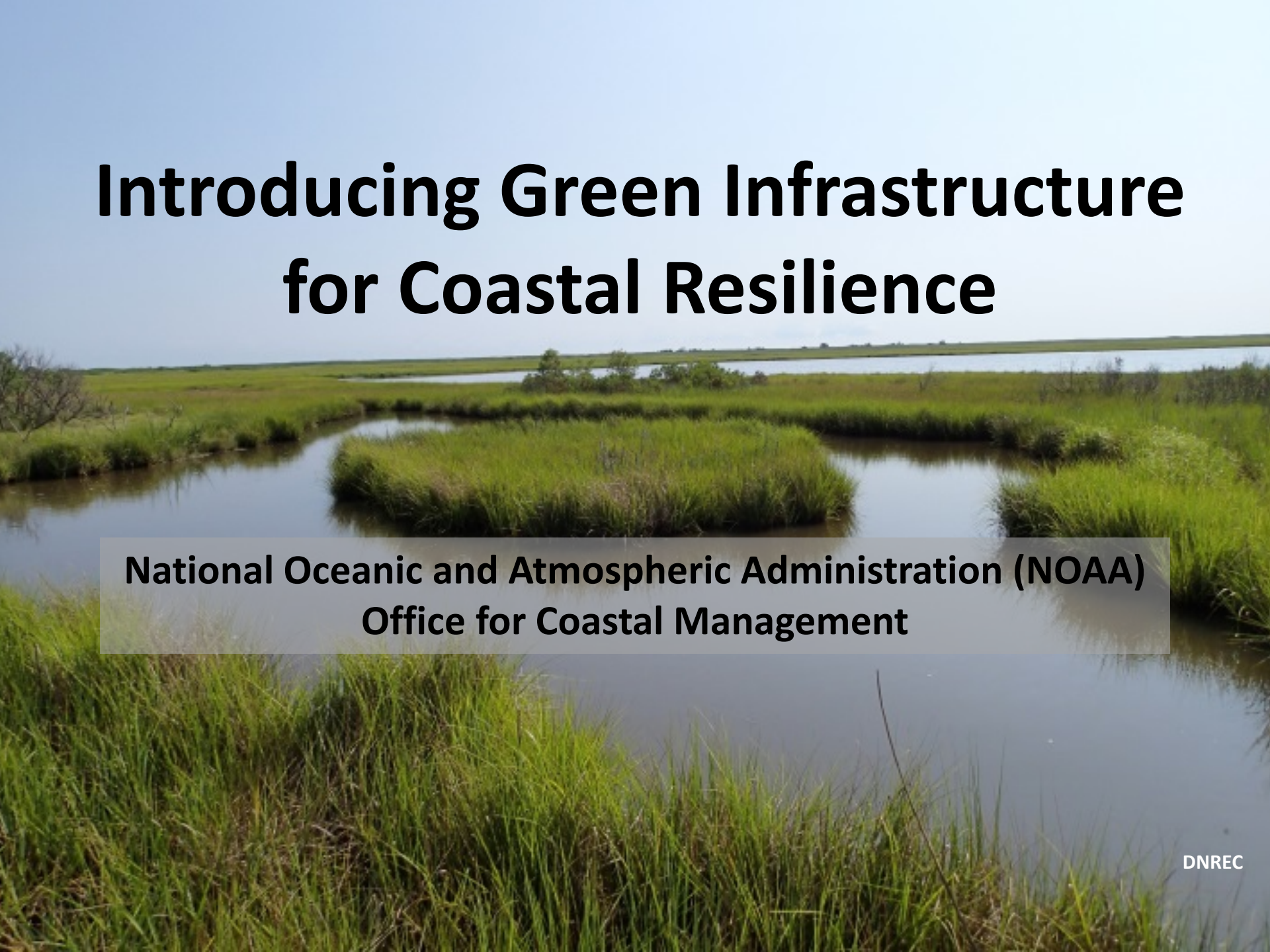
Introducing Green Infrastructure for Coastal Resilience



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

DNREC

What Is “Resilience”?

