6 Virginia Institute of Marine Science-West, Gloucester County

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

6.1 Site Background

The Virginia Institute of Marine Science (VIMS) is located at Gloucester Point, Virginia (Figure 6-1). VIMS was established in 1940 as the Virginia Fisheries Laboratory. The west coast of Gloucester Point has been an accretionary spit feature for many years. Like the VIMS East shoreline, the sand beach/dune system was a product of sedimentary processes along the York River (Hardaway et al., 2019). The high eroding upland banks upriver of Gloucester Point had, for many years, provided sand to the littoral system that helped build the point feature and occurred in the nearshore (Figure 6-2). As these banks were developed and subsequently hardened with bulkhead, revetments and later small breakwaters; the sand source and sediment transport pathways were greatly reduced.

The transformation of Gloucester Point began in 1960 when the boat basin and entrance channel were dredged out from the existing tidal marsh and two small jetties were installed to secure the channel inlet (Figure 6-3). A long wood groin was installed on the shoreline sometime before 1978 along with a small groin just upriver of the boat basin entrance channel. The effect of these can be seen in 1978 aerial imagery (Figure 6-4). Sometime between 1978 and 1994, sand had accreted against the long wood groin, and sand was bypassing around the groin. Three short gabion basket breakwaters also were put in the embayed coast between the long groin and the channel entrance, the downriver reach. However, because sand was bypassing the wood groin, these small structures were completely covered in sand.

Since 1937, the upriver shoreline has been eroding while the downriver shoreline accreted. By 2002, the effects of upriver, updrift shoreline hardening and breakwaters resulted in a reduced beach near the upriver boundary of VIMS, but shore advance on the downriver reach (Figure 6-5). The VIMS west shoreline is impacted by a high energy regime. The shoreline faces west, and the fetch from the northwesterly direction is about 25 miles. During post-northeast storms, wind waves travel the length of the York River to impact this site. Tide range is 2.3 ft.

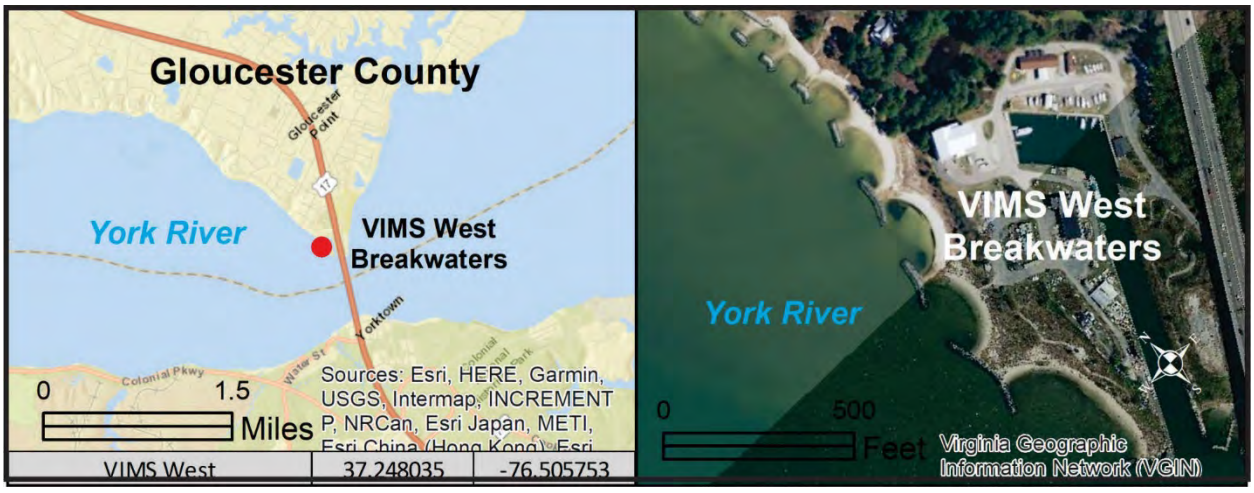

Figure 6-1. Location of VIMS West living shoreline breakwater shore protection system.

