

# Low-Lying Roads Project

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Fall 2021- June 2023

Project funded by:  
Municipal Vulnerability Preparedness Program  
Economic Development Administration

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# Purpose and Objectives of Workshop

- **Review flood projections and impacts on roadways for the town under future scenarios**
- **Discuss vulnerable low-lying roads or other transportation infrastructure**
- **Prepare the town to address priority road segments for design and permitting**

# Agenda

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- Welcome
- Project Overview
- Vulnerability and Risk Assessment
- Results of Low-Lying Roads Screening
- Discussion/Breakout Groups
- Next Steps

# Low-Lying Roads



**10**  
TOWNS

- |            |           |
|------------|-----------|
| Barnstable | Orleans   |
| Bourne     | Sandwich  |
| Brewster   | Truro     |
| Dennis     | Wellfleet |
| Eastham    | Yarmouth  |



Flooding vulnerability assessment of low-lying roads and transportation infrastructure



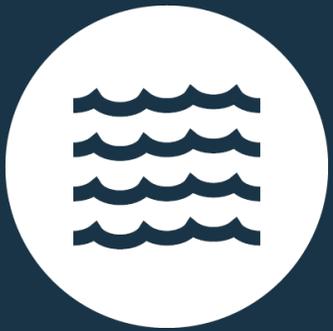
Support municipal road segment prioritization



Identify range of potential design solutions, costs

Work performed by Cape Cod Commission and Woods Hole Group

HAZARD  
Storms, SLR  
& Flooding



# Adaptation Strategies



- | Gray Infrastructure, or Traditional Engineering Structures
- | Green Infrastructure, or Nature-based Solutions
- | Other approaches – Assisted Relocation, Abandonment

# PROJECT TIMELINE & ELEMENTS



# Questions?

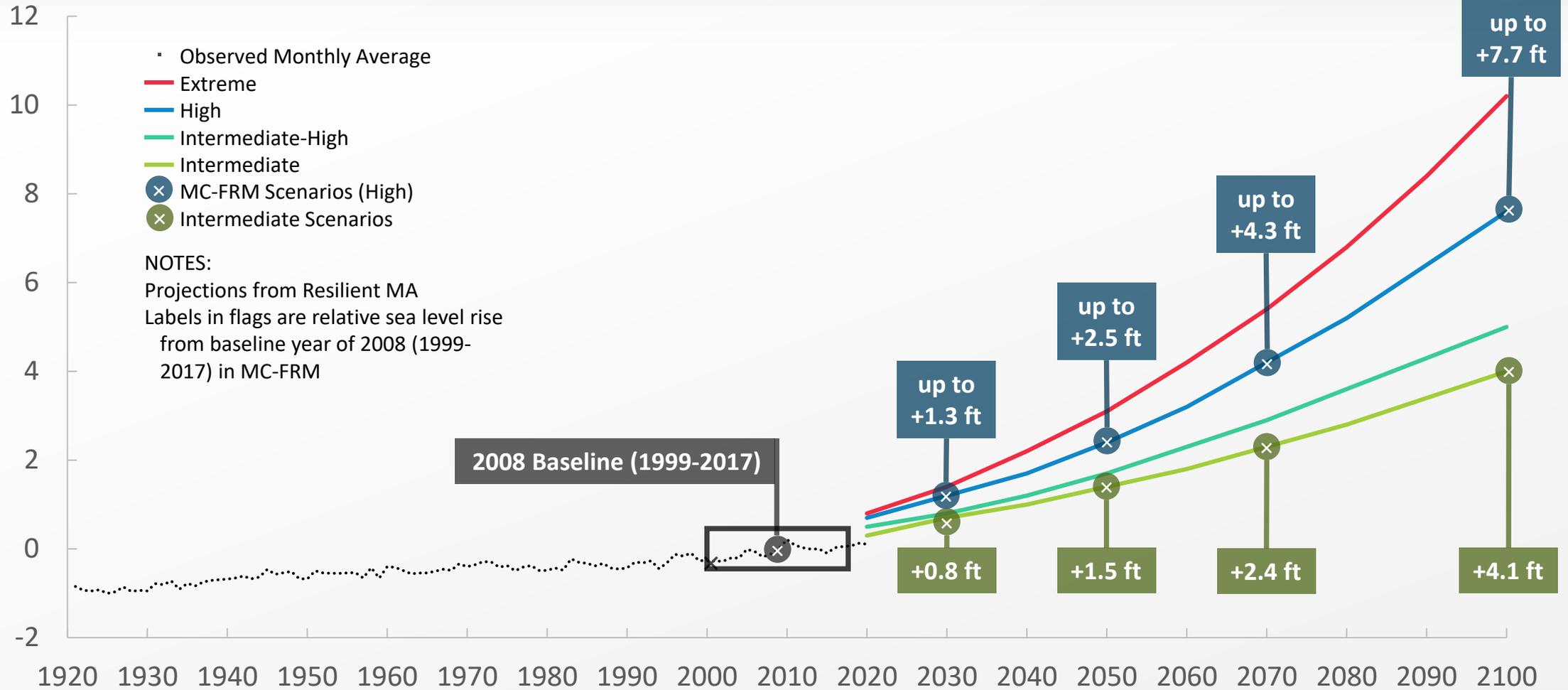
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- Workshop Purpose or Objectives
- Low Lying Roads project
  - Key components
    - Vulnerability Assessment - Identify Potential Sites
    - Public Outreach and Engagement
    - Roadway Feasibility and Alternative Solutions
    - Solutions Identification
  - Timeline

# MA EOEEA Probabilistic Sea Level Rise Projections

MC-FRM NORTH (DeConto & Kopp, 2017)

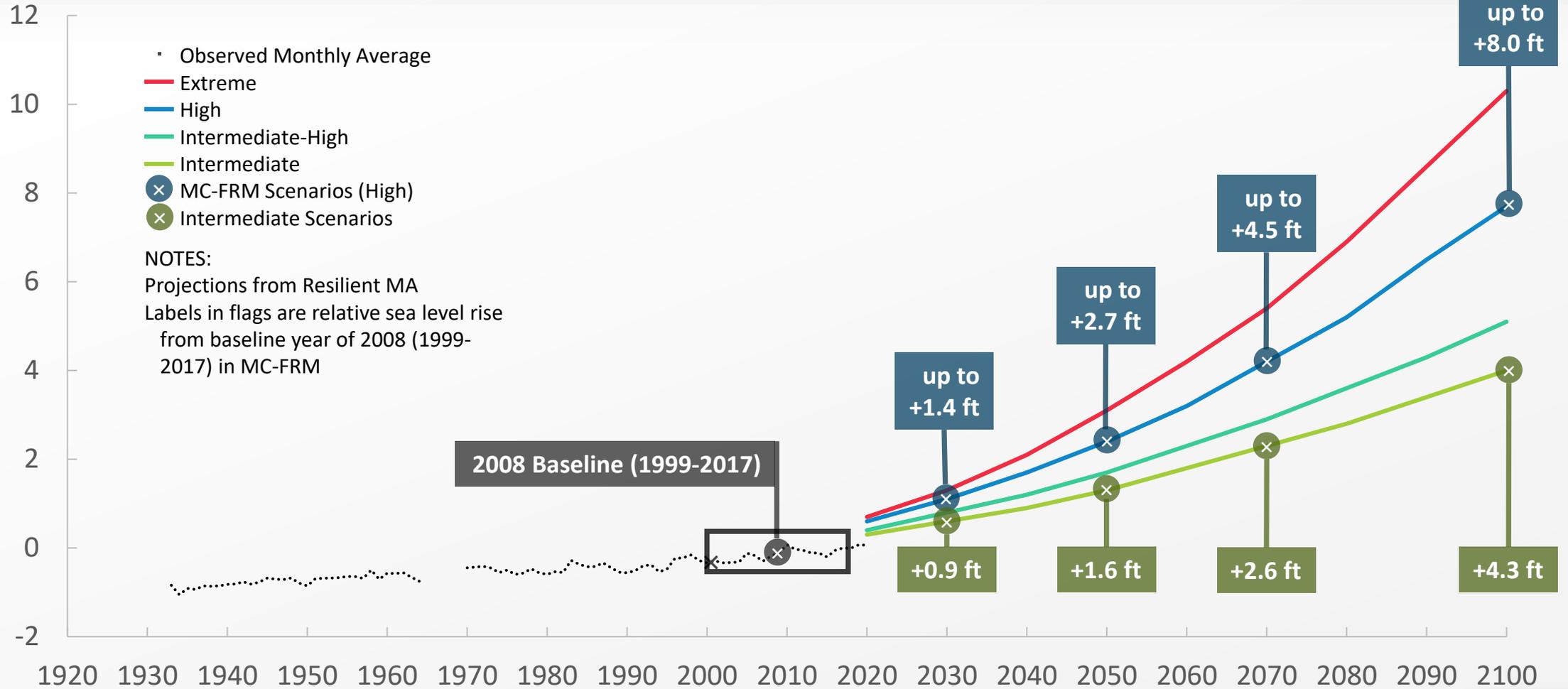
Relative Mean Sea Level (feet NAVD88)



