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Exploring the Feasibility of Marsh Elevation Enhancement in South Carolina

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Who's Involved: Project Team

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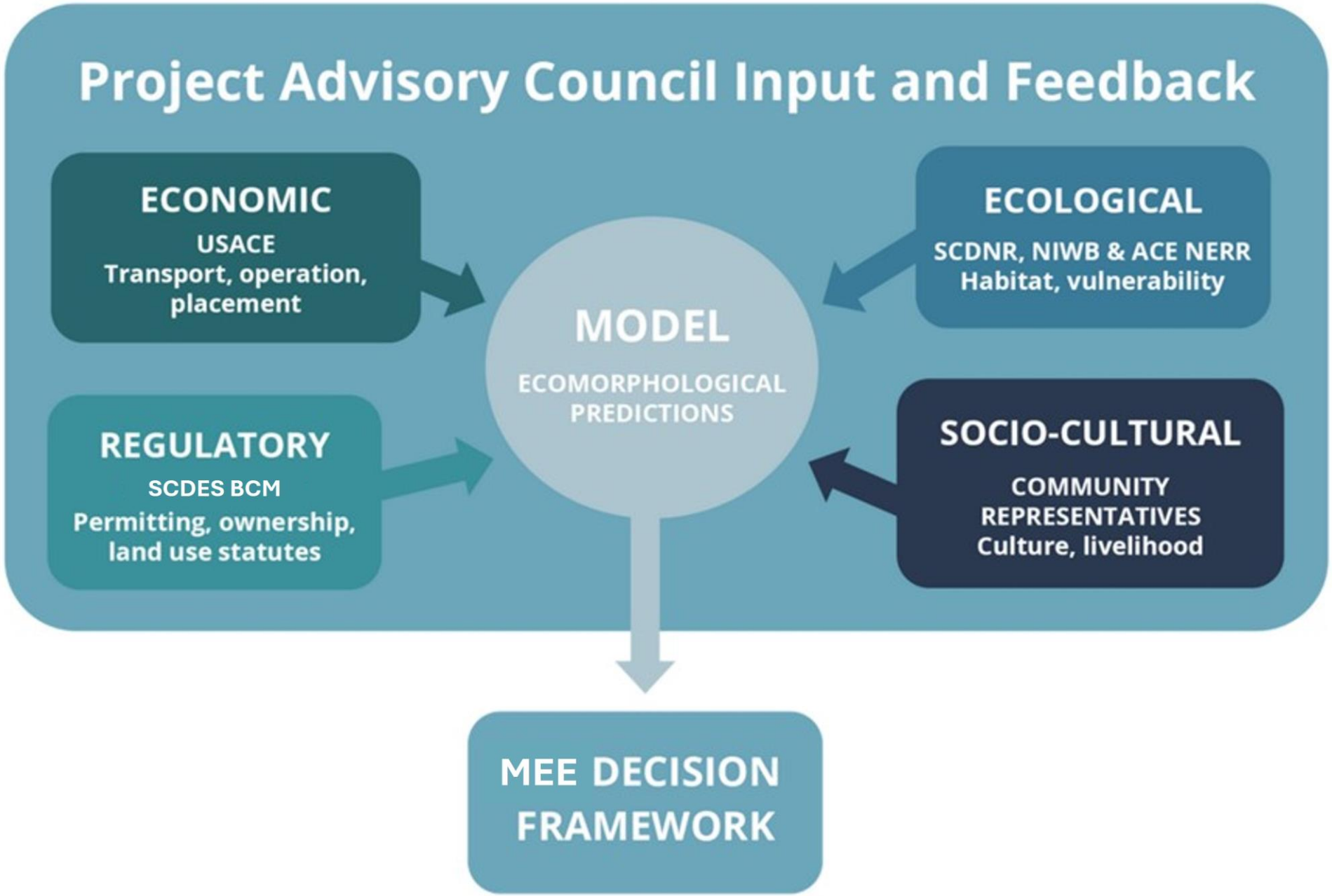
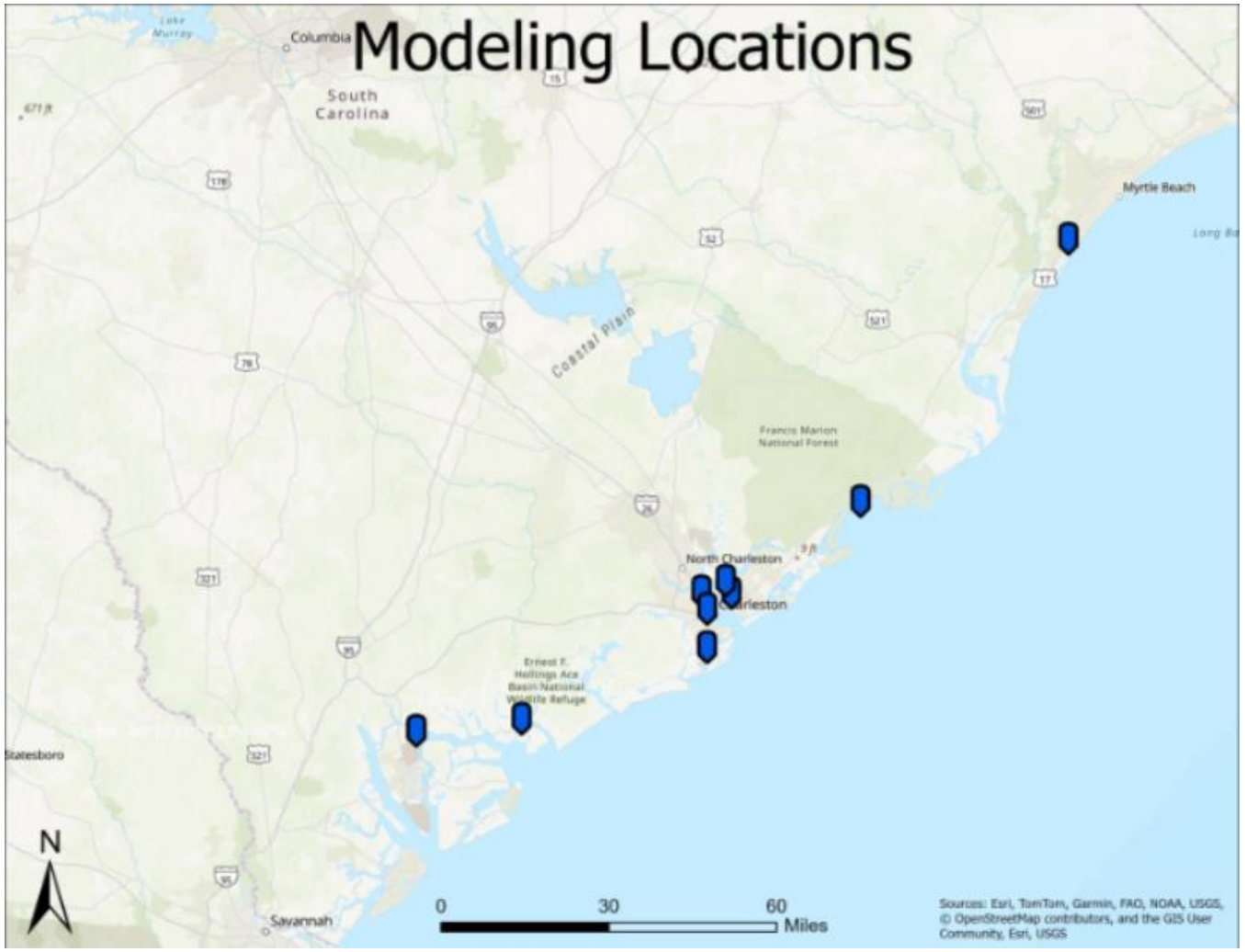

Project Advisory Council Input and Feedback
ECONOMIC
USACE
Transport, operation, placement
ECOLOGICAL
SCDNR, NIWB & ACE NERR
Habitat, vulnerability
MODEL
ECOMORPHOLOGICAL PREDICTIONS
REGULATORY
SCDES BCM
Permitting, ownership, land use statutes
SOCIO-CULTURAL
COMMUNITY REPRESENTATIVES
Culture, livelihood
MEE DECISION FRAMEWORK



