



*Photo courtesy of U.S. Fish & Wildlife Service*

**Natural Floodplain Functions Alliance (NFFA)  
WEBINAR SERIES PRESENTS:**

**Green Infrastructure Resources for  
Coastal Flood Risk Management**

**Maria Honeycutt, PhD, CFM  
Lauren Long  
Tashya Allen**



*NFFA Webinars Hosted By*



**NOAA Office for  
Coastal Management**

**March 6, 2018  
2:00pm – 3:30pm CT**



**Thank you for  
joining us today!**

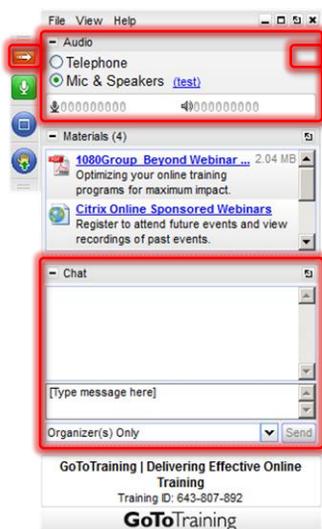
- ✓ Presentation will conclude by 3:30pm CT.
- ✓ Q&A will follow the presentation, should it run past 3:30pm CT the recording will continue

## Certificates & CECs



- Attendees must participate in the **entire event** in order to receive a certificate (emailed within 1 week)
- CFMs must participate in the **entire event** in order to receive CECs.
- CFMs do not need to submit paperwork for CEC credit **EXCEPT** CFMs located in: AR, NM, OK, TX

## Attendee Participation



### Your Participation

Open and hide your control panel using the red arrow button

Join audio:

- Choose **Mic & Speakers** to use VoIP
- Choose **Telephone** and dial using the information provided

Submit questions and comments via the Chat panel

## Audio & Web Settings



- All lines will be automatically be muted
- Use the chat panel to submit questions and responses during the presentation

## Handouts/Slides



- PDF of today's slides can be found in the Handouts window
- Double click or right click on the file to download/open

This Session is being Recorded



## AGENDA



1. NFFA Federal Updates (15 min)
2. Webinar Topic (45 min)
  - Green Infrastructure Resources for Coastal Flood Risk Management
3. Webinar Q&A (10 min)

# NFFA Update



*Photo courtesy of U.S. Fish & Wildlife Service*

**Larry Larson, P.E., CFM**  
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# Green Infrastructure Resources for Coastal Flood Risk Management

*Natural Floodplain Functions Alliance Webinar  
March 6, 2018*

**Maria Honeycutt, PhD, CFM**  
**Lauren Long**  
**Tashya Allen**



**NOAA Office for Coastal Management**



## Reducing Risks, Building Resilience



Harvey, Texas



Maria, Puerto Rico



Irma, St. Thomas



Sandy, New Jersey

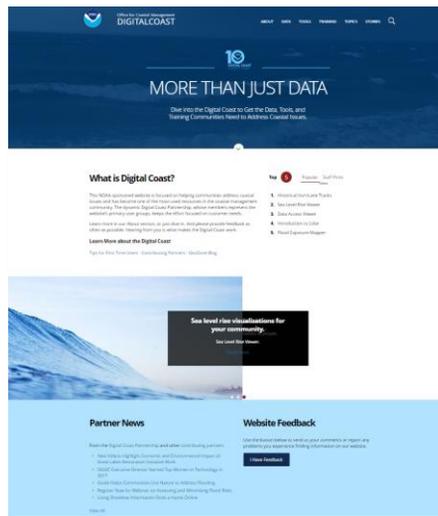
## By Using Green Infrastructure



## Digital Coast

**Approach:** Bring the geospatial and coastal management communities together

**Outcome:** A constituent-driven, integrated, enabling platform supporting coastal resource management that is used



[coast.noaa.gov/digitalcoast](http://coast.noaa.gov/digitalcoast)

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## Digital Coast Partnership

