7 Werowocomoco National Park, Gloucester County

(Excerpt from "Living Shoreline Sea Level Resiliency: Performance and Adaptive Management of Existing Breakwater Sites, Year 3 Summary" Report)

7.1 Site Background

Werowocomoco is located on the York River in Gloucester County, Virginia (Figure 7-1). Historical documents identified Werowocomoco as the headquarters of Powhatan, the Algonquian political and spiritual leader when the English founded Jamestown in 1607. For many years, the exact location of the site was unknown; however, in 2003, archeological digs at the site on the York River between Leigh and Bland Creeks confirmed the location. The site has been occupied by Native Americans since 8,000 before the common era (BCE) and is one of the most important Native American sites in the nation.

In 2016, the 264-acre Werowocomoco site came under the protection of the National Park Service. Presently, the site is part of the Captain John Smith Chesapeake National Historic Trail. The property has almost two miles of open water tidal shoreline (Figure 7-2) along Leigh Creek, the York River, and Bland Creek (Milligan et al., 2016). Shoreline erosion, historically, is greater along the more open reaches of the York River, but the marshes on either end of the site are also eroding quickly. The calculated rates of change between 1937 and 2017 indicate that the middle section of the property along the York River had very low rates of change (<-1 ft/yr) while the ends are eroding at low (-1 to -2 ft/yr) and medium (-2 to -5 ft/yr) rates of change (Figure 7-3). The shoreline has fetches of 2.4 miles to the west, 3.5 miles to the west-northwest, and 2.8 miles to the southwest which results in a medium energy wave climate (Milligan et al., 2016). Tide range is 2.8 ft. The estimated water level associated with a 10-year storm return frequency is 6.8 ft MLW (FEMA, 2014).

Werowocomoco sits within the natural embayment of Purtan Bay. The upland in the vicinity of the shoreline is relatively high and ranges from 12-27 feet MLW (Milligan et al., 2016). The marshes on either side of the upland at the entrances to the creeks are much lower,

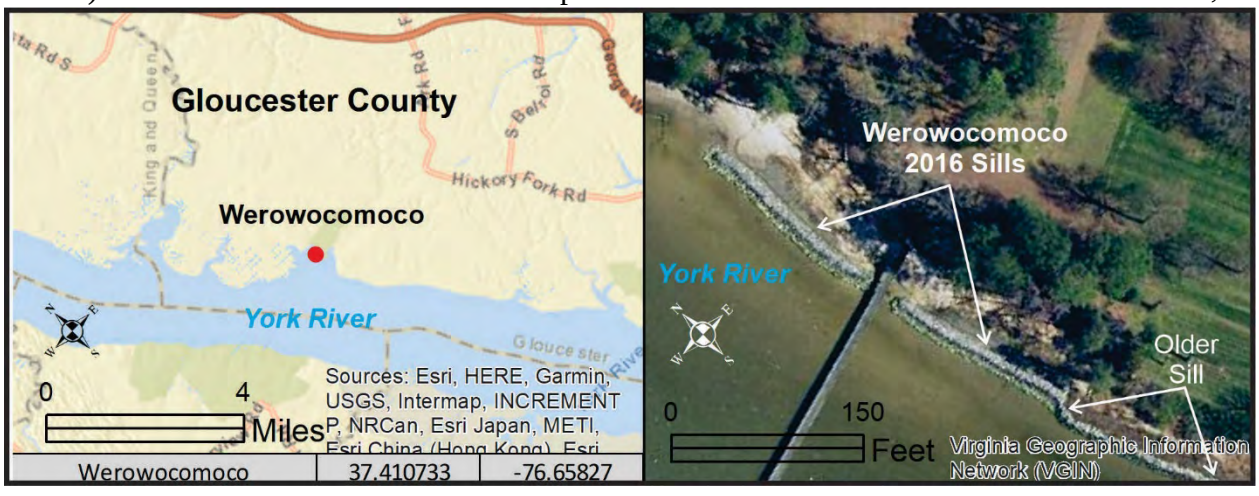

Figure 7-1. Location of Werowocomoco living shoreline sill shore protection system.

Several sections of the York River shoreline are protected with a high sill in front of the house and a revetment along the York River shoreline closer to Bland Creek. However, the section of shoreline near the pier was eroding into the bank (Figure 7-4). Great concern existed for the loss of high value archaeology associated with Powhatan and the Native American occupation of the site due to continued erosion of the bank in unprotected areas. This resulted in the construction of a stone gapped sill living shoreline system (Figure 7-1).

In 2014, VIMS received a grant from the National Fish and Wildlife Foundation to design, permit, and build the structures (#45177) and develop an overall shoreline management plan for the entire tidal shoreline. Additional funding from the Virginia Department of Conservation and Recreation's Water Quality Improvement Fund (WQIF-2016-03) was received to support the construction project (Milligan et al., 2016). The project was built in March to May 2016, and planted with marsh grasses in May to June 2016.

