Coastal Community Vulnerability & Resilience Assessment

Greenwich Township, New Jersey

April 4, 2011 Summary Presentation

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New Jersey Coastal Management Office

Outline

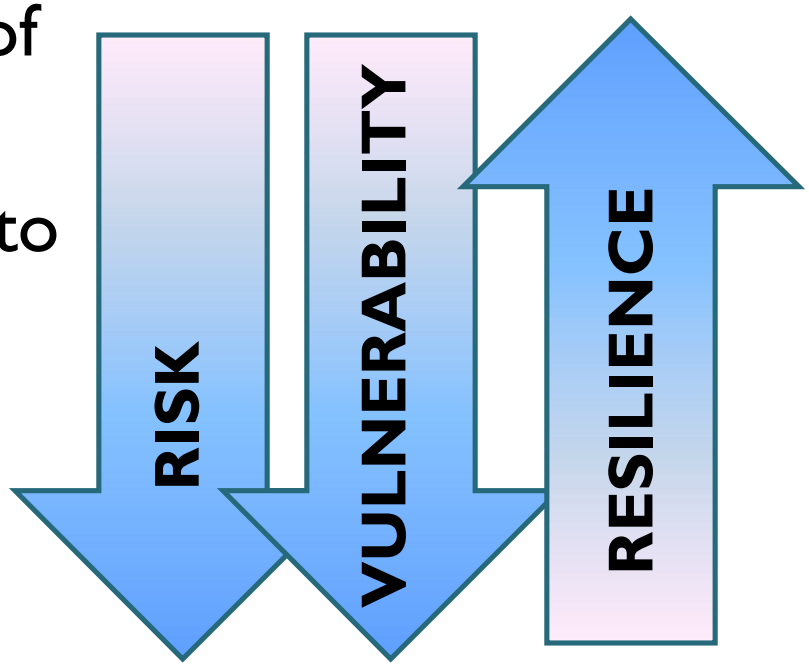
- Project Description
- Background: Hazards and Sea Level Rise
- Part I: Coastal Vulnerability Mapping
- Part II: "Getting to Resilience" Questionnaire
- Research Findings

Project Description

- Pilot of Two Tools Developed by NJOCM
  - Coastal Community Vulnerability Assessment Protocol- GIS Mapping
  - Getting to Resilience Questionnaire
- Outreach Goals
  - To Provide Coastal Communities with Information on Hazards and Sea Level Rise
  - To Help Local Decision Makers Identify Opportunities to Improve Local Resilience

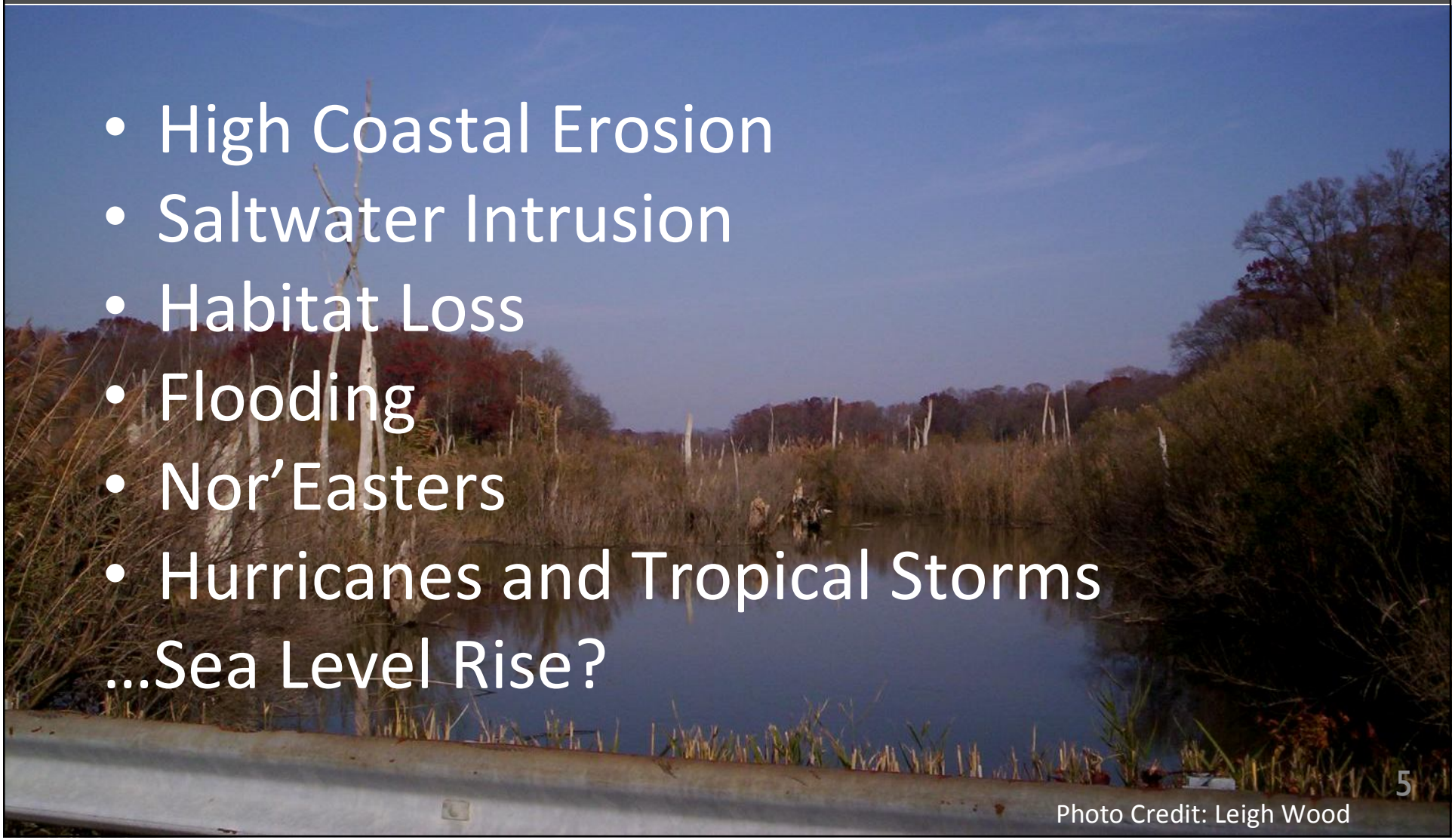
Definitions

- **Risk --** "the type and severity of a hazard and its frequency of occurrence." [1]
- **Vulnerability –** "the degree to which a human or natural system is unable to cope with adverse effects." [2]
- **Resilience --** "the ability of a system to respond and recover from disasters." [3]



[1] US Indian Ocean Tsunami Warning System. 2007. *How Resilient is Your Coastal Community?*
[2] Worldwatch Institute. 2009. *State of the World.*
[3] S. Cutter (2009)

Focus on the Delaware Bay

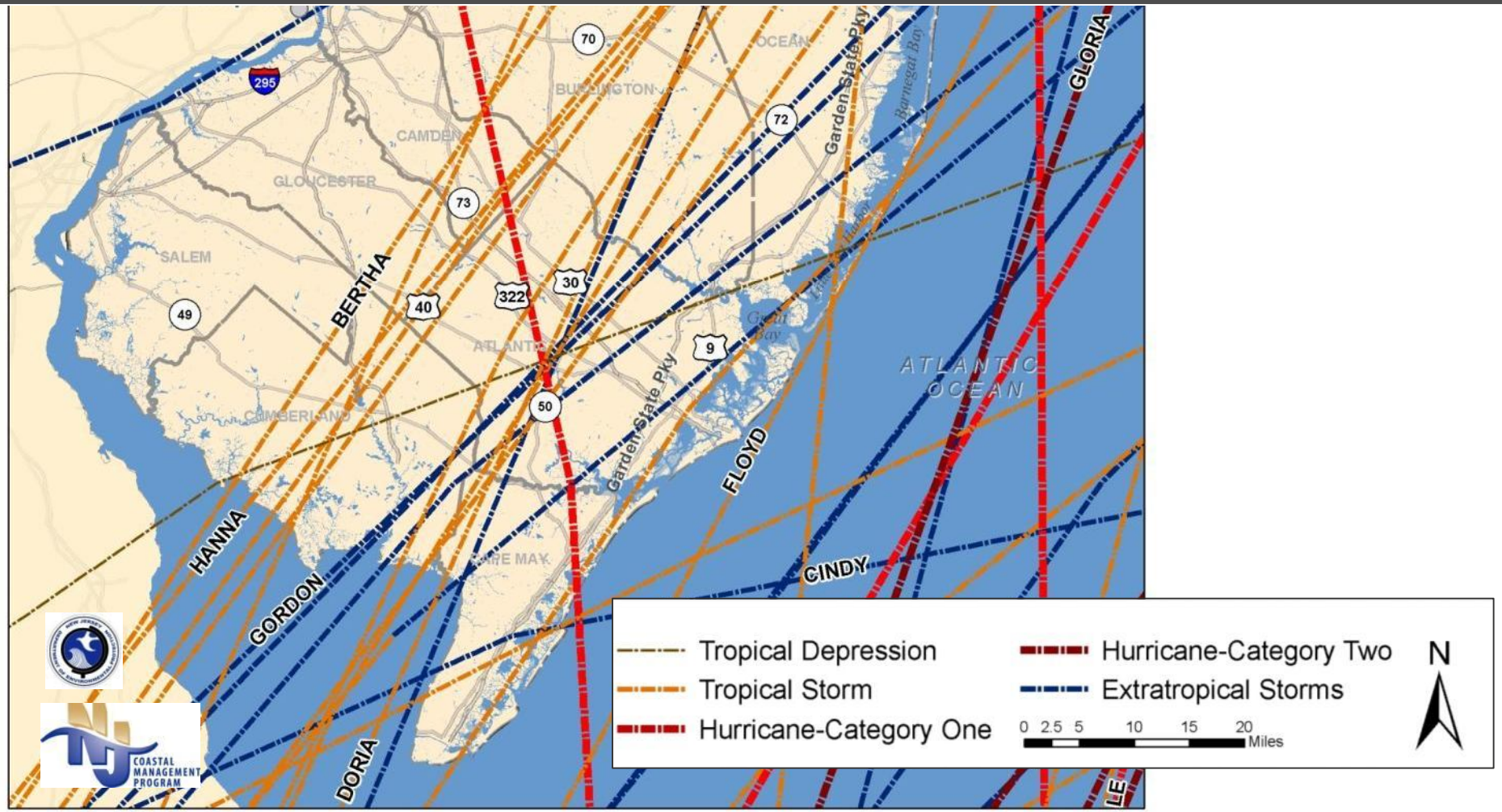


- High Coastal Erosion
- Saltwater Intrusion
- Habitat Loss
- Flooding
- Nor'Easters
- Hurricanes and Tropical Storms

…Sea Level Rise?

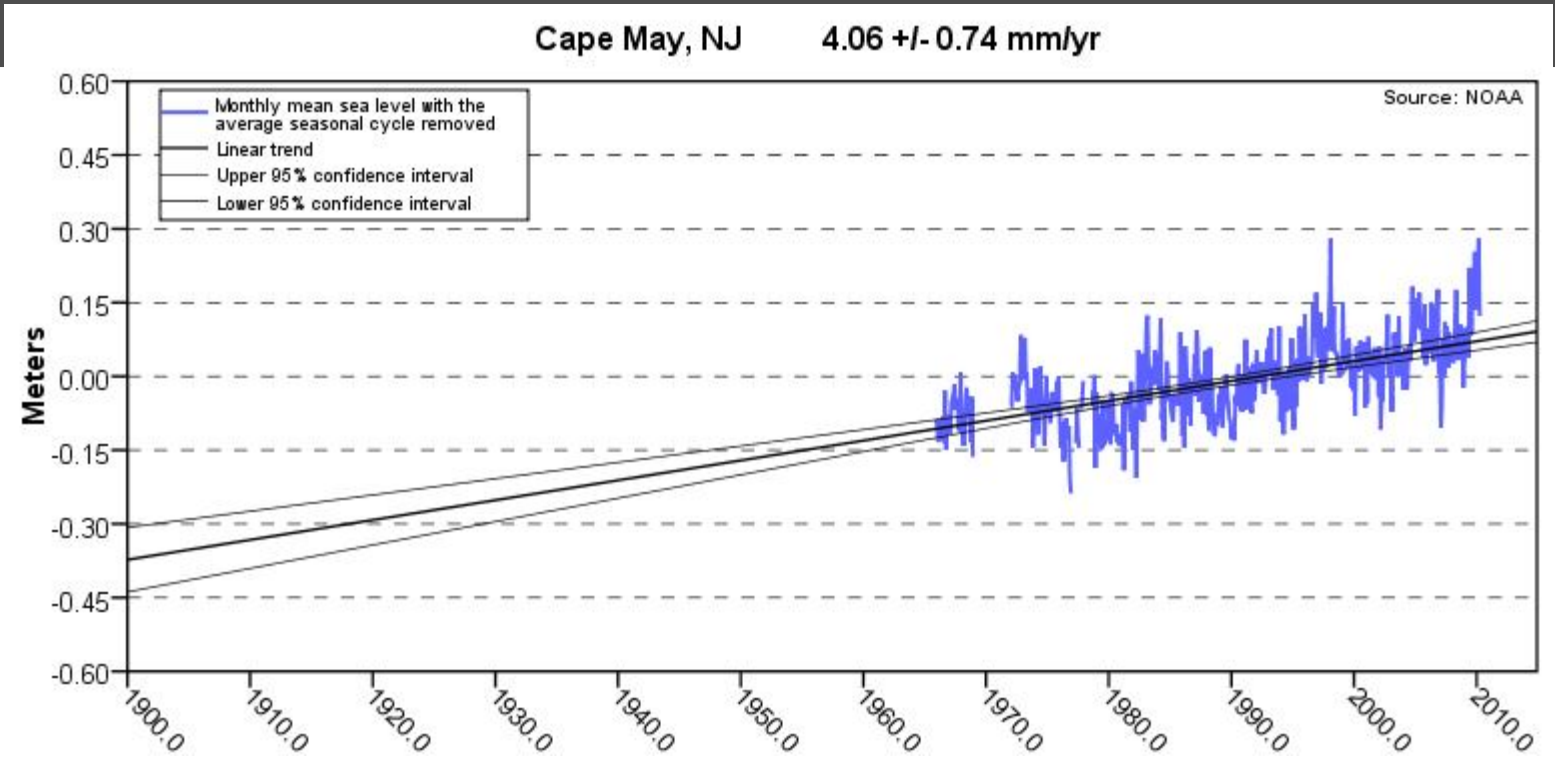
Photo Credit: Leigh Wood

Historic Storm Tracks 1850-2008



Storm Track GIS Source: NOAA Coastal Services Center

Sea Level Rise on the Delaware Bay



Cape May, NJ Relative SLR Trend:~ 4 mm/year (~15.8 in/century)[1]

Delaware Estuary Relative SLR Projections: ~ 19.7 – 59.1 in x 2100[2]

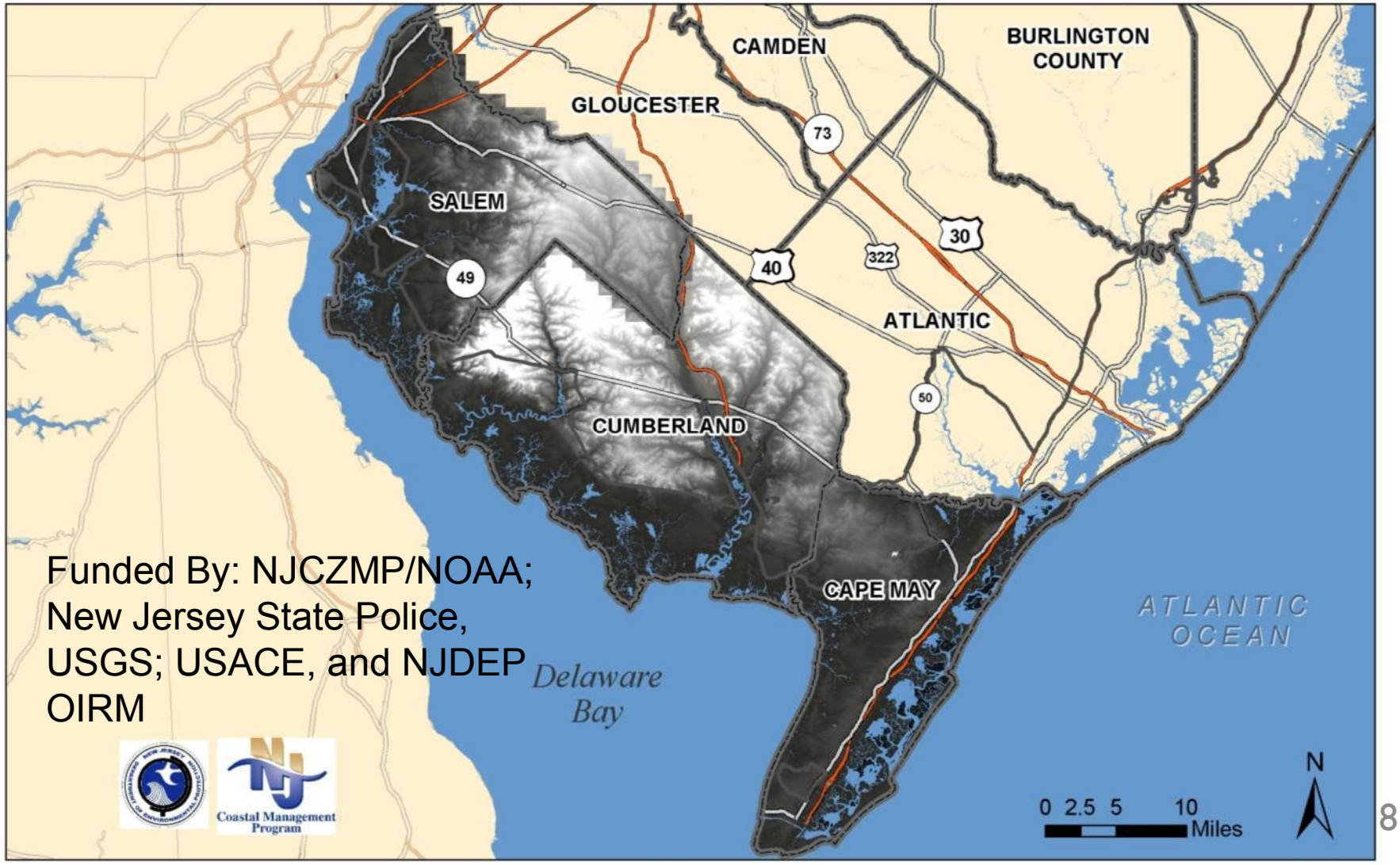
IPCC Global SLR Projections: 7.1 – 23.2 in x 2100[3]

Global Projections Underestimate Local Rates of Sea Level Rise!

1. NOAA. 2010. Sea Level Rise Trends. http://tidesandcurrents.noaa.gov/sltrends/sltrends_station.shtml?stnid=8536110
2. Partnership for the Delaware Estuary. 2010. Climate Change and the Delaware Estuary. P. 6
3. IPCC. 2007. Fourth Assessment Report

