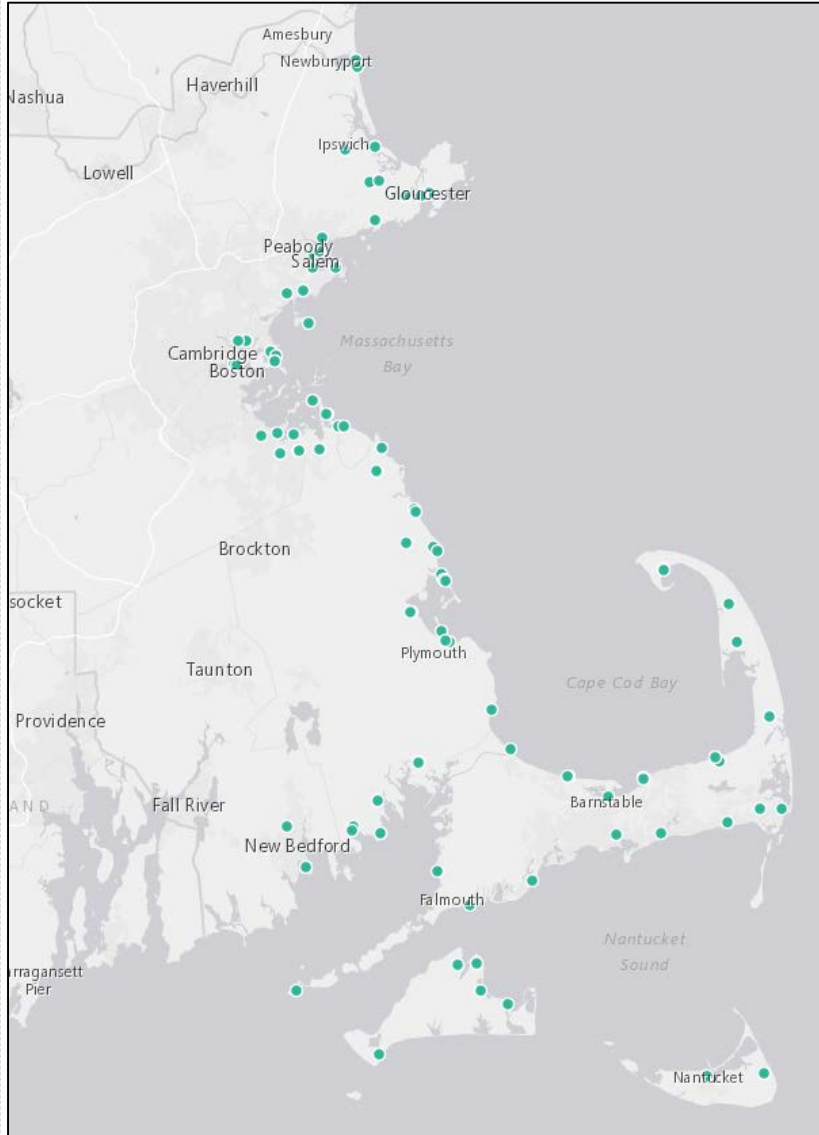


Planning, Design, Permitting & Public Education for Beach & Dune Nourishment at Critically Eroded Beaches in Marshfield & Duxbury



May 4, 2020

Overview



CZM Coastal Resilience Grant Program

*Questions & Comments:
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*Valerie Massard
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Project Goals & Funding

Explore ways to incorporate more resilient strategies for shore protection that will supplement the Town's existing approaches to shoreline management.

Project Funding: CZM Coastal Resiliency Grant

Project Cost: \$234,546

Grant Award: \$175,842

Town Match: \$58,704 (cash & in-kind services)

Grant Awarded: September 2019

Study Completion: June 30, 2020

Marshfield & Duxbury Today

- *Vibrant coastal communities*
- *Year-round and seasonal residents*



Source: marinas.com



Source: New England Air Photography

Coastline Characteristics



Development

- Single-family
- Commercial

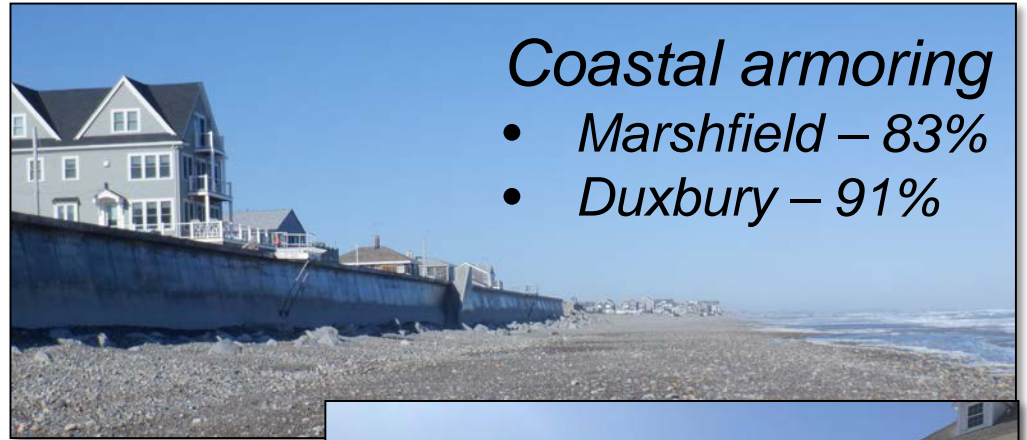
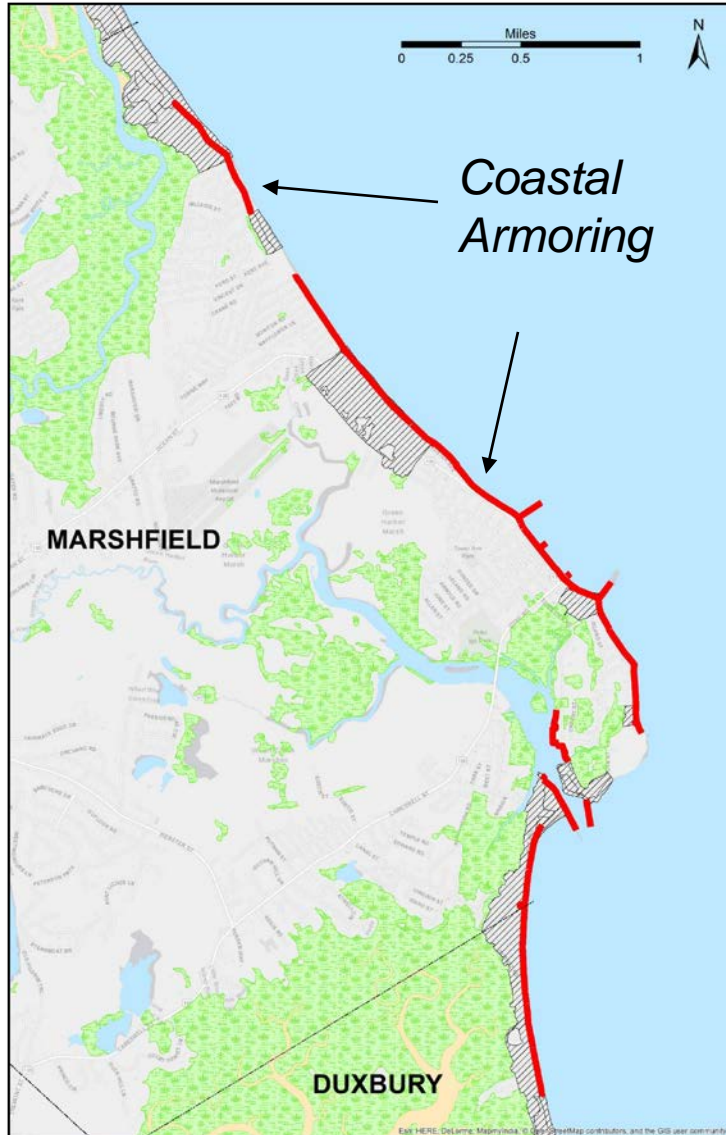