A conceptual Shoreline Management Plan for the VIMS shoreline was developed in 2002 and modified in 2008; it consisted of three subaerially attached breakwaters and a channel jetty spur for the west coast (Figure 6-6 and 6-7). Significant damage occurred to the VIMS shoreline in September 2003 with the passage of Hurricane Isabel. The ferry pier and wave gauge were destroyed and flooding of the boat basin occurred. Subsequent storms, including Hurricane Ernesto, caused additional damage leading VIMS to implement the Shoreline Management Plan. Under a design/build contract, the structures were constructed in 2010.

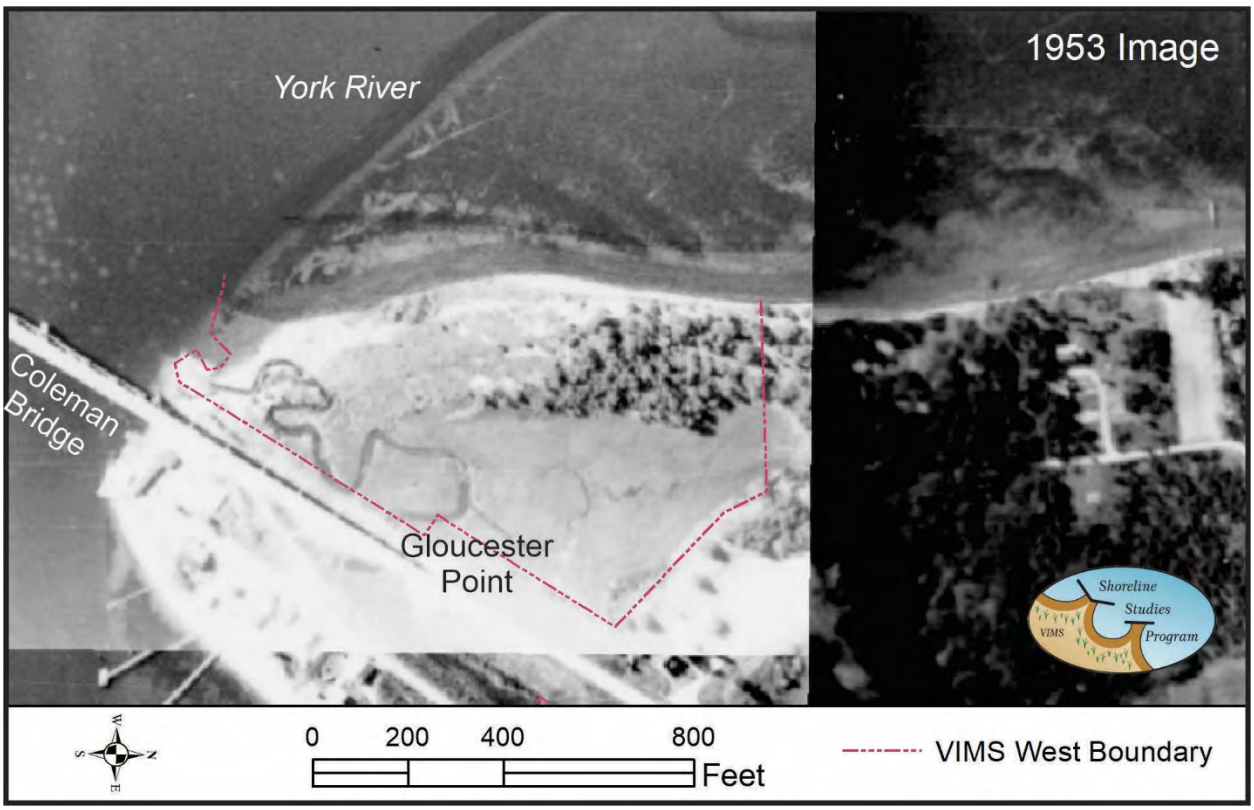

Figure 6-2. VIMS West shoreline in 1953 showing the present-day boundary of the VIMS West campus. In subsequent years, the tidal marsh was dredged to become the marine institute's boat basin (from Shoreline Studies Program shore change database).