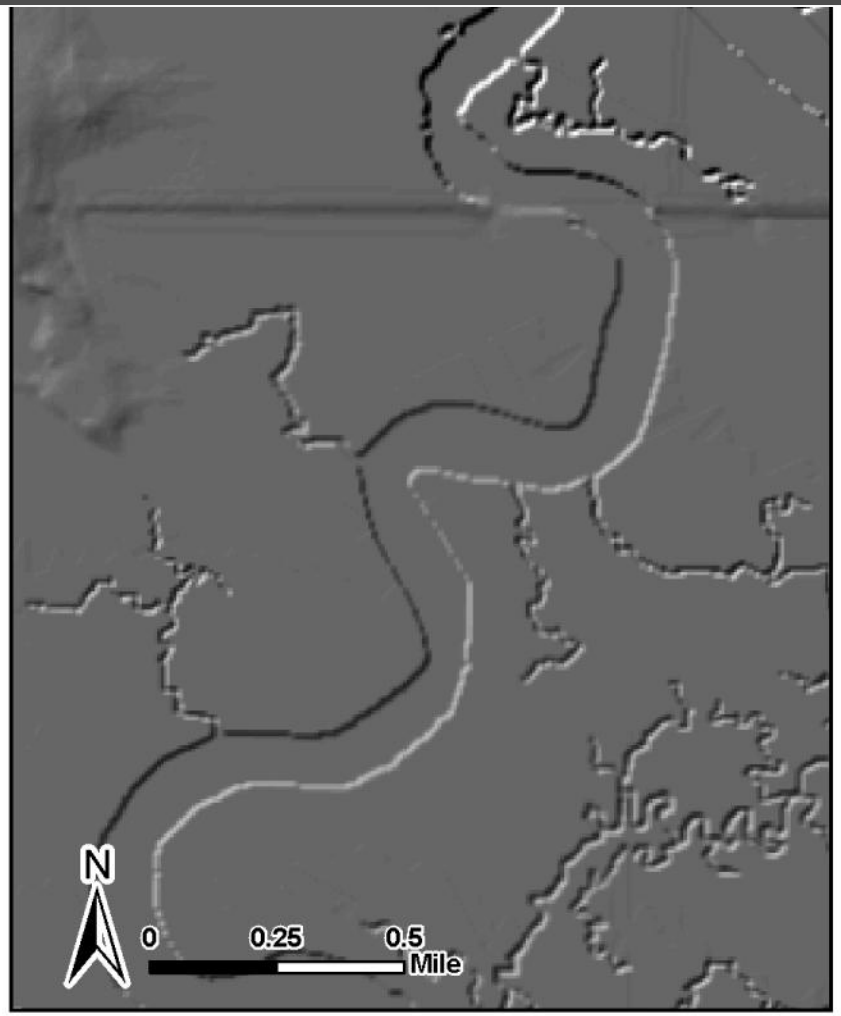
Elevation Data Improvements

LiDAR Acquisition

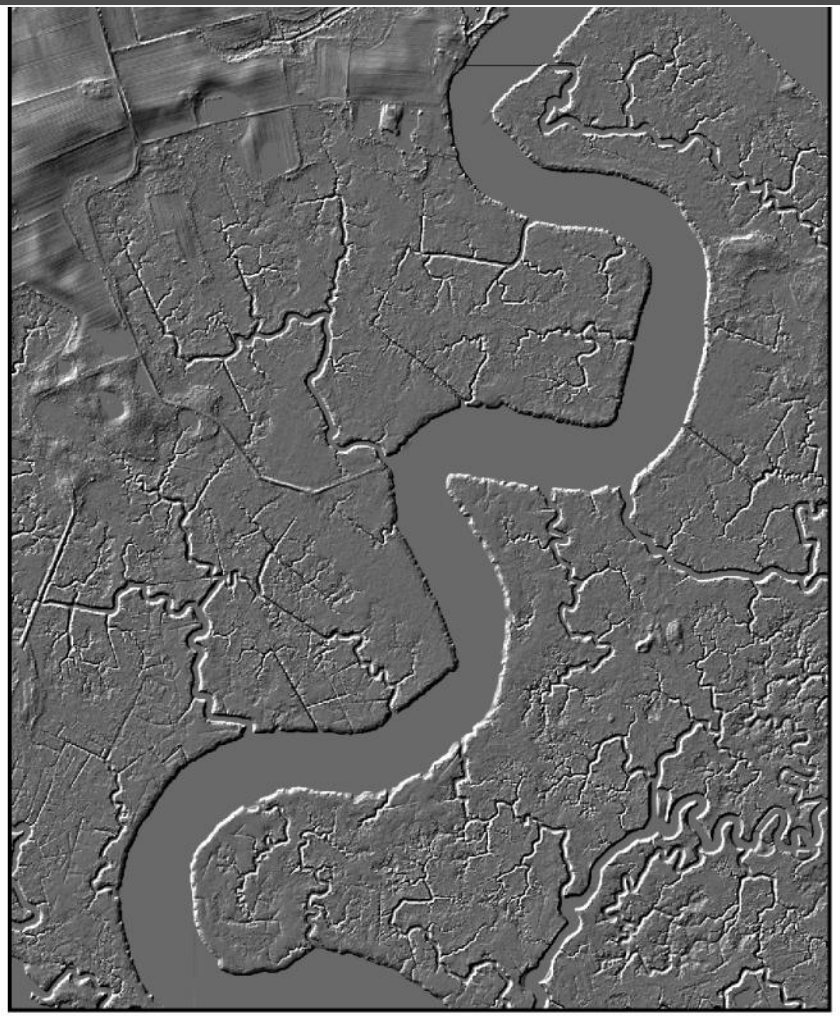


Funded By: NJCZMP/NOAA; New Jersey State Police, USGS; USACE, and NJDEP OIRM

Elevation Data Improvements



10 METER DIGITAL ELEVATION MODEL

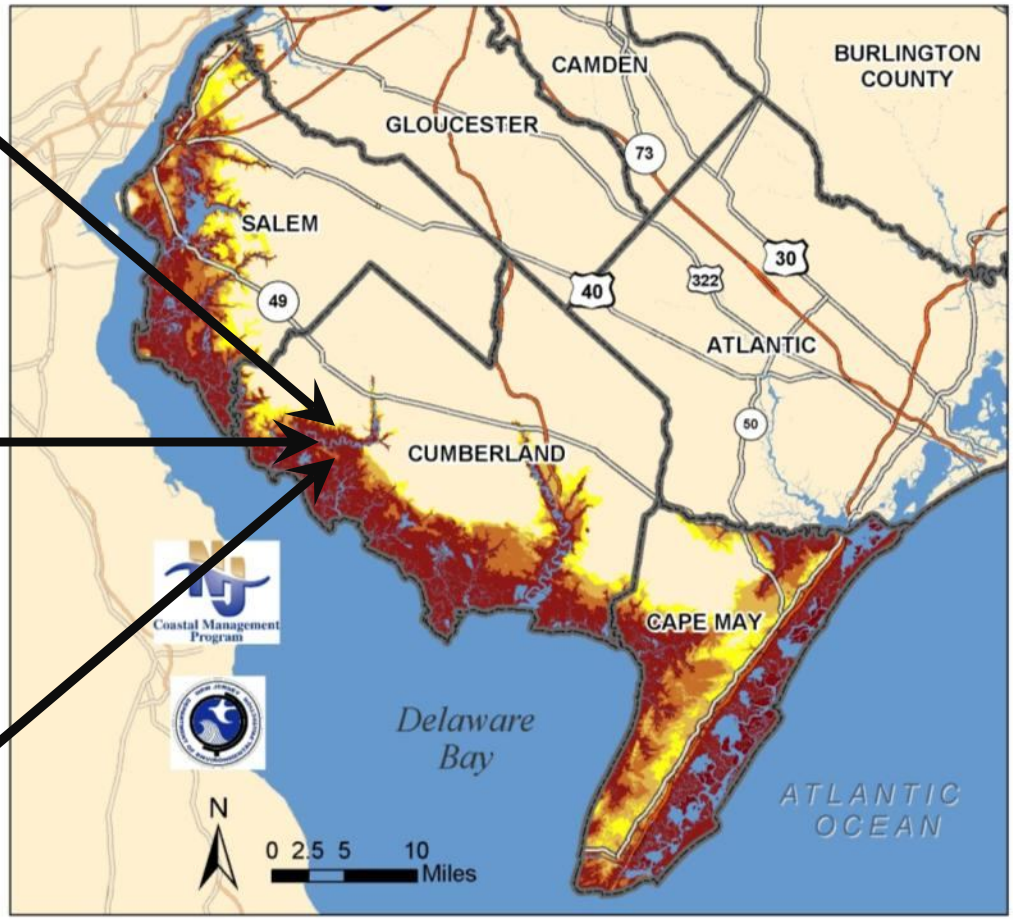


2 METER DIGITAL ELEVATION MODEL

Part I
Coastal Community Vulnerability Assessment Protocol

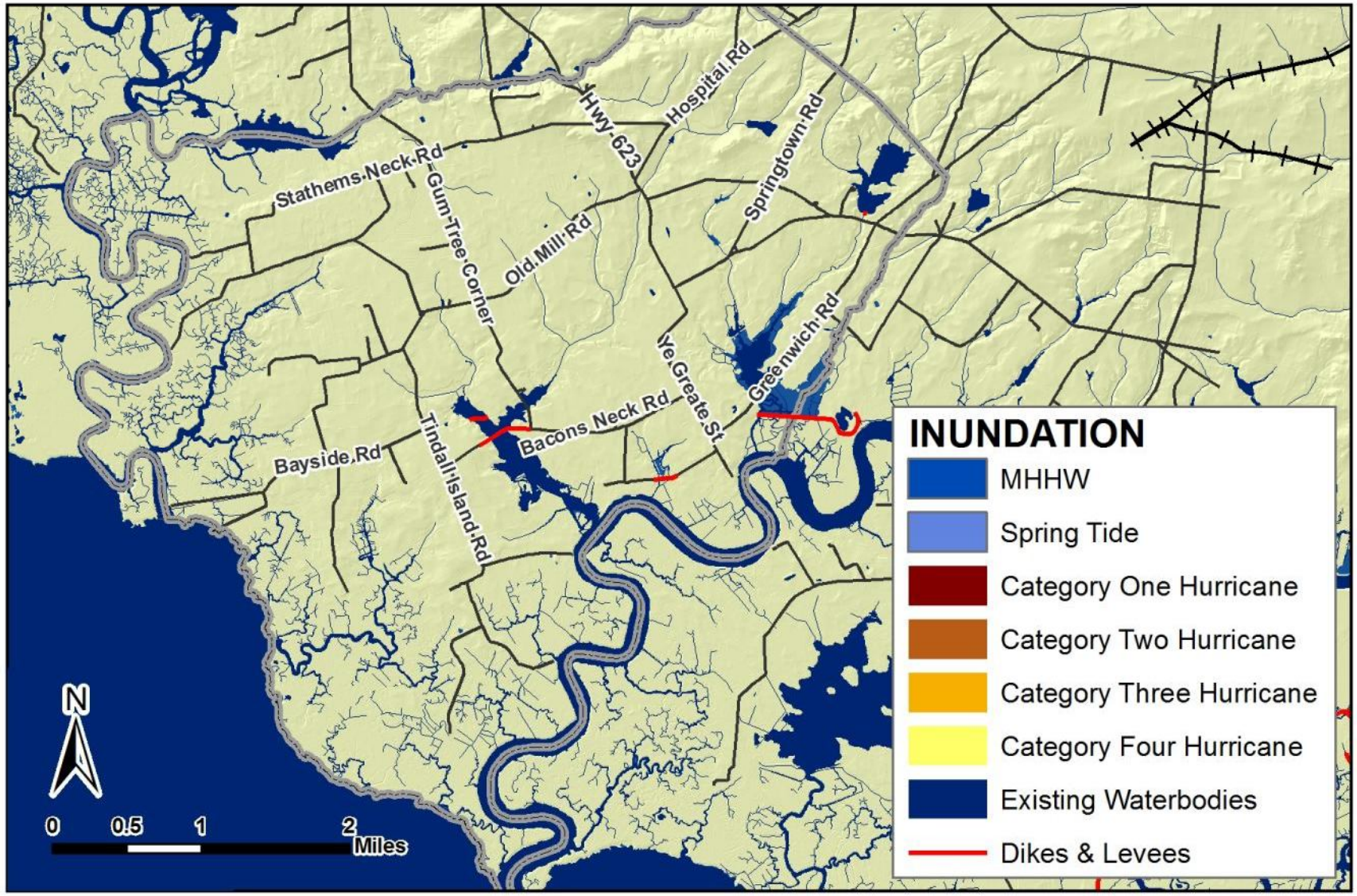
Photo Credit: Carey Hedlund

Coastal Community Vulnerability Assessment Protocol

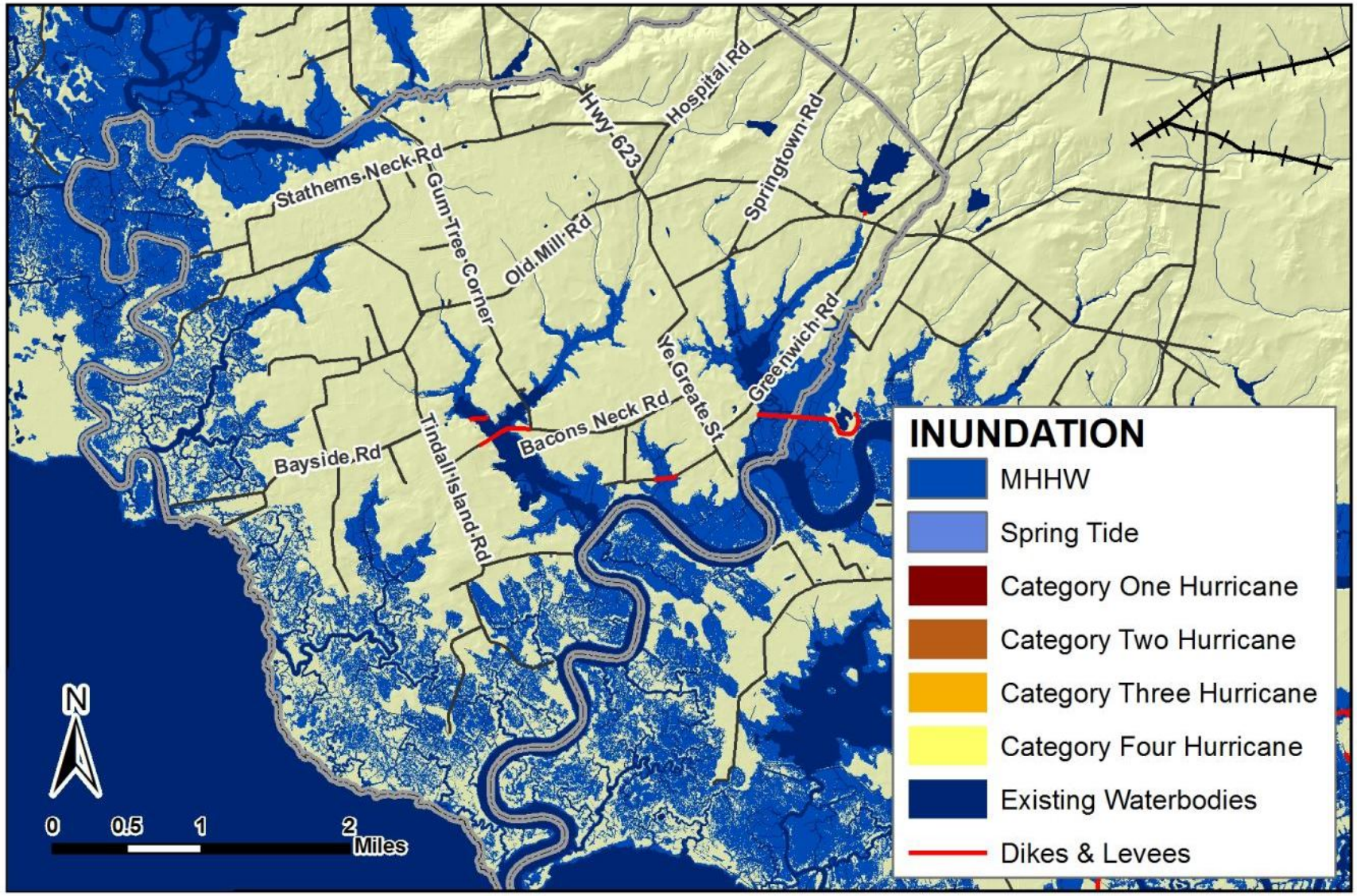


Methods Defined By: NOAA CSC; Hazard & Vulnerability Institute

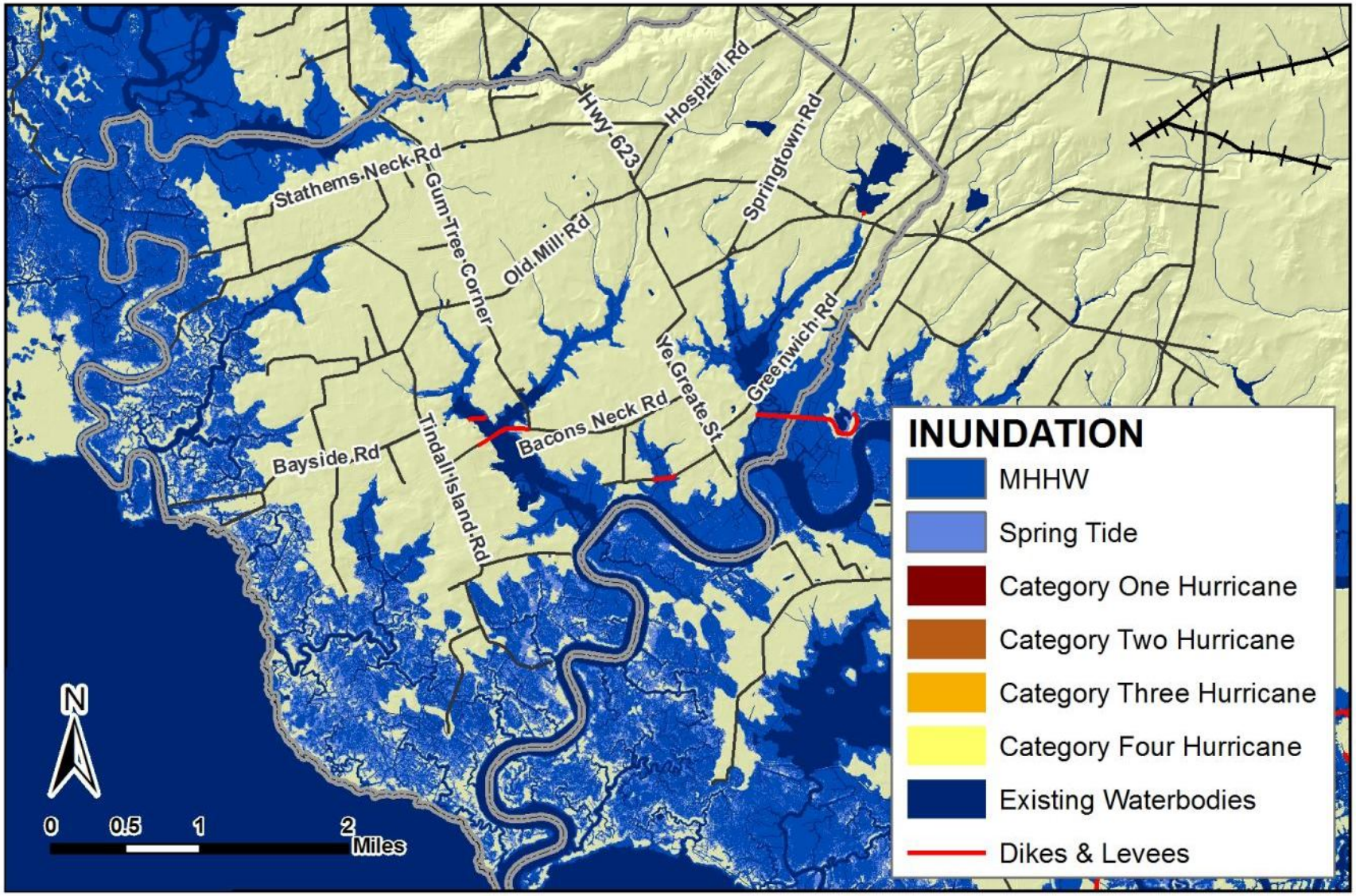
Present Conditions



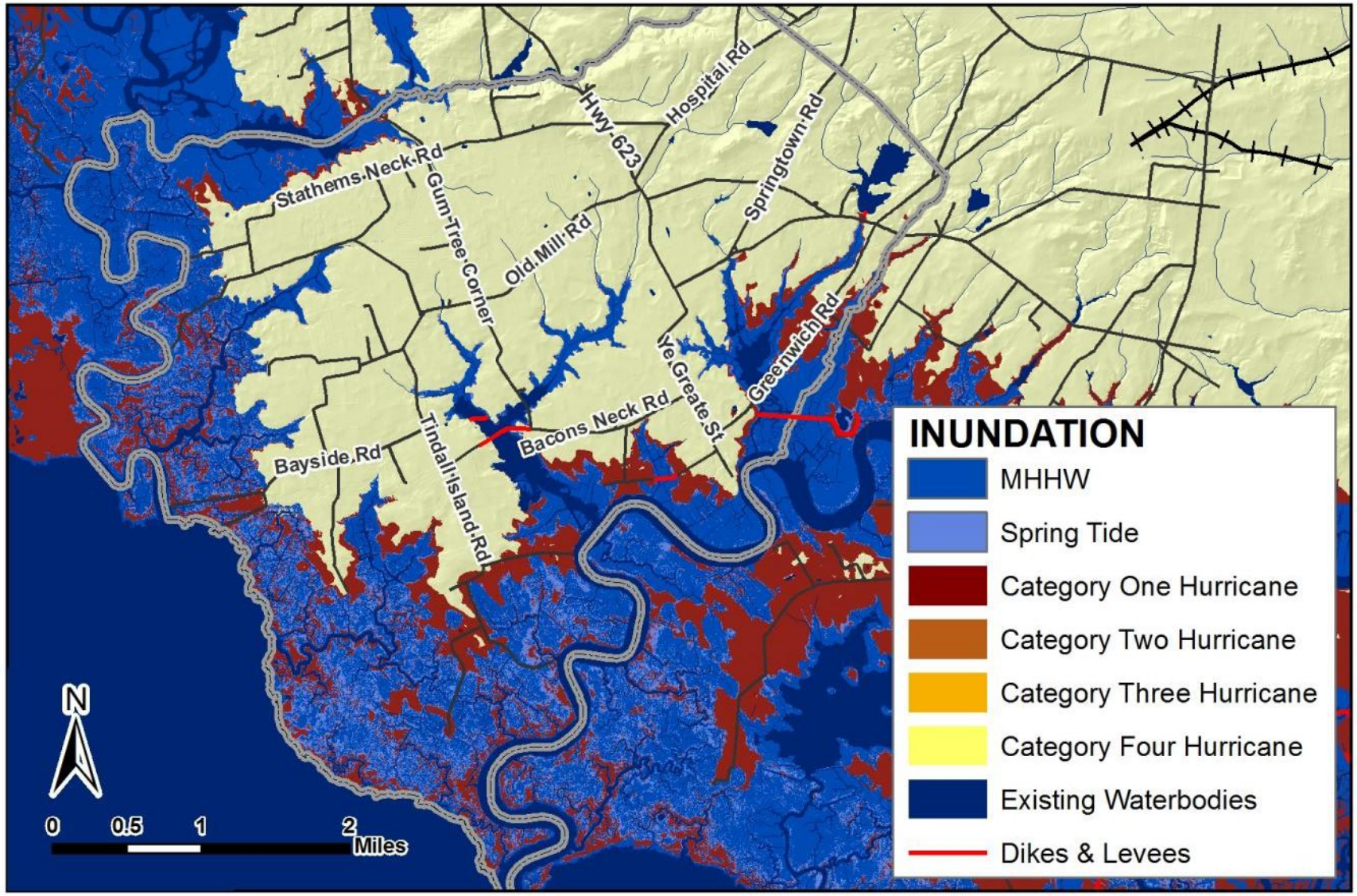
Mean High Higher Water



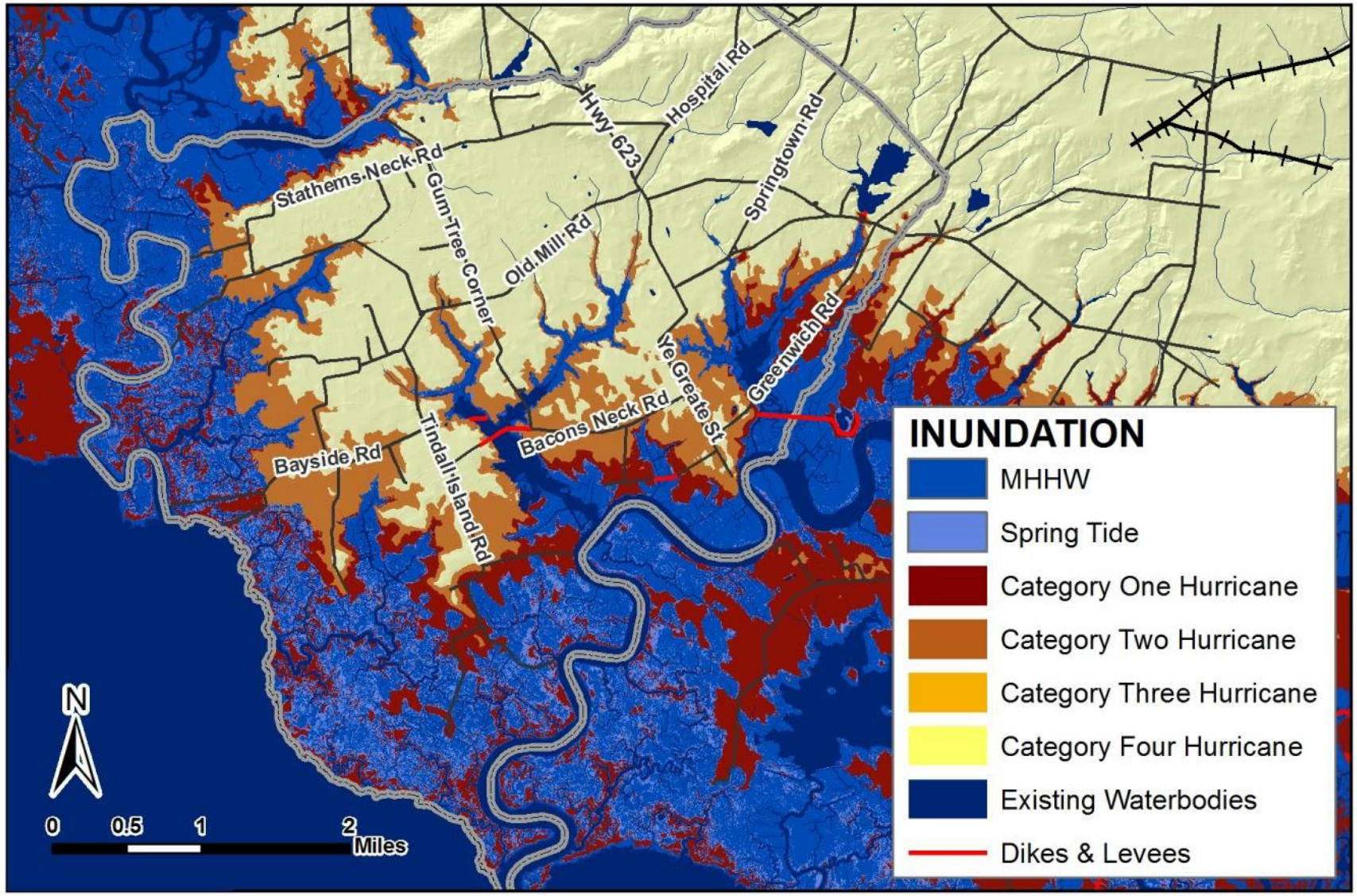
Spring Tide


Stathems Neck Rd
Gum Tree Corner
Old Mill Rd
Hwy 623
Hospital Rd
Springtown Rd
Greenwich Rd
Ye Greate St
Bacons Neck Rd
Bayside Rd
Tindall Island Rd
N
0
0.5
1
2
Miles
INUNDATION
MHHW
Spring Tide
Category One Hurricane
Category Two Hurricane
Category Three Hurricane
Category Four Hurricane
Existing Waterbodies
Dikes & Levees

