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

What is Suspended Pavement?

Traditional planting

Design for maturity

deeproot

Image: James Urban

Custom System

Christian Science Center, Boston, MA
Trees planted in 1968 in a custom system.
Approximately 800 cubic feet of soil per tree
Bethesda, Philadelphia, Denver & Charlotte

deeproot

Custom Systems

Chicago River Walk River Theatre- 2017
2018 General Design Award
Sasaki- Jacobs Ryan

deeproot

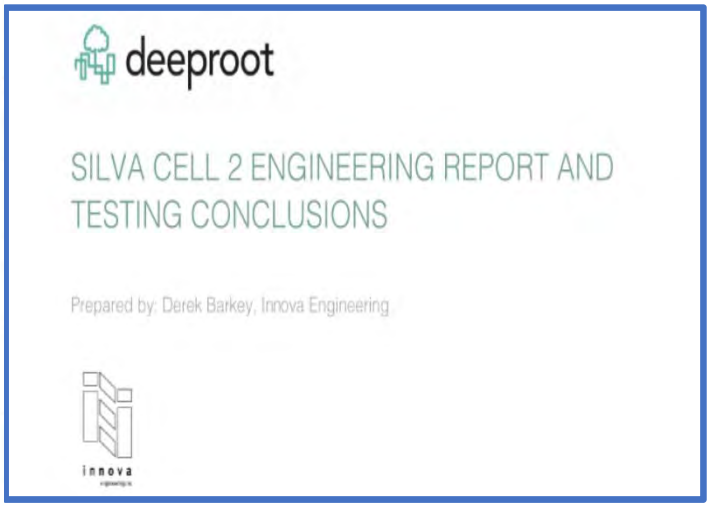
Silva Cell 2- 2015-??

deeproot

Silva Cell Loading Capacity: 160kpa; 36,000lbs

ULIMATE WHEEL LOAD BY STANDARD PAVEMENT TYPE

Silva Cell 2 System Type	Traffic Loading Standard	Pavers 3.15" pavers 1" sand base 12" of aggregate	Asphalt 4" of asphalt 12" of aggregate	Concrete 4" of concrete 4" of aggregate	Pavers with Concrete 2.36" pavers 5" concrete
1X	H-20	30,200 lbs	46,600 lbs	34,900 lbs	38,600 lbs
	HS-20	31,800 lbs	48,700 lbs	35,900 lbs	41,100 lbs
2X	H-20	33,200 lbs	51,200 lbs	38,300 lbs	42,400 lbs
	HS-20	34,900 lbs	53,500 lbs	39,500 lbs	45,200 lbs
3X	H-20	28,200 lbs	43,500 lbs	32,600 lbs	36,000 lbs
	HS-20	29,700 lbs	45,500 lbs	33,600 lbs	38,400 lbs

