About Us & Our Team

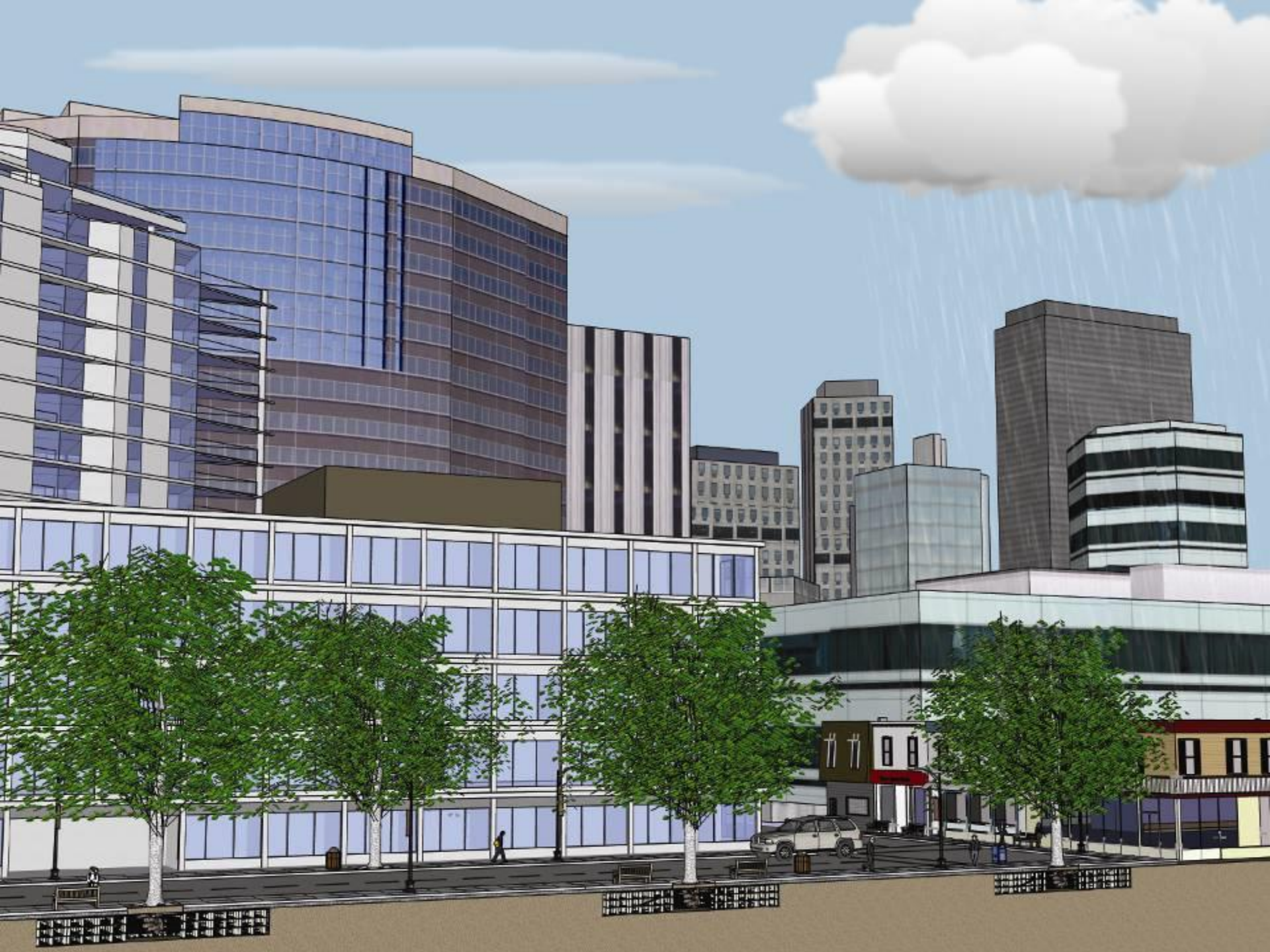
Mission Statement, Expertise & Silva Cell

The DeepRoot Mission

To restore ecosystem services to the built environment by integrating trees, soil and stormwater.

With significant contributions by:

E. Thomas Smiley, PhD
Bartlett Tree Research Laboratory
Bill Hunt, PhD
NC State University



Silva Cell 2

1x system

- H System Height: 16.7”
- W Width: 24”
- L Length: 48”

Soil volume capacity:
approximately 10 cubic ft of soil

2x system

- H System Height: 31”
- W Width: 24”
- L Length: 48”

Soil volume capacity:
approximately 20 cubic ft. of soil

3x system

- H System Height: 43”
- W Width: 24”
- L Length: 48”

Soil volume capacity:
approximately 30 cubic ft. of soil

DESIGN FEATURES

FOOTPAD & BASE

*Allows easy walking during installation.
*Posts twist & snap into base cups with a quarter turn.
*high density polyethylene.

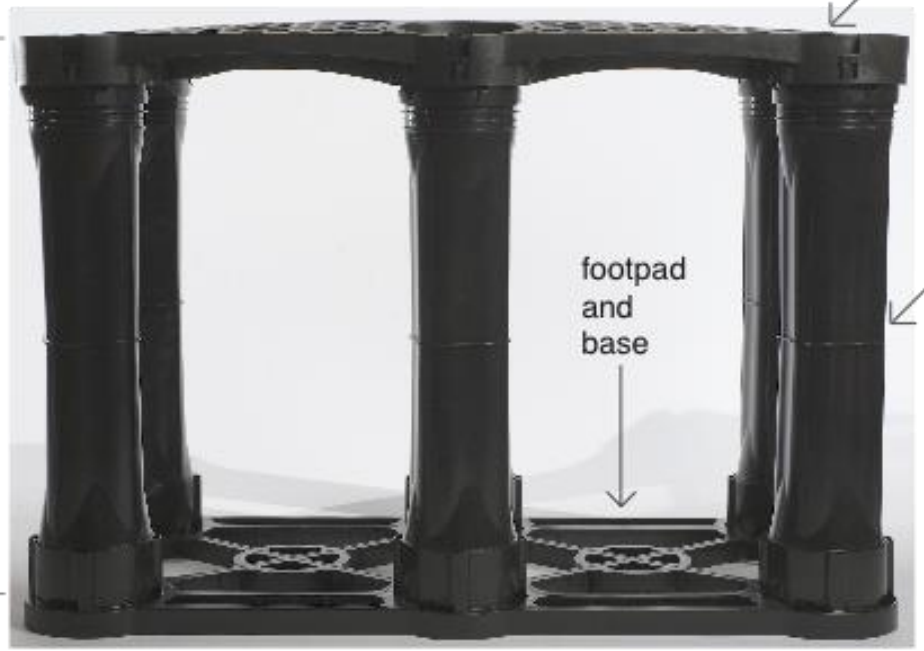
POST

*Engineered to transfer paving loads vertically downward to a compacted sub-base.
*Posts come in 2 sizes that can be combined using a quarter turn to create a third size.
*high density polyethylene.

DECK

*Permeable to allow water to flow through.
*Easier to snap into place on top of posts.
*glass filled reinforced polypropylene.

2x SYSTEM - holds approx. 20 cubic ft. of soil and stores 20% water.

