Geospatial Modeling & Suitability Analysis for Beneficial Use

AN INTEGRATED APPROACH

WEDA 2019 | Chicago, IL

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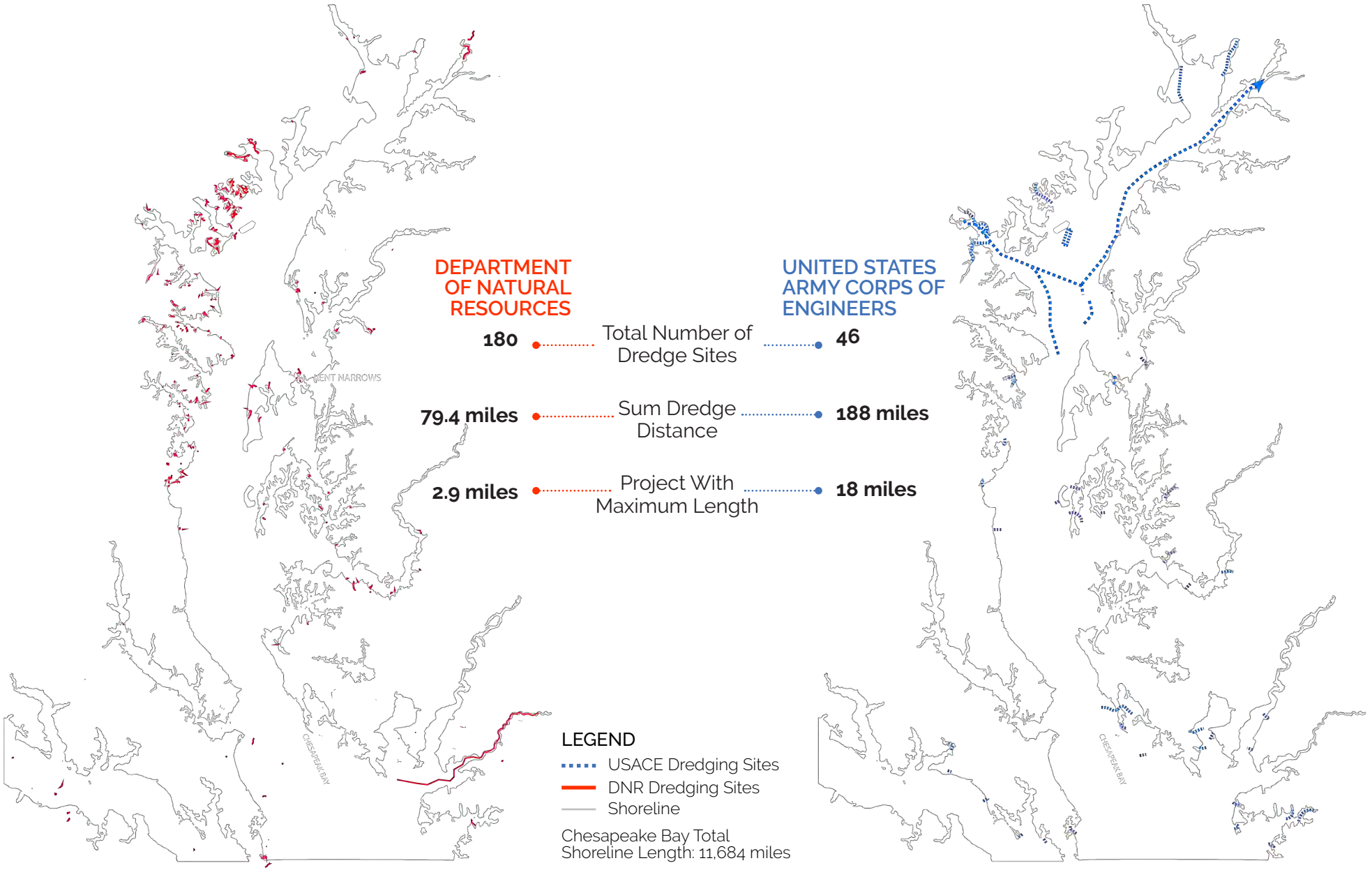
MARYLAND
DEPARTMENT OF
NATURAL RESOURCES


NOAA
NATIONAL OCEANIC AND ATMOSPHERIC ADMINISTRATION
U.S. DEPARTMENT OF COMMERCE



CHESAPEAKE BAY DREDGING

| In the Maryland waters of the Bay, the US Army Corp of Engineers (USACE) and the Maryland Department of Natural Resources (DNR) oversee dredging operations. DNR is responsible for small scale dredging operations that are geographically distributed and typically underfunded.

FOCUS AREAS

DNR identified two focus areas for the beneficial use suitability mode based on the frequency of channel dredging, volume of dredged sediment, cost of dredging, and commercial and recreational impacts associated with shoaling in each of the areas.

Department of Natural Resources Dredge Channel

- Authorized Depth (ft): **7**
- Authorized Width (ft): **75**
- Last Dredged: **2007**
- Approx. Dredging Frequency (years): **5**
- Last Dredge Volume (cubic yards): **25,031**

Department of Natural Resources Dredge Channel

- Authorized Depth (ft): **14**
- Authorized Width (ft): **150**
- Last Dredged: **2013**
- Approx. Dredging Frequency (years): **4**
- Last Dredge Volume (cubic yards): **124,687**

KENT NARROWS

Kent Narrows is a waterway used by recreational and commercial vessels to travel from the Chester River to the Eastern Bay. DNR has previously implemented beneficial use projects at the Chesapeake Bay Environmental Center and Ferry Point Park.

LOWER WICOMICO RIVER

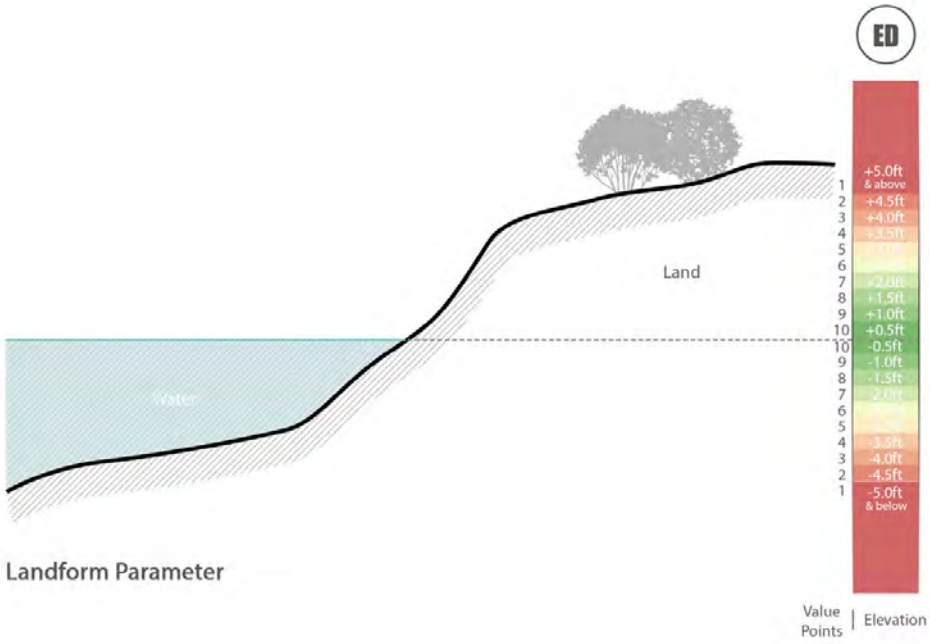
The Lower Wicomico River is a navigation channel that leads to the Port of Salisbury on the Eastern Shore. DNR has previously implemented a beneficial use project at the Ellis Bay Wildlife Management Area.