Source: Marshfield Mariner



Source: bostoncondos

Coastal Armoring



- Coastal armoring*
- Marshfield – 83%
 - Duxbury – 91%



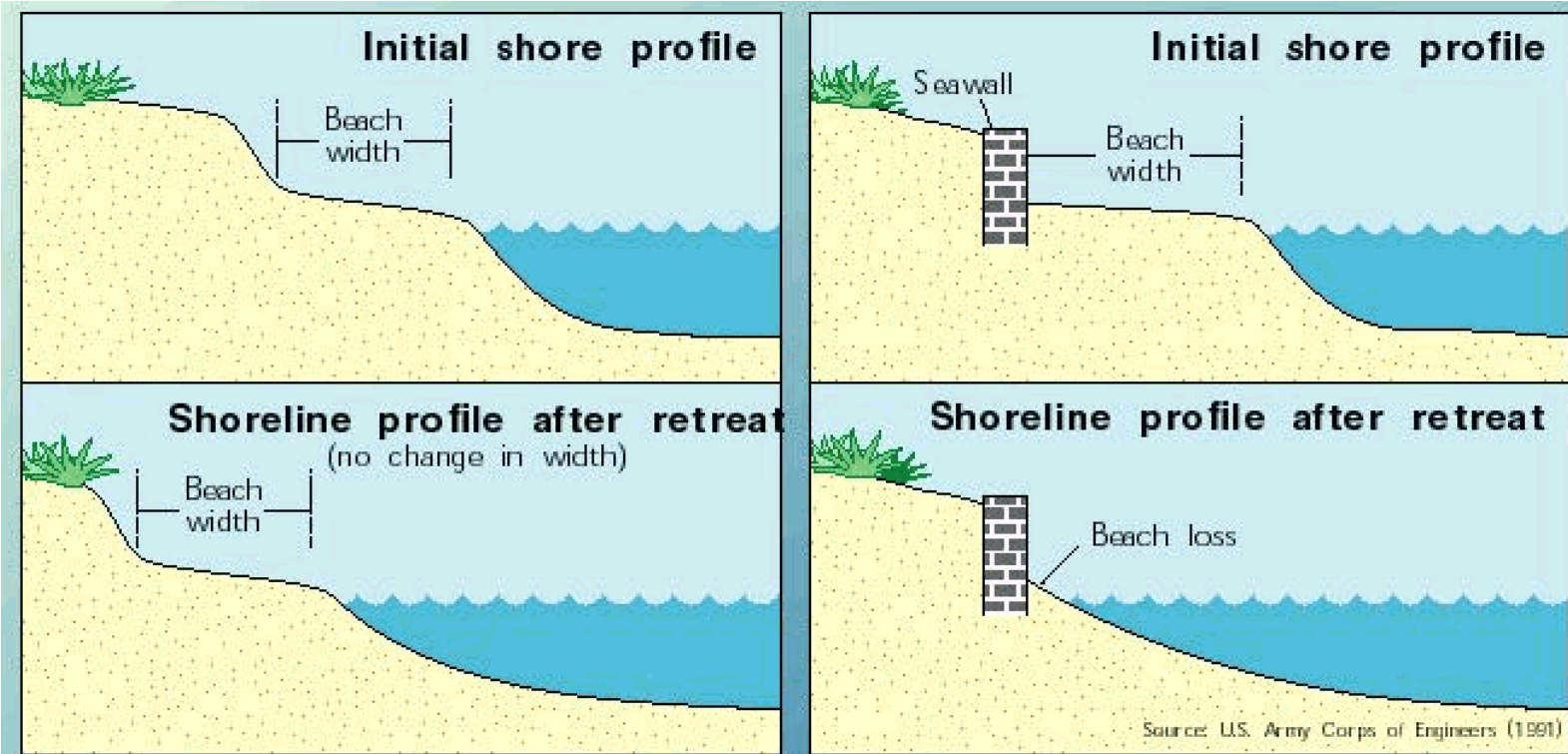
Source: CBS Boston

Coastal Armoring Impacts

- *Benefits: last line of defense for erosion*
- *Disadvantage: adversely impacts fronting beaches*

*Natural beaches:
maintain beach width & elevation*

*Armored shorelines:
beach narrows & elevation drops*



Coastal Armoring Impacts (cont.)

- Lower beach elevation → deeper water during storms
- Deeper water → larger waves impacting the walls
- Larger waves → more overtopping
- More overtopping → increased damage



History of Storm Damage

- FEMA Flood Insurance Claims*

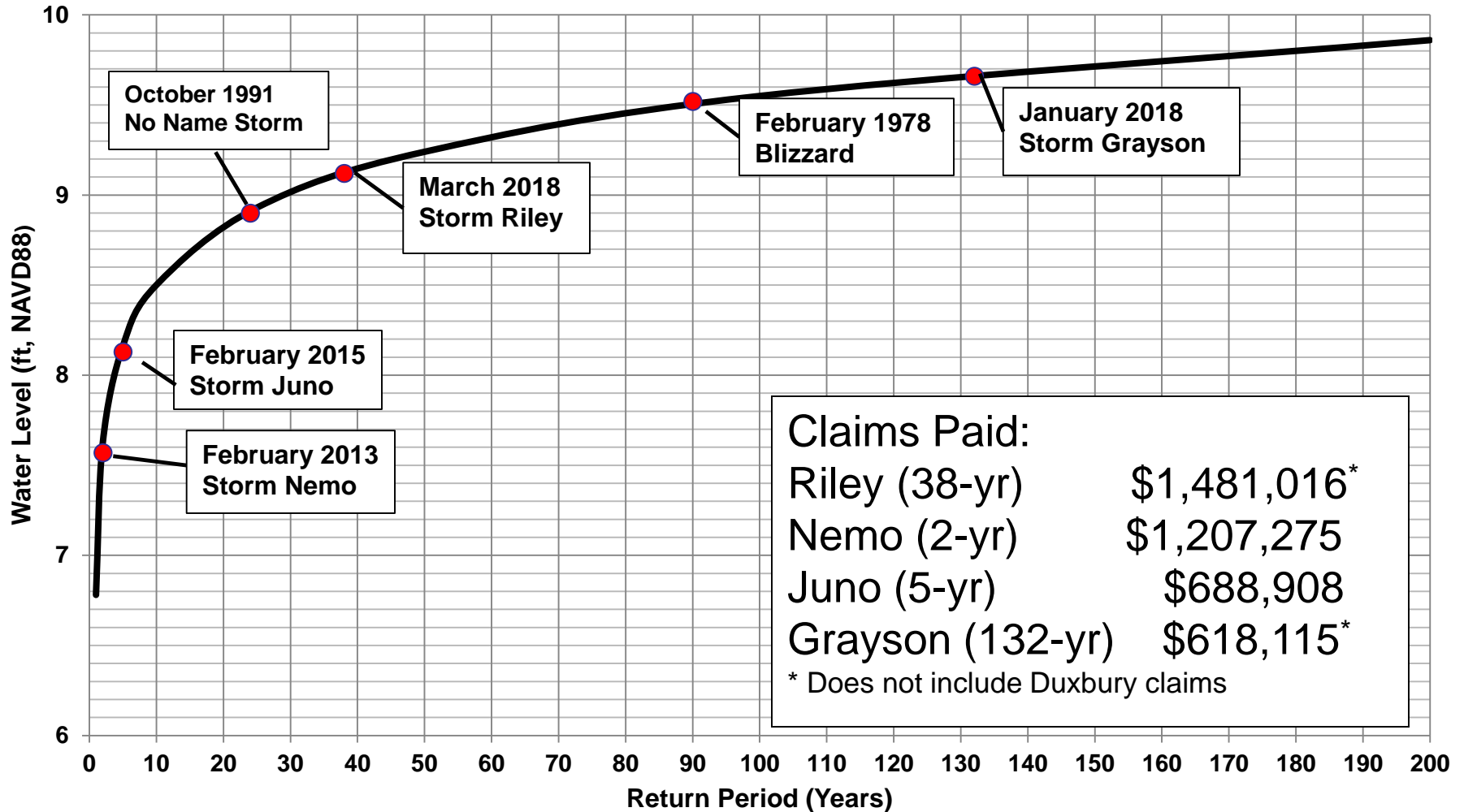
	Flood Insurance Claims Paid 1978 to 2017	# Repetitive Loss Properties as of 2009	# Repetitive Loss Properties as of 2017	Percent Increase
Marshfield	18.4 million	442	629	30%
Duxbury	5.8 million	121	179	32%
TOTAL	24.2 million			

