



# Coastal Banks



[thetrustees.org/coast](http://thetrustees.org/coast)





Portable modular aluminum stairs can be removed before major storms. Stairs allow safe visitor access without eroding the banks.  
Photo credit: Tom O'Shea

## Background

Like all coastal properties along the Commonwealth's shorelines, the Trustees of Reservations coastal reservations inhabit an ever-changing environment where storm events and sea level rise threaten the existence of the built and natural environments. With support from the Massachusetts Office of Coastal Zone Management (CZM), the Trustees and their partners launched A Focus on Our Most Vulnerable Places, a project to raise awareness and understanding about climate vulnerabilities in coastal areas and the nature-based coastal resilience measures to manage those risks. Using three reservations—a tiny sliver of the 120 miles of coastline the Trustees manage—the Trustees engaged local community members and coastal engineers to understand their perspectives about coastal change, the inherent risk associated with dynamic coastal areas, and adaptation options for barrier beaches, coastal banks, and publicly accessible shorelines.

This case study highlights perspectives on the threats to Wasque Reservation's coastal banks and potential adaptation options available to coastal bank property owners. Situated on the southeasternmost corner of Chappaquiddick Island on Martha's Vineyard, Wasque Reservation is part of a coastal ecosystem characterized by barrier beaches to the west and to the east. Erosion of the coastal banks at Wasque is not uncommon. In fact, it has some of the highest erosion rates in the Commonwealth, resulting in a loss of natural storm protection, increased risk to infrastructure, loss of recreational beach area and habitat, and diminished public access. As a result of the dramatic erosion of coastal banks on this property and the potential negative impacts from bank stabilization approaches, The Trustees adopted a 'Shoreline Stabilization Policy' which states that The Trustees would consider bank stabilization options only if there was a conservation benefit.

## Vulnerabilities and Potential Impacts on Coastal Banks

The Trustees and their partners engaged individuals familiar with Wasque's coastal environment in interviews and online workshops to understand their perspectives about coastal vulnerabilities, the changes they see occurring, and the adaptation options that could be employed to manage Wasque's coastal banks. Their perspectives and insights are summarized below.

### Erosion of Coastal Banks

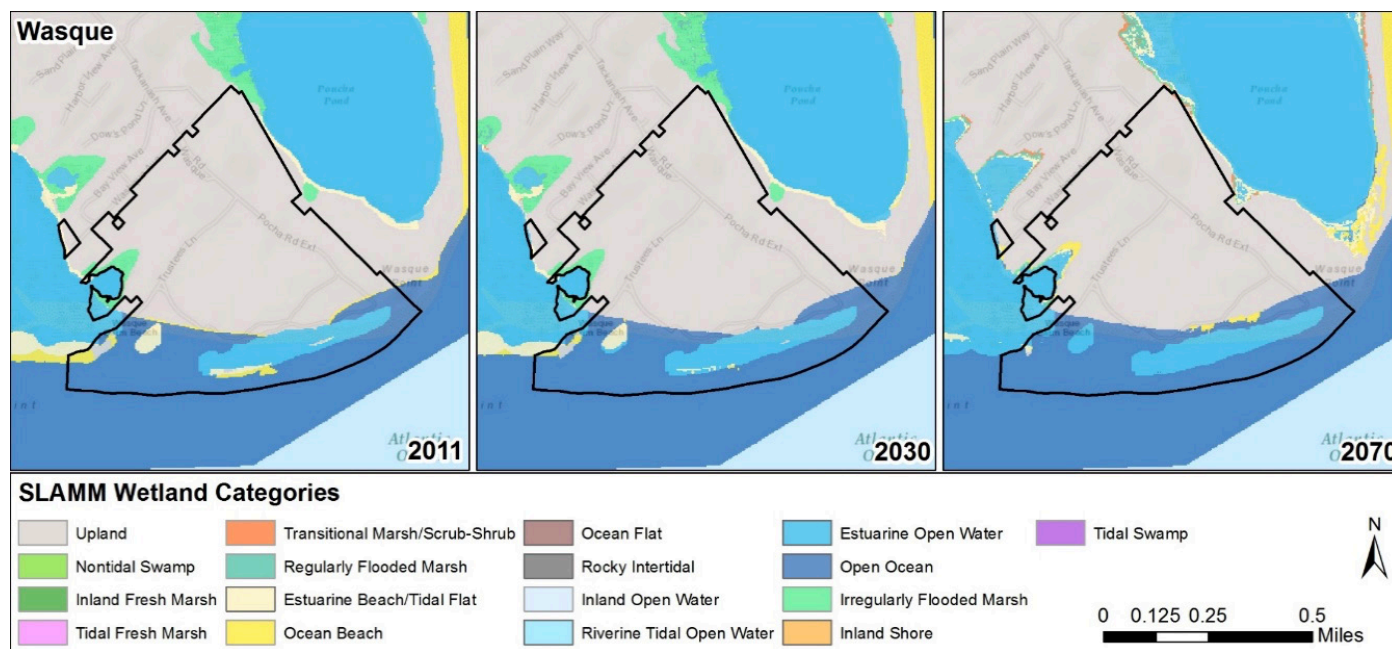
Interviewees from Martha's Vineyard overwhelmingly cited coastal erosion as a key threat to shorelines generally and to coastal banks such as those at found at Wasque;