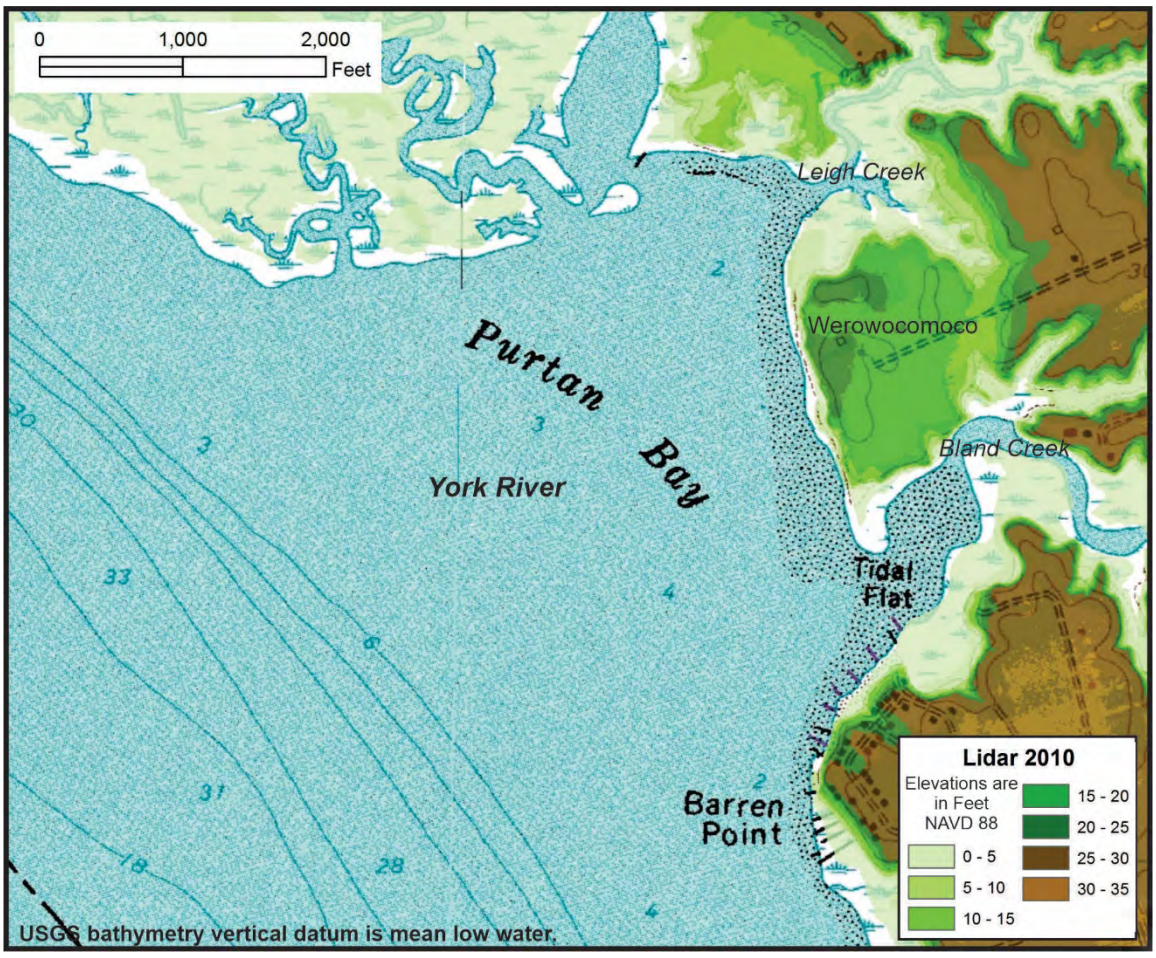

Figure 7-2. Lidar elevation data and bathymetric data in the vicinity of Werowocomoco. From Milligan et al., 2016.

