COASTAL PROCESSES SPECIALIST
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July27, 2023

TO: West Tisbury Conservation Commission

CC: George A. Sourati, P.E. (Sourati Engineering Group LLC)

FROM: Greg Berman, Coastal Processes Specialist (WHSG & CCCE)

RE: Site report for 271 John Cottle Road, West Tisbury, MA

Background: Since the inception of the coastal processes position established within WHSG & CCCE, on-site and remote technical assistance on coastal processes has been and continues to be an on-going, effective technical information communication and dissemination tool. Technical assistance relating to coastal processes, shoreline change, erosion control alternatives, coastal landform delineation, potential effects of various human activities on coastal landforms, coastal floodplains, coastal hazards and hazard mitigation analyses, and dune restoration techniques provided in the field and remotely will continue to be provided on an as-needed basis. Site visits generally address site-specific coastal processes or coastal hazards related issues. Follow-up unbiased, written technical alternatives analyses are generally provided.

Site Details: This report focuses on the property of 271 John Cottle Road, in West Tisbury (Figure 1). A NOI has been submitted to the West Tisbury Conservation Commission to rebuild the existing rock revetment, extending it on both ends, and adding a transition of gabions/fiber rolls at the terminus of the structure.

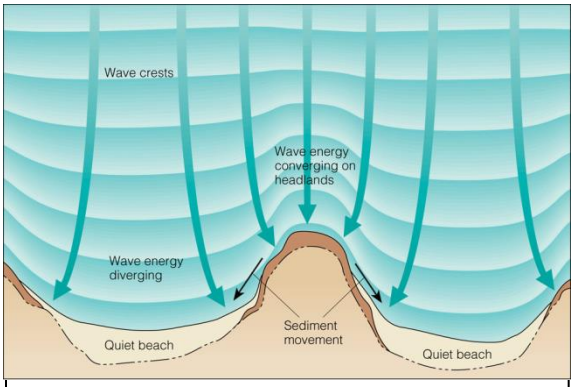
A series of photographs was taken during a site visit on 07/06/2023. Photograph 1 shows the edge of the cottage (built in the 1930s and so pre-dating the Wetlands Protection Act) is ~ 16' from the top of the bank. There has been some minor erosion recently at the top of the bank. There was no observed surface runoff issue at the site despite lawn extending to the top of the bank. A narrow (ex. 5-10') buffer zone of low native vegetation suitable for stabilization might reduce the erosion rate at the top of the bank. This would have little effect on the toe of the bank, which is only stabilized by the remains of a rock revetment. Photograph 2 shows the eastern end of the existing revetment, which extends further seaward than the adjacent shoreline. A cobble deposit extends 5-10' from the toe of the coastal bank. This cobble is more erosion resistant than sand and may be reducing the erosion rate at adjacent areas. The western end of the existing revetment (Photograph 3) also extends further seaward than the adjacent shoreline. There is a similar cobble deposit extending 5-10' from the toe of the coastal bank. The existing boulders from the revetment still provide some protection for the coastal bank, but will become less effective in the future. Areas to the west of the revetment (Photograph 4) have experienced erosion of the toe of the bank, which appears to have led to slumping of portions of the landform down the face of the bank. The cobble berm does not seem sufficient to prevent this erosion.

After the site visit, historic shoreline migration trends were examined through a time series of shorelines available from the Massachusetts Shoreline Change Project as shown on the Shoreline Change Viewer of the MassMapper website provided by Massachusetts Office of Coastal Zone Management. (Figure 2 , data available at https://maps.massgis.digital.mass.gov/MassMapper/MassMapper-CZM-Shorelines.html). At this location short term rates should not be used due to very high uncertainty (labeled -9999 on the table). The long term rates also have uncertainty values higher than the rates, indicating that the actual long term shoreline change rates could vary from 1.41'/yr of erosion to 1.09'/yr of accretion. The 1943-1969 shoreline is further landward than the current top of bank indicating coastal bank formation since that time, which is highly unlikely. This shoreline change data is not very accurate, but still may be the best available. The +/- 60 cubic yards of proposed annual sand nourishment is likely a sufficient volume to make up for the loss of eroded material supplying downdrift beaches.