Introducing Green Infrastructure for Coastal Resilience

The Strand in Old New Castle

Course Objectives

Participants:

- Recognize green infrastructure terms and concepts
- Understand ecological, economic, and societal benefits of green infrastructure
- Understand the wide variety of contexts and scales of approaches referred to as “green infrastructure” today
- Identify new or existing planning processes suitable for integrating green infrastructure concepts and techniques
- Identify local green infrastructure activities and experts with additional information and resources

Course Outline

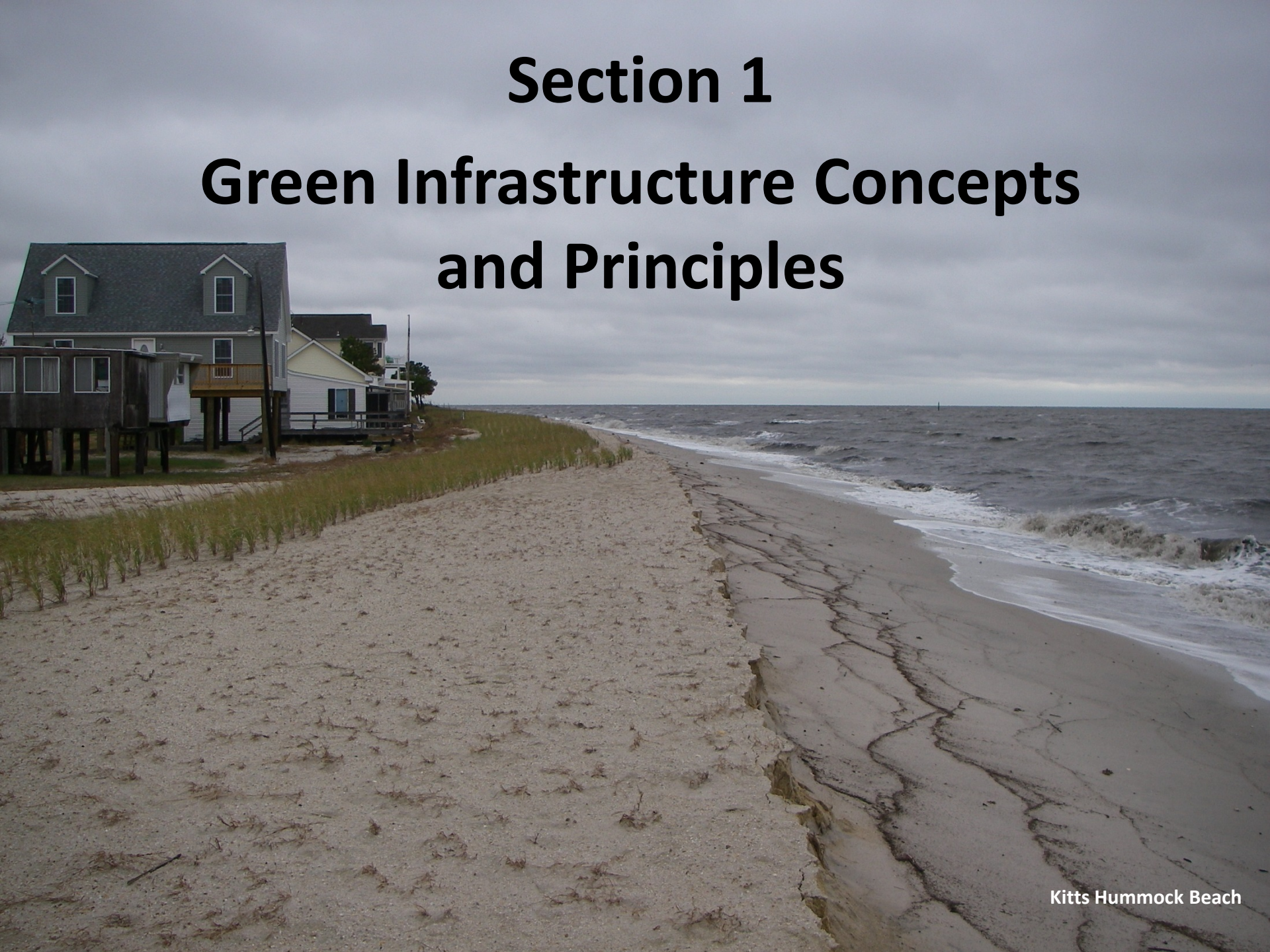
Introducing Green Infrastructure for Coastal Resilience

1. Green Infrastructure Concepts and Principles
2. The Practice of Green Infrastructure
3. Integrating with Local Plans and Practices

A Quick Hello!