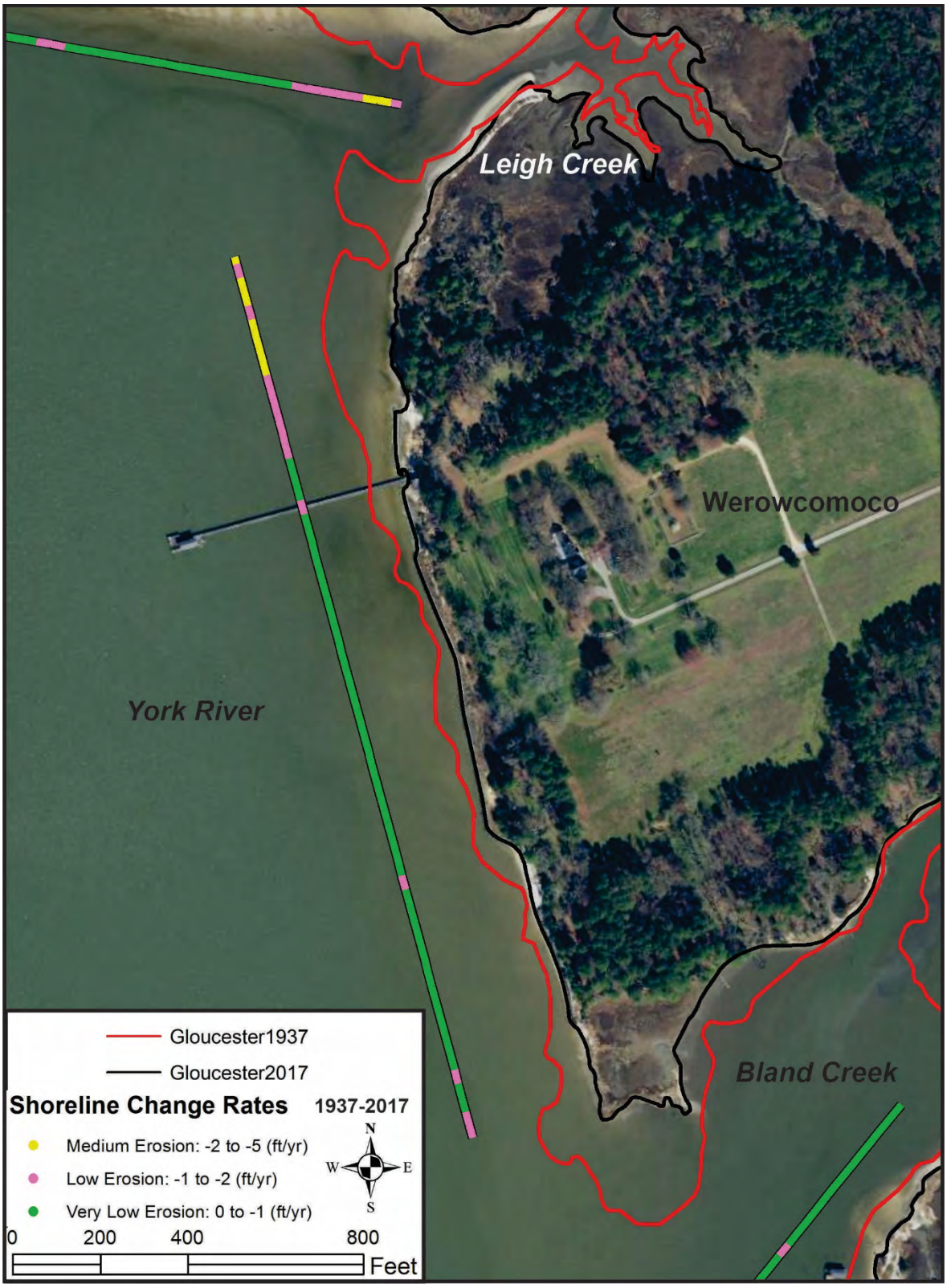

Figure 7-3. Shorelines digitized on the 1937 and 2017 aerial photos and the calculated rate of change along Werowocomoco's York River shoreline. From Shoreline Studies Program's shoreline change database.

Figure 7-4. Werowocomoco shoreline and eroding upland bank in 2012. Very little of what used to be an extensive marsh fronting the upland bank remained, and the bank was being directly impacted by high water levels during storms. Photo credit: Shoreline Studies Program, VIMS.

7.2 Site Performance

The Werowocomoco Living Shoreline project created/restored estuarine intertidal and riparian habitat, provided sustainable coastal hazards protection to a vulnerable historic resource, and provided the structure to mitigate the effects of sea level rise as well as sediment reduction to Chesapeake Bay. Two stone, gapped sills (152 and 170 ft long) with one window (25 ft wide) were constructed along 330 feet of shoreline (Figure 7-5). The southern sill (Sill 1) was attached to an existing higher, continuous sill. The upper elevation of sand fill was set at +5.0 ft MLW to interface with the eroding bank, and extended on a 12:1 slope to about mean tide level at the back of the stone sills (Figure 7-6).

After installation, the placed sand was allowed to adjust for about 2 weeks. Soon after, approximately 15,000 square feet of *Spartina alterniflora* (low marsh) and *Spartina patens* (high marsh) were planted in May/June 2016 to create marsh habitat (Milligan et al., 2016). The grasses were planted on a 2 ft grid, and Osmocote fertilizer was put in the hole at time of planting (Figure 7-7). Generally, the grasses were planted from mid-tide to the base of the bank,

and goose exclusion fencing was placed at the site to protect the marsh grass plugs from geese.

The site was surveyed before construction (31 Mar 2014), after construction (7 Jun 2016), and on 26 Oct 2020, more than 4 years after installation (Figure 7-8). The mean high water (MHW) line advanced riverward due to the placement of sand for the project. Most areas behind the sill have maintained the sand. The riverward advances on the Sill 2 are due to placement of additional sand after the as-built survey. The sand placed in front of the revetment at the pier has shifted. Of note, the shoreline north of Sill 2 is continuing to erode. Additional structures are needed to protect this section of shoreline (Figure 7-9).

