Low-lying Roads: Eastham

Project funded by the Municipal Vulnerability Preparedness Program and the Economic Development Administration

Cape Cod Commission: Heather McElroy, Martha Hevenor, Michele White, Liz Kellam, Dave Nolan, and Tara Lewis
Woods Hole Group: Joe Famely

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

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

Low Lying Roads Project

10

TOWNS

EDA and MVP funding thru 2023

Vulnerability assessment of low-lying roads and transportation infrastructure

Municipal prioritization

Potential design solutions

NEXT STEPS: PUBLIC MEETINGS

Prioritize most critical road segments for development of alternative solutions for sea level rise and storm surge adaptation

FALL - DECEMBER

6 public workshops

LATE WINTER - SPRING

4 public workshops

FALL

Yarmouth, Orleans, Eastham, Wellfleet, Sandwich, Dennis

WINTER

SPRING

Barnstable, Bourne, Brewster, Truro

HAZARD

Storms, SLR & Flooding

Adaptation Strategies

- Green Infrastructure, or Nature-based Solutions
- Gray Infrastructure, or Traditional Engineering Structures
- Other approaches – Managed Retreat, Abandonment

PROJECT TIMELINE

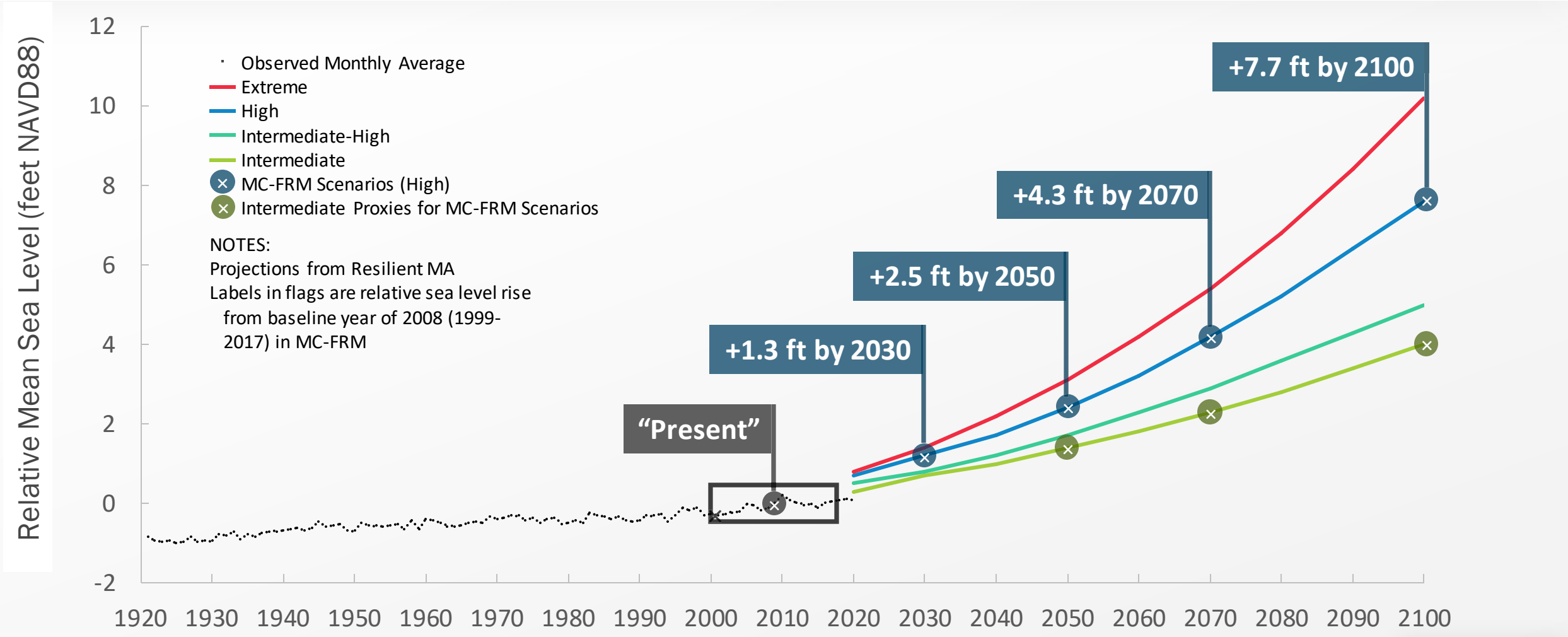
Shoreline Projections	Vulnerability Assessment	Prioritize Roadway Segments	1st Workshop: Vulnerable & At-Risk Roads	Roadway analysis & solutions ID	2nd Workshop: Present alternatives
September	October		December	Winter 2022	Fall 2022

Questions?

- 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)



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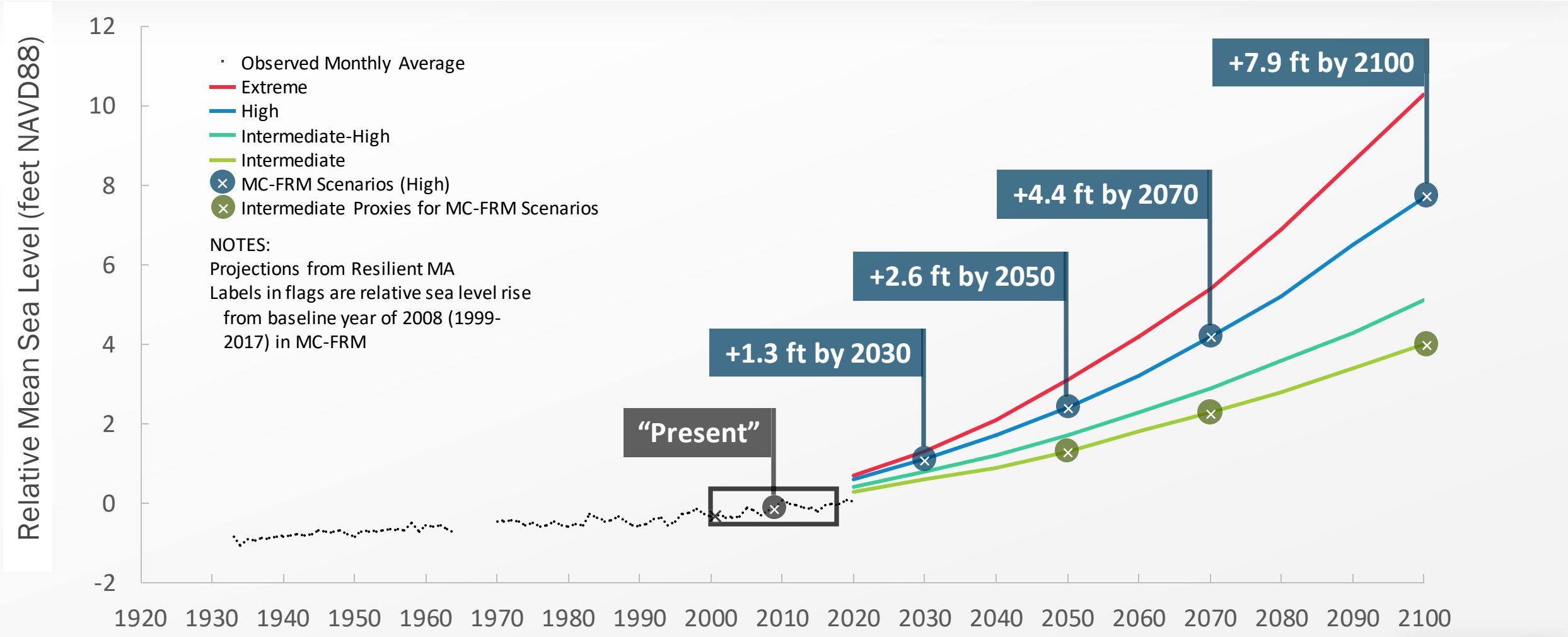
MA EOEEA Probabilistic Sea Level Rise Projections

MC-FRM SOUTH (DeConto & Kopp, 2017)



