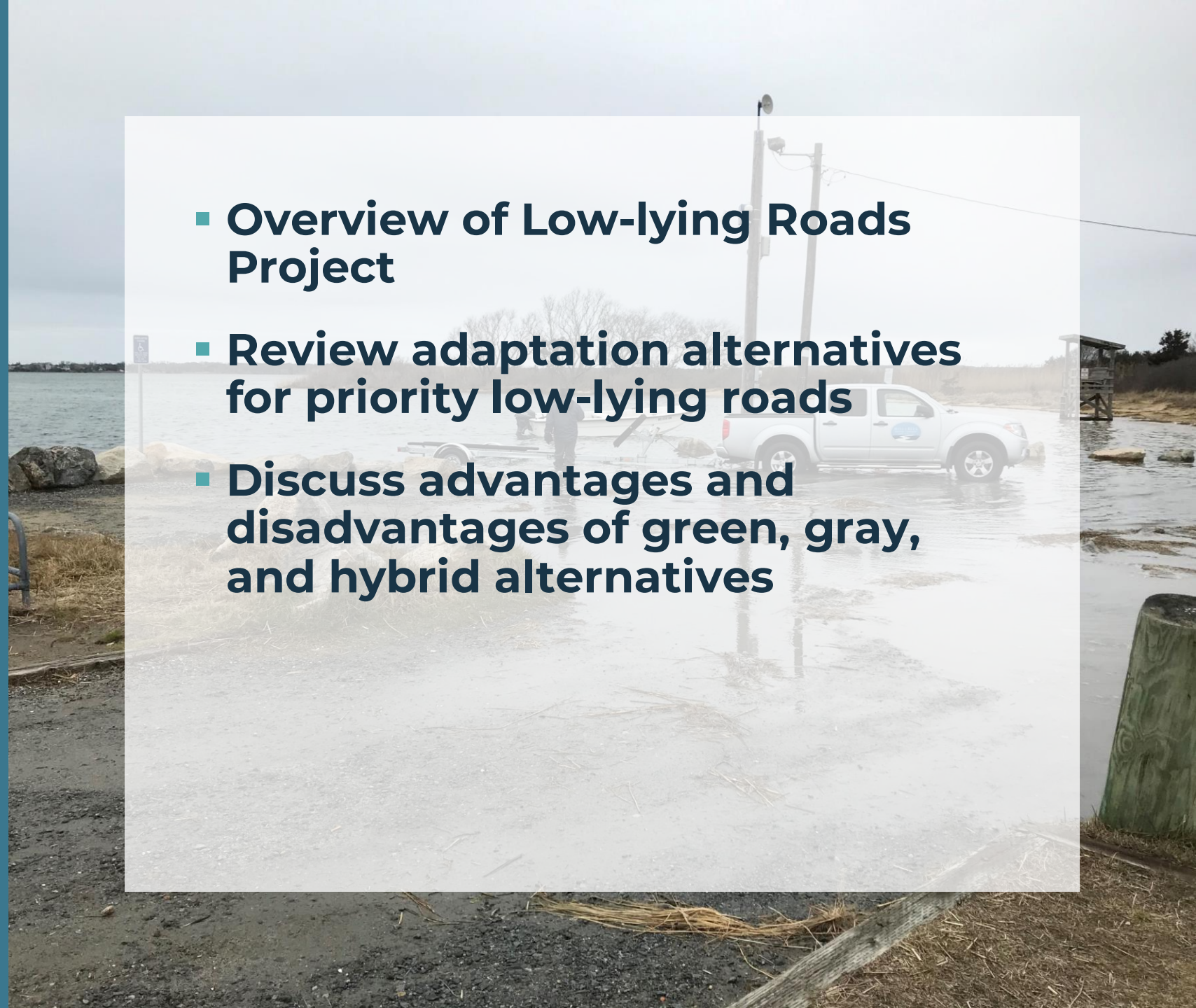
Low-lying Roads: Chatham

Project funded by the Municipal Vulnerability Preparedness Program

Purpose and Objectives of Public Meeting



- **Overview of Low-lying Roads Project**
- **Review adaptation alternatives for priority low-lying roads**
- **Discuss advantages and disadvantages of green, gray, and hybrid alternatives**

Agenda

- Project Overview – Heather McElroy, CCC and Joe Famely, WHG
- Presentation of conceptual design alternatives – Linnea Laux, WHG
  - Ridgevale Road
  - Morris Island Road
- Questions, comments, and discussion
- Next Steps – Heather McElroy

Low-Lying Roads 2

5

TOWNS

Chatham
Falmouth
Harwich
Mashpee
Provincetown

- 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

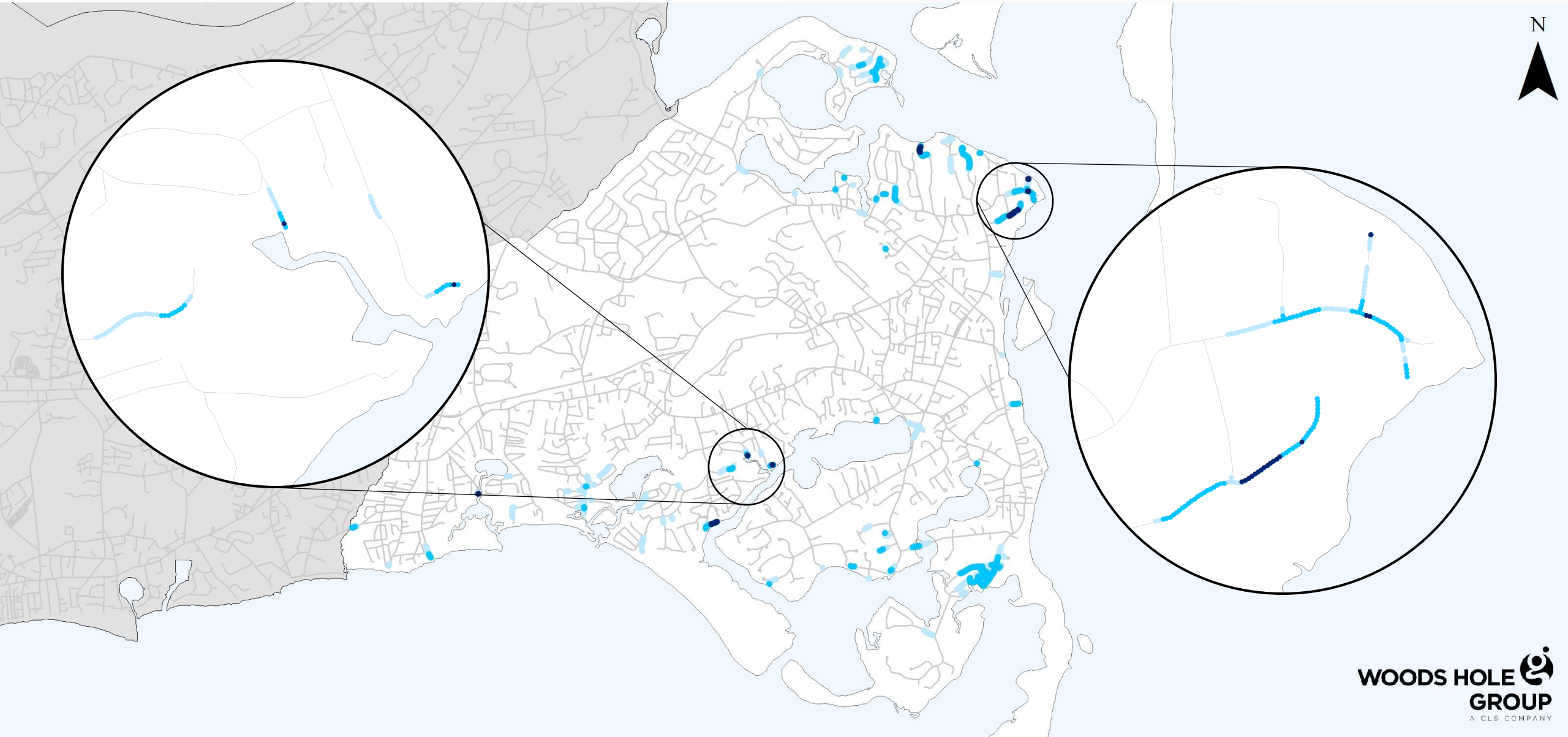
PROJECT TIMELINE & ELEMENTS

March 2023	April 2023	May 2023	Summer 2023	Winter 2024
Vulnerability Assessment: Roads and Bridges 3 Future Time Horizons - 2030, 2050, 2070	Criticality Assessment: Prioritize Roadway Segments	1st Workshop: Vulnerable & At-Risk Roads	Roadway analysis & solutions ID	2nd Workshop: Present alternatives

Additional Context & Information

- **Detailed information on webpages:** https://www.capecodcommission.org/our-work/low-lying-roads-project/
- **Format for meeting**