Figure 7-10 shows the cross-sections of the shoreline. Profile 150 shows that very little change has occurred since installation. At profile 200, which occurs between the structures, some of the sand fill has been eroded in front of the small, existing rock revetment. Sand was dumped over the bank on both sides of the pier so that the machinery could access the shoreline. This was done in lieu of grading to protect the existing archeology. Both profiles 200 and 250 show that sand was placed farther up the bank to facilitate access. Some additional sand was placed at profile 350 after the as-built survey occurred.

Since installation, this living shoreline project is functioning as expected. The eroding shoreline now has a wide high and low marsh behind the sills (Figure 7-11 and Figure 7-12) except for in the small embayment at the pier, which is beach. A well-established, lush marsh occurs from the back of the sill to the base of the bank. The sand was placed on a 12:1 slope which is slightly gentler than many other sills in Chesapeake Bay. This increased the width possible for the marsh, which in turn provides more wave reduction during storms and reduces wave impact on the upland bank. This southwest facing shoreline provides an extremely suitable area for marsh growth.

The site was only planted to mid-tide but now has filled in completely behind sill. Additionally, *S. patens* was planted up the slope of the upland bank where the sand was placed to provide access to the shoreline (Figure 7-13). It has done well growing up the slope. The survey also revealed that the approximate line between where *S. alterniflora* and *S. patens* were growing was at about 3.1 ft MLW in 2020 (Figure 7-14). This biologic benchmark is about the same as it was before the project was built, 3.2 ft MLW on the adjacent marsh shoreline.

