

MARSH FUTURES:

Assessment and Mapping of Salt Marsh Vulnerabilities to Guide Restoration at the Local Scale

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The Nature Conservancy

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Natural Lands Trust



Coastal Resilience

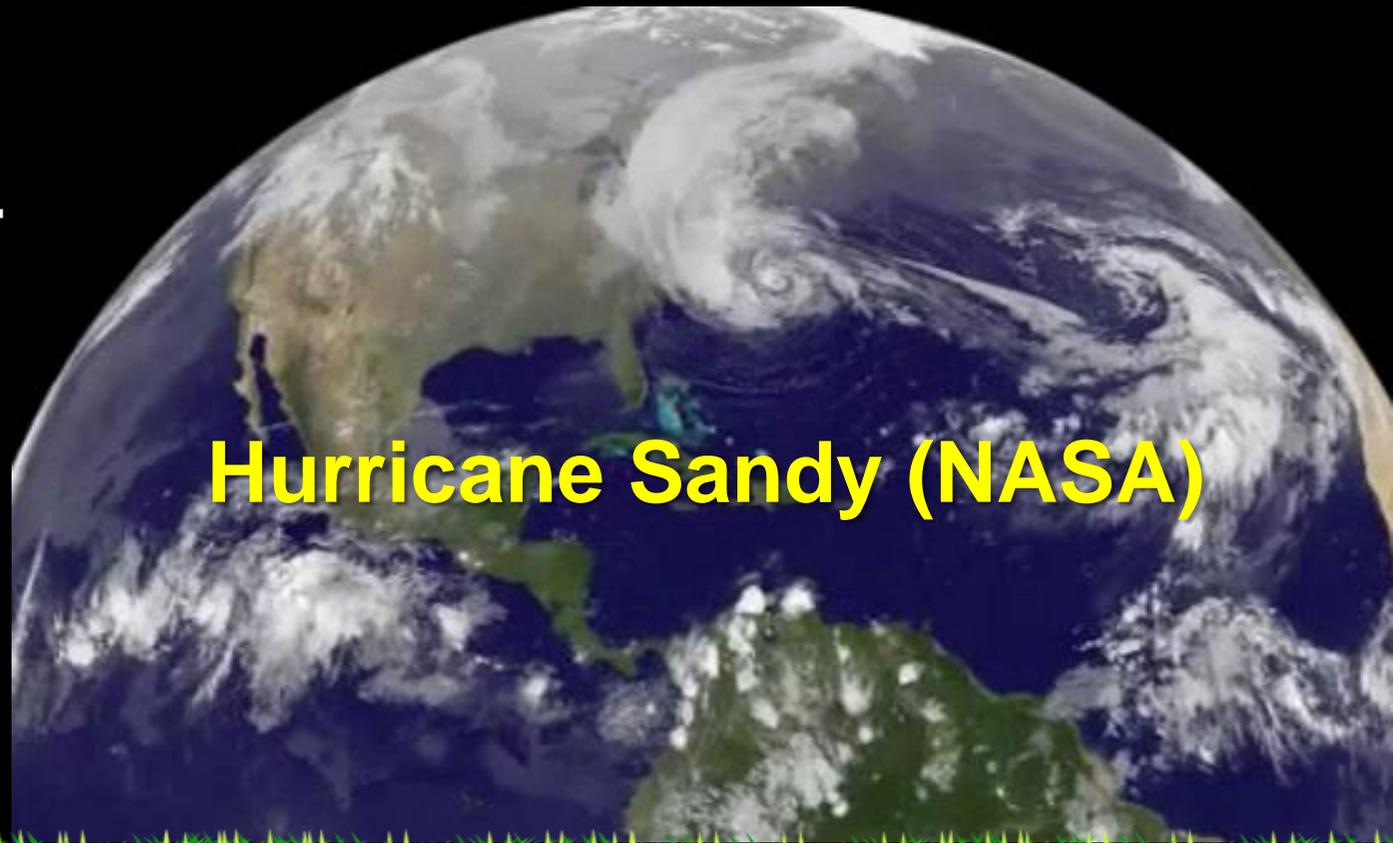
Climate:

Shifting Baselines
Greater Oscillations

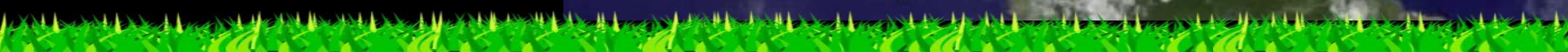
→ Coastal Wetlands

Need to Sustain

Ecoservices
Buffers



Hurricane Sandy (NASA)



Post-Sandy Lessons

Flooding and storm damage was lower adjacent to protective coastal wetlands and dunes





Habitat Benefits

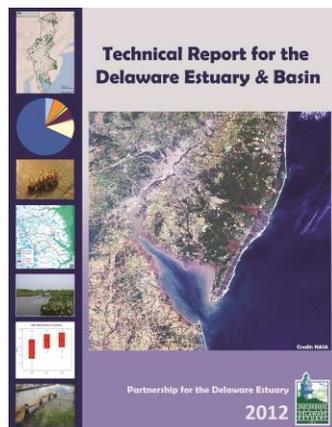
Table N-2 Coastal Storm Risk Management Functions, Multi-Benefits, and Resilience

Aggregated Measure Type ¹	Category ²	Coastal Storm Risk Management Function		Erosion	Multi-Benefits ³	Resilience	
		Flooding	Wave Attenuation			Adaptive Capacity ⁴	
Deployable floodwalls	STR	Medium	None	None	None	Low	
Floodwalls and levees	STR	High	Low	None	Low	Low	
Shoreline stabilization (seawalls, revetments, bulkheads)	STR	Low	High	High	Low	Low	
Storm surge barriers				none	high	medium	none
Living shorelines	STR/NNBF	Low	Medium	Medium	High	High	
Overwash fans (e.g., back bay tidal flats/fans)	NNBF	Low	Medium	High	Medium	High	
Reefs	NNBF	Low	Medium	Medium	High	High	
Submerged aquatic vegetation	NNBF	Low	Low	Low	High	Medium	
Wetlands	NNBF	Low	Medium	Medium	High	High	

