NATURE-BASED SOLUTIONS FOR COMMUNITY RESILIENCE ON

North Nantasket Beach

Public Meeting

April 24, 2019

North Nantasket Beach Resiliency

Agenda

1. Team Introductions – *Who are we?*
2. Project Background – *Why are we here? What are the issues?*
3. Project Overview – *What are we trying to do and why?*
4. Coastal Processes – *What happens out there?*
5. Existing Beach and Dune Conditions – *What is it like out there?*
6. Dune Rehabilitation and Beach Nourishment – *What? Why?*
7. Discussions – *Your turn!*
8. Next Steps – *How are we going to use this information?*

Team Introductions

Project Working Group

Town of Hull

- Philip E. Lemnios, Town Manager
- Christian Krahforst, Conservation Administrator
- Jim Dow, Director of Public Works
- Chris Dilorio, Director of Community Development and Planning
- David MacDougall, Beach Management Committee

Consultants

- Julie Conroy, AICP, Kleinfelder
- Nasser Brahim, Kleinfelder
- Kirk Bosma, PE, Woods Hole Group
- M. Leslie Fields, CFM, Woods Hole Group

Partners

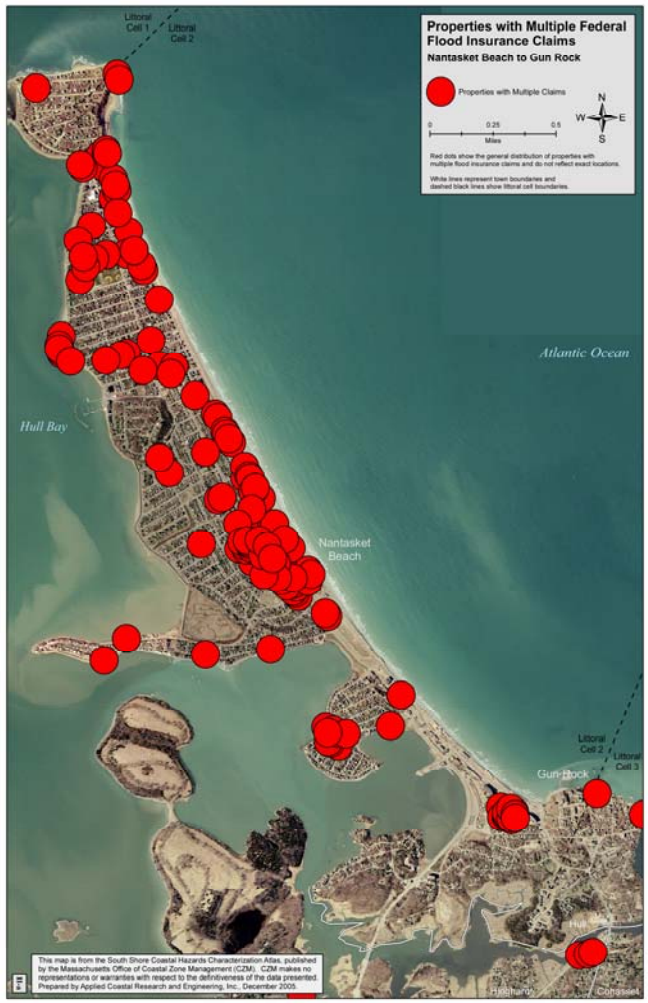
- Rebecca Haney, MA CZM
- Jason Burtner, MA CZM
- Patricia Bowie, MA CZM

Project Background

Past Flooding and Storm Damage in Hull

Historic Flooding

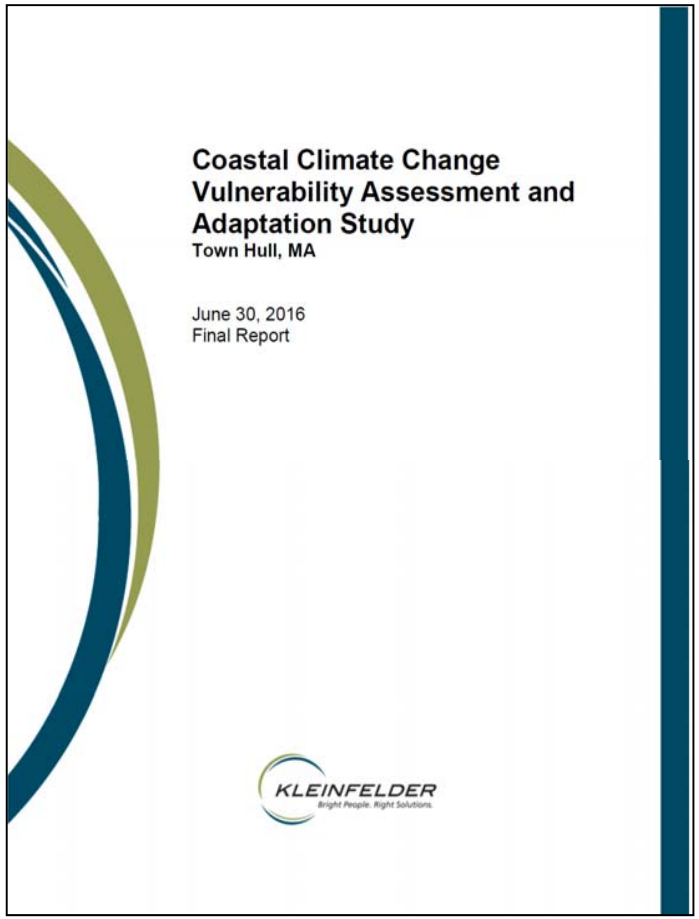
- Hull has the **3rd highest** number of repetitive loss claims in the state
- About 1/3 of Hull's claims are landward of North Nantasket Beach
- About $10 million in National Flood Insurance Program claims paid
- Damage and losses would be much higher if not for the barrier beach and dune

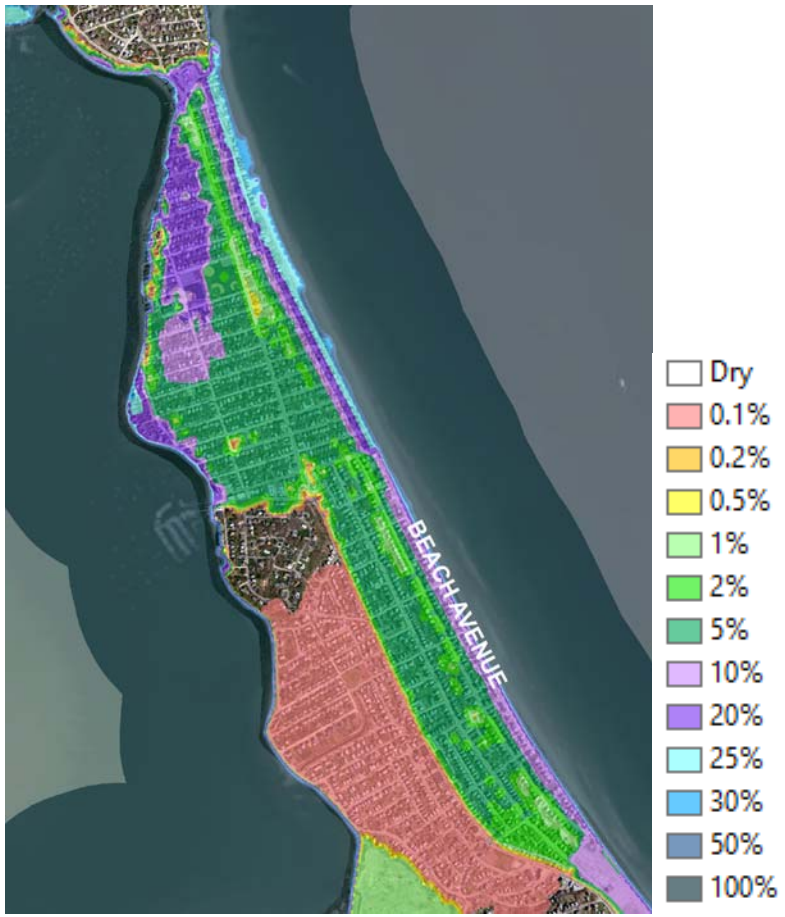


CZM South Shore Coastal Hazards Characterization Atlas, 2005

Project Background

Climate Change Vulnerability & Adaptation Study (2016)





Dunes/beach are the first line of defense from sea level rise and coastal storms!

Climate Change Vulnerability & Adaptation Study (2016)

North Nantasket Dunes and Beach

Key Findings

- High public safety, economic, and environmental consequences of failure
- High probability of failure
- High risk
- High priority

Table 12. Vulnerable Municipal Assets' Consequence Scores, Probabilities of Flooding, and Risk Scores

(Colors indicate which risk score quartile the asset is in for the given time horizon. Red = High, Orange = Moderate-High, Yellow = Moderate-Low, Green = Low. In addition, Pink = High risk score with very low consequence)

Asset Name/Number	Conse-quence Score	Present Probability (%)	Present Risk Score	2030 Probability (%)	2030 Risk Score	2070 Probability (%)	2070 Risk Score	Composite Risk Score
Hull Sewer Plant	92	0.1	9	1	92	50	4583	949
Barrier Dunes (Alphabet Streets)	88	20	1750	25	2188	100	8750	3281
Barrier Dunes (Lewis St)	88	10	875	25	2188	100	8750	2844
Barrier Dunes (Phipps St to Malta St)	88	5	438	10	875	100	8750	2231
Hull Memorial Middle School & Emergency Ops Center	79	1	79	2	158	100	7917	1670
Hull High School	71	0	0	0	0	10	708	142
A Street Fire Station	63	0	0	0.5	31	30	1875	384
Municipal Light Dep't	58	0.5	29	5	292	100	5833	1269
DPW Barn	58	0	0	0.2	12	30	1750	354
Spring Street	54	10	542	30	1625	100	5417	1842
Main Street (S Main St to Windmill Point)	54	10	542	25	1354	100	5417	1760
Nantasket Ave (V St to Fitzpatrick Way)	54	1	54	20	1083	100	5417	1435

Table 13. Loss of Beach Width on North Nantasket Beach from Sea Level Rise

Road Intersection	Beach Width (ft.)		Loss of Beach Width by 2070	
	Present	2070	ft.	%
Malta Street	525	390	135	26
A Street	520	400	120	23
T Street	340	230	110	32

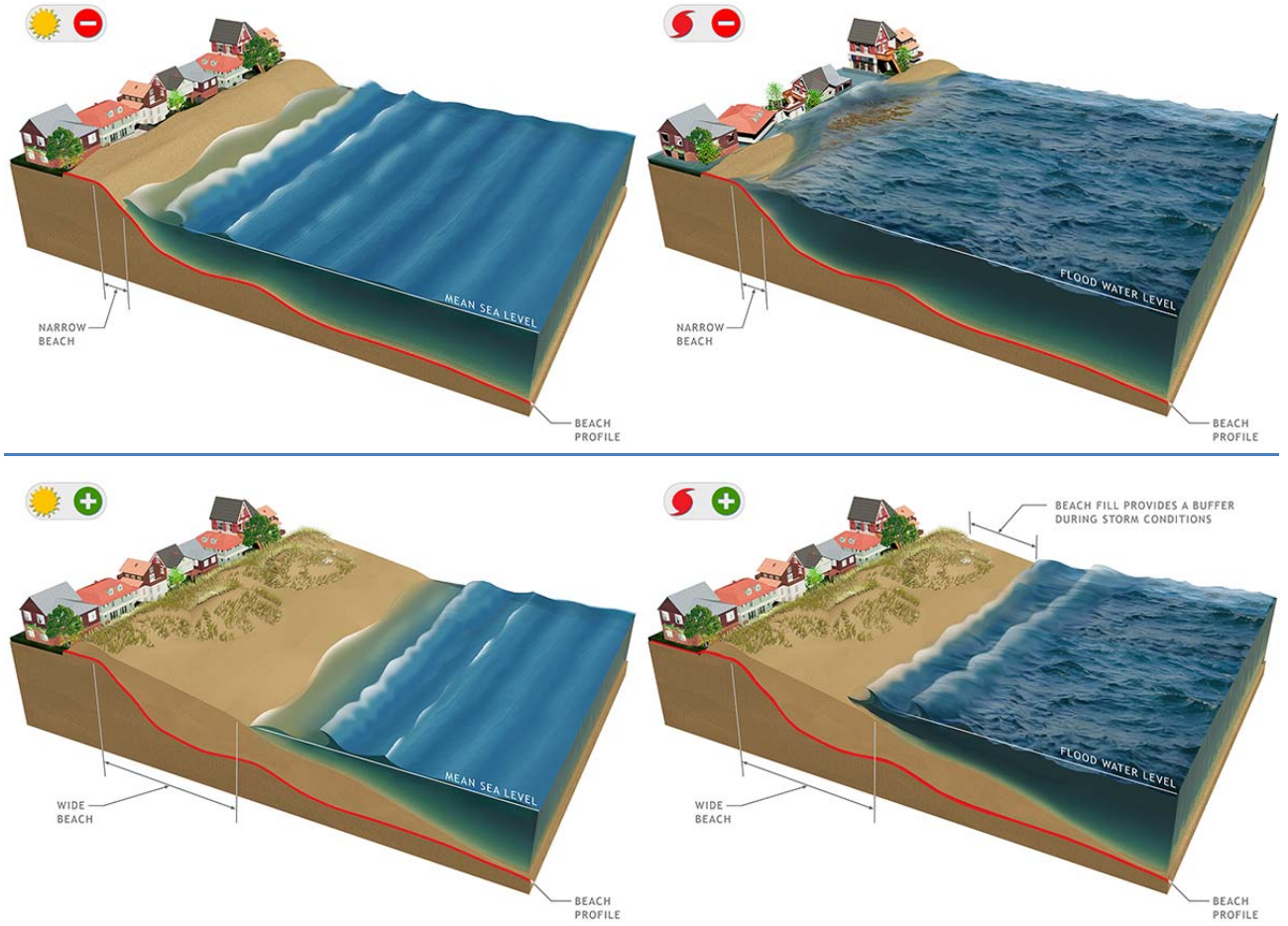
Climate Change Vulnerability & Adaptation Study (2016)

Dune & Beach Enhancement Strategy

Key Findings

Substantial and multiple potential benefits:

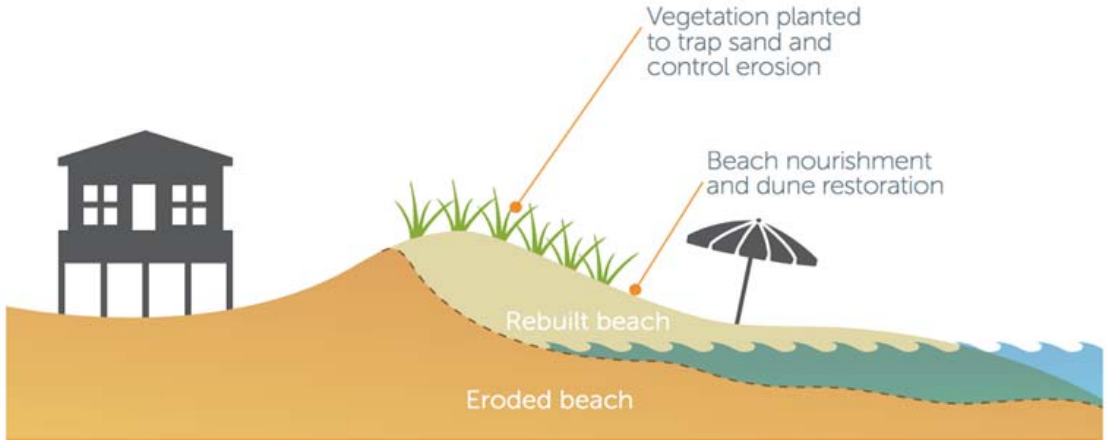
- Mitigate storm surge flooding
- Absorb wave energy
- Protect from erosion and sediment loss
- Enhance recreation, tourism, and habitat



Project Overview – North Nantasket Beach

Project Goal and Tasks

Goal: Build long-term resilience by enhancing the natural storm-damage protection function of the North Nantasket barrier dune and beach system.