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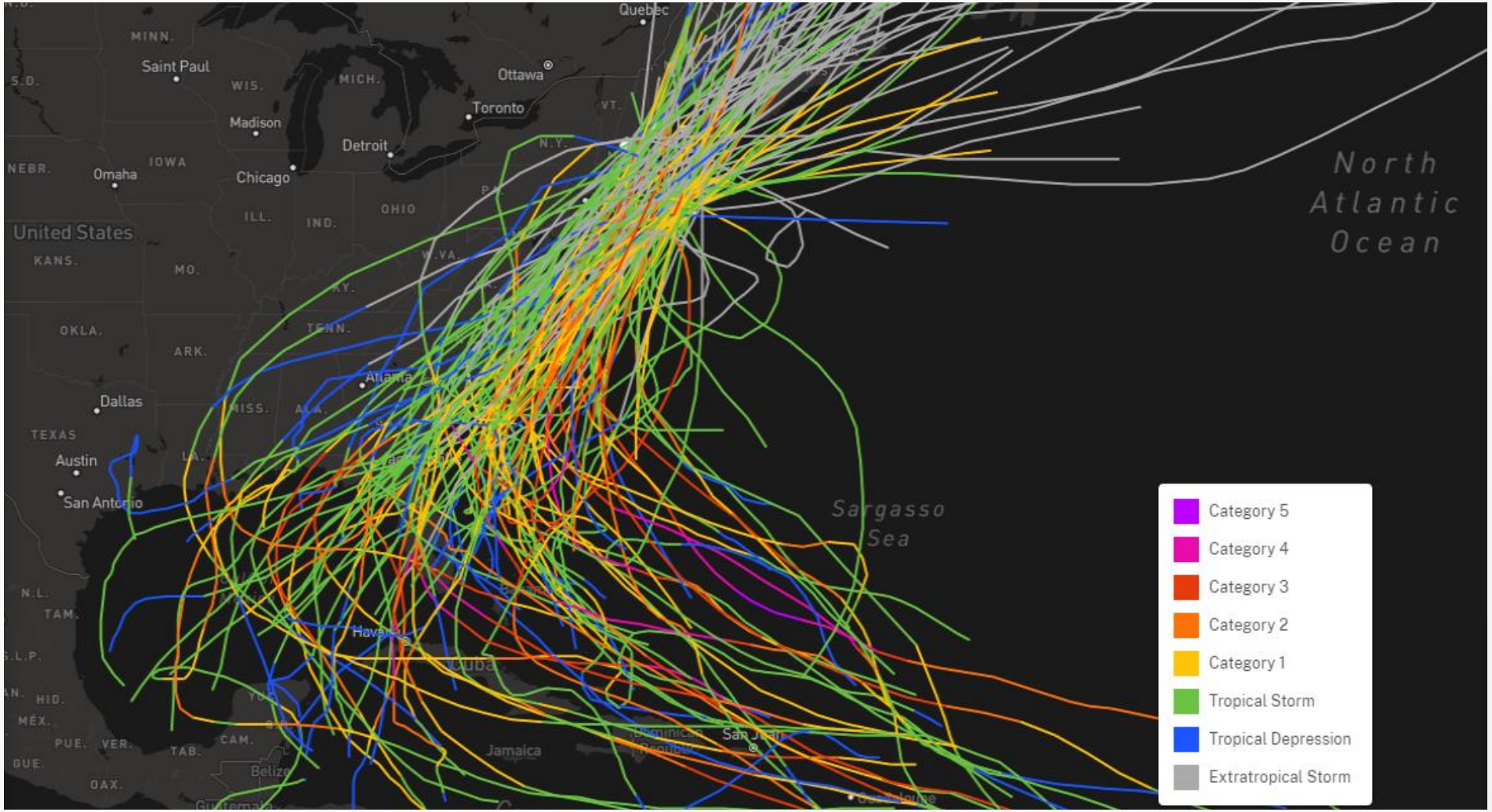
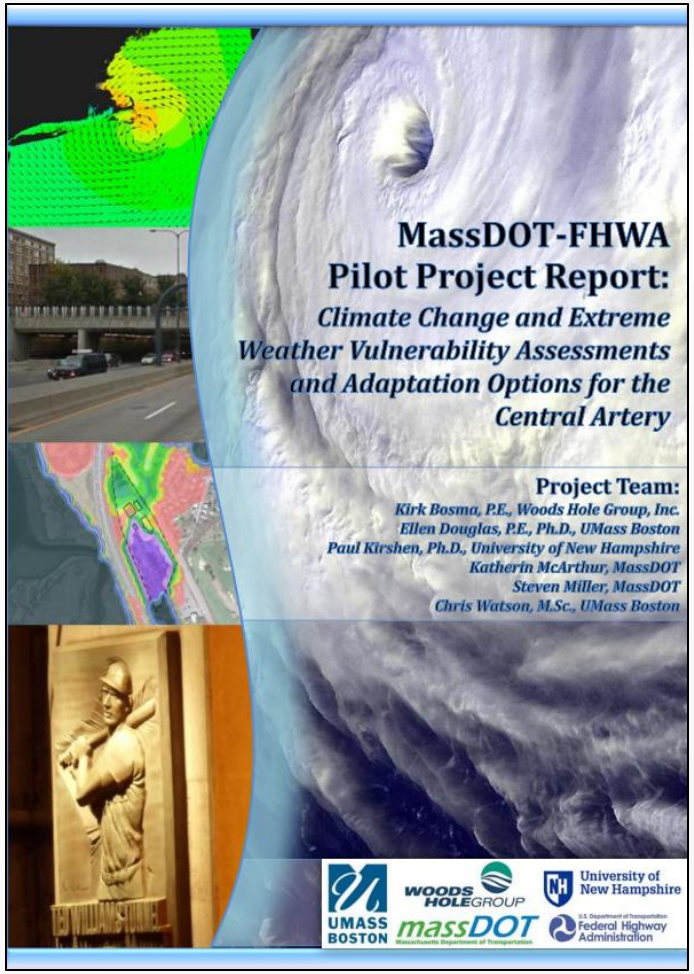
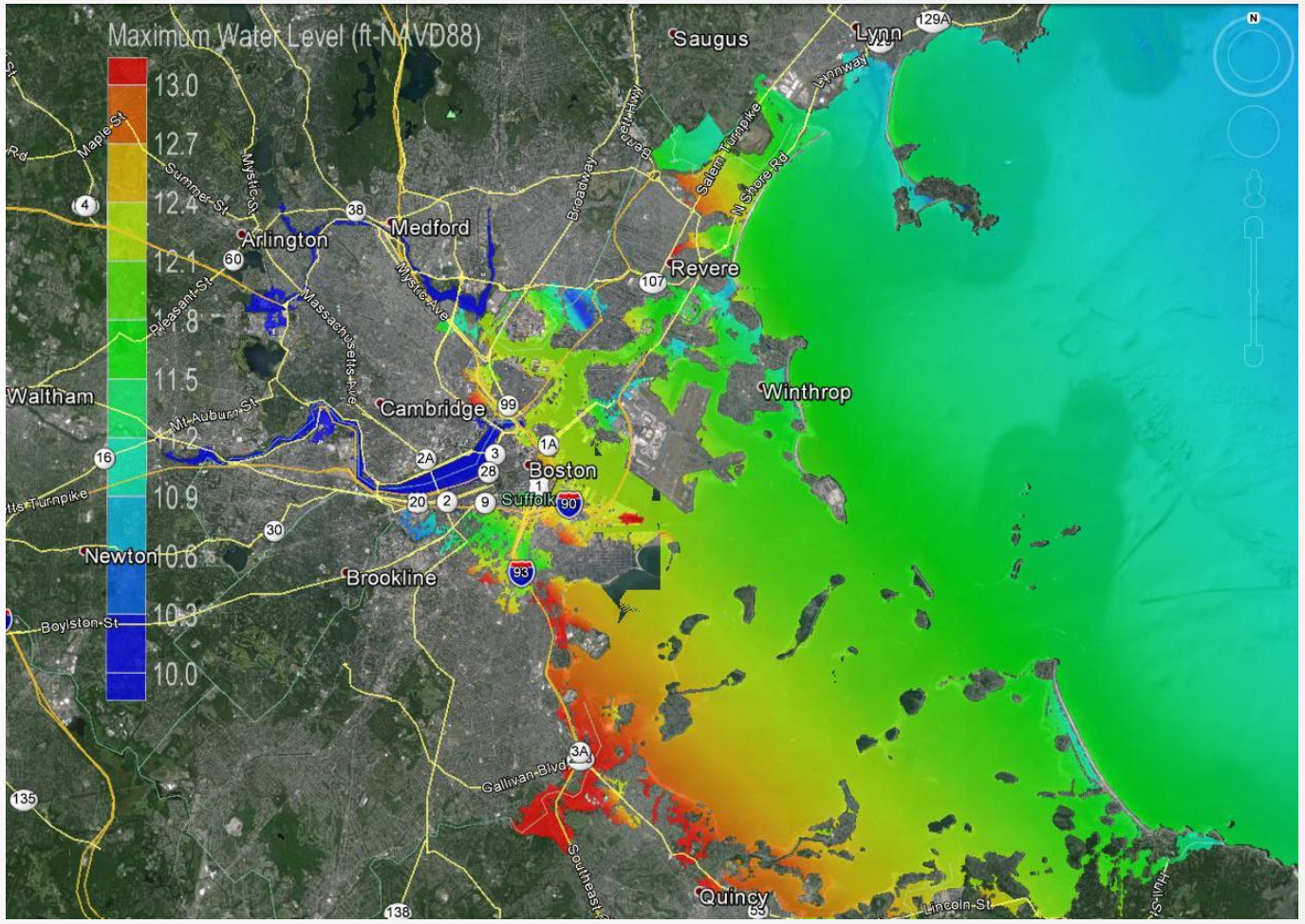
Tropical / Extra-tropical Storms



NOAA National Ocean Service

Why Hydrodynamic Modeling? Why Probabilistic?





Massachusetts Coast Flood Risk Model (MC-FRM)

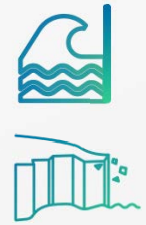
INPUTS

- 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



OUTPUTS

- FLOOD PROBABILITY
- FLOOD DEPTH
- FLOOD DURATION
- FLOOD VOLUMES
- FLOOD PATHWAYS
- WINDS
- WAVES
- CURRENTS

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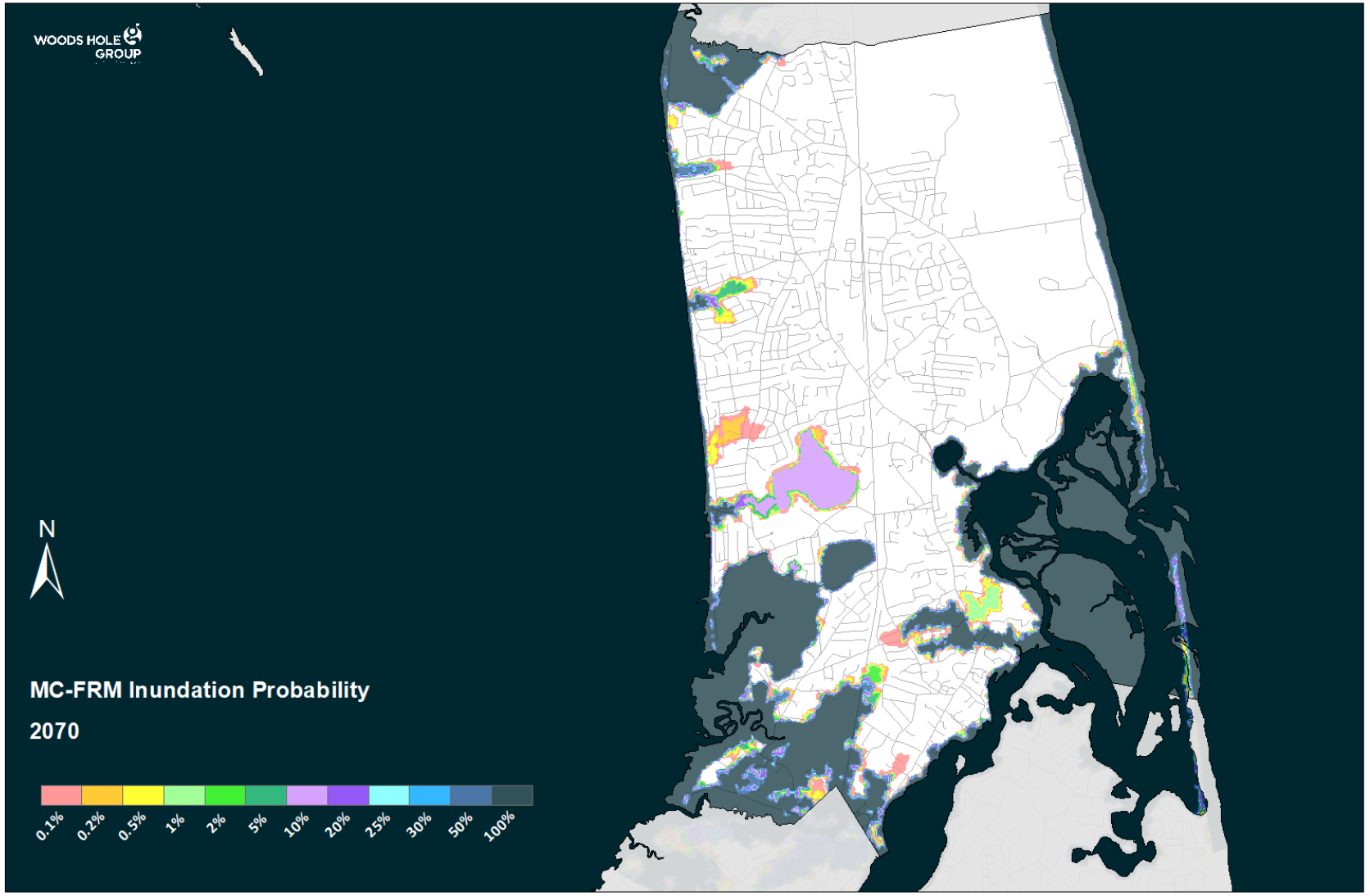
MC-FRM Resolution - Eastham

MC-FRM Coastal Flood Exceedance Probability – Eastham



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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?

