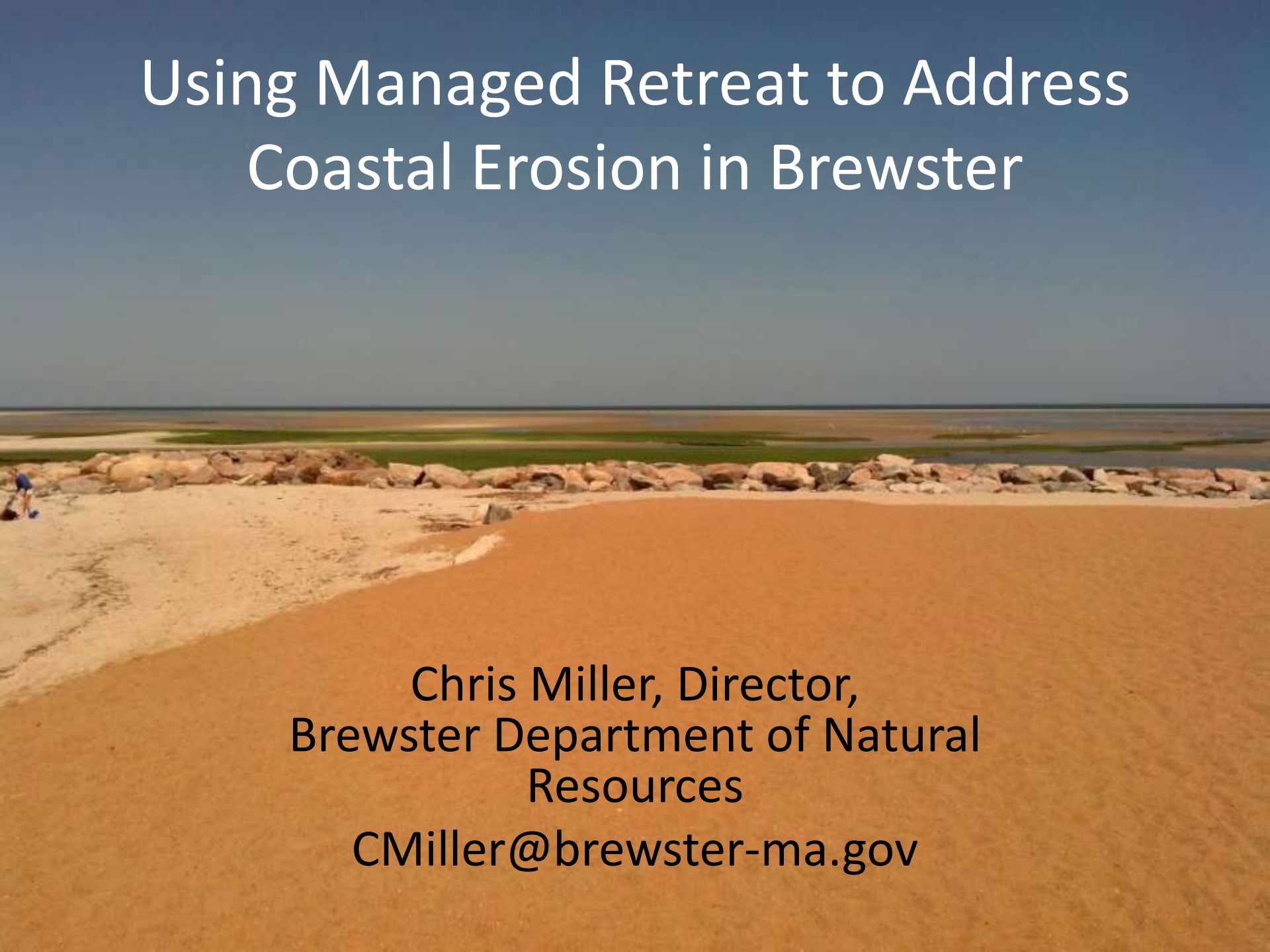
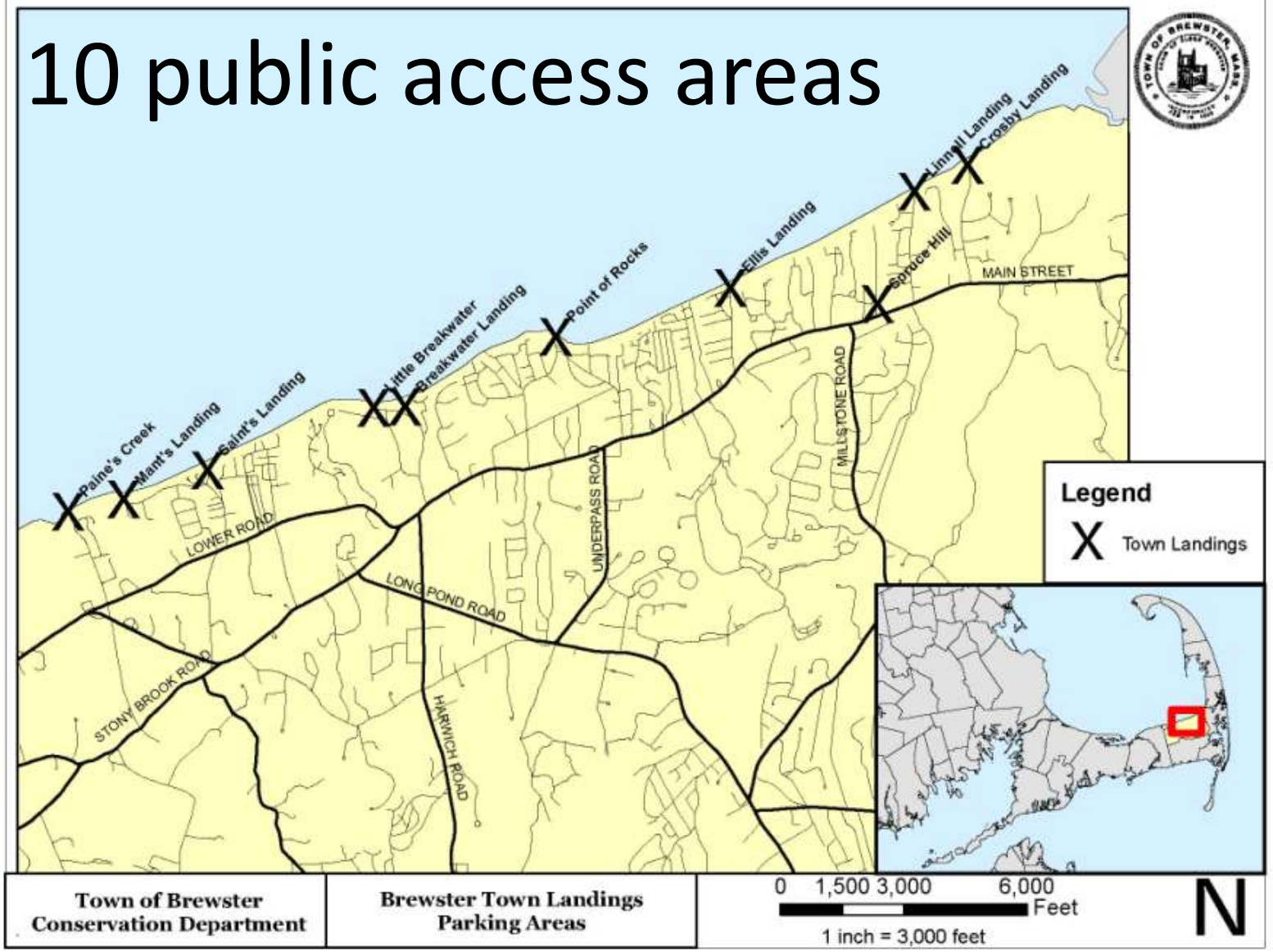
Using Managed Retreat to Address Coastal Erosion in Brewster



