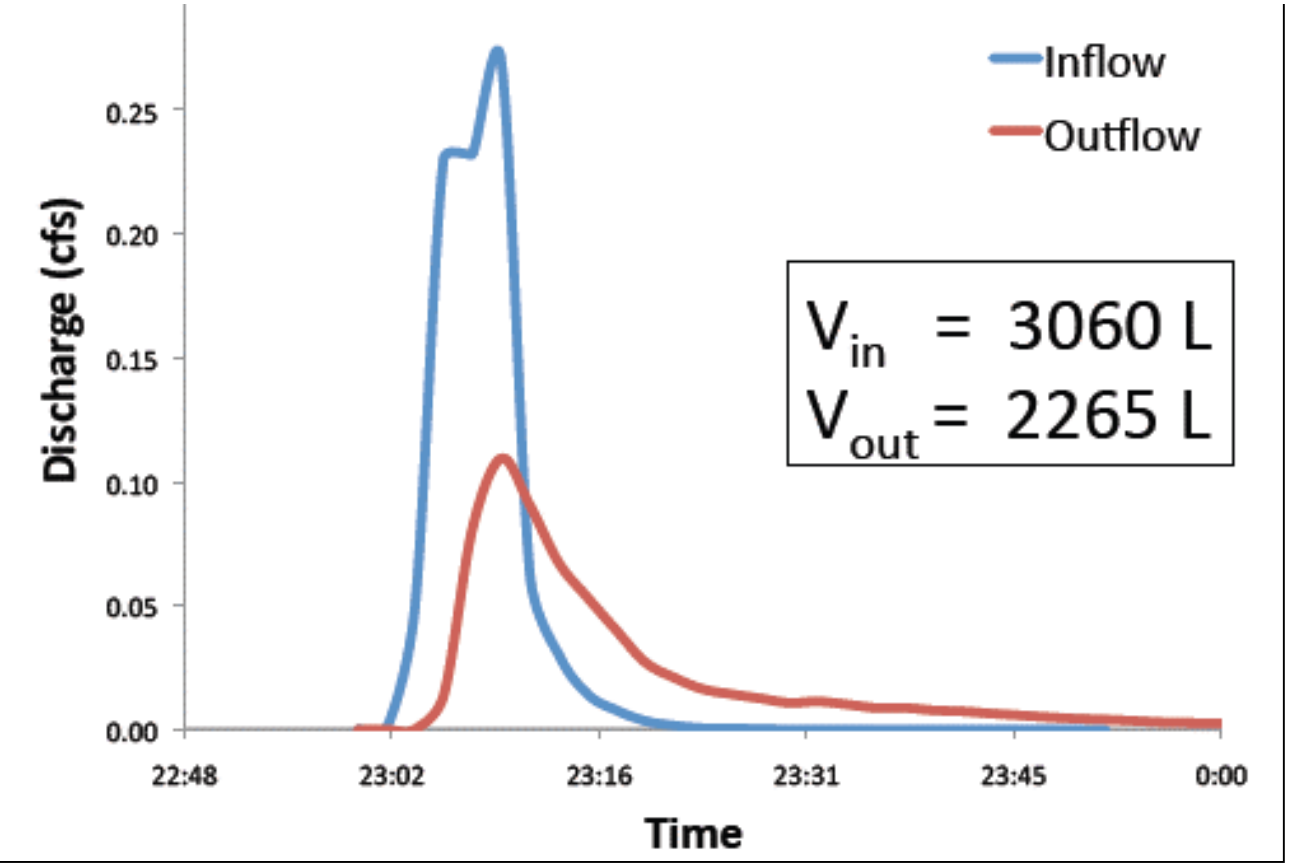
Control monitoring equipment

Control Monitoring Equipment

The monitored parameters for this study are:

- Inflow and outflow volumes and rates
- nitrate-nitrite nitrogen (NO_{2-3}-N)
- total ammoniacal nitrogen (TAN)
- total Kjeldahl nitrogen (TKN)
- total nitrogen (TN)
- Orthophosphate
- total phosphorus (TP)
- total suspended solids (TSS)
- the heavy metals zinc (Zn), copper
- (Cu), and lead (Pb)