- Jan. & Mar. 2018 Storms*
> 2.5 million in claims
Extensive seawall damage



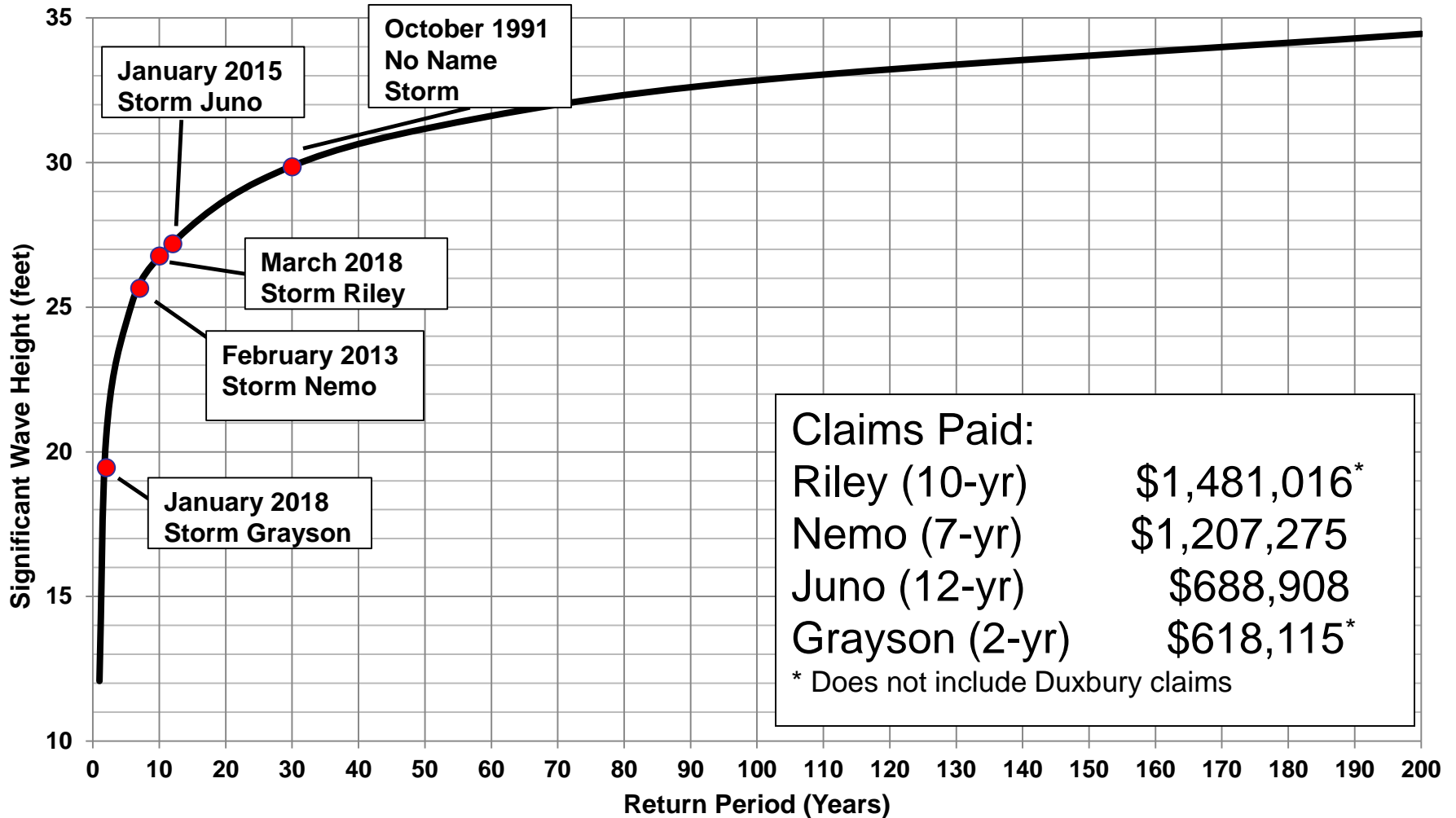
Storm Water Level vs. Damage

Storm Return Period - Based on Water Level



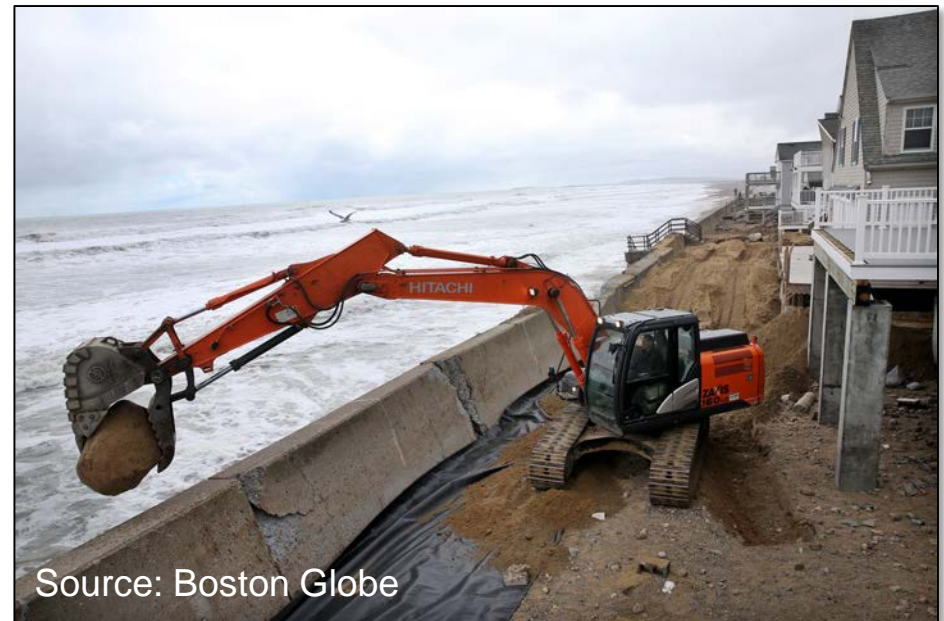
Storm Wave Height vs. Damage

Storm Return Period - Based on Wave Height



Current Management Approach

- *Maintain/repair shore protection structures*
- *Elevate/buy out structures*
- *Regulate development in high hazard areas*
- *Planning studies – MVP, CZM resiliency, etc.*



Costs Associated with Status Quo

	Projected Costs Over Next 30 Years			
Town	FEMA Repetitive Loss Claims	Seawall Repairs	Storm Related Public Services	Total
Marshfield	\$15.1 million	\$49.5 million	\$7.3 million	\$71.9 million
Duxbury	\$5.0 million	\$15.9 million*	\$5.5 million	\$26.4 million

* doesn't include costs for annual maintenance

- *Continued overtopping & damage to properties*
- *Continued risks to public safety*
- *Continued seawall damage*
- *Increased costs to repair/replace/maintain walls*
- *Potential loss of tax revenue*
- *Loss of beach for storm damage protection*
- *Loss of beach for recreation and wildlife habitat*
- *Decline in tourism*