Section 1

Green Infrastructure Concepts and Principles



Kitts Hummock Beach

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

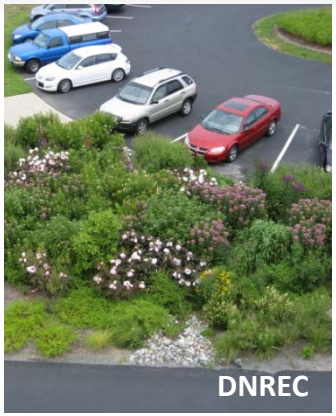
1970s

Foundations of Green Infrastructure

Green Infrastructure Concepts and Principles

Landscape approach?

Site-level approach?



Applicability across Scales

Green Infrastructure Concepts and Principles

Landscape and watershed

Community and site

Shore and coastal zone

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

Why Green Infrastructure?

Green Infrastructure Concepts and Principles

Old Corbitt Road, Odessa Nor'easter

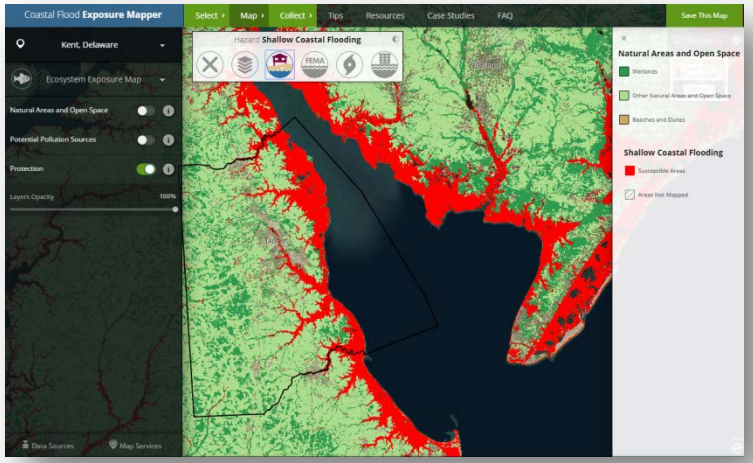
Little Creek Nor'easter

Kitts Storm Photos

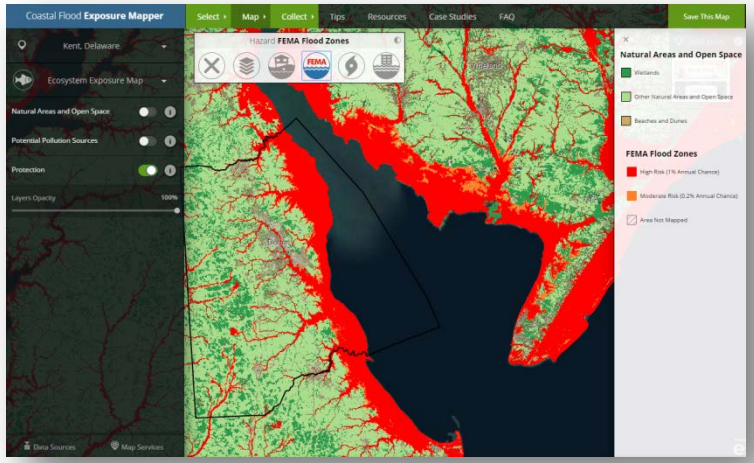
Bowers Beach

Exposure to Coastal Hazards

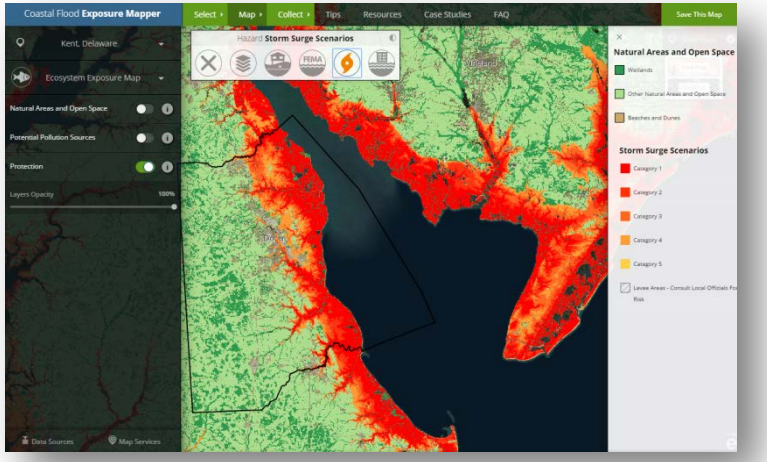
Green Infrastructure Concepts and Principles