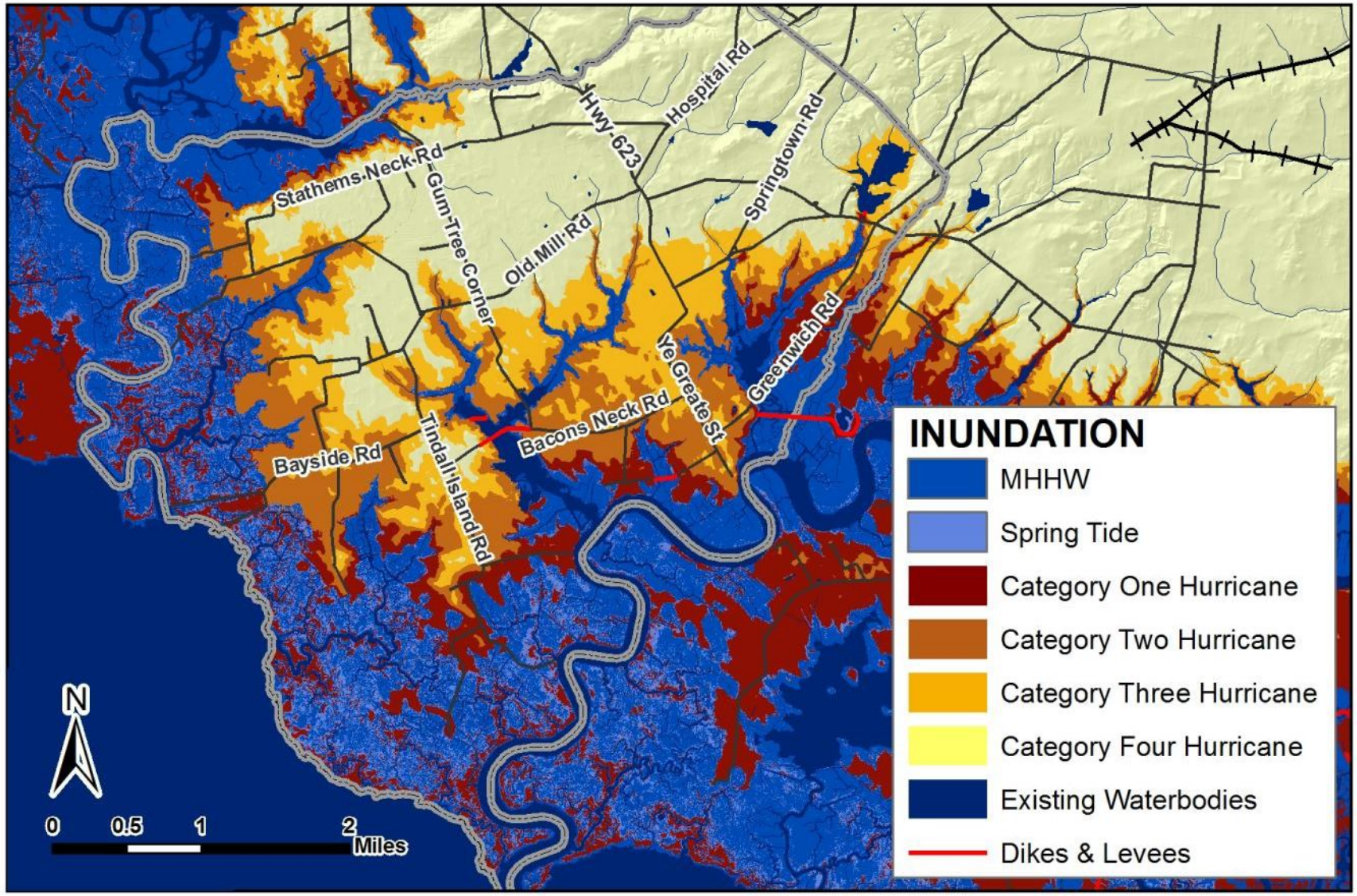
Storm Surge
Category One



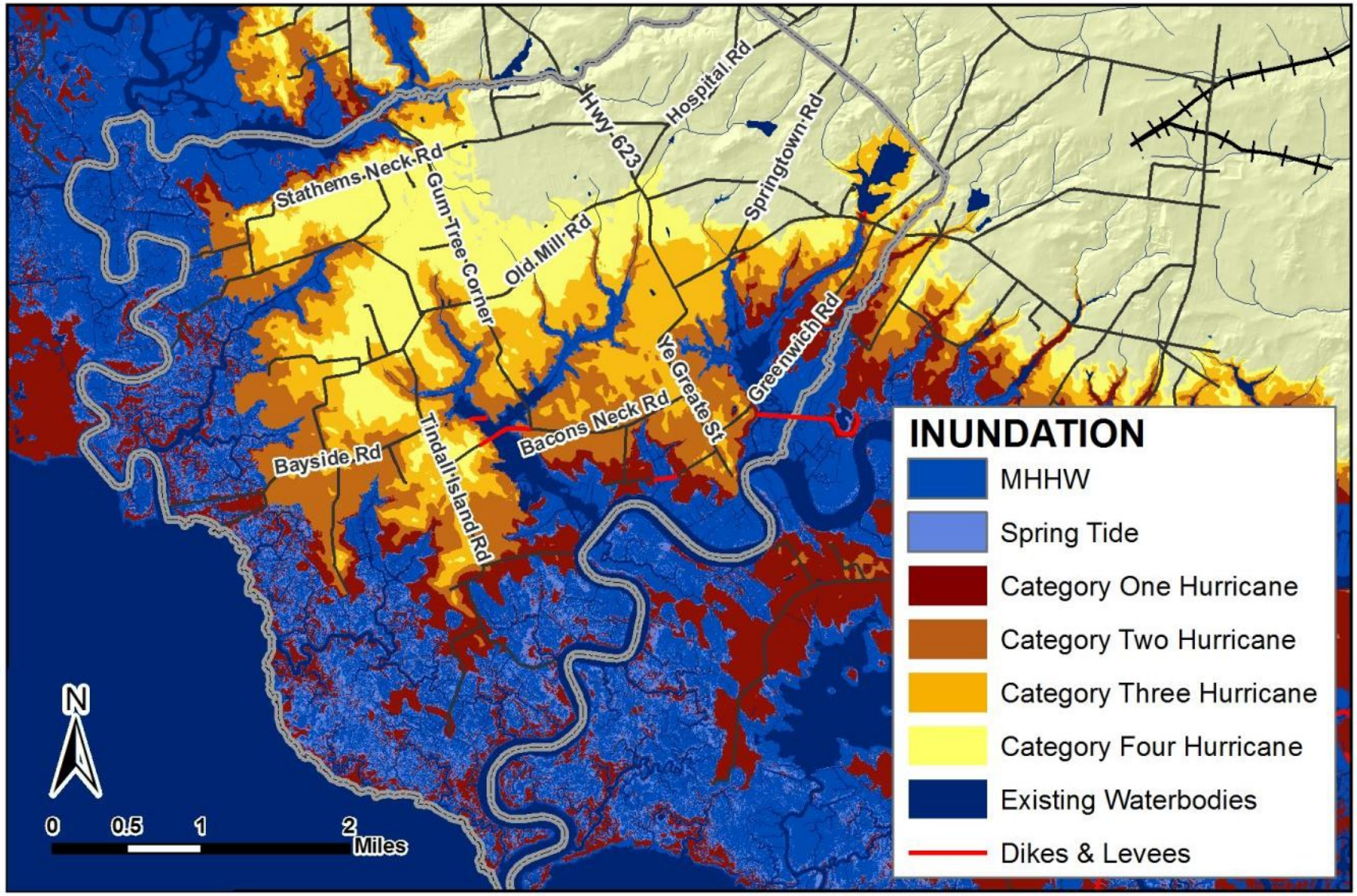
Storm Surge
Category Two



Storm Surge
Category Three



Storm Surge
Category Four



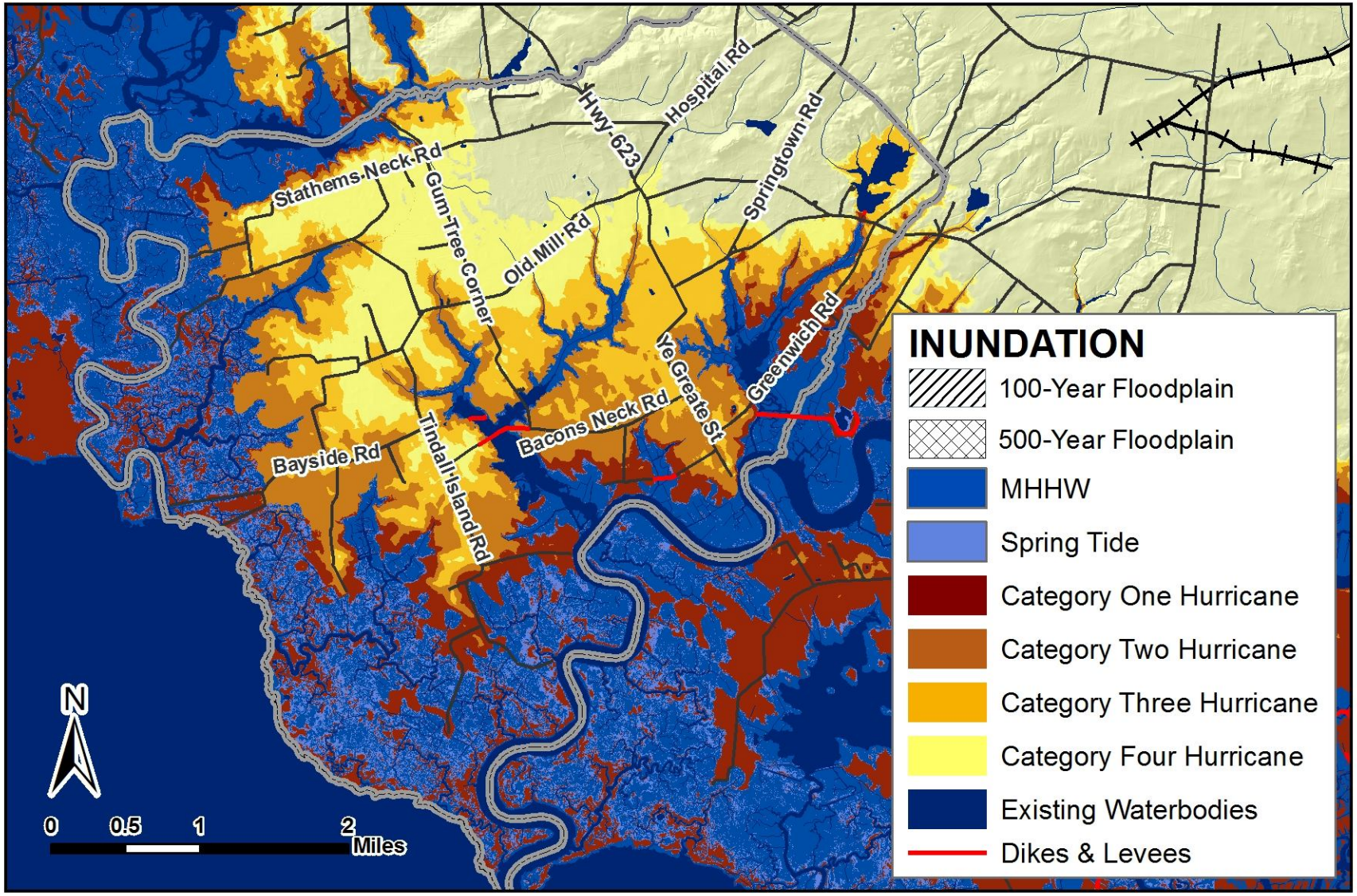
Potential Water Depths

- Hurricanes tracking towards New Jersey at High Tide could result in these water depths:

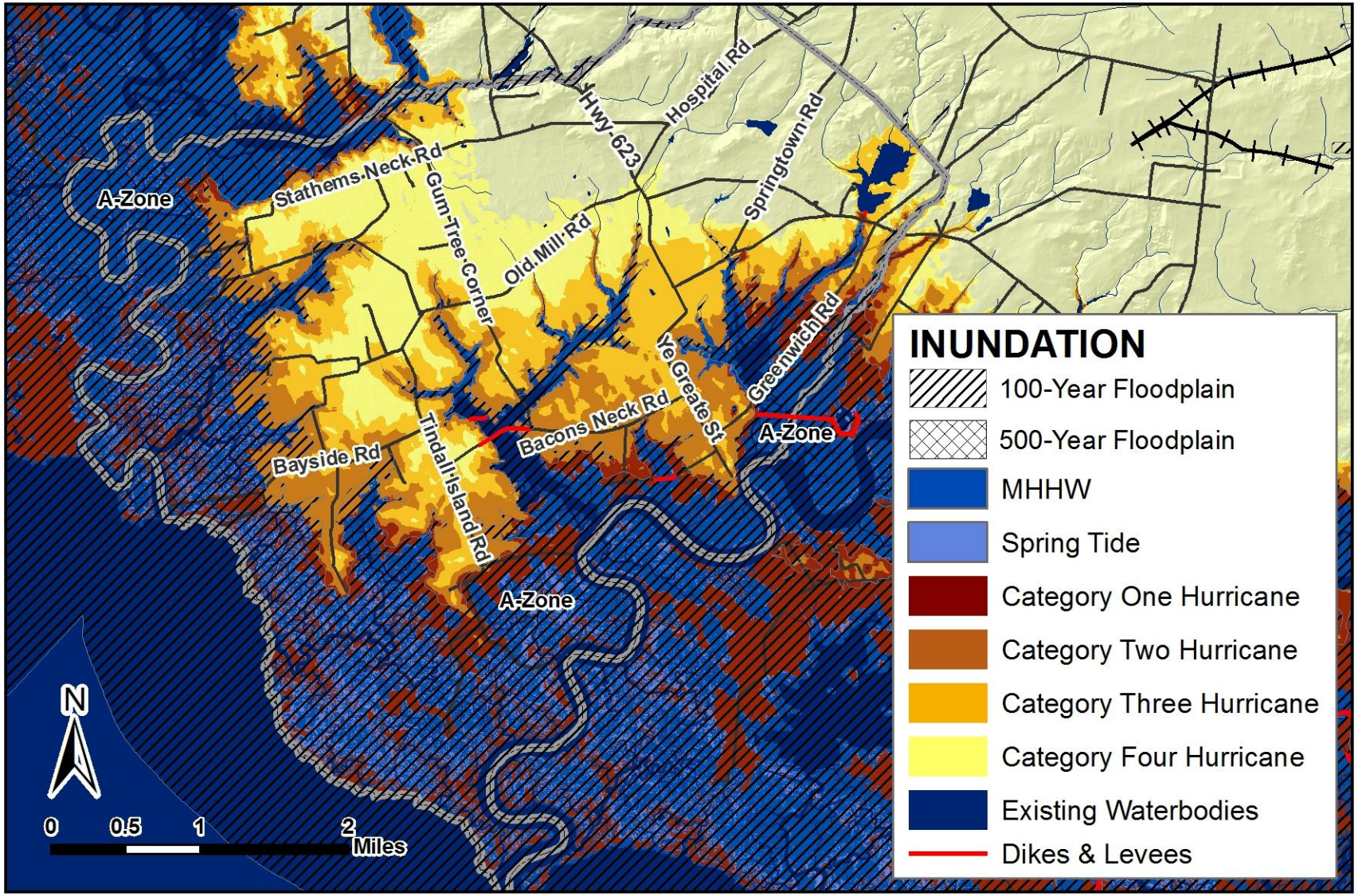
LOCATION	HURRICANE CATEGORY			
	ONE	TWO	THREE	FOUR
Greenwich Road near Dike	5.3	9.5	13.5	16.5
Bacons Neck Road at Dike	3.5	9.2	19.7	24.8
Bacons Neck Rd at Ye Greate St	0	0.3	6.6	11.5
Market Lane at Ye Greate St	0	2.8	7.8	13.0
Springtown Rd at Ye Greate St	0	0	6.3	10.7

- Estimates derived from National Hurricane Center Storm Surge Models
  - Depths do not account for wave action or upland rainfall
  - Depth Accuracy: ± (20 % + ~ 1 foot)