Chris Miller, Director,
Brewster Department of Natural Resources
CMiller@brewster-ma.gov

Brewster, Massachusetts

Almost 1/3 of town preserved as open space, including water department lands and Nickerson State Park. Many shorefront cottages being converted to larger or year round homes.



Parking spaces: Crosby 60, Linnell 25, Spruce Hill 12, Ellis 19, Point of Rocks 3 + 8, Breakwater 62, Little Breakwater 6, Saints 38, Mants 44, Paines Creek 15 =292.

The Brewster Flats

At low tide there are approximately 12,000 acres of exposed tidal flats extending up to two miles off shore in Brewster.

Shellfish aquaculture

The Problems…

- Repetitive losses
- Erosion rates of up to 2 feet/year (15’ in Sandy and related storms)
- Now, little or no buffer between infrastructure and the beach
- Loss of parking while increasing demand for access
- Rising sea level
- More severe storms, increasing frequency
- Higher rainfall amounts – poor stormwater infrastructure

Progress to date

- Purchase of coastal salt marsh and extensive open space
- Removal/restoration of coastal restrictions
  - Namskaket under bike trail, new culvert in 2007
  - Quivett Creek culvert under Sea Street in 2006
  - Rt. 6A culvert at Paines Creek 2009 (ARRA grant)
  - Freemans Pond culvert 2013
- Paines Creek parking lot project
- NRCS, state stormwater grants
  - Watershed approach, protect shellfish beds.
  - From headwater Mill Pond complex to shore at Stony Brook/Paines Creek

Old layout, Paines Creek Landing

Longshore Sediment Transport

Barnstable County, Massachusetts

Notes
Basemap: MassGIS 2009
Horizontal Datum: NAD 1983
Projection: StatePlane MA Mainland

N
W E
S

0 0.5 1

Miles

WOODS HOLE GROUP

www.woodsholegroup.com
FAX: 508.540.1001
TELEPHONE: 508.540.8080
Woods Hole Group 81 Technology Park Drive E. Falmouth, MA 02536 USA

September 1, 2009

Mr. Robert Bersin, P.E., Supt.
Town of Brewster DPW
201 Run Hill Road
Brewster, MA 02631

Re: Feasibility Study for Paine's Creek Beach Parking Area Protection and Improvements, Brewster, MA

Dear Mr. Bersin,

Woods Hole Group is pleased to present this initial evaluation of existing conditions and potential improvements to the Paine's Creek Beach area in Brewster, MA. We understand that the area is subject to erosion and there is a degraded culvert structure at the site which connects Stony Brook with Freemans Pond. We also understand that you are interested in learning more about the feasibility of expanding the Town beach's parking area and potential alternatives to address erosion at the site so that the beach facility can be protected and used as a recreational resource for years to come.

Woods Hole Group visited the beach facility on January 23, 2009 to observe the local physical processes and to assess the Town's areas of concern. During the site visit, we photographed the site and investigated the existing erosion problem on the western end of the parking lot. We also investigated the existing culvert structure that connects Stony Brook with Freemans Pond, and gathered information pertaining to the existing conditions at the site.

Based on the observations made during our site visit and our conversations, a set of tasks were defined for the feasibility study to better understand the existing conditions and potential improvements for the Paine's Creek Beach area. This letter report serves to summarize the results of this study and to provide the following:

- A brief overview of the present conditions and site description
- Details of site-specific research and data collection
- An evaluation of options for expanding resident parking
- An evaluation of potential shore protection alternatives
- An assessment of the Freemans Pond culvert

Figure 1. **2005 aerial of Paines Creek Beach, Brewster, MA (Mass GIS).**


Stone Dike
Groin Structures
Dune Area
Area of Erosion
Entrance to Stony Brook
Culvert Connecting
to Freemans Pond