SUITABILITY MODEL PARAMETERS

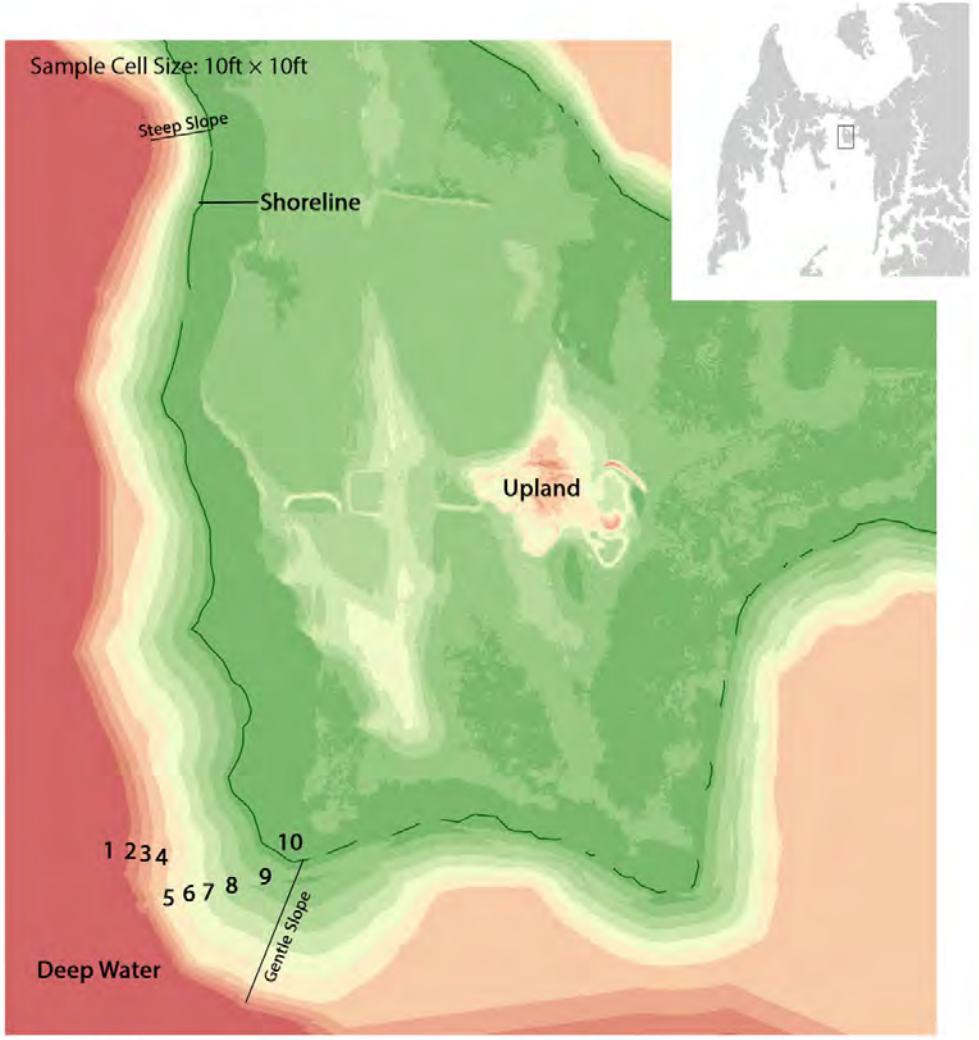
The suitability model uses a multi-parameter framework to identify and prioritize locations for beneficial use of sediment. The model output for Kent Narrows highlights the different ways each individual parameter influences the composite analysis.

LANDFORM PARAMETER

Purpose: Outline the most valuable area for dredge placement by identifying shallow area within five-foot range of elevation from the sea level