Need for Increased Resiliency

Project Goal: ID Resilient Strategies that will

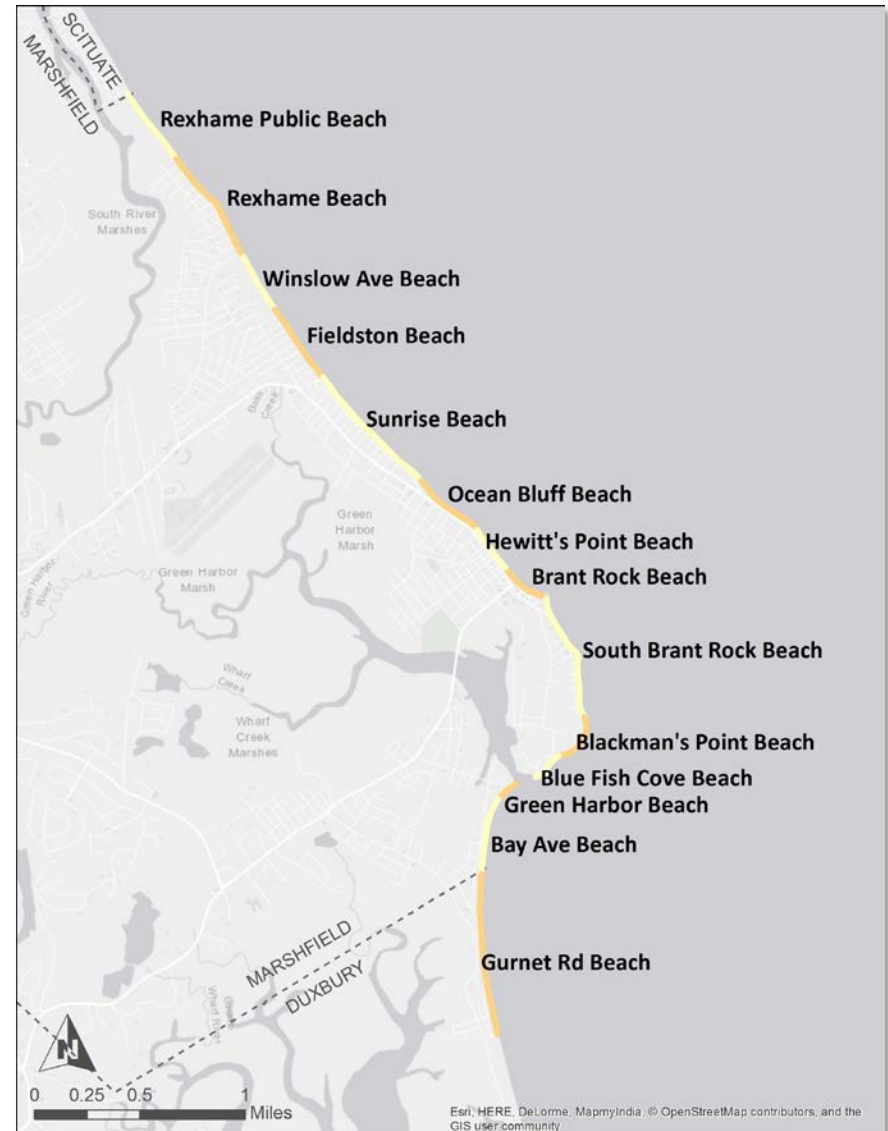
- *improve storm damage protection*
- *reduce damages caused by coastal flooding*
- *reduce wave-induced damages*
- *create resiliency to climate change*
- *augment current management approach*



Source: Shoreline Aviation

Shoreline Evaluation

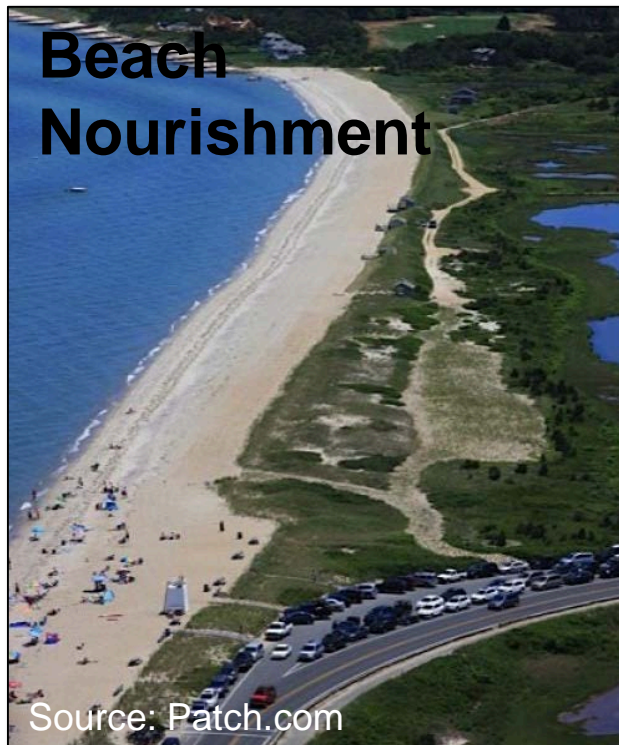
- **Natural beach & dune**
 - *Rexhame Public Beach*
 - *Winslow Ave*
 - *Green Harbor*
- **Seawalls**
 - *Fieldston & Sunrise*
 - *Hewitt's Point*
 - *Brant Rock*
- **Seawalls w/ revetment**
 - *Sunrise (south end)*
 - *Bay Ave*
 - *Gurnet Rd*
- **Revetments**
 - *Ocean Bluff*
 - *Hewitt's Point*



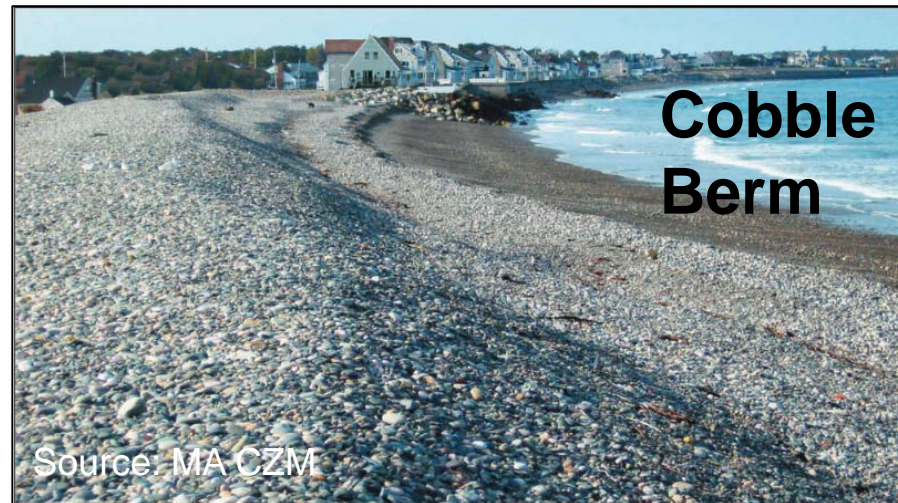
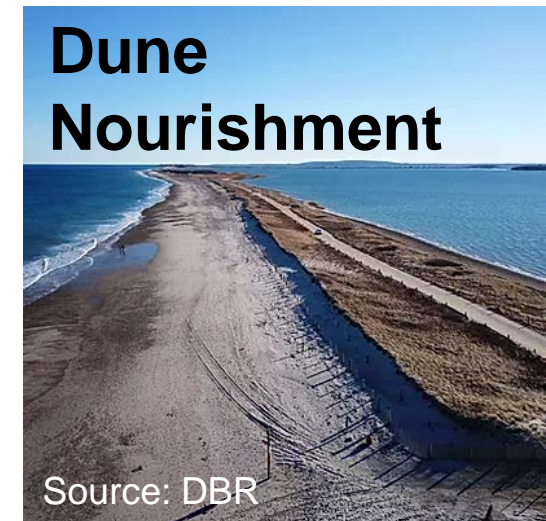
Resiliency Alternatives Considered

