



Low-lying Roads: Provincetown

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
 - Commercial Street at Point Street
 - Commercial Street in the East End
- 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



Additional Context & Information

- **Detailed information on webpages:**

<https://www.capecodcommission.org/our-work/low-lying-roads-project/>

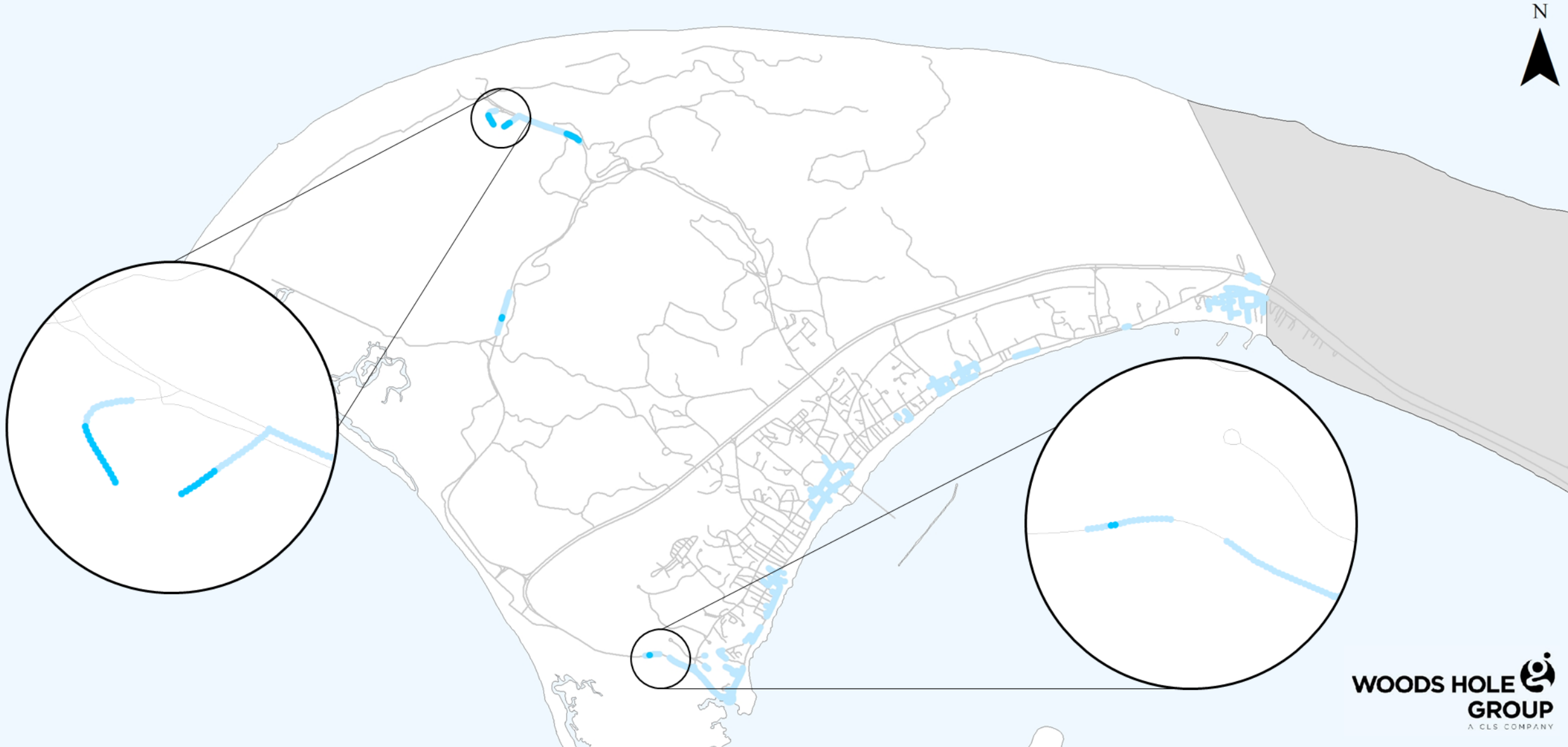
- **Format for meeting**



Low Lying Roads Nuisance Flooding

Road Surface Elevations Below MHW

- 2070 (5.5 mi)
- 2050 (0.2 mi)
- 2030 (0.0 mi)



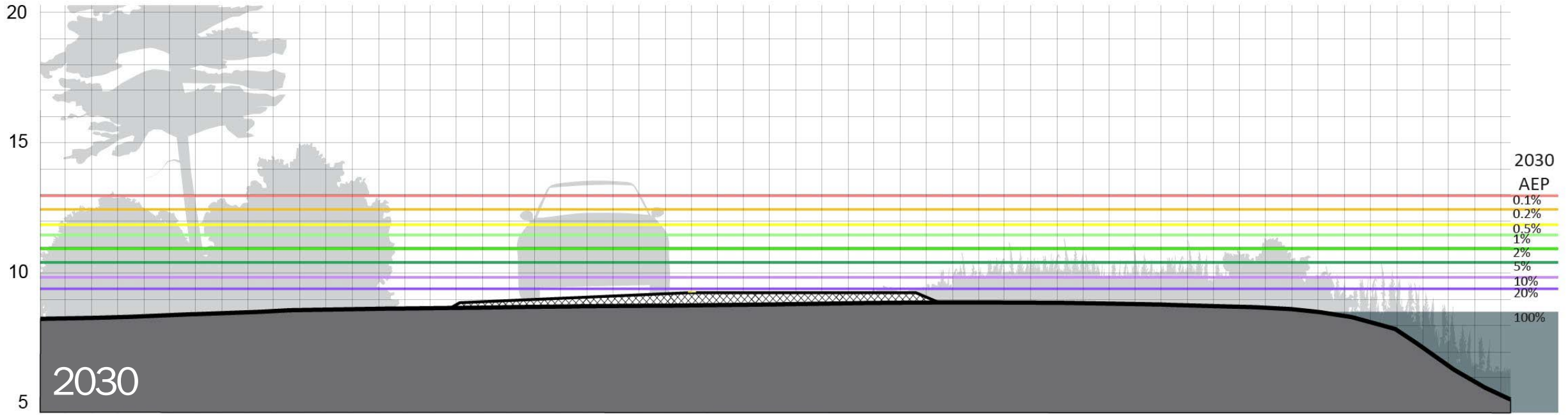
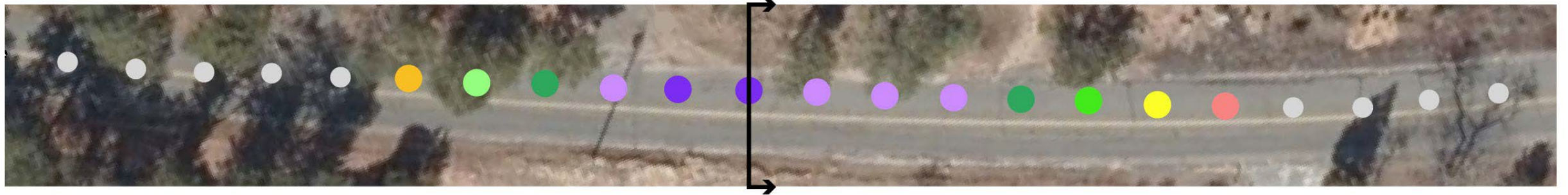
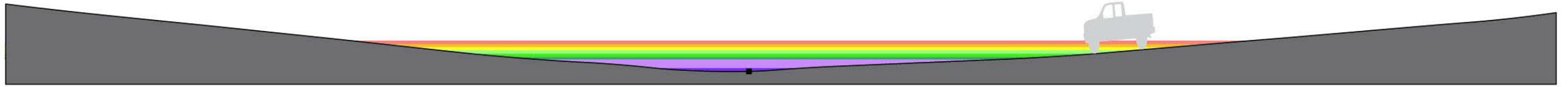
Cape Cod Low Lying Roads Vulnerability Assessment Methods

COASTAL FLOOD EXCEEDANCE PROBABILITY



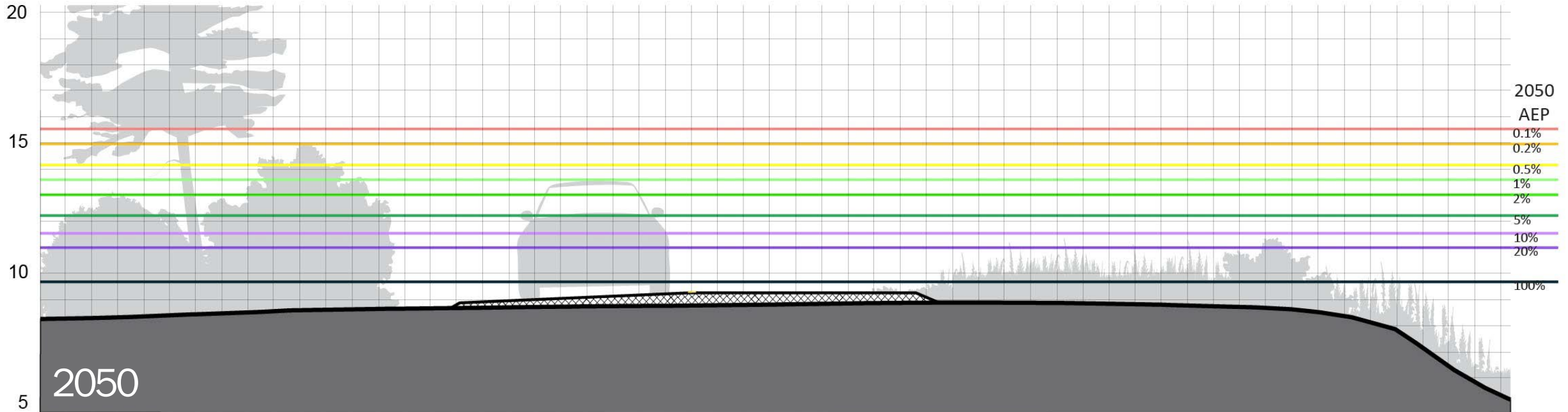
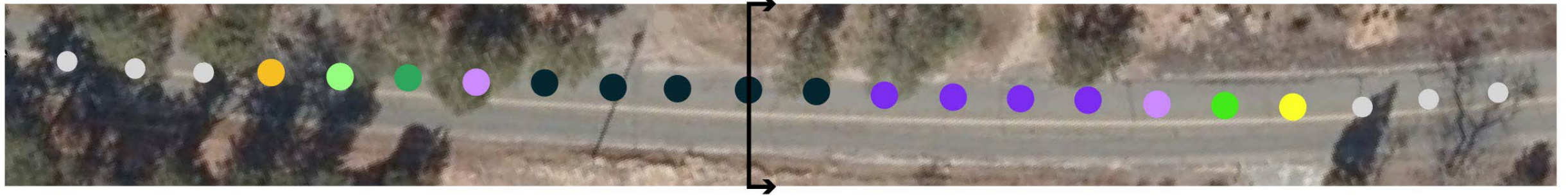
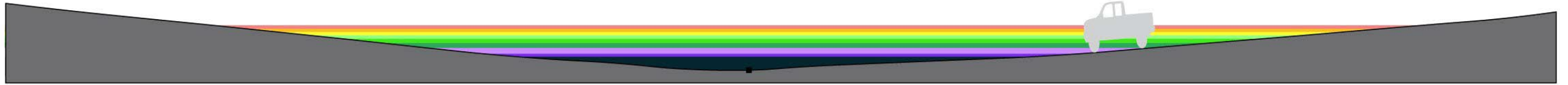
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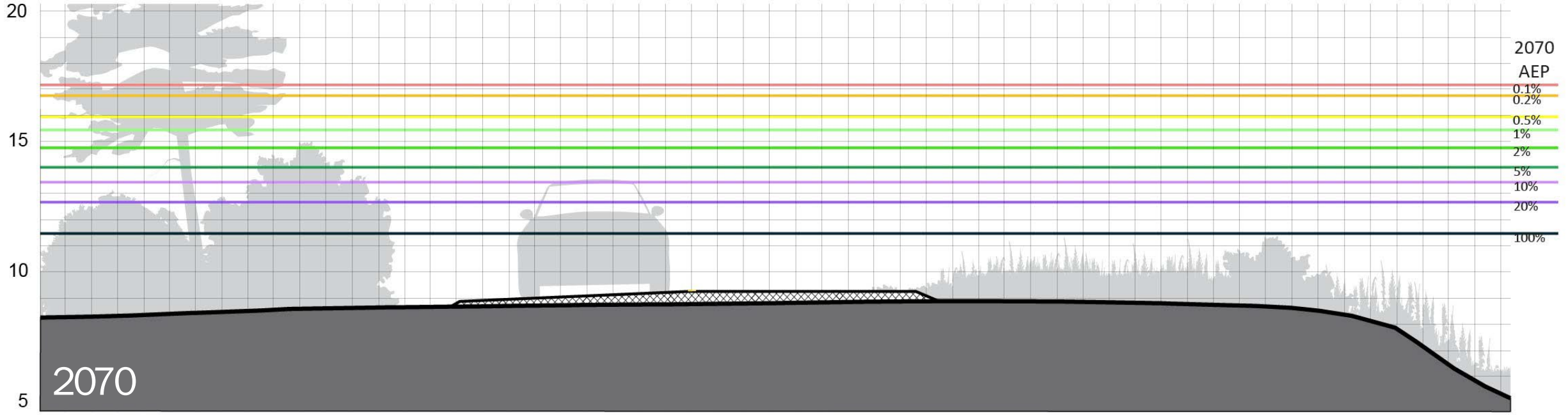
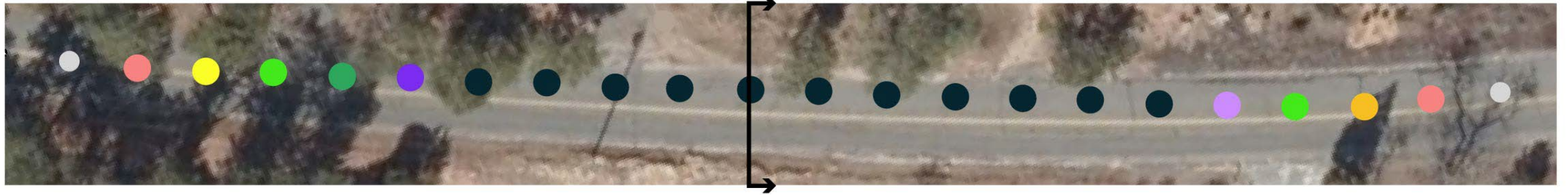
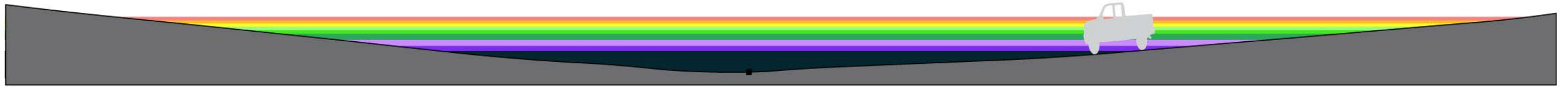
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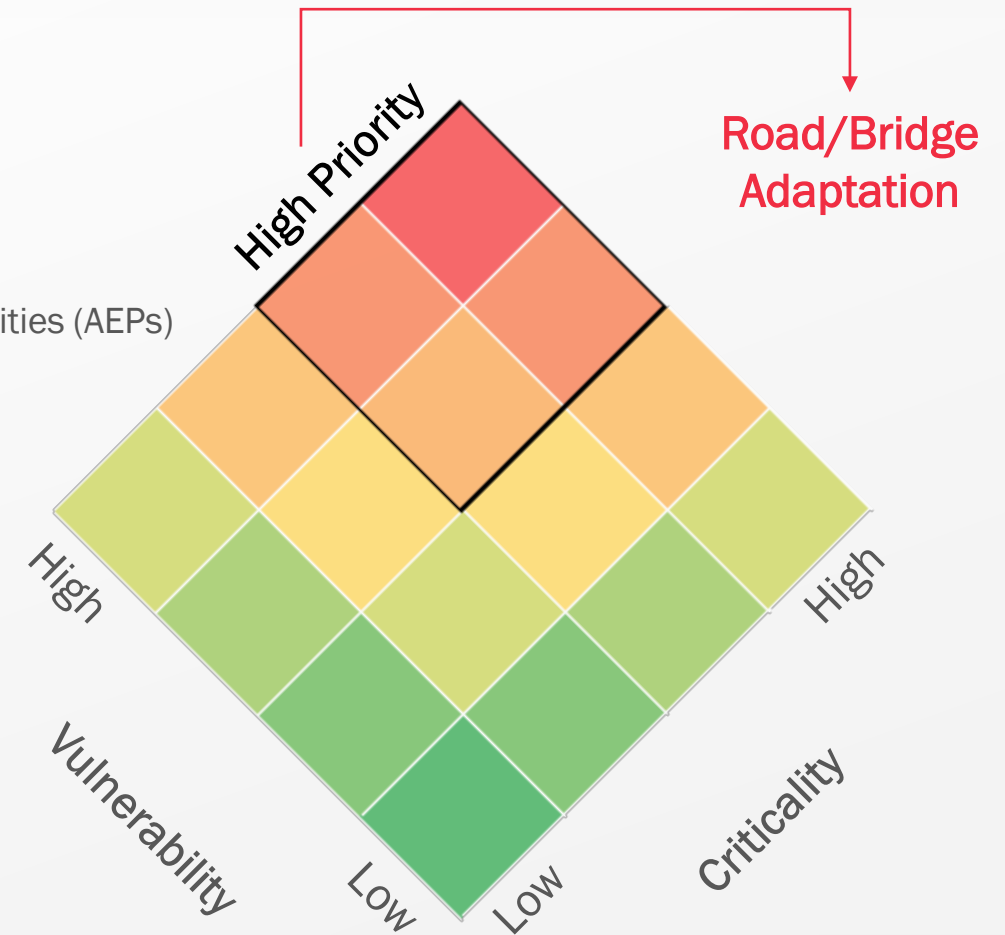
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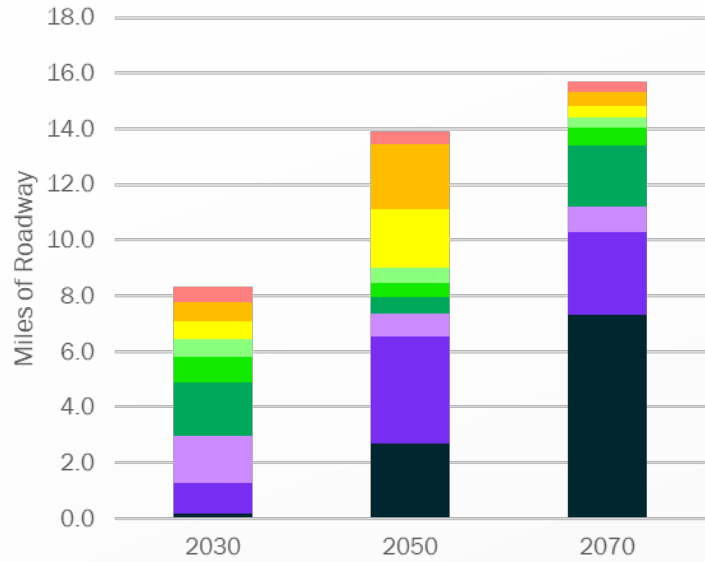


