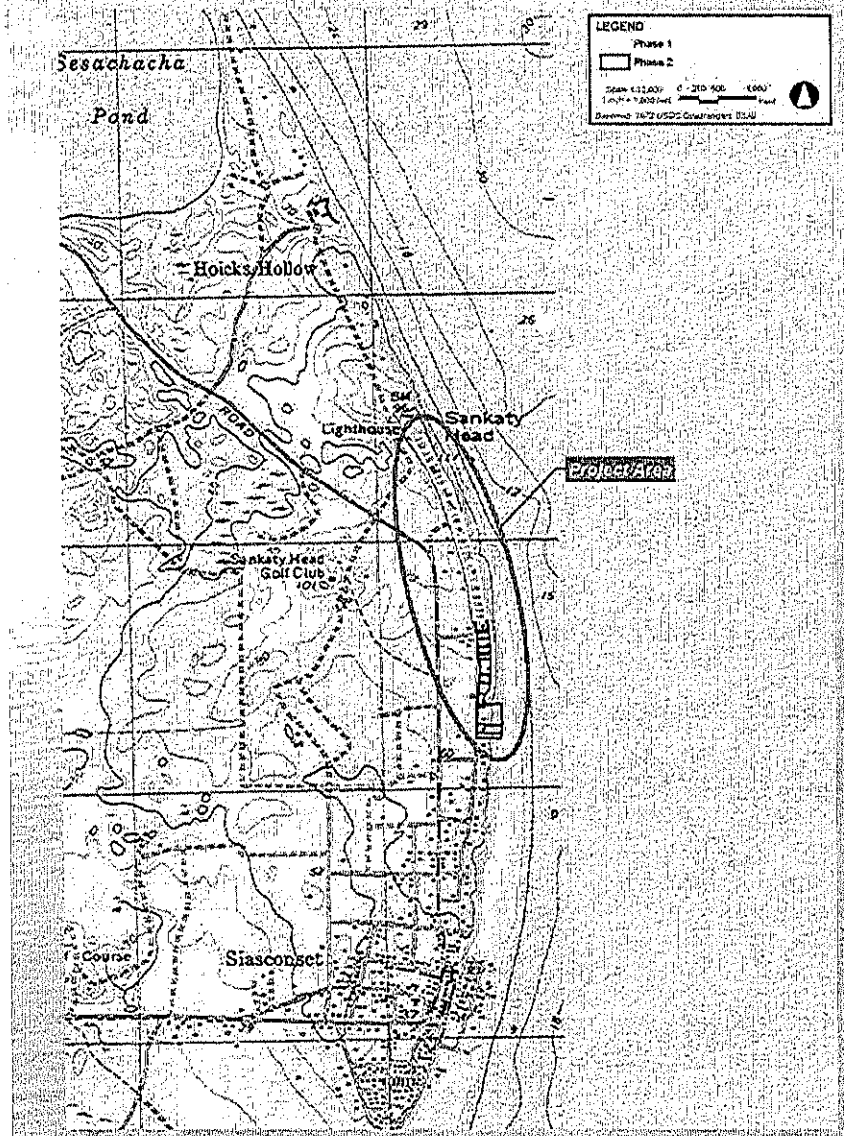


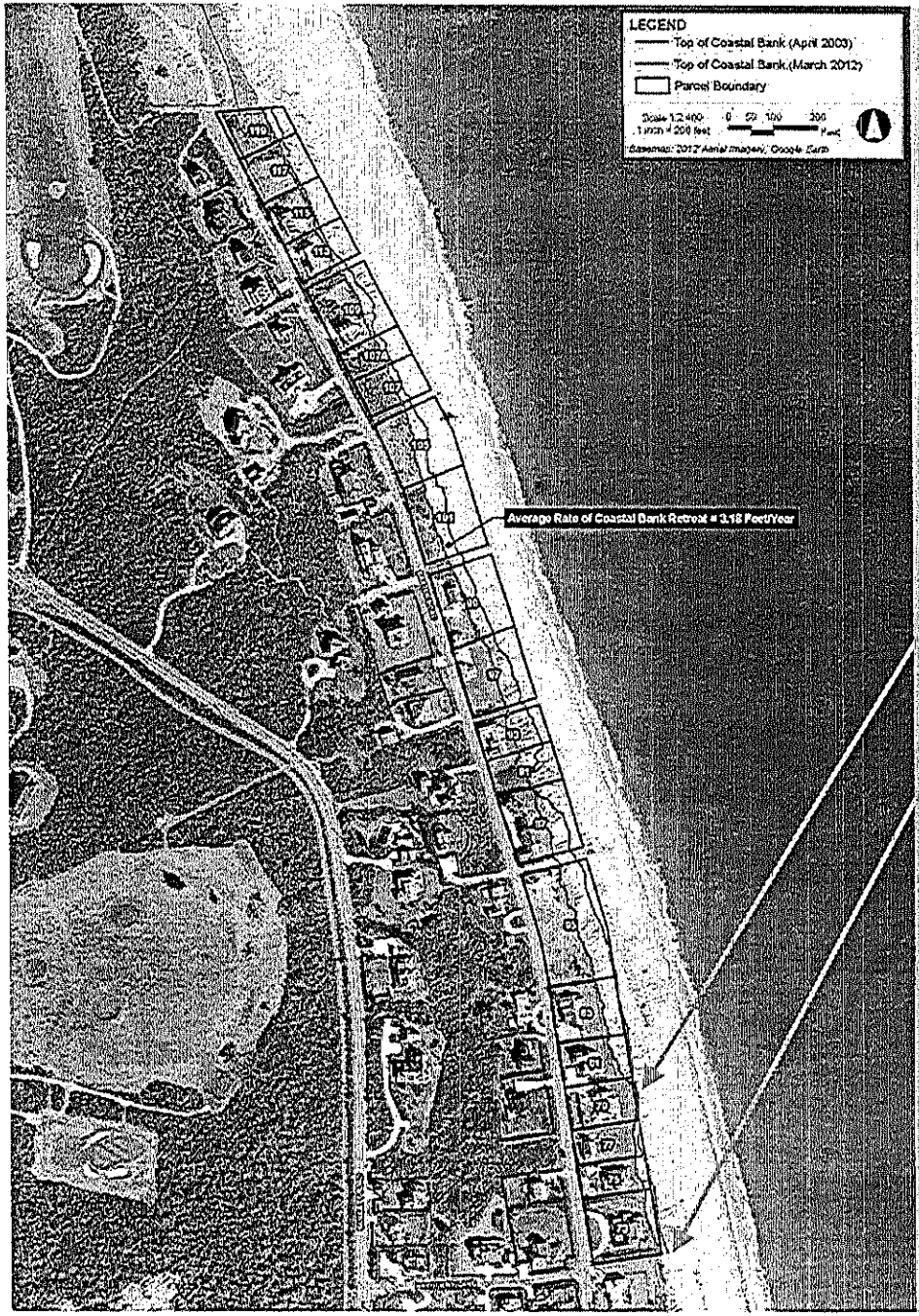
Baxter Road and Sconset Bluff Storm Damage Prevention Project

