



Living Shorelines in the Decade Since Sandy

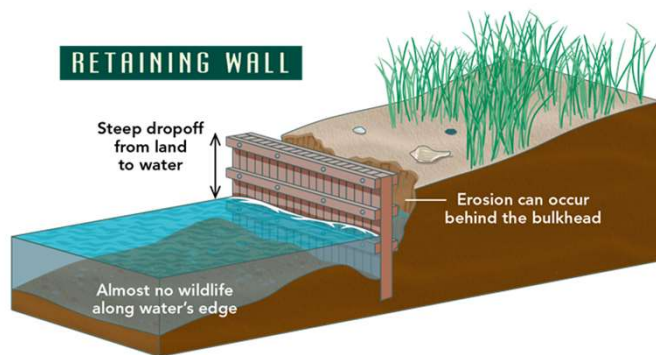
Lessons Learned and Implications for
Future Design

Jon K. Miller, Laura Kerr, Amy Bredes
Katherine Gannon, and Ian Day

October 7, 2022



Time Travel...



Not only do Living Shorelines defend land against destructive waves, but they also provide crucial habitat for fish and wildlife.

Dark Ages



Dark Ages



Time Travel...



DELSI

Delaware Estuary Living Shorelines Initiative

- PDE/Rutgers
- Project initiated in 2008
- Maurice River
- Coir Log & Shell Bag
- Key Takeaways
 - Permitting is painful
 - Effective on moderate/low energy shorelines
 - Can survive large storms
- [Project story map](#) created in 2021



BEFORE: Marina in New Jersey's Heislerville Fish and Wildlife Management Area in April of 2010.



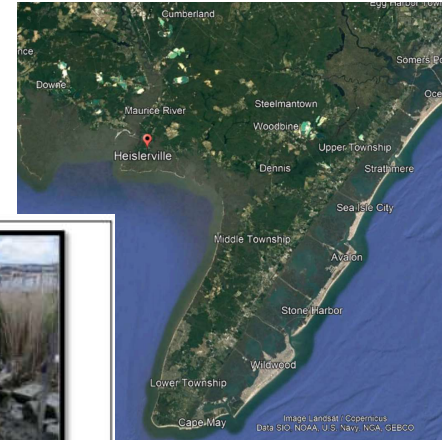
BEFORE: Day of installation of coconut-fiber (coir) logs and mats in New Jersey's Heislerville Fish and Wildlife Management Area in May of 2010.



AFTER: One year later, June 2011, native marsh grass can be seen flourishing in the soil that has collected behind the new "living shoreline." Not only does this defend land against destructive waves, but also it serves as fish habitat during high tides.



AFTER: September 2011- the site remained stable after Hurricane Irene and Tropical Storm Ike.



NJDEP

Early Living Shorelines Initiatives

- NJDEP – Living Shorelines Whitepaper
 - November 2009
 - Set the stage for the development of a general permit
 - “The regulatory preference for permitting bulkheads and similar structures should be changed to favor more ecologically beneficial solutions.”
- Regulatory Rule Writing Workshop
 - 2010?
 - Invited experts from around the region
 - Accelerated the development of a “Living Shorelines General Permit”

NJ Coastal Management Office

November 2009

Mitigating Shoreline Erosion along New Jersey's Sheltered Coast: Overcoming Regulatory Obstacles to Allow for Living Shorelines

Office of Coastal Management
NJDEP – November 2009

WHITE PAPER FOR DISCUSSION

"This 'white paper' was prepared with the assistance of CSC Fellow, Leigh Wood for the Coastal Management Office (2009) in response to the 'permitting experience' of the first living shorelines pilot project implemented by the Partnership for the Delaware Estuary. This paper was developed to help the NJDEP and the CMO examine pilot project opportunities that explore the technical and science knowledge necessary to expand the universe of living shorelines projects and to make this knowledge and methodology available to the general public in response to climate adaptation, sea level rise and shoreline erosion. It does not address more recent changes to regulations and policies."

Dorina Frizzera
Environmental Scientist I
NJDEP – Coastal Management Office
9/2011

WHITE PAPER FOR DISCUSSION



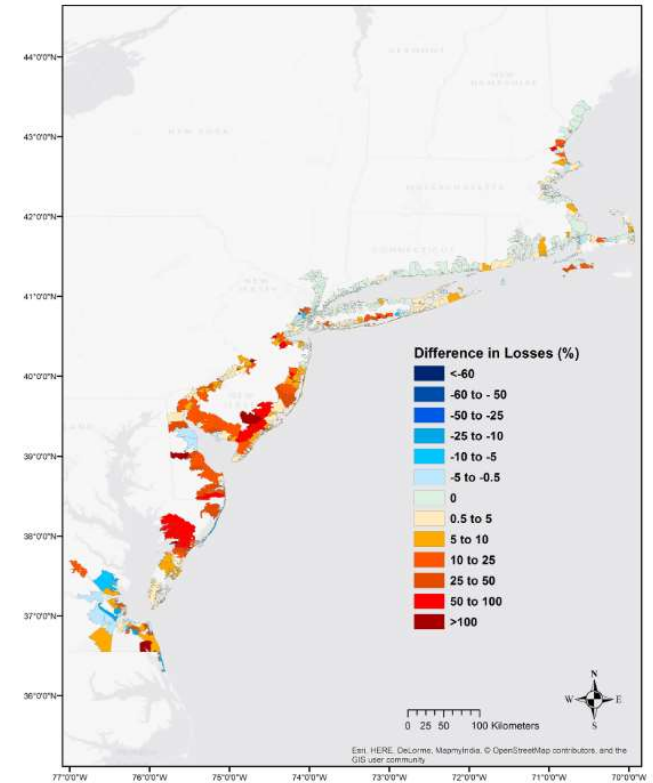
Time Travel...