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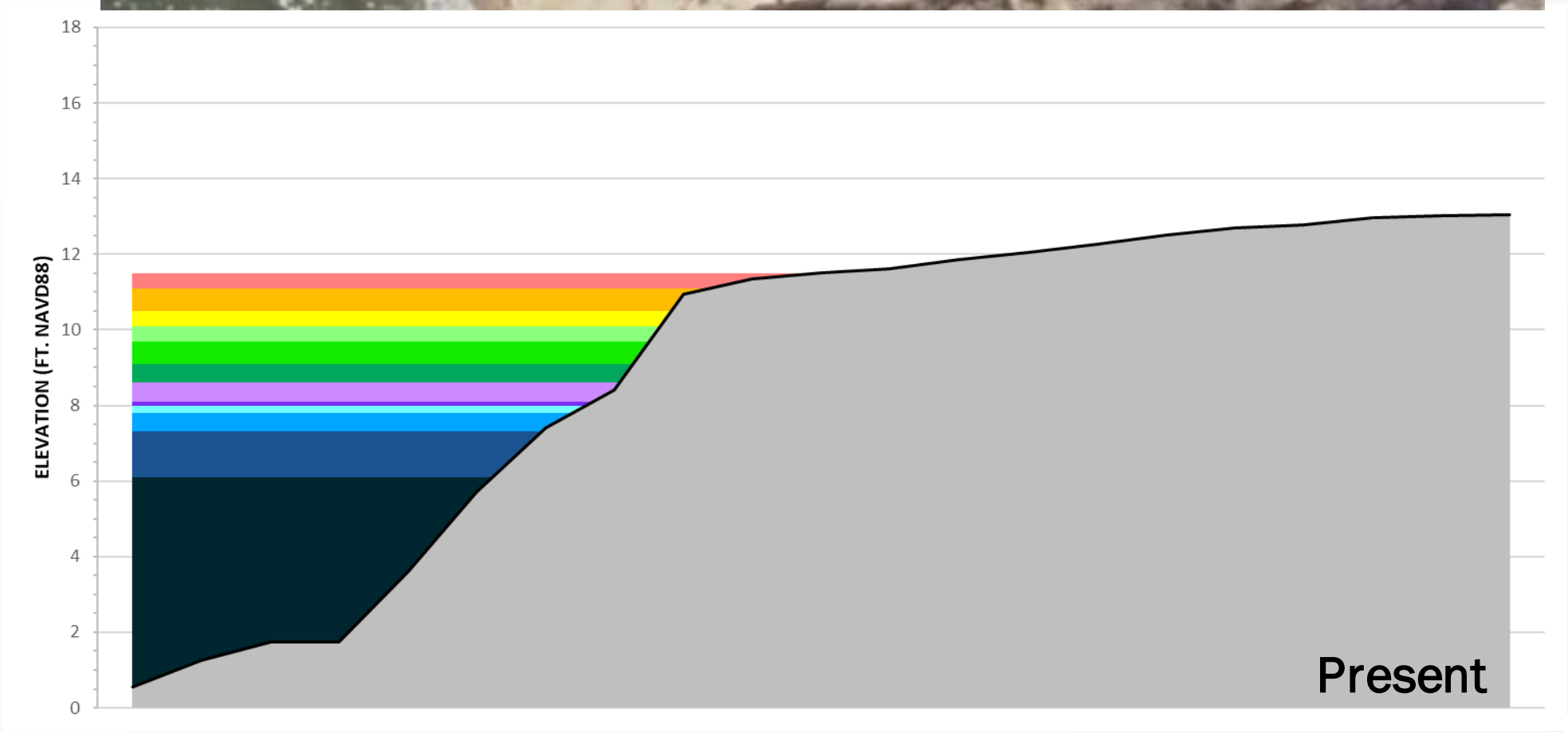
Cape Cod Low Lying Roads Vulnerability Assessment Methods



COASTAL FLOOD EXCEEDANCE PROBABILITY

0.1% 0.2% 0.5% 1% 2% 5% 10% 20% 25% 30% 50% 100%

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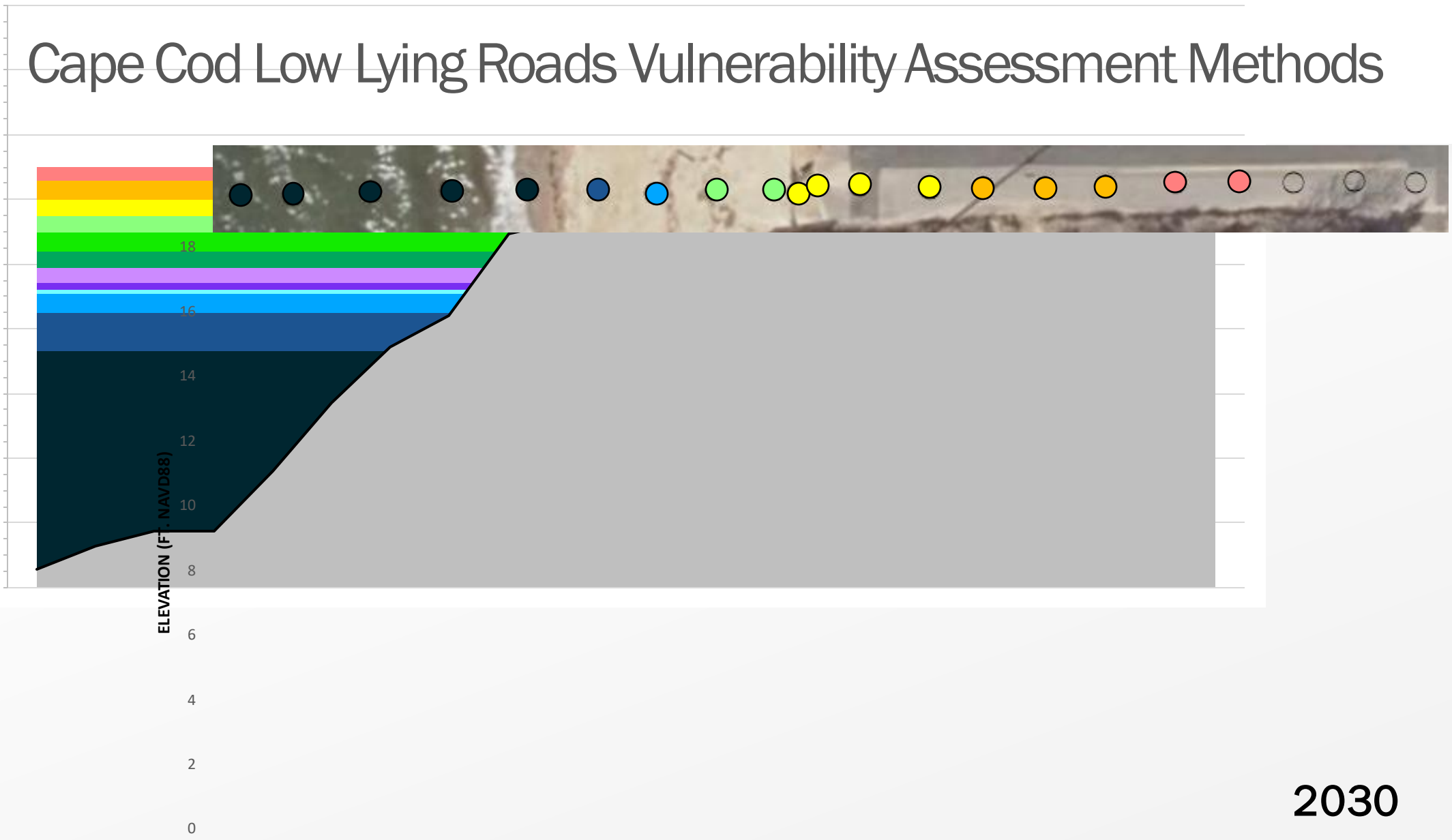
Cape Cod Low Lying Roads Vulnerability Assessment Methods



