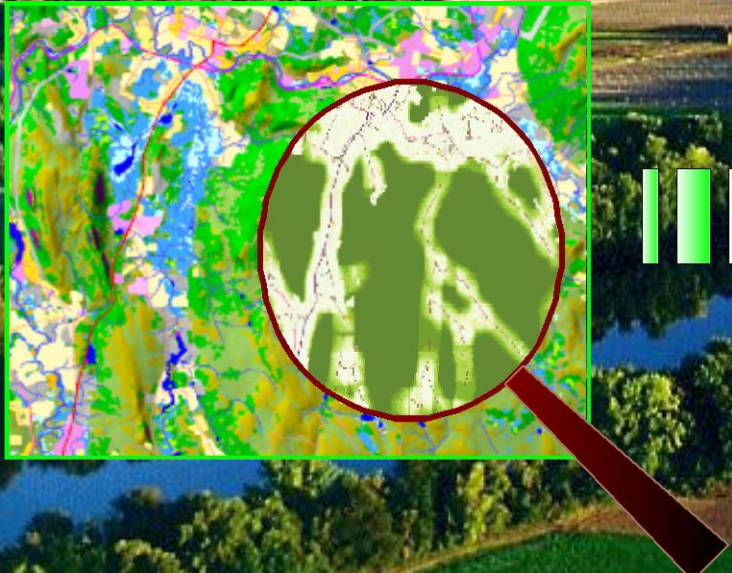
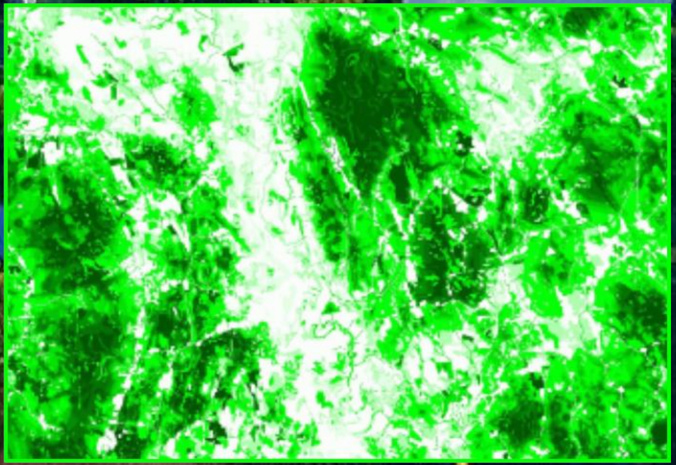
Designing Sustainable Landscapes in the Northeast

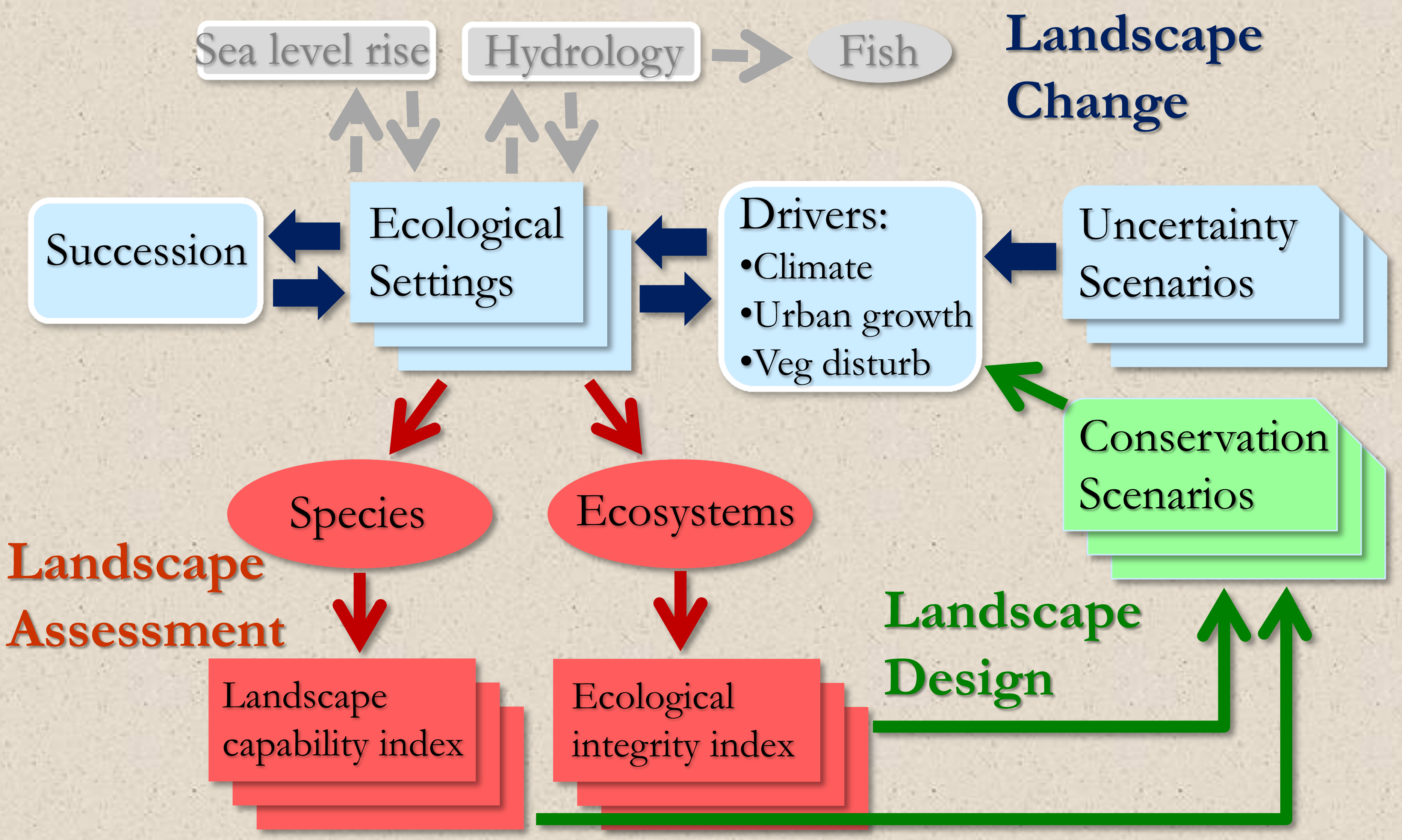
A project of the North Atlantic Landscape Conservation Cooperative & Northeast Climate Science Center

Hurricane Sandy Workshop
December 7-8, 2014





LCAD Model


Sea level rise
Hydrology
Fish
Landscape Change
Succession
Ecological Settings
Drivers:
•Climate
•Urban growth
•Veg disturb
Uncertainty Scenarios
Conservation Scenarios
Species
Ecosystems
Landscape Assessment
Landscape capability index
Ecological integrity index
Landscape Design

Landscape Change

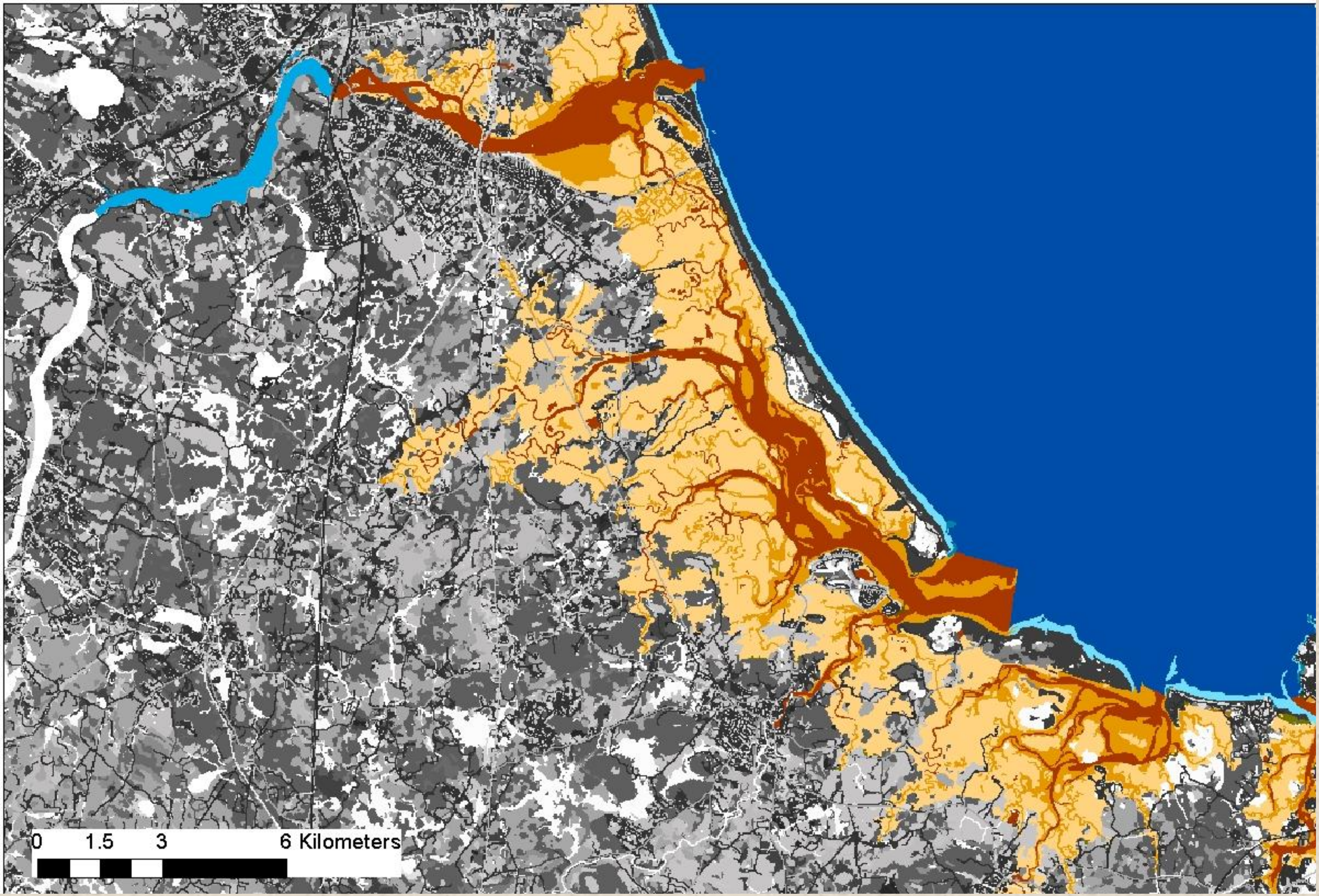
Ecological settings

- *Temperature*
  - ✓Growing season degree-days
  - ✓Minimum winter temperature
  - ✓Heat index 35
  - ✓**Water temperature**
- *Energy*
  - ✓Incident solar radiation
- *Chemical & Physical substrate*
  - ✓**Water salinity**
  - ✓Substrate mobility
  - ✓CaCO3 content
  - ✓Soil available water supply
  - ✓Soil depth
  - ✓Soil pH
- *Physical disturbance*
  - ✓Wind exposure
  - ✓Slope
- *Moisture and Hydrology*
  - ✓Wetness
  - ✓Flow volume
  - ✓Flow gradient
  - ✓**Tidal regime**
- *Vegetation*
  - ✓Dominant life form
  - ✓Above ground live biomass
- *Anthropogenic*
  - ✓Traffic rate
  - ✓Imperviousness
  - ✓Developed
  - ✓Terrestrial barriers
  - ✓Aquatic barriers