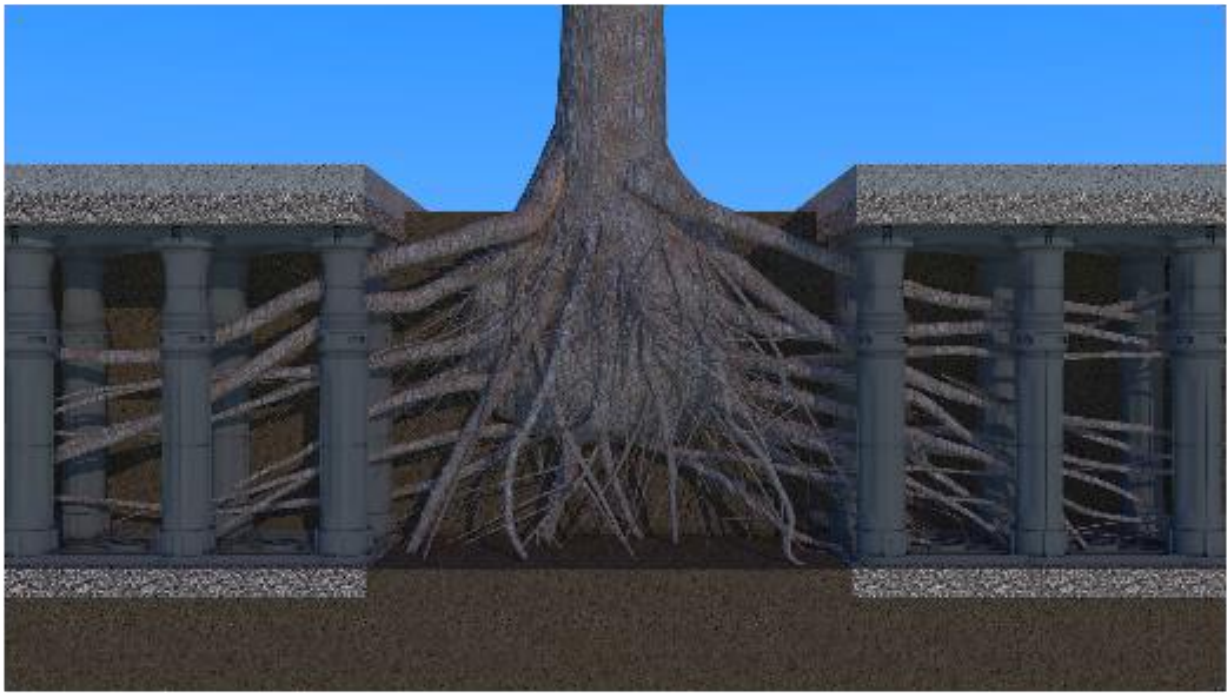


Dimensions
length: 48 inches
width: 24 inches

SILVA CELL 2 – ADDED VALUE FOR YOU

streamlined **SYSTEM**

Lighter with 20% less material and a lower carbon footprint.
More efficient space delivers same functional soil volume but requires less excavation depths.
More durable to withstand the construction installation process.
Open rooting space delivers functional soil to the entire void space available.



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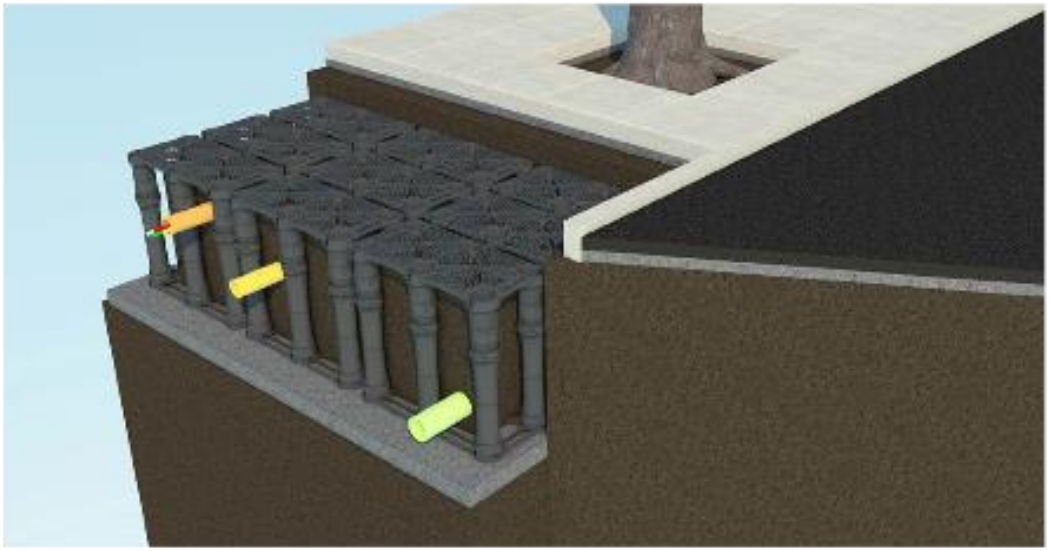
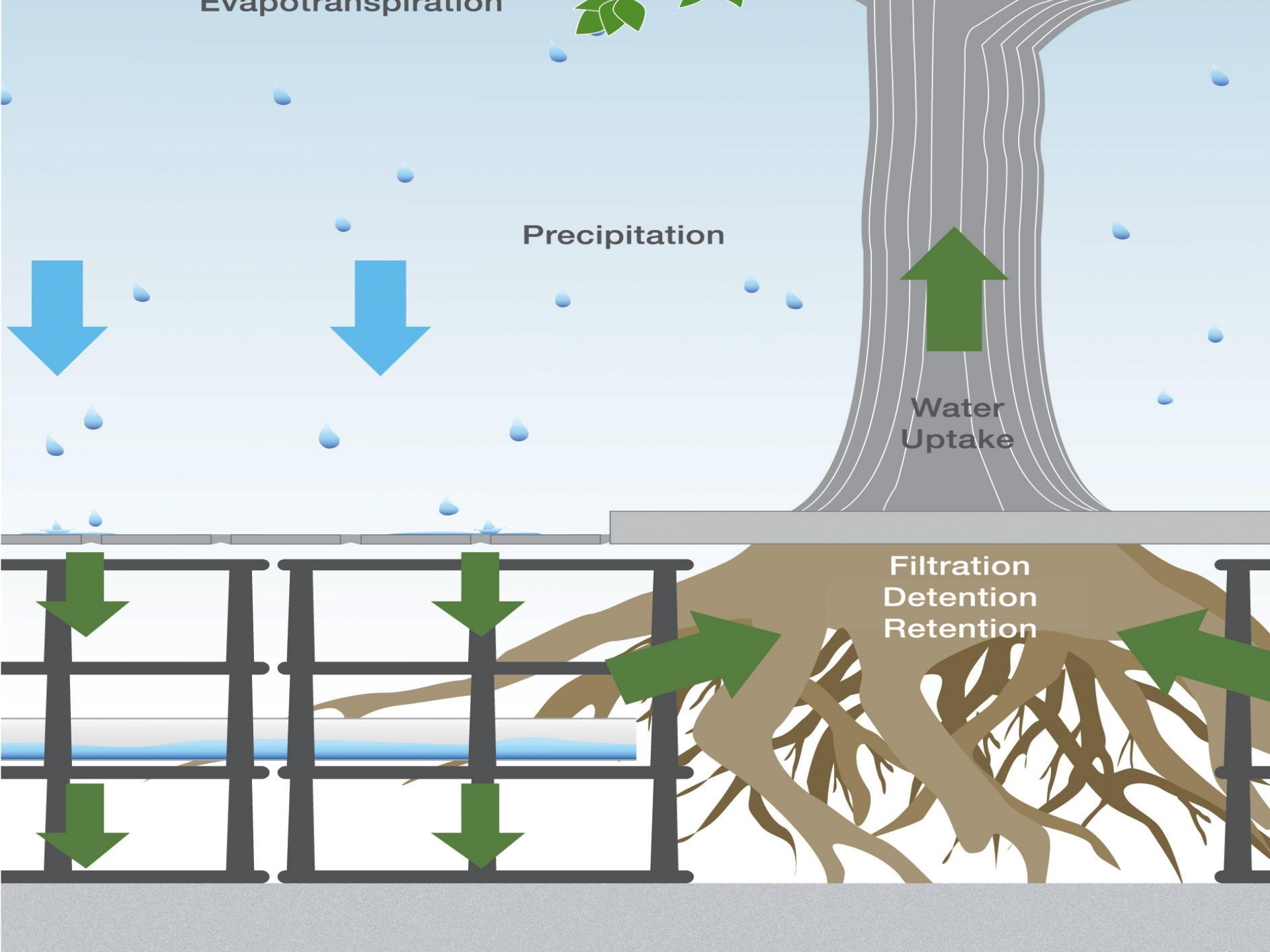
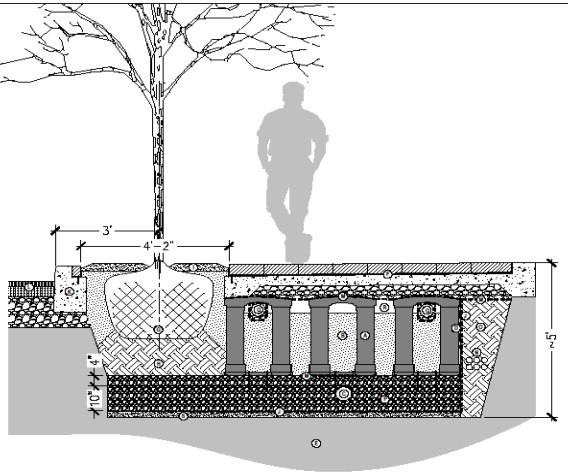
More efficient space delivers same functional soil volume but requires less excavation depths.
More durable to withstand the construction installation process.
Open rooting space delivers functional soil to the entire void space available.

faster **INSTALLATION**

Fewer pieces, and all parts snap or twist together with greater fit tolerances.
Elimination of cross beam enables easy walking access during installation.
Industry leading 12 inch openings readily accommodates new or existing utilities.
Each stack stands alone as a module, giving greater design flexibility and allowing adjustments in the field.