Nantucket, Massachusetts

Siasconset Beach Preservation Fund

Responses to Comments from July 24, 2013 Conservation Commission Hearing

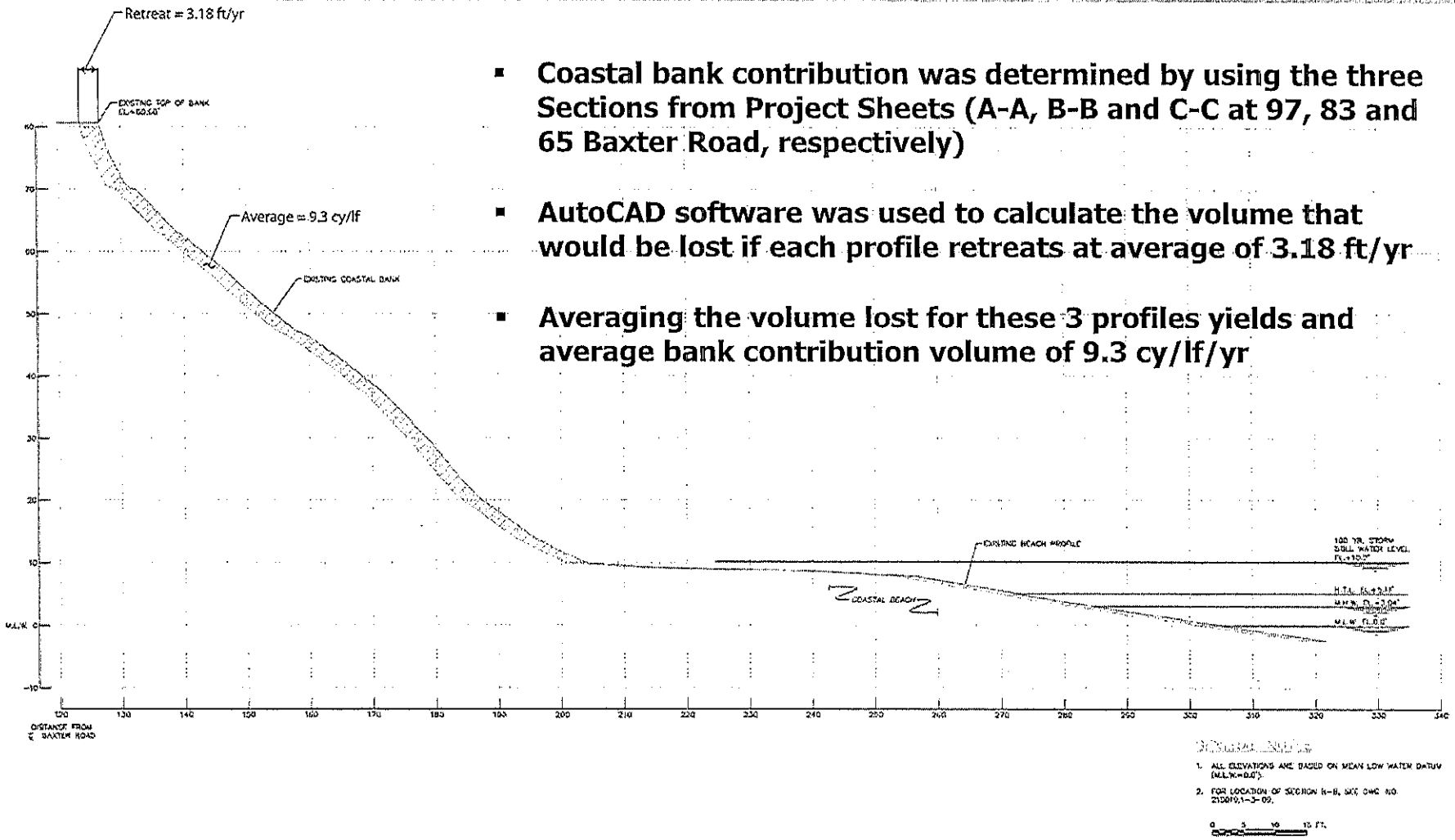
Rec @ meeting 7/30 by SBPF



Sand Mitigation Calculation

- Long-term erosion rate determined using aerial photography from 2003-2012 where active erosion was occurring
- 79 Baxter Road was excluded as terraces considerably slowed retreat
- South of 73 Baxter Road was excluded due to no active coastal bank retreat
- Calculated retreat is 3.18 ft/yr
- Lower than calculated retreat of 4.96 ft/yr from previously Bluff Stabilization NOI because that project was limited to Pilot project of only 77 to 85 Baxter Road

Sand Mitigation Calculation (continued)



- Coastal bank contribution was determined by using the three Sections from Project Sheets (A-A, B-B and C-C at 97, 83 and 65 Baxter Road, respectively)
- AutoCAD software was used to calculate the volume that would be lost if each profile retreats at average of 3.18 ft/yr
- Averaging the volume lost for these 3 profiles yields and average bank contribution volume of 9.3 cy/lf/yr