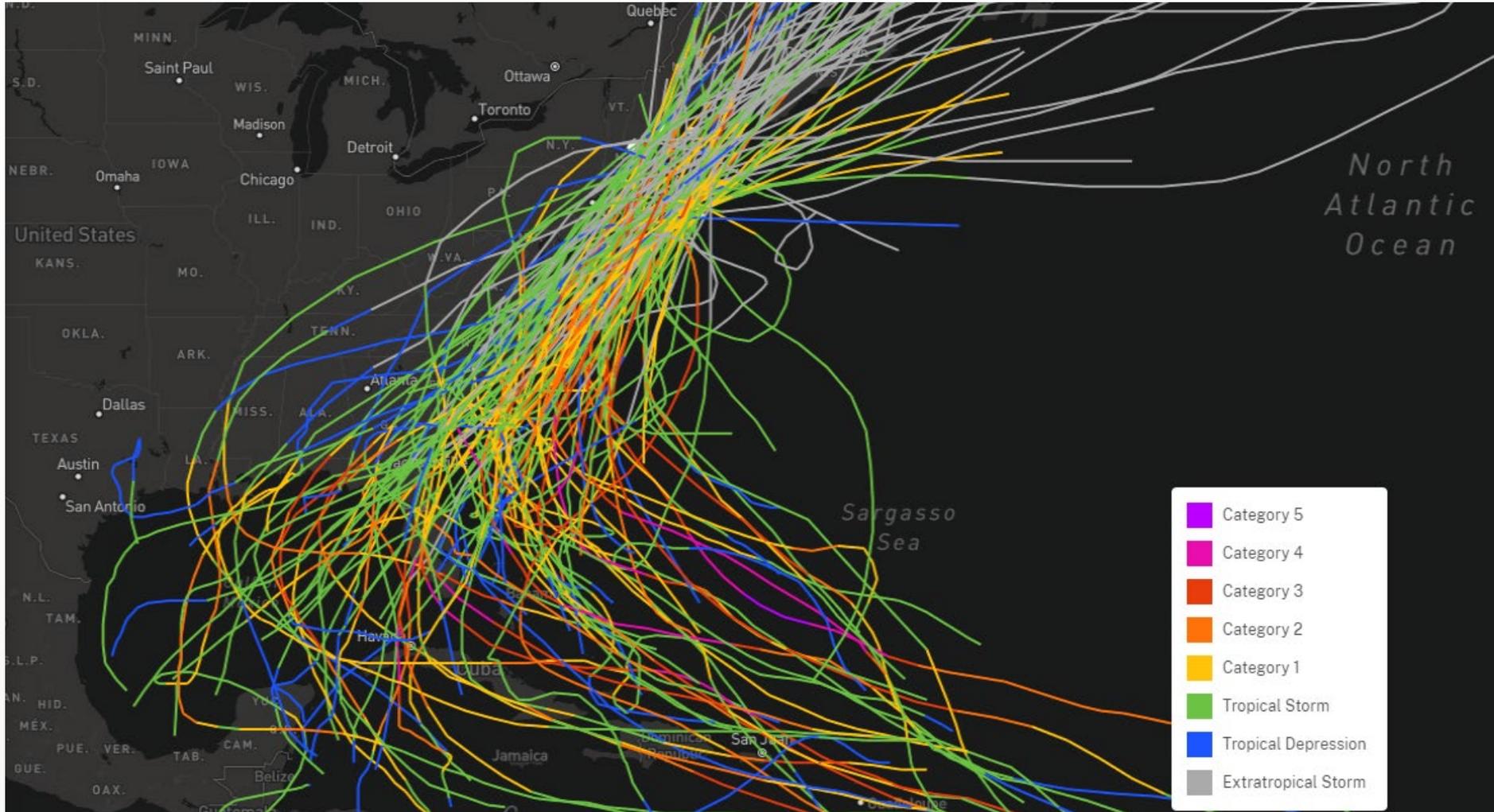
# MA EOEEA Probabilistic Sea Level Rise Projections

MC-FRM SOUTH (DeConto & Kopp, 2017)

Relative Mean Sea Level (feet NAVD88)



# Tropical / Extra-tropical Storms



NOAA National Ocean Service



# Massachusetts Coast Flood Risk Model (MC-FRM)

INPUTS



SEA LEVEL  
RISE



TROPICAL / EXTRA-  
TROPICAL STORMS



LANDSCAPE



ELEVATION



CHANGING  
CLIMATE

PROBABILISTIC /  
HYDRODYNAMIC  
MODEL



Includes relevant physical processes:  
sea level rise, tides, storm surge, wind, wave setup  
/ run-up / overtopping, future climate scenarios

Future version to incorporate coastal erosion



FLOOD  
PROBABILITY



FLOOD  
DEPTH



FLOOD  
DURATION



FLOOD  
VOLUMES



FLOOD  
PATHWAYS



WINDS



WAVES



CURRENTS

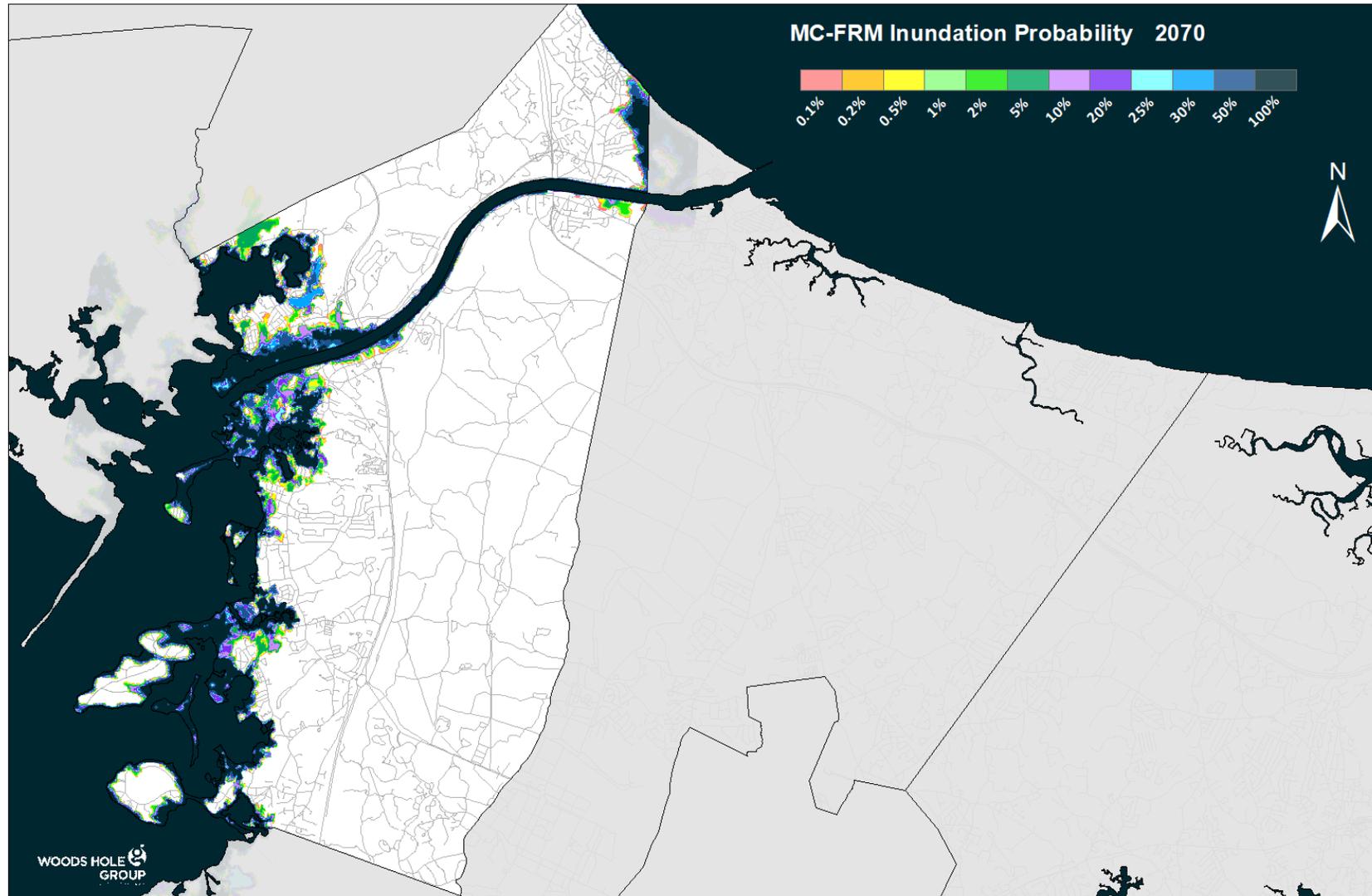


OUTPUTS

# MC-FRM Resolution - Bourne



# MC-FRM Coastal Flood Exceedance Probability – Bourne



# Massachusetts Coast Flood Risk Model

## SUMMARY

Hydrodynamically modeled projections

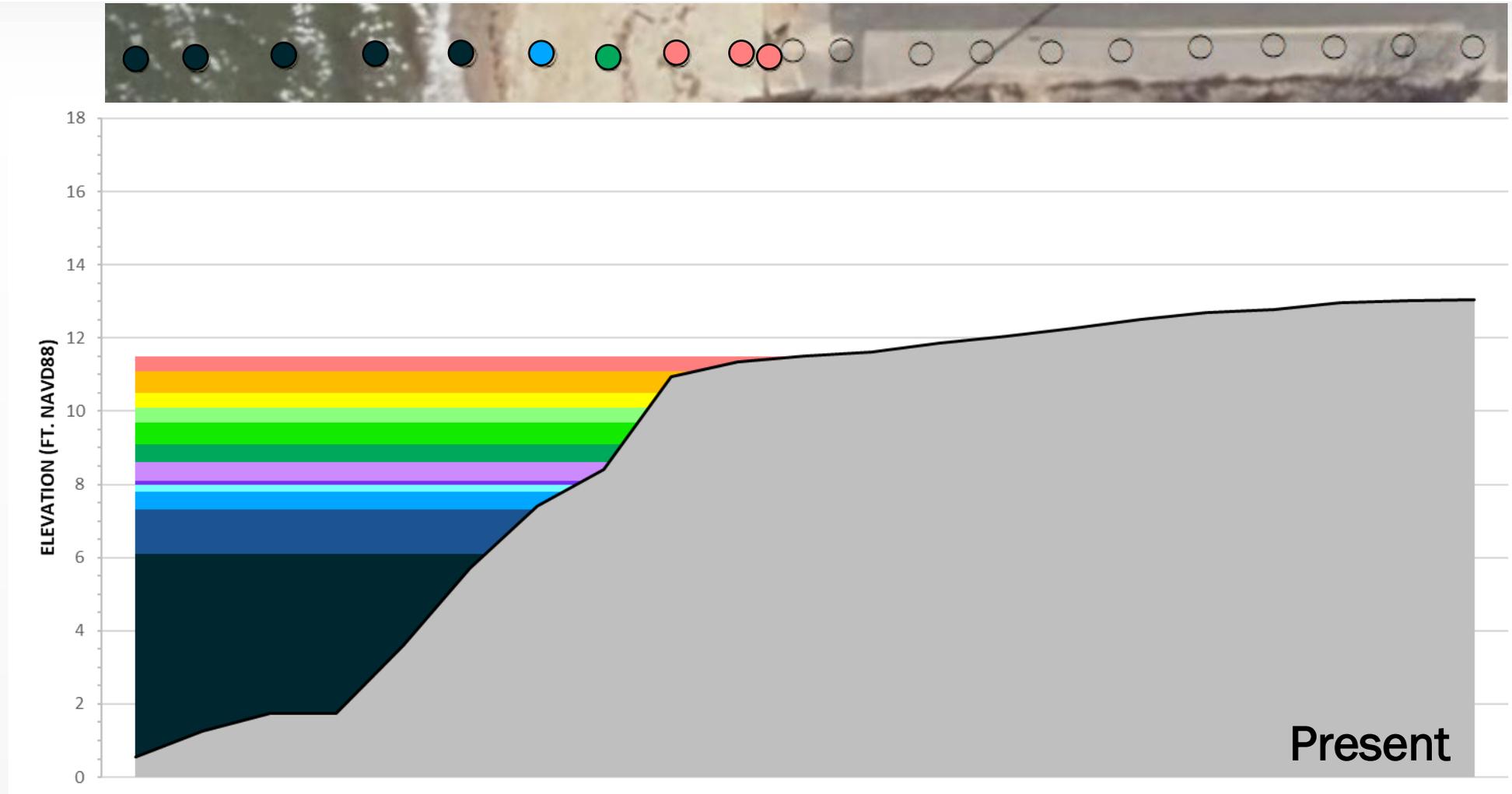
Sea level rise and storm surge – combined