According to the state Wetland Protection Act regulations 310CMR10.30(3) *"...a coastal engineering structure shall be permitted when required to prevent storm damage to buildings..."*. West Tisbury regulations (Section V.C.4.) go further by stipulating that the structure would need to be protect from *"...imminent danger."* While the erosion rate is uncertain, erosion has been occurring adjacent to the site and at the top of the bank. While the erosion is minor, the ~16' buffer from cottage to the top of the bank is likely close enough to be considered imminent danger as the erosion from just one storm could conceivably cause damage to the cottage.

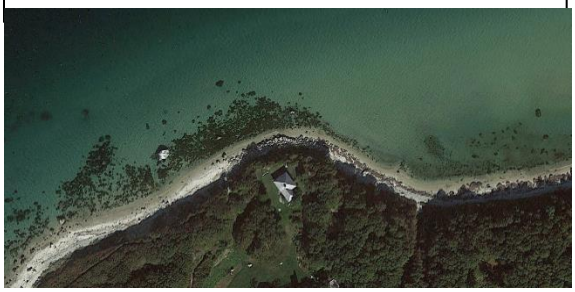
A revetment reconstruction project, such as this one, provides an opportunity to include design improvements based on the best available techniques to reduce impacts, improve structure longevity, and minimize maintenance costs. As the new revetment is proposed to be located as far landward as possible (to minimize interaction with waves and tides) it may help to reduce erosion to the fronting beach and adjacent areas. By removing the old "slumped" revetment and replacing it, storm protection can be provided with less of a footprint (i.e., horizontal area) occupied. This area of removed material (old revetment) could provide habitat in an area that has not been exposed for decades.

Erosion has been observed on both ends of the revetment, which has likely been accelerated by wave energy being refracted around the revetment and being focused on the shoreline, as well as the reduction in sediment supply from the upland protected by the existing revetment. The existing revetment has created a headland area (see images to the right) upon which wave energy is concentrated. The diagram shows how waves slow down in the shallow water in front of headlands, and move faster in the deeper water of bays. The bottom friction changes the wave direction (called wave refraction). As a result, the wave front parallels the coastline and wave energy is concentrated on the headlands. The coastline would have a very different configuration if this revetment had never been constructed. However, without this structure, the building it was originally designed to protect may have been damaged or lost.



Above: Graphic showing how the bathymetry near a headland tends to converge wave energy onto the headland. Image from //science.kennesaw.edu

Below: An aerial photograph of the site rotated to match the graphic.



It is likely that wherever this revetment ends it will experience high potential erosion due to "normal" terminal effects of the revetment, combined with the wave energy converging on the headland-type shoreline. An important element of CES design is how the CES transitions to the native coastal bank material. This site is especially susceptible to terminal erosion, and the proposal does include a reasonable transition of gabion baskets and fiber rolls. Both of these should remain covered with beach compatible sediment in order to prevent the materials from breaking down too quickly and to reduce the wave impacts to the adjacent beach. If regulators determine there is a need to maintain the beach in front of the gabion/fiber rolls, then a triggered nourishment requirement (aka trigger) might be included in the Order of Conditions, either instead of, or in addition to the annual requirement. When the beach drops below an elevation-based marker for a designated period of time, nourishment would be brought in to bring the beach back up to design elevation. This type of nourishment strategy would require a monitoring plan. More information on monitoring plans, triggered nourishment, and beach

nourishment in general is available in a new extension bulletin: https://seagrant.whoi.edu/wp-content/uploads/2023/05/Beach-Nourishment-Marine-Extension-Bulletin-2023.pdf