however most interviewees also noted that coastal erosion is a natural process that always has, always is, and always will occur. Some interviewees suggested that bank erosion seems to be occurring faster now than in the past, though this perspective may depend on the stretch of coastal bank the interviewee had in mind. Other interviewees noted that erosion rates at Wasque increased for several years following a breach in Norton Point and then leveled off when the breach repaired itself. Many interviewees pointed out that storm events result in significant change—eroding banks or beach areas and/or depositing sand along shorelines. Some noted that sea levels and tides are higher than they were fifty

years ago, and speculated that sea level rise and changes in the strength and duration of storm events would exacerbate coastal bank erosion in the future. The interviewees also highlighted a range of impacts from coastal bank erosion including damage to homes or other built infrastructure (e.g. septic systems, stairs, boardwalks, parking lots, roadways), loss of access and beach area and the associated impacts on tourism and the local economy. The interviewees also commented on habitat changes from significant coastal bank erosion. Several interviewees noted that sediment deposition after erosive events can negatively impact shellfish and finfish habitat, as well as the individuals who rely on fishing for nutrition or income. Another interviewee observed that upland pine habitat had eroded and converted to grassy habitat with fewer trees.

Coastal geologists and modelers from Woods Hole Group provided insight on the vulnerabilities and potential impacts of climate change and sea level rise at Wasque Reservation<sup>1</sup>. Based on data and analysis from CZM, Wasque experiences up to 10 feet of erosion every year. Between now and 2100, researchers estimate that sea levels will rise by five feet and areas that are barely wet today could be inundated daily sometime between 2070 and 2100. The new water levels could exacerbate erosion and undermine walking trails, parking areas, staircases, and other infrastructure located along the coastal banks. Modeling also predicts that sea level rise will change the habitats around Wasque. For example, open beach and barrier beach areas may transition into open ocean.

<sup>1</sup> Assessment and Analysis of Adaptive Interventions For Coastal Martha's Vineyard Properties (of The Trustees), Woods Hole Group, May 2020



Sea level affecting marsh migration modeling (Woods Hole Group study completed in 2017)

## Potential Interventions to Reduce Vulnerability

Several broad adaptation responses are available to coastal property owners to manage vulnerability along coastal banks, including:

- » *Avoid* – When planning future investments, locate assets out of harm’s way.
- » *Protect* – Construct barriers to protect assets and sustain operations in vulnerable locations.
- » *Accommodate* – New assets, if installed in vulnerable locations, will be designed to adapt to changing environmental conditions; assets currently in vulnerable locations could be retrofitted to adapt to changing environmental conditions. Plan use over time and transition uses to take advantage of opportunities presented by the new conditions.
- » *Retreat* – Move currently vulnerable assets and associated programming out of harm’s way and continue operations in a new, safe location.
- » *Accept loss* – Remove assets from the risk zone and discontinue associated operations.
- » *Do nothing* – Taking no action and allowing nature and time to take its course.