Low Lying Roads Nuisance Flooding

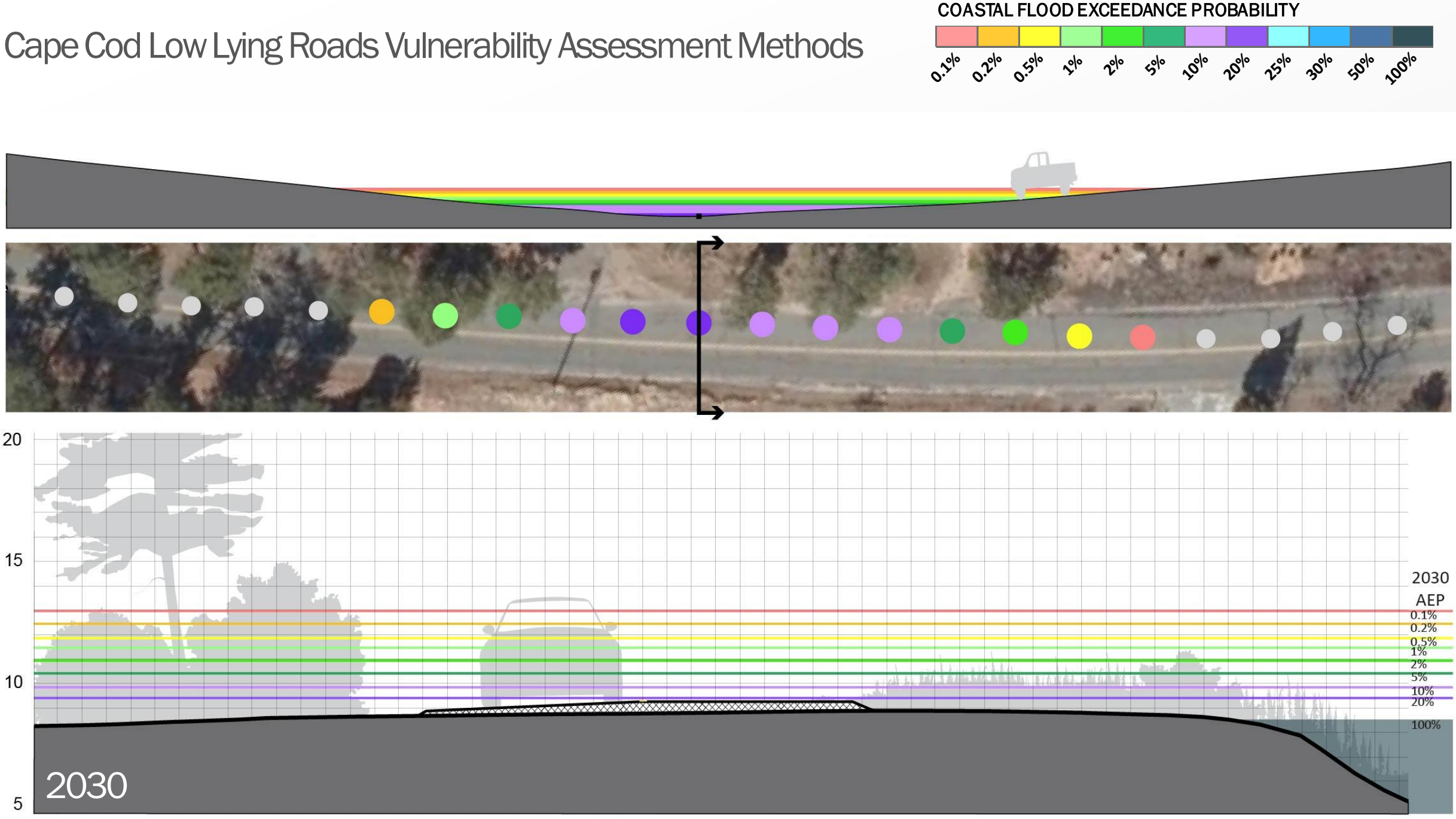


Cape Cod Low Lying Roads Vulnerability Assessment Methods

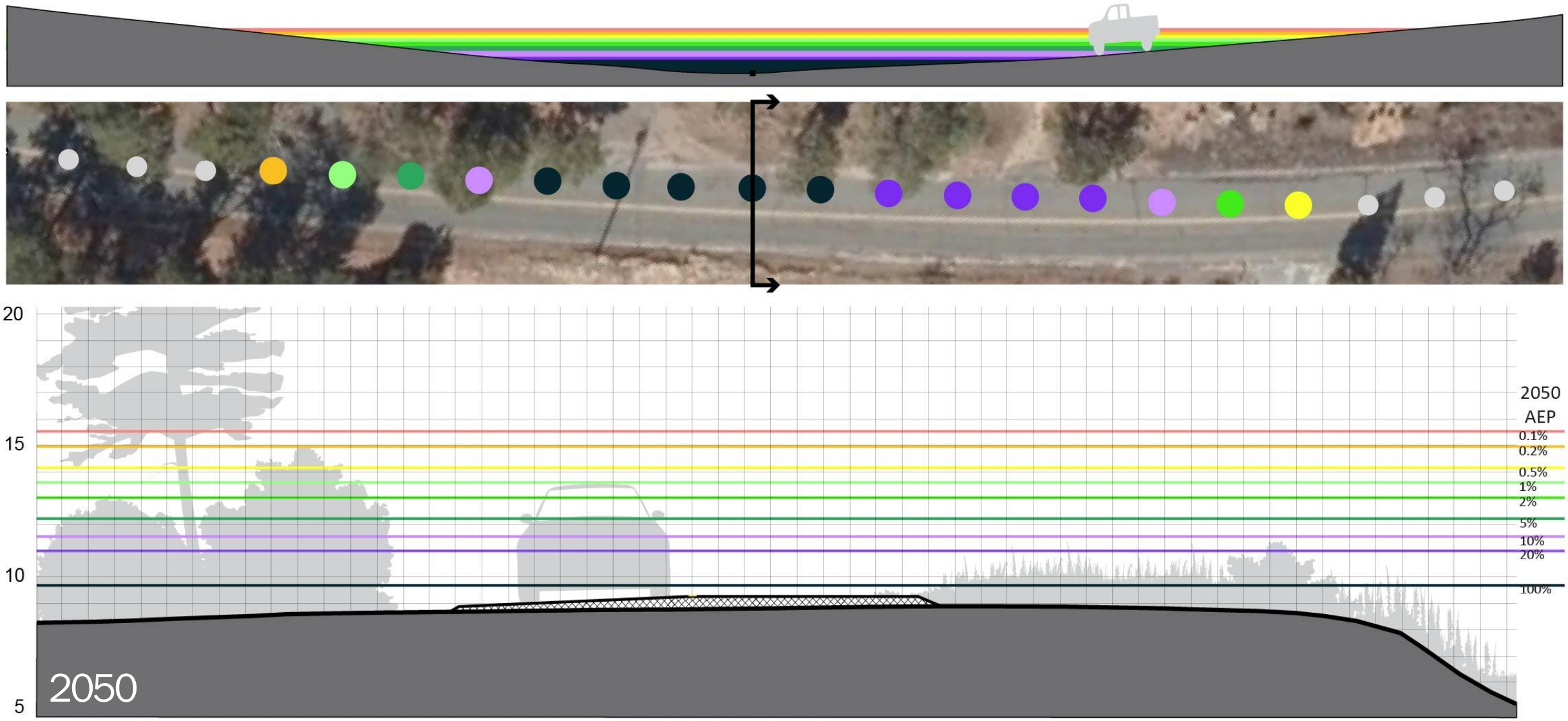
COASTAL FLOOD EXCEEDANCE PROBABILITY

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

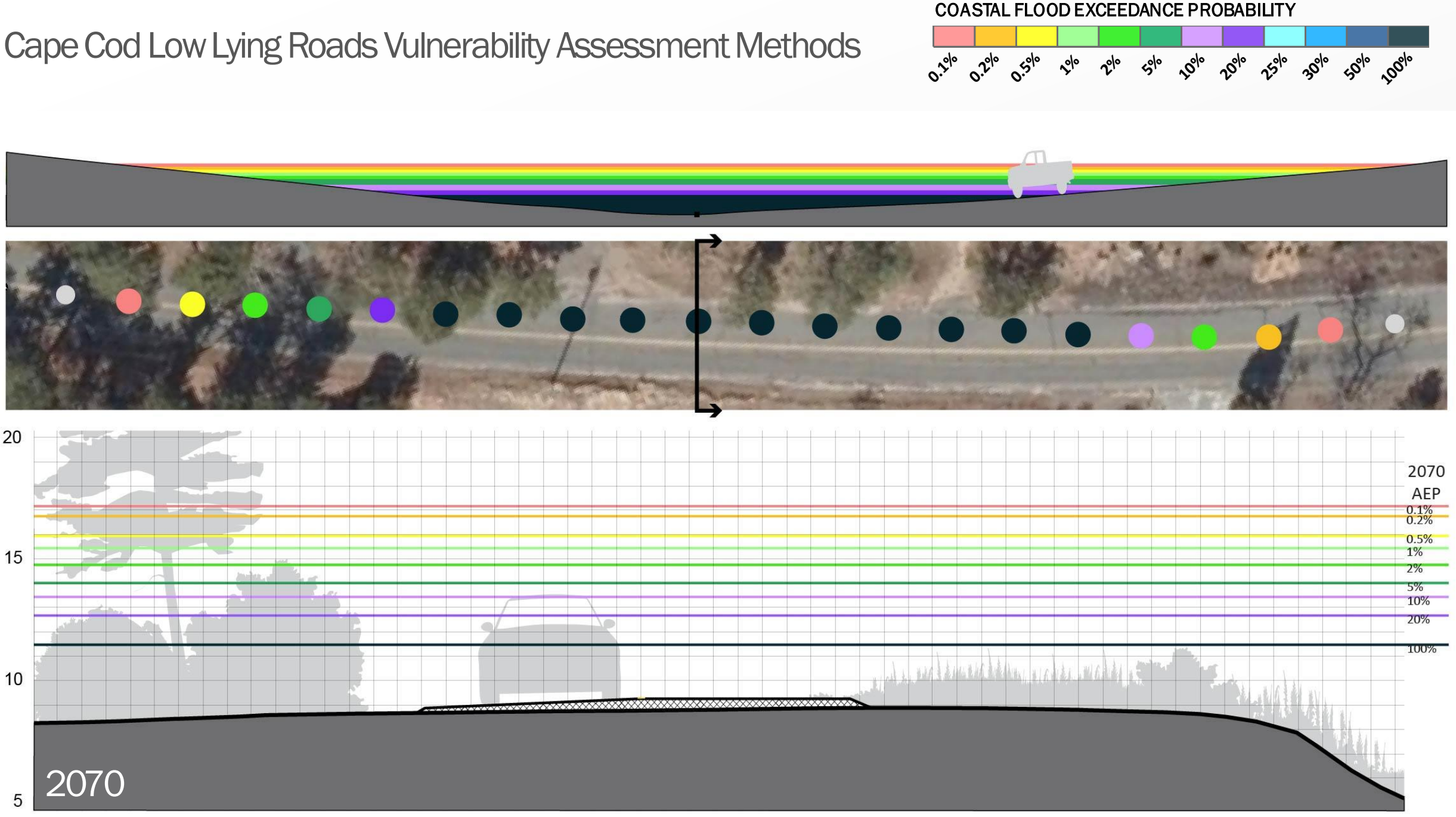
Cape Cod Low Lying Roads Vulnerability Assessment Methods



Cape Cod Low Lying Roads Vulnerability Assessment Methods

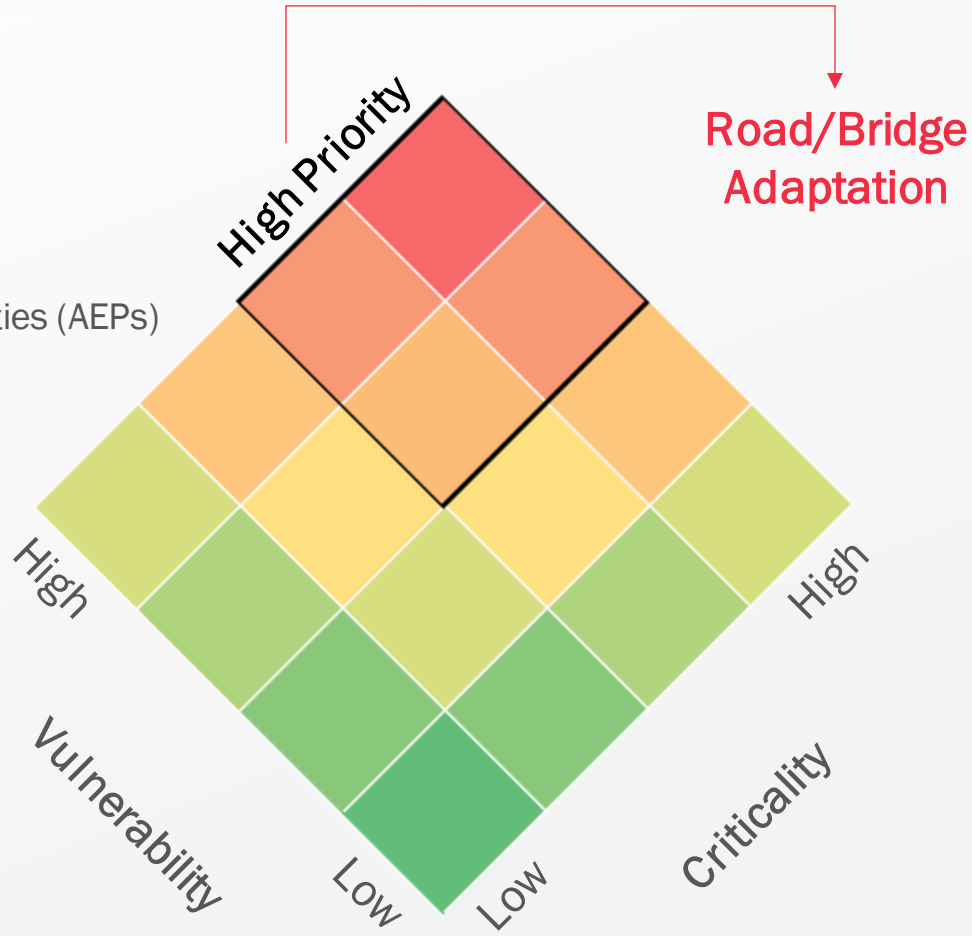


Cape Cod Low Lying Roads Vulnerability Assessment Methods

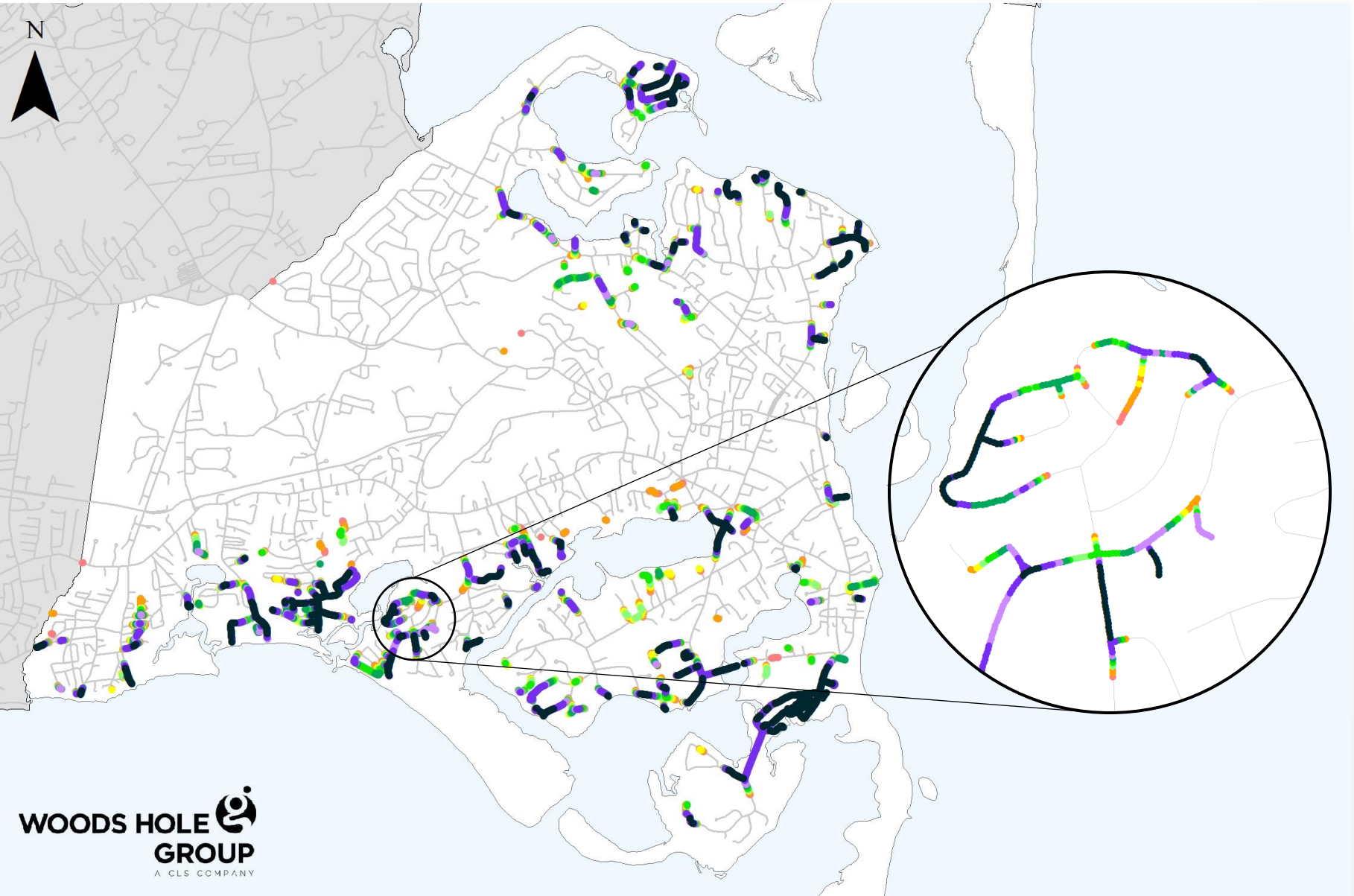


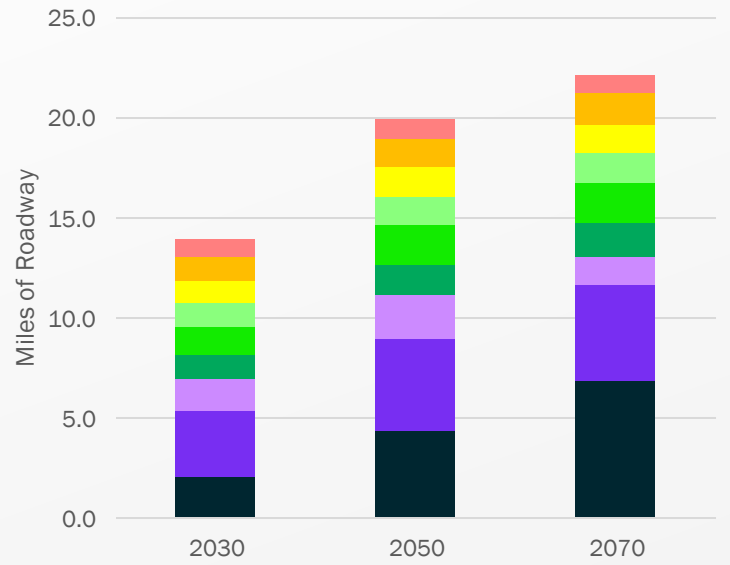
Cape Cod Low Lying Roads Risk Assessment Approach

