# BAXTER ROAD AND SCONSET BLUFF STORM DAMAGE PREVENTION PROJECT
# NOTICE OF INTENT

## RESPONSES TO QUESTIONS FROM NANTUCKET CONSERVATION COMMISSION ASKED AT PUBLIC HEARING ON JULY 24, 2013

Below is a summary of issues raised at the July 24, 2014 hearing for the above-referenced project, organized by topic.

1. Sand Mitigation and Delivery
   a. Description of Calculation:

   The Baxter Road and Sconset Bluff Storm Damage Prevention Project intends to follow the state standard of "**Best Available Measure**[1]," which is to provide to the littoral system, on an annual basis, the average amount of sand that would have been provided by the eroding bank absent the project. This amount has been historically required by the Nantucket Conservation Commission and DEP.

   This number is calculated for the project by first determining the long-term erosion rate of Sconset bluff using aerial imagery. While some erosion can be observed dating back to 1994, the time period of 2003-2012 was utilized for this analysis because it reflects the timeframe when most of the coastal bank was undergoing active retreat. Further, 2012 is the most recent aerial imagery available. The project area from 73-119 Baxter Road was utilized in the calculation; south of 73 Baxter Road was excluded because the top of the coastal bank was not yet actively retreating in 2003. Likewise, 79 Baxter Road was also excluded from the analysis since the presence of the terraces has considerably slowed bank retreat. This calculation yields a long-term bank erosion rate of 3.18 ft/yr (Figure S-1). This calculated rate of bank retreat is lower than the calculated retreat rate of 4.96 ft/yr for the previously filed Bluff Stabilization NOI because that previous calculation was only for the coastal bank from 77 to 85 Baxter due to the limited Pilot project area of this earlier filing.

   The coastal bank contribution volume was determined by selecting the three Sections from the project sheets (A-A, B-B and C-C at 97, 83 and 65 Baxter, respectively). These used the 2010 LIDAR survey of the project area. Then AutoCad computer software was used to calculate the volume that would be lost if each of these profiles retreated by the average bank erosion rate of 3.18 ft/yr. Averaging the volume lost from each of the three profiles yields an average bank contribution volume of 9.3 cy/lf/yr.

[1] **Best Available Measure**(s) is defined in 310 CMR 10.04 as "… the most up-to-date technology or the best designs, measures or engineering practices that have been developed and that are commercially available.

This calculated bank contribution volume corresponds well to the estimated amount contributed by the terraces of over the past 5-7 years. Several years' experience with the terraces has demonstrated that, through the provision of sand mitigation approximately 9 cy/lf/yr, (1) there is no downdrift impact to nearby beaches even when the lower bank has been protected from erosion, and (2) there remains a significant beach seaward of the terraces (i.e. more than 80 feet to MLW line) at 79 Baxter Road. While the terraces are not an effective long-term solution (see discussion in Section 2.8 of the Alternatives Analysis included as Attachment E to the NOI), the experience with the terraces strongly suggests that toe protective provided by a revetment, coupled with a sand mitigation program of approximately 9 cy/lf/yr, will sufficiently mimic the natural coastal bank contribution amount such that the project will not have any adverse impacts on adjacent beaches.

b. **Impact of delivering average amount of sand on system.**

The amount of sediment supplied for mitigation is part of the overall sediment budget for the coastal system. There are multiple inputs (from bluff erosion and longshore sediment transport) and multiple outputs (also from longshore sediment transport and also outputs to the offshore). Mitigation is supplied to equal the input to the system from bluff erosion. Sand mitigation is typically supplied on an annual basis, usually after the winter storm season, and that is what we propose here. Because there are multiple inputs to the sediment budget, the impact from changing any one input (i.e., supplying an average amount of sand in a severe storm year) will be offset if the other inputs remain the same.

While there are times when larger amounts of sand are removed by erosion, there are also times when less is removed. The **Best Available Measure** is to use an average volume of sand mitigation each year based on the average bank retreat rate to maintain the average sediment budget of the system whether the previous year's sand contribution has been lost or not. The sand mitigation is placed on the back of the beach and washes away during large storms, but most of this sand will remain part of the sediment budget of this coastal system. There is not a special attempt to replicate the loss of greater or lesser amount of sediment in a given year.

If end scour is observed at the time of this sand mitigation, sufficient sand will be supplied to restore any localized scouring. Long term monitoring will be performed to determine if there are longer term erosion impacts that can be attributed to the proposed revetment. If these are measured, additional mitigation sand will be added to the system to restore the overall sediment budget. This proposed approach is the **Best Available Measure** for dealing with end scour.

c. **Will this project force island pits to run out of sand?**

With a sand mitigation volume of 9.3 cy/lf/yr and the total build-out of the 4,200 foot long revetment, the total sand volume per year would be 39,060 cy. Based on this volume, the two existing island pits would have a life of over 20 years. Future sand could be provided by opening new pits on the island or using sand sources from off island. The cost for sand at the island pits is set based on the cost to deliver sand to the island using a barge.

