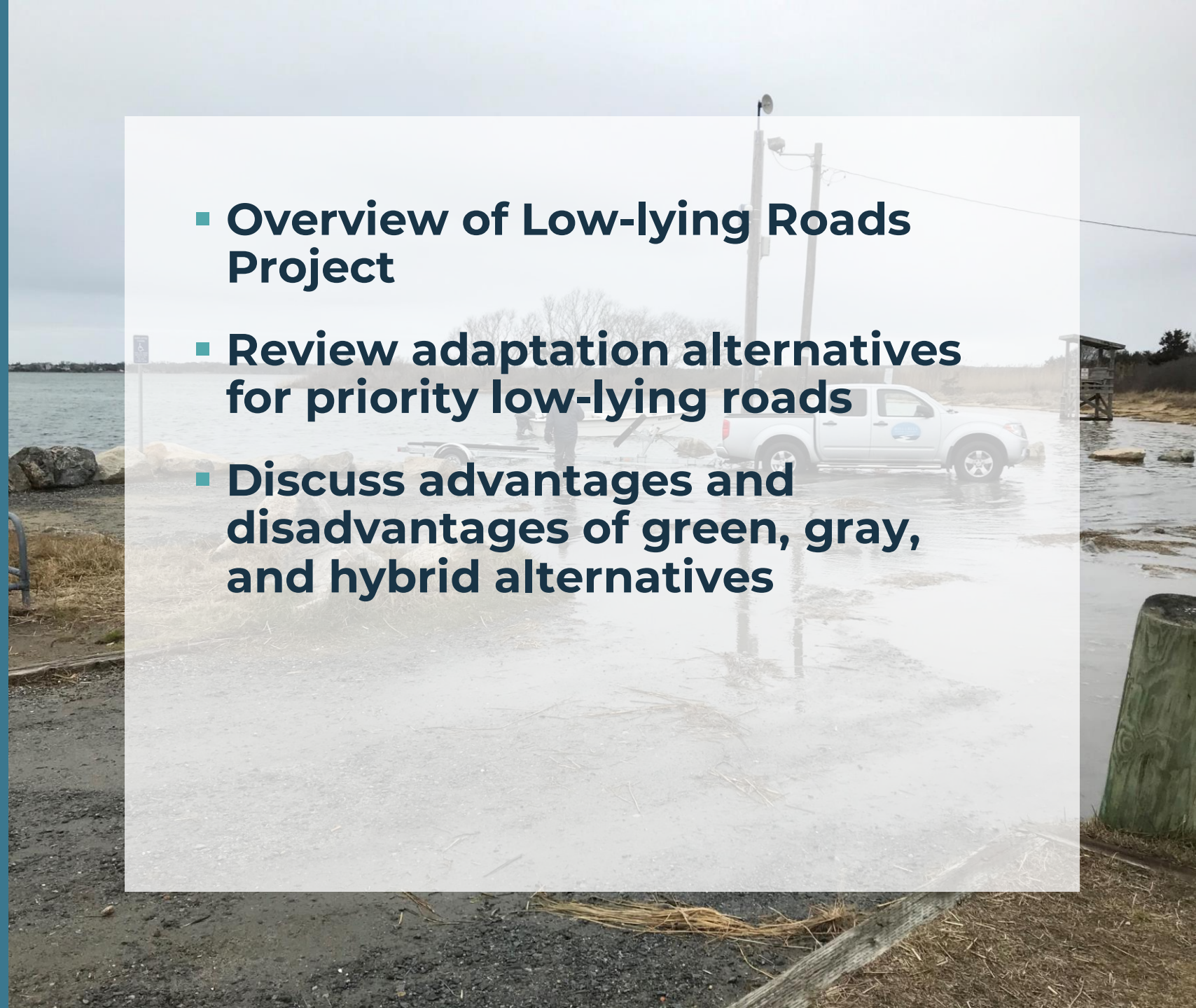
Low-lying Roads: Harwich

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
  - North Road
  - Bay Road at Route 28
- 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

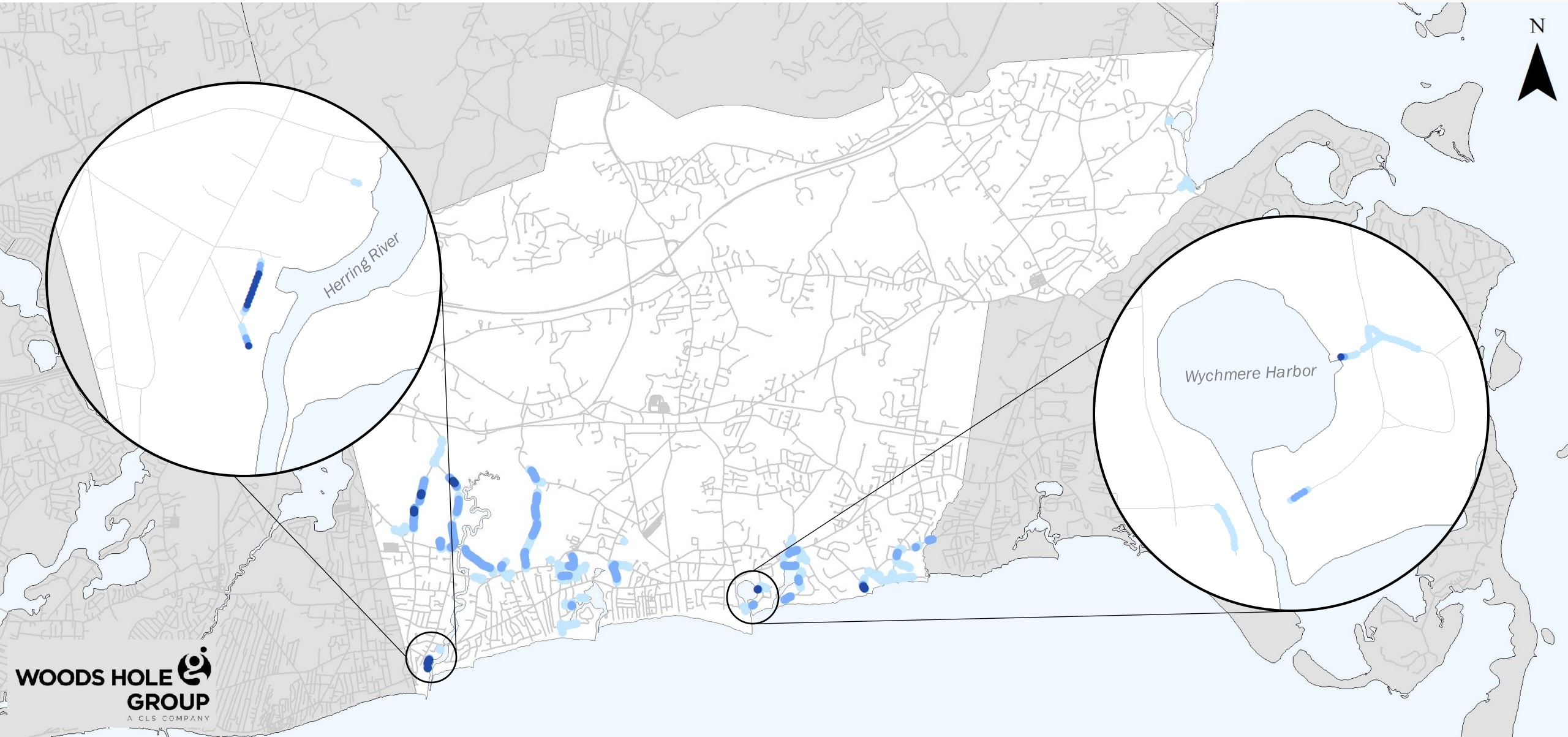
PROJECT TIMELINE & ELEMENTS

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/
- **Clarifying questions**
- **Format for meeting**