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% Annual Exceedance Probabilities (AEPs)
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



Low Lying Roads 2070 Flood Probability (Annual Exceedance Probability)





Flood Probability	Road Miles
0.1%	22.2
0.2%	21.3
0.5%	19.6
1%	18.3
2%	16.8
5%	14.8
10%	13.0
20%	11.6
100%	6.9

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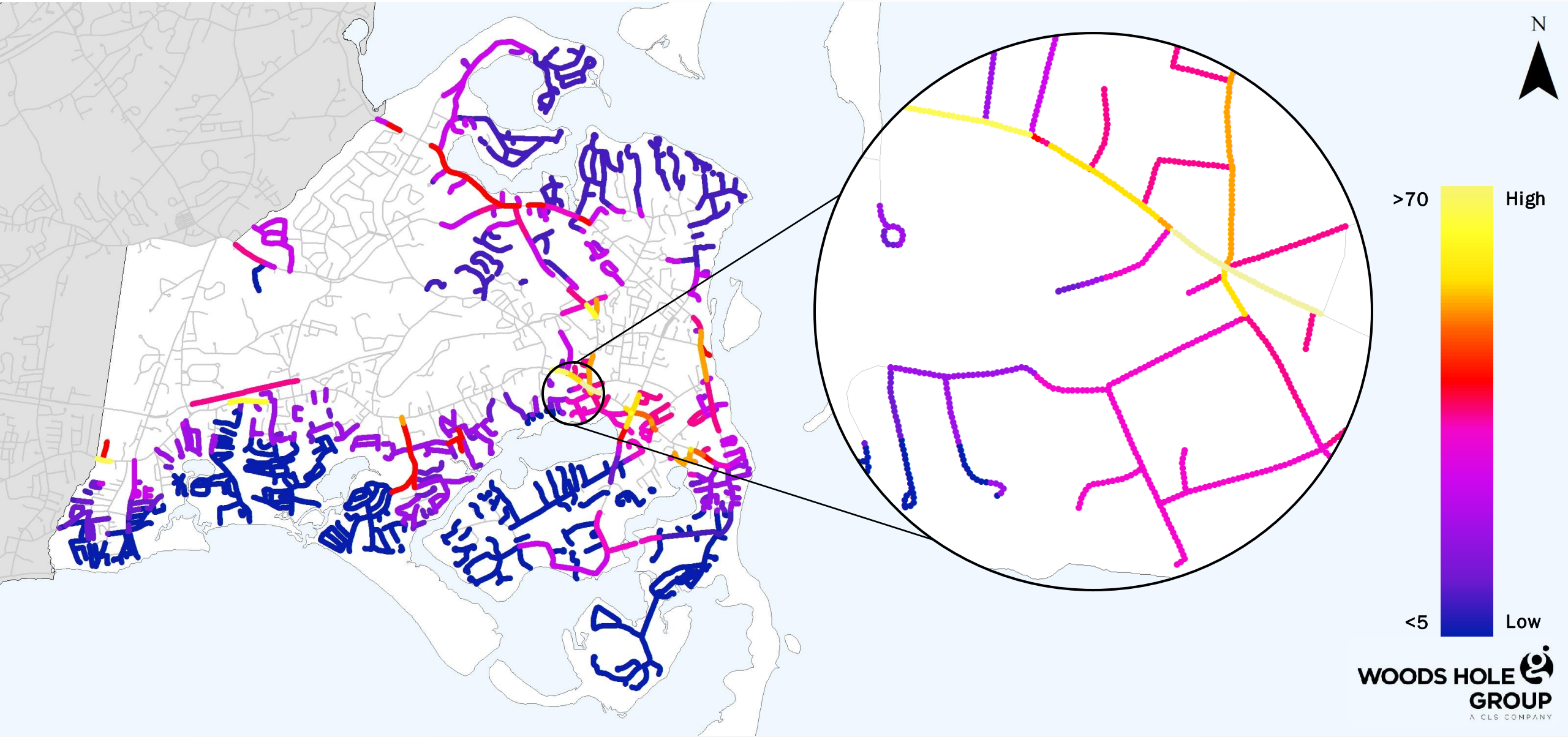
A CLS COMPANY

Low Lying Roads Criticality Scoring



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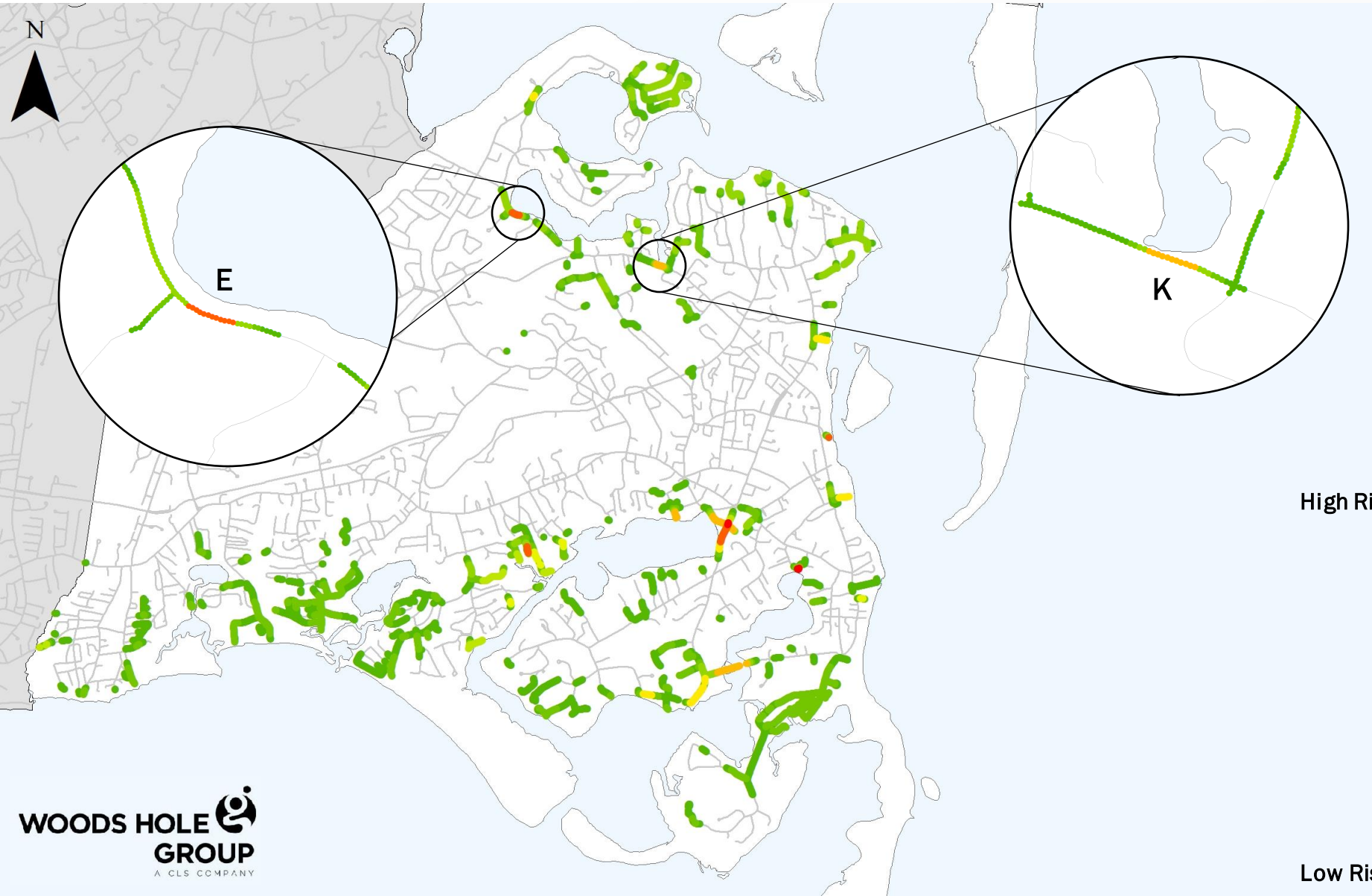
Low Lying Roads 2070 Risk Results



	High Risk Road Segments
A	Bridge St
B	Champlain Rd
C	Deep Hole Rd
D	Old Wharf Rd
E	Orleans Rd/Rte 28 (West)
F	Stage Harbor Rd & Pond St
G	Stage Harbor Rd & Champlain Rd
H	Morris Island Rd
I	Ridgevale Rd
J	Hardings Beach Rd
K	Orleans Rd/Rte 28 (East)
L	Fox Hill Rd
M	Seapine Rd
N	Barn Hill Rd

Summary of High Priority Road Segments

	Road Name	Length (ft)	Description	AEP 2030	Criticality Score		2030 Risk Score		Tidal Flooding Length (ft)		
									2030	2050	2070
A	Bridge St	760	western approach to Mitchell River Bridge	100	26		2600		0	260	600
B	Champlain Rd	300	west of Port Fortunes Ln	100	23		2300		0	140	220
C	Deep Hole Rd	300	eastern approach to Red River crossing at Harwich line	100	11		1100		0	120	200
D	Old Wharf Rd	600	between Old Harbor Rd and Linnell Ln	100	9		900		0	420	520
E	Orleans Rd/Rte 28 (West)	940	at top of Ryder Cove crossing Herring Brook	20	37		740		0	0	400
F	Stage Harbor Rd & Pond St	820	behind Oyster Pond Beach	20	36		720		0	0	520
G	Stage Harbor Rd & Champlain Rd	500	at Harbormaster Office and creek crossing	20	23		460		0	80	320
H	Morris Island Rd	2440	between Outermost Harbor and Tom's Neck	100	4		400		0	1280	2120
I	Ridgevale Rd	980	between Cranberry Ln and Patterson Rd	100	4		400		0	0	520
J	Hardings Beach Rd	760	between Buena Vista Rd and Howes Ln	20	4		80		0	0	380
K	Orleans Rd/Rte 28 (East)	420	at Frost Fish Creek crossing	20	27		540		0	0	260
L	Fox Hill Rd	360	connection to Nickersons Neck at Crows Pond Landing	10	20		200		0	0	140
M	Seapine Rd	300	connection to Harbor Coves along southern shore of Crows Pond	10	9		90		0	0	0
N	Barn Hill Rd	240	connection to Barn Hill at top of Sulphur Springs marsh	2	36		72		0	0	0
O	Taylors Pond Rd	280	connection to neighborhood at Taylors Pond landing	20	4		80		0	0	160