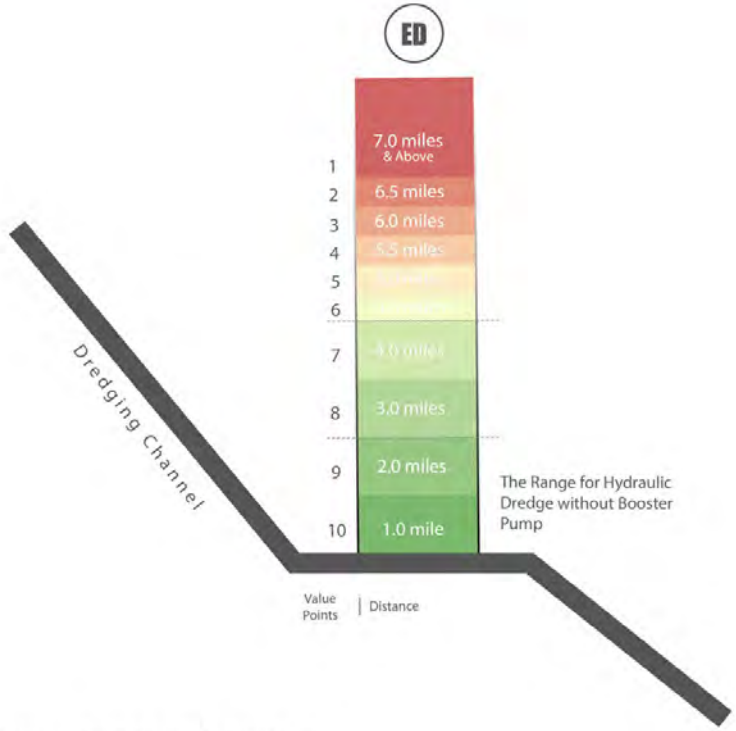
Landform Parameter



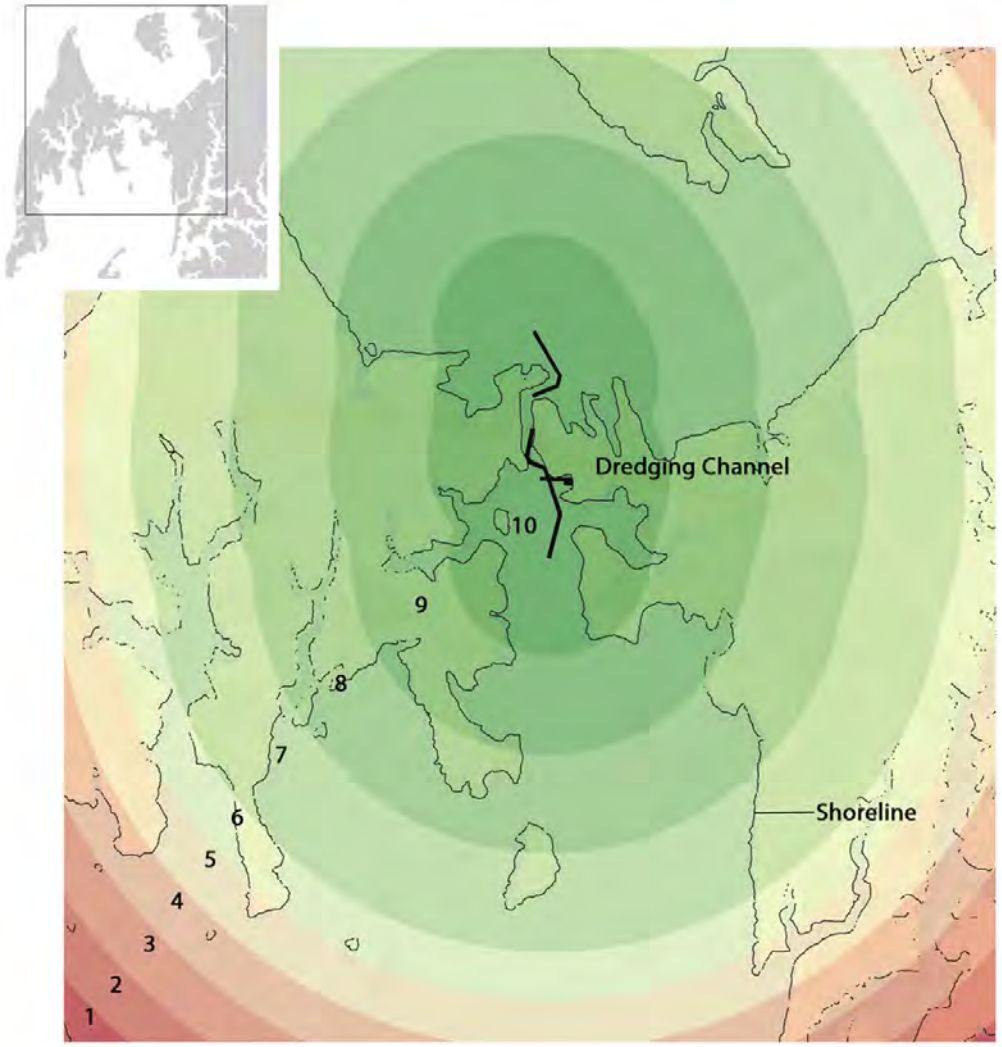
Map Illustration

DREDGE PROXIMITY PARAMETER

Purpose: Rank the suitable area based on the distance from dredging channel to potential placement sites



Dredge Proximity Parameter



Map Illustration

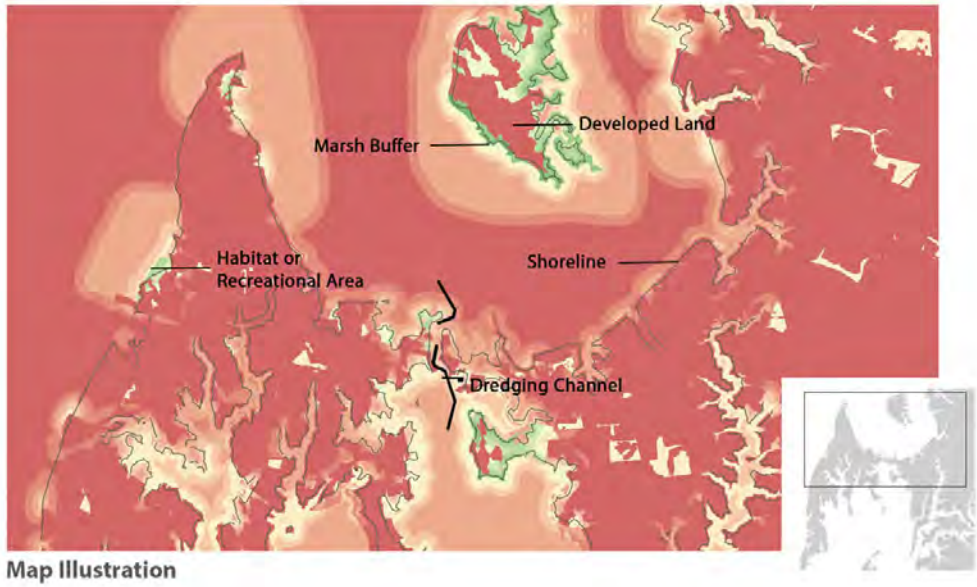
BENEFICIAL USE PARAMETER

Purpose: Rank the suitable area for beneficial end use
by integrating land cover, habitat and recreational use data

Beneficial Use Parameter

- Protected Land Potential Value — WO 40%
  - Protected Federal Lands — MO
  - DNR Owned Properties and Conservation Easement — MO
  - Local Protected Lands — MO
  - Private Conservation Lands — MO
- Land Cover Potential Value — WO 30%
  - Marsh Buffer — WO 70%
  - Beach Buffer — WO 30%
- Habitat Potential Value — WO 20%
  - Terrapin Habitat — MO
  - Horseshoe Crab Habitat — MO
  - Spot Weakfish Croaker Juvenile Habitat — MO
  - Waterfowl Habitat — MO
  - Herring Juvenile Habitat — MO
  - White Perch Juvenile Habitat — MO
- Waterfront Recreational Potential Value — WO 10%
  - Boat dock & Boat ramp — MO
  - Public Park & Conservation Area — MO
- Developed Land Subtraction — −
- Oyster Sanctuaries Subtraction — −
- Submerged Aquatic Vegetation Subtraction — −

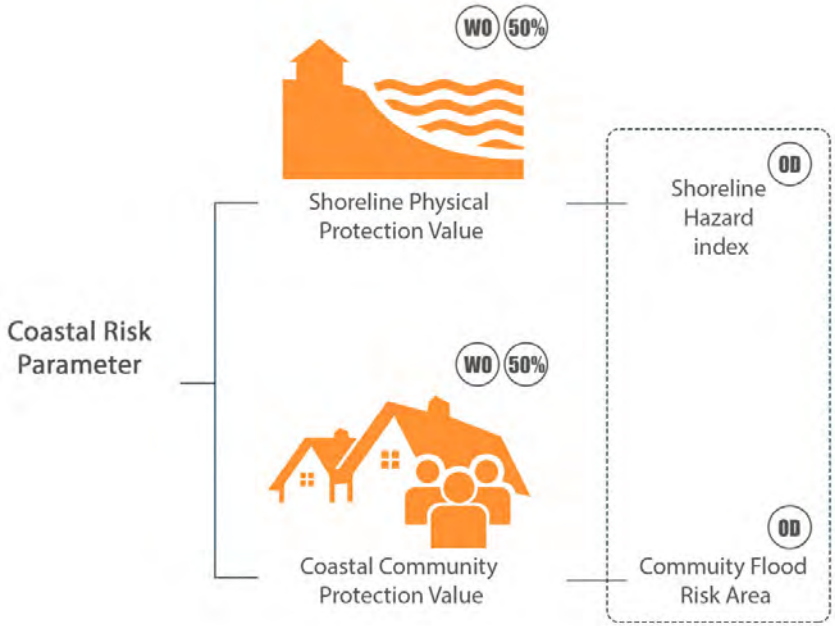
Ranking the Buffer Zone (Excluding Protected Land Potential Value)