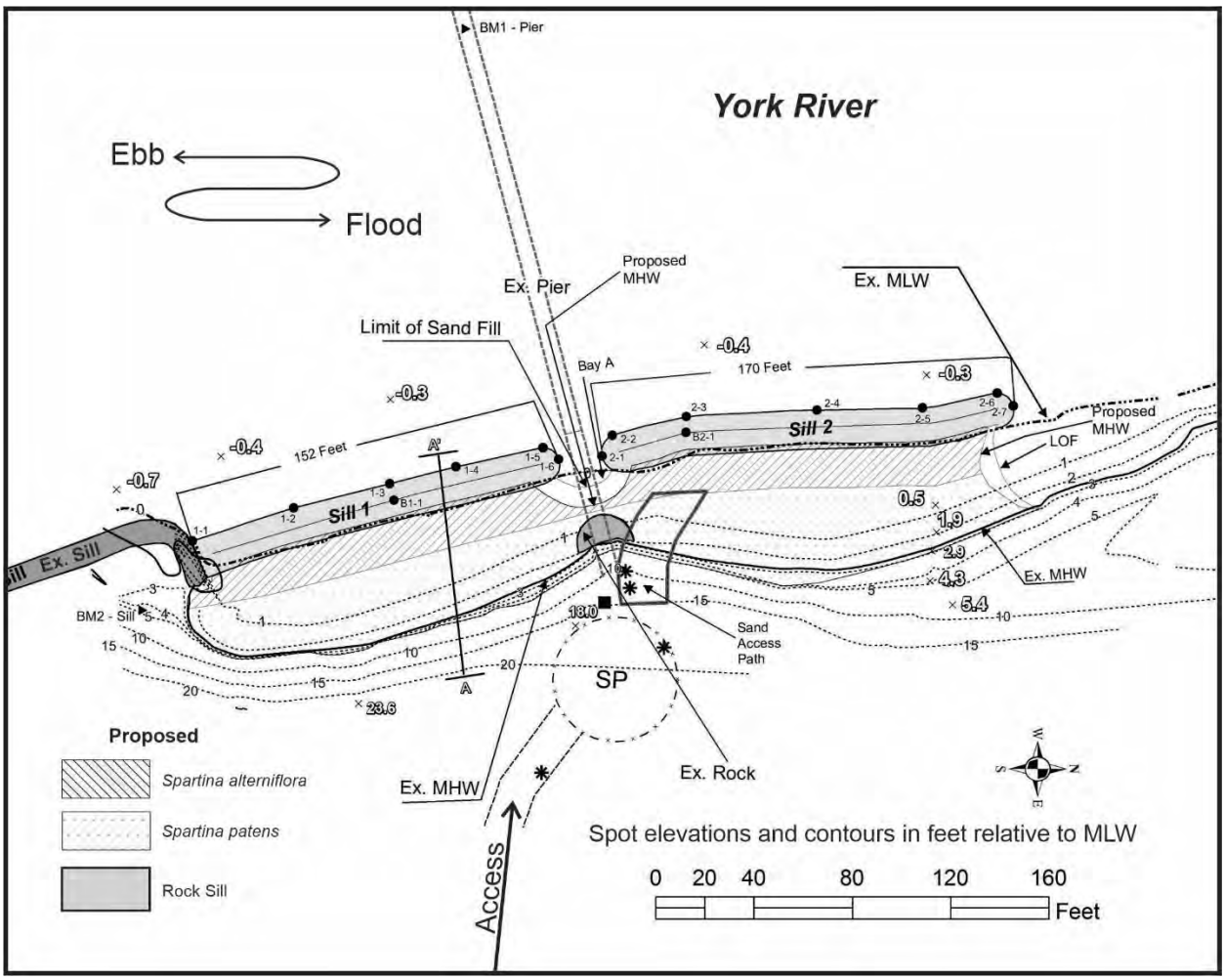

Figure 7-5. Planform of existing and proposed conditions at Werowocomoco living shoreline project.

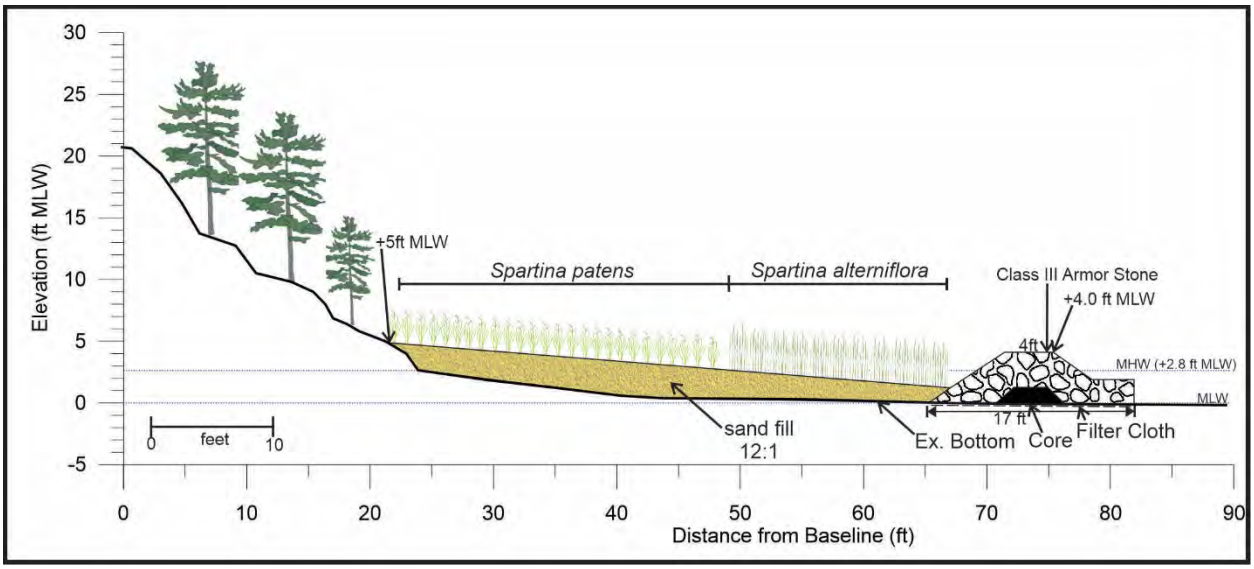

Figure 7-6. Typical cross-section of the sill and sand fill at Werowocomoco living shoreline project.

