Sconset Bluff May 2018 Aerial Survey Report

Baxter Road and Sconset Bluff Stabilization Project Nantucket, MA

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2018 ANNUAL BLUFF AERIAL SURVEY REPORT

1.0 Introduction

The Baxter Road and Sconset Bluff Stabilization Project (the "Project") consist of three-four tiers of geotextile tubes, vegetation planting on the bluff face, and the installation of stormwater runoff drainage system. The Project was constructed in two phases by the Sconset Beach Preservation Fund ("SBPF"). The first phase was constructed in late December 2013 and January 2014 under an Emergency Certification approval issued by the Nantucket Conservation Commission. The first phase consisted of the installation of three stacked tiers of 45-foot circumference geotextile tubes at the base of the eroding Sconset Bluff. The geotextile tube installation was approximately 852 feet long and extends along the toe of the bank from 87-105 Baxter Road. The second phase was constructed in October 2015 through February 2016 and includes the installation of a fourth tier of geotextile tubes on lots 91-99, intermediate returns, end returns, and a surface runoff drainage system. With the returns included, the total project length is now 947 feet.

SBPF intends to perform an annual survey of the bluff face each year, to facilitate the calculation of the following parameters:

- Annual change in volume of the bluff face above the geotubes
- Annual change in volume of the unprotected bluff sections to the north and south of the geotextile tubes.
- Volume of sand in the sand template.

The 2018 photogrammetry survey described below is the second aerial survey conducted since the Project's Order of Conditions was issued in fall 2015.

2.0 Annual Aerial Survey and Data Processing

An aerial survey of Sconset Bluff was performed by AirShark on May 14 and 15, 2018. As described in the "Southeast Nantucket Beach Monitoring, May 2018, 76th Survey Report" prepared by Woods Hole Group and dated July 2018, this aerial survey included the bluff, dune, and beach areas within the Siasconset Monitoring Area from Low Beach to Wauwinet[1] that have been monitored by Woods Hole Group and others for over 20 years. A subset of the aerial survey data was processed and used to produce a digital surface model (DSM) of those parts of Sconset Bluff within and immediately adjacent to the area of the geotextile tubes. The remainder of this report focuses on the aerial survey data from the area of Sconset Bluff within and immediately adjacent to the geotextile tubes.

[1] As noted in the "Southeast Nantucket Beach Monitoring, May 2018, 76th Survey Report," profiles 81 to S1 were monitored by the UAV and Profile W was surveyed using the traditional survey methods.

The spring post-storm sand delivery on Sconset Bluff was completed by the end of April, prior to the May 14 and 15 aerial survey.

2.1 2018 Survey Details

AirShark was contracted by the SBPF to conduct a UAV flight on May 14 and 15, 2018 of Siasconset Bluff. The UAV utilized Light Detection and Ranging (LiDAR) to map the bluff, geotextile tubes, and beach along Baxter Road. LiIDAR measures distance to a target by illuminating that target with a pulsed laser light, and measuring the reflected pulses with a sensor.

The LiDAR mission was flown with a customized DJI M600 Pro flight platform, with a LiDAR capture system provided by Phoenix Aerial Systems. The platform was flown at approximately 200 – 250 feet above ground level (AGL) above the beach in a series of oval pattern flights. This resulted in a single pass directly up the beach, with the return pass capturing data along the bluff and giving an approximate 40% sidelap across the previous LiDAR track. The point spacing of the project is generally between 30-40 points/m^2 due to the large size of the project area, with a Root Mean Square Error along the z (vertical) axis (RMSEz) of approximately 5 centimeters (cm).

The aerial survey by AirShark was conducted coincident with the traditional spring beach survey performed by Woods Hole Group. As noted above, the UAV flight conducted mapping of Sconset Bluff, the dune, and the beach berm while the Woods Hole Group collected RTK GPS data along the seaward face of the beach profile and traditional electronic total station survey data in the surf zone. Both survey types collected data for portions of the beach, and Woods Hole Group compared cross-shore profiles generated from both types of data. For the 2018 results, there was good agreement between the topographic data and the UAV data sets for that portion of the beach where the two datasets overlapped. This finding is consistent with the detailed data comparison between the Woods Hole Group and UAV data included in the Sconset Bluff 2017 Survey Report.

3.0 Changes in Bluff Volume

To understand changes in the bluff volume since Project construction, the results of the 2018 survey were compared to the previous aerial photogrammetry surveys of the Project area that were conducted in August 2017 and July 2013. The July 2013 survey was conducted about 6 months prior to the installation of the geotextile tubes.