http://www.nad.usace.army.mil/Portals/40/docs/NACCS/NACCS_main_report.pdf

Coastal Marsh Declines

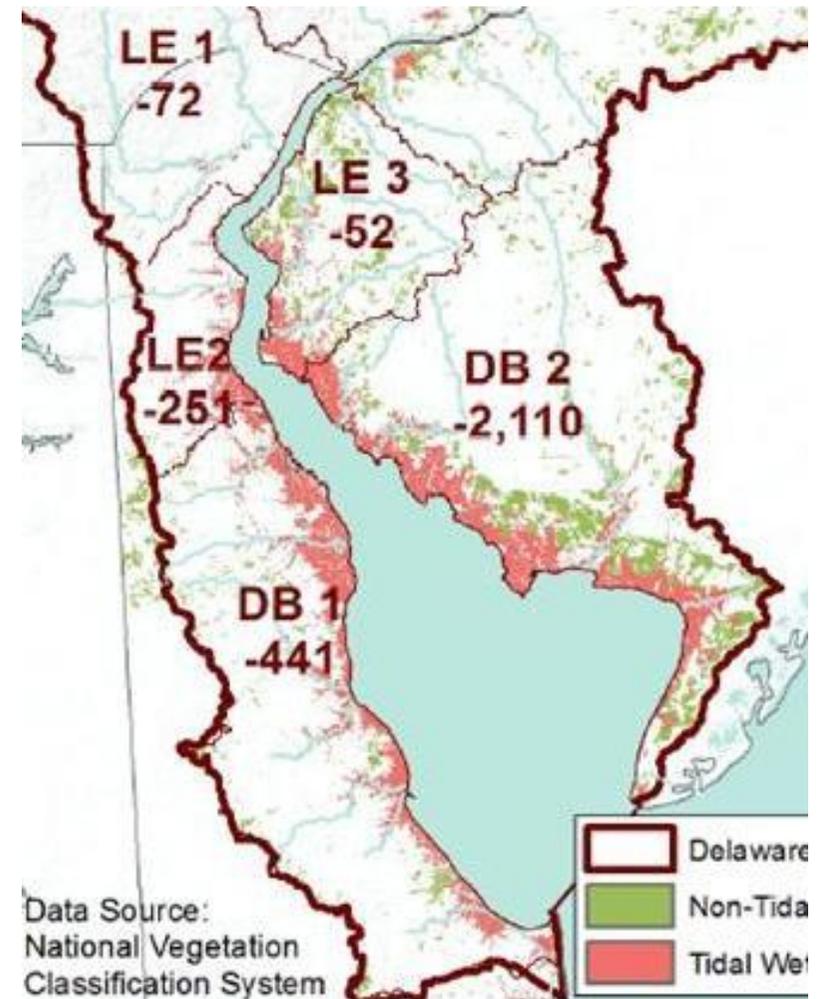
- Losing ~1 acre per day in the Delaware Estuary
- Losses due to various stressors



Sources:

Technical Report for the Delaware Estuary and Basin, 2012

Science Summit 2013



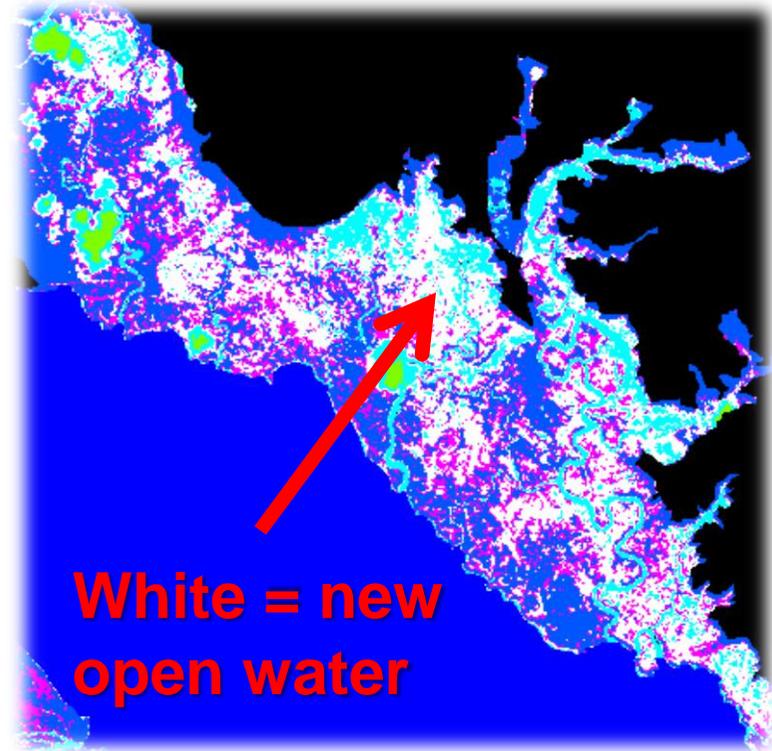
Two Decline Patterns

Edge Erosion (Horizontal)

> 1 m per year edge loss



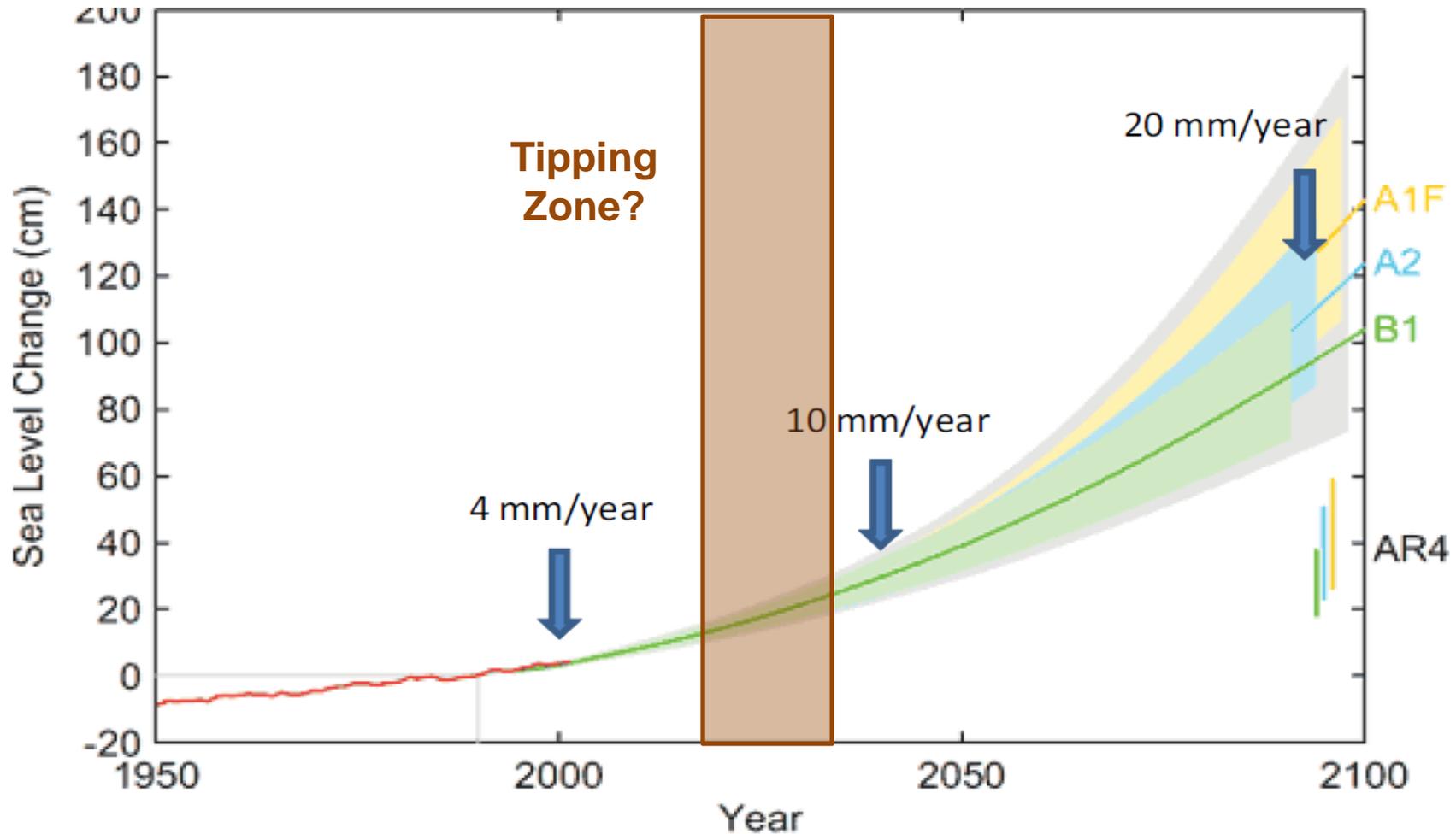
Interior Drowning (Vertical)