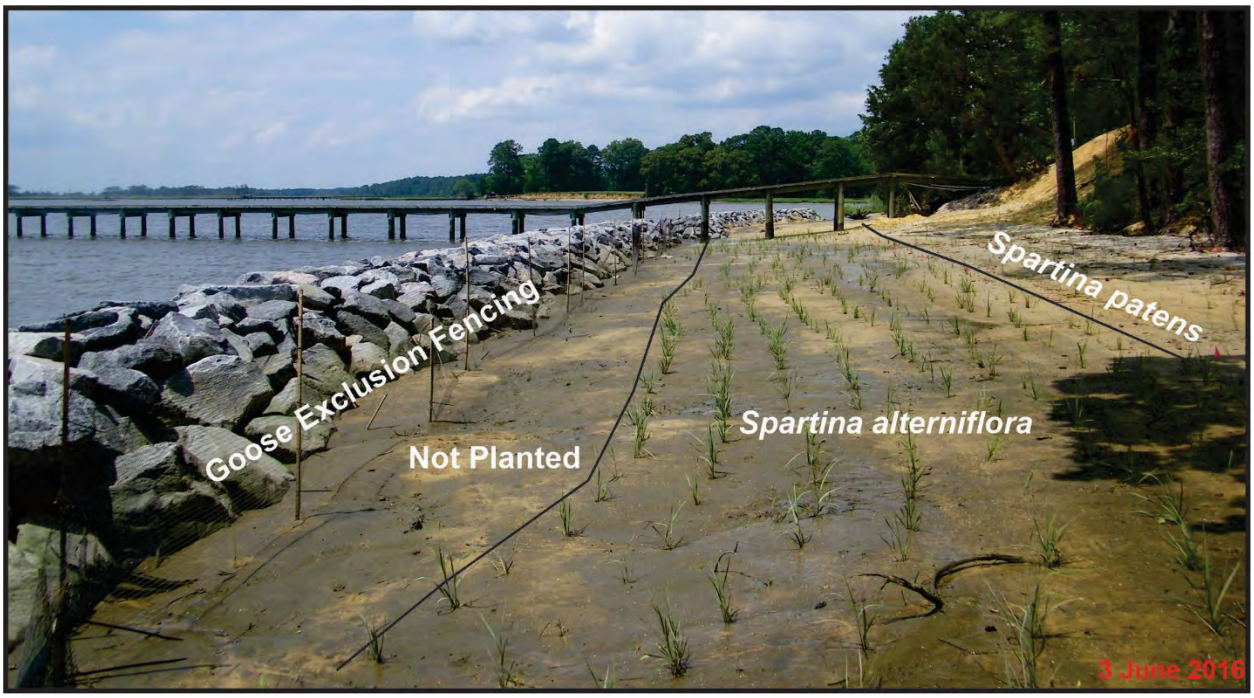

Figure 7-7. Planting zones of low and high marsh grasses. The sand equilibrated for about two weeks after it was placed. Photo credit: Shoreline Studies Program, VIMS.

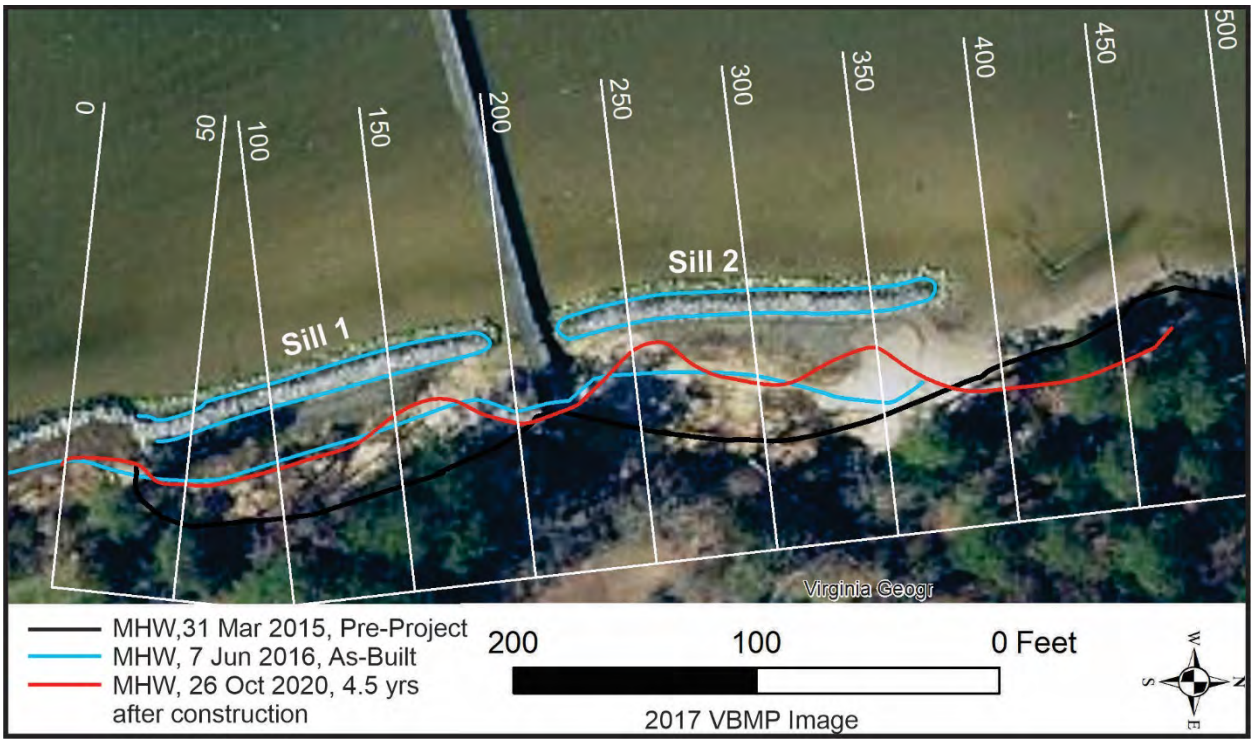

Figure 7-8. The survey baseline and profiles at Werowocomoco. Also shown is the surveyed mean high water line at each of the survey dates.

Figure 7-9. Eroding shoreline north of Sill 2. An additional structure is needed to protect the bank along this section of shoreline. Photo credit: Shoreline Studies Program, VIMS.