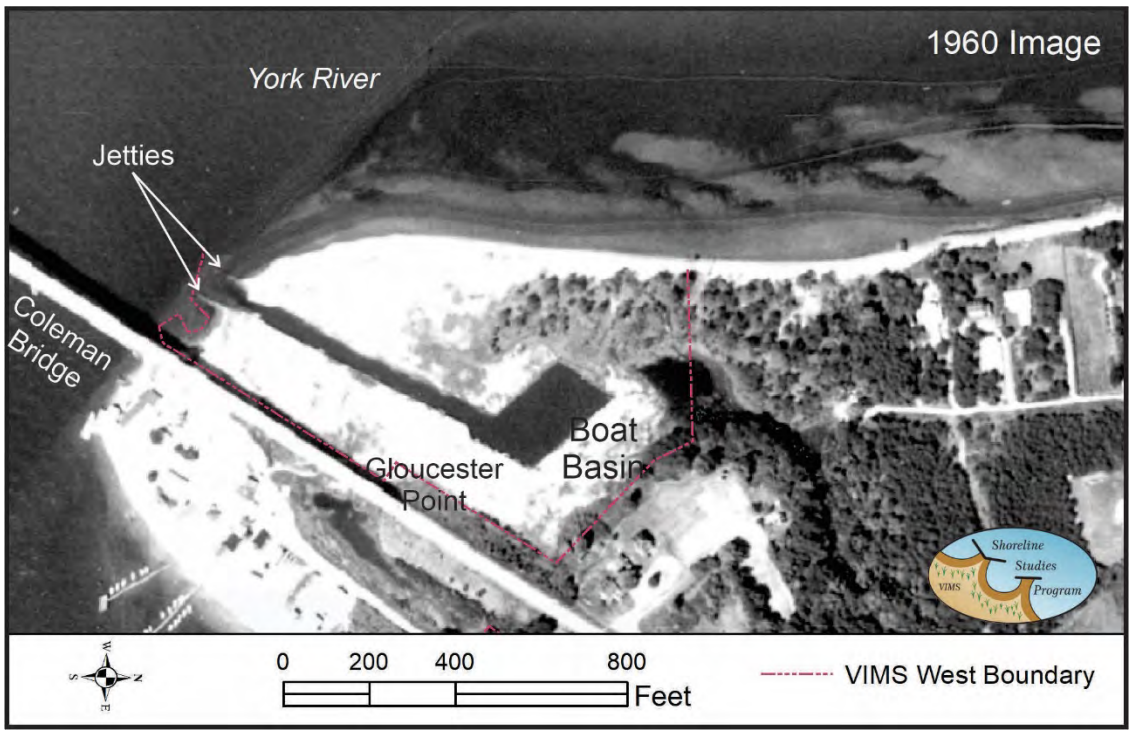

Figure 6-3. VIMS West shoreline in 1960 showing the present-day boundary of the VIMS West campus and the construction of the marine institute's boat basin (from Shoreline Studies Program shore change database).