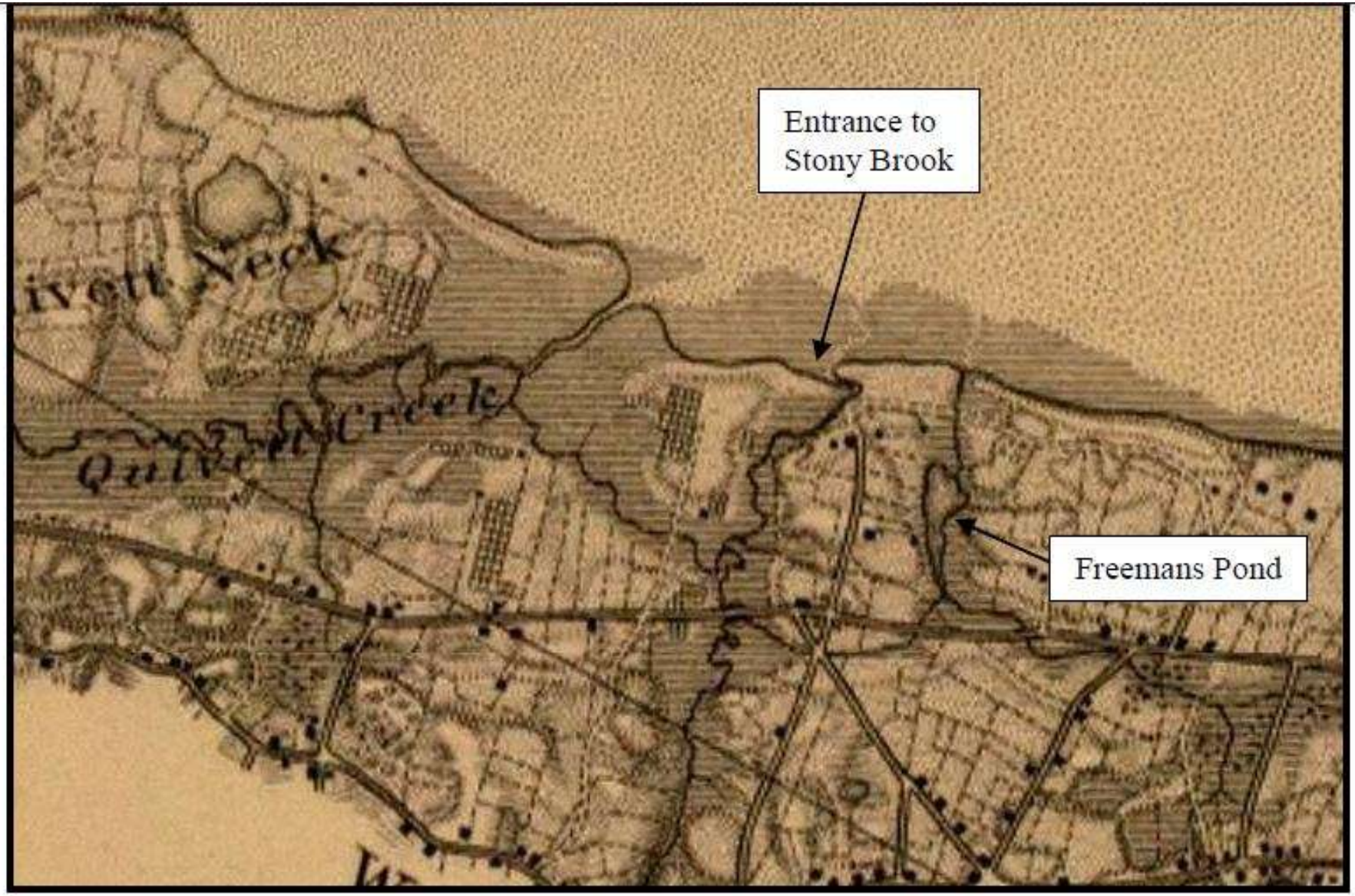


Figure 15. Portion of Coast Chart No. 10, Cape Cod Bay published by U.S. Coast Survey in 1872 (Mass GIS).

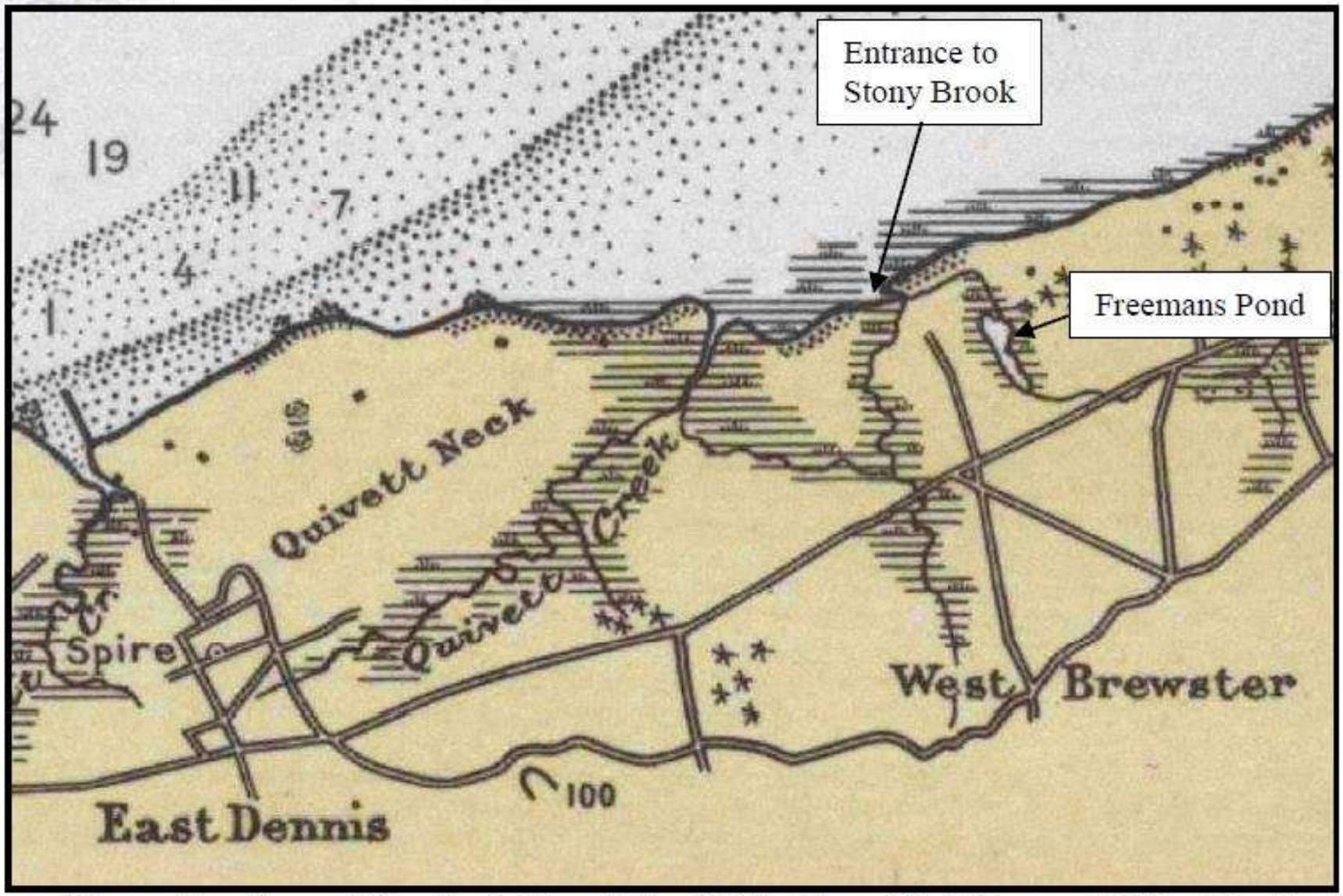


Figure 16. Portion of Nautical Chart No. 1208, Cape Cod Bay published by the U.S. Coast and Geodetic Survey in 1933 (Mass GIS).

2009

Figure 6. Replenishment of sand material at western end of Paines Creek Beach parking area (photo taken January 23, 2009).