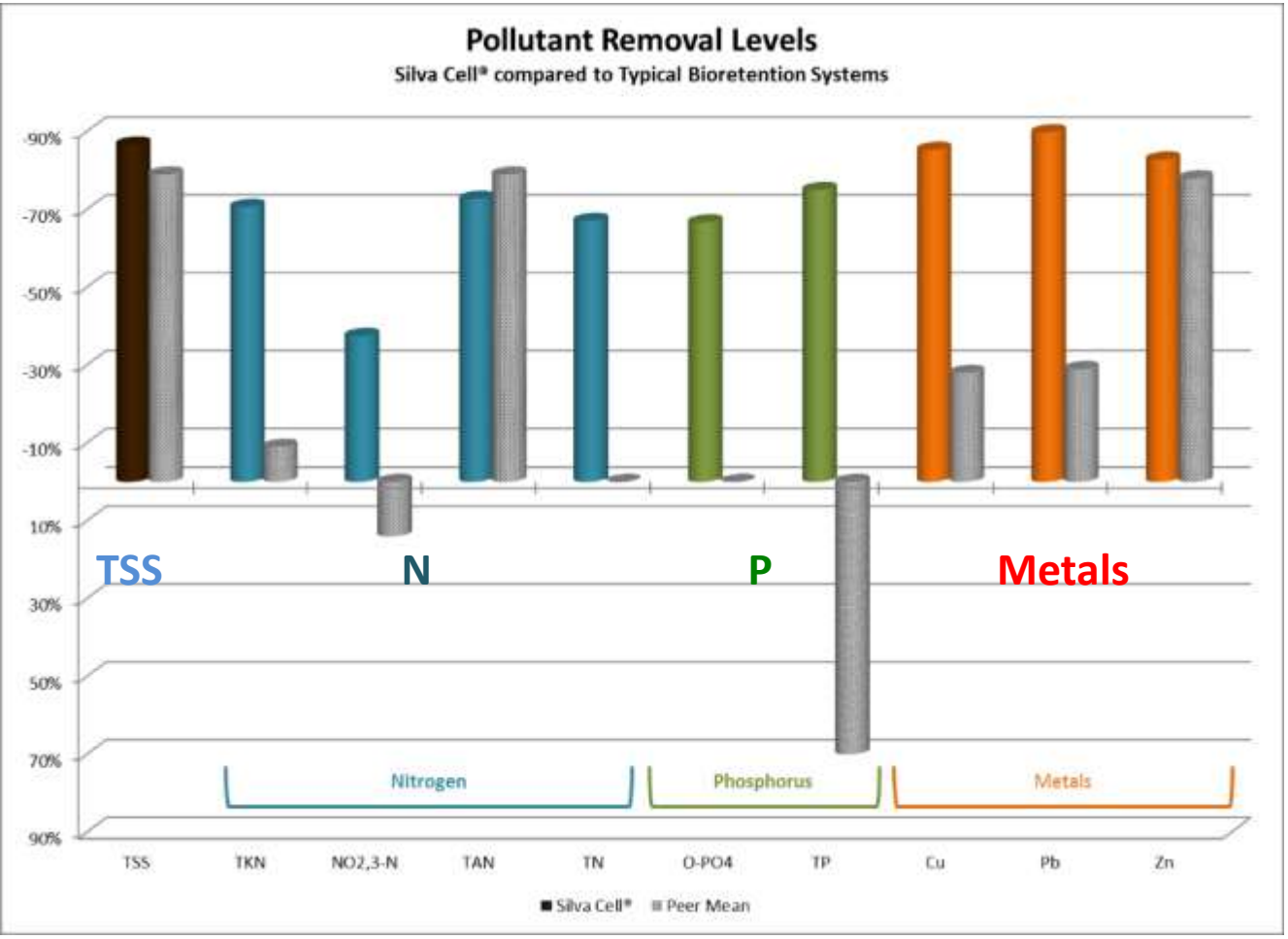
Wilmington Silva Cell Monitoring Results
Volume reduction and timing
62% of the rain events did not generate by pass