2030

COASTAL FLOOD EXCEEDANCE PROBABILITY

0.1% 0.2% 0.5% 1% 2% 5% 10% 20% 25% 30% 50% 100%

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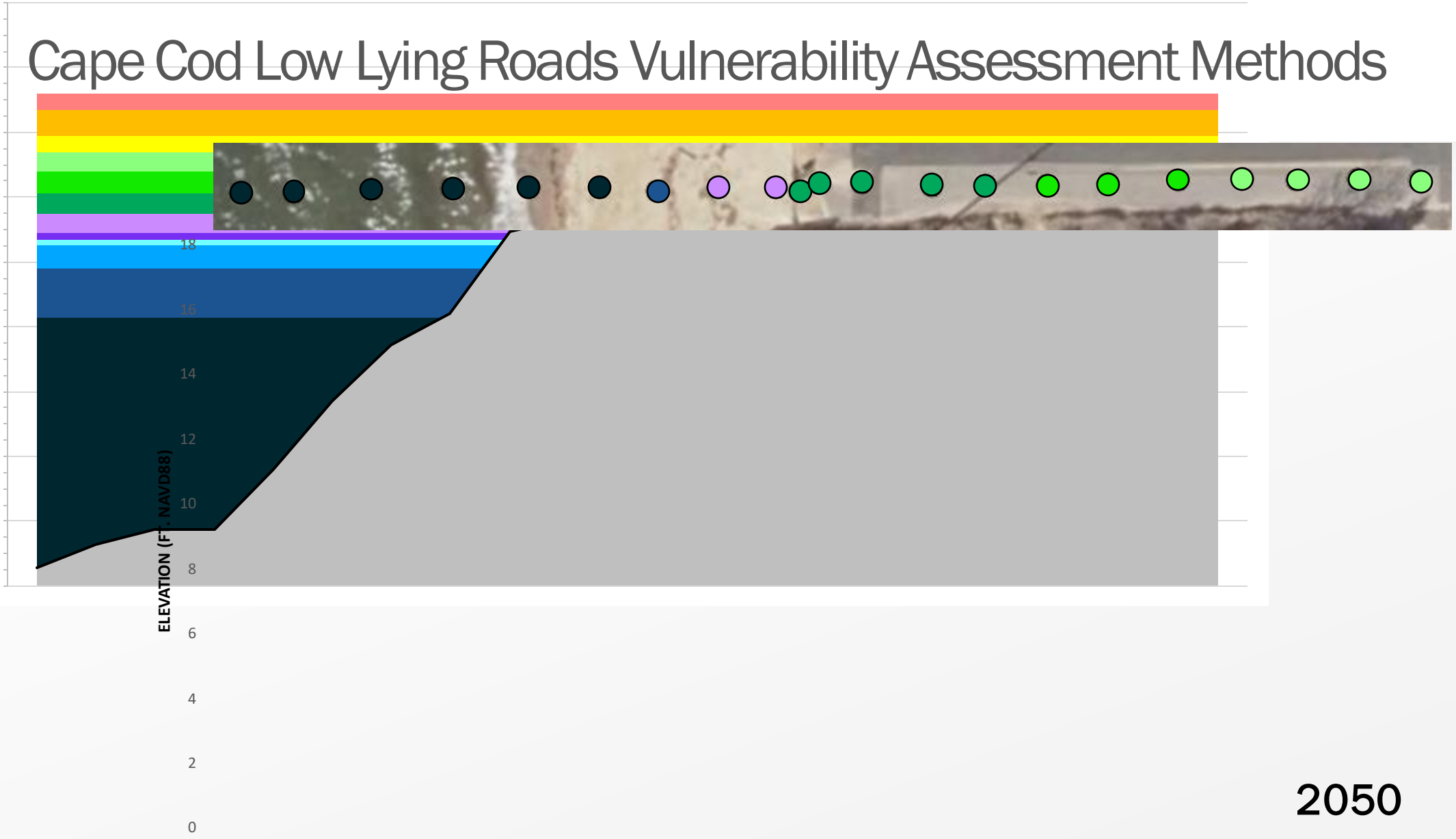
Cape Cod Low Lying Roads Vulnerability Assessment Methods



2050

COASTAL FLOOD EXCEEDANCE PROBABILITY

0.1% 0.2% 0.5% 1% 2% 5% 10% 20% 25% 30% 50% 100%

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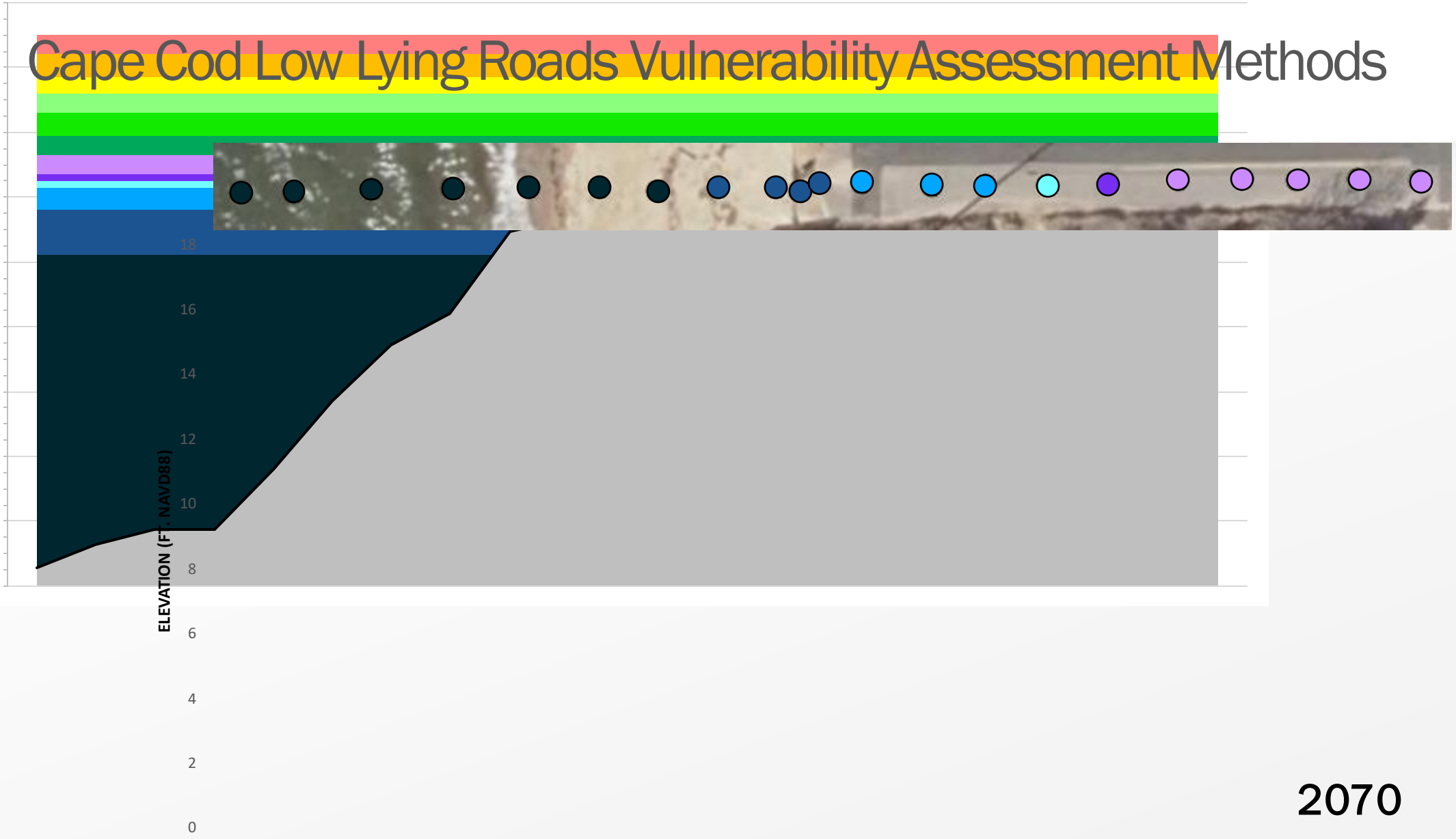
Cape Cod Low Lying Roads Vulnerability Assessment Methods



2070

COASTAL FLOOD EXCEEDANCE PROBABILITY

0.1% 0.2% 0.5% 1% 2% 5% 10% 20% 25% 30% 50% 100%

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Cape Cod Low Lying Roads Criticality Scoring Framework

Community / Emergency Services

Schools
Town Hall
Transit Facilities
Senior Services
Communications
Community Centers
Hospital / Urgent Care
Police Station
Fire Station
Harbormaster Office
Emergency Shelters
DPW Facilities

Usage/Network Function

MassDOT Functional Classification
Average Annual Daily Traffic

Vulnerable Populations

Environmental Justice Populations
Social Vulnerability Index (Housing /Transportation)

Economy

Business Activity Density

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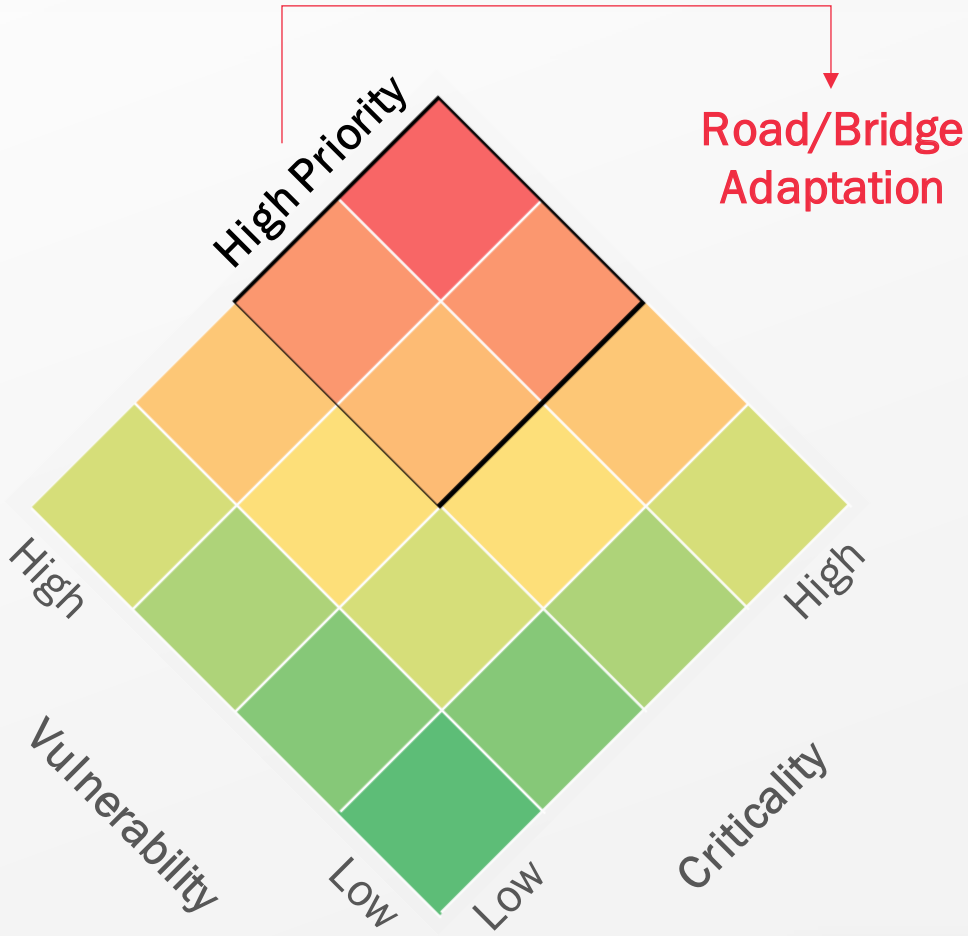
Cape Cod Low Lying Roads Risk Assessment Approach

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. Probability * Criticality = Risk
6. Prioritize high-risk road segments for community consideration