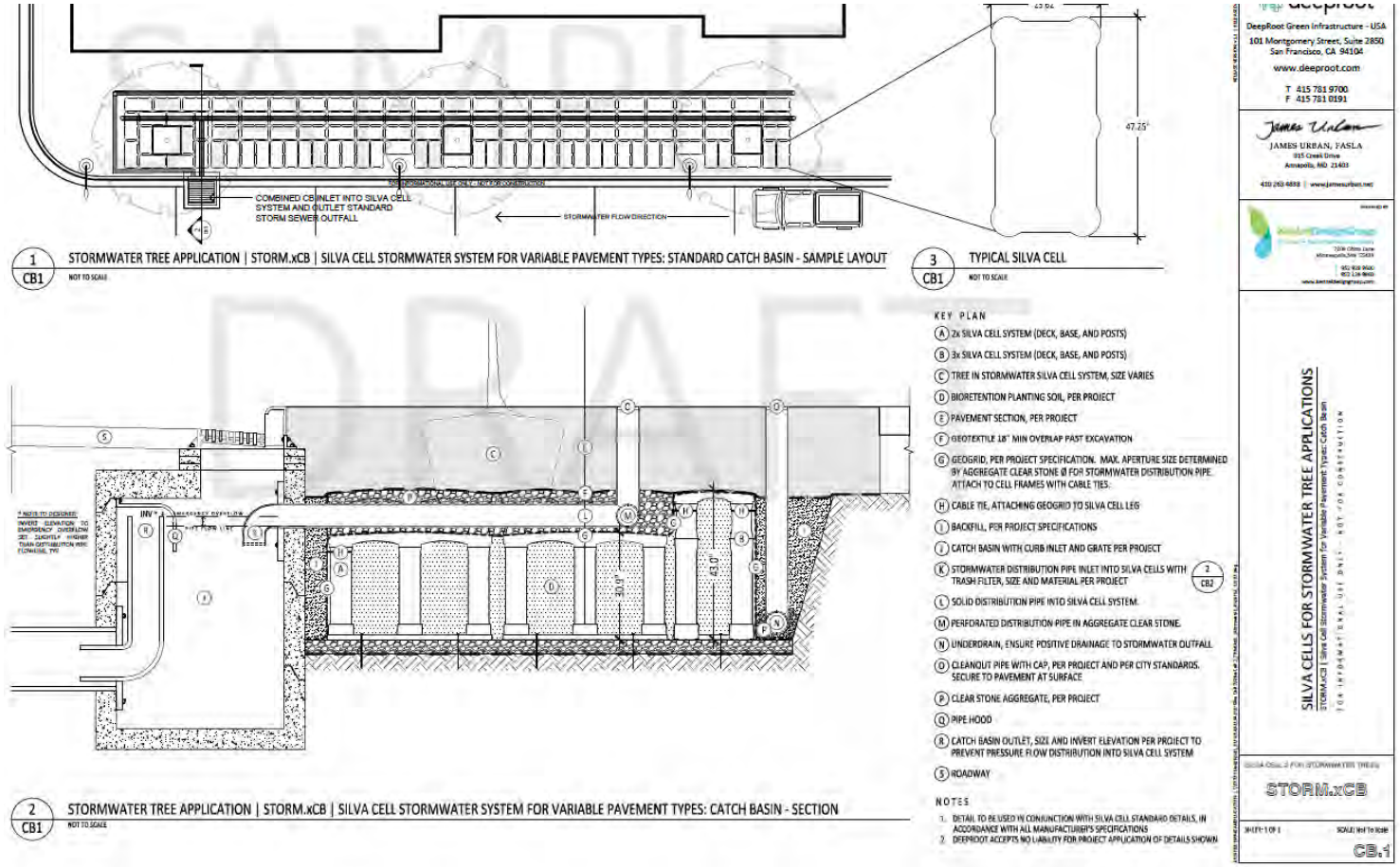


Independent engineering report available on our website

We stamp our drawings to meet AASHTO H-20 and HS 20

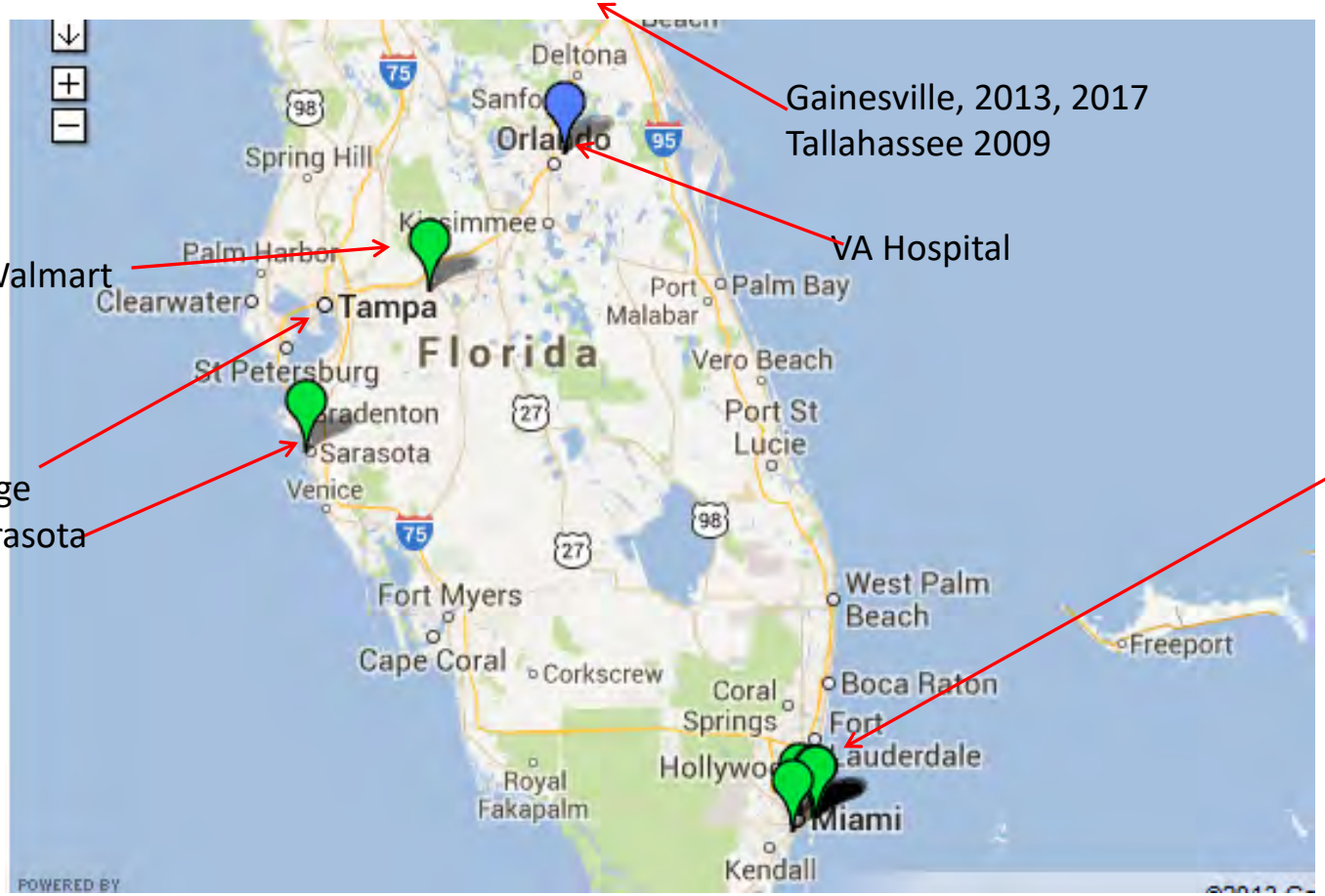
deeproot

Storm Water Detail Typical



deeproot

65 FL Projects



Gainesville, 2013, 2017
Tallahassee 2009

VA Hospital

Lakeland Walmart

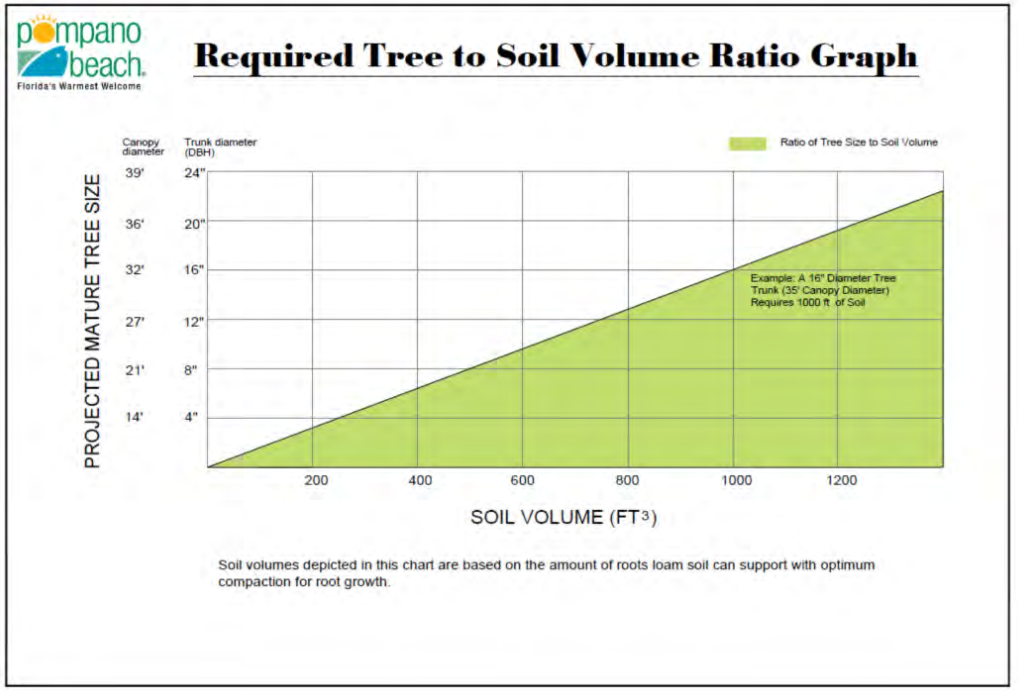
Hyde Park Village
Main Street Sarasota

Lincoln Road
UM Life sciences
Coconut Grove (2)
New World Symphony
Lincoln Park
1111 Lincoln Road
1600 Collins
AC Hotel
Pennsylvania Garage
Pompano Beach