**White = new
open water**

Source: Riter and Kearney 2009

Future Challenges



Most Salt Marshes Cannot Survive When Sea Levels Rise >1 cm Per Year



Oyster/Rock Breakwaters



Living Shorelines



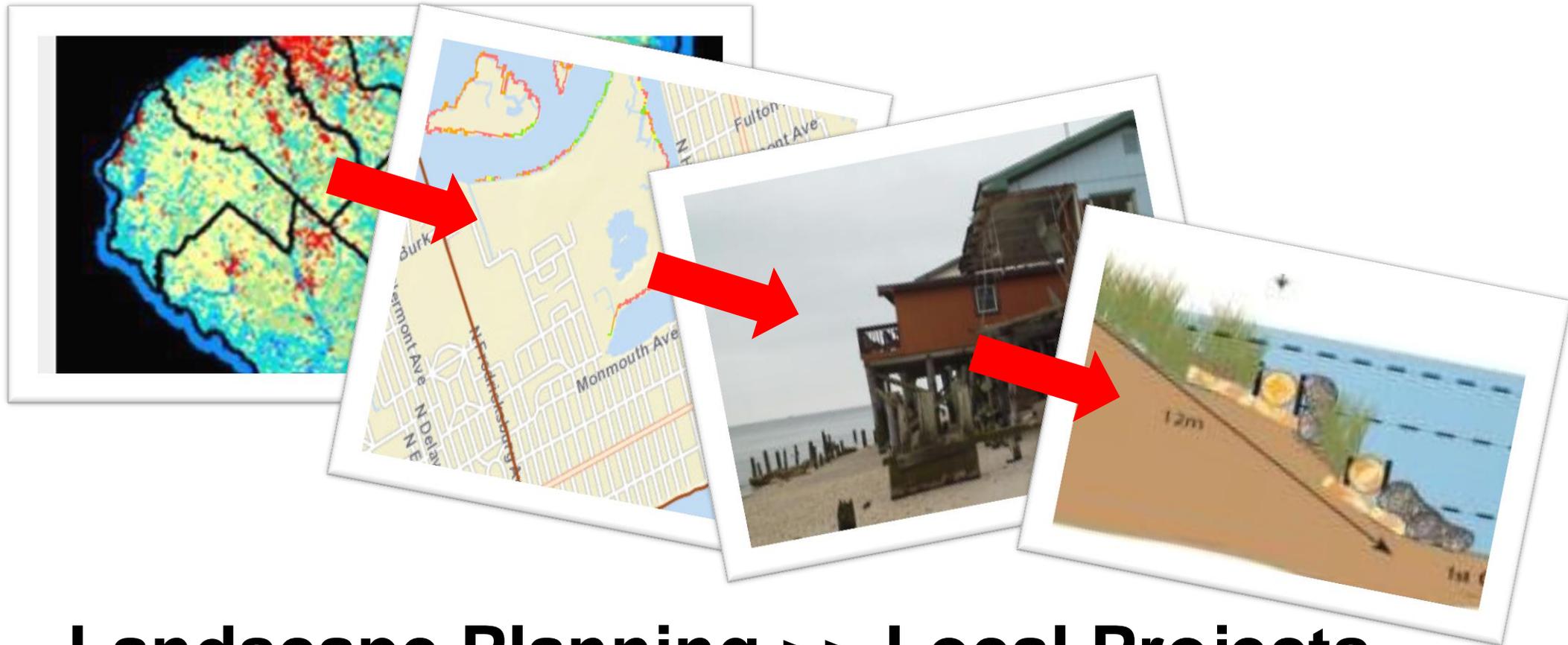
Sediment Placement



**What Tactics?
Where Best?
Successful?**



Hierarchical Analysis



Landscape Planning >> Local Projects





Hierarchical Analysis

1. Regional Prioritization



2. Remote Sensing Analyses, Models



3. On-the-Ground Analyses, Project Concepts



4. Highly Detailed Analysis, Project Plans



Hierarchical Analysis

1. Regional Prioritization

Regional Restoration Initiative



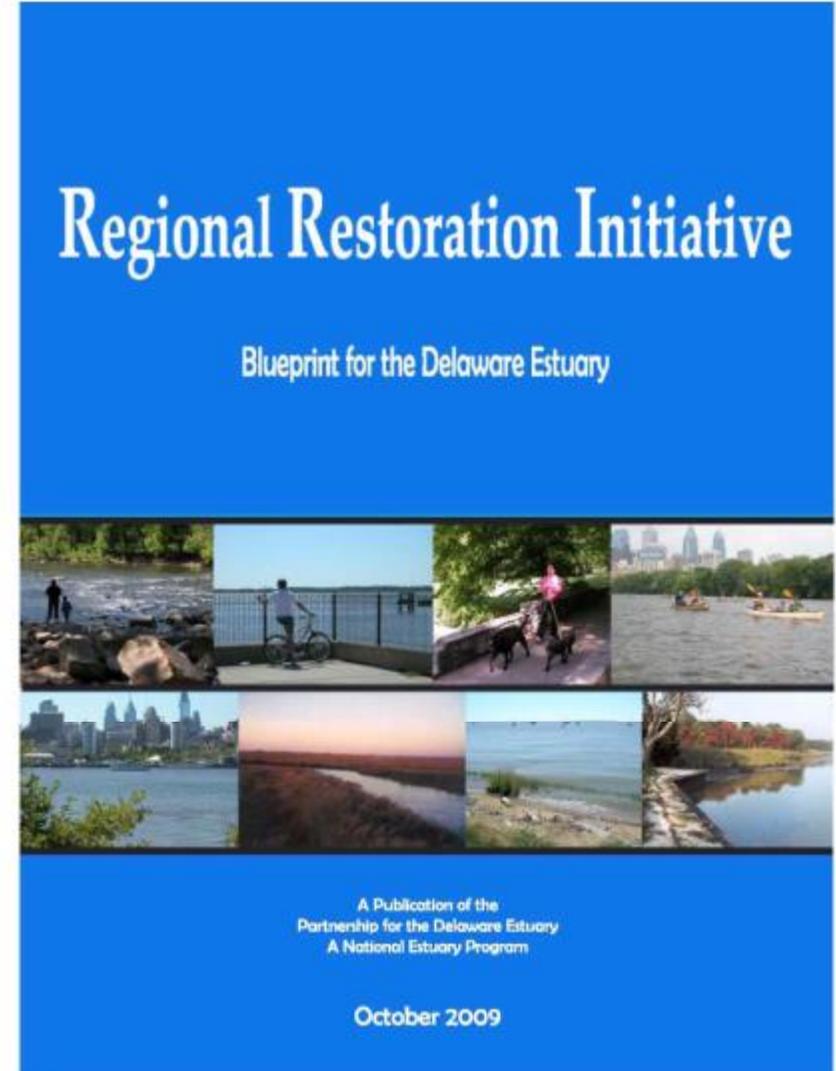
2. Remote Sensing Analyses, Models



3. On-the-Ground Analyses, Project Concepts

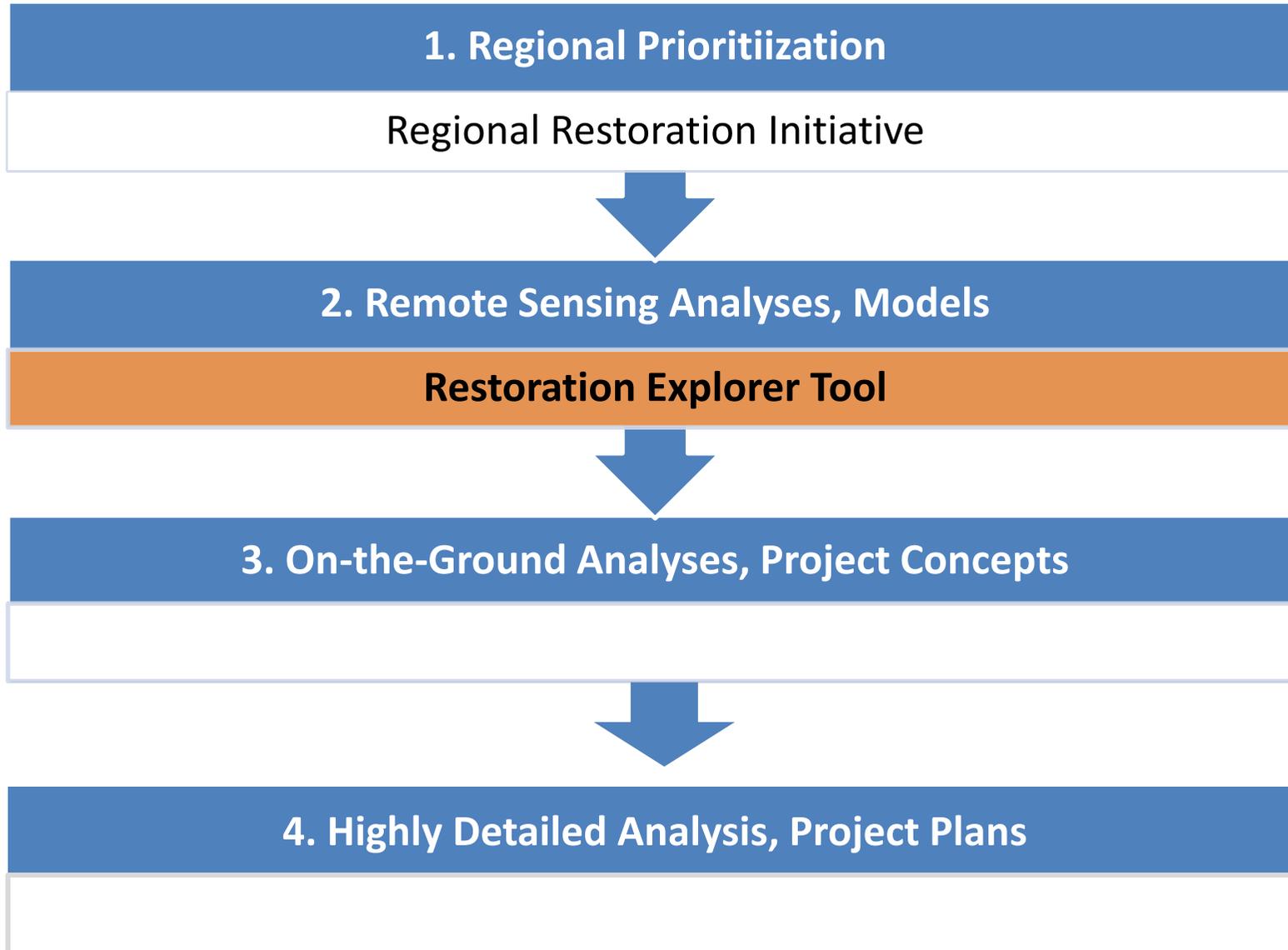


4. Highly Detailed Analysis, Project Plans





Hierarchical Analysis



Restoration Explorer Tool

COASTAL RESILIENCE

NEW JERSEY

GET STARTED

TOUR

GO TO ▾

The Nature Conservancy

The screenshot displays the Restoration Explorer tool interface. On the left is a sidebar with navigation options: 'Map Layers', 'Flood & Sea Level Rise', 'Restoration Explorer' (highlighted), and 'Split View'. The main map area shows a coastal region with various colored overlays representing different restoration techniques. A central panel titled 'Restoration Explorer' is open, showing configuration options for 'Atlantic County' and 'Ventnor City'. A callout box over the map states: 'Ventnor City has 15.4 miles of shoreline. Zoom in to see which shoreline enhancement techniques apply here.'

Restoration Explorer

Atlantic County ▾

Ventnor City ▾

[View Municipal Summary](#)

- Select the shoreline type**
 - Tidal Marsh
 - Forested, Beach or Bulkhead
- Select a disturbance process**
 - Shoreline edge erosion
- 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

Restoration Explorer Tool

Option: View Details on Specific Tactics

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?