1. Murrells Inlet
2. Cape Romain
3. Molasses Creek
4. Shem Creek
5. Citadel Boat Basin
6. Plum Island
7. Folly Island
8. Fenwick Cut
9. Marine Corps Air Station (MCAS) Beaufort - Brickyard Creek

GIS Layers

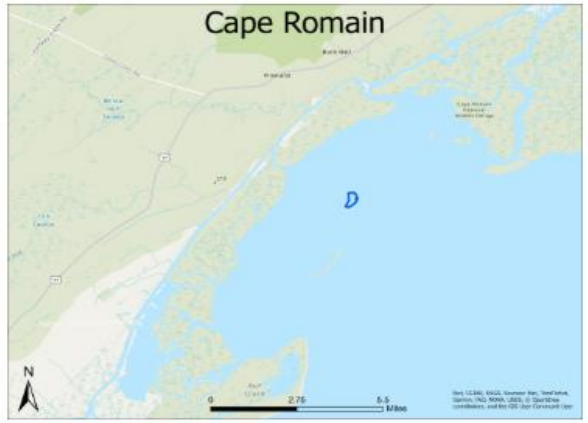
- USACE shoaling areas
- USACE disposal areas
- (Some) private dredging locations
- Potential BU areas
- Areas of concern identified by Regional Sediment Management
- Oyster presence
- Shellfish leases
- Marsh Vegetation Type
- Marsh Lifespan
- UVVR
- Social values mapping

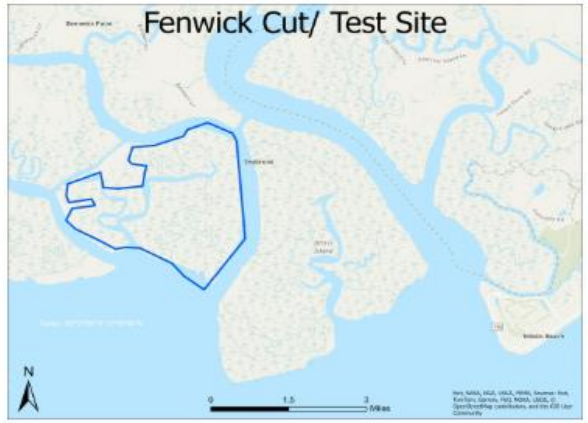
Site Selection Criteria

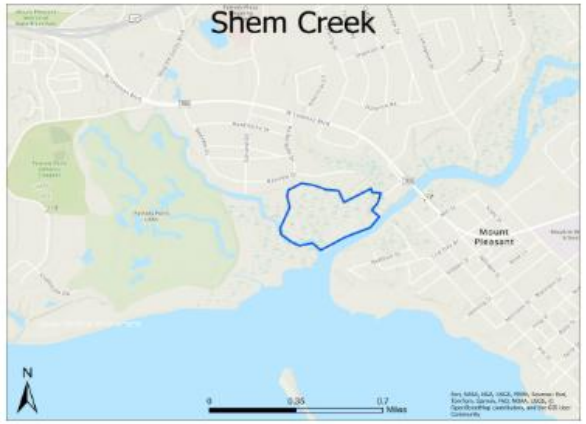
- Resilience Urgency:
  - Reflects coastal risk of environmental and cultural resources (population and infrastructure) to inundation hazards and coastal flooding events.
- Community Benefit:
  - Reflects the sites is adjacent to an area recognized as a gathering or resource for communities especially those that are underserved.
- Navigation Benefit:
  - Reflects the sites proximity to a mapped dredged area which provides the source of sediment for the beneficial use site construction.
- Ecosystem Goods and Services (EGS) Benefit:
  - Reflects the loss of EGS benefit as calculated by the National Ecosystem Services Classification System (NESCS) Tool for marsh/wetlands, considers transition of marshes to unconsolidated sediment and open water habitat.
- Wildlife Habitat:
  - Reflects the level of opportunity to improve and protect important wildlife habitat areas. Are there threatened and endangered species present? Biodiversity?
- Ecosystem Urgency:
  - Reflects the level of ecosystem change or vulnerability to future change.

Lead to the Overall Score

Modeling Locations







Key site considerations – what we have learned in SC

- Must prove a current resilience need
- Do not harm shellfish habitat
- Choose sites near where you are already dredging for geographic proximity, otherwise it can become cost-prohibitive
- Vegetation planting will accelerate recovery
- Ensure sediment is not contaminated
- Need to monitor given novelty of method for SC
- Natural containment methods (e.g. coir logs, hay bales) are an option
- Thicker placements have a trade-off: can provide more benefits over time, but vegetation can take longer to recover
    - Thickness targets are highly dependent on site-specific factors

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Estimating Ecosystem Service Benefits of Marsh Elevation Enhancement

Ecosystem Service Primer – Connection to Marsh Elevation Enhancement

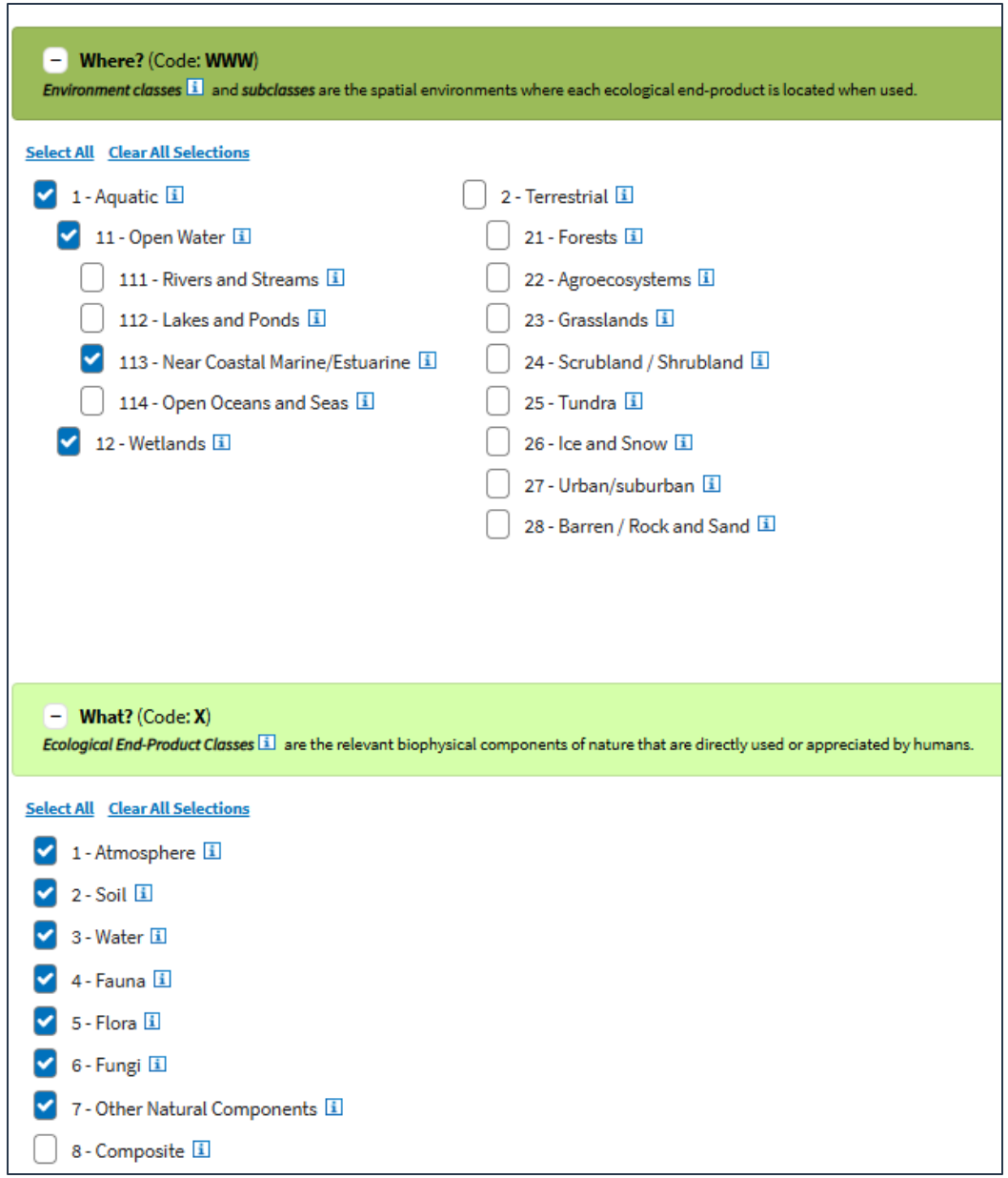
- Salt marshes and other coastal wetlands provide an array of ecosystem services
  - The benefits human populations derive, directly or indirectly, from ecosystem functions
- Marsh Elevation Enhancement (MEE) can protect vulnerable salt marshes
- Healthier habitats = more ecosystem services
- When marshes are lost to sea level rise, development, or other impacts, the ecosystem services that were once provided by the marsh are diminished
- By using MEE to avoid losses in marsh area, we can sustain these ecosystem service benefits