Dynamic settings

Landscape Change

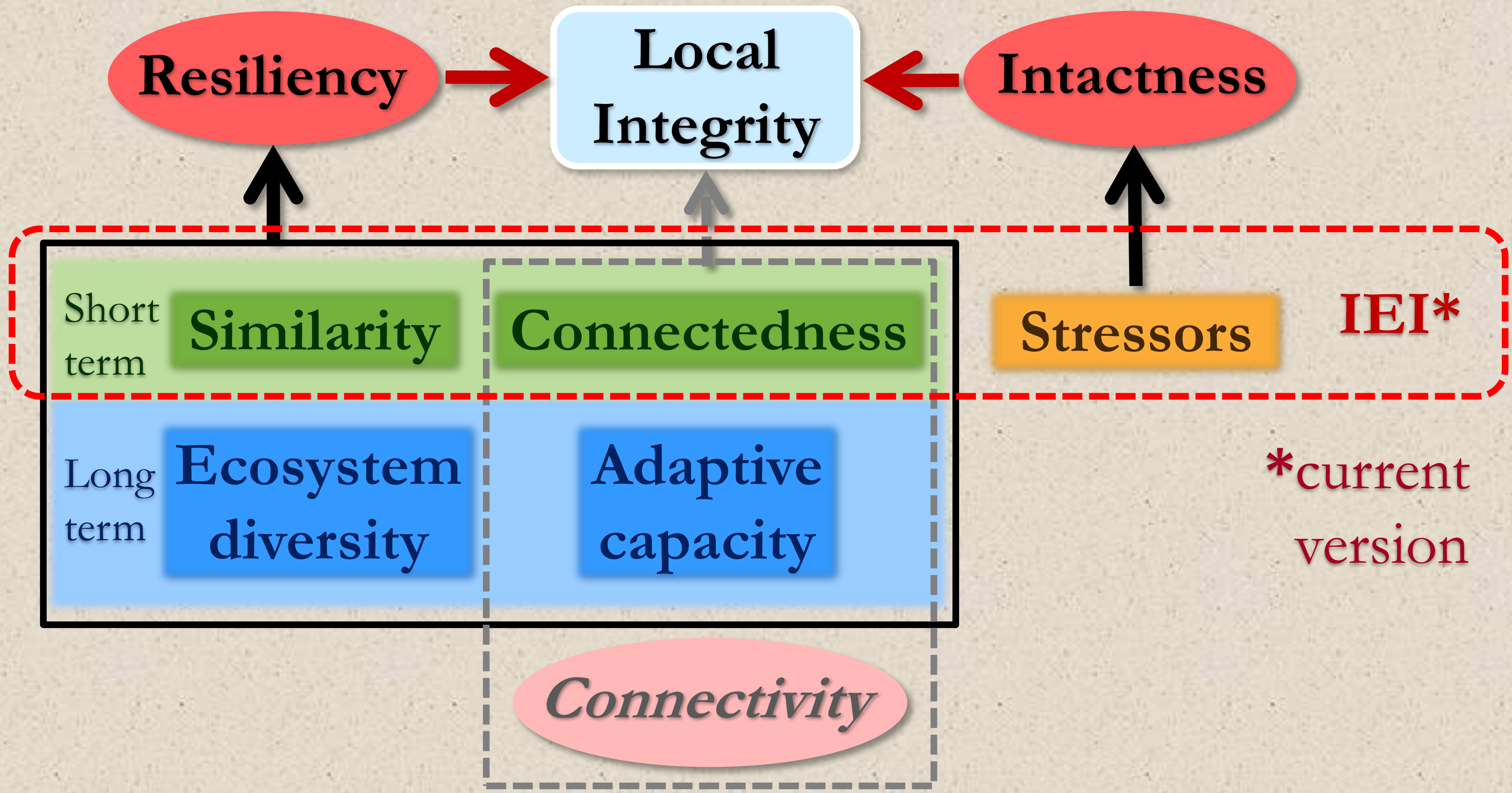
Ecosystems



Landscape Assessment

Ecosystems

"An *integral site* is intact, highly connected and resilient"



Landscape Assessment

Local integrity metrics

Metric Criteria

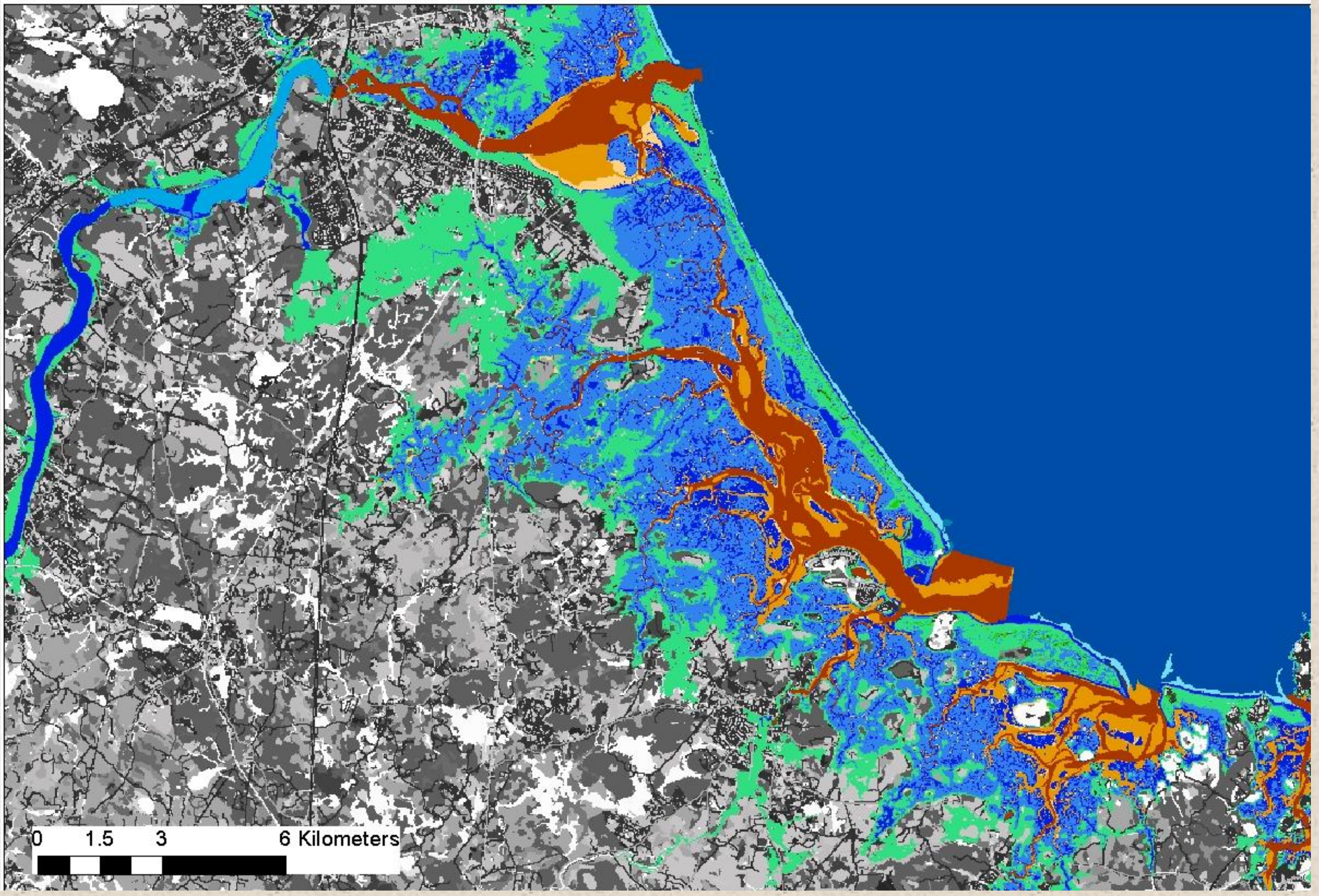
- Development and roads:
  - Habitat loss
  - Watershed habitat loss
  - Road traffic
  - Mowing and plowing
  - Microclimate alterations
- Pollution:
  - Watershed road salt
  - Watershed sediment
  - Watershed nutrient enrichment
- Climate change:
  - Climate alteration*
- Hydrologic alterations:
  - Watershed imperviousness
  - Dam intensity
- Biotic alterations:
  - Domestic predators
  - Edge predators
  - Non-native invasive plants
  - Non-native earthworms
- Resiliency:
  - Similarity
  - (Aquatic) Connectedness
- Coastal alterations:
  - Sea level rise inundation*
  - Tidal restrictions?
  - Salt marsh ditching?
  - Coastal structures?
  - Beach ORVs?
  - Beach pedestrians?

