

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



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



# What is Suspended Pavement?



Traditional planting



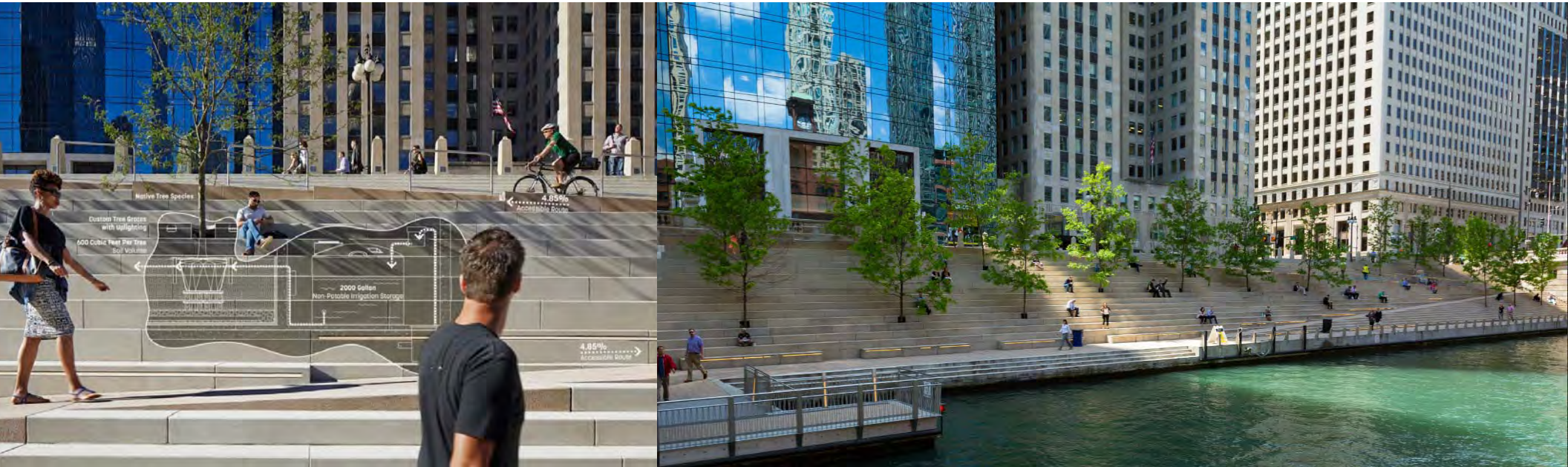
Design for maturity

## 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

# Custom Systems



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

Silva Cell 2- 2015-??



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

ULTIMATE WHEEL LOAD BY STANDARD PAVEMENT TYPE

Silva Cell 2 System Type	Traffic Loading Standard	Pavers	Asphalt	Concrete	Pavers with Concrete
		3.15" pavers 1" sand base 12" of aggregate	4" of asphalt 12" of aggregate	4" of concrete 4" of aggregate	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

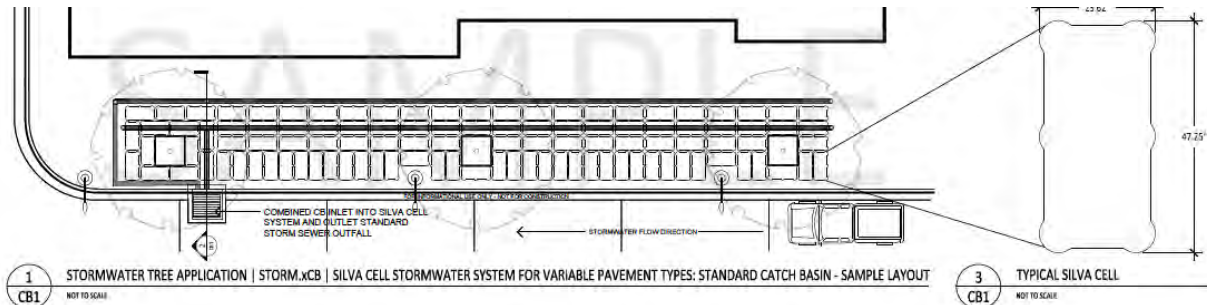


Independent engineering report available on our website

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

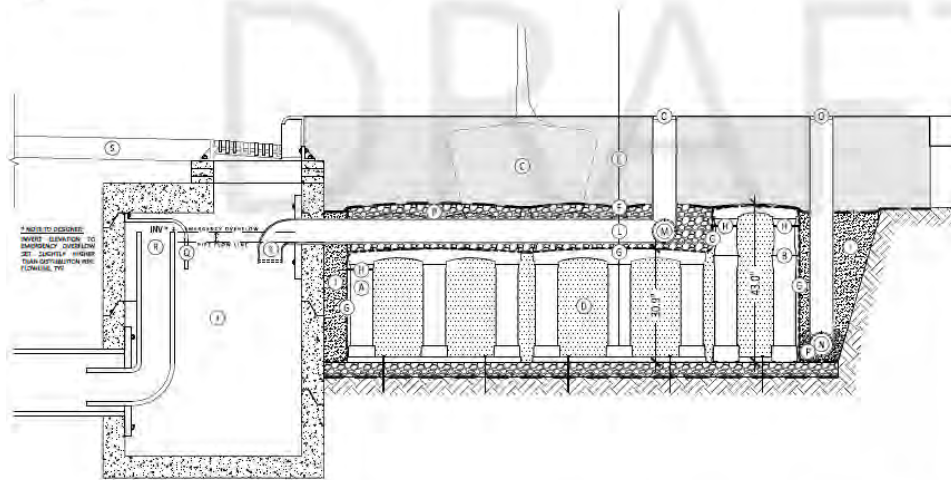


# Storm Water Detail Typical



**1** STORMWATER TREE APPLICATION | STORM.xCB | SILVA CELL STORMWATER SYSTEM FOR VARIABLE PAVEMENT TYPES: STANDARD CATCH BASIN - SAMPLE LAYOUT  
 NOT TO SCALE

**3** TYPICAL SILVA CELL  
 NOT TO SCALE



**2** STORMWATER TREE APPLICATION | STORM.xCB | SILVA CELL STORMWATER SYSTEM FOR VARIABLE PAVEMENT TYPES: CATCH BASIN - SECTION  
 NOT TO SCALE

**KEY PLAN**

- (A) 2x SILVA CELL SYSTEM (DECK, BASE, AND POSTS)
- (B) 3x SILVA CELL SYSTEM (DECK, BASE, AND POSTS)
- (C) TREE IN STORMWATER SILVA CELL SYSTEM, SIZE VARIES
- (D) BIORETENTION PLANTING SOIL, PER PROJECT
- (E) PAVEMENT SECTION, PER PROJECT
- (F) GEOTEXTILE 18" MIN OVERLAP PAST EXCAVATION
- (G) GEOGRID, PER PROJECT SPECIFICATION. MAX. APERTURE SIZE DETERMINED BY AGGREGATE CLEAR STONE Ø FOR STORMWATER DISTRIBUTION PIPE. ATTACH TO CELL FRAMES WITH CABLE TIES.
- (H) CABLE TIE, ATTACHING GEOGRID TO SILVA CELL LEGS
- (I) BACKFILL, PER PROJECT SPECIFICATIONS
- (J) CATCH BASIN WITH CURB INLET AND GRATE PER PROJECT
- (K) STORMWATER DISTRIBUTION PIPE INLET INTO SILVA CELLS WITH TRASH FILTER, SIZE AND MATERIAL PER PROJECT
- (L) SOLID DISTRIBUTION PIPE INTO SILVA CELL SYSTEM.
- (M) PERFORATED DISTRIBUTION PIPE IN AGGREGATE CLEAR STONE.
- (N) UNDERDRAIN, ENSURE POSITIVE DRAINAGE TO STORMWATER OUTFALL
- (O) CLEANOUT PIPE WITH CAP, PER PROJECT AND PER CITY STANDARDS. SECURE TO PAVEMENT AT SURFACE
- (P) CLEAR STONE AGGREGATE, PER PROJECT
- (Q) PIPE HOOD
- (R) CATCH BASIN OUTLET, SIZE AND INVERT ELEVATION PER PROJECT TO PREVENT PRESSURE FLOW DISTRIBUTION INTO SILVA CELL SYSTEM
- (S) ROADWAY

