## Responding to the Surge: Lessons from the Hudson River

### Prepared by:

Emilie Hauser, Coastal Training Program Coordinator NYSDEC Hudson River National Estuarine Research Reserve **Presented by:** 

Eric Roberts, Associate

Consensus Building Institute, Inc.

Responding to the Surge: Coastal Buffers LOCAL SOLUTIONS: Northeast Climate Change Preparedness May 20, 2014 8:30 to 10:00 am









NATIONAL ESTUARINE

**Research Reserve System** 

SCIENCE COLLABORATIVE



## Hudson River National Estuarine Research Reserve

• Mission: improve the health and vitality of the Hudson River Estuary through habitat protection, integrated education, training, stewardship, restoration, and monitoring and research.

• Estuary Training Program seeks to enhance the scientific knowledge and skills of professionals involved in making decisions that affect the habitats, shore lands, and other natural resources of the Hudson River Estuary.













## Hudson River Estuary

- Hudson River Tidal from NYC to Troy ~150 miles
- Approximately half has been "engineered"
- Very little "green" shoreline
- Storms Irene/Lee/Sandy
- Waterfront revitalization, public access
- Railroads 28 %



## The shore zone



Strayer & Findlay, 2010. Ecology of freshwater shore zones.





- Cary Institute of Ecosystem Studies
- Stevens Institute of Technology
- Consensus Building Institute
- NYSDEC Hudson River NERR and Estuary Program

http://www.hrnerr.org/hudson-river-sustainable-shorelines/

















NATIONAL ESTUARINE Research Reserve System Science Collaborative

## **Coordinating Team Members**

**NYSDEC Hudson River National Estuarine Research Reserve** Emilie Hauser, Betsy Blair

> **NYS DEC Hudson River Estuary Program** Daniel Miller, Kristin Marcell

**Cary Institute of Ecosystem Studies** Stuart Findlay, David Strayer

**Consensus Building Institute** Ona Ferguson, Eric Roberts

**Stevens Institute of Technology** Jon Miller, Nickitas Georgas, Andrew Rella

## "Sustainable Shorelines"



Shoreline management practices that seek to protect the shore zone's wildlife habitat, ecological benefits, outdoor recreation, community quality of life, and water-dependent businesses for future generations.

Should be: adaptable & ecologically enhanced Includes: "soft" and "hard"

## Shorelines approaches depend on project goals and location

- Uses
- Energy
  - Waves, currents, wakes, ice
- Geomorphology
- Ecology (fish, shellfish, terrestrial & aquatic plants, )
- Salinity





## **Ecologically Enhanced Shorelines**

Subset of shore protection methods that incorporate measures to attract and support both terrestrial and aquatic biota and desirable ecological functions. These can be either modifications to existing structures through the addition of plantings and other ecological measures or the design of new structures incorporating ecologically-friendly materials, geometry, or placement.



## **Literature Review**

### **Branch Packing**

	App	roach		C	Construction Cost	
Soft			Harc	Low		High
	Mainten	iance Cost			Adaptability	
Low			Hig⊁	Low		High

### Description

The branch packing technique employs alternating layers of live branches and compacted soil to repair gaps or holes on stream bank slopes. The branch packing approach not only repairs missing sections of the shoreline but also aids in the prevention of erosion and scouring.

Branch packing can only be used at sites that have an area less than 4 feet deep and 4 feet wide that need to be filled and supported. The technique is generally ineffective at sites with side slopes in excess of 2:1.

Figure 30: Typical branch padding cross-

section.

### Design and Construction

Some of the important design considerations when applying the branch

packing technique include: the size of the hole being filled, the steepness of the side slope, and the water level. Water level must be considered as the ends of the plants must be able to reach the water, while not receiving so much water as to exceed their flood tolerance.



Figure 31: Shoreline stabilized with branch packing.

Branch packing can employ a variety of materials, including: live stakes, live fascines, live branches, dormant post plantings, dead stout stakes, atjing, smooth wire, wooden stakes, and rebar.

Construction consists of driving wooden stakes vertically into the ground, then placing a four to six inch layer of living branches between the stakes, with their growing tips orientated towards the slope. Construction should begin at the lowest point and proceed up the bank. Subsequent layers of live branches and soil are then added until the structure conforms to the existing slope. Detailed cost information was not available, however branch packing is expected to be inexpensive compared to other shoreline stabilization alternatives based on the minimal material and/or specialized labor requirements.

### Adaptability

The branch packing approach can be extended vertically under potential sea level rise scenarios; however the overall fragility of the structure will make it highly susceptible to dislodgement under increasing flows and/or wave activity.