Annual chance of flooding under 2030/2050/2070 climate conditions

## QUESTIONS?

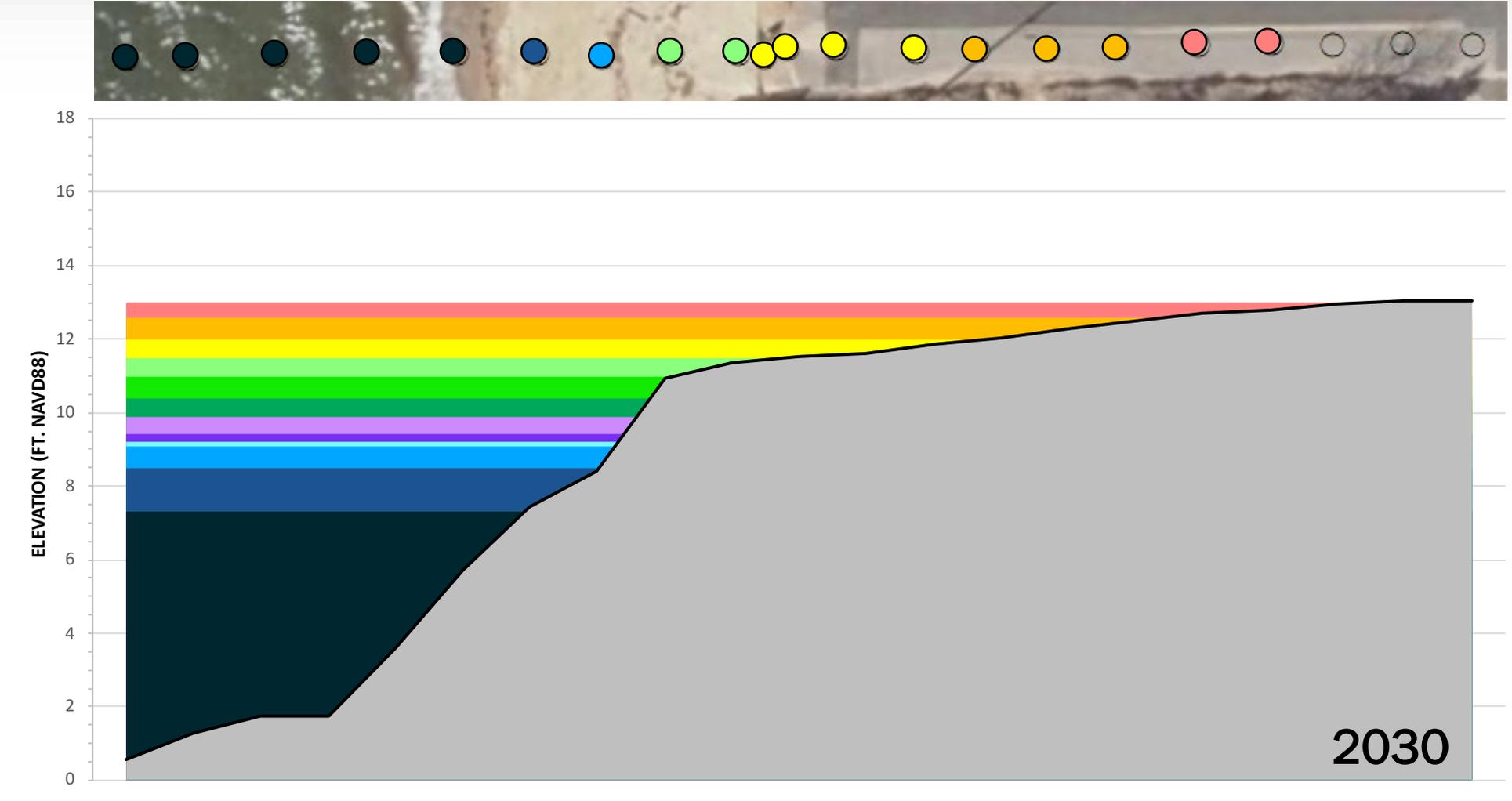


# Cape Cod Low Lying Roads Vulnerability Assessment Methods



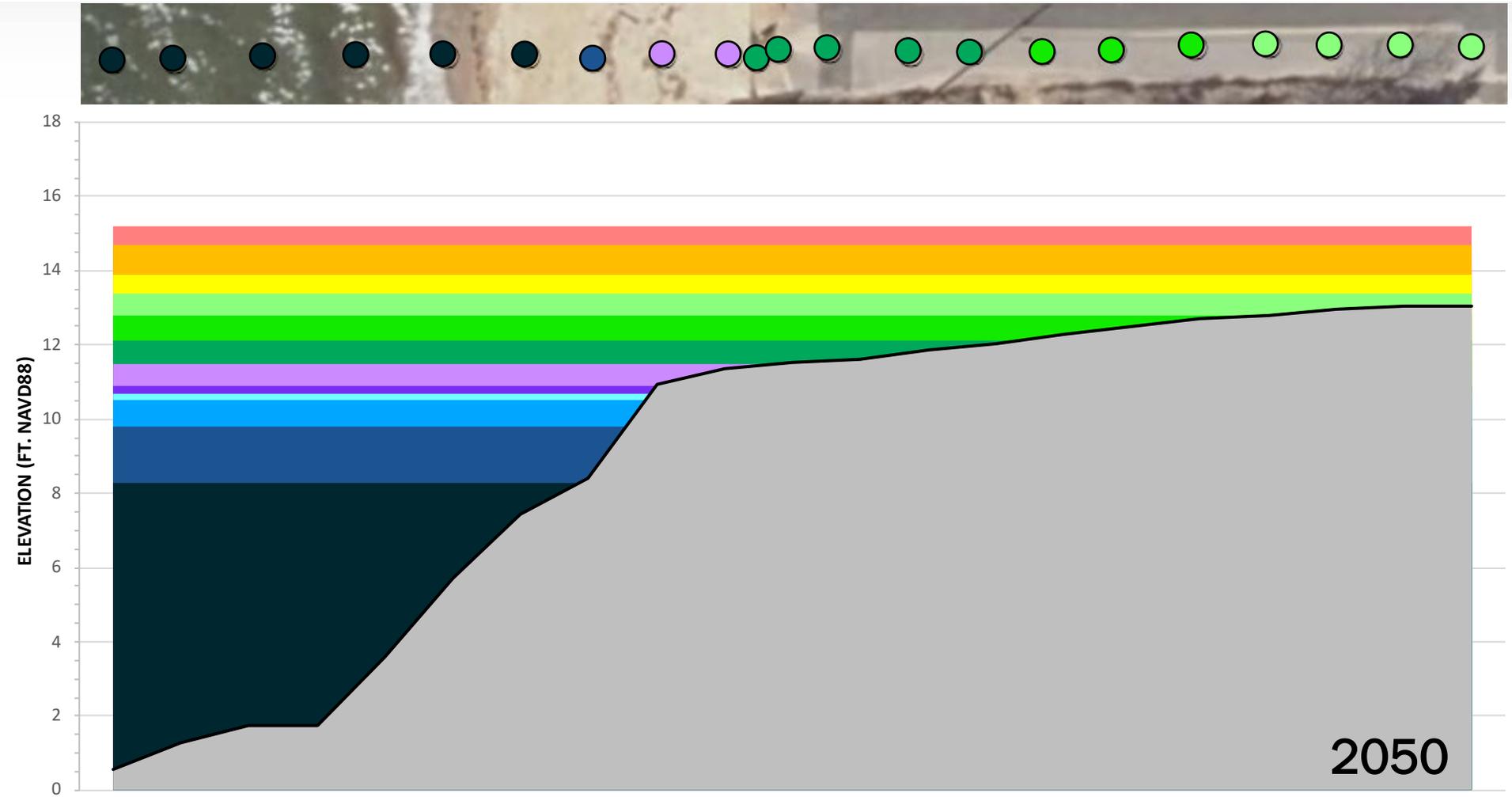
COASTAL FLOOD EXCEEDANCE PROBABILITY

# Cape Cod Low Lying Roads Vulnerability Assessment Methods



COASTAL FLOOD EXCEEDANCE PROBABILITY

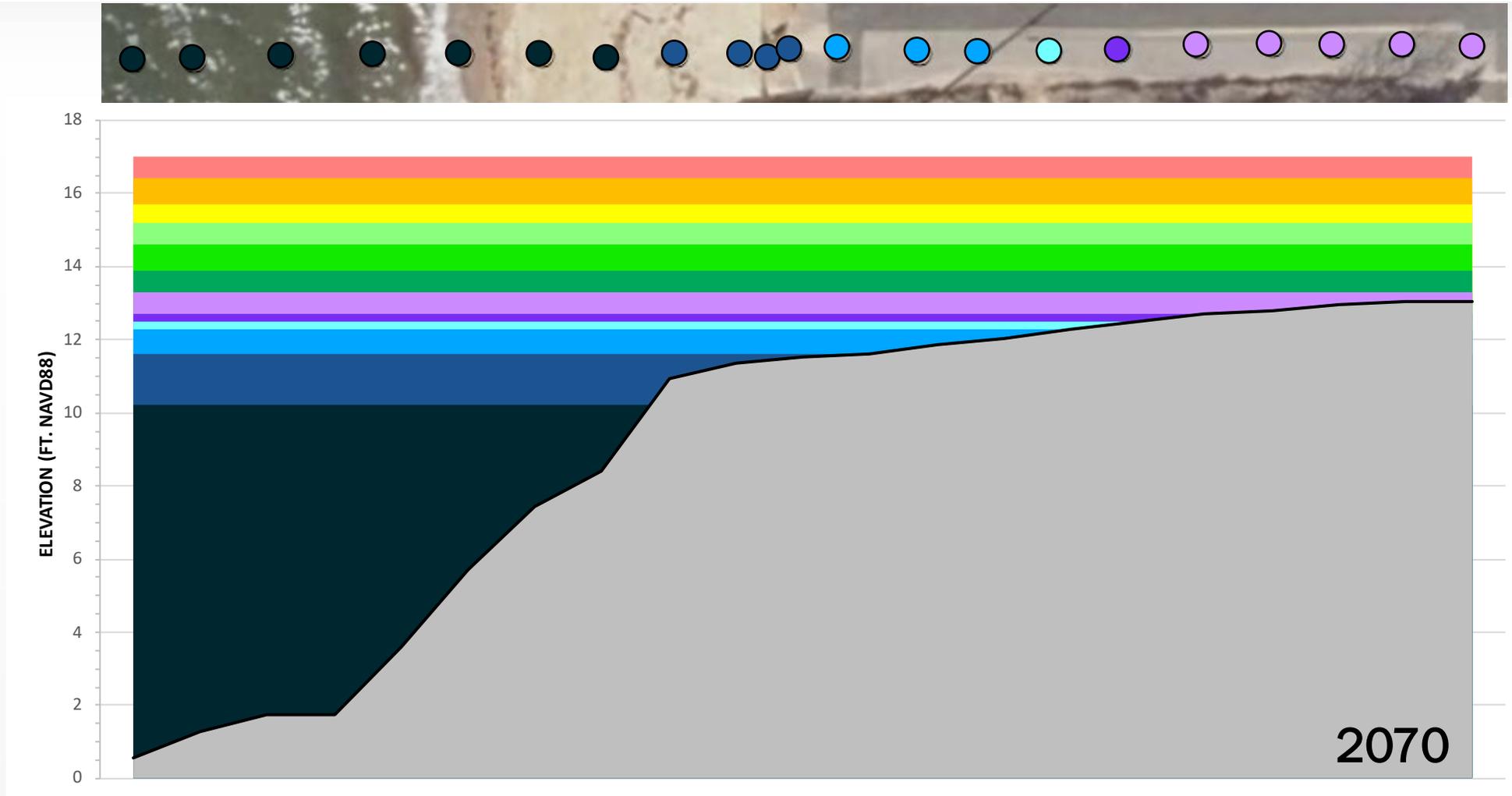
# Cape Cod Low Lying Roads Vulnerability Assessment Methods