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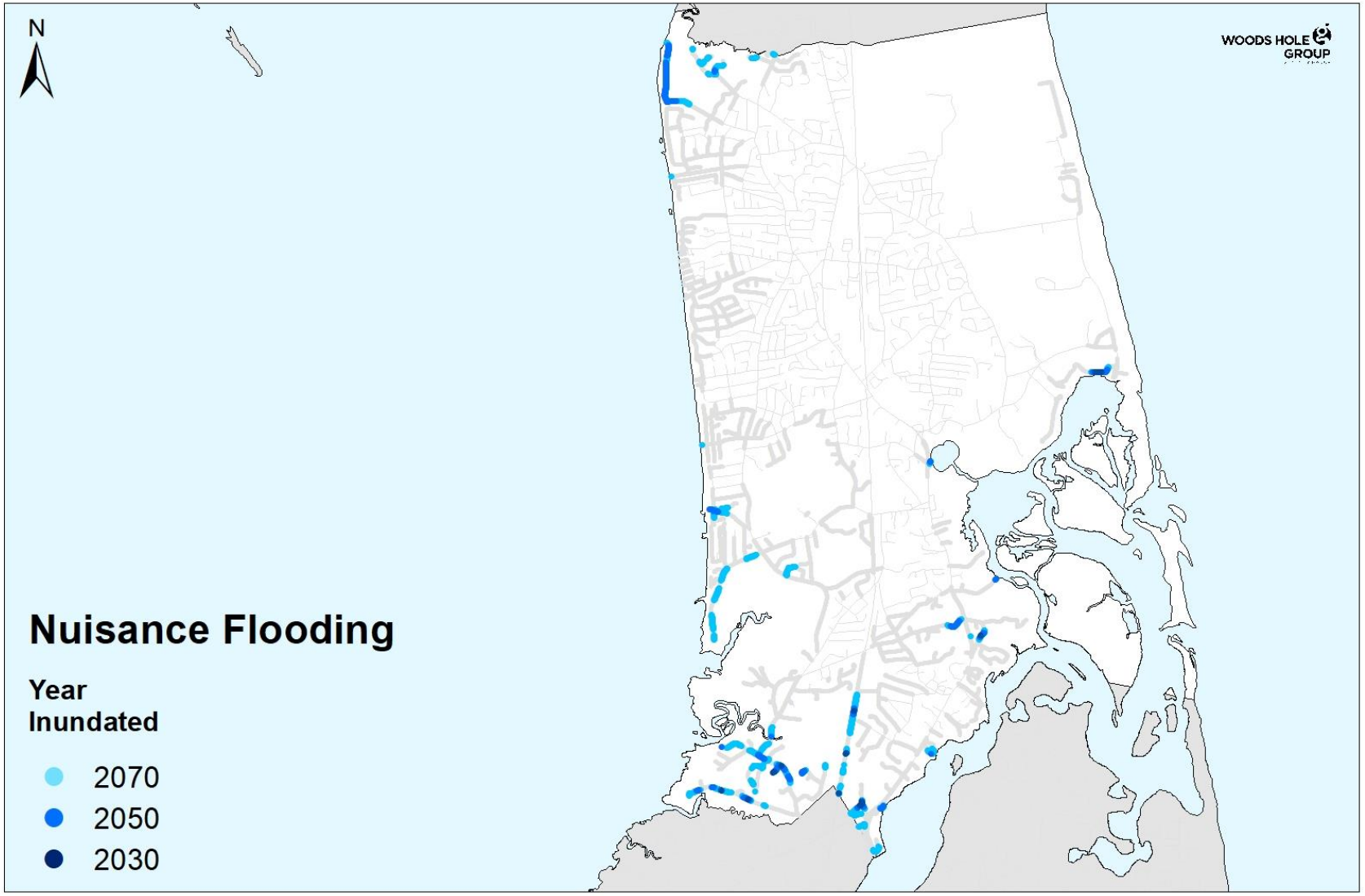
Low Lying Roads Nuisance (MHW) Flooding (Eastham)



Road Miles 2030

0.1/145.7

Road Miles 2050

1.4/145.7

Road Miles 2070

4.5/145.7

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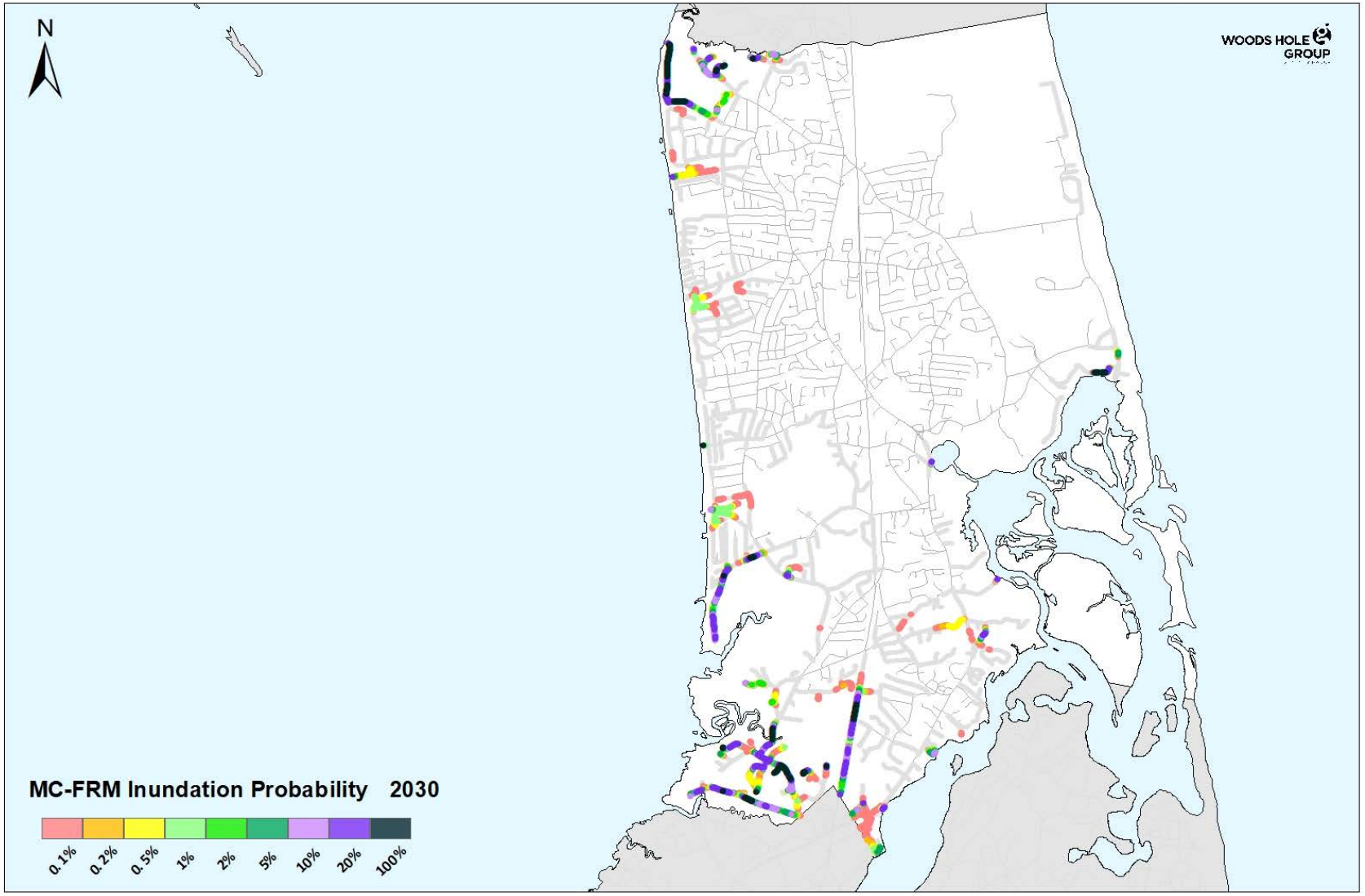
Low Lying Roads 2030 Inundation Probability (Eastham)



	%	Road miles
	0.1	11.3
	0.2	7.6
	0.5	7.0
	1	6.0
	2	5.1
	5	4.4
	10	3.6
	20	2.7
	100	1.0

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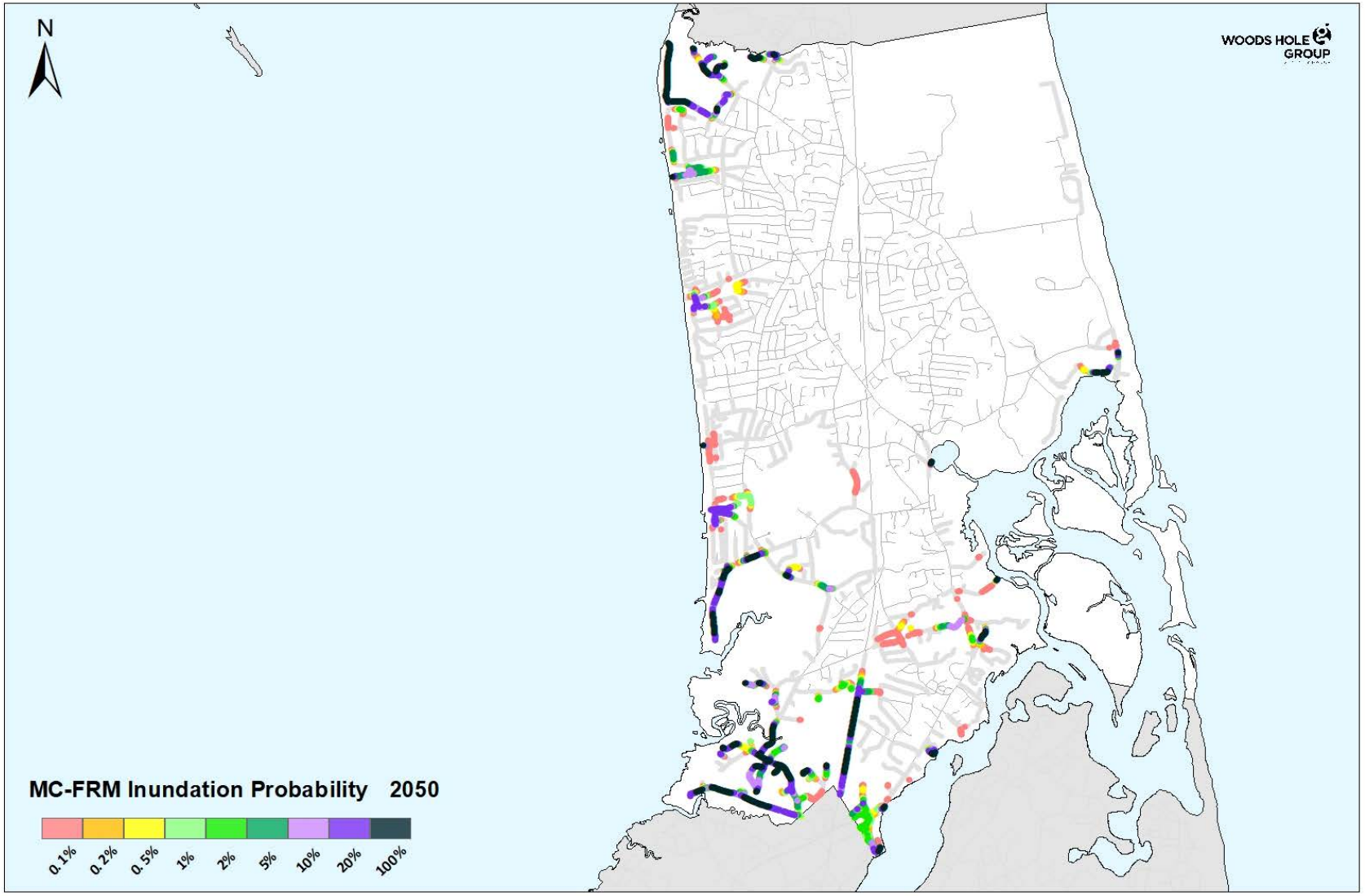
Low Lying Roads 2050 Inundation Probability (Eastham)