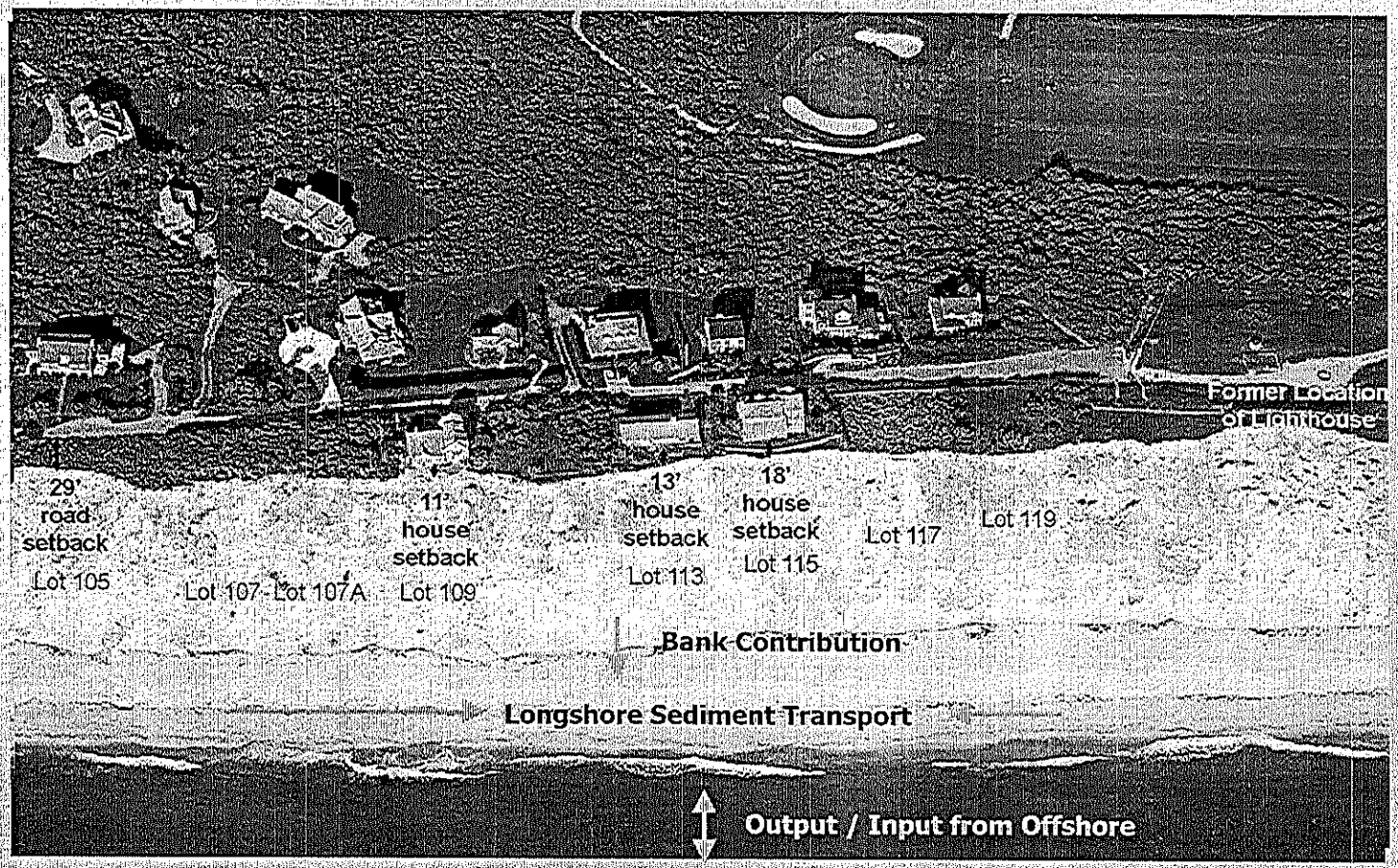
Terraces Sand Contribution

- Existing Terraces have contributed ~7-9 cy/lf/yr for last 5-7 years

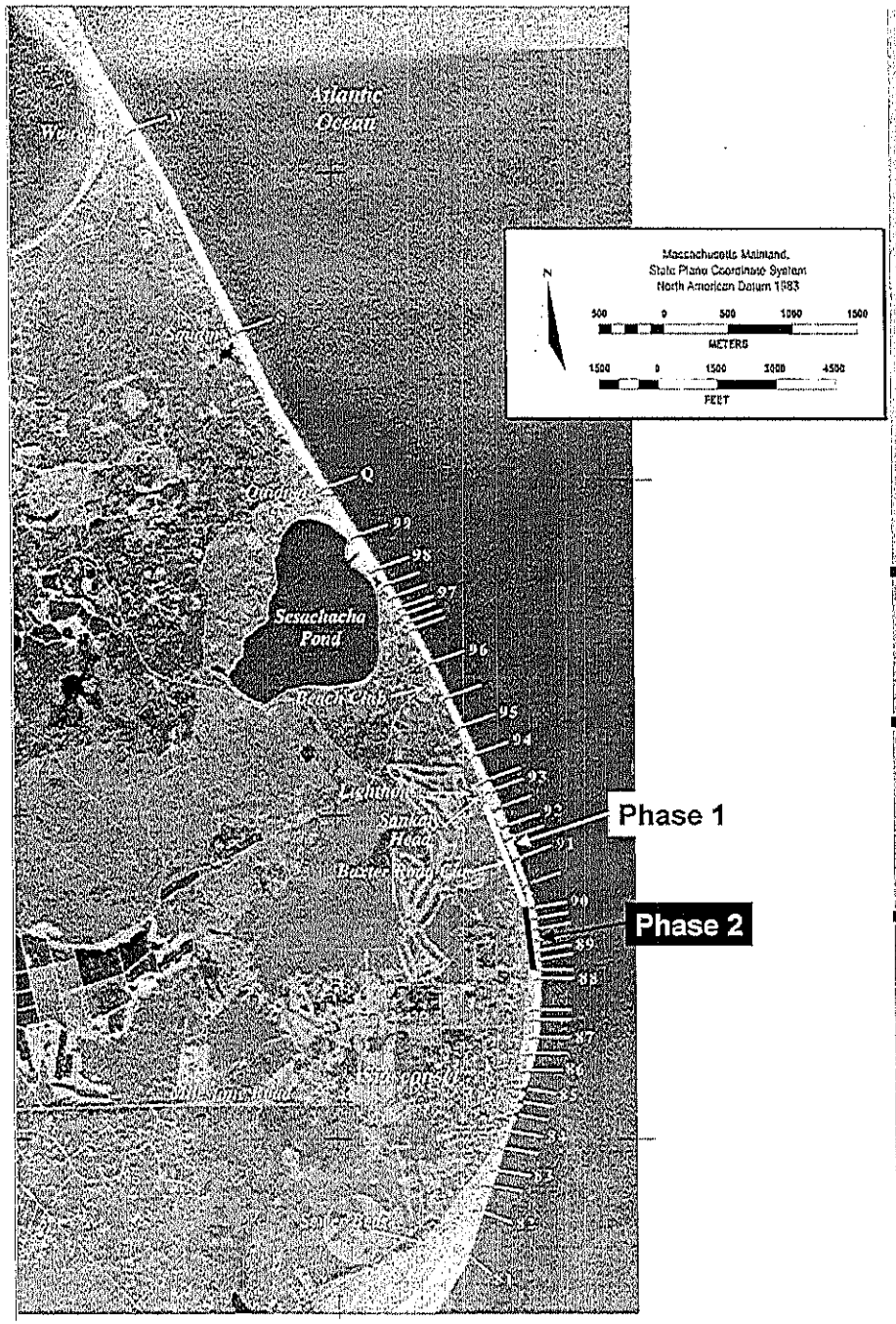
Terraces Sand Contribution (continued)

- Significant beach width remains seaward of Terraces
- No downdrift impacts to nearby beaches due to bank protection

Sand Contribution (continued)



- Sand mitigation on an annual basis is part of overall sediment budget
- Multiple inputs /outputs to sediment budget
- The impact of changing one input will be offset by other inputs/outputs to the system
- Using annual sand mitigation based on bank retreat rate is Best Available Measure.



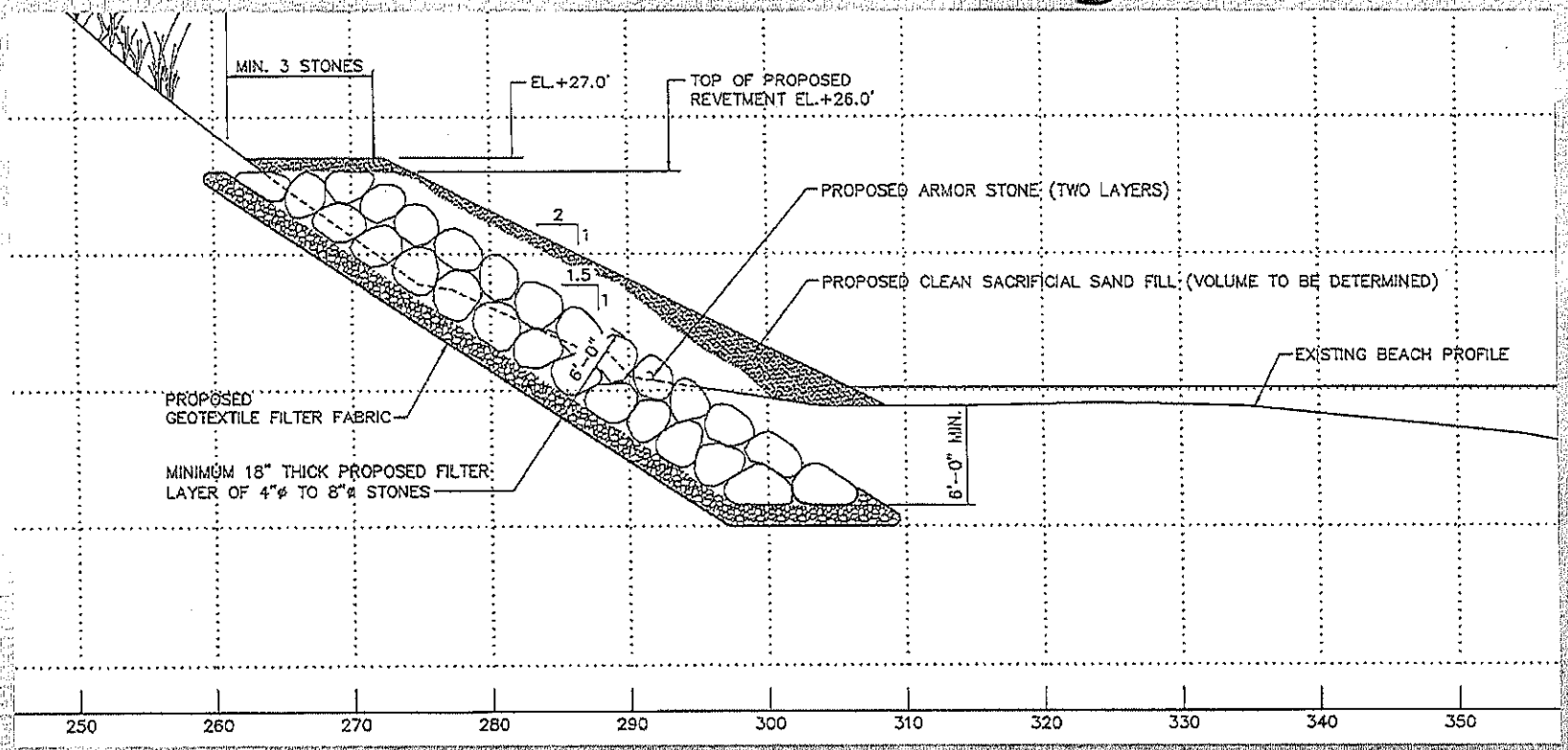
Shoreline Monitoring Transects

- If end scour is observed at time of sand mitigation, sufficient sand will be supplied to mitigate any local scouring
- Long term monitoring will be performed to determine if there are longer term erosion impacts that can be attributed to the revetment
- This proposed approach is the Best Available Measure to deal with end scour or other impacts