COASTAL FLOOD EXCEEDANCE PROBABILITY



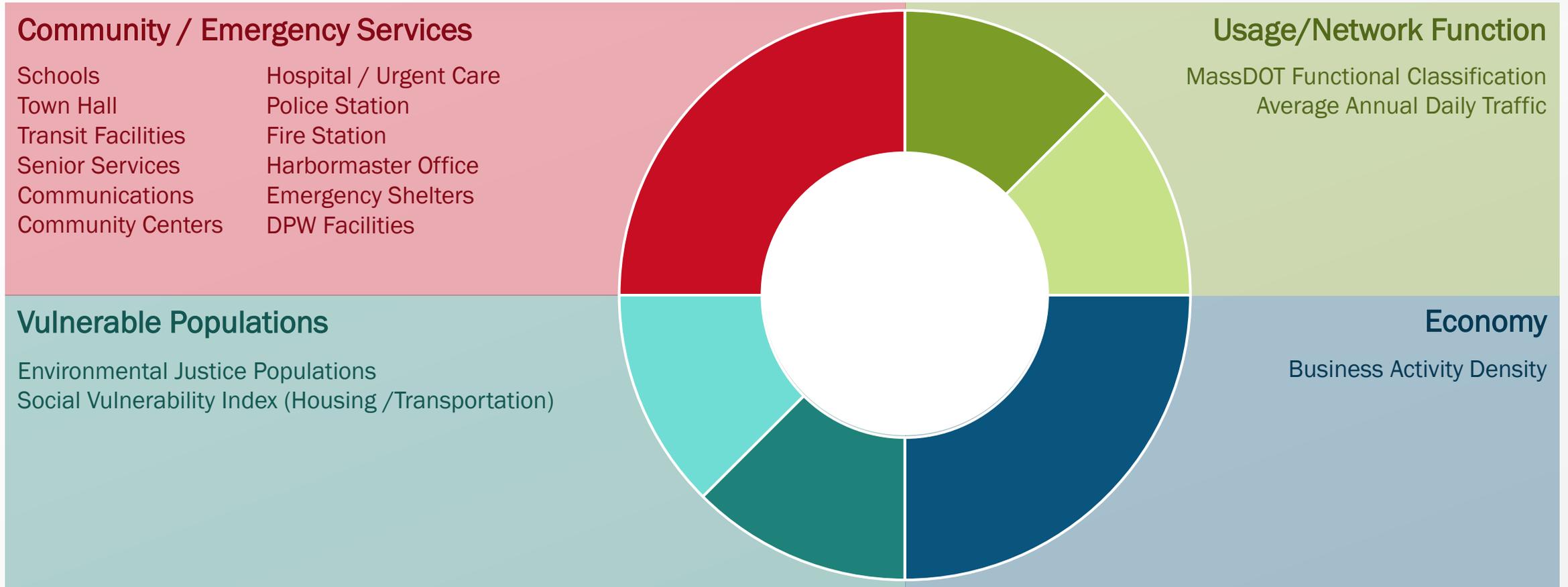
# Cape Cod Low Lying Roads Vulnerability Assessment Methods