EPA National Ecosystem Service Classification System (NESCS)

https://geopub.epa.gov/nescs/application/multipleQuery

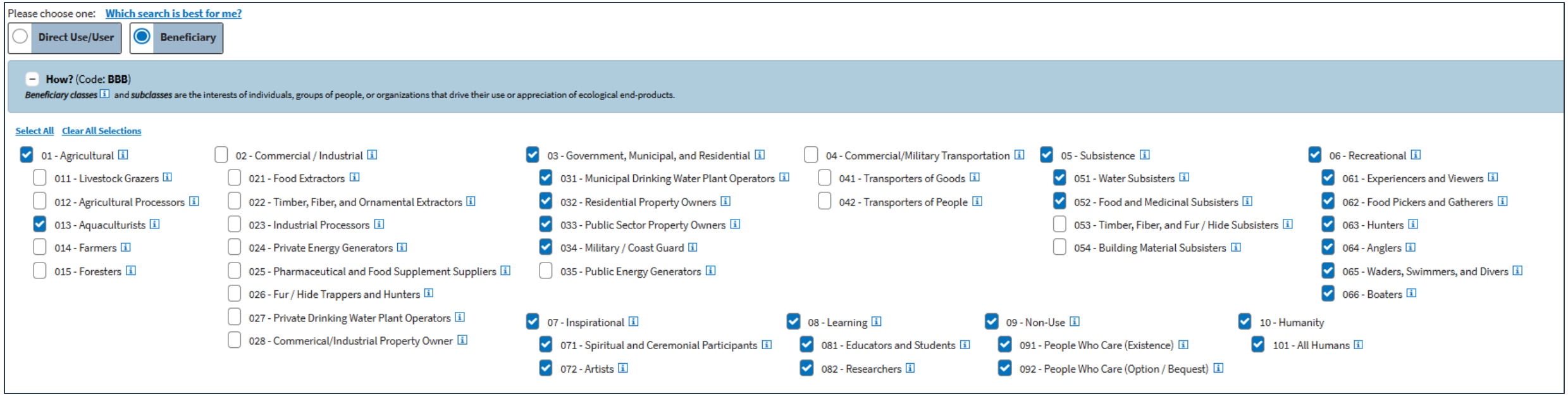
Start with habitats, and ecological end products

*Other natural components = All other biota or biotic material that are not part of / attached to currently living floral / faunal source, including for example driftwood not attached to currently living tree, shells not attached to currently living clams.