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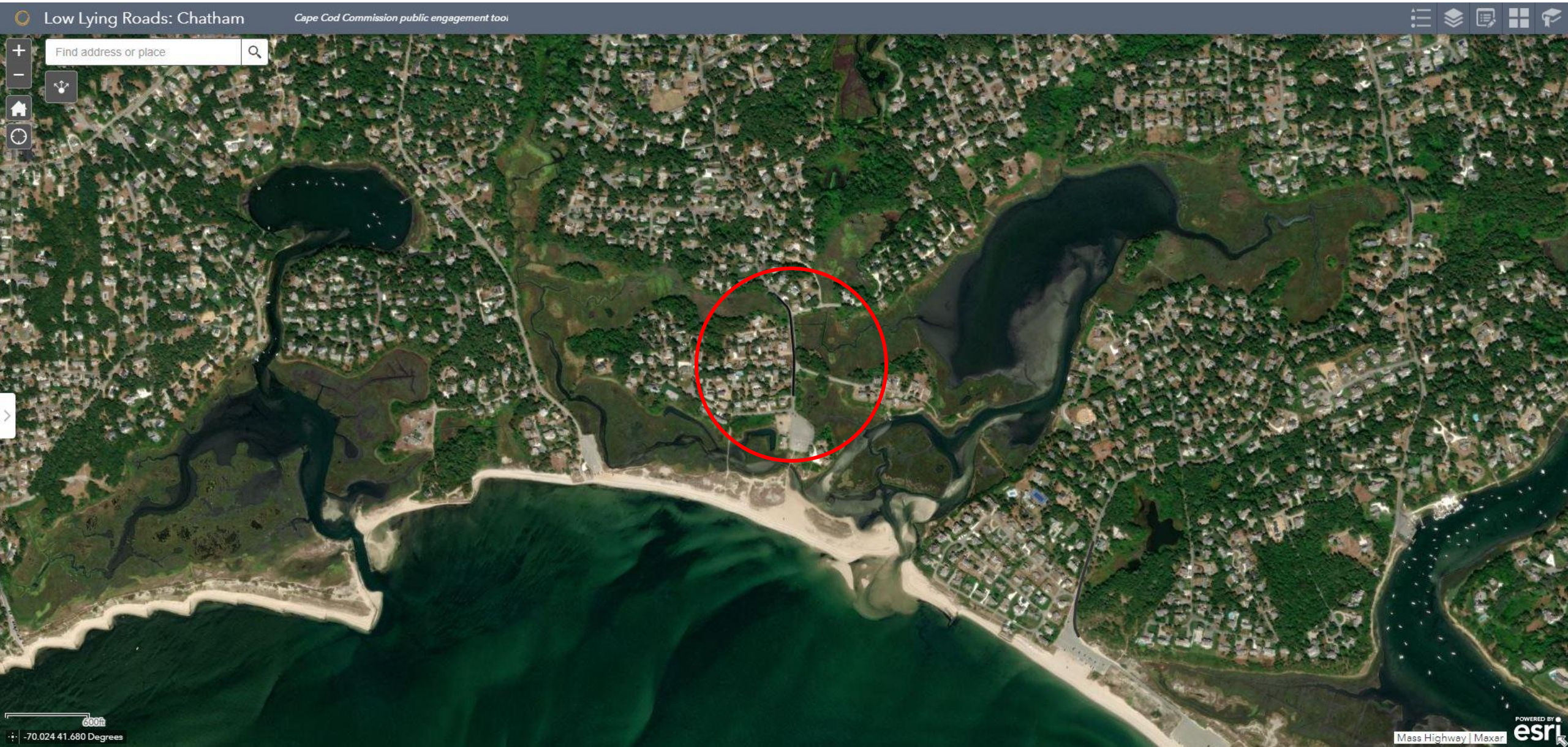
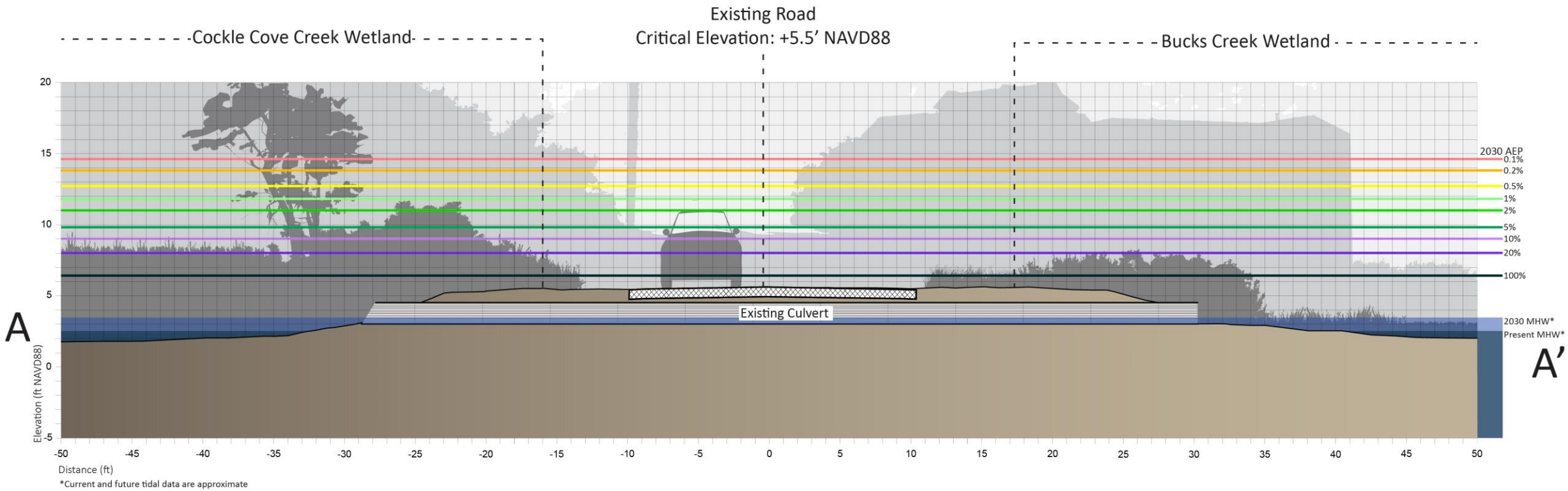
Ridgevale Road





EXISTING CONDITIONS

Ridgevale Road, Chatham

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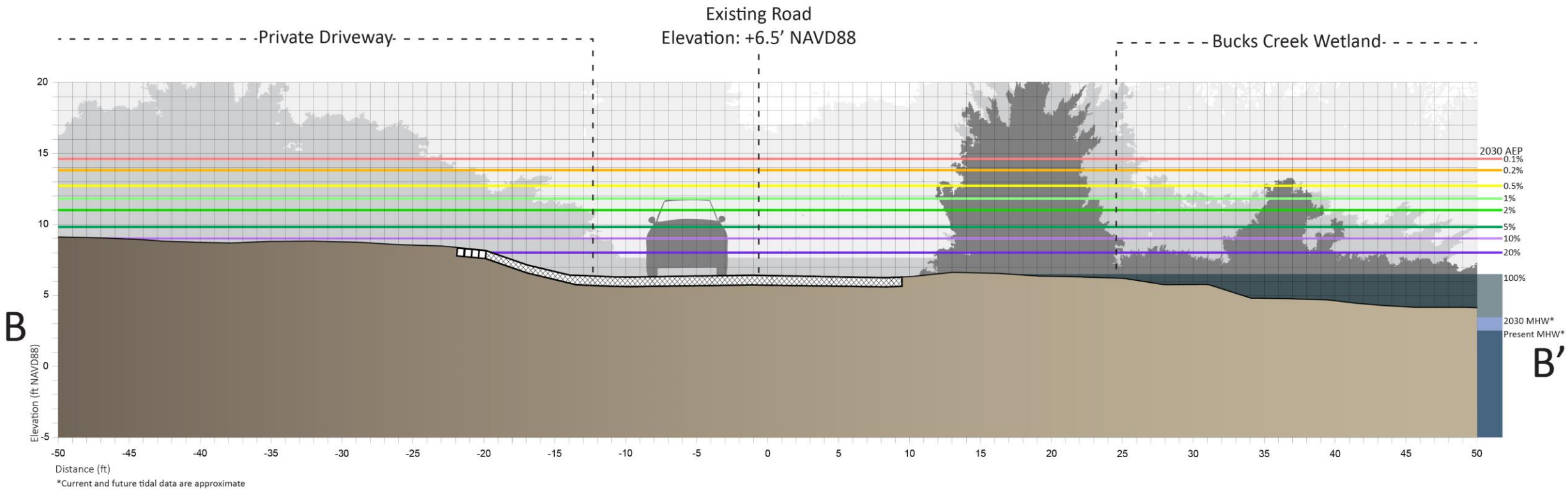

EXISTING CONDITIONS

Ridgevale Road, Chatham

WOODS HOLE GROUP
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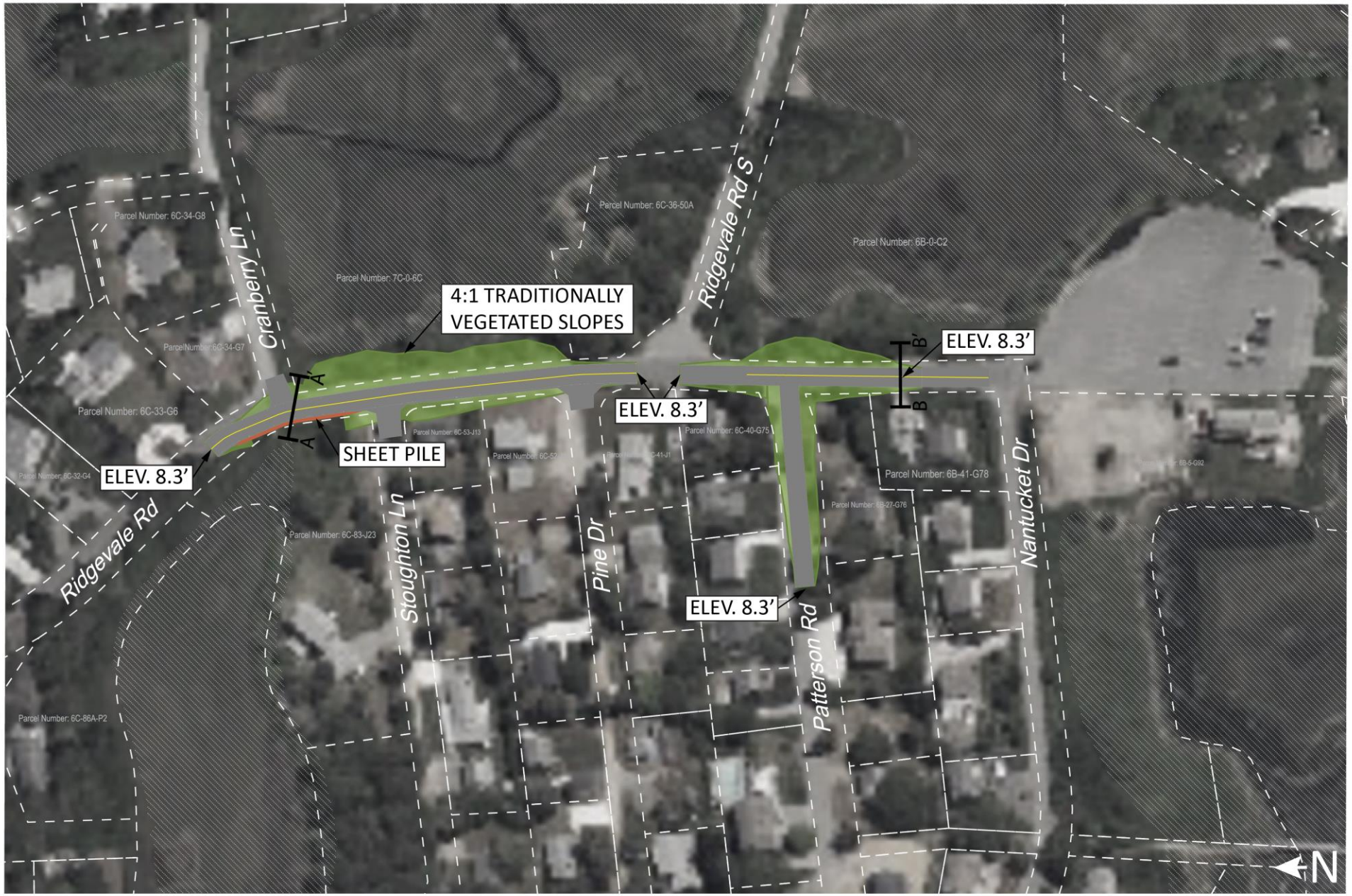

Note: Project overlap with wetland areas, rights of way and property lines is approximate and needs confirmation with a site survey

Ridgevale Road
CHATHAM

ALTERNATIVE 1: GRAY

844 linear feet of town-owned road are elevated from a lowest point of +5.5’ NAVD88 to a lowest point of +8.3’ NAVD88 using 4:1 traditionally vegetated side slopes and sheet pile. The road slopes to meet the existing road elevation near Nantucket Drive.

WOODS HOLE GROUP
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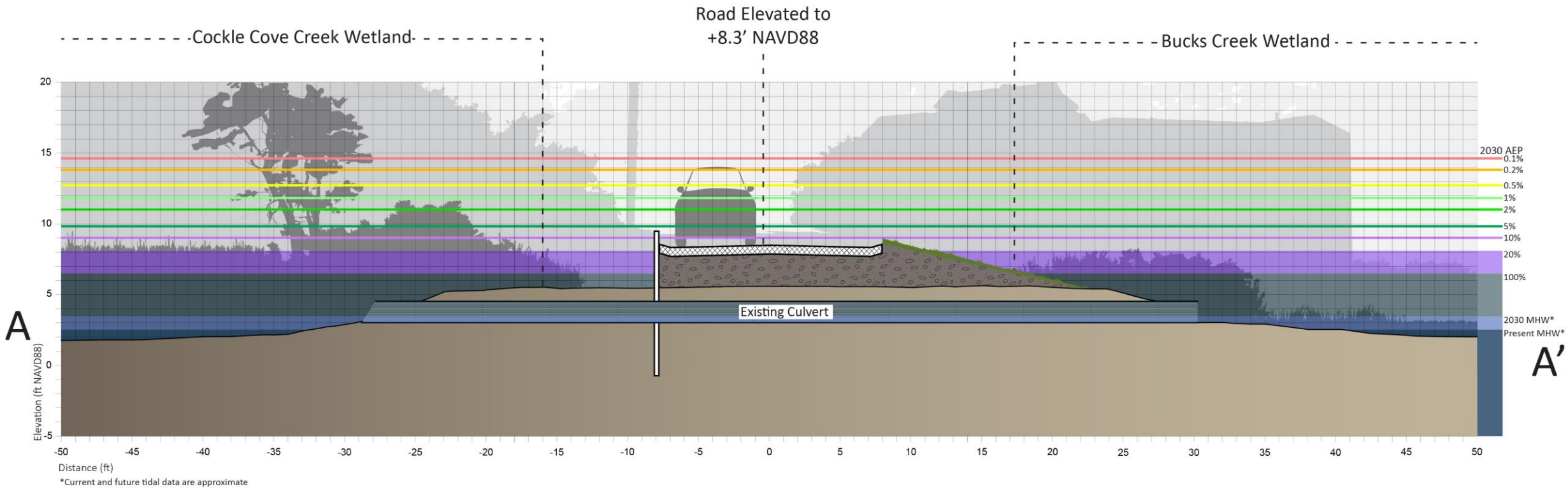