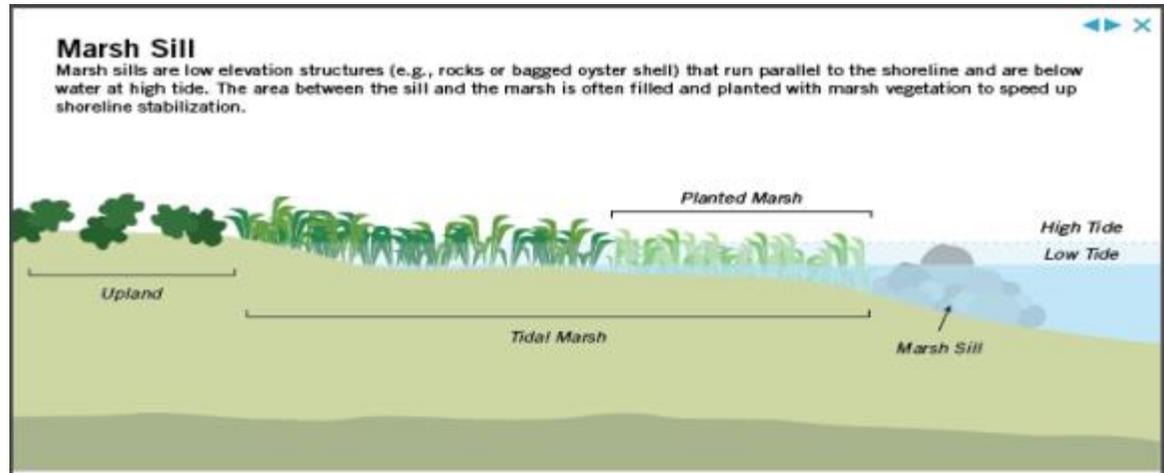
- Show All Techniques in One Map
- Show Information on Individual Techniques

4. Select shoreline enhancement technique

- Nature-Based Living Shoreline
- Living Reef Breakwater
- Marsh Sill
- Breakwater
- Ecologically Enhanced Revetment

View more information on key environmental conditions: 

- Marsh Sill
 - Erosion Shoreline Change
 - Tidal Range
 - Wave Height
 - Ice Cover
 - Shoreline Slope
 - Nearshore Slope



How each restoration technique meets the Erosion Shoreline Change parameter 

Environmental parameter criteria thresholds	Nature-Based Living Shoreline	Living Reef Breakwater	Marsh Sill	Ecologically Enhanced Revetment	Breakwater
Accretion	NA	NA	NA	NA	NA
0-2 ft/yr	Yes	Yes	Yes	NA	NA
2-4 ft/yr	Yes	Yes	Yes	Yes	Yes
4-6 ft/yr	No	No	No	Yes	Yes
>6 ft/yr	No	No	No	Yes	Yes

Restoration Explorer Tool - Caveats

Restoration Explorer

Restoration Explorer

The Restoration Explorer recommends potential living shoreline techniques based on past and current conditions of the coastline. By promoting a series of ecologically friendly techniques to stabilize New Jersey's coastline, communities can reduce nuisance flooding and erosion, increase recreational opportunities, improve water quality, and maintain the coastline's natural aesthetics.

DISCLAIMER: Recommendations made by the Restoration Explorer are intended to be an initial list of possibilities. It is important to consult with ecologists and engineers to determine the specific design requirements for any proposed project, as well as with federal, state and local officials regarding permitting requirements, prior to engaging in design work. The Nature Conservancy makes no representation that potential projects will gain all required Federal, State or local approvals.

**Tool is
Only a
Starting
Point**



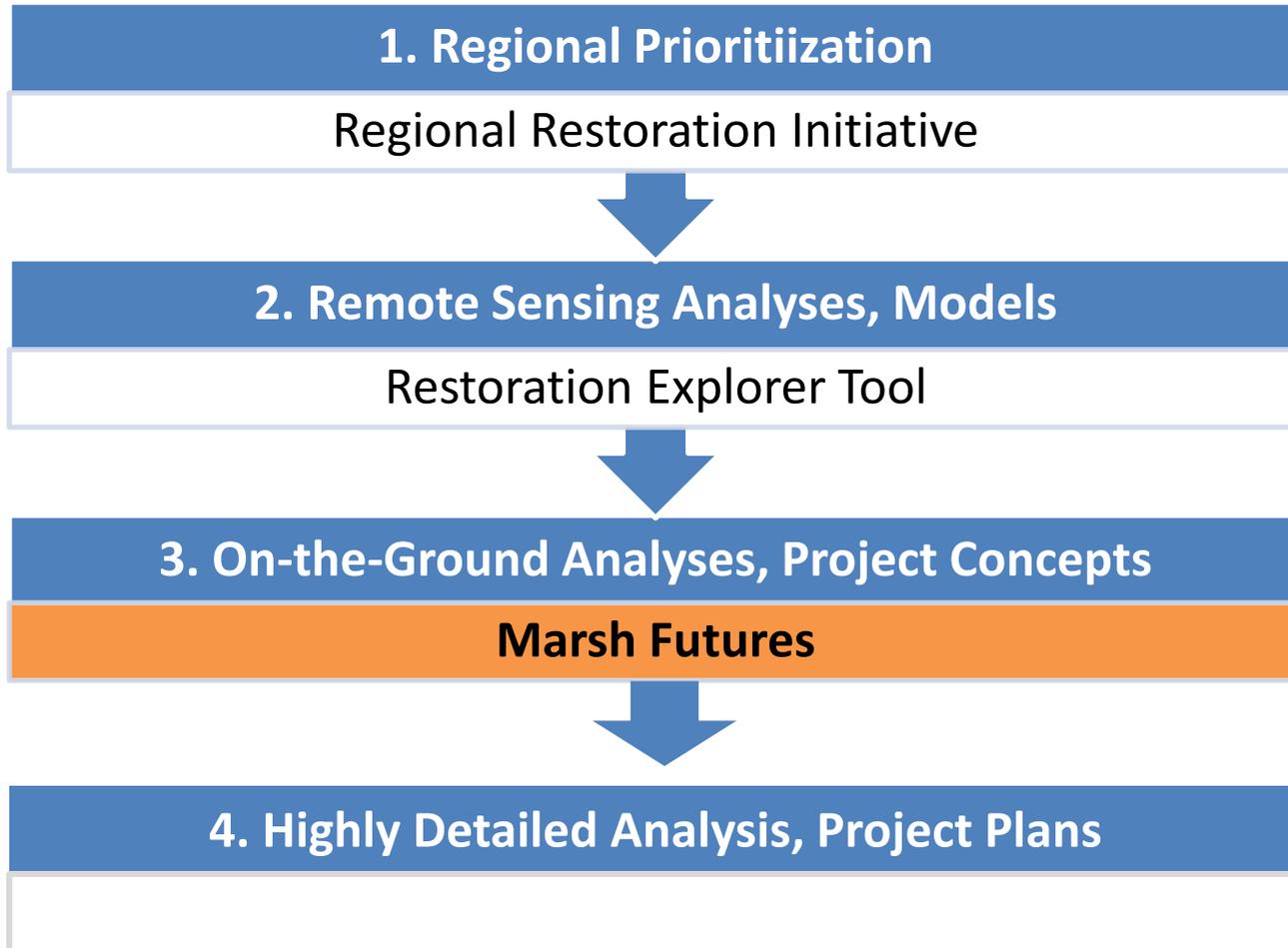
Don't Show This on Start

Continue





Hierarchical Analysis



Goal & Desired Outcome

Goal: Develop a field-based rapid assessment method to guide suitable projects that enhance salt marsh integrity