Traditional Nature Based Alternatives

- *Buffer to storm waves*
- *Restore sediment to the system*
- *Combine with coastal armoring*



- Require renourishment



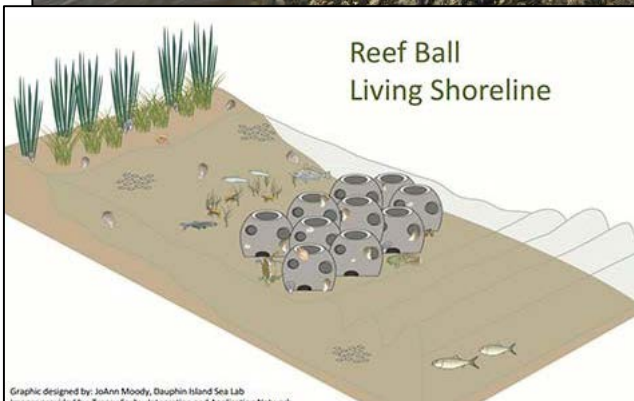
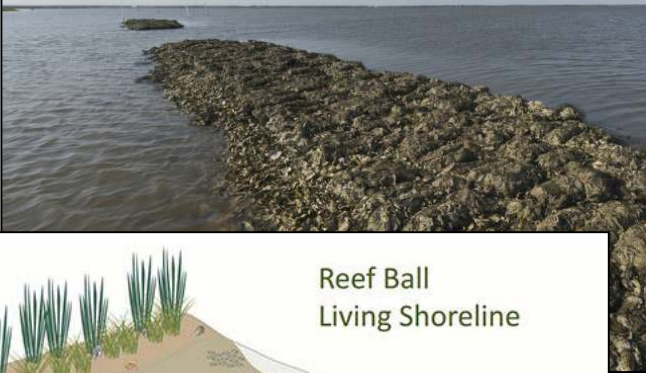
Resiliency Alternatives Considered

Hybrid Alternatives

- *Reduce wave energy*
- *Layered or individual*
- *Flexible adaptation over time*

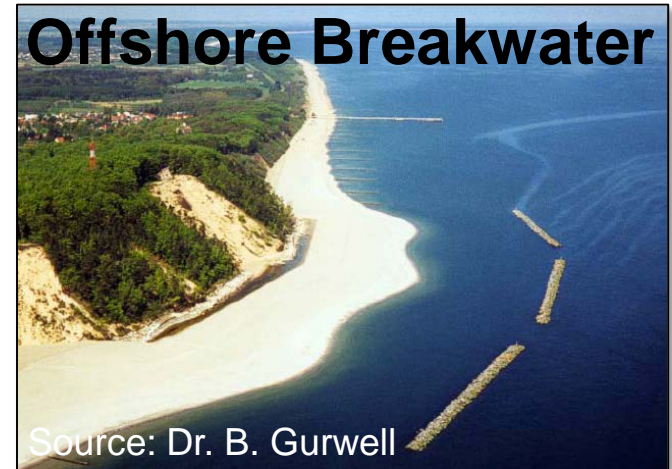
Offshore Reefs

Source: Univ. of California, 2018



Graphic designed by JoAnn Moody, Daughlin Island Sea Lab
Images provided by: Teagan Kealy, Intercession and Annapolis Network