EPA NESCS

Then select beneficiary classes



EPA NESCS

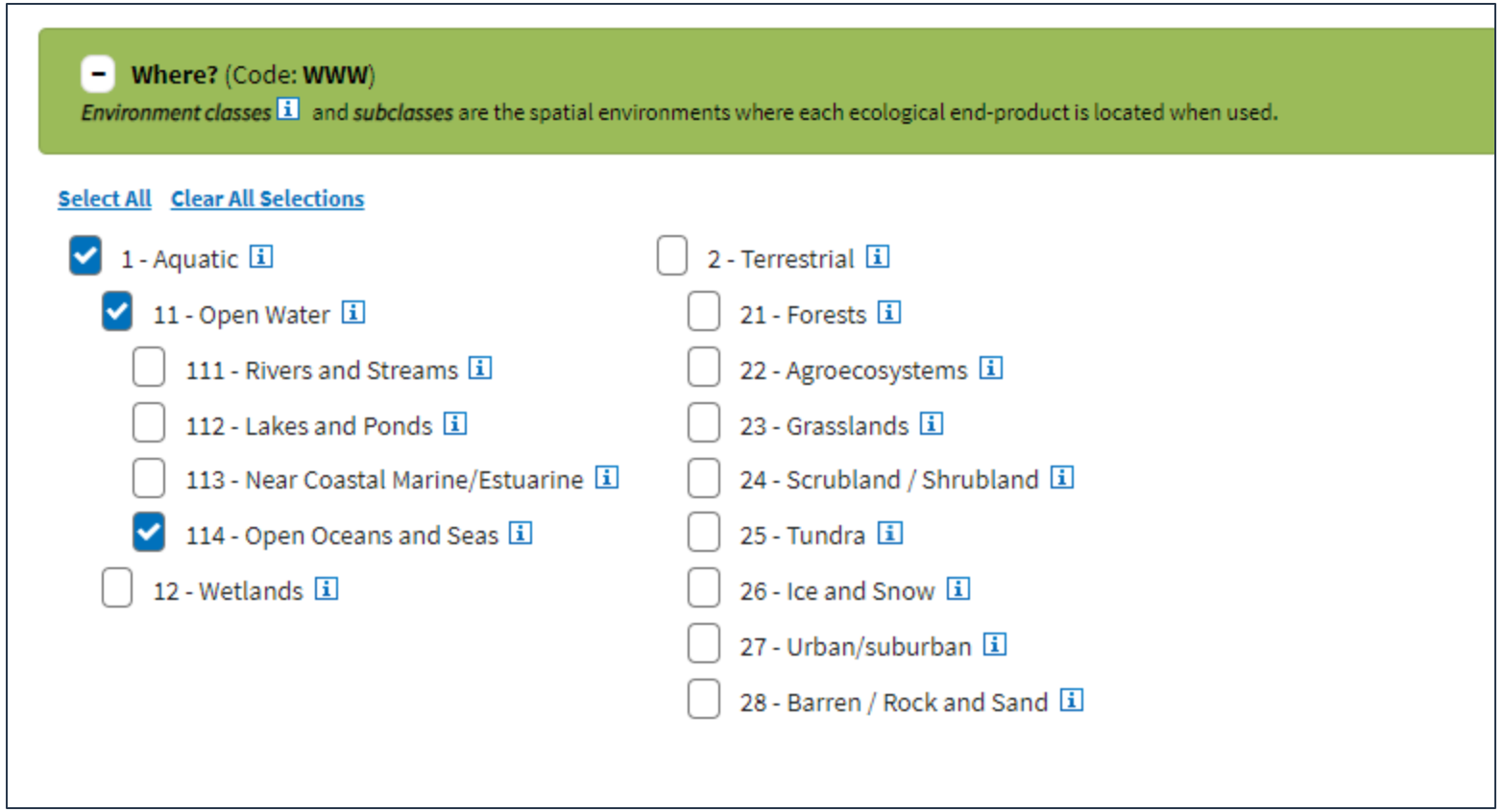
Then compare results for

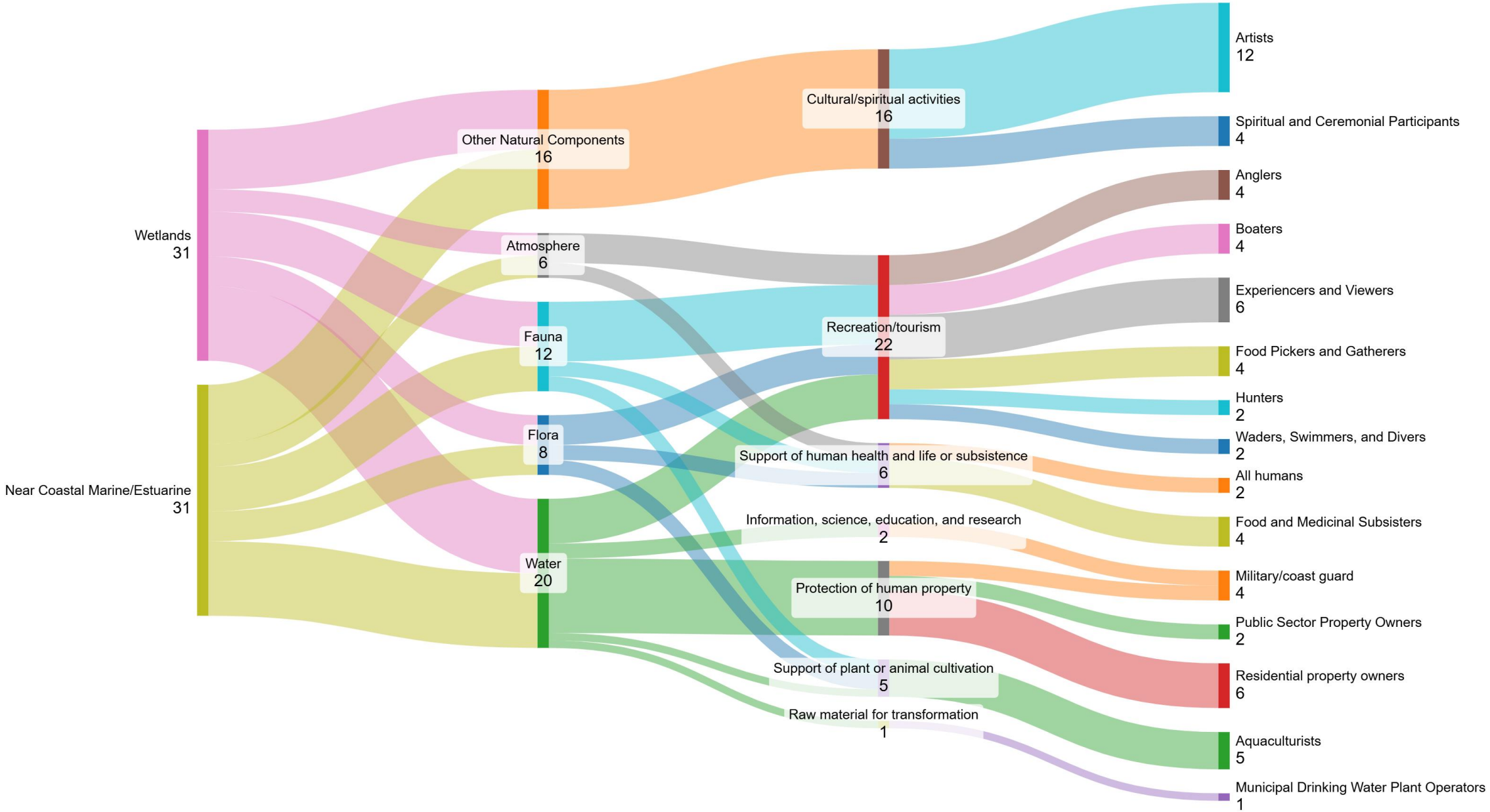
“near coastal marine/estuarine” and “wetlands”

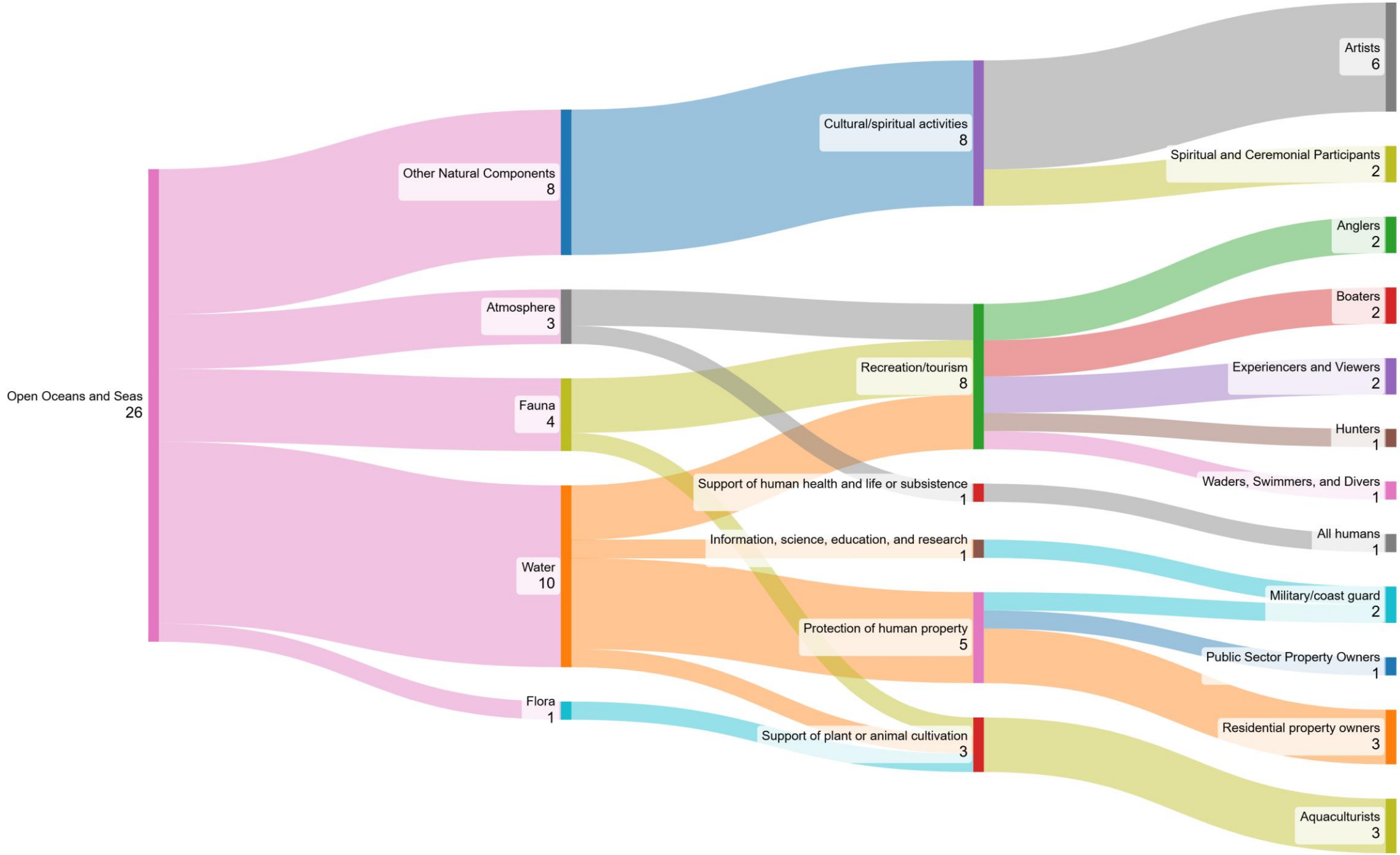
to

“open water”