**NOTES**

1. DETAIL TO BE USED IN CONJUNCTION WITH SILVA CELL STANDARD DETAILS, IN ACCORDANCE WITH ALL MANUFACTURER'S SPECIFICATIONS
2. DEEPROOT ACCEPTS NO LIABILITY FOR PROJECT APPLICATION OF DETAILS SHOWN

DeepRoot Green Infrastructure - USA
   
 101 Montgomery Street, Suite 2850
   
 San Francisco, CA 94104
   
 www.deeroot.com
   
 T. 415 781 9700
   
 F. 415 781 0191

JAMES URBAN, P.A.S.L.A.
   
 315 Owell Drive
   
 Annapolis, MD 21403
   
 410 263 6899 | www.jamesurban.net

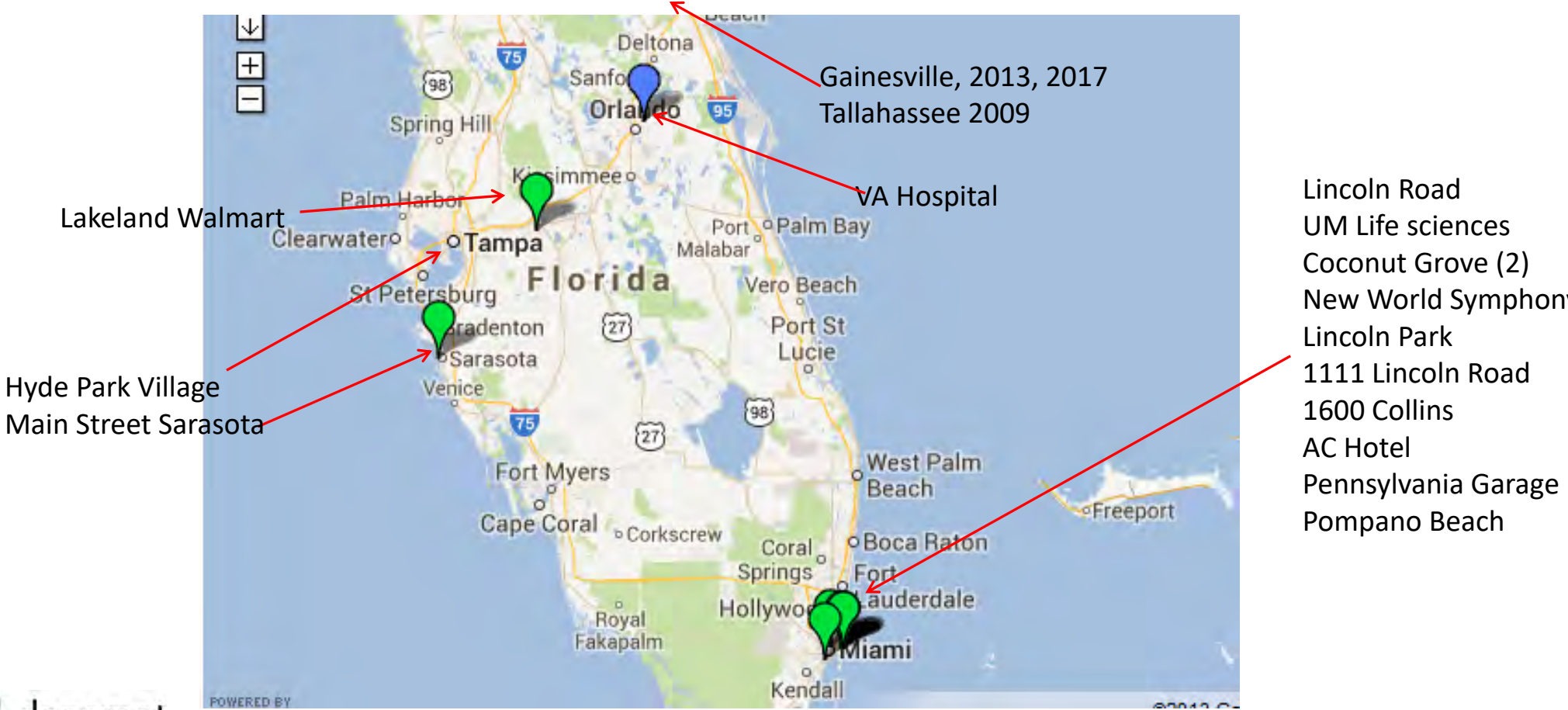
STORM.xCB
   
 7316 Owell Lane
   
 Annapolis, MD 21408
   
 410 263 6899
   
 www.stormxcb.com

**SILVA CELLS FOR STORMWATER TREE APPLICATIONS**
  
 (STORM.xCB) Silva Cell Stormwater System For Variable Pavement Types: Catch Basin
   
 FOR INFORMATION ONLY ONLY ONLY - NOT FOR CONSTRUCTION

SECTION 25.00 - STORMWATER TREES
   
**STORM.xCB**

SHEET 1 OF 1
   
 SCALE: 1/4" = 1'-0"
   