deeproot

Pompano Beach TOD Standard

Pompano Beach Parking Facility



deeproot

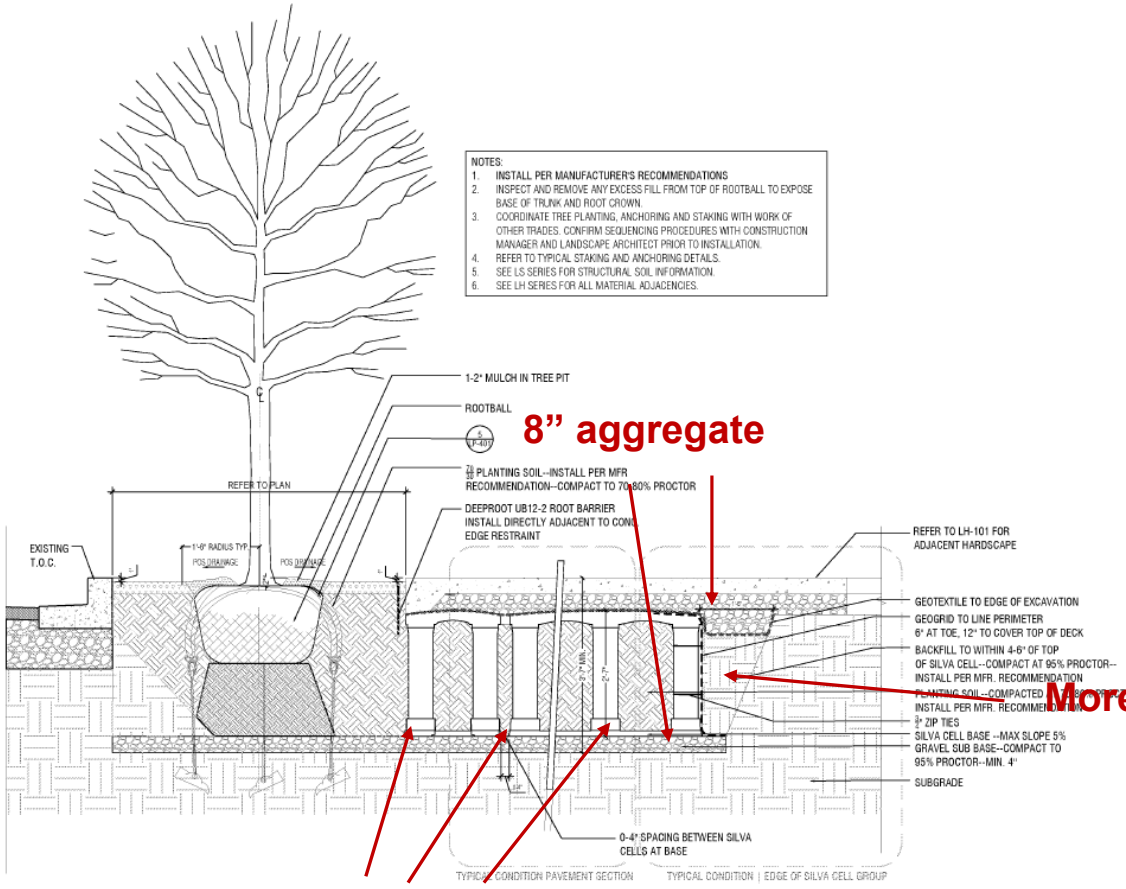
2018 Miami Beach Convention Center

February

June

deeproot

MBCC- Typical Section- SW potential



cells 6" apart
Columns 8 Gallons each

deeproot

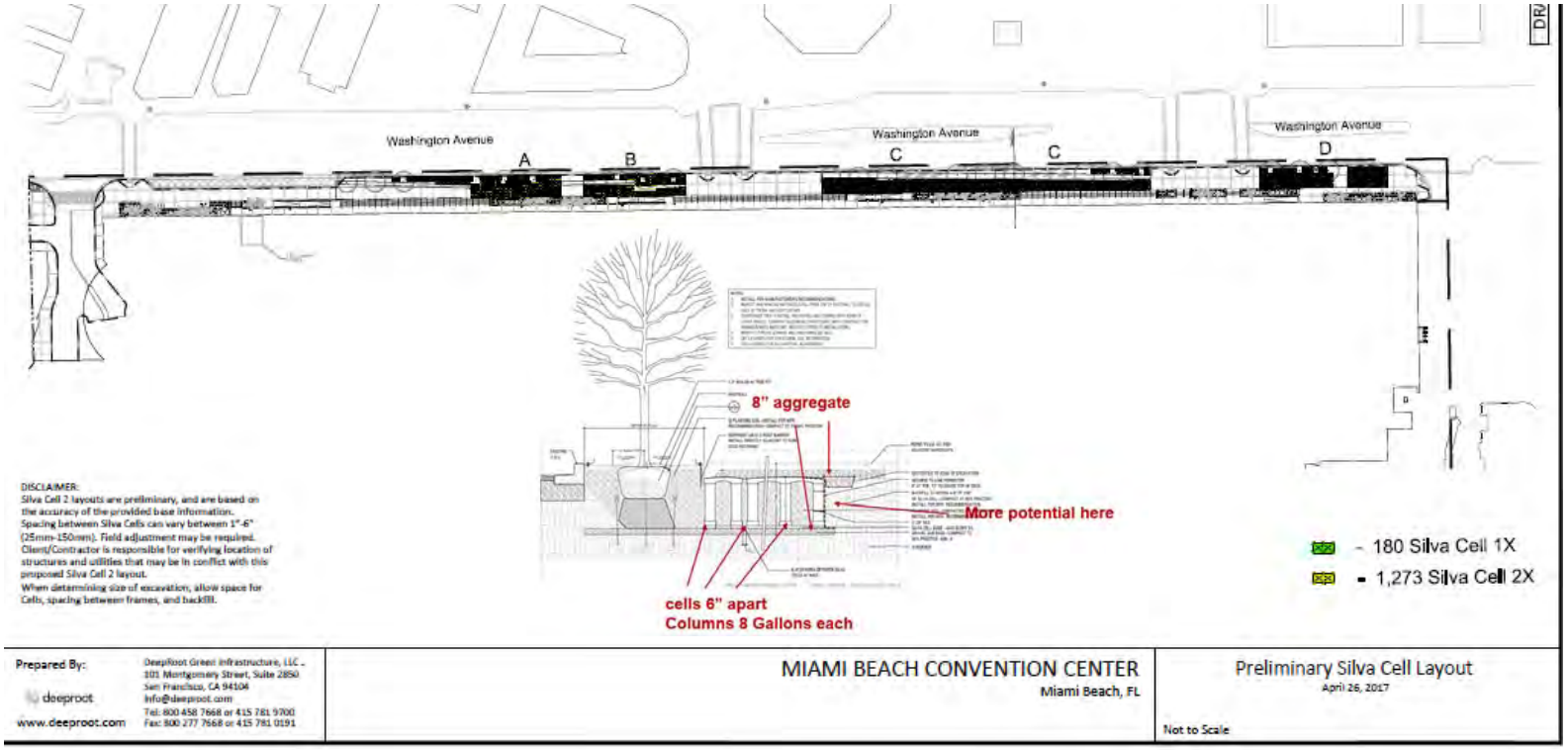
Stormwater Potential MBCC- Washington Avenue

1271 2x systems
7626 columns
8 gallons each
61,008 gallons

Max area 14,298 ft2
6” ponding 7150 ft3
53,485 gallons
8 inches CA
1123.5ft3
4196 gallons