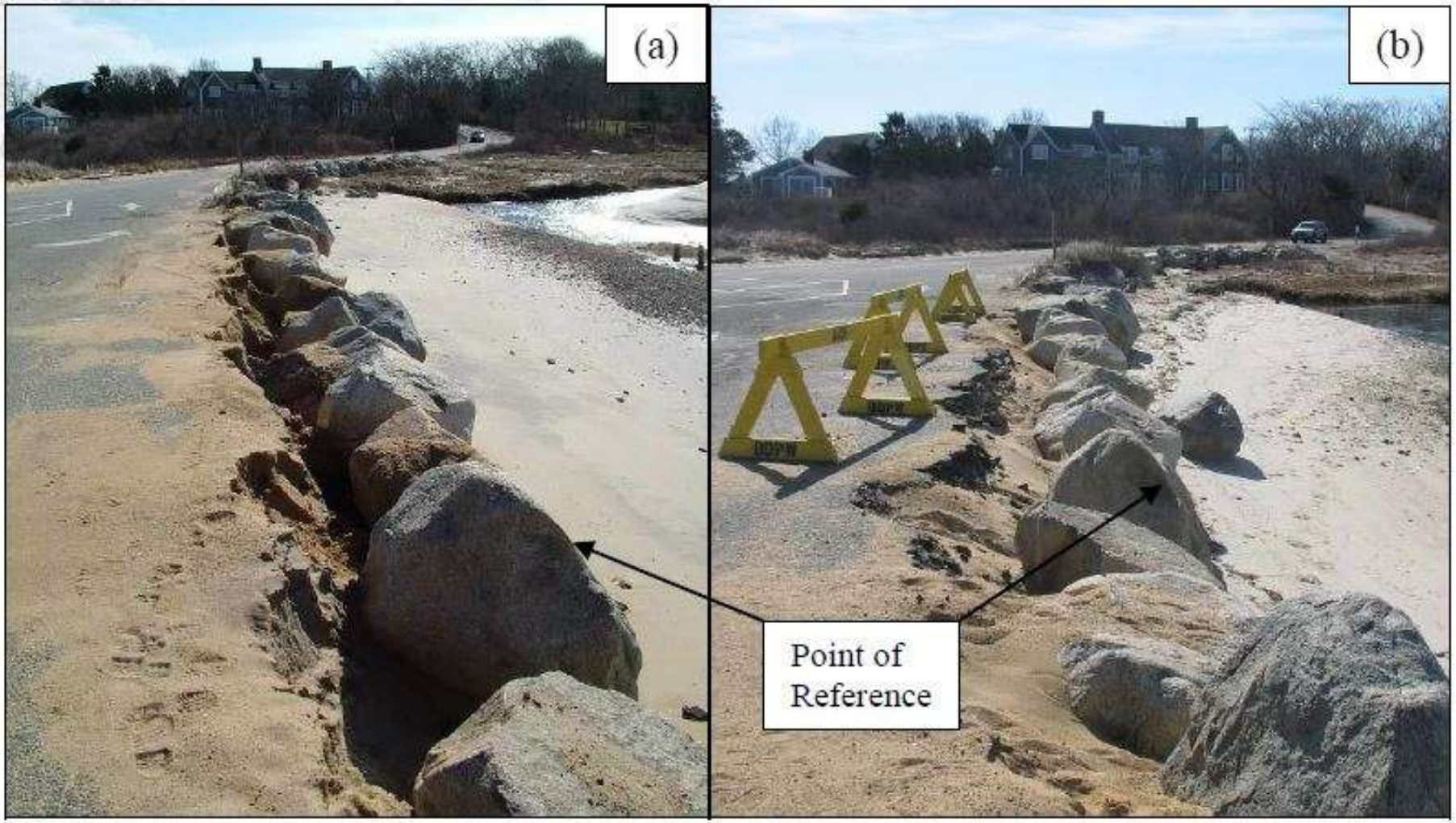


Figure 7. Progressive erosion occurring at western end of Paines Creek Beach parking area. Panel (a) is photo taken on February 13, 2009 (looking southeast) while panel (b) shows same view taken on March 26, 2009.

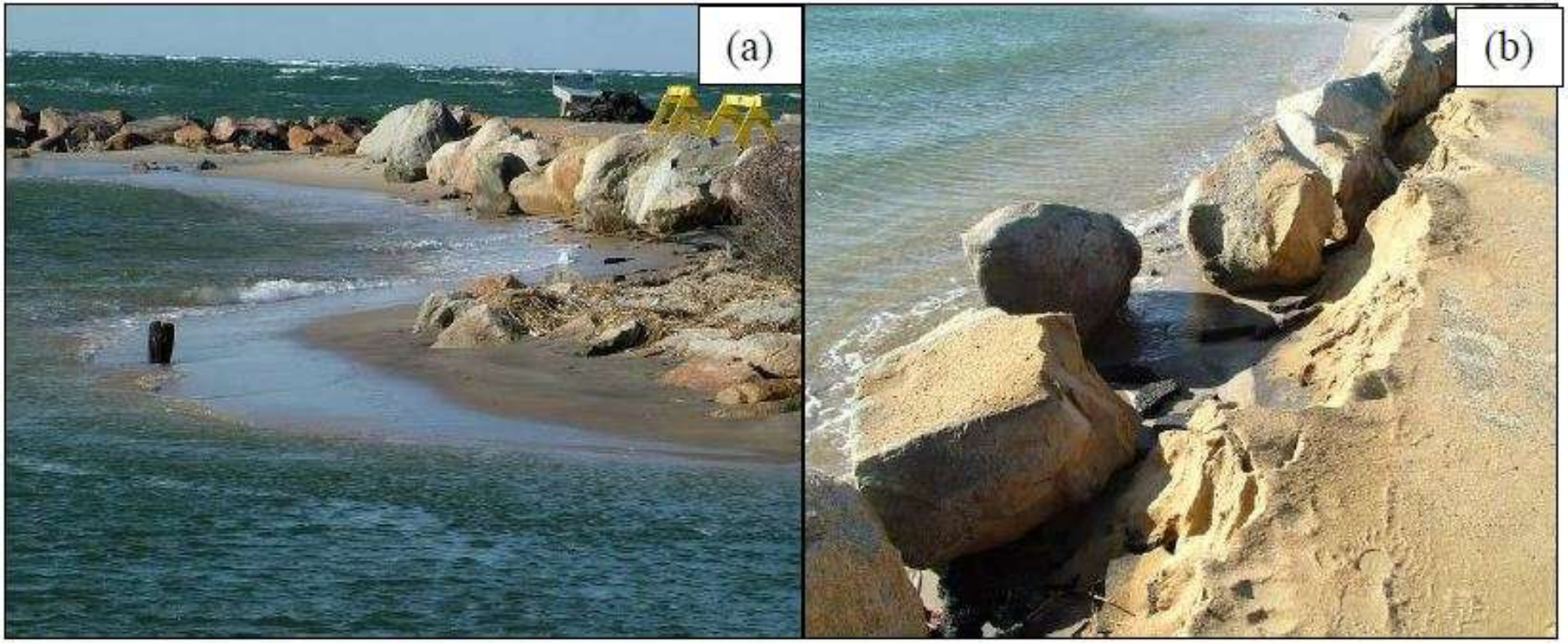


Figure 8. Elevated water level and ensuing erosion at western end of Paines Creek Beach parking area. Panel (a) shows elevated water level encroaching on parking area while panel (b) shows displaced boulder and erosion of sand fill.

Figure 9. Seaward end of culvert connecting Stony Brook with Freemans Pond showing deteriorating embankment protection (photo taken January 23, 2009).