2. Design of revetment
   a. **Wave energy calculations, wave height data, and how revetment is designed for this energy (Ramsey, Oktay, others)**

The Project Design Parameters are provided in Section 3.1 of the NOI including:

- Wave run-up elevation during 100-year storm
- 100-year still water elevation
- Beach elevation at toe of coastal bank
- Estimated maximum depth of scour at the toe of the revetment during 100-year storm

Attached are OCC's wave calculations and revetment stone size calculations. Please note the original wave calculations were performed in 2010 for the mattress/gabion project (see attached OCC Alternative Analysis Report, September 2010). The results of those calculations are relevant to the revetment design. The wave height was increased to 5.5 ft for this project in an effort to size the revetment stone more conservatively. This revetment design meets the standard of Best Available Measure.

b. **Front beach will narrow and if no sacrificial sand were delivered could create a hole in front causing failure.**

A sand mitigation program will be provided as discussed in 1a above. Revetment failure is discussed in 2c. below.

c. **Failure of revetments: How do revetments fail and why, and why ours is designed differently and will not fail.**

The typical methods of revetment failure are as follows:

- Cover layer failure
- Pumping of fines through cover layer
- Toe scour
- Flanking and
- Overtopping

Cover layer failure:
This can occur if the armor cover stones are not properly sized for the wave environment. Hudson's equation was used to size the stones in the outer layer of the rock revetment for the anticipated wave events. The Sconset revetment has been designed to withstand predicted waves during a 100-year storm event (see attached calculations). This is the Best Available Measure for revetment cover design.

Pumping of fines through cover layer:
This occurs when geotextile fabric and/or a smaller gradation of stones are not placed as an underlayer to prevent the underlying soils from being pumped through the overlying layers of a revetment when impacted by storm waves. The Sconset revetment has been designed with a geotextile filter fabric layer at the base followed by an overlying layer of 18 inch minimum filter layer of stones to prevent failure by pumping of fines. This is the Best Available Measure for revetment design to prevent pumping of fines through the cover layer.

Toe Scour:
Vertical scour at the toe of a revetment can cause the underlying beach sediments to be exposed to waves. At Sconset the toe of the revetment will be at a depth of 8.0 feet below the beach level which is below the estimated scour from a 100-year storm. This is the Best Available Measure for revetment design to prevent toe scour. If future erosion of the beach is determined to pose a risk of toe scour, more stones can be added to the revetment toe.

Flanking:
Flanking occurs when adjacent unprotected coastal bank areas continue to erode due to storm wave attack. This erosion removes sand/soil behind the wall and if it is allowed to continue can lead to revetment failure. Flanking can be avoided or mitigated by extending the wall, using a return wall and/or placing mitigative sand over the end of the wall. At Sconset flanking will be prevented or mitigated by extending or tapering the ends of the revetment and by placing mitigative 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 also minimize the number of revetment ends and the need for flanking mitigation.

Overtopping:
Splash over the top of a revetment can lead to failure by exposing the underlying sediments/soils to waves. This is prevented by extending the elevation of the revetment high enough so that overtopping is not a problem. In the case of the Sconset revetment, the revetment has been designed so that it is not overtopped during a 100-year storm event. Wave run-up during a 100-year storm event has been calculated and the top of the revetment has been located at +26.0 feet MLW to prevent overtopping. This is the Best Available Measure for revetment design to prevent overtopping.

d. Revetment Slope: Is the proposed revetment slope of 1.5:1 stable and does it meet Best Available Measures? Does it follow the existing slope or does it require changes?

OCC has designed the revetment at the steepest stable slope of 1.5:1 to minimize the extension of the revetment onto the coastal beach. There is obviously a balance between the slope of the revetment and how far it would extend onto the coastal beach. OCC is of the opinion that the slope of 1.5:1 is the Best Available Measure for the slope of this revetment.

The revetment will only be on the lower 16 feet of the coastal bank slope, whereas the coastal bank height ranges from about 58 feet in the south to about 80 feet in the north, thus the percentage of bank covered will range from about 28 percent in the south to 20 percent in the north. Some minor grading will be required to install the revetment as shown on the project Proposed Sections A-A, B-B and C-C. In coastal bank areas where the bank is oversteepened at the top, there may be some continued slumping of the upper slope after revetment construction until a stable angle of repose is reached.

e. "Unaware of any revetment in this wave energy". (Ramsey, others.) Example of other revetment with this wave energy.

Most of Outer Cape Cod facing the Atlantic Ocean is within the Cape Cod National Seashore where no new development and protective structures are allowed.
The South Shore coastline of Massachusetts from Hull to Plymouth is exposed to Northeasters which tend to be the most severe storms for our coastal area as they can last several days over multiple high tides as was experienced during the Blizzard of '78. Wave energy along the South Shore during Northeasters can be quite severe and comparable to Sconset during these storms and consequently this shoreline has been protected with many revetment structures (see Figure S-2).

The North Shore coastline consists of more bedrock and pocket beaches such as the coastlines of Rockport and Gloucester. More developed beach areas tend to be protected with seawall structures such as in Swampscott, Lynn, Revere and Winthrop.