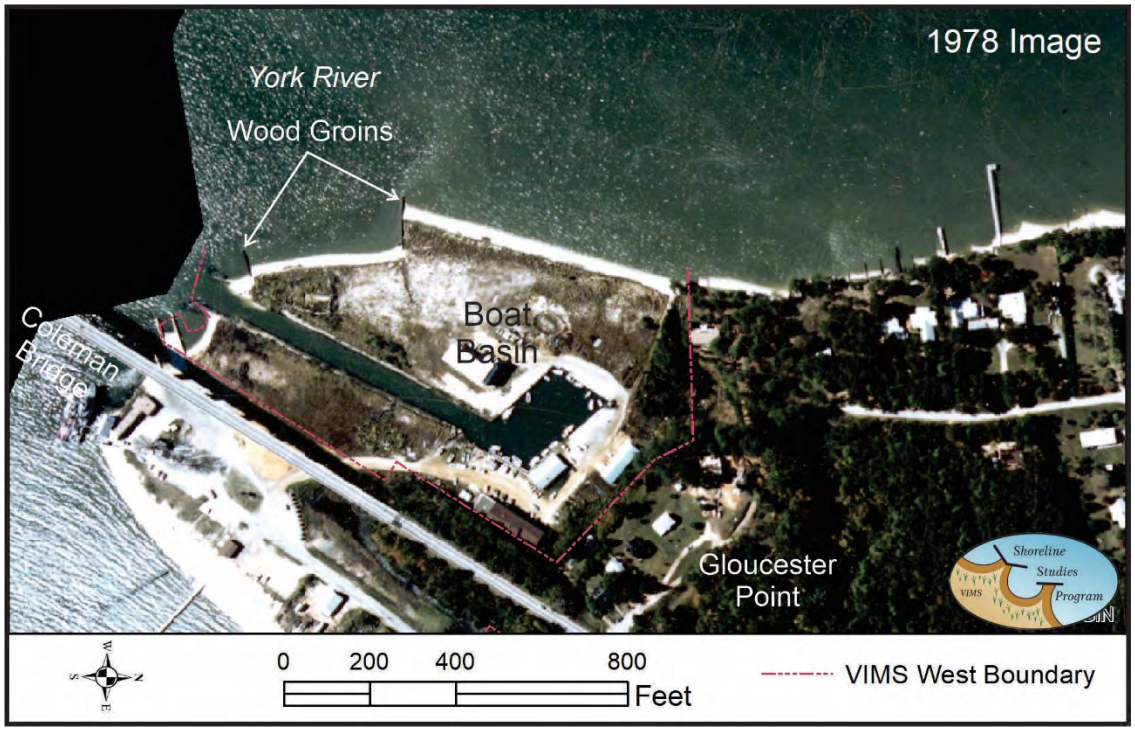

Figure 6-4. VIMS West shoreline in 1978 showing the present-day boundary of the VIMS West campus and the impact of two wood groins constructed along the shoreline (from Shoreline Studies Program shore change database).

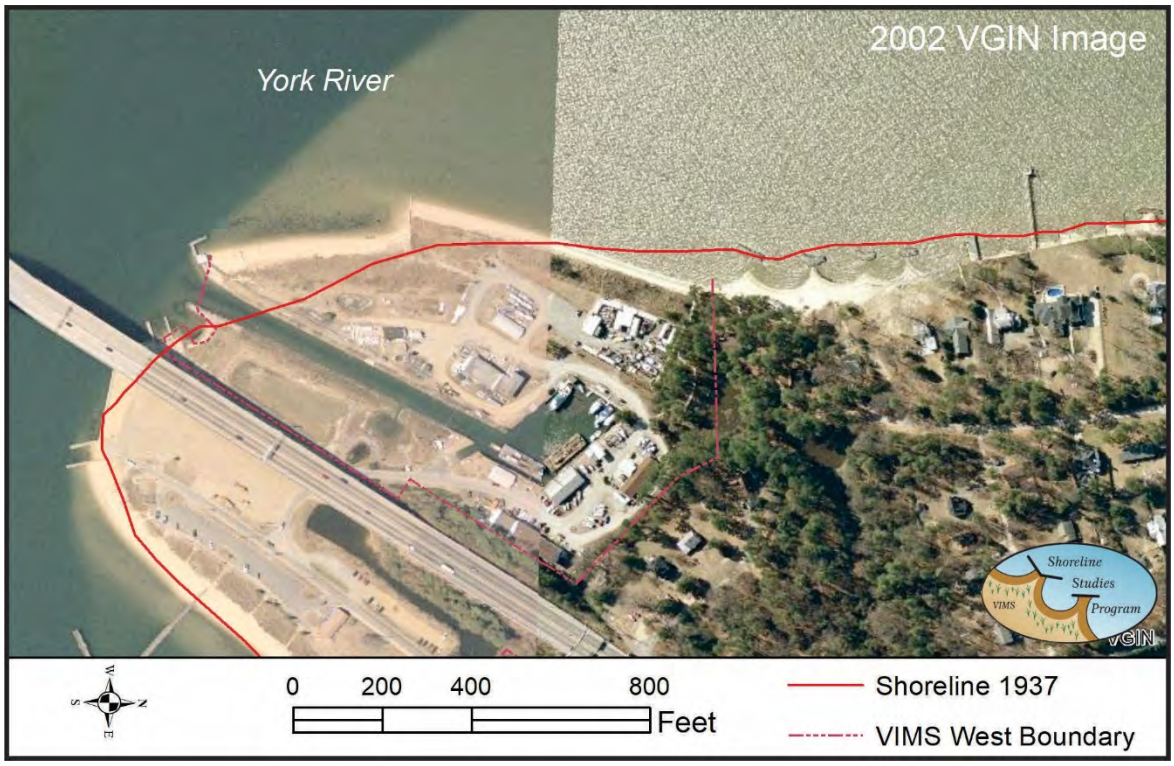

Figure 6-5. VIMS West shoreline in 2002 showing the present-day boundary of the VIMS West campus and the 1937 digitized shoreline (from Shoreline Studies Program shore change database). Over the years, many buildings were constructed around the VIMS boat basin and were impacted by storms.