**CB.1**

# 65 FL Projects

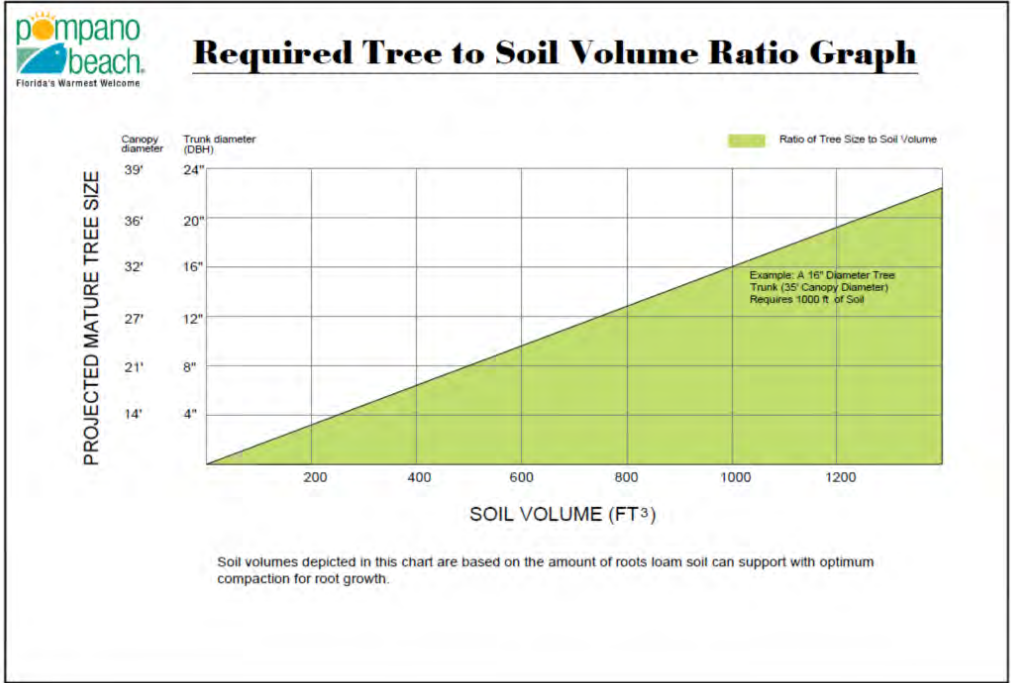




# Pompano Beach TOD Standard



Pompano Beach Parking Facility



# 2018 Miami Beach Convention Center

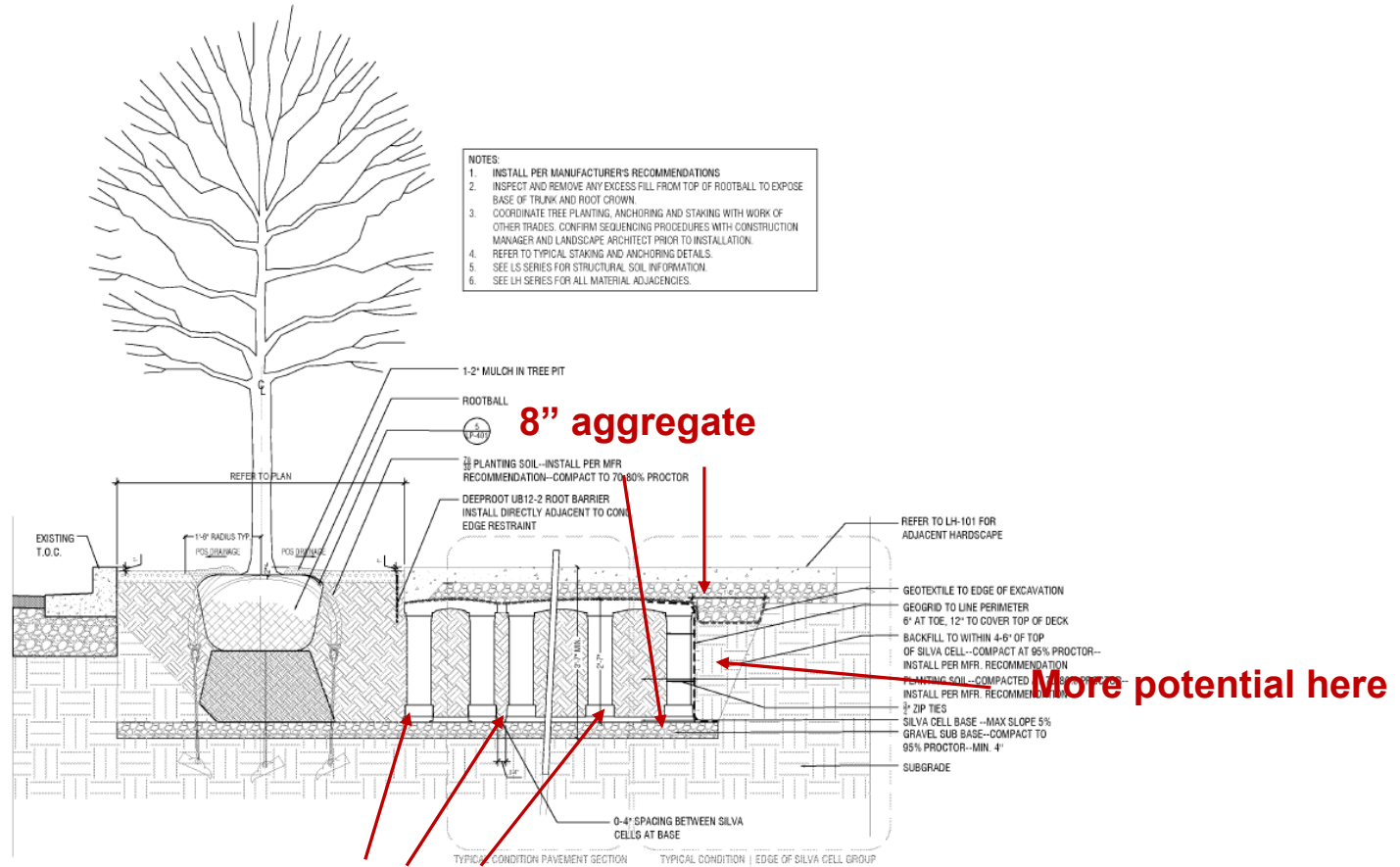


February



June

# MBCC- Typical Section- SW potential



**cells 6" apart  
Columns 8 Gallons each**

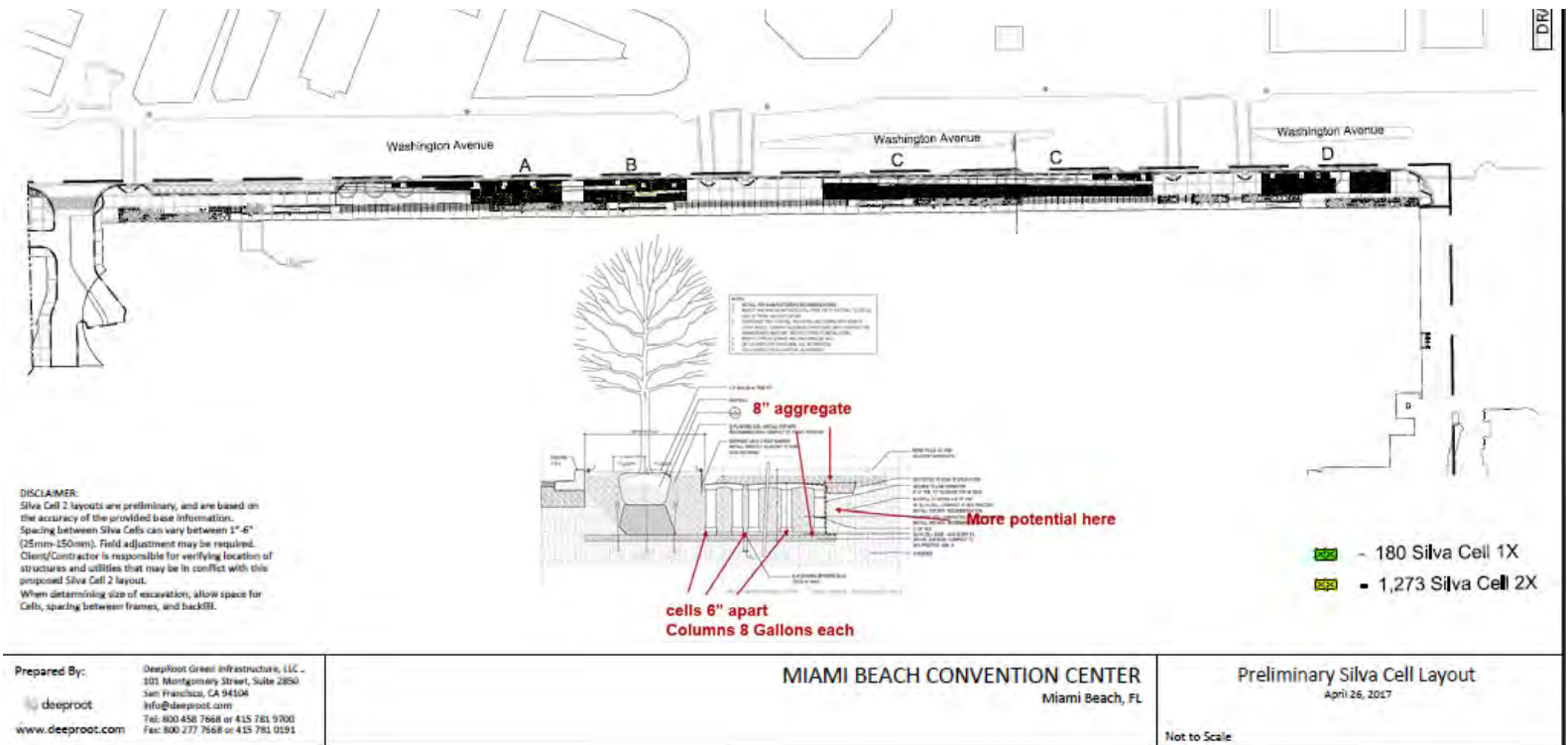
# Stormwater Potential MBCC- Washington Avenue