Task 1: Stakeholder Engagement

- Working Group
- Charette and open house
- Public presentation

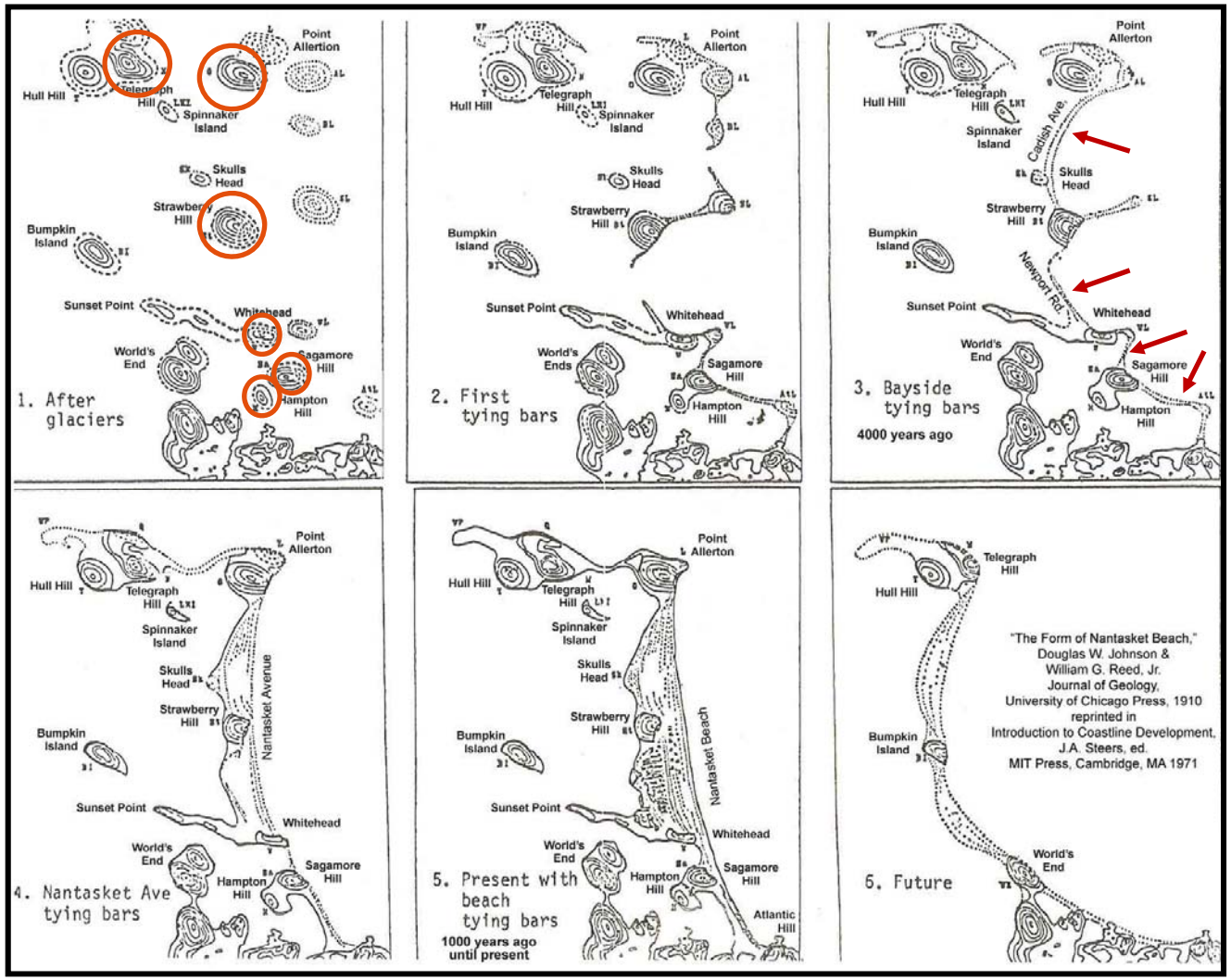
Task 2: Near-Term Dune Rehabilitation Strategies

- Dune crossings
- Patios and other infrastructure
- Sediment, grading, and vegetation

Task 3: Large-Scale Beach & Dune Nourishment Planning

- Wave and sediment transport modeling
- Design alternatives and performance
- Permitting and costs

History of Nantasket Beach



Nantasket Beach is a Complex Tombolo

- Series of Drumlin Islands
- Land Bridges
- Historically Accretionary (contributions from offshore deposits)
- Anthropogenic Activities
  - Railroad (1880)
  - Seawalls and bulkheads (1900s)
  - Beach Maintenance activities
  - Additional armoring
  - Ongoing development

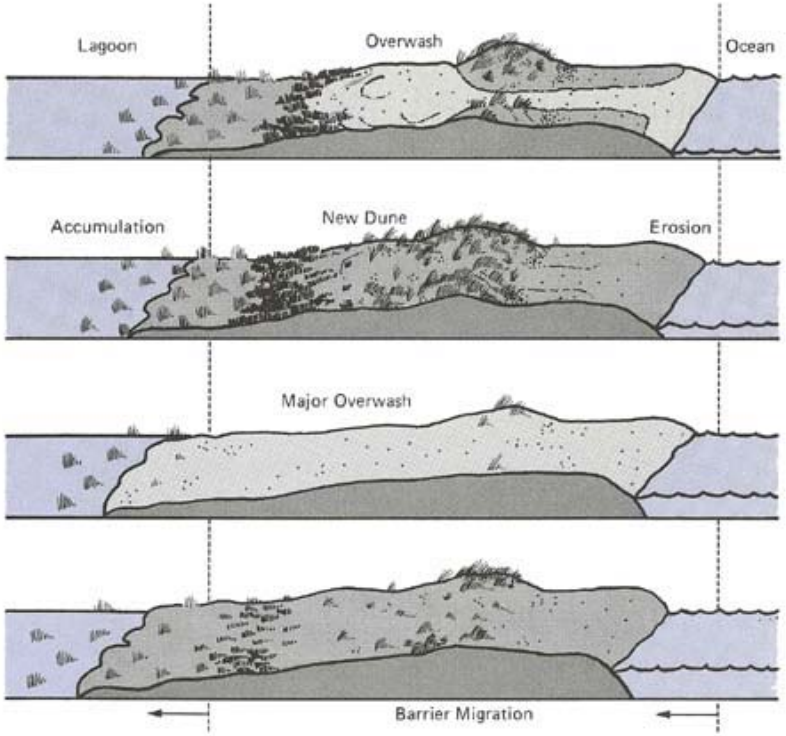
Coastal Processes

History of Nantasket Beach

What if Nantasket Beach wasn't developed?

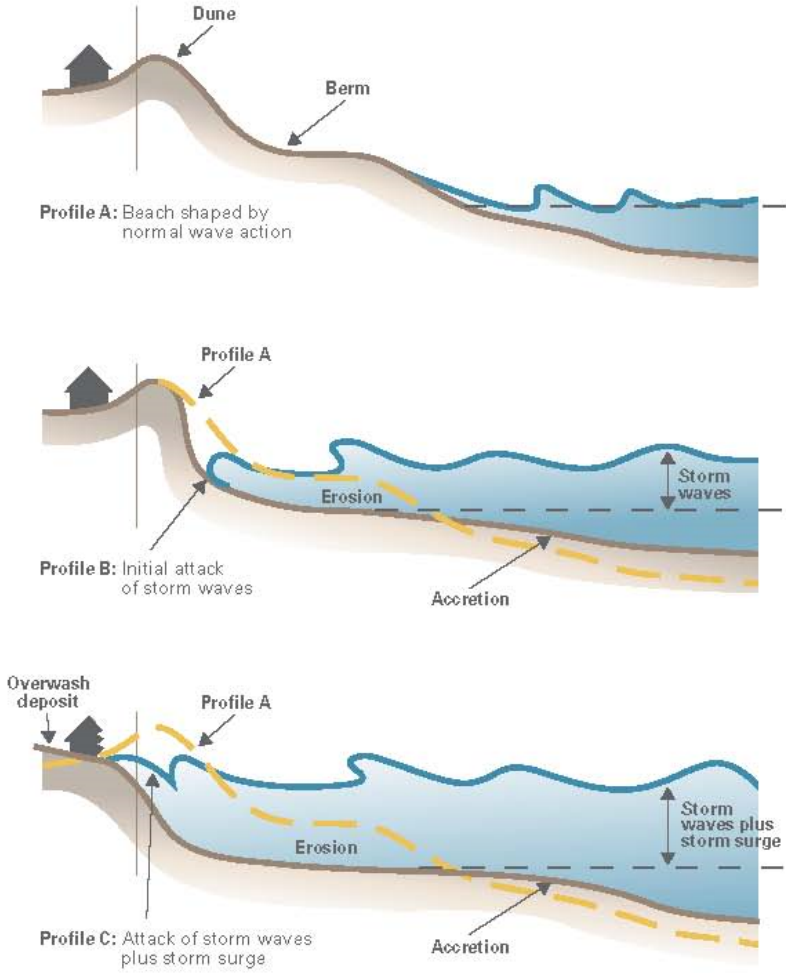
Coastal Processes

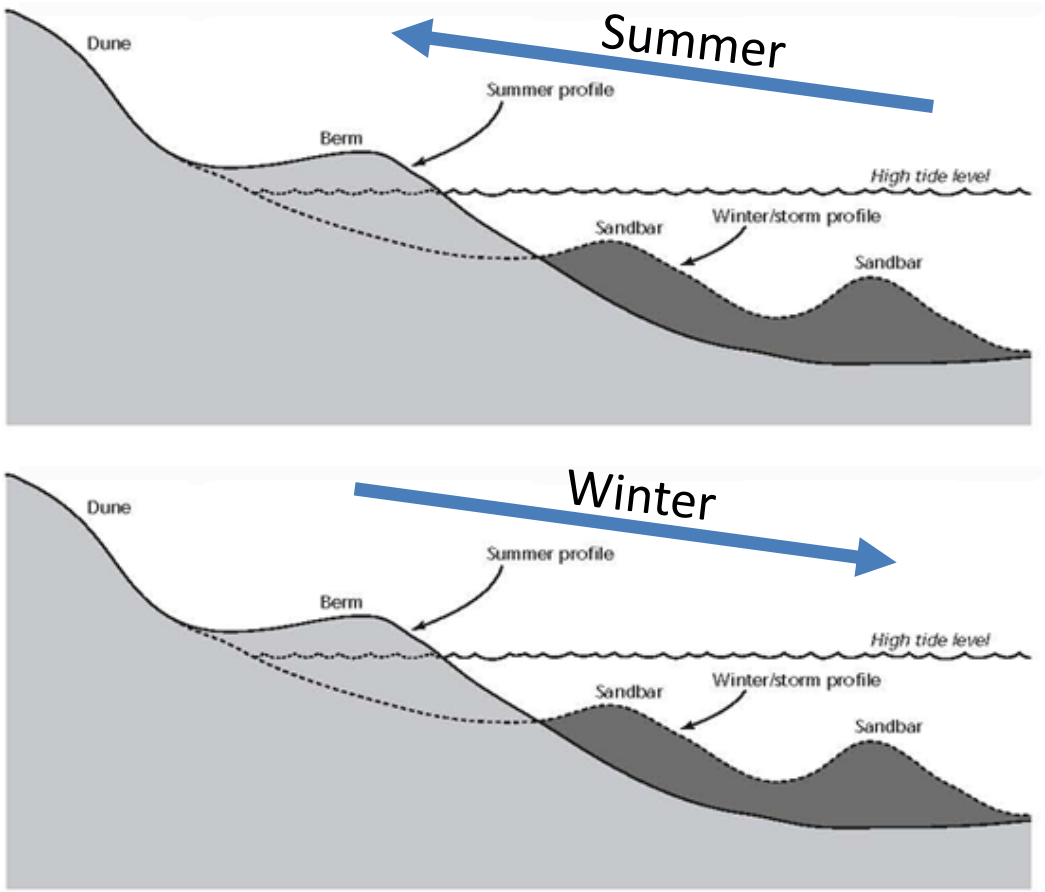
Barrier Beach



Coastal Processes

Coastal Beach and Dune System

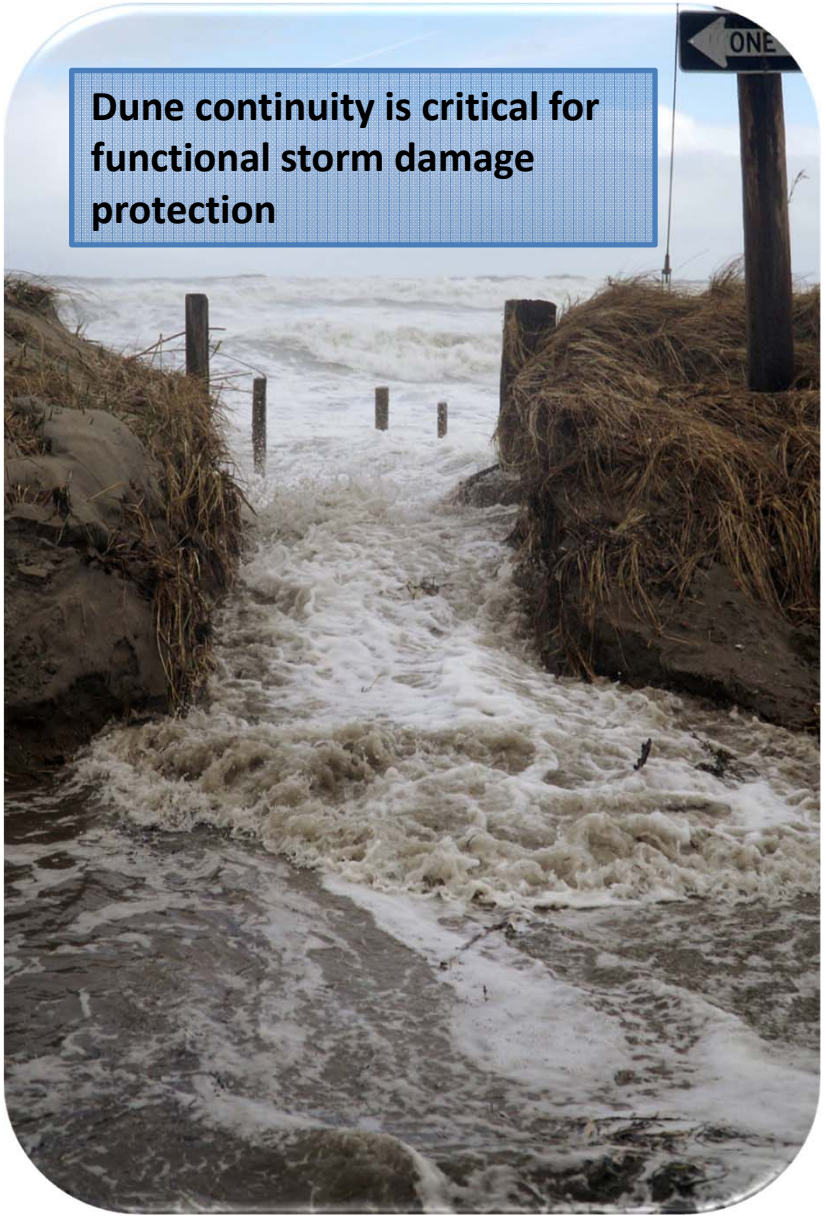




Dunes

Importance

- Storm Protection (flooding and erosion)
- Energy Absorption
- Sediment Supply
- Overall Resilience

