Highlights from WERF Stormwater Research and Future Opportunities

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WEFTEC 2013
Stormwater Pavilion
"We still do not know one thousandth of one percent of what nature has revealed to us."

- Albert Einstein
What data is available on the performance of green infrastructure and BMPs?
Welcome! The International Stormwater Best Management Practices (BMP) Database project website features a database of over 530 BMP studies, performance analysis results, tools for use in BMP performance studies, monitoring guidance and other study-related publications. New to the site? Start Here

News
- National Stormwater Quality Database Has A New Home
- 2013 BMP Database Release
- 2012 BMP Performance Summaries

Related Databases & Research
- National Stormwater Quality Database
- Agricultural BMP Database
- Construction BMP Database
- Chesapeake Bay Research Portal

Urban Stormwater Research Reports
- 2012 BMP Performance Summaries
- 2012 Statistical Appendices
- 2012 Manufactured Device Performance Analysis Summary
- 2012 Volume Reduction in Bioretention
- 2012 Database Overview
- 2012 Chesapeake Bay BMP Performance Summary

Retrieve Urban Stormwater BMP Performance
- BMP Study Retrieval Tool
- BMP Map Tool
- BMP Category Reports
- Online Statistical Analysis Tool
- Download Access Database
BMP Database Overview

- BMP Database includes over 530 BMP monitoring studies, including significant GI/LID BMPs.

- From 2008-2013, a key focus has been to better integrate green infrastructure through:
  - Monitoring Guidance (Updated)
  - New Data Entry Spreadsheets
  - Updated Analysis Results
BMP Summary

- Representative Green Infrastructure BMP Categories:
  - Bioretention
  - Biofilters
  - Green Roofs
  - Permeable Pavement
  - Rainwater Harvesting
  - Site-scale LID

<table>
<thead>
<tr>
<th>BMP Category</th>
<th>Count</th>
</tr>
</thead>
<tbody>
<tr>
<td>BR Bioretention</td>
<td>31</td>
</tr>
<tr>
<td>BI Biofilter - Grass Strip</td>
<td>45</td>
</tr>
<tr>
<td>BS Biofilter-Grass Swale</td>
<td>41</td>
</tr>
<tr>
<td>CO Composite</td>
<td>25</td>
</tr>
<tr>
<td>DB Detention Basin</td>
<td>39</td>
</tr>
<tr>
<td>GR Green Roof</td>
<td>17</td>
</tr>
<tr>
<td>IB Infiltration Basin</td>
<td>2</td>
</tr>
<tr>
<td>LD LID</td>
<td>2</td>
</tr>
<tr>
<td>MD Manufactured Device</td>
<td>82</td>
</tr>
<tr>
<td>MF Media Filter</td>
<td>38</td>
</tr>
<tr>
<td>MP Maintenance Practice</td>
<td>28</td>
</tr>
<tr>
<td>OT Other</td>
<td>6</td>
</tr>
<tr>
<td>PP Porous Pavement</td>
<td>39</td>
</tr>
<tr>
<td>PT Percolation Trench</td>
<td>13</td>
</tr>
<tr>
<td>RP Retention Pond</td>
<td>75</td>
</tr>
<tr>
<td>WB Wetland Basin</td>
<td>31</td>
</tr>
<tr>
<td>WC Wetland Channel</td>
<td>19</td>
</tr>
<tr>
<td>Total BMPs</td>
<td>533</td>
</tr>
<tr>
<td>CX Control/Ref. Sites</td>
<td>21</td>
</tr>
</tbody>
</table>
Quick Overview of 2012-13

- Performance Summaries Updates:
  - TSS, Nutrients, Metals, Bacteria, Volume Reduction

- New Detailed Analyses:
  - Bioretention Volume Reduction
  - Manufactured Device Unit Processes

- New On-line Tools:
  - Map Interface
  - Custom Statistical Queries
On-line Search Tool

BMP Test Sites (358)
- Test Sites with Exact Coordinates.
- Test Sites with Approximate Coordinates.
- Sites are clustered when zoomed out beyond the city level.
- Show All Test Sites (358)

