



# Diverse Environments Diverse Solutions

*Engineering Challenges Of  
Nature Based Solutions*

Jon K. Miller, PhD  
Research Associate Professor  
Stevens Institute of Technology  
[jmiller@stevens.edu](mailto:jmiller@stevens.edu) @NJBeachProf



# Dynamic Environments



DOWNNE TOWNSHIP, NJ

Search Purchase AL

Overlays (Off) Slide

**Aerials**

- 2013
- 2012
- 2010
- 2008
- 2006
- 2002
- 1997
- 1991
- 1972
- 1963
- 1956
- 1951
- 1940
- 1931
- Topos**
- T1993
- T1984
- T1980
- T1973
- T1969
- T1958

**Aerials**

- 2013
- 2012
- 2010
- 2008
- 2006
- 2002
- 1997
- 1991
- 1972
- 1963
- 1956
- 1951
- 1940
- 1931
- Topos**
- T1993
- T1984
- T1980
- T1973
- T1969
- T1958

100 m  
500 ft



# BESCCH Engineering Objectives

Provide technical assistance to NJ communities considering ecological approaches for addressing coastal hazards

**Key question 1:** What are the primary project objectives?

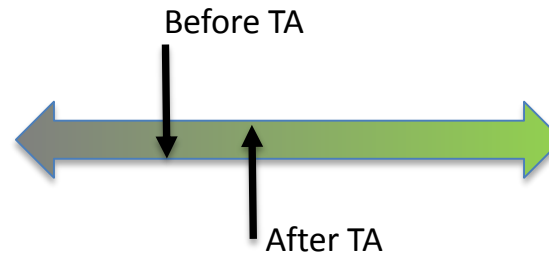
**Key question 2:** Can ecological solutions be a part of the solution?

In many cases yes

In some cases no



*“Move the Needle”*





# NJ Living Shorelines Engineering Design Guidelines



Living Shorelines Engineering Guidelines  
Draft Report

Prepared for:  
New Jersey Department  
of Environmental Protection

Prepared by:  
Jon K. Miller, Ph.D., Andrew Rella, Erin Hopson

SIT-DL-14-9-Draft



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

# Restoration Explorer Tool



www.maps.coastalresilience.org/newjersey/

COASTAL RESILIENCE NEW JERSEY

GET STARTED TOUR GO TO The Nature Conservancy Partners Legal Disc

Search by Address

**Restoration Explorer**

Ocean County

Tuckerton Borough

View Municipal Summary

1. Select the shoreline type

- Tidal Marsh
- Forested, Beach or Bulkhead

2. Select a disturbance process

- Shoreline edge erosion

3. How would you like to view results?

- Show All Techniques in One Map
- Show Information on Individual Techniques

Show All Techniques on One Map:  Turn results on or off

Project Information

Opaque Transparent

Tuckerton Borough has 35.2 miles of shoreline. Zoom in to see which shoreline enhancement techniques apply here.