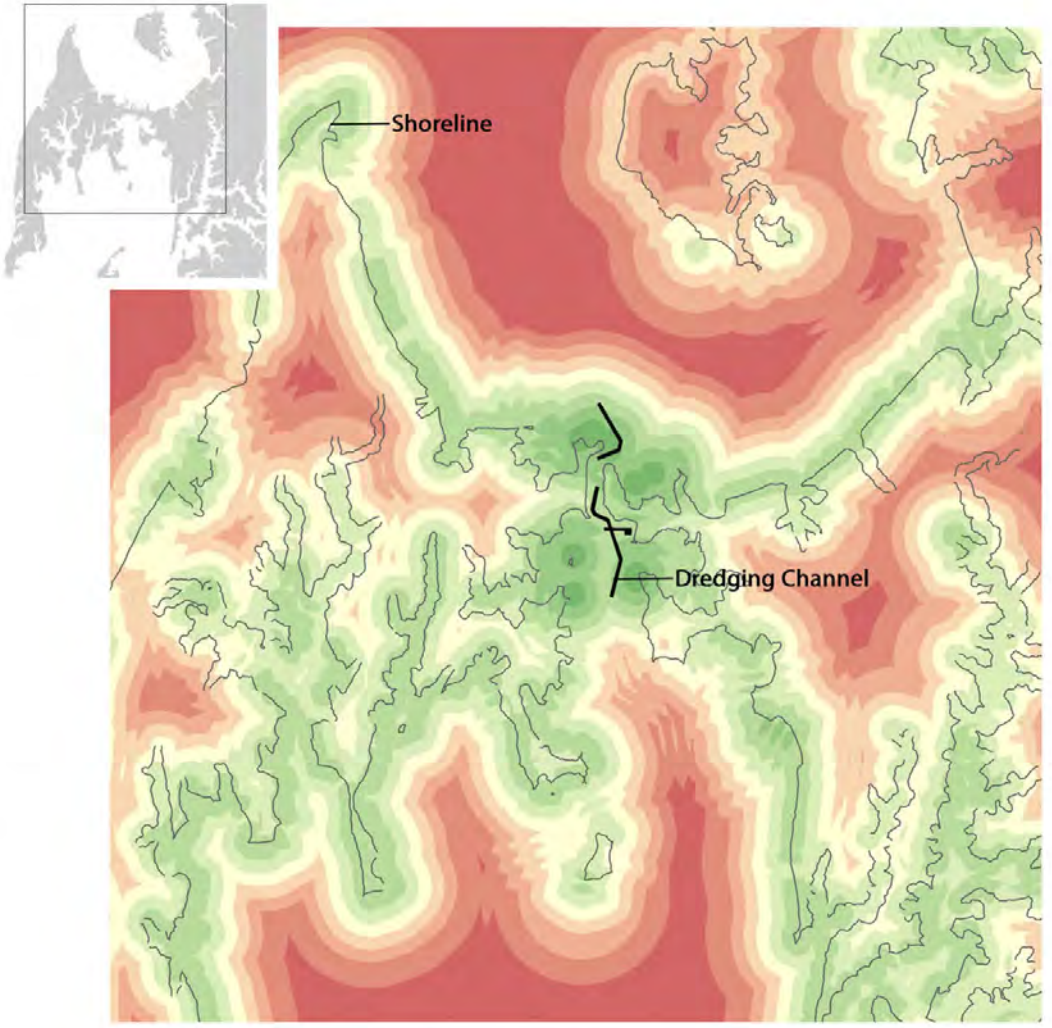


Map Illustration

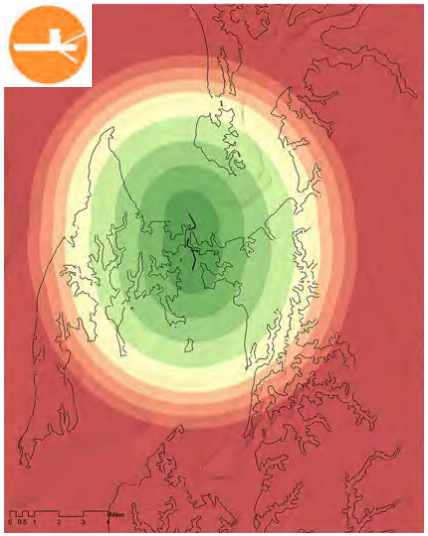
COASTAL RISK PARAMETER

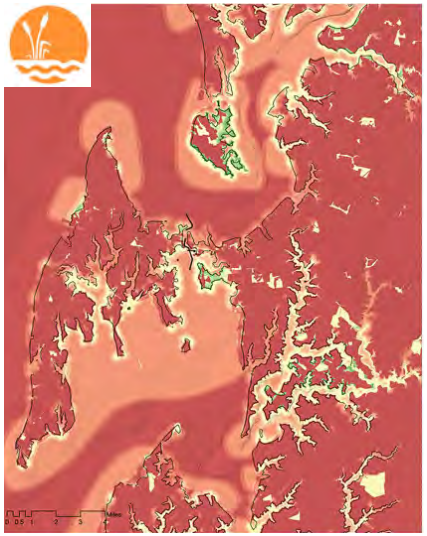
Purpose: Rank the suitable area where shorelines are necessary to be protected by placing dredging materials in responding to coastal hazards





Map Illustration





KENT NARROWS Suitability Map Outputs

1 2 3 4 5 6 7 8 9 10

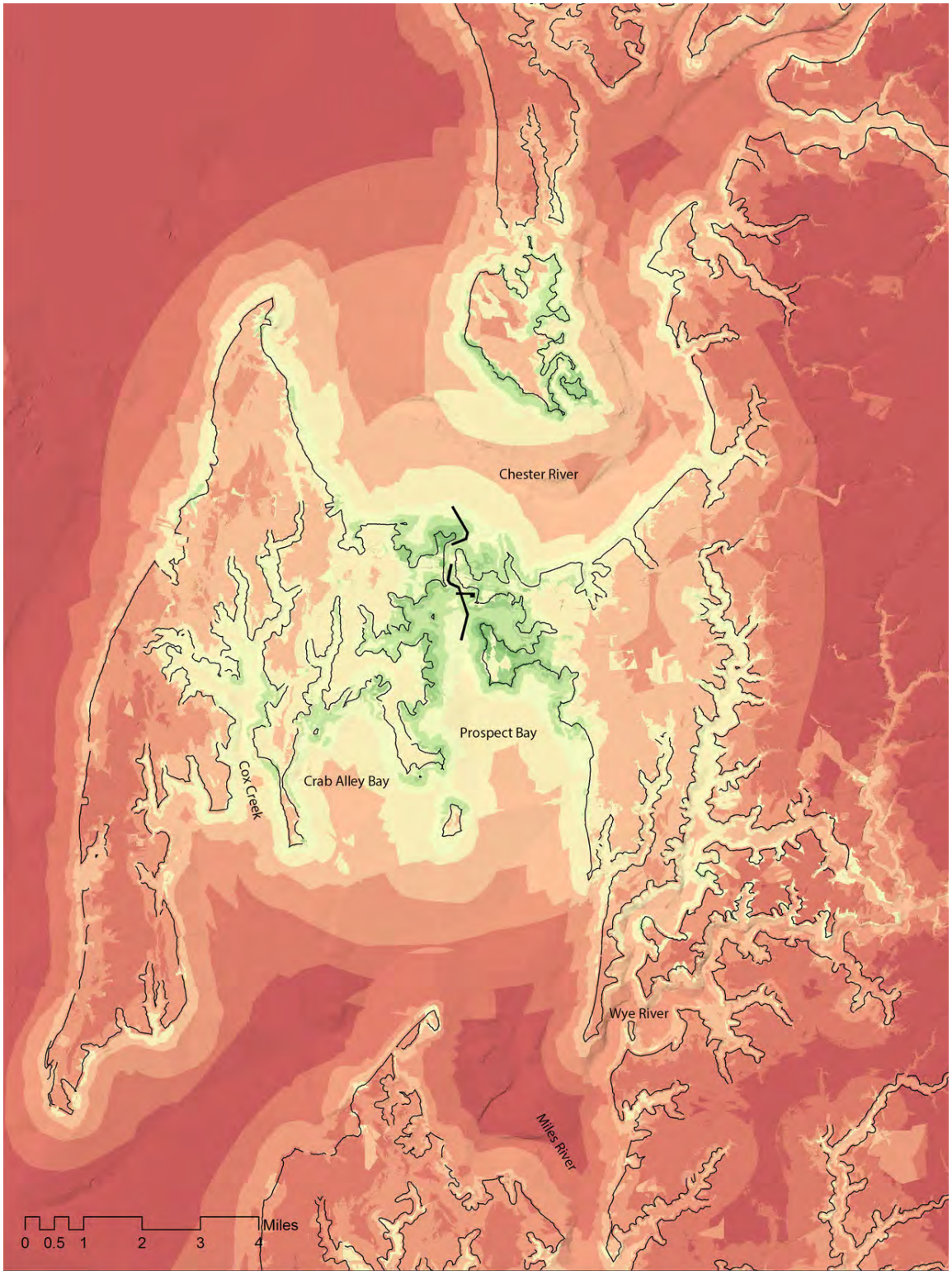
Low Suitability High Suitability

KENT NARROWS SUITABILITY MODEL

The Kent Narrows suitability output uses an aggregate weight of Landform 10%, Dredge Proximity 35%, Beneficial Use 35%, and Coastal Risk 20%. High suitability sites are shown in dark green while low suitability sites are shown in dark red.