### Advantages

Branch packing has many advantages over other engineered shore protection approaches, among them are:

- It is an inexpensive method of erosion prevention.
- Vegetation grows quickly and offers immediate protection.
- As the plants grow, the system becomes more efficient in reducing runoff and erosion.
- The branches can encourage sediment deposition along the shore.

#### Disadvantages

Branch packing has many disadvantages compared to other engineered shore protection approaches, among them are:

- They are ineffective in holes that are larger than 4 feet deep by 4 feet wide.
- Stream flow must be diverted if branch packing is being considered at a site that was previously damaged by high velocity flow.
- Scouring can occur if branch packing is not flush with the existing bank.

### Similar Techniques

Alternatives include: joint planting, live fascines, brush mattresses.

Engineered Approaches for Limiting Erosion along Sheltered Shorelines: A Review of Limiting Methods

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> > August National Aug

> > > Andreas - Rolla, S (m. 4. Million - Ph. 5)







### Revetment

## Joint Plantings

### Live Stakes / Joint Planting











## **Bulkhead**



# Bulkheads Approach Construction Cost Soft Hard Low Maintenance Cost Adaptability Low High Low High

## Ecologically Enhanced Bulkhead





## **Timber Cribbing / Crib Wall**



## Live Crib Wall



## **Comparative Cost Analysis includes:**

- Initial Costs (IC)
  - Material and labor costs to construct the stabilization measure
- Maintenance and Repair Costs (M&R)
  - Costs associated with routine maintenance and repairs (i.e. not associated with any given storm)
- Damage Costs (DC)
  - Costs associated with restoring a structure to its original function after a specific storm causes damage
- Replacement Costs (RC)
  - Costs of replacing a structure once it reaches the end of its serviceable life. (Typically associated with material decay/degradation)

Rella, A. and Miller, J., 2012b . A Comparative Cost Analysis of Ten Shore Protection Approaches at Three Sites Under Two Sea Level Rise Scenarios.

## **Comparative Cost Analysis**



## Demonstration Site Case Studies

- Overview
- Location
- Participants
- Background and Story
- Assessment, Planning & Design
- Plan Implementation & Design
- Lessons Learned

CASE STUDY: ESOPUS MEADOWS PRESERVE & WATER TRAIL SITE

### OVERVIEW

An entring degraded building, showine amoning, and impervious surfaces were removed and replaced with an ecruism resistant thereine that has natural features which have improved habitat and recreational access.

### LOCATION & ACCESS

This Scenii: Hudson property is located in the Town of Esepur, New York, located on Brooknide Detre off County Toute 24/Rever Enail. This site is reached by water as part of the Greenway Water Taul located on the west side of the Hudson at river mile 36.3.

### PARTICIPANTS

nate Overser Scenic Hudson, Inc. metal Caste Manager Scenic Hudson, Inc. Design: Creative Haldent Corp. & Scenic Hudson, Inc. Design: Creative Haldent Corp. & Scenic Hudson, Inc. Cent 5212,000 or E230,755 (according to Hudson Eirer Estuary Program hunding documents) Grantic Hudson Eirer Estuary Grant Program Project (\$73,000), Hudson Eirer Classenery Water Taul Grant (\$18,000), and Hudson Eirer Inspressment Fund (\$5,000) Timeframe: 2004-2006



http://www.hrnerr.org/hudson-river-sustainable-shorelines/demonstration-site-network/

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## Sharing what we've learned

- User-friendly "key findings" documents
- Technical assistance
- Decision toolsTraining

www.hrnerr.org/ hudson-riversustainableshorelines/

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	The Hudson F	River Sustainable Shorelines Project aims to develop science-based recommendations for shore zone i	nanagement that

preserve or enhance natural benefits while meeting engineering needs

HUDSON RIVER SHORELINE RESTORATION

## Kingston Tidal Waterfront Flooding Task Force

Falls

Honewell



Planning for Rising Waters: Final Report of the City of Kingston Tidal Waterfront Flooding Task Force



(42)

September 18, 2013



Recreation Park Map data ©2014 Google



Waterfront



# Climate Action Plan, Oct 2012 Climate Smart Kingston, Oct 2012 – present and others





City of Kingston CLIMATE ACTION PLAN 2010 Community-Wide & Local Government Operations Energy and Greenhouse Gas Emissions Inventory





## The timing was right...

- Kingston community felt the impacts of flooding and had started thinking about impacts of climate change.
- Regional efforts raised community awareness about the potential impacts of sea level rise.
- State efforts produced many relevant climate change and sea level rise documents.
- The State wanted to pilot a project, and Scenic Hudson and CBI acquired funding to work with the community.

