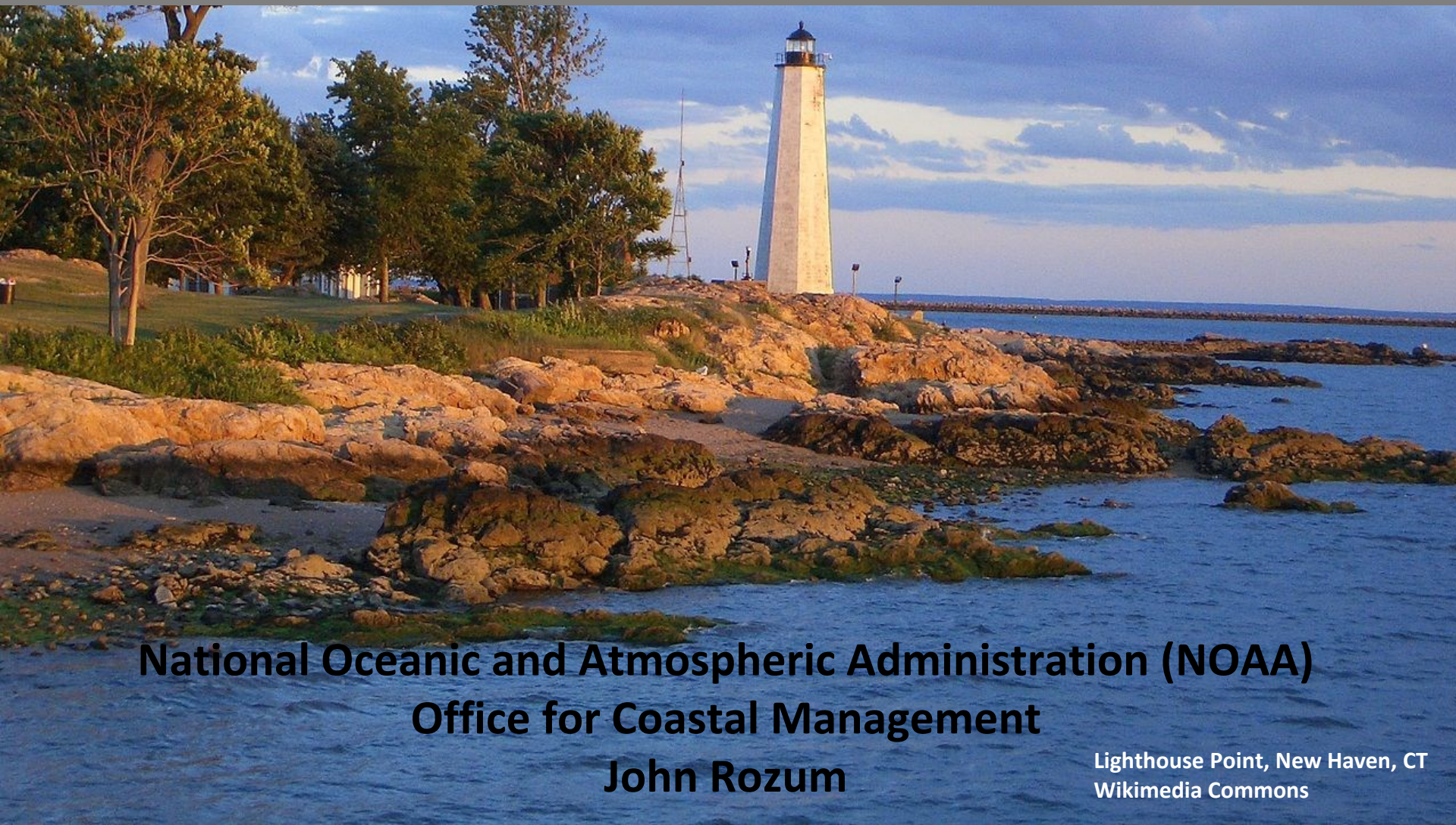
Introducing Green Infrastructure for Coastal Resilience



National Oceanic and Atmospheric Administration (NOAA)
Office for Coastal Management
John Rozum

Lighthouse Point, New Haven, CT
Wikimedia Commons

What Is “Resilience”?

Introducing Green Infrastructure for Coastal Resilience

Course Objectives

Participants:

- Recognize green infrastructure terms and concepts that contribute to community resilience
- Understand ecological, economic, and societal benefits of green infrastructure
- Understand the wide variety of contexts and scales of approaches
- Understanding of how green infrastructure fits into existing planning processes, tips on engaging stakeholders, and potential funding opportunities
- Identify local green infrastructure activities and experts with additional information and resources

Course Outline

1. Green Infrastructure Concepts and Principles
2. The Practice of Green Infrastructure
3. Implementing Green Infrastructure

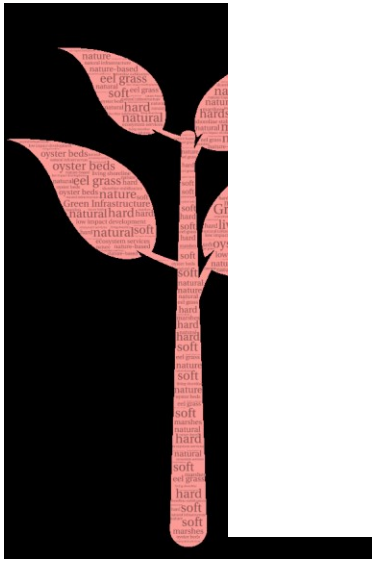
Who's in the Room?

- **One Word** you think of when you hear the term "Green Infrastructure"

Section 1

Green Infrastructure Concepts and Principles

The Terminology Thi



OFFICE FOR COASTAL MANAGEMENT

NATIONAL OCEANIC AND ATMOSPHERIC ADMINISTRATION

Foundations of Green Infrastructure

Green Infrastructure Concepts and Principles

Landscape Architecture

1860s

Landscape Ecology

1930s

Design with Nature

1960s

Conservation Biology

1970s

Clean Water Act

1970s

Foundations of Green Infrastructure

Green Infrastructure Concepts and Principles

Landscape approach?

Site-level approach?

Applicability across Scales

Landscape and watershed

Community and site

Shore and coastal zone

Green Infrastructure Concepts and Principles

Importance of Context

Green Infrastructure Concepts and Principles

Green infrastructure practices are context sensitive.

Rural → Urban

Coastal → Upland

Why Green Infrastructure?

Green Infrastructure Concepts and Principles

Coastal Shoreline Counties

Population

123.3 million

Coastal Shoreline County population in 2010.