Hydrograph from 12.7 mm (0.5 in) storm on 9/6/12, Ann Street (typical street tree soil), (Courtesy of Jonathan Page, Ryan Winston and William Hunt)

Complete Date Available including Pollutant Removal rates at
www.deeproot.com
OR
Google “NC State Silva cell”

Demonstrated pollutant removal using Silva Cell®



- NCSU performance monitoring study in Wilmington, NC
- Removal rates ***at or above*** peer mean bioretention mixes
- Particularly good nutrient removal
  - **Nitrogen:** 72-74% removal vs. typical 14% leaching (nitrates)
  - **Phosphorus:** 35-60% removal vs. 70% leaching

Source: Page, J.L., R.J. Winston, and W.F. Hunt, III. 2013. Field Monitoring of Two Silva Cell™ Installations in Wilmington, North Carolina: Preliminary Monitoring Report.

Toronto Waterfront, ON

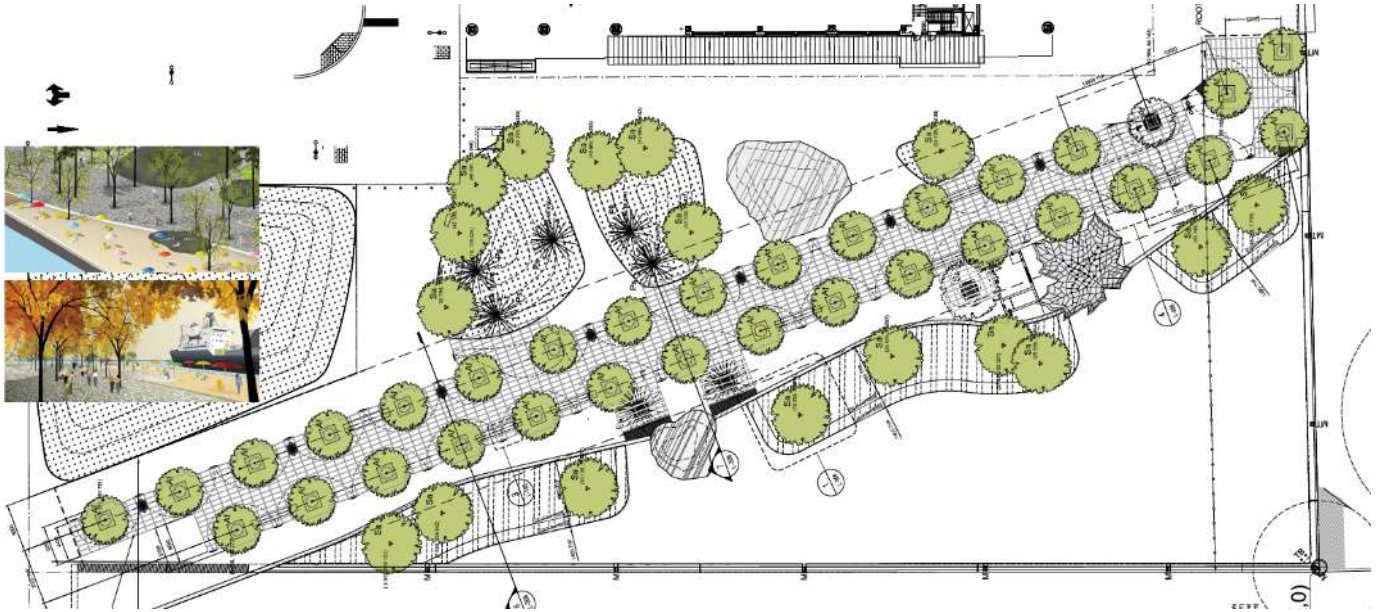
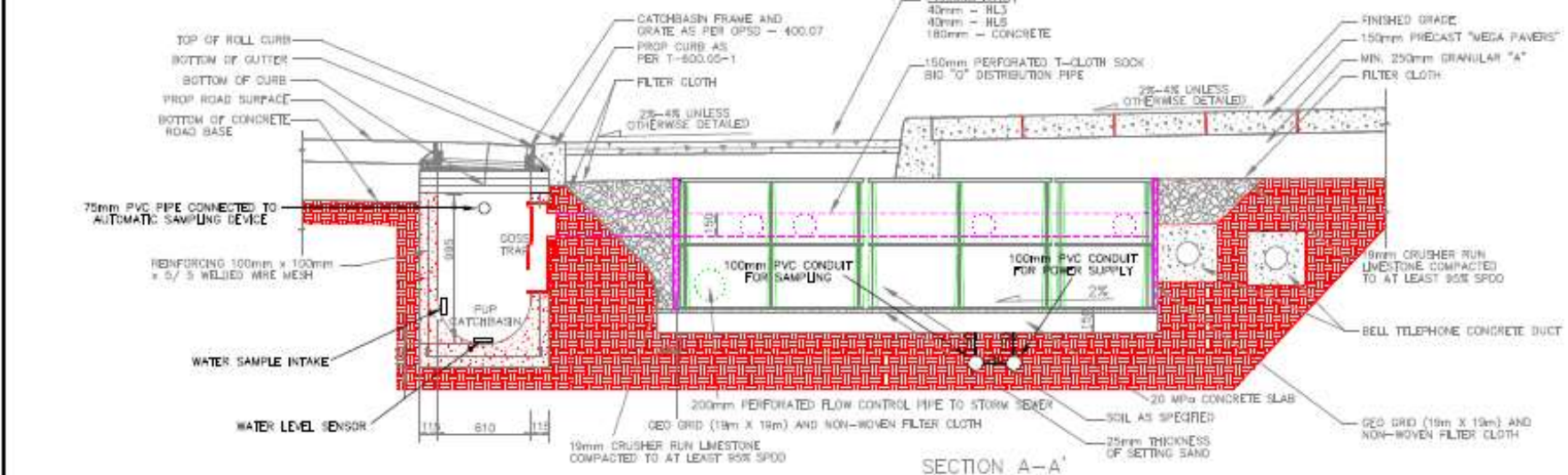