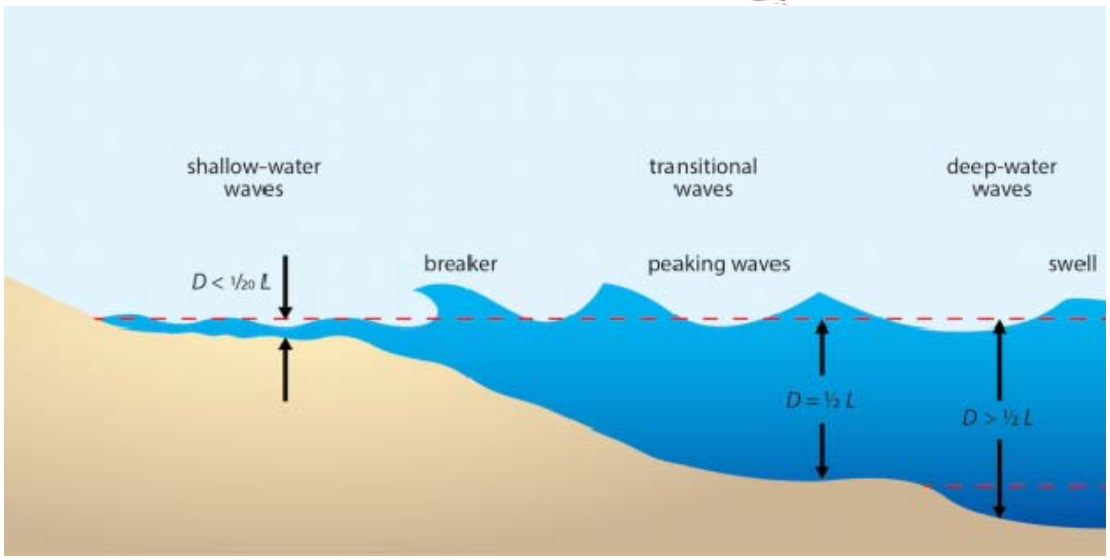


Beaches

Importance

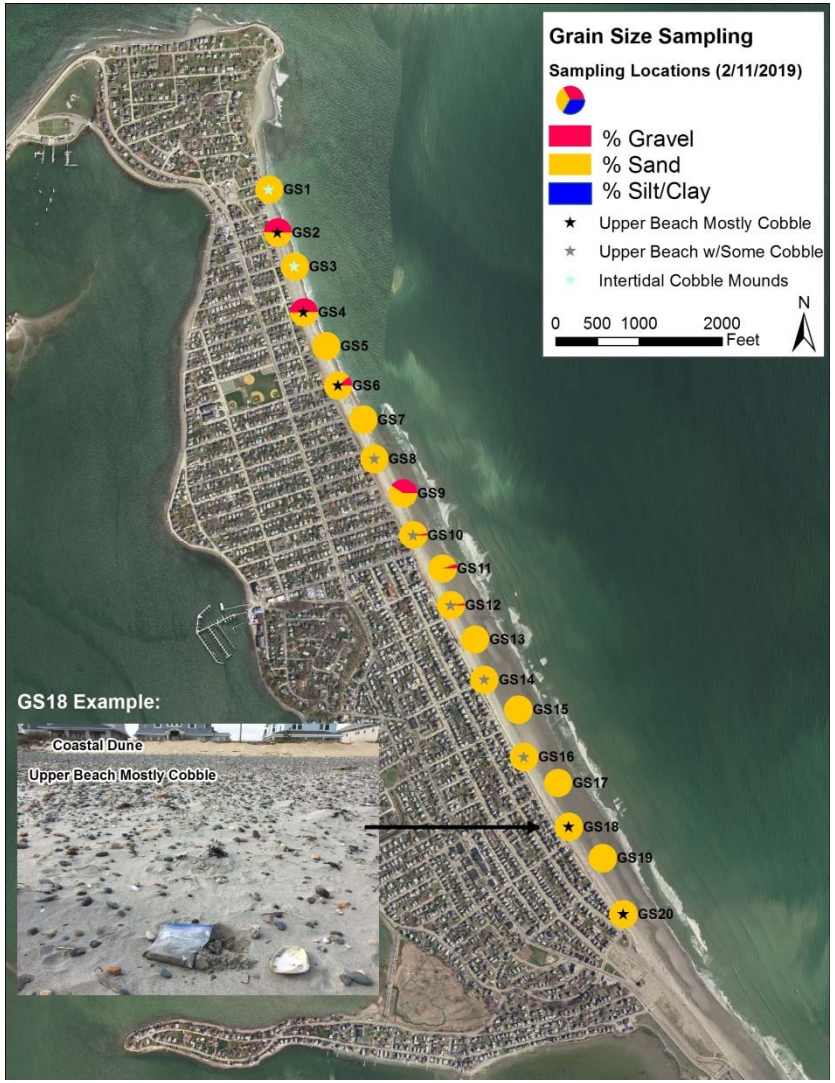
- Wave Energy Absorption
- Mobile Buffer
- Recreation Value / Economy
- Ecological Value
- Self-Protection Ability
- Overall Resilience

Narrowing of both dune and beach due to lack of sediment supply



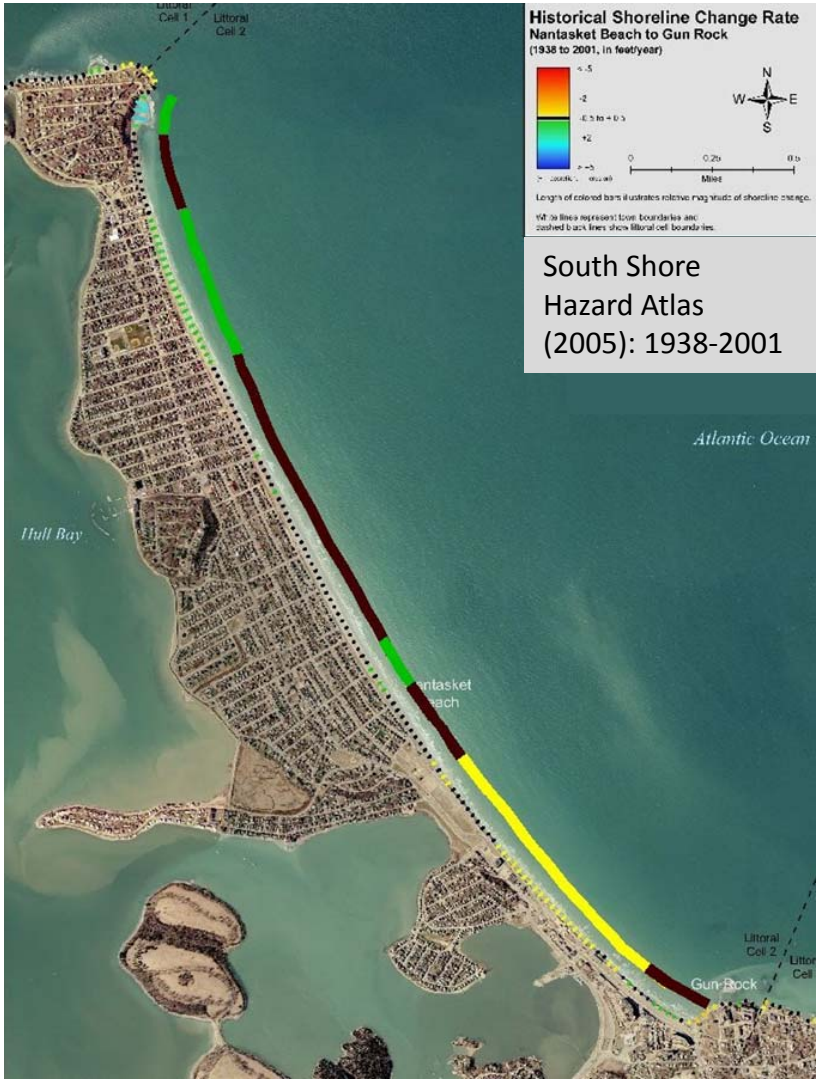
Existing Conditions

Sediment Distribution



Existing Conditions

Shoreline Changes



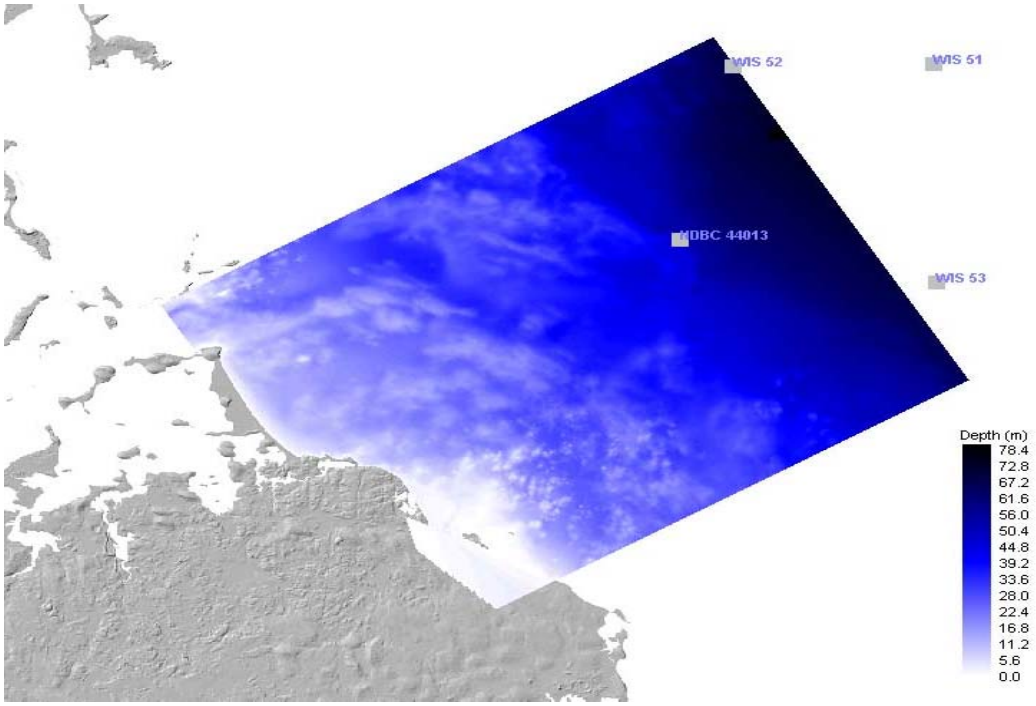
South Shore Hazard Atlas (2005): 1938-2001

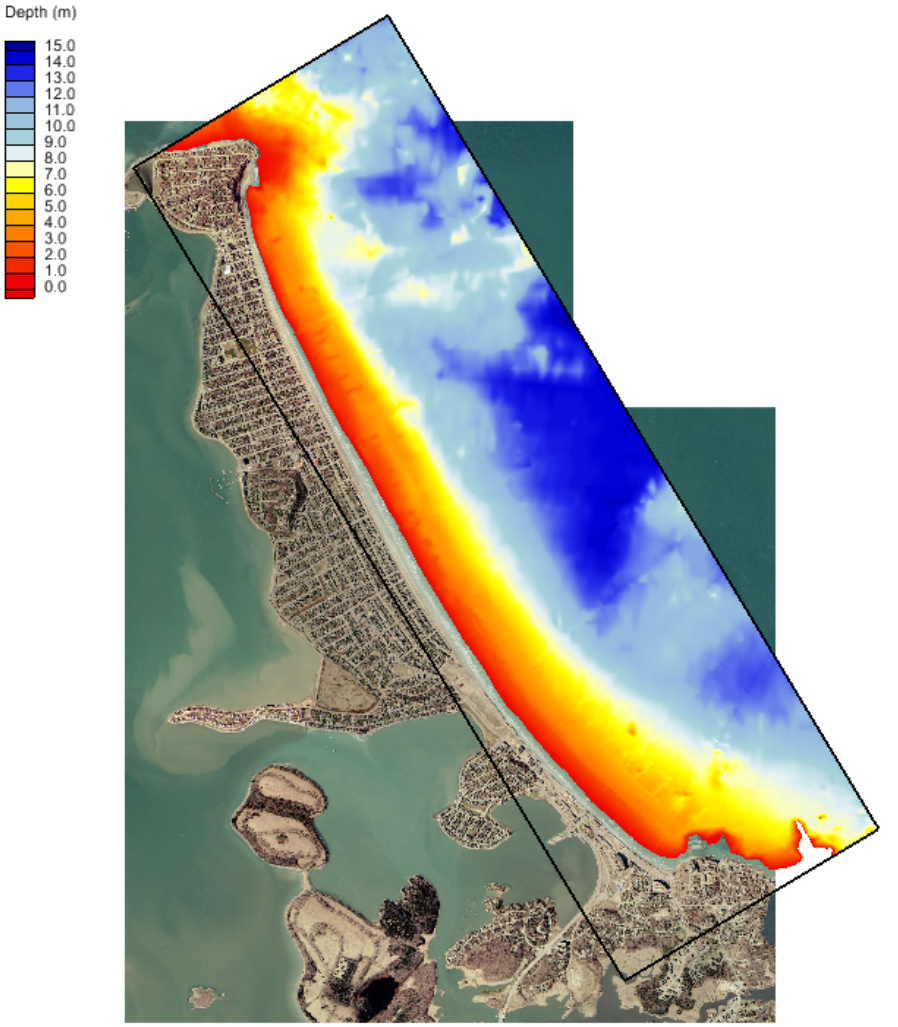
MA-CZM (2001): 1847-1994

Existing Conditions

Wave Transformations

- Three nested grids
  - Offshore grid - 100 meter
  - Regional grid - 25 meter
  - Nearshore grid - 10 meter