Sandy

NNBF shown to reduce damage

- NRC advocates consider the full spectrum of options available
- USACE calls for integrated approach to risk management that draws from the full array of available measures
- “The Value of Coastal Wetlands for Flood Damage Reduction in the Northeastern USA”
 - Wetlands avoided \$625 million in direct flood damage during Sandy
 - 16% average reduction in annual flood losses by Salt Marshes



GP 24

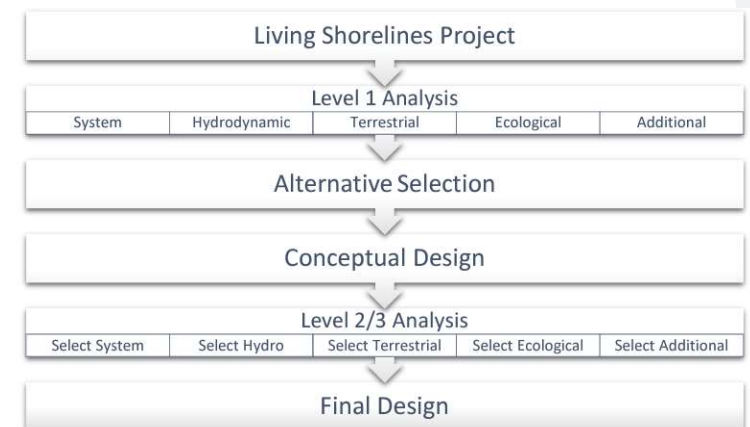
NJ Living Shoreline General Permit

- Originally released in 2013 as GP 29
- Projects must have the endorsement of a “sponsor” with experience designing and implementing living shorelines projects.
- Projects must have a reasonable likelihood of success unless they are constructed as a research project with a university partner.
- The project area below the mean high-water line must be one acre or less unless the applicant is a county, State or Federal agency that demonstrates the necessity of a larger project.
- Projects must minimize disturbance to special areas as defined in [N.J.A.C. 7:7-9](#), unless the proposed activities are deemed sufficiently environmentally beneficial as to outweigh the negative environmental impacts of reduction.
- Projects intended to restore an existing shoreline must limit fill to the footprint of the shoreline shown on the applicable Tidelands Map, except for structural components intended to reduce wave energy.

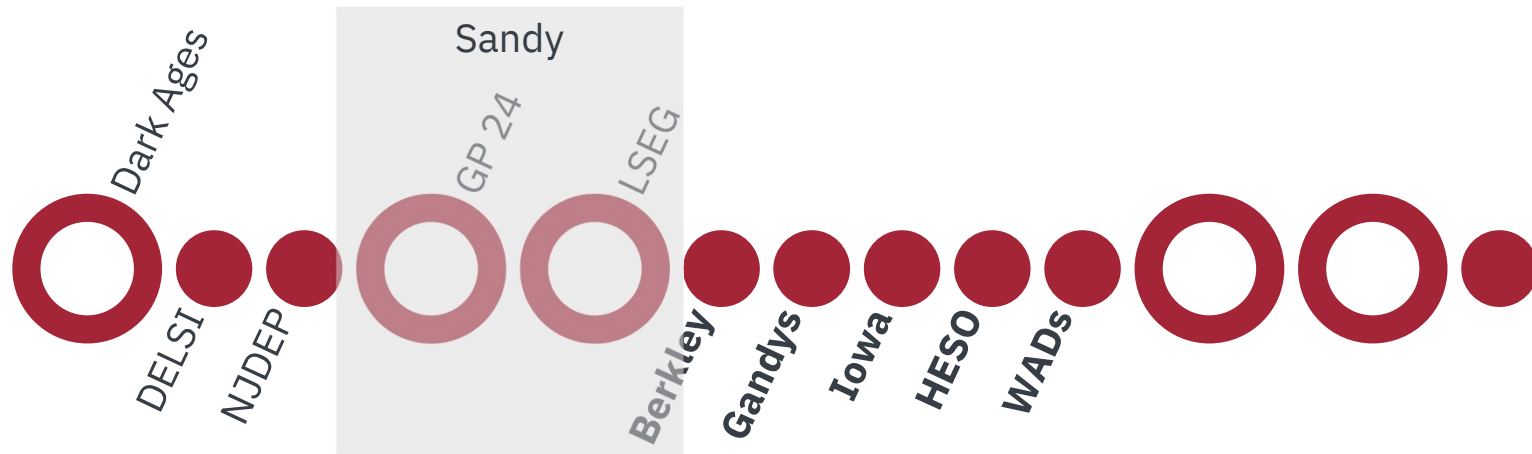
NJ Living Shorelines Engineering Guidelines