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

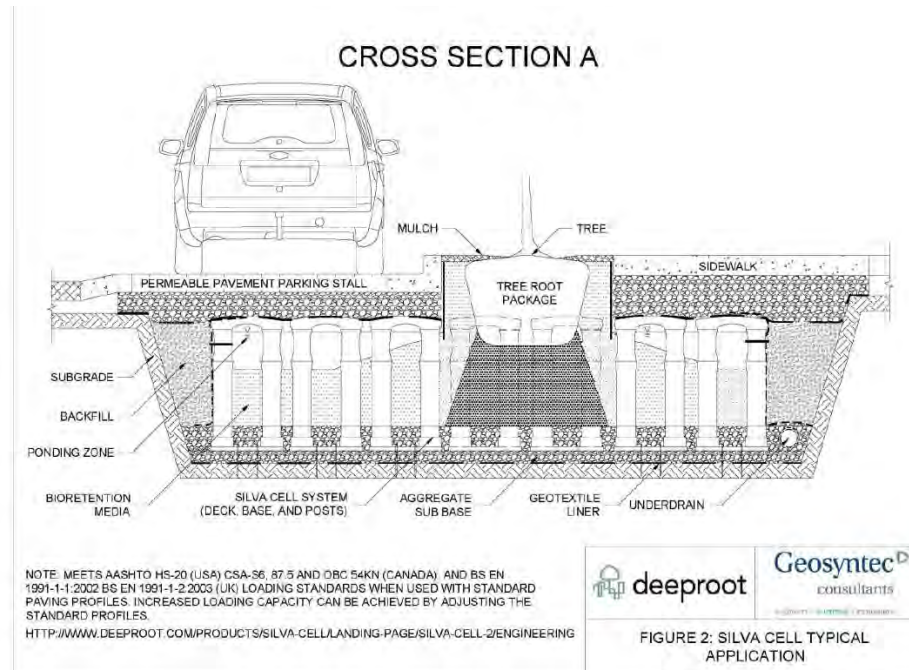
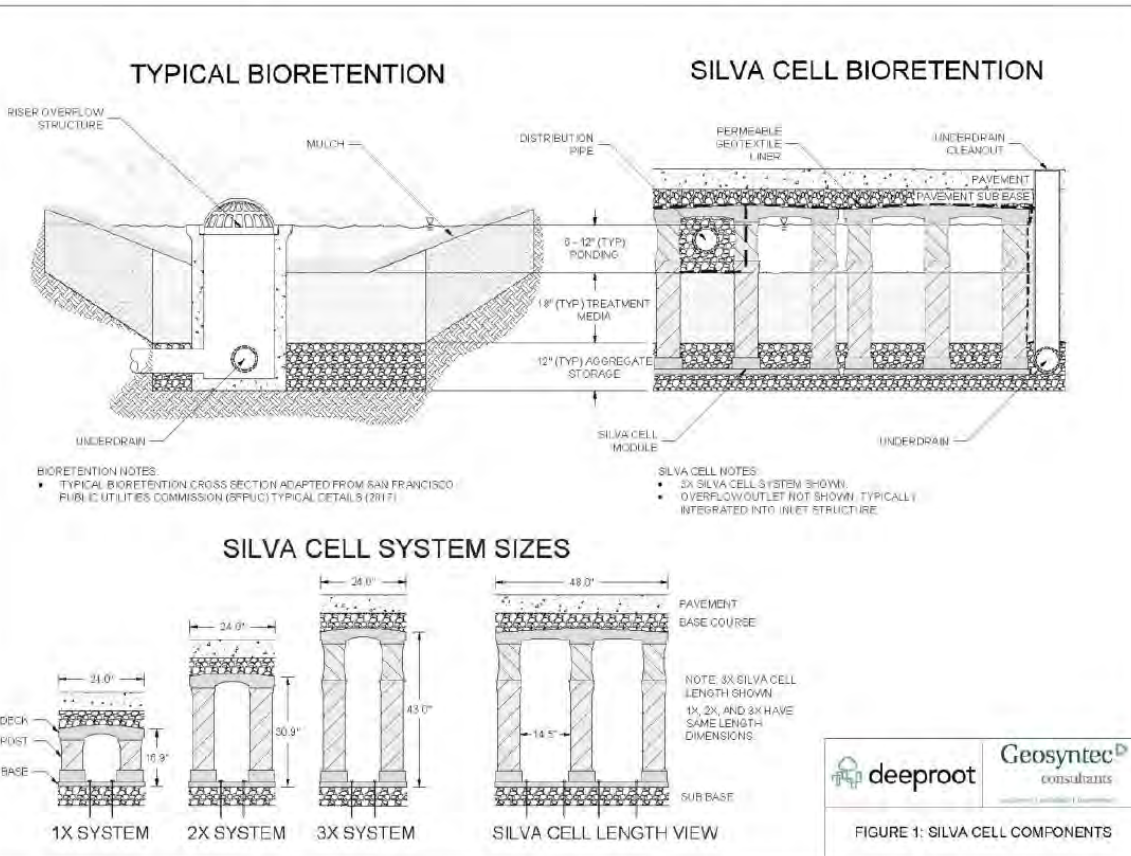
Max area 14,298 ft<sup>2</sup>  
 6" ponding 7150 ft<sup>3</sup>  
 53,485 gallons  
 8 inches CA  
 1123.5ft<sup>3</sup>  
 4196 gallons