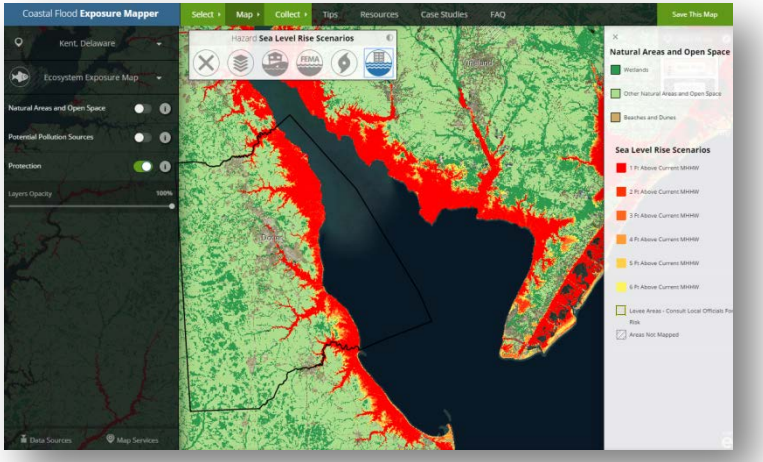
Shallow Coastal Flooding



FEMA Flood Zones



Storm Surge



Sea Level Rise

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

Ecosystem Services

Green Infrastructure Concepts and Principles

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

http://nca2014.globalchange.gov/report/regions/coasts

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.

coast.noaa.gov/greeninfrastructurevis/

OFFICE FOR COASTAL MANAGEMENT
NATIONAL OCEANIC AND ATMOSPHERIC ADMINISTRATION

Table Discussion 1

- Part 1: What coastal hazard-related issues is your community experiencing? (e.g., flooding, stormwater runoff)

- Part 2: What natural benefits (ecosystem services) are you interested in preserving or engineering to enhance community resilience to the issue (e.g., flood water storage)?

Section 2

The Practice of Green Infrastructure

Planning Concepts

The Practice of Green Infrastructure

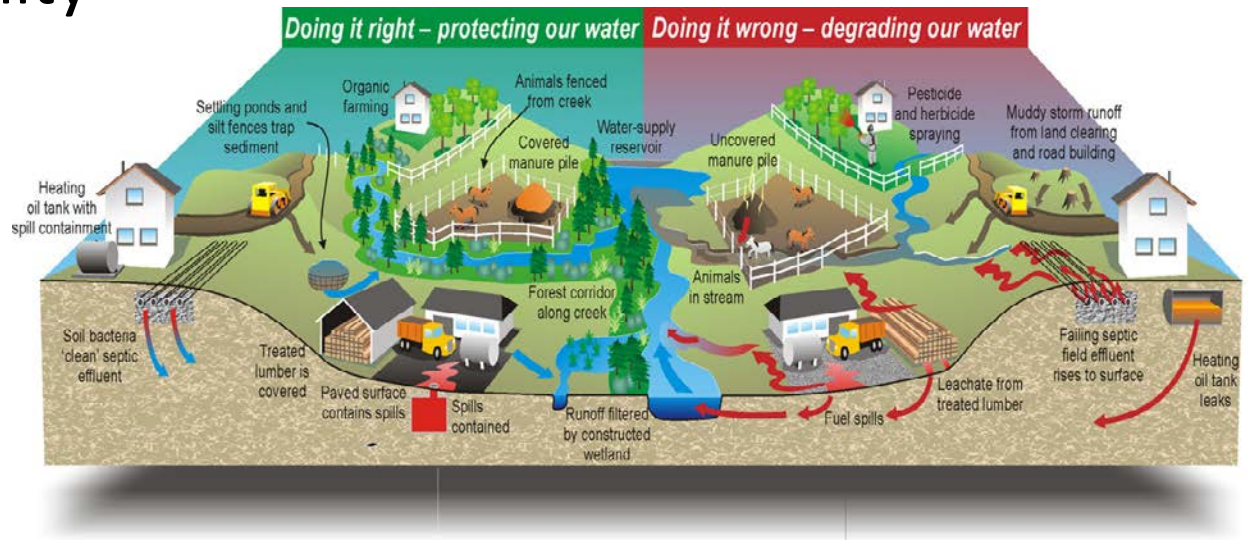
- Approach will depend on the ***scale*** you are addressing
- All practices, regardless of scale, use ***ecosystem services*** to acquire maximum benefits
- Design methods are repeatable and grounded in ***science***
- ***Context*** is important