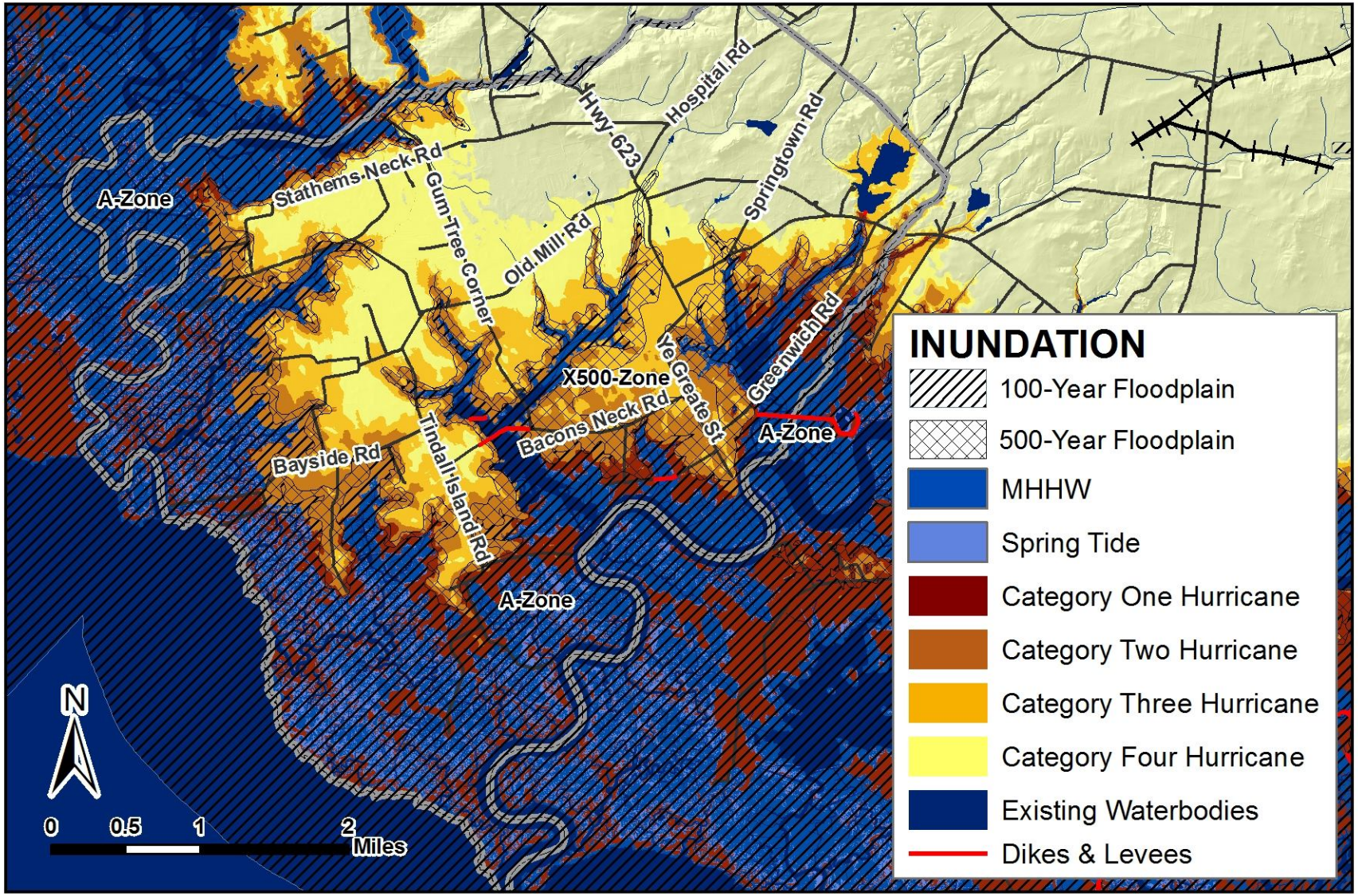
Storm Surge v Floodplain



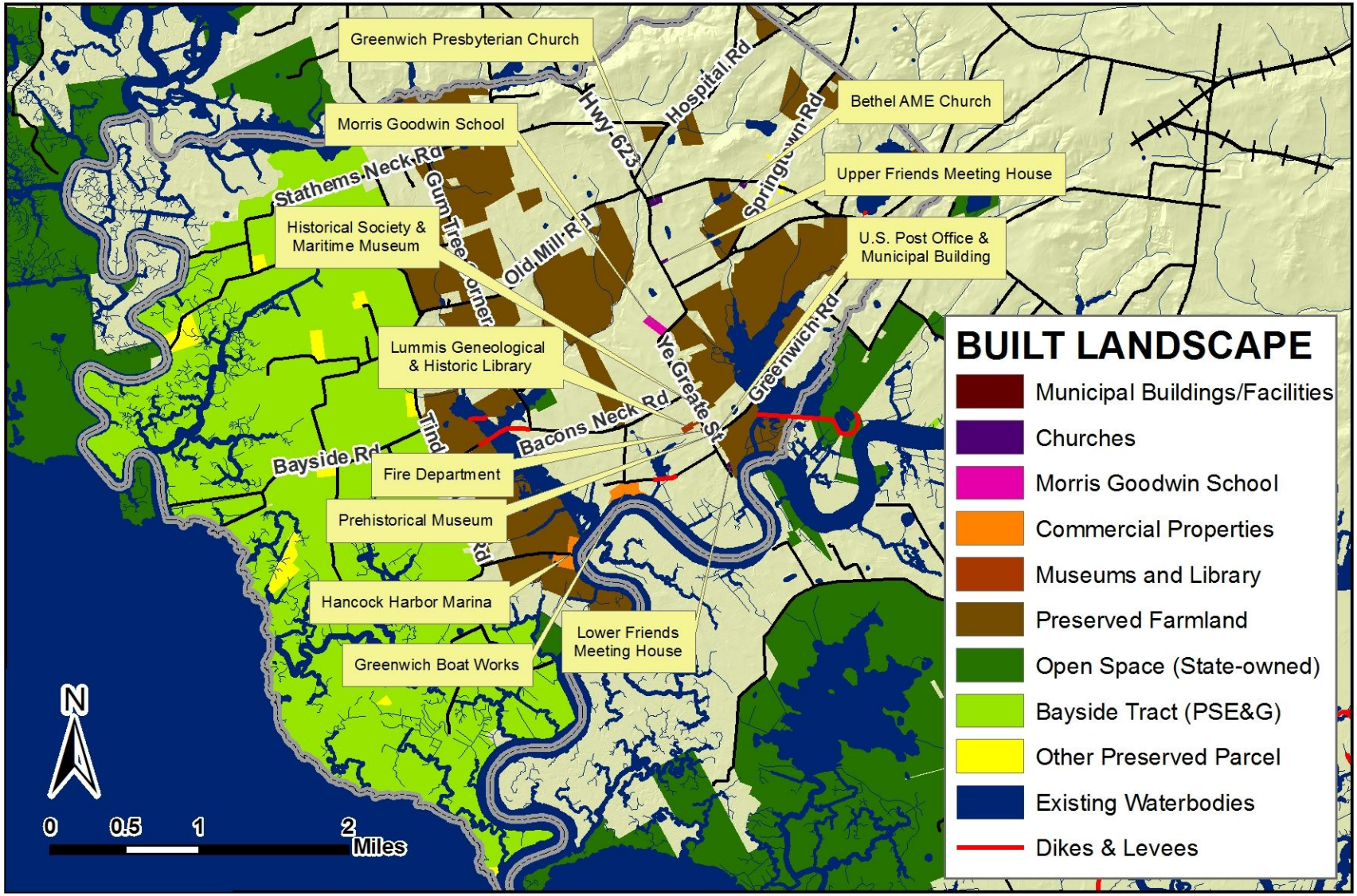
Storm Surge v Floodplain



Storm Surge v Floodplain

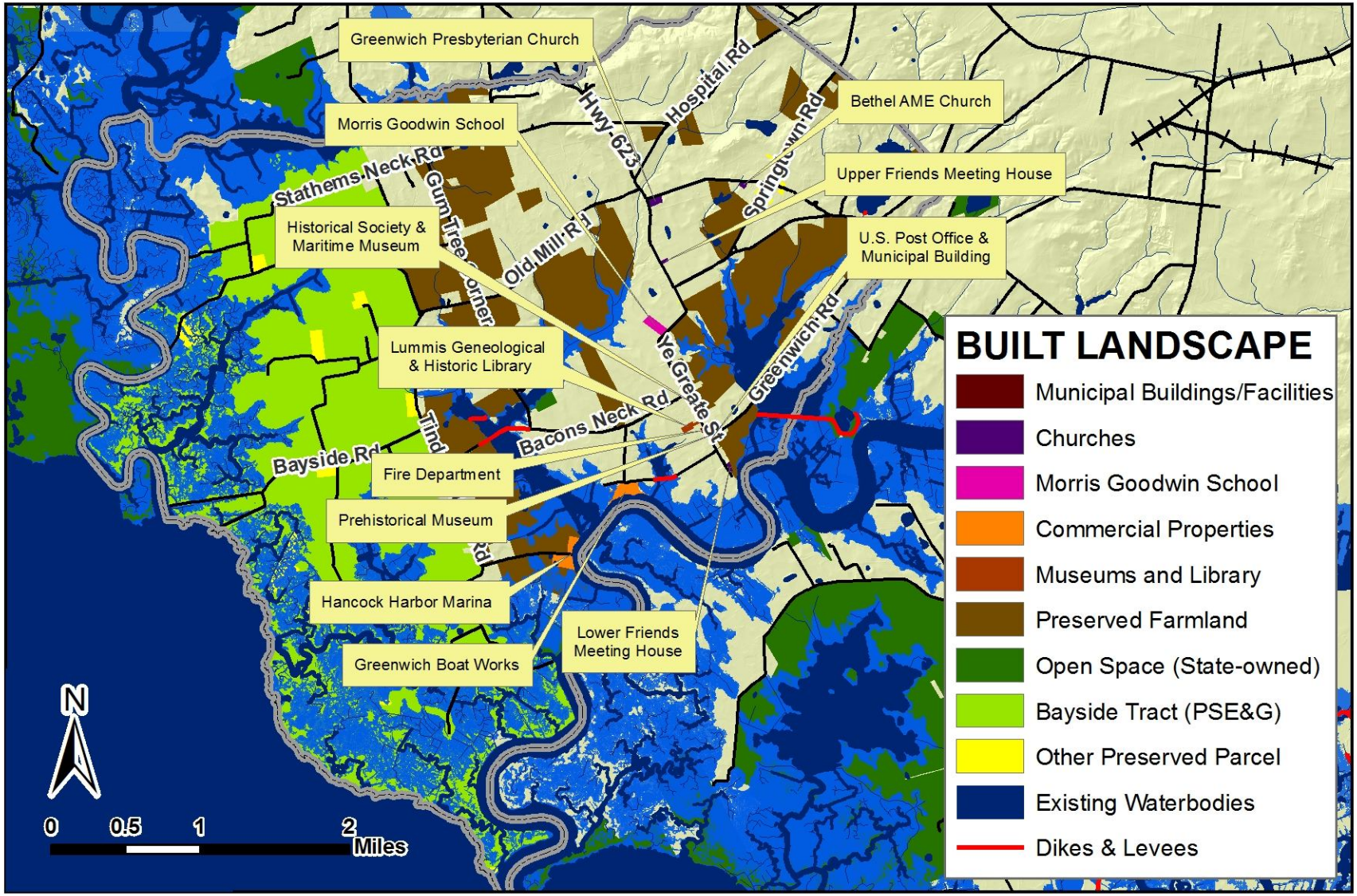


Built Environment



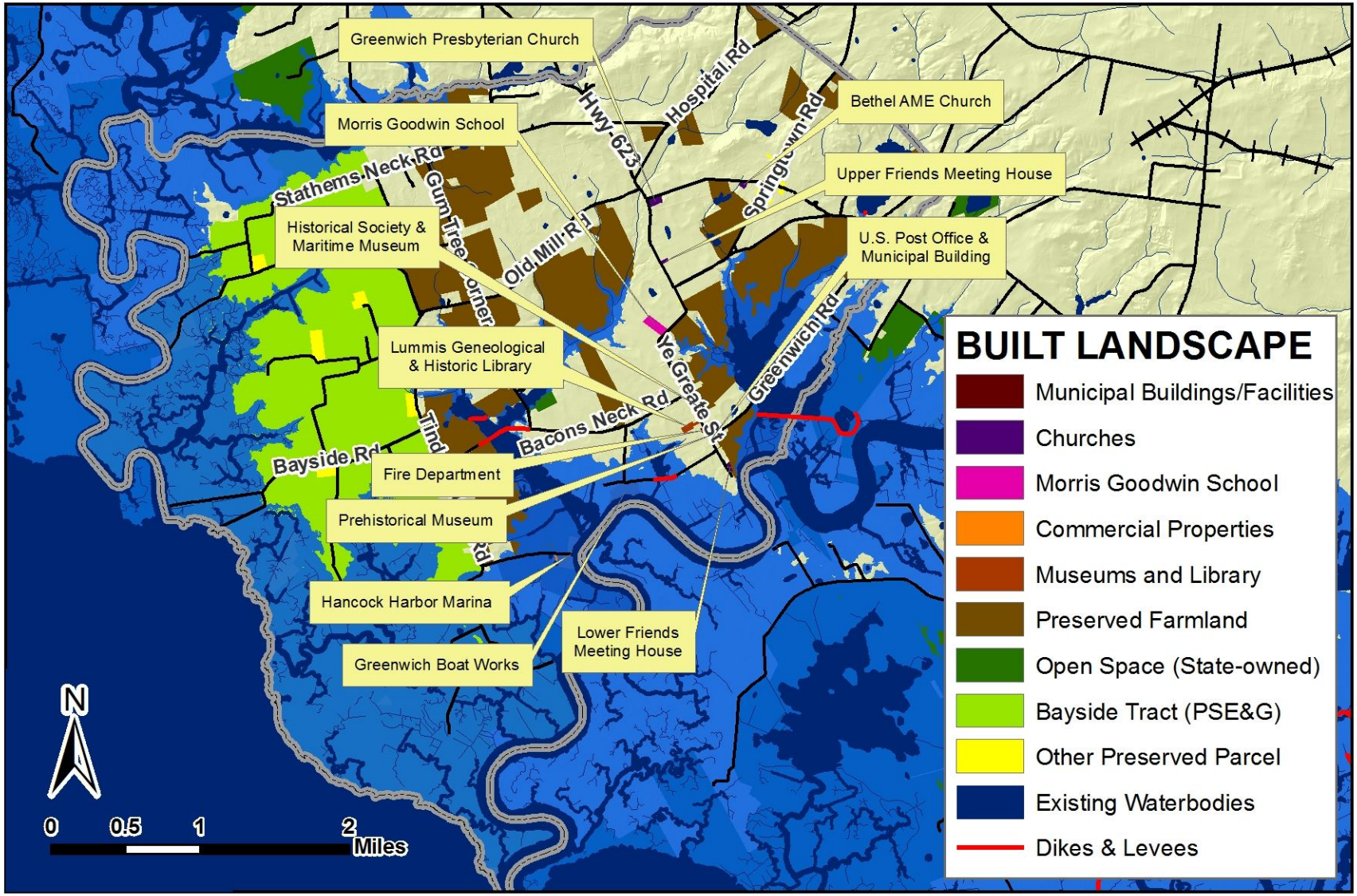
Built Environment

Spring Tide



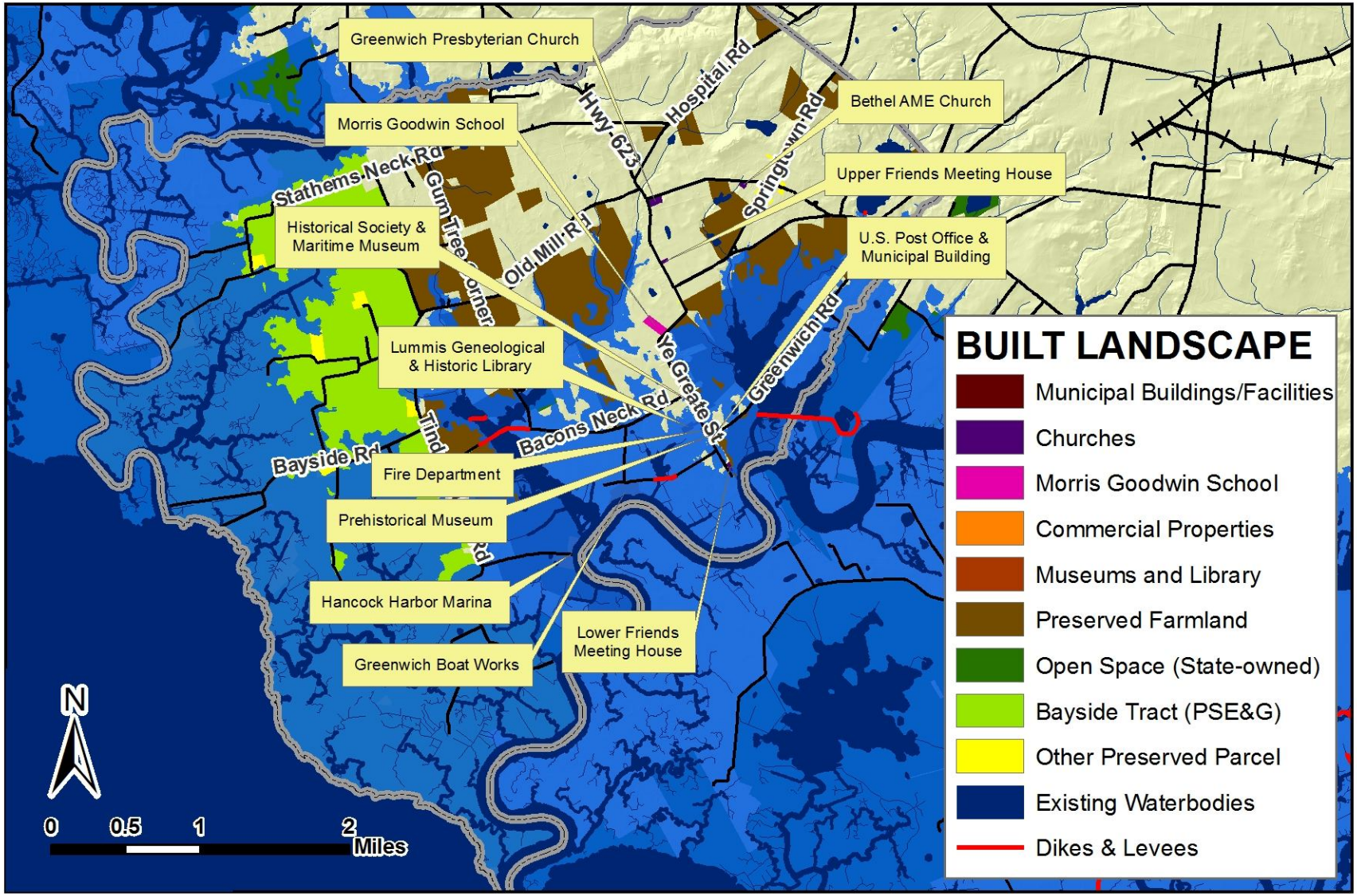
Built Environment

Category One



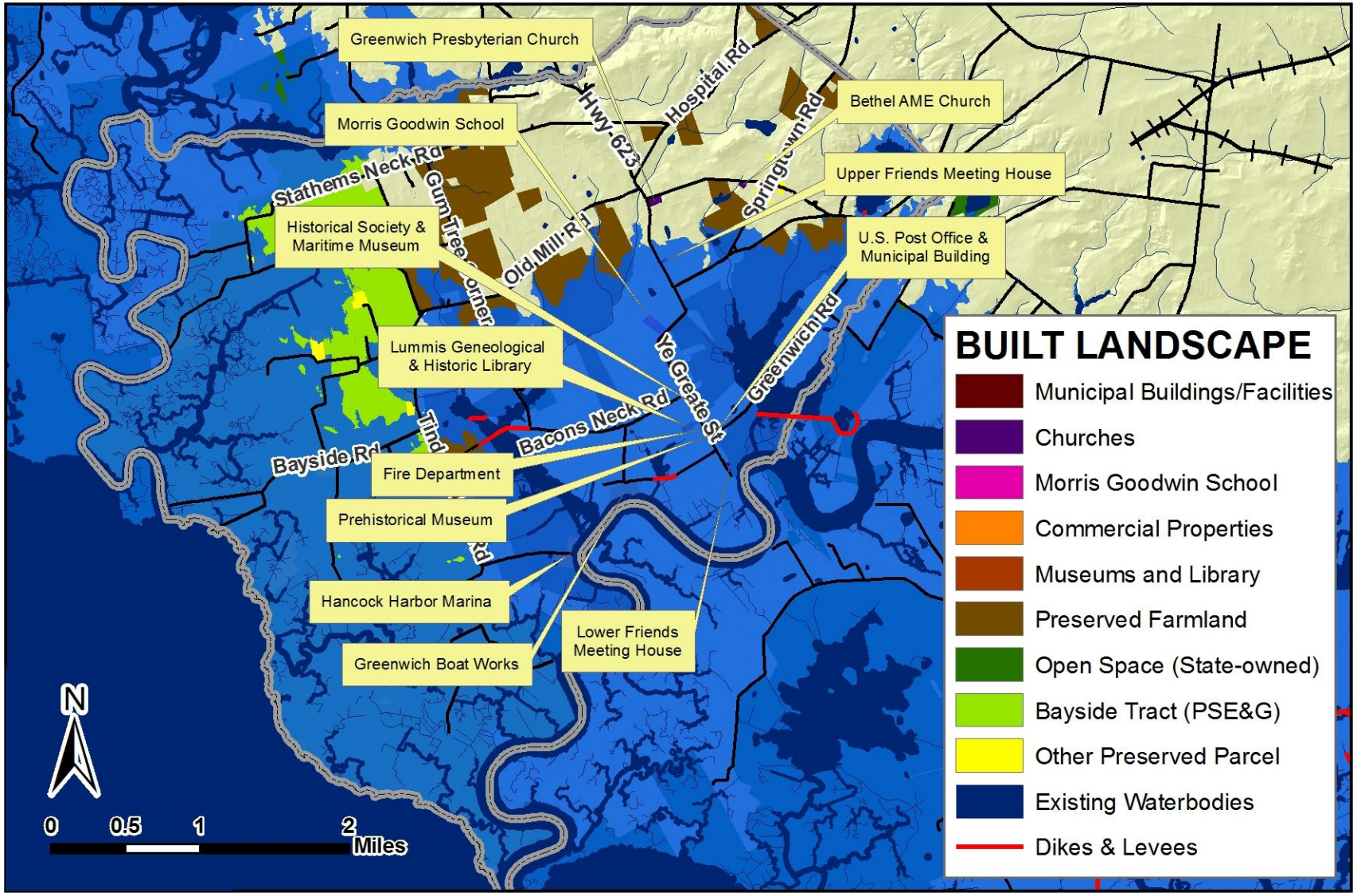
Built Environment

Category Two



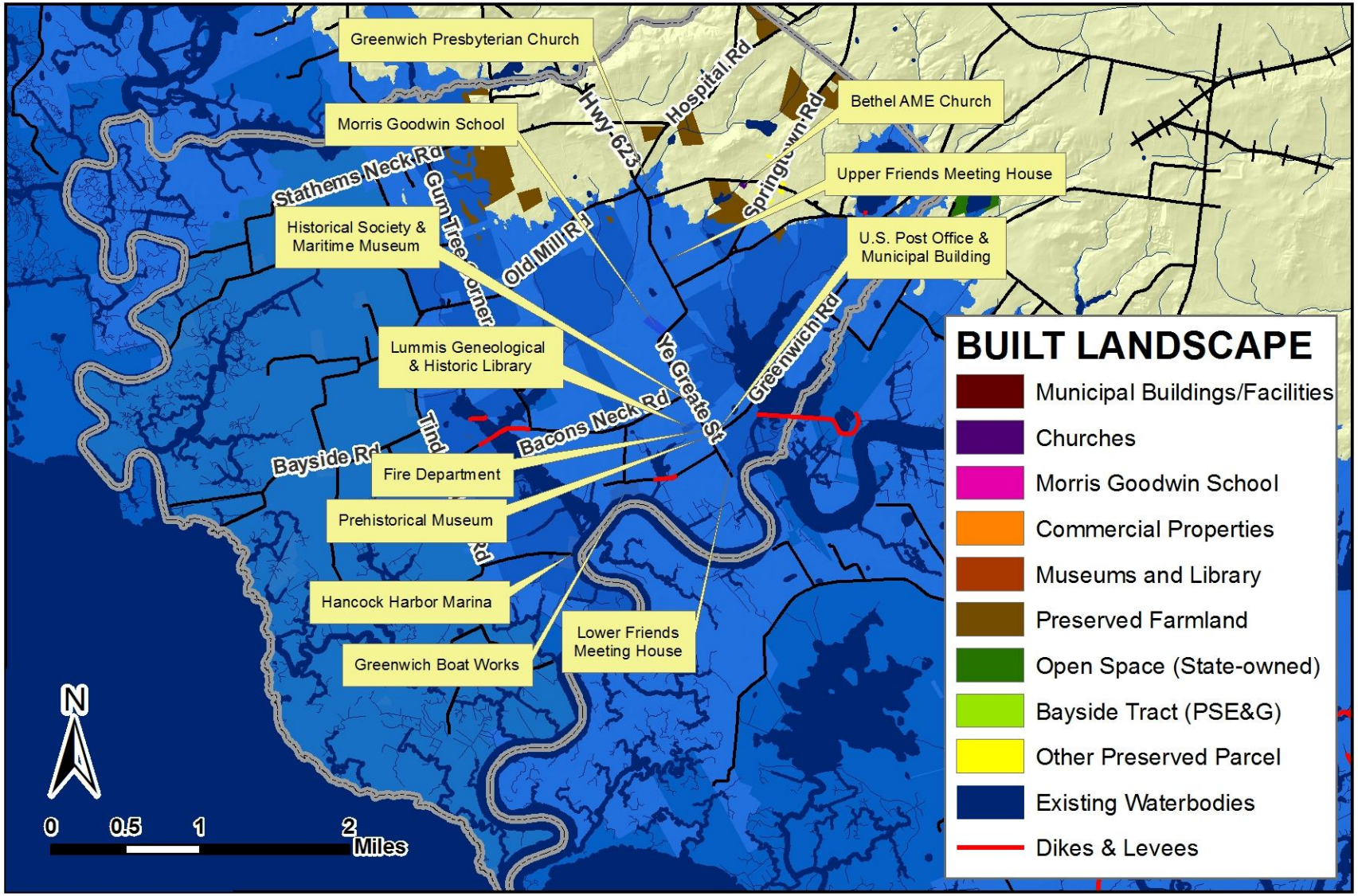
Built Environment

Category Three



Built Environment

Category Four

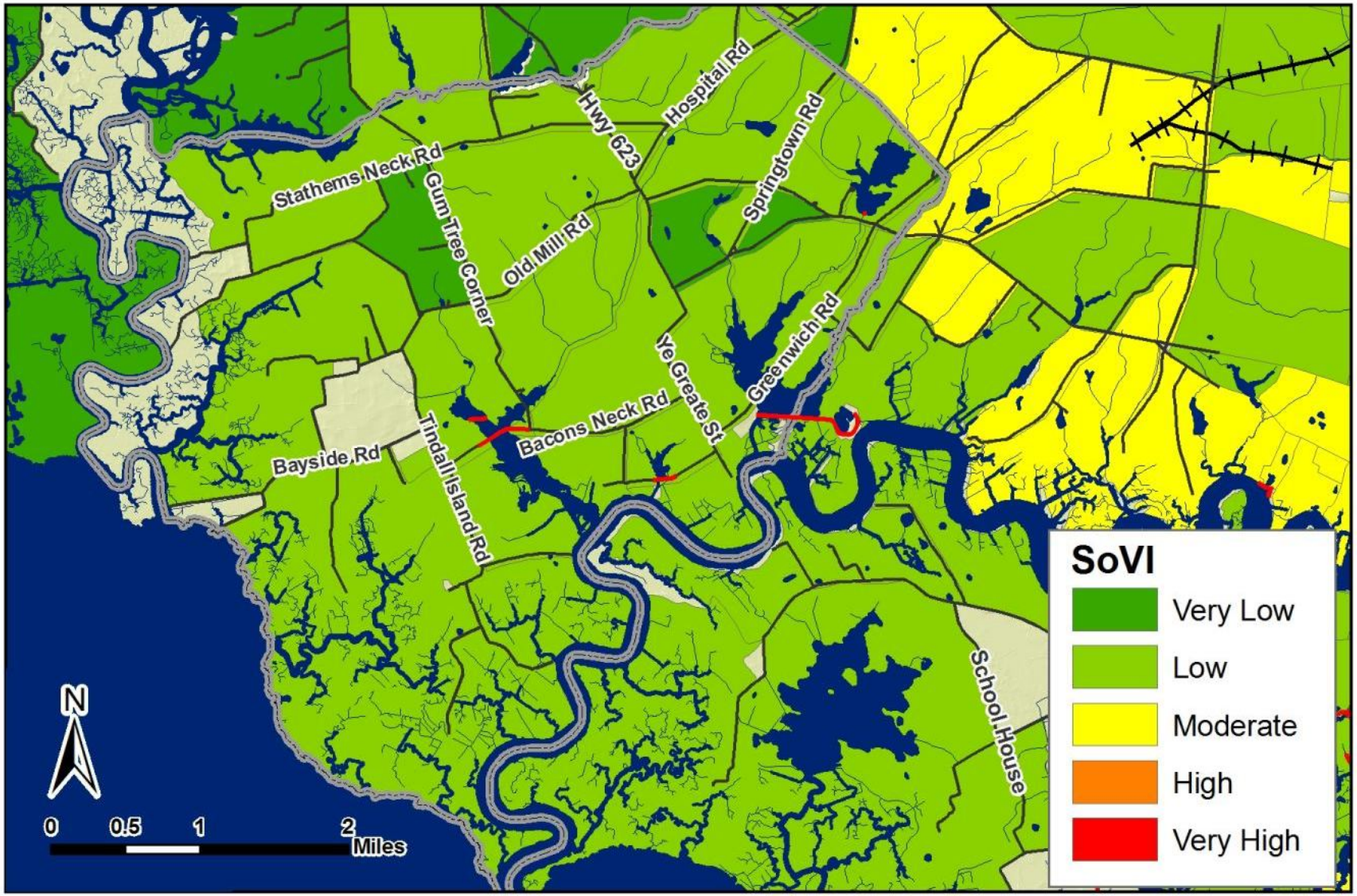


Inundation Vulnerability

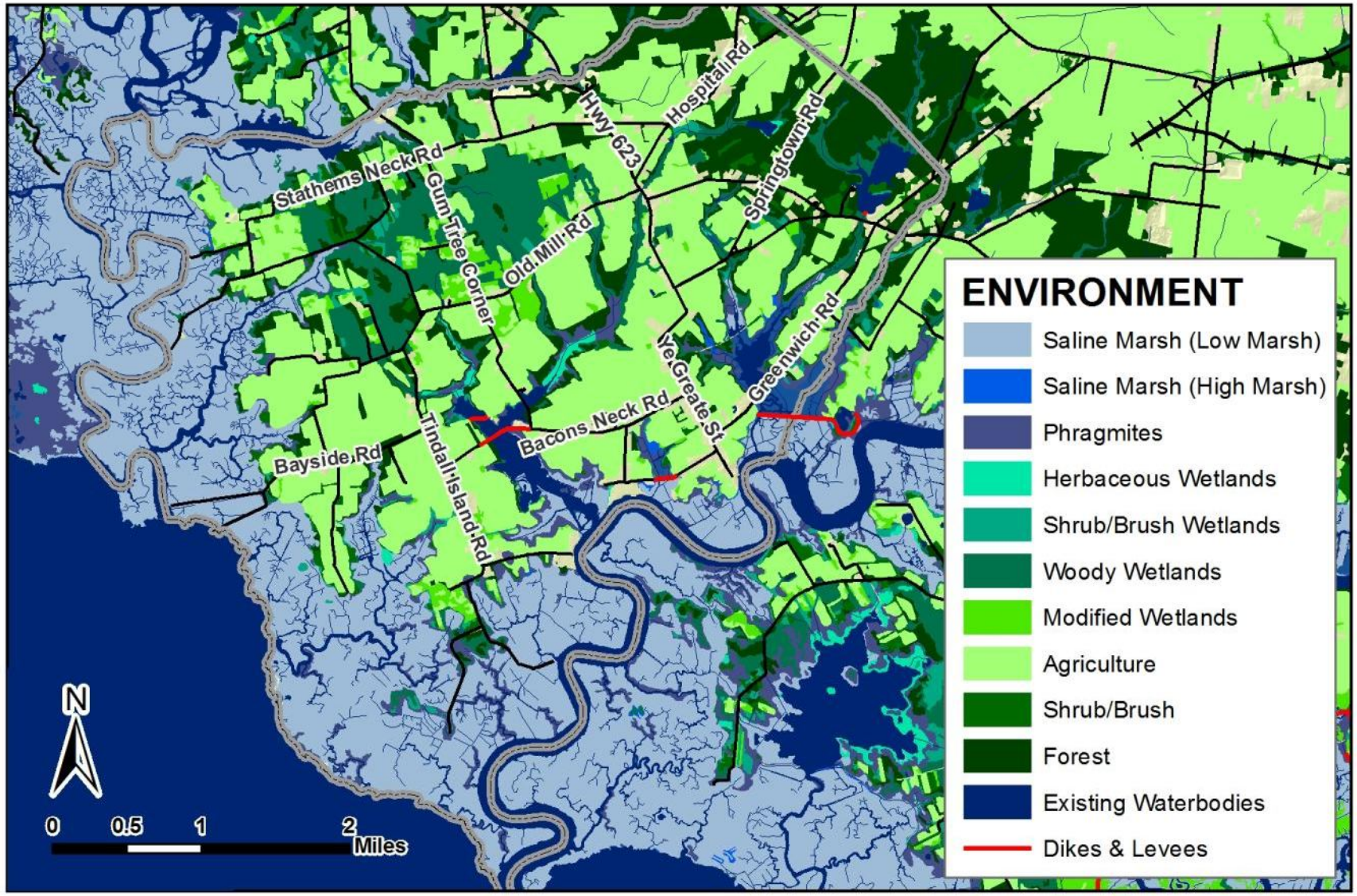
PROPERTY	SPRING TIDE	HURRICANE CATEGORY			
		ONE	TWO	THREE	FOUR
1. Municipal Building	-	-	X	X	X
2. Greenwich Township Fire Department	-	-	X	X	X
3. Greenwich Country Store & Post Office	-	-	X	X	X
4. Morris Goodwin School	-	-	-	X	X
5. Greenwich Presbyterian Church	-	-	-	-	-
6. Bethel AME Church	-	-	-	-	-
7. Friends Lower Meeting House	-	-	X	X	X
8. Friends Upper Meeting House	-	-	-	X	X
9. Hancock Marina/Bait Box Restaurant	-	X	X	X	X
10. Greenwich Boat Works/ Ship John Inn Restaurant	Partial	X	X	X	X
11. Lummis Genealogical and Historical Library	-	-	X	X	X
12. Gibbons House/Greenwich Historical Society	-	-	X	X	X
13. Cumberland County Prehistorical Museum	-	-	X	X	X
14. John DuBois Maritime Museum	-	-	X	X	X

- A Hurricane Could Cause Extensive Flood and Wind Damage, Cause Saltwater Intrusion, and Impair Ecosystems.