Image Courtesy of Claude Cormier + Asscocies

City of Toronto and Toronto Water Demonstration Site - 2008

Rainwater catchment area for the Silva Cells

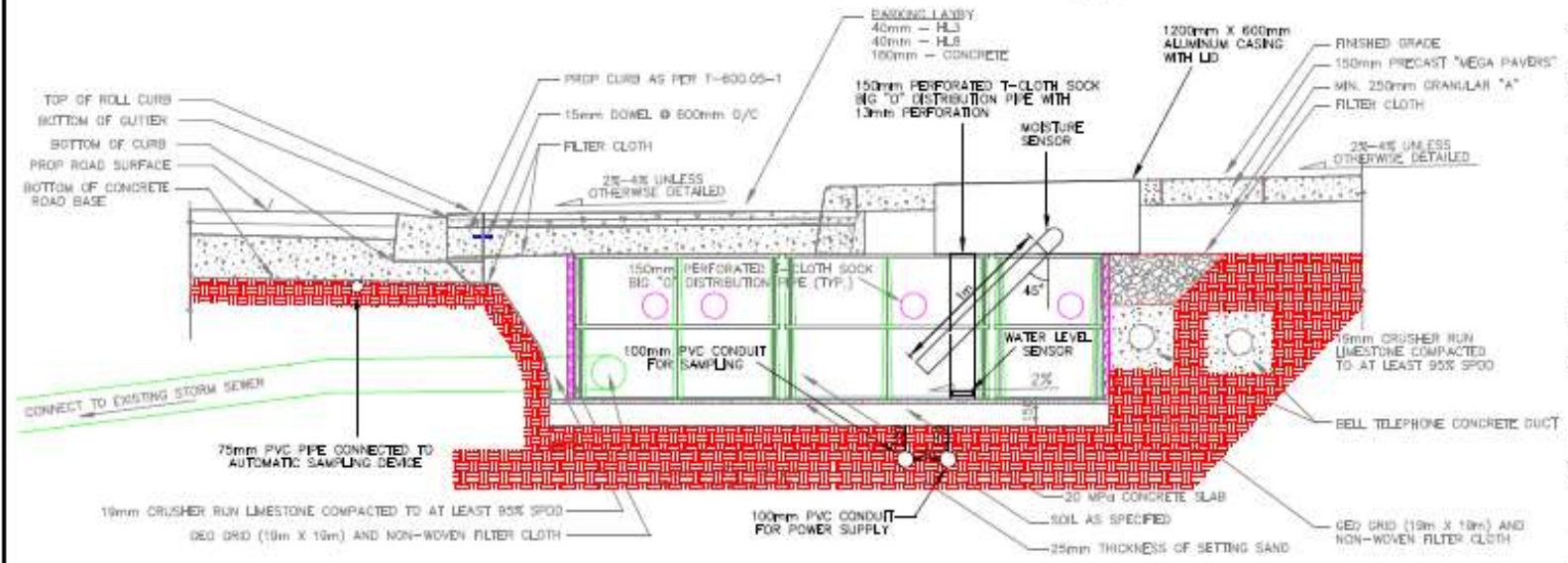
Parking Bay Silva Cell trenches



SECTION A–A'

CATCHBASIN DETAIL INCLUDING SUSTAINABLE SIDEWALK CELLS

N.T.S.



SECTION C–C'

MOISTURE SENSOR (LOCATED IN THE MIDDLE OF THE SUSTAINABLE SIDEWALK CELL) INSTALLATION DETAIL

N.T.S.