Cape Cod Low Lying Roads Risk Assessment Approach

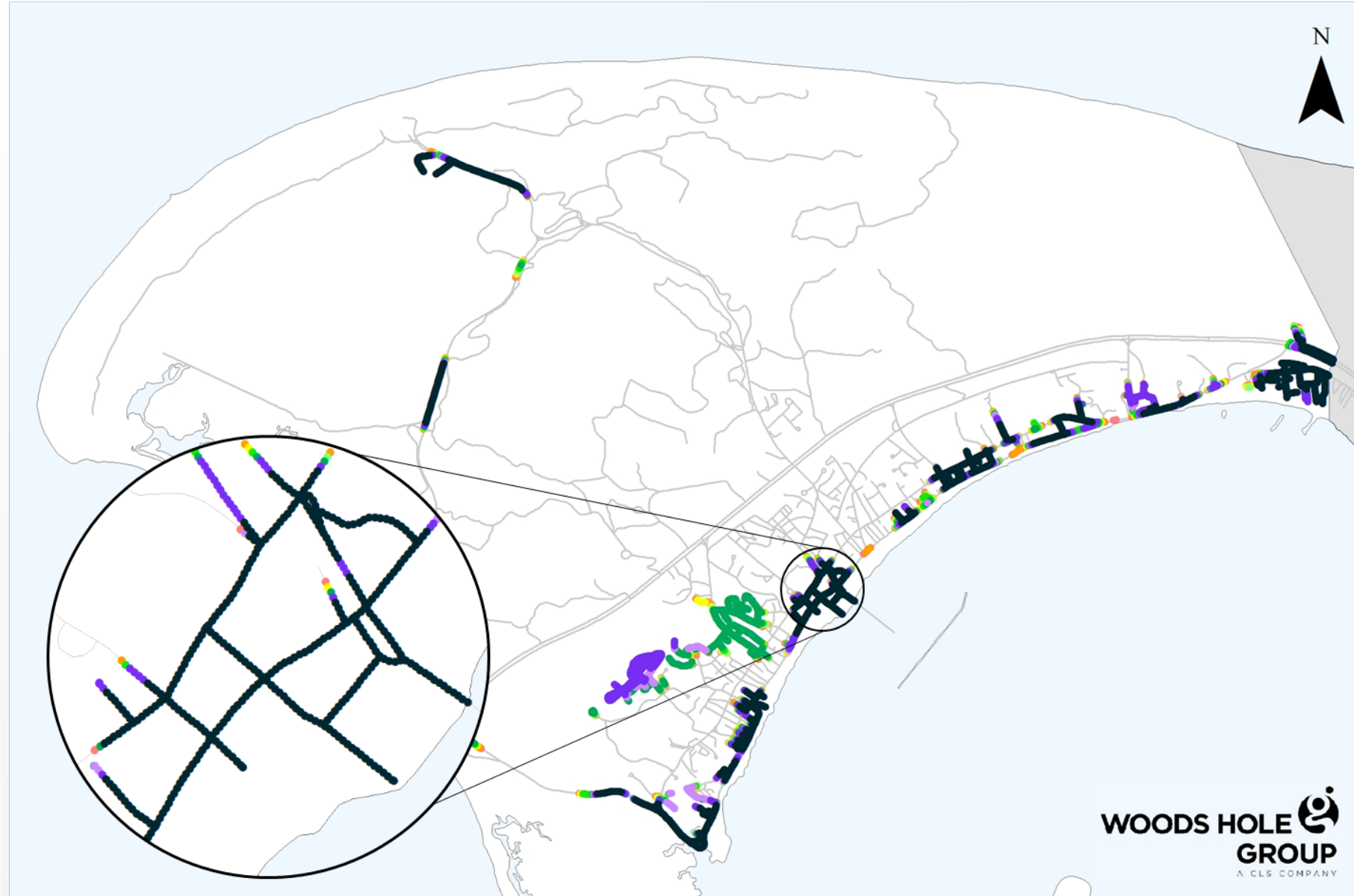
1. Extract roadway/bridge critical elevations (CEs)
 - › From LiDAR at 20m interval along surface
2. Compile 2030/2050/2070 MC-FRM water surface elevations (WSEs)
 - › 0.1%, 0.2%, 0.5%, 1%, 2%, 5%, 10%, 20%, 100% Annual Exceedance Probabilities (AEPs)
3. Compare CEs to WSEs to determine vulnerability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



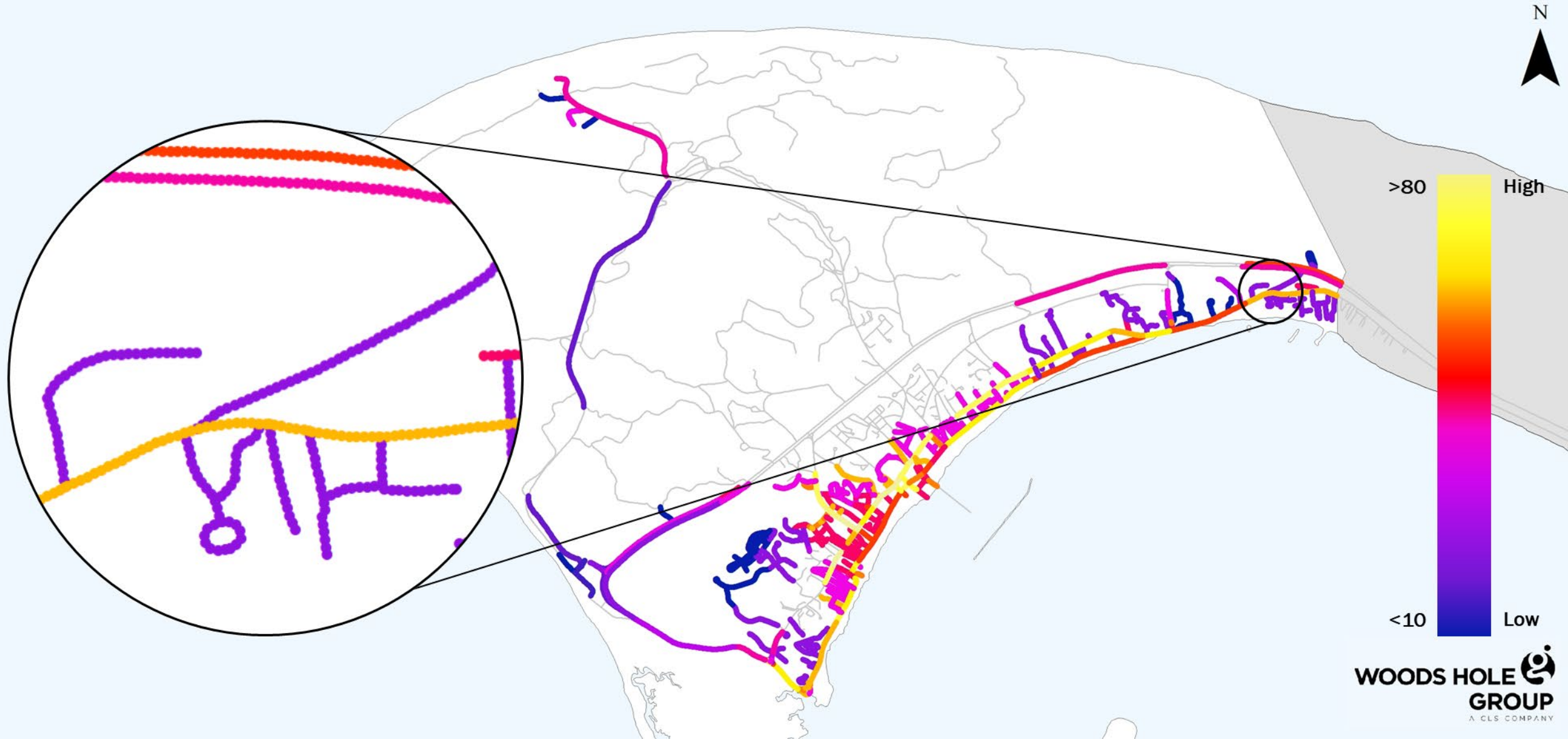
Low Lying Roads 2070 Flood Probability (Annual Exceedance Probability)