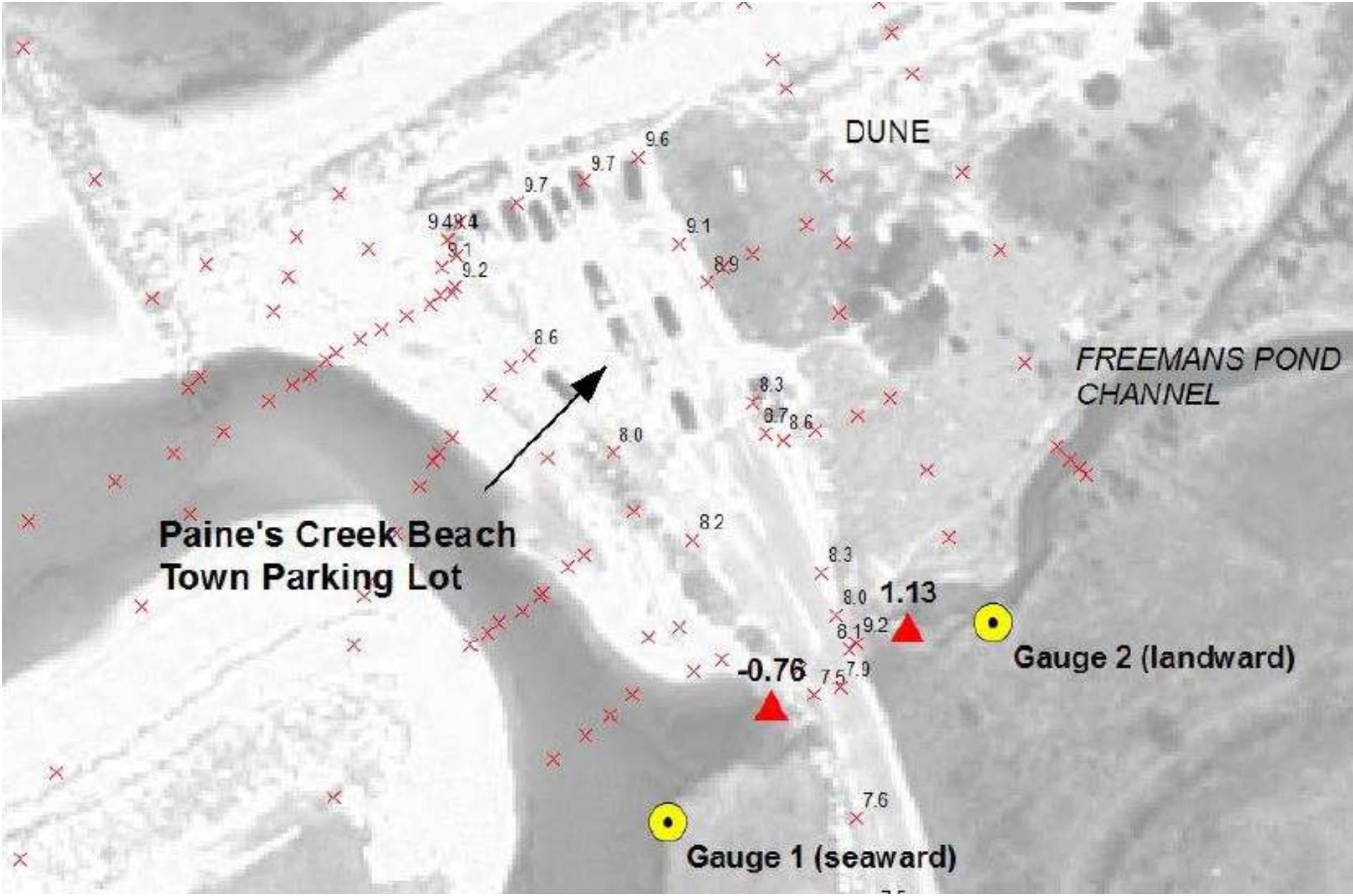

DUNE
FREEMANS POND
CHANNEL
Paine's Creek Beach
Town Parking Lot
1.13
-0.76
Gauge 2 (landward)
Gauge 1 (seaward)
9.6
9.7
9.7
9.4
9.1
9.2
9.1
8.9
8.6
8.3
8.7
8.6
8.0
8.2
8.3
8.0
8.1
9.2
7.9
7.5
7.6

Table 5. Alternatives analysis for shoreline protection at Paines Creek Beach

ALTERNATIVE	Overall Effectiveness	Shoreline Stabilization	Structural Lifetime *	Permitability	Permitting / Engineering Cost	Construction Cost *	Construction Feasibility	Maintenance Requirements
1. Do Nothing	○	○	N/A	N/A	N/A	N/A	N/A	○
2. Stone Revetment	●	●	●	◎	◎	○	●	●
3. Vertical Wall/bulkhead (timber/steel/composite)	●	●	●	○	○	○	◎	●
4. Rock-filled Gabion Baskets	◎	◎	◎	○	○	○	◎	◎
5. Coir Logs	◎	◎	○	●	●	●	◎	◎
6. Cobble Berm	◎	○	○	◎	◎	◎	●	○

* = Relative to other alternatives, varies depending on alternative items and local costs

● = Good

◎ = Medium

○ = Poor

N/A = Not Applicable


January 20, 2010
PAINES CREEK
BEACH AND LANDING REGULATIONS


BDPW
PERMIT
PARKING
ONLY
NO
PARKING


BDPW


BDPW

March 2010

Stormwater erosion from parking area at southeast side on March 14, 2010.


12/21/2010


12/21/2010


12/21/2010


12/21/2010


12/21/2010


12/21/2010


12/21/2010

2011

- Repeat of 2010: extensive damage to parking area, loss of pavement and asphalt fragments throughout beach and creek.
- AmeriCorp helps install another 1000 sandbags to shore up area.
- Very short term repair, additional damage in spring.

NRCS Stormwater Grants

- Saints Landing
- Paines Creek Road – North
- Paines Creek Road – South, including town landing
  - Instead of capturing and infiltrating stormwater at beach parking lot, we considered the retreat alternative, restoring the dune and building a similar sized lot in the road layout further inland.

Coastal Retreat

- Repetitive losses, high cost
- Environmental damage (asphalt/fill etc.)
- Long term likelihood of failure with rising seas and increasing storm intensity
- Hard solution would not be allowed
- Any permanent wall would result in loss of beach

Old layout, Paines Creek Landing

Stormwater

- NRCS grant requires 75 year life for structure.
- Stormwater basins in a dune?
- Instead, repurpose grant to remove asphalt, restore to natural habitat, reconstruct a smaller and better designed and resilient parking area.


Stony Brook
Paines Creek
Landing and Beach

Winter storm “Nemo”

Sandy and Nemo

- Since parking lot retreat, several severe storms.
- Old parking lot would have likely suffered extensive damage, if not completely destroying it.
- Restored area lost a lot of beach sand.
- New parking area inundated but minimal damage.

Freemans Pond Culvert

Figure 9. Seaward end of culvert connecting Stony Brook with Freemans Pond showing deteriorating embankment protection (photo taken January 23, 2009).