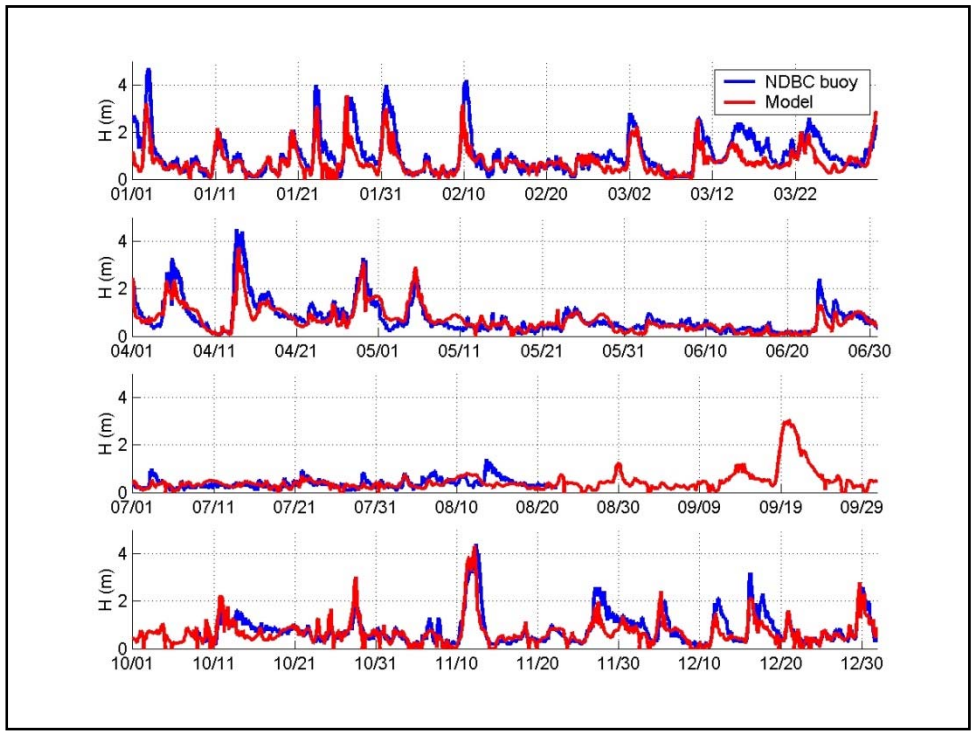




Existing Conditions

Wave Transformation Modeling

- **Simulation cases**
  - Annual wave climate
  - Representative year (1987)
  - Model validation

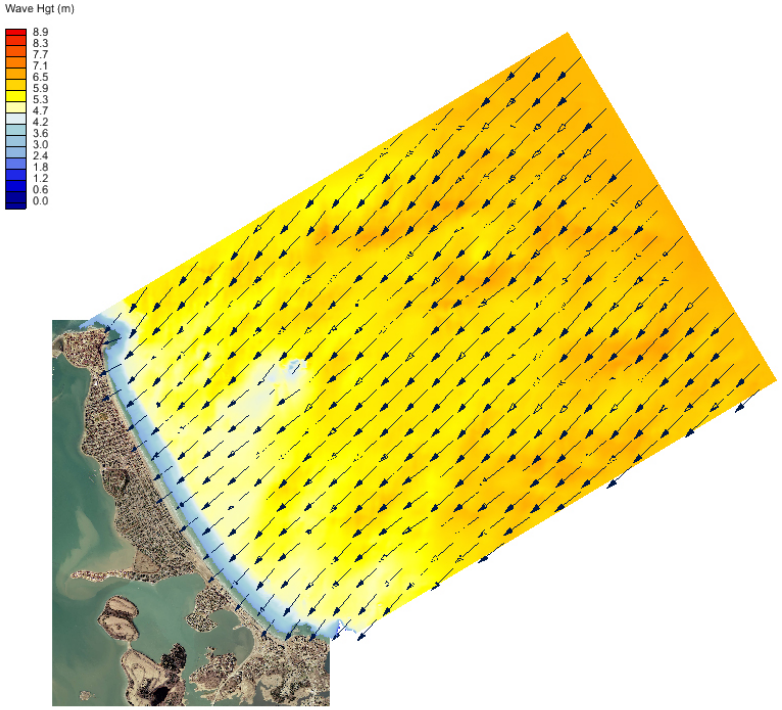


- **Storm Simulations**

  -Perfect Storm, Dec. 1992 Nor'Easter

  -April 1, 1997 Storm

  -10-, 25-, 50-, 100-yr return period storms

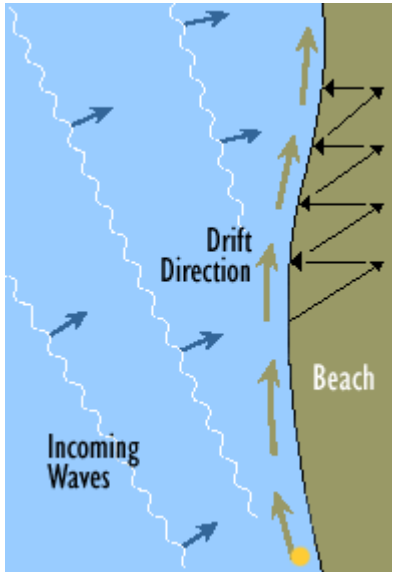


Existing Conditions

Sediment Transport

- Average annual and year long simulation
- Sediment initiation
- Sand and gravel/cobble