Figure 6-6. Shoreline Management Plan created by Shoreline Studies Program for the VIMS West shoreline in 2002 and modified in 2008.

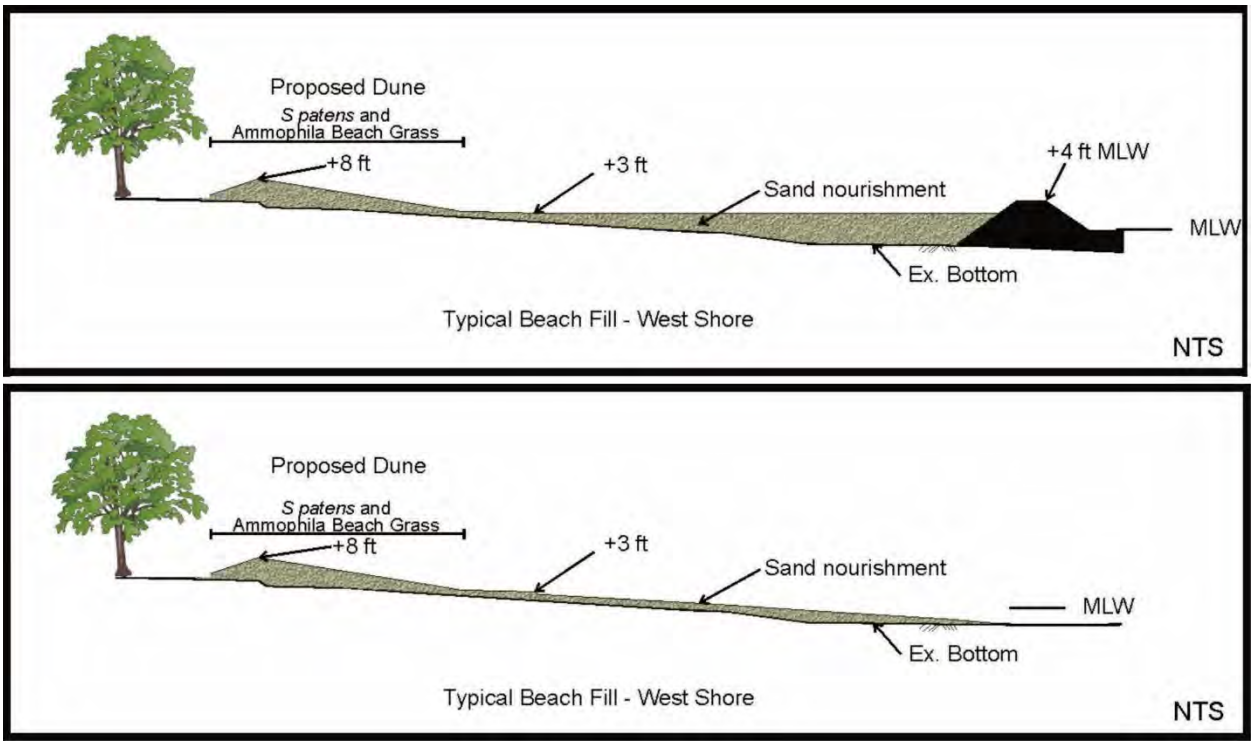

Figure 6-7. Typical cross-sections of the VIMS West Shoreline Management Plan developed by Shoreline Studies Program.

6.2 Site Performance

Prior to construction, the VIMS West shoreline was sandy with a low marsh upland (Figure 6-8). Though the shoreline near the point was stable, the upriver section was eroding. After several large storms impacted the VIMS shoreline, funding was received to construct living shorelines on both sides of the VIMS campus. The VIMS West breakwaters and beach fill were placed in September 2010 (Figure 6-9 and 6-10). Beach grasses were planted the following spring (Figure 6-11).