Sand Availability

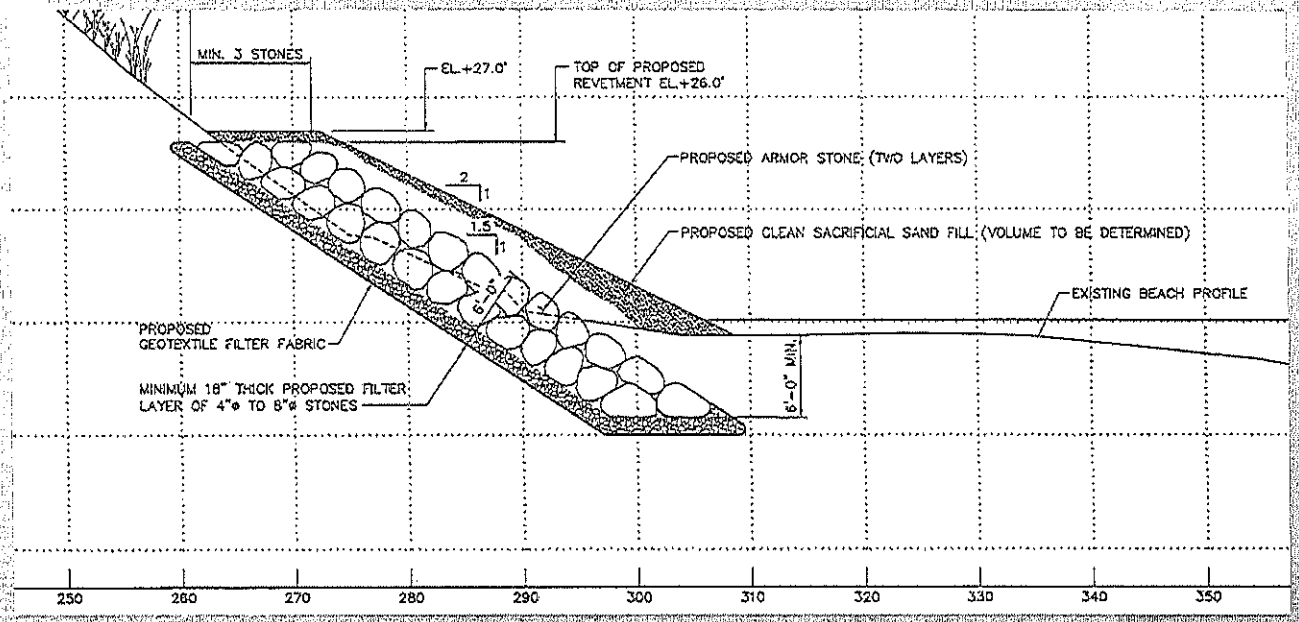
- Sand mitigation at rate of 9.3 cy/lf/yr will use a sand volume of 39,060 cy for total 4,200 ft long revetment
- Based on this amount, the two existing island pits would have a life of over 20 years
- The cost of sand at island pits is set based on the cost to deliver sand to the island by barge

Revetment Design



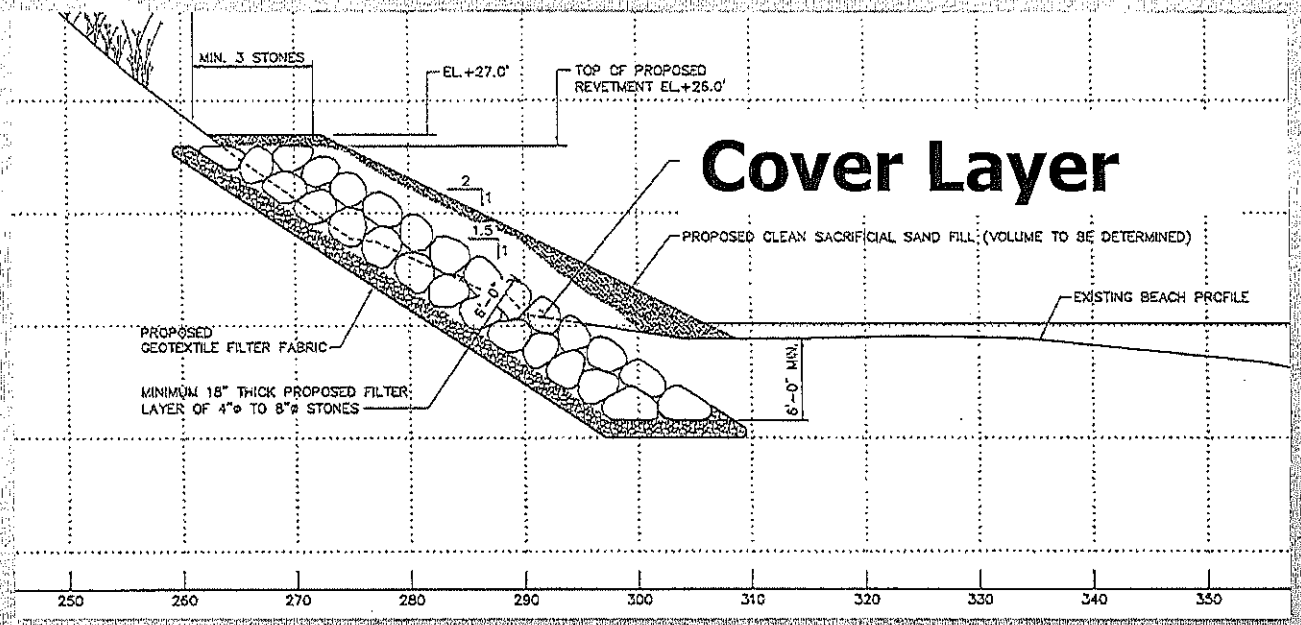
- Top at EL 26′ MLW – includes wave run-up for 100-yr storm +1′ sea level rise
- Toe set at EL 0.0′ MLW based on scour from 100-yr storm
- Armor stone sized for 100-yr design storm
- Geotextile Filter Fabric lines the coastal bank
- Filter layer of 4-8″ dia crushed stone
- 2 layers of armor stone
- Revetment sloped at 1.5:1