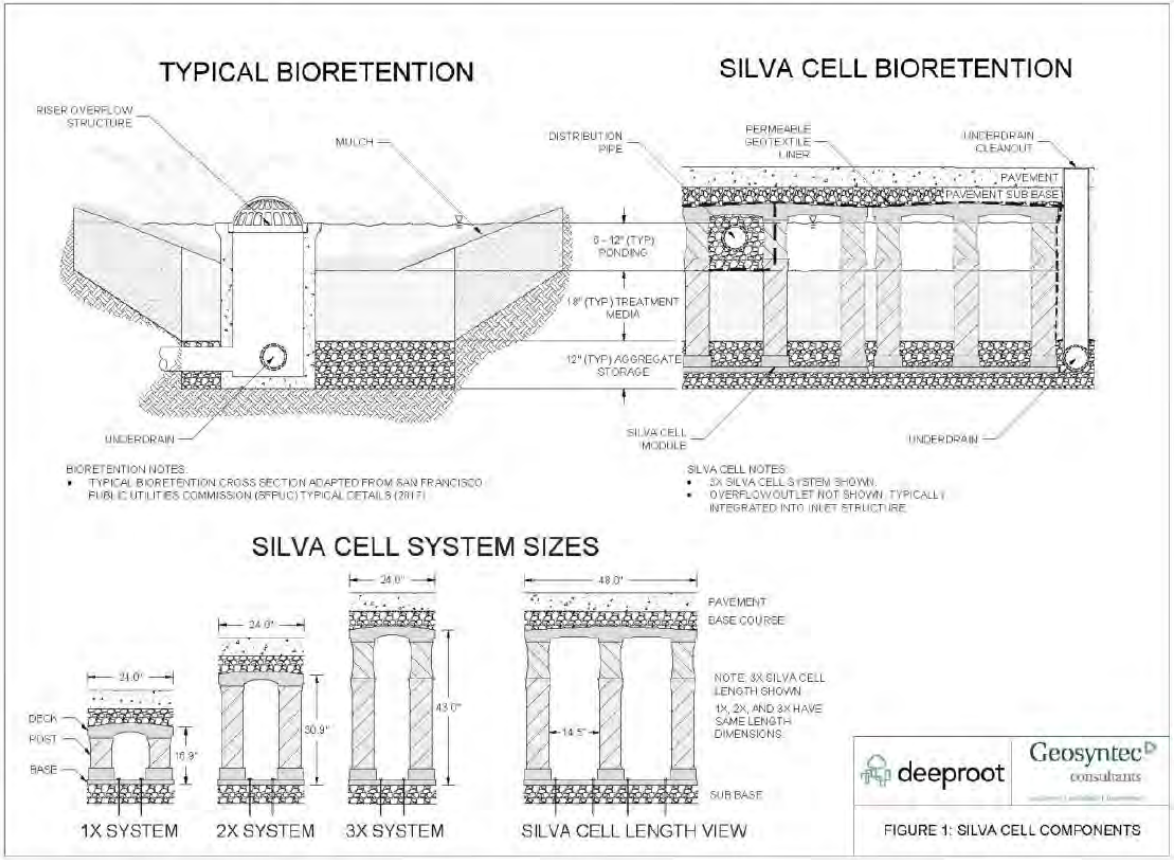
Total SW volume:
118, 689 gallons

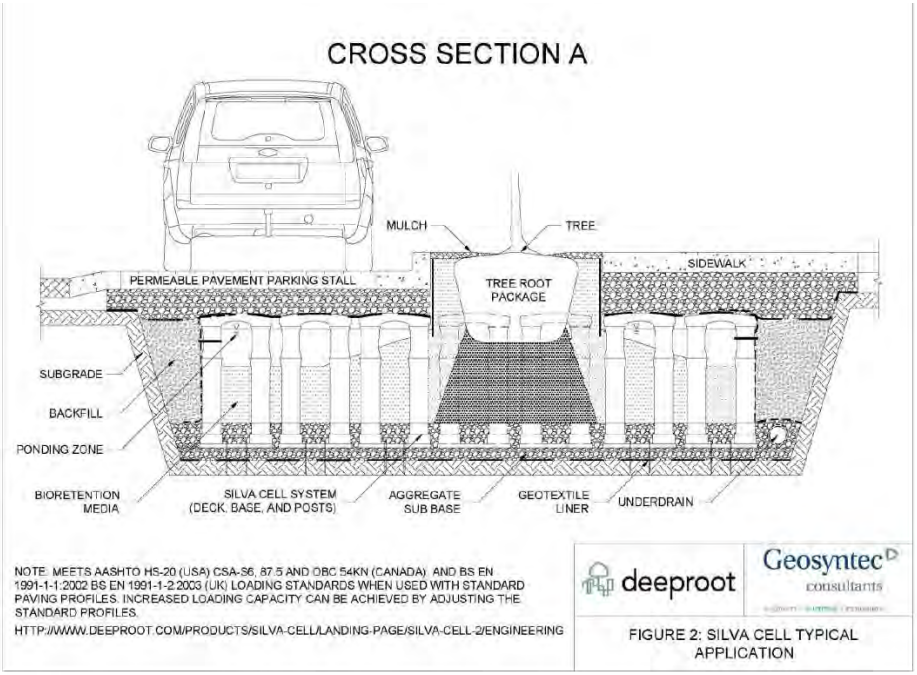
Plus similar configuration
On Convention Center Drive