Storms impacted VIMS West after the project was installed, particularly in 2012 (Hurricane Sandy) and in 2013 (March Extratropical Cyclone). As shown in Figure 6-12, water levels completely overtopped the structures at VIMS West. As a result, the subaerial attachment at breakwaters 2 and 3 became narrow. However, maintenance planting and natural marsh vegetation colonized the attachment (Figure 6-13). Over the next six years, natural low marsh vegetation increased behind breakwaters 2 and 3, increasing the width of the attachment (Figure 6-14). In addition, the gabion breakwaters that were uncovered are functioning as semi-detached breakwaters. The channel jetty spur supports that embayment, Bay A.

Net change in shoreline position is dramatic pre-post project (Figure 6-15). In some areas, the position of MLW is shifted over 100 ft riverward. The center of the embayments had the least change between pre and post construction. All profiles showed a large volume of sand placed except Profile 5 (Figure 6-16). Since construction, generally, the upriver section of

shoreline is accreting (north of BW3), embayments B and C are stable, but embayment A is still equilibrating to its equilibrium position (Figure 6-17). The gabion breakwaters have become uncovered and are influencing the shoreline in embayment A as well.

The vegetation is an important component of the shore protections system by providing substrate stability. Both the high and low marsh at the site are very lush (Figure 6-18). The beaches in the embayments are relatively steep, and some shrubs have colonized in the backshore where beach grasses were planted. However, generally, the beach grasses are sparser than the high and low marsh grasses (Figure 6-19).

SAV occurs in the embayments. Prior to the installation of the breakwaters, historical SAV records show that the underwater grasses come and go at the site. Yearly records indicate a lack of SAV at the site between 1971 and 1990. After that, patches occurred at the site until 2002 when the nearshore was covered with SAV along the entire site. However, that coverage declined until no SAV existed in 2007. With the construction of the breakwaters in 2010, the opportunity existed for SAV to colonize the shallow embayments between the structures, and presently, a large amount of SAV occurs at the site (Figure 6-14).

Figure 6-8. The VIMS West coast was a low eroding shoreline with wood groins for shore protection prior to installation of the breakwaters. Photo credit: Shoreline Studies Program, VIMS

Figure 6-9. VIMS West shoreline during construction of the living shoreline in 2010. Photo credit: Shoreline Studies Program, VIMS.