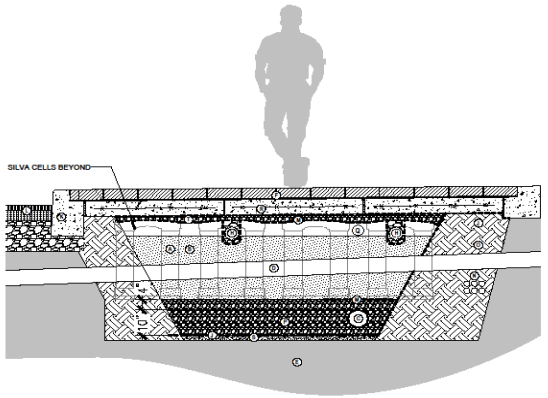



Evapotranspiration
Precipitation
Water
Uptake
Filtration
Detention
Retention



KEY NOTES
- (A) 2x SILVA CELL SYSTEM (DECK, BASE, AND POSTS) 6" MAX. SPACING
- (B) BIORETENTION PLANTING SOIL - 25" MIN. DEPTH (70% SAND, 25% UNSCREENED LOAM BASED SOIL, 5% BIOCHAR)
- (C) 6" UNDERDRAIN TO STORMWATER OUTFALL (4" BELOW SILVA CELLS)
- (D) GEOGRID, ATTACH TO CELLS WITH CABLE TIES
- (E) NATIVE COMPACTED SUBGRADE
- (F) PRECAST CONCRETE PAVERS ON CONCRETE BASE WITH CLEAN WASHED STONE AGGREGATE SUBBASE
- (G) STREET TREE ROOTBALL
- (H) COMPACTED BACKFILL FOR TREE ROOTBALL FOUNDATION
- (I) OPEN AIR TREE PLANTER, WITH STONE MULCH - DECOMPOSED GRANITE
- (J) IMPERMEABLE LINER, WITHIN 10' OF BUILDING FOUNDATIONS
- (K) MOD. CG-2 CURB
- (L) ROADWAY
- (M) GEOTEXTILE FILTER FABRIC
- (N) PRIVATE UTILITY CONDUIT
- (O) COMPACTED BACKFILL
- (P) INTERNAL WATER STORAGE (IWS) ZONE (#67 STONE)
- (Q) PERFORATED DISTRIBUTION PIPE IN CLEAN STONE AGGREGATE
- (R) 3"- 6" AIR VOID, PONDING ZONE
- (S) 2" SAND

1 SILVA CELL TREE PLANTING – CROSS SECTION
1/2"=1'



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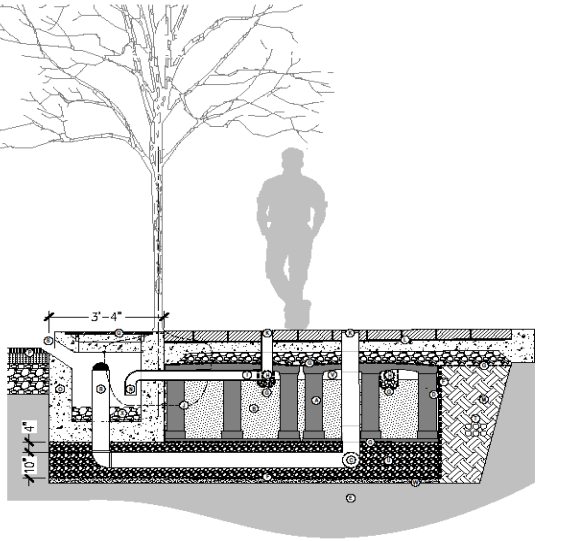
- (D) PUBLIC UTILITY LATERAL
- (E) NATIVE COMPACTED SUBGRADE
- (F) PRECAST CONCRETE PAVERS ON 8" REINFORCED STRUCTURAL CONCRETE BASE
- (H) PERFORATED DISTRIBUTION PIPE IN CLEAN STONE AGGREGATE
- (J) IMPERMEABLE LINER, WITHIN 10' OF BUILDING FOUNDATIONS
- (K) MOD. CG-2 CURB
- (L) ROADWAY
- (M) GEOTEXTILE FILTER FABRIC
- (N) PRIVATE UTILITY CONDUIT
- (O) COMPACTED BACKFILL
- (P) INTERNAL WATER STORAGE (IWS) ZONE (#67 STONE)
- (Q) 3"- 6" AIR VOID, PONDING ZONE
- (R) 6" PRE-CAST STRUCTURAL SLABS (REMOVABLE) WITH PREFORMED JOINT FILLER
- (S) 2" SAND
- (T) 2" AGGREGATE LEVELING COURSE WRAPPED IN GEOTEXTILE FABRIC TO PROVIDE LEVEL BASE FOR STRUCTURAL SLABS

3 SILVA CELL TREE PLANTING – UTILITY CROSSING SECTION
1/2"=1'



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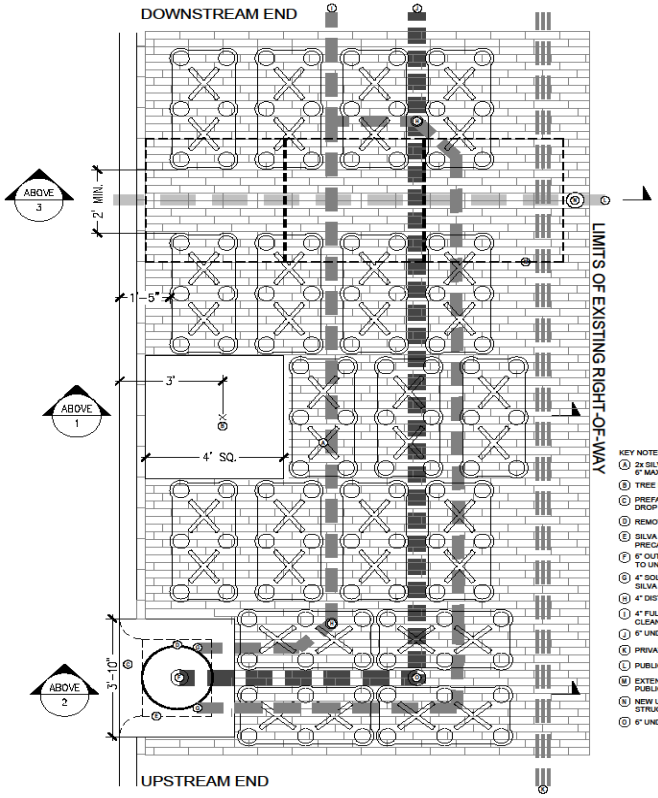
- (C) 6" UNDERDRAIN TO STORMWATER OUTFALL (4" BELOW SILVA CELLS)
- (D) GEOGRID, ATTACH TO CELLS WITH CABLE TIES
- (E) NATIVE COMPACTED SUBGRADE
- (F) IMPERMEABLE LINER, WITHIN 10' OF BUILDING FOUNDATIONS
- (G) GEOTEXTILE FILTER FABRIC
- (H) PERFORATED DISTRIBUTION PIPE IN CLEAN STONE AGGREGATE
- (I) SOLID DISTRIBUTION PIPE INTO SILVA CELL SYSTEM
- (J) STREET TREE ROOT BALL OUTLINE, BEYOND
- (K) CLEANOUT PIPE WITH CAP
- (L) PRECAST CONCRETE PAVERS ON CONCRETE BASE
- (M) COMPACTED BACKFILL
- (N) STORMWATER DISTRIBUTION INLET INTO SILVA CELLS WITH TRASH FILTER
- (O) SILVA CELL PRETREATMENT FACILITY (MODIFIED PRECAST DI-3A CURB DROP INLET)
- (P) ROADWAY
- (Q) REMOVABLE ACCESS GRATE
- (R) DOMED ATRIUM GRATE OUTLET RISER FOR EMERGENCY OVERFLOW TO SUBDRAIN (PERFORATED FOR DRAW DOWN)
- (S) PREFAB CURBCUT (MODIFIED PRECAST DI-3A CURB DROP INLET)
- (T) PRIVATE UTILITY CONDUIT
- (U) INTERNAL WATER STORAGE (IWS) ZONE (#67 STONE)
- (V) 3"- 6" AIR VOID, PONDING ZONE
- (W) 2" SAND
- (X) STONE FILTER LAYER TO PREVENT RISER PERFORATIONS FROM CLOGGING