deeproot

Traditional Bioretention Rethought





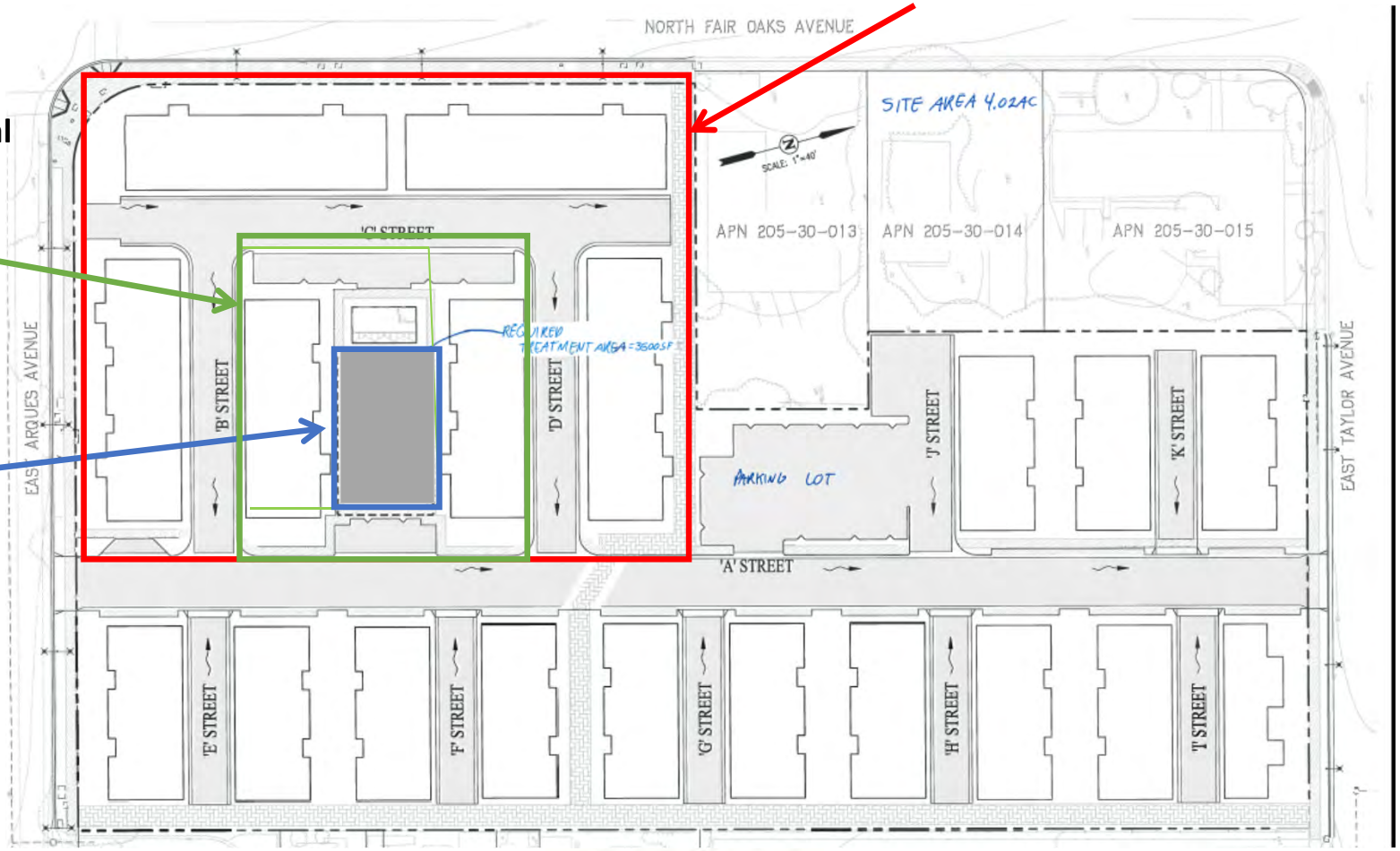
deeproot

East Arques Ave, Sunnyvale, California

4 acres catchment area

Approx Original Stormwater Pond Area

Central Plaza and Silva Cell Treatment Area (3500ft2)



East Arques Ave, Sunnyvale, California

deeproot

East Arques Ave, Sunnyvale, California

deeproot

NCSU- Modeling Quality and Volume

deeproot

NC STATE UNIVERSITY

Bio&Ag ENGINEERING

NCDENR

KestrelDesignGroup

CITY OF WILMINGTON NORTH CAROLINA

deeproot

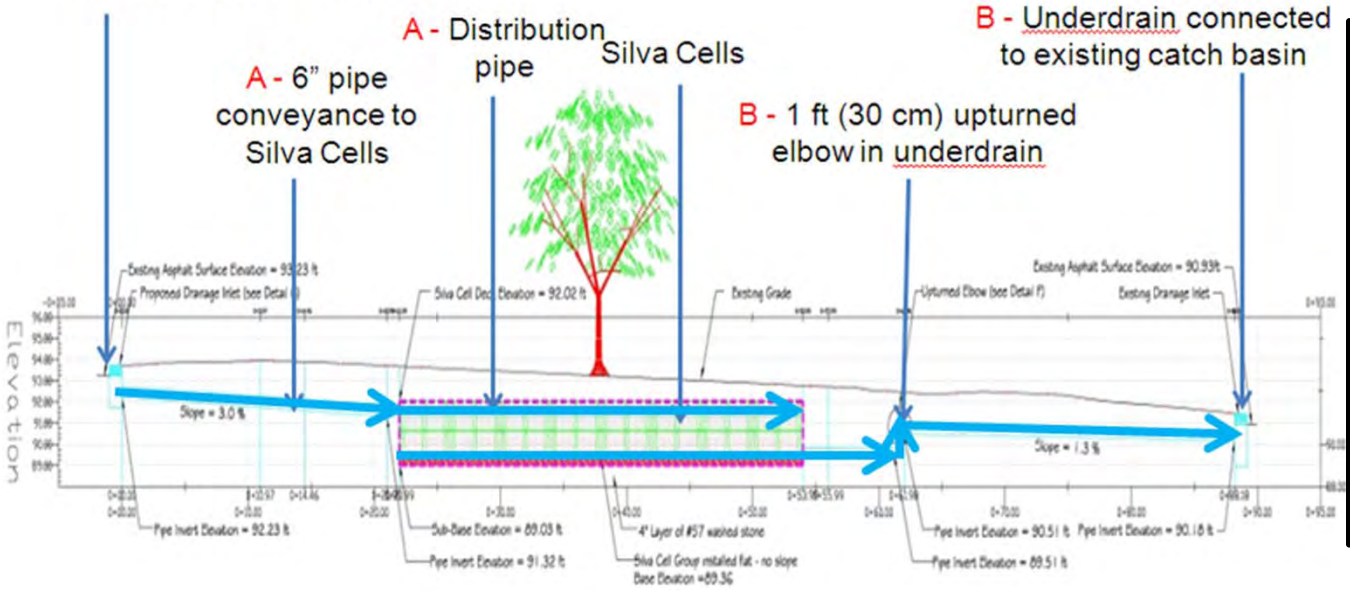
NCSU- Test site install

deeproot

NCSU Silva Cell Schematic & Install

Stormwater Routing Cross Section

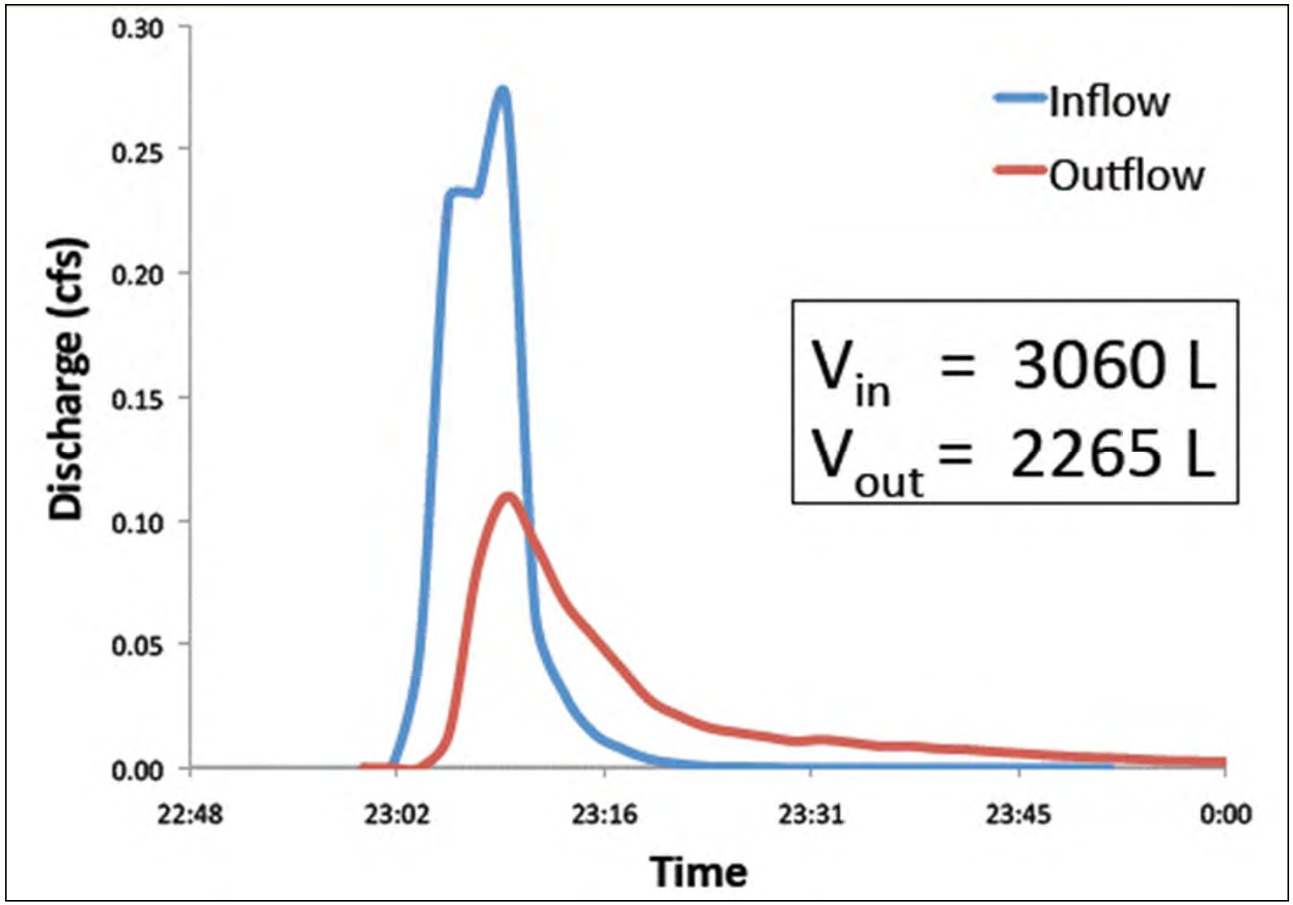
A - New catch basin with sump along curb line at upslope end of system



deeproot

NCSU- Typical Data-Volume

Hydrograph from 12.7 mm (0.5 in) storm on 9/6/12, Ann Street (typical street tree soil),