Revetment Failure



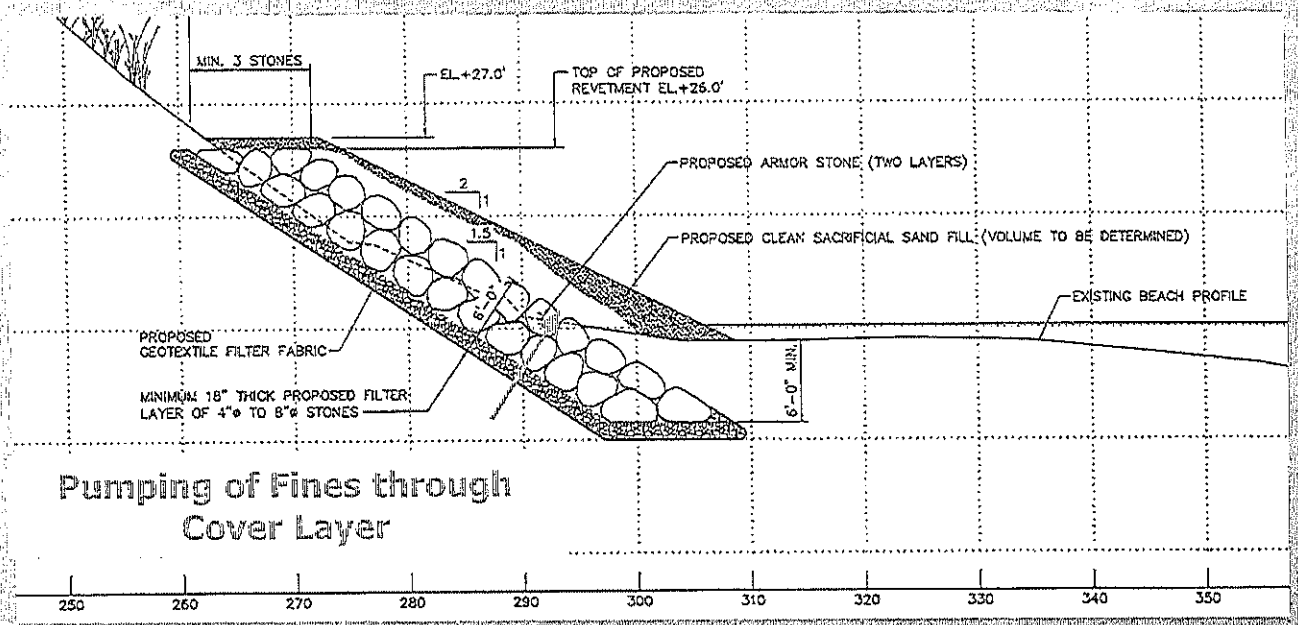
- Cover Layer Failure
- Pumping of Fines through Cover Layer
- Toe Scour
- Flanking
- Overtopping

Revetment Failure - Cover Layer Failure



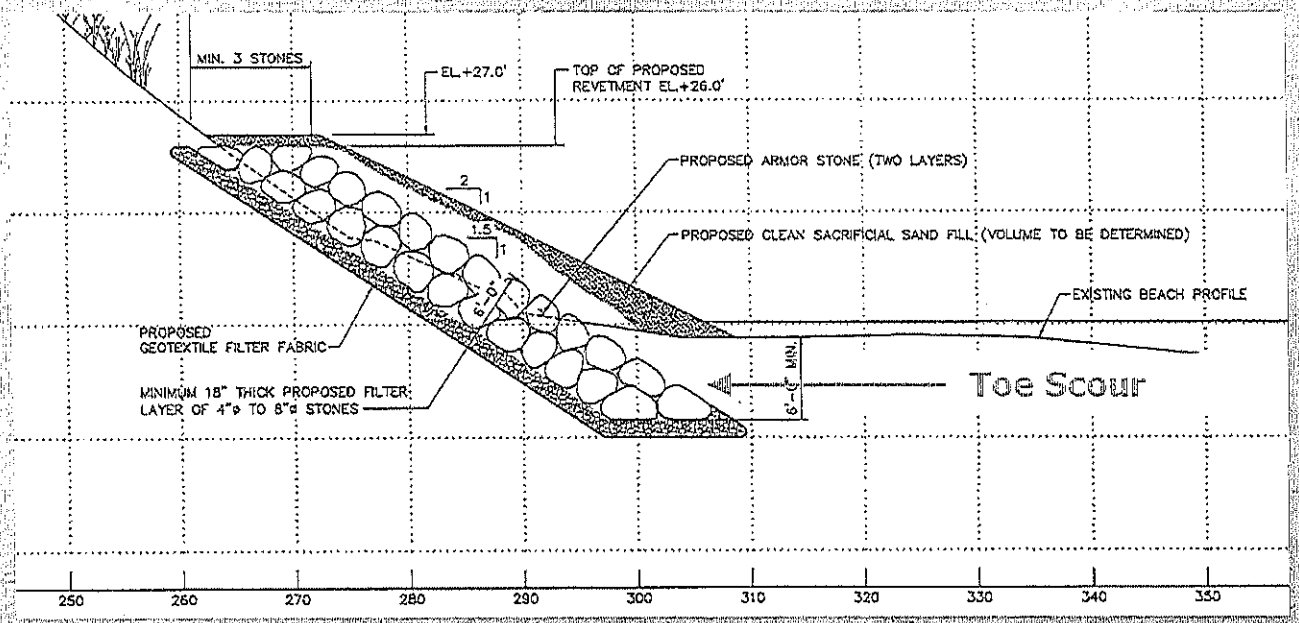
- Occurs when cover stones are not properly sized for the Wave Environment
- OCC calculated the size of the cover stones using Hudson's Equation and 100-year storm event wave input
- This is the Best Available Measure for cover layer design

Revetment Failure - Pumping of Fines through Cover Layer



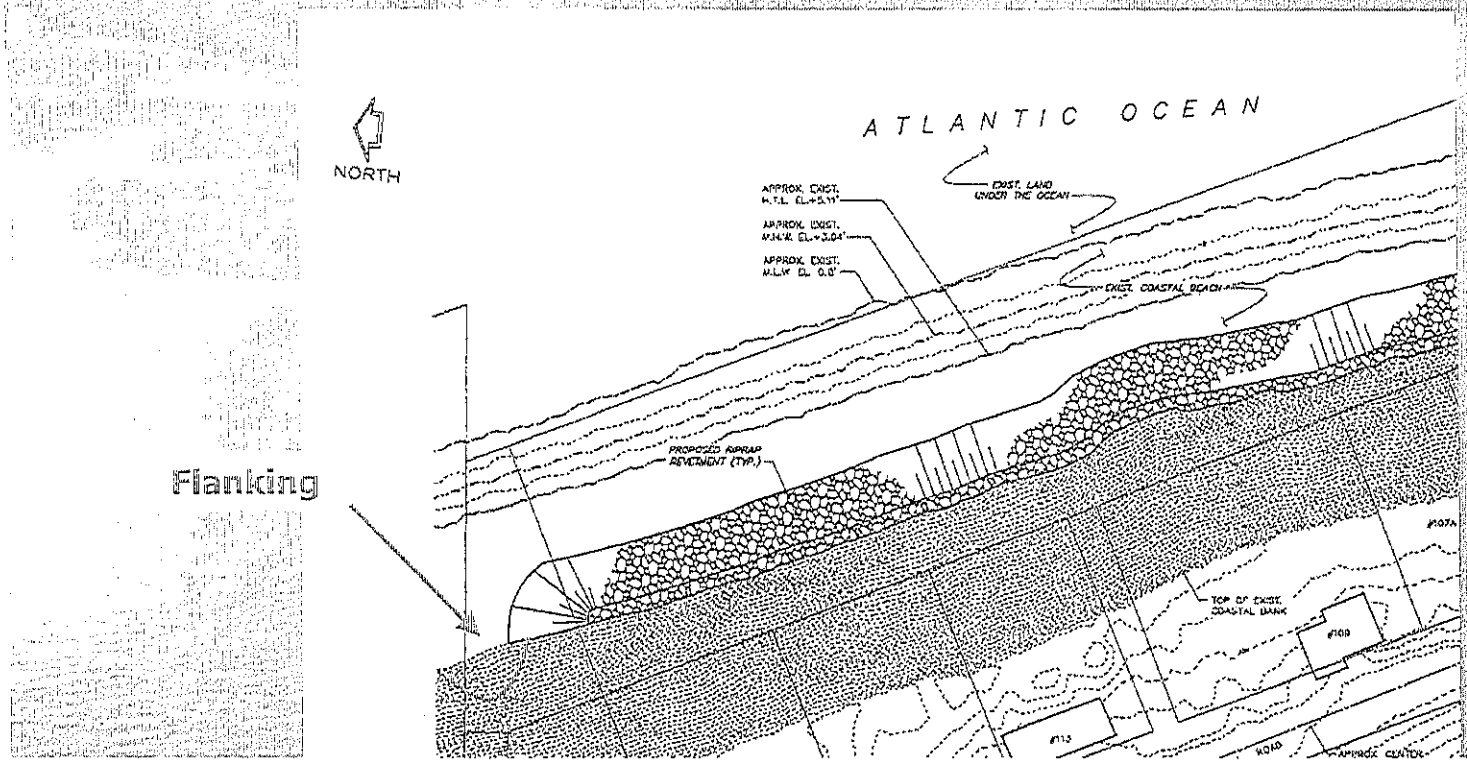
- Occurs when Geotextile Filter Fabric and Stone Filter Layers are <u>not</u> used
- OCC has designed this revetment with the appropriate Geotextile and Stone Filter Layers
- This is the Best Available Measure to prevent the pumping of fines through the cover layer