2 SILVA CELL TREE PLANTING – CROSS SECTION @ INLET DRAIN
1/2"=1'

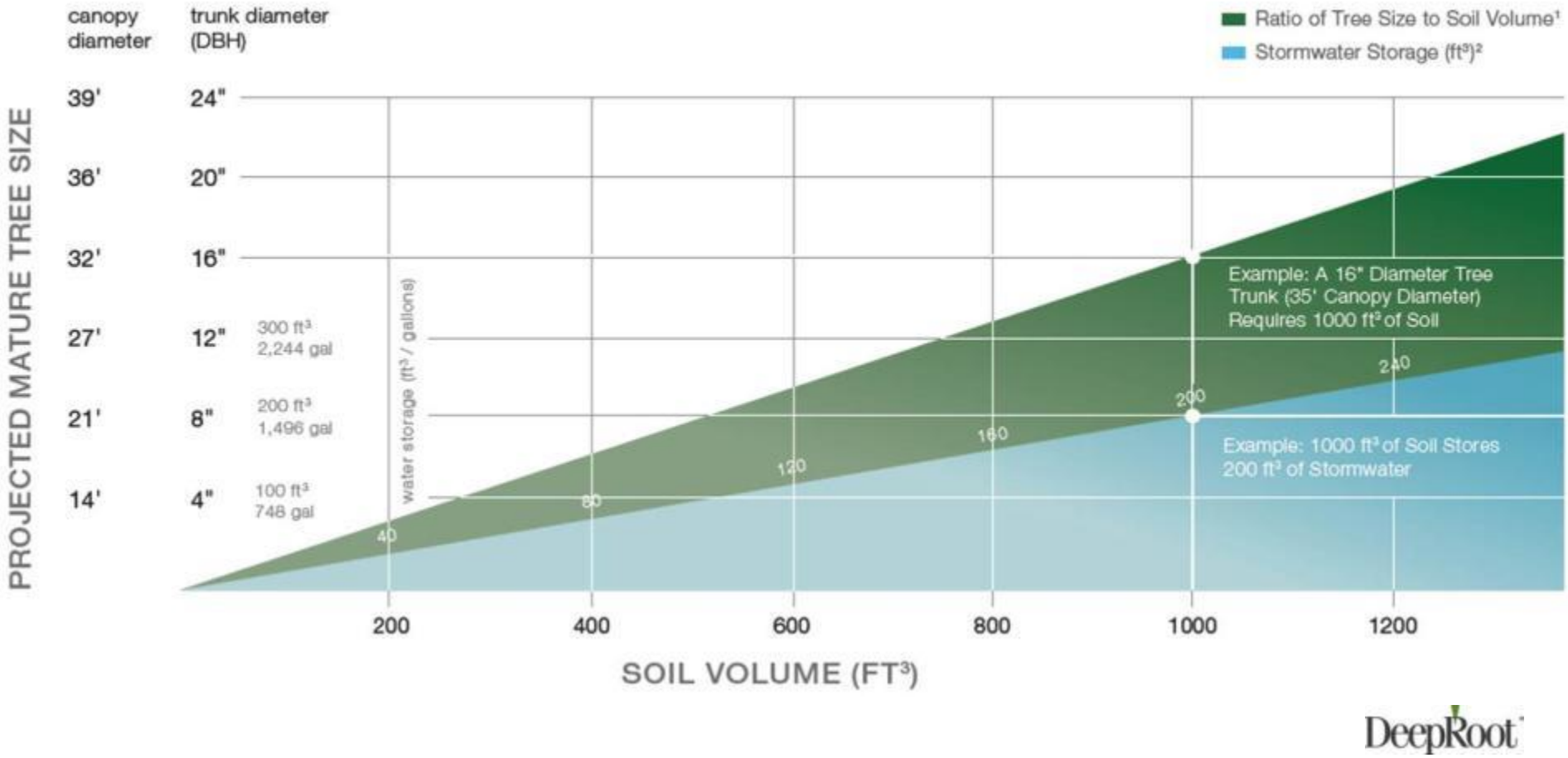


KEY NOTES
- (A) 2x SILVA CELL SYSTEM (DECK, BASE, AND POSTS) 6" MAX. SPACING
- (B) TREE PLANTER (4'X4')
- (C) PREFAB CURBCUT (MODIFIED PRECAST DI-3A CURB DROP INLET)
- (D) REMOVABLE ACCESS GRATE
- (E) SILVA CELL PRE-TREATMENT FACILITY (MODIFIED PRECAST DI-3A CURB DROP INLET)
- (F) 6" OUTLET RISER FOR EMERGENCY OVERFLOW TO UNDERDRAIN (PERFORATED FOR DRAW DOWN)
- (G) 4" SOLID DISTRIBUTION PIPES INTO SILVA CELL SYSTEM
- (H) 4" DISTRIBUTUTION CLEANOUT PIPE WITH CAP
- (I) 4" FULLY PERFORATED DISTRIBUTION PIPE IN CLEAN STONE AGGREGATE
- (J) 6" UNDERDRAIN TO STORMWATER OUTFALL
- (K) PRIVATE UTILITY CONDUIT
- (L) PUBLIC UTILITY LATERAL
- (M) EXTENTS OF 8" STRUCTURAL SLAB OVER PUBLIC UTILITY LATERAL (ESTIMATED 4'X4')
- (N) NEW UTILITY METER SET BEYOND REMOVABLE STRUCTURAL SLAB
- (O) 6" UNDERDRAIN CLEANOUT PIPE AND CAP

4 SILVA CELL TREE PLANTING – PLAN ENLARGEMENT
1/2"=1'

How to Size a Successful System?

1000 cubic feet of healthy soil can store 1500 gallons



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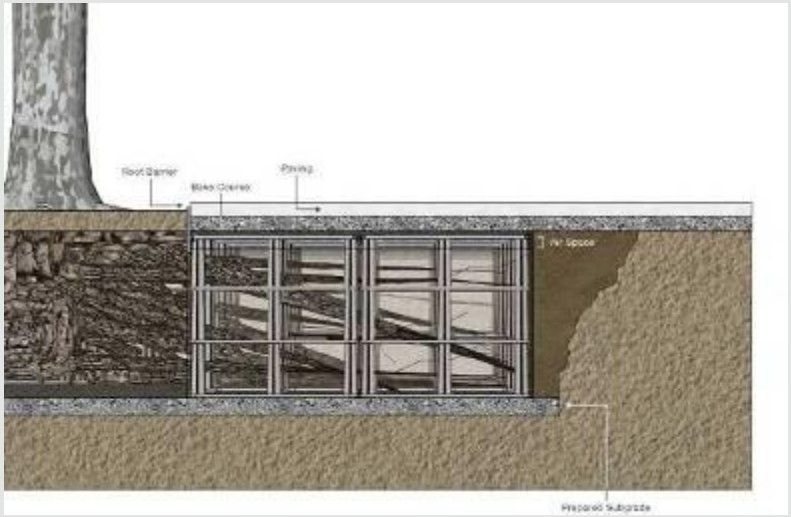
Bring The Functionality of the Forest to the City

The Silva Cell



Basic Applications:
Parking lots; parking lay-bys; plazas and promenades; green walls; green roofs & break-out zones

Image courtesy of Sharp & Diamond Landscape Architects

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Wilmington, NC Silva Cell Field Test

- Two Silva Cell site installations completed in July 2012
- Two types of bioretention soil
- Systems wrapped in impermeable geomembranes
- 700 ft^3 (19.8 m^3) of soil for tree growth and stormwater treatment
- Planted with Crape Myrtle (*Lagerstroemia spp.*)

Catchment Areas

Designation	Silva Cell A	Silva Cell B
Location	10th Street and Ann Street	10th Street and Orange Street
Catchment Area (ac)	0.14	0.12
Average Slope (%)	1.8	2.5
Imperviousness (%)	100	100