Flood Probability	Road Miles
0.1%	15.7
0.2%	15.3
0.5%	14.8
1%	14.4
2%	14.0
5%	13.4
10%	11.2
20%	10.3
100%	7.3

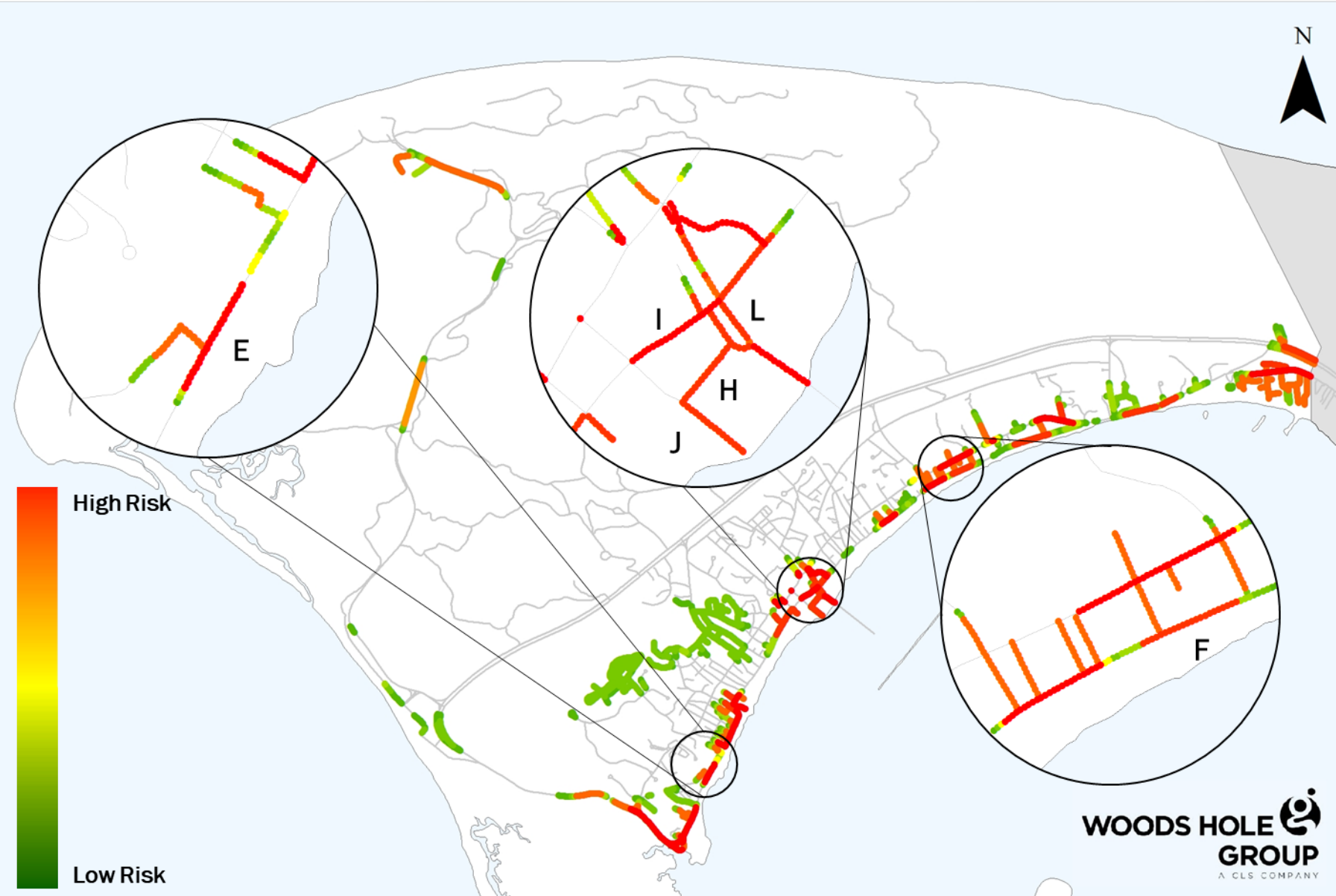


Low Lying Roads Criticality Scoring



Low Lying Roads 2070 Risk Results

High Risk Road Segments	
A	Province Lands Rd and Commercial St at West End
B	Province Lands Rd at Long Point Marshes
C	Province Lands Rd near Hatches Harbor Trailhead
D	Commercial St at Soper St
E	Commercial St at Point St
F	Commercial St between Hancock St and Kendall Ln
G	Commercial St at Suzanne's Garden
H	Commercial St at MacMillan Pier
I	Bradford St at Bas Relief Park
J	Ryder St
K	Shore Rd at Truro Town Line
L	Standish St
M	Commercial St at Kiley Ct
N	Race Point Rd
O	Commercial St at Berry Ln
P	Rte 6 at Truro Town Line



Summary of High Priority Road Segments

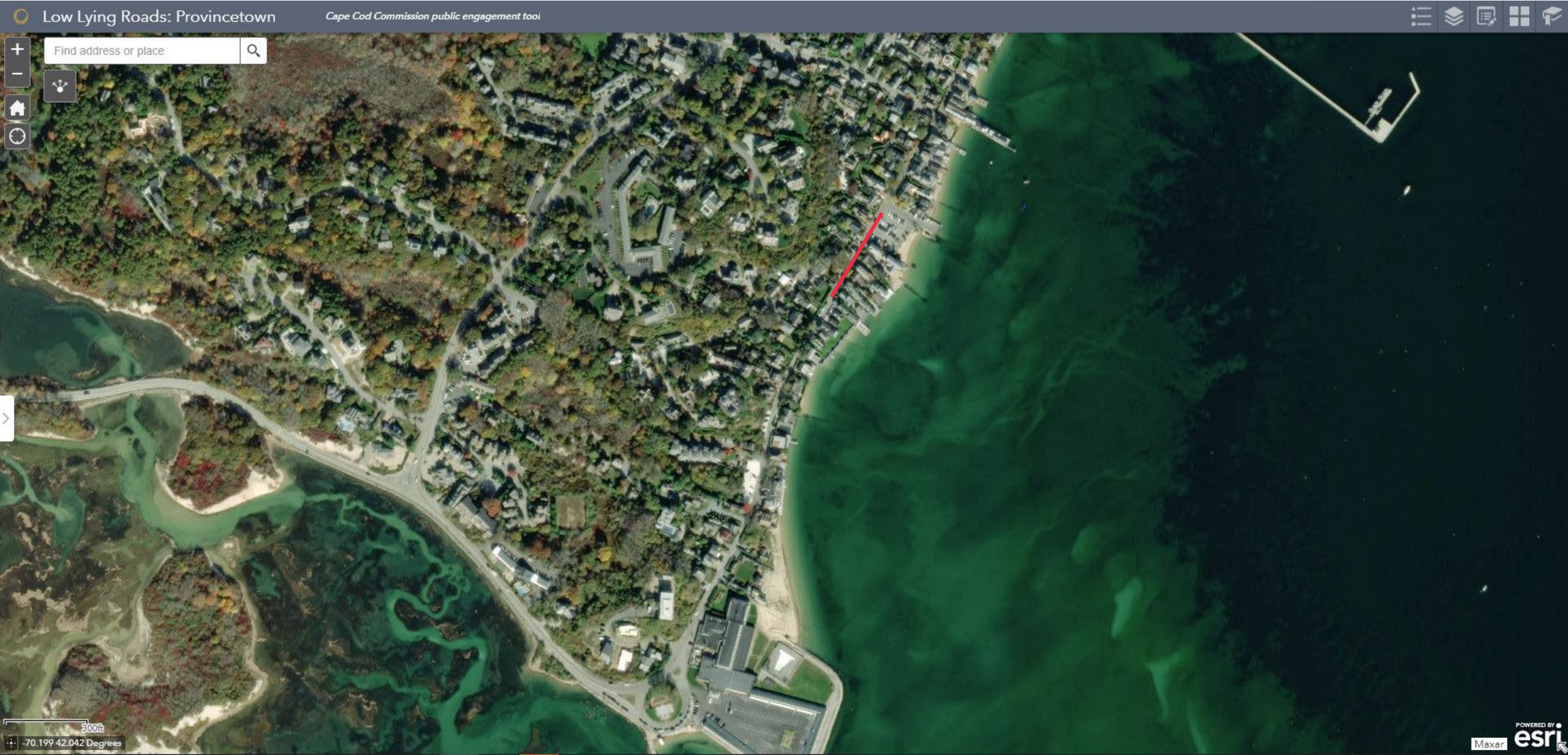
	Road Name	Length (ft)	Description	AEP 2030	Criticality Score	2030 Risk Score	Tidal Flooding Length (ft)		
							2030	2050	2070
A	Province Lands Rd & Commercial St at West End**†	3660	NW and NE approaches to Pilgrims' First Landing Park	100	62	6200	0	0	3520
B	Province Lands Rd at Long Point Marshes*	580	culvert crossing west of Bradford St Extension	100	27	2700	0	40	380
C	Province Lands Rd near Hatches Harbor Trailhead*	1280	north of the Hatches Harbor lot parallel to Bike Trail	100	18	1800	0	60	1060
D	Commercial St at Soper St	840	West End south of Coast Guard Station	20	69	1380	0	0	820
E	Commercial St at Point St	520	West End near Dog Beach	20	69	1380	0	0	440
F	Commercial St between Hancock St and Kendall Ln	520	East End 500 block east of Fire Station No.5	20	50	1000	0	0	460
G	Commercial St at Suzanne's Garden†	580	East End 600 block between Allerton St and Snow St	20	50	1000	0	0	560
H	Commercial St at MacMillan Pier†	1380	200-300 block between Post Office and Lopes Square	10	75	750	0	0	1300
I	Bradford St at Bas Relief Park†	940	below Pilgrim Monument from Alden St to Prince St	10	81	810	0	0	920
J	Ryder St†	460	from Ryder St Beach to Bradford St	10	65	650	0	0	380
K	Commercial St at Truro Town Line†‡	1240	Route 6A from Dewey Ave east to Truro town line	10	60	600	0	0	1160
L	Standish St	600	from Lopes Square to Bradford St, behind MacMillan	5	36	184	0	0	0
M	Commercial St at Kiley Ct	260	East End 400 block south of Bangs St	20	62	1250	0	0	160
N	Race Point Rd*	1700	east of Provincetown Municipal Airport	10	37	370	0	360	1680
O	Commercial St at Berry Ln	1200	700 block east of Snail Rd by Foss Woods	10	50	500	0	0	140
P	Rte 6 at Truro Town Line*	1640	east of Mayflower Ave to Truro town line	0.5	36	18	0	0	540