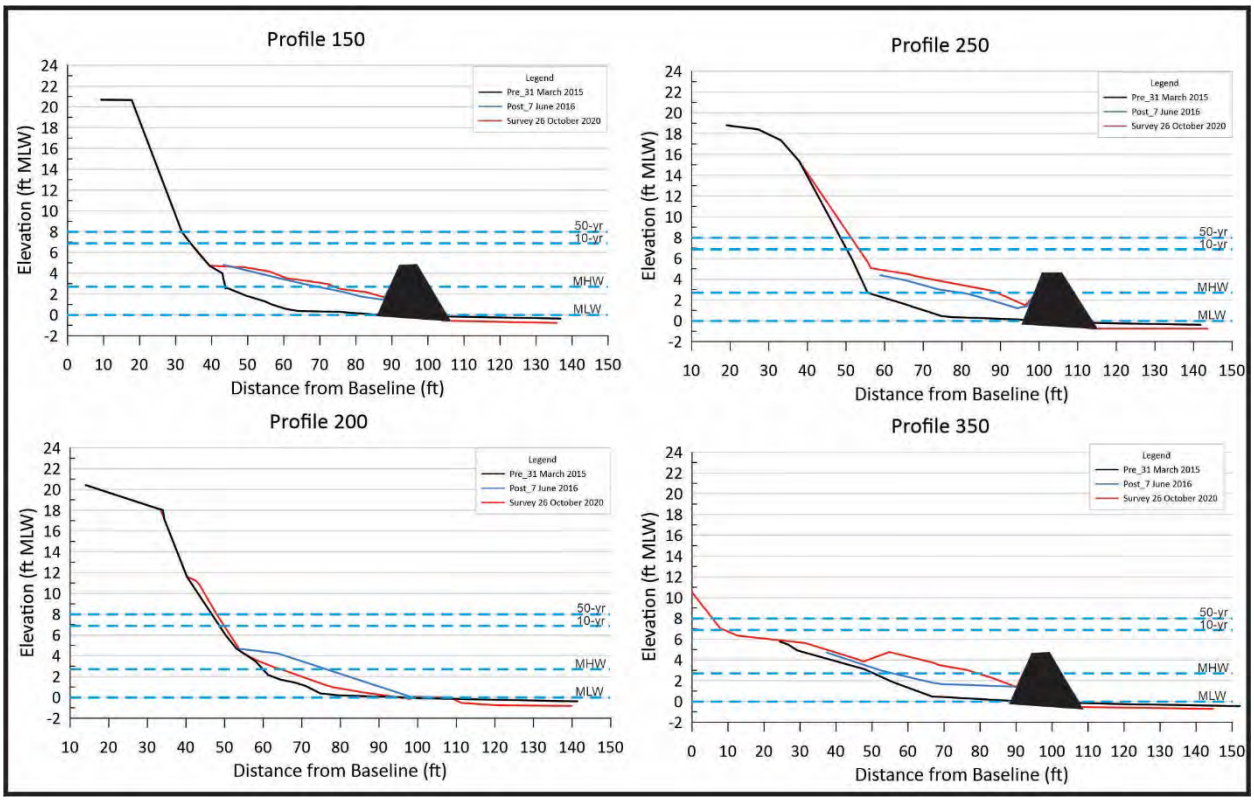

Figure 7-10. Profiles at Werowocomoco living shoreline pre-project, as-built and about 4.5 years later.

Figure 7-11. Pre-project shoreline showing an eroding bank with fallen trees (top); and Sill 2 about 4.5 years after construction showing a lush marsh (bottom). Photo credit: Shoreline Studies Program, VIMS.

Figure 7-12. Pre-project shoreline showing an eroding bank with fallen trees (top); During construction of Sill 1 (middle); and Sill 1 about 4.5 years after construction showing a lush marsh (bottom). Photo credit: Shoreline Studies Program, VIMS.