The Nature Conservancy

**Map Legend**

Marsh

Number of tidal marsh shoreline edge techniques that are applicable

- 1
- 2
- 3
- 4
- 5

# Gardner's Basin, Atlantic City

## Key Engineering Challenges

Space constraints

Existing outfall

Existing site use

Wakes

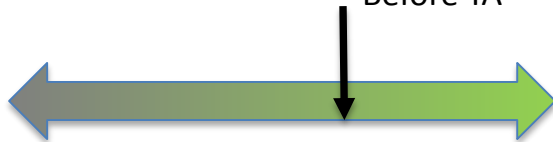
## Key Ecological Considerations

Horseshoe crabs

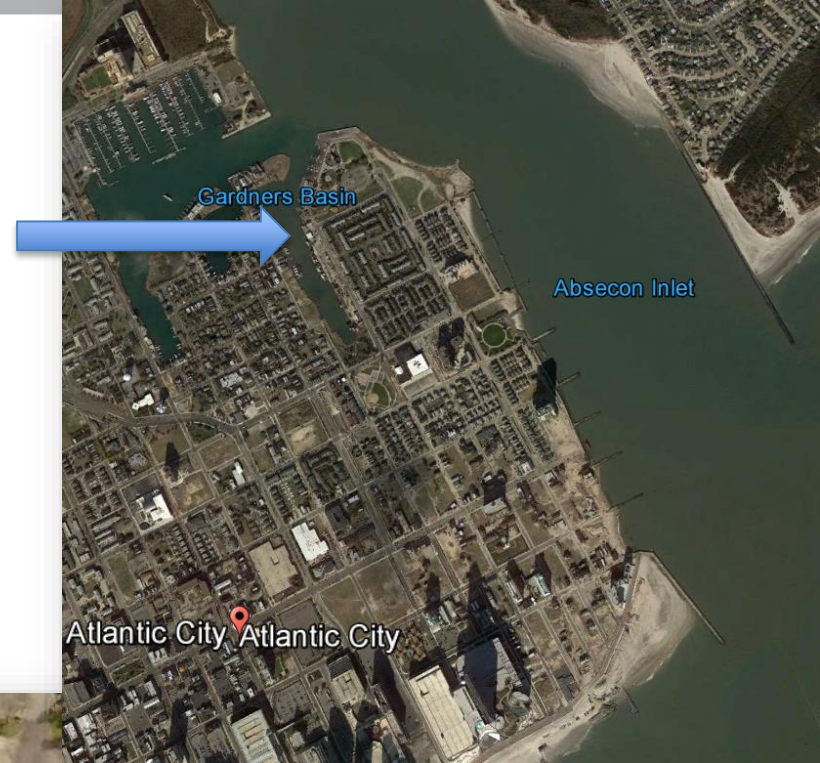
## Original Design

Breakwater, wetland  
planting, vegetated berm

Before TA



Design: Arthur Ponzio & Associates







# Upper Township

## Key Engineering Challenges

Anticipating roadway/bulkhead elevation projects

Space

Adjacent bulkhead

Adjacent drainage ditch

## Key Ecological Considerations

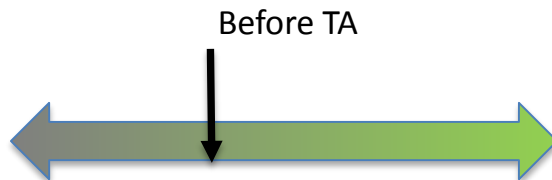
Restore eroding marsh edge

Reestablish vegetation



## Original Design

Extend boat ramp and bulkhead





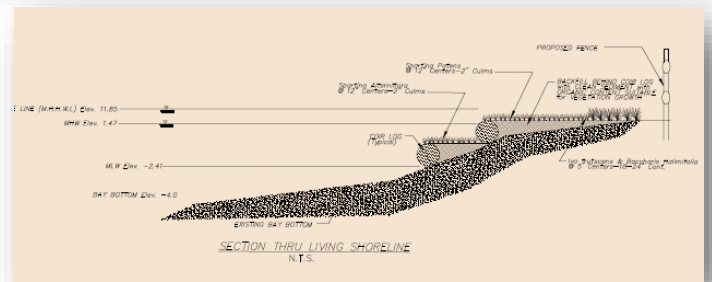
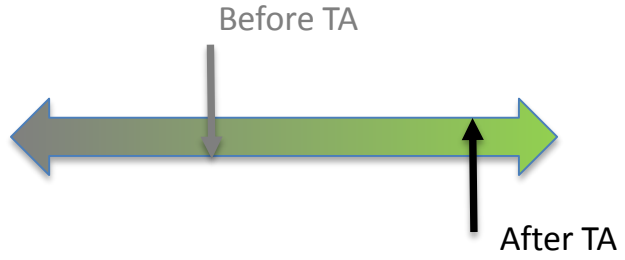
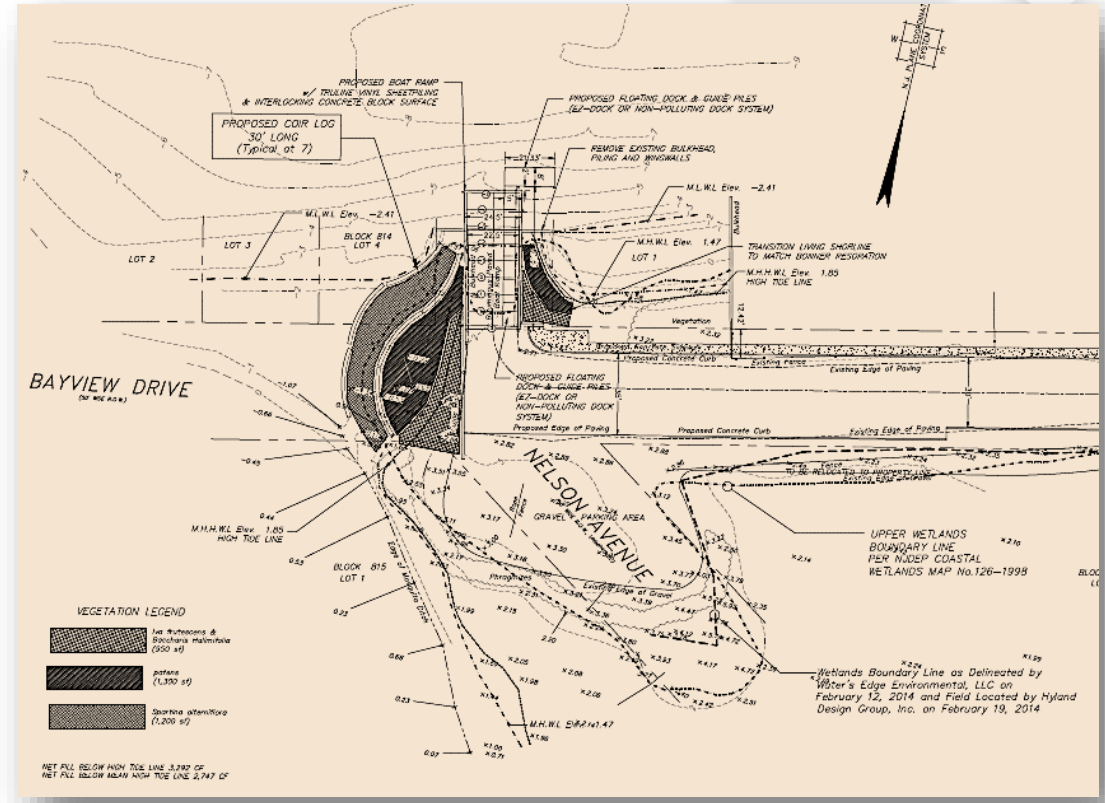
# Upper Township