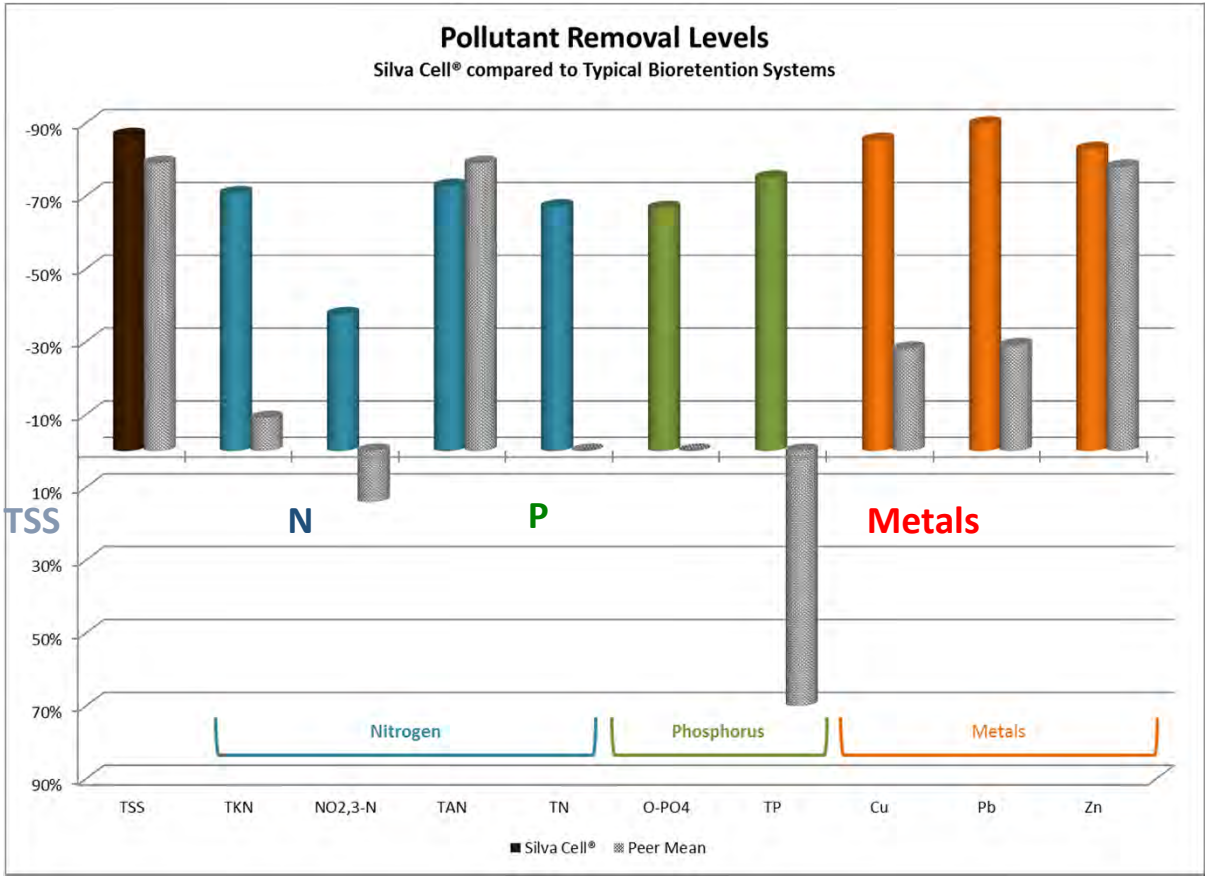


Source: Page, J.L., R.J. Winston, and W.F. Hunt, III. 2013. Field Monitoring of Two Silva Cell™ Installations in Wilmington, North Carolina: Preliminary Monitoring Report.

deeproot

Demonstrated pollutant removal

- 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
  - Very Good TSS removal



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.

deeproot

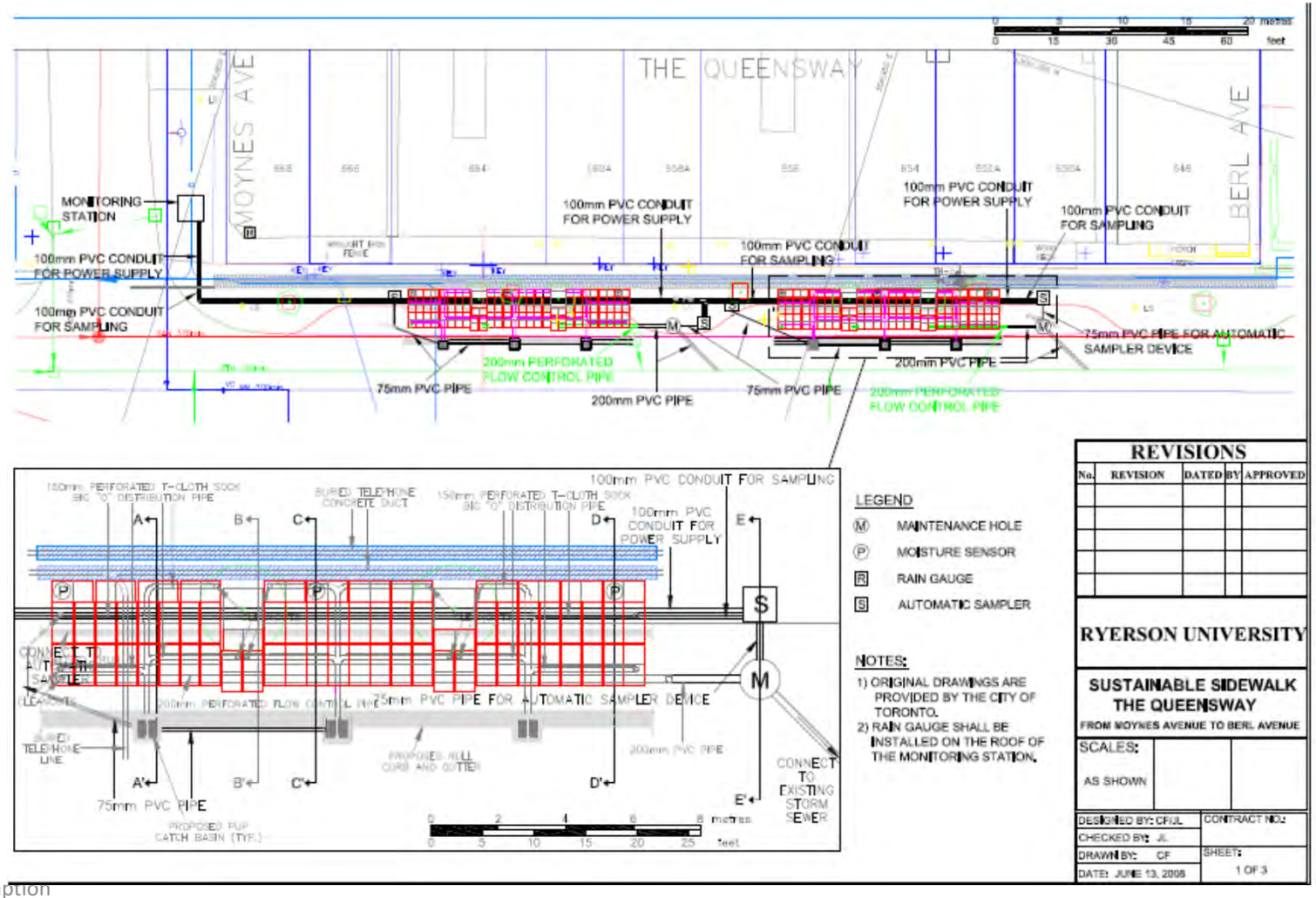
City of Toronto and Toronto Water Demonstration Site - 2008