While the revetment is proposed to be higher than the existing boulders on the beach, it is still proposed 3' below the 100 year floodplain elevation, and would allow ~16' of natural coastal bank above the rocks. The proposed revetment would extend 50' past the (right angle formed by the outer cottage walls) and the gabion/fiber rolls would extend another 50' past the proposed revetment. While there is no fixed "rule" as to how far the revetment and transition need to extend, there may be some reduction possible while not jeopardizing the cottage. Perhaps a larger percentage of the gabion/fiber transition and a reduction of the revetment extension could be explored. The gabion baskets are proposed at a 1:1 slope, which is greater than the preferred maximum of 1.5:1 for rock revetments. The fiber rolls are proposed at a 1.5:1. Both of these slopes are a bit steeper than what would be preferred. Also, the gabion baskets extend seaward, although this is under the beach elevation. If erosion exposes these gabion baskets they will be steep and would reflect wave energy. There may be potential to reduce the number of gabion baskets (and/or fiber rolls) and re-slope the bank further landward if needed.

No return is shown on the site plans for the gabion/fiber rolls, however hopefully it is intended to taper and return them to match the existing coastal bank and account for natural erosion of the adjacent area. While the installation contactor may not have been selected yet, a group with experience would be critical to getting the transition from rock revetment to gabion/fiber rolls correct, as well as tapering and returning the gabion/fiber rolls into the natural coastal bank.

Additional Considerations:

- With a cottage predating the Wetlands Protection Act (built circa 1930s) that has an existing revetment that also predates the WPA (built circa 1960s) it is highly likely that this property would be granted a rebuilt revetment by state regulators.
- It is likely that some expansion of the revetment (to the east and west) is warranted as wave energy will be focus at the terminal ends of the revetment. The proposal includes a transition (gabion/fiber roll), which is important for this site. The exact distance the revetment and transition should extend from the existing revetment could potentially be reduced, however there is no "standard equation" for this type of extension.
- The proposed revetment would break up wave run-up more effectively if it was a "rough" face.
- The NOI/plans mention that an access route would involve driving ~700' on the beach. As the coastal bank at the site is going to have a significant disturbance during construction, it might be desirable for the applicant to construct a temporary access road over the coastal bank which could be restored. This would avoid ~700' on the beach disturbance in exchange for disturbing a portion of the coastal bank that proposed to be armored anyway.
- A planting plant for the overall site, and specifically for the nourished fiber roll area, would help the Conservation Commission understand if the sediment covering the fiber rolls is intended to be sacrificial or planted and stabilized.

Figure 1. Location of site.