COASTAL FLOOD EXCEEDANCE PROBABILITY

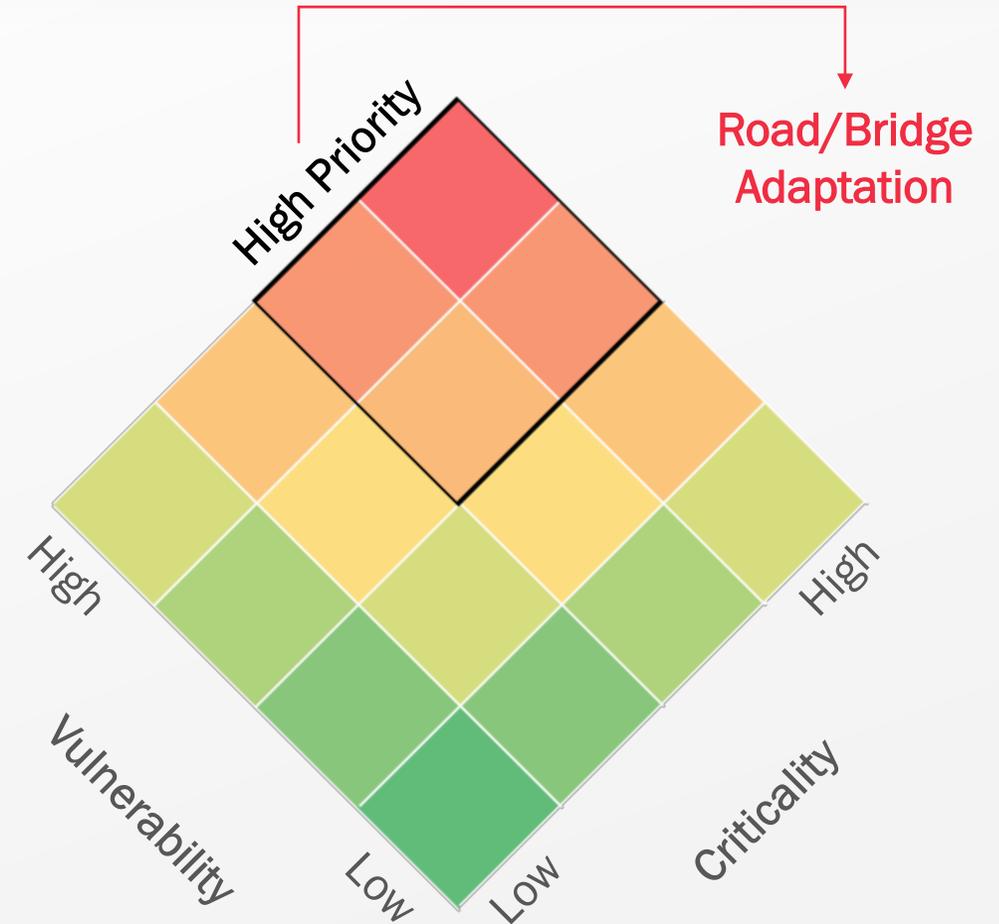


# Cape Cod Low Lying Roads Criticality Scoring Framework

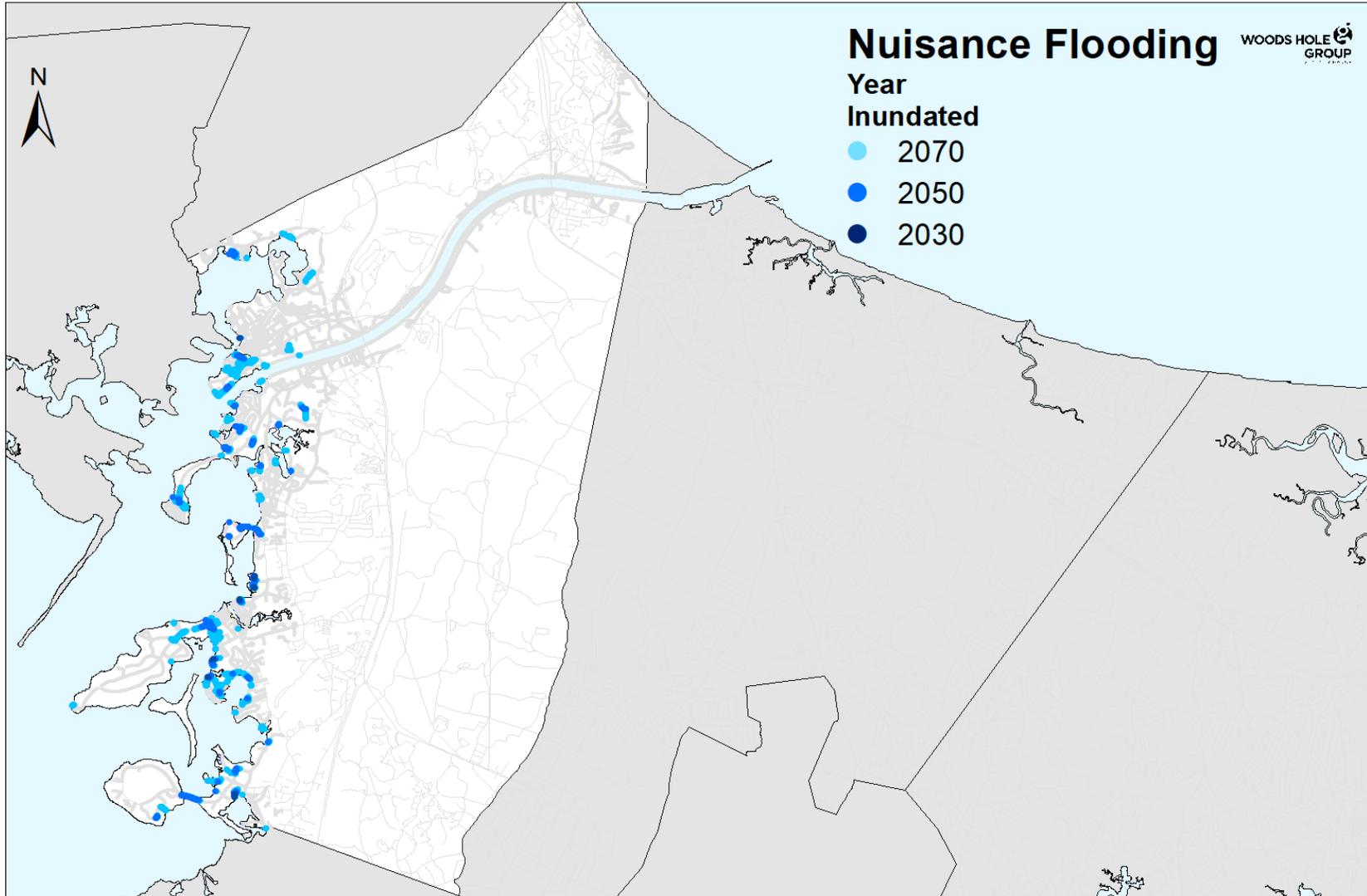


# Cape Cod Low Lying Roads Risk Assessment Approach

1. Extract roadway/bridge critical elevations (CEs)
  - › From LiDAR at 20m interval along surface
2. Compile 2030/2050/2070 MC-FRM water surface elevations (WSEs)
  - › 0.1%, 0.2%, 0.5%, 1%, 2%, 5%, 10%, 20%, 100%
3. Compare CEs to WSEs to determine vulnerability
  - › Highest probability WSE exceeding CE
4. Score road segment criticality
  - › Usage/Network Function
  - › Economy
  - › Vulnerable Populations
  - › Community and Emergency Services
5.  $\text{Probability} * \text{Criticality} = \text{Risk}$
6. Prioritize high-risk road segments for community consideration