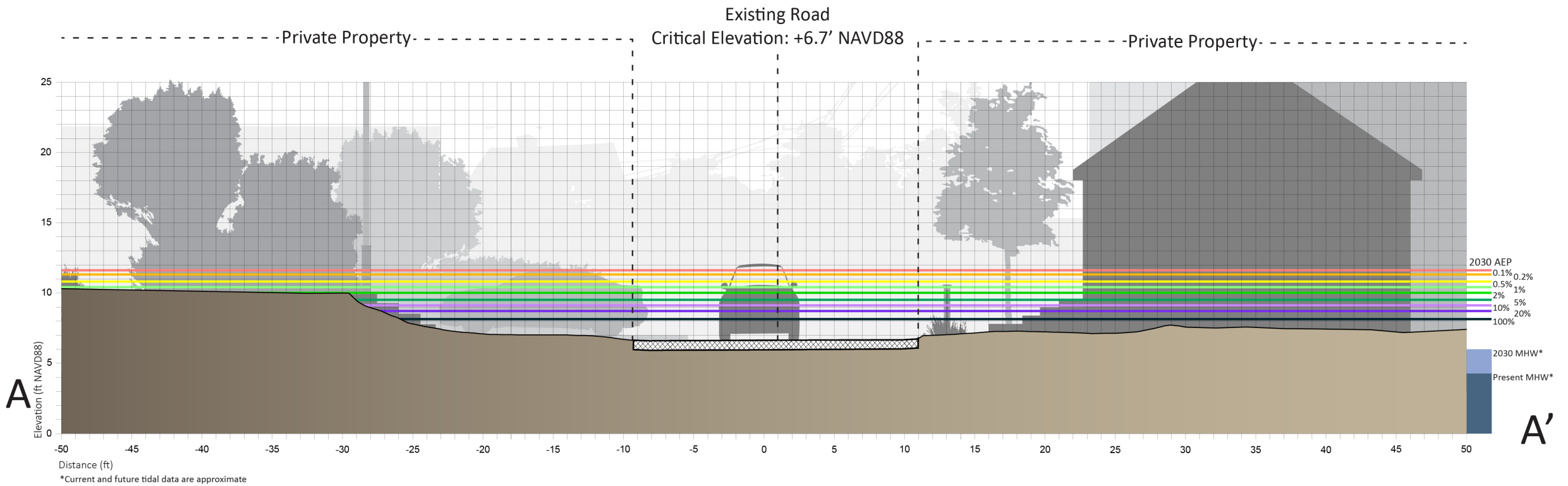
* = State or National Seashore Roadway

† = Existing planning work underway

‡ = Segment also listed for Truro

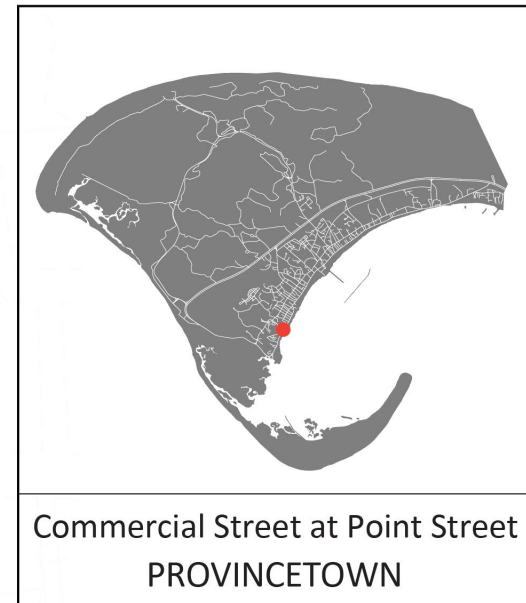
Commercial Street at Point Street





EXISTING CONDITIONS

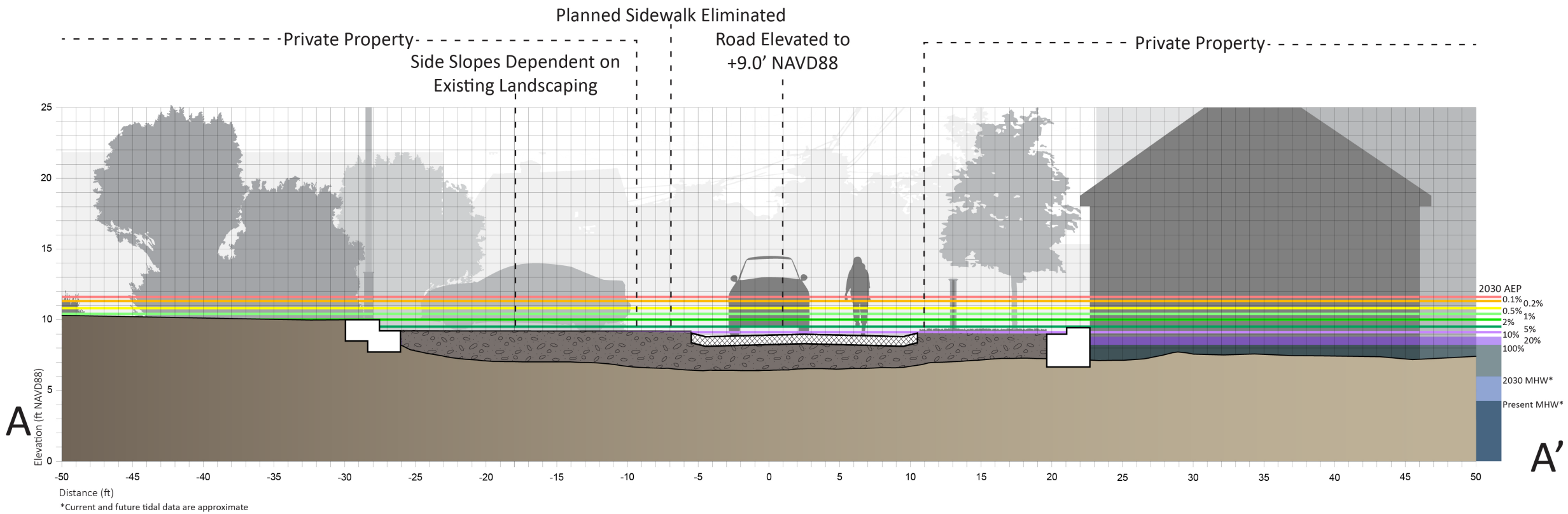
Commercial Street at Point Street, Provincetown



ALTERNATIVE 1: GRAY

373 linear feet of town-owned road are elevated from a lowest point of +6.7' NAVD88 to a lowest point of +9.0' NAVD88. Side slopes are blended with existing landscape where possible, and retaining walls are used where not. The planned sidewalk extension is eliminated, and signage and road markings indicate a shared street. Over time, the Town works with property owners to eliminate flood pathways, and a new standard bulkhead elevation of +11.0' NAVD88 is set.

Note: Project overlap with wetland areas, rights of way and property lines is approximate and needs confirmation with a site survey
 *Element not included in costing, permitting, or flood reduction considerations.

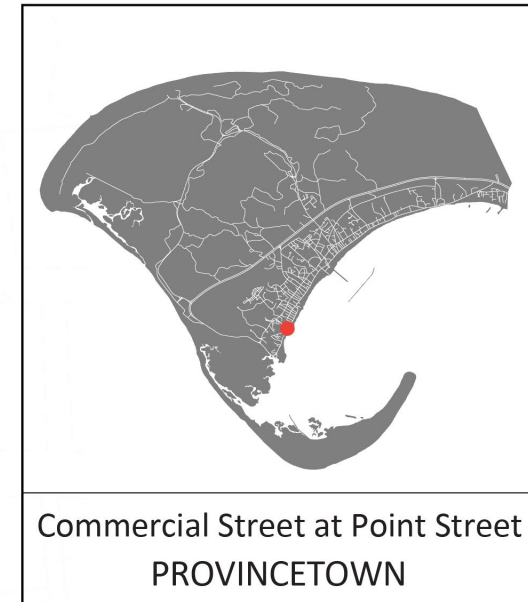


ALTERNATIVE 1: GRAY

Commercial Street at Point Street, Provincetown

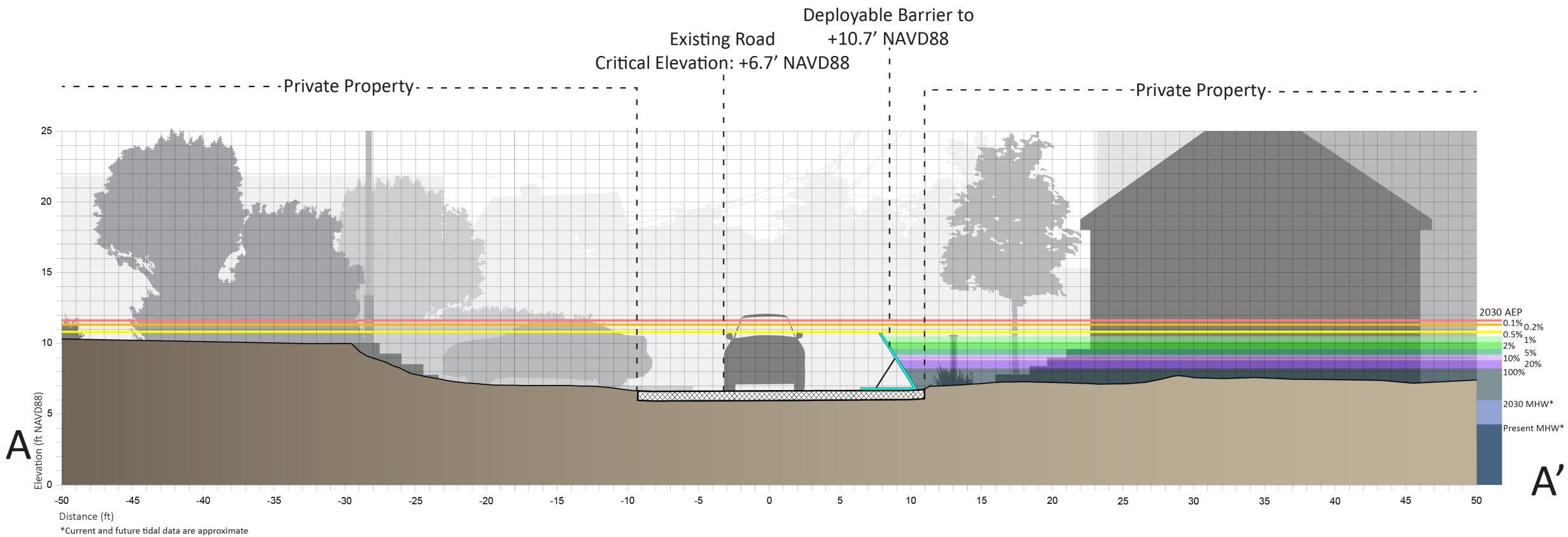


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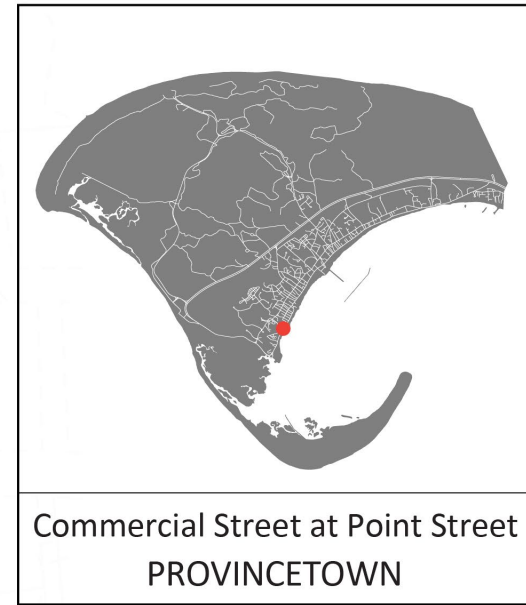
ALTERNATIVE 2: DEPLOYABLE

380 linear feet of 48" tall deployable barriers protect the road to an elevation of +10.7' NAVD88. Parking is restricted during storm events in order to maintain a full travel lane while accommodating the barriers. In the long-term, segments of fixed wall and permanent gates reduce the amount of time and effort required to deploy barriers before storms. Additional barriers across the beach parking lot could reduce wave runoff and overtopping impacts. Some walls and gates may be located on private property and require coordination with owners.



ALTERNATIVE 2: DEPLOYABLE

Commercial Street at Point Street, Provincetown



ALTERNATIVE 3: GREEN

In the long term, 16 low-lying waterfront and inland properties are acquired to facilitate a dune and beach restoration and stormwater storage park. Future regulatory changes and storm impacts may provide opportunities for community-driven change in waterfront land use.

Note: Project overlap with wetland areas, rights of way and property lines is approximate and needs confirmation with a site survey
*Element not included in costing, permitting, or flood reduction considerations.