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

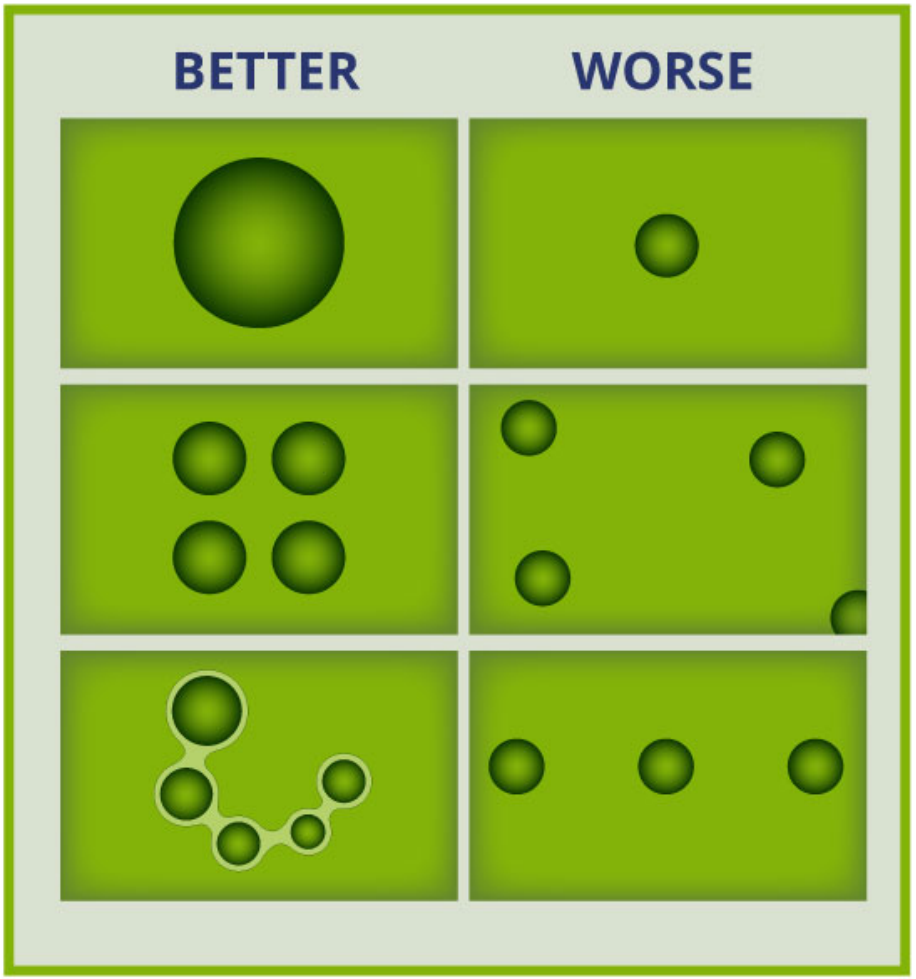
Community and site

Shore and coastal zone

Landscape Design Concepts

The Practice of Green Infrastructure

- Area
- Proximity
- Connectivity
- Buffer



Landscape Design Concepts

The Practice of Green Infrastructure

Area

Better

Worse

Landscape Design Concepts

The Practice of Green Infrastructure

Proximity

Better

Worse

Landscape Design Concepts

The Practice of Green Infrastructure

Connectivity

Better

Worse

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

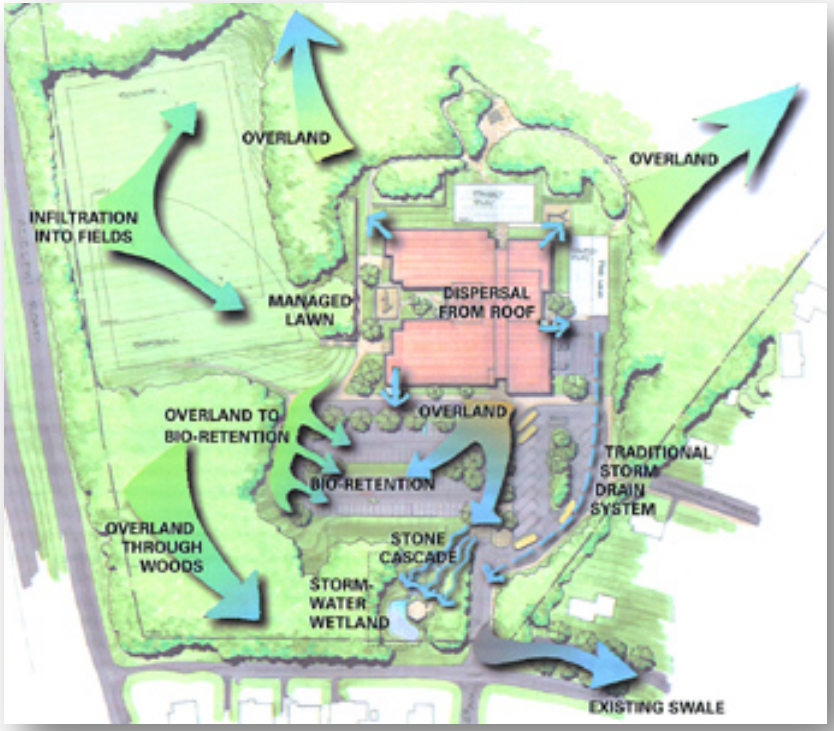
Coos Bay, Oregon

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

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
  - Flood proofing

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

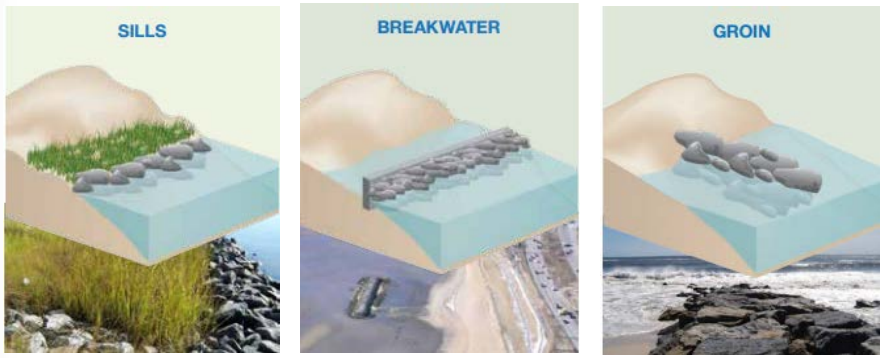
Oyster and Coral Reefs

- 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