Developed by Stevens for NJDEP

- Released in 2013; revised in 2015 & 2022
- Objectives
 - Provide guidance to engineers and regulators on the engineering components of living shorelines
 - Ensure consistency with GP 24 (N.J.A.C. 7:7-6.24)
 - Reduce the number of failures due to poor engineering/construction
 - Intended to be a living document
- Approach
 - Identify factors relevant to living shoreline design
 - Describe approaches for determining those parameters
 - Provide guidance on alternative selection
 - Provide example applications of those parameters to design

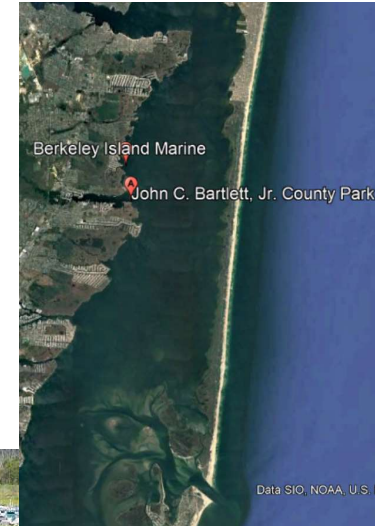


Time Travel...



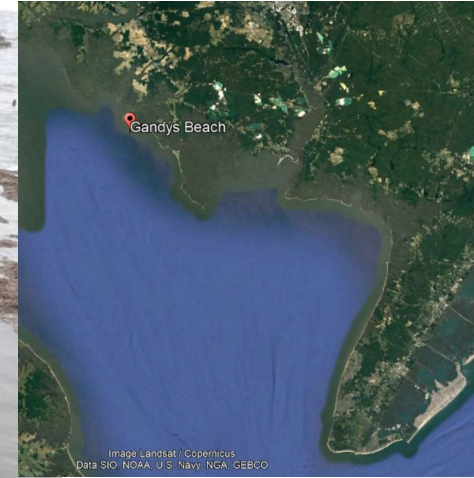
Berkeley Island

- Site characteristics:
 - Erosion Rate: 1-3 ft/yr
 - Estimate Wave Heights: 0.5-1.5 ft
 - Tidal Range: < 0.5 ft
 - Beach type: Marsh
 - Region: Barnegat Bay
- Original design: segmented rock sill
- Final design: linear stone/bulkhead sill



Gandys Beach

- Site characteristics:
 - Erosion Rate: 4-8 ft/yr
 - Estimate Wave Heights: 0.5 – 3 ft
 - Tidal Range: >6 ft
 - Beach type: Marsh and sand
 - Region: Delaware Bay
- Design: Oyster Castle Breakwater
 - Complex
 - Mostly submerged (60-80%)



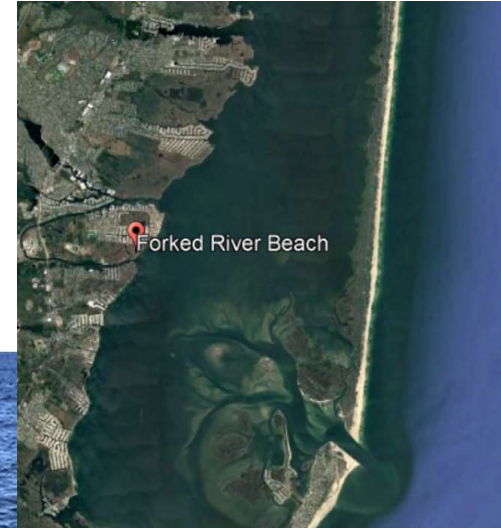
Iowa Court

- Site characteristics:
 - Erosion Rate: 2-10 ft/yr
 - Estimate Wave Heights: 1-4ft
 - Tidal Range: ~ 3 ft
 - Beach type: Marsh
 - Region: Barnegat Bay
- Design: Sill with bulkhead spine & fill
 - No water behind sill except during storms



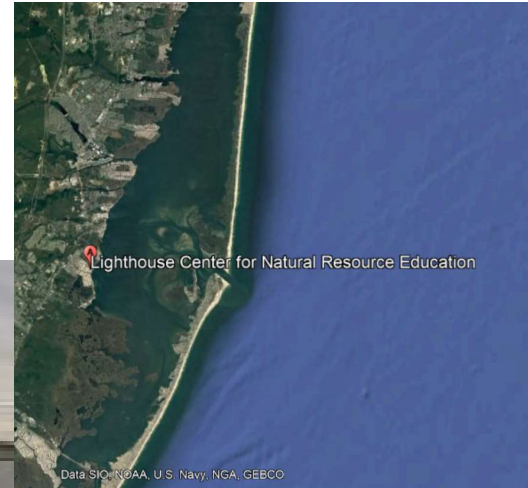
Forked River Beach

- Site characteristics:
 - Erosion Rate: 2-8 ft/yr
 - Estimate Wave Heights: 0.5-3ft
 - Tide Range: < 0.5ft
 - Beach type: Sandy
 - Region: Barnegat Bay
- Design: HESCO basket breakwater
 - Varied angles and gaps
 - Rock interior with shell veneer