Low Lying Roads Nuisance Flooding

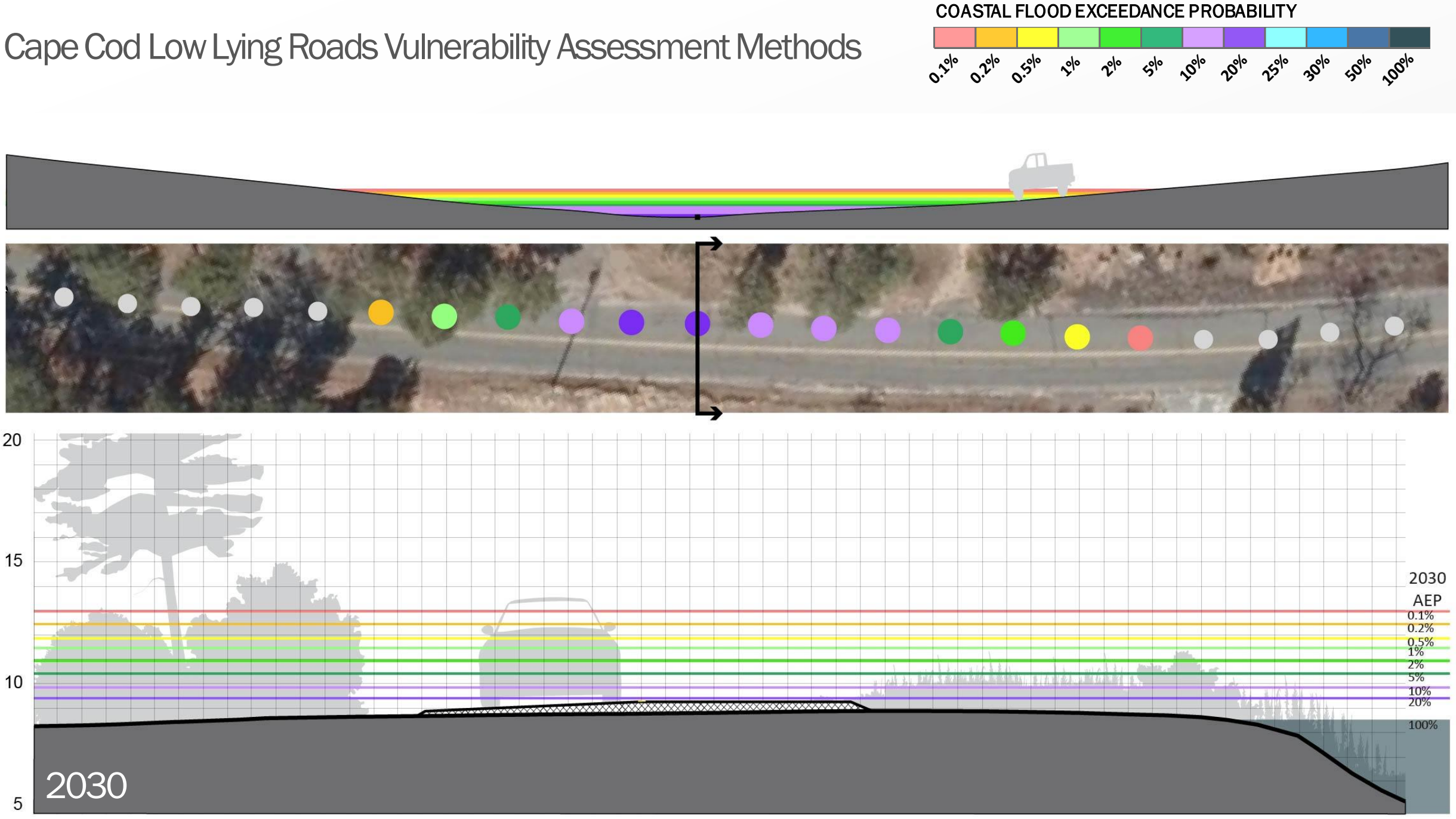


Cape Cod Low Lying Roads Vulnerability Assessment Methods

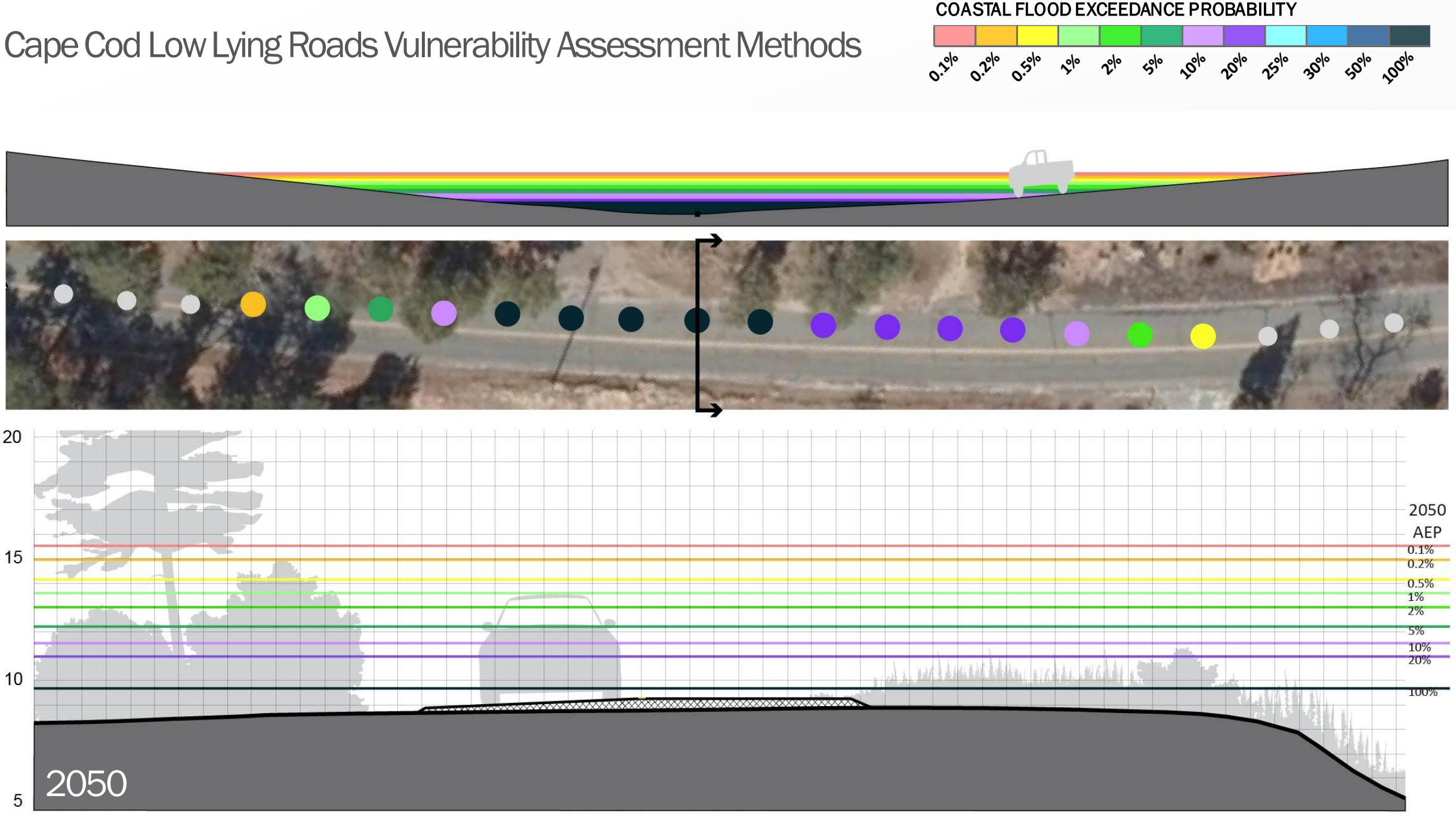
COASTAL FLOOD EXCEEDANCE PROBABILITY

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

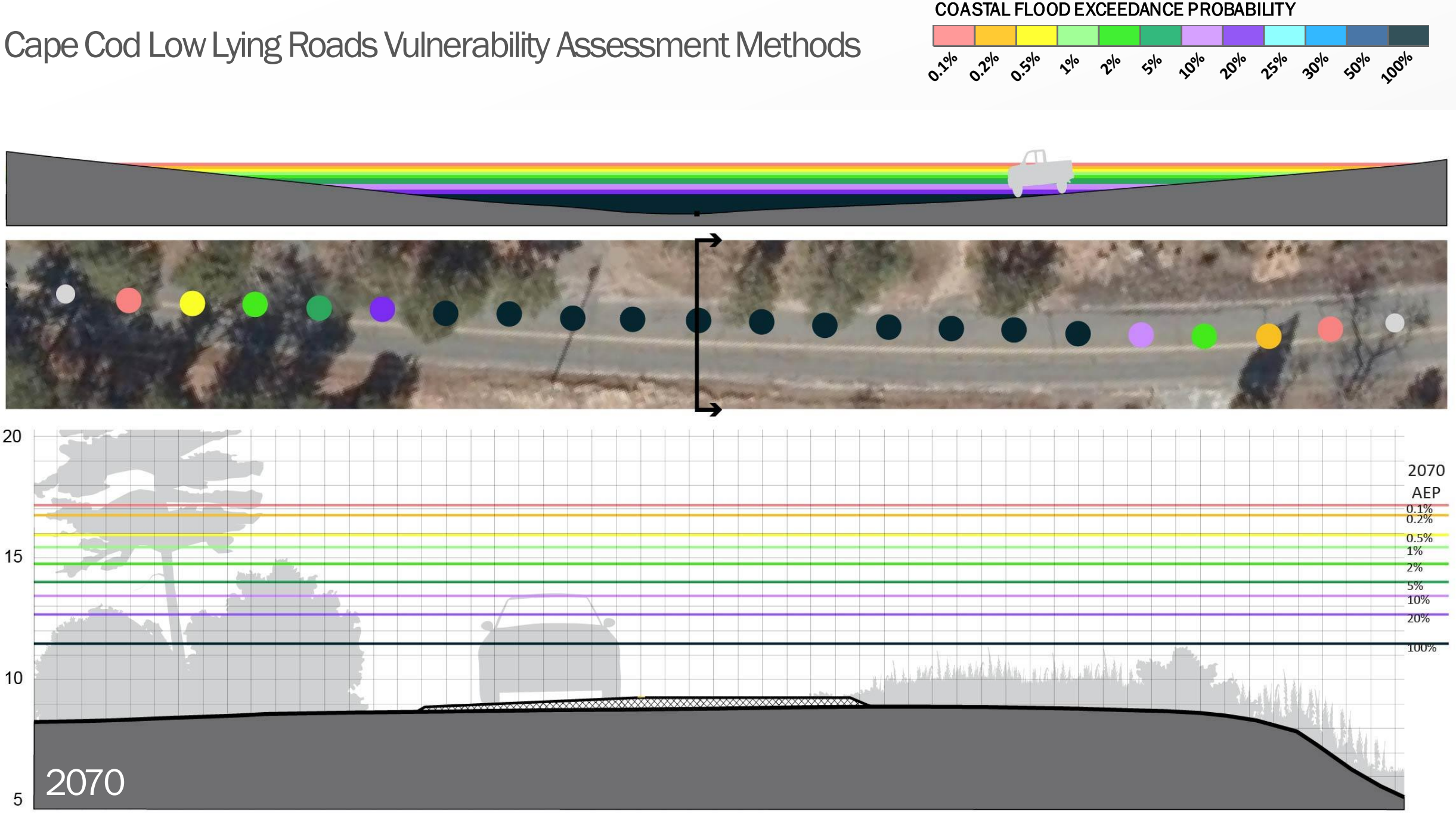
Cape Cod Low Lying Roads Vulnerability Assessment Methods