REVISIONS

No.	REVISION	DATED	BY	APPROVED

RYERSON UNIVERSITY

SUSTAINABLE SIDEWALK
THE QUEENSWAY
FROM MOYNES AVENUE TO BERL AVENUE

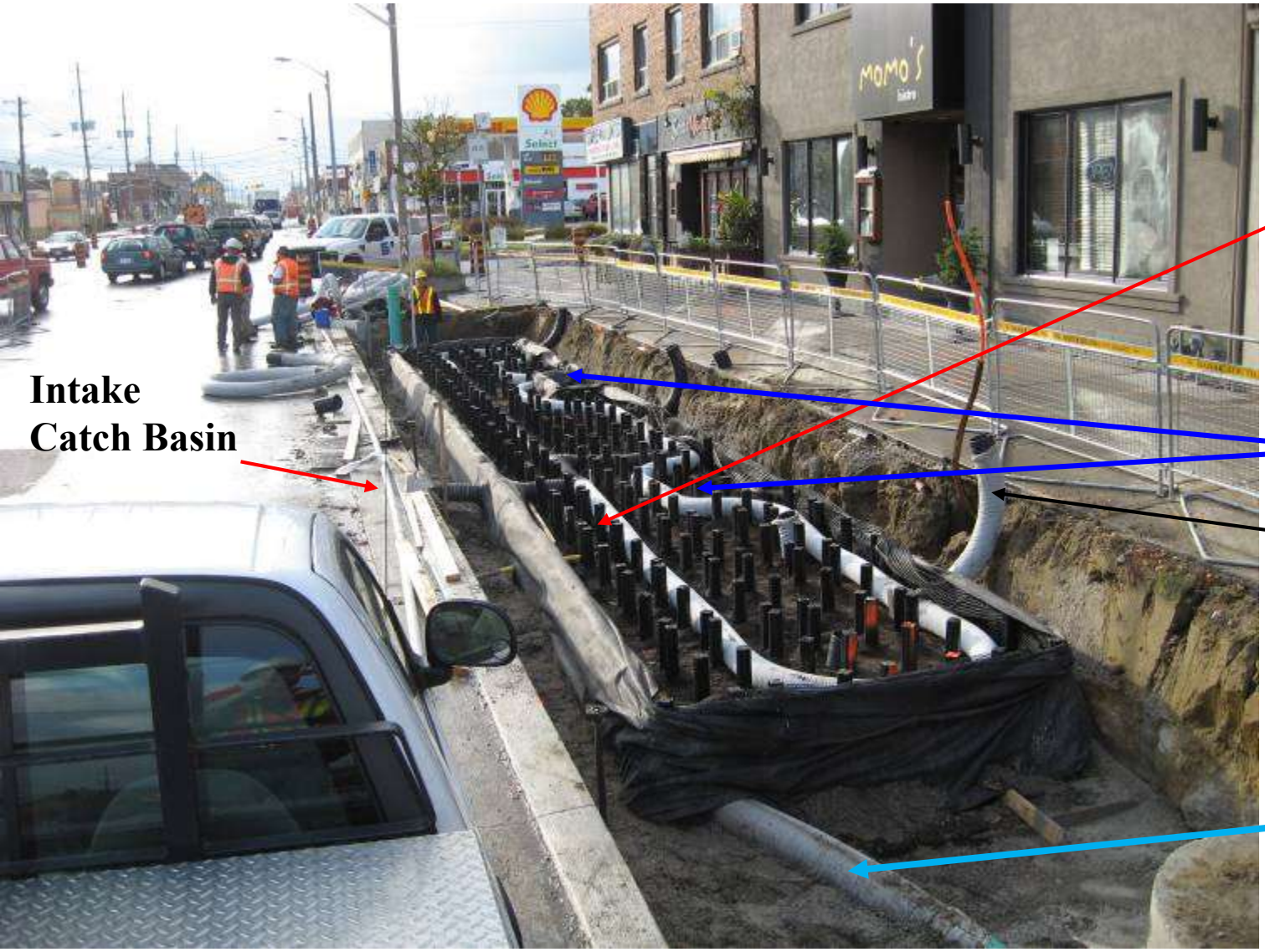