- American Planning Association
- Association of State Floodplain Managers
- Coastal States Organization
- National Association of Counties
- National Estuarine Research Reserve Association
- National States Geographic Information Council
- The Nature Conservancy
- Urban Land Institute



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## A Small Sampling of Our Contributors

Federal	State	NGO	Academic	Private
				
				
				
				
				

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## A Broad Spectrum Approach: Increasing Understanding and Facilitating Use



DISCOVER



DOWNLOAD



MAP



ANALYZE



LEARN



SHARE

DATA

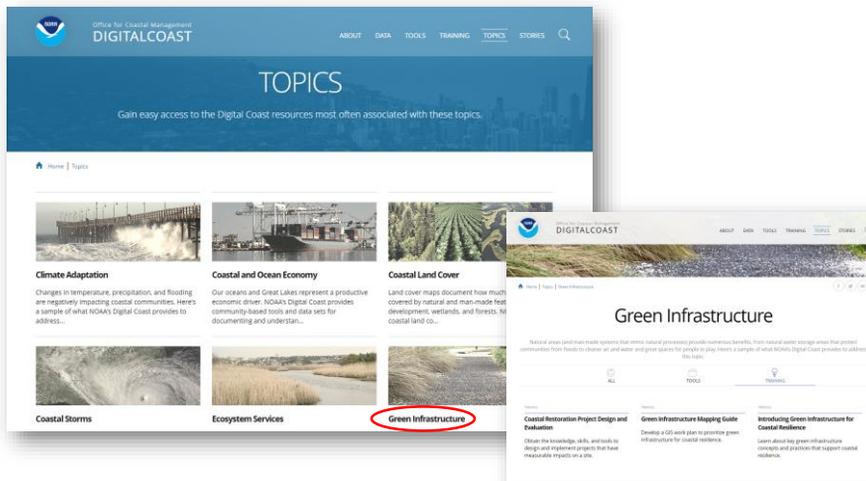
INFORMATION

ACTION

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## Find Green Infrastructure Resources Here



[coast.noaa.gov/digitalcoast/topics/green-infrastructure](http://coast.noaa.gov/digitalcoast/topics/green-infrastructure)

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## Agenda

- Visualizing coastal hazards and climate change impacts using the **Coastal Flood Exposure Mapper**
- Options and effectiveness of green infrastructure practices to reduce flooding using the ***Green Infrastructure Options to Reduce Flooding*** quick reference and **Green Infrastructure Effectiveness Database**
- Mapping open space to reduce flooding and gain FEMA Community Rating System credit using a new **How-to Guide**
- **Case study** on a community restoring open space in the floodplain to reduce impacts



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# Visualizing Coastal Hazards and Climate Impacts

[coast.noaa.gov/digitalcoast/tools/flood-exposure](http://coast.noaa.gov/digitalcoast/tools/flood-exposure)



## Identifying Green Infrastructure Options to Reduce Flooding



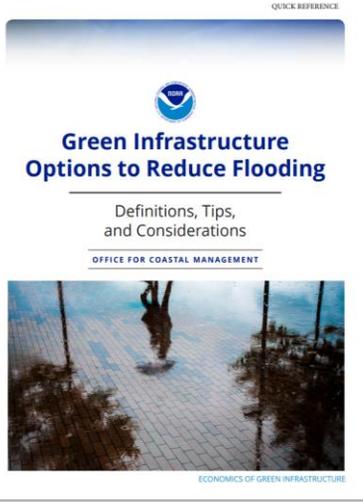
 **Conserving or Restoring Natural Areas**



**Recreating Natural Processes** 

# Identifying Green Infrastructure Options to Reduce Flooding

[coast.noaa.gov/digitalcoast/training/gi-reduce-flooding](http://coast.noaa.gov/digitalcoast/training/gi-reduce-flooding)



## Green Infrastructure Options to Reduce Flooding

The practices described in this handout can be used to reduce flooding and help communities design a green infrastructure strategy. It should be noted that while green infrastructure practices make communities more resilient, flooding might not be totally alleviated.