ALTERNATIVE 1: GRAY

Ridgevale Road, Chatham

WOODS HOLE GROUP
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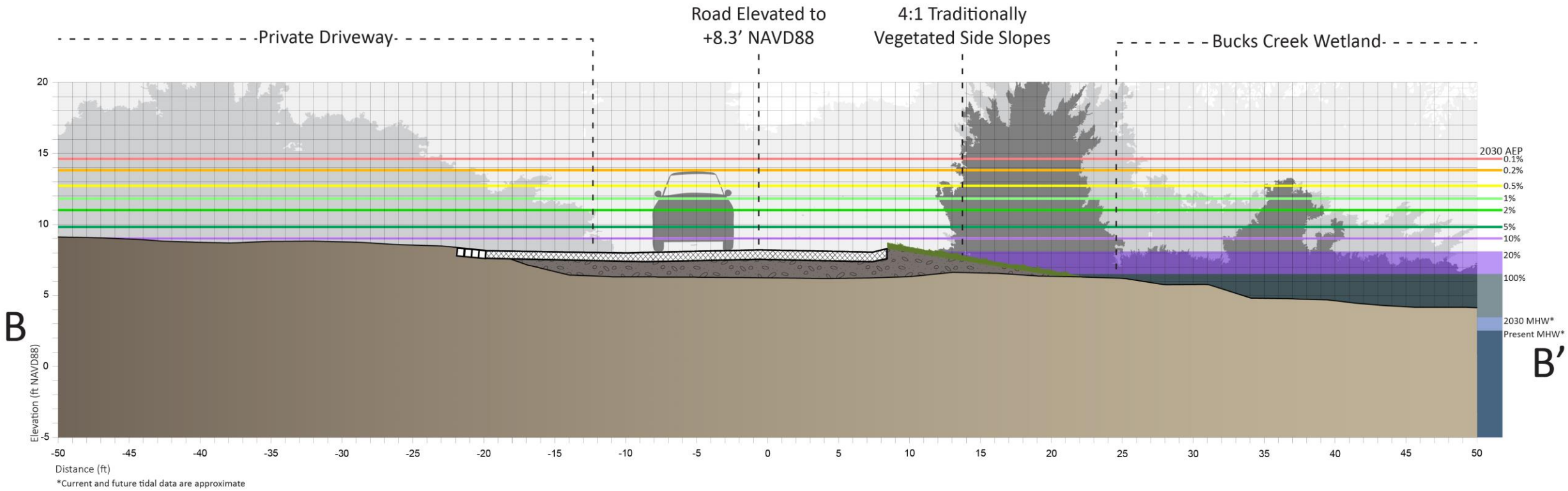

ALTERNATIVE 1: GRAY

Ridgevale Road, Chatham

WOODS HOLE GROUP
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Ridgevale Road
CHATHAM

ALTERNATIVE 2: HYBRID

415 linear feet of town-owned road between Cranberry Lane and Ridgevale Rd S are elevated from a lowest point of +5.5’ NAVD88 to a lowest point of +8.3’ NAVD88 using 4:1 native vegetated side slopes and sheet pile. The culvert under the road is upsized. A 250 linear foot wall reaching elevation +8.3’ NAVD88 is constructed on the eastern side of the road south of Ridgevale Road S. A road table ties the wall elevation in to a driveway and maintains access to the southernmost house on Ridgevale Road.

Note: Project overlap with wetland areas, rights of way and property lines is approximate and needs confirmation with a site survey

WOODS HOLE GROUP
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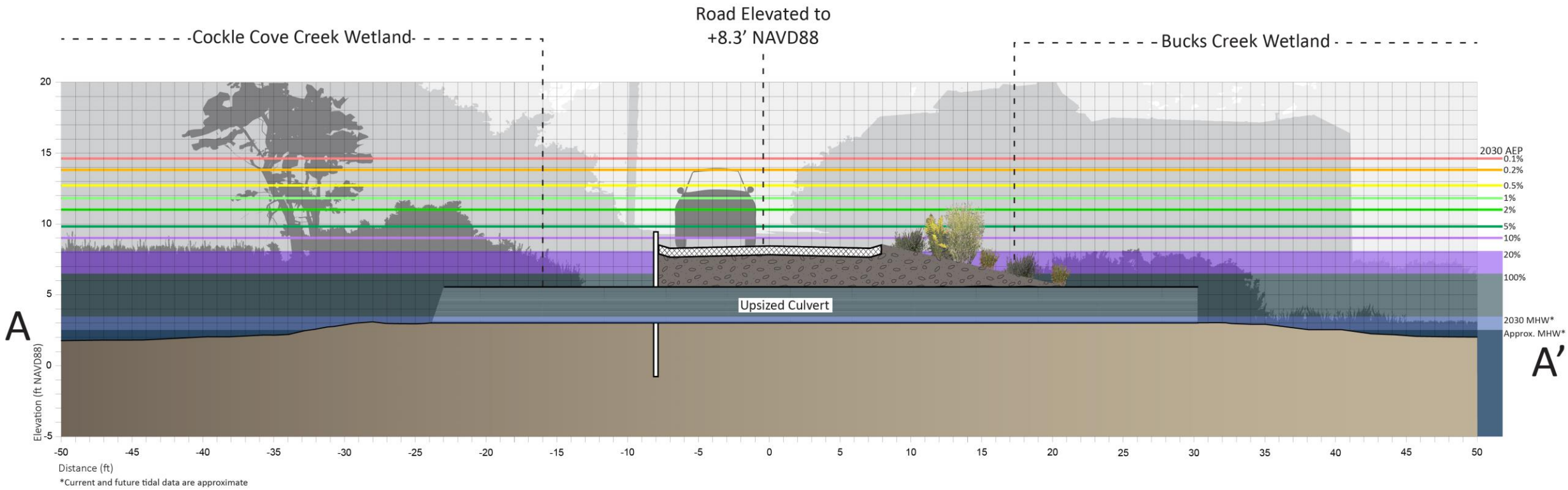

ALTERNATIVE 2: HYBRID

Ridgevale Road, Chatham

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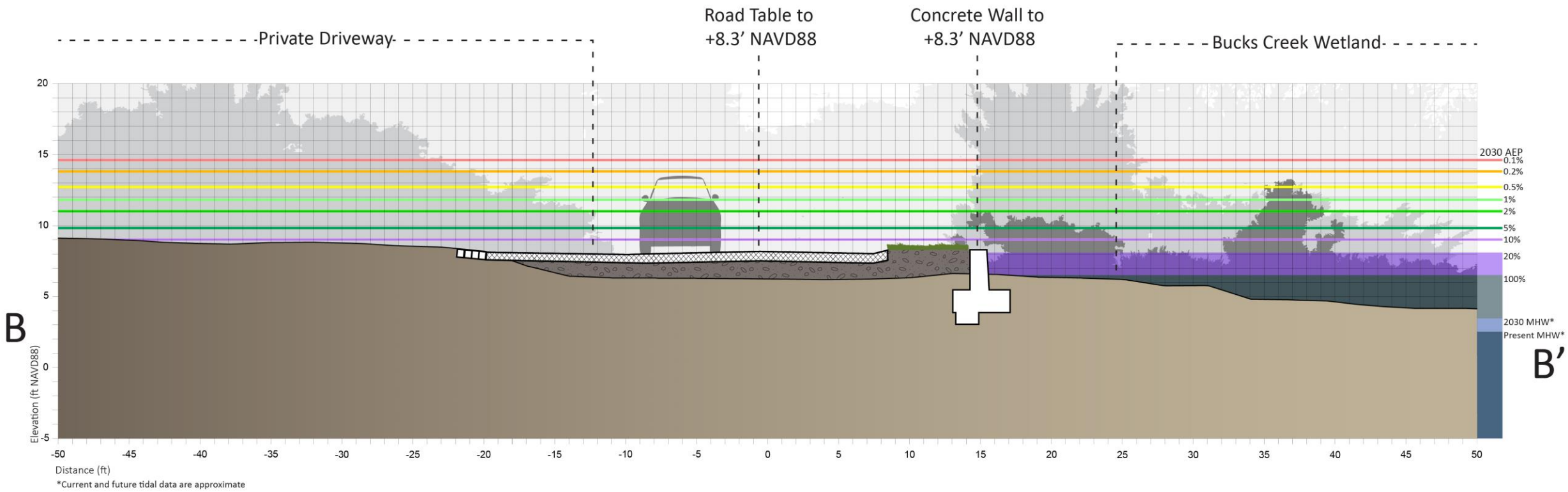

ALTERNATIVE 2: HYBRID

Ridgevale Road, Chatham

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RIDGEVALE ROAD, CHATHAM

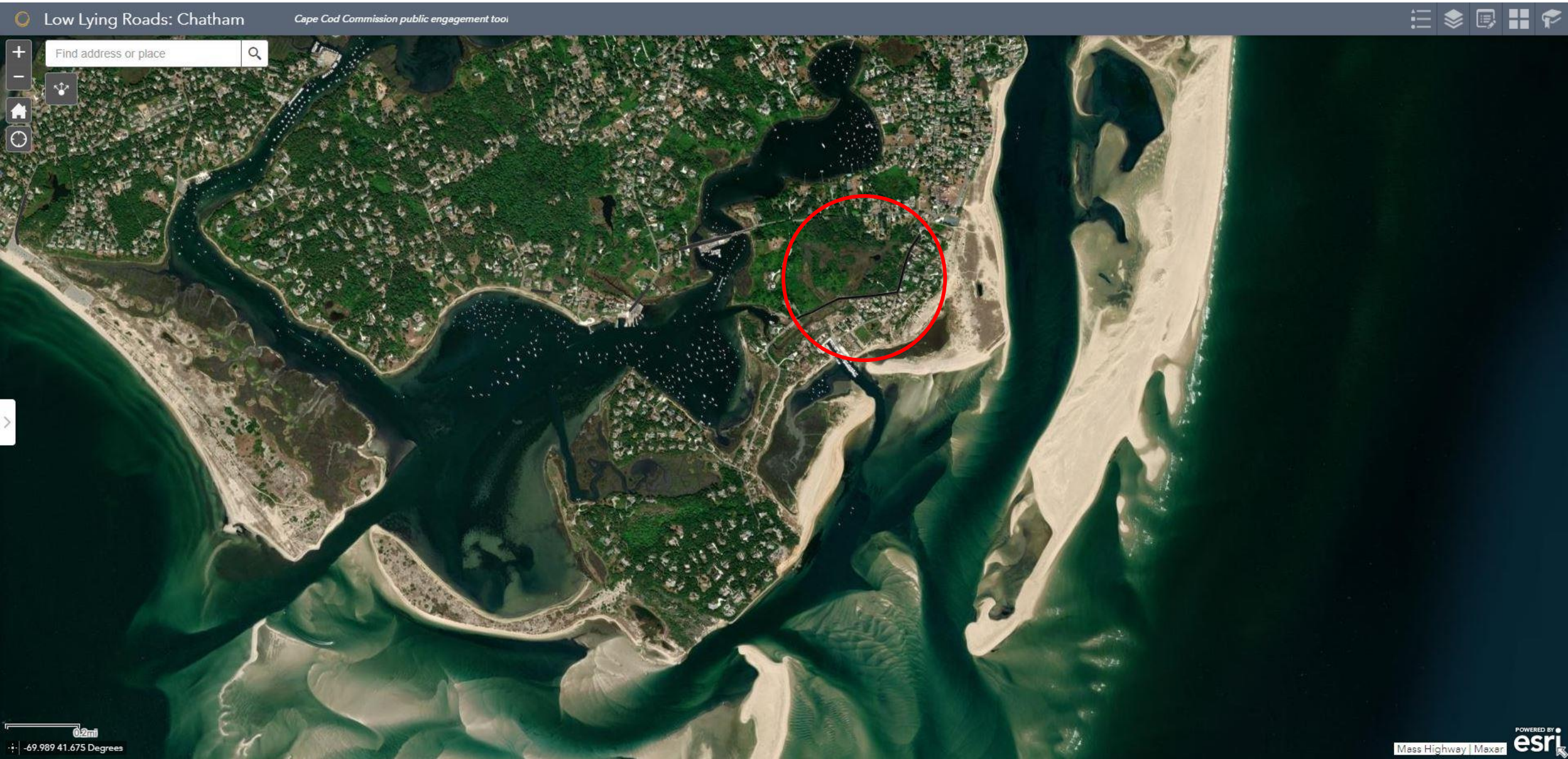
Summary of alternatives

	Description	Critical Elevation (NAVD88)	Annual Exceedance Probability			Vulnerable to Tidal Flooding†	Wetland Impacts	Impacts to Private Property	Estimated Cost*
			2030	2050	2070				
EXISTING	A segment of 18 foot wide road leading to a neighborhood and beach.	5.5 feet	100%	100%	100%	2070	N/A	N/A	N/A
ALTERNATIVE 1: GRAY	844 linear feet of town-owned road are elevated from a lowest point of +5.5' NAVD88 to a lowest point of +8.3' NAVD88 using 4:1 traditionally vegetated side slopes and sheet pile. The road slopes to meet the existing road elevation near Nantucket Drive.	8.3 feet	10%	20%	100%	No	Minimal	Moderate	$1,660,000
ALTERNATIVE 2: HYBRID	415 linear feet of town-owned road between Cranberry Lane and Ridgevale Rd S are elevated to +8.3' NAVD88 using 4:1 native vegetated side slopes and sheet pile. The culvert under the road is upsized. A 250 linear foot wall reaching elevation +8.3' NAVD88 is constructed on the eastern side of the road south of Ridgevale Road S. A road table ties the wall elevation in to a driveway and maintains access to the southernmost house on Ridgevale Road.	8.3 feet	10%	20%	100%	No	Possible benefits from larger culvert	Moderate	$1,440,000