COASTAL COMMUNITY RESILIENCE GRANT PROGRAM FY14

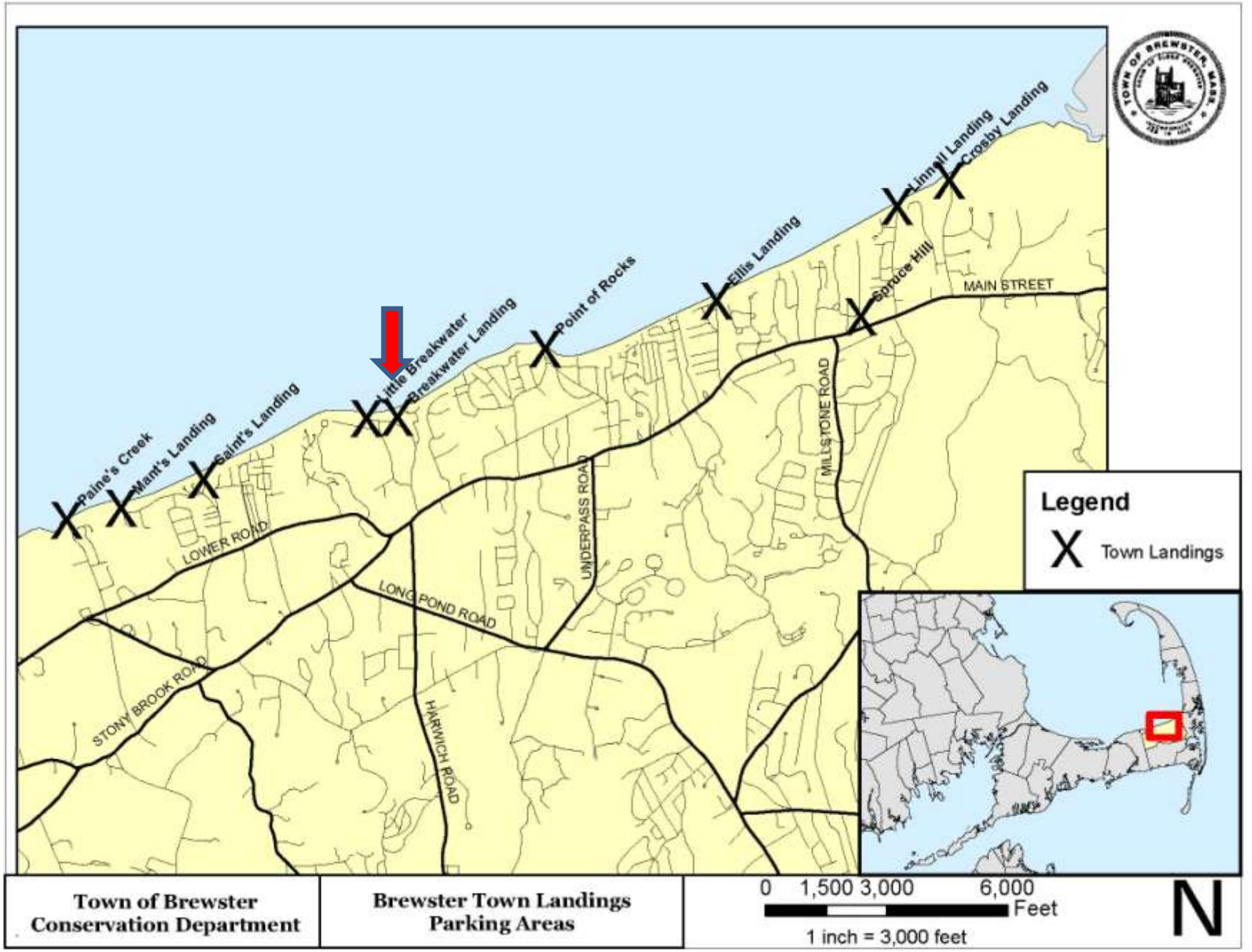
- **Brewster's Coastal Adaptation Project**
  - Public education or other communication initiatives;
  - Assessing vulnerability and risk;
  - Identifying and implementing management measures;
  - Redesigning to accommodate changing conditions; and
  - Enhancing natural storm-damage protection.
  - Straight from the CZM "**Stormsmart Coasts**" guidance.

Coastal Resilience Grant

- **Total Project Cost: $298,925**
- **Match Amount $98,925 (33%)**
  - **Town & Partner Match ($50,000 cash, $18,000 in-kind by Town, $10,000 match in other work by Town, $10,925 In-Kind match by the Association to Preserve Cape Cod (APCC), $10,000 match in grant funds by APCC)**
- **Grant Amount Awarded : $200,000**

Breakwater Beach Resiliency Design

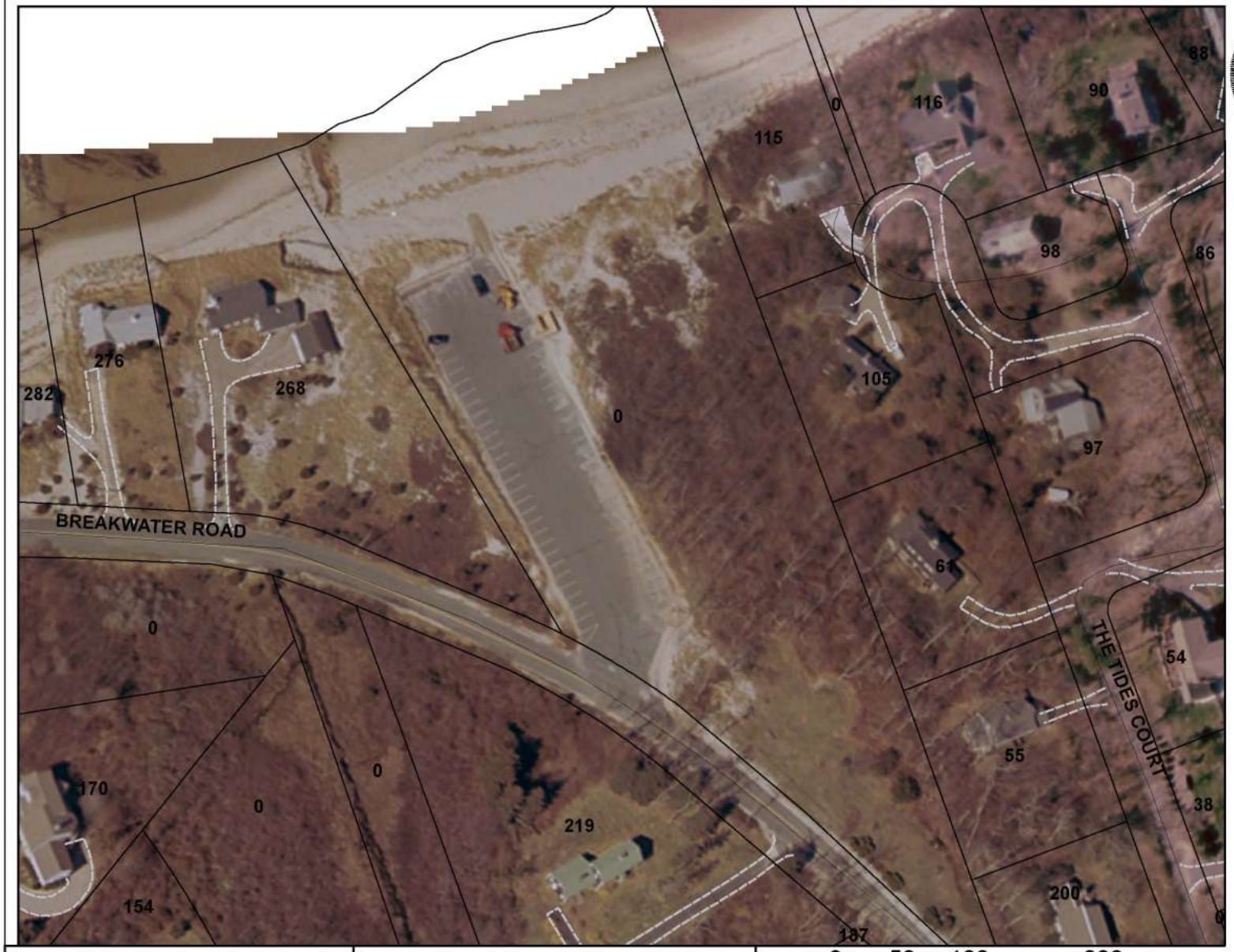
- **Relocation of Breakwater Landing Beach Parking Area, Restoration of Beach and Dune Habitat, Green Stormwater Infrastructure**:
  - **Outputs:** 100% design plans and bidding documents for removal and relocation of the parking lot, restoration of habitat, and improved access paths.
- **Green Infrastructure grant** awarded for implementation: $155,000 plus town match of $69,000.