COMMERCIAL STREET AT POINT STREET, PROVINCETOWN

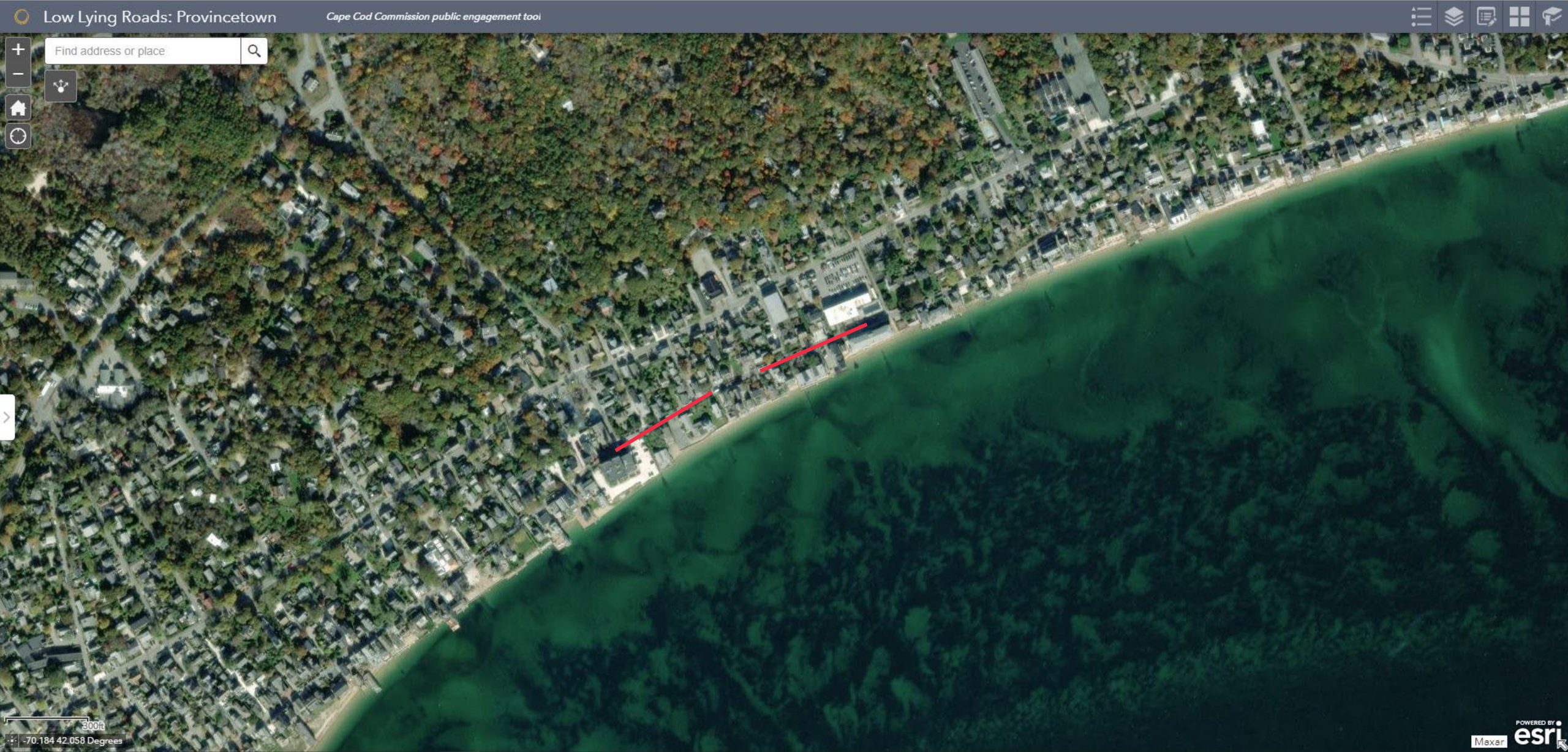
Summary of alternatives

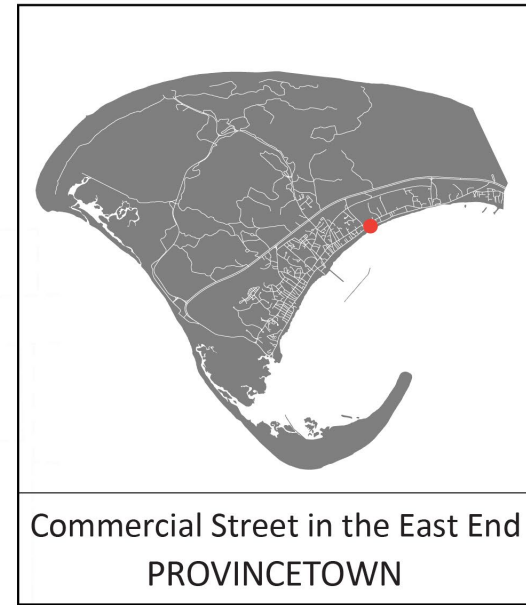
	Description	Critical Elevation (NAVD88)	Annual Exceedance Probability			Vulnerable to Tidal Flooding†	Permitability Concerns	Impacts to Private Property	Estimated Cost*
			2030	2050	2070				
EXISTING	Primarily residential stretch of Commercial Street near Dog Beach.	6.7 feet	100%	100%	100%	2050	N/A	N/A	N/A
ALTERNATIVE 1: GRAY	373 linear feet of town-owned road are elevated from a lowest point of +6.7' NAVD88 to a lowest point of +9.0' NAVD88. Side slopes are blended with existing landscape where possible. Bulkhead gaps are closed, and a new standard bulkhead elevation of +11.0' NAVD88 is set.	9.0 feet	10%	100%	100%	2070	Eliminates sidewalk	Moderate	\$273,000
ALTERNATIVE 2: DEPLOYABLE	380 linear feet of 48" tall deployable barriers protect the road to an elevation of +10.7' NAVD88. Parking is restricted during storm events in order to maintain a full travel land while accomodating the barriers.	10.7 feet	0.5%	20%	100%	2050	N/A	Temporary	\$155,000
ALTERNATIVE 3: GREEN	In the long term, 16 low-lying waterfront and inland properties are acquired to facilitate a dune restoration and stormwater storage park.	10.0 feet	2%	20%	100%	No	Resource area restoration, buyouts	Severe	\$187,000+ (cost of buyouts and demolition not included)

*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.

Commercial Street in the East End

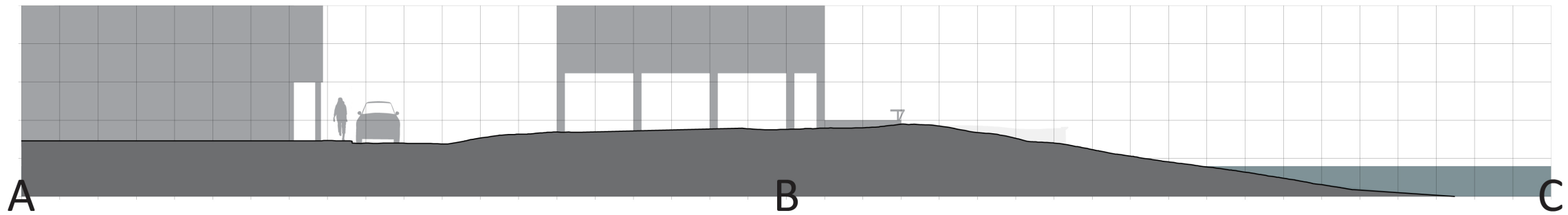
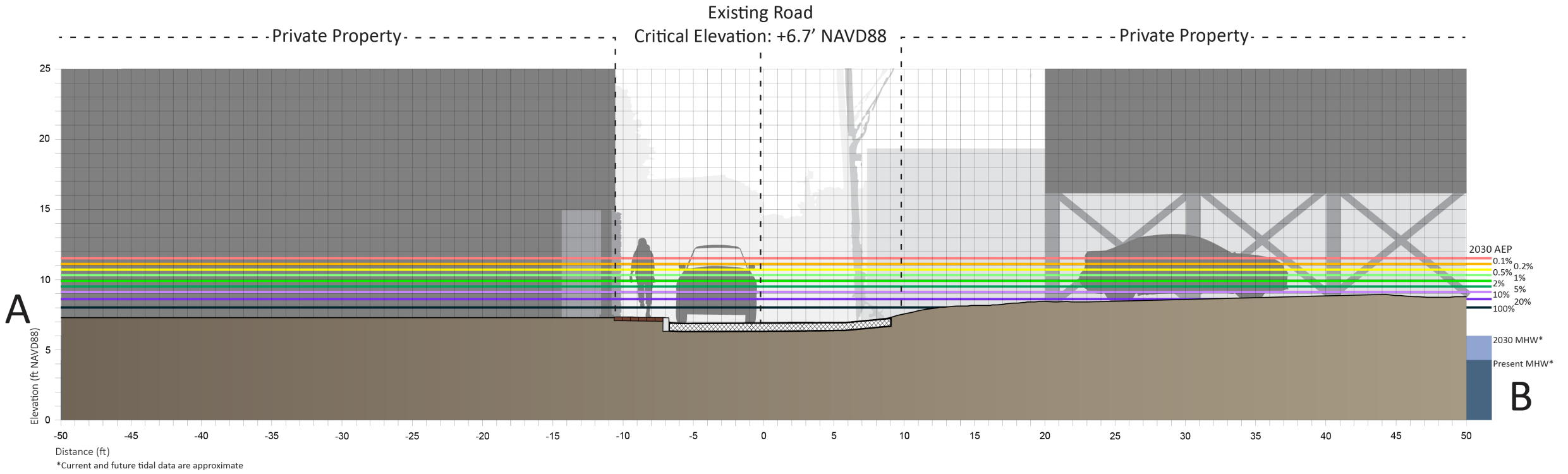




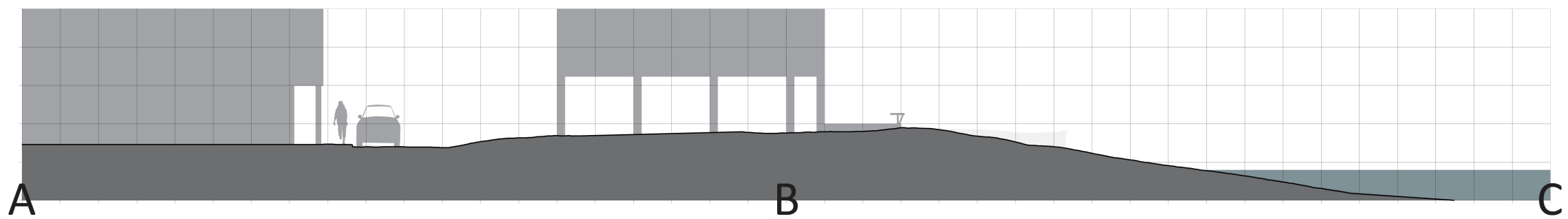
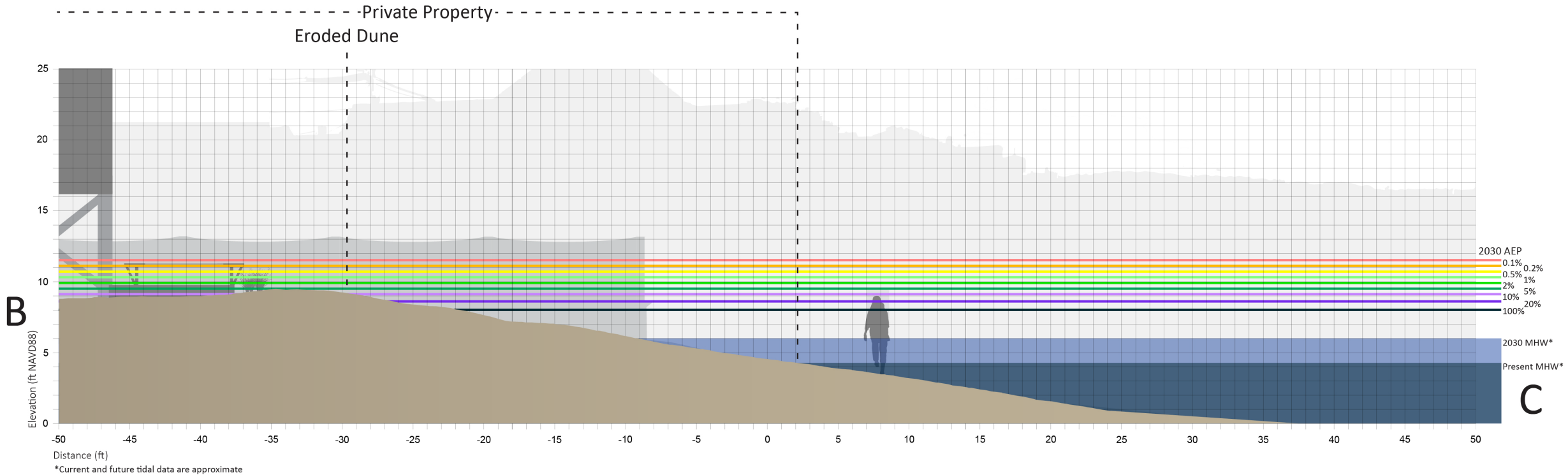
Commercial Street in the East End
PROVINCETOWN

EXISTING CONDITIONS

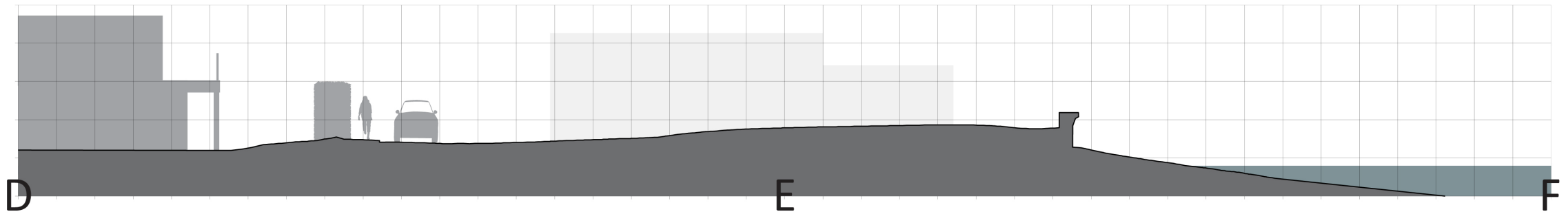
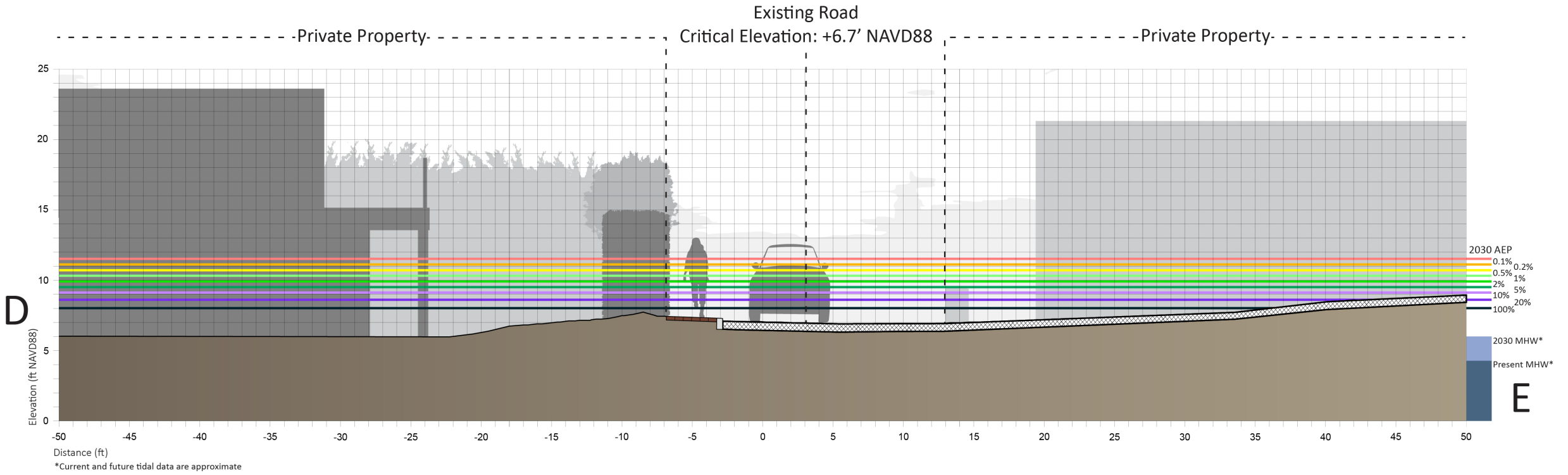
Note: Project overlap with wetland areas, rights of way and property lines is approximate and needs confirmation with a site survey