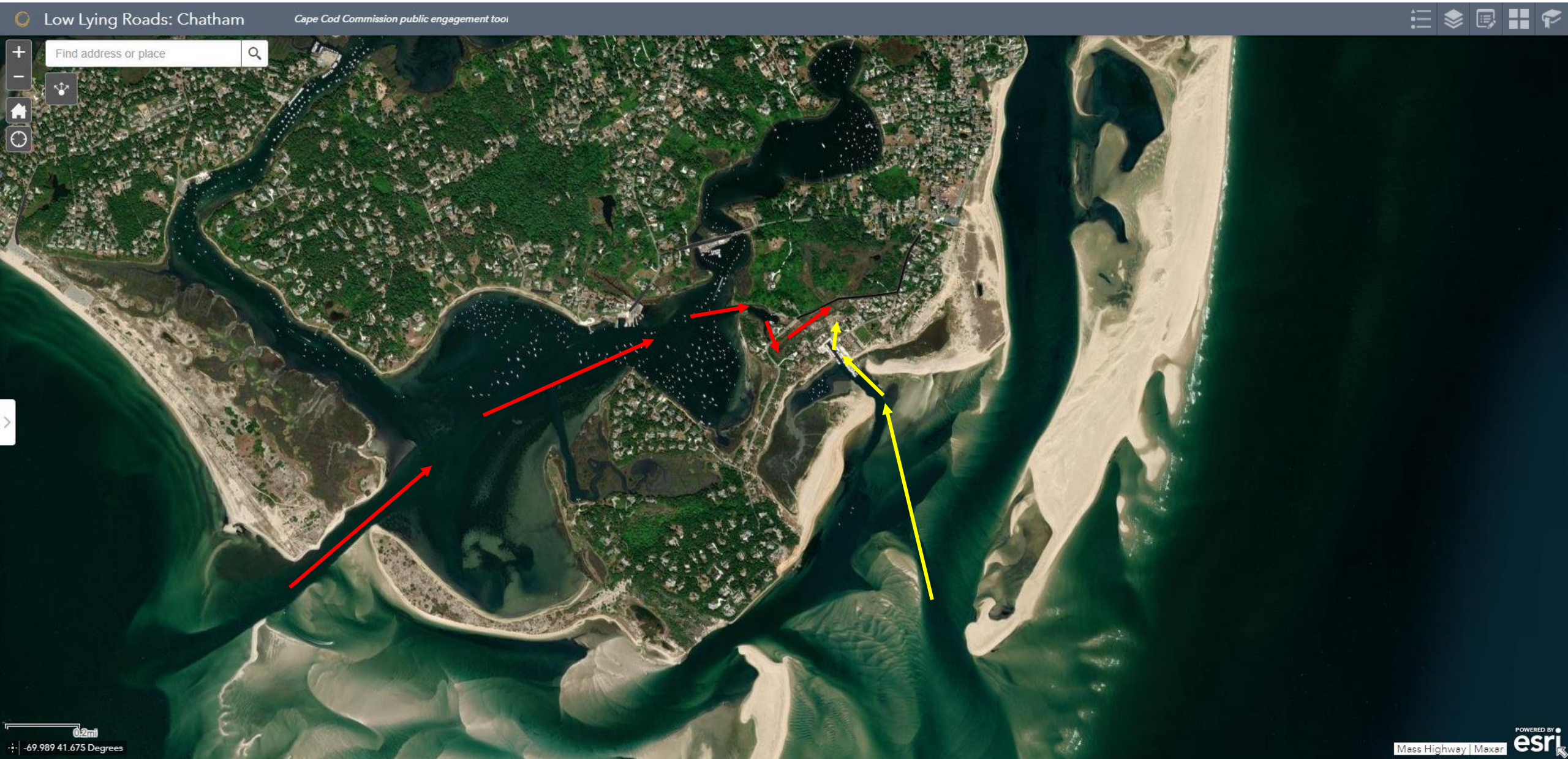
*2023 installed material cost +40% escalation (through 2029) and 15% contingency. Excludes design, permitting, mobilization, stormwater and wastewater infrastructure, and site controls. Costs based on experienced contractor opinion and MassDOT costing data.

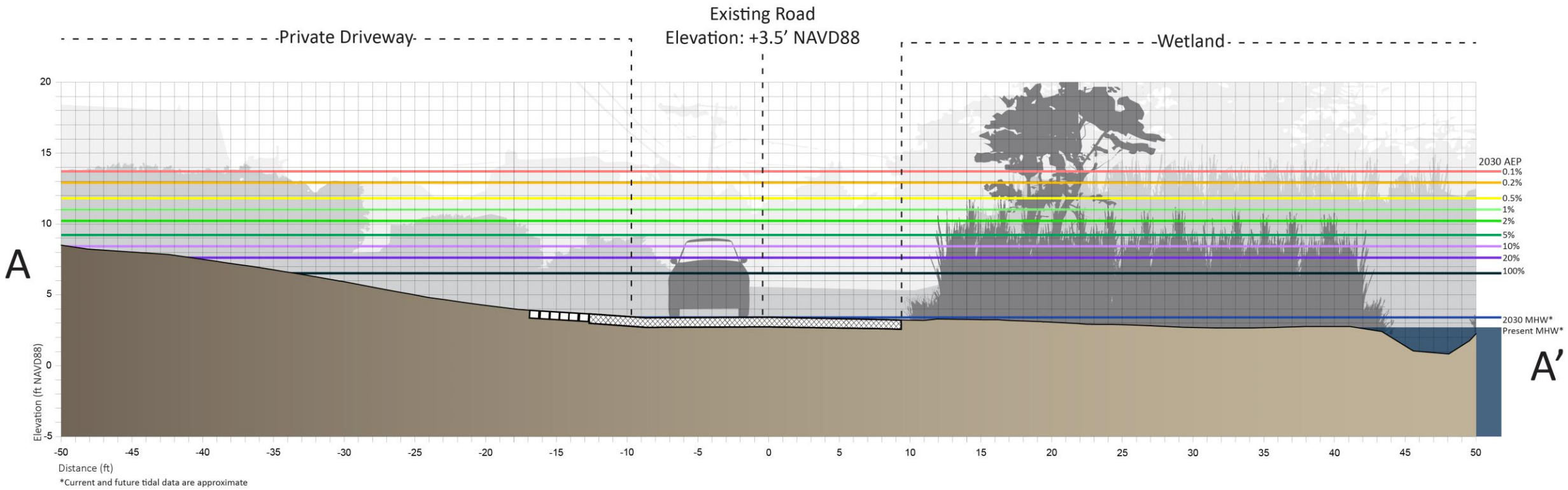
†Future tidal datums are approximate.

Morris Island Road



Morris Island Road





EXISTING CONDITIONS

Morris Island Road, Chatham

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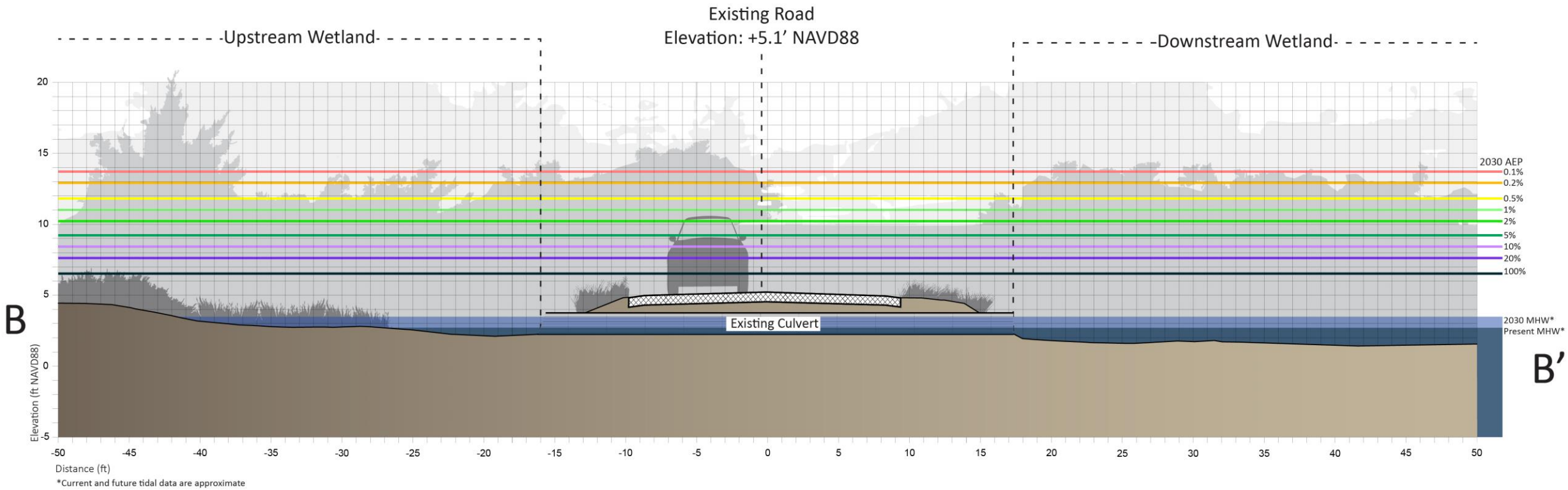

EXISTING CONDITIONS

Morris Island Road, Chatham

WOODS HOLE GROUP
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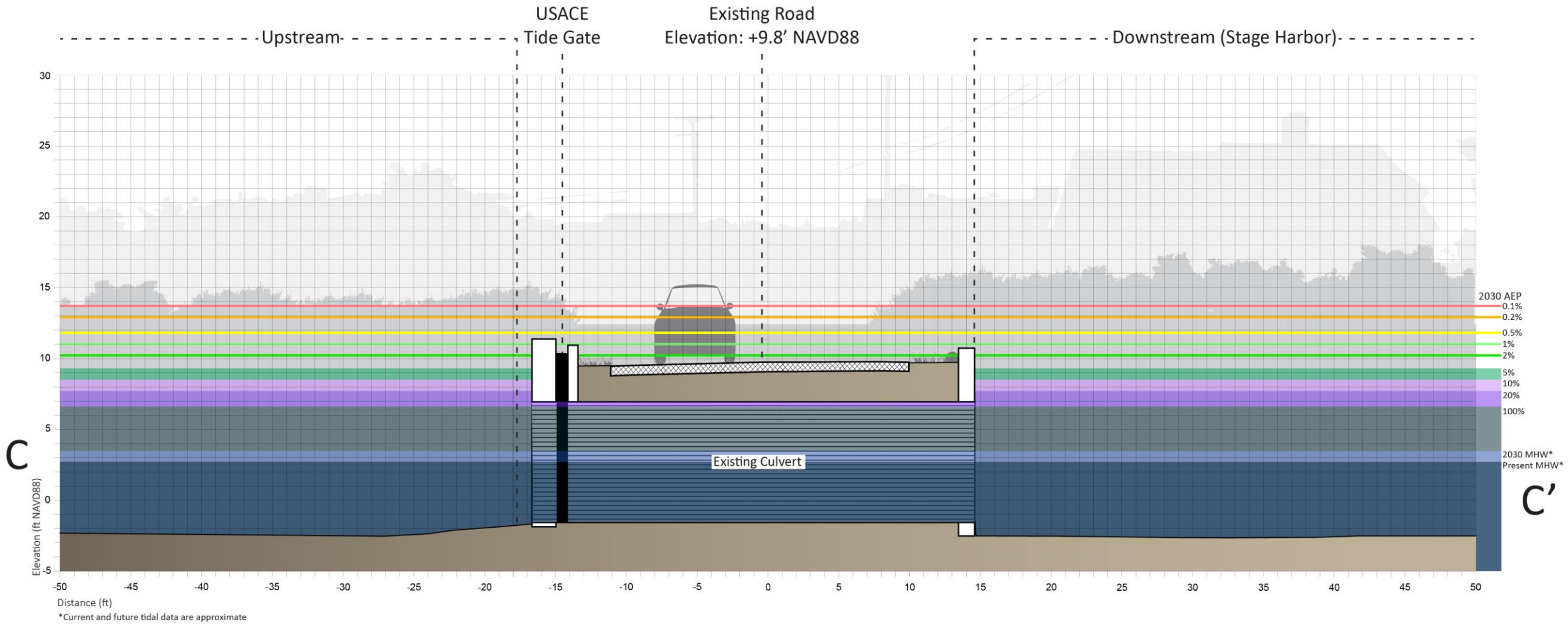

