A CASE STUDY on BMP’s/LID at Penn’s SHOEMAKER GREEN

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SHOEMAKER OVERVIEW
OVERVIEW OF STUDY
DATA
Takeaways/Next Steps
Overview of Site

- **COST:** $8,500,000
- **Constructed:** 2011-2012
- **Opened:** Fall 2012
- **Architects:** Andropogon Associates
- **Purpose:** New commons area, rec space, stormwater mgmt/green infrastructure
So...A big opportunity for stormwater management and green infrastructure to intersect!
Stormwater

Rainfall - First 1"

* Additional water source is the condensate from the adjacent buildings

<table>
<thead>
<tr>
<th>Area</th>
<th>Capture Volume</th>
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<tbody>
<tr>
<td>Rittenhouse Lab</td>
<td>0.8 acres 21,000 gallons</td>
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<tr>
<td>Palestra</td>
<td>1.1 acres 30,000 gallons</td>
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<tr>
<td>Hutchinson Gym</td>
<td>0.9 acres 24,000 gallons</td>
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<tr>
<td>3216 Chancellor</td>
<td>0.3 acres 9,000 gallons</td>
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</table>

87,000 gallons total per year
GOALS OF THE STUDY

- Five Year Monitoring Plan – UPenn Student Managed
- Best Management Plan (BMP)/Low Impact Development (LID)
- Sustainable SITES Initiative
- *COMPREHENSIVE MONITORING*

COMPREHENSIVE MONITORING

- STORMWATER
- SOILS
- VEGETATION/ Transpiration
- SOCIAL BEHAVIOR
- BMP’S/LID
- *Sustainable SITES Requirements*
Stormwater and Soils - Monitoring

**Stormwater Objs:**
- Manage stormwater onsite
- Improve water quality (comparison with surrounding sites).
- Create aesthetically pleasing stormwater facilities.

**Soils Objs:**
- To re-establish healthy soils on a former grayfield site.

**SPECIFIC OBJECTIVES**
- To rebuild the site’s ability to support healthy plants, water storage, and infiltration.
### Vegetation Objectives:
- Establish regionally appropriate vegetative biomass
- Plant appropriate vegetation that is native to the eco-region
- Provide vegetated areas significant enough in size to contribute to the regional diversity of flora and provide habitat for native wildlife
- Utilize vegetation and other design features to reduce urban heat island effects

### Social Objectives
- To understand how people utilize the space

### Specific Objectives
- To monitor the site throughout the year and at various days and times of day to determine if elements of the site design influence the usage of the space.
## Instrumentation and Sample Collection

**PENN GREENFUND GRANT:** $12,300

<table>
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<th>Item</th>
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<td>Turf-Tec Infiltrometer</td>
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<tr>
<td>Jet-Fill Tensiometer Model</td>
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</tr>
<tr>
<td>Automatic Stormwater / Wastewater Sampler</td>
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</tr>
<tr>
<td>SC-1 Leaf Porometer</td>
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</tr>
<tr>
<td>LP-80 PAR/LAI</td>
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<tr>
<td>Other Ancillary Supplies</td>
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Student Input and Collection
**STORMWATER - DATA**

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<tr>
<th>Sample</th>
<th>8.11.13 12pm Storm</th>
<th>9.10.13 Rsampler</th>
<th>10.7.13 shoe waterfall</th>
<th>rainbarrel 10.12.13</th>
<th>Tapwater 1</th>
<th>Tapwater 2</th>
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<tbody>
<tr>
<td>Concentration</td>
<td>ppm</td>
<td>ppm</td>
<td>ppm</td>
<td>ppm</td>
<td>ppm</td>
<td>ppm</td>
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<tr>
<td>Cr</td>
<td>ppm</td>
<td>-</td>
<td>&lt;0.002</td>
<td>0.003</td>
<td>&lt;0.002</td>
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<tr>
<td>Na</td>
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<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
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<td>-</td>
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</table>

*N, P, DO, turbidity pH to be analyzed using self-test kits, manual sampler*
STORMWATER – TRANSDUCER DATA

Site 1 – Rain Garden

Site 2 – 33rd St. Manhole

Site 4 – Lower Lawn

Site 3 – COMBINED SEWER 33rd St.
Soil Classification

- USDA Classification system:
  - Soil Classified as: SAND
- Unified Soil Classification
  - SP-SM (Poorly graded SAND-Silty SAND)
- Est. Permeability: $3.2 \times 10^{-2} \text{ cm/s}$ [Hazen correct.]

SOILS - DATA

- Grant Scavello - UPenn

Graphs showing percentage passing vs. grain size for different sample sites.
<table>
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<tr>
<th>Date</th>
<th>Time</th>
<th>Conductance - g total</th>
<th>Temperature</th>
<th>Sample ID</th>
<th>Sensor</th>
<th>Leaf Sensor</th>
<th>Filter Sensor</th>
<th>Plant</th>
<th>Energy loss per unit leaf area ( J (W m^{-2}) )</th>
<th>A (m) crown diameter</th>
<th>LAI</th>
<th>Energy loss per tree ( E^* ) ( LAI^* ) ( A )</th>
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</table>

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SOCIAL BEHAVIOR - DATA

Data Measured by:

- Activity on Space
  - (1-9 coded)
- General Age (YA/A)
- Gender
  - EX: 3AF = Biking, adult Female
- 5 Minute Survey – Behavioral/ Green Infrastructure
- Behavioral Data Integrated/Heat-Mapped via GIS Software

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LESSONS LEARNED

THE FUTURE

In Two Seasons of Monitoring, We’ve Learned...

- Projects like Shoemaker are expensive... How to afford on citywide/larger scale
- Initial setup can take awhile. Detailed action plan important
- Collaboration/shared practices with Universities, surrounding community essential
  → Penn/Villanova/Drexel/ Temple

FUTURE WORK ➔ THROUGH YR. 5

➢ Present to Penn FRES Quarterly to give Penn Greenfund updates
➢ Annual Reporting to Sites Initiative ➔ Shoemaker Certified
➢ Continued Education for Students to Monitor Through 5-Yr Duration
➢ Submission of Data to Andropogon, PWD/GWCC, Stormwater Publications

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Special Thanks to:

- Andropogon Associates
- Craig Calabria, PE, Ph.D. – Project Advisor
- Penn Student Team
  - Alicia Coleman, Nathan Sell, Sara Kinslow
- Penn GreenFund

Questions?

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