- Bioretention (30)
- Control (25)
- Composite (19)
- Detention Basin (39)
- Green Roof (13)
- Biofilter (66)
- Infiltration Basin (2)
- LID (2)
- Manufactured Device (79)
## BMP Database Vision

### International Stormwater BMP Database

<table>
<thead>
<tr>
<th>Urban Stormwater BMPs</th>
<th>Agricultural BMPs</th>
<th>Stormwater Quality</th>
<th>Construction BMPs</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Partners:</strong></td>
<td><strong>Partners:</strong></td>
<td><strong>Partners:</strong></td>
<td><strong>Partners:</strong></td>
</tr>
<tr>
<td>WERF</td>
<td>WERF</td>
<td>University of Alabama</td>
<td>IECA</td>
</tr>
<tr>
<td>ASCE-EWRI</td>
<td>NCGA</td>
<td>EPA</td>
<td></td>
</tr>
<tr>
<td>FHWA</td>
<td>MCGA</td>
<td>Planned for 2013.</td>
<td></td>
</tr>
<tr>
<td>EPA</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>APWA</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>NFWF</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Currently under development.</td>
<td></td>
<td></td>
<td>Potential Future.</td>
</tr>
</tbody>
</table>
New WERF Modeling Tools

- BMP Performance Algorithms Report
  - Includes new approaches for modeling LID

- SELECT Tool
  - Simple spreadsheet based planning tool to evaluate alternative BMP scenarios
  - www.werf.org/select

- Framework v1.0—Coming Dec 2013
  - Comprehensive modeling tool to link BMP performance to receiving water impacts
How can I estimate the costs of GI and BMPs?
BMP and LID Whole Life Cost Tools

User’s Guide to the BMP and LID Whole Life Cost Models
Version 2.0

www.werf.org/bmpcost
## Whole Life Cost Summary (example)

### Curbed Bioretention

**Site Name:** Webinar Demp  
**Site Location:** National  
**Date:** May, 2009

#### Cost Summary

<table>
<thead>
<tr>
<th></th>
<th>Included in WLC Calculation</th>
<th>Total Cost</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>CAPITAL COSTS</strong></td>
<td>Model</td>
<td>User</td>
</tr>
<tr>
<td>11 Total Facility Base Cost</td>
<td>$39,300</td>
<td>$39,300</td>
</tr>
<tr>
<td>12 Total Associated Capital Costs (e.g., Engineering, Land, etc.)</td>
<td>$21,113</td>
<td>$21,113</td>
</tr>
<tr>
<td><strong>Capital Costs</strong></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

#### REGULAR MAINTENANCE ACTIVITIES

<table>
<thead>
<tr>
<th>Activity</th>
<th>Months Between Events</th>
<th>Cost per Event</th>
<th>Total Cost per Year</th>
<th>Included in WLC Calculation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Inspection, Reporting &amp; Information Management</td>
<td>24</td>
<td>$100</td>
<td>$50</td>
<td>$50.00</td>
</tr>
<tr>
<td>Vegetation Management with Trash &amp; Minor Debris Removal</td>
<td>3</td>
<td>$200</td>
<td>$600</td>
<td>$600.00</td>
</tr>
<tr>
<td>Pick up fruit and prune tree</td>
<td>12</td>
<td>$100</td>
<td>$120</td>
<td>$120.00</td>
</tr>
<tr>
<td>Add additional activities if necessary</td>
<td>0</td>
<td>$50</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td><strong>Annual Totals, Regular Maintenance Activities</strong></td>
<td></td>
<td></td>
<td>$550</td>
<td>$550</td>
</tr>
</tbody>
</table>