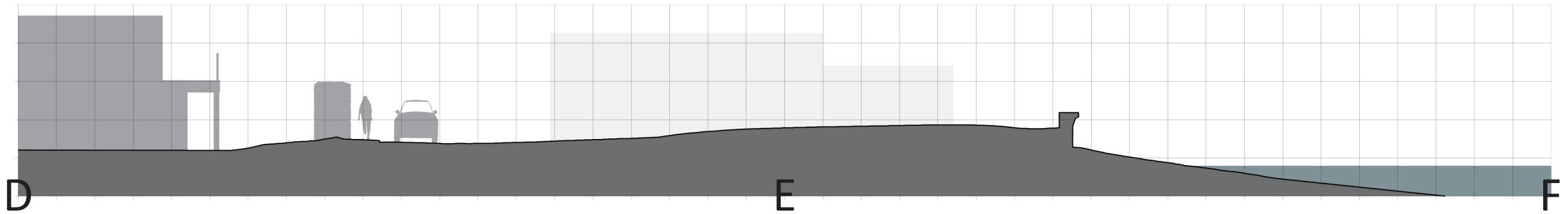
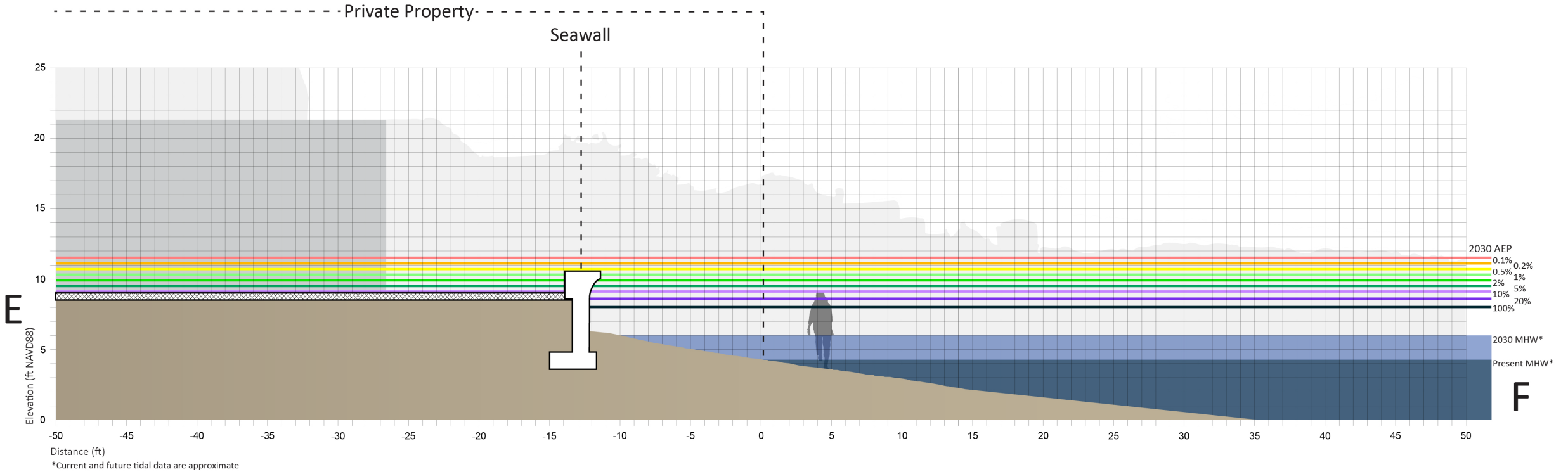
EXISTING CONDITIONS
Commercial Street in the East End, Provincetown



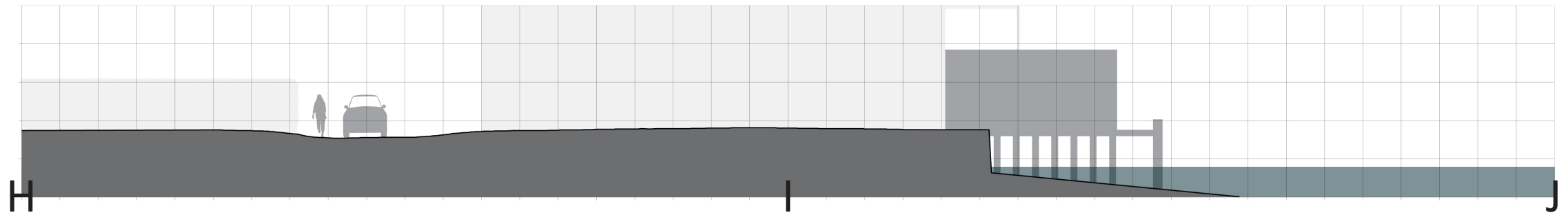
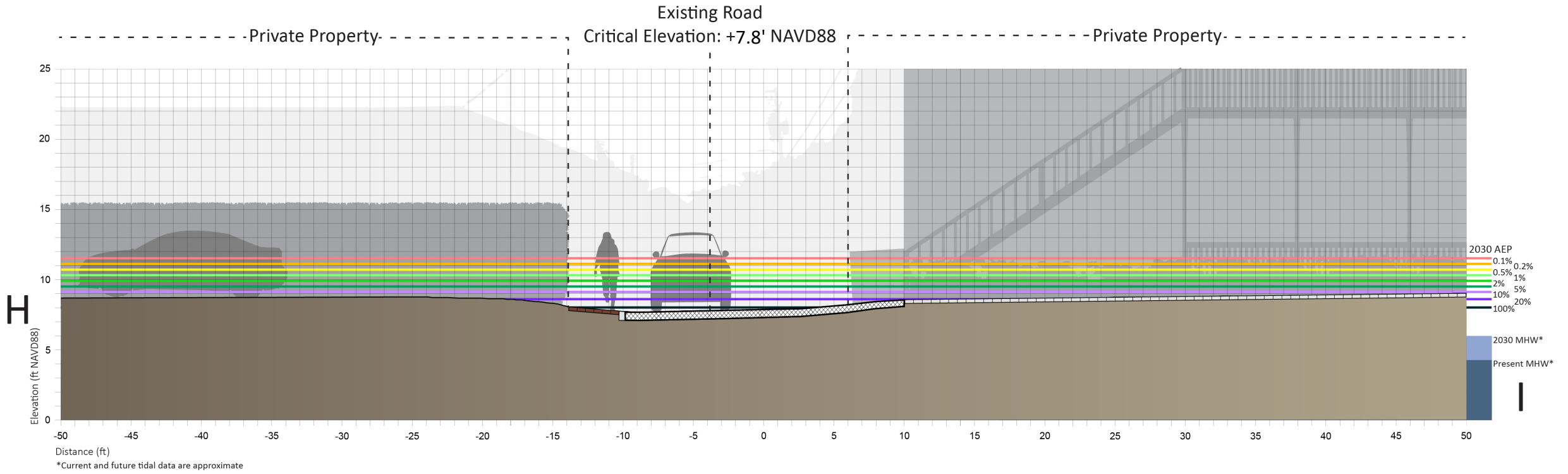
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 Commercial Street in the East End, Provincetown



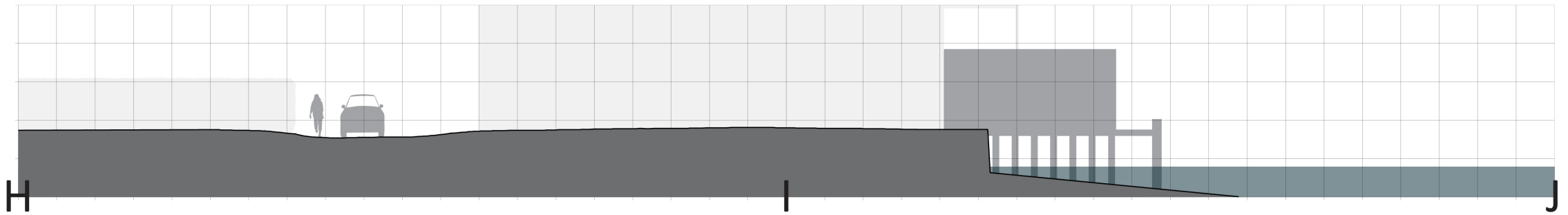
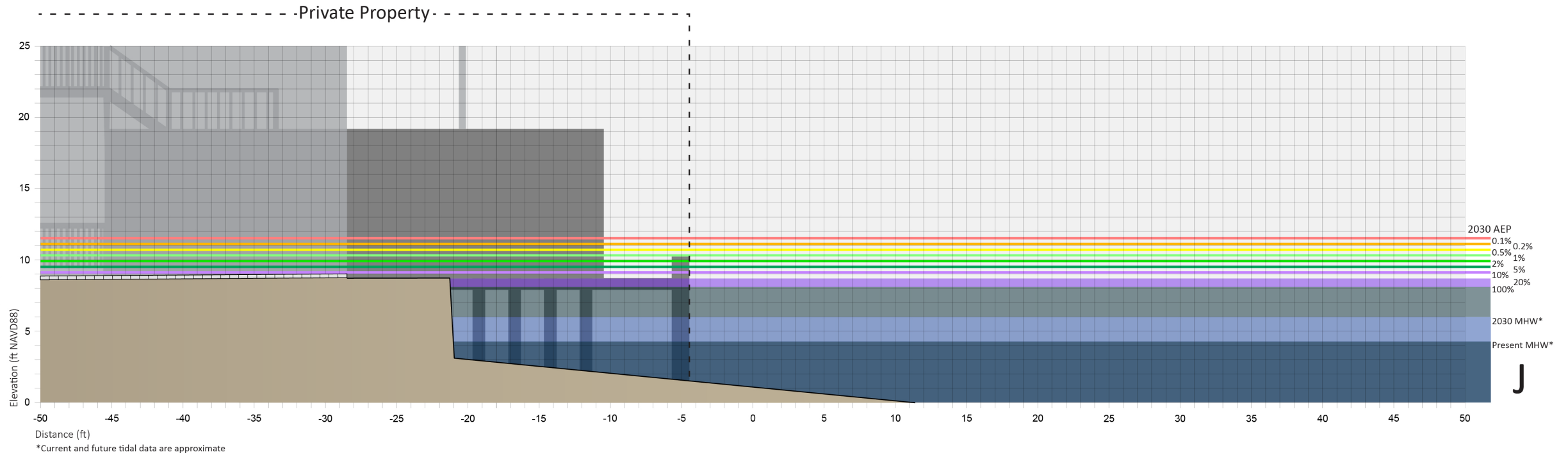
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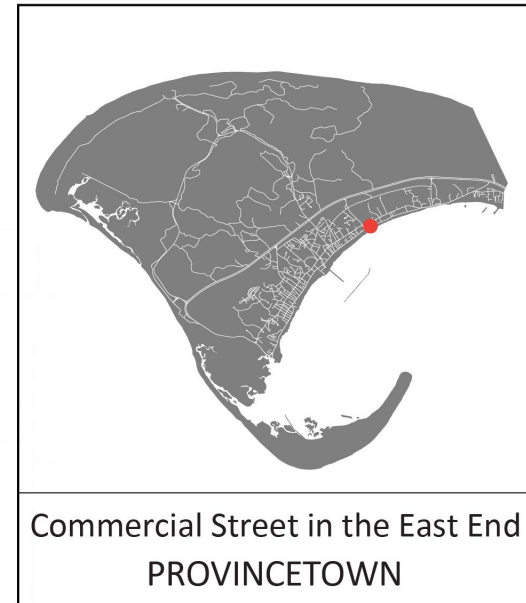
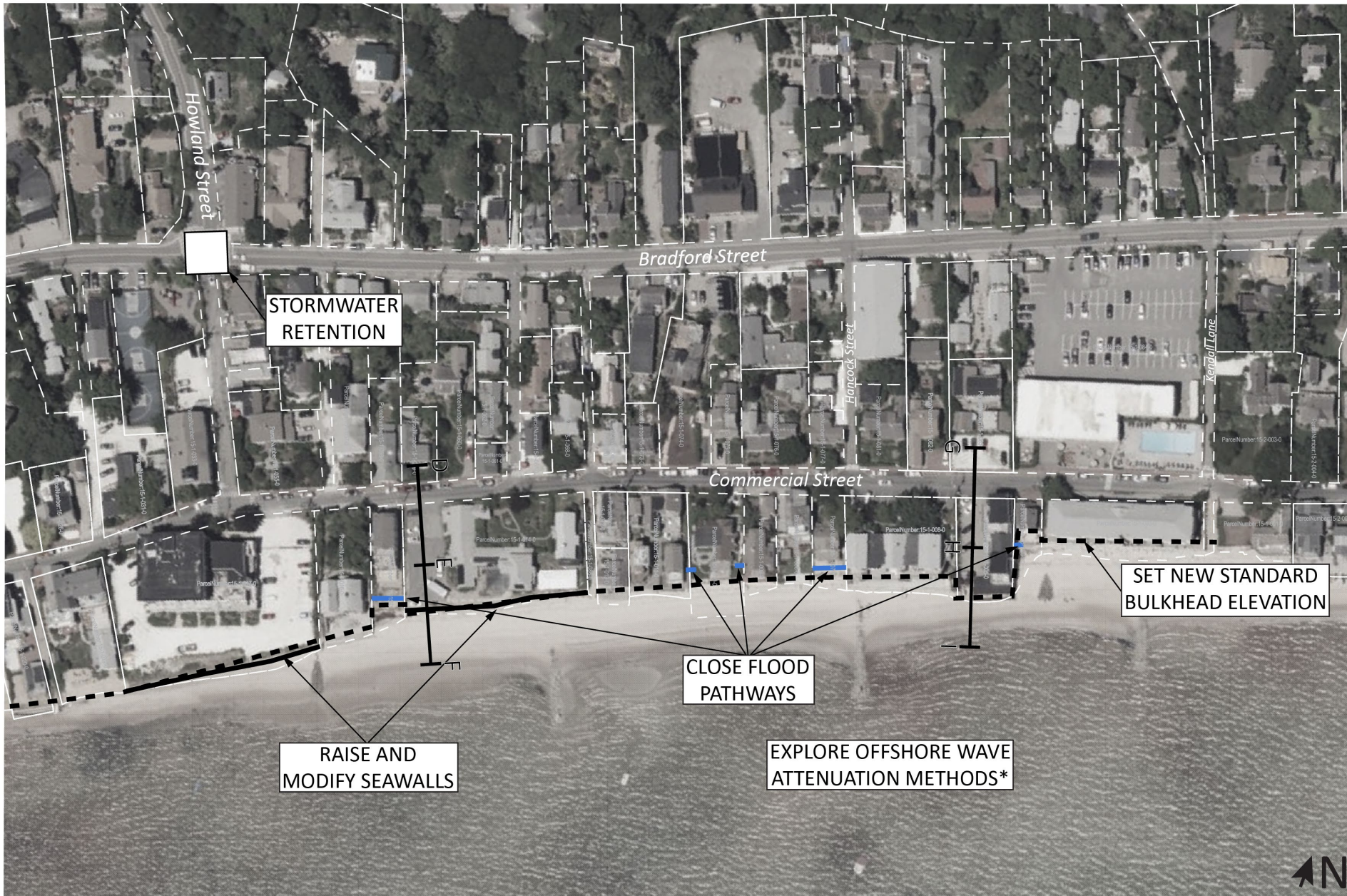
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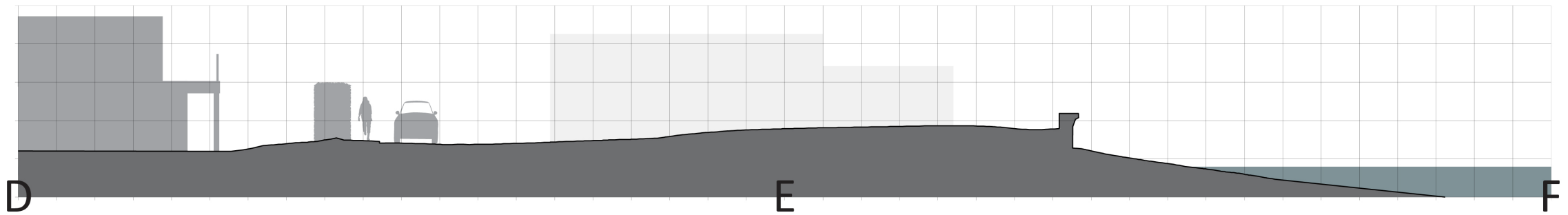
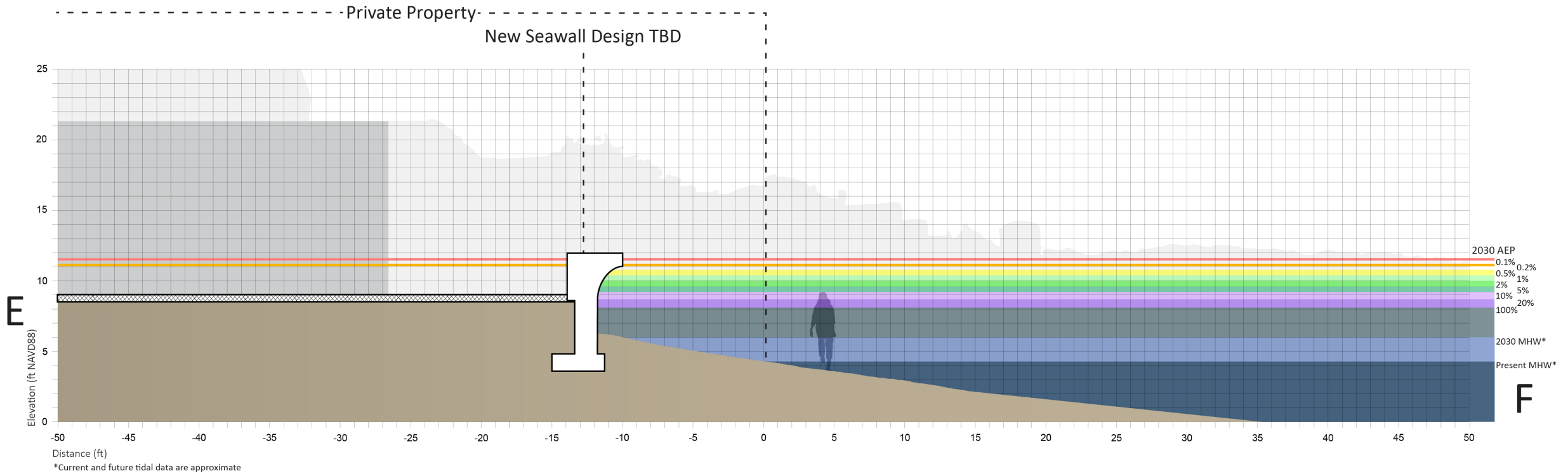