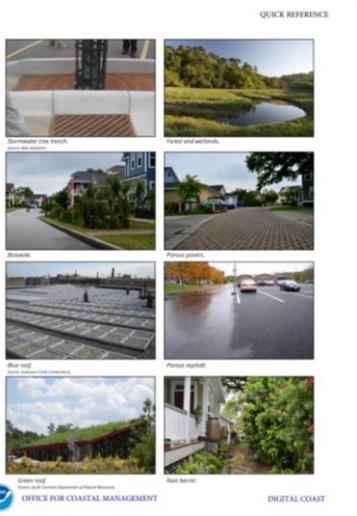
This document is a companion piece to the *Process Guide for Assessing Costs and Benefits of Green Infrastructure for Flood Mitigation*. Step 3 in this publication, which involves identifying how a flood reduction target can be met with green infrastructure, is addressed here. The larger process guide is available by sending an email request to [coastal.info@noaa.gov](mailto:coastal.info@noaa.gov).

Information in this handout includes

- **Section 1 - Green Infrastructure Practices.** Most communities implement a variety of approaches to reach their flood reduction goals. Basic information about the most common is described here.
- **Section 2 - Considerations for Planning and Implementation.** Numerous tips and considerations are provided to help community planners develop the best green infrastructure plan for their unique situation.
- **Section 3 - Estimating Storage Potential and Costs.** Cost and capacity matter. Use this chart and the examples provided to start the calculations.
- **Section 4 - For More Information.** This document provides a good overview, but additional information resources are provided for those ready to dive deeper into this topic.

# Identifying Green Infrastructure Options to Reduce Flooding

[coast.noaa.gov/digitalcoast/training/gi-reduce-flooding](http://coast.noaa.gov/digitalcoast/training/gi-reduce-flooding)



### TREE PLANTINGS AND CONSERVATION

**Description:** Planting native trees or conserving existing trees can slow down, capture, and store runoff in the canopy and release water into the atmosphere through evapotranspiration. Tree roots also create soil conditions that promote infiltration.

**Benefits:** Tree plantings reduce stormwater, pollutants, temperatures, and noise; absorb carbon dioxide; provide habitat for urban wildlife and nectarivores; increase property value; and reduce costs of cleaning and grading by keeping areas natural. Larger, older trees can intercept more stormwater.

**Limitations:** They need adequate space and soil to ensure their health. Check with local ordinances to see which species are allowed for planting in the proposed area. Trees need to be maintained, especially near powerlines.

**Maintenance required:** Participants must water and prune, control pests, and maintain proper landscaping.

### STORMWATER TREE TRENCHES

**Description:** A stormwater tree trench is a row of trees that are connected by an underground trench engineered with layers of gravel and soil that store and filter stormwater runoff. They work well in streets and parking lots that have limited space to manage stormwater.

### BIOSWALES AND RAIN GARDENS

**Description:** Bioswales convey stormwater at a slow, controlled rate, and the flood-tolerant vegetation and soil act as a filter medium, cleaning runoff and allowing infiltration. Bioswales generally are installed within or near paved areas such as parking lots or alongside roads and sidewalks, in locations with low infiltration rates; undergrounds can be used to collect excess water and discharge the treated runoff to another green infrastructure practice or storm sewer system.

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**Maintenance required:** Participants must water, mulch, and ensure plant survival and density; control invasive species; maintain inlets, and collect garbage, removing litter as needed; inspect annually for erosion, sediment buildup, and proper vegetative conditions; and inspect inlets, outlets, and cleanouts twice annually.