## Proposed Design

Extended boat ramp

Terraced edge with coir log toe

Native vegetation



Design: Upper Township – Paul Dietrich

# Gandy's Beach, Downe Township



## Key Engineering Challenges

Coordination with ongoing projects

Coordination with USACE nourishment project

Back side flooding

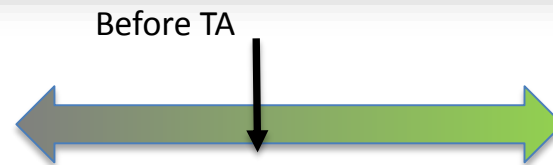
## Key Ecological Considerations

Horseshoe crabs

Eroding wetlands

## Original Design

Headland breakwaters



# Gandy's Beach, Downe Township



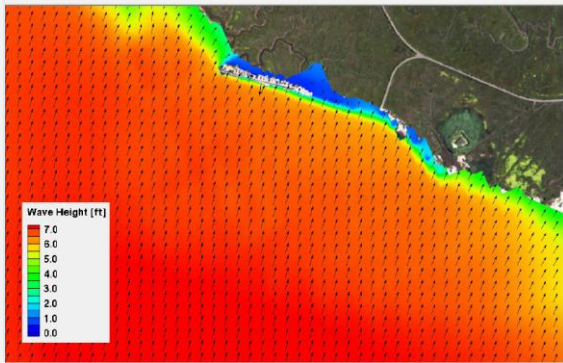
## Proposed Design

Nourishment and structure(s)