39%

Percent of the U.S. population that resides in Coastal Shoreline Counties in 2010.

34.8 million

Coastal Shoreline County population change from 1970 to 2010, a 39% increase.
(U.S. average 52%)

10 million

Projected population change in Coastal Shoreline Counties from 2010 to 2020, an 8% increase.
(U.S. average 10%)

Humpback Whale National Marine Sanctuary. Credit: Fiona Langenberger

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Figure 3 | Population Change in Coastal Shoreline Counties: 1970-2010

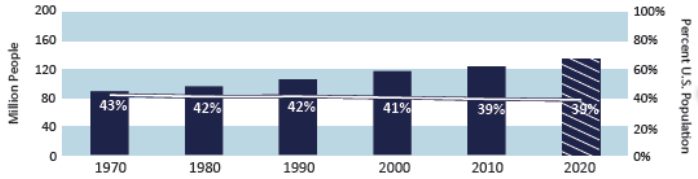
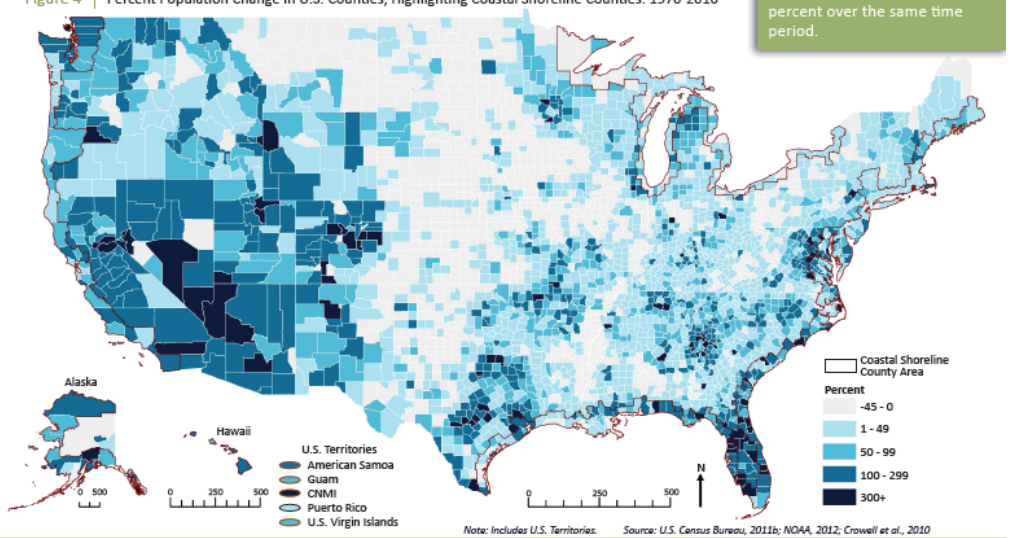


Figure 4 | Percent Population Change in U.S. Counties, Highlighting Coastal Shoreline Counties: 1970-2010



Note: Includes U.S. Territories. *Source: U.S. Census Bureau, 2011b; NOAA, 2012; Crowell et al., 2010*

The Bottom Line

In 2010, 123.3 million people, or 39 percent of the nation's population lived in Coastal Shoreline Counties. Population growth in these counties occurred at a lower rate than the nation as a whole from 1970 to 2010. The population in Coastal Shoreline Counties increased by 34.8 million people, a 39 percent increase, while the nation's entire population increased by 52 percent over the same time period.

NOAA's National Coastal Population Report

Why Green Infrastructure?

Green Infrastructure Concepts and Principles


Collins Cover, Salem
Courtesy, Elizabeth Hollin


Hurricane Sandy
Courtesy, Brian Birke

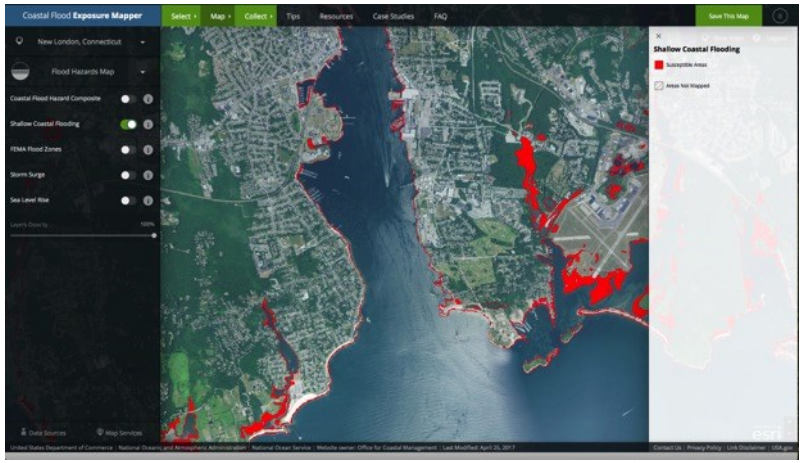

Hurricane Sandy
Courtesy, Brian Birke

Why Green Infrastructure?

Green Infrastructure Concepts and Principles

Exposure to Coastal Hazards

Green Infrastructure Concepts and Principles



Shallow Coastal Flooding

FEMA Flood Zones

Storm Surge

Sea Level Rise

coast.noaa.gov/digitalcoast/tools/flood-exposure

Ecosystem Services

Natural ecosystems provide multiple benefits to people, including food and water production, improved air and water quality, and recreation and spiritual inspiration.

Multiple Benefits

- Environmental
- Societal
- Economic

Who's Benefit

Green Infrastructure Concepts and Principles

A wide variety of stakeholders stand to benefit. Engaging stakeholders is an essential part of understanding the benefits and how they are valued by people.