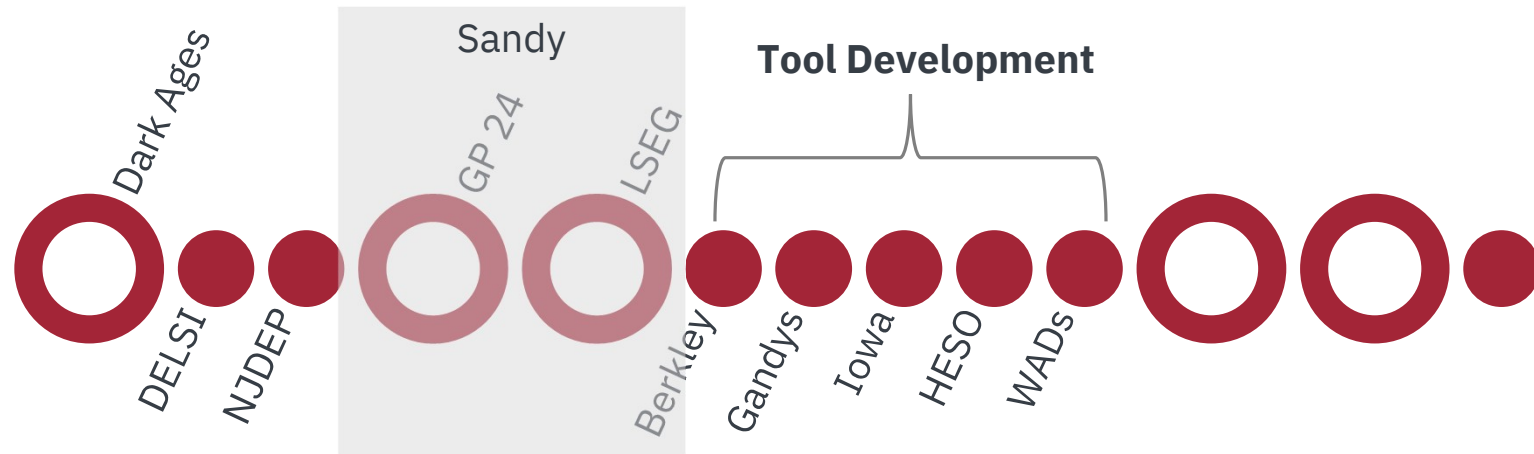


Lighthouse Center

- Site characteristics:
 - Erosion Rate: 1-4 ft/yr
 - Estimate Wave Heights: 0.5-2 ft
 - Tide Range: ~0.5 ft
 - Beach type: Marsh
 - Region: Barnegat Bay
- Design: WAD sill/breakwater
 - Emergent



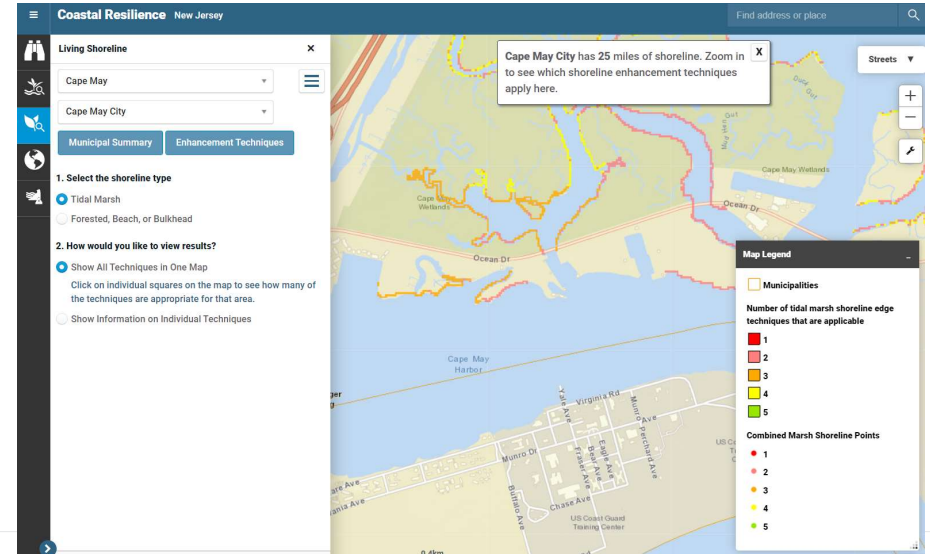
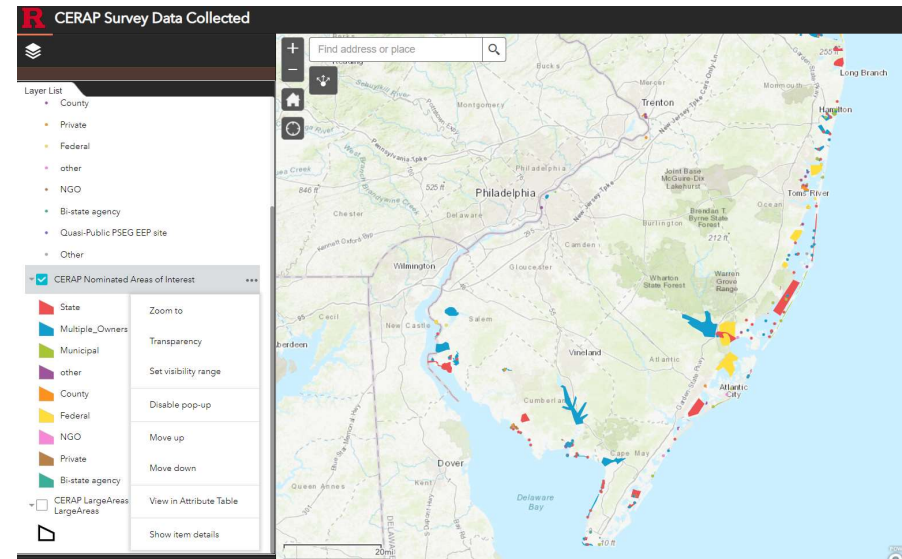
Time Travel...