Total SW volume:  
 118, 689 gallons

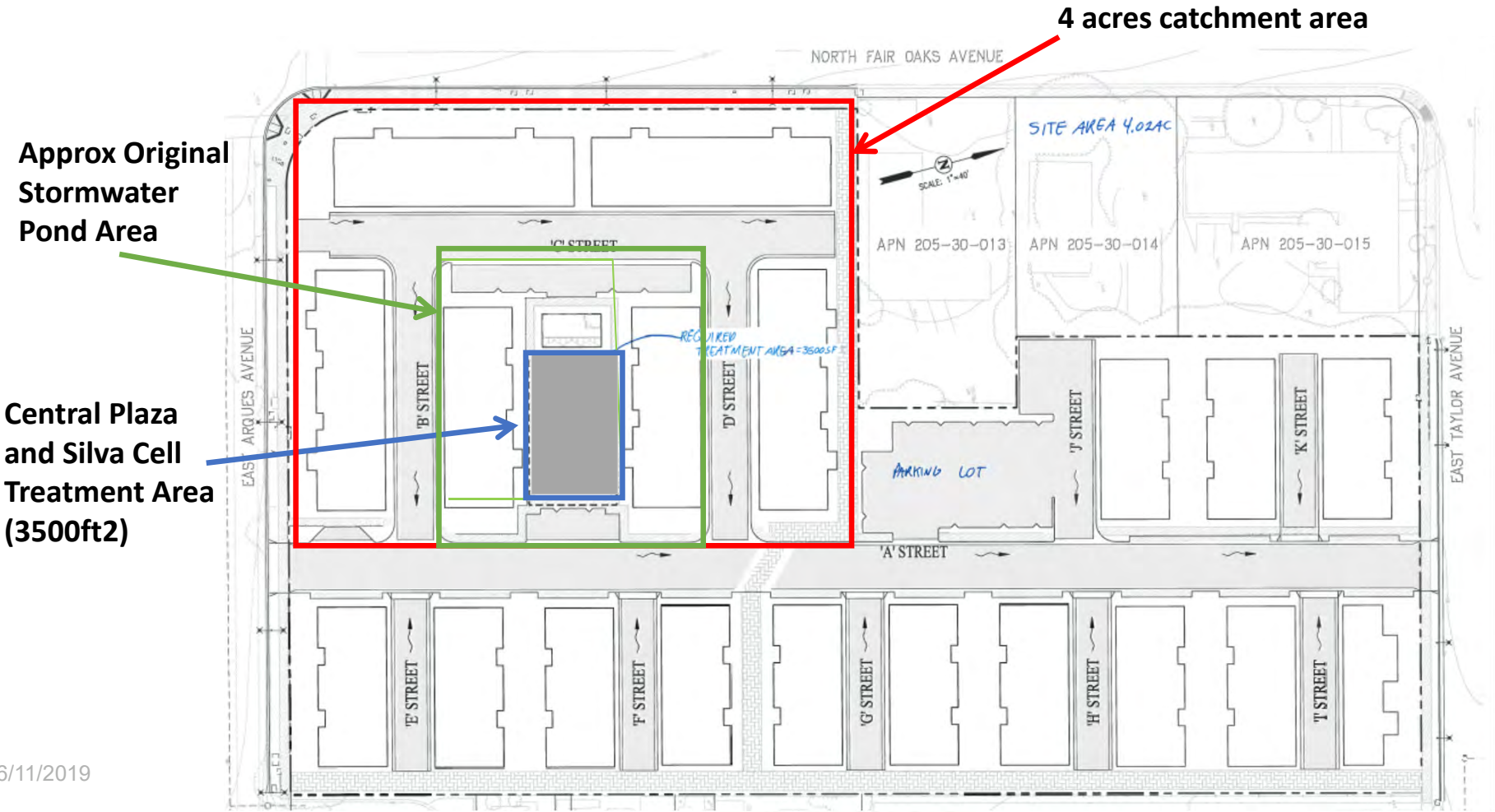
Plus similar configuration  
 On Convention Center Drive