Group Discussion 1

What coastal hazard issues is your community experiencing? (e.g., flooding, stormwater runoff)

Section 2
The Practice of Green Infrastructure


East Haddam, CT

Planning Concepts

The Practice of Green Infrastructure

- Approach will depend on the ***scale*** you are addressing
- All practices, regardless of scale, use ***ecosystem services*** to acquire maximum benefits
- Design methods are repeatable and grounded in ***science***
- ***Context*** is important

Design Concepts

The Practice of Green Infrastructure

Successful green infrastructure practices incorporate

- Multi-functionality
- Resilience
- Sense of place
- Return on investment

Green Infrastructure in Practice

The Practice of Green Infrastructure

Landscape and watershed

Community and site

Shore and coastal zone

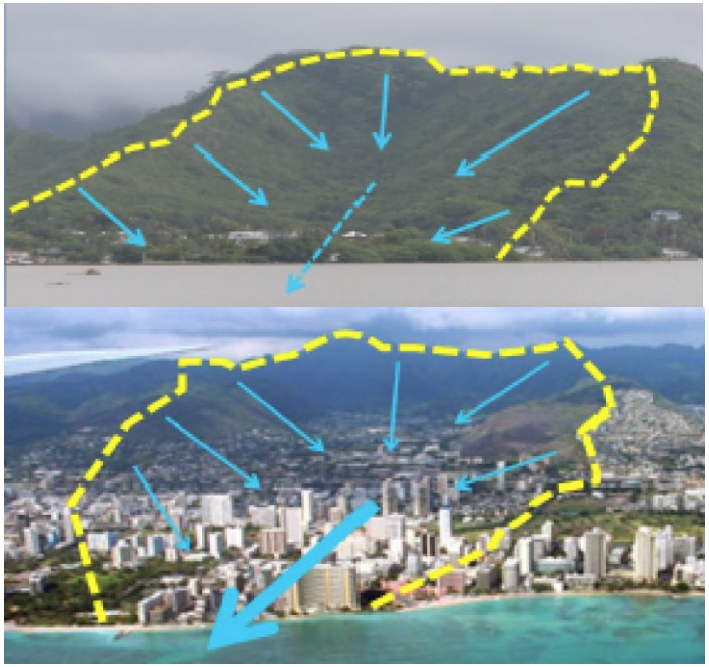
Landscape Design Concepts

The Practice of Green Infrastructure

	BETTER	WORSE
Area		
Proximity		
Connectivity		

Watershed Design Concepts

The Practice of Green Infrastructure



Source: Horsley Witten Group; Center for Watershed Protection

- Preserve native vegetation
- Protect steep slopes
- Buffer stream channels
- Reduce connected impervious cover
- Seek multiple benefits

Landscape and Watershed Approaches and Resilience

The Practice of Green Infrastructure

- Recent study* on flood reduction during Hurricane Sandy showed:
  - Coastal wetlands saved more than $625 million in flood damages
  - Where they exist, coastal wetlands reduced damages by more the 10% on average
  - In Ocean County, NJ wetland conservation can reduce average annual losses by more than 20%

*Coastal Wetlands and Flood Damage Reduction: Using Risk Industry-Based Models to Assess Natural Defenses in the NE USA, 2016.

Community and Site Design Concepts

The Practice of Green Infrastructure

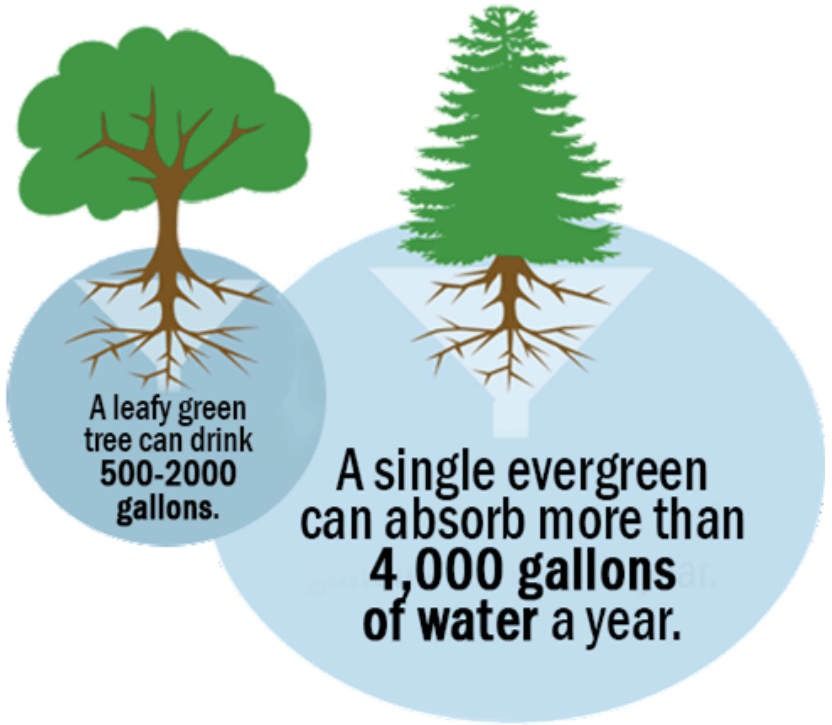
- Natural areas and open spaces should serve multiple functions (e.g., recreation, stormwater storage, filtration)
- Connect people to open areas through greenways and trails
- Preserve or mimic the natural hydrological functions of a site or drainage area
- Use urban streetscapes to provide ecosystem benefits in urban areas

Community and Site Approaches

The Practice of Green Infrastructure

Urban Forestry

- Trees provide enormous environmental, economic, and societal benefits
- Develop a tree planting program designed to maximize benefits
- To the extent possible, protect existing forested areas, particularly large specimen trees



Community and Site Approaches

The Practice of Green Infrastructure

Green Streets

- Key linking component in green infrastructure network
- Design dependent on local conditions but generally include
  - Alternative street widths
  - Swales
  - Bioretention
  - Permeable pavements
- Provides multiple benefits

Philadelphia Water Department

Coos Bay, Oregon

Community and Site Approaches

The Practice of Green Infrastructure

Environmental Site Design

- Place the site in context to greater community
- Preserve and enhance natural features
- Mimic or enhance existing hydrology
- Minimize impervious cover
- Key component of low impact development (LID)

TrockWorks Architectural Services

Community and Site Approaches

The Practice of Green Infrastructure

Low Impact Development Practices

Bioretention (Infiltration and Filtering)

- Rain gardens
- Bioswales
- Stormwater planters

Green Roofs (Storage and Evapotranspiration)

- Blue roofs
- Cisterns

Permeable Pavements (Infiltration)

- Porous asphalt/concrete
- Grass or gravel pavers
- Pavers

Community and Site Approaches and Resilience

The Practice of Green Infrastructure

- Many studies on the effectiveness of these practices for
  - Reducing the heat island effect
  - Improving water quality
  - Recharging groundwater
  - Providing societal benefits

- For LID, flood reduction is a ‘co-benefit’
  - City of Portland, OR reduced peak flow of stormwater runoff by 93%, cooling costs by 27%, and heating costs by 15%.