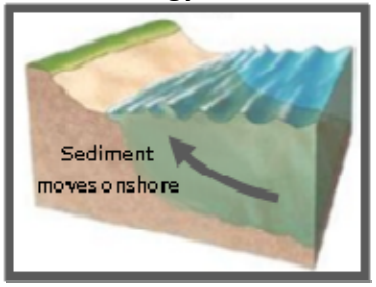
Alongshore Sediment Movement

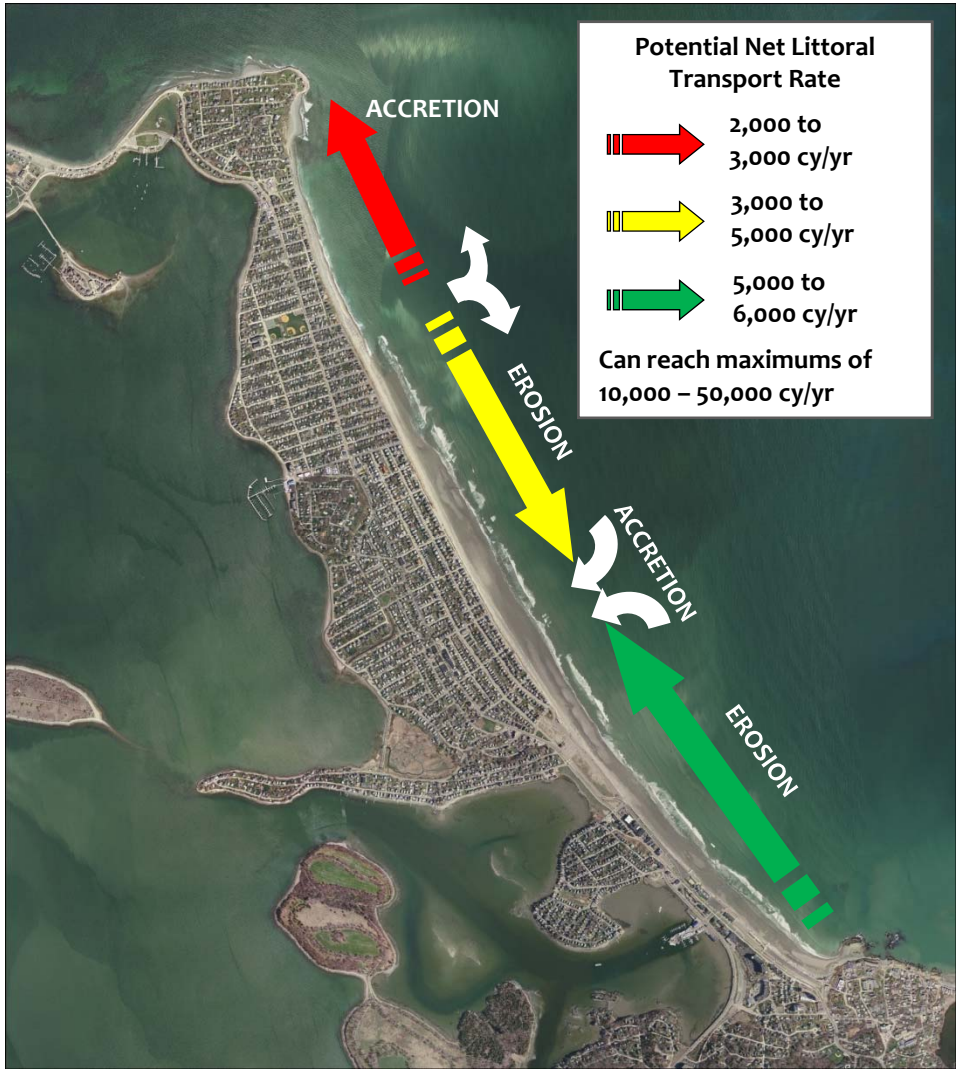


Cross-shore Sediment Movement

High Energy Waves

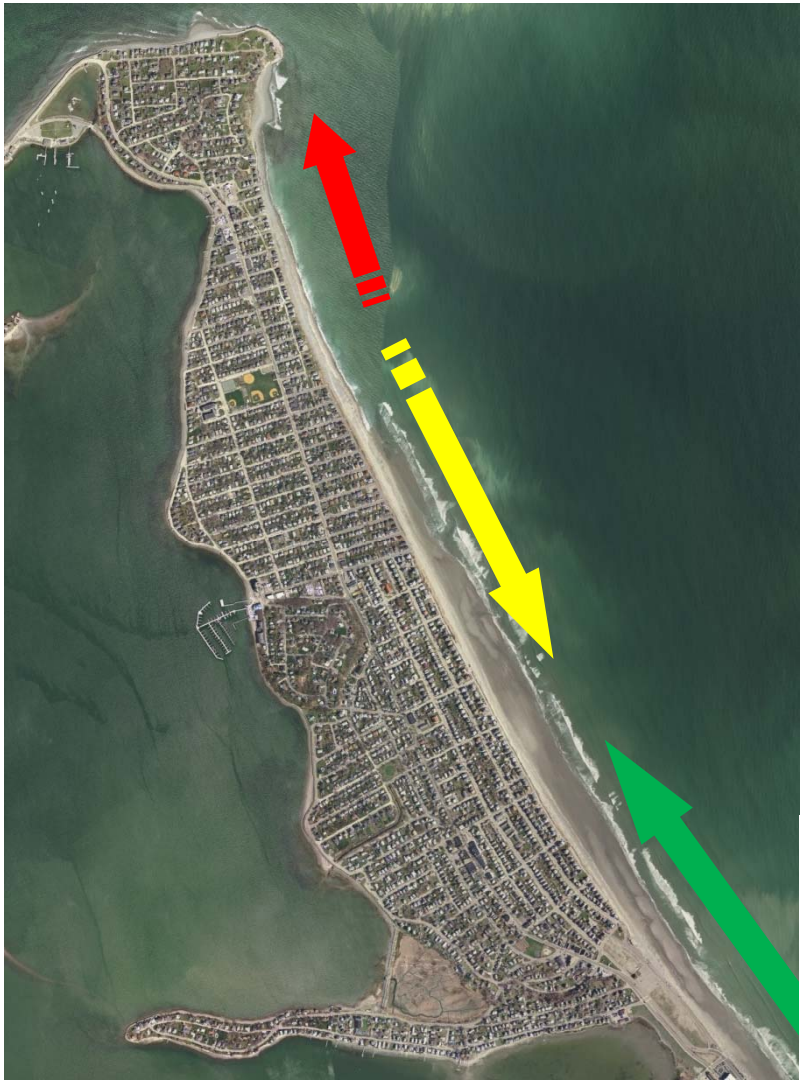
Low Energy Waves

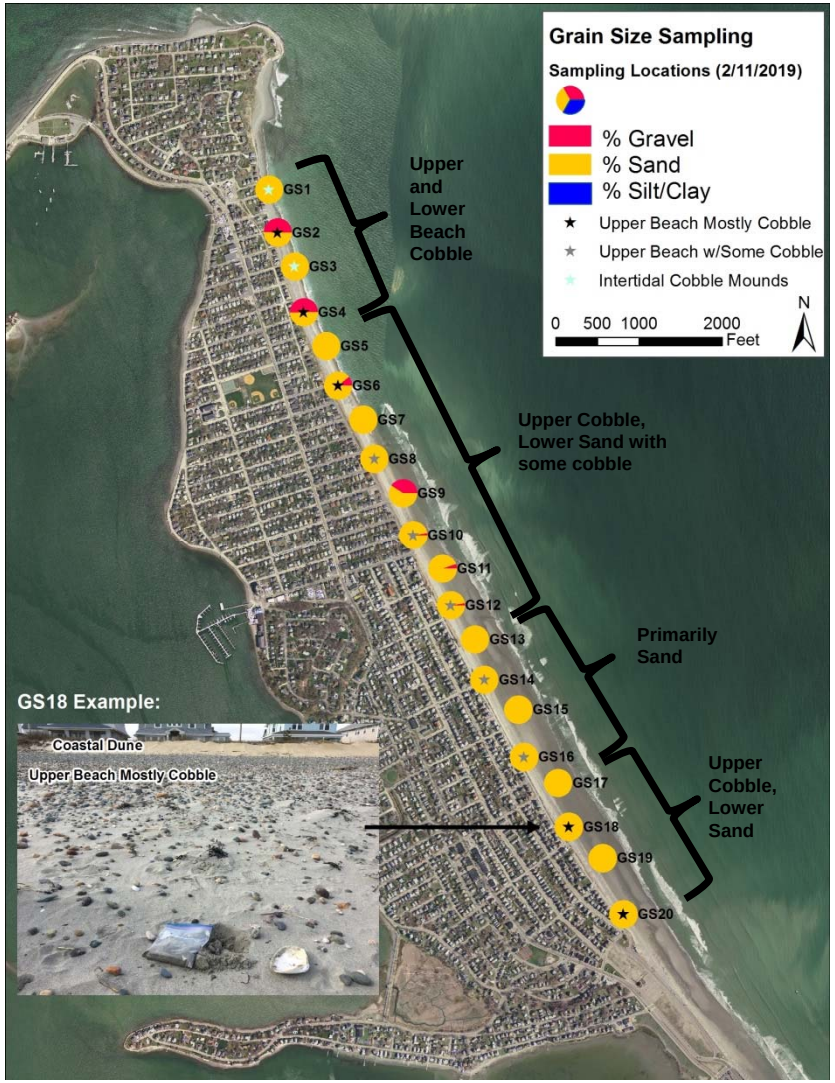




Existing Conditions

Alongshore Sediment Transport

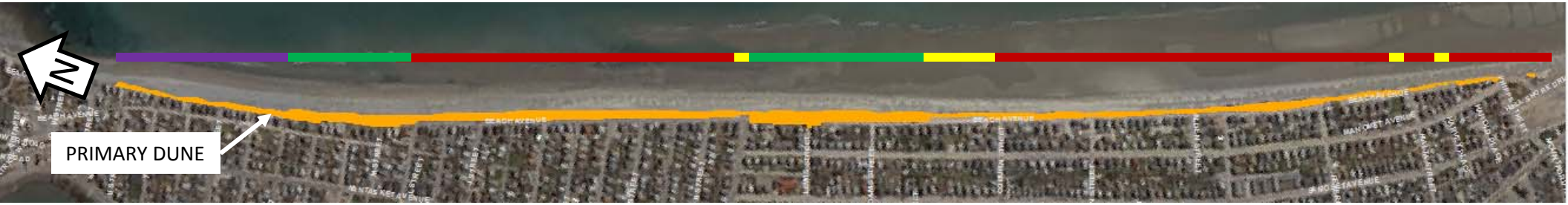




Existing Conditions

Primary Frontal Dune

ALTERED DUNE



Cobble dune
(typically flat, semi-vegetated)

Wide, vegetated dune
(typically with a flattened crest)

Narrow, vegetated dune
(typically with a steeper crest)

Existing Conditions

Primary Frontal Dune – Storm Impacts and Response

Existing Conditions

Town Maintenance Activities

Following the January and March 2018 floods, DPW repaired eroded dunes

Existing Conditions

Town Maintenance Activities

Every winter, before nor'easter season, DPW places sand in crossings to minimize potential flood breach through openings

Existing Conditions

Dune Crossing Vulnerabilities

Non-permitted dune crossings are much more vulnerable to erosion and flood breach during coastal storms than permitted crossings due to design practices and maintenance.

Non-Permitted

Photo by Anne Goldman

Town-Maintained

Photo by Anne Goldman

Existing Conditions

Typical Existing Crossing Types

January 2019 Inventory

- 69 Crossings
- 32 (46%) Permitted, Town-Maintained
- 37 (54%) Unpermitted

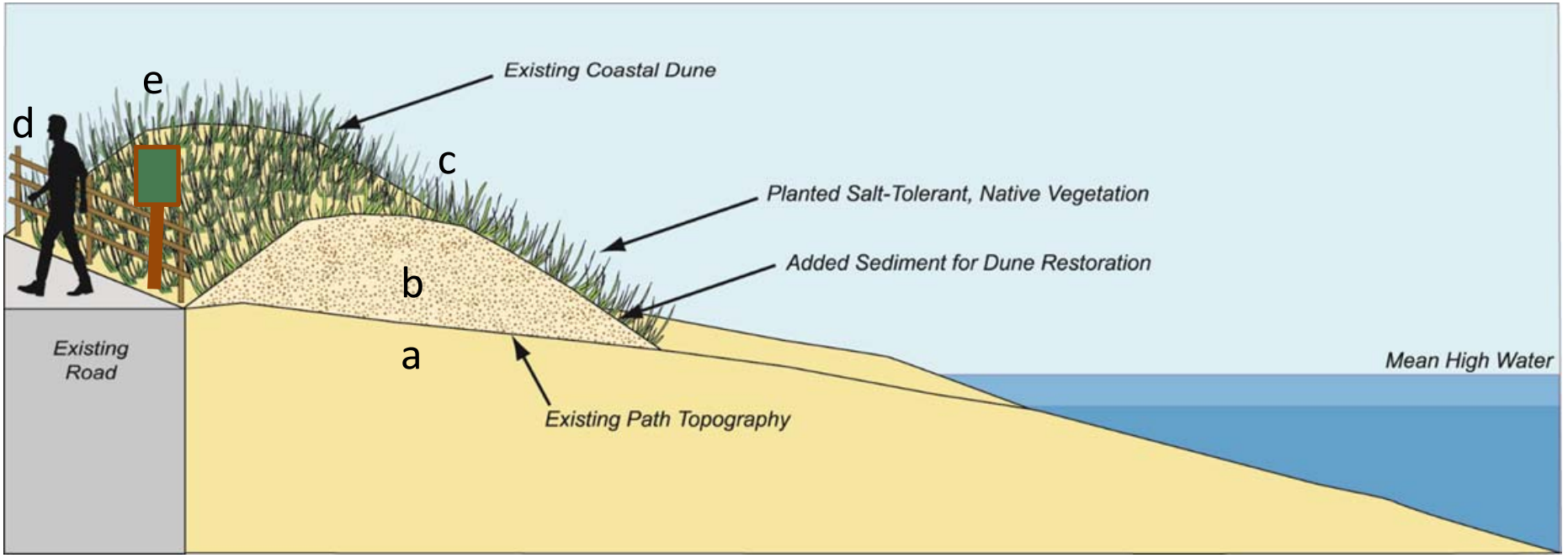
Permitted Town-maintained crossing

Non-permitted crossing

Handicap (ADA) access ramp

Dune Rehabilitation

Strategy 1 - Reduce Number of Crossings



a. Close non-permitted crossings
b. Add sediment to match adjacent dune profiles and crest elevations
c. Plant beach grass and other native, salt-tolerant vegetation
d. Install sand fencing at landward edge of dune to prevent new paths
e. Install signage to educate and navigate to nearest crossings

Strategy 1 – Reduce Number of Crossings

Benefits

Hull Beach Management Plan (2018)

Strategy 1 – Reduce Number of Crossings

Preliminary Recommendations – Alternative 1A

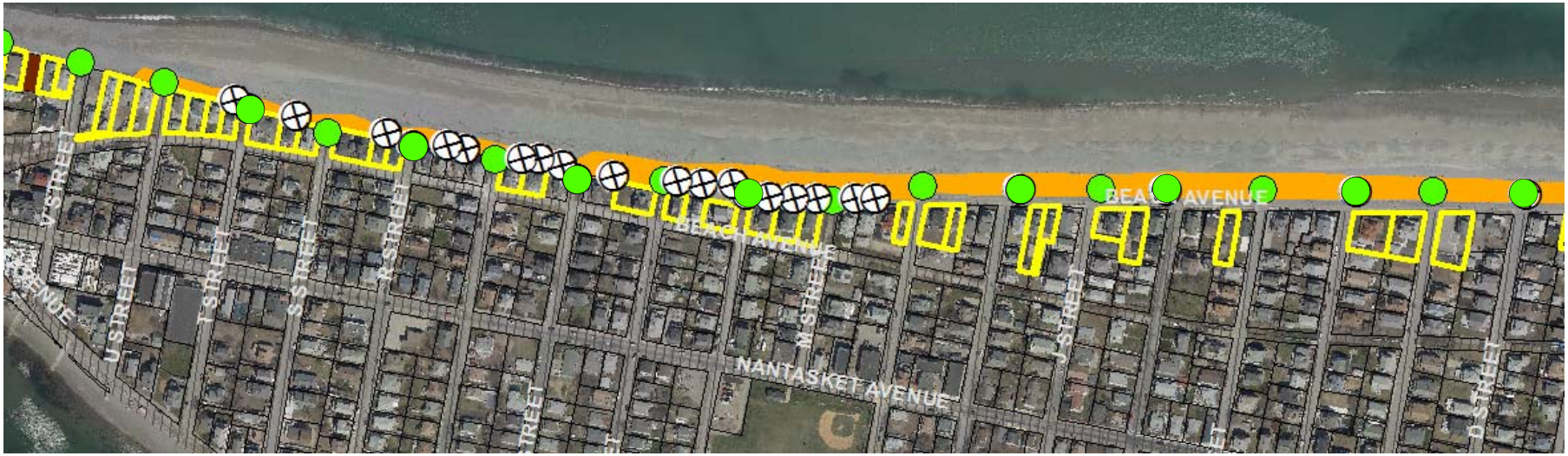
Phipps Street to A Street

- Close 1 of 9 Town-maintained crossings (Beach Ave @ Kenberma St)
- Close 17 of 20 non-permitted crossings
- Allow 4 landlocked parcel owners opportunity for permitted crossings
- Longest walking distance from Beach Ave residences with private beach rights to remaining 9 permitted crossing post-implementation would be ~420 ft. (2 minutes), average would be ~250 ft. (1 minute)

Strategy 1 – Reduce Number of Crossings

Preliminary Recommendations – Alternative 1A

L Street to V Street



- ⊗ Close 17 of 17 non-permitted crossings
- Longest walking distance from Beach Ave residences with private beach rights to remaining 11 permitted crossing post-implementation would be ~120 ft. (<1 minute), average would be ~60 ft. (<1 minute)

Strategy 1 – Reduce Number of Crossings

Preliminary Recommendations – Alternative 1B

A Street to V Street

- Implement recommendations from Alternative 1A
- ⊗ Close 9 of 21 Town-maintained crossings from A Street to V Street (every other crossing)
- □● Longest walking distance from Beach Ave residences with private beach rights to remaining 12 permitted crossing post-implementation would be ~250 ft. (1 minute), average would be ~140 ft. (<1 minute)

Dune Rehabilitation

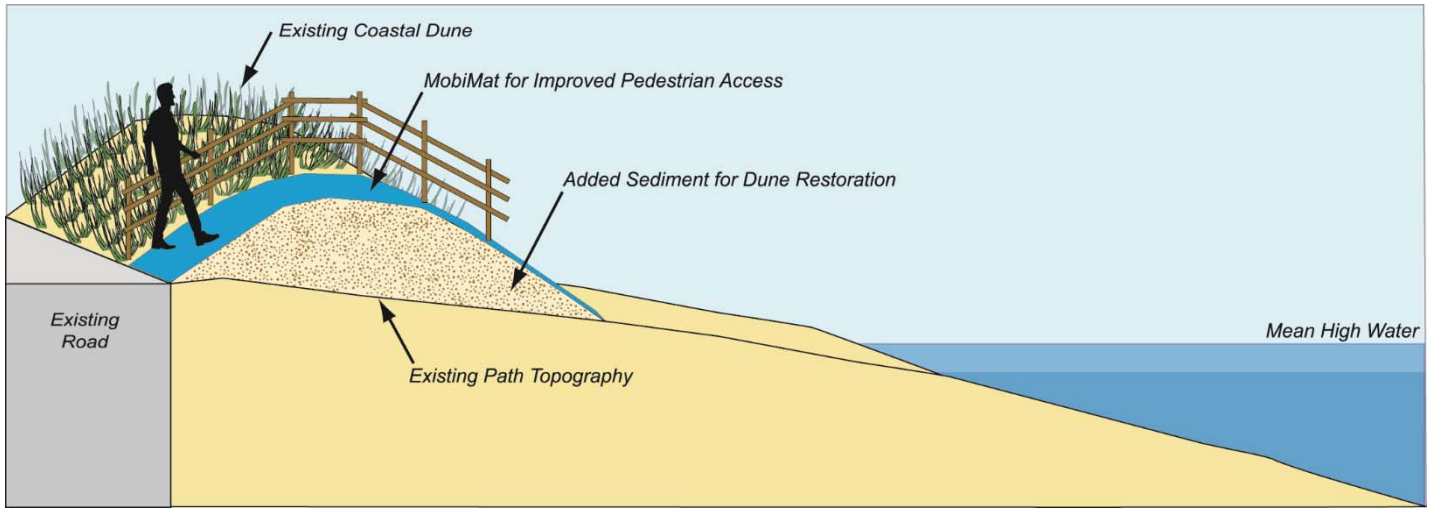
Strategy 2 - Strengthen Permitted Crossings

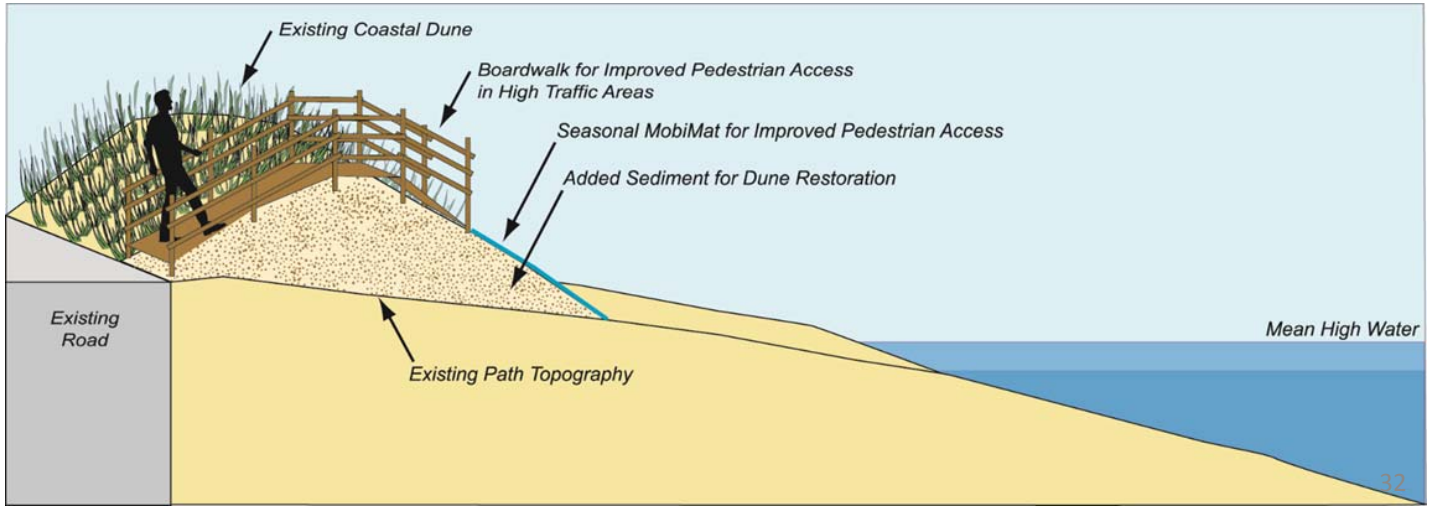
Preliminary Alternatives being Considered