Social Vulnerability

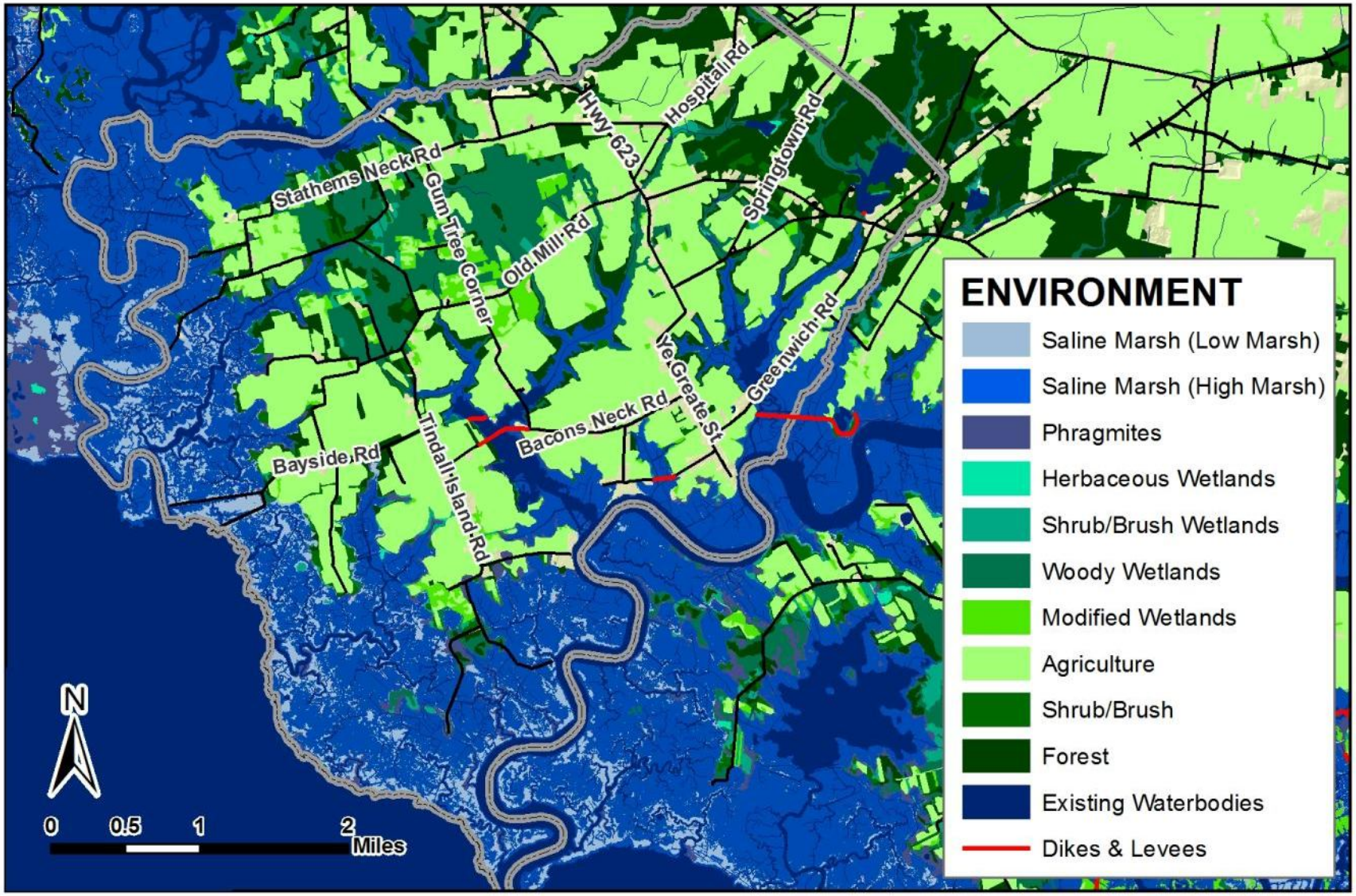


Natural Environment



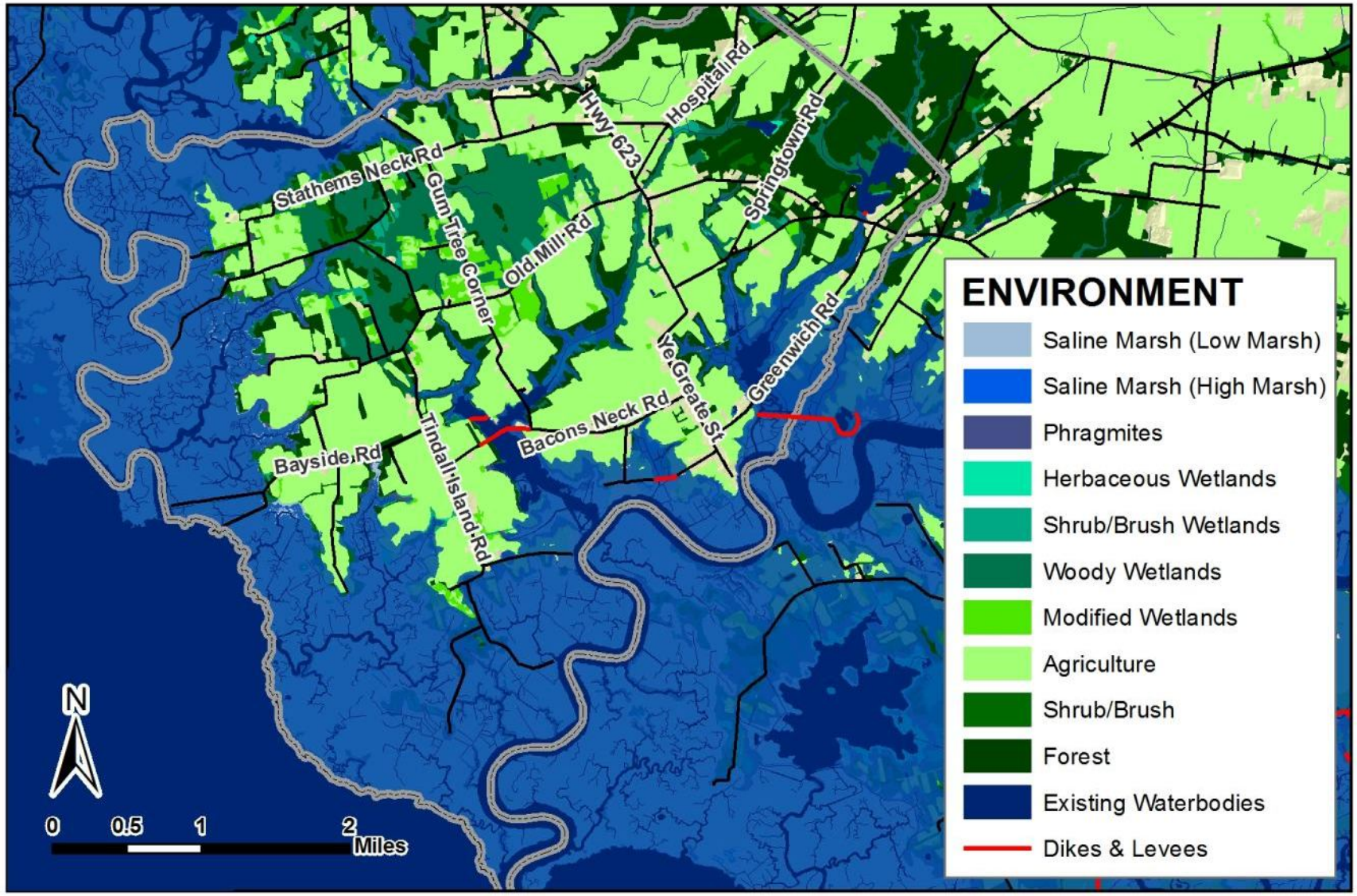
Natural Environment

Spring Tide



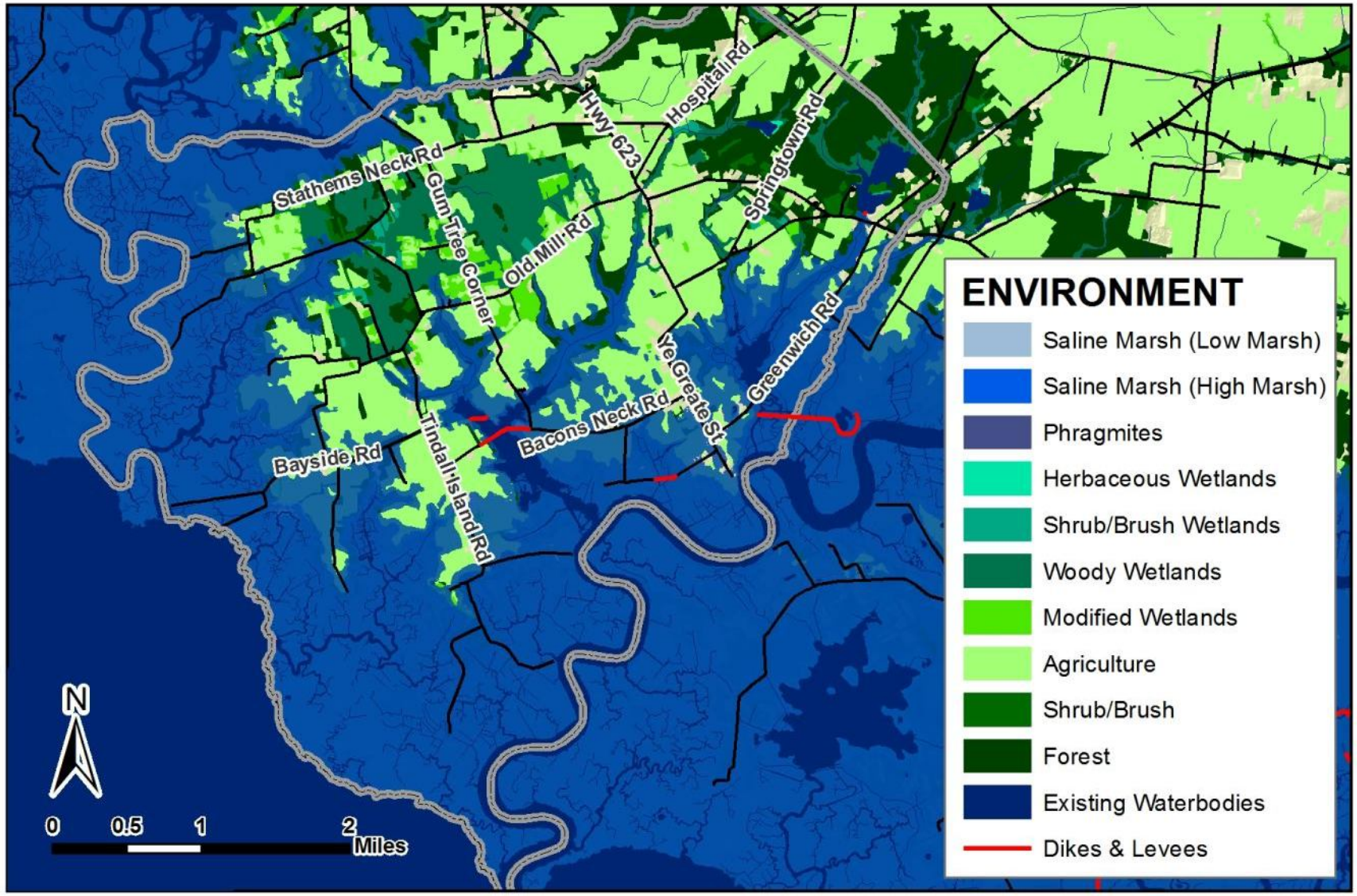
Natural Environment

Category One



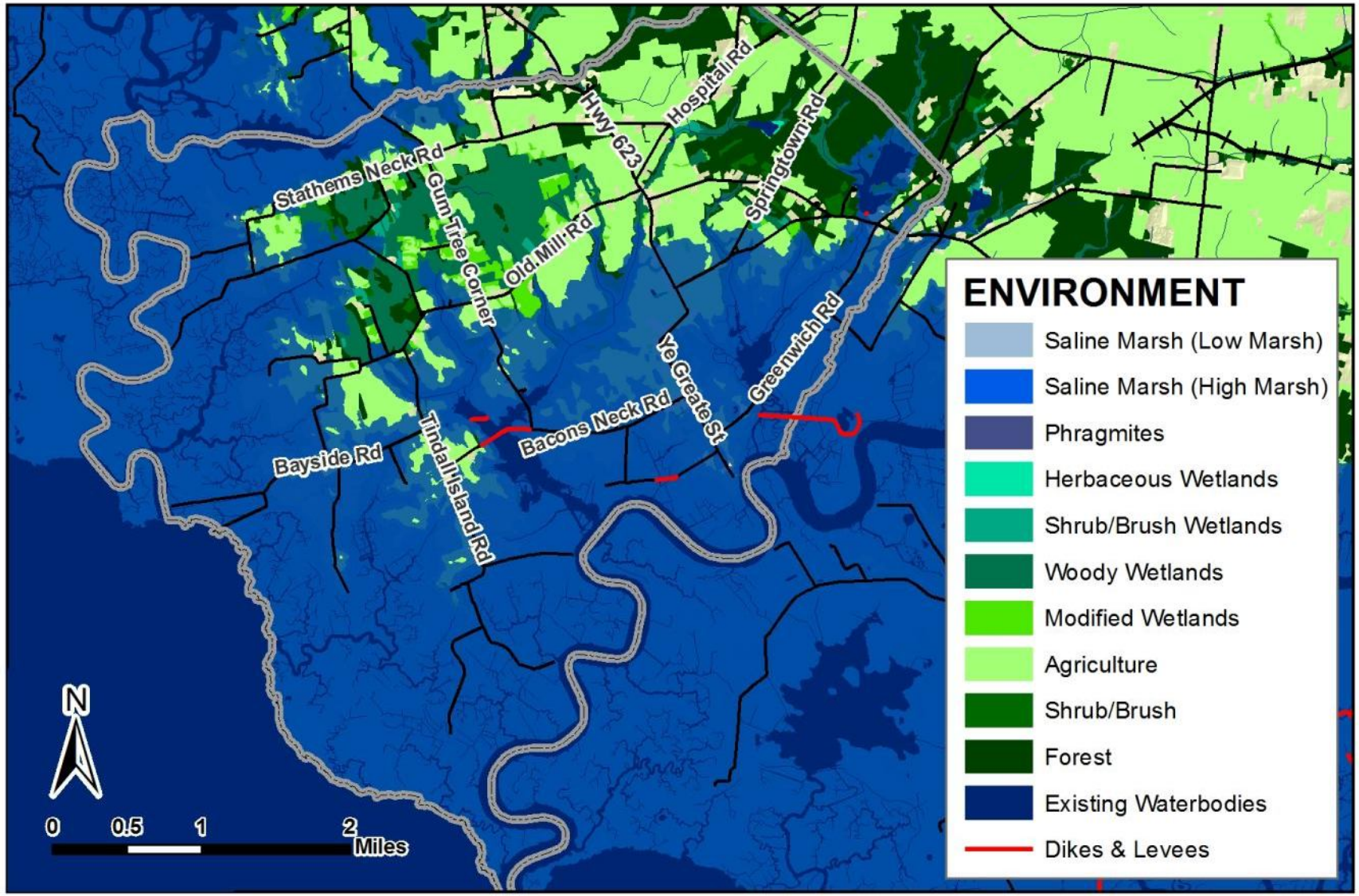
Natural Environment

Category Two



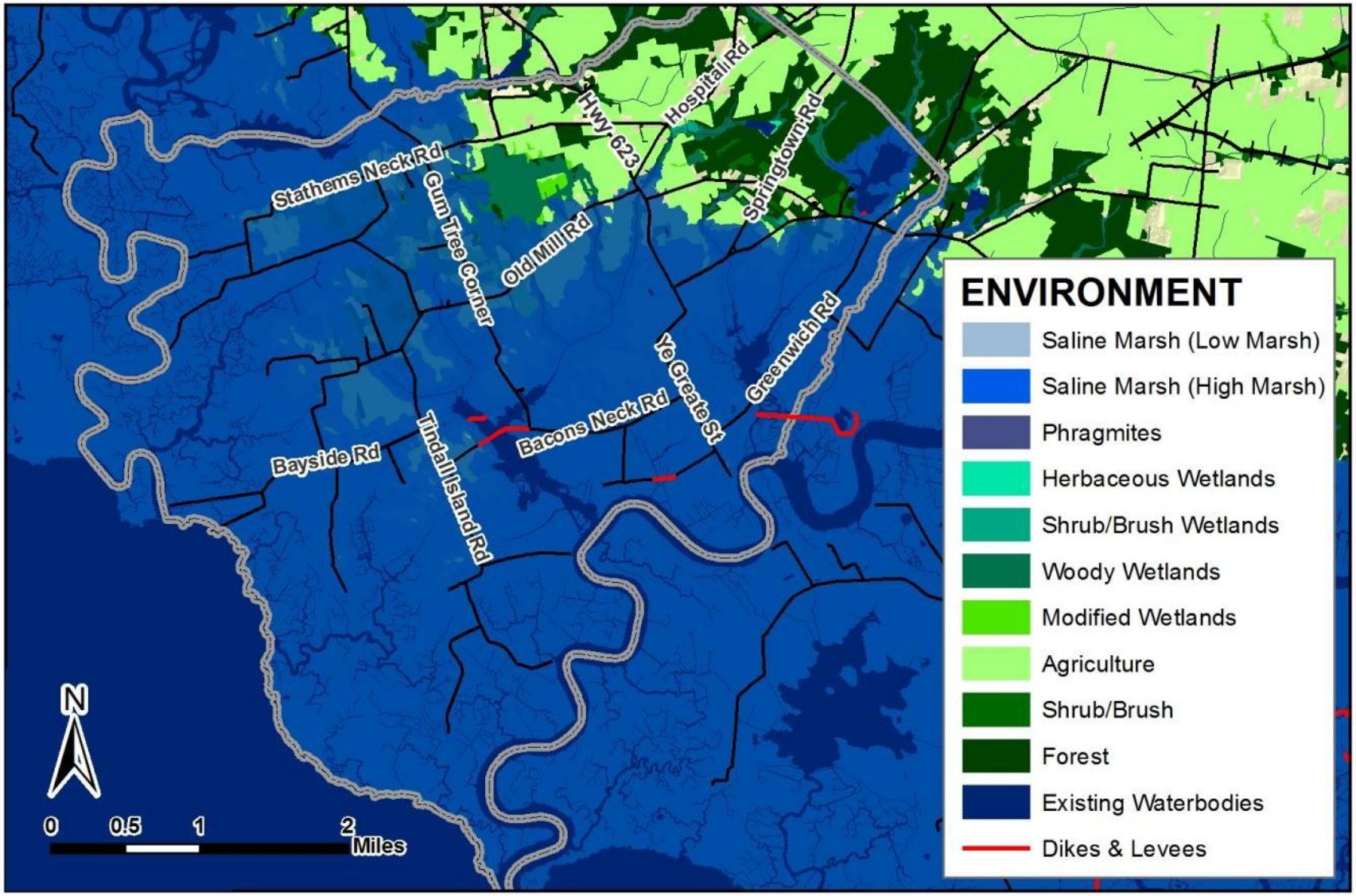
Natural Environment

Category Three



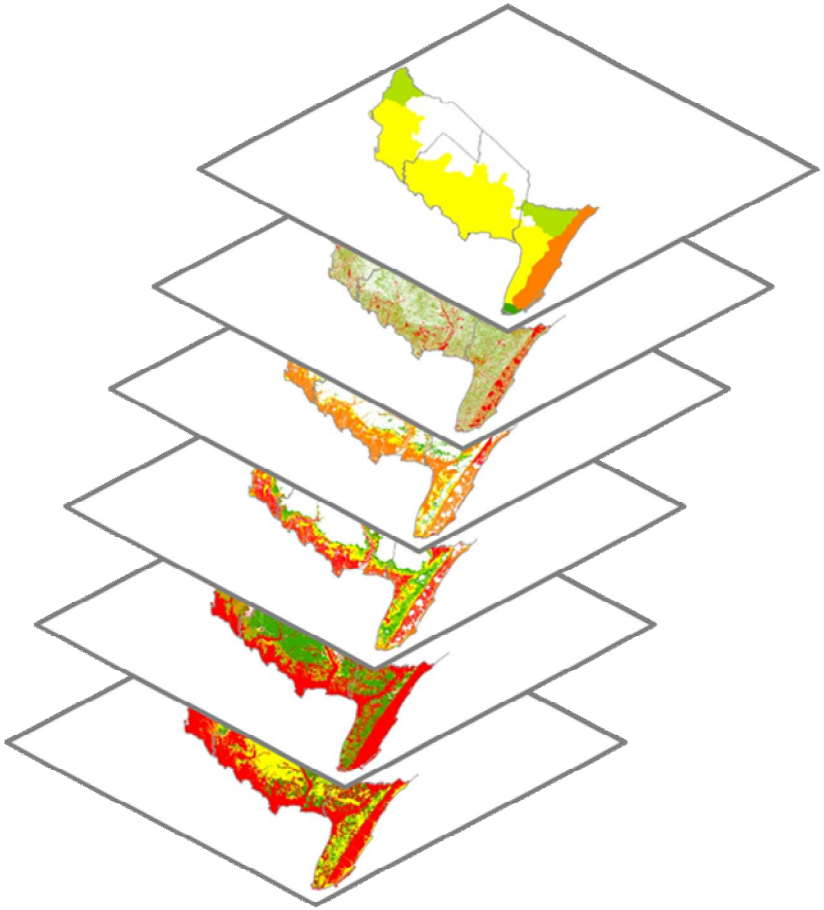
Natural Environment

Category Four



Coastal Vulnerability Index

Identifying Susceptible Land Areas



Where CVI =

(a) Geomorphology

(b) Slope (% Rise)

(c) Flood Prone Areas

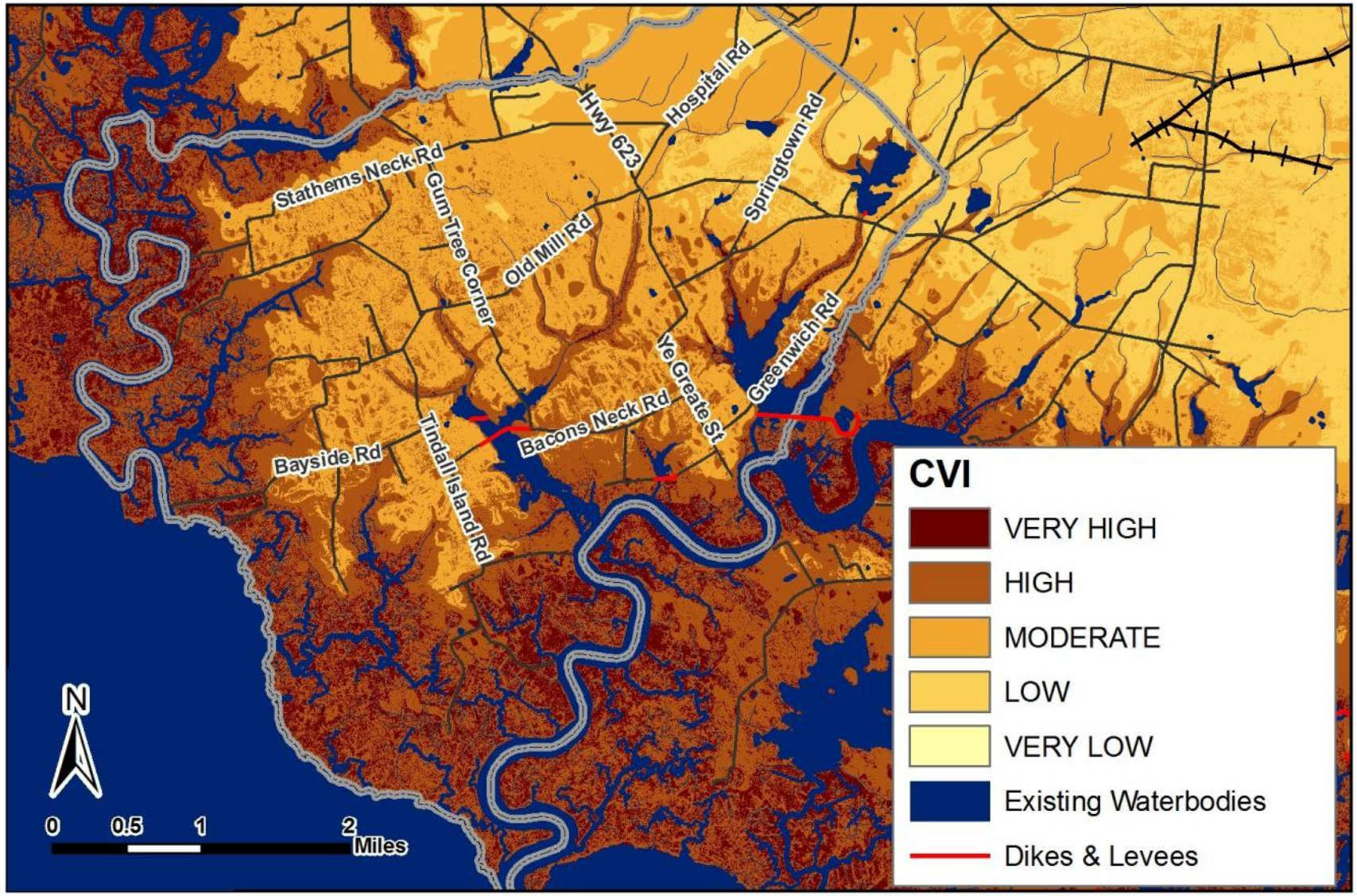
(d) Storm Surge (SLOSH)