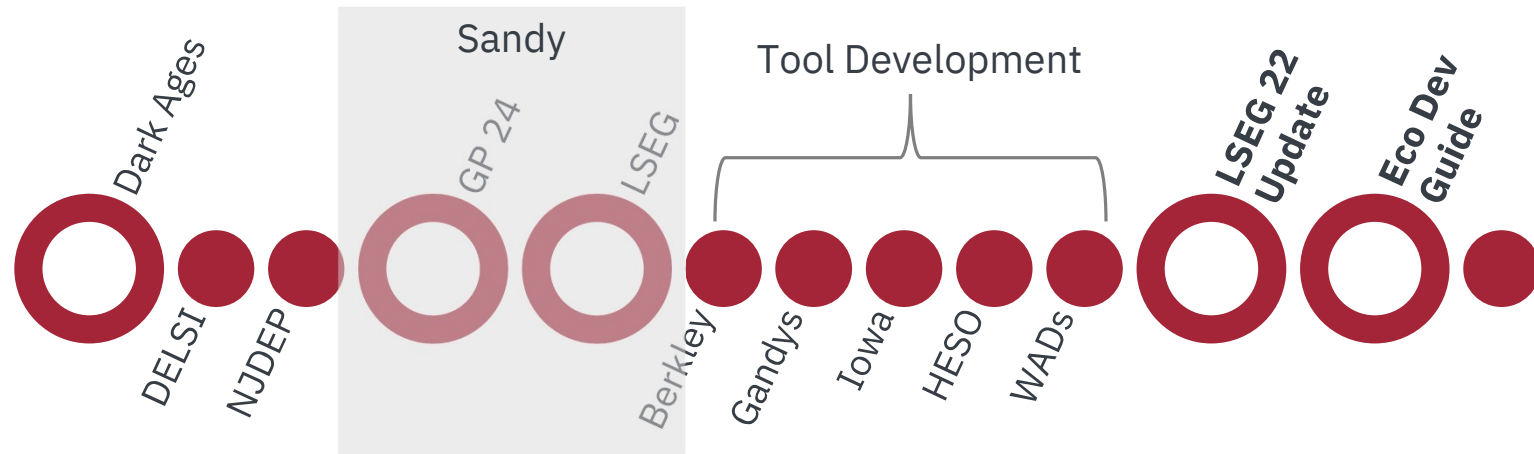
Tool Development

Incomplete list

- [Living Shorelines Engineering Guidelines](#) (2022 Update Soon) – Stevens
- [Restoration Explorer](#) – TNC
- [Wetland Assessment Tool for Condition and Health \(WATCH\)](#) - PDE
- [New Jersey Coastal Ecological Restoration and Adaptation Plan \(CERAP\)](#) – Rutgers/NJDEP
- [Mid-Atlantic Coastal Wetlands Assessment \(MACWA\)](#) - Multiple
- [A Community Resource Guide for Planning Living Shoreline Projects New Jersey](#) – Multiple
- [A Framework for Developing Monitoring Plans for Coastal Restoration and Living Shorelines Projects in New Jersey](#) – TNC
- [Building Ecological Solutions to Coastal Community Hazards](#) – NWF
- [Ecoshorelines on Developed Coasts Guidance and Best Practices](#) – Stevens



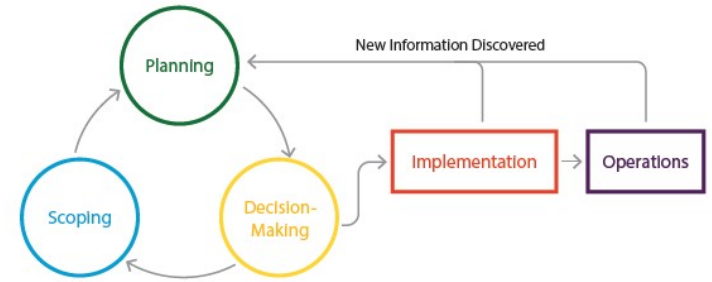
Time Travel...



