

Green Infrastructure for All Leveraging the Landscape for Water Management



Prepared by: Jeremiah D. Bergstrom, LLA, ASLA
Mark Anderson, LLA, ASLA



Why change the way we design and build infrastructure?

- } Protect environmental health
- } Prevent water quality impairments
- } Minimize localized flooding
- } Reduce capital and maintenance costs for infrastructure
- } Mitigate impacts of increasing storm frequency, intensity, and duration as a result of climate change



Flooding in New Jersey



Landscape Architects

- } Collaborate with allied design and planning professionals
- } Focus on responsible stewardship of natural and cultural resources
- } Provide a balanced approach to land planning and design integrating multiple systems including:
 - Vegetation and healthy soils
 - Natural drainage patterns
 - Stormwater management
 - Ecological restoration, environmentally distressed sites



NJ Licensed Landscape Architects

- } Professionals licensed by the State of NJ (LLA)
- } Completed a four to five year degree in Landscape Architecture from an accredited institution
- } Formal education and training includes:
 - Hydrology
 - Site grading
 - Drainage
 - Environmental sciences
- } Passed rigorous testing and licensing process



Rutgers Landscape Architecture students working with the public in a design charrette

Professional Expertise

Uniquely qualified to lead the process to identify and incorporate *green infrastructure* techniques emphasizing:

- Soils
- Hydrology
- Plant Communities
- Climate
- Ecology
- Cultural Systems
- Human Health



Bioswale in New York City

Infrastructure for All

- } ASLA has been leading efforts to re-define infrastructure and seek a balance in the redevelopment of the built environment



What is Green Infrastructure?

- } Green infrastructure is an approach to wet weather management that is cost-effective, sustainable, and environmentally friendly. Green Infrastructure management approaches and technologies infiltrate, evapotranspire, capture and reuse stormwater to maintain or restore natural hydrologies. [\(USEPA. 2009. Green Infrastructure Manual.\)](#)
- } On-site management of stormwater runoff using soils and vegetation that is cost-effective when mitigating cultural impacts on the environment

Green Infrastructure provides...

- } Systems-based planning and design approach
- } Landscapes that function on many scales
- } Sustainable cost-effective solutions
- } Multiple benefits to communities
 - Stormwater management
 - Water quality
 - Urban heat island effect
 - Open space/green space
 - CSO mitigation
 - Air quality improvements
 - Habitat enhancement
 - Management of maintenance costs



Parking Lot Filter Strip

Why Green Infrastructure?

- } Provides cost-effective solutions for managing stormwater
- } Improves and protects water quality
- } Reduces stormwater volume
- } Minimizes localized flooding
- } Infiltrates and recharges groundwater
- } Adaptable and resilient
- } Sustainable



Curb inlets, permeable pavers, and tree filter box

[USEPA Green Infrastructure](#)

Infrastructure in our Community

} Roads

} Curbs & Gutters

} Catch Basins

} Sewer Pipes

} Retention &
Detention Ponds

} Treatment Plants

} **Trees**

} **Wetlands**

} **Parks**

} **Gardens**

} **Dunes**

} **...and more!**

Green Infrastructure Design Tools

Site

- } Green Roofs
- } Rain Harvesting
- } Downspout Disconnection
- } Planter Boxes
- } Rain Gardens
- } Permeable Pavements
- } Vegetated Swales
- } Naturalized Stormwater Basins

Neighborhood

- } Green Parking
- } Green Streets & Highways
- } Pocket Wetlands
- } Trees & Urban Forestry
- } Brownfield Redevelopment
- } Infill and Redevelopment

Watershed

- } Riparian Buffers
- } Habitat Preservation & Restoration





































What does Green Infrastructure look like?




- } Landscape Architects creatively integrate green infrastructure into projects as members of multi-disciplinary design teams.