EXISTING CONDITIONS

Morris Island Road, Chatham

WOODS HOLE GROUP
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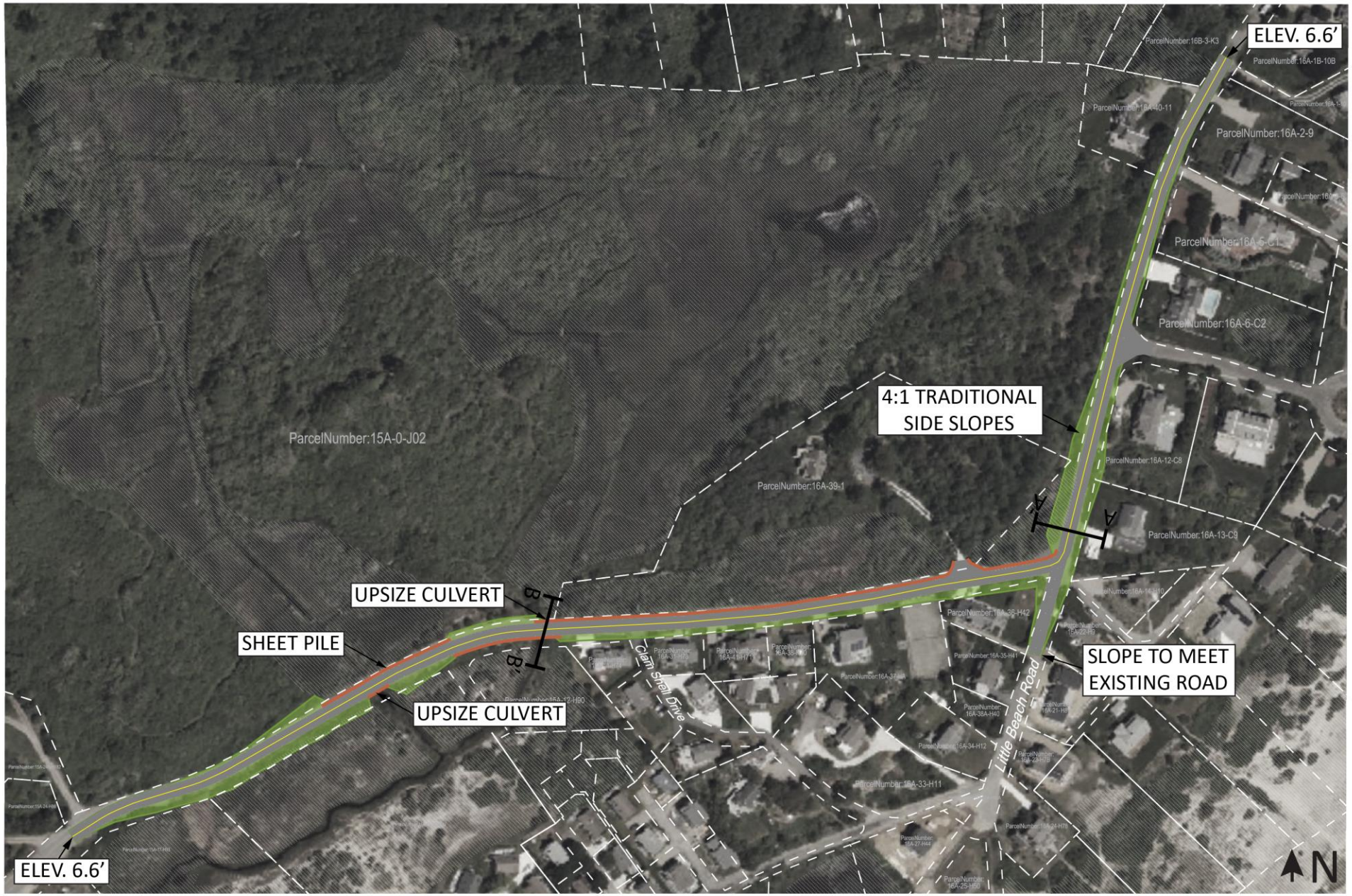

Note: Project overlap with wetland areas, rights of way and property lines is approximate and needs confirmation with a site survey

Morris Island Road
CHATHAM

ALTERNATIVE 1: GRAY

2,474 linear feet of town-owned road are elevated from a lowest point of +3.0’ NAVD88 to a lowest point of +6.6’ NAVD88 using 4:1 traditionally vegetated side slopes and sheet pile. Both small culverts under the road are upsized. Further modeling is needed to determine marsh and property impacts upstream. Sheet pile use may be reduced slightly if areas of salt marsh can be restored to compensate for filled wetlands.

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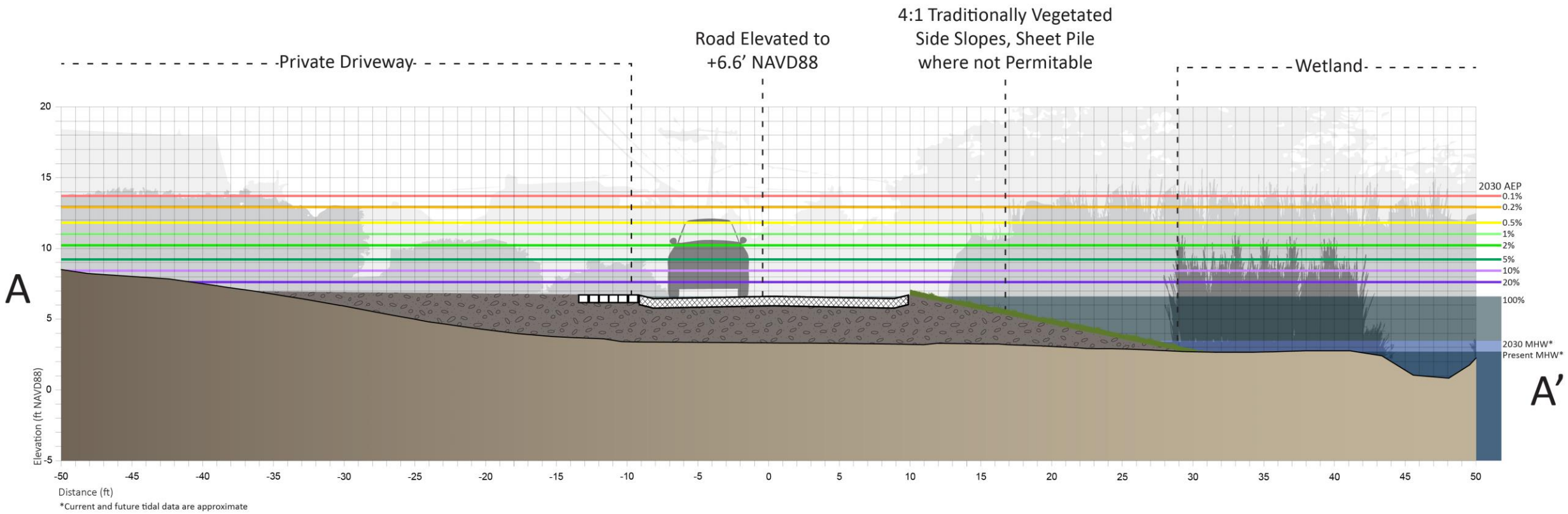

ALTERNATIVE 1: GRAY

Morris Island Road, Chatham

WOODS HOLE GROUP
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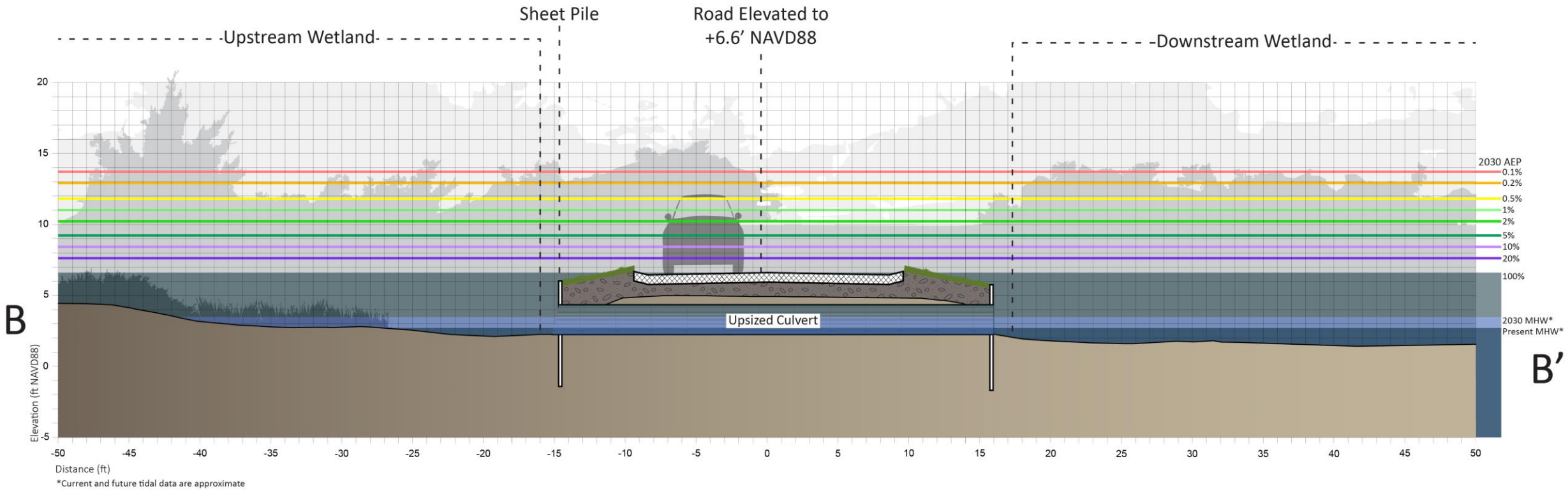

ALTERNATIVE 1: GRAY

Morris Island Road, Chatham

WOODS HOLE GROUP
A CLS COMPANY

Note: Project overlap with wetland areas, rights of way and property lines is approximate and needs confirmation with a site survey

Morris Island Road
CHATHAM

ALTERNATIVE 2: HYBRID A

Alternative 2 is based on previous coastal resilience work carried out by Horsley Witten Group and the Town of Chatham in Little Beach. In that proposal, a combination of dunes, seawalls, bulkhead elevation, and deployable barriers achieve an elevation of +8.8' NAVD88 on the ocean side. The bulkhead at Outermost Harbor is raised 1.5' in total. We propose replacing the aging culvert and tidal control to prevent flooding from Stage Harbor.

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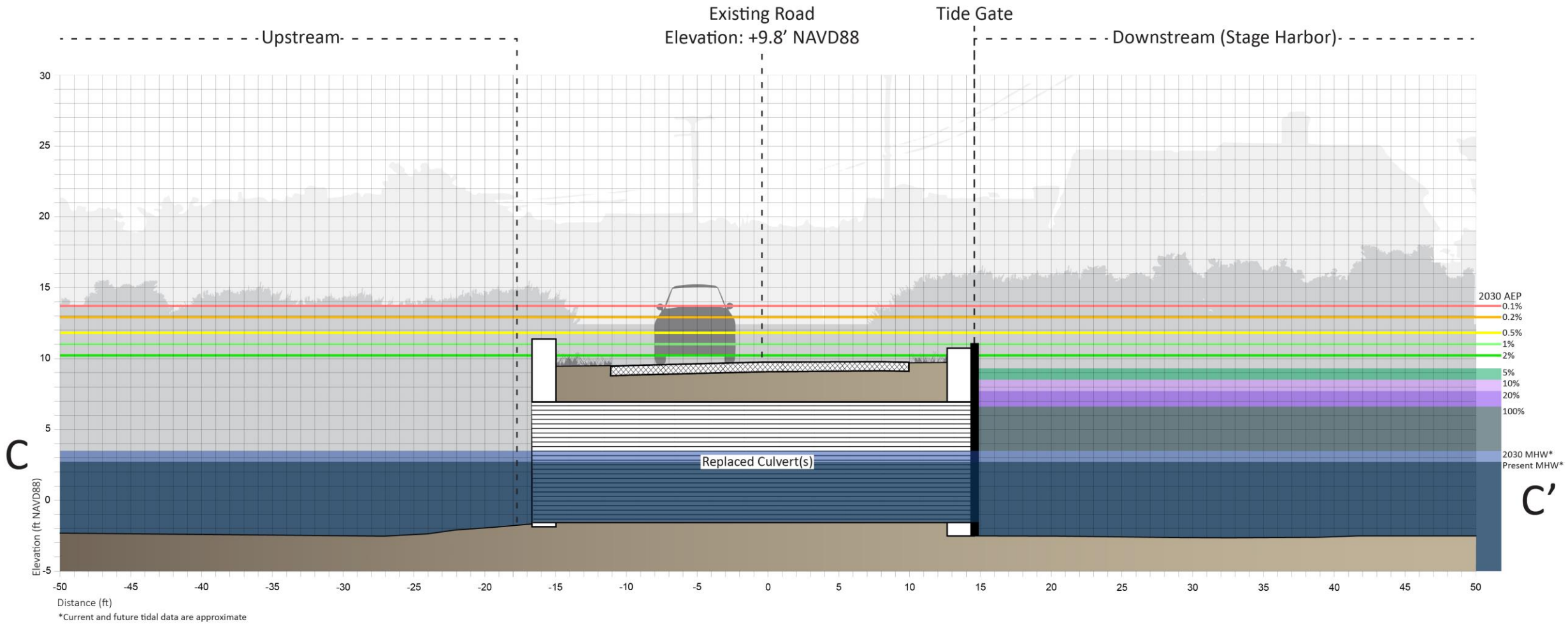

ALTERNATIVE 2: HYBRID A

Morris Island Road, Chatham

WOODS HOLE GROUP
A CLS COMPANY

Note: Project overlap with wetland areas, rights of way and property lines is approximate and needs confirmation with a site survey

Morris Island Road
CHATHAM

ALTERNATIVE 3: HYBRID B

Alternative 3 represents other options for work at Outermost Harbor and on the USACE culvert. A combination of dunes, concrete knee walls, and road tables achieve an elevation of +7.1' NAVD88 on the ocean side. A concrete knee wall to +7.1' NAVD88 is constructed on the southern side of Morris Island Road. The two small culverts are upsized and tide gates are added. Further modeling is needed to determine marsh and property impacts upstream. No proposed walls are taller than 3.5 feet.