Revetment Failure -Toe Scour



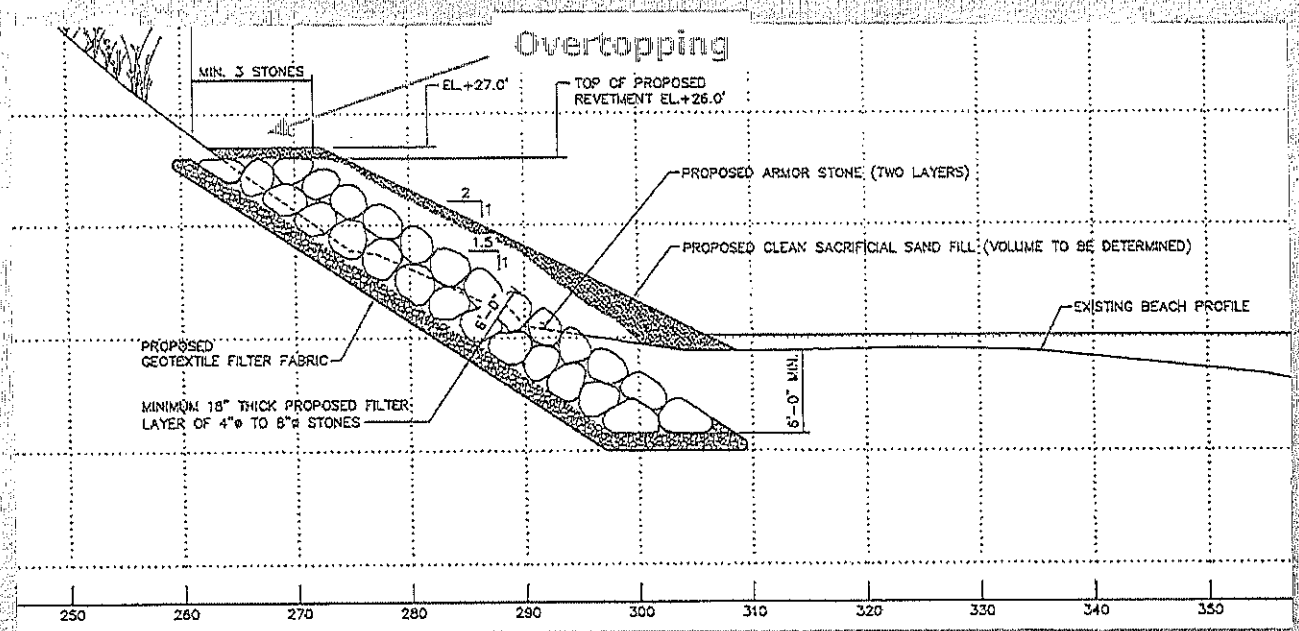
- Occurs when the underlying beach sediments are exposed to wave erosion
- OCC has designed this revetment with the toe set at a depth of 8 feet below the beach level which is below the estimated scour due to a 100-year storm
- This is the Best Available Measure to prevent toe scour

Revetment Failure - Flanking

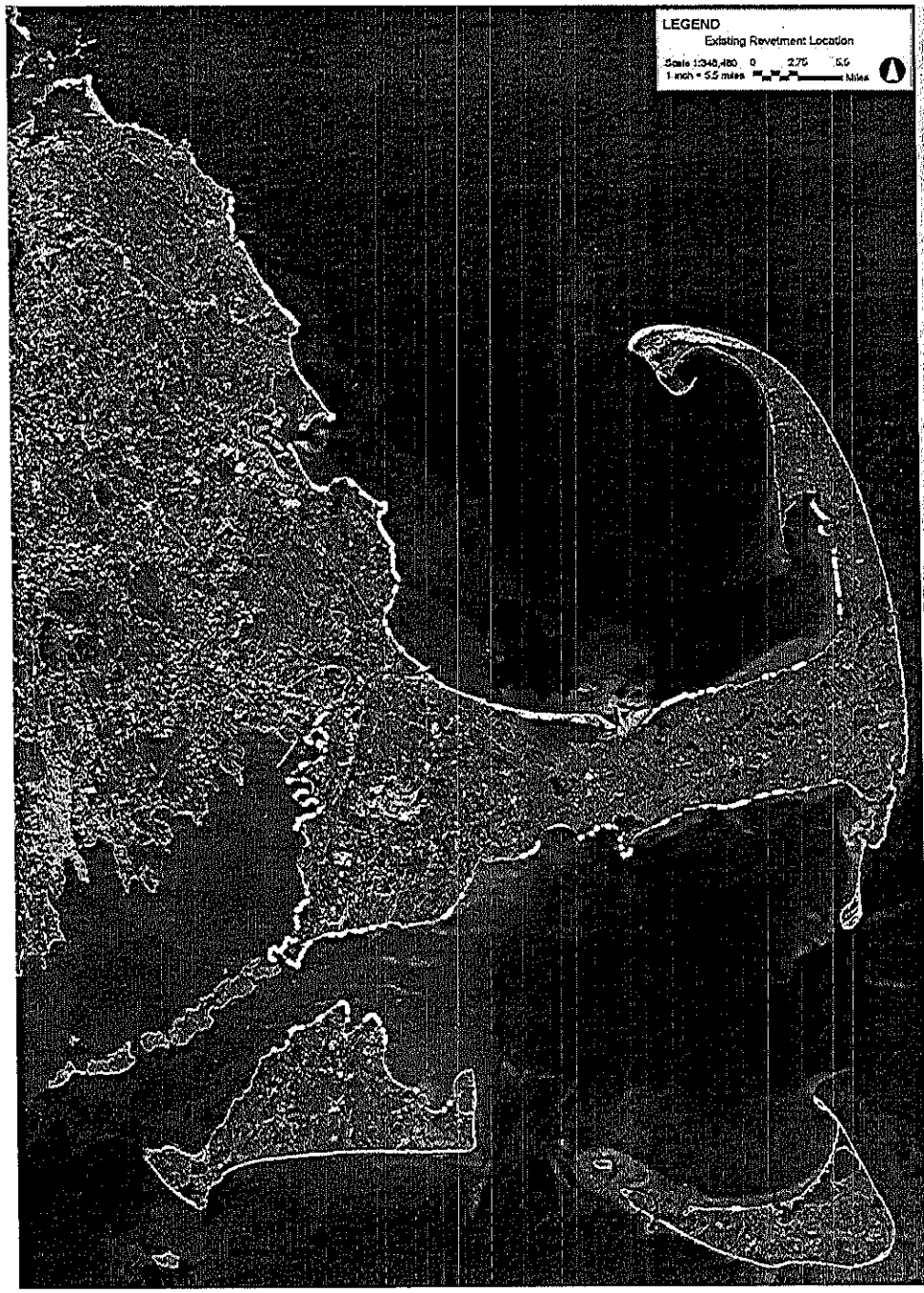


- Flanking occurs when the coastal bank continues to erode due to storm wave attack and this erosion removes soil behind the wall
- Flanking can be avoided or mitigated by extending the wall, using a return wall and/or placing sand over the end of the wall
- At Sconset flanking will be prevented or mitigated by extending or tapering the ends and by placing sand at the revetment ends
- This is the Best Available Measure to prevent or mitigate flanking. Also, gaps in the revetment will be minimized which will minimize revetment ends