Kingston Tidal Waterfront Flooding Task Force

## Planning Team Members

- City of Kingston
- Scenic Hudson
- NYS Department of Environmental Conservation
- NYS Department Of State
- Consensus Building Institute

## Task Force Members

- Marinas
- City employees
- Museums
- Churches
- Businesses
- Developers
- Residents











## **Planning Team**

Scenic Hudson: Sacha Spector

Consensus Building Institute: Ona Ferguson

City of Kingston: Julie Noble (Conservation Advisory Council) Gregg Swanzey (Economic Development) Suzanne Cahill (Planning)

NYS Department of State: Barry Pendergrass

### NYS Department of Environmental Conservation:

Mark Lowery (Office of Climate Change) Kristin Marcell (Hudson River Estuary Program/ Cornell) Libby Murphy (Hudson River Estuary Program/ Cornell) Emilie Hauser (Hudson River National Estuarine Research Reserve) Christina Tobitsch (Hudson River National Estuarine Research Reserve)

Catalysis Adaptation Partners: JT Lockman









Scanning the





training, and information needed to turn these data into the information most needed by coastal resource management professionals. <u>Read more.</u>

Resilient Coasts: A Blueprint for Action



### Urban Waterfront Adaptive Strategies



• I.C.L.E.I Local Governments for Sustainability









#### PREPARING FOR CLIMATE CHANGE A Guidebook for Local, Regional, and State Governments



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# The Task Force chose projections for Kingston to plan for:

Year Sea Level Rise Scenario	2060	2100
Low	20 inches	33 inches
High – rapid ice melt	36 inches	68 inches



## Scenic Hudson's Sea Level Rise Mapper

### LEGEND



INUNDATION DEPTH

HH Railroad

Libraries

Schools

Wastewater Treat-

Brownfields & EPA Hazardous Sites

ment Faciliities



### http://www.scenichudson.org/slr/mapper

## **CANVIS** West Strand in Kingston





Kingston waterfront Simulation: elevated sea level (4')

http://www.csc.noaa.gov/digitalcoast/to ols/canvis

### Worst case scenario

Year 2100, With High Sea Level Rise and a 100-year Storm 1% Probability of Occurrence in Any Given Year

Total Damage for this Event: \$39.9 Million Damage to Wastewater Treatment Plant: \$27.6 Million

Lost Value Due to Sea Level Rise Lost Value Due to Sea Level Rise + Storm Surge





Cumulative Expected Damages by 2100 *With High Sea* Level Rise = \$126 Million





## Guidebooks and Resources

New York State Climate Smart Communities



### **Climate Smart Resiliency Planning**

A Planning Evaluation Tool for New York State Communities



Climate Smart Communities is a program of the New York State departments of Environmental Conservation, Health, State and Transportation; State Public Service Commission; and State Energy Research and Development Authority.

December 2013

### COASTAL CLIMATE RESILIENCE Urban Waterfront Adaptive Strategies

GEORGETOWN CLIMATE CENTER A Leading Resource for State and Federal Policy adaptation

Adaptation Tool Kit: Sea-Level Rise and Coastal Land Use

How Governments Can Use Land-Use Practices to Adapt to Sea-Level Rise

> Jessica Grannis Octobar 2011

## Final recommendations of Task Force fall into 6 categories

- City operations, funding and decision-making
- Resilient structures
- Promotion of a waterfront economy and economic revitalization
- Collaboration and public outreach
- Emergency management
- Site-based recommendations



## Next steps

- FEMA "Sandy" monies
  - \$5 million Waterfront Resiliency Project



- \$500,000: Emergency generators at Wastewater Treatment Plant
- Stewardship of process forward by various community organizations
- Buy-in from community and municipal staff
- Investigate policy changes to reduce risks
- Follow up with Community Rating System (to reduce insurance rates)

## All Kingston documents available at www.kingstoncac.org

Planning for Rising Waters: Final Report of the City of Kingston Tidal Waterfront Flooding Task Force





New York State Climate Smart Communities



Climate Smart Communities Certification Manual



Climate Smart Communities is a program of the New York State departments of Environmental Conservation, Health, State and Transportation; State Public Service Commission; and State Energy Research and Development Authority.

April 22, 2014







## Thank You!

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### **Presented by:**

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### For more Information:

- www.hrnerr.org
- www.nerrs.noaa.gov/Reserve.as px?ResID=HUD



## **Additional Resources**

## Raising Capacity: Hudson River SLR and Waterfront Resources

















## New York Climate Change Studies









## **Informative Plans and Studies**







Stormwater Management Plan Tidal Rondout Watershed Management Plan Brownfield Opportunity Area and GEIS