Offshore Breakwater



Source: Dr. B. Gurwell

Intertidal Boulder Field

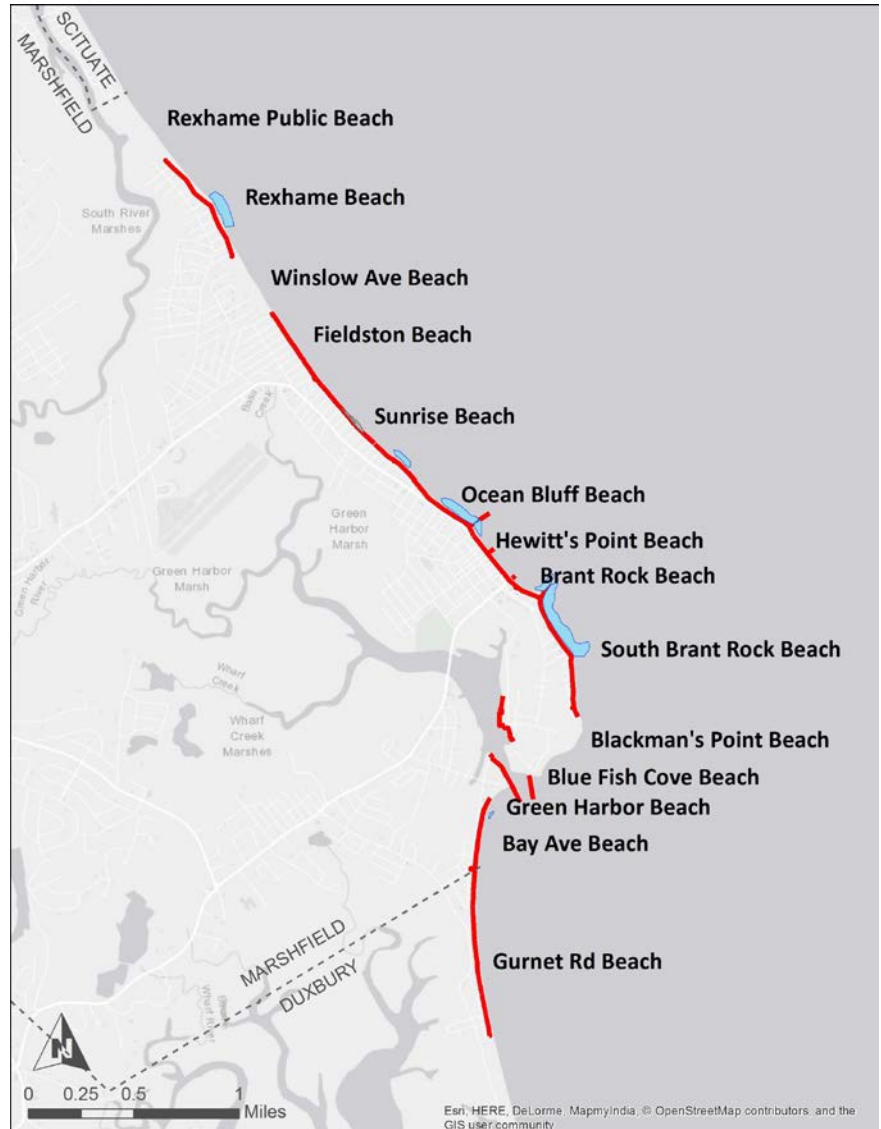


Source: UC Santa Cruz 2019

Evaluation of Alternatives

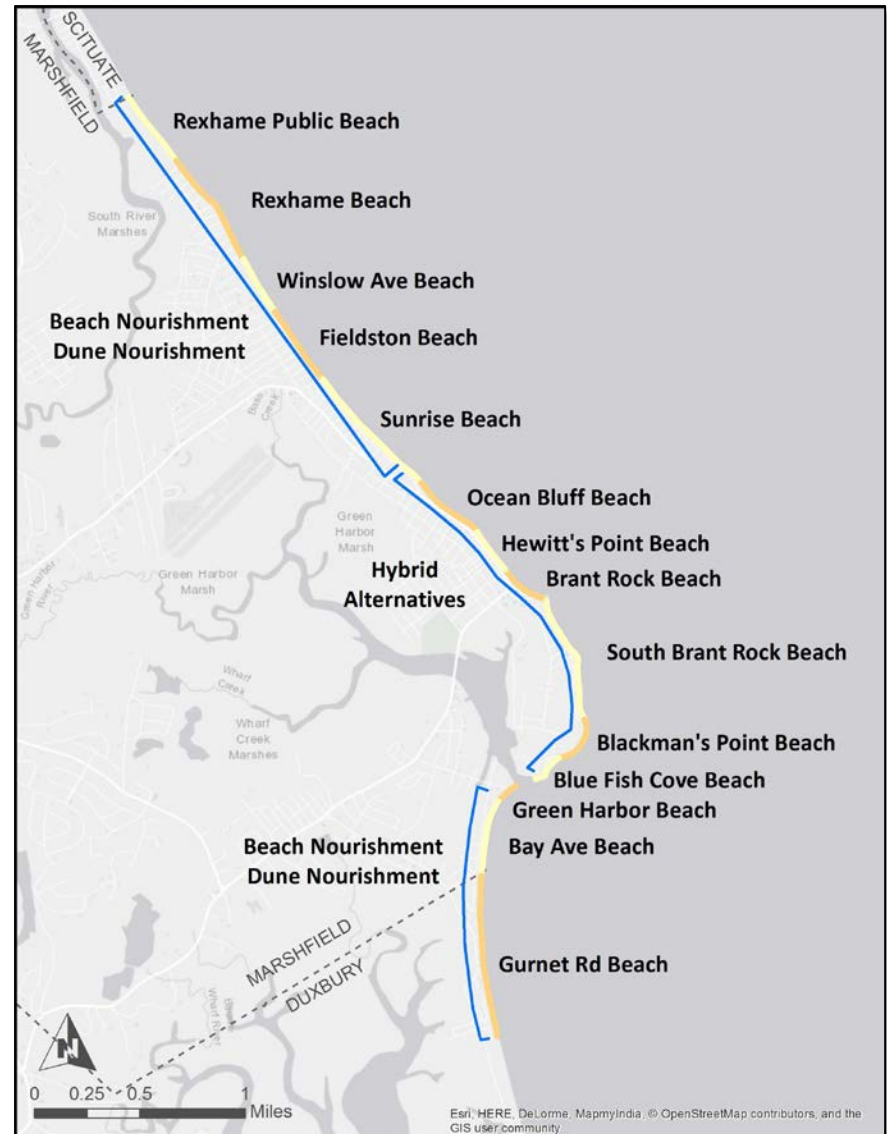
Evaluation Factors

- *Presence/absence of coastal armoring*
- *Beach width, slope, elevation, grain size*
- *Nearby sensitive coastal resources*
- *Directions of sediment transport*
- *Capacity to reduce storm damage & improve resiliency*

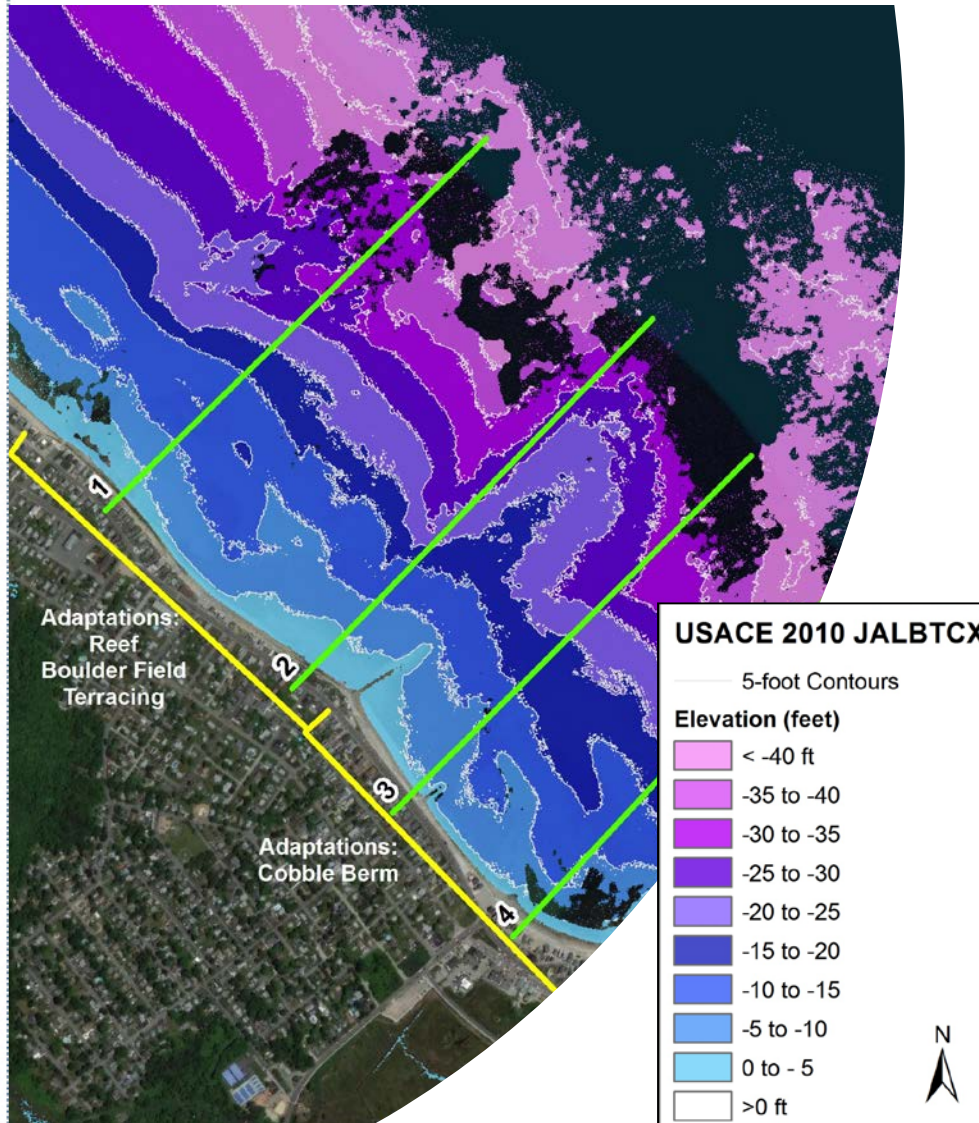


Alternatives Identified

- *Beach & dune nourishment*
 - *Rexhame Public Beach thru Sunrise Beaches*
- *Hybrid alternatives with co-benefits*
 - *Ocean Bluff through Blackman's Point Beaches*
- *Beach & dune nourishment*
 - *Bay Ave thru Gurnet Rd Beaches*