Shoreline Design Concepts

The Practice of Green Infrastructure

- Natural or Nature-Based
  - Dunes and beaches
  - Vegetated features (salt marsh, wetlands, submerged aquatic vegetation)
  - Oyster and coral reefs
  - Barrier islands
  - Maritime forest/shrub communities
- Hybrid
  - Natural and structural features
- Nonstructural
  - Floodplain policy and management

Shoreline Approaches

The Practice of Green Infrastructure

Natural or Nature-based

Dune and Beach Creation

- Break offshore waves
- Attenuate wave energy
- Slow inland water transfer

Salt Marshes, Wetlands, Vegetation, SAV

- Break offshore waves
- Attenuate wave energy
- Slow inland water transfer
- Increase infiltration

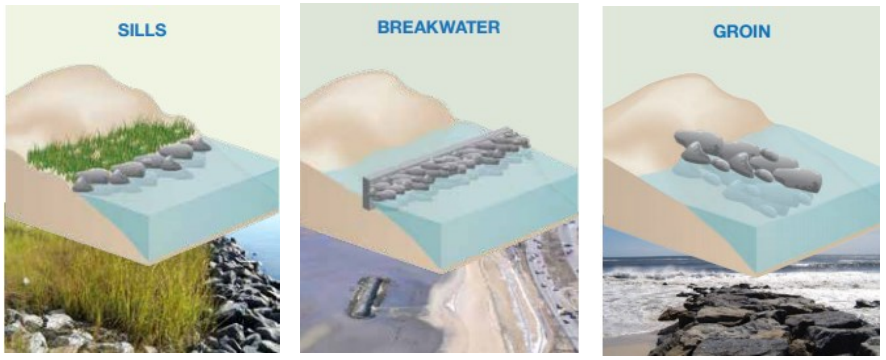
Oyster and Coral Reefs

- Break offshore waves
- Attenuate wave energy
- Slow inland water transfer

Shoreline Approaches

The Practice of Green Infrastructure

Hybrid



http://sagecoast.org/info/information.html

- Blends both nature-based and structural approaches
- Derives benefit of wave energy dissipation from structural practices
- Derives ecosystem service benefits from nature-based practices

Shoreline Approaches and Resilience

The Practice of Green Infrastructure

- Study* conducted in North Carolina before and after Hurricane Irene showed:
  - Marshes with and without sills are more durable and protected shorelines from erosion better than the bulkheads during the Category 1 storm.
  - 76% of bulkheads were damaged in the storm.
  - No damage occurred to shorelines with or without sills.

Courtesy, Tracy Skrabal, NC Coastal Federation

*Marshes with and without sills protect estuarine shorelines from erosion better than bulkheads during a Category 1 hurricane, 2014

Table Discussion 2

What green infrastructure-related projects are you working on now, or hope to, that contribute to preserving resilience-enhancing ecosystem services in your community?

Record one sentence project description, location, your contact information

Put a "P" if it is an existing or planned project
Put an "I" if it is an idea.

Section 3

Implementing Green Infrastructure

Courtesy Eastern CT Conservation District

Barriers to Green Infrastructure

Implementing Green Infrastructure

Technical and Physical

- Lack of understanding
- Lack of data showing benefits, costs, and so on
- Insufficient technical knowledge or experience
- Lack of design standards, codes, and ordinances

Financial

- Not enough data about costs and economic benefits
- Perceived high costs over short and long terms
- Lack of funding for implementation
- Too much risk – not enough incentives

Legal and Regulatory

- Local rules lacking, conflicting, or restrictive
- State policies
- Property rights issues
- Federal rules can be conflicting

Community and Institutional

- Insufficient information and green infrastructure benefits for political leaders, administrators, staff, developers, builders, and landscapers
- Community and institutional values that underappreciate green infrastructure aesthetics and characteristics
- Lack of interagency and community cooperation

Green Infrastructure Can Inform Planning

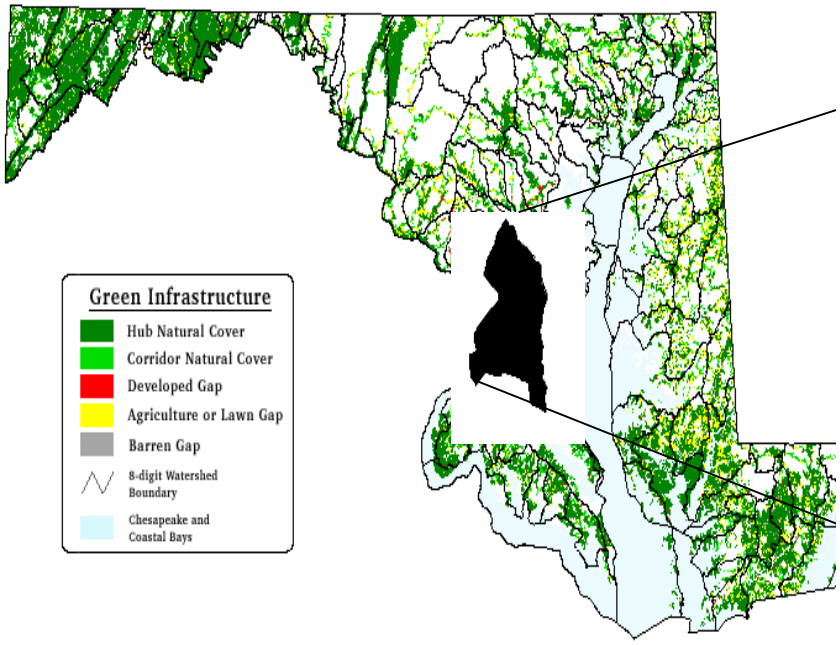
Implementing Green Infrastructure

Incorporate green infrastructure into planning efforts:

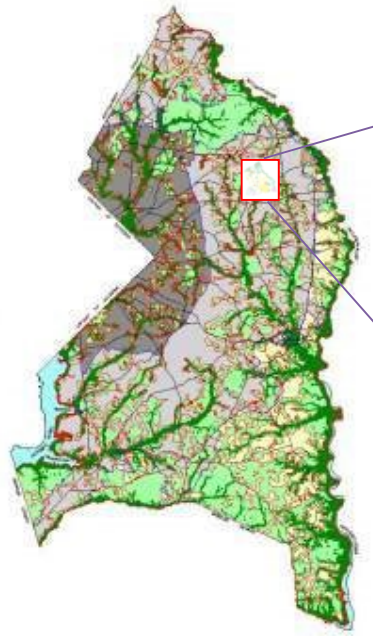
- Comprehensive
- Transportation
- Smart growth
- Watershed
- Conservation
- Hazard mitigation
- Stormwater
- Climate change adaptation
- Resilience
- Land use