SCALES: AS SHOWN

DESIGNED BY: CF/JL
CHECKED BY: JL
DRAWN BY: CF
DATE: JUNE 13, 2008

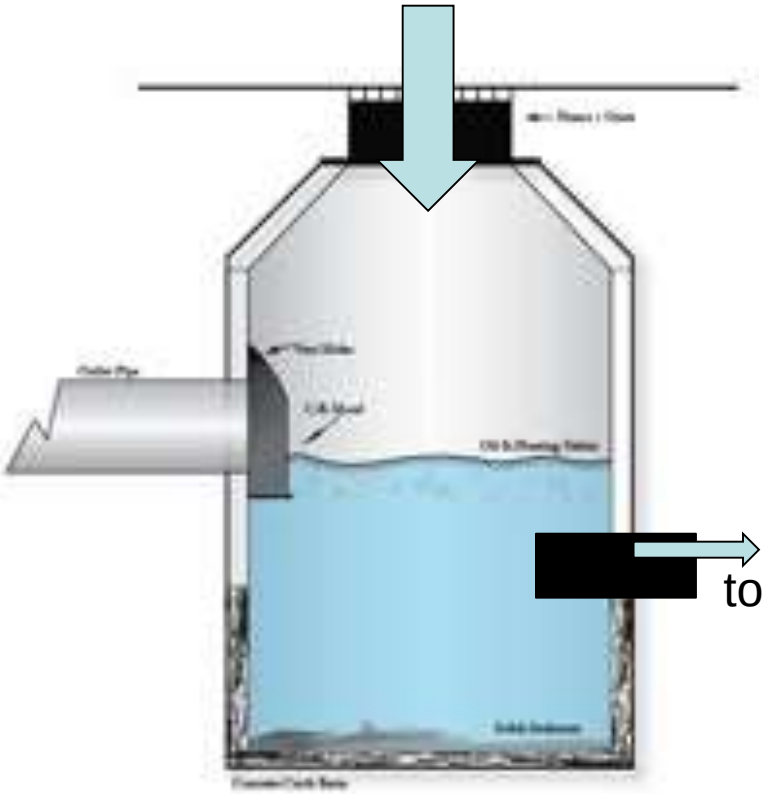
CONTRACT NO.:

SHEET: 2 OF 3

City of Toronto and Toronto Water Demonstration Site - 2008



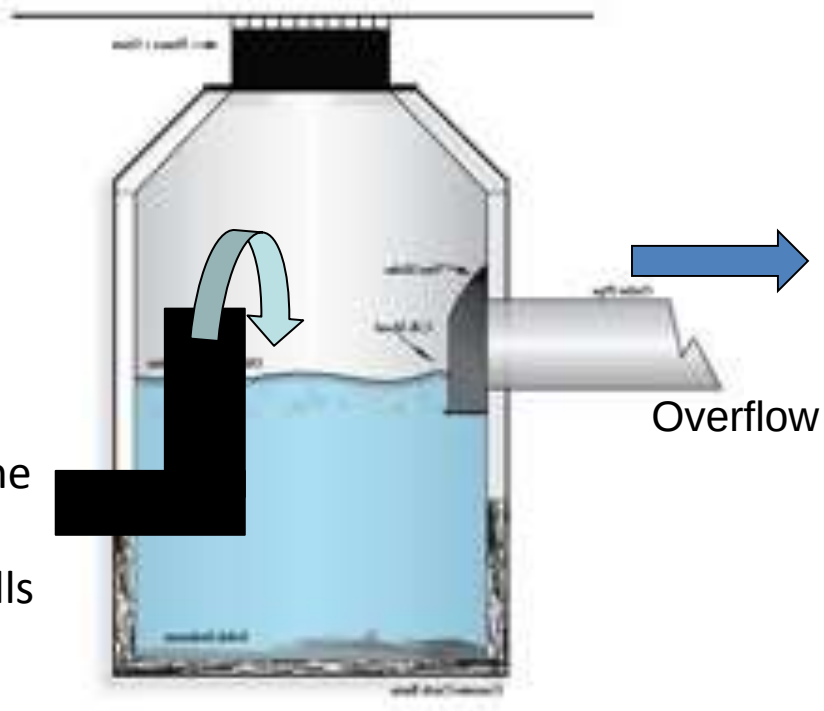
City of Toronto and Toronto Water Demonstration Site - 2008



1st Flush

to Silva Cells

In Flow CB



Overflow

Drain line from Silva Cells

Out Flow CB

City of Toronto and Toronto Water Demonstration Site - 2010

July 2010

1.5 years old


July 2013
ON SIDEWALK
L.L.B.O.


2014

Sugar Beach, Toronto, ON

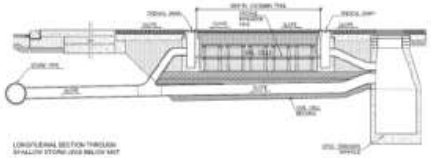
Sugar Beach, Toronto, ON 2010-2012

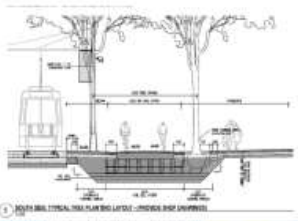
Sugar Beach, Toronto

Sugar Beach- October 2016

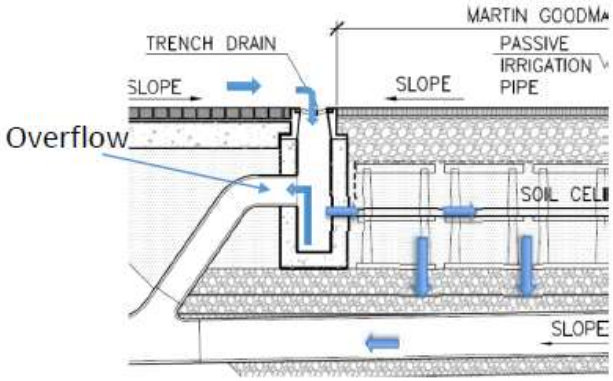
Queen Quay Vision Reality

The Vision





Finished



47% of the surface area runoff is diverted into the Silva Cells. The entire system was designed to handle the 100 year rain event.

Installation Summary

Average soil volume per tree: 15m3 (533 ft3)
Number of Trees: 134 (in Silva Cells)
Tree Species: Maple, Honey locust, Elm, Linden, London Plane
Total Silva Cells: 10,800 frames, 5,400 decks
Installation Date: Spring 2014
Installation Type: Integrated – Trees and Stormwater
Project Site: Streetscape
Project Designer: West 8 + DTAH
Contractors: Eastern Construction, Aldershot

Queen Quay Vision Reality

Thank you!

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