1 2 3 4 5 6 7 8 9 10

Low Suitability High Suitability



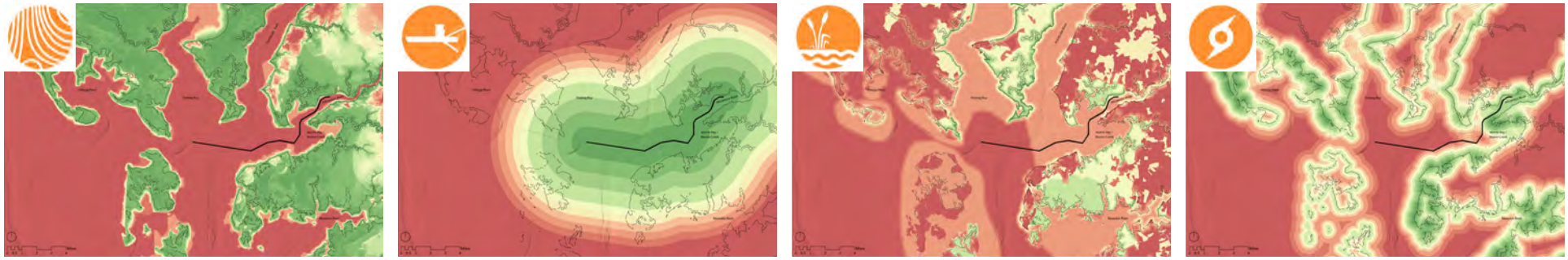
INTEGRATED MAP

Landform **10%**

Dredge Proximity **35%**

Beneficial Use **35%**

Coastal Risk **20%**



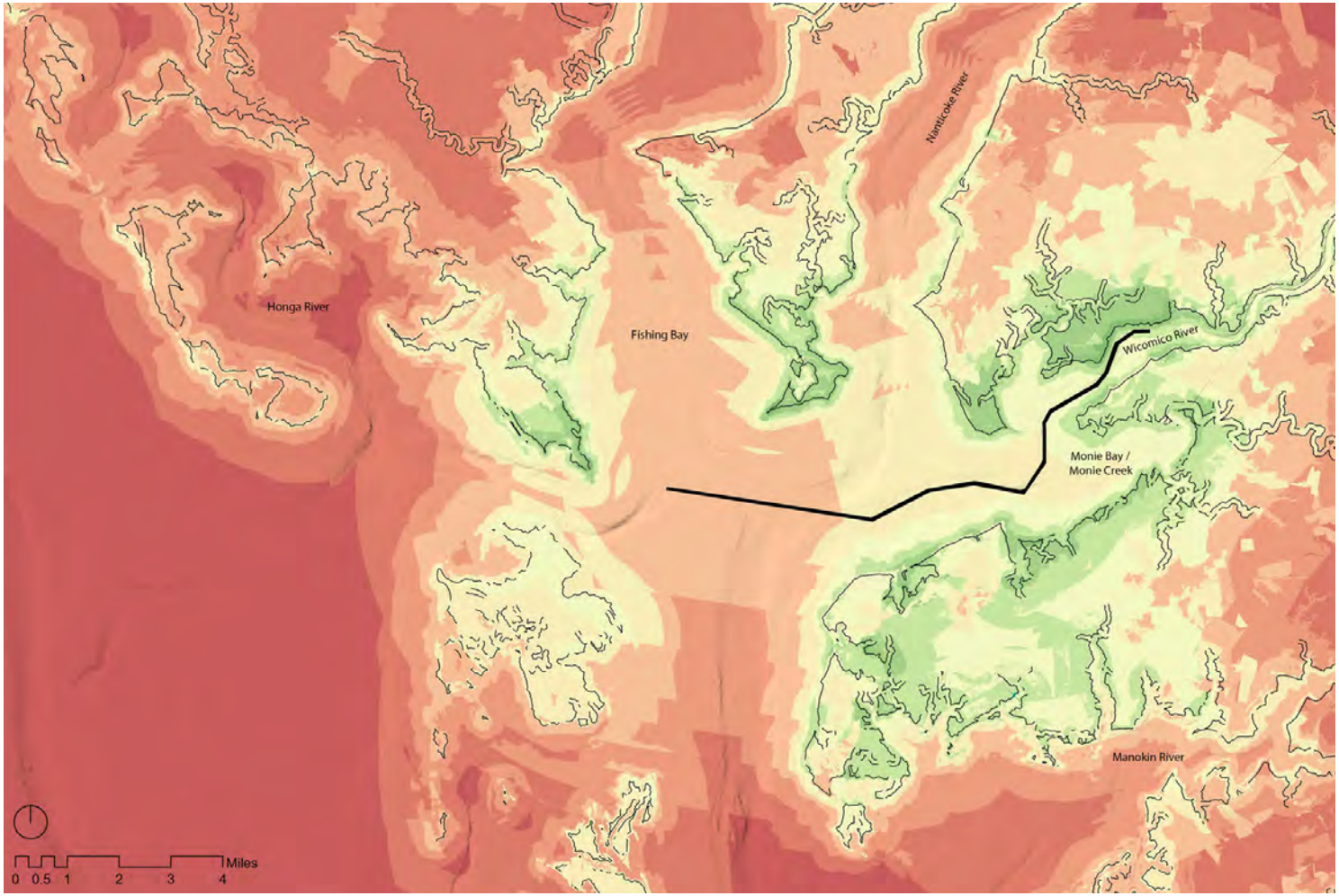
LOWER WICOMICO RIVER Suitability Map Outputs

1 2 3 4 5 6 7 8 9 10

Low Suitability — High Suitability

LOWER WICIMICO RIVER SUITABILITY MODEL

The Lower Wicomico River suitability output uses an aggregate weight of Landform 10%, Dredge Proximity 35%, Beneficial Use 35%, and Coastal Risk 20%. High suitability sites are shown in dark green while low suitability sites are shown in dark red.



1 2 3 4 5 6 7 8 9 10

Low Suitability High Suitability

INTEGRATED MAP

Landform **10%**

Dredge Proximity **35%**

Beneficial Use **35%**

Coastal Risk **20%**

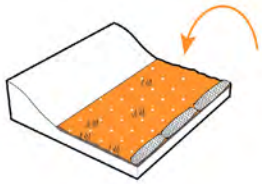
PRECEDENT PROJECTS

To support implementation of the beneficial use design strategies, the team researched successful regional and international precedents. These examples of beneficial use highlight the value of sediment in habitat restoration and coastal resiliency applications.