Cape Cod Low Lying Roads Vulnerability Assessment Methods

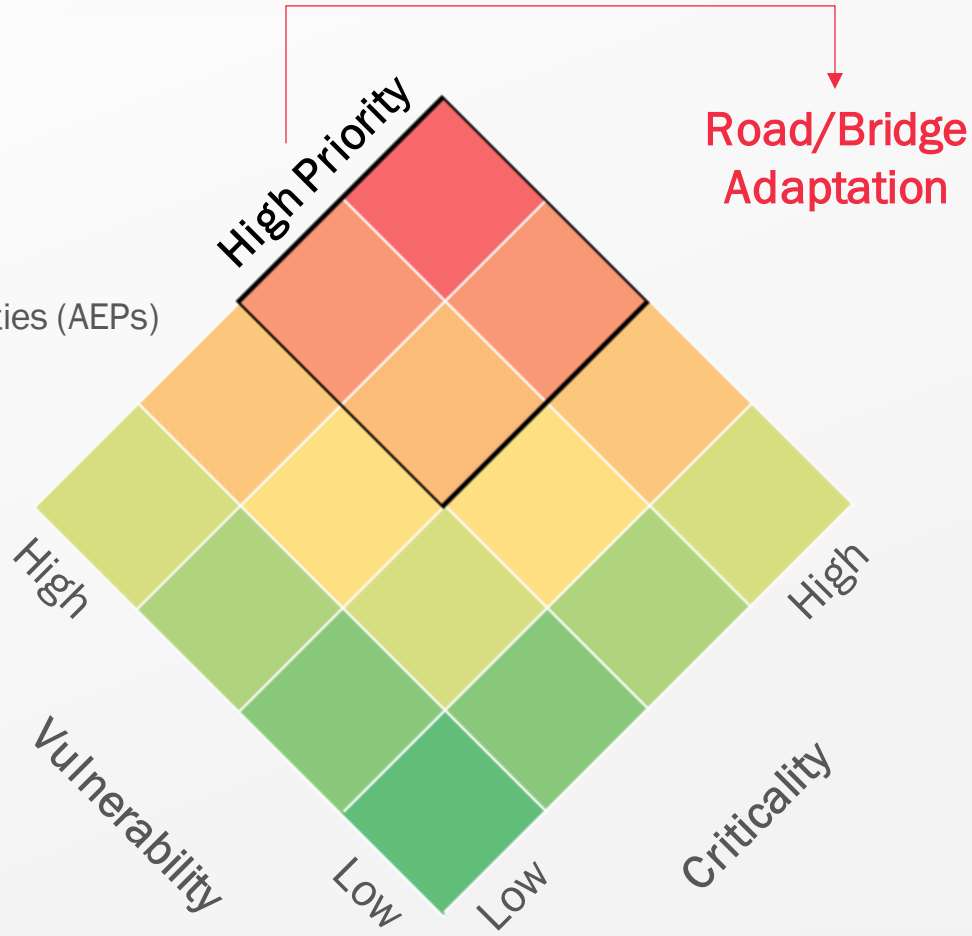


Cape Cod Low Lying Roads Vulnerability Assessment Methods

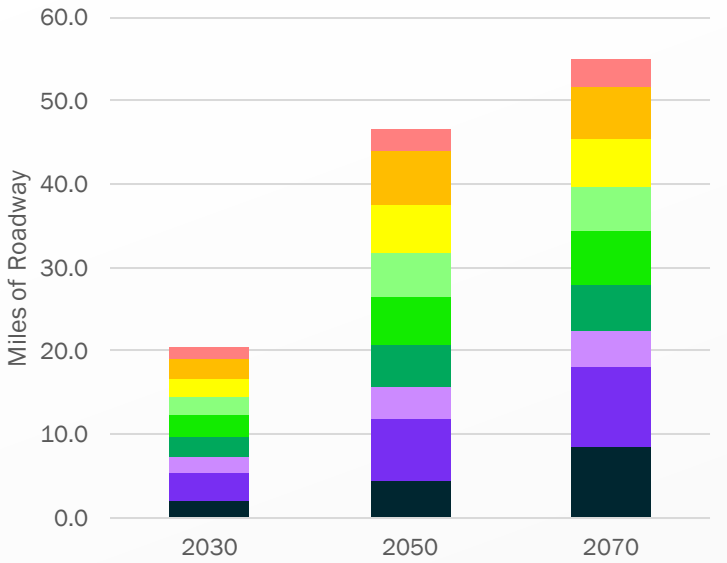


Cape Cod Low Lying Roads Risk Assessment Approach

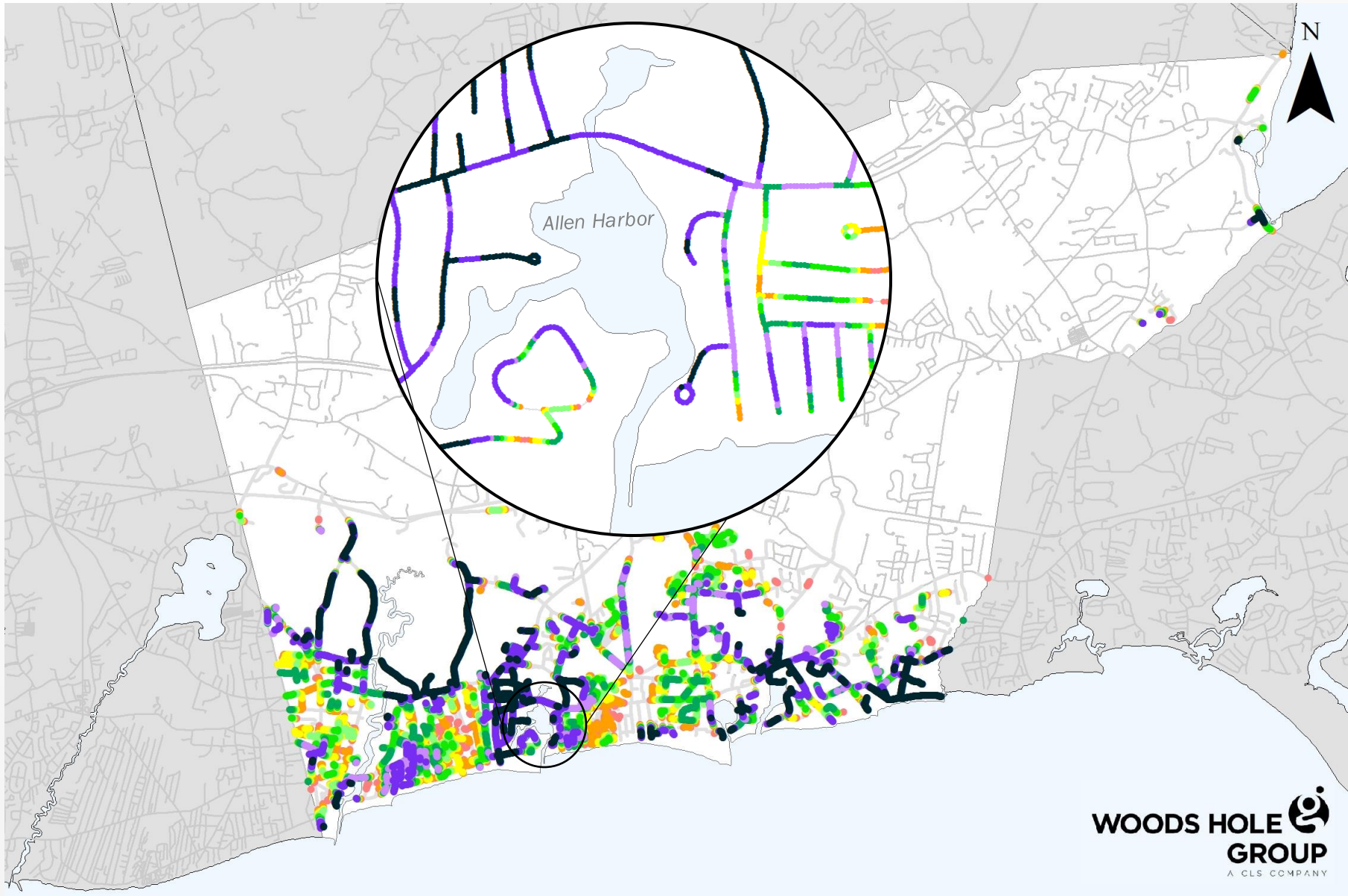
1. Extract roadway/bridge critical elevations (CEs)
   - From LiDAR at 20m interval along surface
2. Compile 2030/2050/2070 MC-FRM water surface elevations (WSEs)
   - 0.1%, 0.2%, 0.5%, 1%, 2%, 5%, 10%, 20%, 100% Annual Exceedance Probabilities (AEPs)
3. Compare CEs to WSEs to determine vulnerability
   - 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



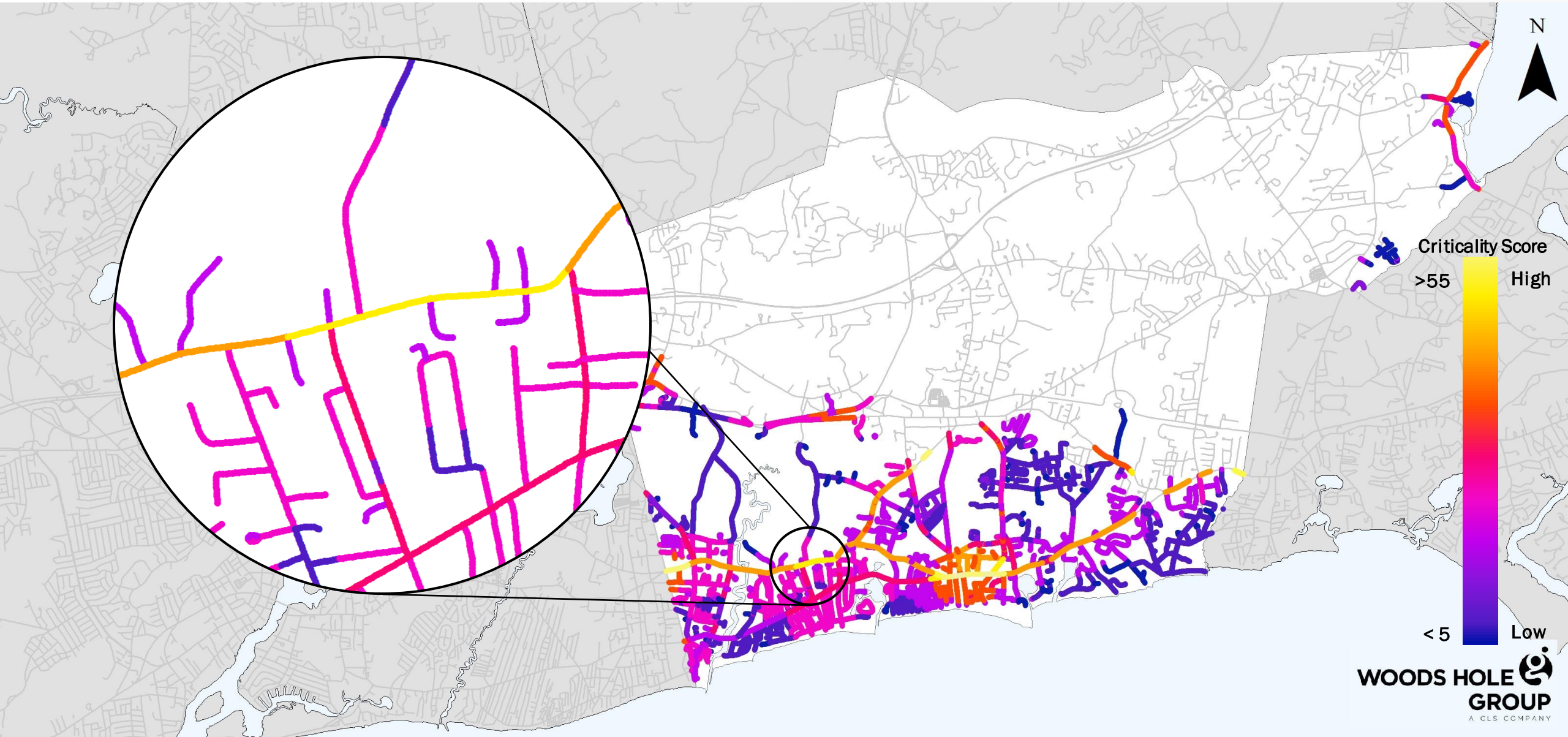
Low Lying Roads 2070 Flood Probability (Annual Exceedance Probability)



Flood Probability	Total Road Miles
0.1%	55.1
0.2%	51.7
0.5%	45.3
1%	39.5
2%	34.3
5%	27.8
10%	22.4
20%	18.1
100%	8.3

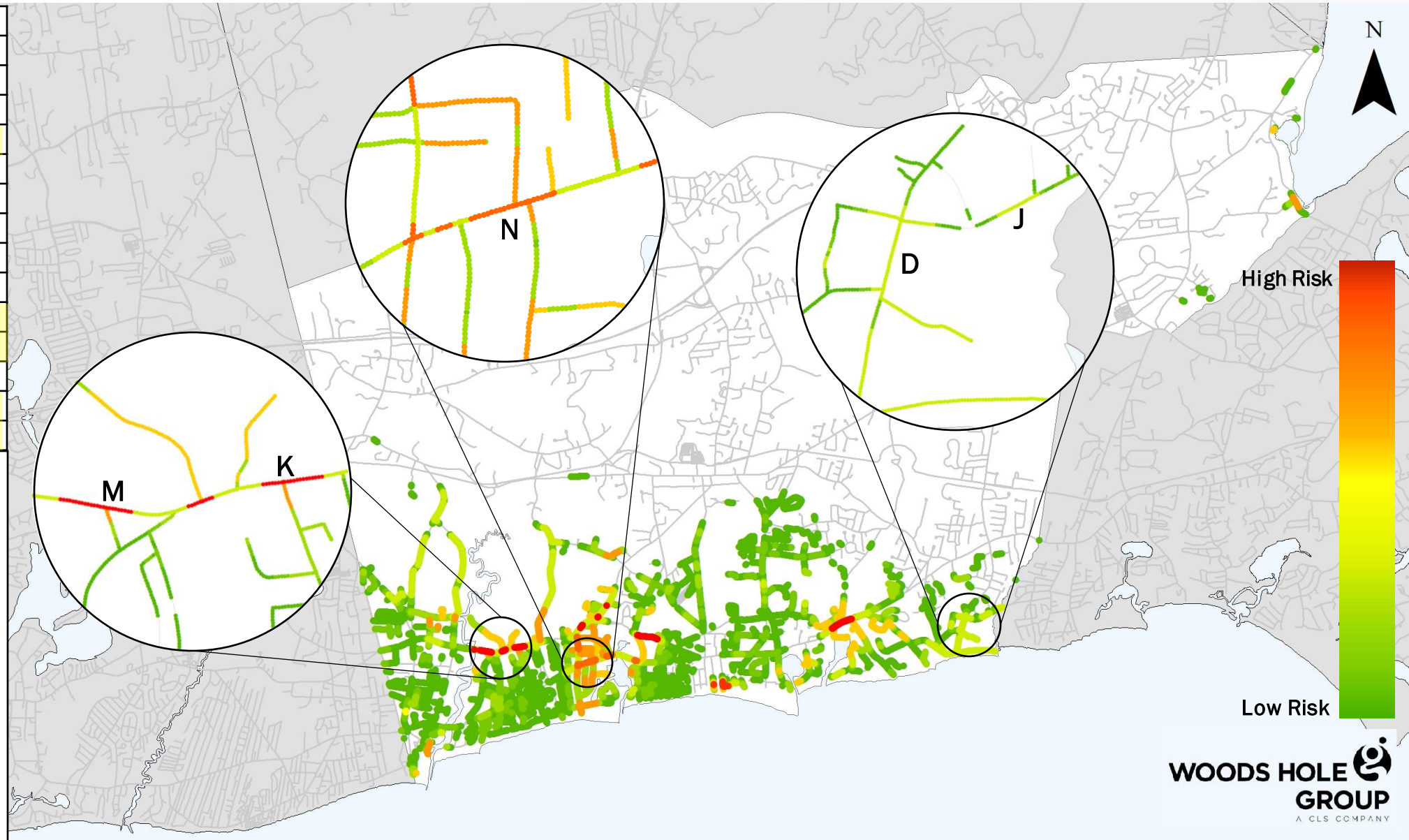


Low Lying Roads Criticality Scoring



Low Lying Roads 2070 Risk Results

	High Risk Road Segments
A	Rte 28 at Gorham Rd
B	Rte 28 at Kildee Rd
C	Kildee Road
D	Uncle Venies Road
E	Rte 28 at Bay Rd
F	Harbor Way
G	North Rd at Smith St
H	Brooks Rd
I	Neel Road
J	South Chatham Rd
K	Rte 28 at Grey Neck Rd
L	Rte 28 at Brooks Rd
M	Rte 28 at River Rd
N	Lower County Rd at Wequasset 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	Rte 28 at Gorham Rd*	1700	Main St between Squatucket Harbor and Neel Rd, w/ Andrews River crossing	100	40	4000	0	220	1360
B	Rte 28 at Kildee Rd*	940	Main St between Doane Rd and Seaport Ln, w/ Doanes Creek crossing	100	37	3700	0	20	680
C	Kildee Road	1020	between Lower County Rd and Main St, w/ Doanes Creek crossing	100	19	1900	0	560	800
D	Uncle Venies Road	900	between Bob White Ln and South Chatham Rd	100	10	1000	0	180	400
E	Rte 28 at Bay Rd*	660	Head of the Bay Rd at Jackknife Cove	20	20	400	0	0	440
F	Harbor Way	180	to landing at Wixon Dock on Herring River	100	20	2000	20	60	120
G	North Rd at Smith St	1480	southern segment along Herring River	100	8	800	0	1100	1320
H	Brooks Rd	460	intersection with Dunes Rd	20	20	400	0	0	440
I	Neel Road	1060	between Main St and Geraldine Ave	20	19	380	0	0	360
J	South Chatham Rd‡	1000	between Brettwood Rd and Chatham line, w/ Red River crossing	100	9	900	0	200	440
K	Rte 28 at Grey Neck Rd*	760	Main St between Grey Neck Rd and Earle Rd	10	38	380	0	0	320
L	Rte 28 at Brooks Rd*	540	Main St at intersection w/ Brooks Rd	20	38	760	0	0	0
M	Rte 28 at River Rd*	560	Main St between Chase St and Herring River bridge	20	38	760	0	0	400
N	Lower County Rd at Wequasset Rd	900	between Brooks Rd and Wequasset Rd	20	30	600	0	0	0