Green Infrastructure Primer

A Delaware Guide to Using Natural Systems in Urban, Rural, and Coastal Settings

DELAWARE DEPARTMENT OF NATURAL RESOURCES AND ENVIRONMENTAL CONTROL

Delaware Division of ENERGY & CLIMATE

Table Discussion 2

The Practice of Green Infrastructure

- 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 info.**

- Who are you working with on these projects?

- Any new ideas or opportunities after hearing the presentations so far this morning?

Section 3

Integrating with Local Plans and Practices

The Strand in Old New Castle

Consider . . .

Integrating with Local Plans and Practices

What planning activities are occurring in your area?

Where are there opportunities to integrate green infrastructure into plans, policies, and activities?

Green Infrastructure Can Inform Planning

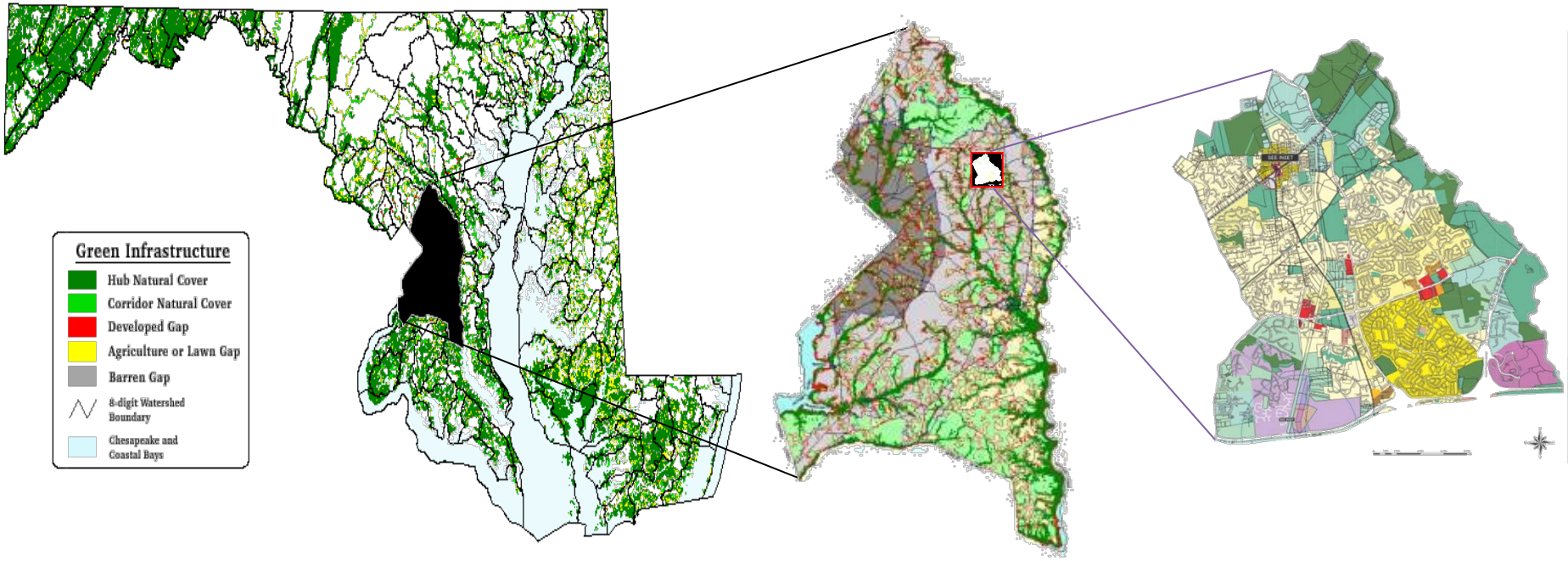
Integrating with Local Plans and Practices