NJ Living Shorelines Engineering Guidelines

2022 Update

- Adopts simplified IGNNBF terminology (design phases)
- Scoping Phase is added – Tools
- Adaptive management discussion is added
- Research gap appendix added
- Design parameters, conditions, and ranges updated
- Joint-planted revetment and reef ball specific sections have been removed
 - Alternative substrates addressed under living reef section
 - Vegetation addressed in developed coast document



	Marsh Sill	Breakwater	Living Reef
System Characteristics			
Erosion History	Low-Med	Med-High	Low-Med
Sea Level Rise	Low-Mod	Mod-High	Low-Mod
Tidal Range	Low-High	Low-High	Low-Mod
Hydrodynamic Characteristics			
Wind Waves	Low-Mod	Mod-High	Low-Mod
Wakes	Low-Mod	Mod-High	Low-Mod
Currents	Low-Mod	Low-High	Low-Mod
Ice	Low	Low-High	Low
Storm Water Level	Low	Mod-High	Low
Terrestrial Characteristics			
Upland Slope	Mild-Mod	Mod-Steep	Mild-Mod
Shoreline Slope	Mild-Mod	Mild-Steep	Mild-Mod
Width	Mod-High	Mod-High	Mod-High
Nearshore Slope	Mild-Mod	Mild-Mod	Mild-Mod
Offshore Depth	Shallow-Mod	Mod-Deep	Shallow-Mod
Soil Bearing	Mod-High	High	Low-Mod
Ecological Characteristics			
Water Quality	Poor-Good	Poor-Good	Good
Soil Type	Any	Any	Any
Sunlight Exposure	Mod-High	Low-High	Mod-High

Scoping Level Analysis

Replaces “Level 0”

- TNC Restoration Explorer
- PDE WATCH tool
- CERAP



Wetland Assessment Tool for Condition & Health (WATCH) v 2.0

A user's guide for operating WATCH v 2.0 including definitions, data input, interpreting outcomes, and training scenarios

How each restoration technique meets the Tidal Range condition

Environmental parameter criteria thresholds	Nature-Based Living Shoreline	Living Reef Breakwater	Marsh Sill	Ecologically Enhanced Revement	Breakwater
0-2 ft	Yes	Yes	Yes	Yes	Yes
2-4 ft	Yes	Yes	Yes	Yes	Yes
4-6 ft	No	No	No	Yes	Yes
> 6 ft	No	No	No	Yes	Yes

Which Environmental Conditions are Met in this Area?

Living Reef Breakwater
 Shoreline Change Rate: Yes - 1 feet/year
 Tidal Range: Yes - 1.2 feet
 Salinity: Yes - 27.8 ppt
 Wave Height: Yes - 1.7 feet
 Ice Cover: Yes - Low
 Shoreline Slope: Yes - 4%
 Nearshore Slope: Yes - 3%
 Total Conditions Satisfied: 7

CERAP Survey Data

Find address or place

March 2020

A publication of the Partnership for the Delaware Estuary—A National Estuary Program

(1 of 3)

CERAP Nominated Projects NJDEP Meeting - CERAP OC Projects for DEP: Thompsons-Moore's Beach Complex

A Site Name	Thompsons-Moore's Beach Complex
B Project Name	Thompsons Beach Restoration
C Lead Organization	American Littoral Society
D Project Lead	Shane Godshall
E Project Contact Email	shane@littoralsociety.org
F Lead Organization Type	NGO
G Other Partners Involved	Stockton CRC, Wildlife Restoration Partners, USFWS, NJDEP/NJDPW

Additional Considerations

- Adaptive management
 - prevents overbuilding at the design phase
 - reduces upfront costs by allowing management of unknowns over time
 - provides flexibility to adjust project goals over time as the needs of the site change
 - **But** requires project monitoring and an open regulatory environment
- Beneficial reuse
 - Consideration of 1977 tidelands line (N.J.A.C. 7:7-6.24)
 - Consideration of existing sediment size requirements (N.J.A.C. 7E-4.8)
 - Coarser sediments typically placed along the edge with finer sediment placed on the interior/platform