Paine's Creek
Mant's Landing
Saint's Landing
Little Breakwater
Breakwater Landing
Point of Rocks
Ellis Landing
Spruce Hill
Linnell Landing
Crosby Landing
MAIN STREET
MILLSTONE ROAD
UNDERPASS ROAD
LOWER ROAD
LONG POND ROAD
STONY BROOK ROAD
HARWICH ROAD
Legend
Town Landings
Town of Brewster
Conservation Department
Brewster Town Landings
Parking Areas
0 1,500 3,000 6,000
Feet
1 inch = 3,000 feet
N

Breakwater Bath house c.1900

Breakwater Beach Bath Houses c.1900

Some of these bath houses were owned by the town, with the town collecting the rent (in 1930 about $7 for the summer), and some were privately owned. The last bath houses were torn down in 1945 when the property was sold.



Town of Brewster
Conservation Department

Breakwater

0 50 100 200 Feet

1 inch = 100 feet

N

Town of Brewster
Conservation Department

Breakwater Landing

0 50 100 200 Feet

1 inch = 100 feet

NORTH

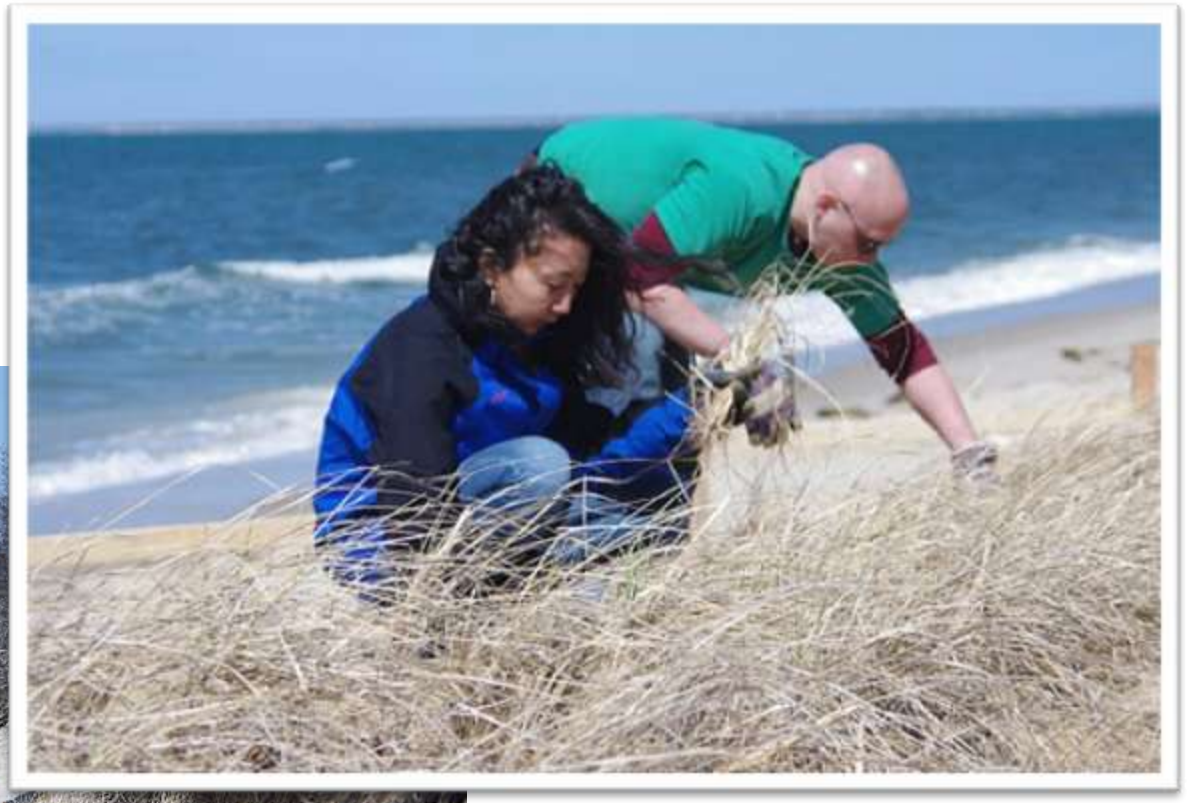
Breakwater March 2010

Breakwater May 2010

Since 2010

- Much larger sacrificial dune supported by sturdy sand fence
- Beach grass planted on dune to add resiliency
- Size of dune allows infiltration of stormwater without a “blow out” through dune or entrance.
- Neighbor to west improves end of revetment with reinforced coir logs, sand nourishment, sturdy sand fence.