Justifying Green Infrastructure

- Communities need to stretch available infrastructure dollars further
- Reducing energy use (\$\$) and increasing efficiency is a common goal
- Frequent flooding takes a toll on our economy
- Pollution and contamination continue to impact our quality of life and the environment

Benefit	Reduces Stormwater Runoff				Increases Available Water Supply	Increases Groundwater Recharge
	Reduces Water Treatment Needs	Improves Water Quality	Reduces Grey Infrastructure Needs	Reduces Flooding		
Practice						
Green Roofs						
Tree Planting						
Bioretention & Infiltration						
Permeable Pavement						
Water Harvesting						

 Yes
  Maybe
  No

SOURCE: The Value of Green Infrastructure, Center for Neighborhood Technology 2010

Green infrastructure is cost-effective

- } It can be less costly than grey infrastructure when addressing CSO abatement and water quality impairments
 - Downspout disconnection, curb extension rain gardens, vegetated swales, parking lot infiltration islands, and permeable pavements are less expensive “per gallon removed from combined sewer system” than grey alternatives.

“The City of Portland, Oregon found costs for these green infrastructure approaches ranged from \$0.89 to \$4.08 per gallon removed.”



SOURCE: Banking on Green: A Look at How Green Infrastructure Can Save Municipalities Money and Provide Economic Benefits Community-wide, April 2012.

Sustainable City Network

But will developers and communities embrace Green Infrastructure?



"many developers describe the cost of implementing stormwater controls as minor compared to the other economic factors they considered in deciding whether or not to pursue a project."

Market adjustments along with increased regulatory certainty have the potential to lower costs of green infrastructure:

- Availability of materials
- Better technologies
- Improved design & engineering
- More experienced installers
- Standardized codes and permitting reviews and approvals

SOURCE: Managing Stormwater in Redevelopment and Greenfield Development Projects Using Green Infrastructure – Economic Factors that Influence Developers' Decisions, June 2011.

Green infrastructure reduces energy consumption

- } Widespread adoption of Green Infrastructure practices can reduce electricity use in communities
- } Can lead to measurable increases in energy efficiency and reduced energy demands from existing water infrastructure
- } Green roofs and street trees can directly affect energy consumption on individual properties

"Washington DC's urban forest reduces building energy consumption costs by \$2.65 million per year."



SOURCE: Banking on Green: A Look at How Green Infrastructure Can Save Municipalities Money and Provide Economic Benefits Community-wide, April 2012.

But will developers and communities embrace Green Infrastructure?



Photo: Tracy Tackett, Seattle Public Utilities

"...economic benefits to developers include bioswales and other vegetative stormwater controls that improve the appearance and market appeal of a development while also reducing overall landscaping costs, and greenroofs that reduce energy costs and the long-term cost of roof maintenance."

"Enhancing the private benefits developers receive from green infrastructure by passing through some of the public benefits can create a more economically efficient outcome for society."



Photo: Ellen Greenberg, Arup.

SOURCE: Managing Stormwater in Redevelopment and Greenfield Development Projects Using Green Infrastructure – Economic Factors that Influence Developers' Decisions, June 2011.

Green infrastructure minimizes localized flooding

Conventional approaches to stormwater management move runoff quickly from properties and neighborhoods and into storage facilities that reduce peak flows but **NOT** runoff volumes

Green infrastructure practices provide a feasible and cost-effective alternative that manages precipitation **on-site** and **reduces loads** in local storm sewers and waterways.



But will developers and communities embrace Green Infrastructure?



"FEMA estimates that up to 25% of economic losses resulting from flooding occur in areas not designated as being in a "floodplain," but as a consequence of urban drainage."

"While most effective at managing localized flooding, runoff volume capture can also significantly reduce the impact of larger scale flooding events. Recent research on the impacts of green infrastructure employed on watershed-scale flooding suggest that green infrastructure can be effective at reducing peak flows for large infrequent storm events as well as provide noticeable volume reduction for smaller more frequent storms."



SOURCE: Banking on Green: A Look at How Green Infrastructure Can Save Municipalities Money and Provide Economic Benefits Community-wide, April 2012.

Green infrastructure protects water quality

Polluted runoff is the primary cause of impairment for almost 40% of water bodies across the country that fail to meet water quality standards. Critical pollutants carried in stormwater include:

- } Sediment
- } Nitrogen & Phosphorus
- } Bacteria
- } Insecticides
- } PCBs
- } Heavy metals (copper & lead)

"Incorporating green infrastructure into stormwater management plans helps to protect public health by reducing the amount of polluted runoff entering surface waters used for recreation and drinking water supplies."