Rainwater catchment area for the Silva Cells

Parking Bay Silva Cell trenches

deeproot

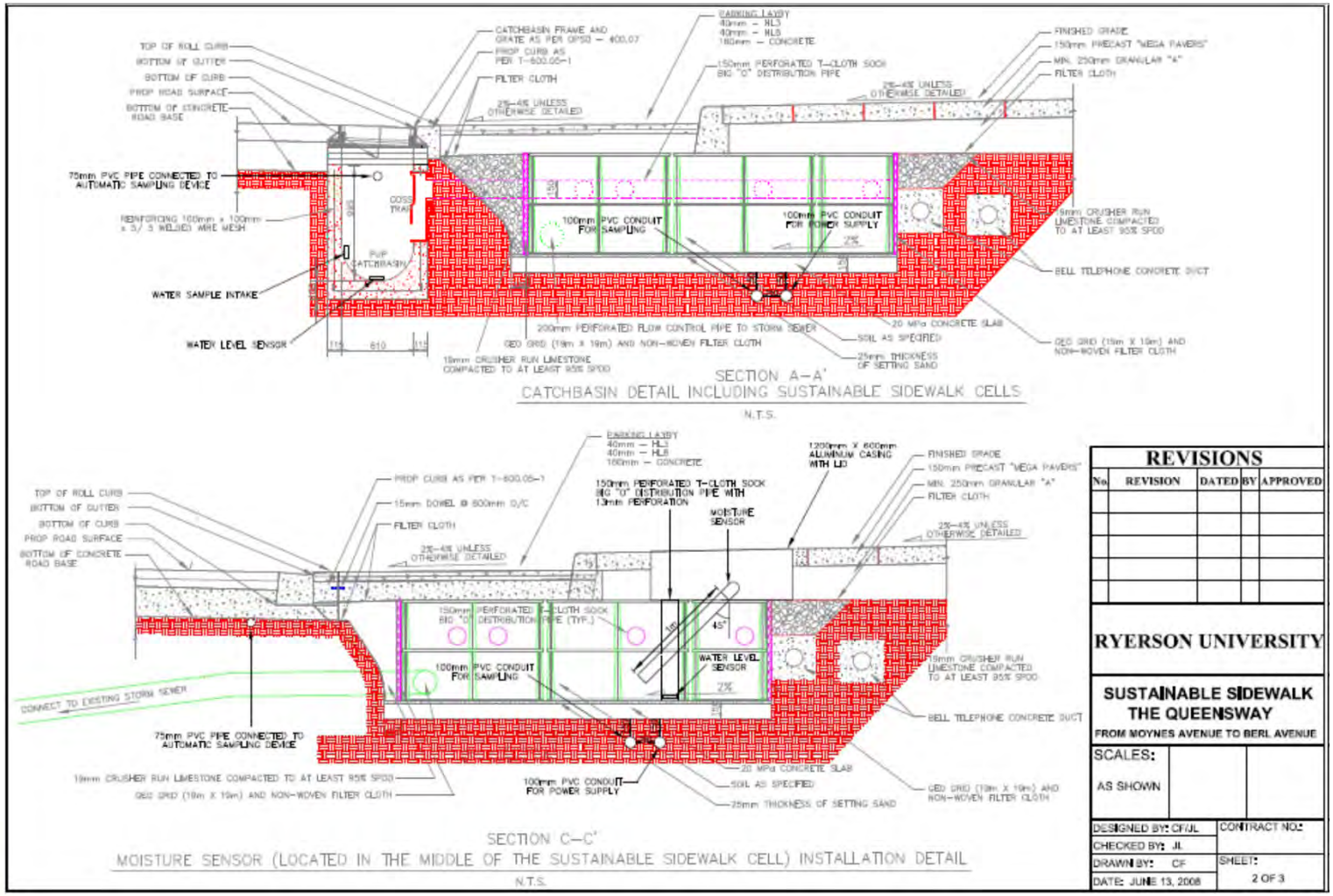
City of Toronto and Toronto Water Demonstration Site - 2008