Green Infrastructure Can Inform Planning

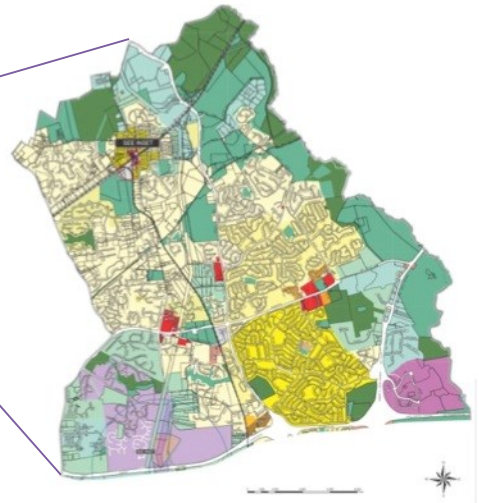
Implementing Green Infrastructure



Maryland State Plan



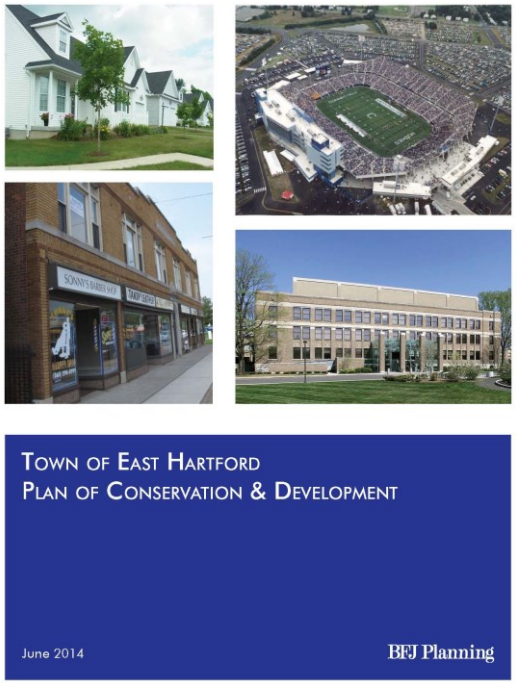
Prince George's County

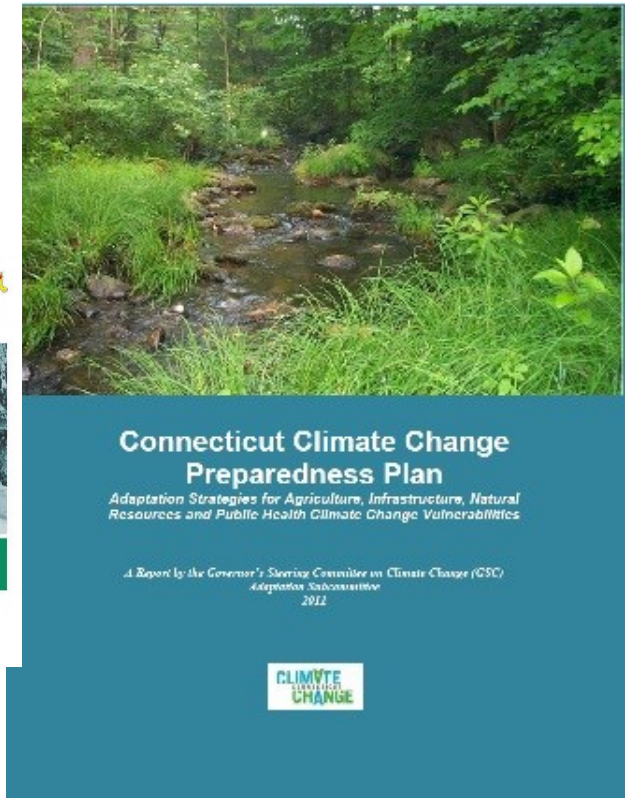


Bowie Planning Area

Comprehensive, Hazard Mitigation, and Climate Adaptation Planning

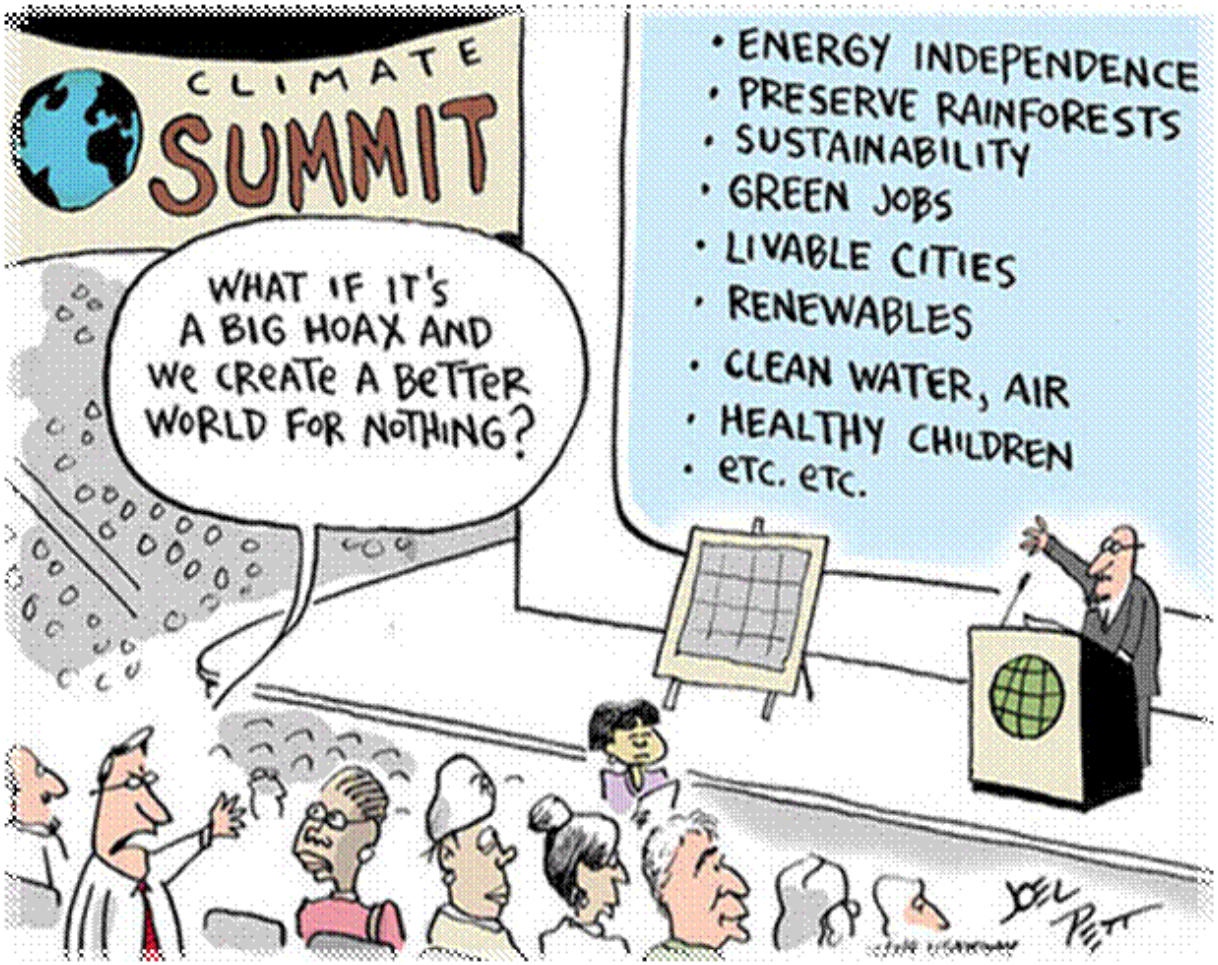
Implementing Green Infrastructure





Multiple Benefits

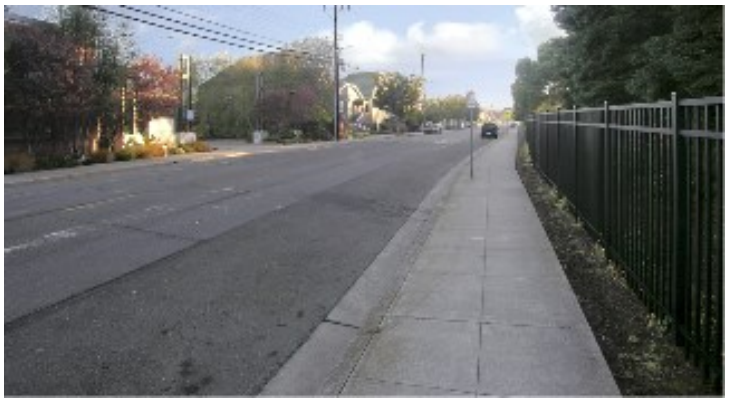
Implementing Green Infrastructure



Engaging Stakeholders

Implementing Green Infrastructure

- Have a plan
- Speak to their interests, not yours
- Explain the hazard risk and offer solutions
- Use multiple ways to communicate



Engaging Stakeholders

Implementing Green Infrastructure

coast.noaa.gov/digitalcoast/training/gi-animation

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NATIONAL OCEANIC AND ATMOSPHERIC ADMINISTRATION

Engaging Stakeholders

Implementing Green Infrastructure

Put Green Infrastructure between Your Community and the Next Coastal Storm.

There are many benefits.

Tidal and Forested Wetlands
- Slow waves
- Filter and clean floodwaters
- Provide food and jobs

Green Streets
- Capture and clean stormwater
- Beautify streets and encourage economic development
- Provide pedestrian-friendly walkways

Oyster and Coral Reefs
- Slow storm surge
- Provide food
- Clean water

Sand Dunes
- Buffer waves as a first line of defense
- Build economy through tourism

Open Space and Parks
- Store floodwaters and recharge aquifers
- Increase property values

Urban Trees
- Reduce runoff and absorb floodwaters
- Shade and cool homes and businesses
- Provide clean air and water

Living Shorelines
- Slow waves and reduce erosion
- Protect property

Office for Coastal Management
Digital Coast

See the reverse of this page to learn more.

Here's What You Can Do to Protect Your Community.

Green infrastructure can have multiple functions and cost less than using only gray infrastructure.

Conserve Existing Natural Areas

Natural areas such as wetlands, dunes, and vegetated shorelines absorb storm surge waves, reducing damage to nearby homes and roads.

How do we know it works? A study after Hurricane Sandy showed that areas containing wetlands had less damage than those without. Wetlands prevented an estimated $600 million in property losses.

Increase Your Community's Ability to Absorb Stormwater

- Protect and plant trees.
- Implement other practices such as green streets to keep stormwater from running into sewers, lessening the strain on existing systems.