#### CORRECTIVE AND INFREQUENT MAINTENANCE ACTIVITIES (Unplanned and/or >3yrs. betw. events)

<table>
<thead>
<tr>
<th>Activity</th>
<th>Years between Events</th>
<th>Cost per Event</th>
<th>Total Cost per Year</th>
<th>Included in WLC Calculation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Till Soil</td>
<td>4</td>
<td>$400</td>
<td>$1600</td>
<td>$1,600</td>
</tr>
<tr>
<td>Unclog Drain</td>
<td>1</td>
<td>$50</td>
<td>$50</td>
<td>$50</td>
</tr>
<tr>
<td>Replace Mulch</td>
<td>3</td>
<td>$200</td>
<td>$300</td>
<td>$300.00</td>
</tr>
<tr>
<td>Corrective and Infrequent Maintenance Activities (Unplanned and/or &gt;3yrs. betw. events)</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
</tbody>
</table>

**Note:** Annual maintenance costs should be expected to be between 5% and 10% of total capital costs (Kang, et al 2008).
How do you quantify and account for the multiple benefits of GI?
Ongoing Project
21st Century Water Asset Accounting

Objective:

To help utilities account for the cost-savings provided by green infrastructure and watershed protection in a format that parallels current infrastructure valuation techniques.
Future Opportunities and Directions
Future Opportunities

New Targeted Collaborative Research Project Opportunities

- Protocol and Guidance for Using Stream Restoration as a BMP, $150K
- Evaluation of Green Infrastructure Systems Project, $200-400K
Research priorities for Evaluation of Green Infrastructure Systems

- Cost comparison of green vs gray infrastructure?
- What are different maintenance models being used?
- How well do GI systems perform, in particular at scale?
- How can we quantify the multiple benefits of GI?
- With what level of certainty do these systems perform?
Future Opportunities

Pilot Site
Opportunities

- Transforming Our Cities: High Performance Green Infrastructure
Pilot Technology: Advanced Rainwater Harvesting

Simplest Definition: Drain storage in advance of predicted rainfall or other trigger
Pilot Technology: Controlled Under Drain Bioretention
User Experience: Task Specific User Dashboards
Example WERF Pilot Projects

- **Advanced Rainwater Harvesting**
  - 1 System Online, New Bern, NC
  - 7 Systems Online, St. Louis, MO
  - 2 Systems Online, Washington, DC
  - City of Austin: Control rainwater harvesting system at Twin Oaks Library
  - Urban Drainage and Flood Control District, Denver: control a 3,000 gallon above ground cistern at a school

- **Active Green Roof**
  - SAP America’s Headquarters Building, PA

- **Controlled Underdrain Bioretention**
  - Gwinnett County, GA

- **Controlled Wetland for CSO mitigation**
  - St. Joseph, MO

- **Smart Detention**
  - Seattle University: Control underground cistern
Future Opportunities

LIFT Technology Evaluation Program

Leaders Innovation Forum for Technology (LIFT)

LIFT is a joint WERF/WERF initiative designed to help move innovation into practice in the water quality industry. LIFT brings together the best scientific minds and industry specialists to accelerate adoption of innovative technologies that enable utilities and industries to reduce costs, improve processes, and enhance the environment. LIFT provides a comprehensive approach to advance innovation that includes technological, social, and regulatory/policy aspects.

“The LIFT program provides a great opportunity for all stakeholders in the water sector to work together collaboratively for quick diffusion of new technologies. This program will serve as an adaptive model for targeted technology evaluation and adoption, by sharing costs, risks, and insights.”

— Amit Kaldato, Manager, Bioeconomy Group

The LIFT program includes four main components:

- **Technology Evaluation Program (TEP)**
  Provides a means to identify, screen, and evaluate new technologies and share the risk and cost of conducting demonstrations.

- **People & Policy**
  Informs policy at the federal, state, and local level to remove barriers and facilitate adoption of new technologies. Includes benchmarking how utilities accomplish NRD.

- **Communication**
  Provides training, education, and outreach relative to new technologies.

- **Informal Forum for R&D Managers**
  Allows individuals responsible for technology identification and deployment to share experiences, activities, and interests.

**WERF leads the TEP program. Through this program all WERF subscribers gain:**

- A credible, well-documented vetting system to screen new technologies and innovations.

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WERF Water Environment Research Foundation: Collaboration, Innovation, Results.
Thank You!

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