‡Segment also listed for Chatham
*MassDOT roadway

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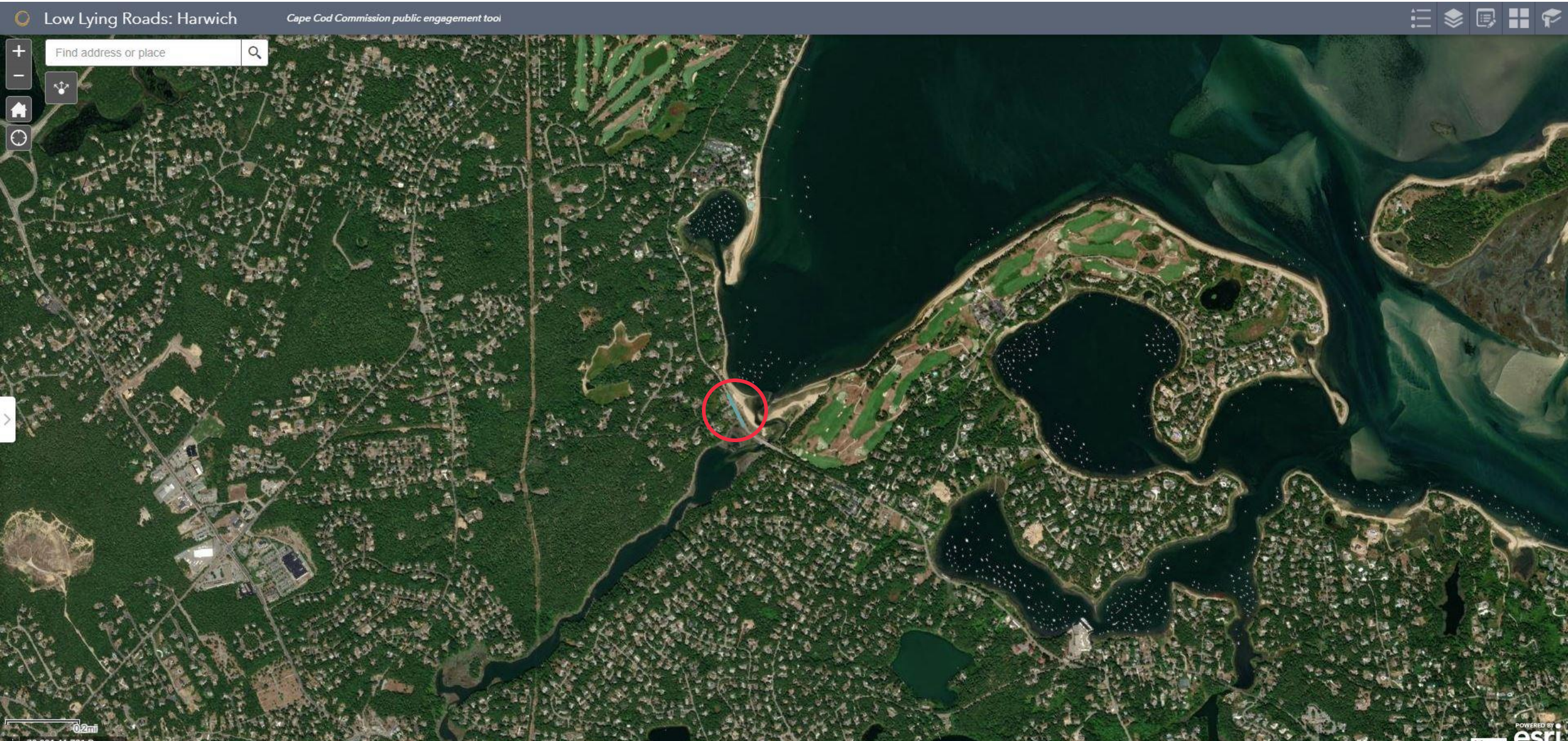
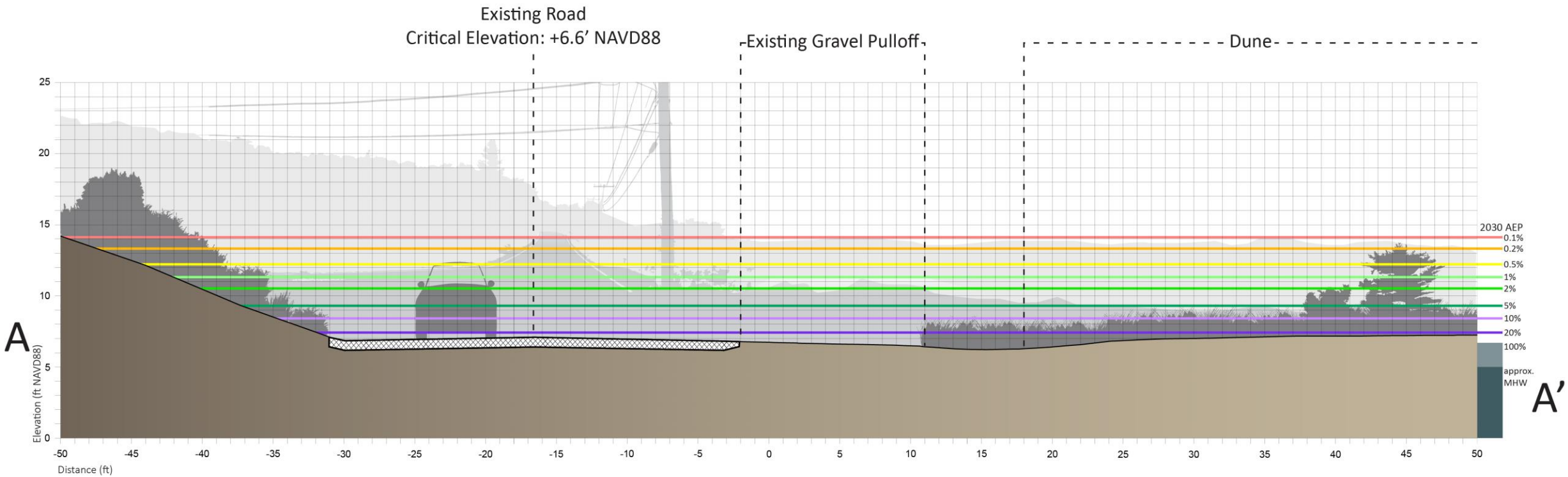
Route 28 at Bay Road





EXISTING CONDITIONS

Route 28 at Bay Road, Harwich

WOODS HOLE GROUP
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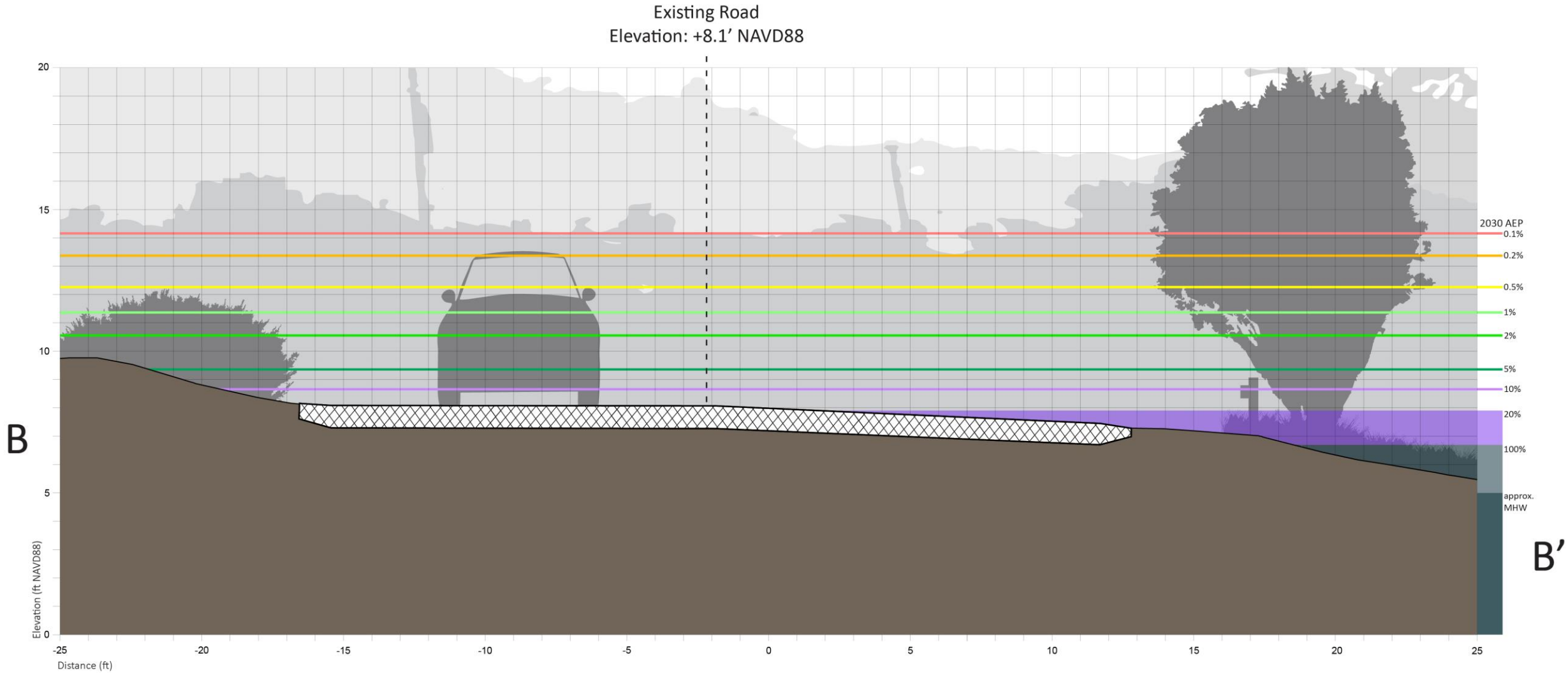

EXISTING CONDITIONS

Route 28 at Bay Road, Harwich

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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

Bay Road at Route 28
HARWICH

ALTERNATIVE 1: GRAY

577 linear feet of state-owned road are elevated to 9.5' NAVD88 using 4:1 traditionally vegetated side slopes and sheet pile. There is the possibility to maintain existing parking and access via ramps. The road is raised by 2.9' at its original low point, which is located near section A-A'.

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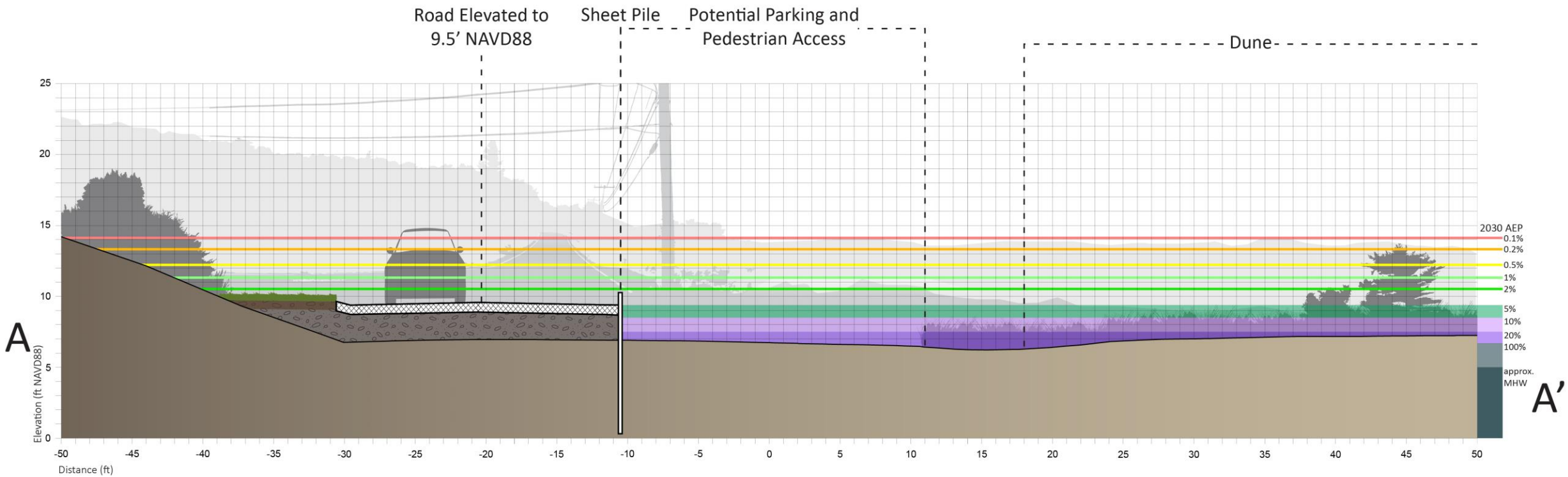

