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
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.
streamlined  **SYSTEM**
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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.
How to Size a Successful System?

1000 cubic feet of healthy soil can store 1500 gallons
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
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

<table>
<thead>
<tr>
<th>Designation</th>
<th>Silva Cell A</th>
<th>Silva Cell B</th>
</tr>
</thead>
<tbody>
<tr>
<td>Location</td>
<td>10th Street and Ann Street</td>
<td>10th Street and Orange Street</td>
</tr>
<tr>
<td>Catchment Area (ac)</td>
<td>0.14</td>
<td>0.12</td>
</tr>
<tr>
<td>Average Slope (%)</td>
<td>1.8</td>
<td>2.5</td>
</tr>
<tr>
<td>Imperviousness (%)</td>
<td>100</td>
<td>100</td>
</tr>
</tbody>
</table>
First Level of Frames + Underdrains Installed

First layer of frames and underdrains… Second layer of frames…
## Wilmington Silva Cell Monitoring

### Water Quality Results

Table adapted from Page, Winston and Hunt

<table>
<thead>
<tr>
<th>Pollutant</th>
<th>Ann Street</th>
<th>Orange Street</th>
<th>PQL* (mg/L^a)</th>
<th>Bioretention Systems in Peer Reviewed Literature^c</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>n</td>
<td>IN (mg/L^b)</td>
<td>OUT (mg/L^b)</td>
<td>Change in Concentration</td>
</tr>
<tr>
<td>TKN</td>
<td>21</td>
<td>0.75</td>
<td>0.22</td>
<td>-71%T*</td>
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<tr>
<td>NO2,3-N</td>
<td>21</td>
<td>0.08</td>
<td>0.05</td>
<td>-35%T*</td>
</tr>
<tr>
<td>TAN</td>
<td>21</td>
<td>0.11</td>
<td>0.03</td>
<td>-73% T^a</td>
</tr>
<tr>
<td>TN</td>
<td>21</td>
<td>0.82</td>
<td>0.27</td>
<td>-66% T^a</td>
</tr>
<tr>
<td>O-PO4^3</td>
<td>20</td>
<td>0.03</td>
<td>0.01</td>
<td>-70% T^a</td>
</tr>
<tr>
<td>TP</td>
<td>21</td>
<td>0.12</td>
<td>0.03</td>
<td>-72% T^a</td>
</tr>
<tr>
<td>TSS</td>
<td>21</td>
<td>45</td>
<td>6</td>
<td>-86% S^*</td>
</tr>
<tr>
<td>Cu^a</td>
<td>21</td>
<td>14.3</td>
<td>2.1</td>
<td>-85% T^*</td>
</tr>
<tr>
<td>Pb^a</td>
<td>21</td>
<td>9.8</td>
<td>1.0</td>
<td>-90% S^*</td>
</tr>
<tr>
<td>Zn^a</td>
<td>21</td>
<td>64</td>
<td>11</td>
<td>-83% T^*</td>
</tr>
</tbody>
</table>

**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

*Significantly different (α=0.05)  
^a Heavy metals concentrations in units of µg/L  
^b Sign test used for statistical comparison  
^c Paired t test used for statistical comparison  
"-" negative sign indicates a decrease in pollutant concentration  
^b Practical quantification limit  
Oct. 27\textsuperscript{th}/2008
Queensway Installation

- Intake Catch Basin
- Perforated distribution pipe
- Clean out risers
- Tree Pits
- Bio Retention soil
  (80\% sand 20\% compost)
- Sidewalk
- Parking lay by
- Stormwater overflow

- Stormwater overflow

- Intake Catch Basin
Lincoln Center
Barclay Capital Grove 2008 - 18,000 ft³ of loam for 30 trees
Lincoln Center  Barclay Capital Grove
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
SILVA CELL WITH RAINGARDEN AND PERMEABLE PAVERS
NOT TO SCALE
Aurora Avenue, Shoreline, WA

Capturing roadway runoff

Sidewalk area

Open planter
Marquette & 2nd Avenue
Trees and stormwater Silva Cell installation (Minneapolis, MN)
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.

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

Campus aerial photo

Installed 2011
Atlanta-Historic Fourth Ward Park-2011 Installation
2015 Update
100 Peachtree Plaza, Atlanta- 2015 Installation
Center Street-North Augusta-2018
Center Street Plaza
Newly Planted Trees
Center Street-2019
Centennial Olympic Park-2018
DeepRoot Green Infrastructure

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