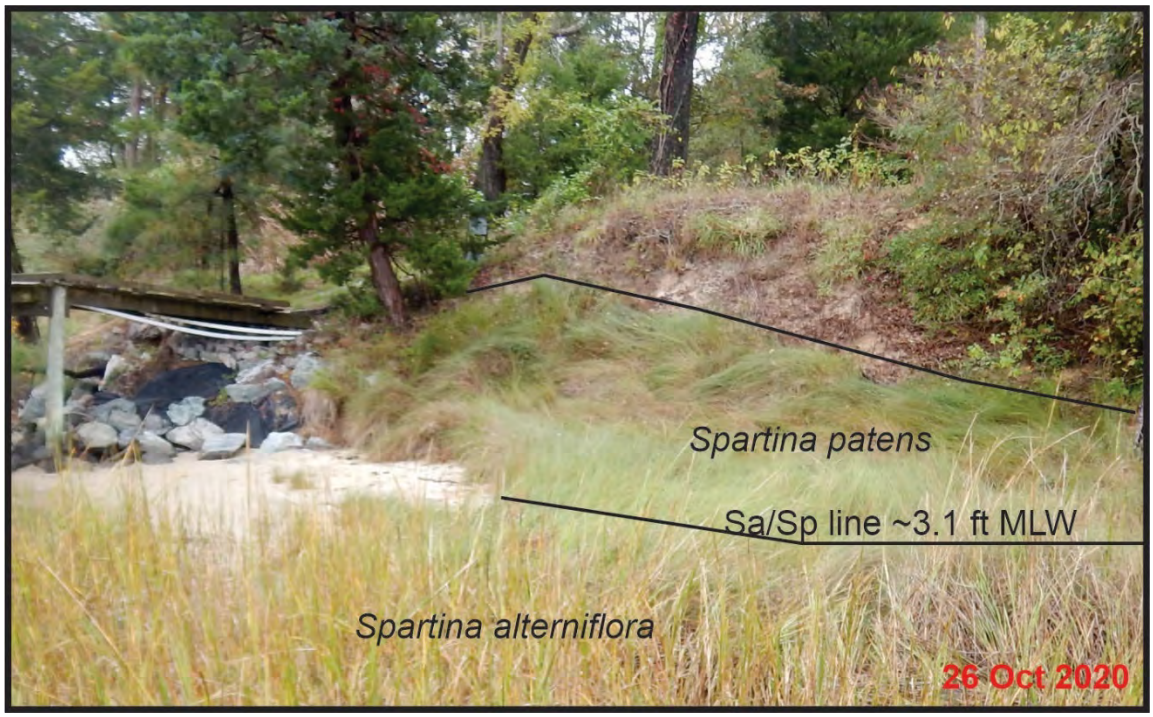

Figure 7-13. Marsh behind Sill 1 about 4.5 years after construction. The S. alterniflora/S. patens biologic benchmark is similar to what it was pre-project. Photo credit: Shoreline Studies Program, VIMS.

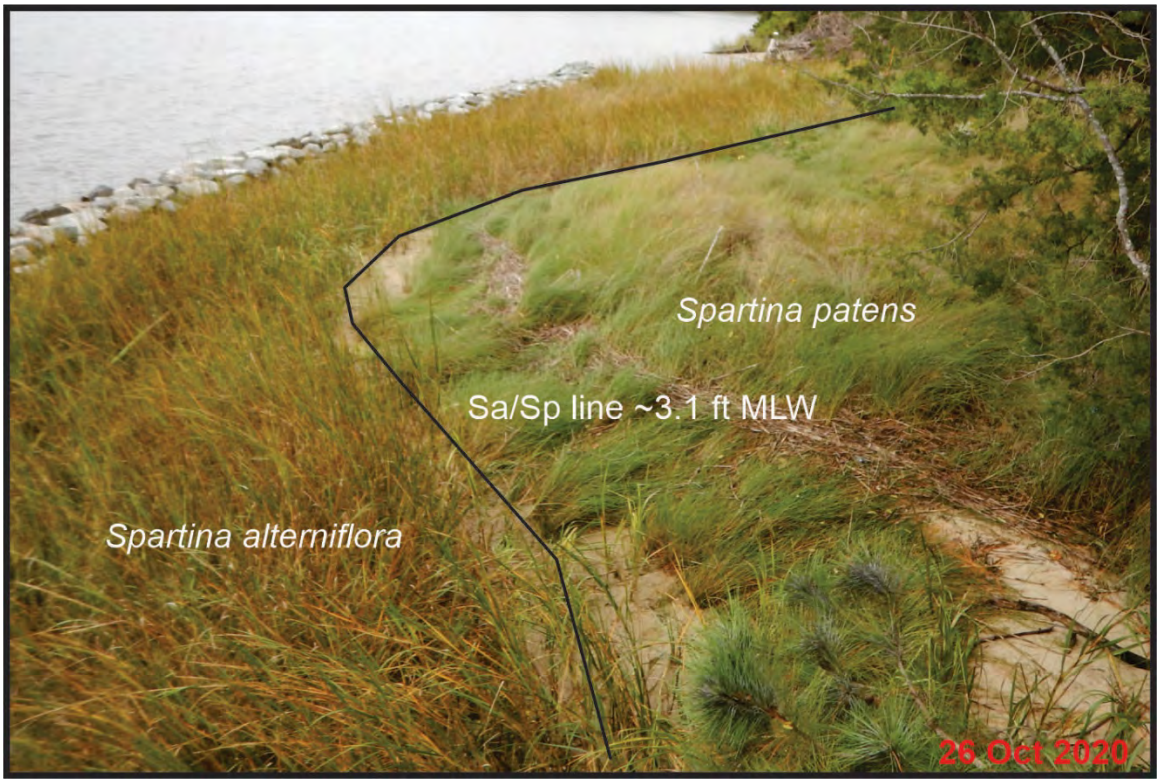

Figure 7-14. Marsh behind Sill 1 about 4.5 years after construction. The S. alterniflora/S. patens biologic benchmark is similar to what it was pre-project. Photo credit: Shoreline Studies Program, VIMS