# Low Lying Roads Nuisance (MHW) Flooding (Bourne)



Road Miles 2030

0.1/129.6

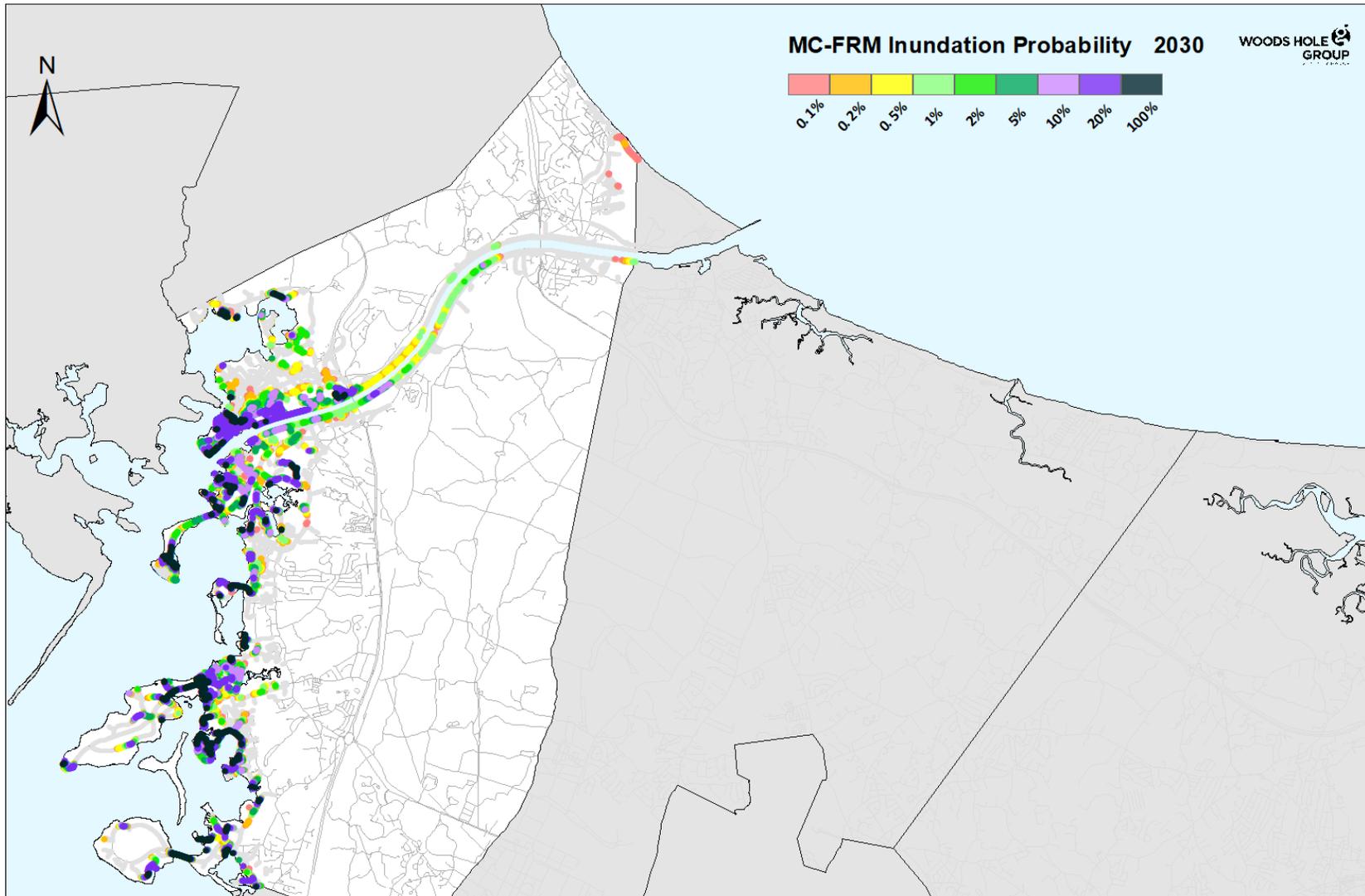
Road Miles 2050

2.3/129.6

Road Miles 2070

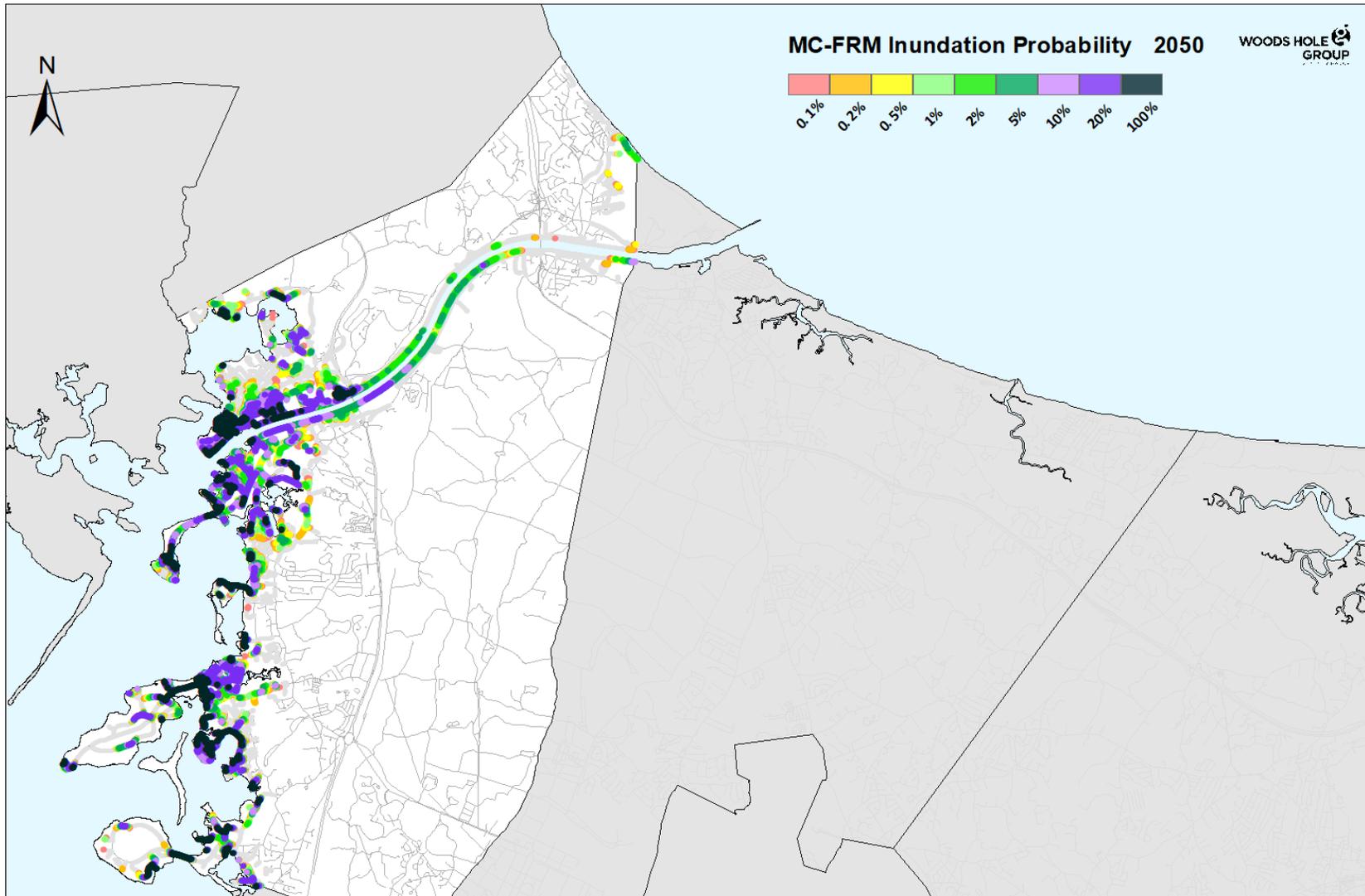
8.1/129.6

# Low Lying Roads 2030 Inundation Probability (Bourne)



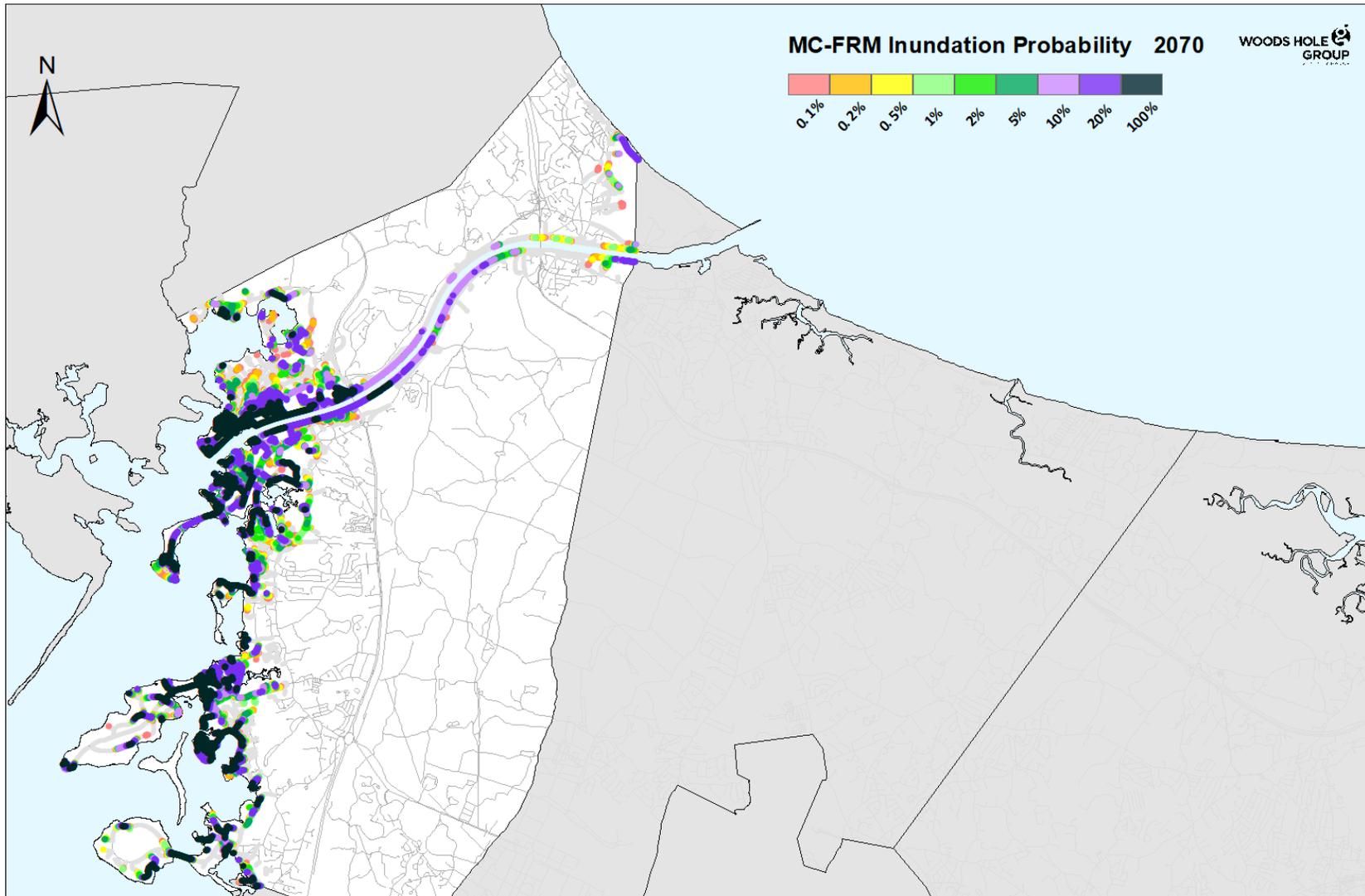
	%	Road miles
	0.1	52.2
	0.2	48.9
	0.5	43.5
	1	38.5
	2	32.9
	5	26.6
	10	21.6
	20	16.5
	100	5.7

# Low Lying Roads 2050 Inundation Probability (Bourne)



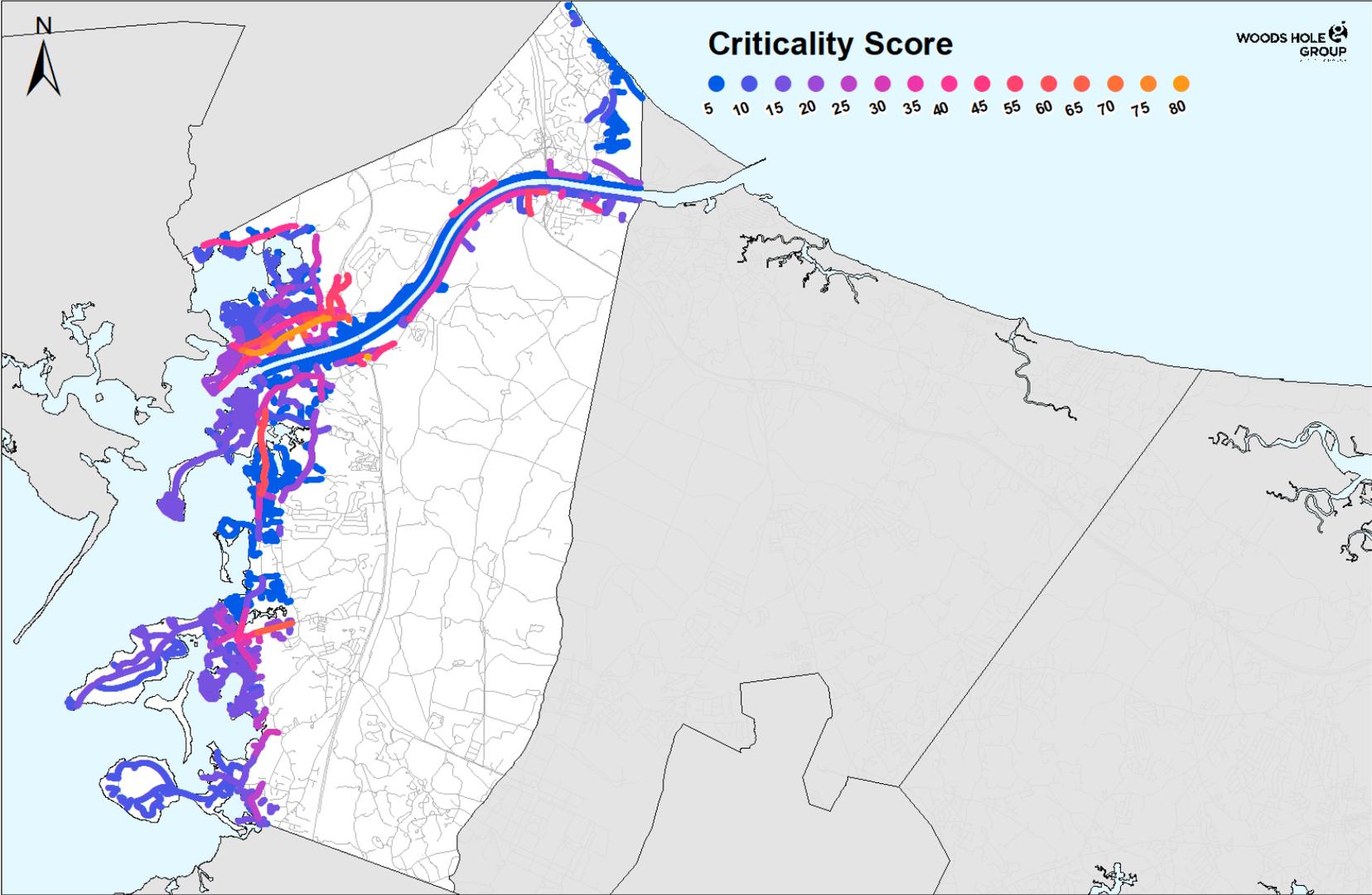
	%	Road miles
	0.1	66.6
	0.2	63.7
	0.5	58.7
	1	54.0
	2	48.8
	5	40.0
	10	32.7
	20	26.2
	100	10.6

# Low Lying Roads 2070 Inundation Probability (Bourne)

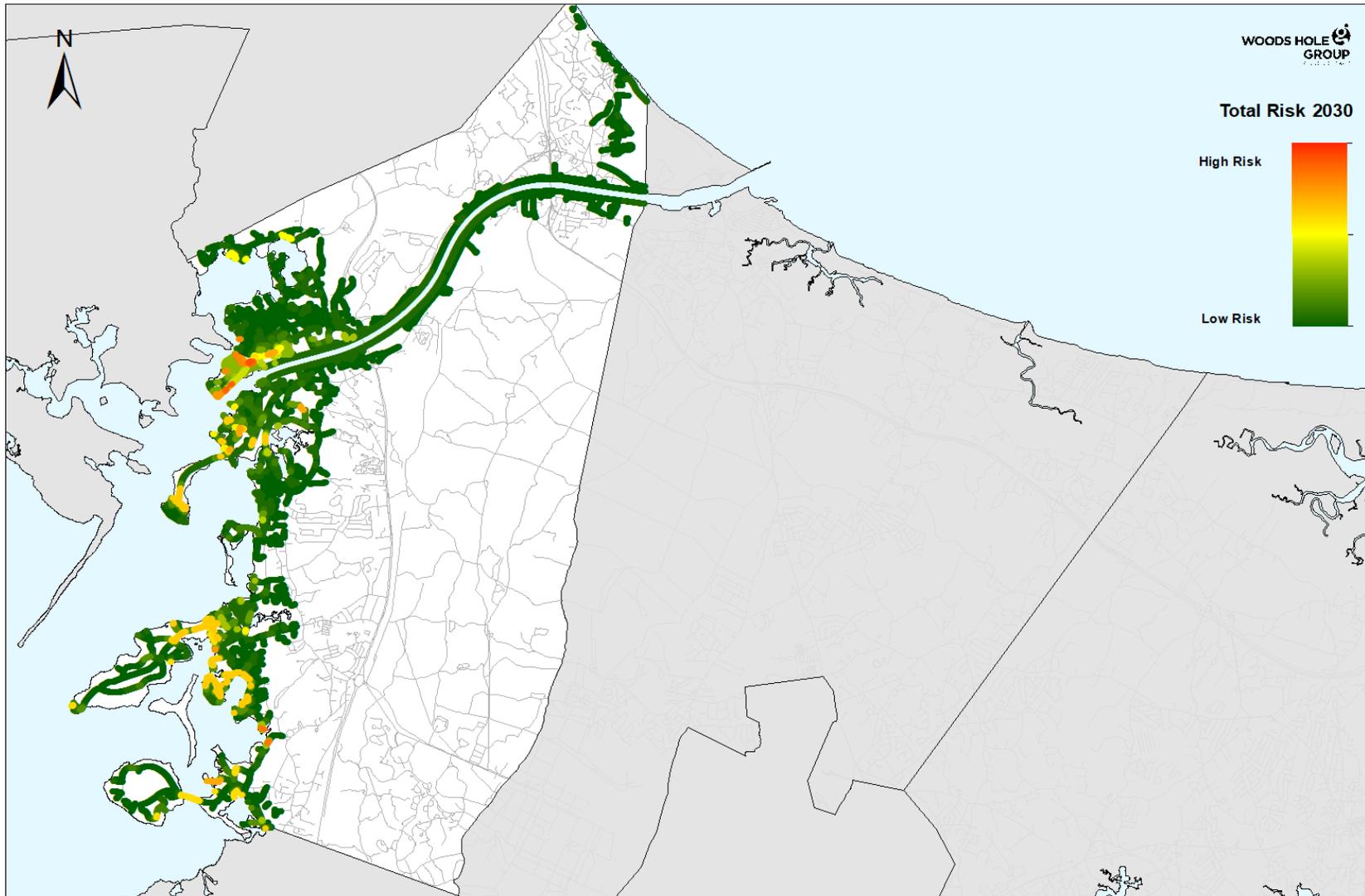


	%	Road miles
	0.1	75.8
	0.2	72.2
	0.5	68.0
	1	63.8
	2	59.2
	5	52.4
	10	45.9
	20	37.5
	100	19.7