Based on assessment and analysis from the report cited above, workshop participants and coastal engineers discussed a range of nature-based, site-specific adaptation options<sup>1</sup>, which fall within the range of adaptation responses outlined above. The site-specific adaptation options could be completed independently or as a combined set of actions to stabilize the coastal banks at Wasque. Decisions about which option(s) to pursue are contingent upon tradeoffs between

## Focus on Nature-Based Adaptation Measures

Woods Hole Group presented an array of nature-based measures that are compatible with The Trustees shoreline stabilization policy and which can be feasibly permitted, rather than hard structures like seawalls and revetments often used in more built environments. Nature-based projects use, enhance, or create natural processes that provide hazard reduction benefits and habitat to sustain plant and animal populations and the industries that rely on them.



Site map (Google Maps, 2020)

### No Action

This option allows erosion to continue without intervention and could result in continued loss of coastal bank and upland property. As bank erosion occurs, the parking areas and walking trails would vanish, habitat acreage would decrease, and public access may diminish. This impact would be significant given the erosion rate of 10 feet per year.

### Altering How Visitors Engage with the Resources and Amenities

For example, fences could be established to close off walking pathways and allow revegetation to occur to provide enhanced stability and limit human-caused disturbance and erosion.

criteria such as the net environmental impact or benefit, how long the treatment would last and how well it would perform, as well as the cost and return on investment, and the ability of the treatment to fulfill the property owner's objectives. Decisions may also require modeling or forecasting future conditions to determine the potential design life and effectiveness.

### Managed Retreat from Coastal Banks

In this scenario, walking paths and other amenities, such as the parking lot, could be moved away from the bluff edge to less vulnerable inland locations. This approach would help to maintain access while minimizing disturbance to the resource areas.

### Stabilizing Coastal Banks with Native Vegetation

Vegetating coastal banks involves decreasing the bank slope, installing erosion control blankets, and planting native vegetation. The blanket biodegrades over time and the roots of the native vegetation hold the soil in place. This approach can stabilize coastal banks, enhance wildlife, and be completed concurrently with invasive species management. In areas where the toe of the bluff is exposed to increased wave and wake energy, vegetated banks can protect the toe of the bank. In these instances, the toe of the bank is constructed with coconut fiber logs or sand filled tubes, which are then covered with additional sand and planted with native vegetation.

### Beach Nourishment at the Base of a Bluff

Sand is deposited at the base of the bluff to create a protective, sacrificial berm. Over time, the sand absorbs wave energy and erodes, thus preventing erosion of the bank itself while also supplying sediment to the system. Sand eroded from a beach nourishment project at Wasque may be deposited on barrier beaches to the east or west.

### Combination of Approaches

Woods Hole Group suggested considering a combination of the above adaptations. This approach included beach nourishment, native plantings, and bank restoration methods for stabilization at target erosion areas, including visitor access points. These demonstration sites could be monitored by volunteers, and lessons shared could feature different designs and learnings that would be shared through coastal interpretation elements on site, websites, and social media.

## Stakeholder Perspectives on Nature-Based Measures for Coastal Banks

Stakeholders offered the following reflections on the options available to manage coastal bank systems. Change is the only continuous feature of coastal areas. These areas have been, are, and will remain in constant flux, with erosion and accretion happening over the course of a short storm event or the course of decades or longer. Some people suggested that human intervention can slow down, but not stop the erosive forces driving coastal change, especially as climate change brings sea level rise and stronger storm systems. People must change their expectations, accept change, and retreat from vulnerable locations, while learning to appreciate coastal areas for the values they provide in the present moment rather than for the values they hope the area will provide next year, in 10 years, or in 50 years.