2A. Raised Path
+ Access Mat

2B. Crossing Structure over Restored Dune
+ Access Mat

2C. Handicap Ramp Crossing Structure over Restored Dune





Strategy 2 – Strengthen Permitted Crossings

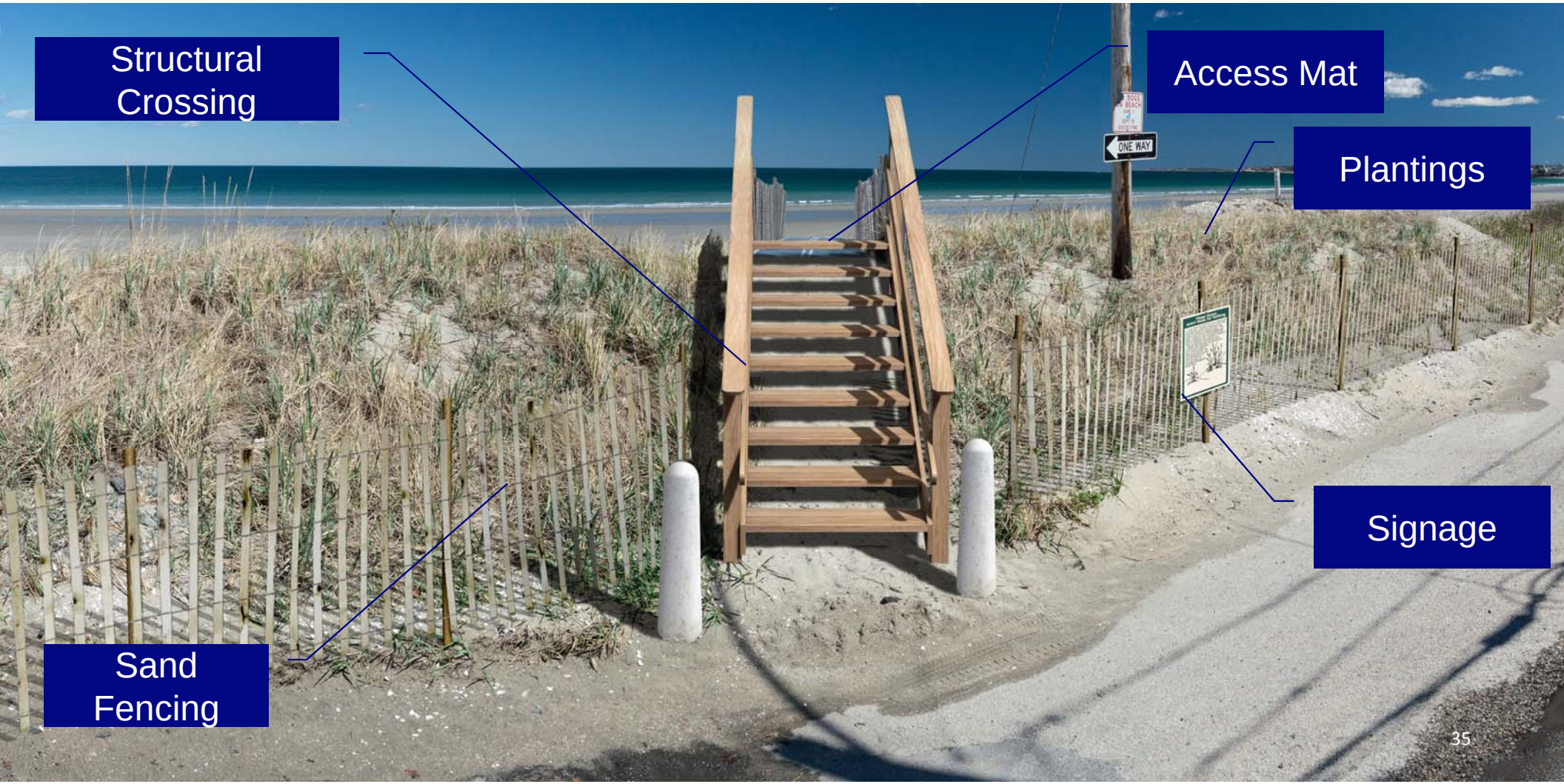
Typical Permitted Crossing – Existing Conditions

Strategy 2 – Strengthen Permitted Crossings

Typical Permitted Crossing – Alternative Strategy 2A

Strategy 2 – Strengthen Permitted Crossings

Typical Permitted Crossing – Alternative Strategy 2B

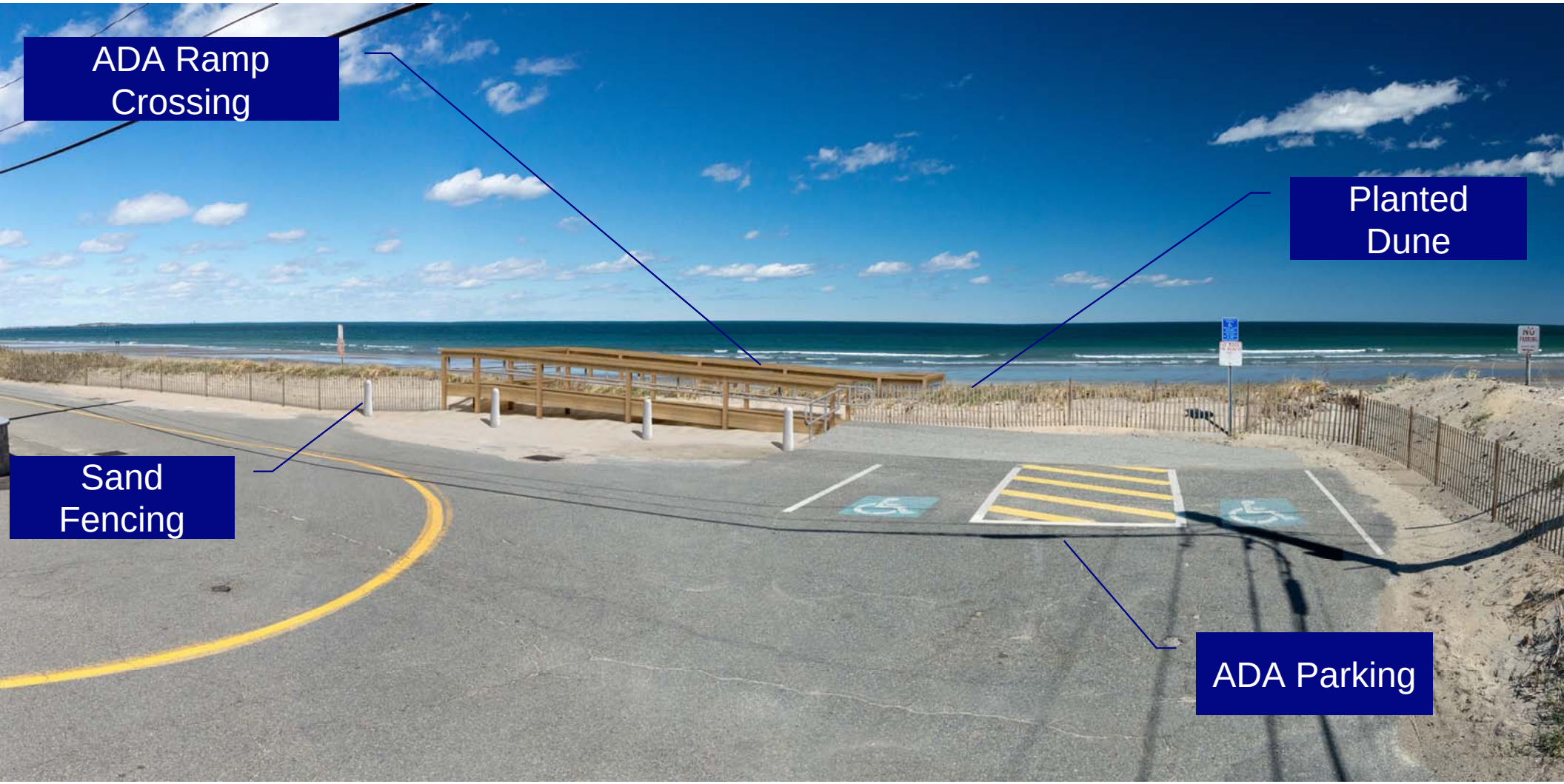


Strategy 2 – Strengthen Permitted Crossings

A Street Handicap Ramp – Existing Condition

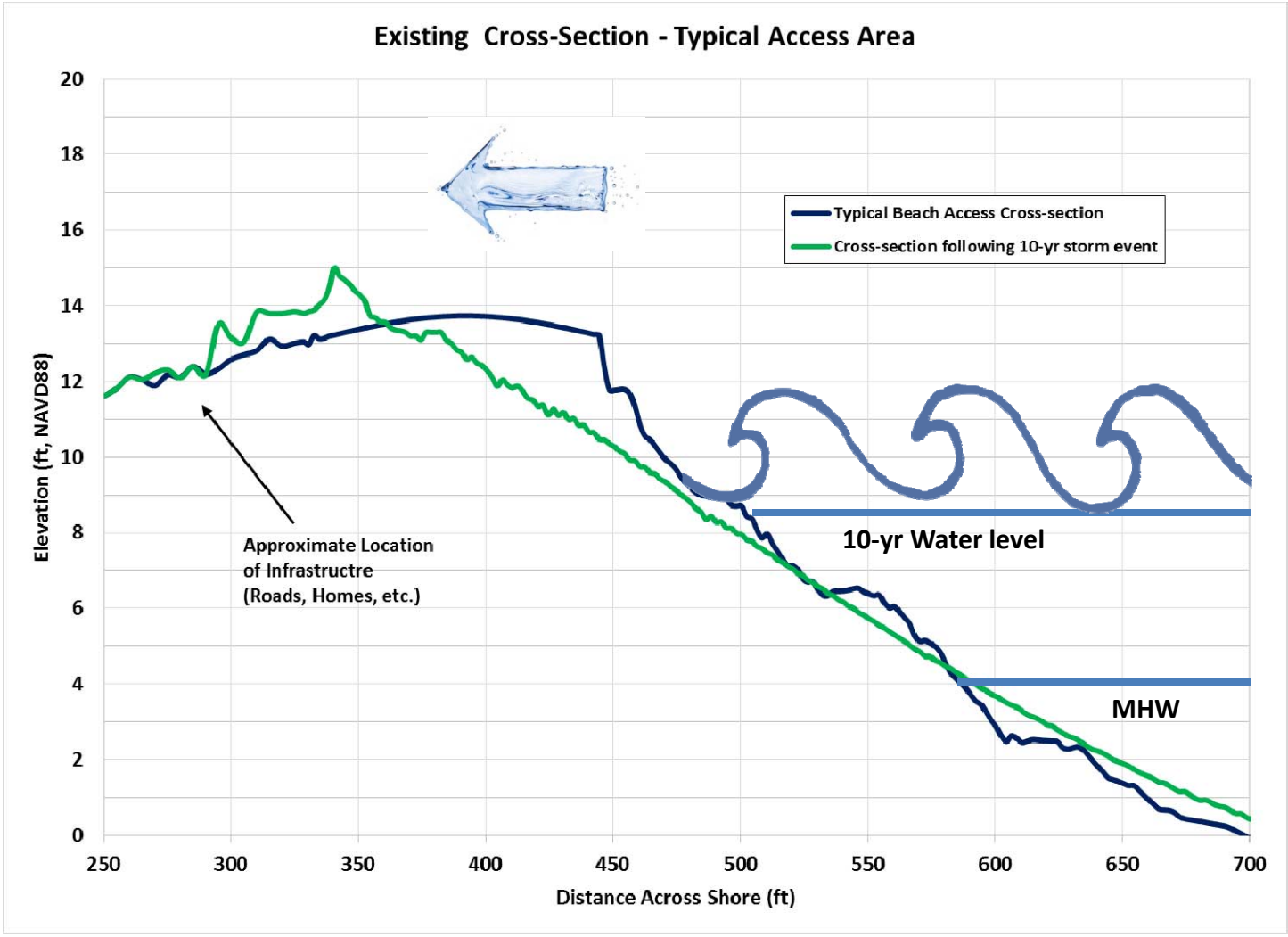
Strategy 2 – Strengthen Permitted Crossings