First Level of Frames
+ Underdrains Installed

First layer of frames and underdrains…

Second layer of frames…

Wilmington Silva Cell Monitoring
Water Quality Results

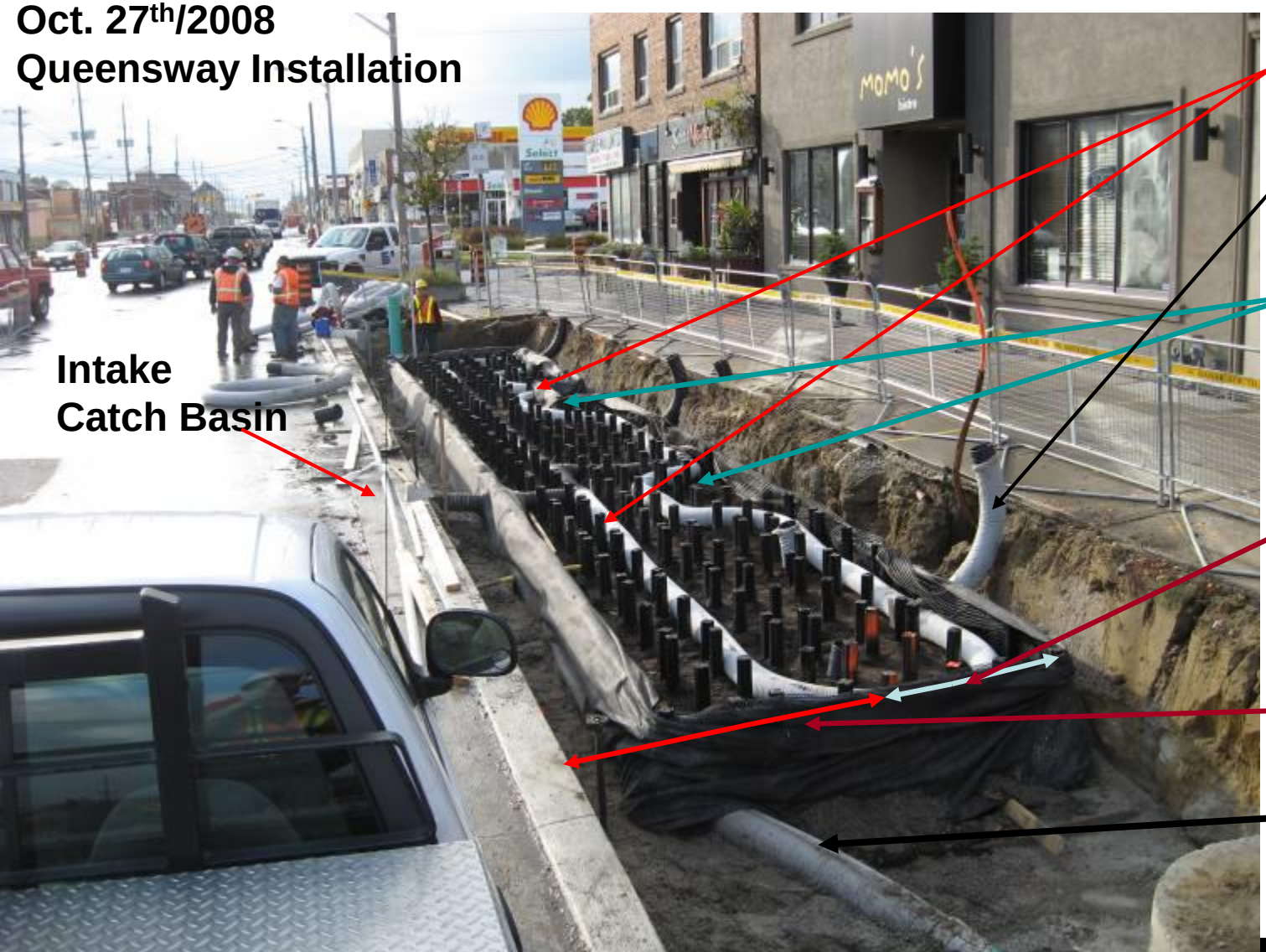
Pollutant	Ann Street				Orange Street				PQL[b] (mg/L[a])	Bioretention Systems in Peer Reviewed Literature[c]
	n	IN (mg/L[a])	OUT (mg/L[a])	Change in Concentration	n	IN	OUT	Change in Concentration		Change in Concentration
TKN	21	0.75	0.22	-71%T*	18	1.99	0.33	-84% T*	0.38	-9
NO2,3-N	21	0.08	0.05	-35%T*	18	0.17	0.07	-60% T*	0.006	+14
TAN	21	0.11	0.03	-73% T*	18	0.33	0.08	-76% T*	0.006	-79
TN	21	0.82	0.27	-66% T*	18	2.17	0.40	-82% T*	NA	
O-PO4^{-3}	20	0.03	0.01	-70% T*	19	0.18	0.03	-82% T*	0.006	NA
TP	21	0.12	0.03	-72% T*	18	0.41	0.11	-74% T*	0.01	+70
TSS	21	45	6	-86% S*	19	101	8	-92% T*	5-10	-79
Cu[a]	21	14.3	2.1	-85% T*	19	10	1.4	-86% T*	2	-28
Pb[a]	21	9.8	1.0	-90% S*	19	16	1.0	-94% T*	2	-29
Zn[a]	21	64	11	-83% T*	19	82	11	-76% T*	10	-78

*Significantly different (α=0.05)
[a]Heavy metals concentrations in units of µg/L
[S]Sign test used for statistical comparison
[T]Paired t test used for statistical comparison
"-" negative sign indicates a decrease in pollutant concentration
[b] Practical quantification limit
[c] based on mean from Brown and Hunt 2011, Davis et al 2001, Dietz and Clausen 2006, Hunt et al 2006, Hunt et al 2008, Li and Davis 2009, and Passeport et al 2009, in Page et al (2014)

Blue: below detection limits
Green: Tree/Soil Systems performed better than mean for bioretention in peer reviewed literature per Page et al 2014
Purple: no comparison from peer reviewed literature provided in Page et al 2014

Table adapted from Page, Winston and Hunt

Oct. 27th/2008
Queensway Installation



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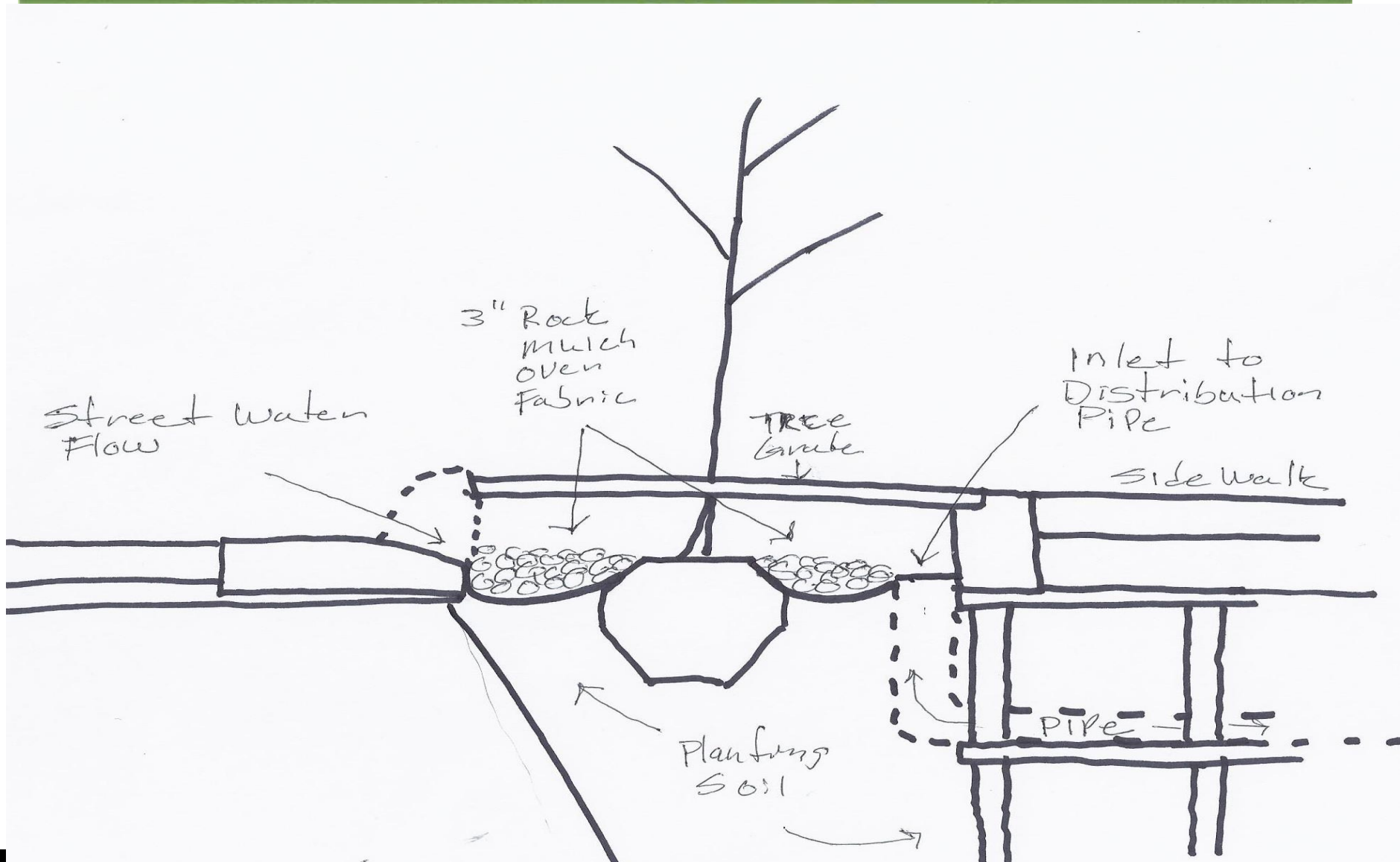
3" Rock Mulch over Fabric
Inlet to Distribution Pipe
Street Water Flow
Tree Grate
Sidewalk
Planting Soil
Pipe