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

Integrating with Local Plans and Practices



Maryland State Plan **Prince George's County** **Bowie Planning Area**

Comprehensive Planning

Integrating with Local Plans and Practices

New Castle County 1673 Delaware

www.nccde.org/350/Comprehensive-Plan

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NATIONAL OCEANIC AND ATMOSPHERIC ADMINISTRATION

Hazard Mitigation Planning

Integrating with Local Plans and Practices

Hazard	Rank
Coastal Flood	1
Riverine Flood	2
Hurricane Wind	3
Earthquake	4
Winter Storm	5
Severe Thunderstorm	6
Extreme Temperatures	7
Tornado	8
Lightning	9
Hail	10
Drought	11

http://delawarecity.delaware.gov/files/2014/12/Delaware-City-Hazard-Climate-Action-Plan_no-appendices_January-20141.pdf

Climate Adaptation Planning

Integrating with Local Plans and Practices

www.dnrec.delaware.gov/pages/slrmaps.aspx

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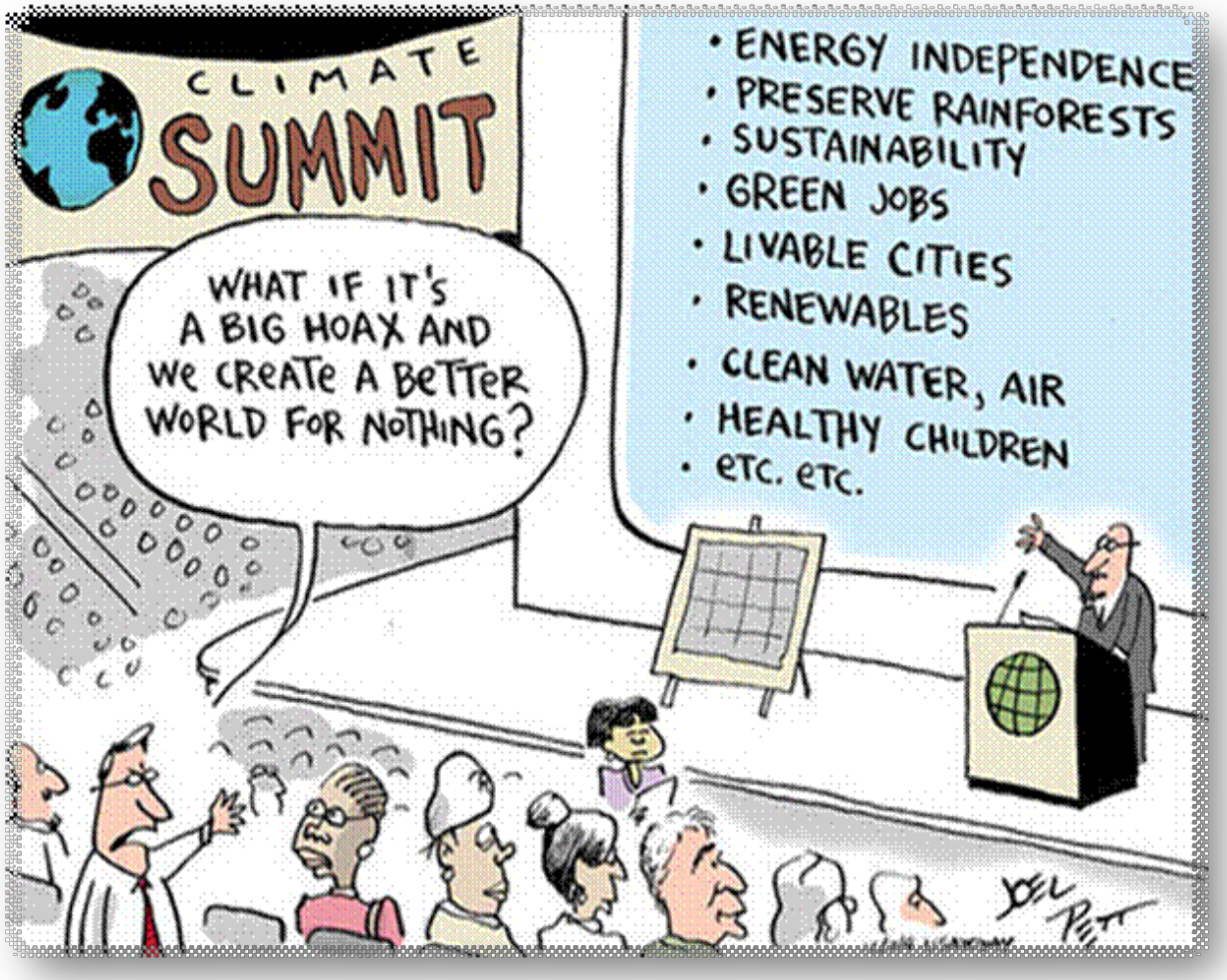
Multiple Benefits