A Street Handicap Ramp – Alternative Strategy 2C



Dune Restoration

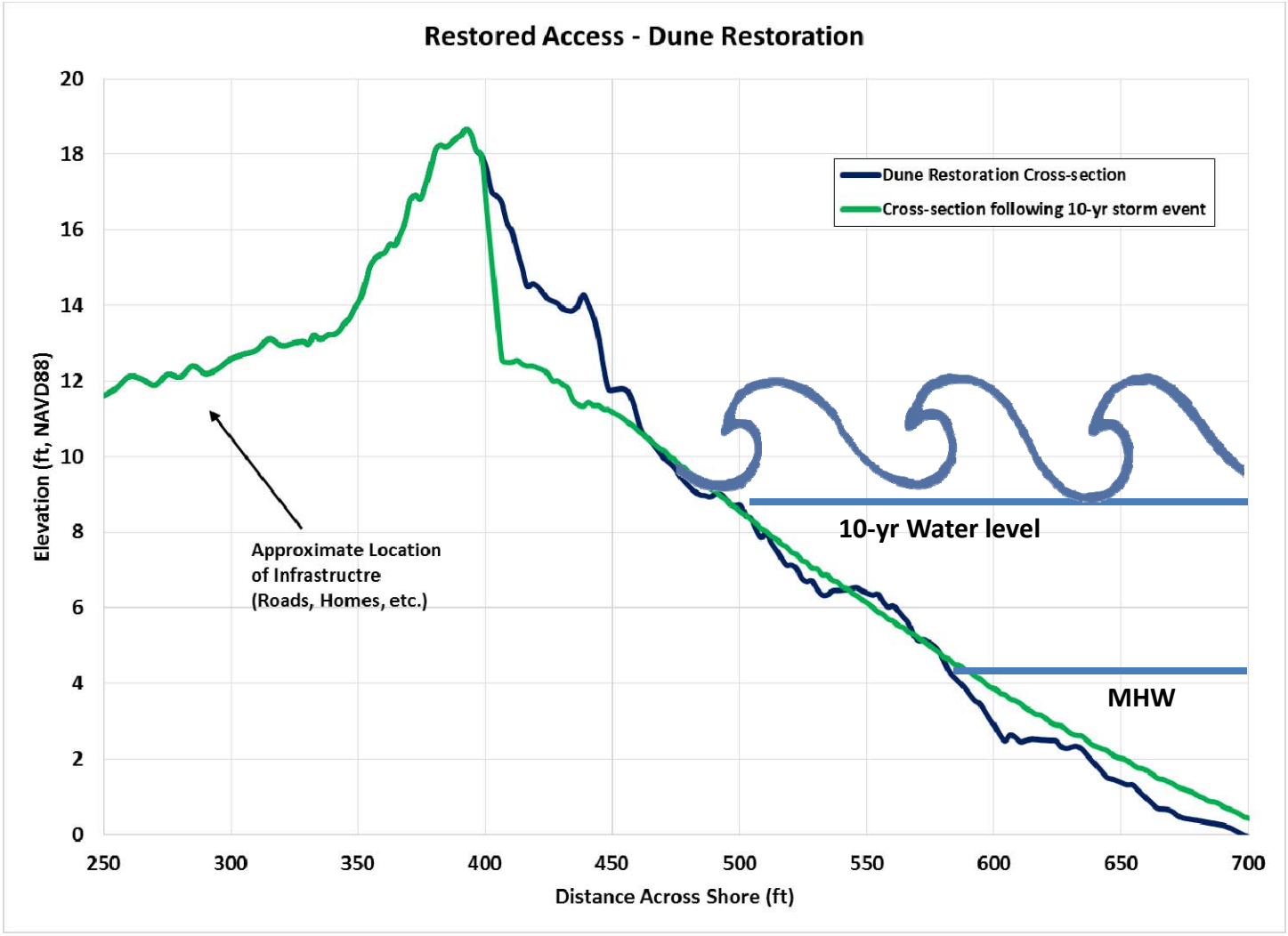
Performance



Restoration
Dunes

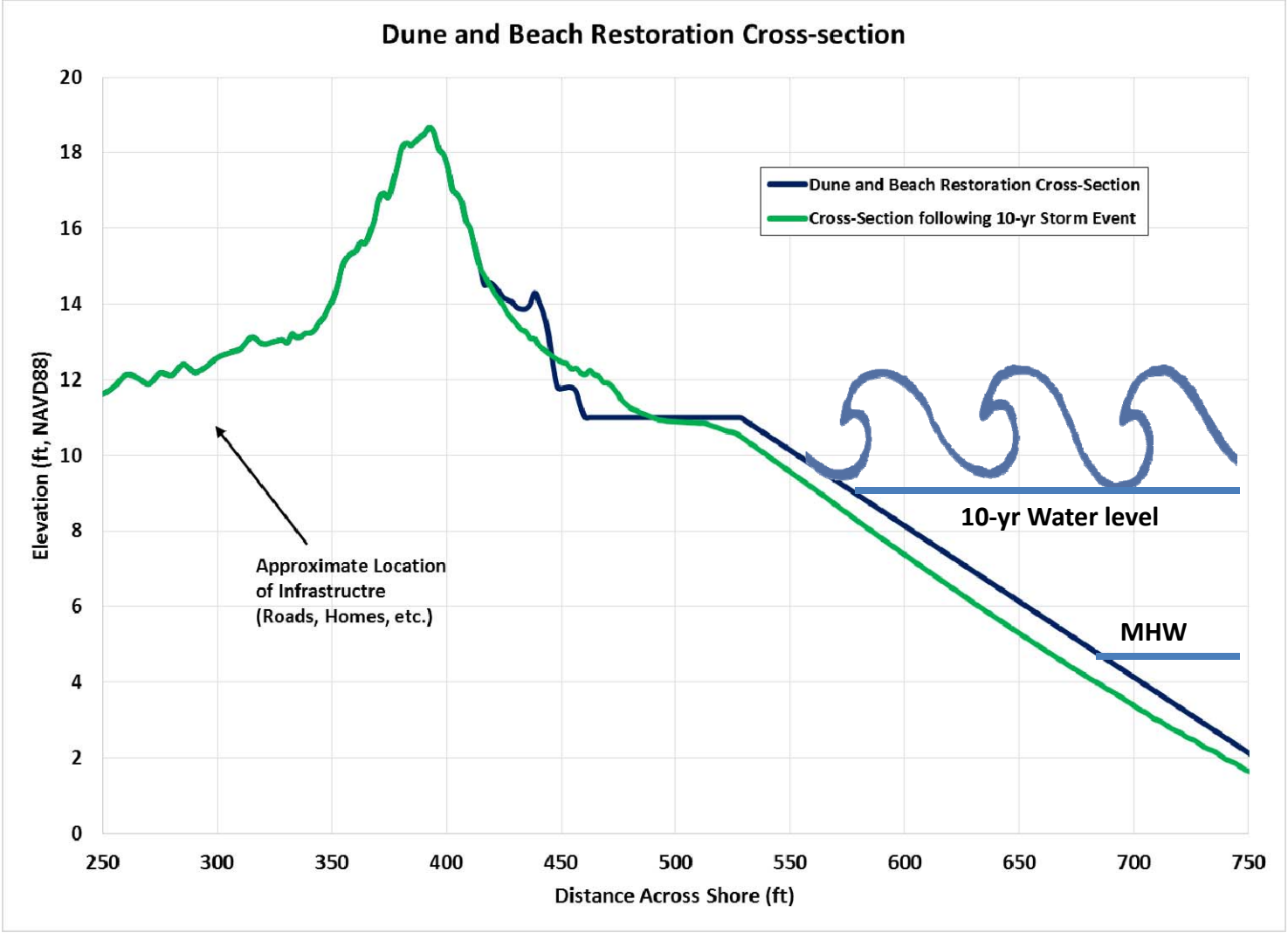
Dune Restoration

Performance



Dune and Beach Restoration

Performance

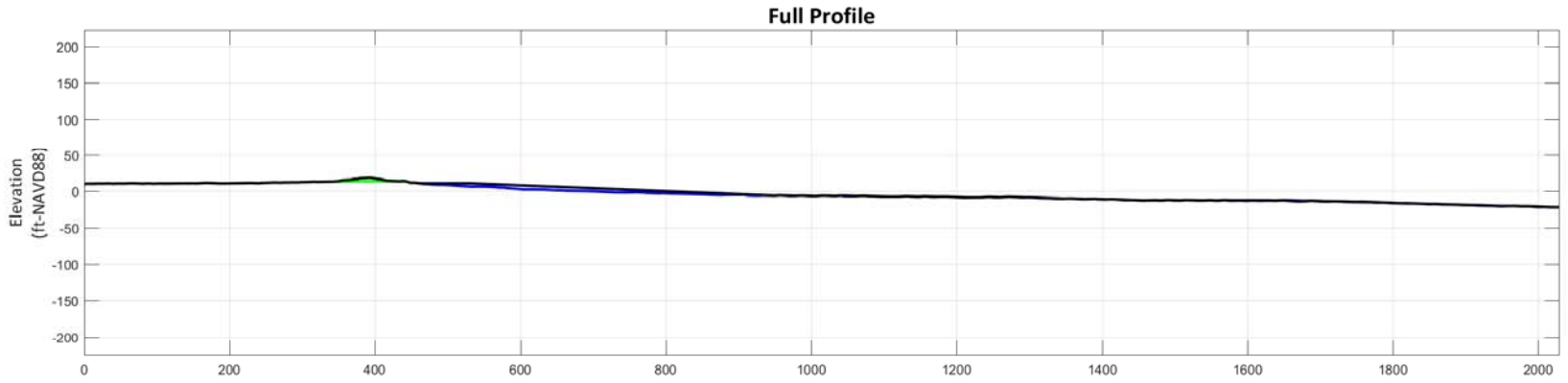


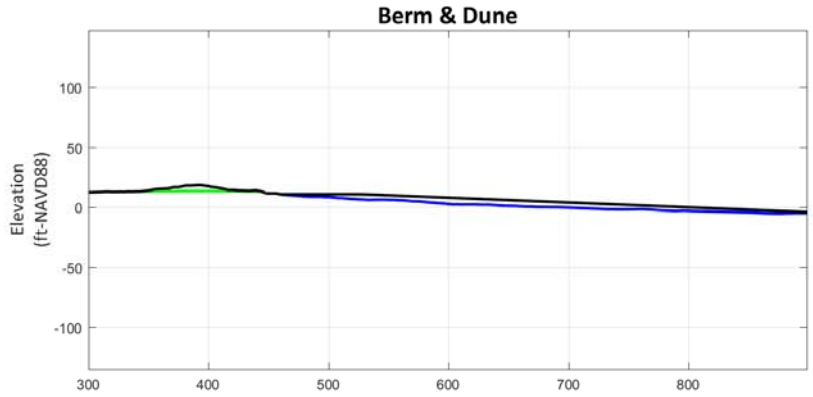
Restoration

Large-Scale Beach & Dune Nourishment Planning

Restoration

Large-Scale Beach & Dune Nourishment Planning





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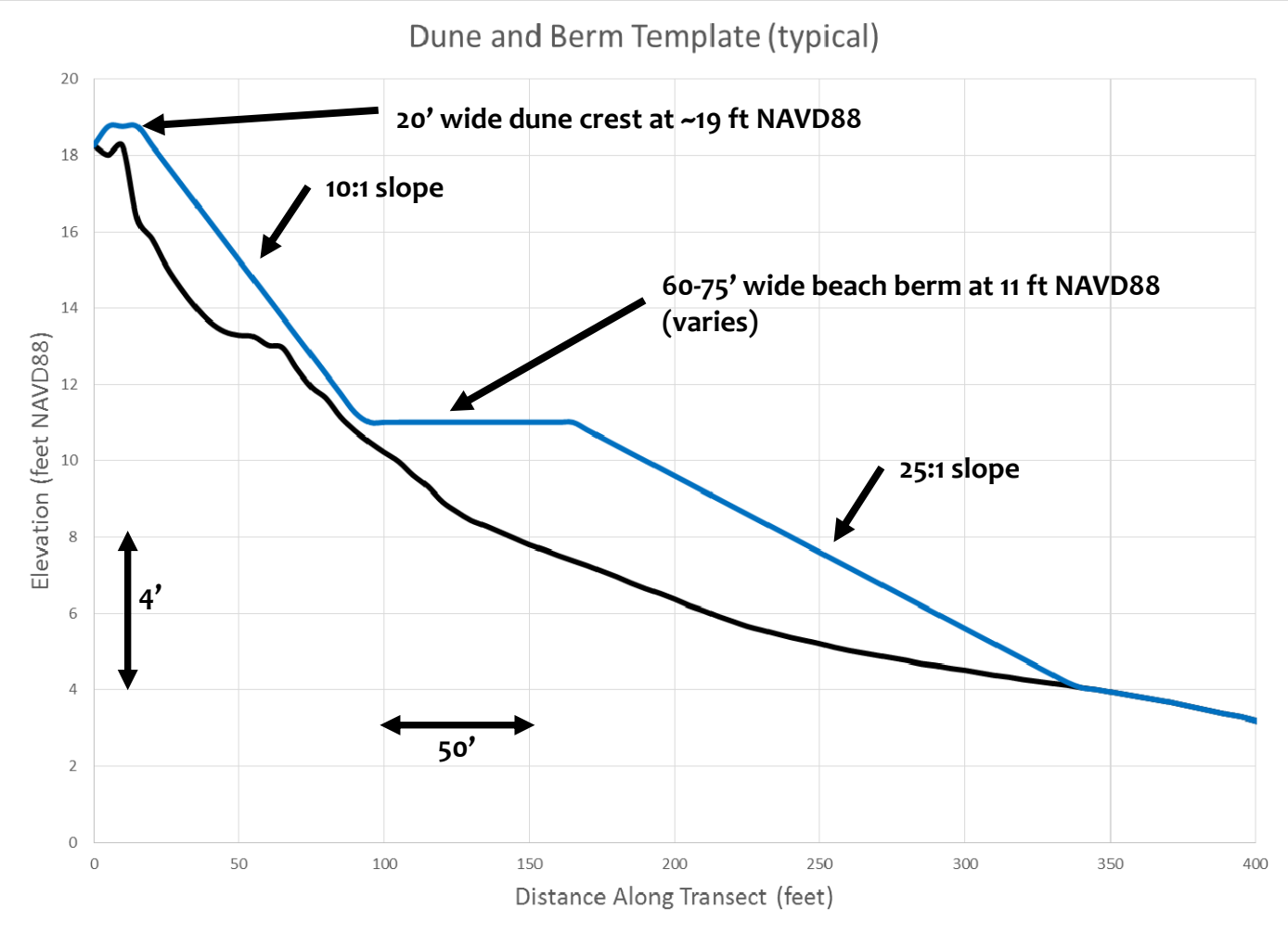
Restoration

Large-Scale Beach & Dune Nourishment Planning



Restoration

Large-Scale Beach & Dune Nourishment Planning

GOALS:

- Permit Large Scale Nourishment for North Nantasket Beach
  - Be prepared to quickly respond if necessary
  - Available to accept beach compatible material

- Provide Flexibility for Range of Options
  - Dune restoration only, Beach restoration only, Combined
  - Various widths, lengths, grain size, and volumes that meet needs and funding
  - Identify most cost-effective placement approach

- Sediment Source
  - Still would need to be approved when sand is available
  - Various sources can be considered in the future