- Use capital improvement projects as an opportunity to fund stormwater projects.

How do we know it works? The City of Portland, Oregon, used a combination of green roofs, green streets, trees, and rain gardens to reduce the peak flow of stormwater runoff by 93 percent, cooling costs by 27 percent, and heating costs by 15 percent.

Photo: Tracy Skrabal, North Carolina Coastal Federation

Create Natural Shorelines

Create living shorelines using oysters, marsh grass, and other natural materials to absorb wave energy and reduce erosion.

How do we know it works? North Carolina properties that used natural shoreline protection measures withstood wind and storm surge during Hurricane Irene better than properties using seawalls or bulkheads.

To learn more, visit *coast.noaa.gov/digitalcoast/topics/green-infrastructure*.

Office for Coastal Management
Digital Coast

Engaging Stakeholders

Implementing Green Infrastructure

EPA

Costs of Low Impact Development

LID Saves Money and Protects Your Community's Resources

LID Barrier Busters Fact Sheet Series

Are Low Impact Development (LID) Practices More Economical Than Conventional Practices?

In many cases, the answer is yes. LID typically includes a variety of low-cost elements such as bioswales that retain rain water and encourage it to soak into the ground rather than allowing it to run off into storm drains where it would otherwise contribute to flooding and pollution problems. LID projects typically include smaller overall development footprints, reduce the amount of runoff generated and increase the amount of natural areas on a site, thereby reducing costs when compared to traditional stormwater management and flood control.

FAQ

Isn't LID too costly?

Barrier Busted!

Communities recognize that using LID can save money.

EPA's LID Barrier Busters fact sheet series...helping to overcome misperceptions that can block adoption of LID in your community.

Example Economic Benefits of LID Elements

- Adding roadside bioswales, making roads narrower and de parking lots with on-site runoff retention **saves money by pavement, curbs and gutters needed**.
- Installing green roofs, disconnecting roof downspouts from (driveways or streets), and incorporating bioretention areas **saves money by eliminating the need for costly runoff pipe delivery systems**.
- Designing more compact residential lots **saves money by and building preparation costs, and can increase the for sale**.
- Preserving natural features in the neighborhood **can incre price of residential lots**.
- Using existing trees and vegetation **saves money by redu and decreasing stormwater volume**.