ALTERNATIVE 1: GRAY

Route 28 at Bay Road, Harwich

WOODS HOLE GROUP
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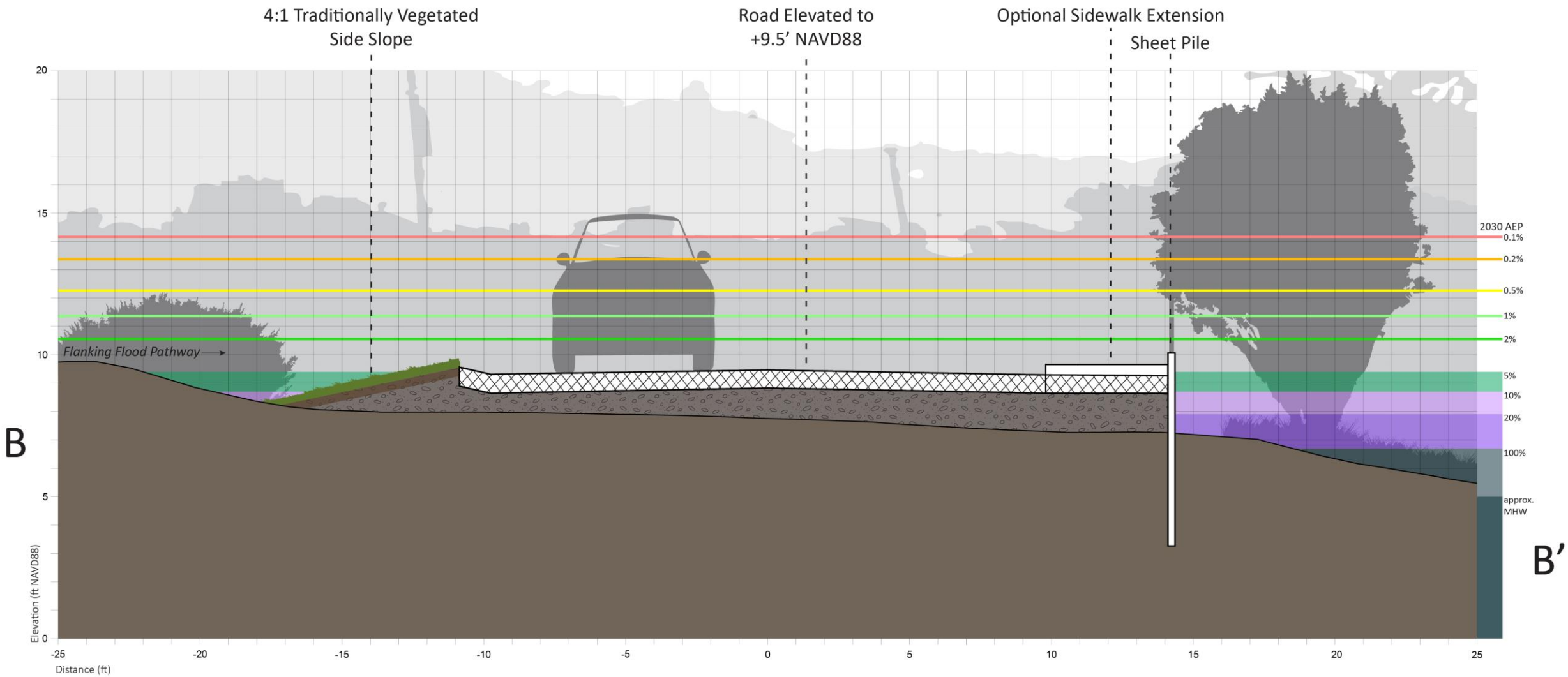

ALTERNATIVE 1: GRAY

Route 28 at Bay Road, Harwich

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

Bay Road at Route 28
HARWICH

ALTERNATIVE 2: DEPLOYABLE

Approximately 600 linear feet of 48" temporary barriers are deployed on the bay side of the road before storms, protecting the road to 10.0' NAVD88. A small flood wall to 10.0' NAVD88 cuts off a flanking flood pathway from Muddy Creek.

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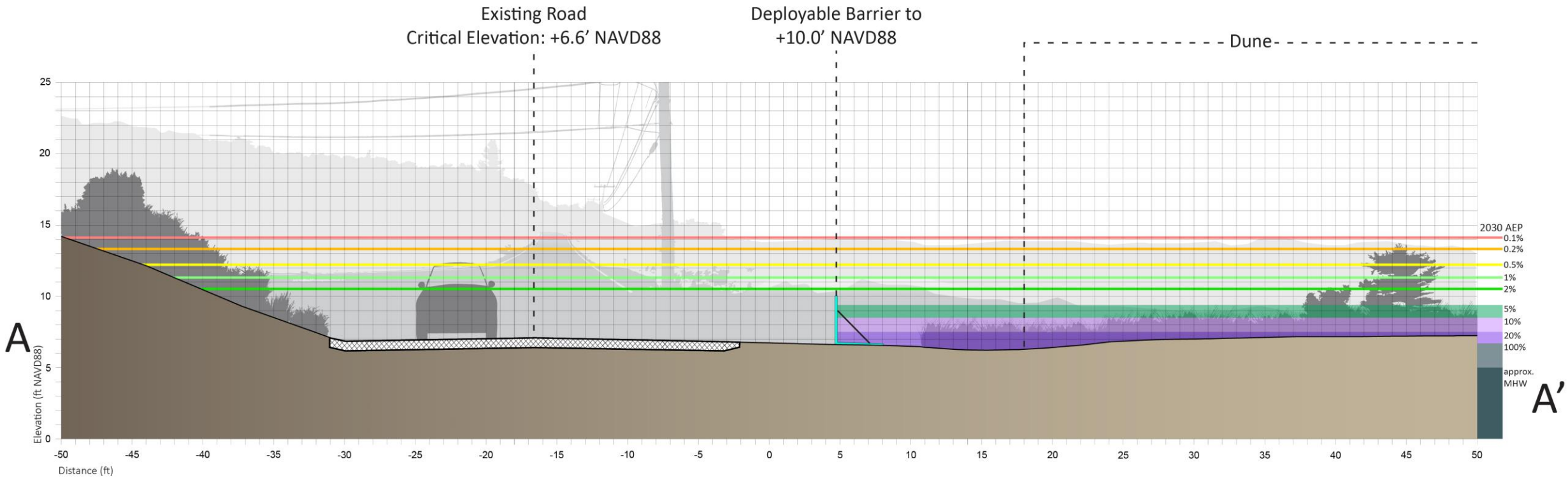
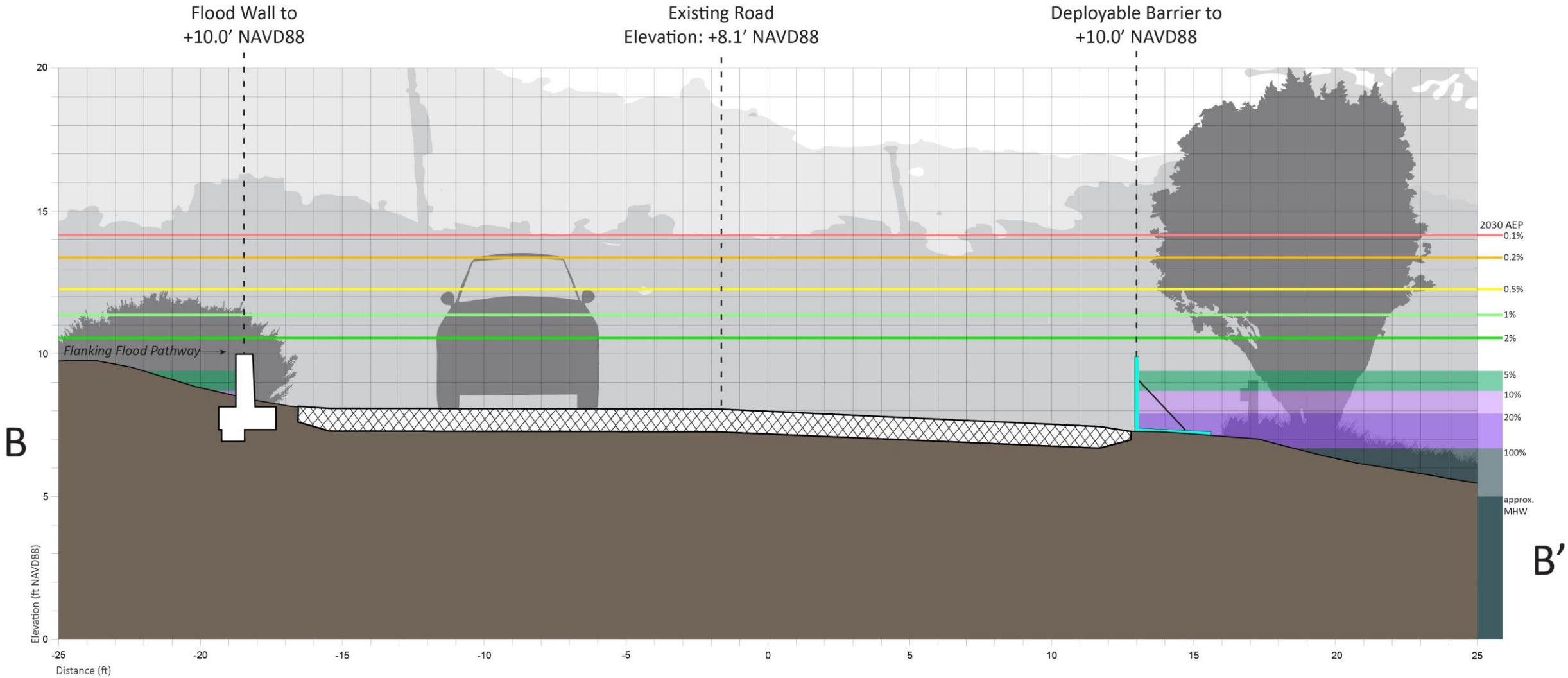


ALTERNATIVE 2: DEPLOYABLE

Route 28 at Bay Road, Harwich

WOODS HOLE GROUP
A CLS COMPANY



ALTERNATIVE 2: DEPLOYABLE

Route 28 at Bay Road, Harwich

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

Bay Road at Route 28
HARWICH

ALTERNATIVE 3: GREEN

A dune restoration to 9.5’ NAVD88 protects the road from bayside flooding. Mobi-mats are placed to prevent dune erosion and improve accessibility. A small flood wall and berm to 9.5’ NAVD88 prevents flanking flooding from Muddy River. An artificial reef array in Pleasant Bay could be investigated to mitigate wave damage and erosion.

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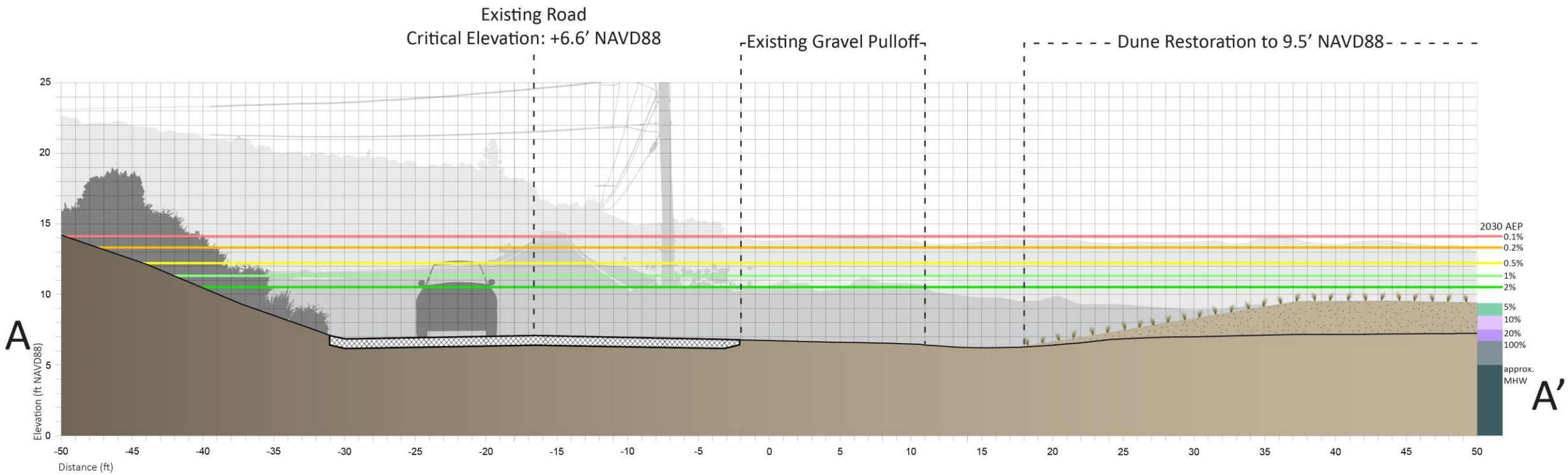
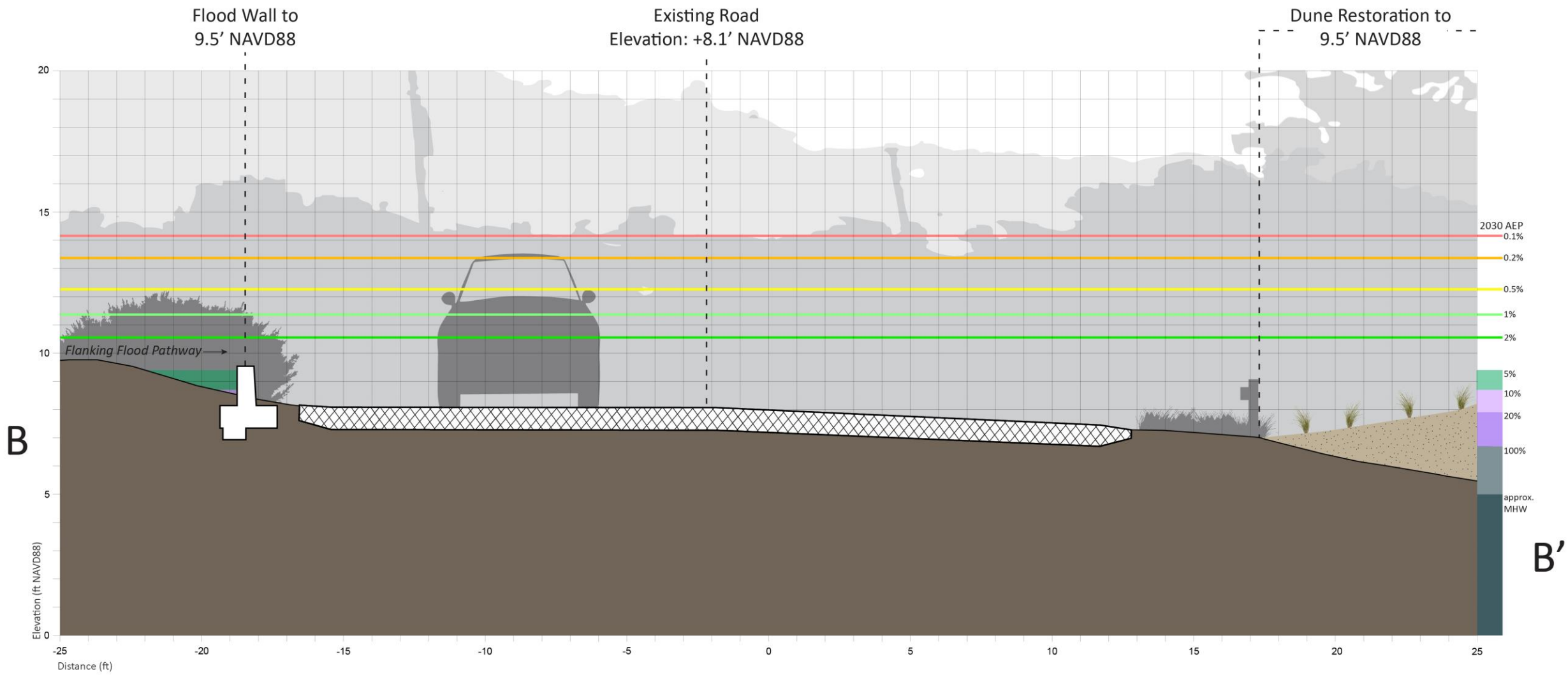