Overflowing sewer in NJ after Hurricane Irene

SOURCE: Banking on Green: A Look at How Green Infrastructure Can Save Municipalities Money and Provide Economic Benefits Community-wide, April 2012.

But will developers and communities embrace Green Infrastructure?

"An EPA study found the contamination and loss of aquatic species and habitats from polluted stormwater runoff costs the commercial fish and shellfish industry up to \$30 million every year."



"Across the country, coastal and marine waters support 28.3 million jobs which depend upon safe, clean water. According to the National Research Council, in 2011, 36% of beach closures across the country were due to polluted runoff and stormwater."

"Every year, up to 3.5 million people become sick from contact with water contaminated by sewage."



SOURCE: Banking on Green: A Look at How Green Infrastructure Can Save Municipalities Money and Provide Economic Benefits Community-wide, April 2012.

Green Infrastructure opportunities for MS4 permit compliance

- } Education programs
- } Reduced repair & maintenance costs
- } Management of localized flooding
- } Meeting requirements of NJ's Stormwater Management Rules:
 - Nonstructural stormwater management strategies
 - Stormwater quantity
 - Groundwater recharge
 - Stormwater quality
 - Stormwater maintenance



Green Infrastructure opportunities for CSO permit compliance

Photo: Tomi/PhotoLink, Getty Images



- } Reduced flow and volume during storm events
- } Fewer overflow events
- } Reduced infrastructure replacement costs
- } Reduced built capital (equipment, installation) costs
- } Reduced operations costs

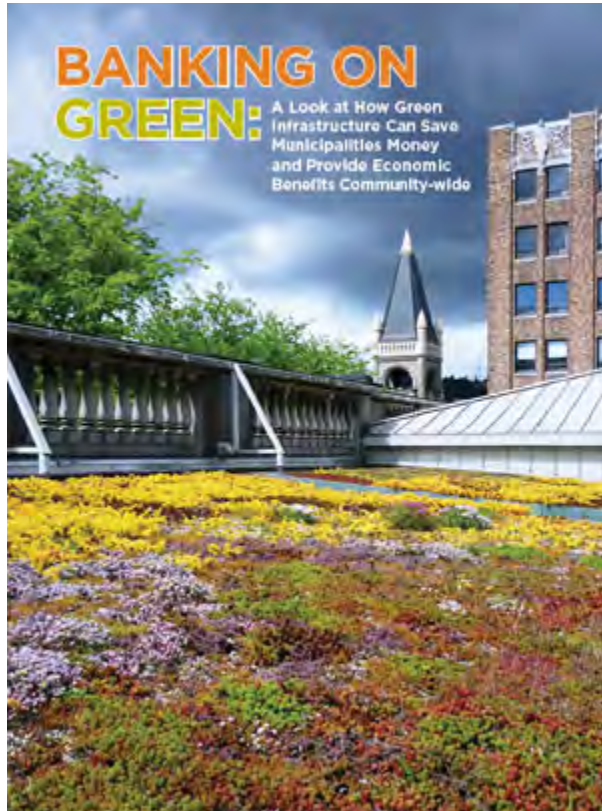
Integrating Green Infrastructure Techniques into the Community

...requires a new approach

- } Creative Thinking
- } Multi-disciplinary problem solving
- } Community Education
- } Balanced Grey/Green Infrastructure Capital Improvement Programs
- } Taking the first step...



Selecting the right tool, technique, and strategy for your Community



- } Consider stormwater management at the earliest stages of a project
- } Look at stormwater as a resource
- } Recognize the value of "*infrastructure*" to enhance onsite landscapes, reduce energy use, manage environmental impacts, and replenish groundwater
- } Understand that "one size does **NOT** fit all..." successful projects will be unique for each site

Landscape Architects are leading the way

- } Collaborating with and directing multi-disciplinary design teams (planners, engineers, architects, etc.)
- } Assessing available and emerging technologies and design techniques
- } Developing creative and unique solutions to meet individual community needs
- } Implementing sustainable green infrastructure programs that balance the needs of the community with the health of the environment

Green Infrastructure...