	%	Road miles
	0.1	14.9
	0.2	12.0
	0.5	11.2
	1	10.3
	2	9.4
	5	7.7
	10	6.7
	20	5.5
	100	2.8

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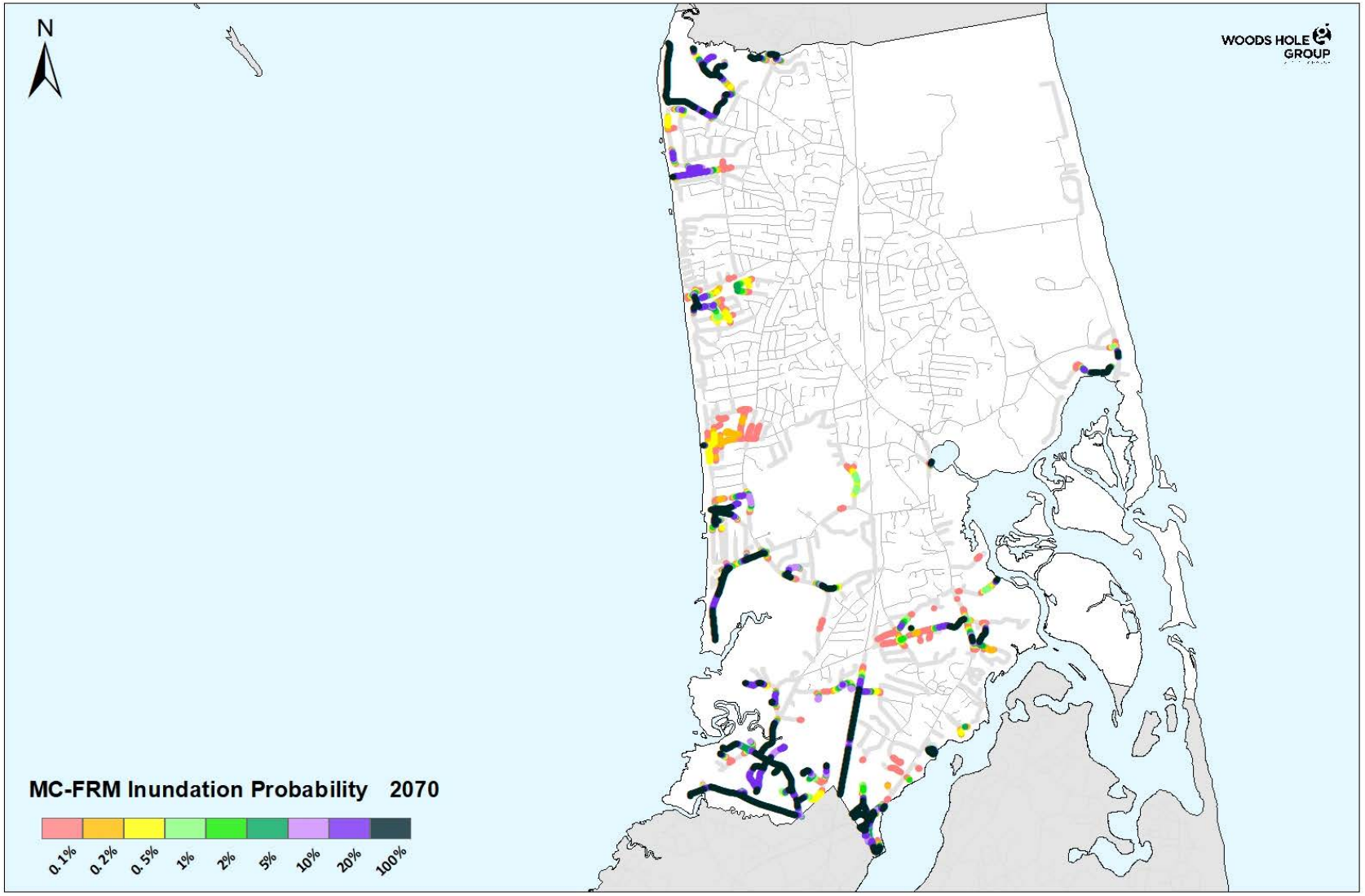
Low Lying Roads 2070 Inundation Probability (Eastham)



	%	Road miles
	0.1	18.9
	0.2	15.2
	0.5	14.0
	1	12.7
	2	12.1
	5	11.5
	10	10.4
	20	9.4
	100	6.6

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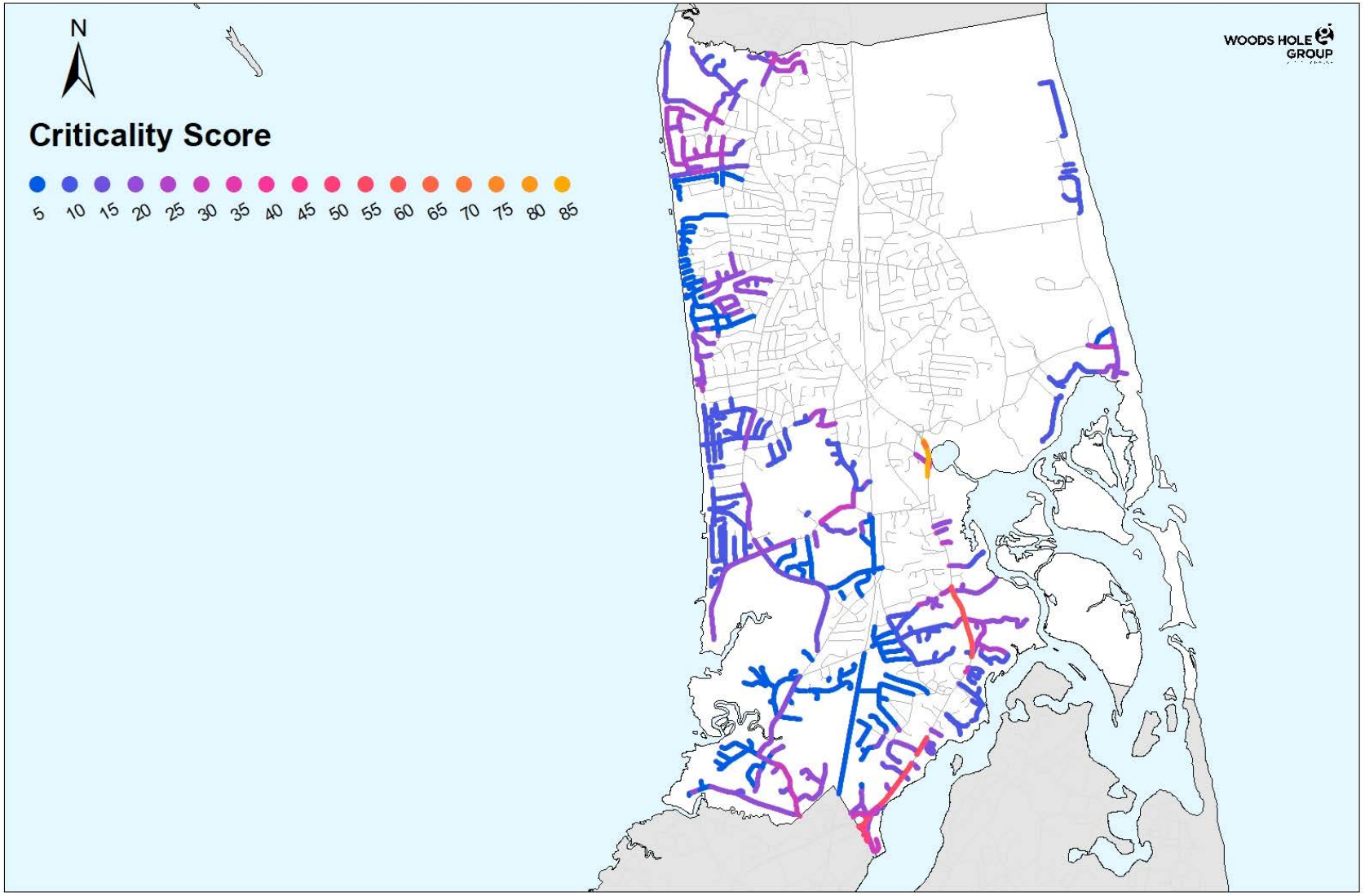
Low Lying Roads Criticality Scoring (Eastham)