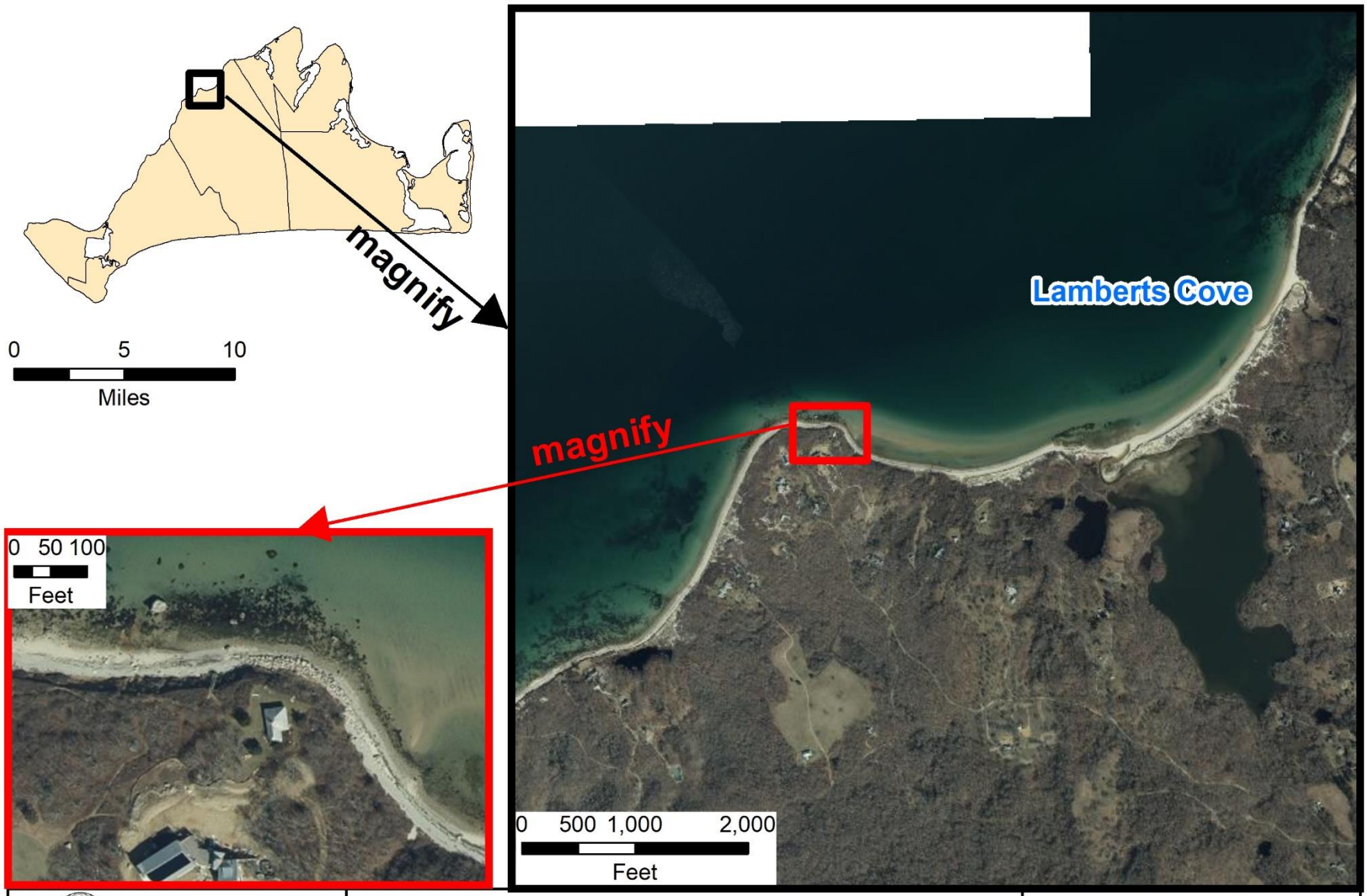