Ocean Bluff to Brant Rock

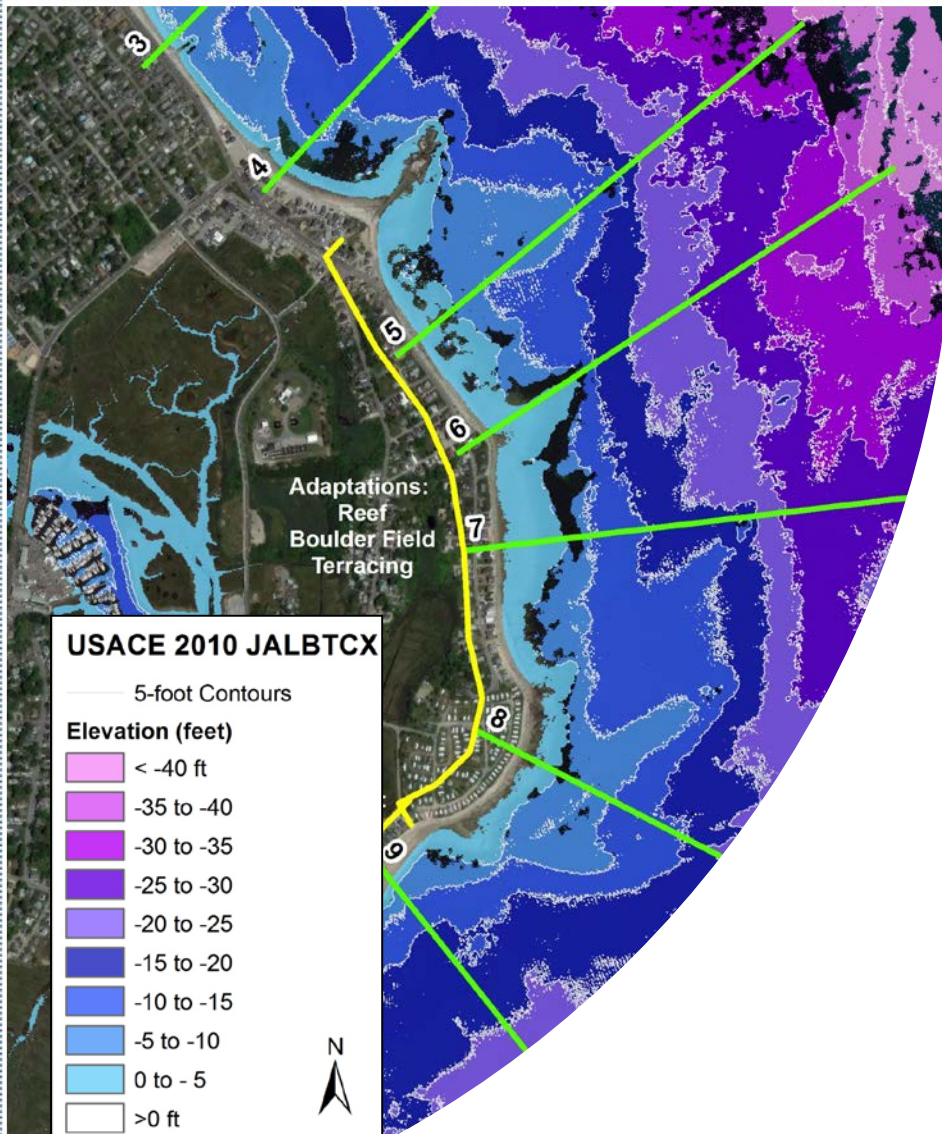


- Resilient building options with co-benefits (ecological habitat and coastal protection)
- Intertidal boulder field in water depths < 5 ft
- Nearshore reefs in water depths between 10 & 15 ft
- Enhance existing cobble berms and explore vegetative terraces

Ocean Bluff to Brant Rock

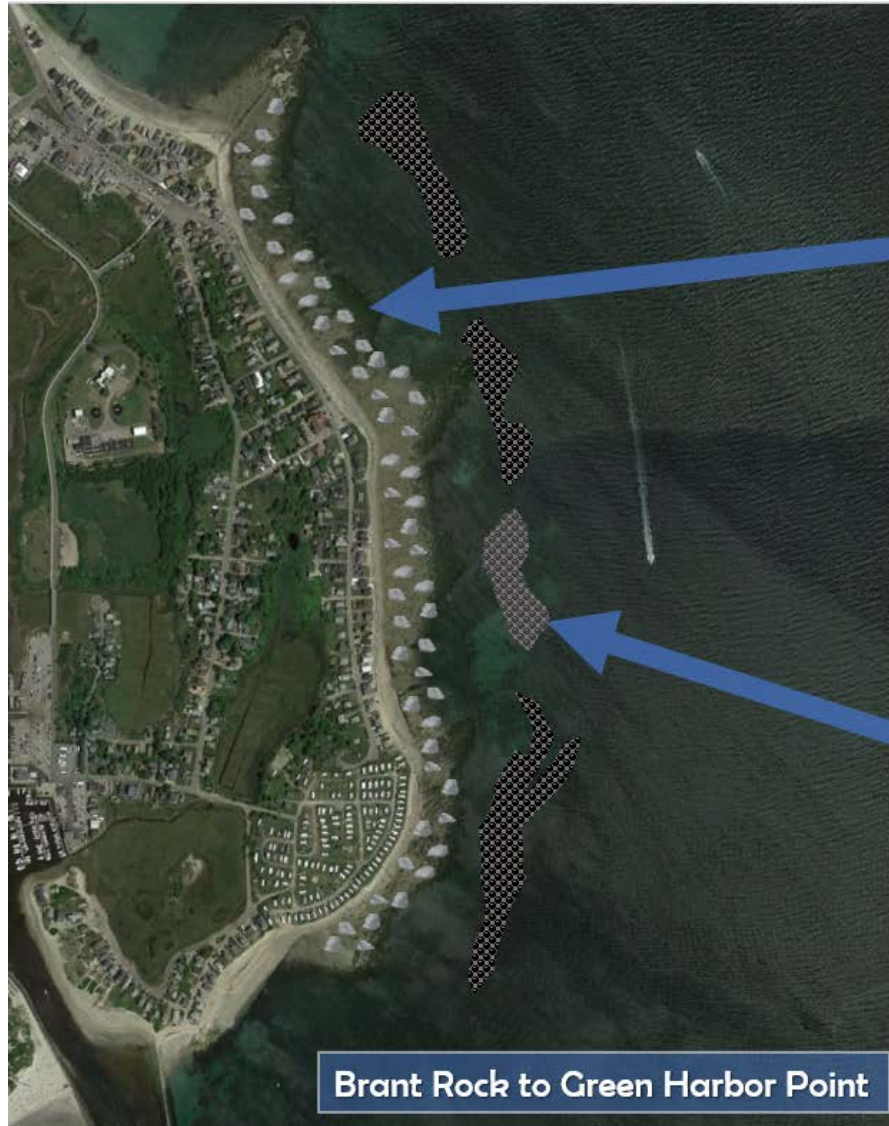


Brant Rock to Green Harbor



- Resilient building options with co-benefits (ecological habitat and coastal protection)
- Intertidal boulder field in water depths < 5 ft
- Offshore reefs in water depths between 10 & 15 ft

Brant Rock to Green Harbor



Brant Rock to Green Harbor Point



Intertidal Boulder Field



Offshore Reefs

Rexhame Beach to Sunrise Beach

Beach & dune nourishment:

- *2,950 & 6,980 ft long*
- *Avoids resources at Beadles Rock*
- *Rexhame volume 150,000 to 200,000 cubic yards*
- *Winslow-Sunrise volume 235,000 to 407,000 cubic yards*



Green Harbor to Gurnet Rd Beach

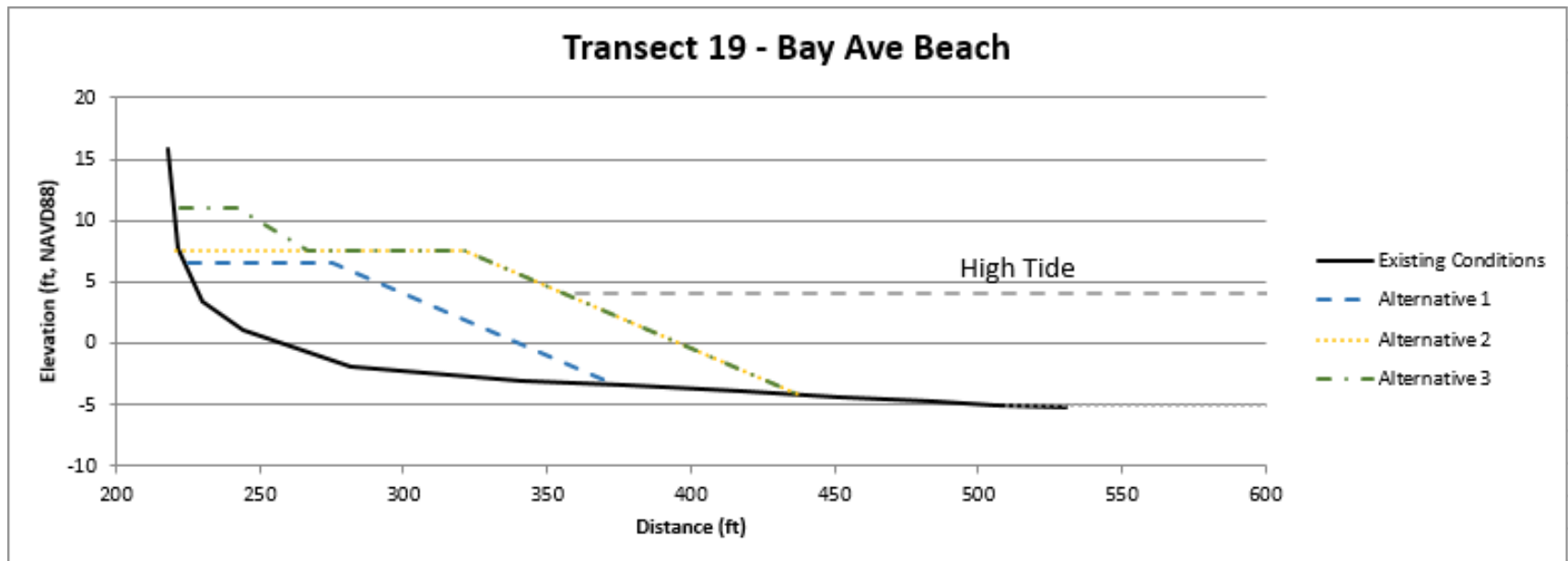
Beach & dune nourishment adaptation:

- *5,480 ft long*
- *74% in Duxbury*
- *26% in Marshfield*
- *310,000 to 470,000 cubic yards*



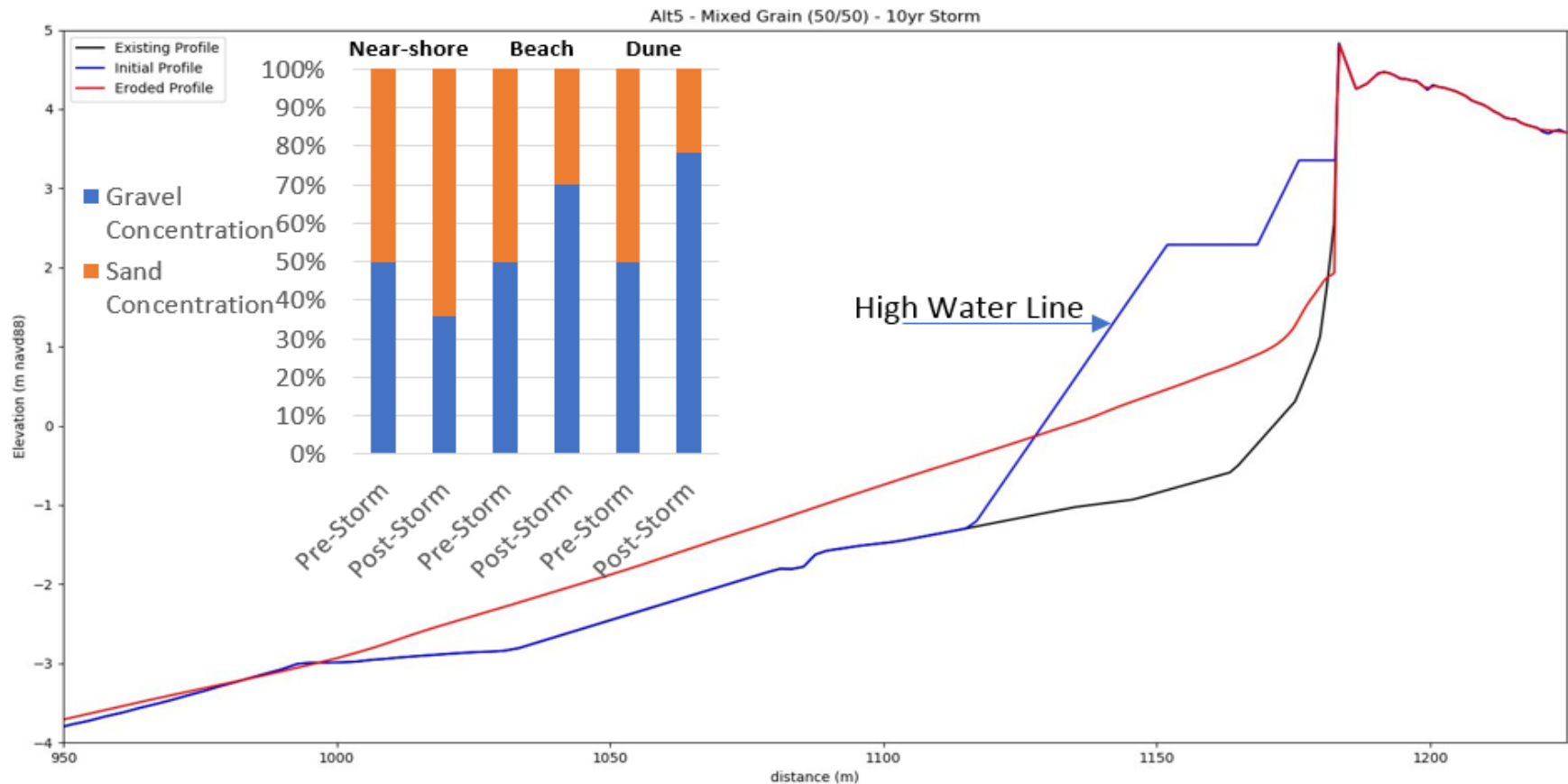
Alternatives for Nourishment

- **Alternative 1**
50 ft wide berm at elevation 6.5 ft; 10:1 slope to natural grade
- **Alternative 2**
100 ft wide berm at elevation 7.5 ft; 10:1 slope to natural grade
- **Alternative 3**
Dune at base of seawall added to Alternative 2



Beach Nourishment Performance

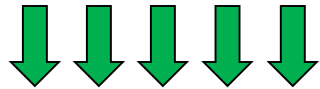
- *Numerical modeling of cross-shore transport*
 - *Mixed grain size (50% sand & 50% gravel)*
 - *Simulates composition of existing beach*



Reductions in Overtopping

Overtopping calculations

- existing vs. nourishment
- 10-yr storm
98% reduction
- Building damages reduced:
structural damage



minor damage to fences & posts

Table VI-5-6
Critical Values of Average Overtopping Discharges

q m ³ /s per m	Existing Conditions		Proposed Conditions			
	SAFETY OF TRAFFIC		STRUCTURAL SAFETY			
	VEHICLES	PEDESTRIANS	BUILDINGS	EMBANKMENT SEAWALLS	GRASS SEA-DIKES	REVTMENTS
10 ⁰						Damage even for paved promenade
10 ⁻¹	Unsafe at any speed	Very dangerous	Structural damage	Damage even if fully protected	Damage	Damage if promenade not paved
10 ⁻²				Damage if back slope not protected		
10 ⁻³				Damage if crest not protected	Start of damage	
10 ⁻⁴	Unsafe parking on horizontal composite breakwaters	Dangerous on vertical wall breakwaters	Dangerous on grass sea dikes, and horizontal composite breakwaters			No damage
10 ⁻⁵	Unsafe parking on vertical wall breakwaters	Uncomfortable but not dangerous	Minor damage to fittings, sign posts, etc.	No damage	No damage	
10 ⁻⁶	Unsafe driving at high speed					
10 ⁻⁷	Safe driving at all speeds	Wet, but not uncomfortable	No damage			

Next Steps

- *Finalize alternatives assessment*
- *Develop cost information*
 - *Cost for construction & maintenance*
 - *Compare costs to existing management*
- *Environmental permitting*
 - *File with MEPA by June 30*
 - *Grant funding available for remaining permitting*
 - *1 to 1.5 years to complete permitting*
- *Public outreach to property owners*
- *Ongoing public outreach*
 - *Public meeting and/or presentations*
 - *Planning department web site updates*

Questions & Comments

Greg Guimond - Marshfield Town Planner
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Valerie Massard - Duxbury Town Planner
Massard@town.duxbury.ma.us

Answers to Frequently Asked Questions:
www.Marshfield-ma.gov/planning-department

www.town.Duxbury.ma.us/planning-department