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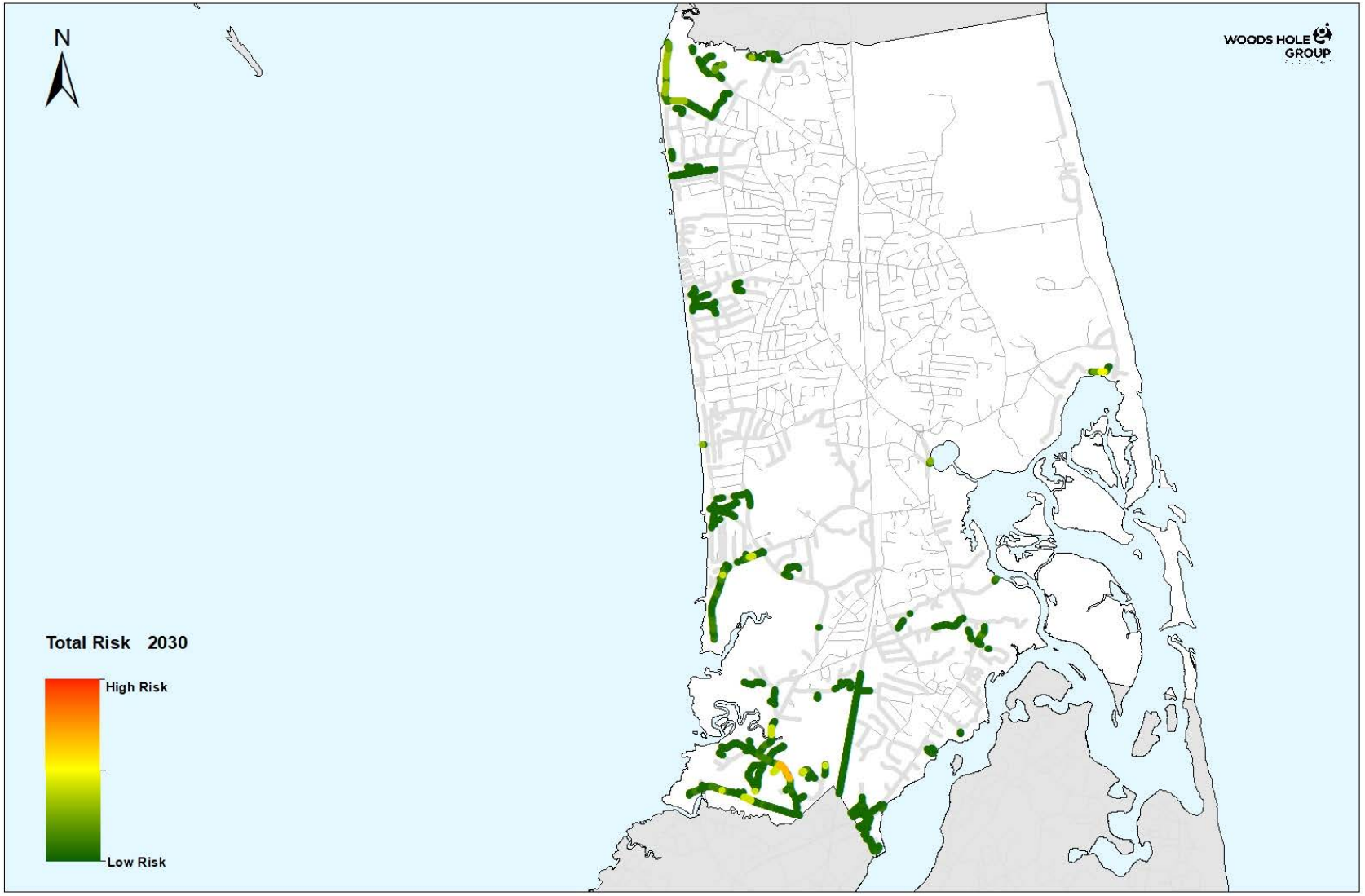
Low Lying Roads 2030 Risk Results (Eastham)



High Risk Road Segments

Bridge Rd & Windjammer Rd (+)
Dyer Prince Rd (+)
Samoset Rd and Sunset Ln (+)
South Sunken Meadow Rd
Governor Prence Rd E
Herring Brook Rd
Massasoit Rd
Ellis Rd
Eldredge Dr and North Sunken Meadow Rd
Bayview Rd
Steele Rd
Grand Army of the Republic*
Eastham Rotary*
Smith Ln*
Governor Prence Rd W
Cole Rd

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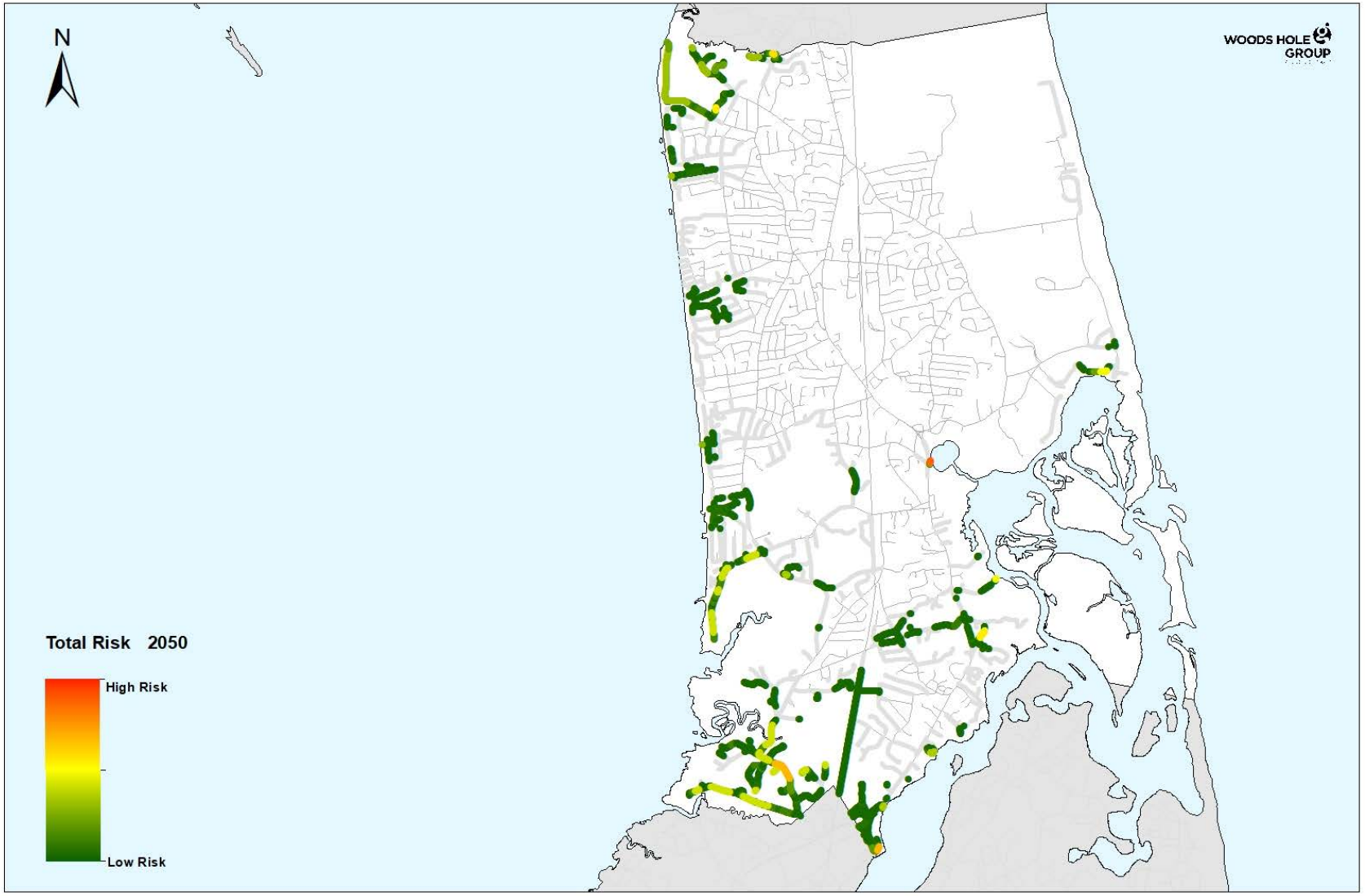
Low Lying Roads 2050 Risk Results (Eastham)



High Risk Road Segments

Bridge Rd & Windjammer Rd (+)
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Ellis Rd
Eldredge Dr and North Sunken Meadow Rd
Bayview Rd
Steele Rd
Grand Army of the Republic*
Eastham Rotary*
Smith Ln*
Governor Prence Rd W
Cole Rd

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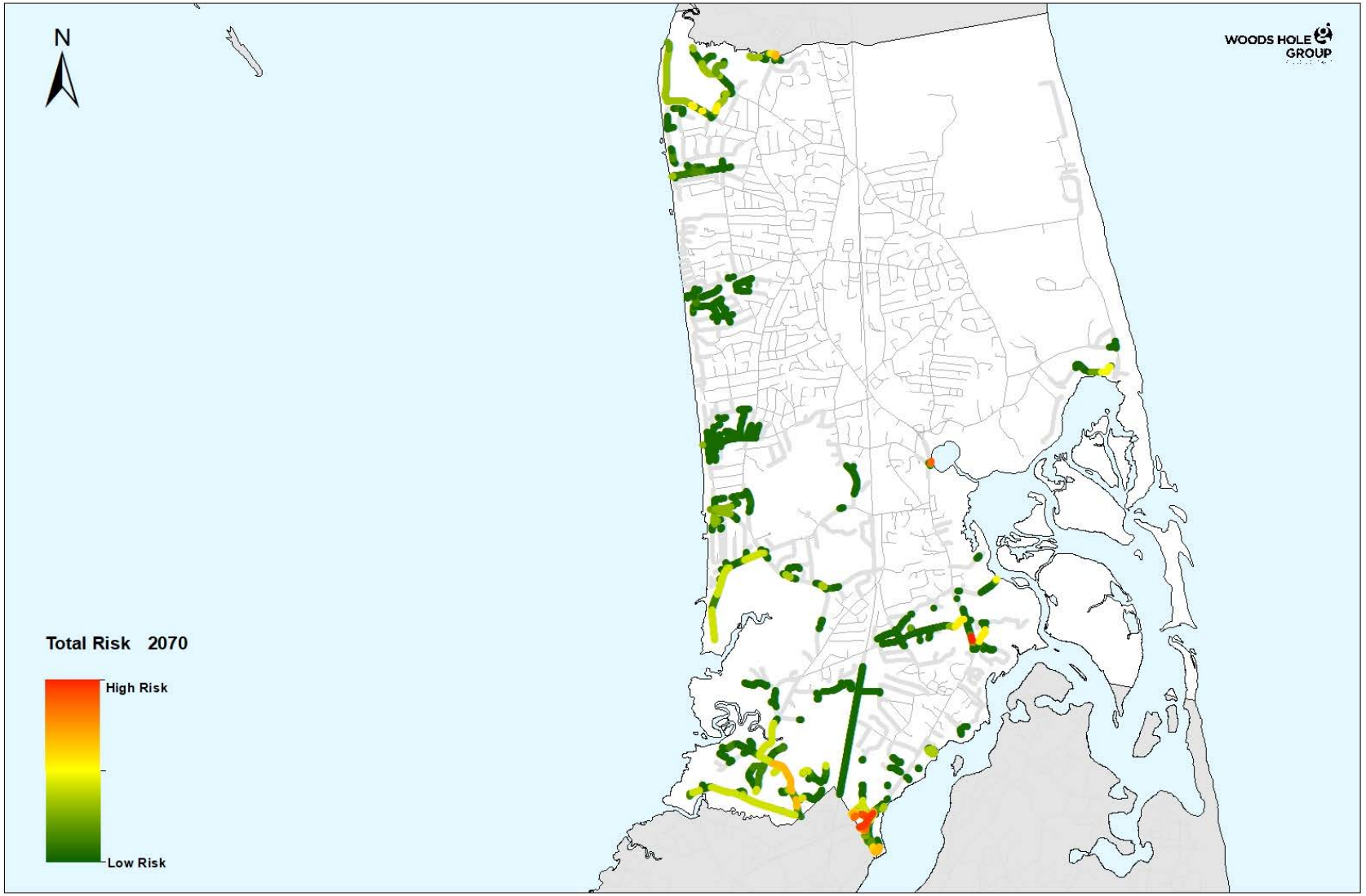
Low Lying Roads 2070 Risk Results (Eastham)