using the same ecological end products and beneficiary classes

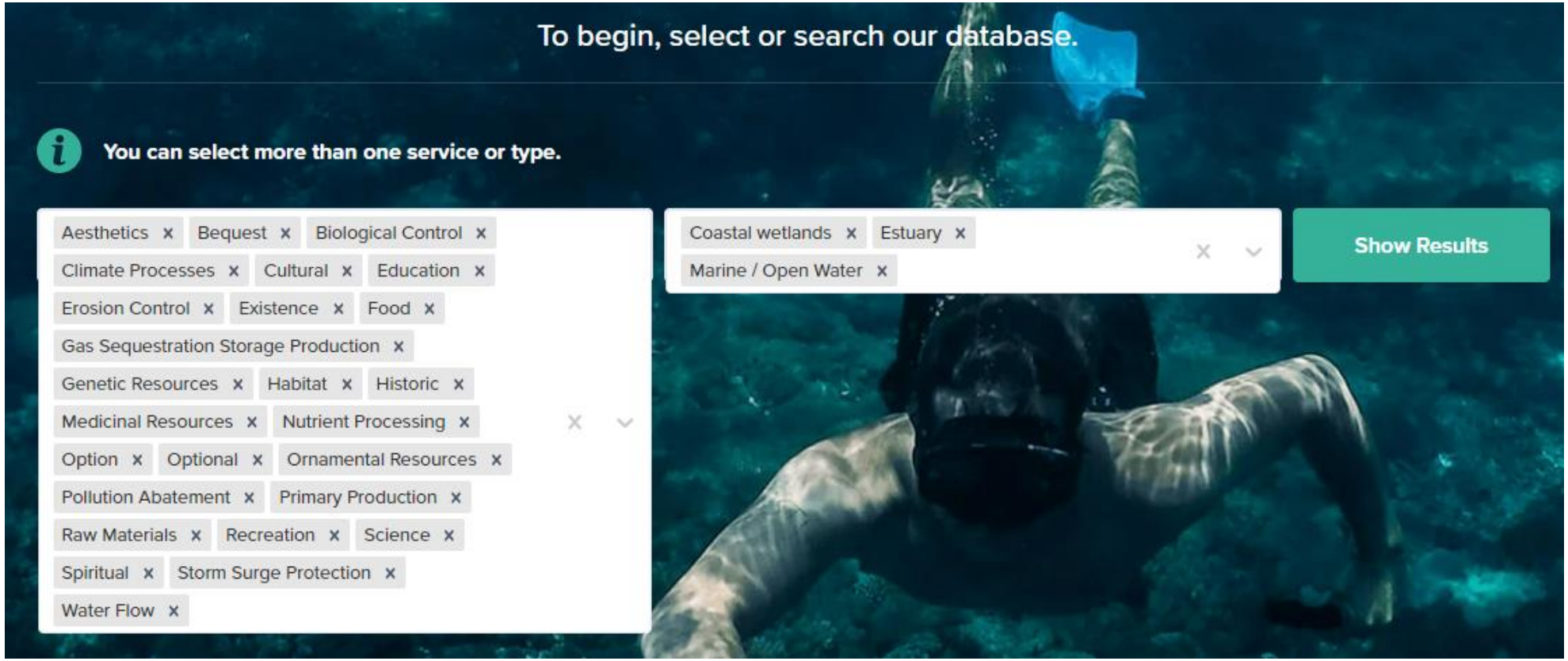





Open Oceans and Seas
26
Other Natural Components
8
Atmosphere
3
Fauna
4
Water
10
Flora
1
Cultural/spiritual activities
8
Recreation/tourism
8
Support of human health and life or subsistence
1
Information, science, education, and research
1
Protection of human property
5
Support of plant or animal cultivation
3
Artists
6
Spiritual and Ceremonial Participants
2
Anglers
2
Boaters
2
Experiencers and Viewers
2
Hunters
1
Waders, Swimmers, and Divers
1
All humans
1
Military/coast guard
2
Public Sector Property Owners
1
Residential property owners
3
Aquaculturists
3
Made at SankeyMATIC.com

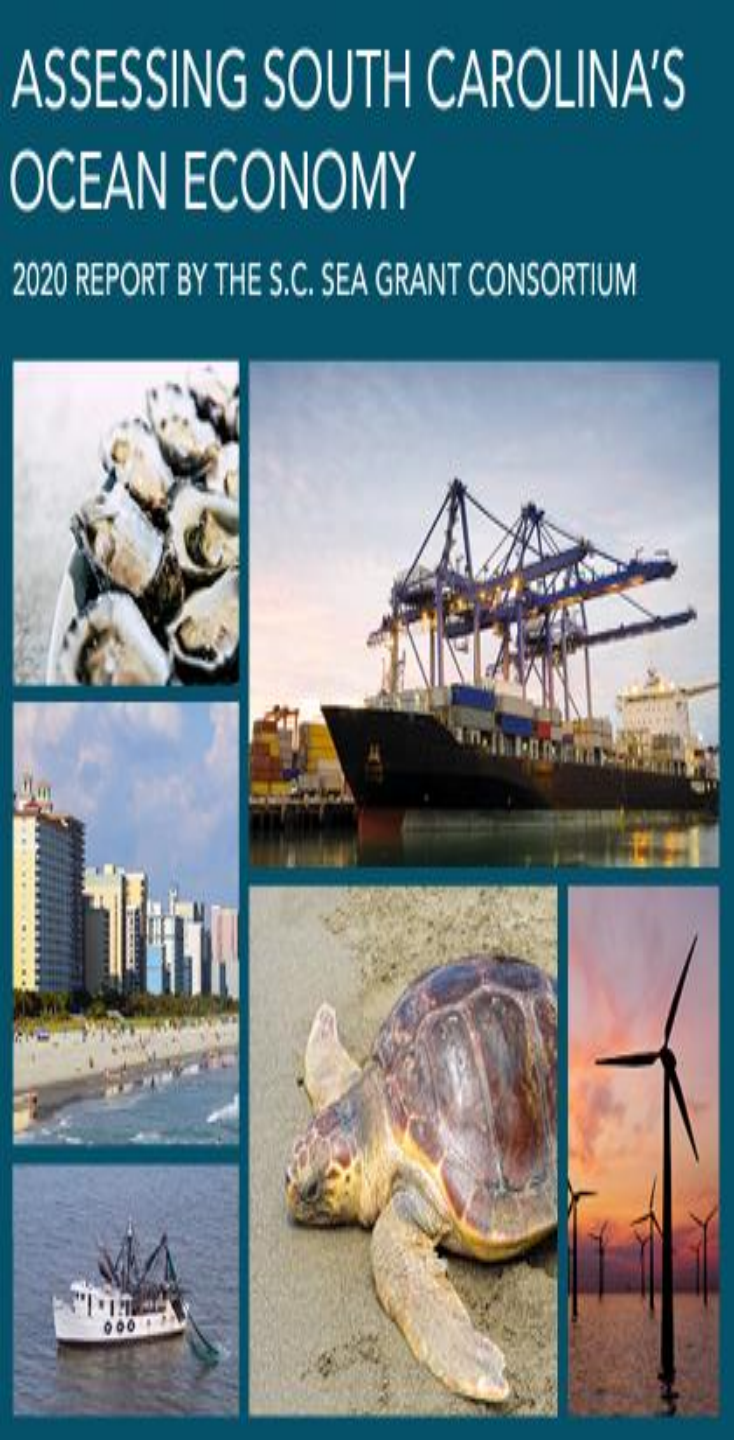
Estimating Economic Benefits of Ecosystem Services

Bluevalue.org



Bluevalue Workflow

- Removed entries outside of USA
- Removed entries outside of the VA to TX region
  - Kept all east coast entries to estimate value of cultural services
- Removed high value outliers
- Removed entries that were not in units of per ha/per yr
- N = 59 estimates
- Ecosystem services left
  - Primary production
  - Raw materials
  - Recreation
  - Storm surge protection
  - Food
  - Pollution abatement
  - Gas sequestration
  - Habitat
  - Nutrient processing
  - Cultural, Spiritual, and Historic