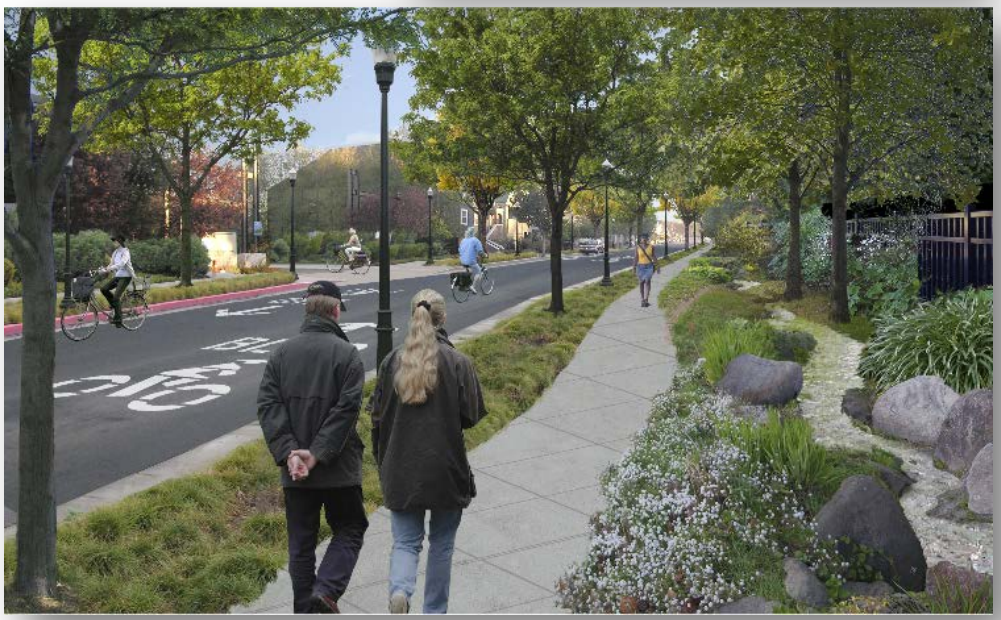
Integrating with Local Plans and Practices



Engaging Stakeholders

Integrating with Local Plans and Practices

- Make it local
- Offer solutions
- Use visualizations



Engaging Stakeholders with Visualizations

Barriers to Green Infrastructure

Integrating with Local Plans and Practices

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

Table Discussion 3

Integrating with Local Plans and Practices

- Part 1: What barriers have you run into around incorporating green infrastructure into planning processes?

- Part 2: How can you overcome these barriers? Does anyone in your group have solutions to these? What plans or regulations does your green infrastructure work fit into? Are there educational and public engagement opportunities? How can green infrastructure practices become the “new normal”?

Next steps or actions?

One Last Thing . . .

***Please* fill out the Evaluation!**

Thank You!

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