High Risk Road Segments

Bridge Rd & Windjammer Rd (+)
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Herring Brook Rd
Massasoit Rd
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Grand Army of the Republic*
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Smith Ln*
Governor Prence Rd W
Cole Rd

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Summary of High Priority Road Segments (Eastham)

	Name	Length (ft)	Description	Segment Storm Probability (%)			Nuisance Length (ft)		
				2030	2050	2070	2030	2050	2070
A	Bridge Rd & Windjammer Rd (+)	4340	Most of roadway with bridge	0-100	1-100	5-100	20	880	2520
B	Dyer Prince Rd (+)	3940	Most of roadway	0-100	1-100	5-100	40	500	1400
C	Samoset Rd and Sunset Ln (+)	4320	Most of roadway	0-100	0-100	0-100			2220
D	South Sunken Meadow Rd	1620	Leading to Sunken Meadow Beach	0.2-100	5-100	20-100		380	880
E	Governor Prence Rd E	540	East of Route 6	0-20	1-100	100	20	240	440
F	Herring Brook Rd	160	South of Heritage Hill Circle	5-20	20-100	100			40
G	Massasoit Rd	160	South of Frodigh Lane	0.5-5	10-20	20-100			
H	Ellis Rd	320	Off of Old State Highway	1-5	20-100	100			320
I	Eldredge Dr and North Sunken Meadow Rd	780	Between Bens Way and Freeman Way	10-20	20-100	100			220
J	Bayview Rd	220	Leading to Boat Meadow Landing	20	100	100			220
K	Steele Rd	1380	Leading to Cooks Brook Beach	0.1-20	2-100	20-100			20
L	Grand Army of the Republic*	180	Route 6	0-0.1	1-2	100			20
M	Eastham Rotary*	1620	Rotary and Route 6	0-0.1	0.2-2	100			440
N	Smith Ln*	500	Roadway and on-ramp to Rotary/Route 6	0.1-5	2-5	100			400
O	Governor Prence Rd W	460	West of Route 6	0.1-0.5	2-10	100		300	400
P	Cole Rd	600	Southeast from Cranberry Lane	0.5-1	10-20	100		160	480

(+) = Prior planning work

* = MassDOT roadway

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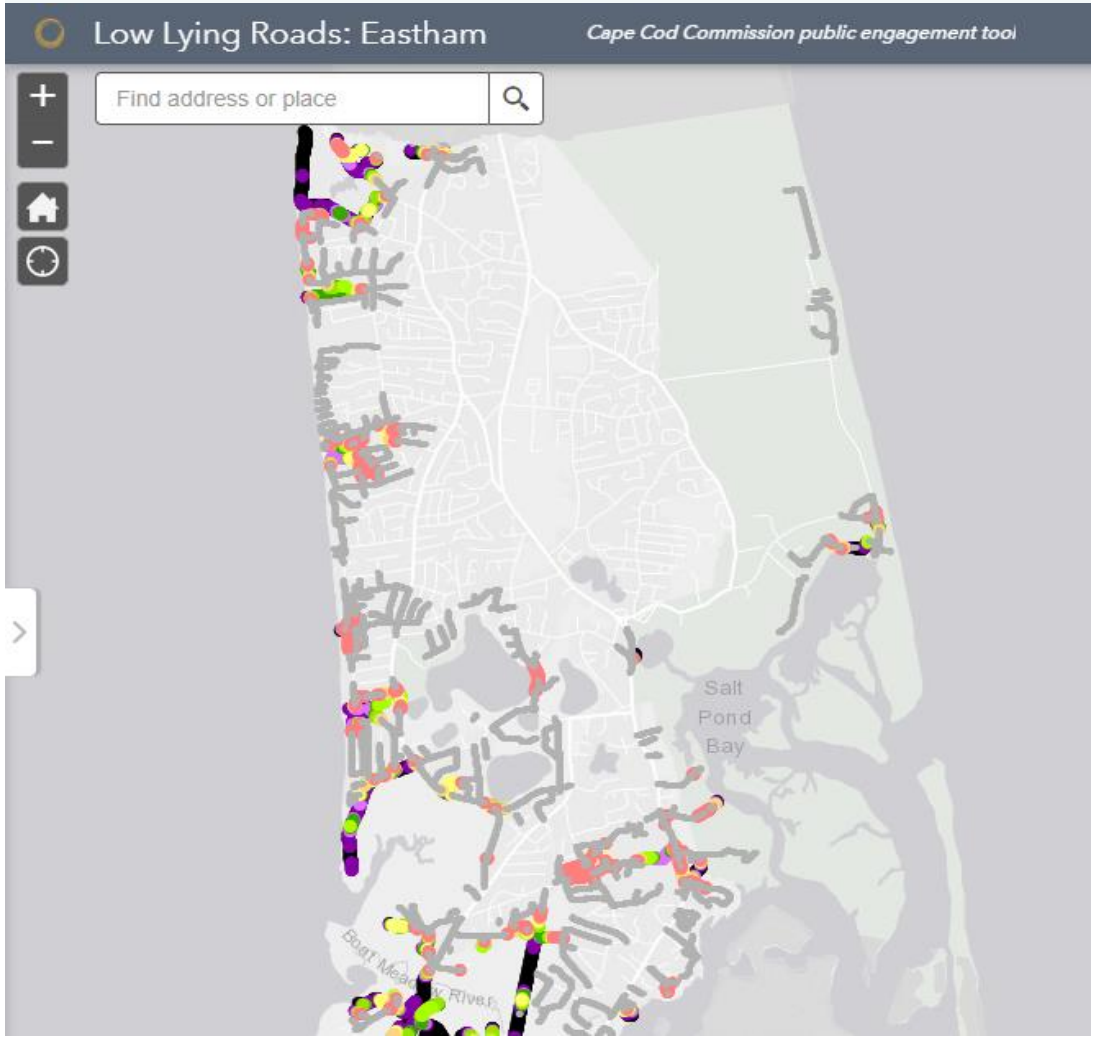
LOW LYING ROADS

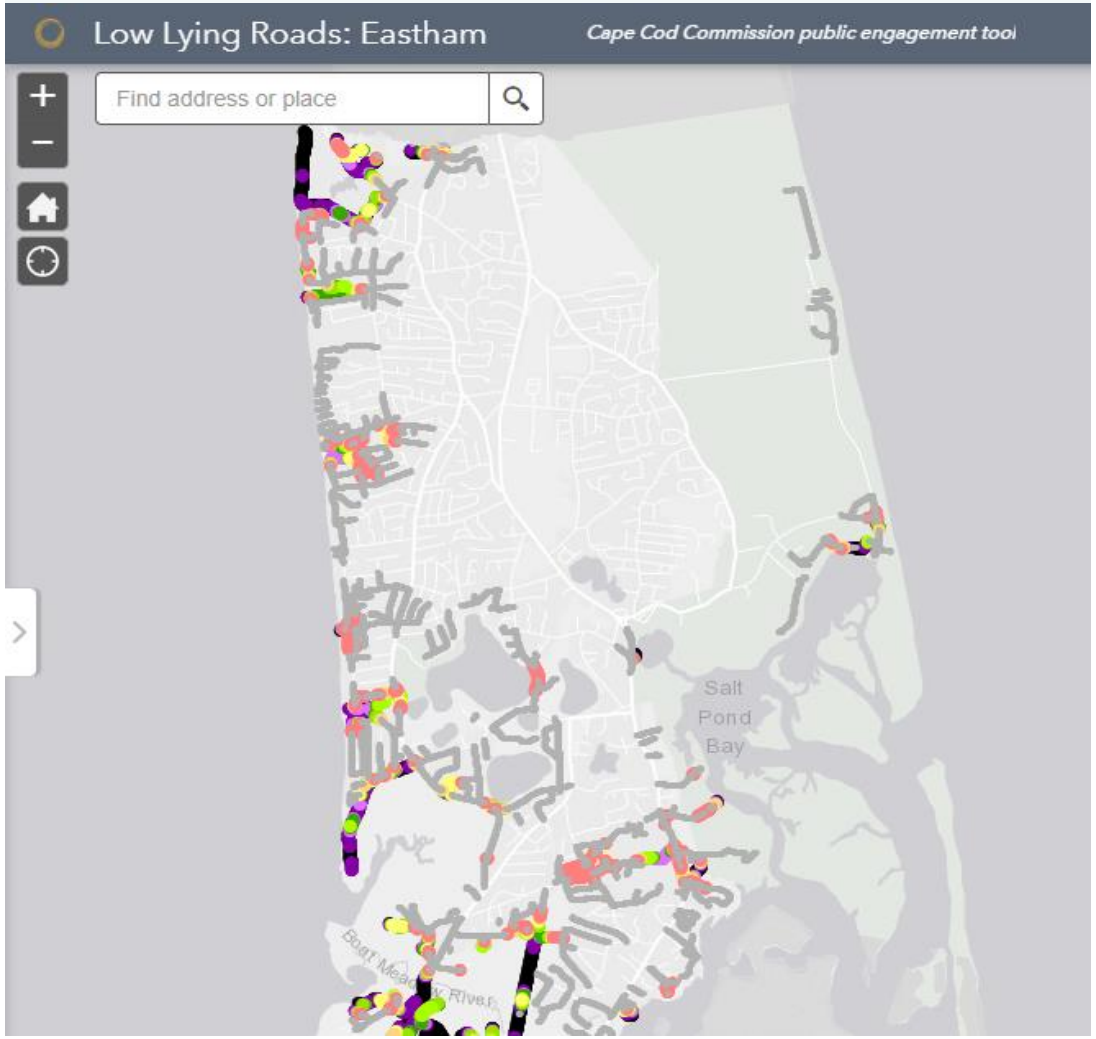
Group Discussion



DISCUSSION ORIENTATION

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 (Eastham)

	Name	Length (ft)	Description	Segment Storm Probability (%)			Nuisance Length (ft)		
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NEXT STEPS

- Town staff to select 4 road segments
- Feasibility analysis
- 3 solutions + costs per segment
- Solutions available to view on Low Lying Road webpage late spring 2022: https://www.capecodcommission.org/our-work/low-lying-roads-project/
- 2nd Workshop date TBD – Fall 2022

THANK YOU!