ALTERNATIVE 3: GREEN

Route 28 at Bay Road, Harwich

WOODS HOLE GROUP
A CLS COMPANY



ALTERNATIVE 3: GREEN

Route 28 at Bay Road, Harwich

WOODS HOLE GROUP
A CLS COMPANY

BAY ROAD at ROUTE 28, HARWICH

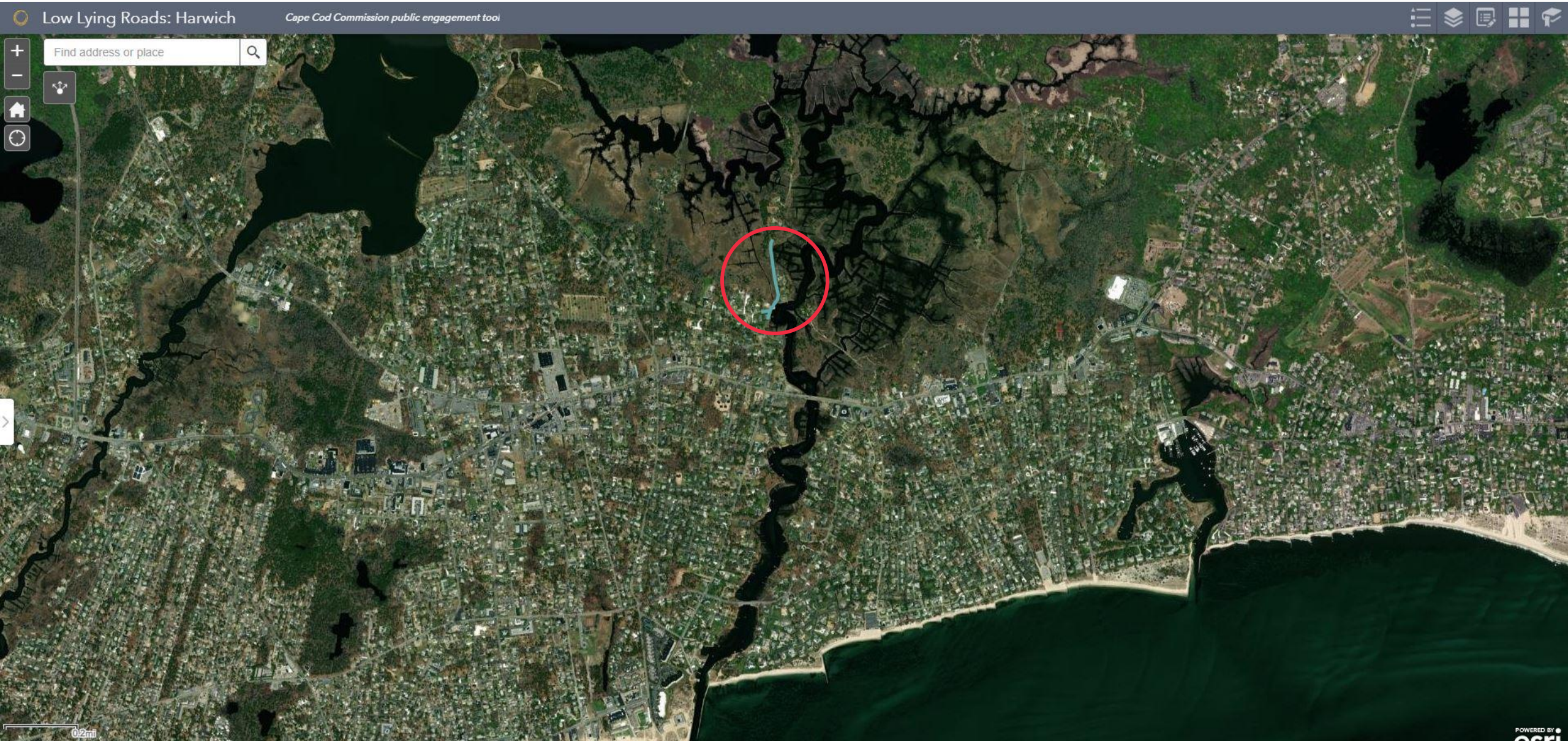
Summary of alternatives

	Description	Critical Elevation (NAVD88)	Annual Exceedance Probability			Vulnerable to Tidal Flooding†	Permitability Concerns	Impacts to Private Property	Estimated Cost*
			2030	2050	2070				
EXISTING	The intersection of state Route 28 and town-owned Bay Road.	6.6 feet	100%	100%	100%	2070	N/A	N/A	N/A
ALTERNATIVE 1: GRAY	577 linear feet of state-owned road are elevated to 9.5’ NAVD88 using 4:1 traditionally vegetated side slopes and sheet pile. There is the possibility to maintain existing parking and access via ramps. The road is raised by 2.9’ at its original low point.	9.5 feet	2%	10%	20%	No	Located in an ACEC, no direct wetland impacts	Minimal	$1,140,000
ALTERNATIVE 2: DEPLOYABLE	Approximately 600 linear feet of 48” temporary barriers are deployed on the bay side of the road before storms, protecting the road to 10.0’ NAVD88. A small flood wall to 10.0’ NAVD88 cuts off a flanking flood pathway from Muddy Creek.	10.0 feet	2%	5%	20%	No	Located in an ACEC, no direct wetland impacts	Minimal	$320,000
ALTERNATIVE 3: GREEN	A dune restoration to 9.5’ NAVD88 protects the road from bayside flooding. Mobi-mats are placed to prevent dune erosion and improve accessibility. A small flood wall and berm to 9.5’ NAVD88 prevents flanking flooding from Muddy River.	9.5 feet	2%	10%	20%	No	Located in an ACEC, resource area restoration	Minimal	$378,000

*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.

North Road


Low Lying Roads: Harwich
Cape Cod Commission public engagement tool
Find address or place
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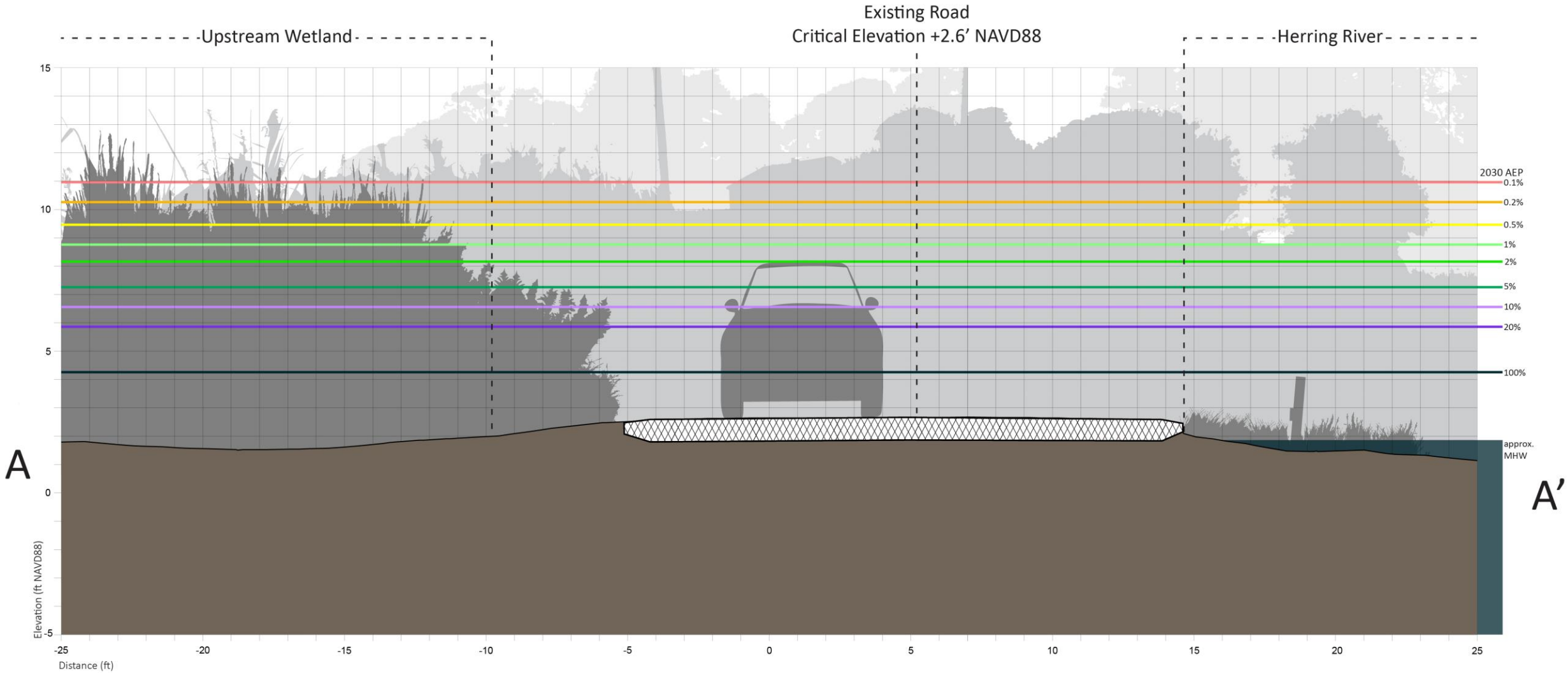
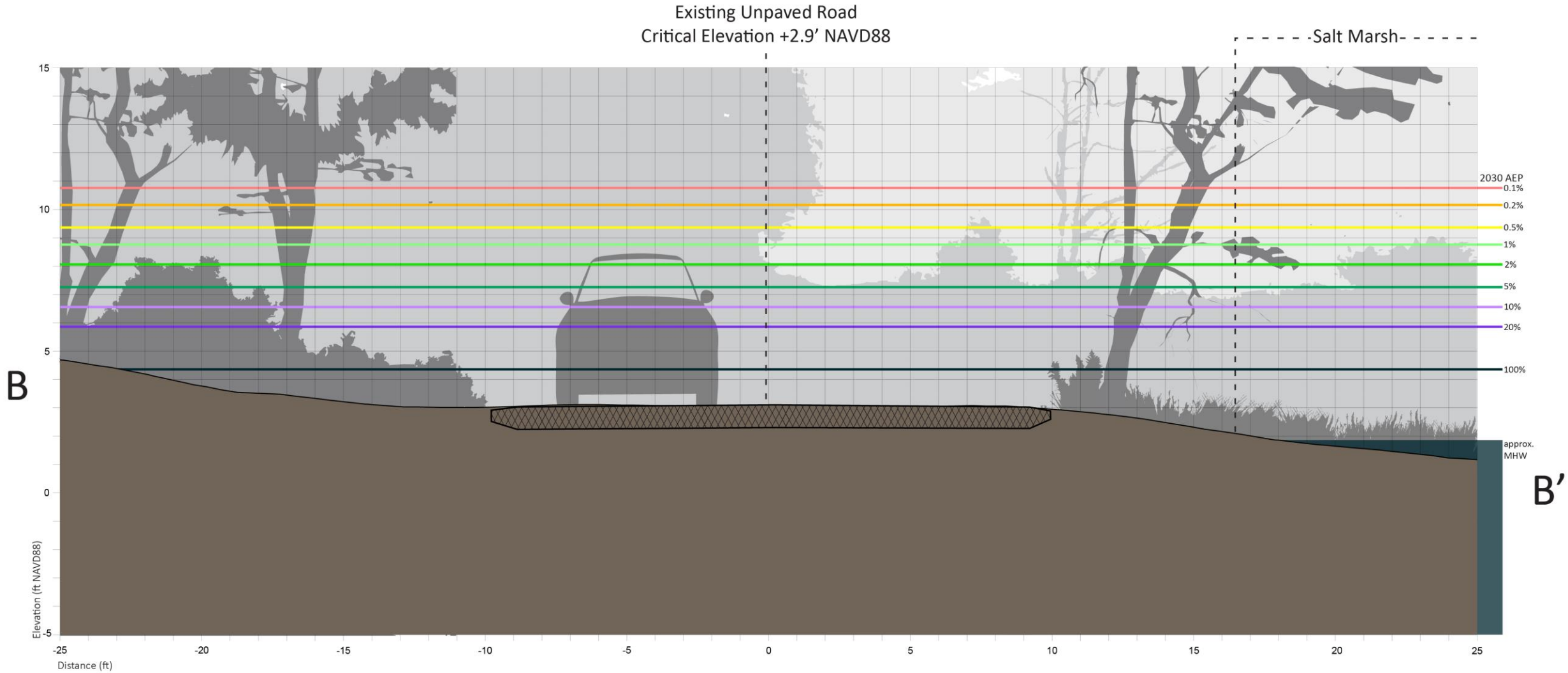