*future only

Landscape Assessment

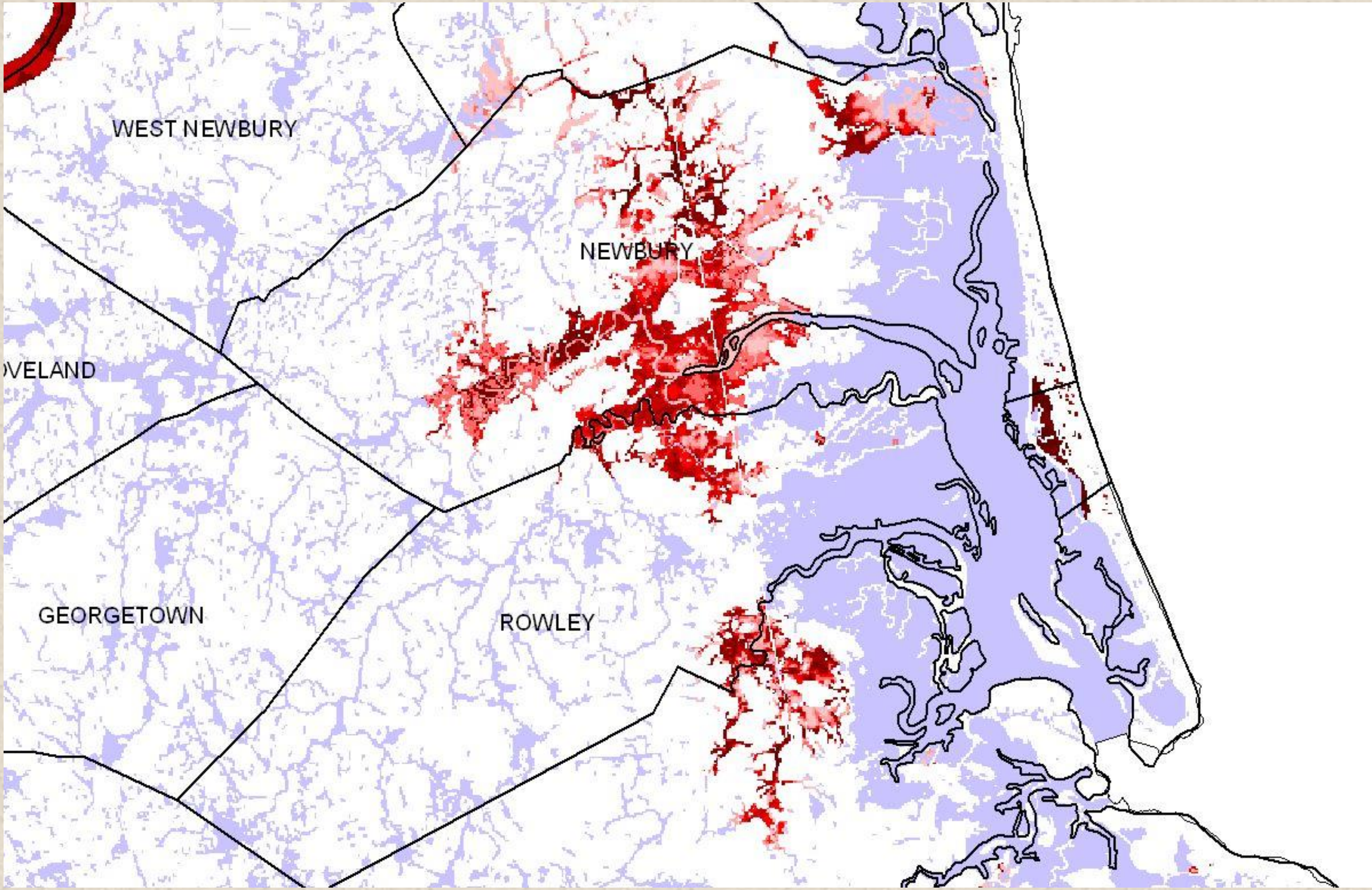
Sea level rise inundation

From Rob Thieler



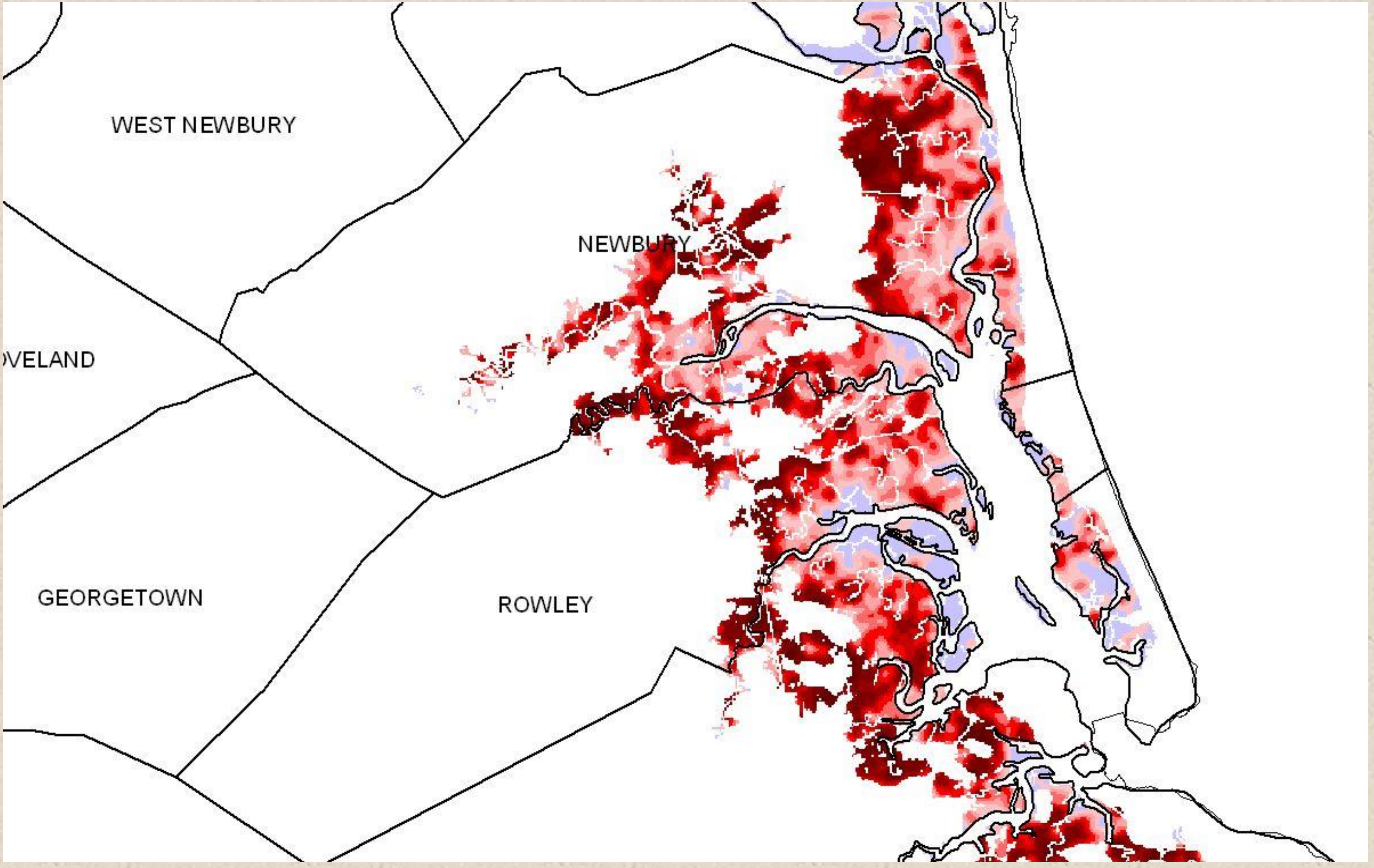
Landscape Assessment

Tidal restrictions



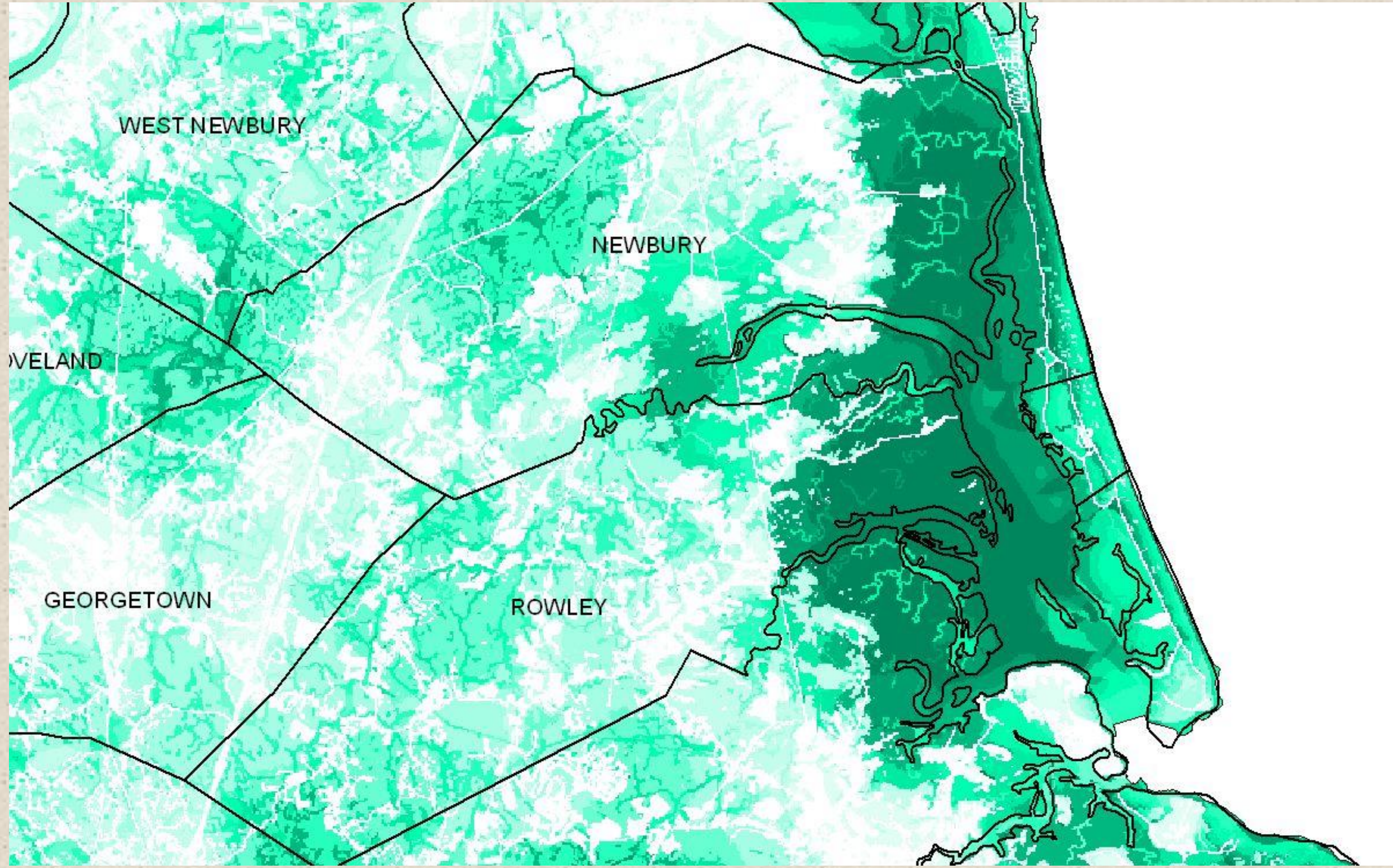
Landscape Assessment

Salt marsh ditching



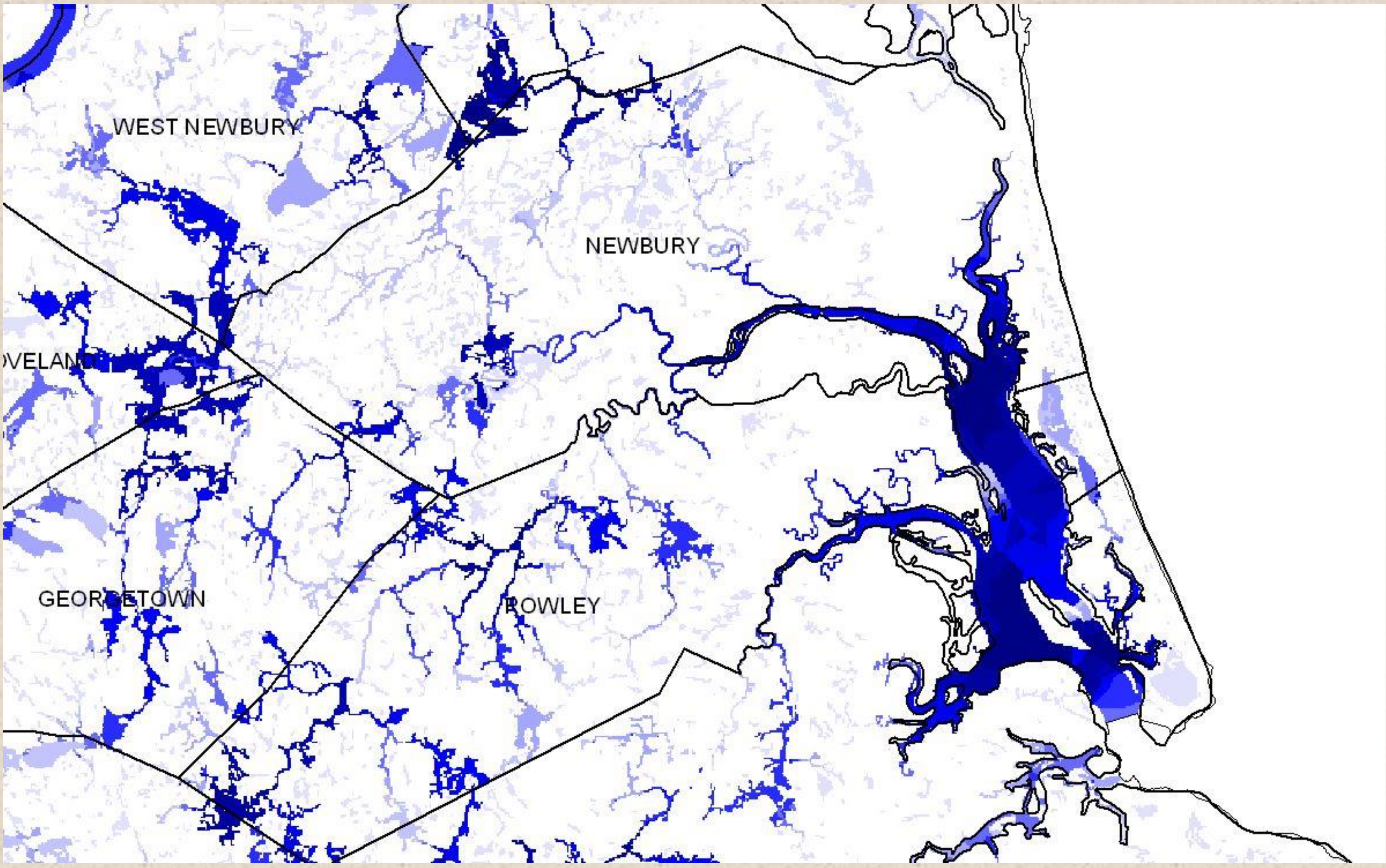
Landscape Assessment

Connectedness



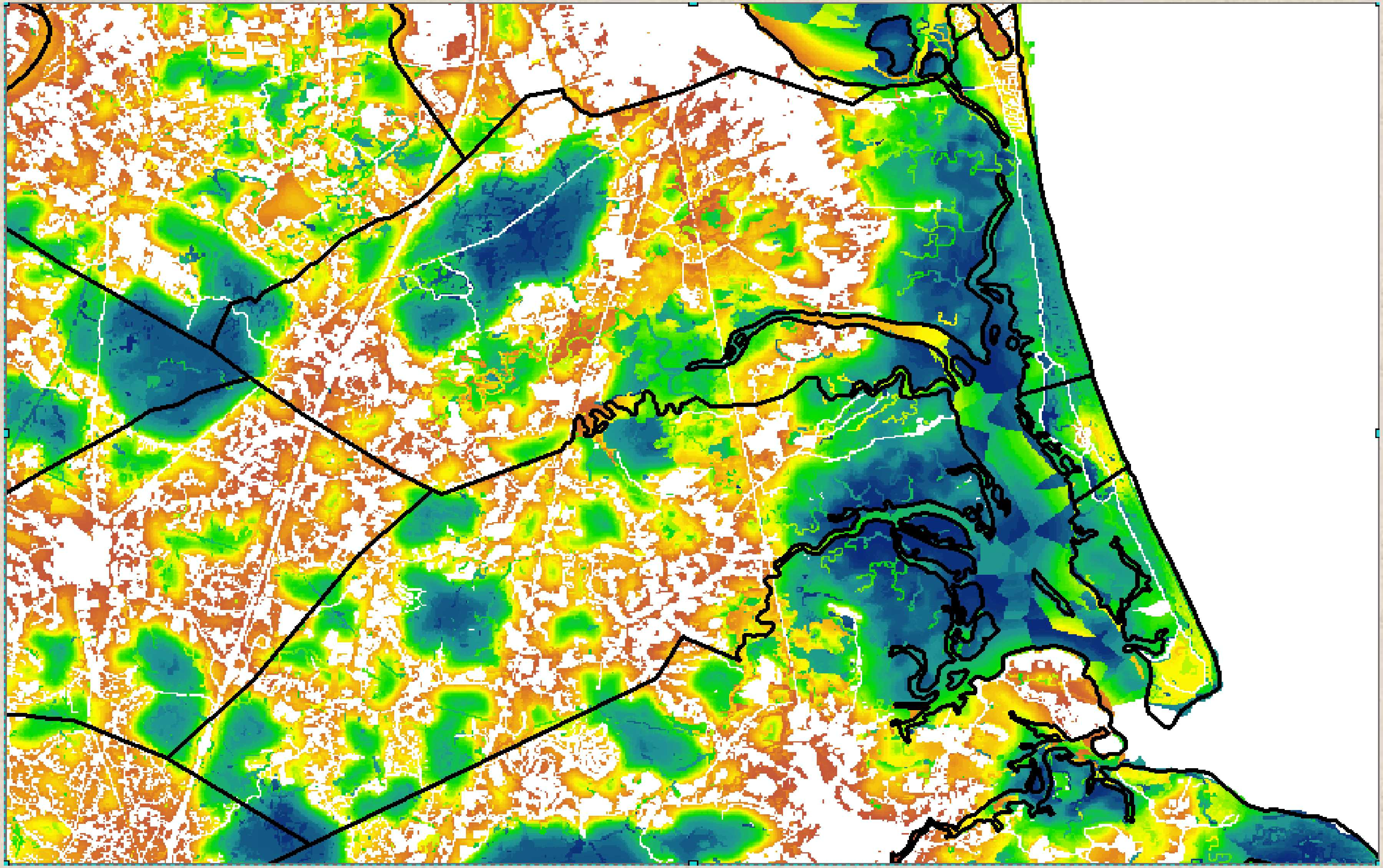
Landscape Assessment

Aquatic connectedness



Landscape Assessment

Index of ecological integrity



Landscape Assessment

Coastal alteration metrics?

Sea level rise inundation	Measures the probability of inundation under sea level rise and the likelihood of a dynamic response (under development)
Salt marsh ditching	Measures the magnitude of temporal loss of open water habitat (i.e., loss of open water habitat during mid to low tides) around the focal cell due to ditching
Tidal restrictions	Measures the magnitude of *hydrologic* alteration to the focal cell due to tidal restrictions
Coastal structures	Measures the proximity of the focal cell (applied only to certain cover types; e.g., beaches, intertidal flats) to up-gradient manmade jetty/groin
Beach pedestrians	Measures the intensity of beach pedestrian traffic at the focal cell (applied to beach settings only)
Beach ORVs	Measures the intensity of beach ORV traffic in the neighborhood surrounding the focal cell (applied to beach settings only)
Boating intensity	Measures the intensity of boat traffic disturbance at the focal cell