# Traditional Bioretention Rethought



# 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



# East Arques Ave, Sunnyvale, California





# NCSU- Modeling Quality and Volume



NC STATE UNIVERSITY



## NCSU- Test site install



# NCSU Silva Cell Schematic & Install

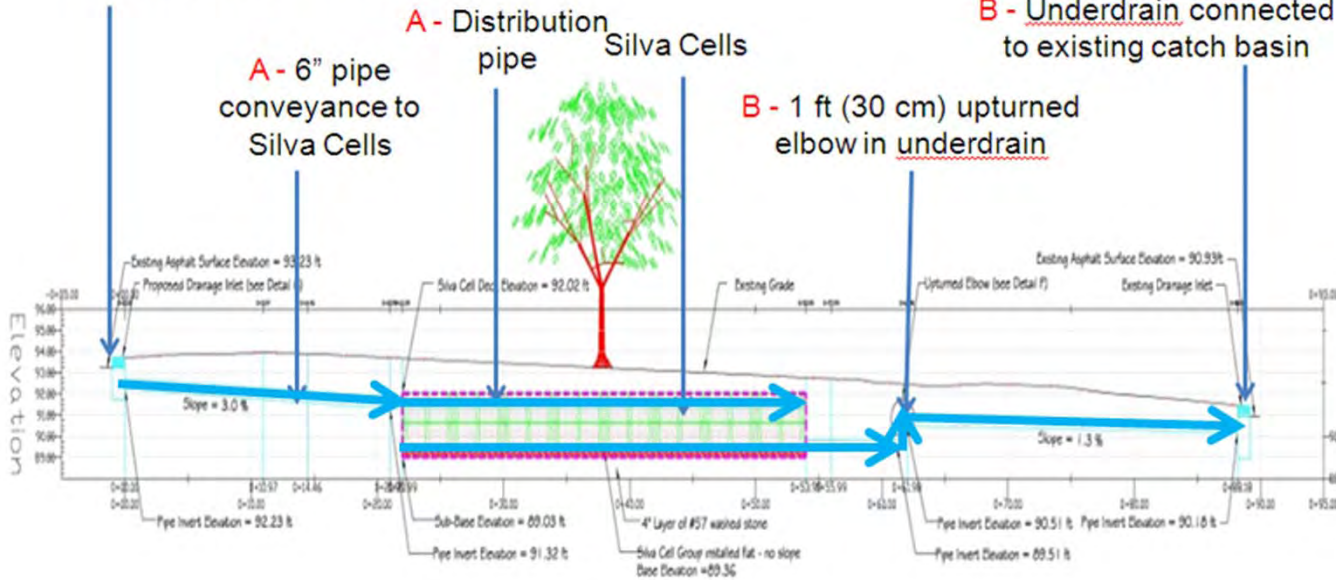
## Stormwater Routing Cross Section

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

**B -** Underdrain connected to existing catch basin

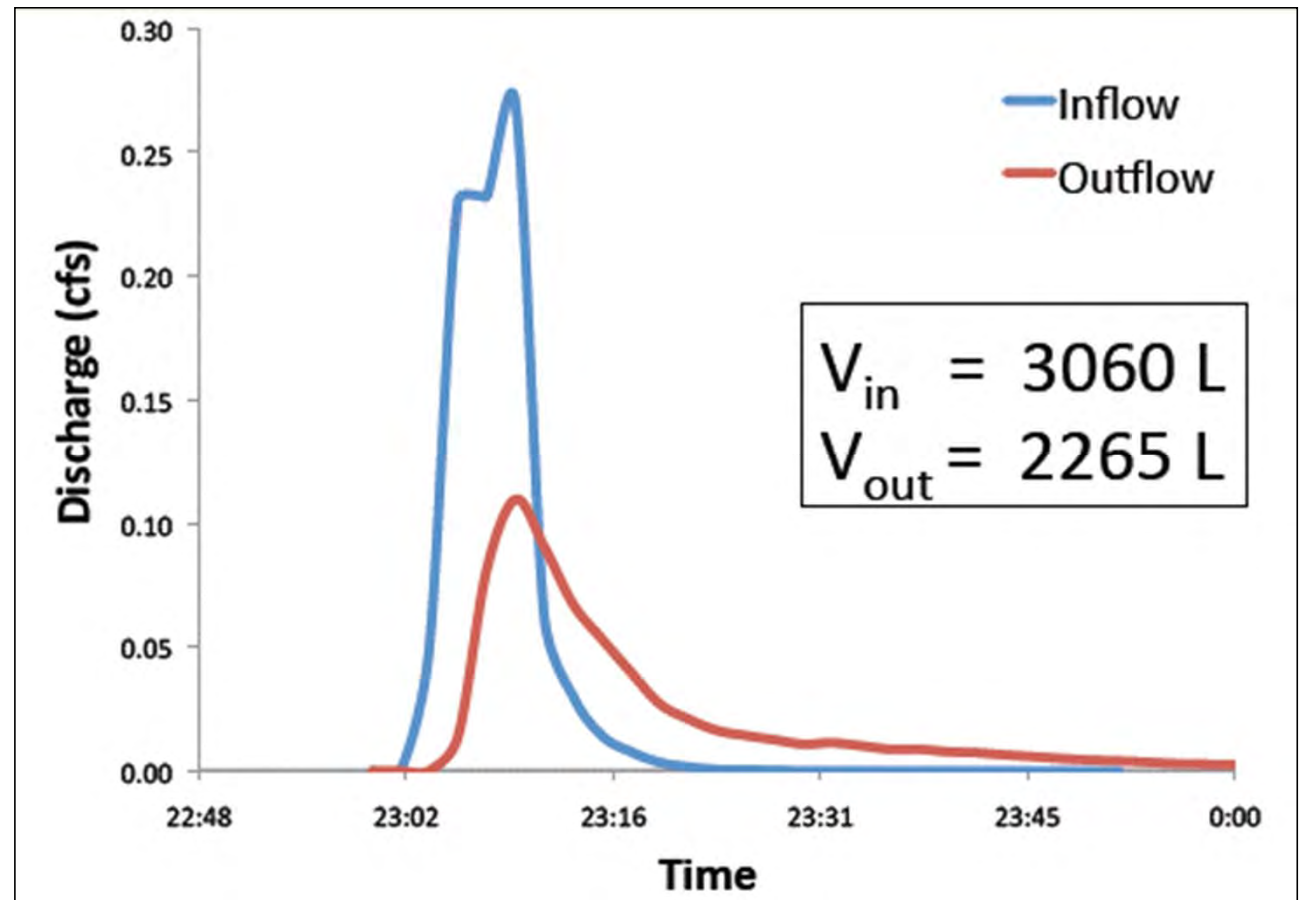
**A -** 6" pipe conveyance to Silva Cells  
**A -** Distribution pipe  
Silva Cells

**B -** 1 ft (30 cm) upturned elbow in underdrain



## NCSU- Typical Data-Volume

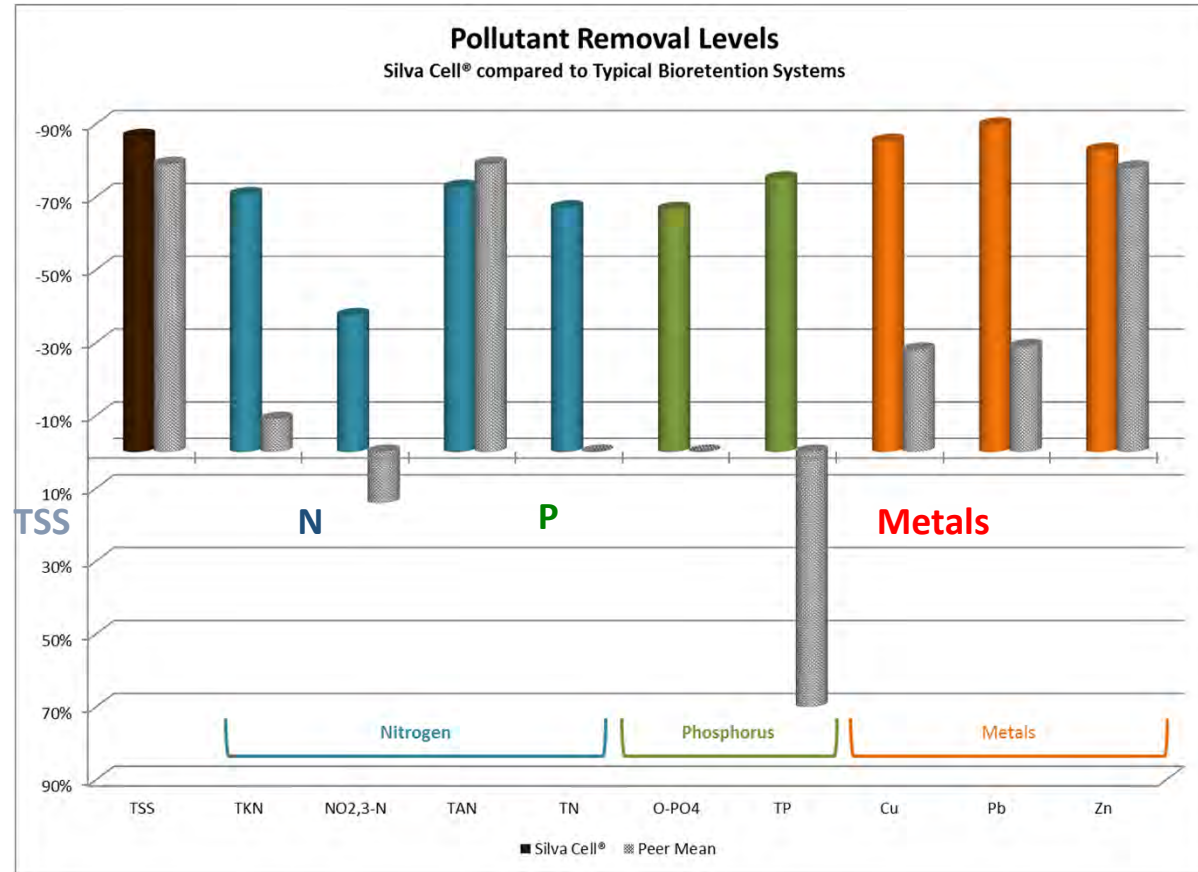
Hydrograph from 12.7 mm  
(0.5 in) storm on 9/6/12, Ann  
Street (typical street tree soil),



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.