Dow
Dow
Dow

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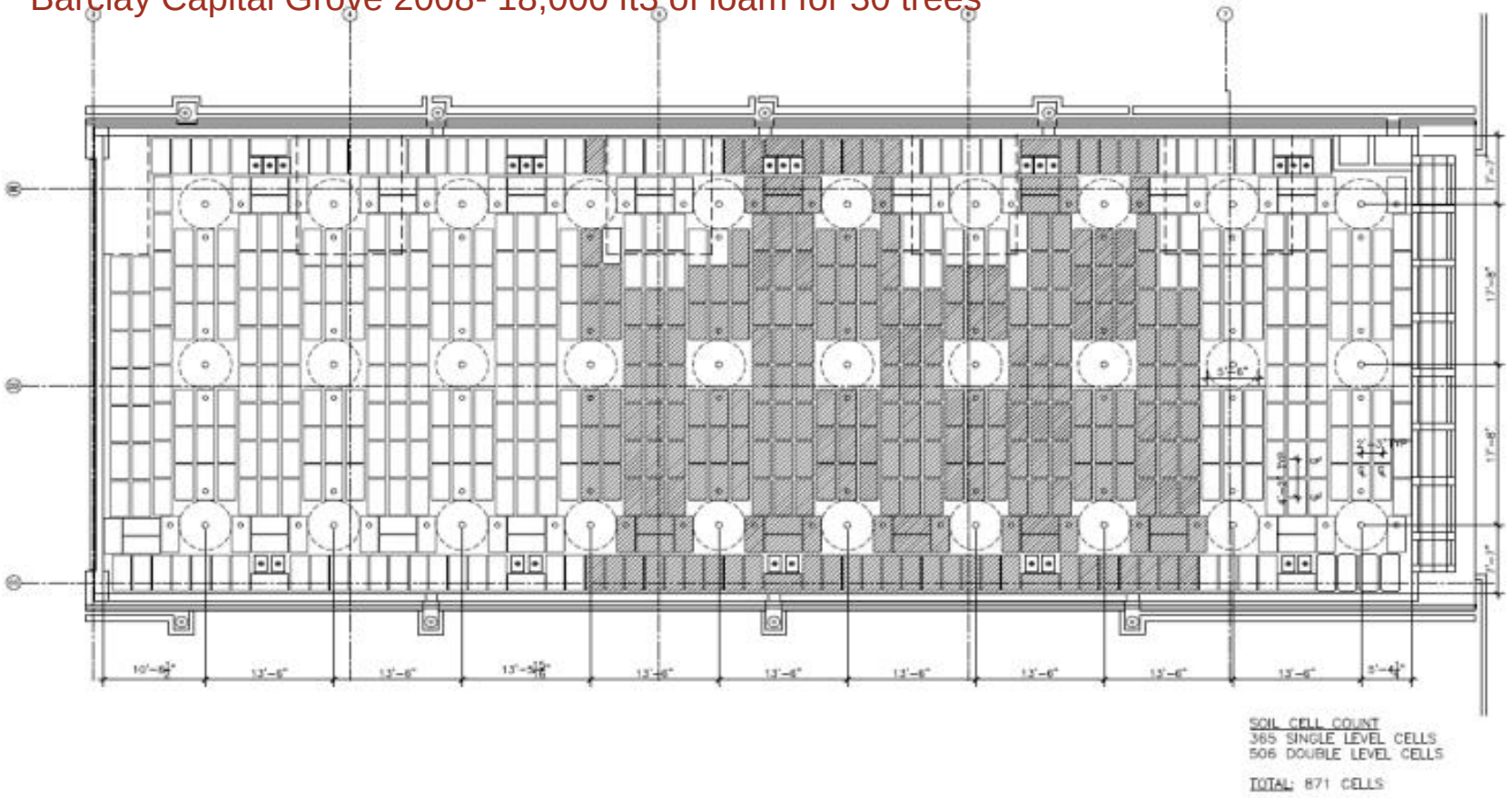
8/21/13

Lincoln Center

Barclay Capital Grove 2008- 18,000 ft3 of loam for 30 trees



Lincoln Center Barclay Capital Grove

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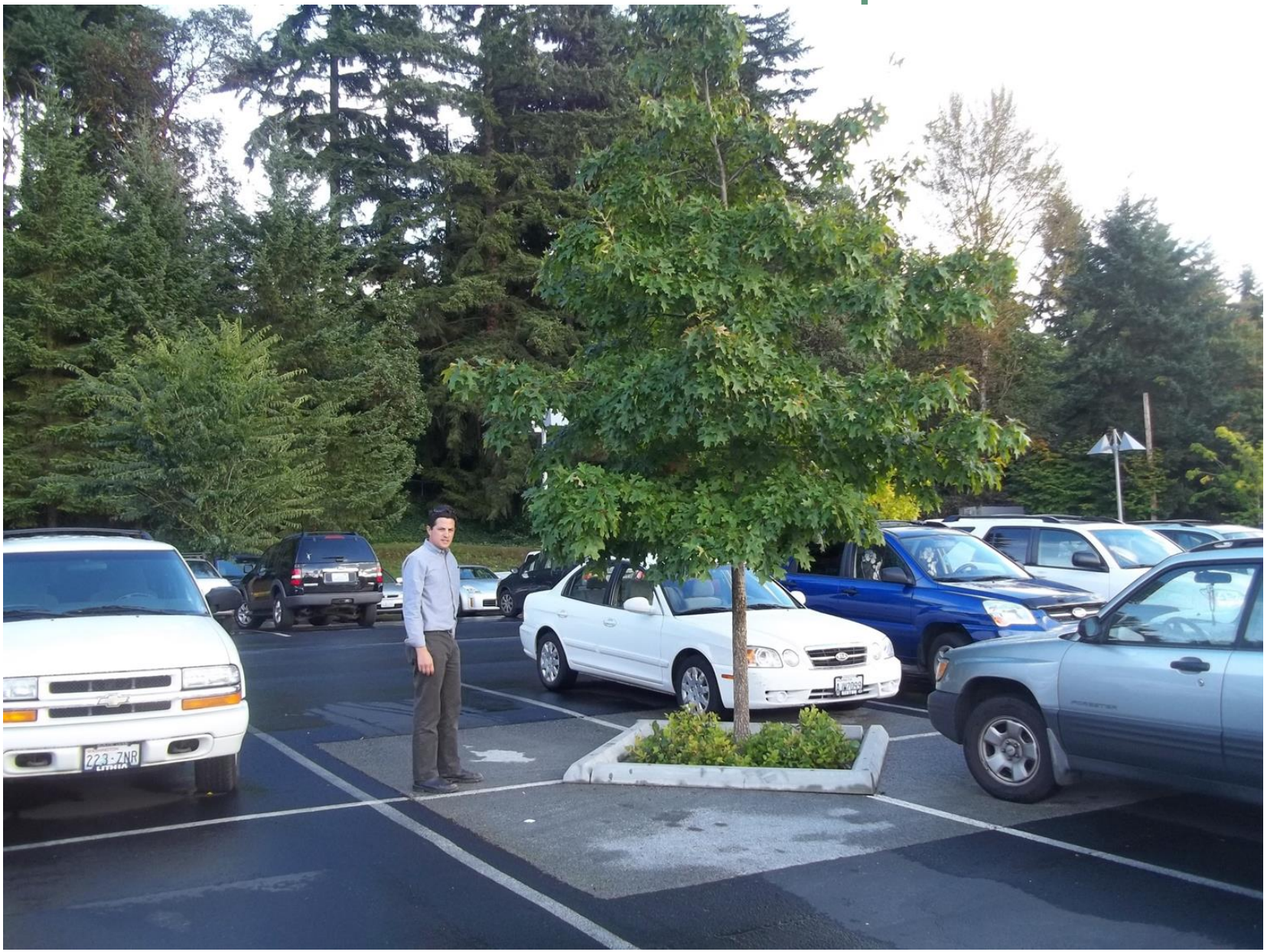
Mountlake Terrace, WA Parking Lot Retrofit- Stormwater Captured for Passive Irrigation