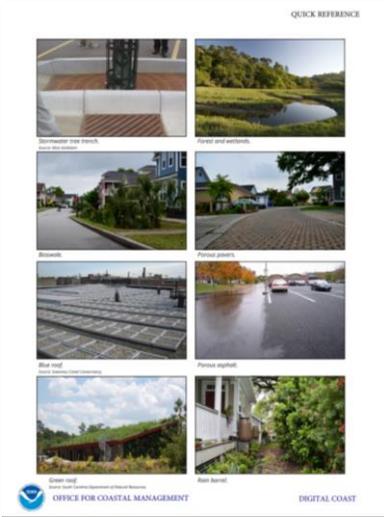
### RAIN GARDENS

**Description:** Rain gardens are composed of drought-tolerant shrubs, flowers, and grasses, and they lack a complex soil matrix and underdrains. They are well-suited for installation in residential lots.

**Benefits:** Rain gardens reduce stormwater runoff volumes and increase groundwater recharge; promote pollutant uptake through vegetation and soil; reduce peak discharges; improve air quality; and provide aesthetic appeal.

# Identifying Green Infrastructure Options to Reduce Flooding

[coast.noaa.gov/digitalcoast/training/gi-reduce-flooding](http://coast.noaa.gov/digitalcoast/training/gi-reduce-flooding)



Green infrastructure practice	Cost estimate**
Existing forests and wetlands	It depends on value of land, opportunity costs.
Stormwater wetlands	Capital cost: \$1 to \$2 per cubic foot of storage provided.
Blue roofs	Capital cost: \$2 to \$10 per cubic foot of storage provided (\$1 to \$5 per square foot with a 6" depth).
Green roofs	Capital cost is \$18 to \$64 per cubic foot of storage provided (\$9 to \$32 per square foot with a 6" depth).
Tree plantings	Capital cost: Tree cost is about \$175 to \$400.
Tree box filter	Capital cost is about \$270 to \$330 per cubic foot of storage provided (includes tree box filter and additional soil). Trees are an additional cost.
Permeable pavement	Capital cost: For sidewalks, the cost is about \$16 to \$17 per cubic foot of storage provided.
Bioretention (bioswales, rain gardens)	Capital cost is about \$7 to \$60 per cubic foot of storage provided (depending on the type of bioretention).
Rain barrels	Capital cost is about \$7 to \$13 per cubic foot of storage provided. An average rain barrel holds about 55 gallons or 7.3 cubic feet.

\*A cubic foot of storage is about 7.5 gallons of water.

\*\*The cost estimates do not account for construction costs or maintenance. Maintenance estimates can be found on the Center for Neighborhood Technology Green Values Calculator cost details sheet, where information is provided in costs per square foot of storage ([http://greenvalues.cnt.org/national/cost\\_detail.php](http://greenvalues.cnt.org/national/cost_detail.php)).

## Polling Question

**Have you or your organization been involved in a project that has utilized green infrastructure?**

- a. Yes and it was effective
- b. Yes and it was not effective
- c. No, but I look forward to integrating these approaches into my work
- d. No



# Understanding the Effectiveness of Green Infrastructure



# Understanding the Effectiveness of Green Infrastructure

[coast.noaa.gov/digitalcoast/training/gi-database](http://coast.noaa.gov/digitalcoast/training/gi-database)

**Green Infrastructure Effectiveness Database**

This database is a compilation of literature resources documenting the effectiveness of using green infrastructure to reduce impacts from coastal hazards.

e.g., Chesapeake, "dune restoration", vegetation

Want to filter on specific items? Show advanced search

**RECENTLY ADDED**

Assessing urban strategies for reducing the impacts of ...

- Author(s):** Pregonato, Maria; Ford, Alistair; Robson, Craig; Gents, Vassilis; ...
- Green Infrastructure:** Green roof/blue roof
- Region(s):** International

Show

# Understanding the Effectiveness of Green Infrastructure

[coast.noaa.gov/digitalcoast/training/gi-database](http://coast.noaa.gov/digitalcoast/training/gi-database)

# Understanding the Effectiveness of Green Infrastructure

[coast.noaa.gov/digitalcoast/training/gi-database](http://coast.noaa.gov/digitalcoast/training/gi-database)