ALTERNATIVE 1: GRAY

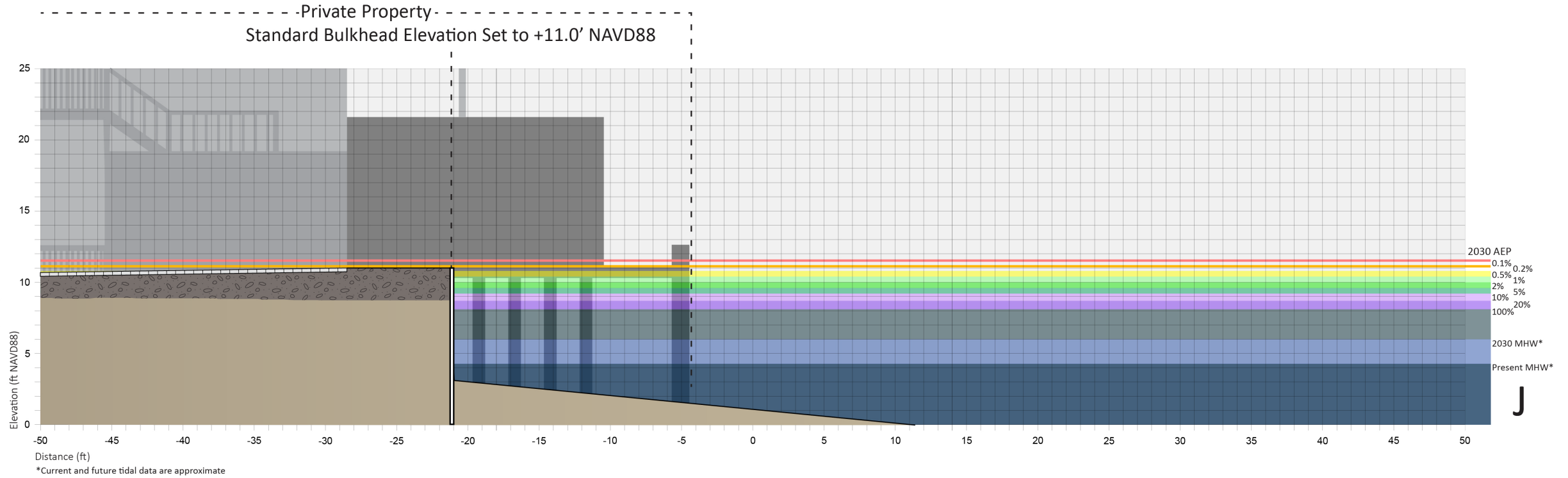
The seawalls at the Icehouse Condominiums and St. Mary of the Harbor are raised and modified to prevent overtopping. A stormwater retention tank is constructed under Bradford Street to mitigate rainwater flooding. Over time, the Town works with property owners to eliminate flood pathways while preserving water access, and a new minimum bulkhead elevation of +11.0' NAVD88 is set. This sets the standard that all repairs or bulkhead raisings must meet that minimum elevation.

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

*Element not included in costing, permitting, or flood reduction considerations.

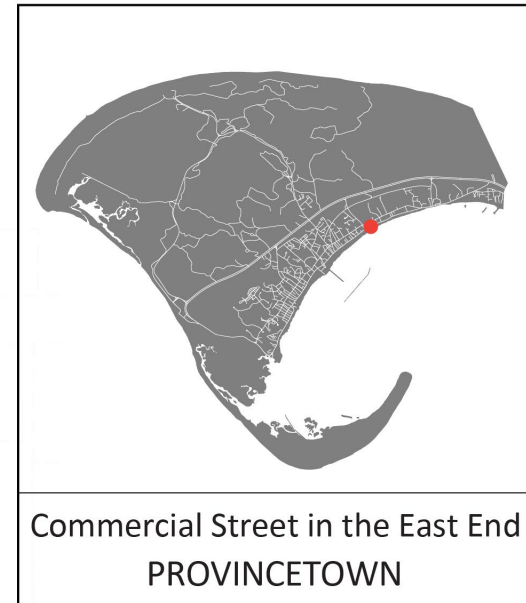


ALTERNATIVE 1: GRAY
 Commercial Street in the East End, Provincetown



ALTERNATIVE 1: GRAY

Commercial Street in the East End, Provincetown

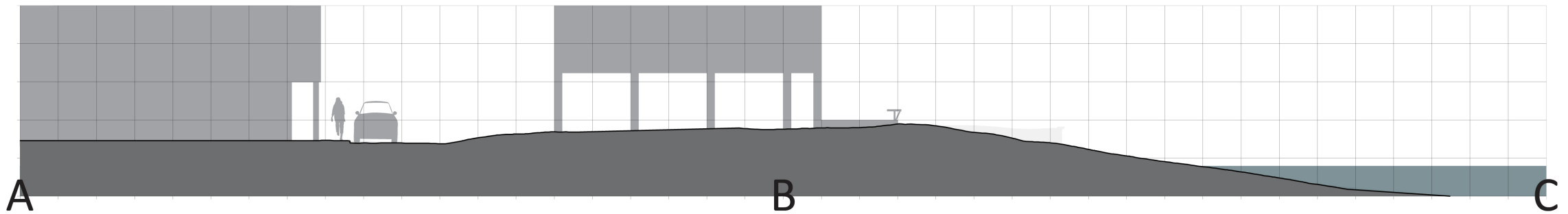
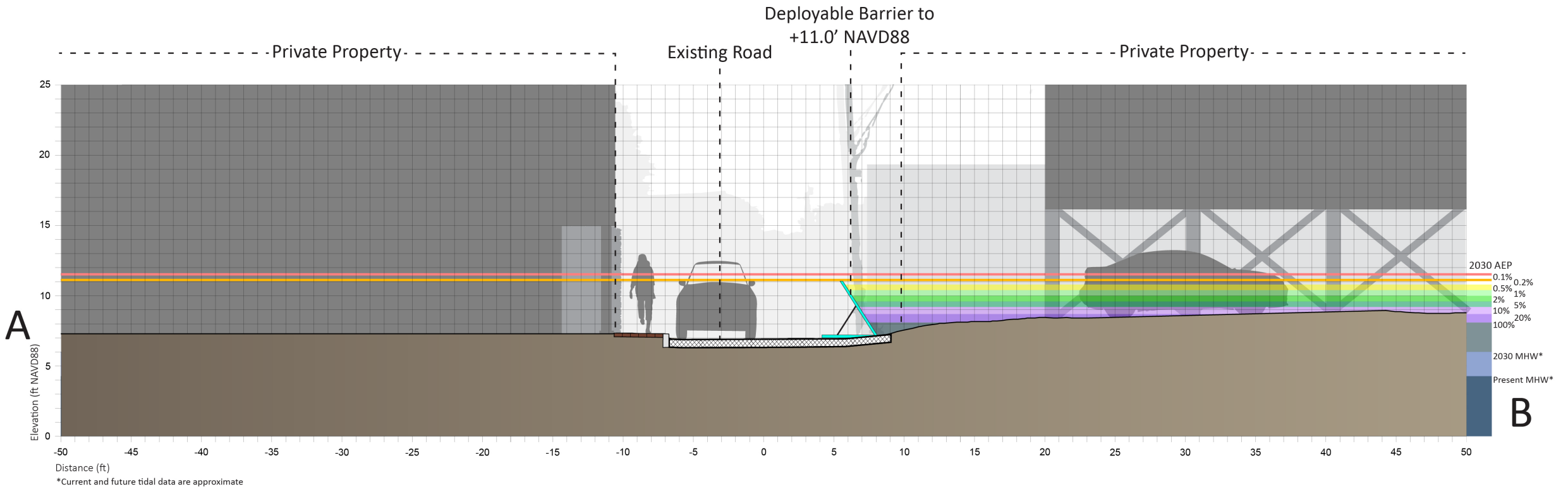