Coastal alteration metrics

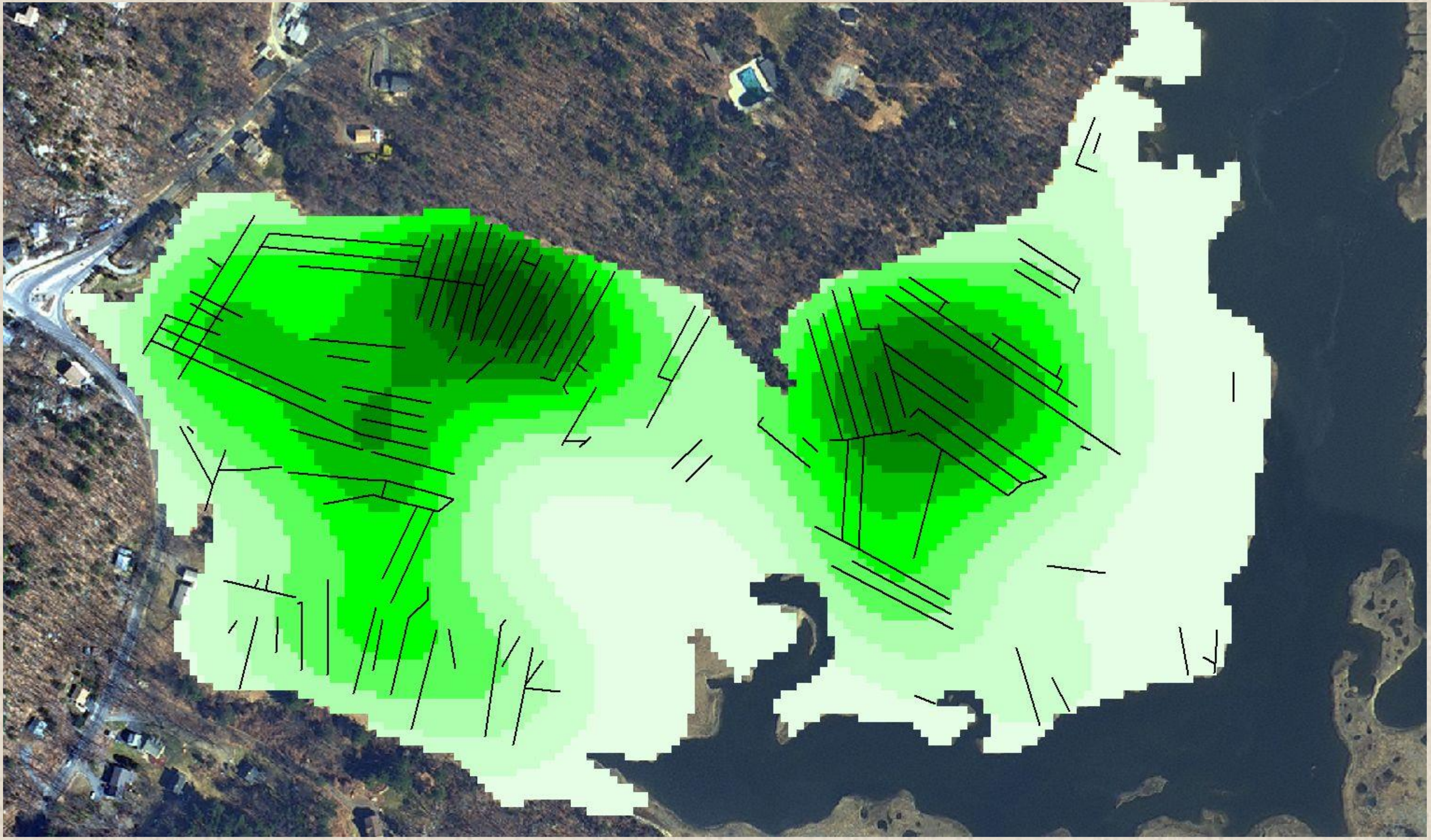
Salt marsh ditching

Coastal alteration metrics

Salt marsh ditching

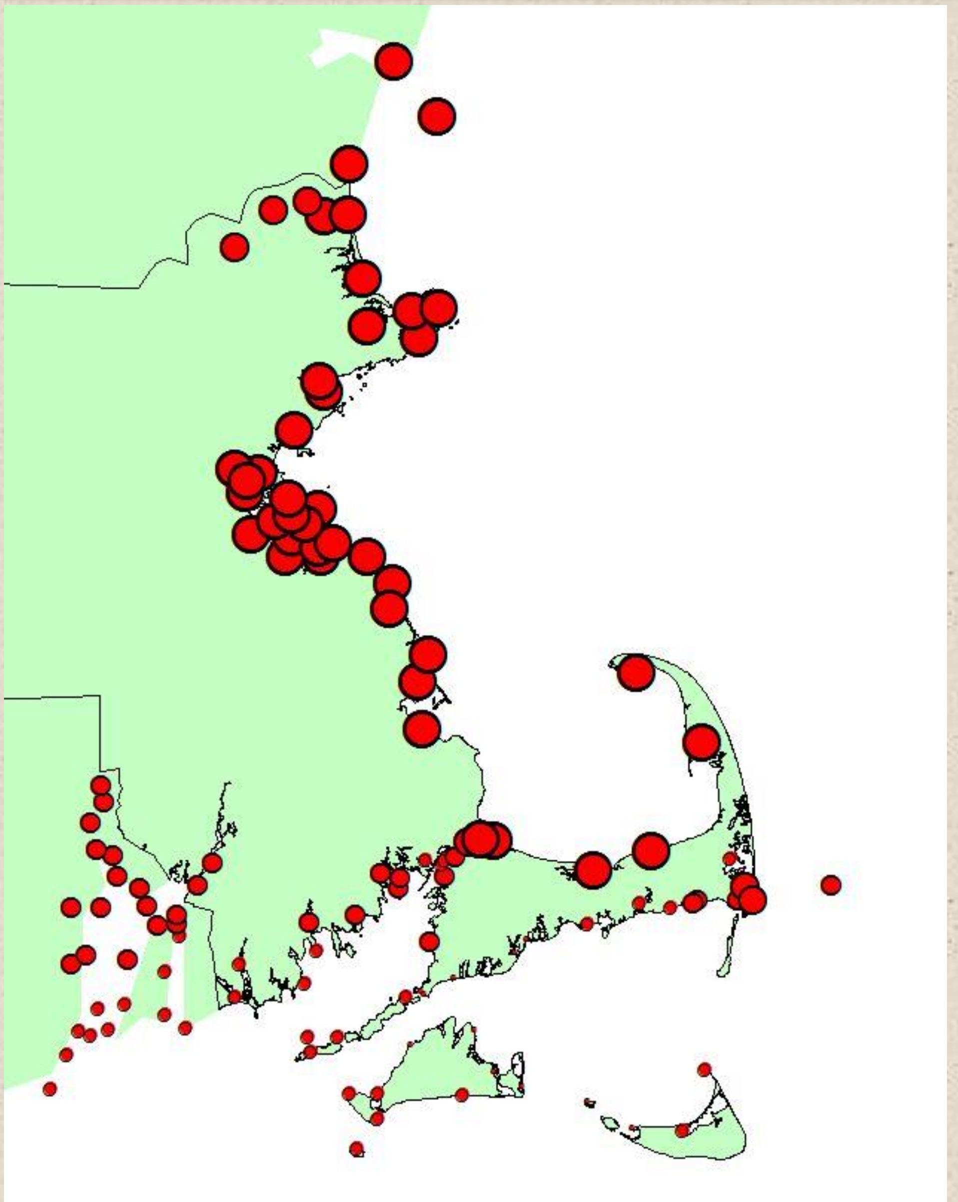
Coastal alteration metrics

Salt marsh ditching



Coastal alteration metrics

Tidal restrictions

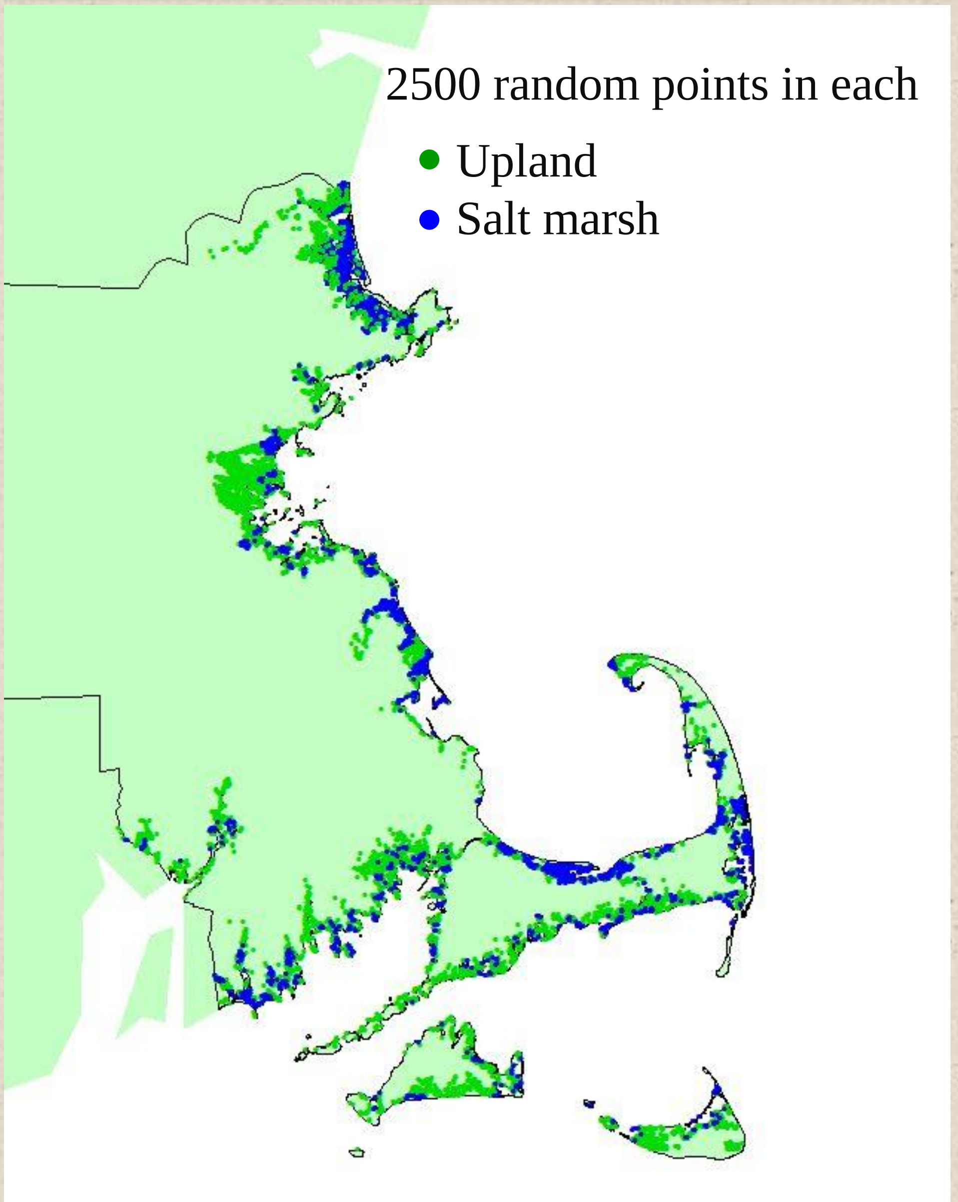


1. Estimate "tidal regime" (from mapped salt marsh)

- Mean tidal range from 120 NOAA tide stations, interpolated for entire coast

Coastal alteration metrics

Tidal restrictions



1. Estimate "tidal regime" (from mapped salt marsh)

Logistic regression:
salt marsh vs. upland
= dem + tide range + dummy

$P < 0.001$
correct classification rate = 91%

	salt marsh	upland
salt marsh	2259	296
upland	149	2406

Coastal alteration metrics

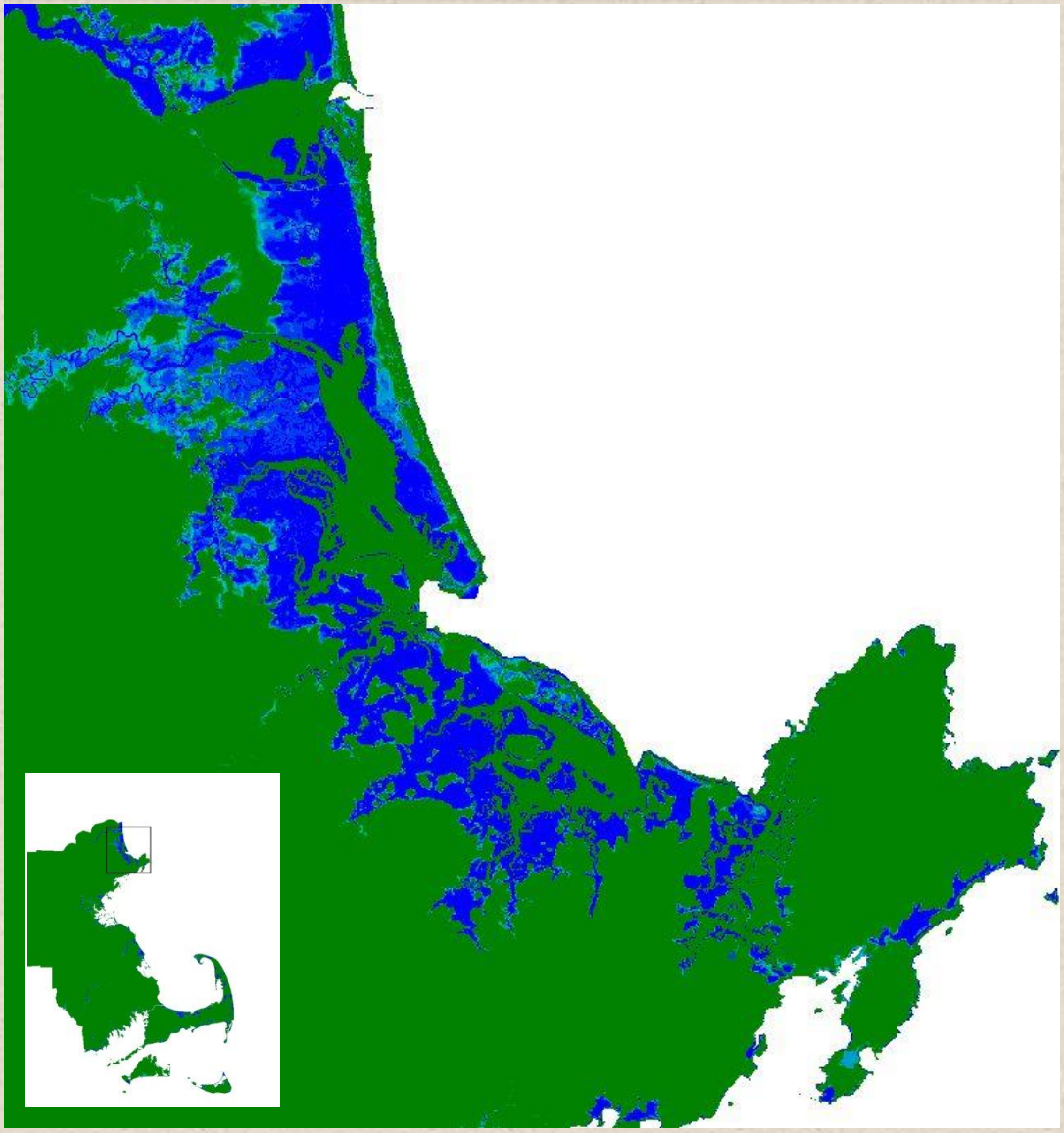
Tidal restrictions

1. Estimate "tidal regime" (from mapped salt marsh)

Tides settings variable:
ranges from 0~1
≈ *P*(salt marsh)