# Low Lying Roads Criticality Scoring (Bourne)



# Low Lying Roads 2030 Risk Results (Bourne)



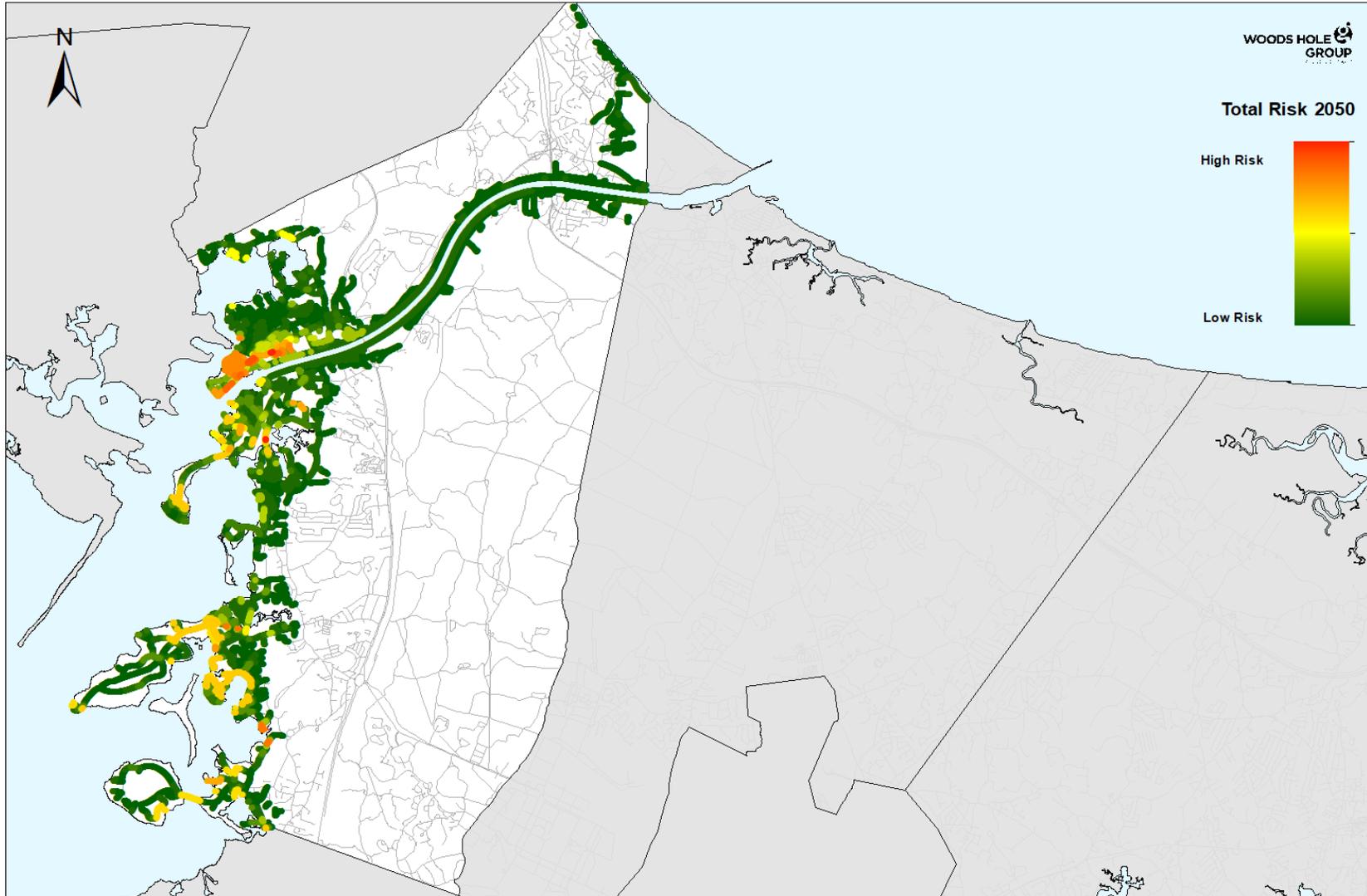
## High Risk Road Segments

Academy Dr, Taylor Rd and Wright Ln

Red Brook Harbor Rd

Harbor Pl

# Low Lying Roads 2050 Risk Results (Bourne)



## High Risk Road Segments

Academy Dr, Taylor Rd and Wright Ln

Red Brook Harbor Rd

Harbor Pl

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Main St, Holt Rd and Canal St

Shore Rd (Back River)

Wings Neck Rd and North Shore Rd

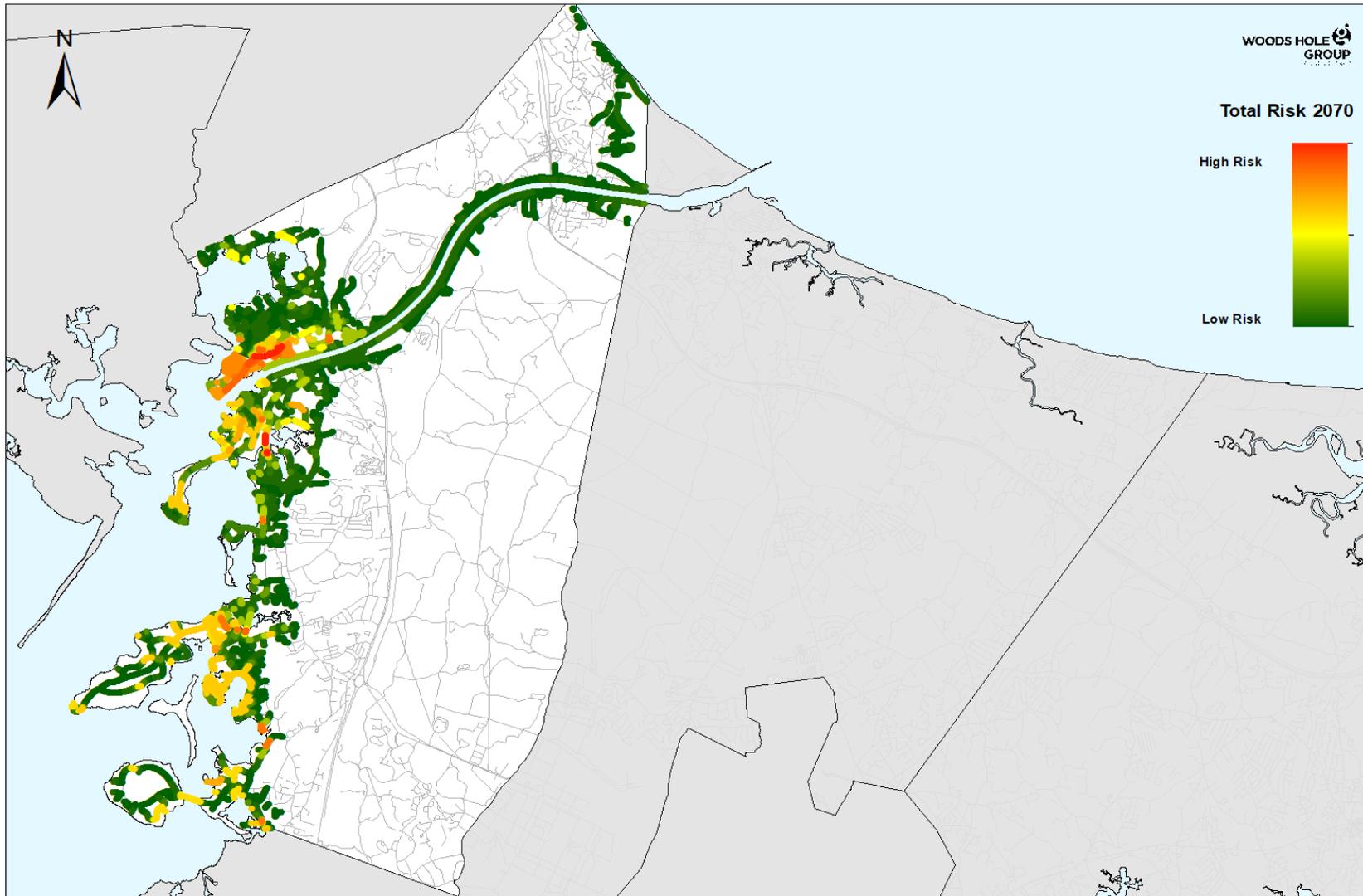
Shore Rd (Pocasset River)

Cohasset Ave and Buzzards Bay Ave

Shore Rd (Monument Beach)

Megansett Rd

# Low Lying Roads 2070 Risk Results (Bourne)



## High Risk Road Segments

Academy Dr, Taylor Rd and Wright Ln

Red Brook Harbor Rd

Harbor Pl

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Main St, Holt Rd and Canal St

Shore Rd (Back River)

Wings Neck Rd and North Shore Rd

Shore Rd (Pocasset River)

Cohasset Ave and Buzzards Bay Ave

Shore Rd (Monument Beach)

Megansett Rd

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Circuit Ave and Bell Buoy Rd