Bluevalue Workflow

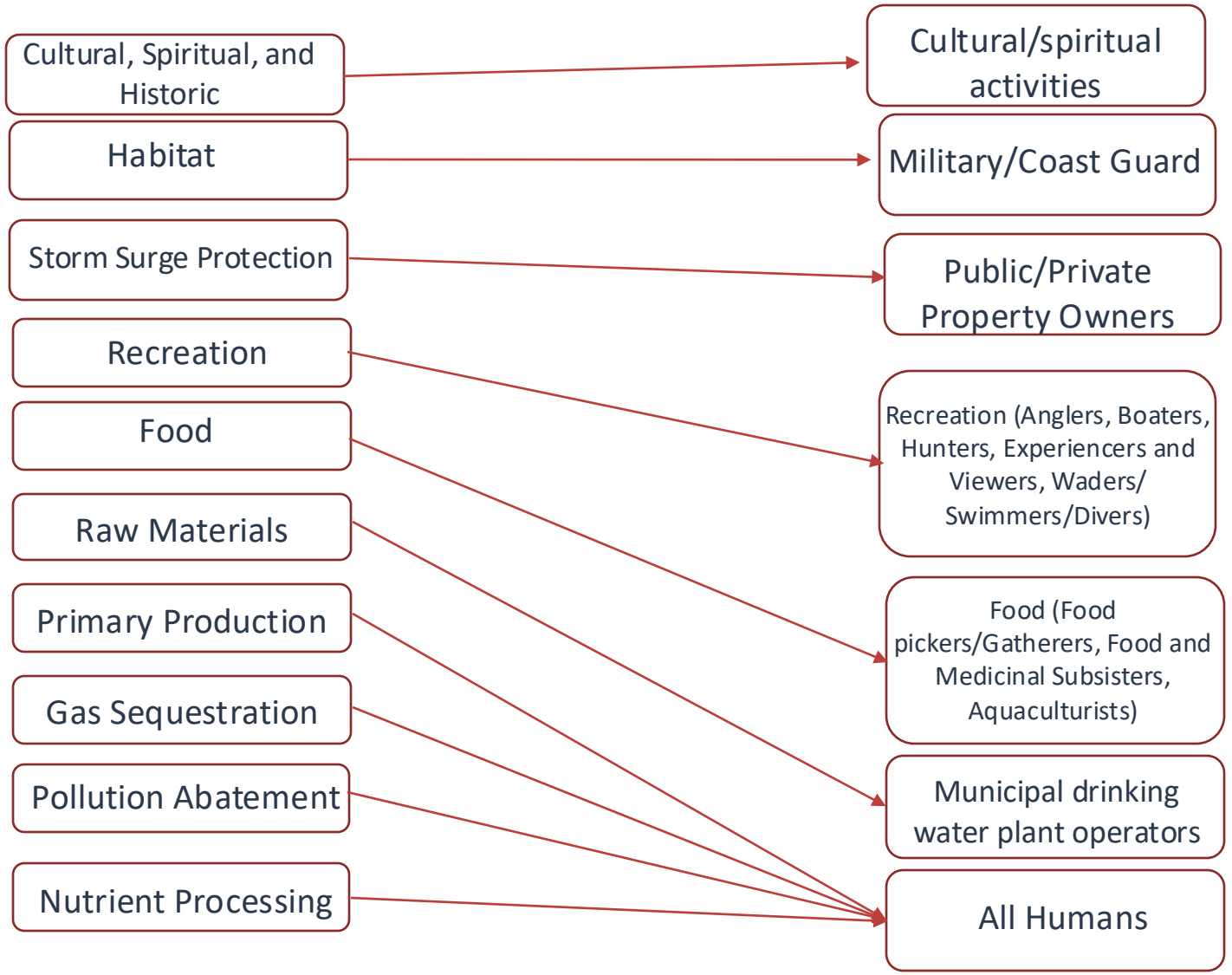
- N = 59 estimates
- Use data to calculate mean and standard error for 95% confidence intervals for each ecosystem service economic benefit estimate
- Used estimates from SC Ocean Economy Report for
  - Storm surge protection
  - Gas sequestration
    - Also utilizing EPA Social Cost of Carbon

Value estimates

Inflation adjust to 2024 dollars

	$ per ha per yr		
Services from bluevalue	converted to 2024$ - mean	converted to 2024$ - LB	converted to 2024$ - UB
Habitat	$377	$179	$576
Raw Materials	$95	$95	$95
Storm Surge Protection	$8,185	$1,960	$22,219
Recreation	$6,460	$0	$13,362
Food	$1,500	$429	$2,571
Primary Production	$2,498	$1,778	$3,217
Pollution abatement	$2,827	$0	$5,733
Nutrient Processing	$1,822	$1,822	$1,822
Gas Sequestration Storage Production	$153	$92	$214
Cultural, Spiritual, and Historic	$596	$305	$887
TOTAL ESV of wetlands	**$23,917**	**$6,356**	**$49,809**

Crosswalking Ecosystem Services (Bluevalue) to Beneficiaries/end users (NESCS)



Estimating Economic Benefits of MEE

LOGIC:

- If wetlands are converted to open water, not all ecosystem services are lost, but they are diminished/decreased
- Use NESCS output to estimate proportional change in the number of beneficiaries if wetlands were to be converted to open water
- MEE can prevent wetlands from being converted to open water

Estimating Economic Benefits of MEE

Beneficiary Subcategory (BBB)	wetlands and estuaries in tact (# of services reveived by user)	wetlands and estuaries converted to open ocean (# of services reveived by user)	opportunitiies lost if wetlands were to be lost to SLR	Blue value ES used	marsh in tact - mean per ha/per yr	avoided losses by keeping marsh in tact - LB per ha/per yr	avoided losses by keeping marsh in tact - UB per ha/per yr
Military / Coast Guard	4	2	50%	Habitat	$189	$90	$288
Public/private property owners	8	4	50%	Storm surge protection	$4,093	$980	$11,109
Recreation	18	8	56%	Recreation	$3,589	$0	$7,423
Anglers	4	2	50%				
Hunters	2	1	50%				
Boaters	4	2	50%				
Experiencers and Viewers	6	2	67%				
Waders, Swimmers, and Divers	2	1	50%				
Food	13	3	77%	Food	$1,154	$330	$1,978
Food Pickers and Gatherers	4	0	100%				
Food and Medicinal Subsisters	4	0	100%				
Aquaculturists	5	3	40%				
Culture	16	8	50%	Cultural, Spiritual, and Histo	$298	$153	$444
Artists	12	6	50%				
Spiritual and ceremonial partic	4	2	50%				
Municipal drinking water plant o	1	0	100%	Raw materials	$95	$95	$95
All humans	2	1	50%	Primary production, gas sequ	$3,650	$1,846	$5,493
TOTAL					**$13,067**	**$3,494**	**$26,830**

Estimating Economic Benefits of MEE over time

10 year net present value (NPV) of ensuring ecosystem service benefits accrue to society each year:

- OMB discount rate for 10 year treasury notes = 4.1%
- 10 year NPV mean = $32,718 per acre
- 10 year NPV lower bound = $8,748 per acre
- 10 year NPV upper bound = $67,180 per acre

Estimates can be used in cost-benefit analysis of habitat restoration (*with caution, see range of estimates*)

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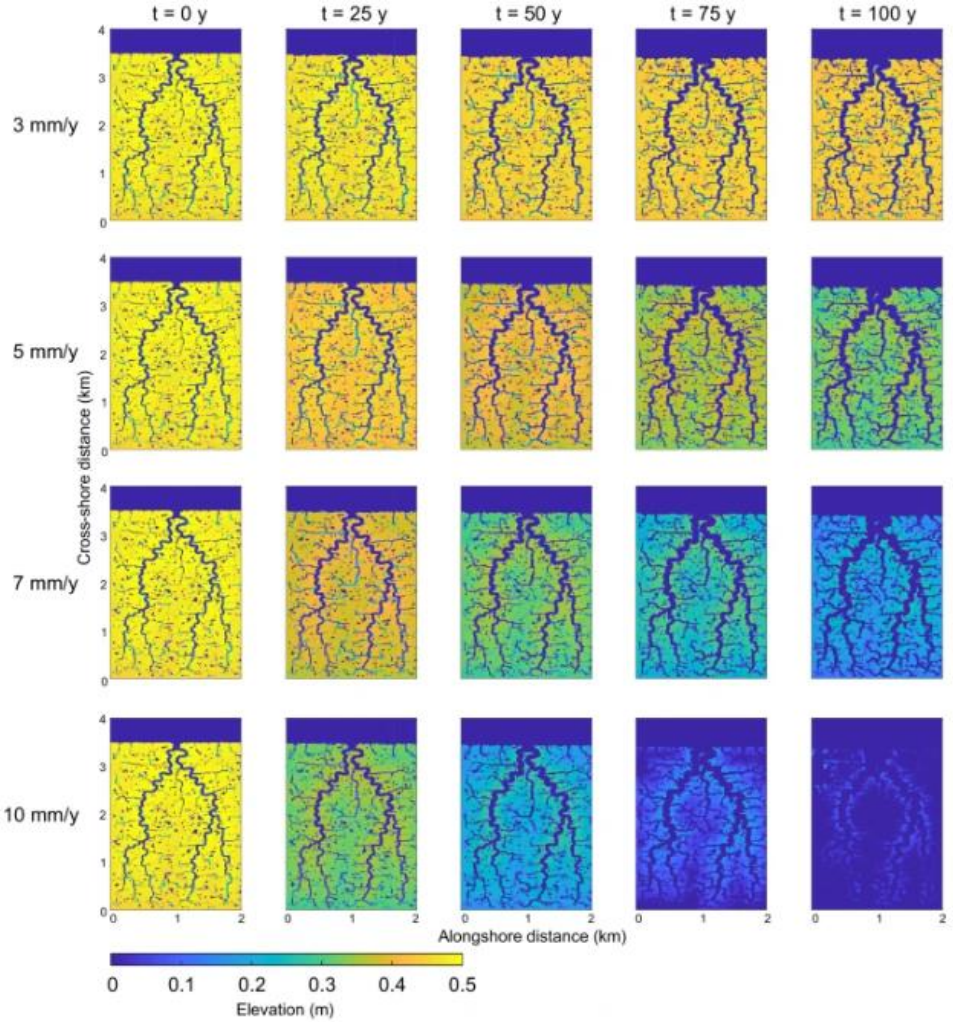
Decision Support