## 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.

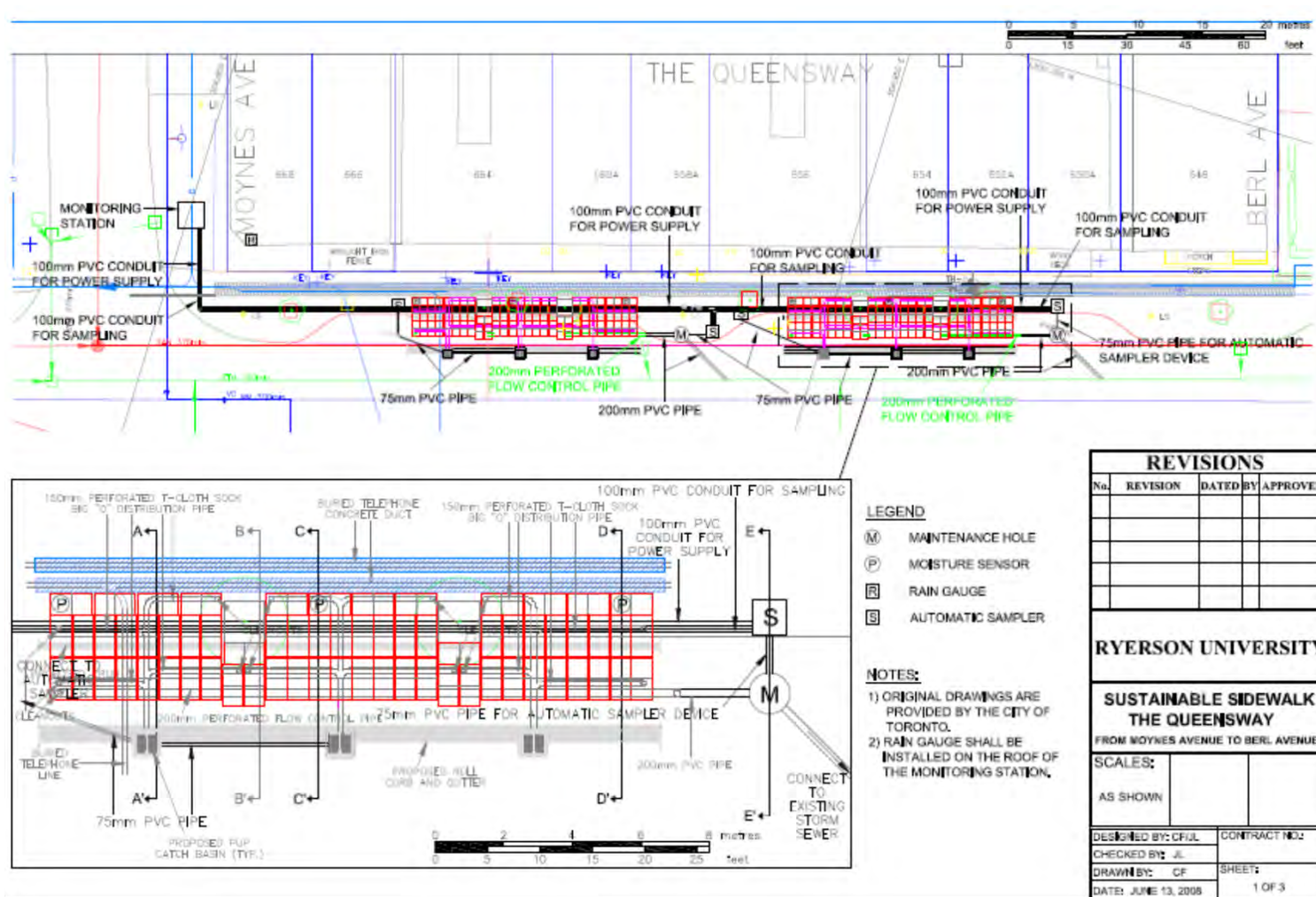
# City of Toronto and Toronto Water Demonstration Site - 2008



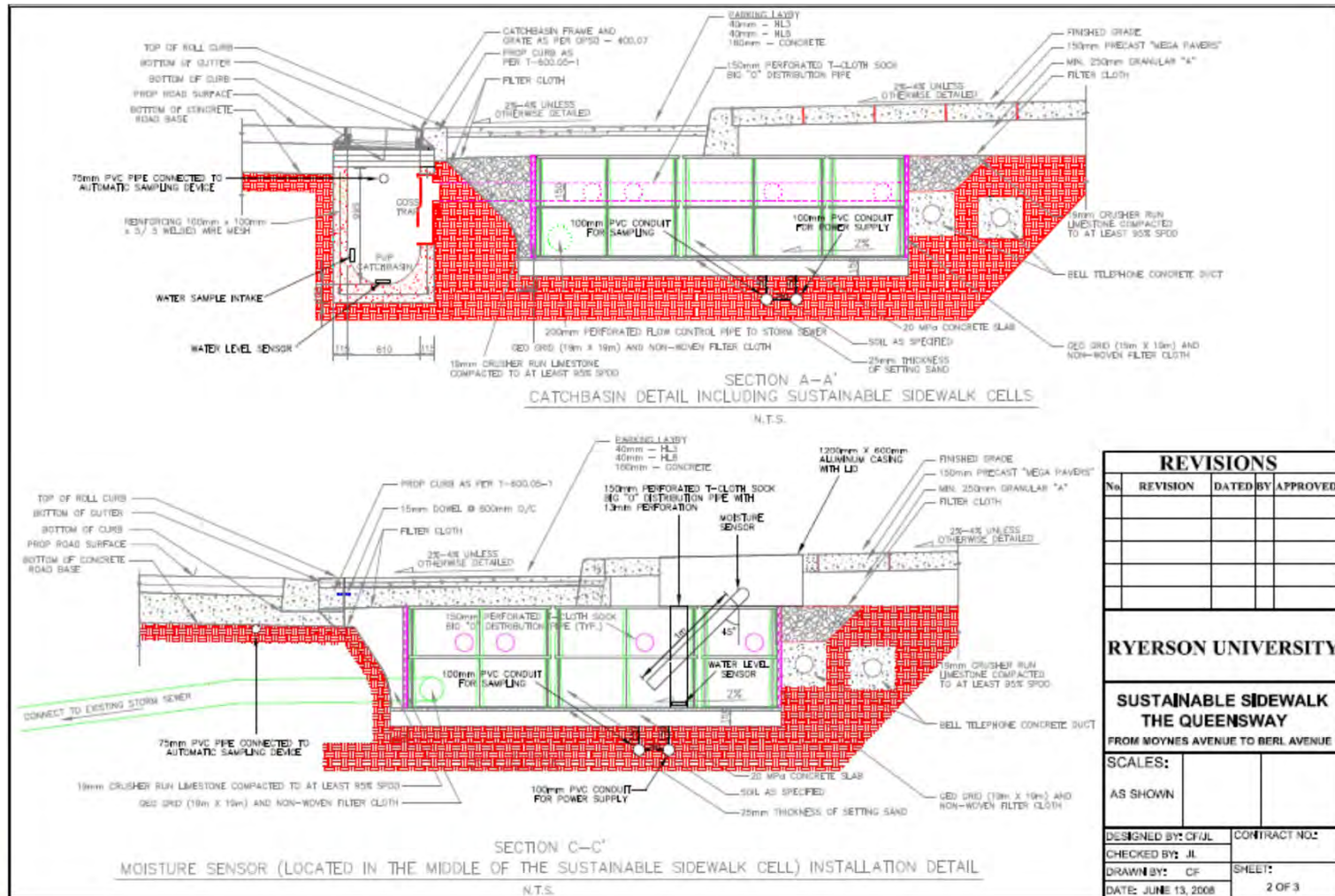
Rainwater catchment area for the Silva Cells