Coastal alteration metrics

Tidal restrictions



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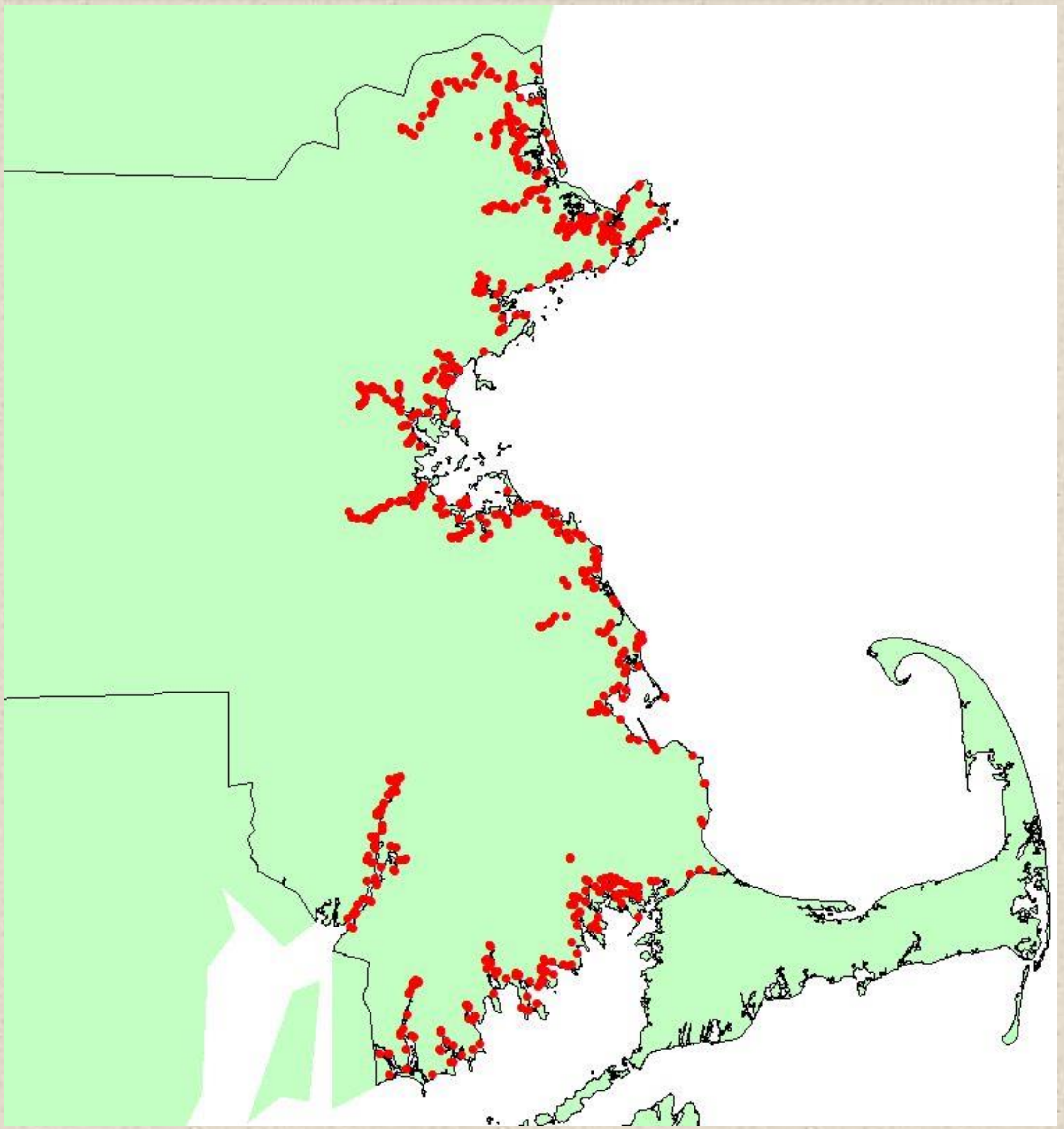
Tides settings variable ranges from 0~1 ≈ P(salt marsh)

Coastal alteration metrics

Tidal restrictions

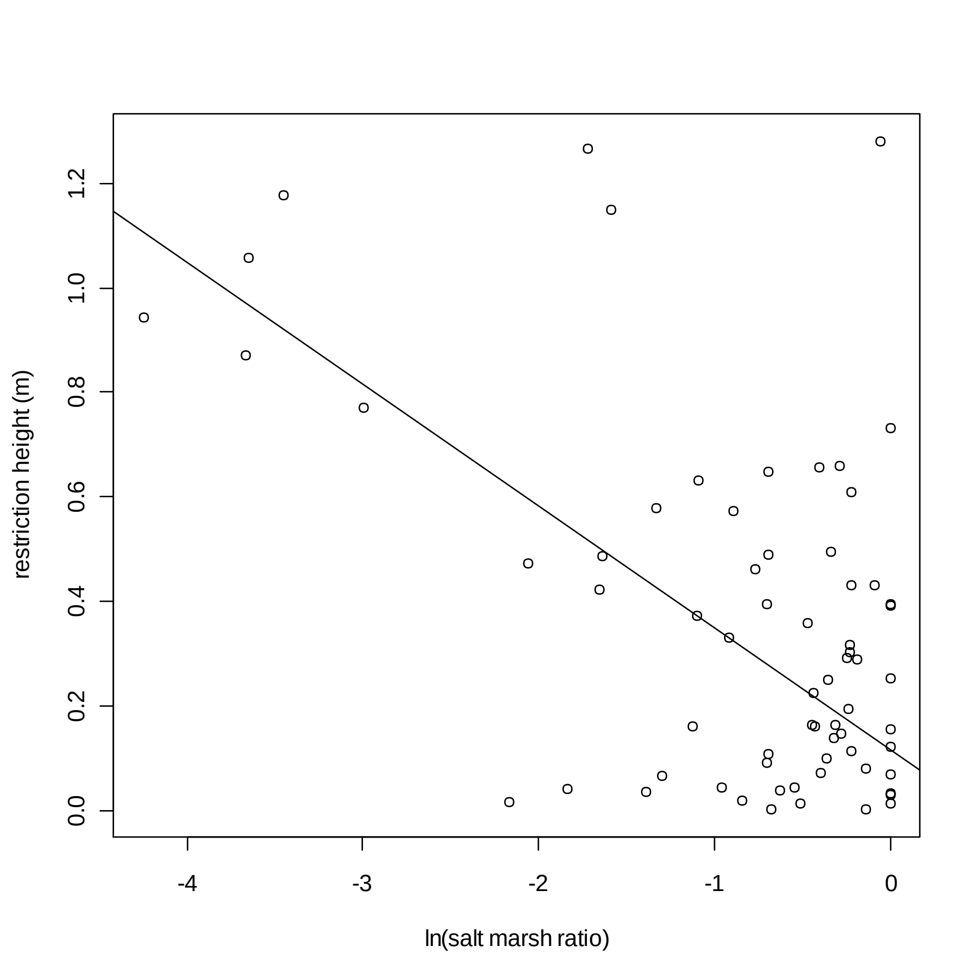


2. Estimate severity of tidal restrictions (from field gauges)

● Estimated tidal restriction points (Cape & islands currently missing)

Coastal alteration metrics

Tidal restrictions



2. Estimate severity of tidal restrictions (from field gauges)

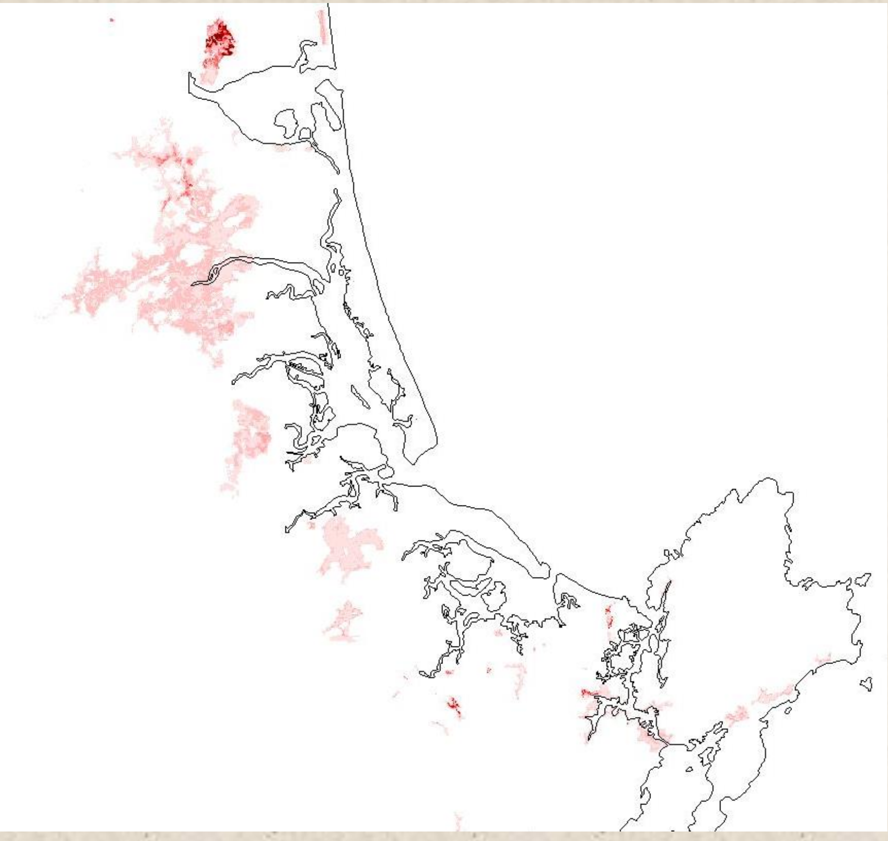
Restriction height =
0.11799 – 0.23254 x ln(min(1,observed sm/predicted sm)) [weighted by predicted]

$n = 67$
$P < 0.001$
$r^2 = 0.41$

Applied to 745 modeled tidal restrictions (crossings of 1st & 2nd order streams). This covers an estimated 80% of restrictions.

Coastal alteration metrics

Tidal restrictions



3. Compute tidal restriction metric

For each watershed,

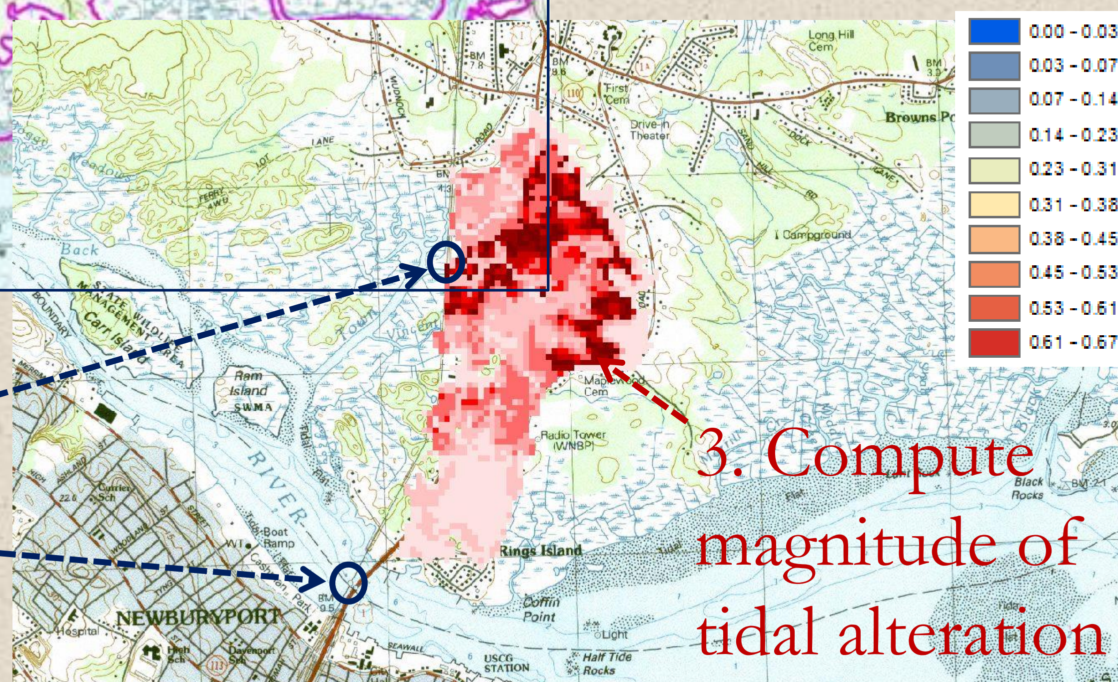
- Follow watershed up, tracking maximum restriction height
- Subtract restrictions from mean tidal range
- Recalculate **tides** settings variable (this time, taking restrictions into account)
- $TR = tides – tides_{restricted}$