(e) Drainage

(f) Erosion

Methods Adapted from: NOAA CSC; Hazard & Vulnerability Institute; USGS

Coastal Vulnerability Index



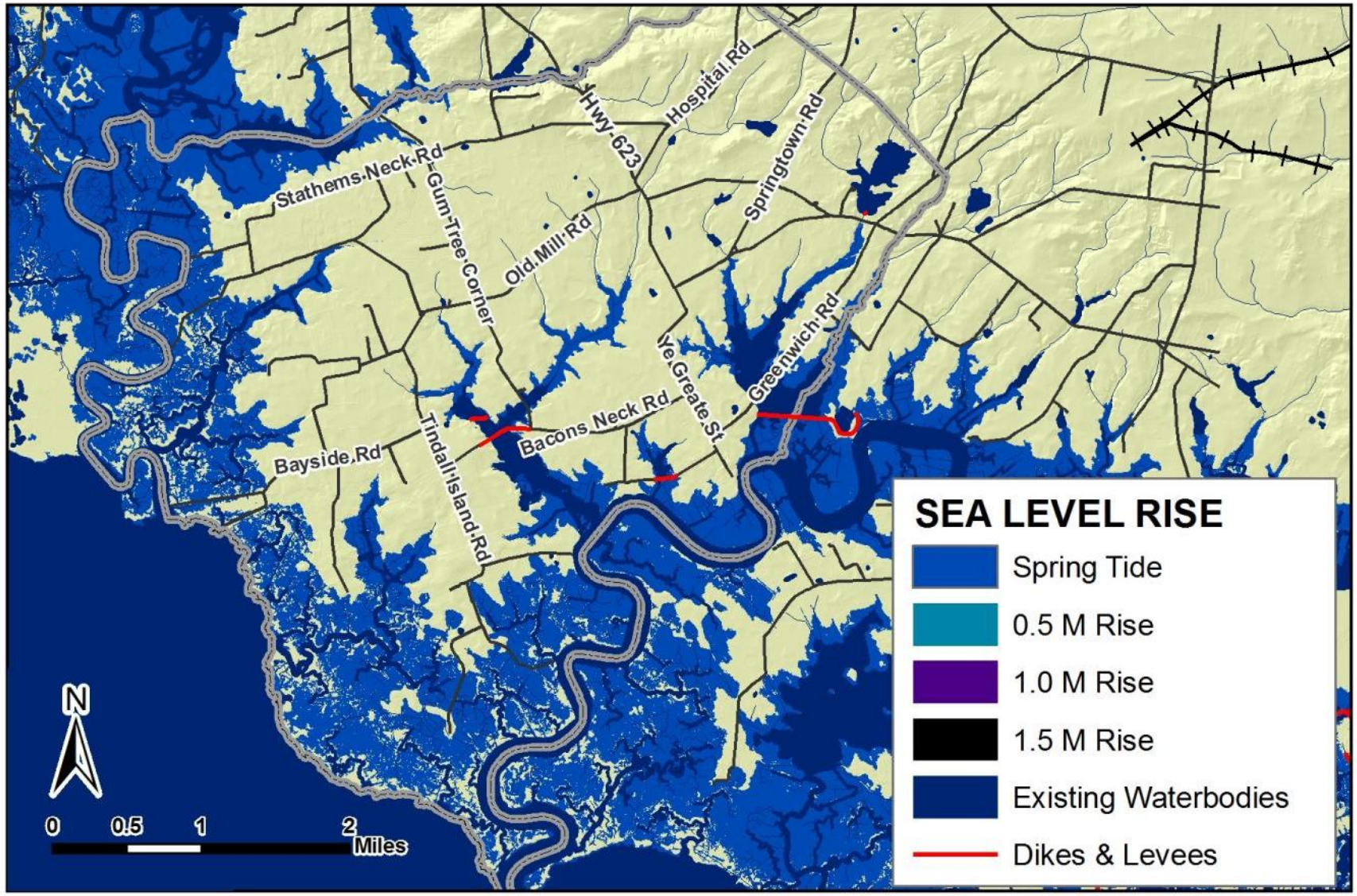
Looking Forward

Incorporating Sea Level Rise into Vulnerability Mapping

Photo Credit: Trudy Hansen

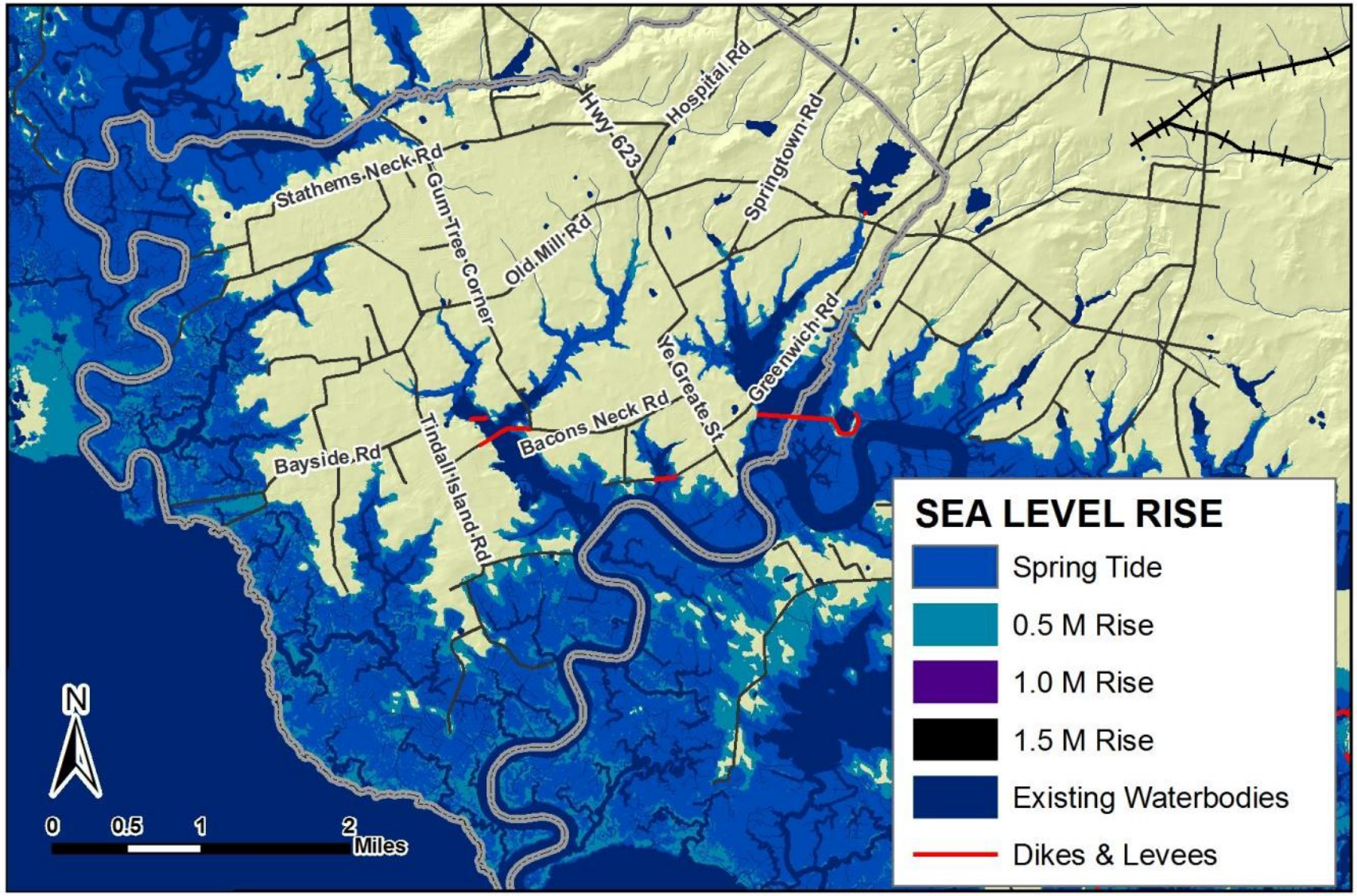
Sea Level

Present Day Spring Tide



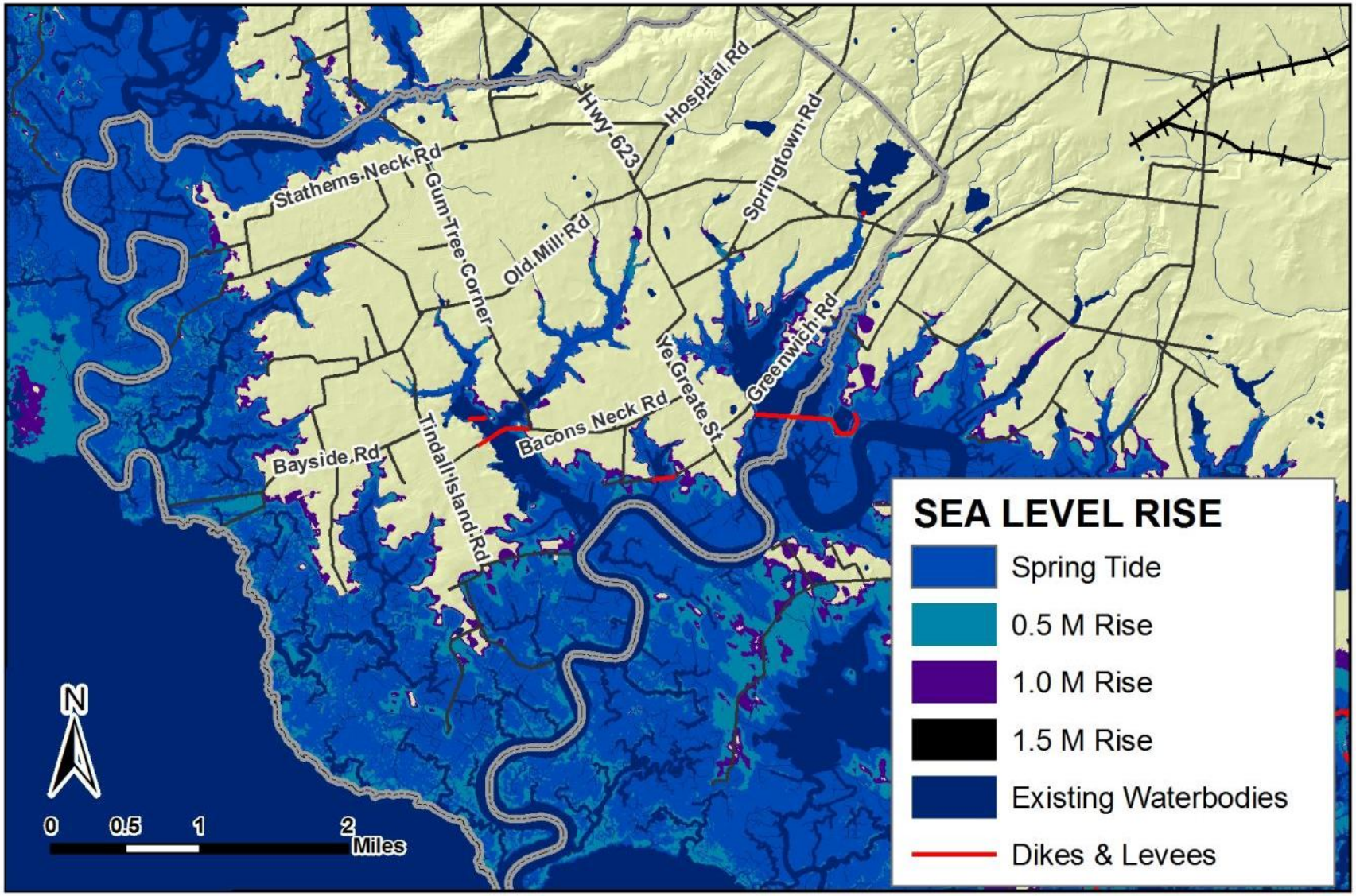
Sea Level Rise

0.5 Meter Rise + Spring Tide



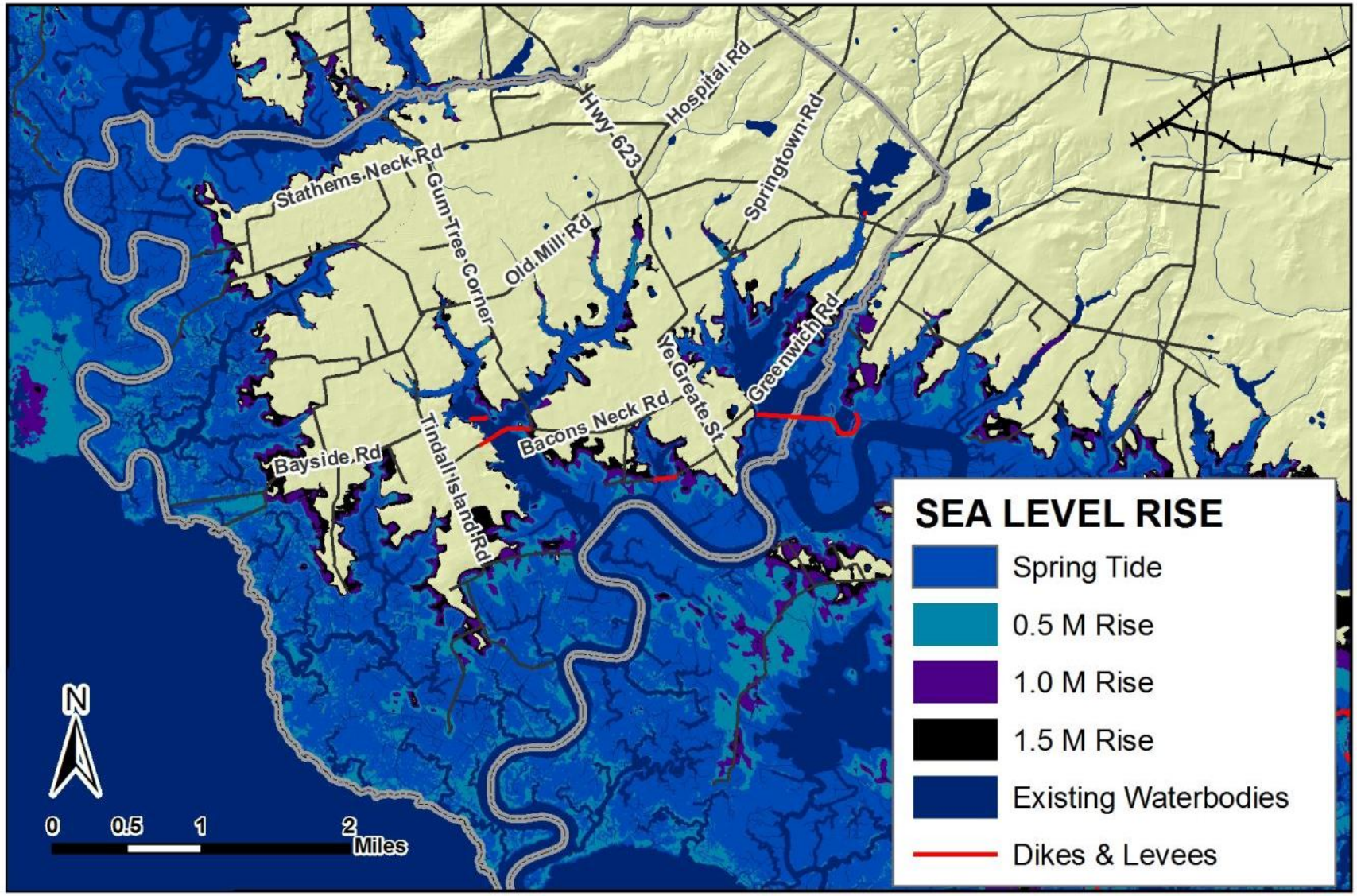
Sea Level Rise

1.0 Meter Rise + Spring Tide

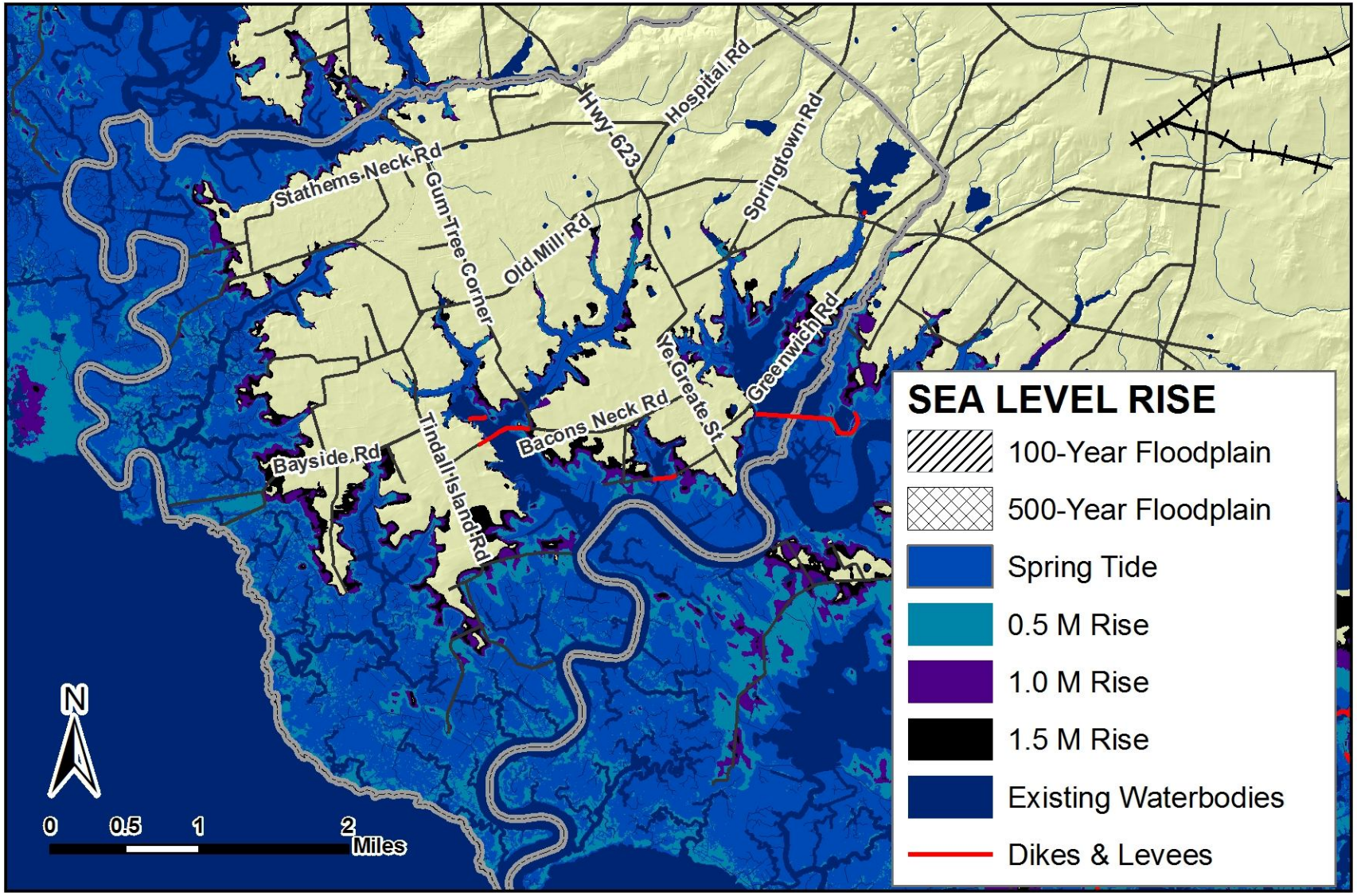


Sea Level Rise

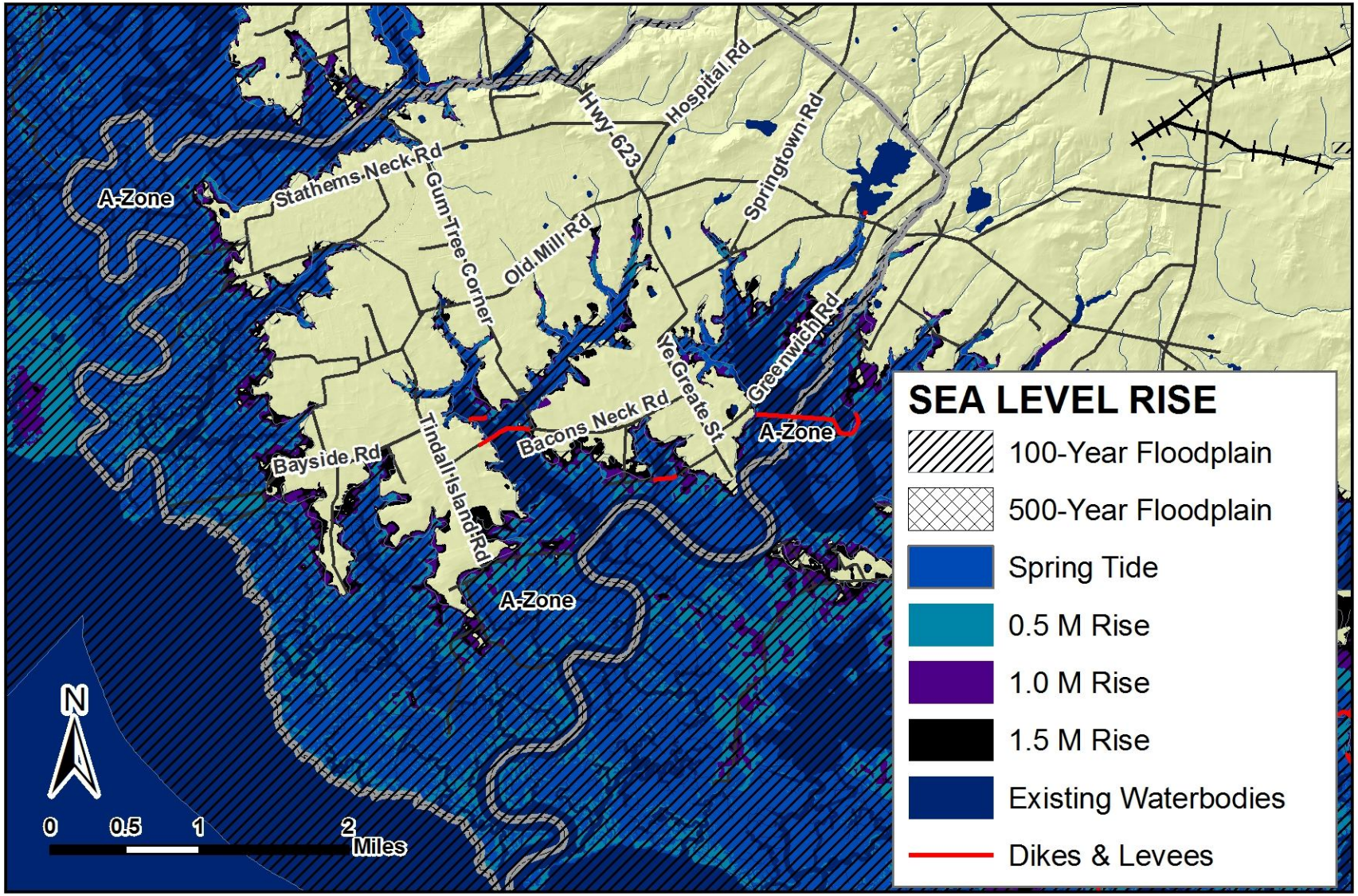
1.5 Meter Rise + Spring Tide



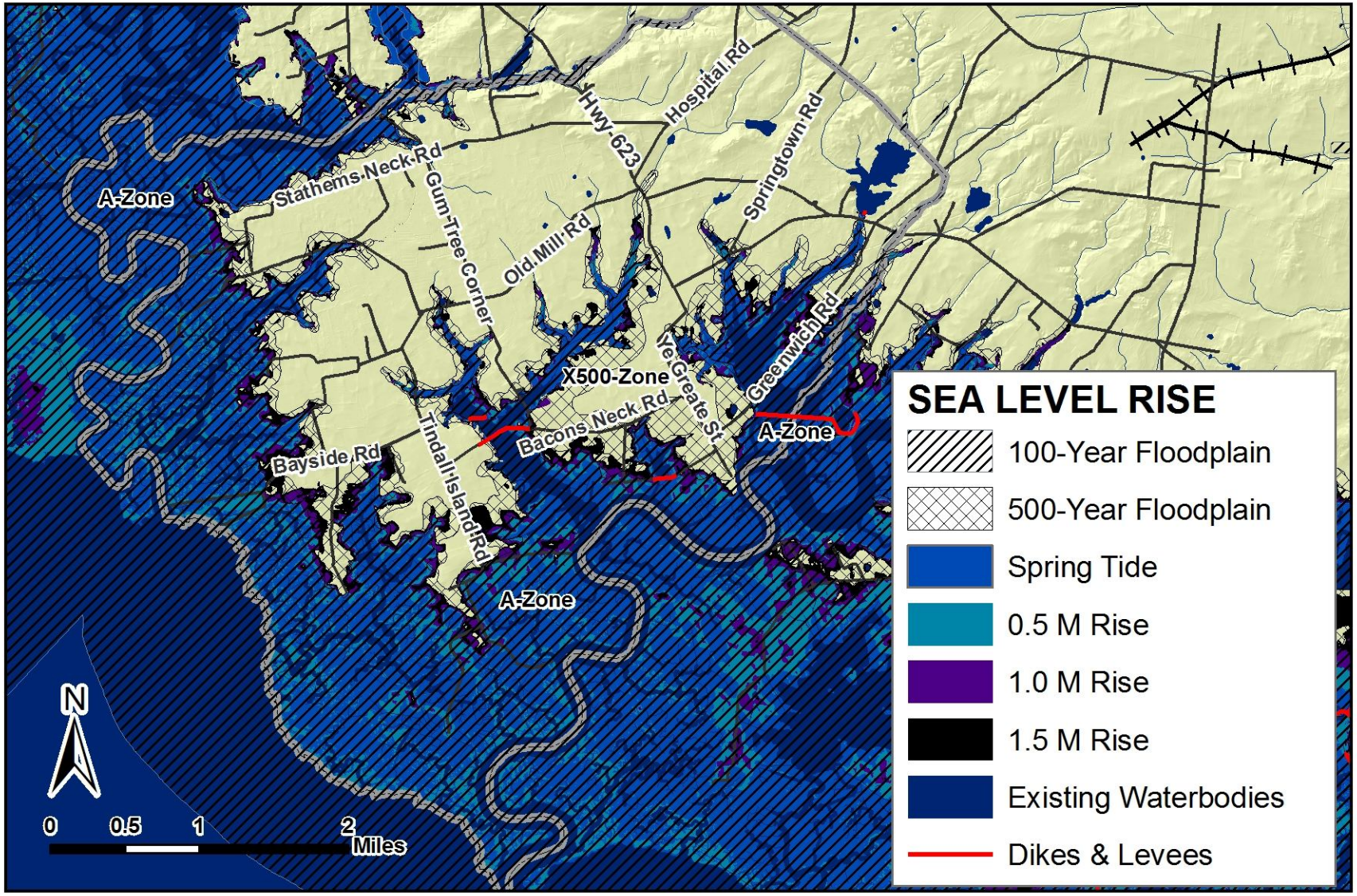
Sea Level Rise v Floodplain



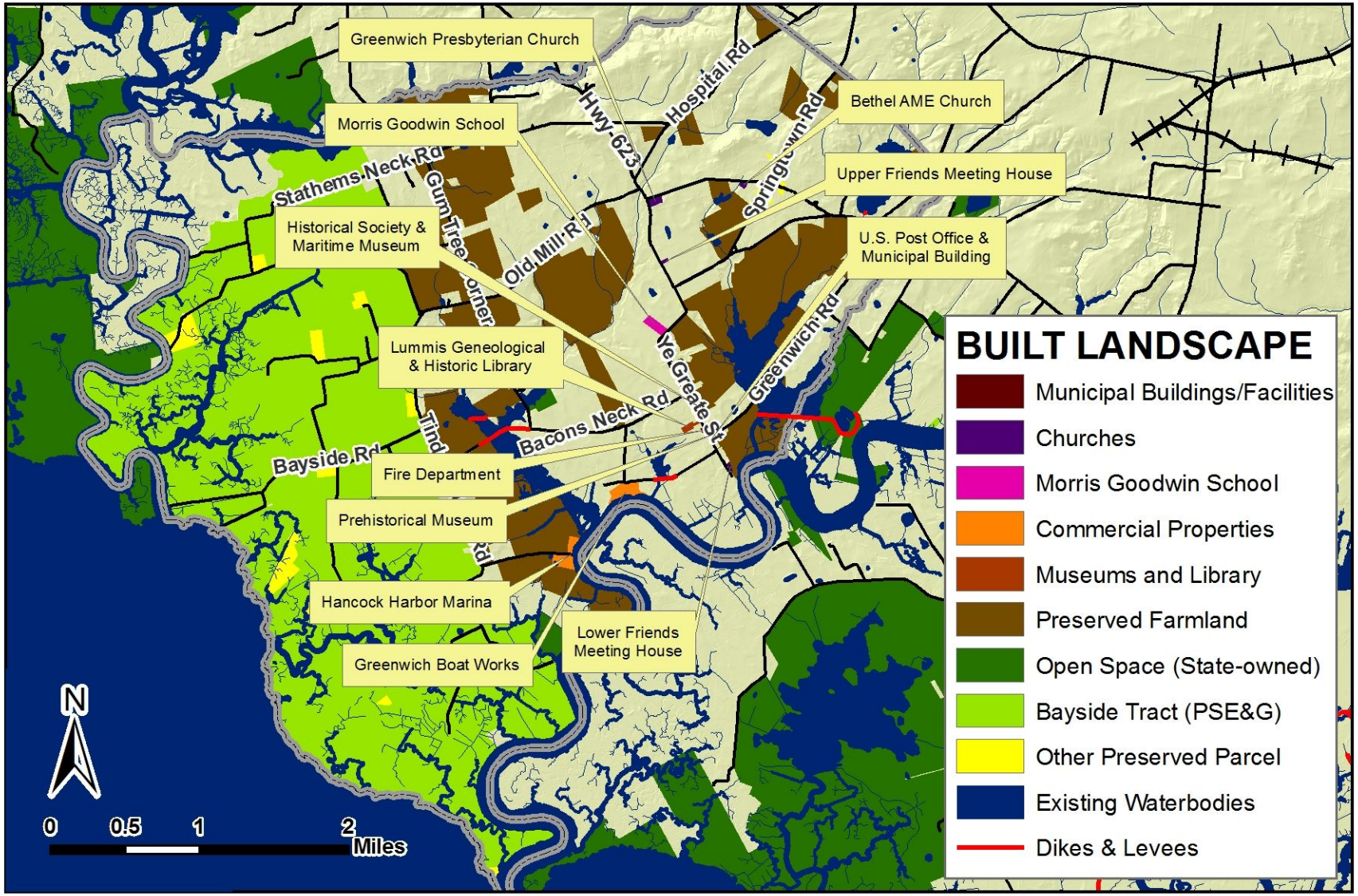
Sea Level Rise v Floodplain



Sea Level Rise v Floodplain

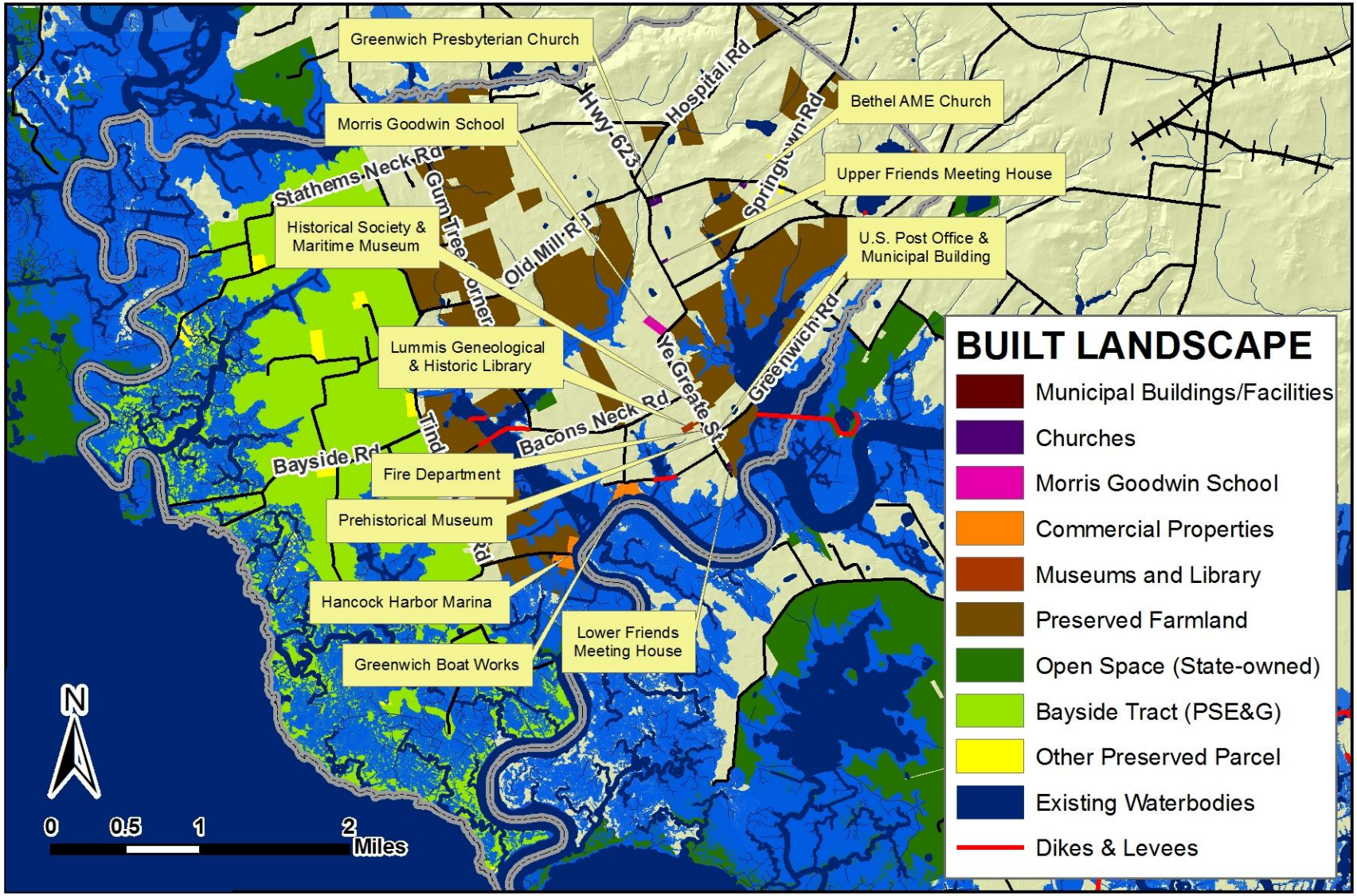


SLR v Built Environment



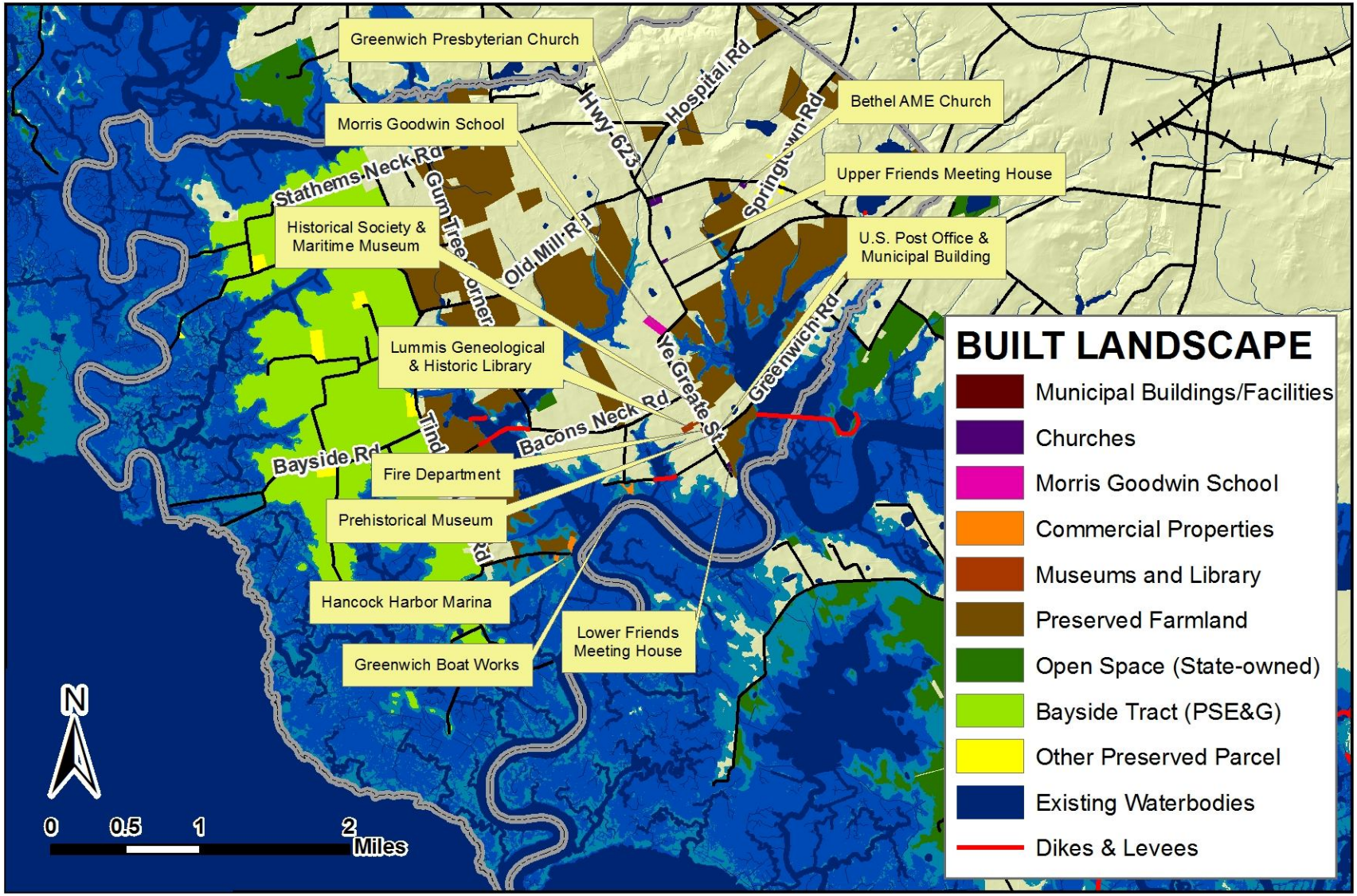
SLR v Built Environment

Present Day Spring Tide



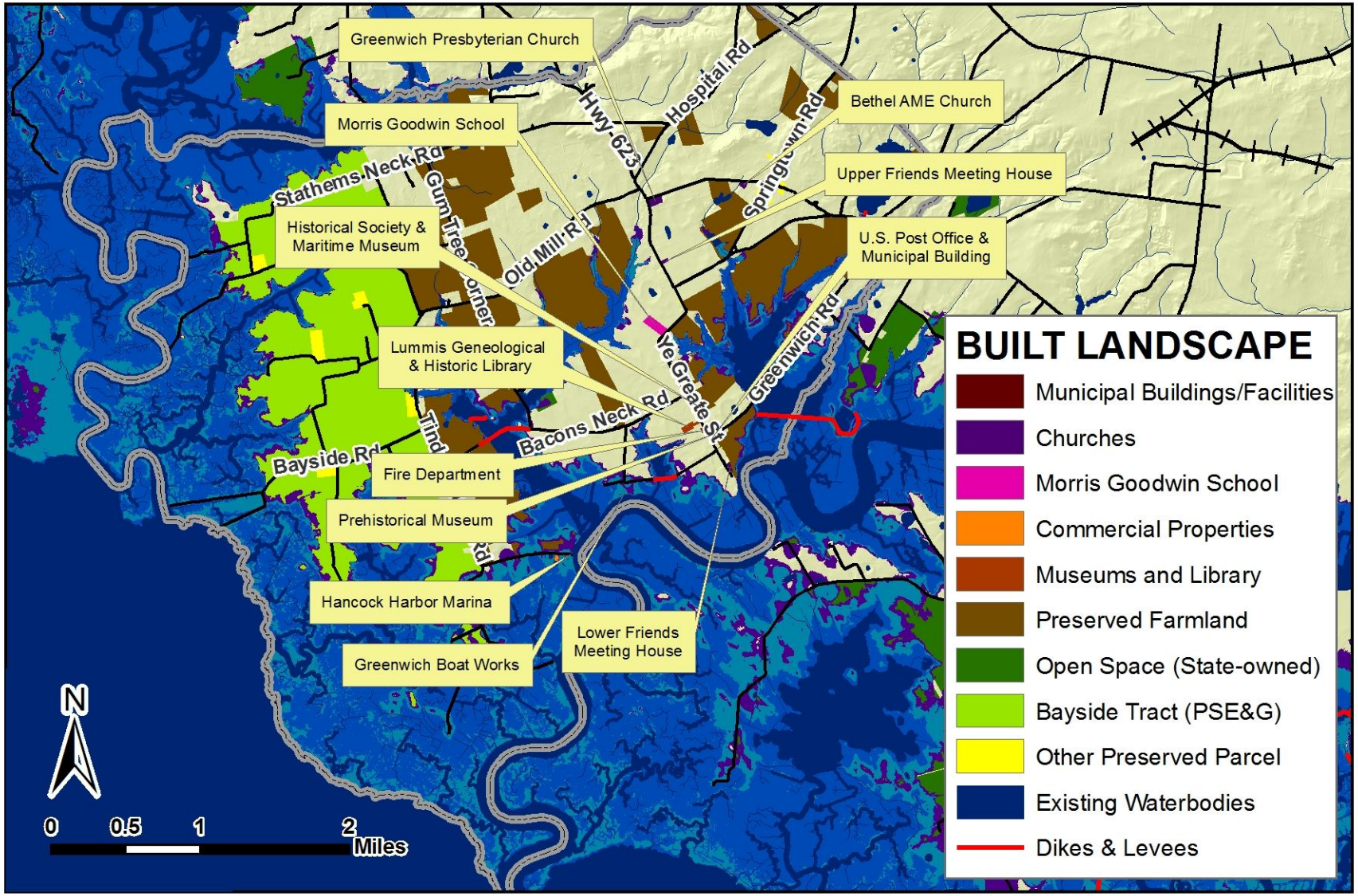
SLR v Built Environment

0.5 Meter Rise + Spring Tide