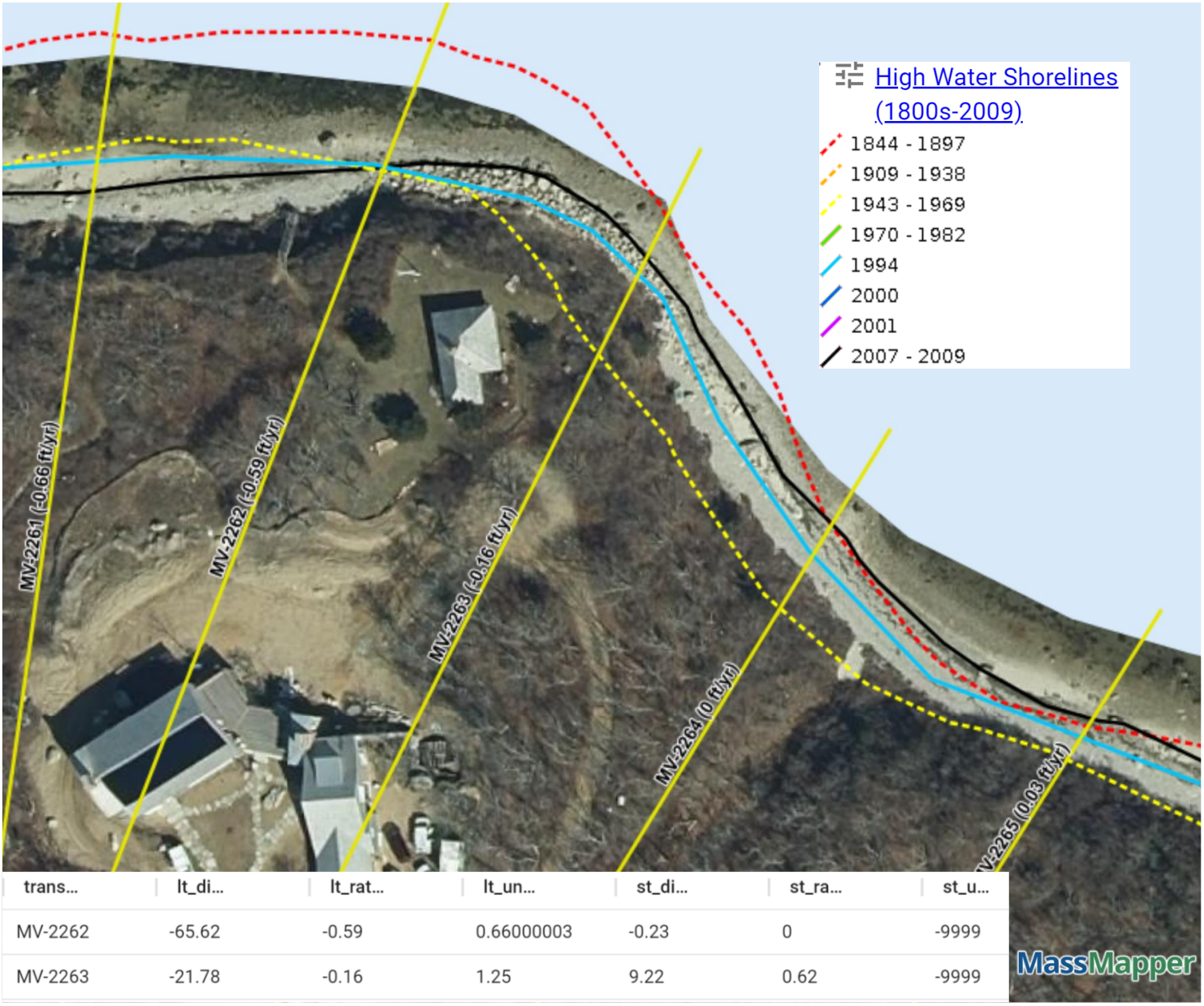