...can be a cost-effective and sometimes less expensive solution, when compared to grey infrastructure options, reducing the cost of stormwater and CSO management.

...can provide tangible financial and community benefits as well as environmental protection that translate into economic values for municipal governments and local communities throughout New Jersey.



New Jersey needs...

...a new approach to designing and building infrastructure that integrates strategies that mimic natural hydrologic functions can provide communities with real savings, strengthen local economies, make communities more resilient, and create healthier, more livable communities while protecting critical water resources.



Rain Garden Planting at Hurfville School

New Jersey ASLA

- } The NJASLA is the NJ Chapter of the American Society of Landscape Architects, a national organization of Landscape Architects, formed in 1899. There are currently over 17,600 members of the ASLA.
- } The Chapter hosts an annual meeting which attracts between 500-600 design professionals each year.
- } Through the efforts of NJASLA, the New Jersey State Legislature adopted new legislation in 2008 to increase the effectiveness of Landscape Architects in providing “quality of life” places and spaces throughout New Jersey and encourage an equal status for Landscape Architects with Architects, Engineers, Planners and Surveyors within the land development process.



Resources

- } <http://www.asla.org/> (American Society of Landscape Architects)
- } <http://njasla.org/> (American Society of Landscape Architects NJ Chapter)
- } <http://www.sustainablesites.org/> (Sustainable Sites Initiative)
- } <http://water.epa.gov/infrastructure/greeninfrastructure/index.cfm> (USEPA)
- } <http://greeninfrastructure.net/> (Green Infrastructure Network at The Conservation Fund)
- } <http://water.rutgers.edu/> (Rutgers Cooperative Extension Water Resources Program)
- } http://www.nyc.gov/html/dep/html/stormwater/nyc_green_infrastructure_plan.shtml (New York City Green Infrastructure Plan)
- } http://www.phillywatersheds.org/what_were_doing/documents_and_data/cso_long_term_control_plan (Philadelphia Water Department Green City, Clean Waters Program)
- } <http://www.dewater.com/education/lowimpact.cfm> (Washington DC Water Low Impact Development Program)

References

1. Banking on Green: A Look at How Green Infrastructure Can Save Municipalities Money and Provide Economic Benefits Community-wide. A joint report by American Rivers, the Water Environment Federation, the American Society of Landscape Architects and ECONorthwest, April 2012. Available at: http://www.asla.org/uploadedFiles/CMS/Government_Affairs/Federal_Government_Affairs/Banking%20on%20Green%20HighRes.pdf.
2. Managing Stormwater in Redevelopment and Greenfield Development Projects Using Green Infrastructure – Economic Factors that Influence Developers' Decisions. ECONorthwest, June 2011. Available at: <http://www.smartgrowthamerica.org/smartgrowthusa/wp-content/uploads/2011/08/managing-stormwater-in-redevelopment.pdf>.
3. Keeping Raw Sewage & Contaminated Stormwater Out of the Public's Water. USEPA Region 2, 2011. Available at: <http://www.epa.gov/region2/water/sewer-report-3-2011.pdf>.
4. Impact of Green Infrastructure and Low Impact Development on the Nation's Water Quality and, Economy, and Communities. HEARING BEFORE THE SUBCOMMITTEE ON WATER RESOURCES AND ENVIRONMENT OF THE COMMITTEE ON TRANSPORTATION AND INFRASTRUCTURE HOUSE OF REPRESENTATIVES ONE HUNDRED ELEVENTH CONGRESS SECOND SESSION. September 30, 2010. Available at: <http://www.gpo.gov/fdsys/pkg/CHRG-111hhr58491/pdf/CHRG-111hhr58491.pdf>.
5. The Value of Green Infrastructure – A Guide to Recognizing its Economic, Environmental and Social Benefits. Center for Neighborhood Technology, 2010. Available at: <http://www.cnt.org/repository/gi-values-guide.pdf>.