Decision Support- Modeling

Marsh Morpho 2D:
Simulates marsh evolution over time

- Considers:
  - Erosion
  - Accretion
  - Tidal Ranges
  - Sea level rise
- Assumptions:
  - Tidal flow is friction dominated and tidally averaged
  - Sediment transport occurs through tidal dispersion
  - It uses a smoothed-fetch wind wave model



Drop Down Menu Variable Options	Range of Parameters
MEE application thickness/target elevation change	3 inches
	6 inches
	12 inches
	18 inches
Sea Level Rise scenario	Intermediate-low
	Intermediate
	Intermediate-high
MEE application frequency	Just once
	Once every 5 years
	Once Every 10 years
	Once every 25 years
Time frame	2050
	2075
	2100
Total Suspended Sediment concentration	30 mg/L
	50 mg/L
	70 mg/L

Elevation Results

Model Criteria Selection

Tool Guidance

Imperial / Metric

Location:

Fenwick Cut

Sediment Application Thickness:

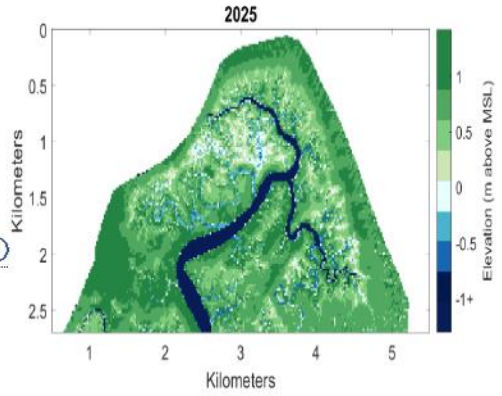
3 in | 6 in | 12 in | 18 in

Future SLR Scenario:

- Intermediate-low
- Intermediate
- Intermediate-high

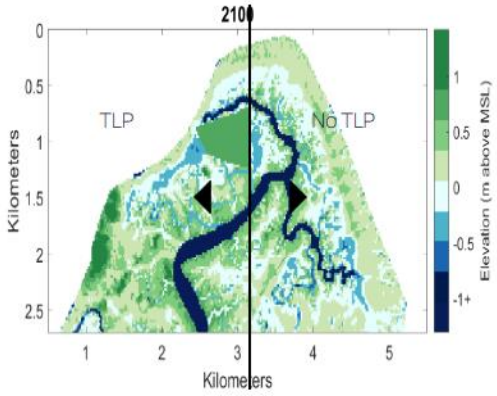
Sediment Application Frequency:

Present Day Elevation



Meters relative to mean sea level.

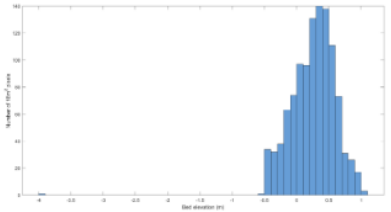
Elevation Change Comparison



Meters relative to mean sea level in selected year (e.g. 2050, 2075, or 2100).

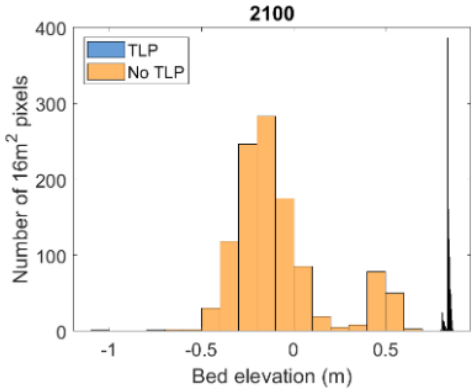
Use the slider to switch between marsh elevation enhancement and non-marsh elevation enhancement.

Present Day Elevation Histogram



Distribution of elevations for the present-day marsh.

Elevation Change Histogram



Distribution of modeled elevations for marsh in selected year (e.g. 2050, 2075, or 2100), with marsh elevation enhancement application(s) and without marsh elevation enhancement application(s).