Commercial Street in the East End
PROVINCETOWN

ALTERNATIVE 2: DEPLOYABLE

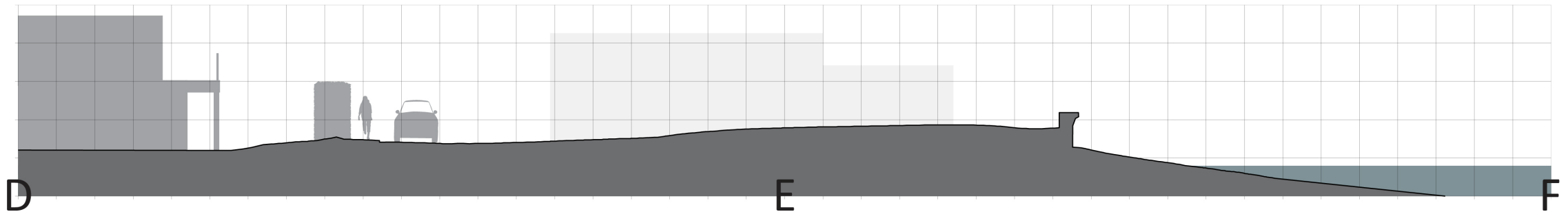
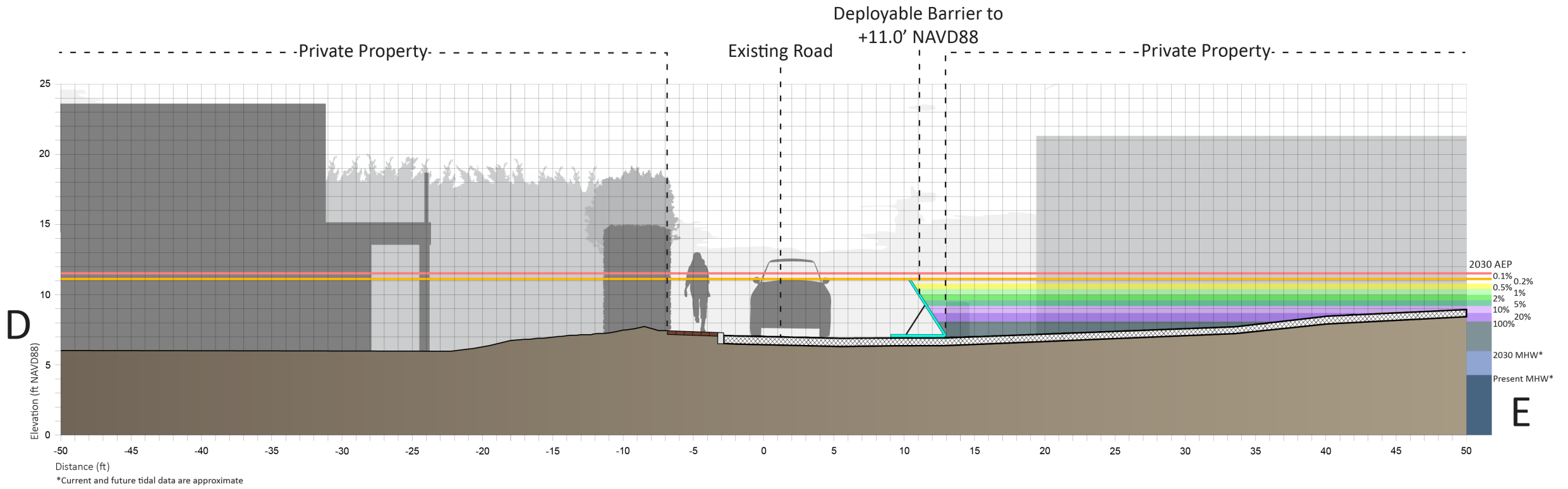
1100 linear feet of 48" tall deployable barriers protect the road to an elevation of +10.6' NAVD88. Parking is restricted during storm events in order to maintain a full travel lane while accomodating the barriers. In the long-term, segments of fixed wall and permanent gates reduce the amount of time and effort required to deploy barriers before storms.

Note: Project overlap with wetland areas, rights of way and property lines is approximate and needs confirmation with a site survey
 *Element not included in costing, permitting, or flood reduction considerations.

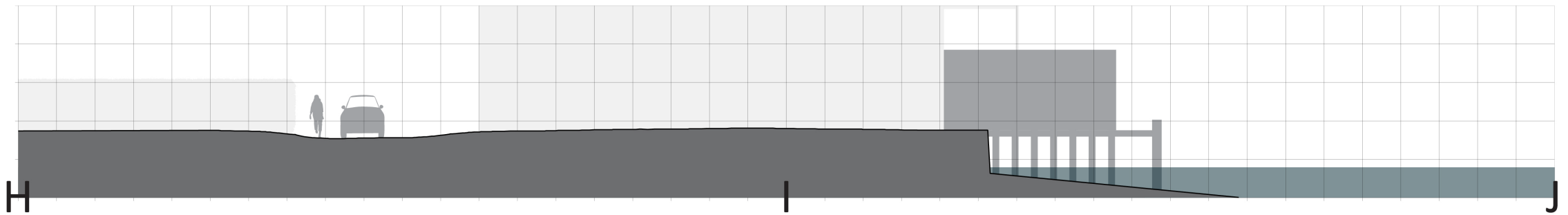
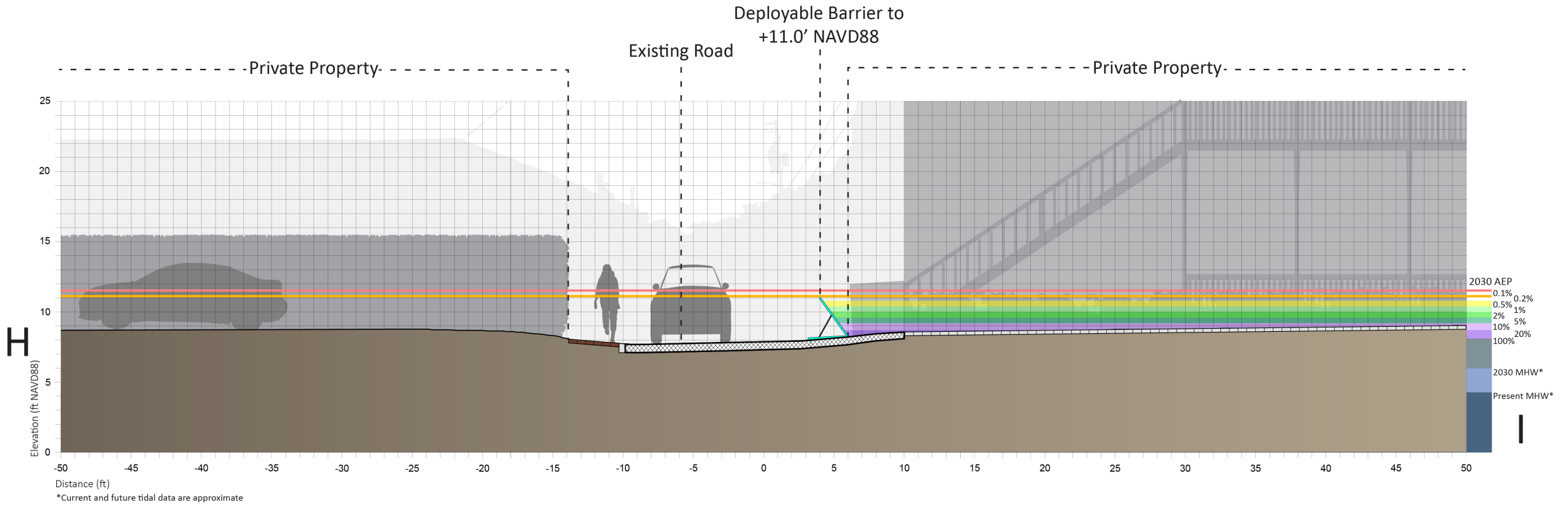


ALTERNATIVE 2: DEPLOYABLE

Commercial Street in the East End, Provincetown

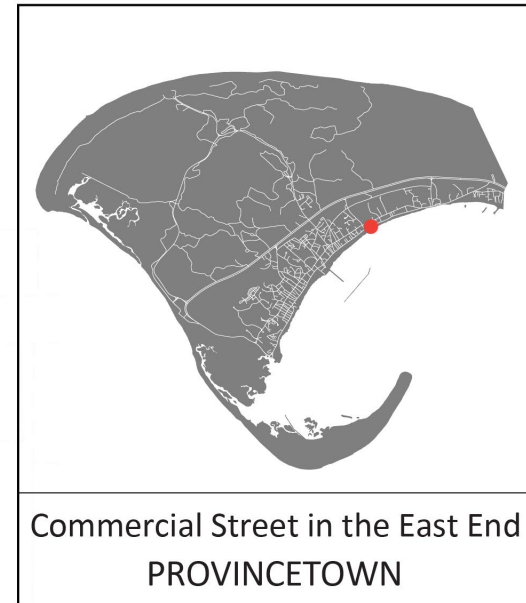


ALTERNATIVE 2: DEPLOYABLE
Commercial Street in the East End, Provincetown



ALTERNATIVE 2: DEPLOYABLE

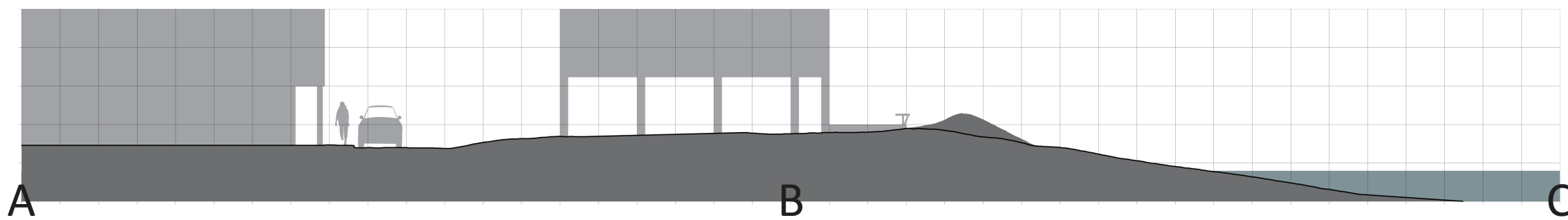
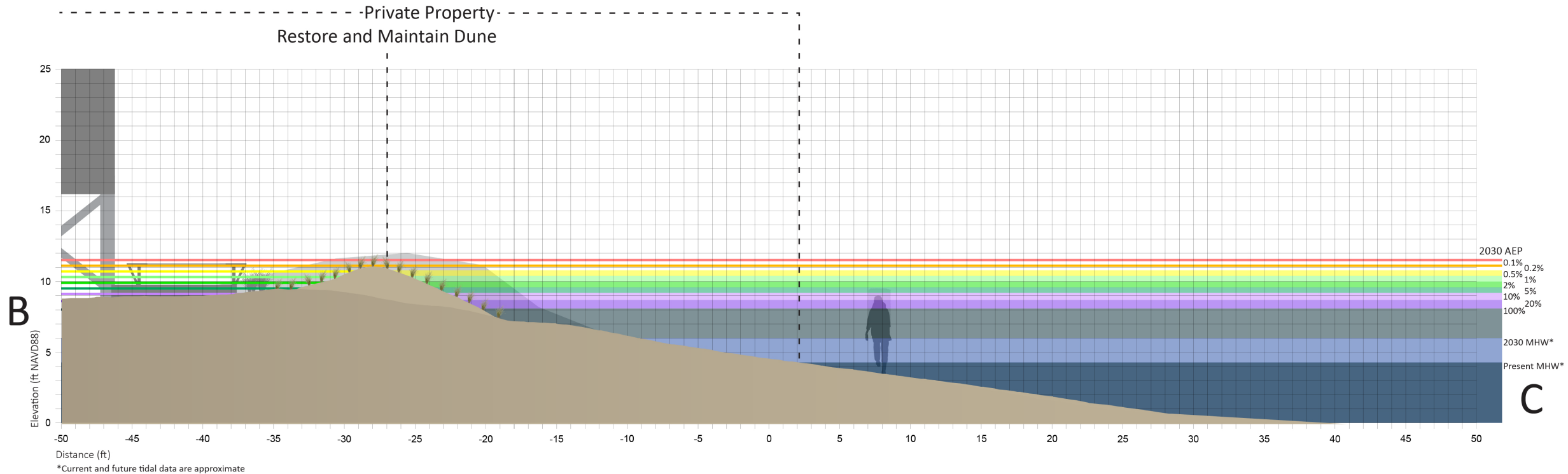
Commercial Street in the East End, Provincetown



ALTERNATIVE 3: GREEN

Bioretention areas are constructed around the Bradford Street intersection to help mitigate stormwater flooding. This strategy is most effective if additional private or public property can be identified for bioretention. In the long term, 14 waterfront properties are acquired to allow a dune to be restored to +11.0' NAVD88. In the interim, the existing dune is restored to an elevation of +8.7' NAVD88. Offshore wave attenuation structures could help prevent dune erosion.

Note: Project overlap with wetland areas, rights of way and property lines is approximate and needs confirmation with a site survey
 *Element not included in costing, permitting, or flood reduction considerations.



ALTERNATIVE 3: GREEN
Commercial Street in the East End, Provincetown

COMMERCIAL STREET IN THE EAST END, PROVINCETOWN

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	Mixed use stretch of Commercial Street in the East End.	6.6 feet	100%	100%	100%	2050	N/A	N/A	N/A
ALTERNATIVE 1: GRAY	The seawalls are raised and modified to prevent overtopping. A stormwater retention tank is constructed under Bradford Street to mitigate flooding. Over time, the Town works with property owners to eliminate flood pathways, and set a new minimum bulkhead elevation of +11.0' NAVD88.	11.0 feet	0.2%	5%	100%	No (assuming adequate stormwater storage and backflow prevention)	N/A	Moderate	\$1,100,000
ALTERNATIVE 2: DEPLOYABLE	1100 linear feet of 48" tall deployable barriers protect the road to an elevation of +10.6' NAVD88. In the long-term, segments of fixed wall and permanent gates reduce the amount of time required to deploy barriers.	10.6 feet	0.5%	10%	100%	2050	N/A	Temporary	\$448,000
ALTERNATIVE 3: GREEN	Bioretention areas are constructed around the Bradford Street intersection to help mitigate stormwater flooding. In the long term, 14 waterfront properties are acquired to allow a dune to be restored to +11.0' NAVD88. In the interim, the existing dune is restored to +8.7' NAVD88.	8.7 feet	20%	100%	100%	2050	Resource area restoration	Moderate	\$53,000+ (cost of maintenance not included)
		11.0 feet	0.2%	5%	100%	2050	Resource area restoration, buyouts	Severe	\$274,000+ (cost of buyouts not included)

*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



- **Commercial Street at Point Street**
- **Commercial Street in the East End**

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	<ul style="list-style-type: none">• 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))• <i>Different eligibilities apply for at-risk coastal infrastructure grants</i>
Eligible projects	<ul style="list-style-type: none">• 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	<ul style="list-style-type: none">• 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!



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