Ecoshorelines on Developed Coasts

Guidance and Best Practices

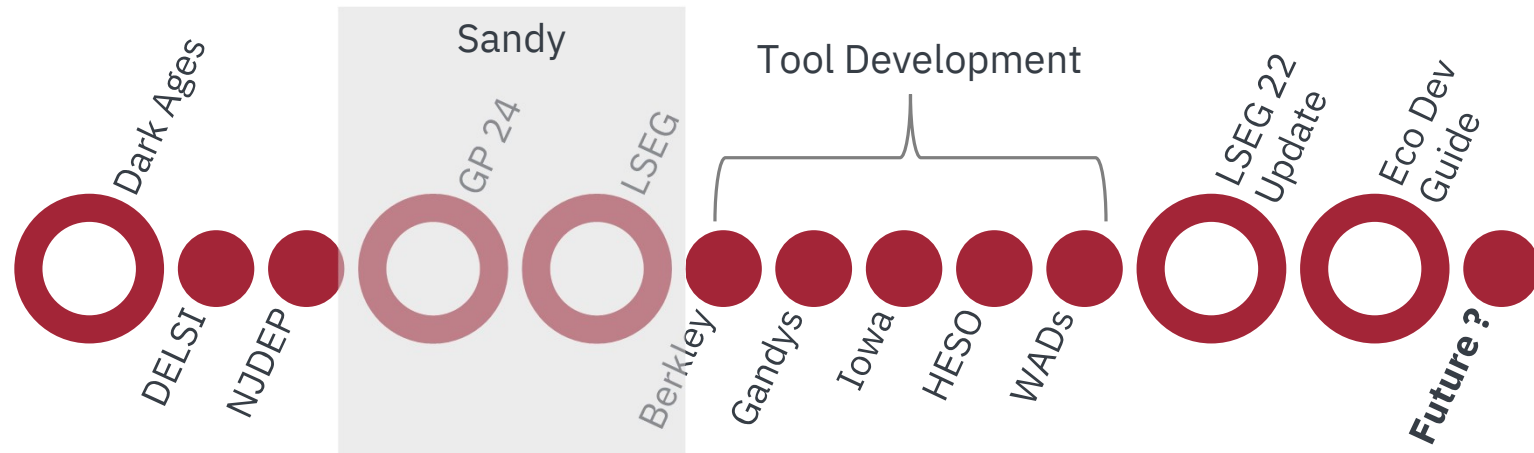
- Sister document to NJ LSEG
- Review of Existing Guidance
 - Waterfront Edge Design Guidelines (Waterfront Alliance)
 - International Guidelines on Natural and Nature Based Features for Flood Mitigation (USACE)
- Case Studies
 - Harlem River, NY
 - Sherman Creek, NY
 - Brooklyn Bridge Park, NY
 - Seattle Seawall, WA
 - Lardners Point, PA
 - San Diego, CA



	WEDG	IGNBF	Harlem River	Sherman Creek	Brooklyn Bridge	Seattle Seawall	Lardners Point	San Diego
Preserve Natural Areas								
Increased Surface Roughness								
Alternative Materials								
Reduce Slope								
Increase Sinuosity								
Allow Light Penetration								
Increase Water Retention								
Resilience/Adaptability								
Monitoring and Assessment								

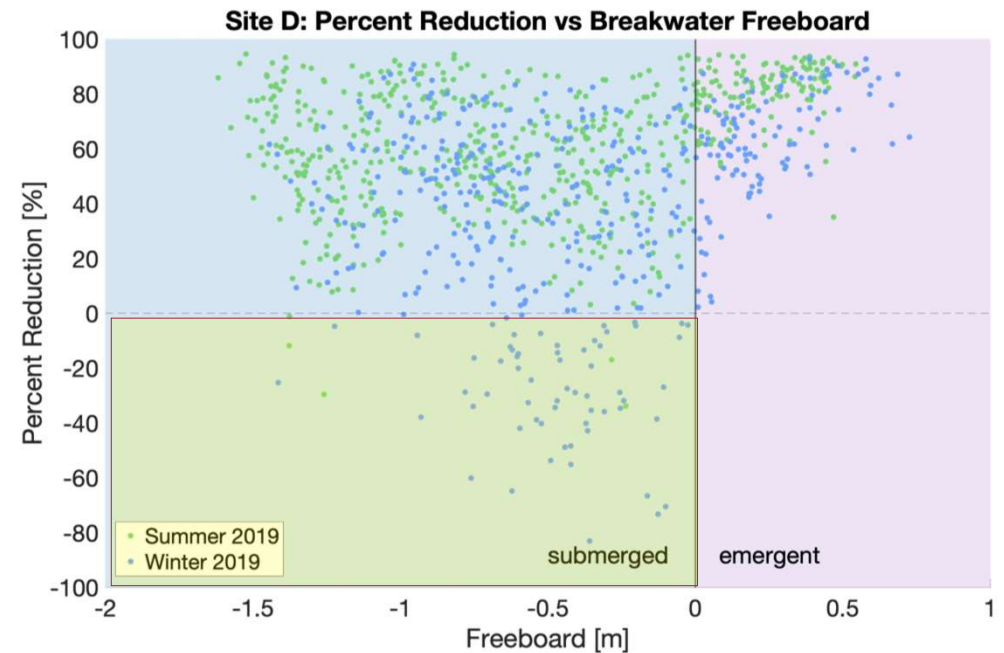


Time Travel...