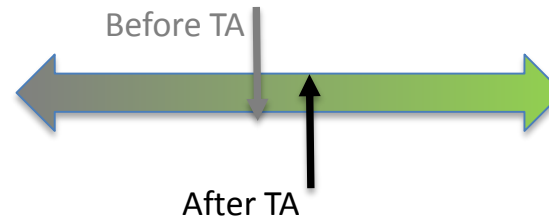
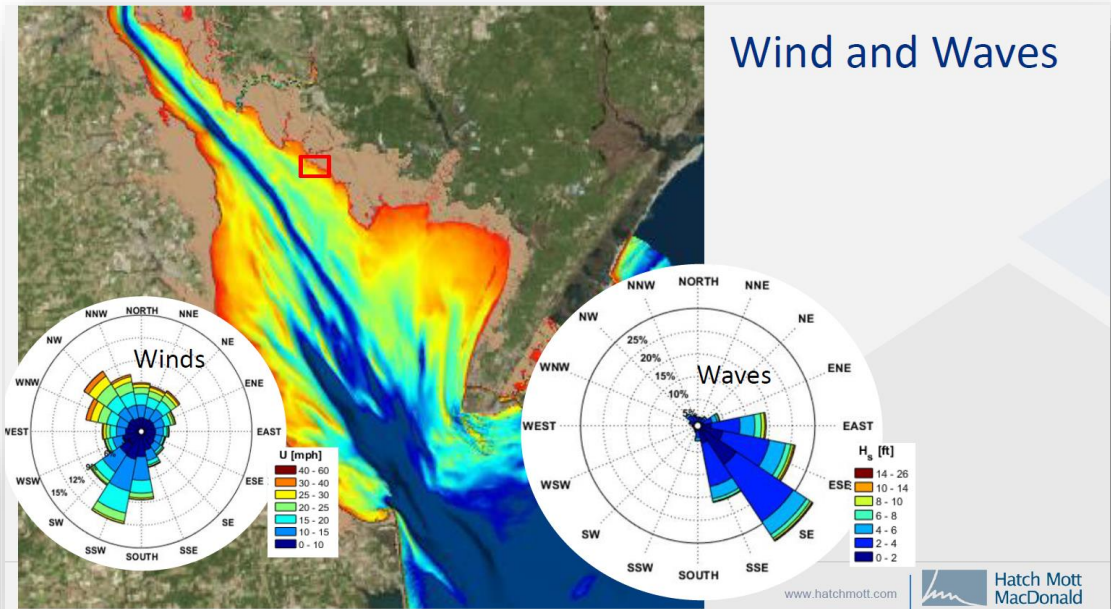
Final design/layout not complete

Coordination with the USACE and others is encouraging

25 year storm  
(includes 25yr WSE)



Modeling: Mott MacDonald





# West Wildwood

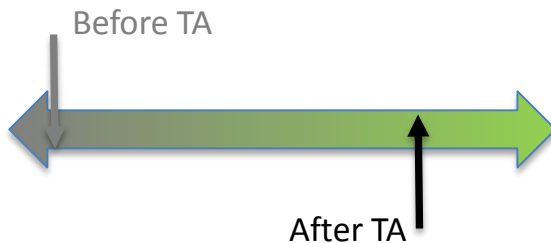
Not one of the BESCCH communities

TA provided through NOAA CREST grant to TNC

Original plan – bulkhead peninsula

Conceptual design – segmented sill

Final design – CH2M



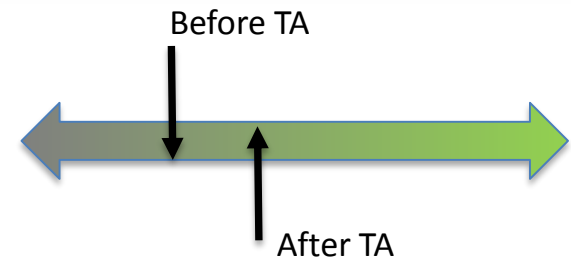
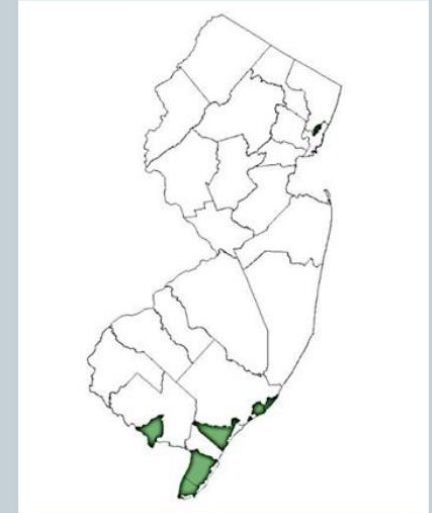
# Summary



- Over three dozen communities receiving assistance
  - 20 Tier 1 communities receiving technical assistance in the form of evaluation of “problem” areas
  - 15 Tier 2 Blue Acres communities being evaluated for the possibility of BESCCH
  - 10 Tier 3 communities receiving design/permitting assistance
    - 3 sill/breakwater, 4 vegetated berms, 2 beneficial reuse, 1 structure removal, 2 hydrology studies

## Local Partners

- Atlantic City
- Brigantine
- Downe Township
- Margate
- Somers Point
- Secaucus
- Spring Lake
- Lower Township
- Upper Township
- Cape May County



*“We’re moving the needle”*