**Dollars and Sense: Economic Benefits and Impacts from Two Oyster Reef Restoration Projects in the Northern Gulf of Mexico**

**Link to Resource:** <http://www.nature.org/ourinitiatives/regions/northamerica/oyster-restoration-study-kroeger.pdf>

**Keywords:** Restoration; Oyster Reef; Mobile Bay; Erosion; Economic analysis; wave height; wave energy

**Basic Information**

AUTHOR(S)	Kroeger, T.
YEAR PUBLISHED	2012
SOURCE	The Nature Conservancy
SOURCE TYPE	Gray literature
CITATION	Kroeger, Timm. "Dollars and Sense: Economic benefits and impacts from two oyster reef restoration projects in the Northern Gulf of Mexico." The Nature Conservancy (2012).

**Classifications**

GREEN INFRASTRUCTURE TYPES AND/OR TECHNIQUES	Oyster reef
HAZARDS	Wave action (due to storm, hurricane winds), Flooding - coastal (storm surge, high tides, sea level rise, inundation), Erosion
METHODOLOGICAL APPROACHES	Economic analysis

**Location**

## Coastal Marshes



- Reduce storm wave heights by over 50 percent depending on water depth and marsh width
- Can be more effective and cheaper than a submerged breakwater for wave heights up to half a meter

**Coastal marshes in the Northeast prevented more than \$625 million** in direct property damages during post-tropical cyclone Sandy!

*[coast.noaa.gov/digitalcoast/training/gi-database](http://coast.noaa.gov/digitalcoast/training/gi-database)*

## Living Shorelines



Courtesy, Tracy Skrabal, North Carolina Coastal Federation

- Break offshore waves
- Combat coastal erosion
- Enhance shoreline accretion

**Local economic output from two oyster reef construction projects is expected to be \$8.4 million!**

*[coast.noaa.gov/digitalcoast/training/gi-database](http://coast.noaa.gov/digitalcoast/training/gi-database)*

# Low Impact Development

- Reduces stormwater runoff
- Decreases combined sewer overflows
- Saves municipalities money



**By installing rain gardens instead of constructing gray infrastructure to manage stormwater, Aurora, Illinois, saved an estimated \$1.8 million in 2013!**

*[coast.noaa.gov/digitalcoast/training/gi-database](http://coast.noaa.gov/digitalcoast/training/gi-database)*

# Green Infrastructure Benefits Handout

*[coast.noaa.gov/digitalcoast/training/gi-benefits](http://coast.noaa.gov/digitalcoast/training/gi-benefits)*

**Put Green Infrastructure between Your Community and the Next Coastal Storm.**  
There are many benefits.

**Flood and Wetland Benefits**

- Slow runoff
- Filter and clean floodwaters
- Provide food and jobs

**Green Streets**

- Capture and clear stormwater
- Realign streets and encourage economic development
- Provide pedestrian-friendly walkways

**Oyster and Coral Reefs**

- Slow storm surge
- Provide food
- Clean water

**Sand Dunes**

- Buffer seawalls as a first line of defense
- Build economy through tourism

**Open Space and Parks**

- Slow 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 runoff and reduce erosion
- Protect property

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Digital Coast  
03/2017

**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 riparian shorelines absorb more large waves, reducing damage to nearby homes and roads.

**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

**Create Natural Shorelines**  
Create living shorelines using oysters, marsh grass, and other natural resources to absorb wave energy and reduce erosion.