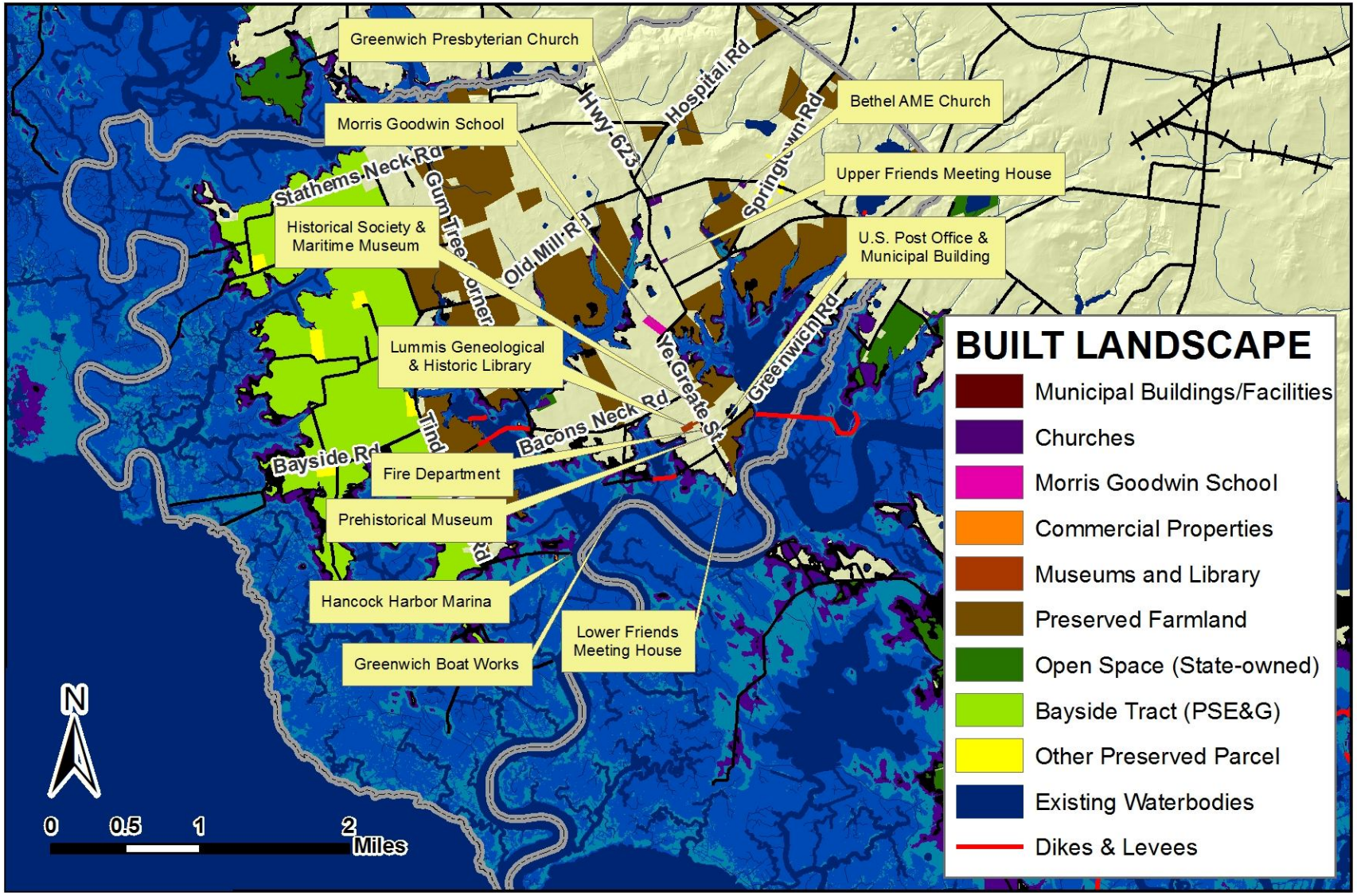
SLR v Built Environment

1.0 Meter Rise + Spring Tide



SLR v Built Environment

1.5 Meter Rise + Spring Tide

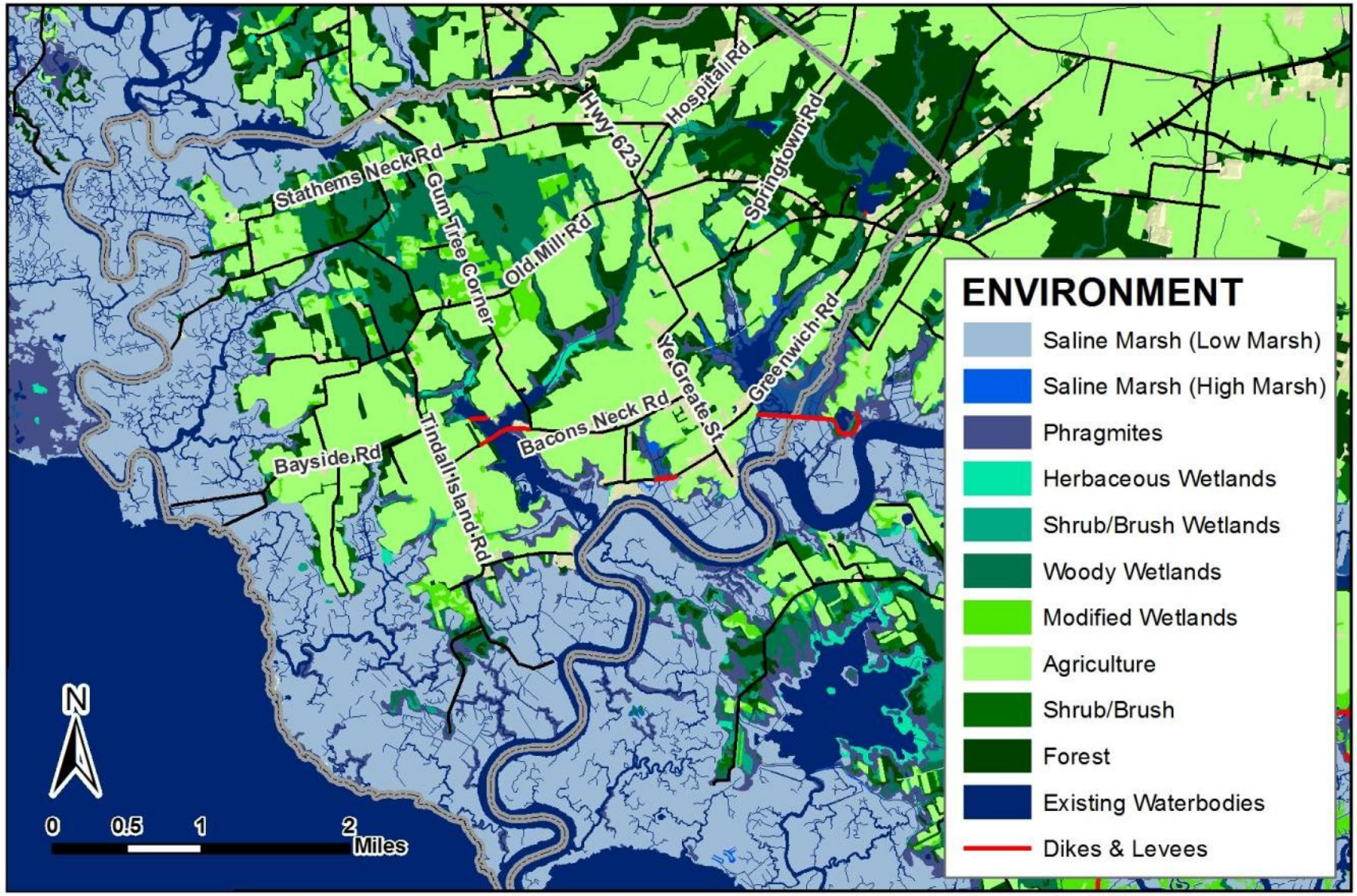


Sea Level Rise Vulnerability

PROPERTY	SPRING TIDE	SEA LEVEL RISE SCENARIO (M)		
		0.5	1.0	1.5
1. Municipal Building	-	-	-	-
2. Greenwich Township Fire Department	-	-	-	-
3. Greenwich Country Store & Post Office	-	-	-	-
4. Morris Goodwin School	-	-	-	-
5. Greenwich Presbyterian Church	-	-	-	-
6. Bethel AME Church	-	-	-	-
7. Friends Lower Meeting House	-	-	-	-
8. Friends Upper Meeting House	-	-	-	-
9. Hancock Marina/Bait Box Restaurant	-	Partial	X	X
10. Greenwich Boat Works/ Ship John Inn Restaurant	Partial	Partial	X	X
11. Lummis Genealogical and Historical Library	-	-	-	-
12. Gibbons House/Greenwich Historical Society	-	-	-	-
13. Cumberland County Prehistorical Museum	-	-	-	-
14. John DuBois Maritime Museum	-	-	-	-

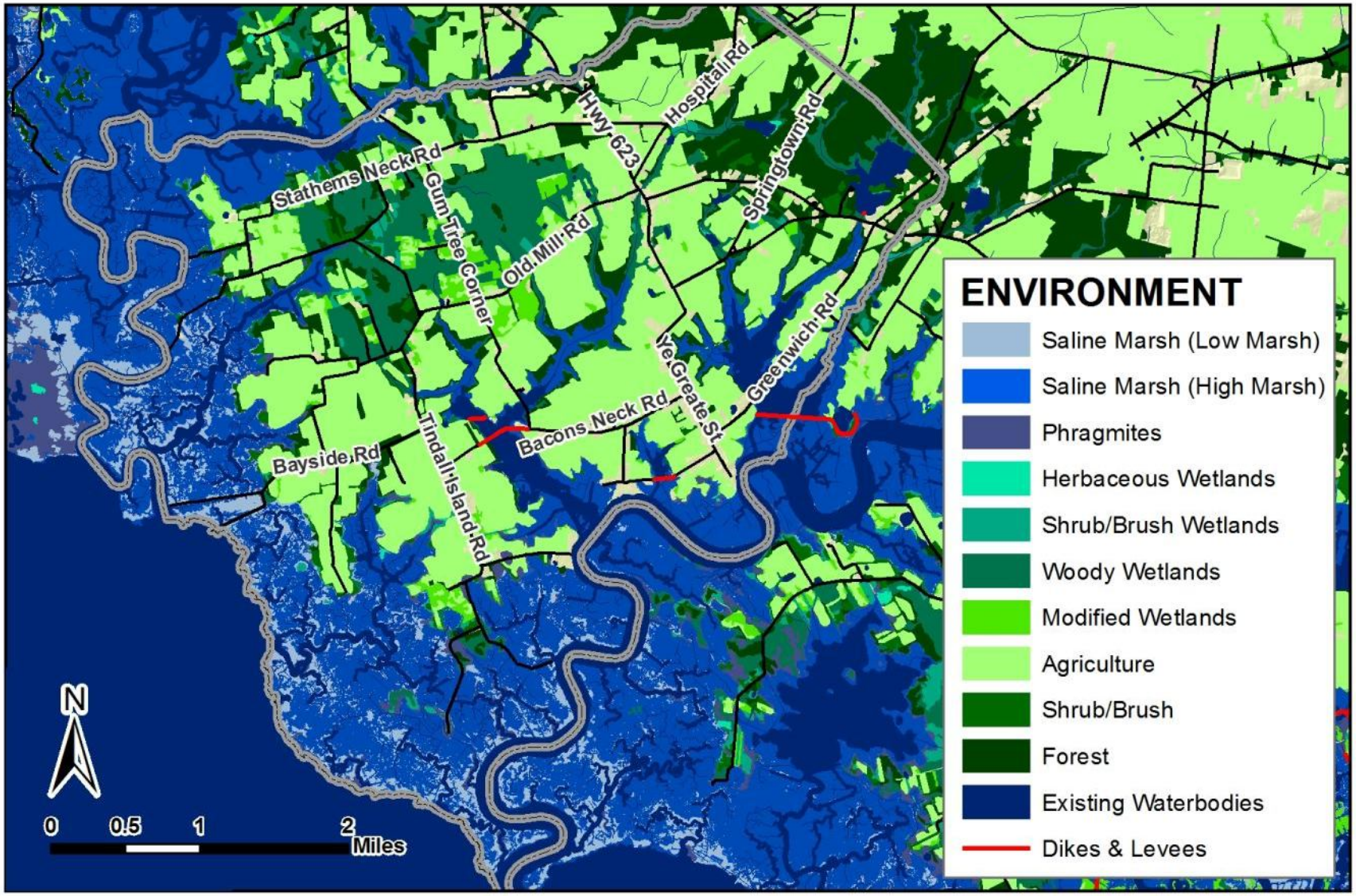
- Marshes, Natural Areas, Preserved Lands, and Marinas are the Most Susceptible to Permanent Inundation.