Cost-Savings Nationwide: LID Case Studies

A U.S. Environmental Protection Agency study of 17 LID case country found that, in the majority of cases, total capital cost to 80 percent when LID methods were used. (For details, see costs07.)

- **Sherwood, Arkansas:** Gap Creek subdivision included 2: natural drainage areas and traffic-calming circles that allo reduce street widths. Results? The lots sold for $3,000 mo to develop than comparable conventional lots. The LID de for stormwater control features, which allowed the develop additional lots.

- **Seattle, Washington:** Seattle's 2nd Avenue Street Edge Alternative project redesigned an entire block with LID techniques such as bioswales in the rights-of-way. Results? Reducing street widths and sidewalks lowered paving costs by 49 percent. Overall, incorporating LID techniques cost $651,548—a savings of $217,255 compared to a conventional retrofit of the block, which would have cost an estimated $868,803.
- **Naperville, Illinois:** Developers at the 55-acre Tellabs corporate campus preserved much of the site's natural drainage features and topography, reducing grading and earthwork costs. They used bioswales and other infiltration techniques in parking lots to manage stormwater. They maximized the amount of natural areas, eliminating the need for irrigation systems and lowering maintenance costs when compared to turf grass. Results? As seen in the table below, total LID project costs were $461,510 less than a conventional design would have been.

Sample Costs: Comparing Conventional Stormwater Controls with LID Techniques in a Corporate Development (Tellabs) in Naperville, Illinois

Construction Item	Cost of Conventional Development	Cost When Using LID Practices	Dollars Saved with LID
Site preparation	$2,178,500	$1,966,000	$212,500
Stormwater management	$480,910	$418,000	$62,910
Landscape development	$502,750	$316,650	$186,100
Total	**$3,162,160**	**$2,700,650**	**$461,510**

LID Provides Added Value for Communities

Besides reducing the capital and other actual costs, using LID practices provides numerous additional economic benefits, some of which are difficult to quantify, including:

- Improved aesthetics for communities
- Expanded recreational opportunities
- Increased property values due to the desirability of the lots and their proximity to open space
- Increased marketing potential and faster sales for residential and commercial properties
- Reduced stream channel damage and pollutant loadings in downstream waters
- Reduced drinking water treatment costs
- Reduced costs associated with combined sewer overflows, where applicable

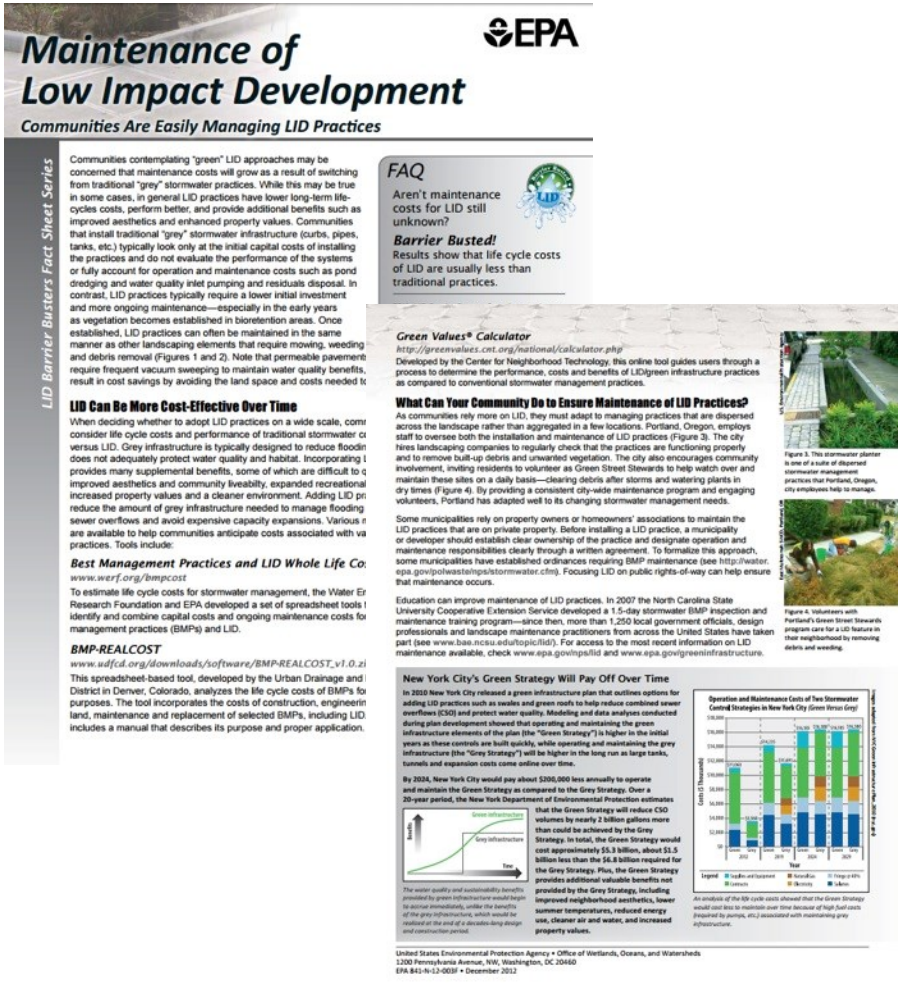
LID offers great flexibility for developing and re-developing properties. A wide range of LID technology choices are available to match the needs of individual sites and the desires of the parties developing or buying the property.

A roadside swale captures and retains runoff in Seattle, Washington. The city saves money with LID by avoiding costly stormwater infrastructure and reducing paving costs.

This bioretention pond in Wilsonville, Oregon collects runoff from the rooftops, sidewalks and yards. The pond offers valuable aesthetic and wildlife habitat benefits while also reducing stormwater control costs.

Philadelphia has been expanding its use of LID by implementing new policies and demonstration projects, such as this roadside bioswale that treats runoff from an adjacent parking lot. The city's use of LID has reduced stormwater runoff volume, saving approximately $170 million in combined sewer overflow costs since 2006.