3.1 Changes in Bluff Volume in Adjacent Unprotected Areas

The results of the 2018 aerial survey were used to calculate the changes in the bluff volume from 2017 to 2018 for those unprotected areas immediately adjacent to the geotextile tube project (Figure 1). The change in the bluff volume in these unprotected areas was calculated from the toe of the bluff (elevation +11 MLW) to the top of the bluff.

- For the north unprotected area, the section of bluff within 802 feet immediately to the north of the geotextile tubes was used.
- For the south unprotected area, the section on bluff within 192 feet immediately to the south of the geotextile tubes was used. Areas farther south than this could not be used because they had coir or jute terraces installed and so were not representative of the unprotected bluff.
- No areas with a bulge of sand from sand delivery activities at the accessway between 85 and 87 Baxter Road were used in the calculations.

As shown in Tables 2a-c, this analysis indicates that the unprotected areas immediately adjacent to the geotextile tubes eroded at the following rates:

- For the most recent year (August 2017 – May 2018), the unprotected areas eroded just over 17,000 cy (Table 2a). This is equivalent to a distance-weighted average of 17.4 cy/lf/yr.
- For the previous reporting period (July 2013 – August 2017), the unprotected areas eroded a distance-weighted equivalent of 5.8 cy/lf/yr (Table 2b).
- For the period from geotextile tube installation to present (July 2013 – May 2018), the unprotected areas eroded a distance-weighted equivalent of 8.1 cy/lf/yr (Table 2c).

Table 2a. Bluff Volume Loss in Unprotected Areas Adjacent to Geotextile Tubes for the Most Recent Year, August 2017 – May 2018

Line	Area	Volume Eroded (CY)	Length (Feet)	Duration (Years)	Annual Change (CY/LF/YR)
1	North Unprotected Area	14,229	802	1.0	17.7
2	South Unprotected Area	3,054	192	1.0	15.9
3	**Total Bluff Erosion for Adjacent Unprotected Areas**	**17,283**			**17.4**

Table 2b. Bluff Volume Loss in Unprotected Areas Adjacent to Geotextile Tubes for the Previous Reporting Period, July 2013 - August 17, 2017

Line	Area	Volume Eroded (CY)	Length (Feet)	Duration (Years)	Annual Change (CY/LF/YR)
1	North Unprotected Area	21,194	802	4.1	6.5
2	South Unprotected Area	2,523	192	4.1	3.2
3	**Total Bluff Erosion for Adjacent Unprotected Areas**	**23,717**			**5.8**

Table 2c. Bluff Volume Loss in Unprotected Areas Adjacent to Geotextile Tubes for the Five Years since Geotextile Tube Installation, July 2013 - May 14, 2018

Line	Area	Volume Eroded (CY)	Length (Feet)	Duration (Years)	Annual Change (CY/LF/YR)
1	North Unprotected Area	35,424	802	5.1	8.7
2	South Unprotected Area	5,578	192	5.1	5.7
3	**Total Bluff Erosion for Adjacent Unprotected Areas (**	**41,002**			**8.1**

The 2017-2018 estimate of the annual loss of sand from unprotected areas of 17.4 cy/lf/yr is higher than the annualized value of 5.8 cy/lf/yr from 2013-2018. This higher value over the most recent year is consistent with the energetic latter portion of the storm season in the 2017-2018 winter, where there were four storms in the month of March.

3.2 Changes in Bluff Volume Above Geotextile Tubes

The change in the bluff volume above the geotextile tubes was not calculated for the 2018-2018 period but will be calculated annually going forward. The 2018 LiDAR provided a "bare earth" elevation whereas the 2017 photogrammetry provided a surface elevation reflective of the height of the vegetation; therefore, these two numbers are not directly comparable. Going forward, "bare earth" elevations generated from the annual LiDAR survey can be compared. The ongoing presence of the vegetation indicates minimal erosion above the geotextile tubes has occurred over the past year.

4.0 Volume of Sand in Template

The volume of the sand template was calculated by determining the total volume of sand within the sand cover at the time of the 2018 aerial survey, and subtracting out the known volume of sand within the geotextile tubes and returns located above beach level. The total volume of sand within the sand cover in May 2018 was approximately 10,200 cy.

Calculations were also performed of that portion of the sand template that is located above the fourth tier. Per the Project's Order of Conditions, the sand on top of the fourth tier is not counted towards the mitigation sand. This volume is calculated as approximately 2,500 cubic yards. It is anticipated that sand on top of the sand template, including sand on top of the fourth year, will continue to be pushed down to recover the geotextile tubes as needed. Therefore, the volume above the fourth tier will become available through time.

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Data Source: Office of Geographic Information (MassGIS), Commonwealth of Massachusetts, Information Technology Division

Baxter Road and Sconset Bluff Storm Damage Prevention Project Nantucket, Massachusetts

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Figure 1

2017 to 2018 Sand Volume Comparison