Planting beach grass



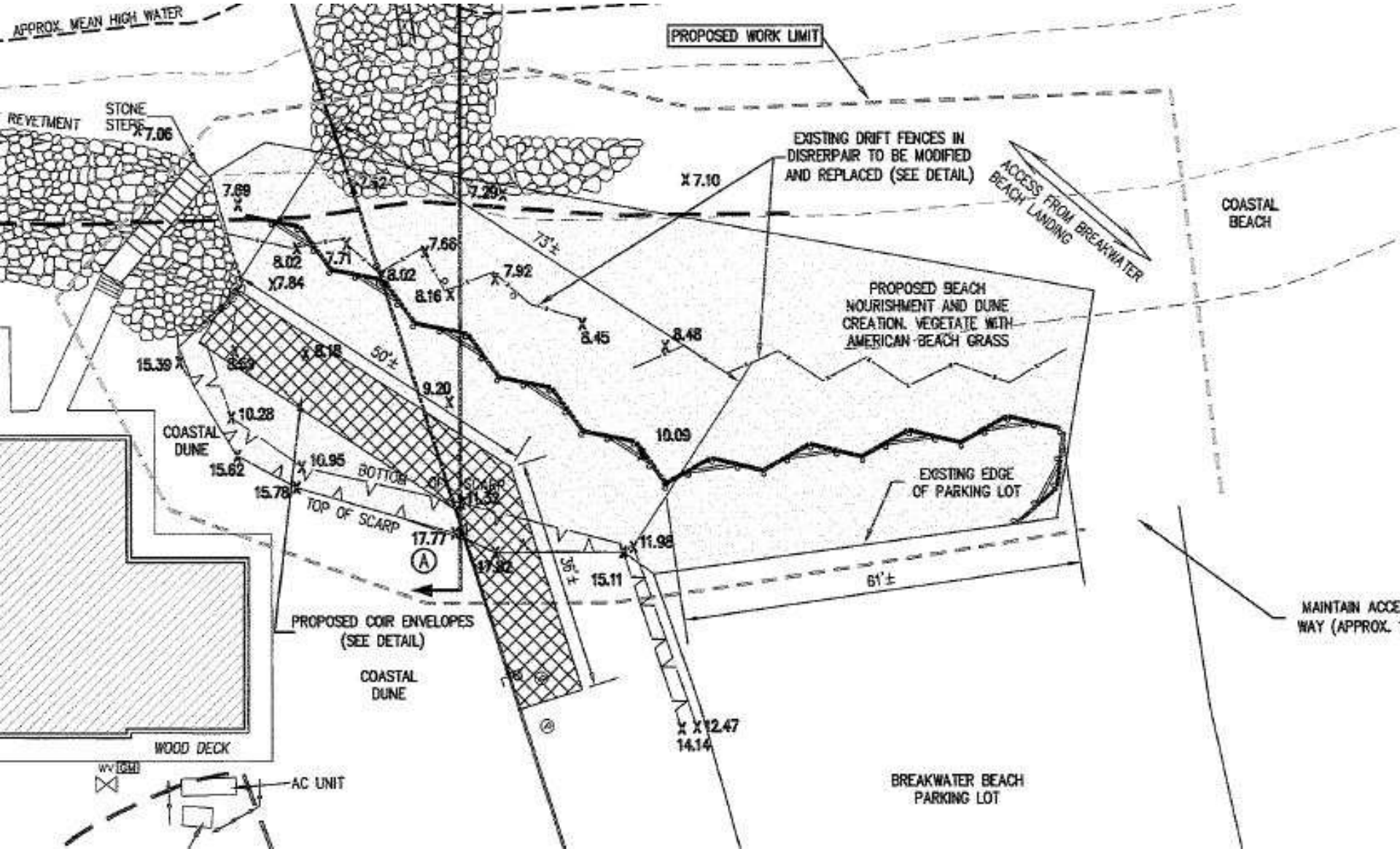
- Alternative spring break, Brandeis University

Breakwater February 2013

Breakwater February 2013

Breakwater spring 2013

End scour from revetment to west

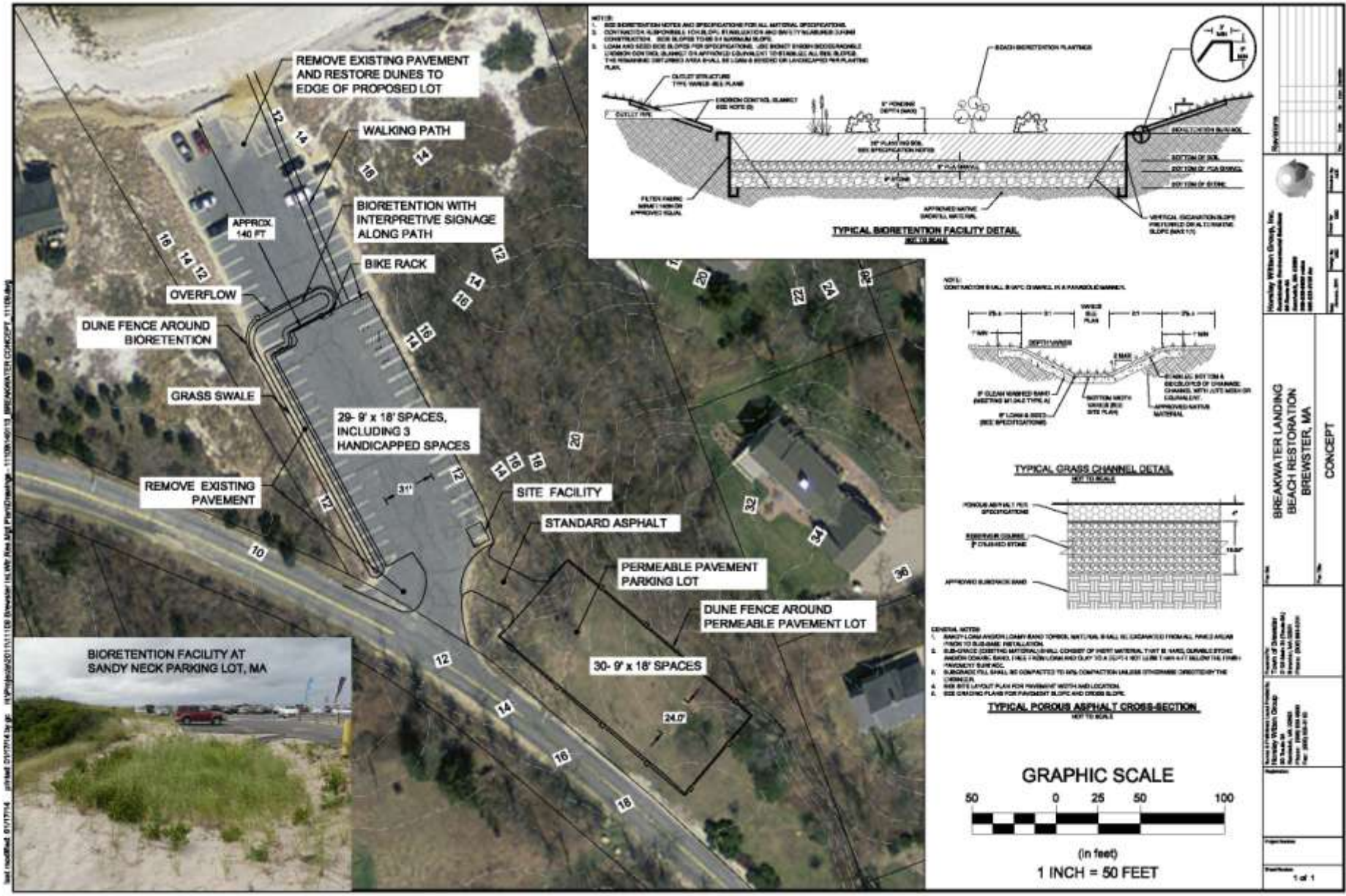


Sturdy sand fence in sacrificial dune at Breakwater

Sturdy fence buried under new dune located slightly further from active beach.


RESERVED
PARKING

Conceptual Plan



Concept: Retreat and rebuild

New replacement lot

Details

- Restore area to coastal dune, add beach sand to increase elevation to match surrounding, plant beach grass and shrubs.
- Articulating concrete mat under sand to allow vehicle traffic access through dunes for emergency response, coastal nourishment projects.
- Seasonal boardwalk through dunes to beach.
- Interpretive displays.