Mashnee Rd\*

Monument Neck Rd and Presidents Rd

Emmons Rd

Scraggy Neck Rd\*

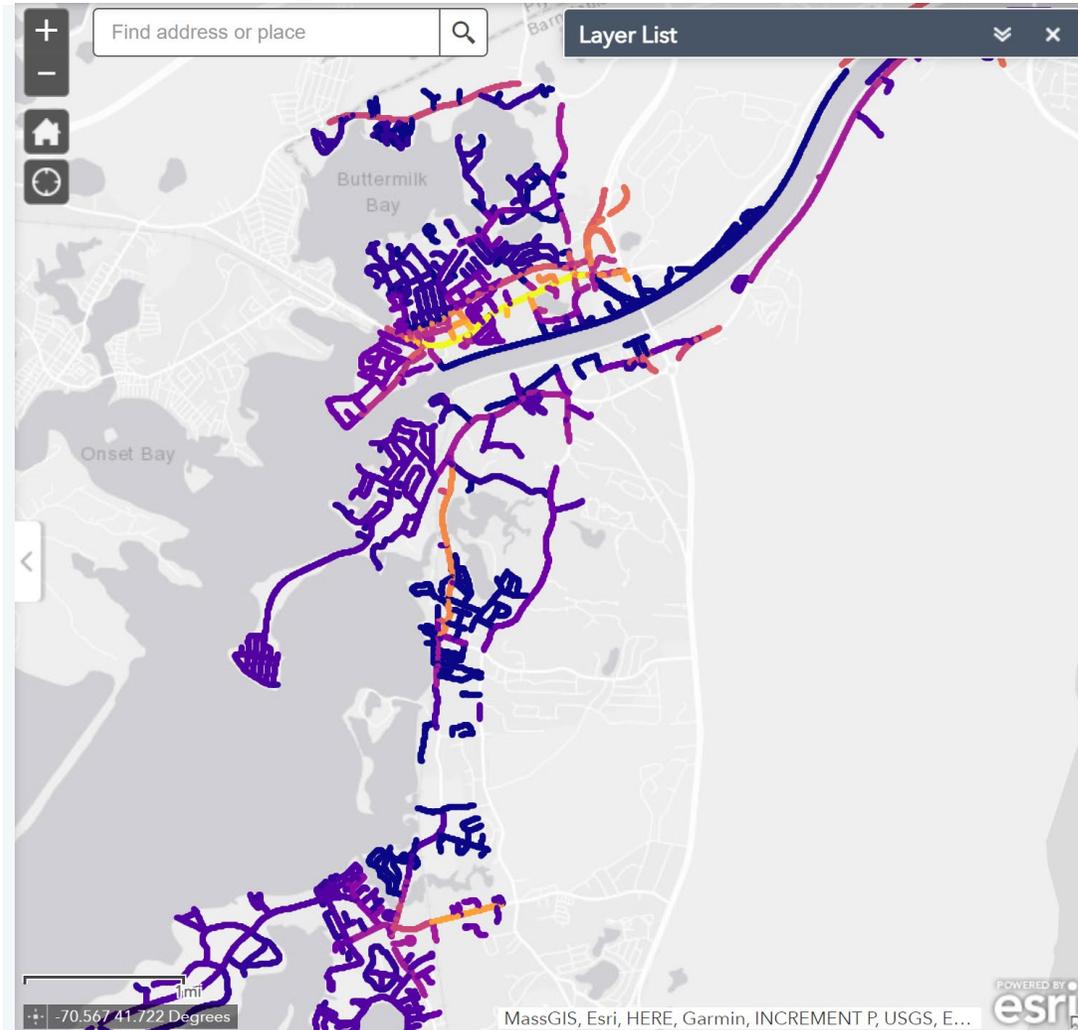
# Summary of High Priority Road Segments (Bourne)

	Name	Length (ft)	Description	Segment Storm Probability (%)			Nuisance Length (ft)		
				2030	2050	2070	2030	2050	2070
A	Academy Dr, Taylor Rd and Wright Ln	4020	Main road leading Mass Maritime	10-100	20-100	100	260	2100	
B	Red Brook Harbor Rd	440	Road backing Parkers Boat Yard	10-100	20-100	100	20	180	
C	Harbor Pl	320	Road segment along Taylor Point Marina	100	100	100	220	320	
D	Main St, Holt Rd and Canal St	3700	Long segment between Academy Dr and Smalley Rd	5-20	20-100	100			
E	Shore Rd (Back River)	720	Road and bridge crossing Back River	10-20	20-100	100			
F	Wings Neck Rd and North Shore Rd	4180	Leads to Wings Neck Island, isolated neighborhood	10-100	20-100	100	720	2720	
G	Shore Rd (Pocasset River)	180	South of Pocasset River Bridge	10-20	20	100			
H	Cohasset Ave and Buzzards Bay Ave	400	E to W road between Buzzards Bay Bypass and Main St	5-10	20	100			
I	Shore Rd (Monument Beach)	180	Backing Monument Beach	10-20	20	100			
J	Megansett Rd	320	Road intersection leading to Amrita Island	2-20	10-100	100			
K	Circuit Ave and Bell Buoy Rd	3260	Backing Hen's Cove Beach, isolated neighborhood	0.2-100	2-100	5-100	200	1660	
L	Mashnee Rd*	580 (5240)	Access to Mashnee Island, isolated neighborhood	0.5-100	2-100	10-100		1120	
M	Monument Neck Rd and Presidents Rd	1120	Main access point to large neighborhoods	1-20	5-20	20-100			
N	Emmons Rd	1580	Road / bridge at Monument Beach, isolated neighborhood	5-100	20-100	20-100	1080	1280	
O	Scraggy Neck Rd*	(1300)	Isolated neighborhood	5-100	10-100	20-100		1220	

\* = Private or partially private

# LOW LYING ROADS

# Group Discussion



**DISCUSSION  
ORIENTATION**

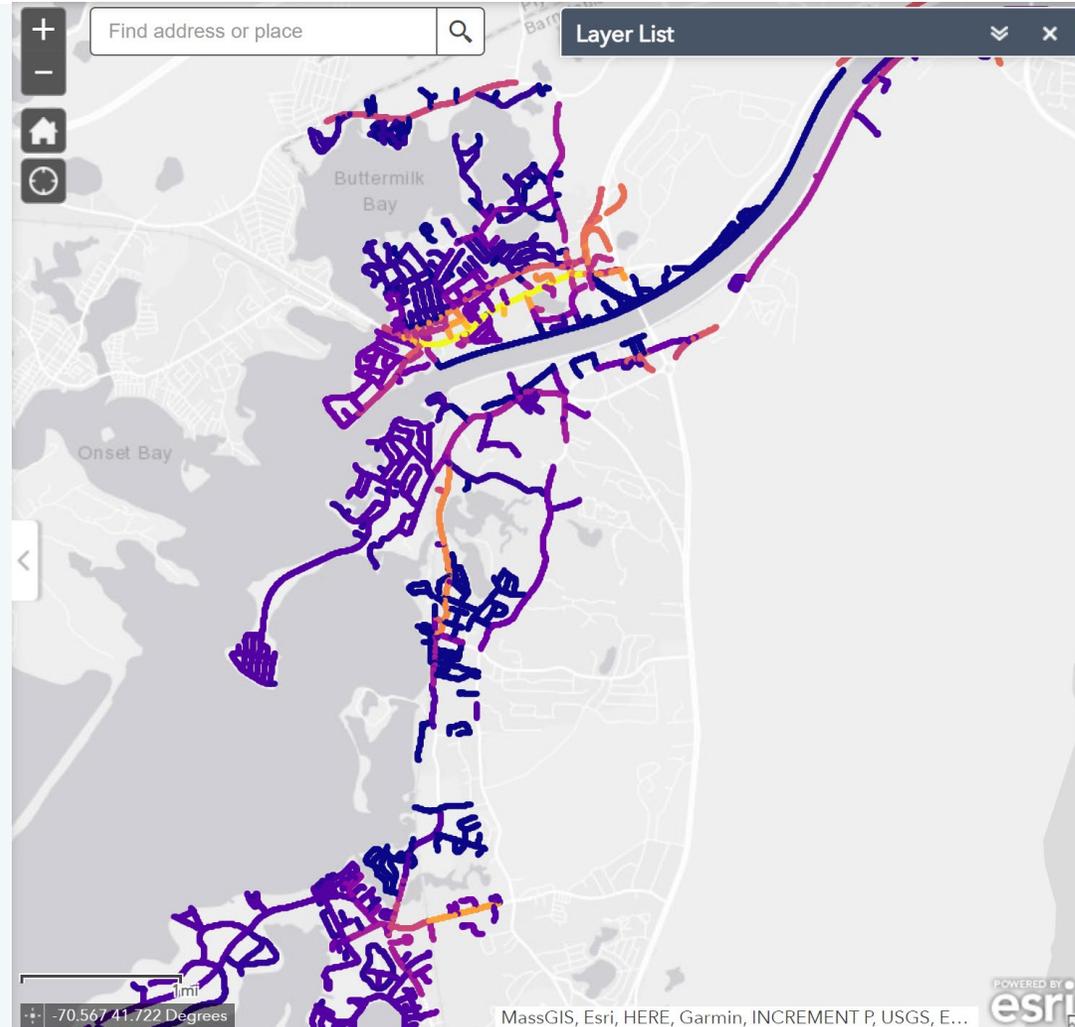
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## Related Town Initiatives

- The Low Lying Roads Project is a highlight of Bourne's Climate Resiliency Infrastructure initiatives.
- The Project could potentially be paid for partly or in whole by the recently created Town of Bourne Climate Resiliency Infrastructure Fund.
- The Town is applying for a CZM grant for a Climate Change Vulnerability Assessment this spring. This, along with Low Lying Roads, will be the foundation of a Resiliency Project Priority Action Plan.

## LOW LYING ROADS

# Group Discussion



## DISCUSSION QUESTIONS

1. Are there roads that we missed?
2. How would you prioritize these roads – what local knowledge or concerns can you bring to the discussion?
3. What are the high-priority road segments?

# Summary of High Priority Road Segments (Bourne)

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# Low Lying Roads: Bourne

[Home](#) > [Work](#) > [Low Lying Roads: Bourne](#)

[Overview](#)

[Workshop Materials](#)

[Data Viewer](#)

## Overview

The Cape Cod Commission is working with 10 Cape towns, including the **Town of Bourne**, to examine vulnerabilities in the roadway network and identify solutions. With funding support from the U.S. Economic Development Administration (EDA) and the Massachusetts Municipal Vulnerability Preparedness (MVP) program, the Commission has contracted with the Woods Hole Group (WHG) to conduct a vulnerability assessment of roadway segments, bridges, and culverts due to flooding from the combined effects of sea level rise and storm surge.

WHG will employ the state-of-the-art Massachusetts Coast Flood Risk Model (MC FRM) to identify vulnerable road segments under different sea level rise scenarios and time scales. One output from this work is a projection of the probability and extent of flooding at the present, 2030, 2050, and 2070.

# NEXT STEPS

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- Town staff to select 2 road segments
- Feasibility analysis
- 3 solutions + costs per segment
- Solutions available to view on Low Lying Road webpage later in 2022: <https://www.capecodcommission.org/our-work/low-lying-roads-project/>
- 2<sup>nd</sup> Workshop date TBD – winter 2023

**THANK YOU!**

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