United States Environmental Protection Agency • Office of Wetlands, Oceans, and Watersheds
1200 Pennsylvania Avenue, NW, Washington, DC 20460
EPA 841-N-12-003C • March 2012



EPA

Maintenance of Low Impact Development

Communities Are Easily Managing LID Practices

LID Barrier Busters Fact Sheet Series

Communities contemplating "green" LID approaches may be concerned that maintenance costs will grow as a result of switching from traditional "grey" stormwater practices. While this may be true in some cases, in general LID practices have lower long-term life-cycles costs, perform better, and provide additional benefits such as improved aesthetics and enhanced property values. Communities that install traditional "grey" stormwater infrastructure (curbs, pipes, tanks, etc.) typically look only at the initial capital costs of installing the practices and do not evaluate the performance of the systems or fully account for operation and maintenance costs such as pond dredging and water quality inlet pumping and residuals disposal. In contrast, LID practices typically require a lower initial investment and more ongoing maintenance—especially in the early years as vegetation becomes established in bioretention areas. Once established, LID practices can often be maintained in the same manner as other landscaping elements that require mowing, weeding and debris removal (Figures 1 and 2). Note that permeable pavement require frequent vacuum sweeping to maintain water quality benefits, result in cost savings by avoiding the land space and costs needed t

FAQ

Aren't maintenance costs for LID still unknown?

Barrier Busted!

Results show that life cycle costs of LID are usually less than traditional practices.

LID Can Be More Cost-Effective Over Time

When deciding whether to adopt LID practices on a wide scale, comm consider life cycle costs and performance of traditional stormwater c versus LID. Grey infrastructure is typically designed to reduce floodin does not adequately protect water quality and habitat. Incorporating L provides many supplemental benefits, some of which are difficult to q improved aesthetics and community liveability, expanded recreational increased property values and a cleaner environment. Adding LID pr reduce the amount of grey infrastructure needed to manage flooding sewer overflows and avoid expensive capacity expansions. Various r are available to help communities anticipate costs associated with va practices. Tools include:

Best Management Practices and LID Whole Life Co

www.werf.org/bmpcost

To estimate life cycle costs for stormwater management, the Water Er Research Foundation and EPA developed a set of spreadsheet tools t identify and combine capital costs and ongoing maintenance costs fo management practices (BMPs) and LID.

BMP-REALCOST

www.udfcd.org/downloads/software/BMP-REALCOST_v1.0.zi

This spreadsheet-based tool, developed by the Urban Drainage and District in Denver, Colorado, analyzes the life cycle costs of BMPs fo purposes. The tool incorporates the costs of construction, engineerin land, maintenance and replacement of selected BMPs, including LID. includes a manual that describes its purpose and proper application.

Green Values® Calculator

http://greenvalues.cnt.org/national/calculator.php

Developed by the Center for Neighborhood Technology, this online tool guides users through a process to determine the performance, costs and benefits of LID/green infrastructure practices as compared to conventional stormwater management practices.

What Can Your Community Do to Ensure Maintenance of LID Practices?

As communities rely more on LID, they must adapt to managing practices that are dispersed across the landscape rather than aggregated in a few locations. Portland, Oregon, employs staff to oversee both the installation and maintenance of LID practices (Figure 3). The city hires landscaping companies to regularly check that the practices are functioning properly and to remove built-up debris and unwanted vegetation. The city also encourages community involvement, inviting residents to volunteer as Green Street Stewards to help watch over and maintain these sites on a daily basis—clearing debris after storms and watering plants in dry times (Figure 4). By providing a consistent city-wide maintenance program and engaging volunteers, Portland has adapted well to its changing stormwater management needs.

Some municipalities rely on property owners or homeowners' associations to maintain the LID practices that are on private property. Before installing a LID practice, a municipality or developer should establish clear ownership of the practice and designate operation and maintenance responsibilities clearly through a written agreement. To formalize this approach, some municipalities have established ordinances requiring BMP maintenance (see http://water.epa.gov/polwaste/nps/stormwater.cfm). Focusing LID on public rights-of-way can help ensure that maintenance occurs.

Education can improve maintenance of LID practices. In 2007 the North Carolina State University Cooperative Extension Service developed a 1.5-day stormwater BMP inspection and maintenance training program—since then, more than 1,250 local government officials, design professionals and landscape maintenance practitioners from across the United States have taken part (see www.bae.ncsu.edu/topic/lid/). For access to the most recent information on LID maintenance available, check www.epa.gov/nps/lid and www.epa.gov/greeninfrastructure.

Figure 3. This stormwater planter is one of a suite of dispersed stormwater management practices that Portland, Oregon, city employees help to manage.

Figure 4. Volunteers with Portland's Green Street Stewards program care for a LID feature in their neighborhood by removing debris and weeding.

New York City's Green Strategy Will Pay Off Over Time

In 2010 New York City released a green infrastructure plan that outlines options for adding LID practices such as swales and green roofs to help reduce combined sewer overflows (CSO) and protect water quality. Modeling and data analyses conducted during plan development showed that operating and maintaining the green infrastructure elements of the plan (the "Green Strategy") is higher in the initial years as these controls are built quickly, while operating and maintaining the grey infrastructure (the "Grey Strategy") will be higher in the long run as large tanks, tunnels and expansion costs come online over time.

By 2024, New York City would pay about $200,000 less annually to operate and maintain the Green Strategy as compared to the Grey Strategy. Over a 20-year period, the New York Department of Environmental Protection estimates that the Green Strategy will reduce CSO volumes by nearly 2 billion gallons more than could be achieved by the Grey Strategy. In total, the Green Strategy would cost approximately $5.3 billion, about $1.5 billion less than the $6.8 billion required for the Grey Strategy. Plus, the Green Strategy provides additional valuable benefits not provided by the Grey Strategy, including improved neighborhood aesthetics, lower summer temperatures, reduced energy use, cleaner air and water, and increased property values.

United States Environmental Protection Agency • Office of Wetlands, Oceans, and Watersheds
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www.epa.gov/green-infrastructure/overcoming-barriers-green-infrastructure

NOAA

OFFICE FOR COASTAL MANAGEMENT

NATIONAL OCEANIC AND ATMOSPHERIC ADMINISTRATION

Funding for Green Infrastructure

Implementing Green Infrastructure

- US Environmental Protection Agency
- NOAA
- Federal Emergency Management Agency
- National Park Service
- National Endowment for the Arts
- US Department of Transportation
- Economic Development Administration
- National Recreation and Parks Association
- Funders Network for Smart Growth and Livable Communities
- Qualified Energy Conservation Bonds

Group Discussion 3

- **Part 1:** What barriers have you run into around implementing green infrastructure?
- **Part 2:** How can you overcome these barriers?

One Last Thing . . .

Please **fill out the Evaluation!**

http://bit.ly/2pXLNFN

Thank You!

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