Revetment Failure - Overtopping



- Occurs when wave run-up splashes over the top of the revetment which can expose the underlying bank sediment / soil to wave erosion
- OCC has designed this revetment with the top of the revetment at +26 ft MLW so that it will not be overtopped during a 100-year storm
- This is the Best Available Measure to prevent overtopping



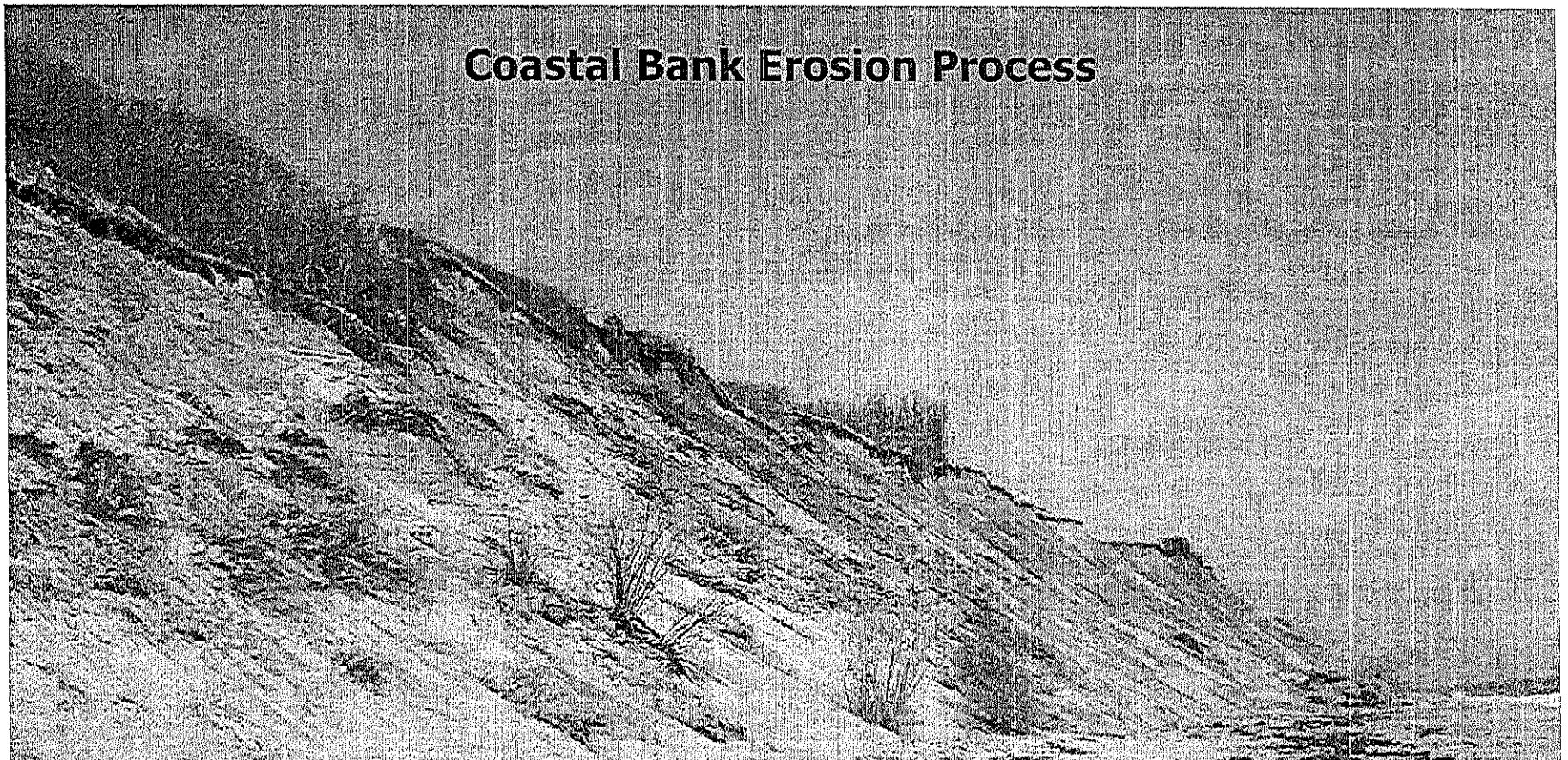
Revetments and Wave Energy

- Many revetments in Massachusetts are exposed to Northeaster storm waves and they have protected upland properties from storm damage
- A inventory of public coastal engineering structures in Massachusetts was prepared in 2009 by the Dept. of Conservation and Recreation, Div. of Waterways
- An engineering review rated each into the following categories: excellent (A), good (B), fair (C), poor (D), critical condition (F). Found that majority of the structures were in good or fair condition with 92% stable ranging from A to C. Only 8% were rated D and F, requiring immediate repair.
- Vast majority of these structures have not undergone repair since the mid-1950's

Revetments and Wave Energy

- Many revetments in other coastal areas of the US and world are exposed to large storm waves and they have protected upland properties from storm damage
- This example is a 4,000 ft long revetment in California which protects the Pacific Coast Highway

Coastal Bank Erosion Process



- Erosion of the toe of the coastal bank during storms is the driving force for coastal bank retreat
- Greatest storm erosion typically occurs during Northeasters which may last more than one day and over several high tide cycles
- Waves lower the beach elevation and remove the toe of the coastal bank
- This undercutting then creates an unstable upper bank which triggers slumping and other forms of downslope sediment movement
- After the revetment is constructed and the upper bank reaches a more stable slope, the upper bank erosion can be prevented by plantings

Impacts on Biological Community

- Dynamic nature of high-energy Sconset beach makes it depauperate (lacking numbers and species diversity) compared to communities in other coastal ecosystems
- Storms regularly eliminate inhabitants of backshore and beach community
- Sand fleas, mole crabs and other infauna are adapted to the hardship of this dynamic environment
- Loss in members of population is quickly compensated by new colonizers which migrate in from adjacent populations
- The NOI reviews how the project meets all state and local performance standards for wildlife