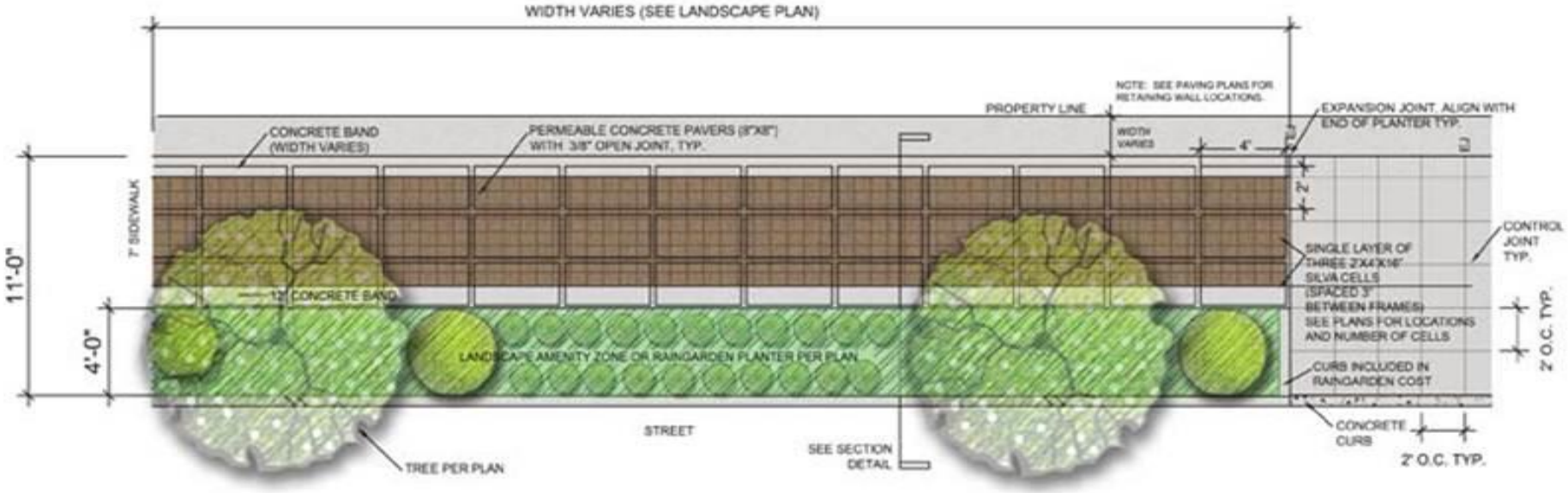
Permeable Concrete Conveys Stormwater into the Silva Cells

2013 Tree Growth Update

2014 Tree Growth Update



2017 Tree Growth Update


WIDTH VARIES (SEE LANDSCAPE PLAN)
NOTE: SEE PAVING PLANS FOR RETAINING WALL LOCATIONS.
PROPERTY LINE
EXPANSION JOINT, ALIGN WITH END OF PLANTER TYP.
CONCRETE BAND (WIDTH VARIES)
PERMEABLE CONCRETE PAVERS (8"X8") WITH 3/8" OPEN JOINT, TYP.
WIDTH VARIES
4'
2"
7" SIDEWALK
11'-0"
12" CONCRETE BAND
4'-0"
SINGLE LAYER OF THREE 2'X4'X16" SILVA CELLS (SPACED 3' BETWEEN FRAMES) SEE PLANS FOR LOCATIONS AND NUMBER OF CELLS
CONTROL JOINT TYP.
2' O.C. TYP.
LANDSCAPE AMENITY ZONE OR RAINGARDEN PLANTER PER PLAN
CURB INCLUDED IN RAINGARDEN COST
STREET
CONCRETE CURB
2' O.C. TYP.
SEE SECTION DETAIL
TREE PER PLAN

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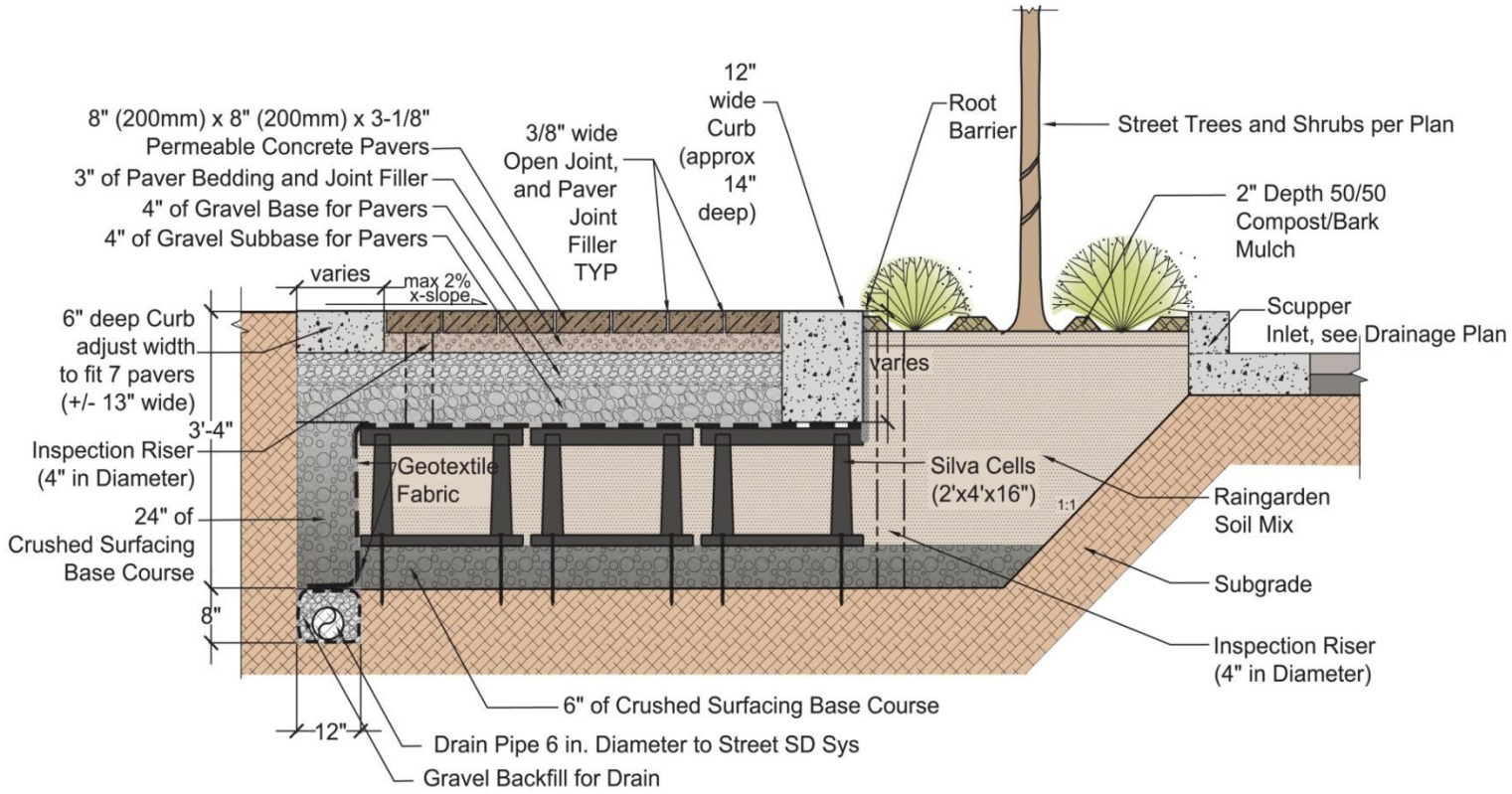