Restoration

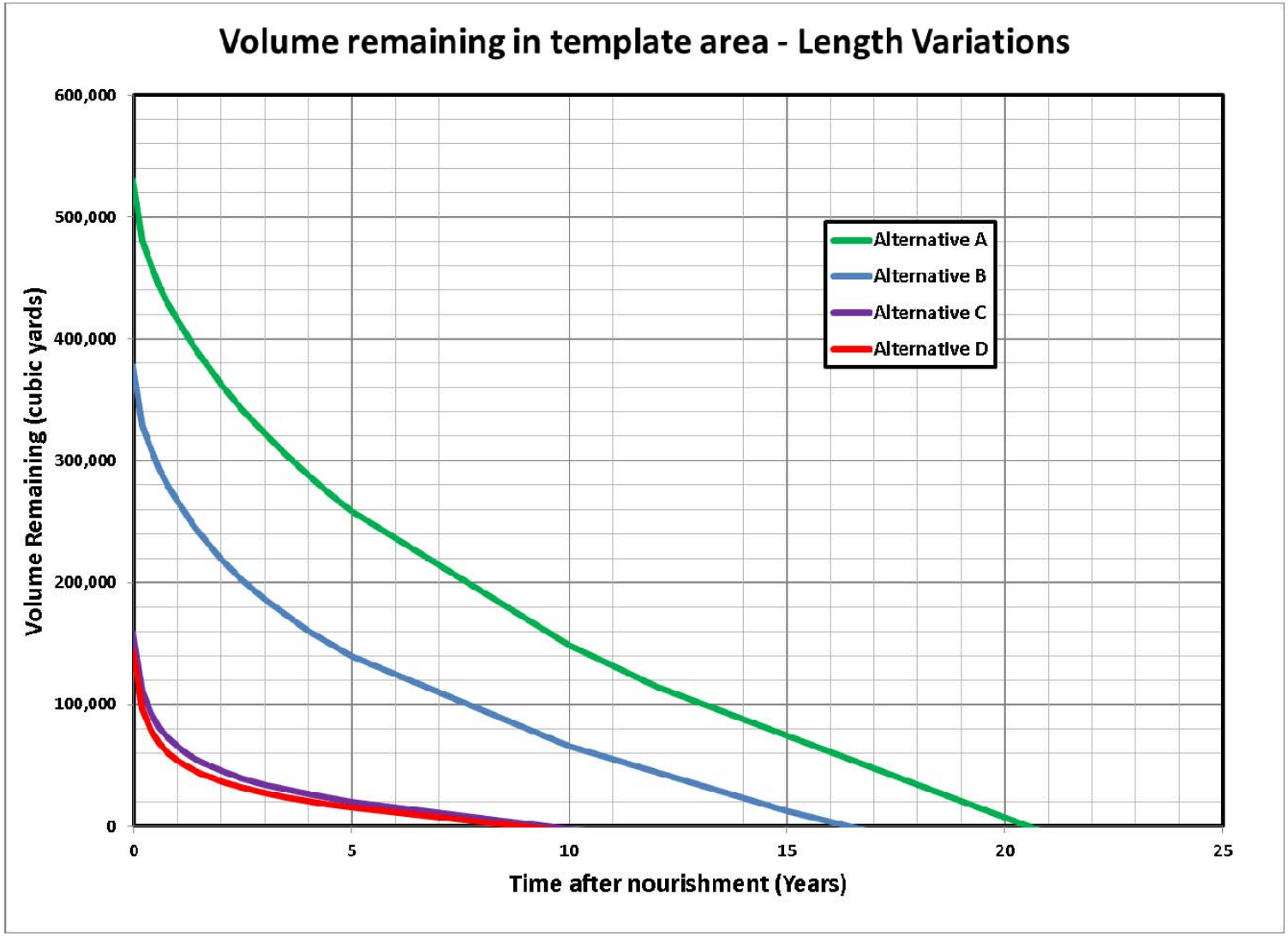
Large-Scale Beach & Dune Nourishment Planning

Restoration

Large-Scale Beach & Dune Nourishment Planning

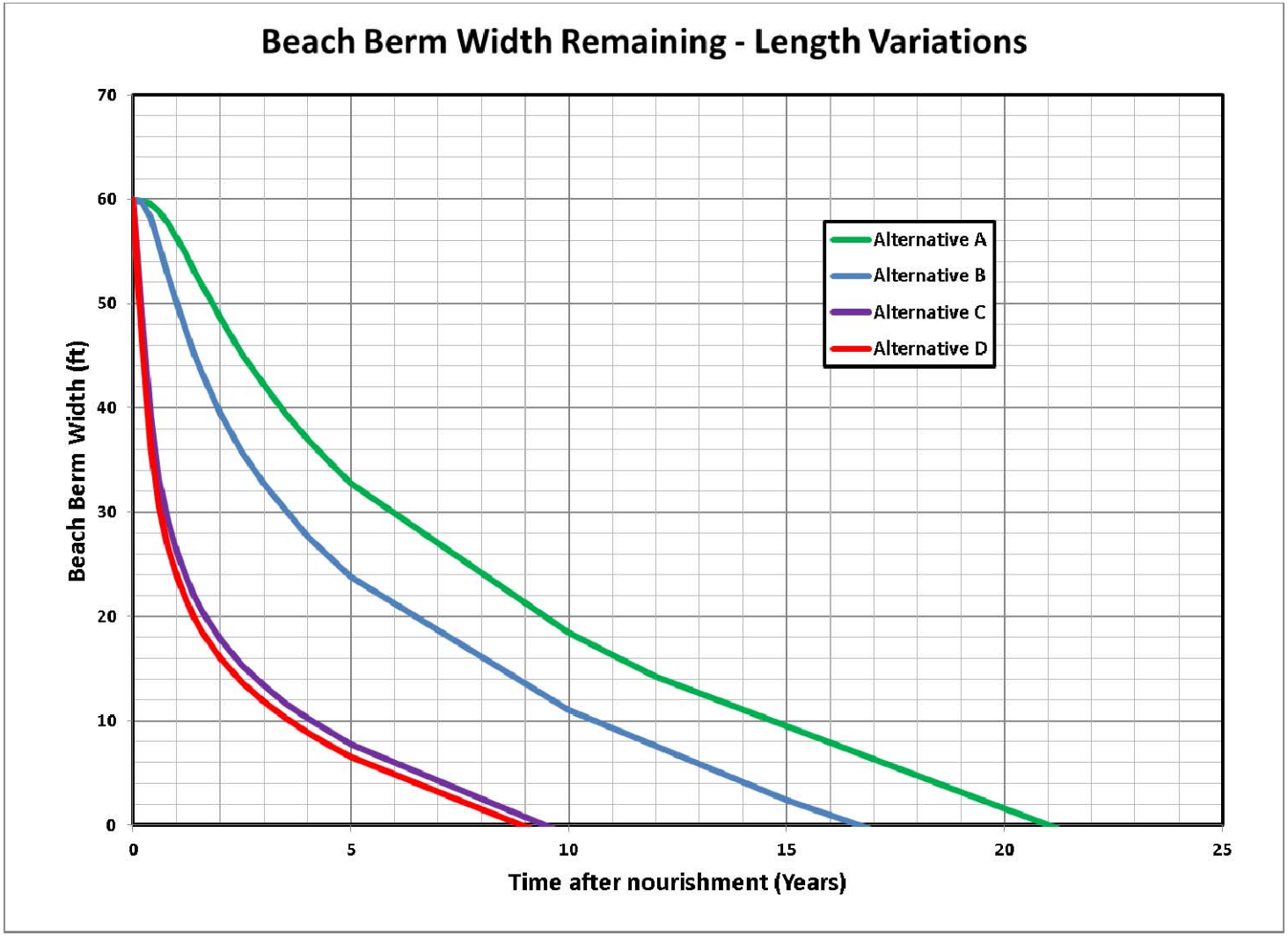
Restoration

Large-Scale Beach & Dune Nourishment Planning



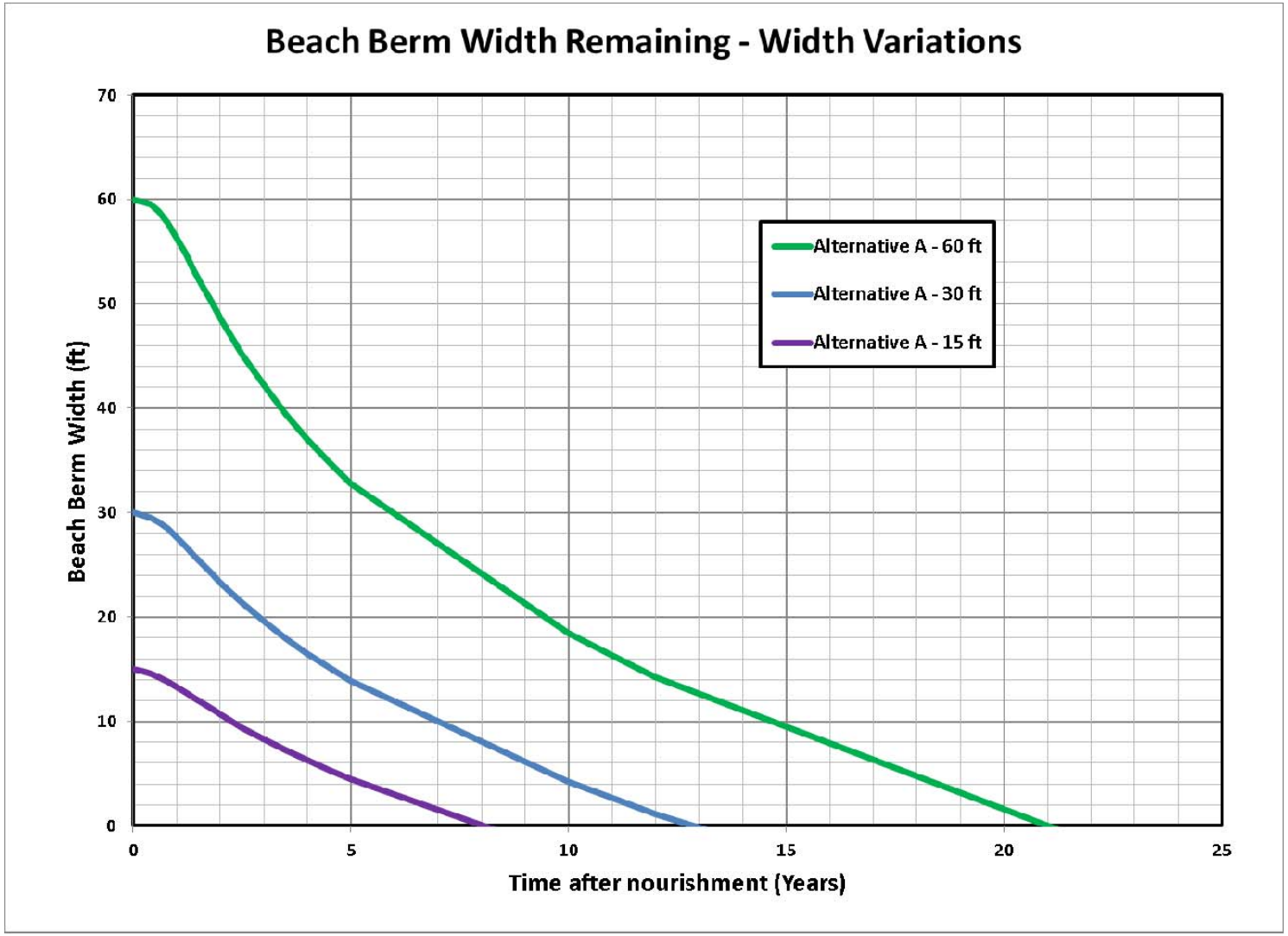
Restoration

Large-Scale Beach & Dune Nourishment Planning



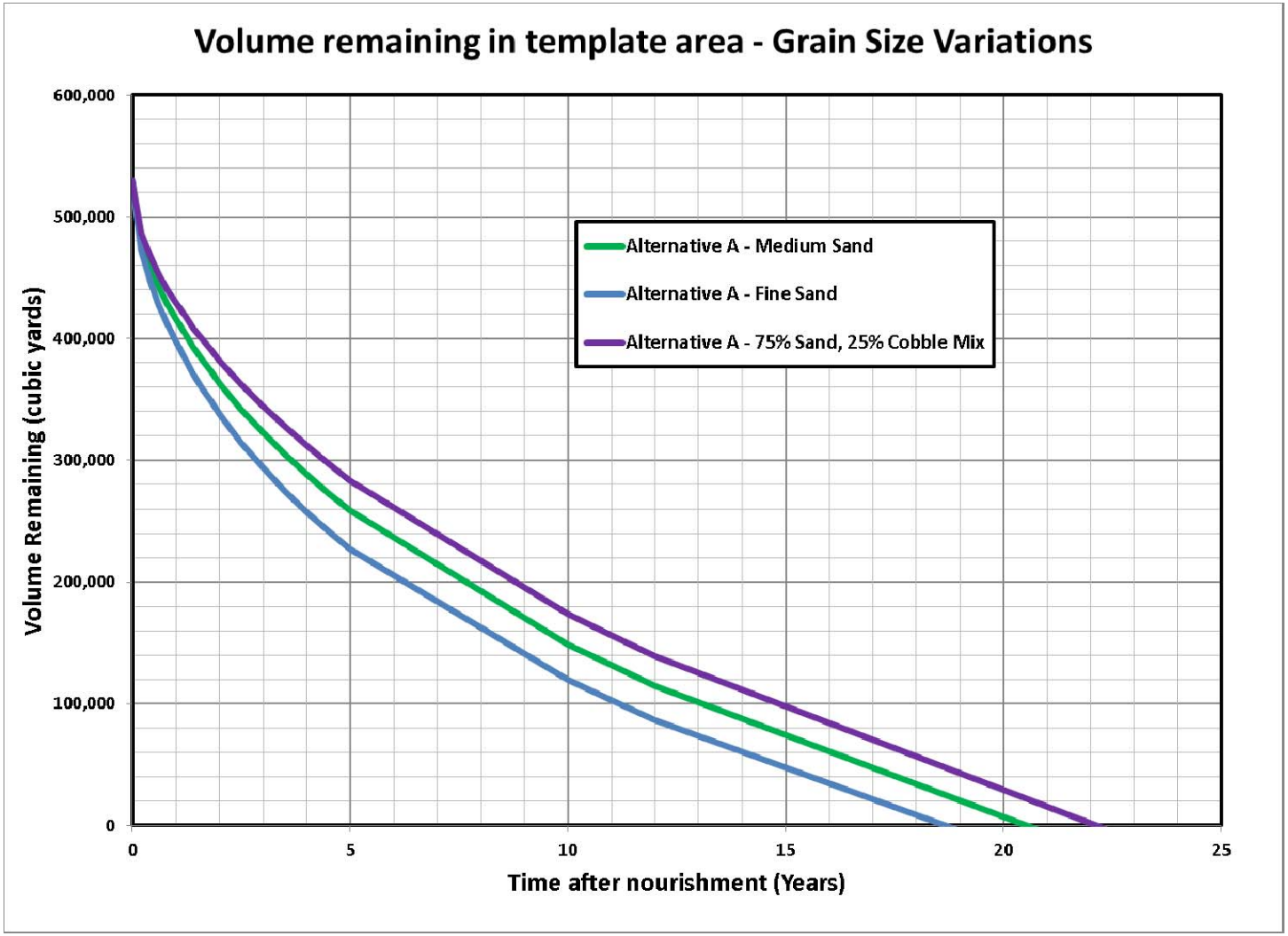
Restoration

Large-Scale Beach & Dune Nourishment Planning



Restoration

LARGE-SCALE BEACH & DUNE NOURISHMENT PLANNING



NEXT STEPS

1. Collect your feedback,
2. Revise / refine alternatives (crossings and restoration)
3. Reconvene at the 2nd Public Workshop to discuss final alternatives

THANK YOU!