Potential Climate Change Impacts

- Sea level rise
- More frequent and intense storms
- Feedbacks
 - Deeper water → larger waves
 - “Modification” of wave attenuation associated with natural and engineered features
 - Potential loss of habitat/natural wave attenuation



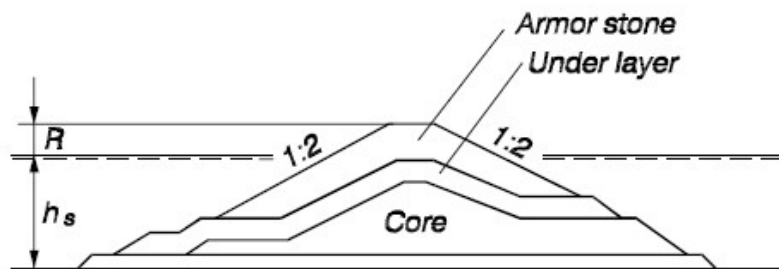
Structural Wave Attenuation

Problem

- Wave attenuation decreases as water levels increase
- Recent evidence suggests waves can become trapped behind structures and amplify when submerged

Solutions

- Build taller structures (not ideal)
- Build wider structures (permitting constraints)
- ***Build adaptable structures – natural and man made***
- ***Plan for active and inactive structures and transitions***



USCRP Funded Project

Evaluating the Influence of Water Level on Wave Attenuation of Natural and Nature Based Features in Low-High Energy Environments



- Phase 1: Collect field data at 4 initial sites, and further data sets at 2 focus sites
- Phase 2: Numerical simulation of the 2 selected focus sites
- Project Advisory Team
 - Josh Moody, PhD – Partnership for Delaware Estuary
 - Captain Al – American Littoral Society
 - Merideth Comi – NY/NJ Baykeeper
 - Adriana Zito-Livingston – The Nature Conservancy
 - Danielle McCulloch – US Fish and Wildlife
 - Tori Tomiceck, PhD – US Naval Academy
 - Erick Doyle – NJDEP Coastal Protection Technical Assistance Service
 - Mary Bryant – USACE ERDC

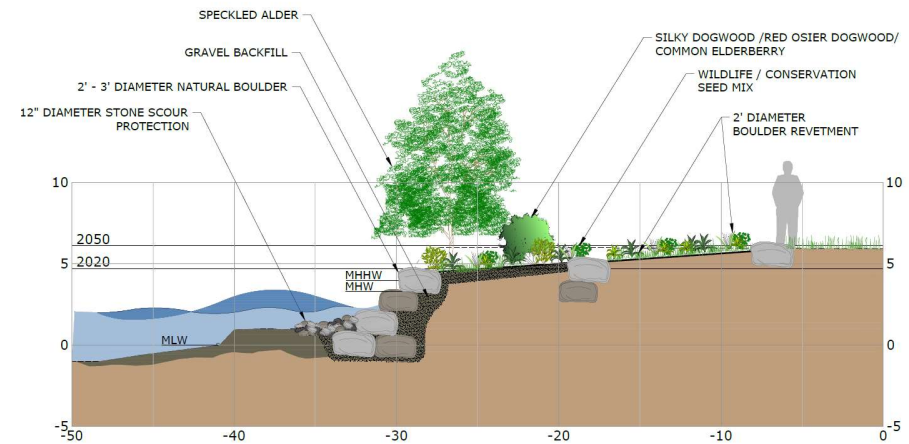
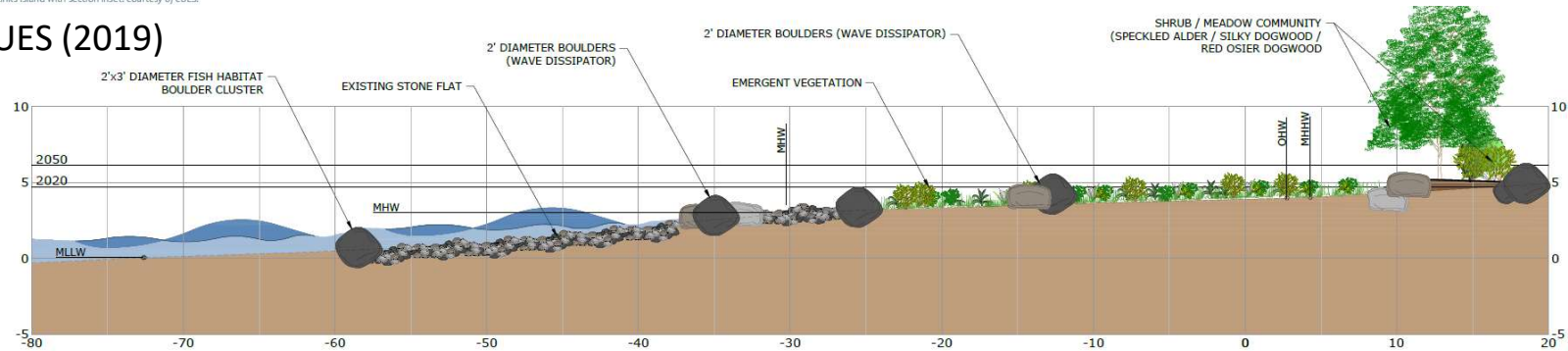


Conceptual Adaptive Designs



Figure 2. Plan view of the proposed Links Island with section inset. Courtesy of CUES.

Rutgers CUES (2019)



Milone and MacBroom

Summary

We've come a long way, but the journey continues

- ***Progress***

- General Permit 24
- LSEG
- Tools
- Projects - dozens

- ***Challenges***

- Document/learn from constructed projects
- Continue to evaluate permitting process
 - Wider structures?
 - Adaptive management?
- Improve Design Guidance
 - Traditional and developed shorelines
 - Consider wave power
- Resilient Design
 - Climate and other
 - Adaptive management
 - Habitat transitions



Questions?

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