Vegetation results

Model Criteria Selection

Tool Guidance

Imperial  Metric

Location: ⓘ

Fenwick Cut

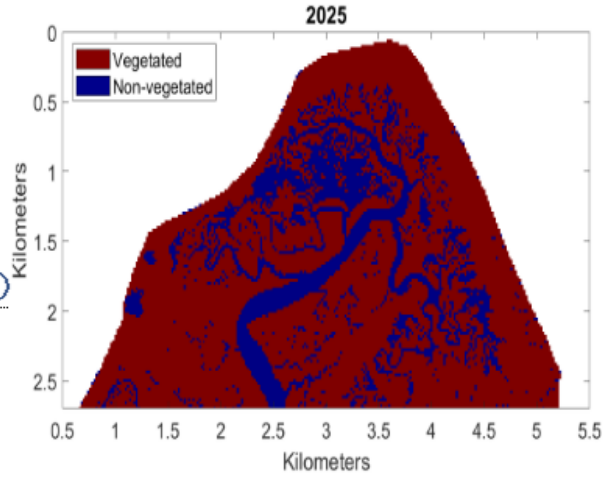
Sediment Application Thickness: ⓘ

Future SLR Scenario: ⓘ

- ○ Intermediate-low
- ◉ Intermediate
- ○ Intermediate-high

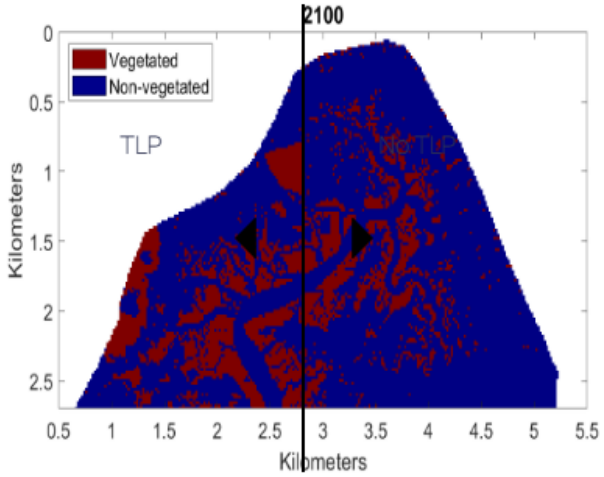
Sediment Application Frequency: ⓘ

Present Day Vegetation



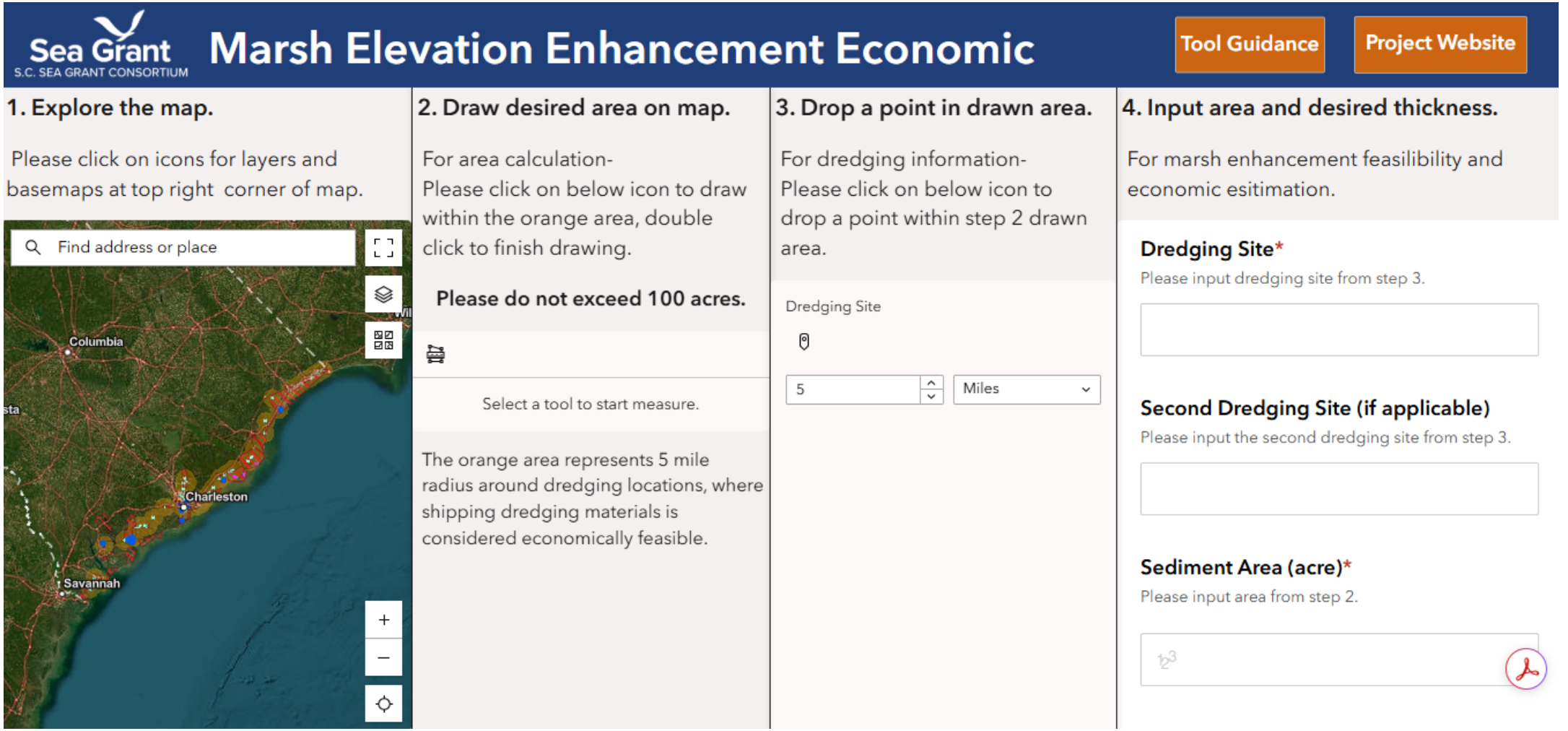
Red shows areas where marsh vegetation could be present, and blue shows areas where marsh vegetation would not be present for the current day. This is calculated related to the mean sea level.

Vegetation Change Comparison



Red shows where marsh vegetation could be present, and blue shows where marsh vegetation would not be present in the selected year (e.g. 2050, 2075, or 2100), calculated related to mean sea level.

GIS Tool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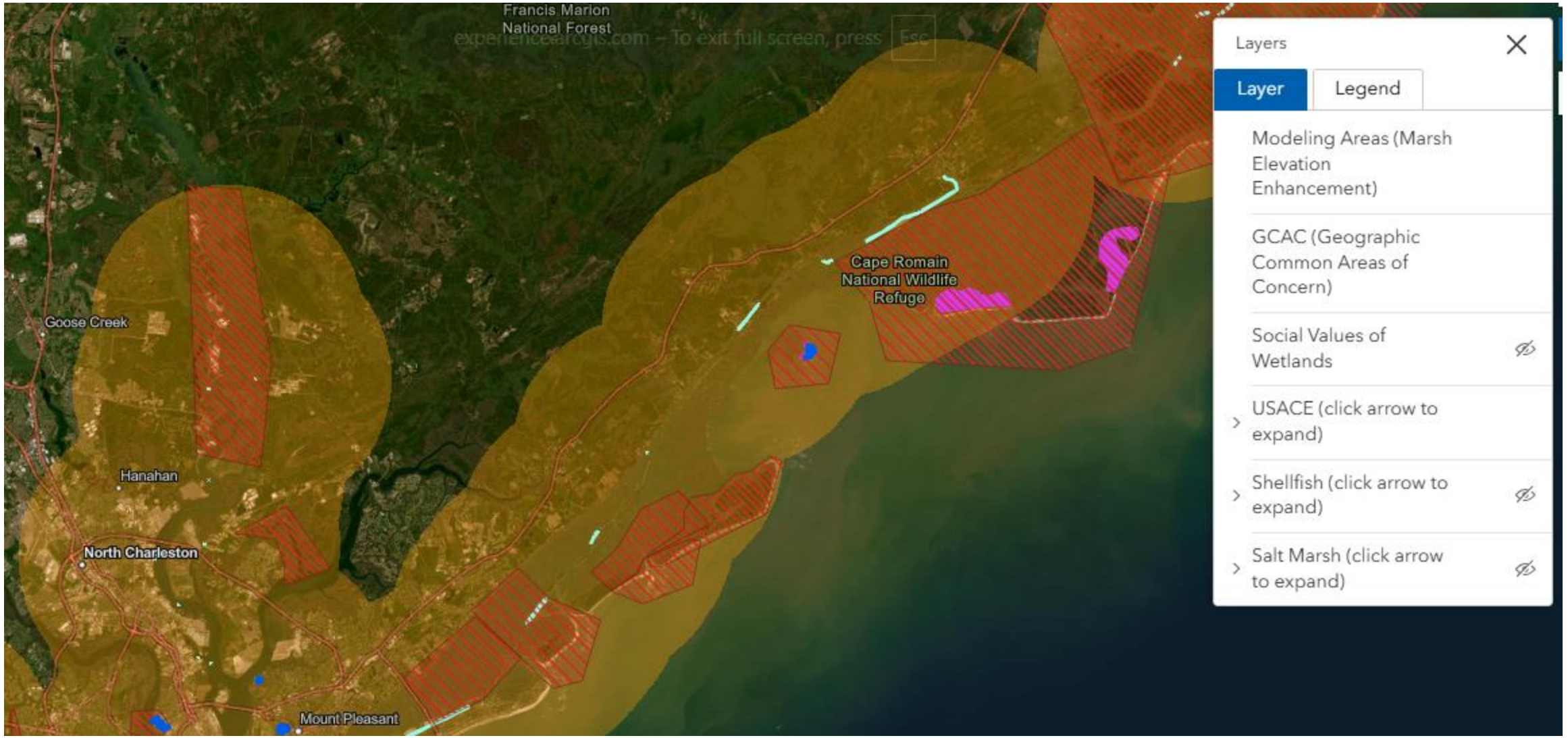
Marsh Elevation Enhancement Economic
Tool Guidance
Project Website
1. Explore the map.
Please click on icons for layers and basemaps at top right corner of map.
Find address or place
Columbia
Charleston
Savannah
2. Draw desired area on map.
For area calculation-
Please click on below icon to draw within the orange area, double click to finish drawing.
Please do not exceed 100 acres.
Select a tool to start measure.
The orange area represents 5 mile radius around dredging locations, where shipping dredging materials is considered economically feasible.
3. Drop a point in drawn area.
For dredging information-
Please click on below icon to drop a point within step 2 drawn area.
Dredging Site
5
Miles
4. Input area and desired thickness.
For marsh enhancement feasilibility and economic esitimation.
Dredging Site*
Please input dredging site from step 3.
Second Dredging Site (if applicable)
Please input the second dredging site from step 3.
Sediment Area (acre)*
Please input area from step 2.


Francis Marion
National Forest
experiencearcgis.com – To exit full screen, press Esc
Cape Romain
National Wildlife
Refuge
Goose Creek
Hanahan
North Charleston
Mount Pleasant
Layers
Layer
Legend
Modeling Areas (Marsh Elevation Enhancement)
GCAC (Geographic Common Areas of Concern)
Social Values of Wetlands
USACE (click arrow to expand)
Shellfish (click arrow to expand)
Salt Marsh (click arrow to expand)

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Questions?

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