There are many shoreline areas in other parts of the United States and worldwide that experience wave energies equal or greater than those experienced at Sconset and the revetments in those areas have withstood those wave forces for decades without failing. For example, there are numerous coastal revetments along the Pacific coast of the U.S., including those in Washington, Oregon and California. In numerous places where the Pacific Coast Highway runs along the shoreline of the Pacific Ocean in California revetments have been used to protect this major north-south highway system. One such section of this highway that is protected by a large revetment which is about 4,000 feet long is shown on the attached Figure S-3.

f. Discuss success/limitation of jute bags

See Attachment E (Alternatives Analysis) to the NOI, where the terraces are discussed in Section 2.8.

3. How does bluff erosion occur and what is the role of run-off and downslope failure?
The driving force for coastal bank retreat is erosion of the toe of the coastal bank by storm waves. Greatest storm erosion 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 creating an undercutting of the bank. This produces an unstable bank situation which leads to upper bank failure in the form of slumping and downslope movement of sediment. The amount of bank erosion can vary greatly from year to year depending on the frequency and severity of coastal storms. If there are storms in rapid succession where the beach does not have time to rebuild in between the bank will be more vulnerable to toe erosion. It also does not provide time for contractors to rebuild the terraces, thus making the terrace-protected bank areas susceptible to toe erosion and failure of the upper bank as well. Other erosion of the coastal bank, such as that due to rain and wind, plays a minor role in the overall erosion problem. This other surface erosion can be prevented using vegetative plantings as are being proposed as part of the proposed project.

4. Impact of revetment on adjacent beaches
Several years' experience with the terraces has demonstrated that, through the provision of sand mitigation in the amount of approximately 9 cy/lf/yr, (1) there is no downdrift impact to nearby beaches even when the lower bank has been protected from erosion, and (2) there remains a significant beach seaward of the terraces (i.e. more than 80 feet to MLW line) at 79 Baxter Road. While the terraces are not an effective long-term solution (see discussion in Section 2.8 of the Alternatives Analysis included as Attachment E to the NOI), the experience with the terraces strongly suggests that toe protective provided by a

revetment, coupled with a sand mitigation program of approximately 9 cy/lf/yr, will sufficiently mimic the natural coastal bank contribution amount such that the project will not have any adverse impacts on adjacent beaches.

Notwithstanding that no adverse impacts are expected based on site-specific experience, monitoring will be conducted. If end scour is observed at the time of this sand mitigation, sufficient sand will be supplied to restore any localized scouring. Note that coastal banks adjacent to the revetment will continue to erode or retreat. This normal coastal bank erosion is not "end scour". End scour refers to additional erosion at the end of a revetment that is due to wave reflection off the revetment or sediment starvation that can be attributed to the updrift or adjacent revetment.

Long term monitoring will be performed to determine if there are longer term erosion impacts that can be attributed to the proposed revetment. If these are measured, additional mitigation sand will be added to the system to restore the overall sediment budget.

5. Impact on plants and biological community

Due to the dynamic wind, wave, and current conditions, the biological community on and within high-energy coastal beaches, such as Sconset Beach, is "depauperate," (i.e., lacking in numbers or variety of species), when compared to communities on either rocky or muddy shores. The regular, localized elimination of the inhabitants of the backshore beach community, and the renewal of that habitat, is a common event resulting from wave activities. For instance, major storms can be assumed to have swept the shoreline clean of any resident plants and animals. Therefore, the proposed project is expected to do little to alter the biologically restrictive conditions that normally exist within and below the work area. In this setting, it is important to recognize that the project area profile and associated biological community present at a given point in time are the result of conditions created by the most recent storm event that washed the Sconset area.

Sand fleas and mole crabs both exist in this challenging environment and are adapted to the inherent "hardship" of a dynamic environment. Neither species forms a stabile community; rather, they survive in and naturally adapt to dynamically unstable conditions. The loss of members of a population is quickly compensated for by new colonizers migrating in from adjacent populations as they disperse or are carried by the wind and water currents into the area. Therefore, the project will not adversely affect the biological community of the back beach or the intertidal zone.

Additional information specific to the mole crab was submitted to the Conservation Commission on July 24, 2013 (see technical memo from Mike Ludwig dated January 23, 2012).

During a review of the marine mattress and gabion project's impacts on the beach community), the Commission's Independent Consultant, Nicolle Burnham of Milone & MacBroom, stated in a letter dated December 29, 2011: "The organisms currently inhabiting this shoreline area are adept at moving/migrating within the intertidal zone on a daily basis, so minimal impact from the proposed shoreline stabilization is expected on said organisms." She concluded "the overall impact is expected to be minimal." The impact from the revetment will be similar as that from the previously proposed marine mattress and gabion project; therefore, no adverse impact to these organisms is expected.

The Notice of Intent fully addresses the project's consistency with the performance standard requirements related to wildlife habitat – see Sections 2.2, 4.0, and 5.0. the project meets all applicable state and local performance standards.

## Regulatory Compliance

a. **Dirk- legal theory of WPA section- 310 CMR 10.30 (7)**

Dirk didn't provide the full language of the regulation. He only picked out section (7) which by itself does not include the full language.

First, there is a preamble:

"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 is for 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** which states as follows;

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 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.