SILVA CELL WITH RAINGARDEN AND PERMEABLE PAVERS

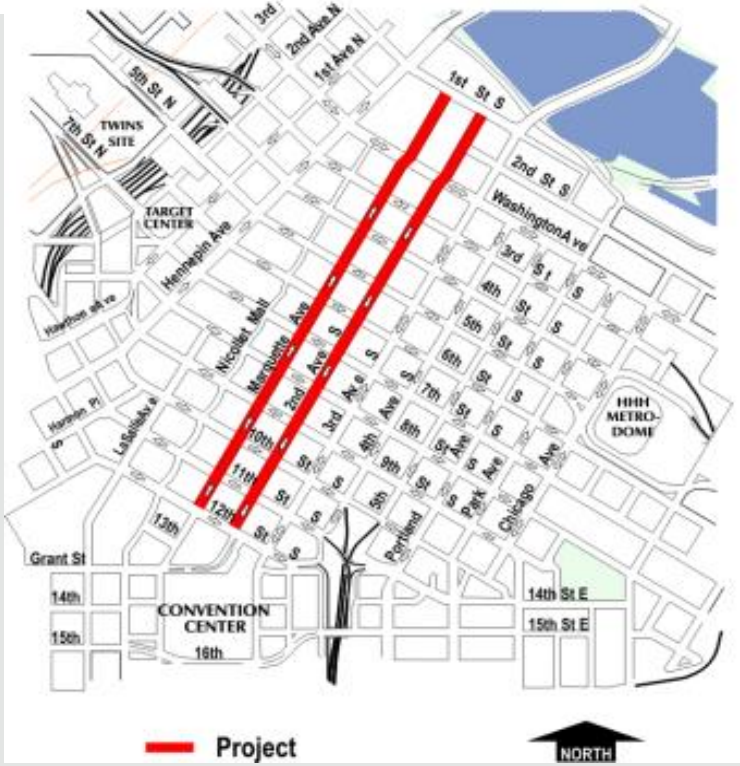
NOT TO SCALE

Aurora Avenue, Shoreline, WA

Capturing roadway runoff

Marquette & 2nd Avenue

Trees and stormwater Silva Cell installation (Minneapolis, MN)



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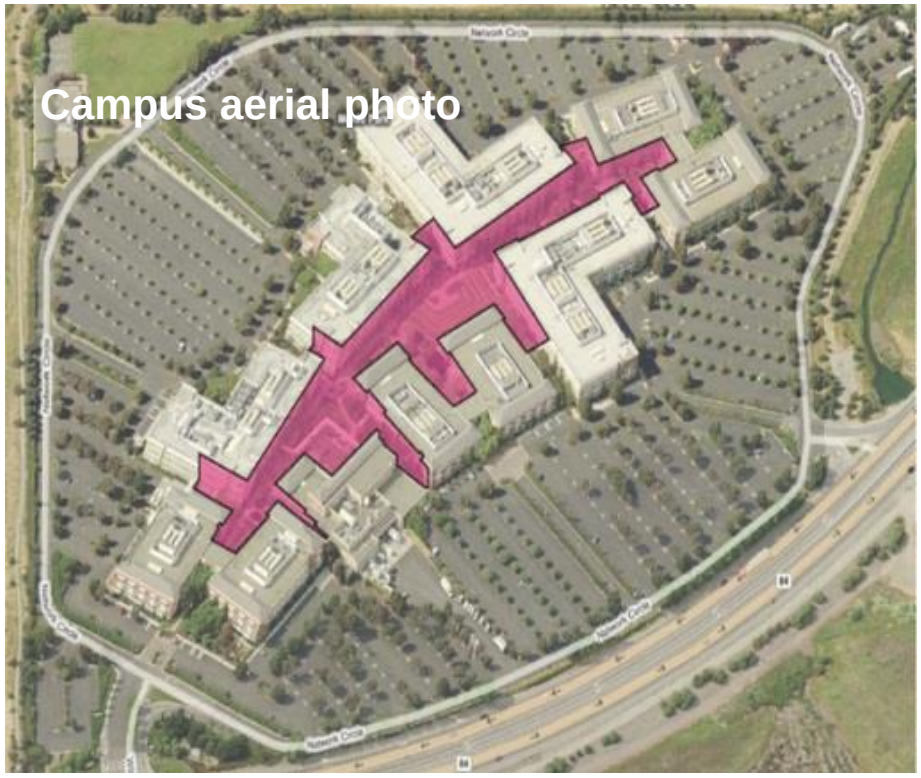
Trees & Storm water- *Marquette & 2nd Avenue*

- The catchment area : 6.6 acres (2.64 hectares)
- 179 trees
- 90% rain event-1.02”
- 670 ft3 of bioretention mix soil Per Tree
- stores 134 ft3 (3.7 m3) of stormwater. Per tree
- Water Treated: 24,000 ft3; 180,000 gallons
- Public Bid Tabulations: $13.42 per cubic foot
- 50-60 year CSO solution

Rather than spending $7.5M to replace the sewer system, the City of Minneapolis spent $1.5M on Silva Cells to meet their stormwater treatment goals.

Case Study: Meet Local Stormwater Requirements Technology Campus, San Mateo, CA



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NO
PARKING
ANY
TIME

Atlanta-Historic Fourth Ward Park-2011 Installation

2013 Update

2013 Update

2015 Update

2018

100 Peachtree Plaza, Atlanta- 2015 Installation

2018

2018

Center Street-North Augusta-2018

Center Street Plaza

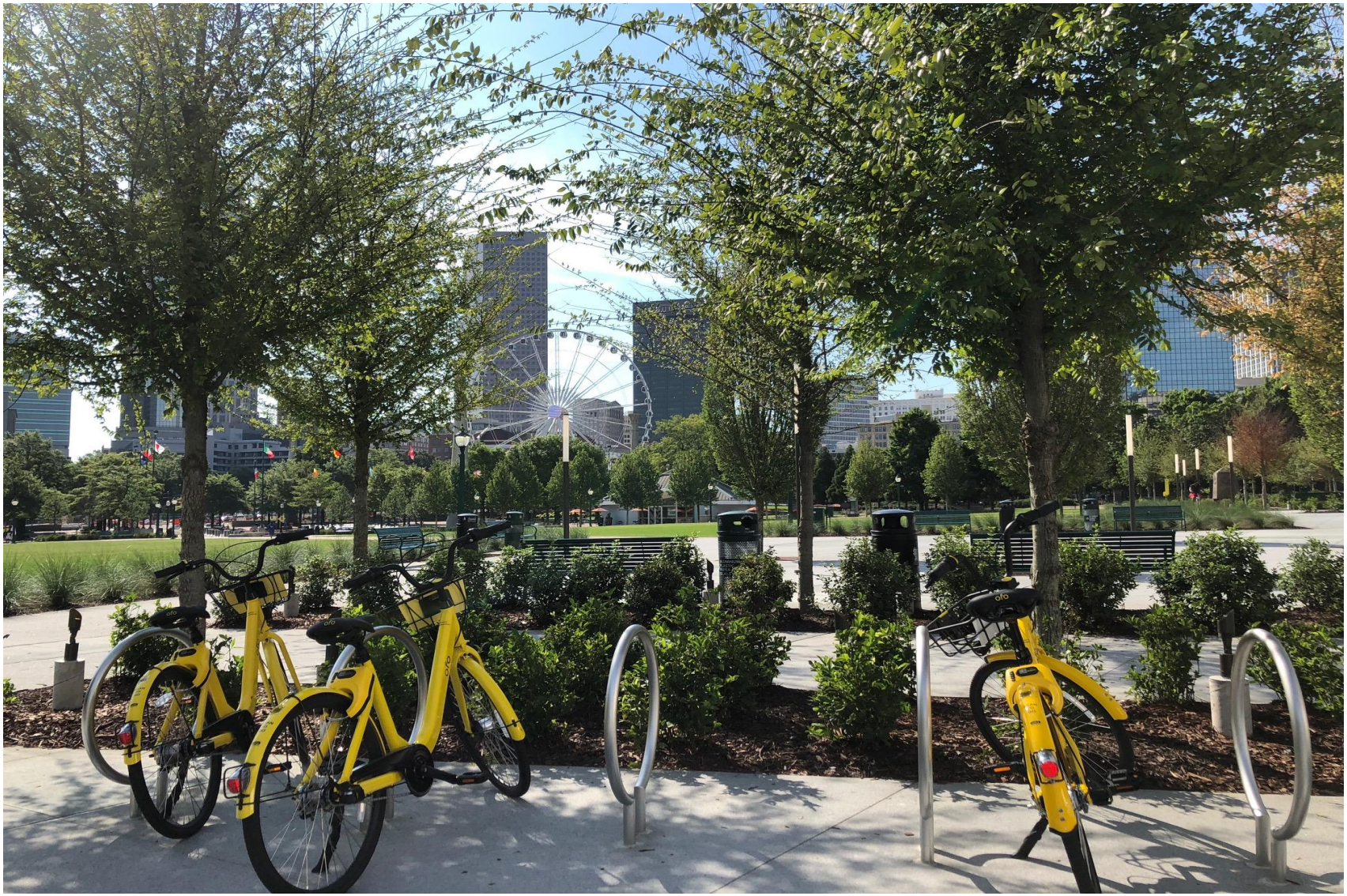
Center Street Plaza
Newly Planted Trees

Center Street Plaza-2019

Center Street-2019

Centennial Olympic Park-2018

2019



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DeepRoot Green Infrastructure

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