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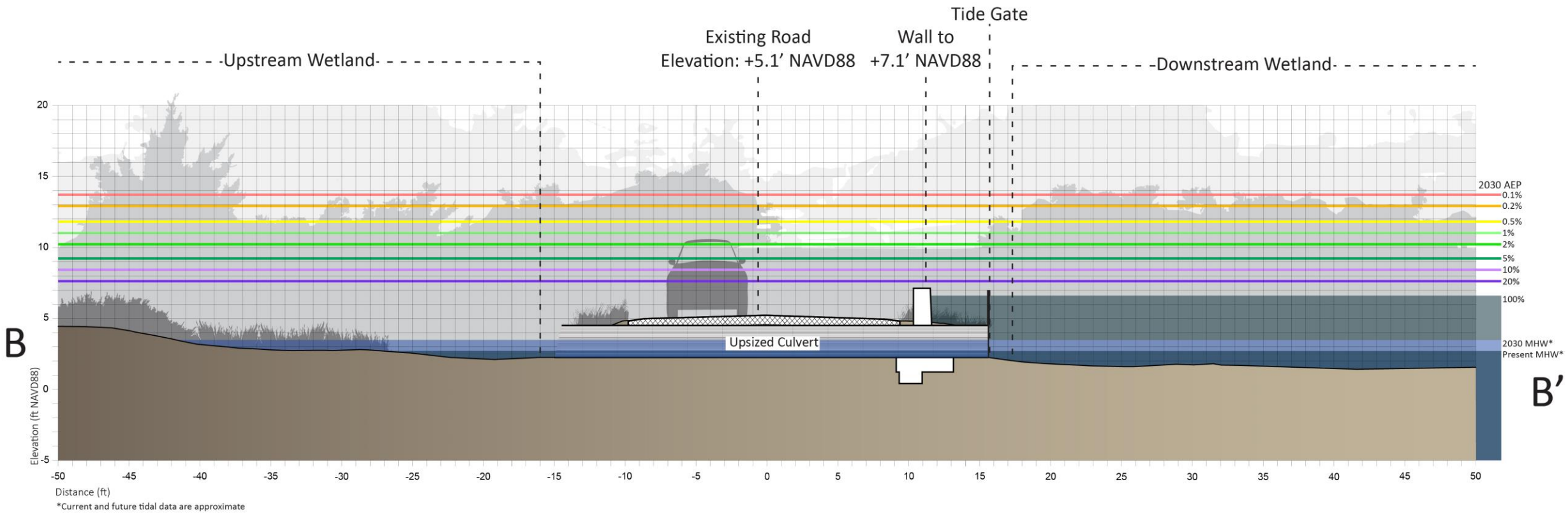

ALTERNATIVE 3: HYBRID B

Morris Island Road, Chatham

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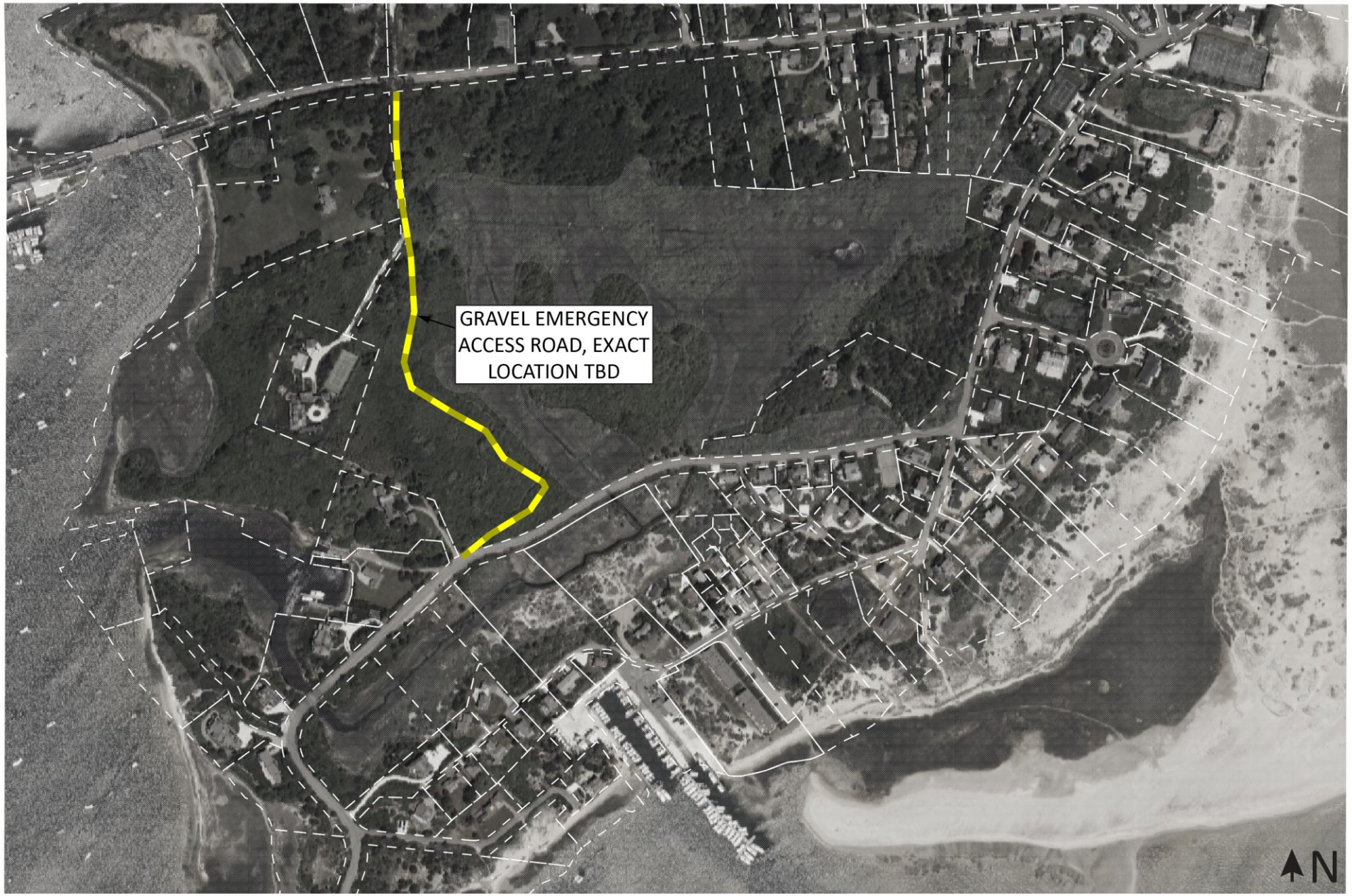


Note: Project overlap with wetland areas, rights of way and property lines is approximate and needs confirmation with a site survey

Morris Island Road
CHATHAM

ALTERNATIVE 4: EMERGENCY ROUTE

A gravel road from Morris Island Road to Bridge Street is constructed through existing conservation land to provide emergency access via high ground to Morris Island. The land is deed-restricted for conservation, so there are significant legal challenges. The road is routed to maintain an elevation above +8.8' NAVD88, avoid impact to wetlands, and use the existing right of way at Cotton Sedge Way. This matches the 2030 5% AEP vulnerability of the Morris Island Road causeway to the west.

WOODS HOLE GROUP
A CLS COMPANY

MORRIS ISLAND ROAD, CHATHAM

Summary of alternatives

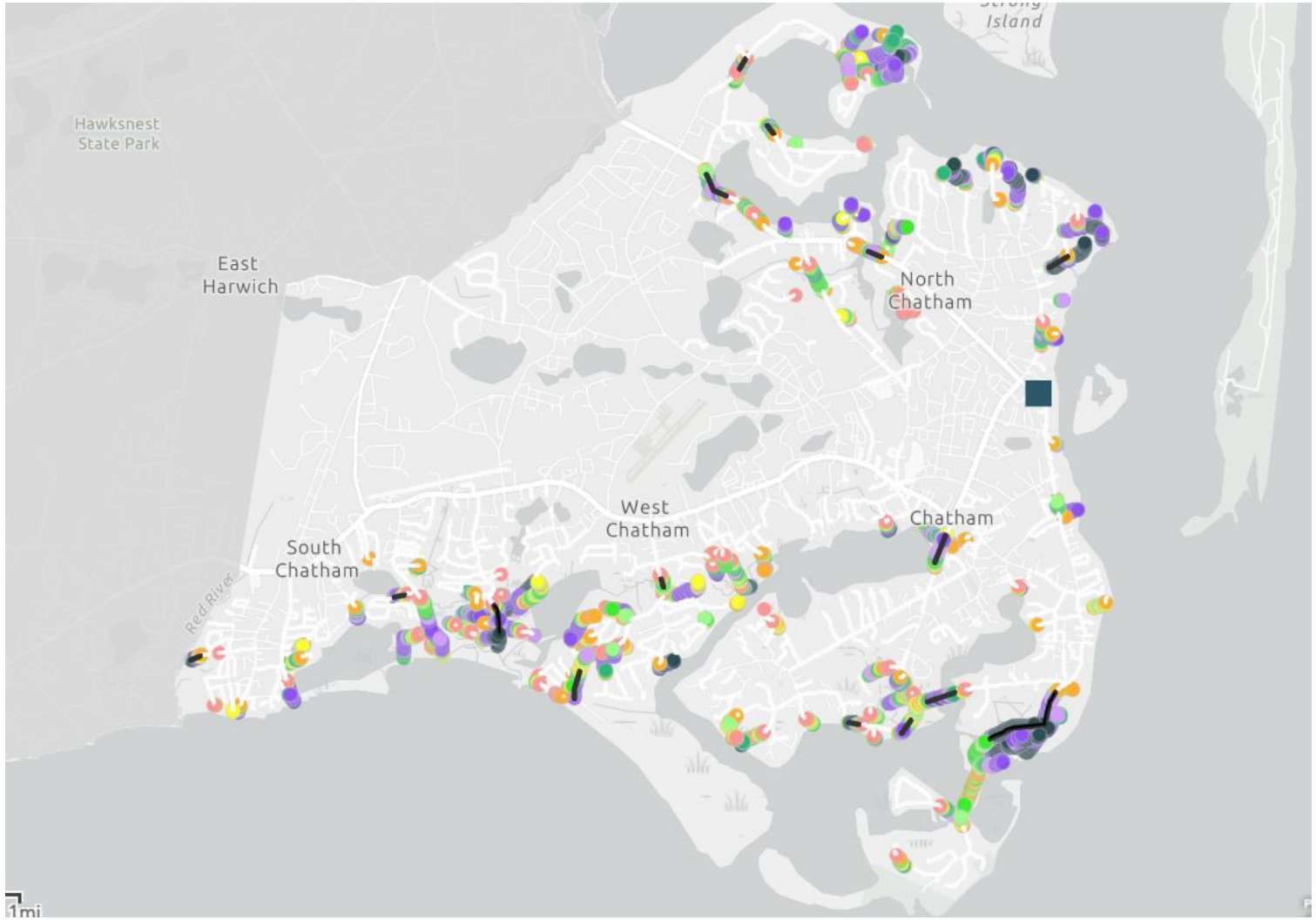
	Description	Critical Elevation (NAVD88)	Annual Exceedance Probability			Vulnerable to Tidal Flooding†	Permitability Concerns	Impacts to Private Property	Estimated Cost*
			2030	2050	2070				
EXISTING	A long stretch of town-owned road through neighborhood and marsh.	3.0 feet	100%	100%	100%	2030	N/A	N/A	N/A
ALTERNATIVE 1: GRAY	2,474 linear feet of town-owned road are elevated to +6.6' NAVD88 using 4:1 traditionally vegetated side slopes and sheet pile. The two small culverts under the road are upsized.	6.6 feet	20%	100%	100%	2070	Potential for wetland impacts	Moderate	$3,770,000
ALTERNATIVE 2: HYBRID A	A combination of dunes, seawalls, bulkhead elevation, and deployable barriers achieve an elevation of +8.8' NAVD88 on the ocean side. The aging culvert and defunct tidal control are replaced to prevent flooding from Stage Harbor.	8.8 feet	5%	20%	100%	2030	Resource area restoration	Moderate	$3,000,000
ALTERNATIVE 3: HYBRID B	A combination of dunes, concrete knee walls, and road tables achieve an elevation of +7.1' NAVD88 on the ocean side. A concrete wall to +7.1' NAVD88 is constructed on the south side of Morris Island Road. The two small culverts are upsized and tide gates are added.	7.1 feet	20%	100%	100%	2070	Resource area restoration	Minimal	$743,000

*2023 installed material cost +40% escalation (through 2029) and 15% contingency. Excludes design, permitting, mobilization, stormwater and wastewater infrastructure, and site controls. Costs based on experienced contractor opinion and MassDOT costing data.

†Future tidal data are approximate.

LOW LYING ROADS

Discussion



- **Ridgevale Road**
- **Morris Island Road**

NEXT STEPS

- Comments! Use form on project webpages
  https://www.capecodcommission.org/our-work/low-lying-roads-project/
- Town staff to determine which projects, designs
  - Review of community input
  - Engineering, permitting
- Identify funding

FUNDING OPPORTUNITIES

Federal Bipartisan Infrastructure Law (BIL)

Federal Highway Administration

- PROTECT – Competitive Resilience Improvement and Planning grants
- Culvert Aquatic Organism Passage Program - competitive grants for the replacement, removal, and repair of culverts or weirs that meaningfully improve or restore fish passage for anadromous fish

[NEW] PROTECT Grants (discretionary)

Purpose	Planning, resilience improvements, community resilience and evacuation routes, and at-risk coastal infrastructure
Funding	$1.4 B (FY 22-26) in Contract Authority from the HTF
Eligible entities	• State (or political subdivision of a State) • MPO • Local government • Special purpose district or public authority with a transportation function • Indian Tribe • Federal land management agency (applying jointly with State(s)) • *Different eligibilities apply for at-risk coastal infrastructure grants*
Eligible projects	• Highway, transit, intercity passenger rail, and port facilities • Resilience planning activities, including resilience improvement plans, evacuation planning and preparation, and capacity-building • Construction activities (oriented toward resilience) • Construction of (or improvement to) evacuation routes
Other key provisions	• Higher Federal share if the eligible entity develops a resilience improvement plan (or is in a State or area served by MPO that does) and the State or MPO incorporates it into its long-range transportation plan • May only use up to 40% of the grant for construction of new capacity

FUNDING OPPORTUNITIES

Nature Based Solutions, Ecological Restoration, Culverts

- FEMA Building Resilient Infrastructure and Communities (BRIC)
- National Coastal Resiliency Fund (NCRF) through National Fish and Wildlife Fund
- Natural Resources Conservation Service (NRCS) through the Cape Cod Conservation District
- Municipal Vulnerability Preparedness Program (MVP)
- Division of Ecological Restoration (DER) Culvert Replacement Municipal Assistance Grant Program

Thank you!

CAPE COD
COMMISSION