Parking Bay Silva Cell trenches

# City of Toronto and Toronto Water Demonstration Site - 2008

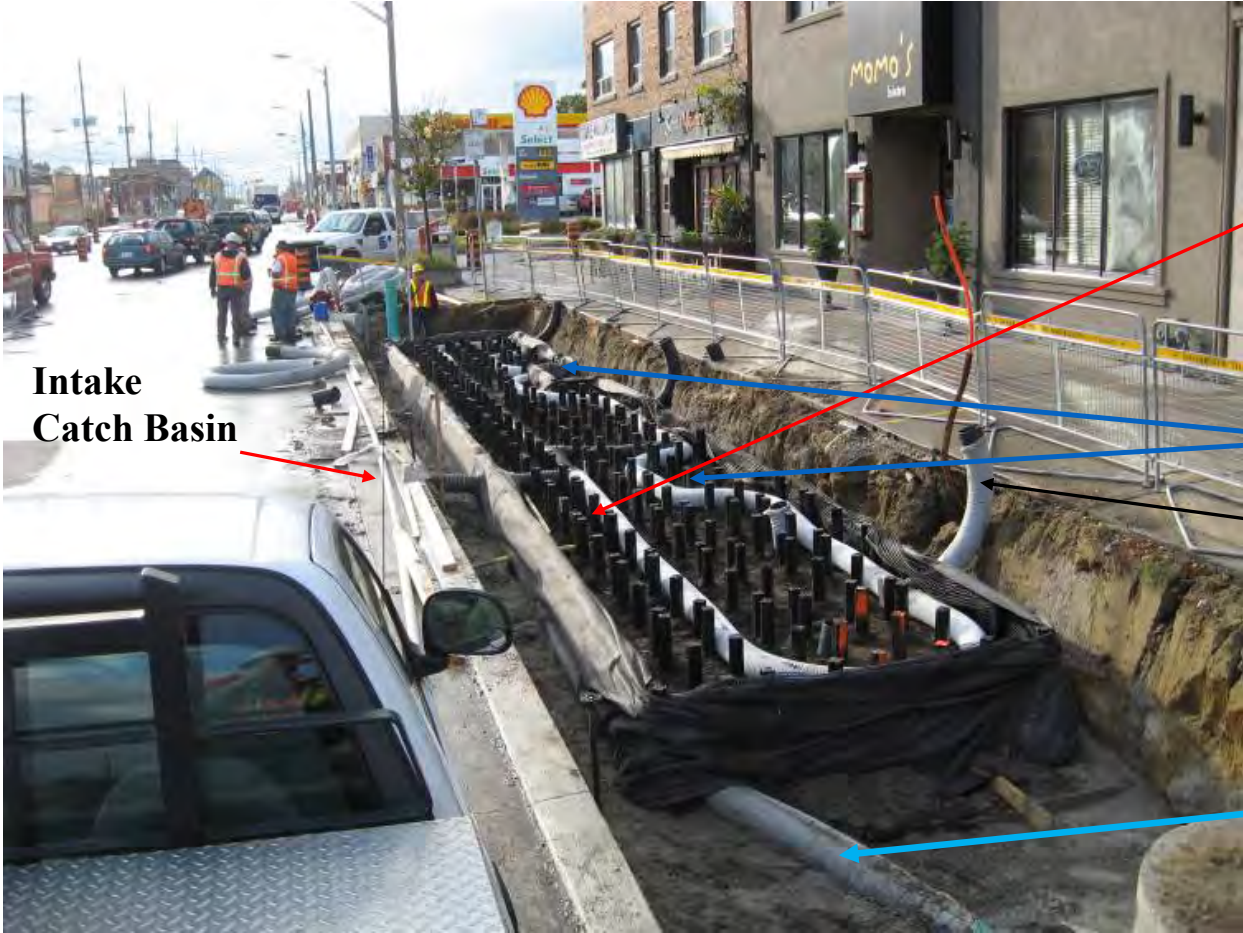


# City of Toronto and Toronto Water Demonstration Site - 2008





# City of Toronto and Toronto Water Demonstration Site - 2008



**Intake  
Catch Basin**

Perforated  
distribution pipe

Tree Pits

Clean out risers

Stormwater  
drains to next CB

# City of Toronto and Toronto Water Demonstration Site - 2008



July 2010

1.5 years old

# City of Toronto and Toronto Water Demonstration Site - 2013



# 10 Years Later



Same tree, 10 years later



caption

The Queensway Sustainable Sidewalk Pilot Project

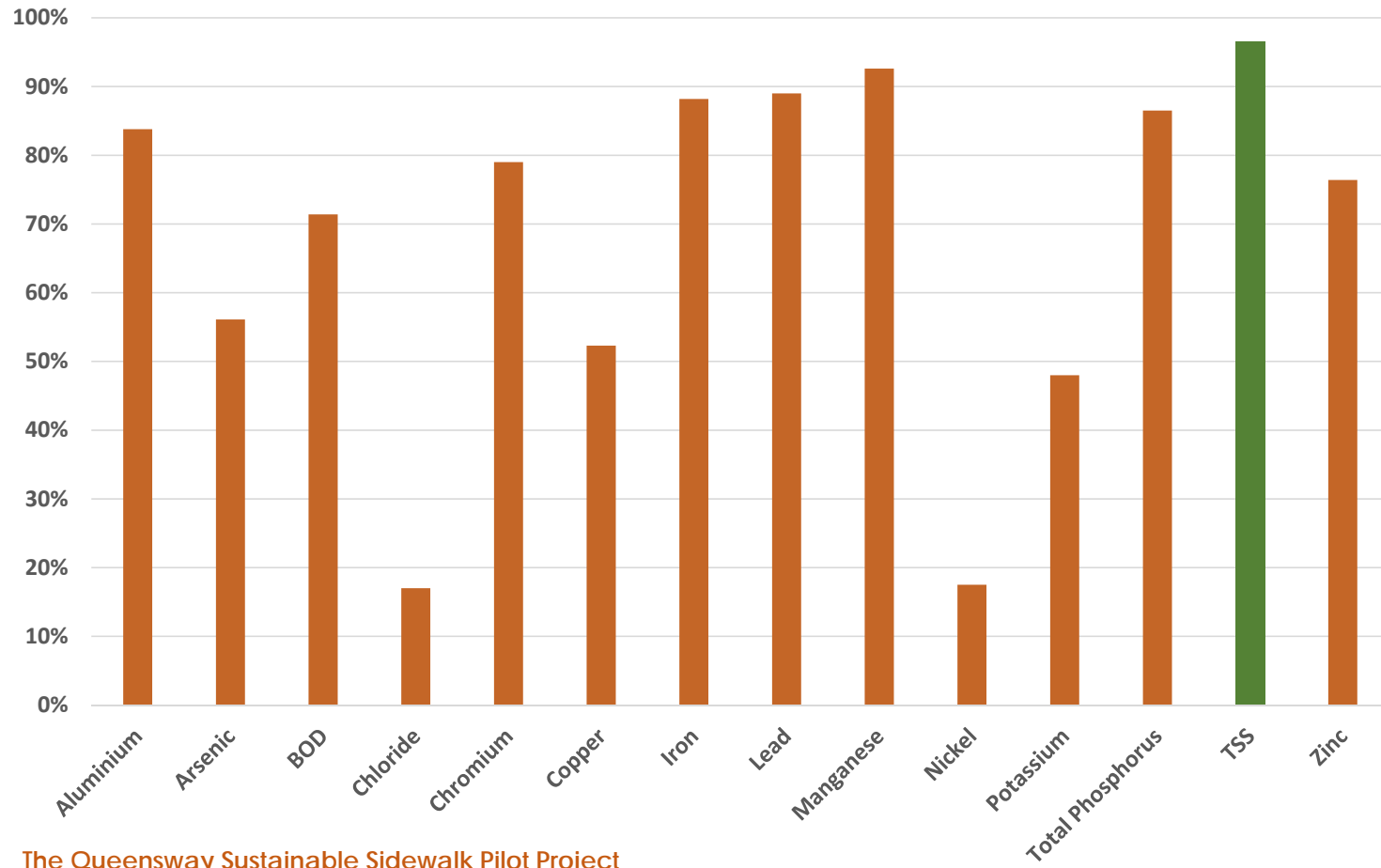


<b>Storm Event Characteristics</b>	<b>Small Event</b>	<b>Large Event</b>
<b>Date</b>	June 12, 2015	June 22-23, 2015
<b>Total Rainfall Depth (mm)</b>	4.20 (on-site rain gauge),	19.40 (on-site rain gauge),
<b>Total Rainfall Volume (m<sup>3</sup>)</b>	1.62 (on-site rain gauge),	7.47 (on-site rain gauge),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

The Queensway Sustainable Sidewalk Pilot Project

Percent  
Reduction

### Queensway Water Quality Results November 2, 2016



The Queensway Sustainable Sidewalk Pilot Project

# Pennsylvania Garage, Miami Beach



# Hyde Park Village, Tampa





Thank you!



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