

Low Impact Development Technology 2011

Design Methods and Case Studies

**Philadelphia, Pennsylvania, USA
25 – 28 September 2011**

Editors:

**Michael L. Clar
Robert G. Traver
Shirley E. Clark
Shannon Lucas**

**Keith Lichten
Michael A. Ports
Aaron Poretsky**

ISBN: 978-1-5108-1920-7

Printed from e-media with permission by:

Curran Associates, Inc.
57 Morehouse Lane
Red Hook, NY 12571



Some format issues inherent in the e-media version may also appear in this print version.

Copyright© (2011) by the American Society of Civil Engineers
All rights reserved.

Printed by Curran Associates, Inc. (2016)

For permission requests, please contact the American Society of Civil Engineers
at the address below.

American Society of Civil Engineers
1801 Alexander Bell Drive
Reston, VA 20191

Phone: (800) 548-2723
Fax: (703) 295-6333

www.asce.org

Additional copies of this publication are available from:

Curran Associates, Inc.
57 Morehouse Lane
Red Hook, NY 12571 USA
Phone: 845-758-0400
Fax: 845-758-2634
Email: curran@proceedings.com
Web: www.proceedings.com

Contents

Introduction.....	1
--------------------------	----------

Rain Gardens/Bioretention

Impacts of Soil Texture, Structure, and Compaction on Bioinfiltration Device Performance: Results of Lab and Field Investigations	4
Redahegn Sileshi, Robert Pitt, and Shirley Clark	

Topsoil Development in Bioretention Cells: What are the Implications?	16
Emily Mitchell Ayers and Patrick Kangas	

The BMP That Keeps on Giving: Quantifying the Impact of Native Plants on Soil Water Properties	26
Scott Dierks	

Effect of Vegetation on the Fate of Petroleum Hydrocarbons in Laboratory-Scale Rain Gardens	37
Gregory H. LeFevre, Paige J. Novak, and Raymond M. Hozalski	

Nutrient Retention Performance of Advanced Bioretention Systems Results from Three Years of Mesocosm Studies	43
William C. Lucas and Margaret Greenway	

Bioretention Performance Findings from the International Stormwater BMP Database.....	59
Jane Clary, Marc Leisenring, and Shannon Tillack	

Green Streets and Hardscapes

Ballard Roadside Rain Gardens, Phase 1—Lessons Learned	70
Shanti Colwell and Tracy Tackett	

A Green Street Retrofit in a Chesapeake Bay Community Using Bioswales.....	81
Shannon Lucas, Michael Clar, and Jim Gracie	

The City of Richmond’s Green Alleys Program: A Tale of Two Alleys.....	91
Charlene Harper	

Green Roofs

Nitrate in Green Roof Runoff.....	98
Susan Morgan, Ric Cooper, and William Retzlaff	

Vegetated Roof Systems: A Review of the Benefits and Design Features of Tray Systems and Built Up Systems	113
James H. Lenhart and Timothy Nash	

Design Methods

Estimating Annual Runoff Based on the NRCS Runoff Curve Number	119
Randell Greer and Stephen Wright	

Development of Low Impact Development Design Guide	128
Xiangfei Li, Faye Zhou, Dan Healy, and Kerri Robinson	

Modeling to Quantify the Benefits of LID for CSO Reduction	136
Uzair (Sam) Shamsi	

A Saturated Seepage Flow Model for Low Impact Development Devices	141
Yuan Cheng	

Open Canopy in Urban Streams Induces Seasonal Variation in Transient Storage	147
Robert J. Ryan, Claire Welty, and Aaron I. Packman	

Hydrogeologic Testing, Engineering, and Start-Up of a Gravity Drain System	159
Jim L. Lolcama, Philip E. Gauffreau, Ryan T. Walters, and Paul A. Fry	

Case Studies and Watershed Restoration

From Gray to Green, Onondaga County's Green Strategy Addressing CSOs	170
Hongbin Gao and Samuel H. Sage	

The Urban Forest Is Broken: How We Can Enhance 1,000,000 Tree Initiatives to Meet Stormwater Goals	182
Peter MacDonagh	

Green Stormwater Retrofits: Objectives and Costing	194
Diane M. Cameron, Jon T. Zeidler, and Danila S. Sheveiko	

Coupling Stormflow Attenuation with Gully and Trail Stabilization, Wissahickon Valley Park, Philadelphia.....	208
Todd Moses, Michael Lower, Gerald Longenecker, and Daniel Aungst	
Stormwater Retrofit of Highwood Estates Detention Basins to Enhance Water Quality Benefits.....	215
Steve Trinkaus and Sean Hayden	