Figure 2. Screenshot of data from the Massachusetts Shoreline Change Project as shown on the Shoreline Change Viewer of the MassMapper website provided by Massachusetts Office of Coastal Zone Management. (Data available at https://maps.massgis.digital.mass.gov/MassMapper/MassMapper-CZM-Shorelines.html). Short term rates should not be used due to very high uncertainty, and the long term rates also have high uncertainty. The 1943-1969 shoreline is further landward than the current top of bank indicating coastal bank formation since that time, which is highly unlikely.



trans...	lt_di...	lt_rat...	lt_un...	st_di...	st_ra...	st_u...
MV-2262	-65.62	-0.59	0.66000003	-0.23	0	-9999
MV-2263	-21.78	-0.16	1.25	9.22	0.62	-9999

The red arrow on the image to the right indicates the location and direction of the photograph at the bottom of this page in red, and the other photographs in the series are yellow.

Photograph 1. The edge of the cottage is ~ 16' from the top of the bank. There was no observed surface runoff issue at the site despite lawn extending to the top of the bank.

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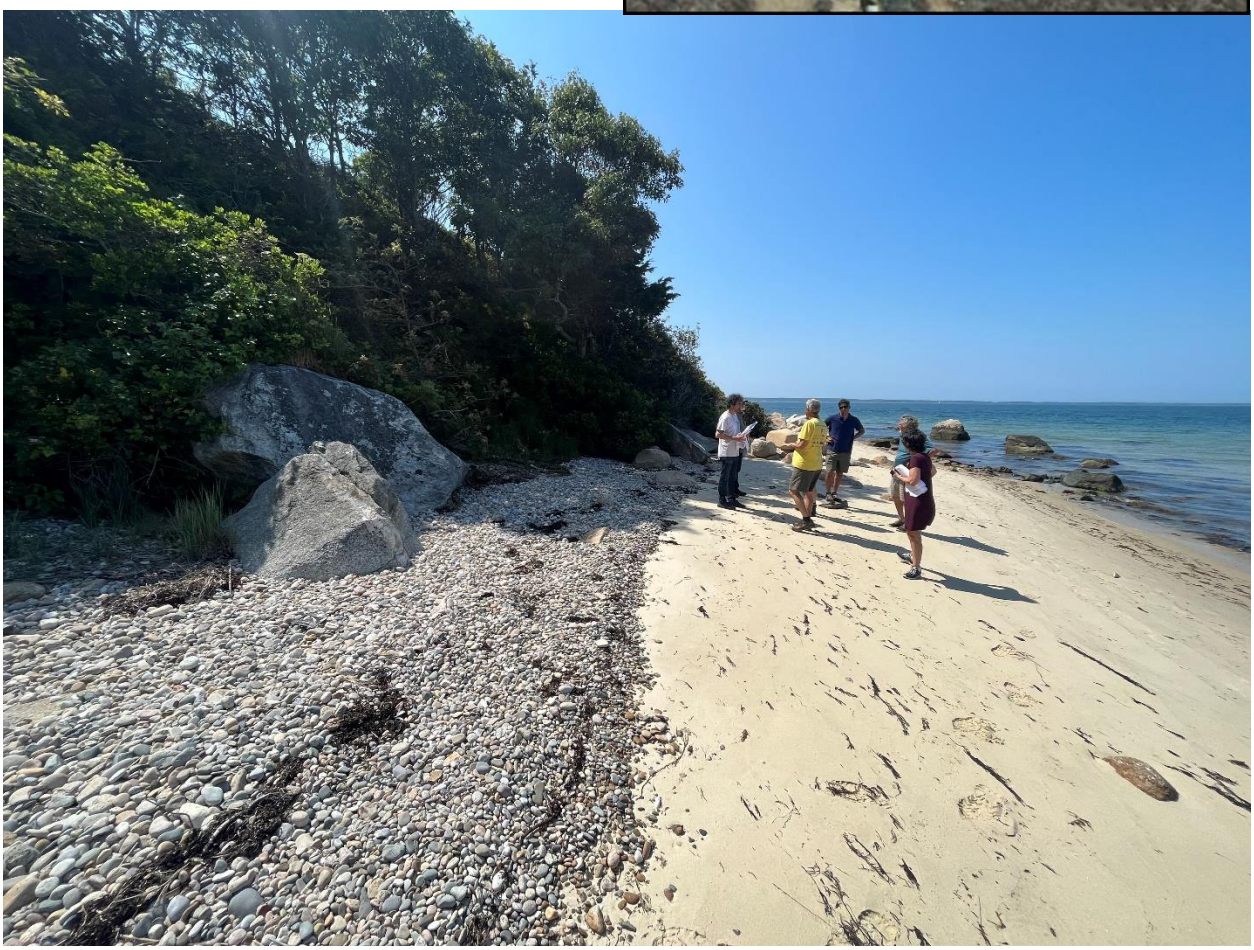
Photograph 2. The eastern end of the existing revetment extends further seaward than the adjacent shoreline. A cobble deposit extends 5-10’ from the toe of the coastal bank.