EXISTING CONDITIONS

North Road, Harwich

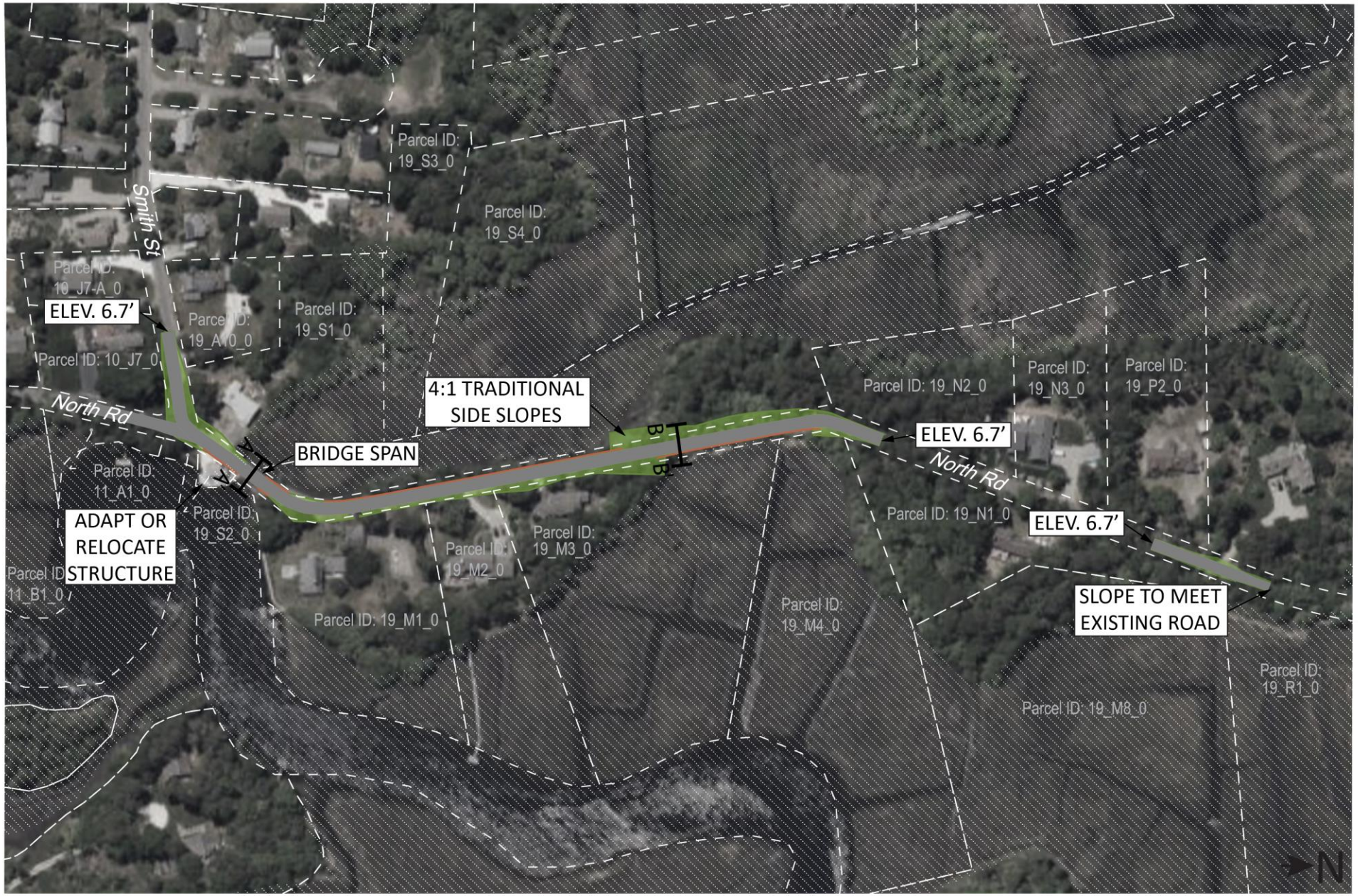
WOODS HOLE GROUP
A CLS COMPANY



EXISTING CONDITIONS

North Road, Harwich

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

North Road
HARWICH

ALTERNATIVE 1: GRAY

1,360 linear feet of town-owned road are elevated to 6.7’ NAVD88 using 4:1 traditionally vegetated side slopes and sheet pile. A 40ft bridge span at the western end of the road allows for salt marsh migration and protects the road from erosion by Herring River.

WOODS HOLE GROUP
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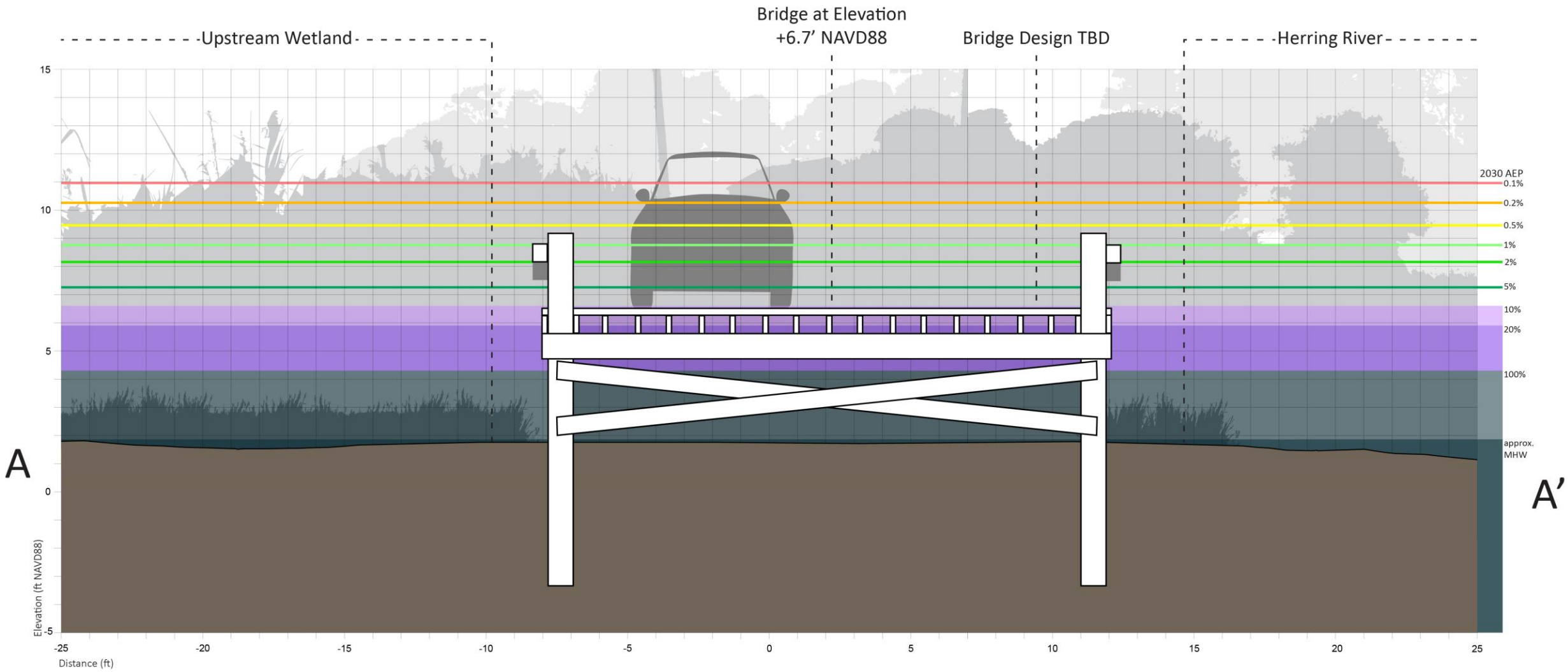
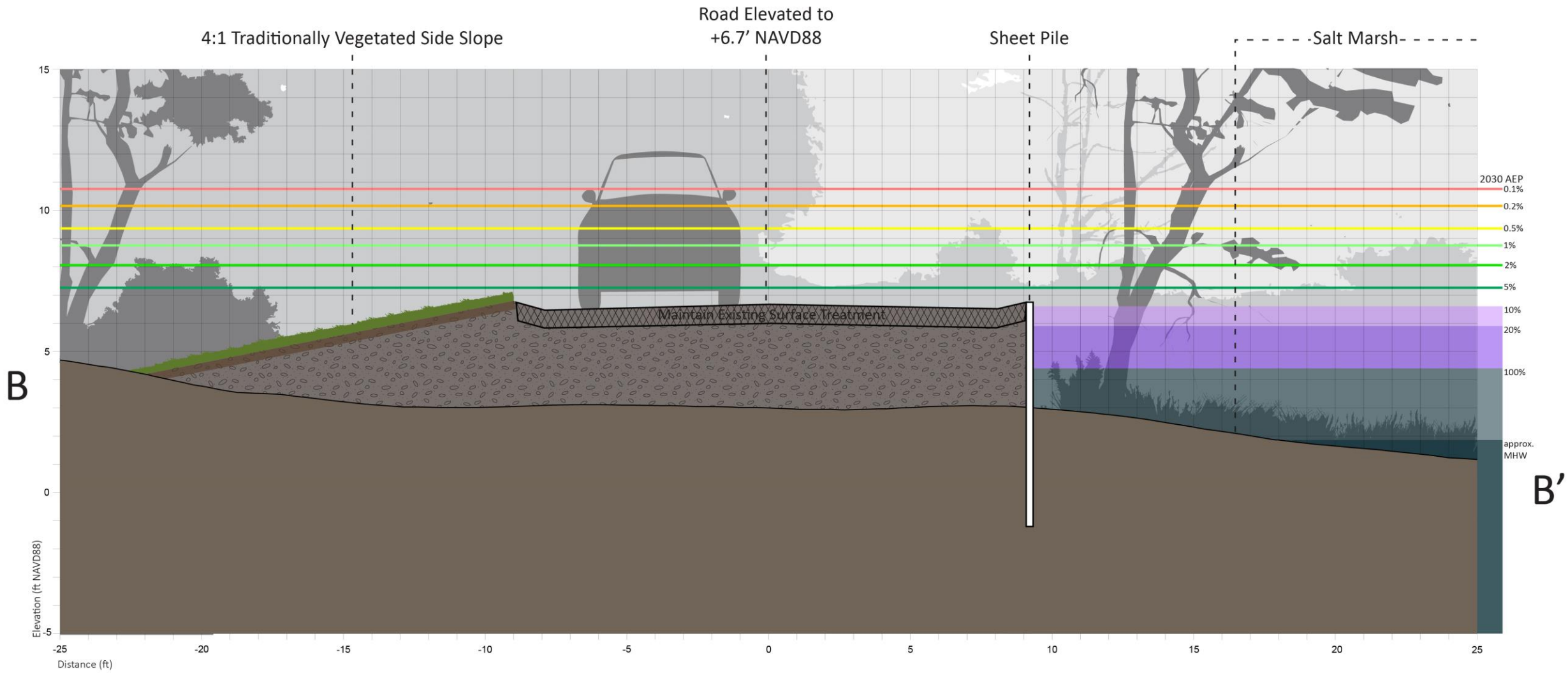


ALTERNATIVE 1: GRAY

North Road, Harwich

WOODS HOLE GROUP
A CLS COMPANY



ALTERNATIVE 1: GRAY

North Road, Harwich

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

North Road
HARWICH

ALTERNATIVE 2: HYBRID

1042 linear feet of town-owned road are elevated to 4.8' NAVD88 using 4:1 native vegetated side slopes and sheet pile. A culvert is installed at the road's current low point to allow for salt marsh migration.