SLR v Natural Environment



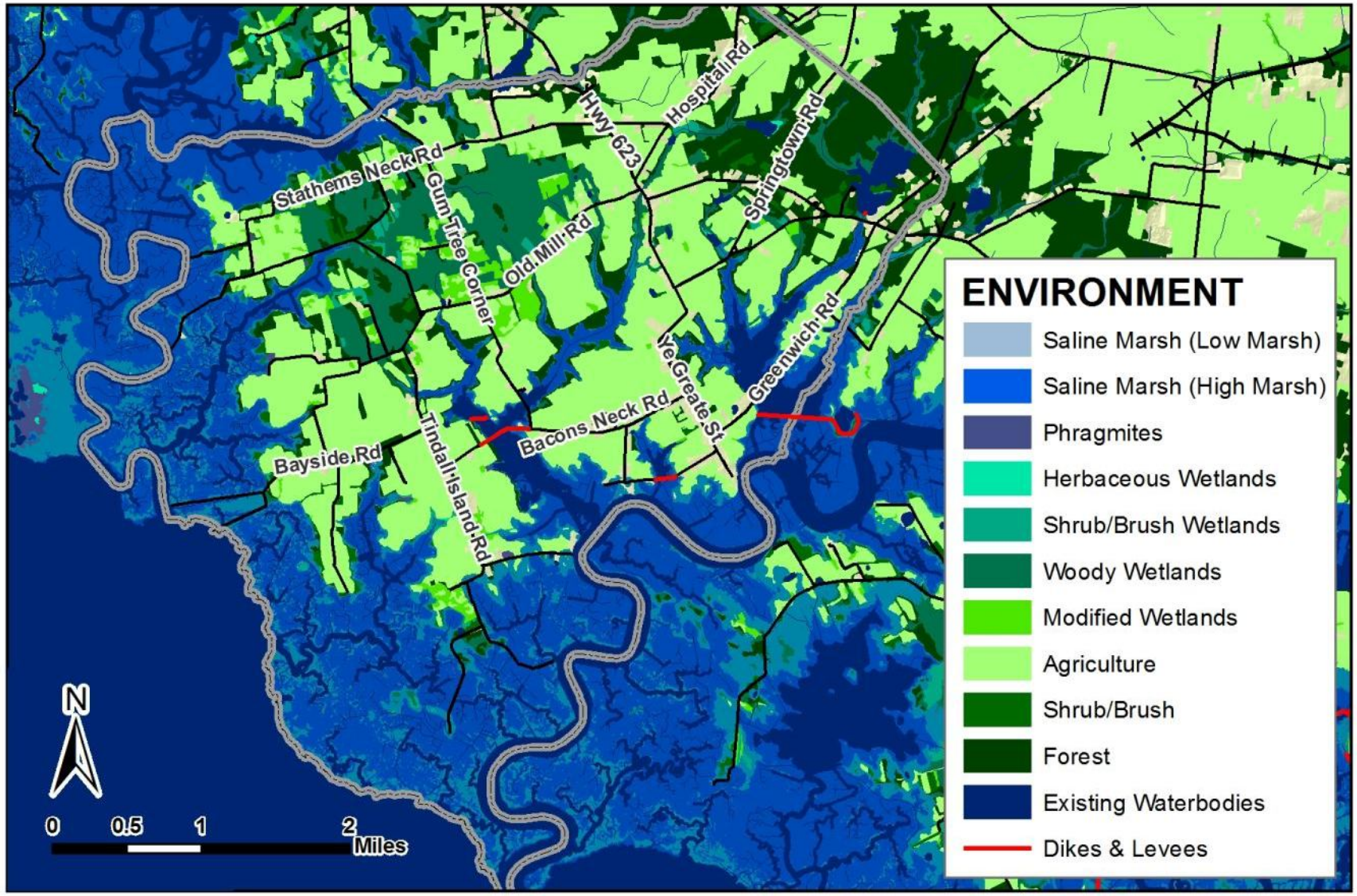
SLR v Natural Environment

Present Day Spring Tide



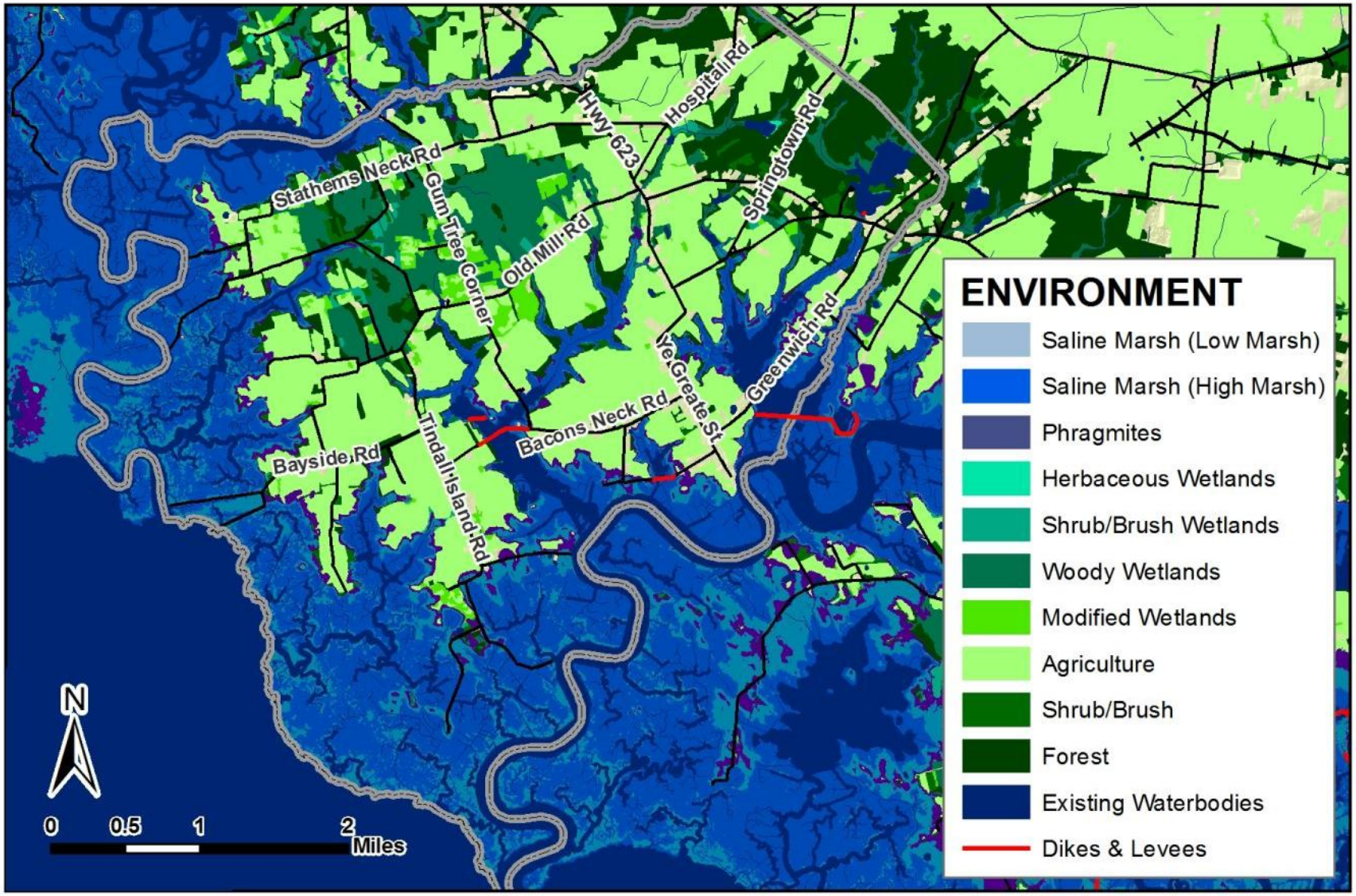
SLR v Natural Environment

0.5 Meter Rise + Spring Tide



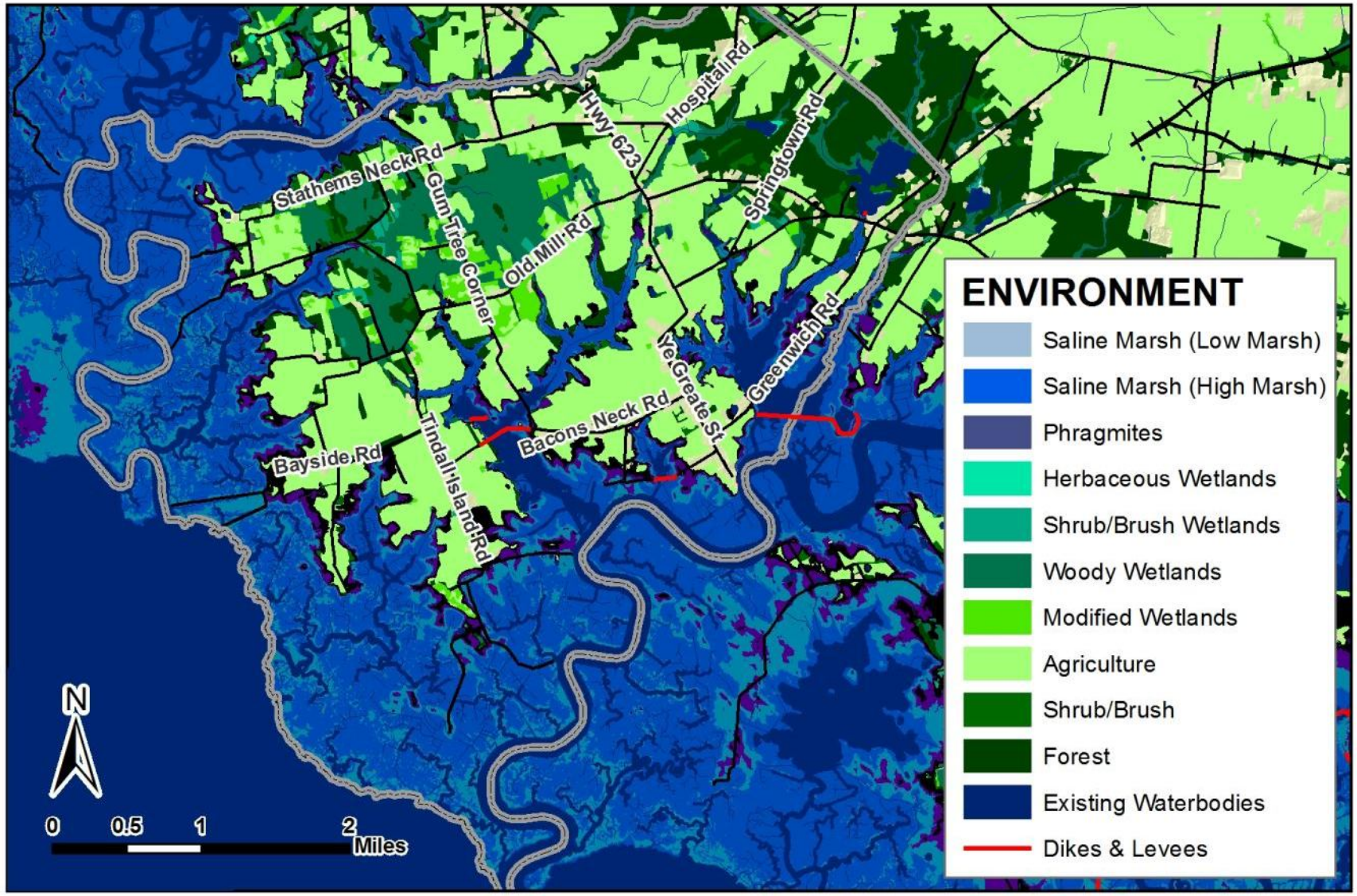
SLR v Natural Environment

1.0 Meter Rise + Spring Tide

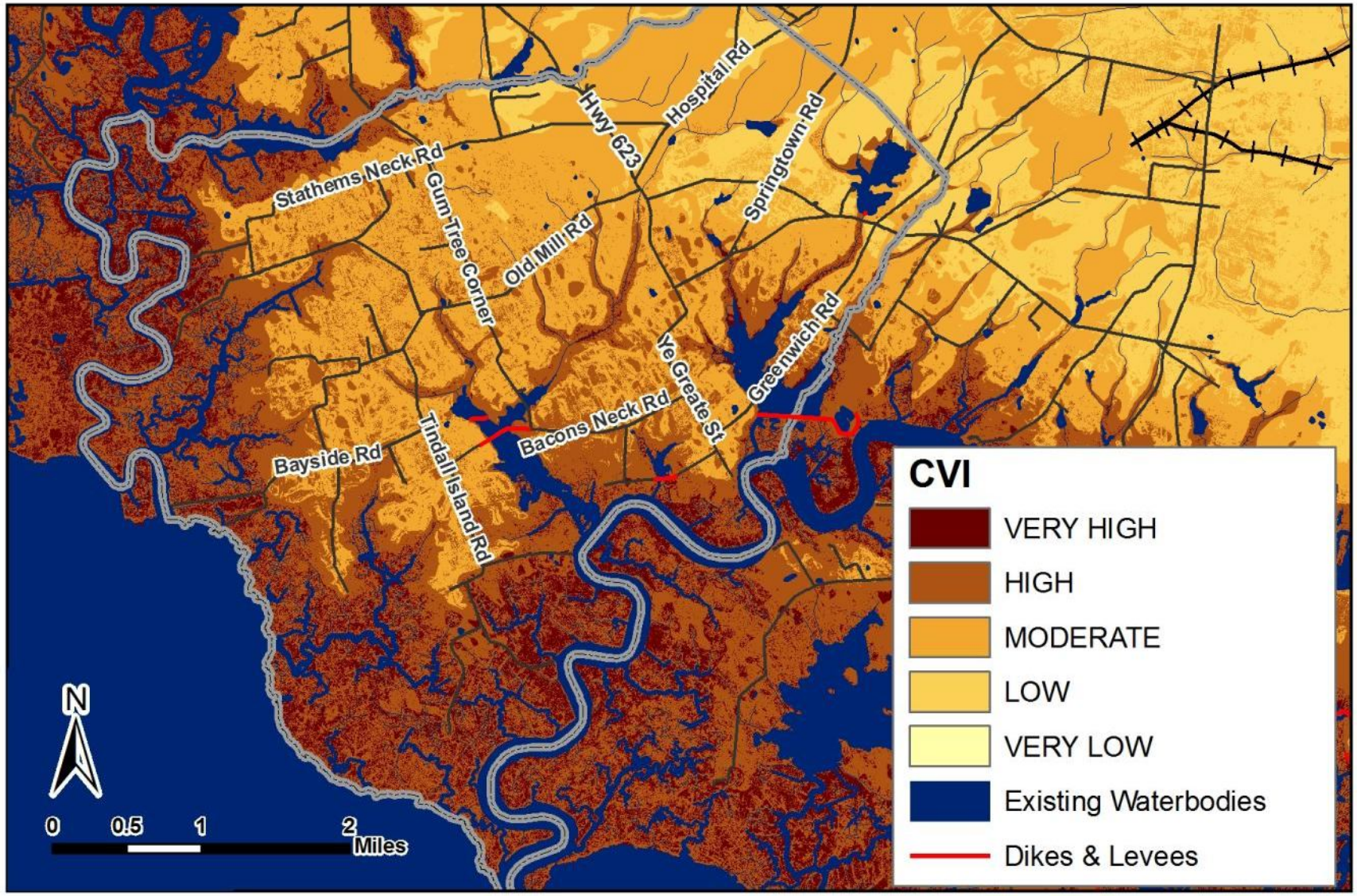


SLR v Natural Environment

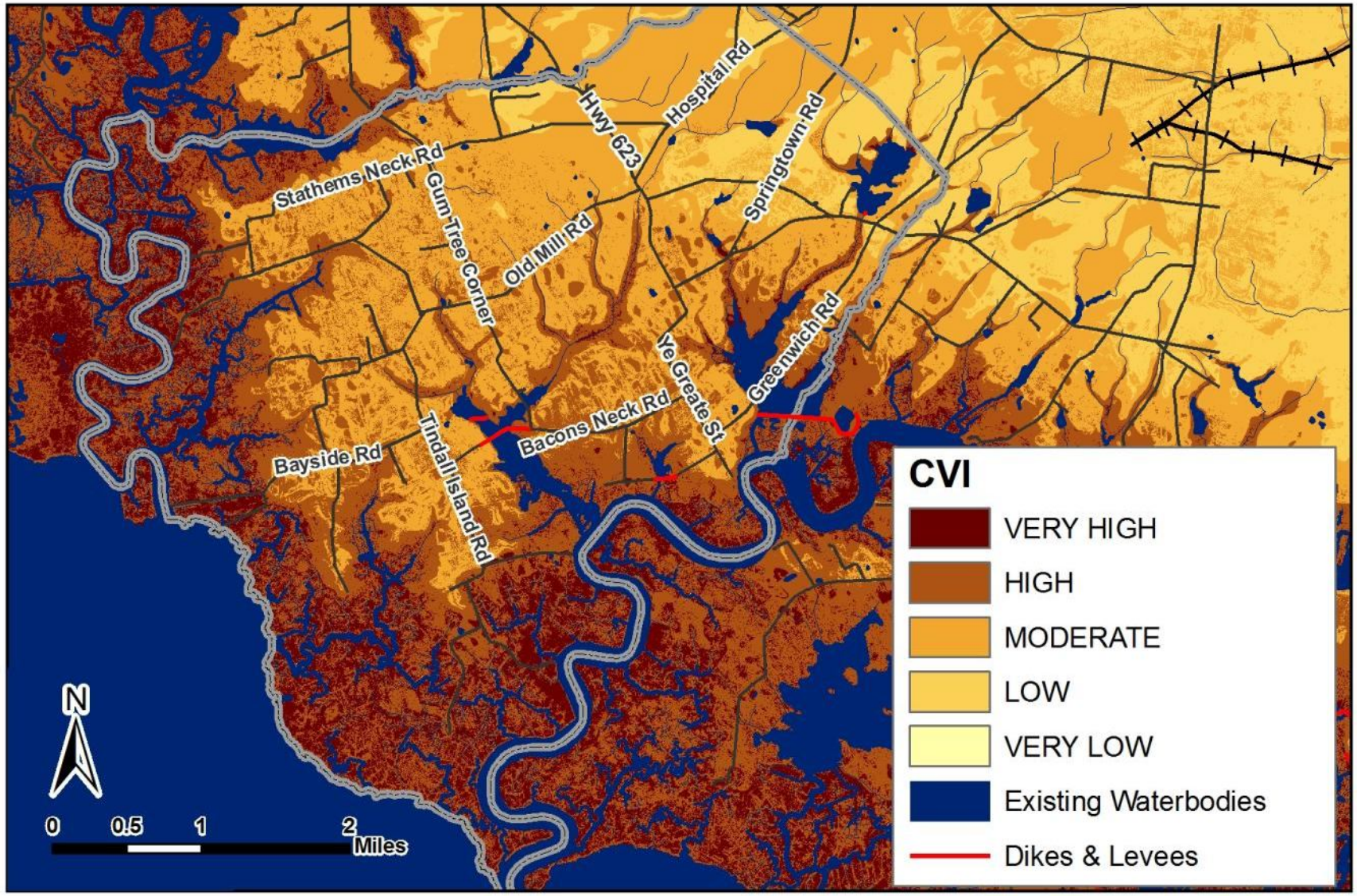
1.5 Meter Rise + Spring Tide



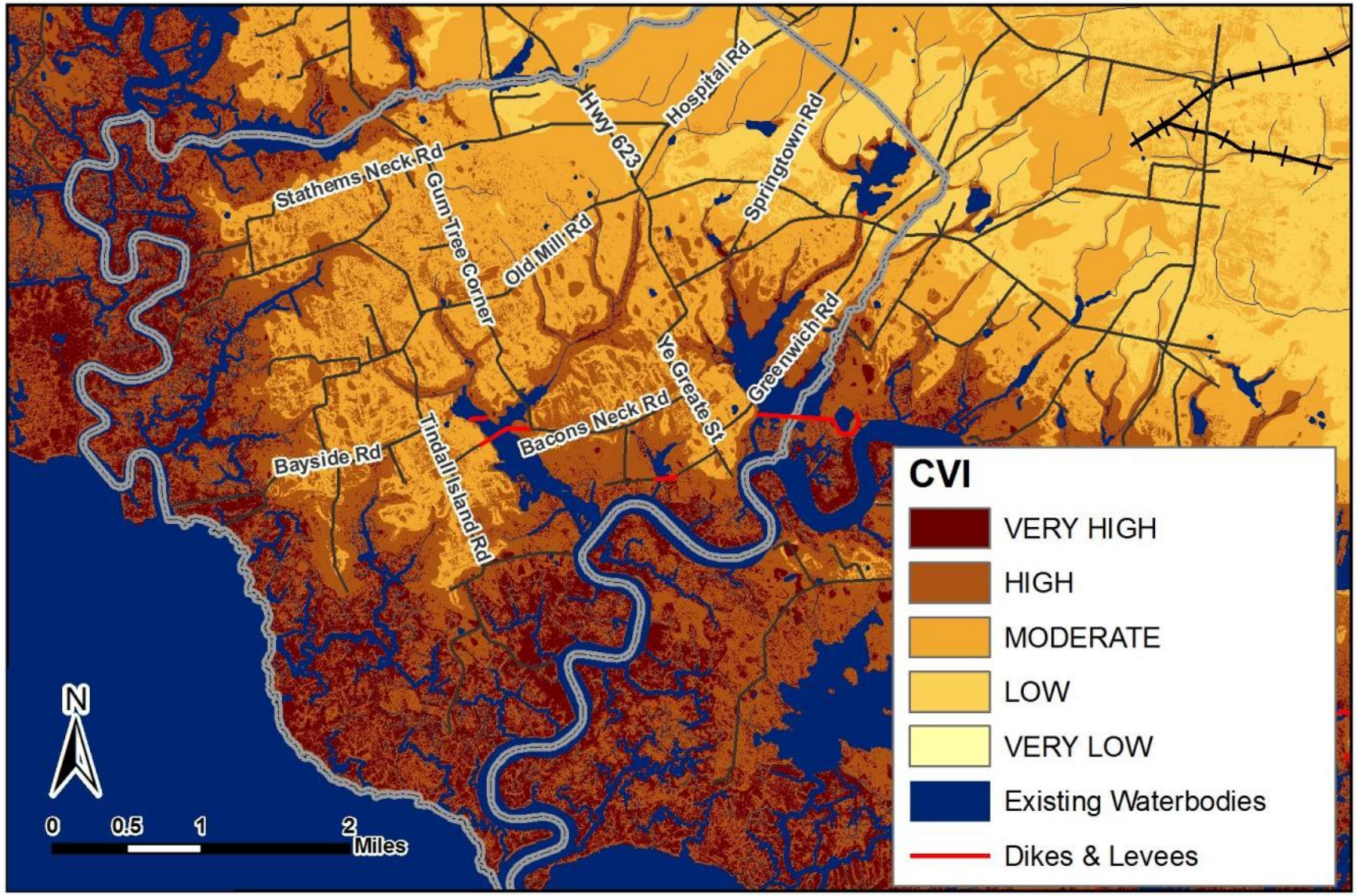
Coastal Vulnerability Index



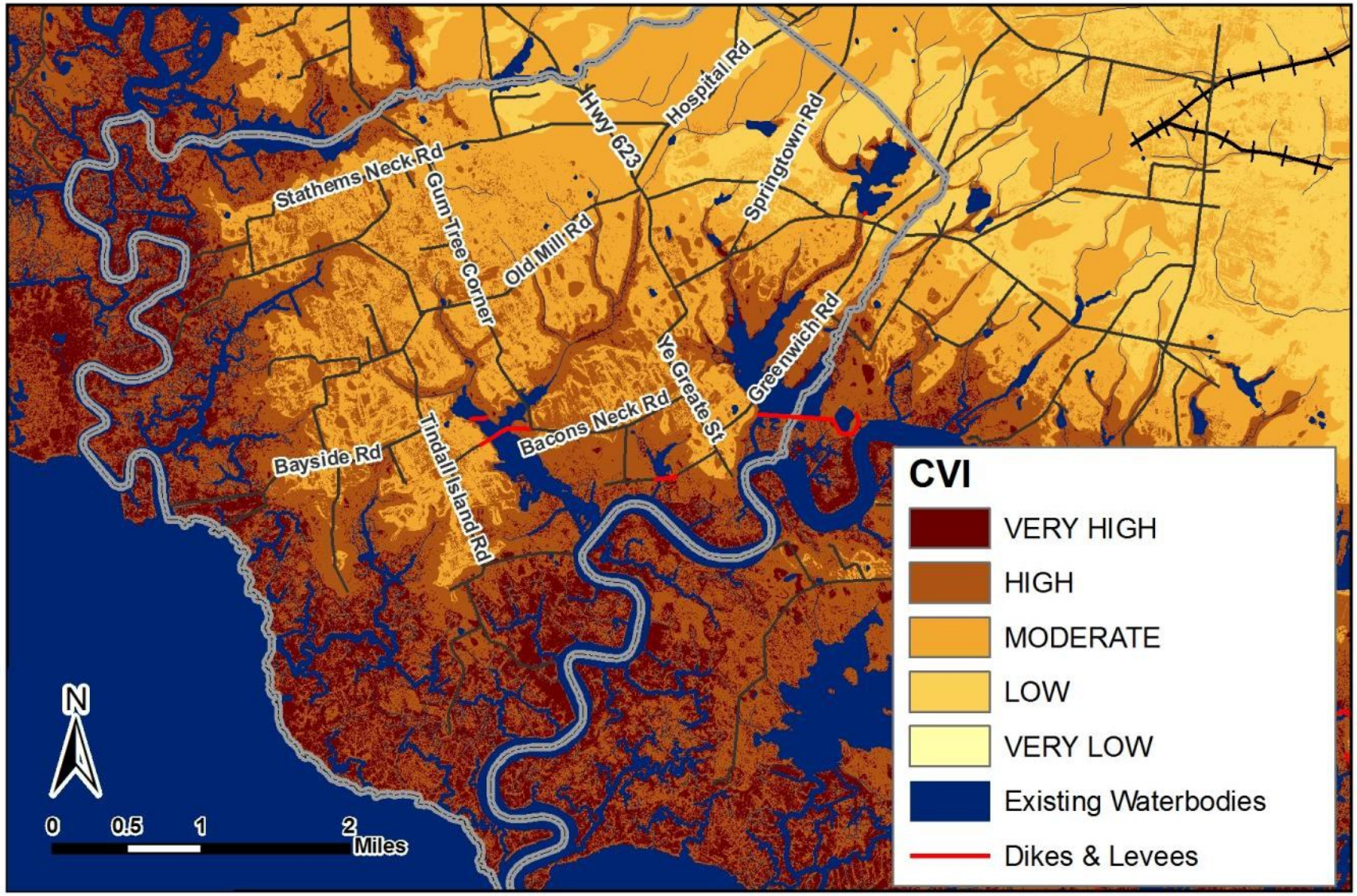
Coastal Vulnerability Index
0.5 Meters of Sea Level Rise



Coastal Vulnerability Index
1.0 Meters of Sea Level Rise



Coastal Vulnerability Index
1.5 Meters of Sea Level Rise



Part II

Getting to Resilience

A Coastal Community Resilience Evaluation Tool

Photo Credit: Trudy Hansen

Getting to Resilience

- To provide a forum for local leaders to discuss existing and future opportunities to improve hazard resiliency.
- To identify local government education and technical needs.
- To emphasize the existing mechanisms that can reduce vulnerability and improve resilience.

Getting to Resilience

- Five Sections
  - Risk and Vulnerability Assessments
  - Public Engagement
  - Planning Integration
  - Disaster Preparedness and Recovery
  - Hazard Mitigation and Implementation

Zoning Map
Municipal Master Plan
All-Hazards Plan
Stormwater Management
Flood Mitigation Plan
Emergency Operations
Evacuation Plans
Land/Open Space Conservation
Wetland Restoration
Post-Storm Redevelopment Plan
Capital Improvements Plan
Local Ordinances

Getting to Resilience Findings

- Community Leaders are Eager to Ensure the Safety of Residents and the Protection of Natural and Historic Resources.
- Community has Made Extensive Progress in Farmland Preservation.
- Residents May Need Access to Information on Storm Vulnerability & the Evacuation Process.
- Residents Need Information on Flood Vents, Weather Proofing, Window Protection.
- The State Needs to Clearly Convey the 2 ft-Freeboard to Municipal Decision-Makers.
- Community Relies Heavily Upon the County for Emergency Assistance in the Event of a Disaster.

Overall Greenwich Findings

- A Category One Hurricane and 1.5 Meters of Sea Level Rise Will Likely have Similar Inundation Patterns- Plan for Both!
- Preserved Lands May Allow Marshes to Naturally Migrate Inland!
- Community Should Continue Land Preservation/Conservation in Low Lying Areas- Use Flood Protection as a New Angle.
- Build Capacity For Resilience Through Grassroots Education on Storm Vulnerability, Disaster Preparedness, & Storm Evacuation Procedures.
- Identify Evacuation Assistance Needs Through Register-Ready or Local Registry/Surveying.
- Collaborate with County and Nuclear Facility on Disaster Response and Re-entry- Share Knowledge with Residents.

Overall Greenwich Findings

Dikes

Terminus Ends May Need to Be Extended

Water May Seep Around

Failing Dike Has Altered the Established Habitat

- Failing Dikes and Subsiding Soils Threaten Municipal Roads, Freshwater Habitat, and Wells.
- Dike Restoration and Repairs Should Account for Higher Sea Levels, More Frequent Flooding, and Greater Flood Extents.

Final Products and Next Steps

- Final Report
- Coastal Vulnerability Mapping
- GIS Data
- Future Outreach & Assistance

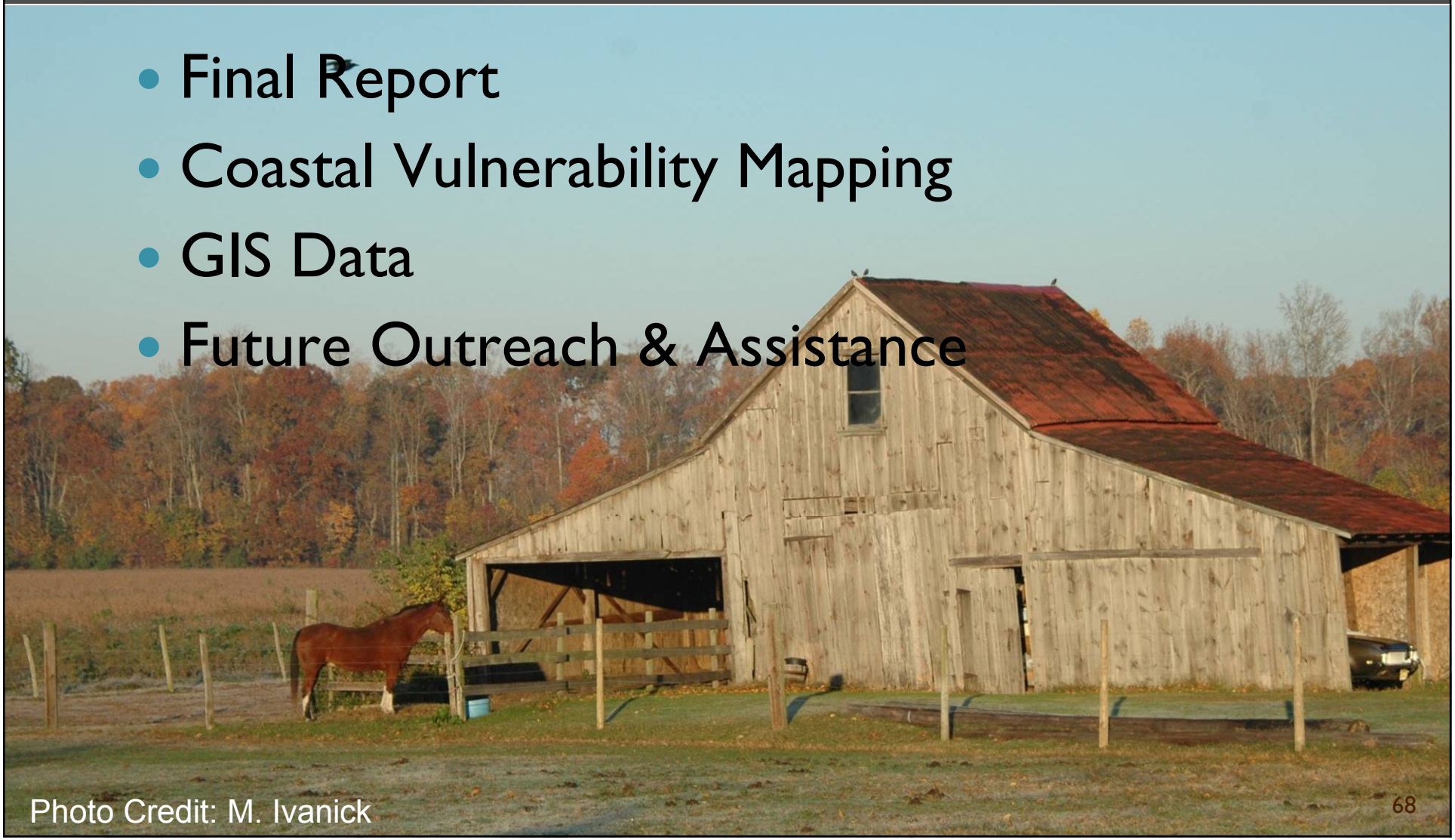


Photo Credit: M. Ivanick

Thank You for Participating! Questions?

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609-633-2201

Photo Credit: Carey Hedlund