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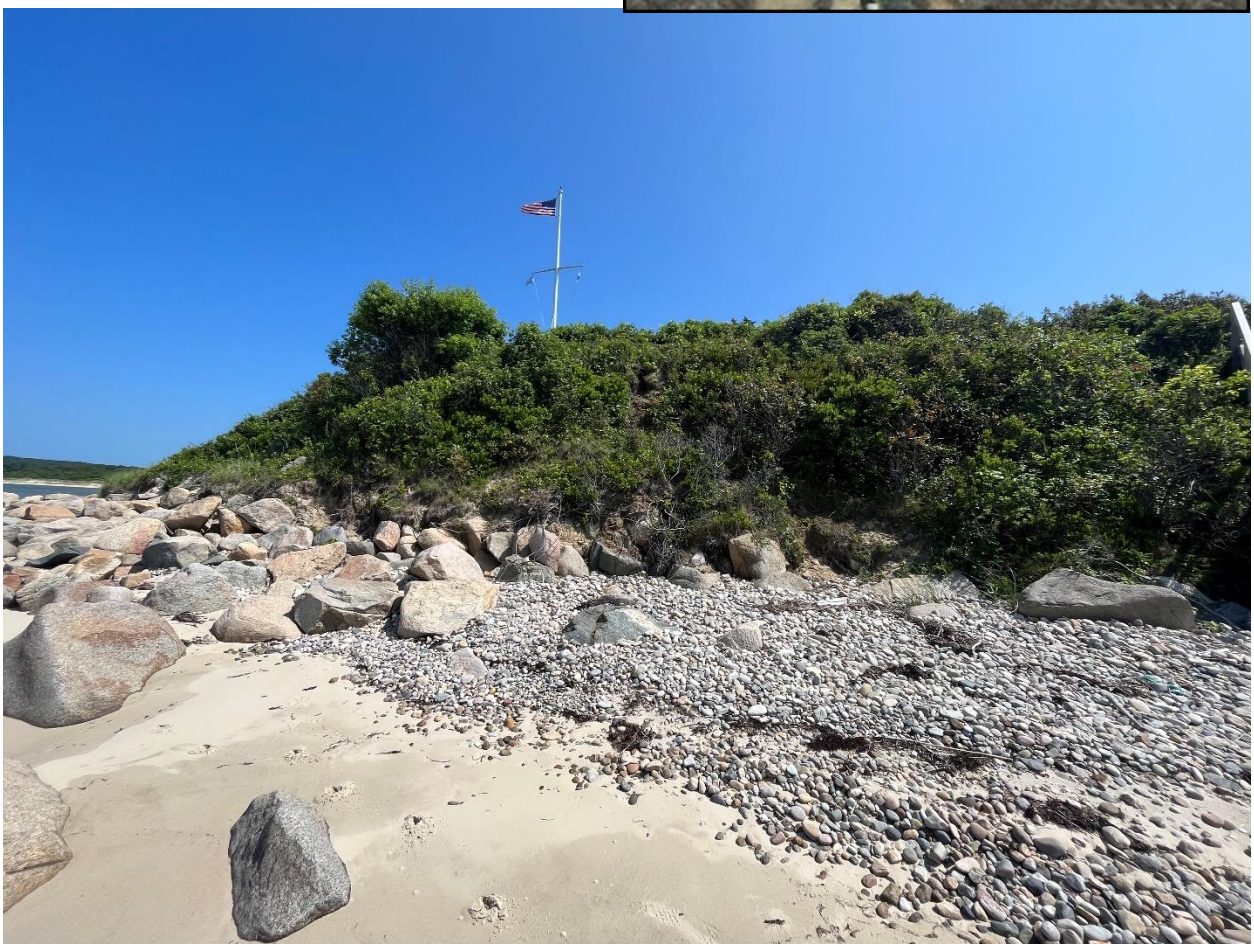
Photograph 3. The western end of the existing revetment also extends further seaward than the adjacent shoreline. A cobble deposit extends 5-10’ from the toe of the coastal bank. The existing boulders from the revetment still provide some protection for the coastal bank, but will become less effective in the future.



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Photograph 4. Areas to the west of the revetment have experienced erosion of the toe of the bank, which appears to have led to slumping of portions of the bank down the face. The cobble berm does not seem sufficient to prevent this erosion.