Outcomes:

- Refined Vulnerability Maps
 - reflect horizontal/vertical processes
- Project Guidance Maps
 - reflect temporal/spatial needs

Local Site
Planning

Verified
Conditions

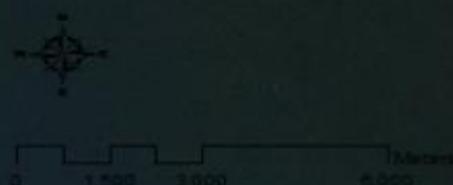
Approach

- 1. Focus on Marshes that People Care Most About**
e.g., areas that protect communities, roads
- 2. Analyze Desktop Data**
e.g., aerials, LIDAR
- 3. Refine Data with Rapid Field Assessments**
e.g., RTK, substrate & vegetation condition
- 4. Map Vulnerability to Erosion & Drowning**
- 5. Map Recommended BMP Tactics**

1. Select Marshes of Interest

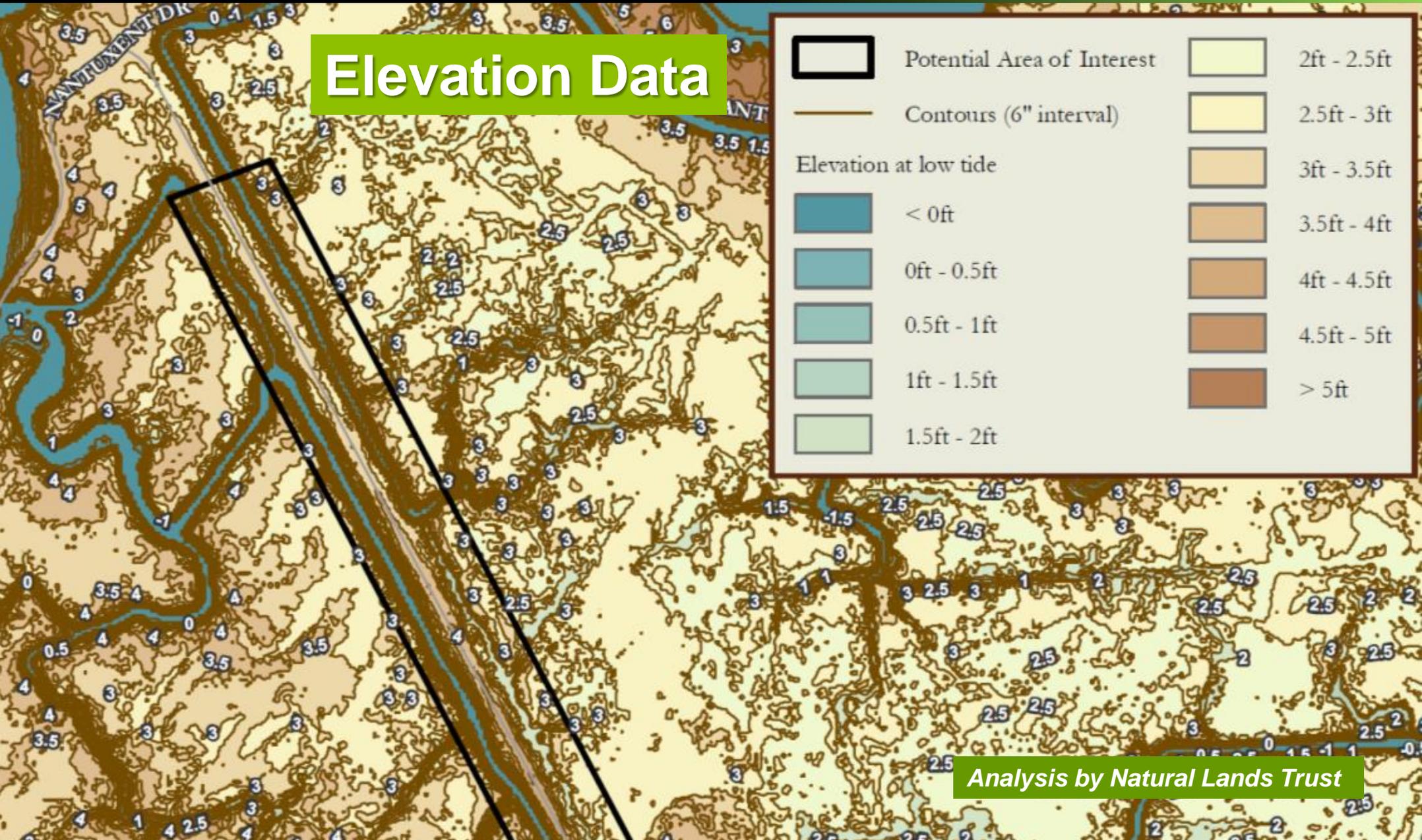


BaySIPP Areas of Interest

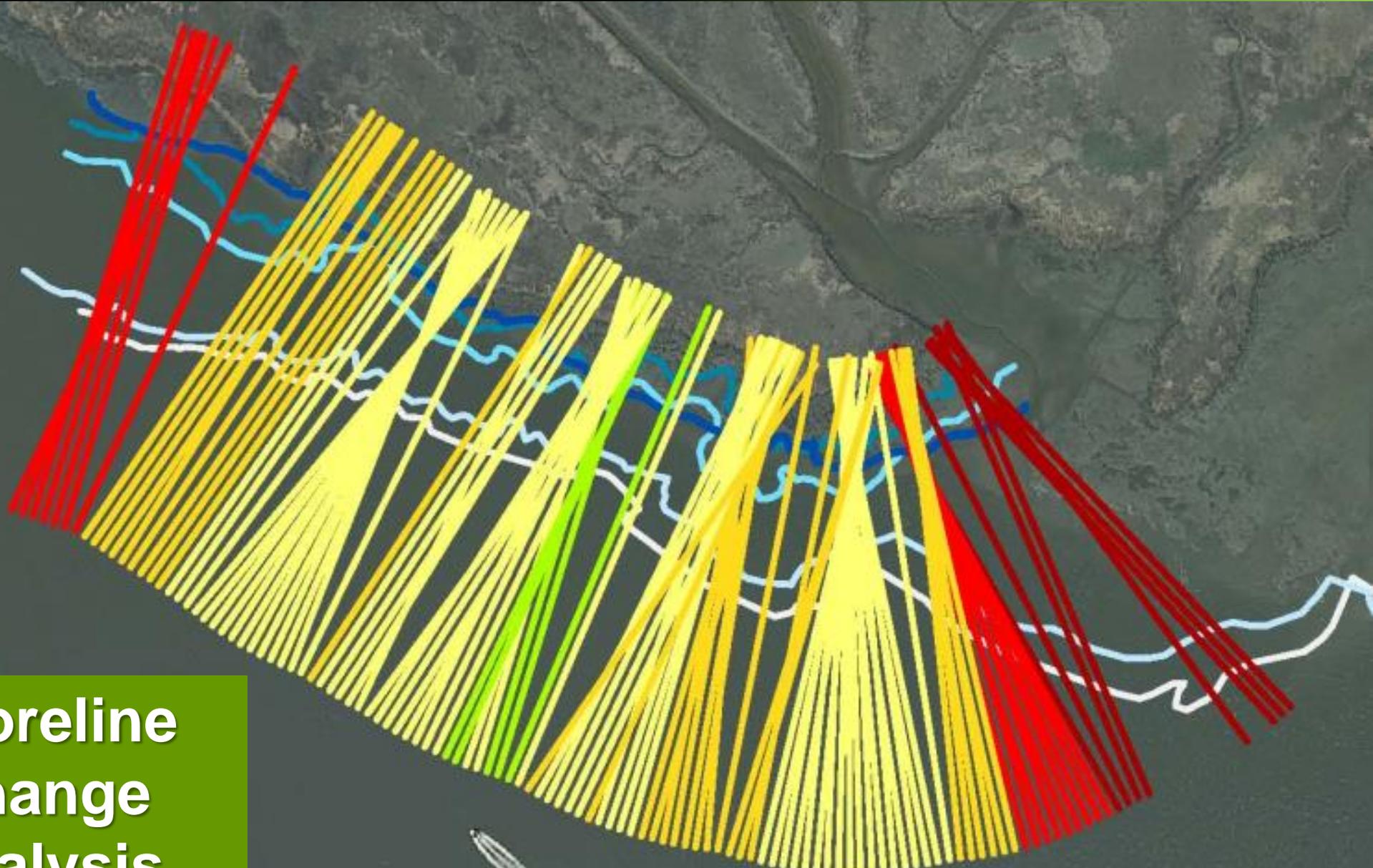


2. Desktop Analyses

Elevation Data



2. Desktop Analyses

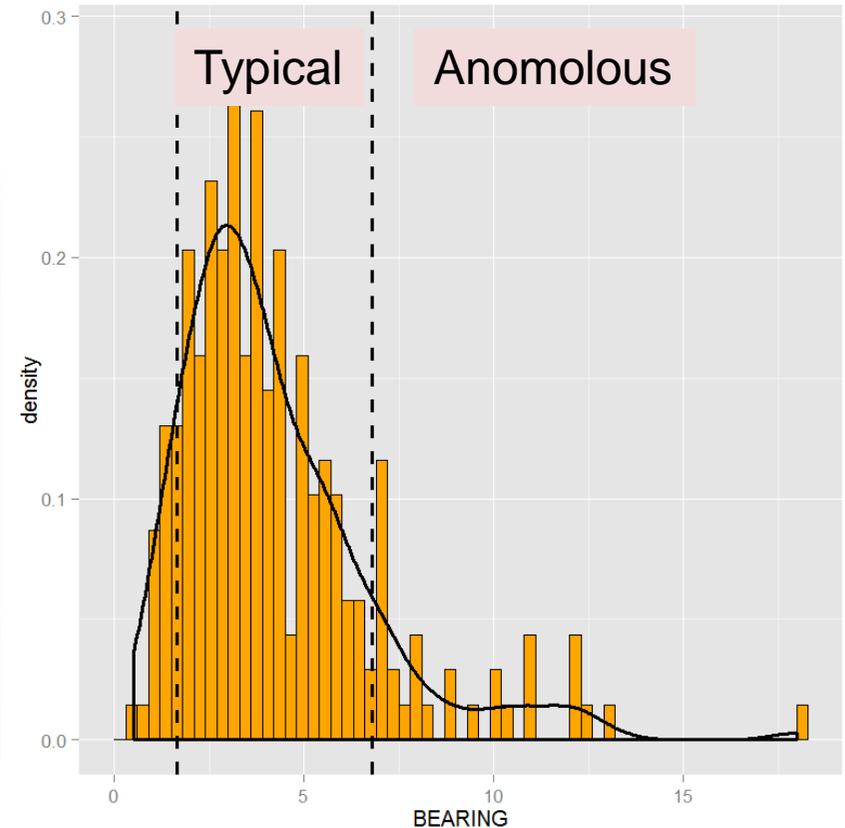


**Shoreline
Change
Analysis**

3. Rapid Field Assessments

Physical – elevation, slope, erosion, substrate firmness

Biological – blade height, light penetration



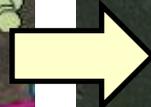