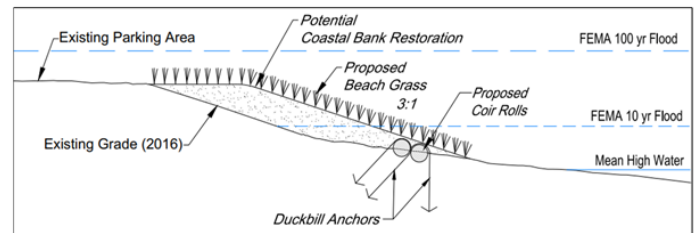
The erosion or accretion occurring at any given time at Wasque are part of an interconnected system, which means that any intervention must address the systemic conditions rather than the site-specific conditions at Wasque. For example, participants observed that erosion at Wasque is tied to breaches in Norton Point, a barrier beach. When the breaches heal, the erosion at Wasque slows and sedimentation resumes at the base and in the beach area between Wasque's banks and the open ocean. Participants noted that success in managing coastal areas requires both acknowledgment of the interconnectedness and willingness among multiple property owners in a littoral cell—an area encompassing the complete sedimentation cycle including sources of erosion, transport pathways, and sinks where sedimentation occurs—to comprehensively plan and agree to collective action.

If action were taken to stabilize shorelines, participants generally supported interventions that work with nature, especially in relatively undeveloped settings such as Wasque. However, though not unsurprisingly given the overwhelming perspective that change is the way of life in coastal ecosystems, participants expressed some reluctance to intervene. One participant suggested that although the vegetated bank stabilization could be a cost effective opportunity, the uniform appearance of vegetated stabilization projects would detract from the raw, cliff-orientated spirit of Wasque, which makes Wasque a unique and special place.

Many participants questioned the effectiveness of nature-based approaches to stabilize dynamic coastal areas, suggesting that large storm events could quickly erode nature-based adaptation projects. An interviewee with experience using a protective toe made of coconut fiber rolls said the ocean's energy quickly destroyed the rolls; however, sand filled tubes proved more effective as a temporary

shoreline stabilization measure. Another participant commented that retreating from vulnerable coastal banks, would be a more practical, cost and time-effective means of management than investing in the design, permitting and construction of temporary coastal adaptation interventions. Additionally, participants suggested that observing and documenting the change, while also retreating, would be a valuable opportunity for The Trustees to educate the public about coastal processes and managed retreat.

Participants suggested additional adaptation options for managing risk in dynamic coastal bank areas in addition to comprehensive planning within a littoral cell, as previously mentioned. One suggestion was to install modular technology for all infrastructure needs. The lightweight, modular materials could easily be relocated prior to storm events and/or over time as the bank erodes.



*Bioengineered intervention for bank stabilization and restoration at Wasque Point*

Additional stakeholder perspectives from summer residents and Trustees who visit the beach annually were surveyed during a virtual webinar with a similar presentation format. This group of stakeholders were more optimistic about trialing a combination of nature-based measures for stabilizing the banks and to be used as demonstration areas for interpretation and learning. When asked 'What intervention options make the most sense to you?' most respondents (n=20) were supportive of some bank stabilization and native planting. The second group (n=8) chose beach nourishment at the bottom of the slope. The remaining respondents selected the option of retreat (n=11) and a few (n=4) chose the 'no action' option.

## Future Choices and Summary

Like any coastal environment, coastal banks and bluffs are highly dynamic. Strategies to adapt to the vulnerabilities of climate change will require property owners to consider the interconnected system in which their coastal bank is situated, the current and future rate of erosion, and the robustness of design that will be required to stabilize the bank for a period of time. Depending both on the assets to be protected and an evaluation of criteria such as environmental impact and benefit, expected performance and design life, and return on investment, retreat on the property may be the most efficient use of resources (assuming the property is large enough to accommodate onsite retreat). While this case study focused on a property without built structures, the options presented can be considered for protecting properties with structures behind the banks.

As we look to the future, The Trustees may consider a combination of approaches that focus on the eroding areas near and part of visitor access trails from the top to the bottom of the coastal banks, a planned retreat when loss of parking lots and trails is likely, and monitoring of erosion rates and bank stabilization efficacy by coastal volunteers. The Trustees intend to use the site for coastal interpretation and for sharing our learnings and trials for other communities, coastal landowners, and visitors.



[thetrustees.org/coast](http://thetrustees.org/coast)

*Design by Erin Connolly*