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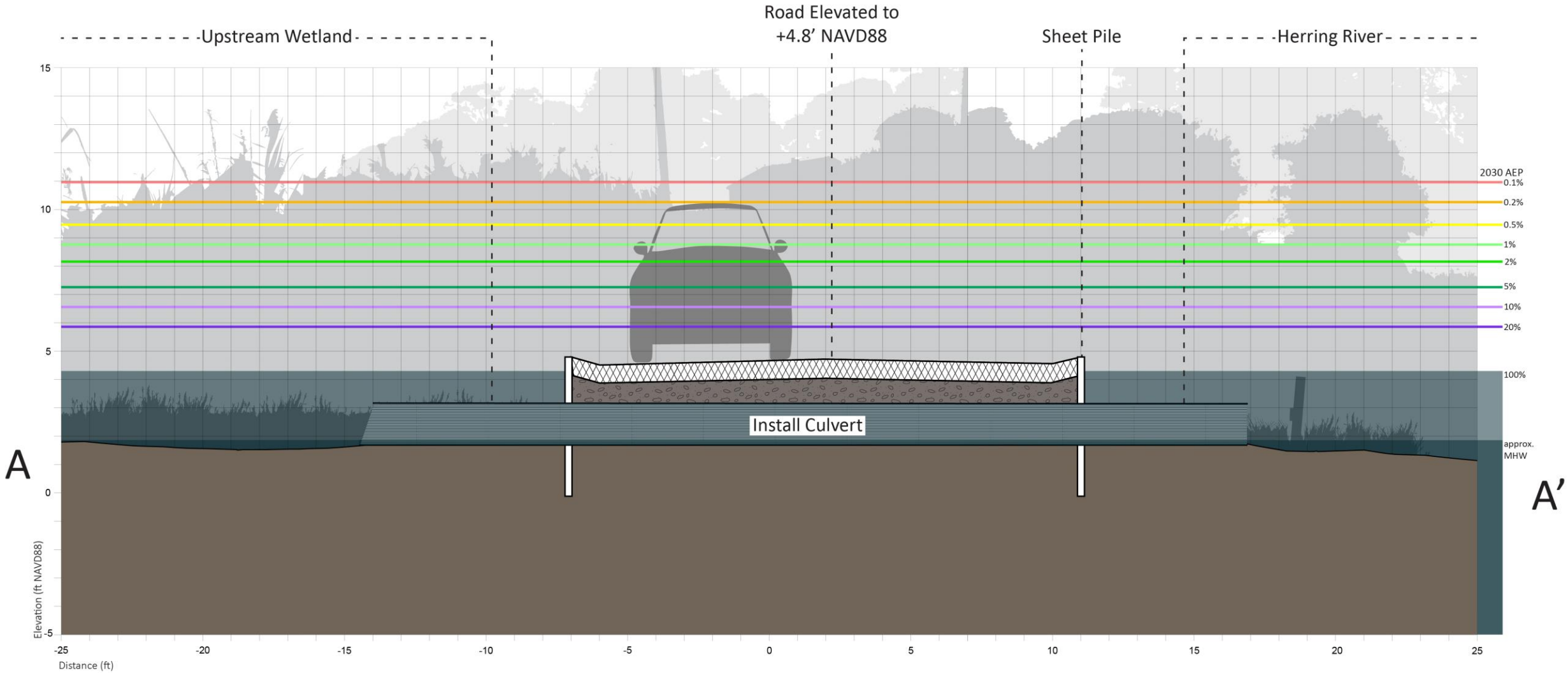

ALTERNATIVE 2: HYBRID

North Road, Harwich

WOODS HOLE GROUP
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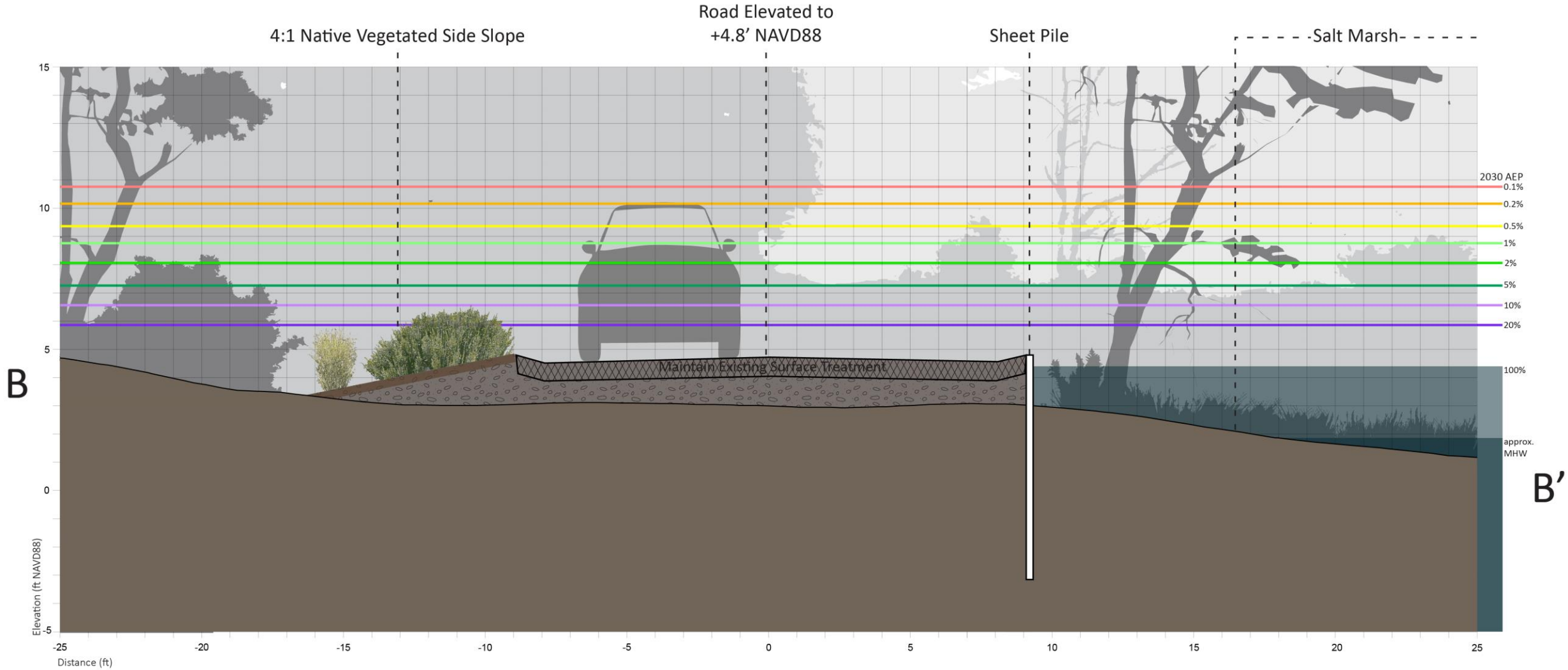

ALTERNATIVE 2: HYBRID

North Road, Harwich

WOODS HOLE GROUP
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NORTH ROAD, HARWICH

Summary of alternatives

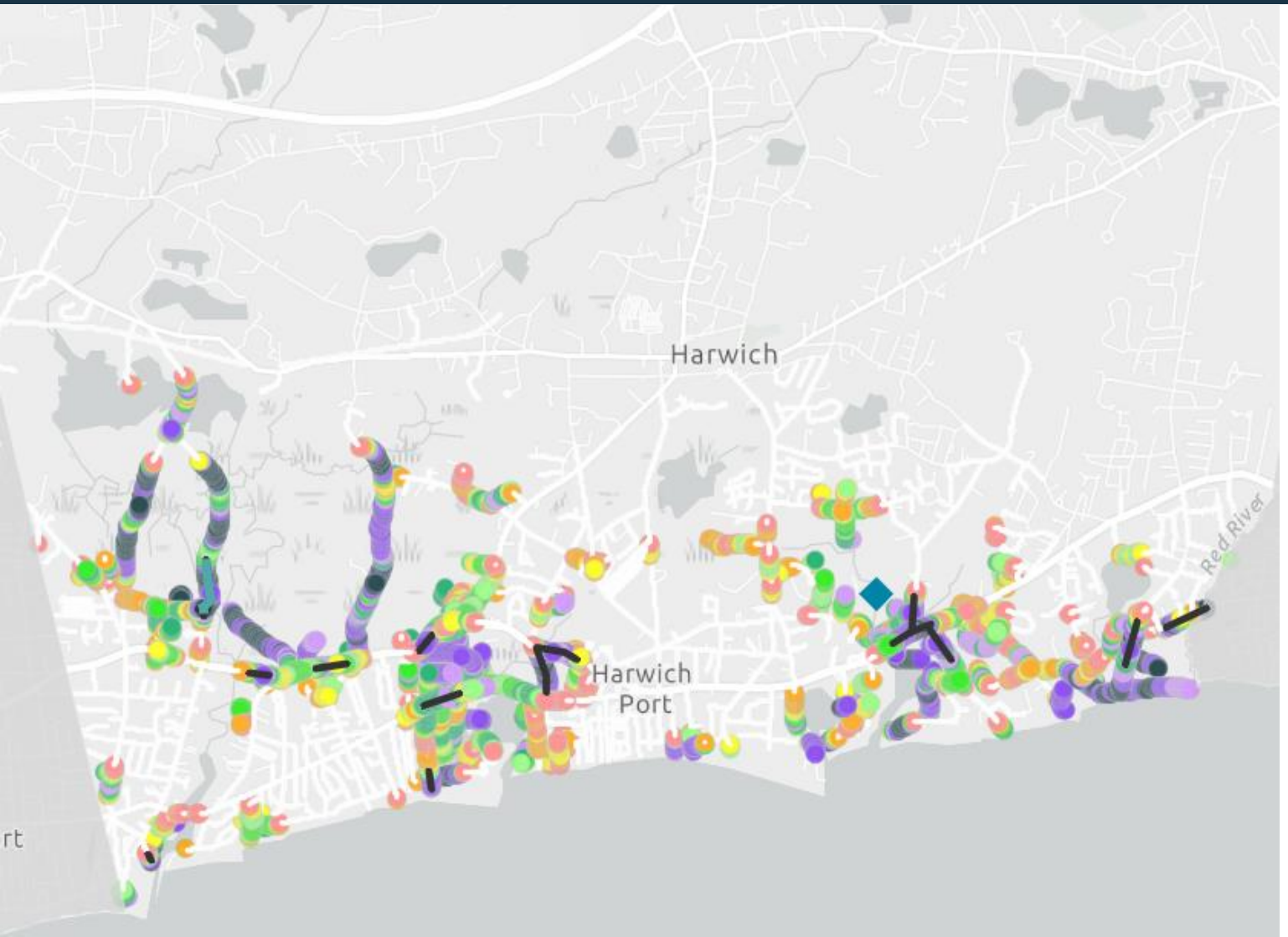
	Description	Critical Elevation (NAVD88)	Annual Exceedance Probability			Vulnerable to Tidal Flooding†	Wetland Impacts	Impacts to Private Property	Estimated Cost*
			2030	2050	2070				
EXISTING	A segment of 18 foot wide road connecting marsh islands.	2.6 feet	100%	100%	100%	2030	N/A	N/A	N/A
ALTERNATIVE 1: GRAY	1,360 linear feet of town-owned road are elevated to 6.7' NAVD88 using 4:1 traditionally vegetated side slopes and sheet pile. A 40ft bridge span at the western end of the road allows for salt marsh migration and protects the road from erosion by Herring River.	6.7 feet	5%	20%	100%	No	New connection between river and marsh	Significant	$2,030,000+ (bridge costs uncertain)
ALTERNATIVE 2: HYBRID	1042 linear feet of town-owned road are elevated to 4.8' NAVD88 using 4:1 native vegetated side slopes and sheet pile. A culvert is installed at the road's current low point to allow for salt marsh migration.	4.8 feet	20%	100%	100%	2070	New connection between river and marsh	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.

LOW LYING ROADS

Discussion



- **North Road**
- **Bay Road at Rte 28**

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