see poster by Josh Moody

4. Vulnerability Mapping

Use anomalies as weights to adjust elevation scores

Elevation Capital Mapping

Weighted measures are unitless

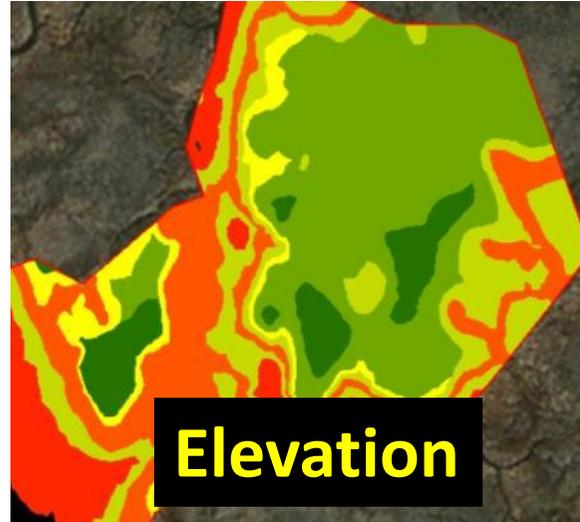


see poster by Josh Moody



4. Vulnerability Mapping

Drowning Risk



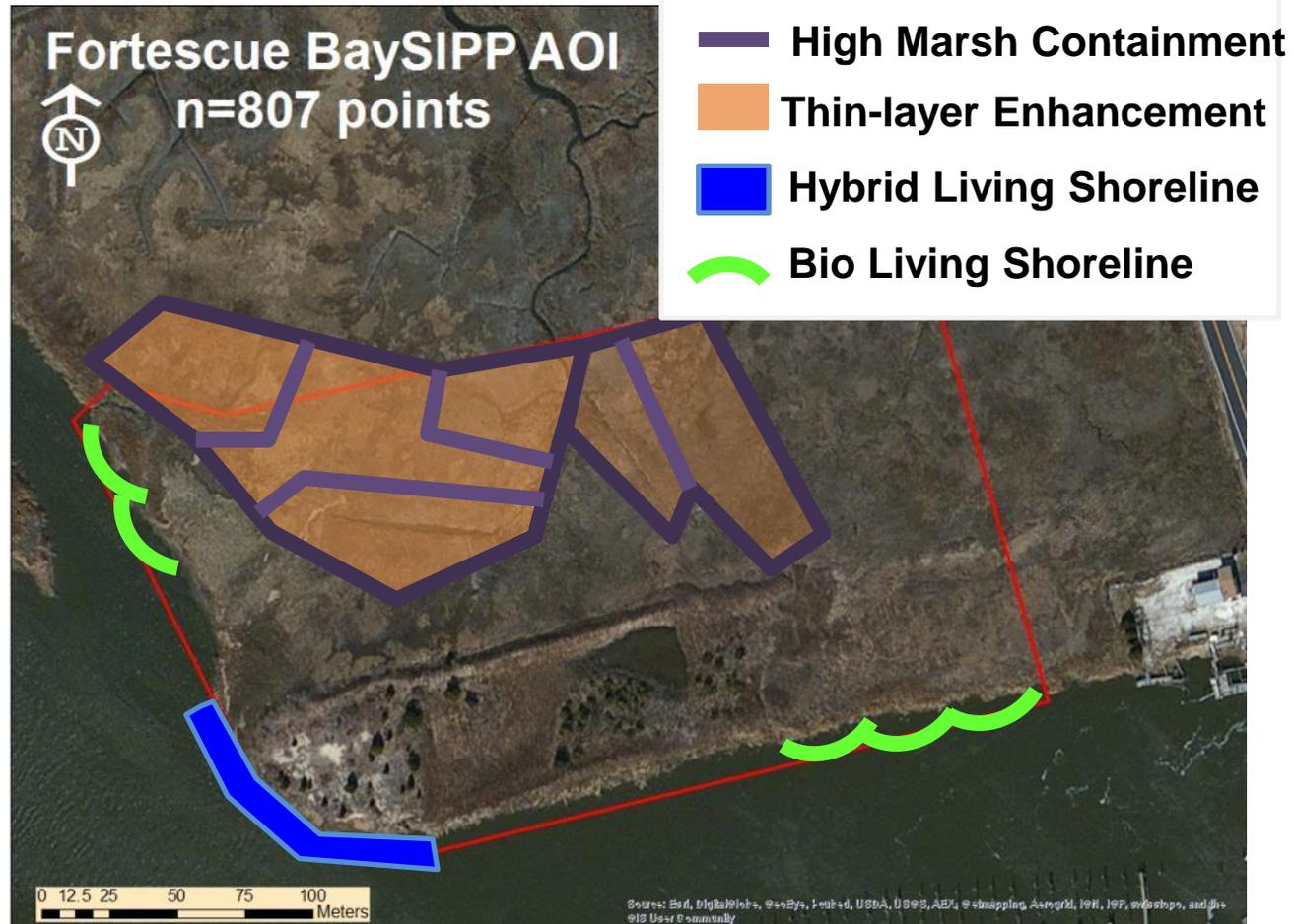
Erosion Risk



5. Project Guidance Mapping

Where will various investments yield greatest outcomes?

What should be the sequence of interventions?



Results – Vulnerability Maps

Edge Erosion Risk

Maurice >> Fortescue > Money Island

Interior Drowning Risk

Fortescue > Money Island > Maurice

Hydrological Impairment

Money Island > Fortescue > Maurice

Results – BMP Maps

Maurice:

Living Shorelines (aggressive mix needed)

Fortescue

Thin Layer Sediment (in low spots)

High Marsh Containment

Living Shorelines (to maintain)

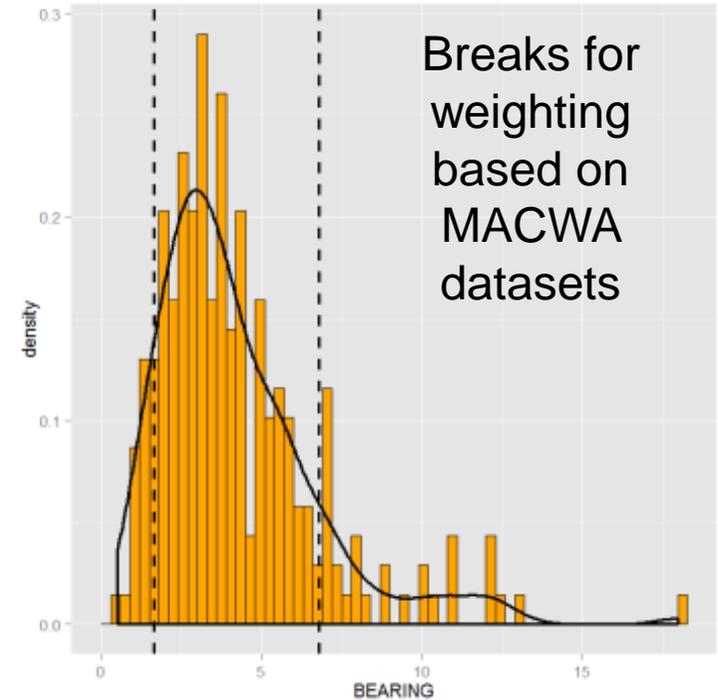
Money Island

Hydrological Connectivity? (more study needed)

High Marsh Containment