Beach Nourishment/Feeder Berm

Sand Engine (South Holland, Netherlands)

South Hayling Island Beach (Hampshire, England)



Thin Layer Placement

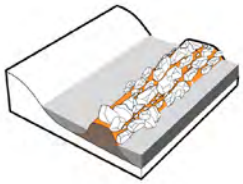
Blackwater National Wildlife Refuge (Maryland, USA)

Blackwater National Wildlife Refuge (Maryland, USA)

Artificial Reef/Oyster Reef

West Bay (Texas, USA)

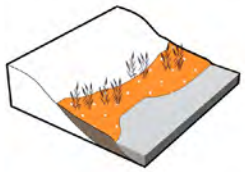
Malcolm Road Beach (Providenciales, Turks & Caicaos Islands)



Living Breakwater

West Bay (Texas, USA)

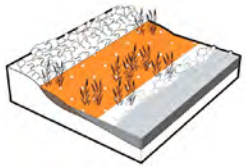
Port of Beirut (Beirut, Lebanon)



Living Shoreline

Eastern Neck (Maryland, USA)

Deadman's Island (Florida, USA)



Structural/Hybrid Living Shoreline/Marsh Sill

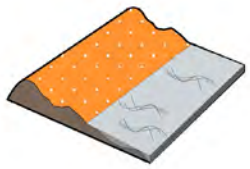
Jefferson Patterson Park & Museum (Maryland, USA)

Pine Knoll Shores (North Carolina, USA)

Coastal/Tidal/Non-tidal Wetland/Wetland Buffer

Poplar Island (Maryland, USA)

Blackwater National Wildlife Refuge (Maryland, USA)



Dunes & Eelgrass

PEI National Park (Prince Edward Island, Canada)

Beach of Annoville (Manche, France)

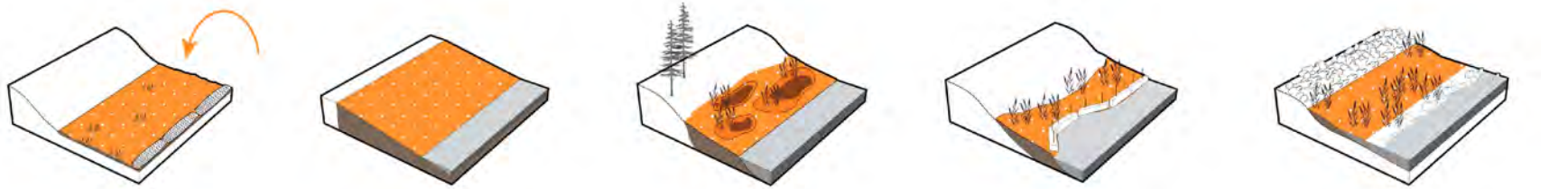
DESIGN STRATEGIES

Beneficial use design strategies offer an opportunity to leverage sediment as a resource in restoration and resiliency efforts. Strategies are categorized according to common landscape types found in the Chesapeake Bay and along a continuum from natural/nature-based to structural.

NATURAL/NATURE-BASED — **STRUCTURAL**

Soil | Soil | Rock & Natural Biodegradable Log, etc. | Dolos

MARSH

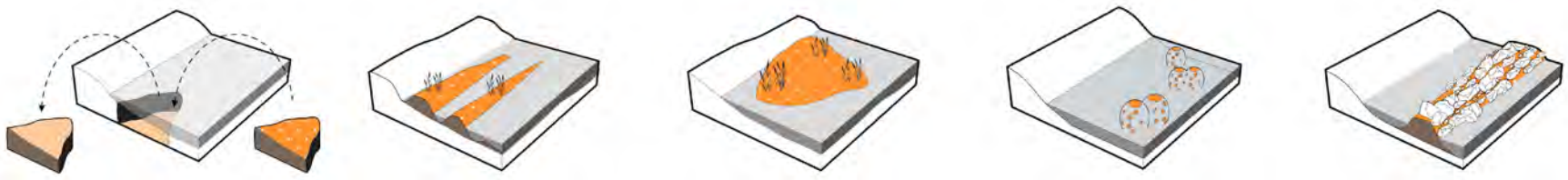


Thin Layer Placement | Horizontal Levee | Wetland Buffer | Living Shoreline | Structural Living Shoreline/Marsh Sill

BEACH

Beach Nourishment/Feeder Berm | Dune with Vegetation | Dune with Fence | Geotube Barrier | Dredge Fill Dike

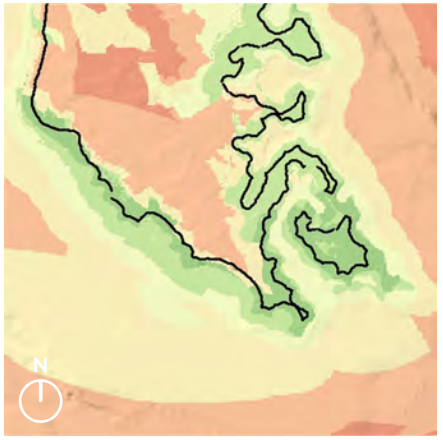
OPEN WATER



Confined Aquatic Disposal (CAD) | Soft Sea Wall Defense | Island Restoration | Artificial Reef Structure | Living Breakwater

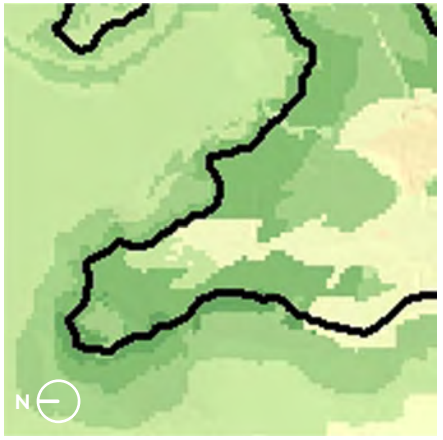
HIGH SUITABILITY SITES

The team identified three high suitability sites for beneficial use within each focus area. The Kent Narrows sites include Eastern Neck North, Chesapeake Bay Environmental Center, and Crab Alley Neck North.



Balanced

Landform 10%
Dredge Proximity 35%
Beneficial Use 35%
Coastal Risk 20%



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Landform 10%
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Beneficial Use 35%
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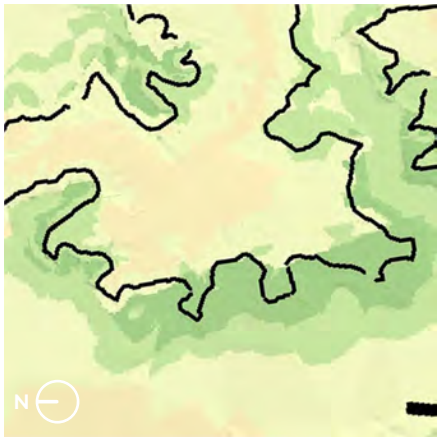


Balanced

Landform 10%
Dredge Proximity 35%
Beneficial Use 35%
Coastal Risk 20%

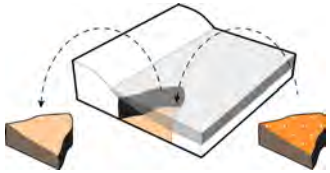
DESIGN STRATEGIES AT EASTERN NECK NORTH

Utilizing insight from both the quantitative and qualitative analysis of the Eastern Neck North site, the team identified potential beneficial use design strategies for each of the site's landscape typologies including beach, marsh, and open water strategies.

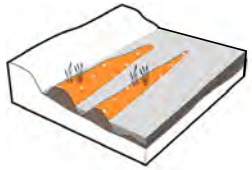
BEACH STRATEGY

Beach Nourishment

OPEN WATER STRATEGY

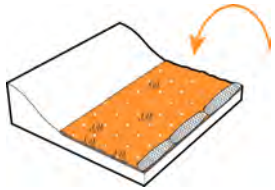


Confined Aquatic Disposal (CAD) and/or

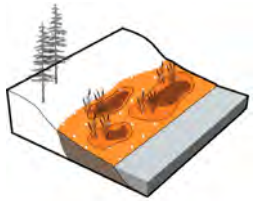


Soft Sea Wall Defense

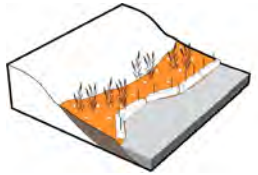
MARSH STRATEGIES



Thin Layer Placement and/or



Wetland Buffer and/or



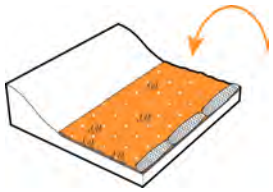
Living Shoreline

Areas with the Highest Suitability Value

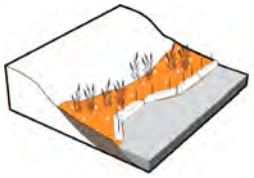
DESIGN STRATEGIES AT CHESAPEAKE BAY ENVIRONMENTAL CENTER

Utilizing insight from both the quantitative and qualitative analysis of the Chesapeake Bay Environmental Center site, the team identified potential beneficial use design strategies for each of the site's landscape typologies including beach, marsh, and open water strategies.