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## **Community Rating System**

### **Activity 420: Open Space Preservation (OSP)**

**Open Space Preservation – Up to 1,450 points for areas in a regulated floodplain that are permanently preserved as open space**

Additional Credits for:

- Deed Restrictions – 50 points
- Natural functions open space – 350 points
- Special flood-related hazard open space – 150 points
- Coastal erosion open space – 750 points

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# How to Map Open Space for Community Rating System Credit

[coast.noaa.gov/digitalcoast/training/crs](http://coast.noaa.gov/digitalcoast/training/crs)

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**Step-by-step  
instructional guide  
for Planners**

**GIS workflow (tasks  
and instructions) for  
Spatial Analysts**

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## Steps

- Step 1 • Calculate impact adjusted Special Flood Hazard Area
- Step 2 • Identify lands that may qualify as open space
- Step 3 • Exclude areas that do not qualify
- Step 4 • Calculate the number of possible OSP credits

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## Steps

- Step 5 • Determine if parcels qualify for “extra credit”
- Step 6 • Gather supporting information for each parcel or area
- Step 7 • Identify opportunities to earn more open space credit

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# Digital Coast Partnership CRS Strategy

*coastalresilience.org/project/open-space*

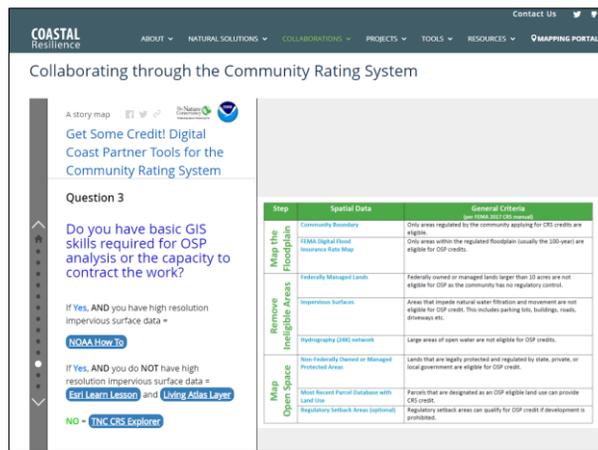


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# Finding the Right Tool

*coastalresilience.org/project/open-space*



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CVS during flooding event



CVS rebuilt in the same location

**Community  
collaboration leads to  
restored floodplain and  
reduced damages**

[coast.noaa.gov/digitalcoast/training/walton-village](http://coast.noaa.gov/digitalcoast/training/walton-village)

**Site before restoration**



**Site after restoration**

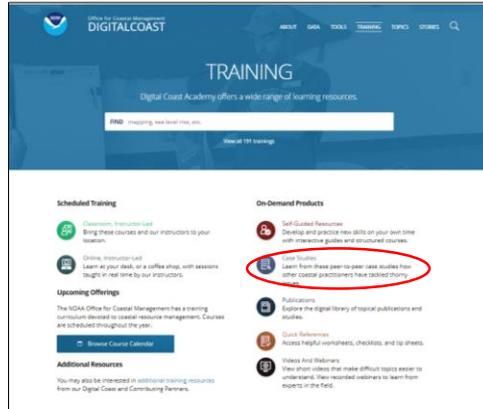


graded to correct  
elevation and slope  
to allow water to  
spread out onto the  
floodplain

[coast.noaa.gov/digitalcoast/training/walton-village](http://coast.noaa.gov/digitalcoast/training/walton-village)

# Find more case studies on Digital Coast Academy

[coast.noaa.gov/digitalcoast/training/home.html](http://coast.noaa.gov/digitalcoast/training/home.html)



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## Summary: Green Infrastructure Resources for Your Flood Risk Management Toolbox

Array of NOAA and partner resources available to:

- Understand and visualize coastal flood hazards and impacts
- Explore options and their effectiveness
- Analyze and map existing assets (and get credit!)
- Learn what other communities have done



[coast.noaa.gov/digitalcoast/topics/green-infrastructure](http://coast.noaa.gov/digitalcoast/topics/green-infrastructure)

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## Polling Question

**What additional information or resources do you need to move green infrastructure forward in your work?**

- a. Training
- b. Funding mechanisms
- c. Stakeholder communication products and visualizations
- d. Economic/financial/cost-benefit data
- e. Other

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## Questions?

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## NFFA Webinars



### **Natural Floodplain Functions Alliance (NFFA) Webinars**

<http://www.aswm.org/watersheds/natural-floodplain-function-alliance>