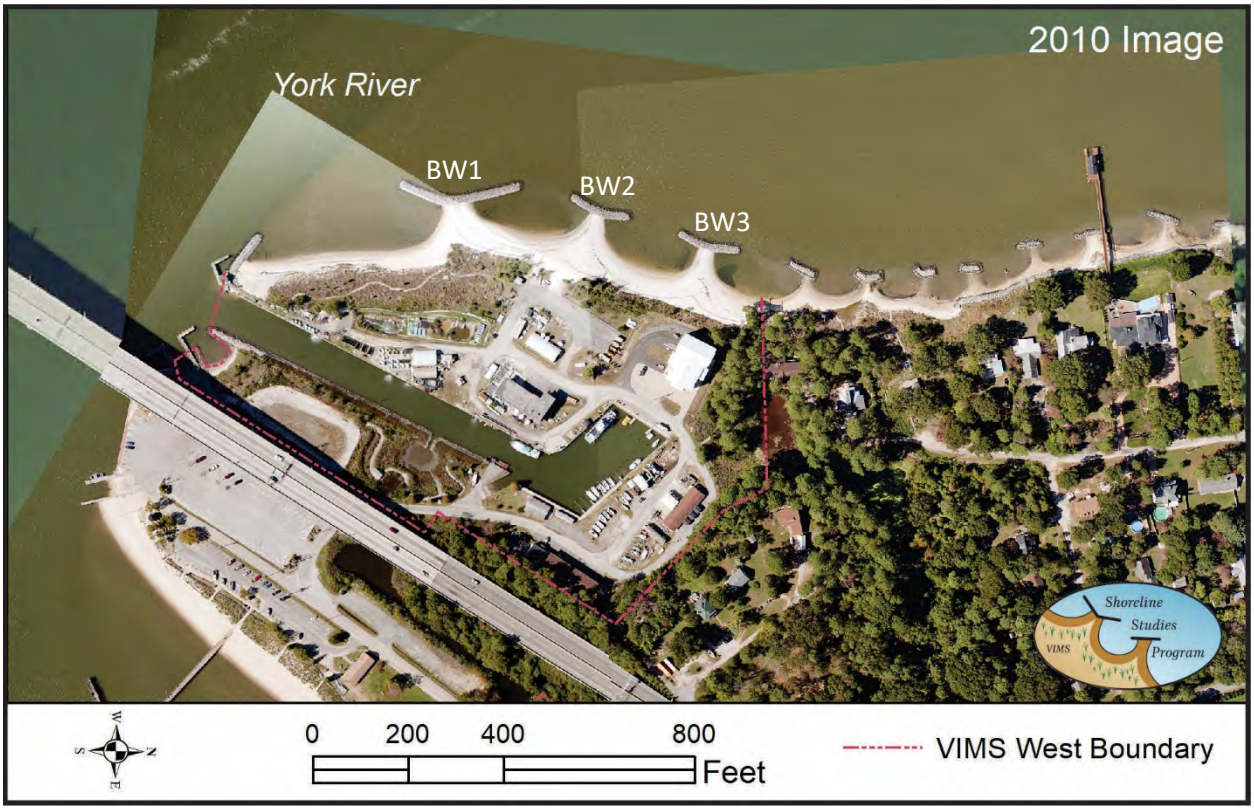

Figure 6-10. VIMS West aerial photo taken October 17, 2010 showing the newly constructed breakwaters and beach fill.

Figure 6-11. Planting of beach grasses took place the spring after construction. Photo credit: Shoreline Studies Program, VIMS

Figure 6-12. Photos taken at VIMS West during the passage of the March 2013 Northeast storm. Water levels are high enough to overtop the structures, but by the next day, tide levels had dropped. Photo credit: Shoreline Studies Program, VIMS

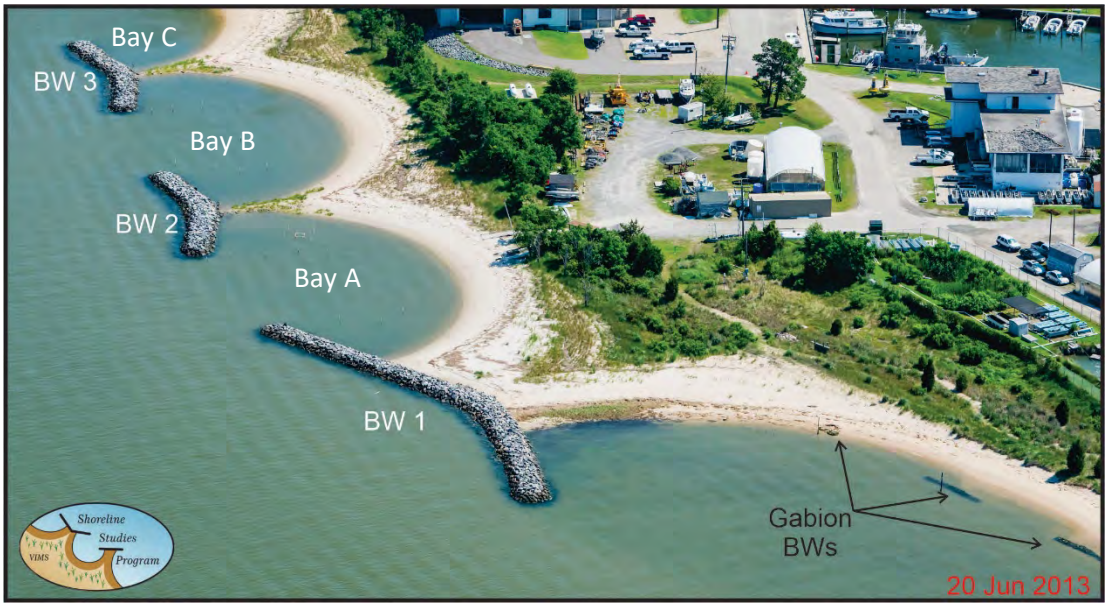

Figure 6-13. Aerial photo taken in June 2013 showing VIMS West 2.5 years after construction.