MARSH STRATEGIES

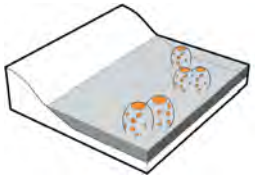


Thin Layer Placement and/or

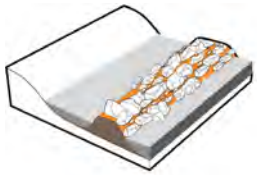


Living Shoreline

OPEN WATER STRATEGY



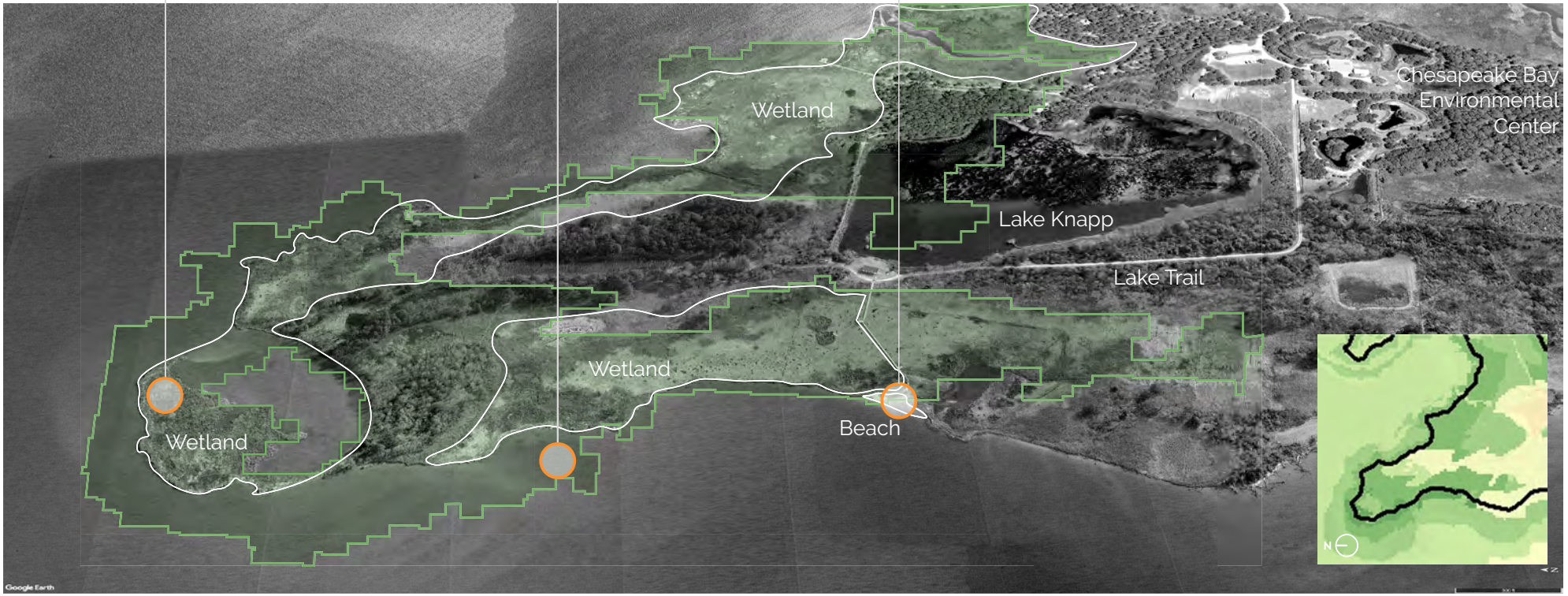
Artificial Reef Structure and/or



Living Breakwater

BEACH STRATEGY

Beach Nourishment/Feeder Berm

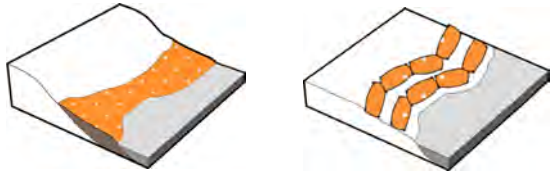


Areas with the Highest Suitability Value

BENEFICIAL USE STRATEGIES AT CRAB ALLEY NECK NORTH

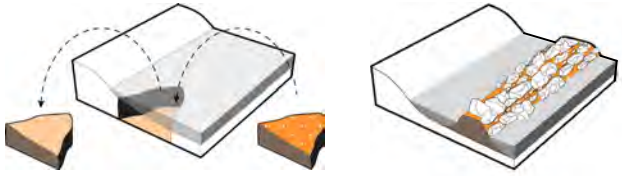
Utilizing insight from both the quantitative and qualitative analysis of the Crab Alley Neck North site, the team identified potential beneficial use design strategies for each of the site's landscape typologies including beach, marsh, and open water strategies.

BEACH STRATEGIES



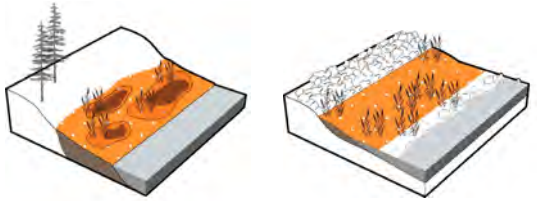
Beach Nourishment/Feeder Berm and/or Geotube Barrier