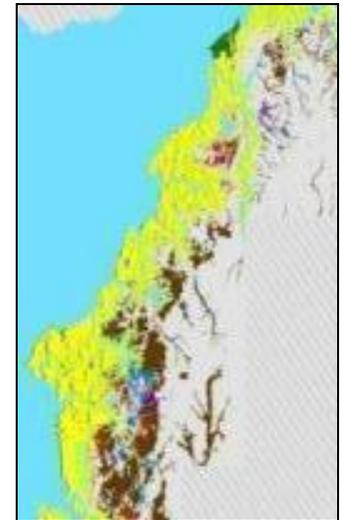
Next Steps

- **Refine Metrics for Elevation Capital Maps with new 2015 Data**
- **Streamline Field Effort to Expand to Larger Areas**
- **Test in More Places with Varying Conditions**
- **Marsh Futures 2.0 Report**



Conclusions

- Coastal wetlands are vital for coastal resilience in the Delaware Estuary and vicinity
- They are in decline and increasingly vulnerable
- Strategic planning for projects is needed due to limited resources
- Marsh Futures is a rapid, science-based method to assess local site conditions for project planning
- Marsh Futures outputs can also provide baseline data to help design projects



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Spencer Roberts
Ryan Kelleher



[For More Info](#)

PDE Report No. 15-03. Marsh Futures: use of scientific survey tools to assess local salt marsh vulnerability and chart best management practices and interventions. <http://delawareestuary.org/sciencereports>



PDE Science Team