deeproot

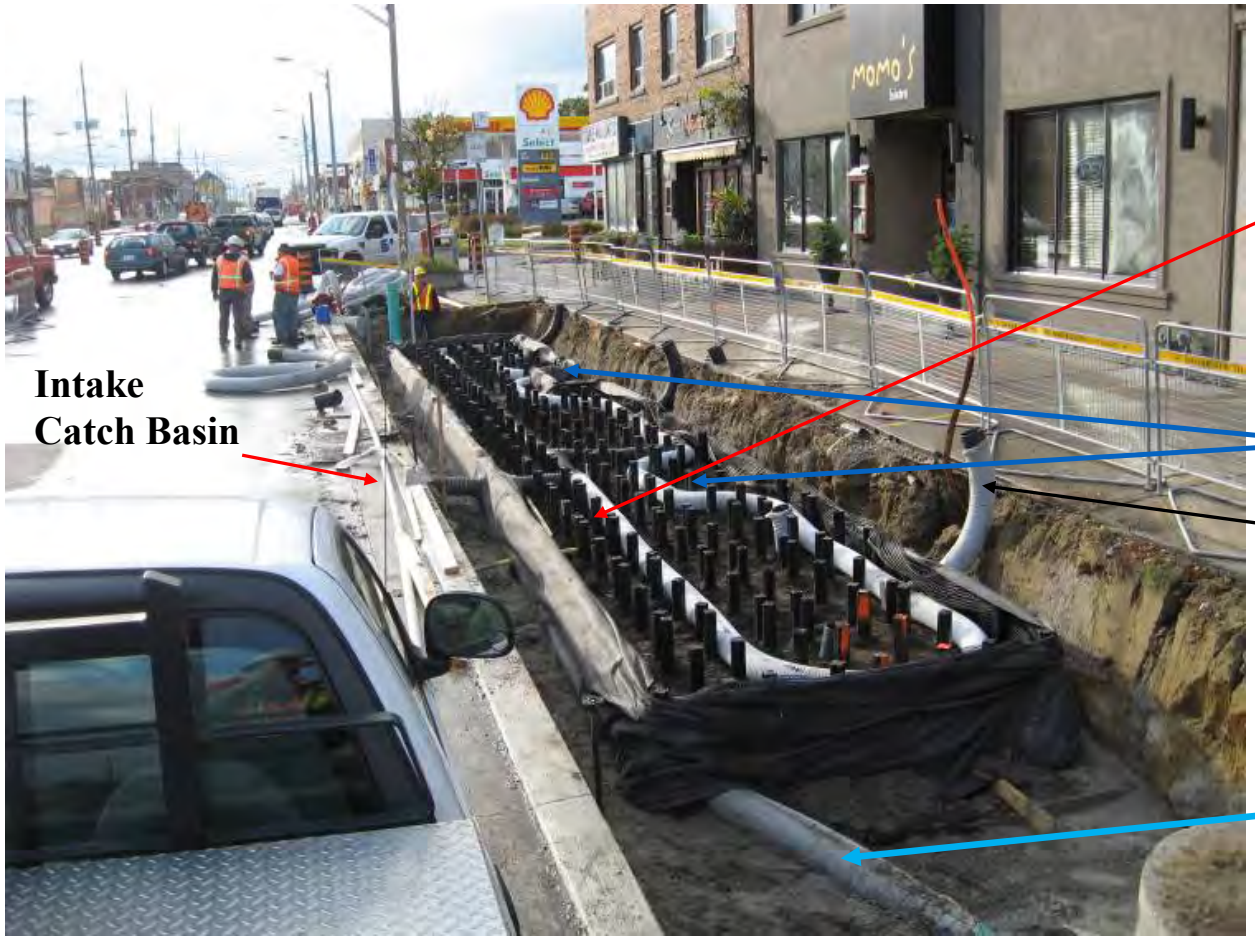
caption

City of Toronto and Toronto Water Demonstration Site - 2008



deeproot

City of Toronto and Toronto Water Demonstration Site - 2008



deeproot

City of Toronto and Toronto Water Demonstration Site - 2008

July 2010

1.5 years old

deeproot

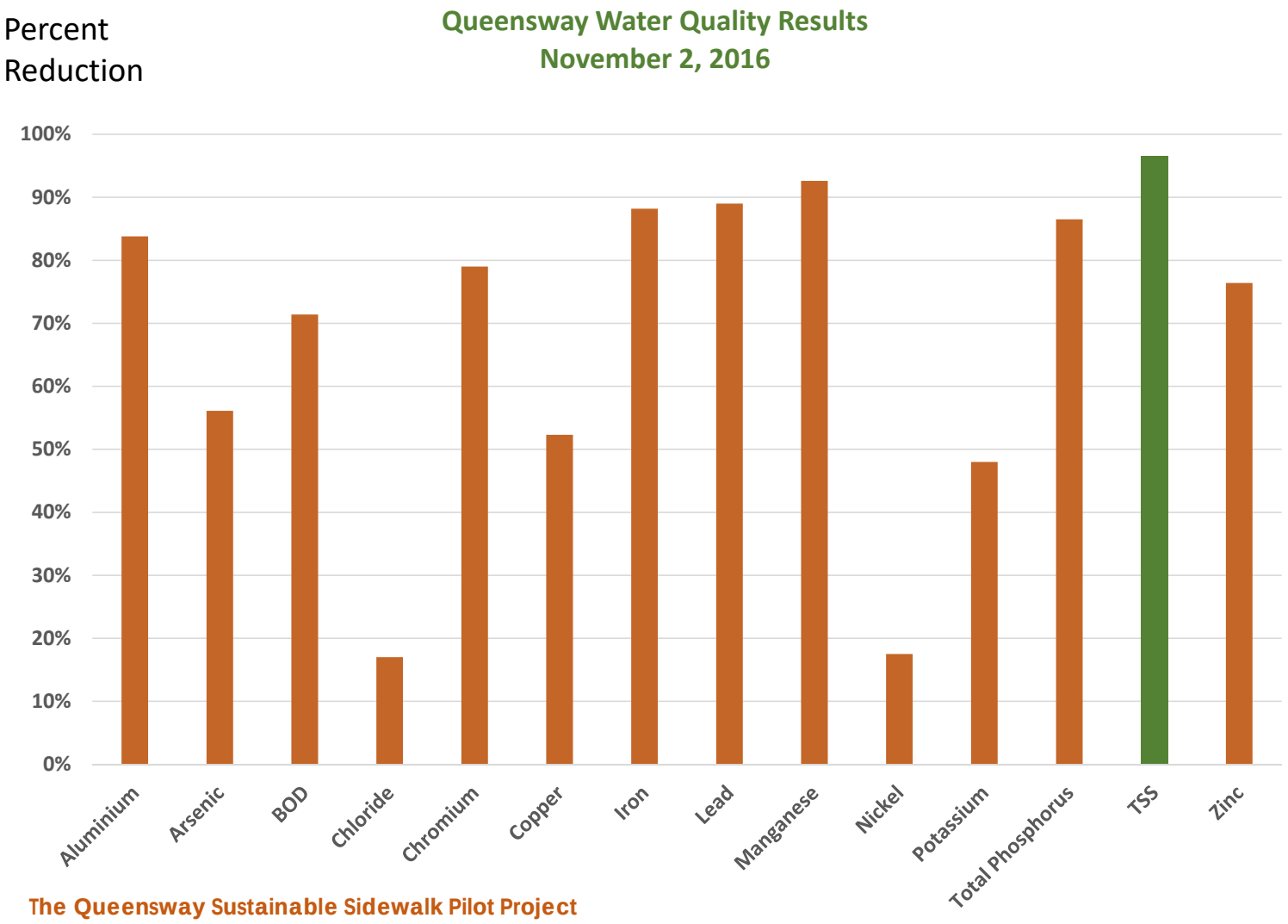
City of Toronto and Toronto Water Demonstration Site - 2013

deeproot


10 Years Later
2008
Same tree, 10 years later
2018
The Queensway Sustainable Sidewalk Pilot Project
TORONTO Water

caption

Storm Event Characteristics	Small Event	Large Event
Date	June 12, 2015	June 22-23, 2015
Total Rainfall Depth (mm)	4.20 (on-site rain gauge),	19.40 (on-site rain gauge),
Total Rainfall Volume (m^3)	1.62 (on-site rain gauge),	7.47 (on-site rain gauge),
Rain Duration (min)	289	336
Peak Intensity (mm/hr)	12.24	76.20


Percent Reduction
Queensway Water Quality Results
November 2, 2016
100%
90%
80%
70%
60%
50%
40%
30%
20%
10%
0%
Aluminium
Arsenic
BOD
Chloride
Chromium
Copper
Iron
Lead
Manganese
Nickel
Potassium
Total Phosphorus
TSS
Zinc

Pennsylvania Garage, Miami Beach

deeproot

Hyde Park Village, Tampa

deeproot

Thank you!

Albert L. Key, Jr Aff. M. ASCE
alkey@deeproot.com
M (917)991-3121
DeepRoot Green Infrastructure, Inc.
@alkey896

709 Alton, Miami Beach