OPEN WATER STRATEGY

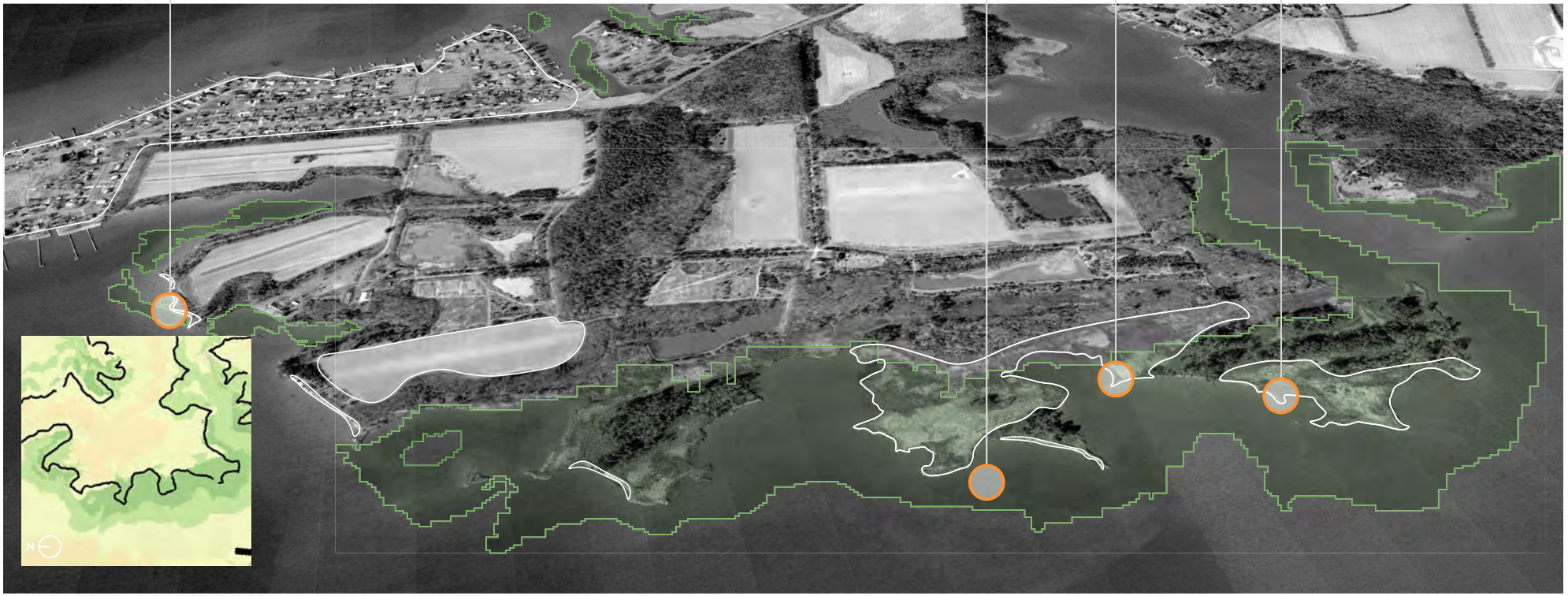


Confined Aquatic Disposal (CAD) and/or Living Breakwater

MARSH STRATEGIES



Wetland Buffer and/or Hybrid Living Shoreline/Marsh Sill



Areas with the Highest Suitability Value

THANK YOU

WEDA 2019 | Chicago, IL

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BENEFICIAL USE SUITABILITY MODEL METHODS

INDEX SYSTEM

Overall Suitability Index (1-10) = **Landform Suitability Parameter (1-10)** × Weight% + **Dredge Proximity Parameter (1-10)** × Weight% + **Beneficial Use Parameter (1-10)** × Weight% + **Coastal Risk Parameter (1-10)** × Weight%

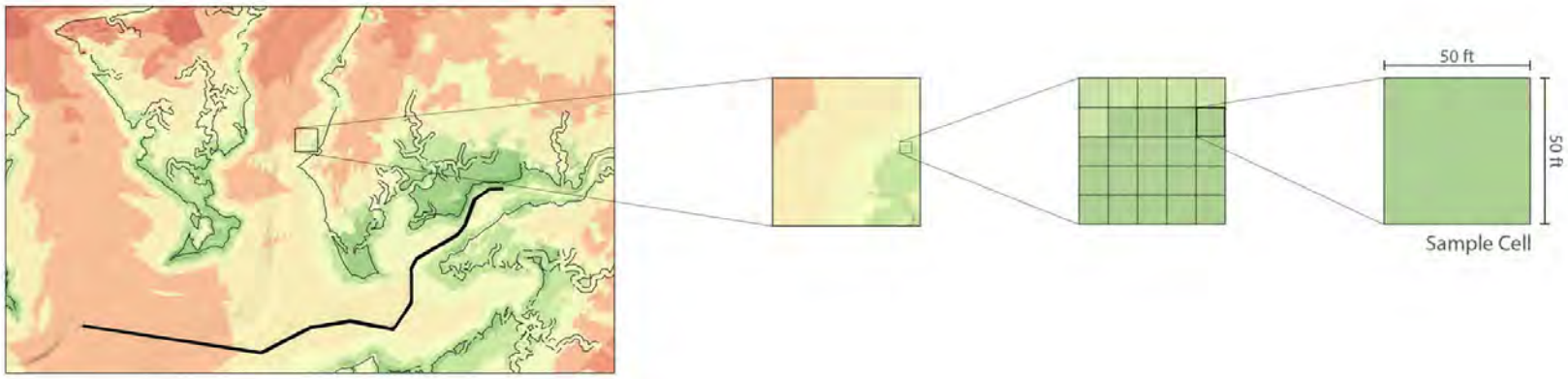
MAP VISUALIZATION

1 2 3 4 5 6 7 8 9 10

Low Suitability — High Suitability

SAMPLE CELL

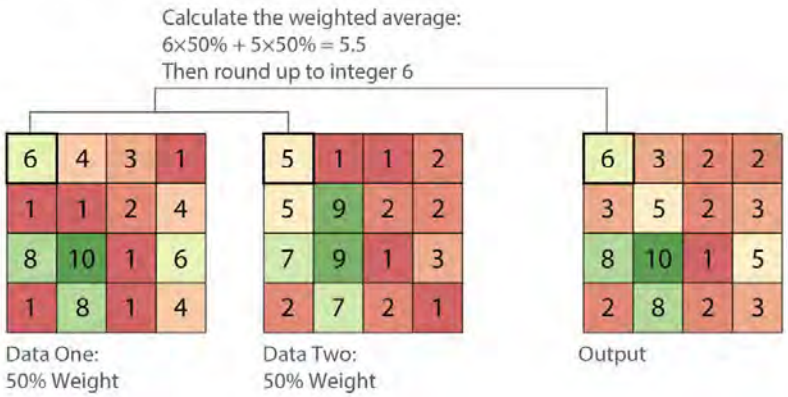
Map Sample Cell Size: 50ft × 50ft



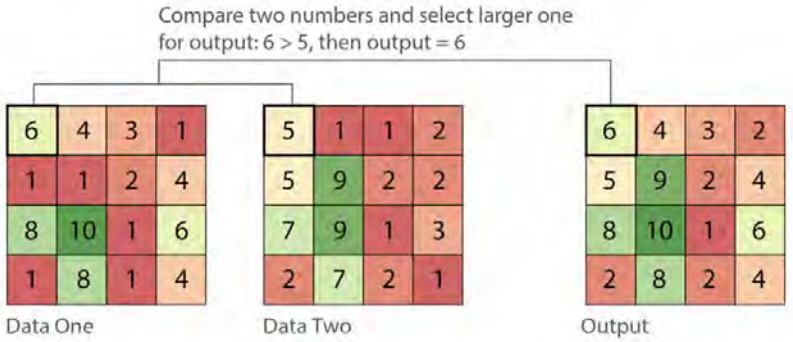
BENEFICIAL USE SUITABILITY MODEL METHODS

OVERLAY

WO Weighted Overlay



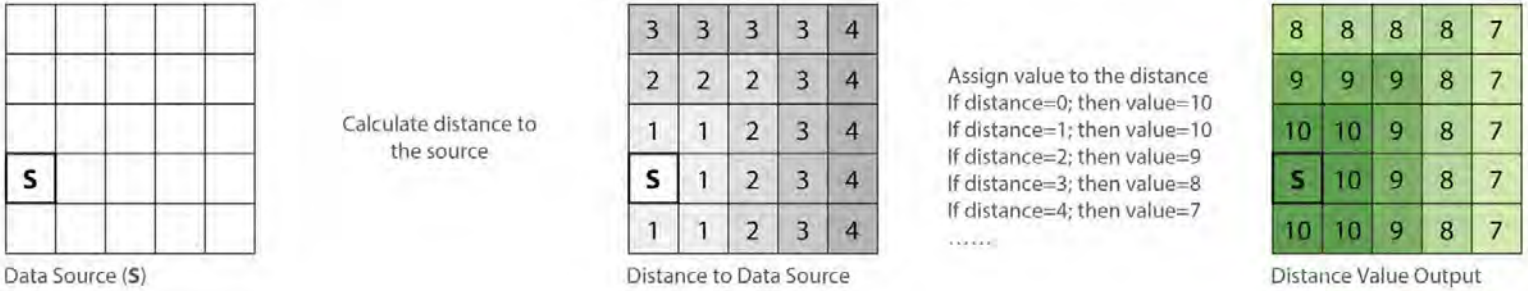
MO Maximum Overlay



BENEFICIAL USE SUITABILITY MODEL METHODS

DISTANCE

ED Euclidean Distance Value



BENEFICIAL USE SUITABILITY MODEL METHODS

COMBINED TOOL

OD Overlay Distance Value