Coastal alteration metrics

Tidal restrictions

1. Estimate “tidal regime”

2. Estimate severity of tidal

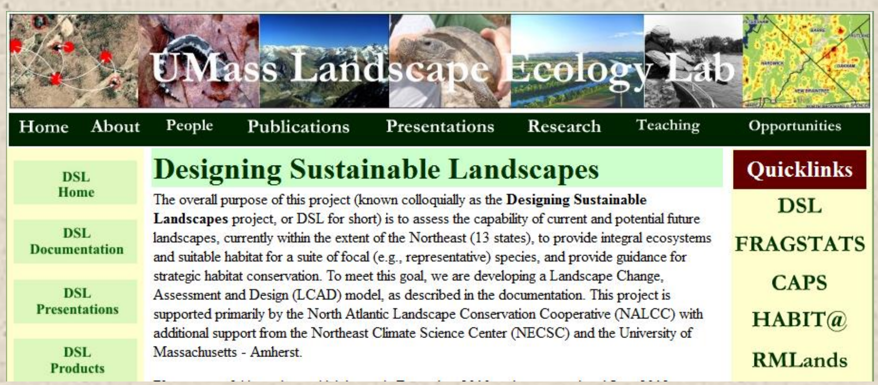


3. Compute magnitude of tidal alteration

For More Information

- **Project website:**

  www.umass.edu/landeco/research/dsl/dsl.html



Feedback:

- **Manager online survey**

North Atlantic Landscape Conservation Cooperative Designing Sustainable Landscapes (DSL) Project

UMass Landscape Ecology Lab: Kevin McGarigal, Brad Compton, Ethan Plunkett, Bill DeLuca, Liz Willey and Joanna Grand .

Manager Feedback and Questionaire

This document is intended primarily for participants of the sub-regional workshops being held with partners of the North Atlantic Landscape Conservation Cooperative (NALCC) to review the results and provide feedback on phase 1 of the DSL project, although any NALCC partner is welcome to provide feedback. Specifically, this document includes a set of questions posed to partners concerning how best to package the landscape design information resulting from the Landscape Change, Assessment and Design (LCAD) model applied to the entire Northeast in phase 2.

Criteria for Feedback

The DSL project aims to provide regionally consistent information pertaining to biodiversity conservation planning and management across the Northeast. With this aim in mind, it is important to recognize the following criteria when providing feedback: 1). All LCAD data products must be regional (i.e., Northeast) in extent. There are lots of data that would be useful to LCAD, for example digital parcel land use zoning data, if they were available across the Northeast, but we are restricted to the use of digital data that are consistent across the Northeast. 2). Approaches for modeling landscape change, assessment and design must be technically feasible given available data and current computing resources. There may be ideal approaches that are not computationally feasible given available data and/or computing resources.

General topics

1) When the LCAD model is extended to the entire Northeast in phase 2, what is the best set of geographic tiles (units) for rescaling ecological integrity and summarizing the model results?

- ☐ By state
- ☐ By watershed (indicated preferred HUC level in the comment box below)
- ☐ By ecoregion (indicated preferred ecoregion classification and level in the comment box below)
- ☐ Other (describe alternative tiling scheme in the comment box below)

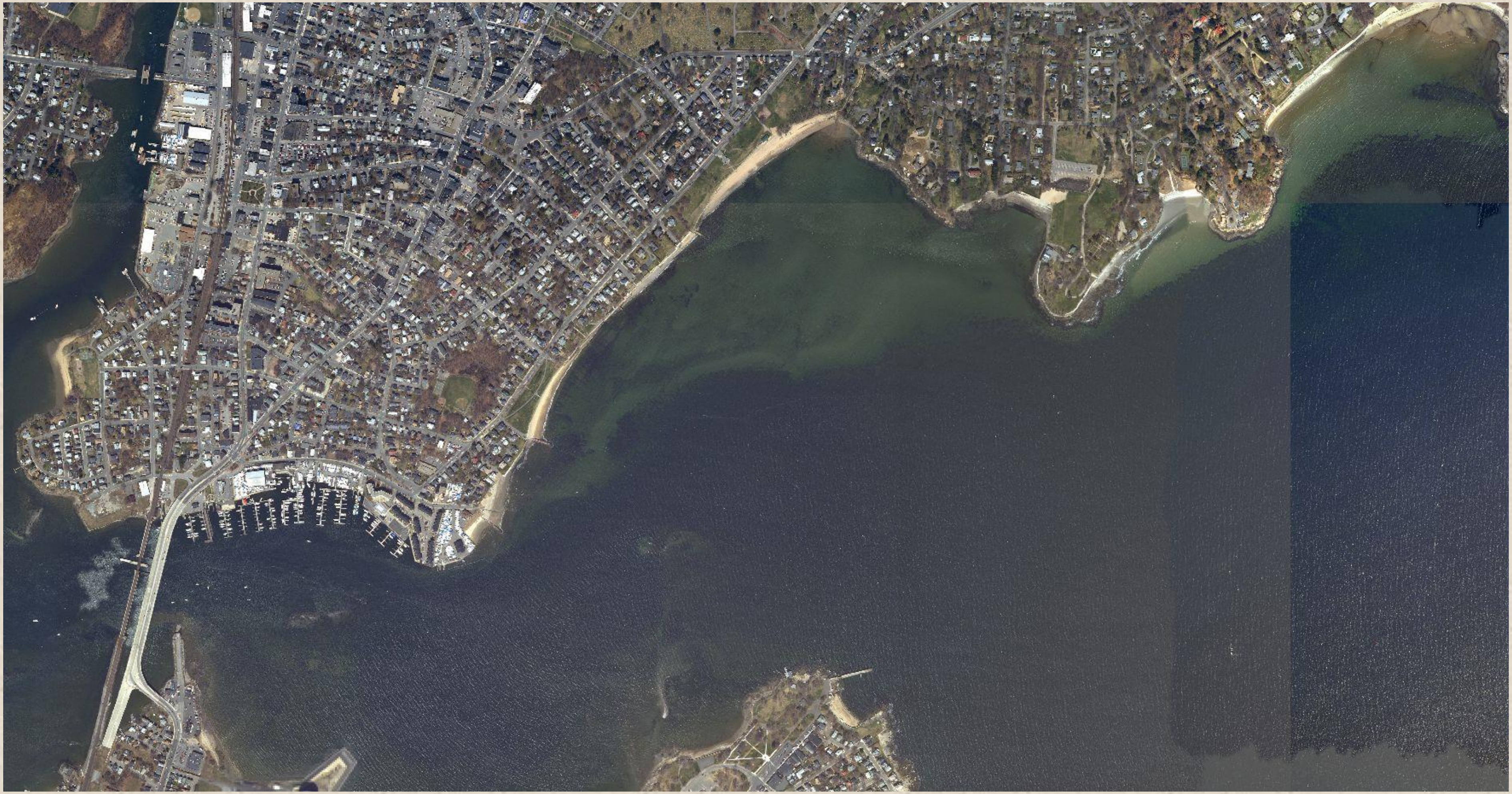
Links to products:

- **Overview**
- **Technical docs**
- **Presentations**
- **Products**

- **Personal contact:** **mcgarigalk@eco.umass.edu**
  413-577-0655

Coastal alteration metrics

Hardened coastal structures

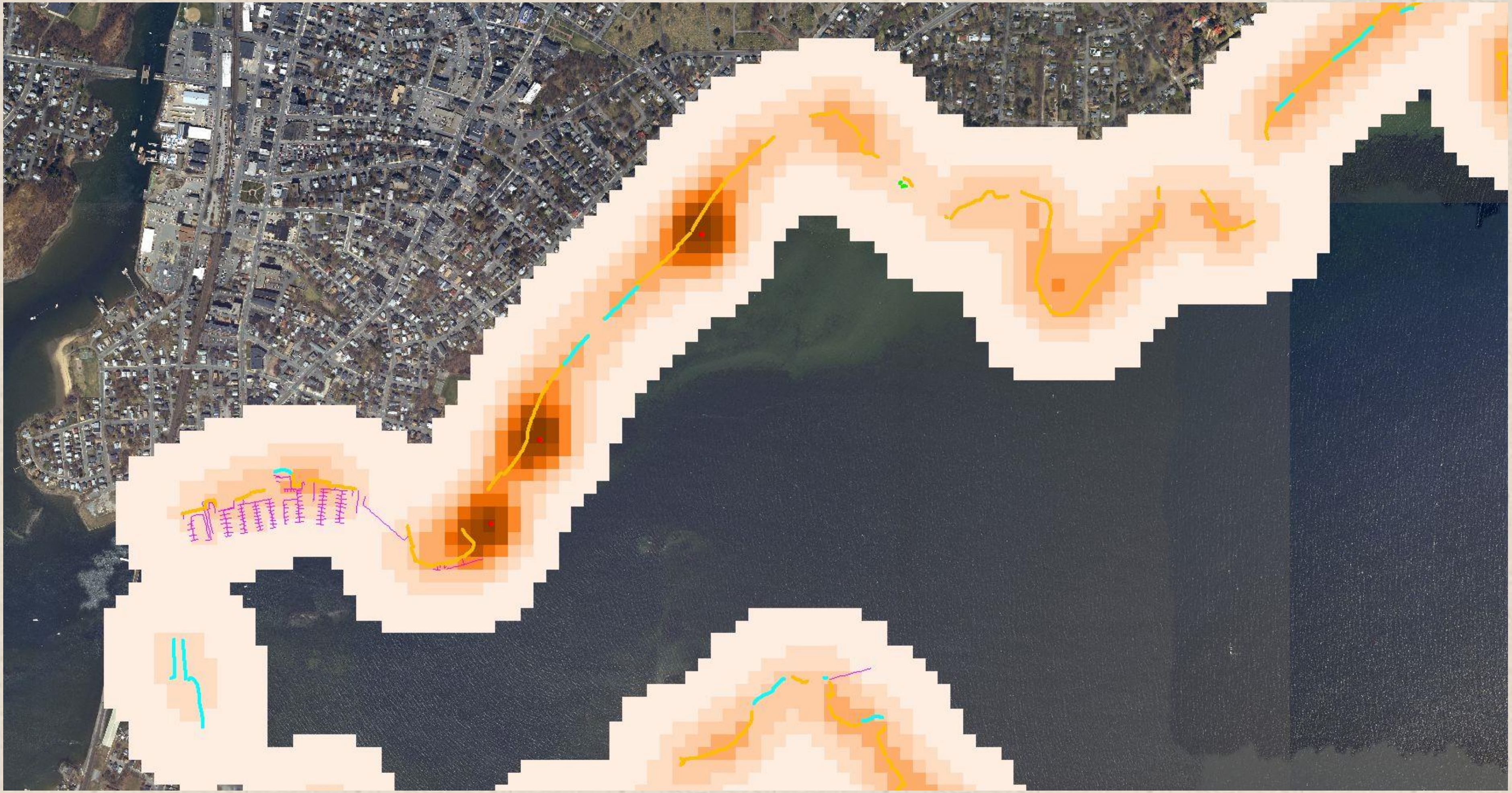


Coastal alteration metrics

Hardened coastal structures

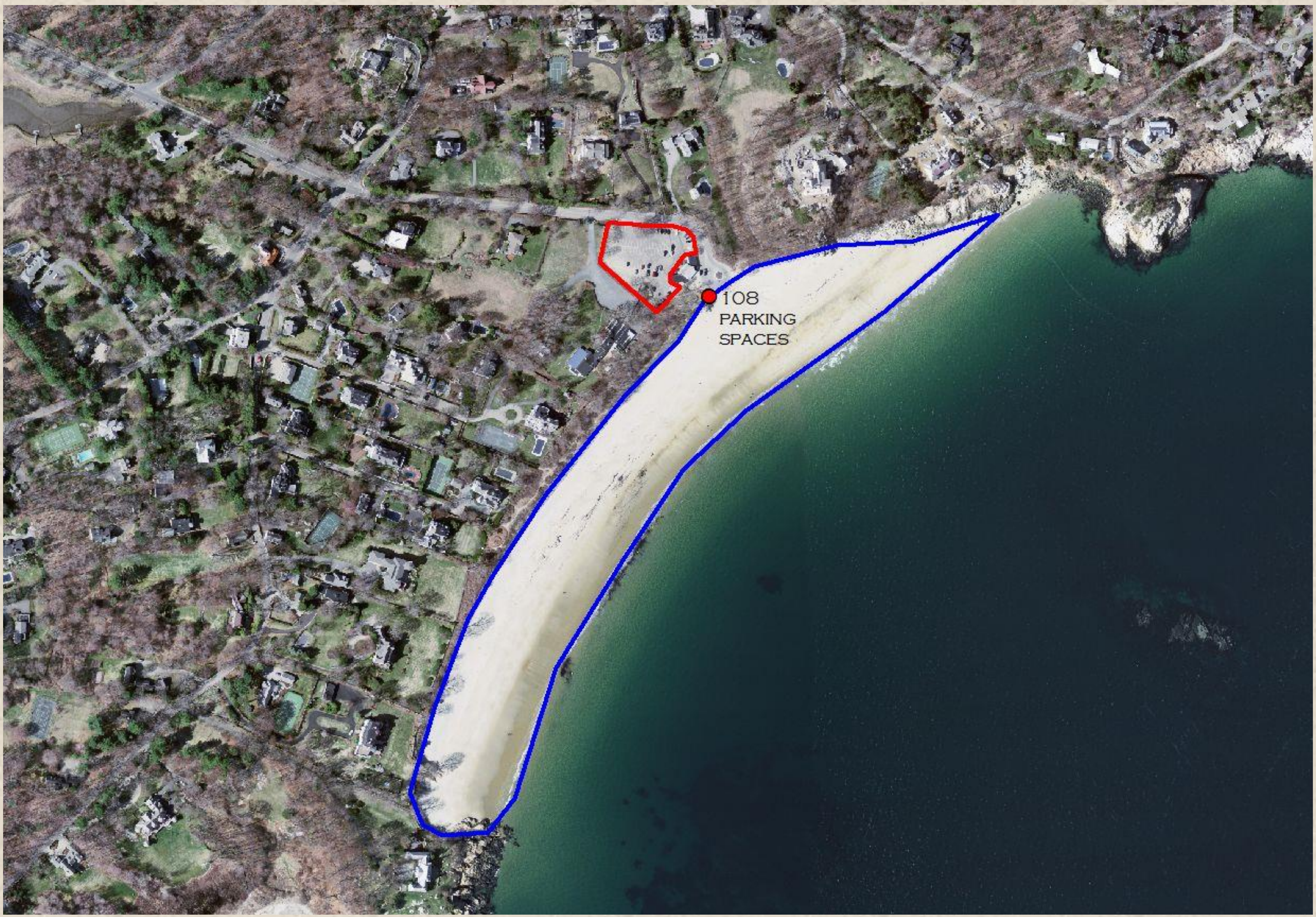
Coastal alteration metrics

Hardened coastal structures



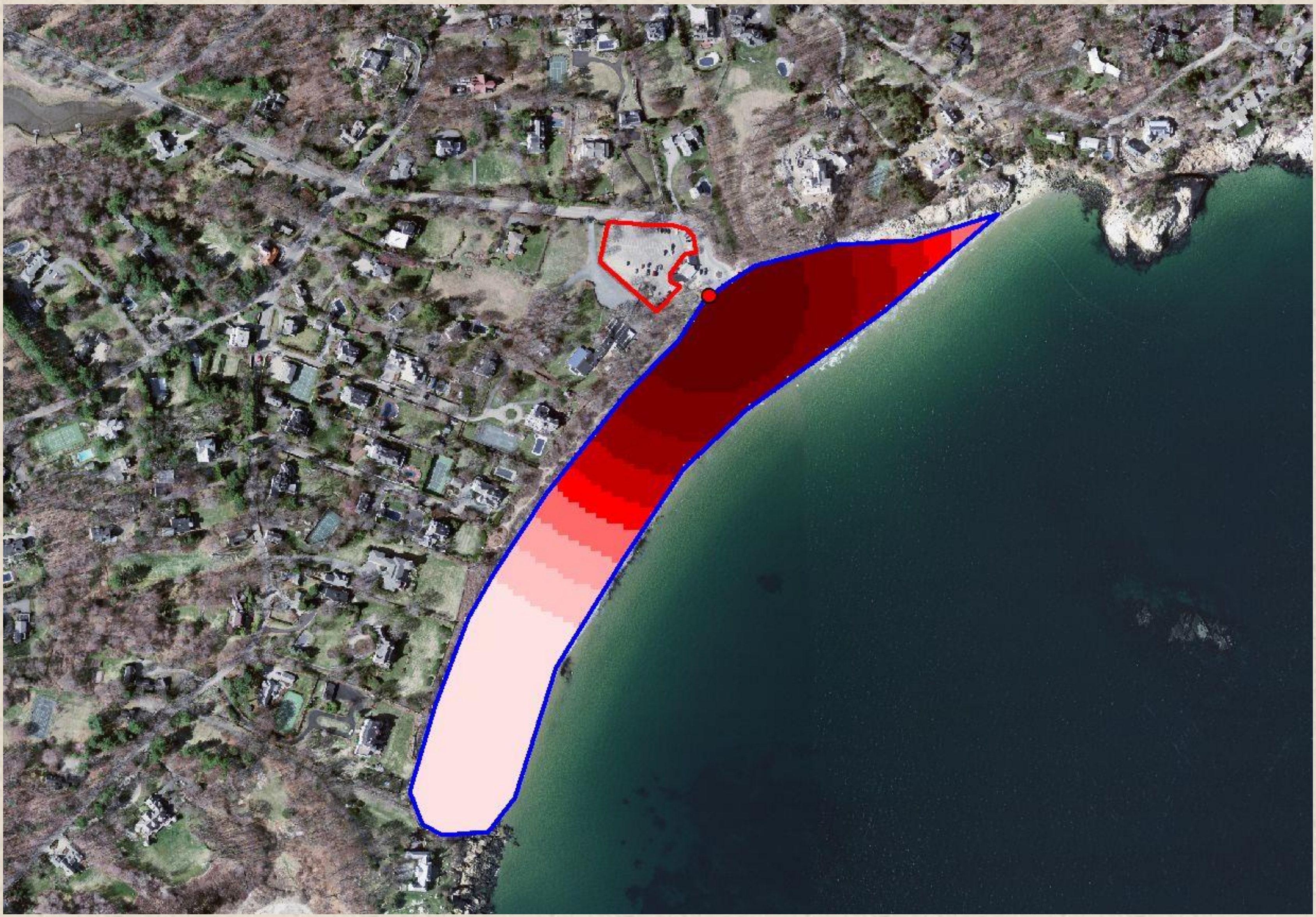
Coastal alteration metrics

Beach pedestrians



Coastal alteration metrics

Beach pedestrians



Coastal alteration metrics

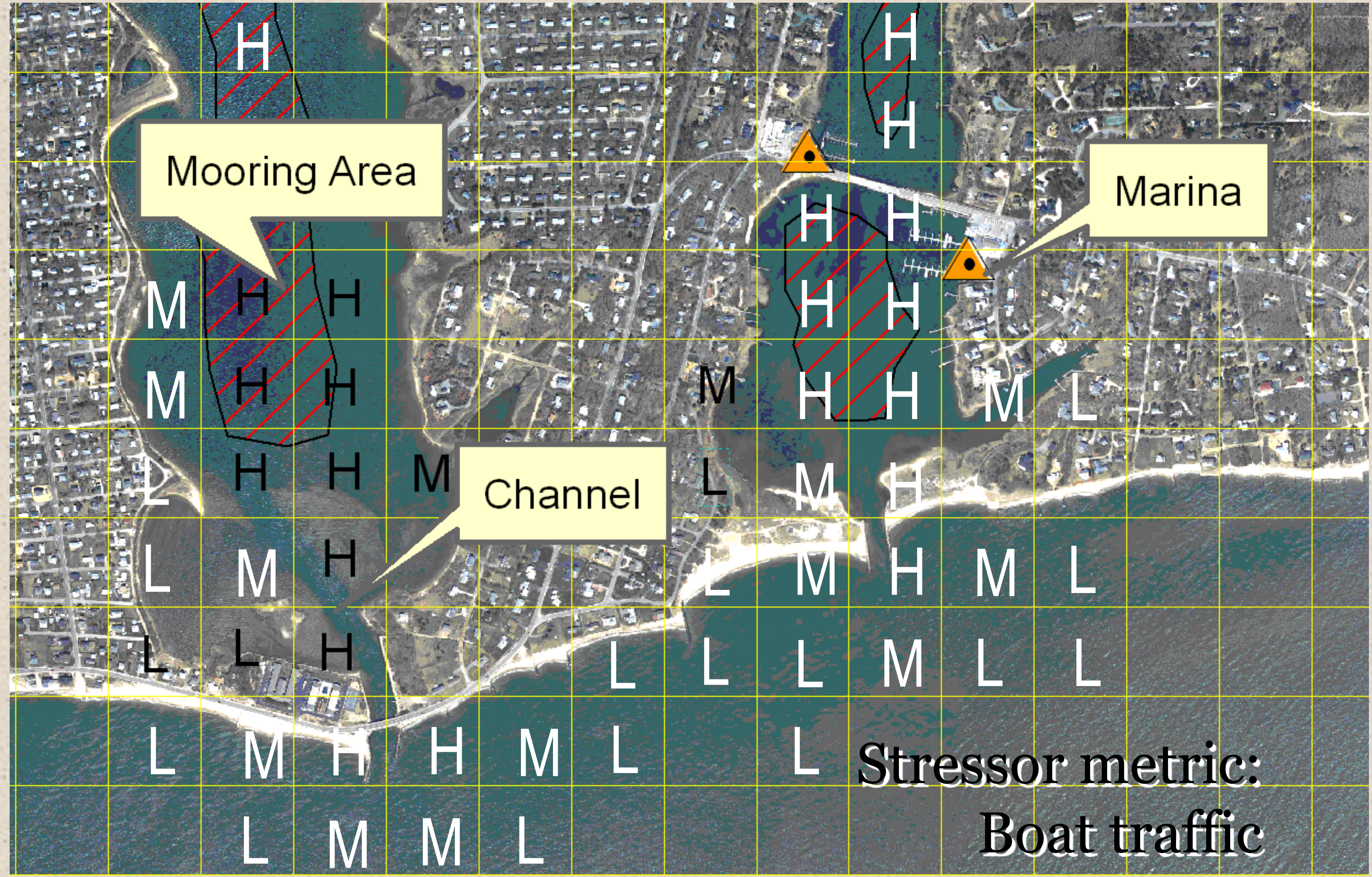
Beach ORVs

Coastal alteration metrics

Beach ORVs

Coastal alteration metrics

Boat traffic



Coastal alteration metrics

Boat traffic