Regulatory Compliance

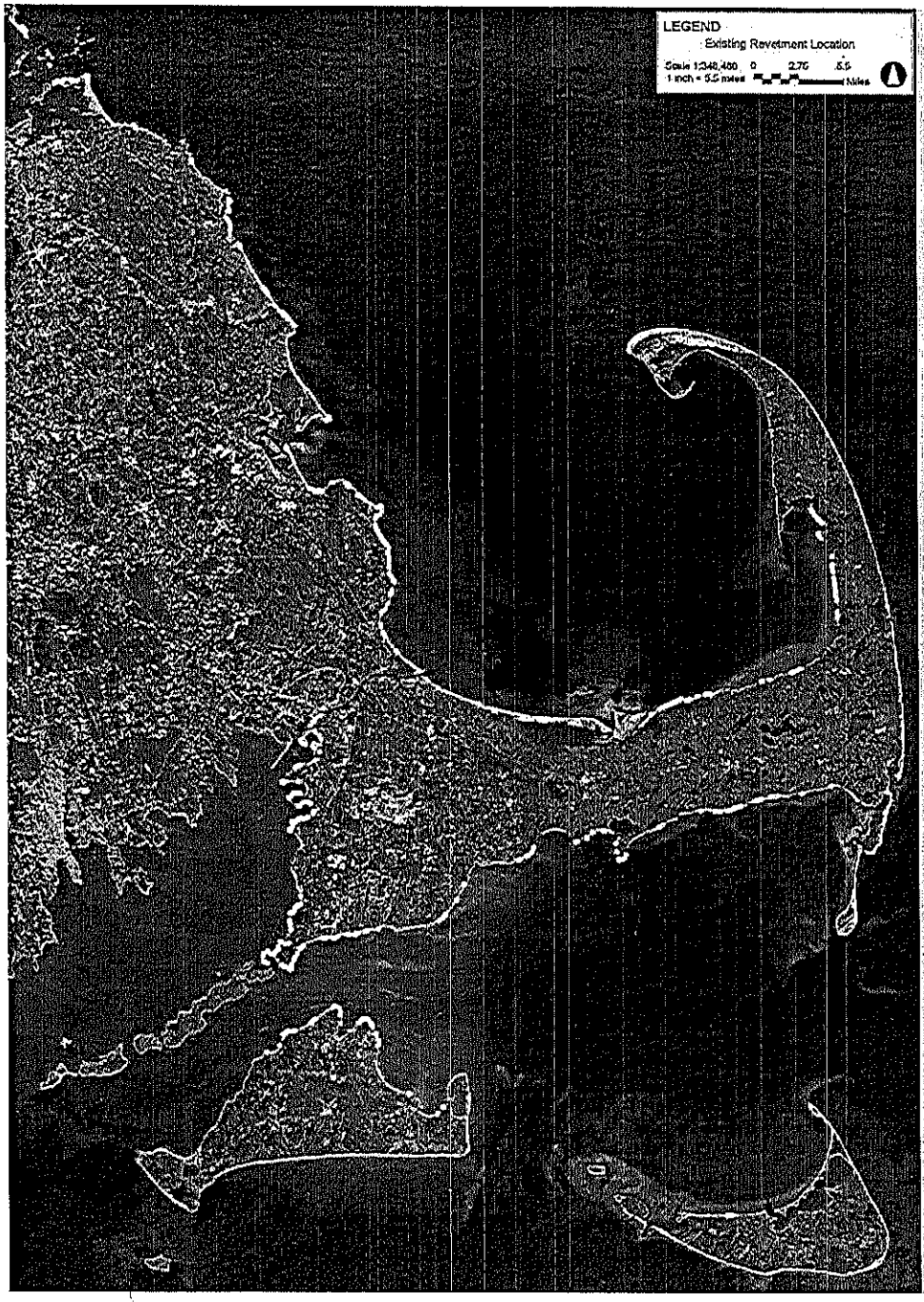
- "WHEN A COASTAL BANK IS DETERMINED TO BE SIGNIFICANT TO STORM DAMAGE PREVENTION AND FLOOD CONTROL BECAUSE IT IS A **VERTICAL BUFFER** TO STORM WATERS, 310 CMR 1030 (6) through (8) SHALL APPLY:"
- Then section (7) " Bulkheads, revetments seawalls, groins or other coastal engineering structures **may** be permitted on **such a coastal bank** except when such a coastal bank is significant to storm damage prevention or flood control because it **supplies sediment** to coastal beaches, coastal dunes, and barrier beaches."
- So it is important to first read the preamble and understand that section (7) only applies to **vertical buffer** type of coastal banks.
- Then section 7 indicates the exception **may** allow the permitting of a CES on a coastal bank that supplies sediment. Thus, this refers the reader to the section of the coastal bank regulations which then deal specifically with those banks that **supply sediment**.

Regulatory Compliance

- WHEN A COASTAL BANK IS DETERMINED TO BE SIGNIFICANT TO STORM DAMAGE PREVENTION OR FLOOD CONTROL BECAUSE IT **SUPPLIES SEDIMENT** TO COASTAL BEACHES, COASTAL DUNES OR BARRIER BEACHES, 310 CMR 10.30(3) though (5) **SHALL** APPLY:

Section (3) reads as follows:

- (3) No new bulkhead, revetment, seawall, groin or other coastal engineering structure **shall be permitted** on such as coastal bank **except** that such as coastal structure shall be permitted when required to prevent storm damage to buildings constructed prior to the effective date of 310 CMR 10.21 through 10.37 **(August 10, 1978)**…"
- This is the **grandfathering** provision which we meet.
- So it is important to understand that Sconset bluff is both a vertical buffer type of coastal bank and a coastal bank that supplies sediment. The vertical buffer coastal bank regulatory language refers the reader to the sediment supply coastal bank regulatory language which we comply with.



Regulatory Compliance

- WPA provides that CESs *may* be allowed on vertical buffer coastal banks, unless the bank provides storm damage protection and flood control by supplying sediment to beaches and dunes. In such cases, CESs are not allowed, except that CESs shall be permitted to protect pre-1978 structures.
- Hundreds of revetments have been permitted by Conservation Commissions and MassDEP under these regulations to protect pre-1978 homes
- Our interpretation is correct as evidenced by hundreds of permits being issued which could not have been issued under the context reading of the law offered by Squam/Quidnet Assoc.

Sediment Delivery

LEGEND

- Phase 1
- Phase 2
- Hopper Location
- Structural Turf Location
- Conveyor Belt for Sediment Delivery
- Chute for Sediment Delivery
- Coastal Bank
- Coastal Dune

Scale 1:3,600
1 inch = 300 feet

0 75 150 300 Feet

Basemap: 2011 Aerial Imagery, ESRI

Truck Traffic

Annual Sediment Mitigation

- ~ 39,060 cy of sediment for annual sediment mitigation (9.3 cy/lf * 4,200 ft).
- Assuming a 20 cy dump truck, ~ 1,953 truck trips required.
- Assuming 20 trips/day (2 trucks making 10 trips each), the full volume could be delivered in just under 100 days.
- Annual sediment mitigation could be delivered during two separate phases: a spring phase (50 days in April and May) and a fall phase (50 days in October and November)
- Based on the results of monitoring, dates of sediment delivery could be adjusted to deliver more or less sediment prior or subsequent to winter storm season.

Truck Traffic

Initial Sediment Mitigation

- Phase One
  - Maximum length is 1,900 lf.
  - Initial sediment covering of 17,670 cy (9.3 cy/lf * 1,900 lf).
  - Assuming a 20 cy dump truck, a total of ~ 884 truck trips.
  - Assuming 20 trips/day, sediment cover supplied in 44 days.
- Phase Two
  - Length is 2,300 lf.
  - Initial sediment covering of 21,290 cy (9.3 cy/lf * 2,300 lf).
  - Assuming a 20 cy dump truck, a total of ~ 1,070 truck trips.
  - Assuming 20 trips/day, sediment cover supplied in 54 days.

Initial sediment volume will either be placed as a cover on the revetment, or placed along the length and ends of the revetment so that it is available to the littoral system.

Roadway Bond

- SBPF is fully prepared to provide a bond as a requirement of the Order of Conditions for the unlikely event that the Baxter Road is irreparably harmed during the course of construction.
- Bond has been discussed with DPW director, Kara Buzanoski, who did not indicate concern for damage to roads between the pits and Baxter Road, but did provide input with respect to the potential damage to Baxter Road along the pullover area.
- In the event that irreparable harm is done to Baxter Road at the location of each pullover area, the scope of repair work was determined by Ms. Buzanoski to be the complete replacement of ninety (90) feet of roadway adjacent to each pullover, the removal of the structural turf from the pullover area, the installation of fresh topsoil to that area, and the hydro seeding of the area.
- Pricing was obtained from local contractors and reviewed with Ms. Buzanoski, who agrees with the amounts established totaling ~ $42,000.

Repair of Revetment

If the beach in front of the revetment is narrowed to the point where SBPF engineers are of the opinion that the toe will be threatened, the following will occur:

- Sediment will first be dumped at the seaward edge of the revetment to make a platform.
- Next, revetment-sized stones will be dumped on top of the sediment platform.
- These stones will sink into the sediment platform and will augment the existing toe scour protection.

Revetment Walkway and Stairs

- A walkway will be created by using flat-faced stones with densely-filled voids at the top of the revetment.
- Stairs from the revetment walkway to the beach will be provided by cutting stairs into the revetment stones, at locations shown on following figure.
- Wooden stairs from the top of the coastal bank down to the revetment walkway will be provided at locations shown on following figure.

Public Access

LEGEND

- Phase 1
- Phase 2
- Existing Bluff Walk
- Existing Stairs
- Possible Future Stairs
- Walkway Across Revetment (Including Stairs)

Scale 1:3,600
1 inch = 300 feet

0 75 150 300 Feet

Basemap: 2011 Aerial Imagery, ESRI