Figure 6-14. Aerial photo taken in September 2019 showing VIMS West nearly 9 years after construction.

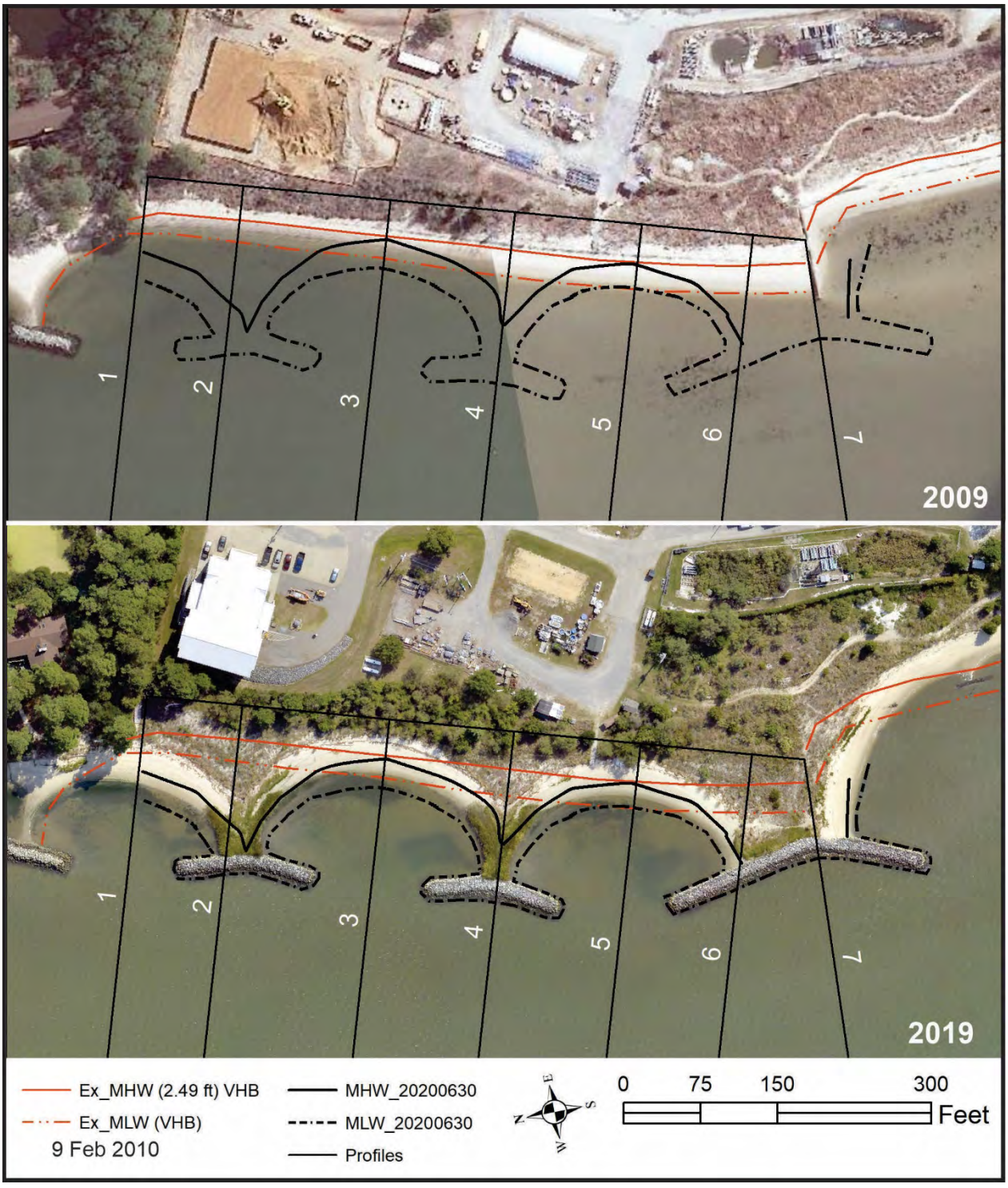

Figure 6-15. Survey data analysis at VIMS West showing the position of MHW and MLW before construction in February 2010 (VHB survey) and in June 2020, about 9.5 years after construction. Top photo base is 2009 VGIN image, bottom image is SSP's September 2019 image.

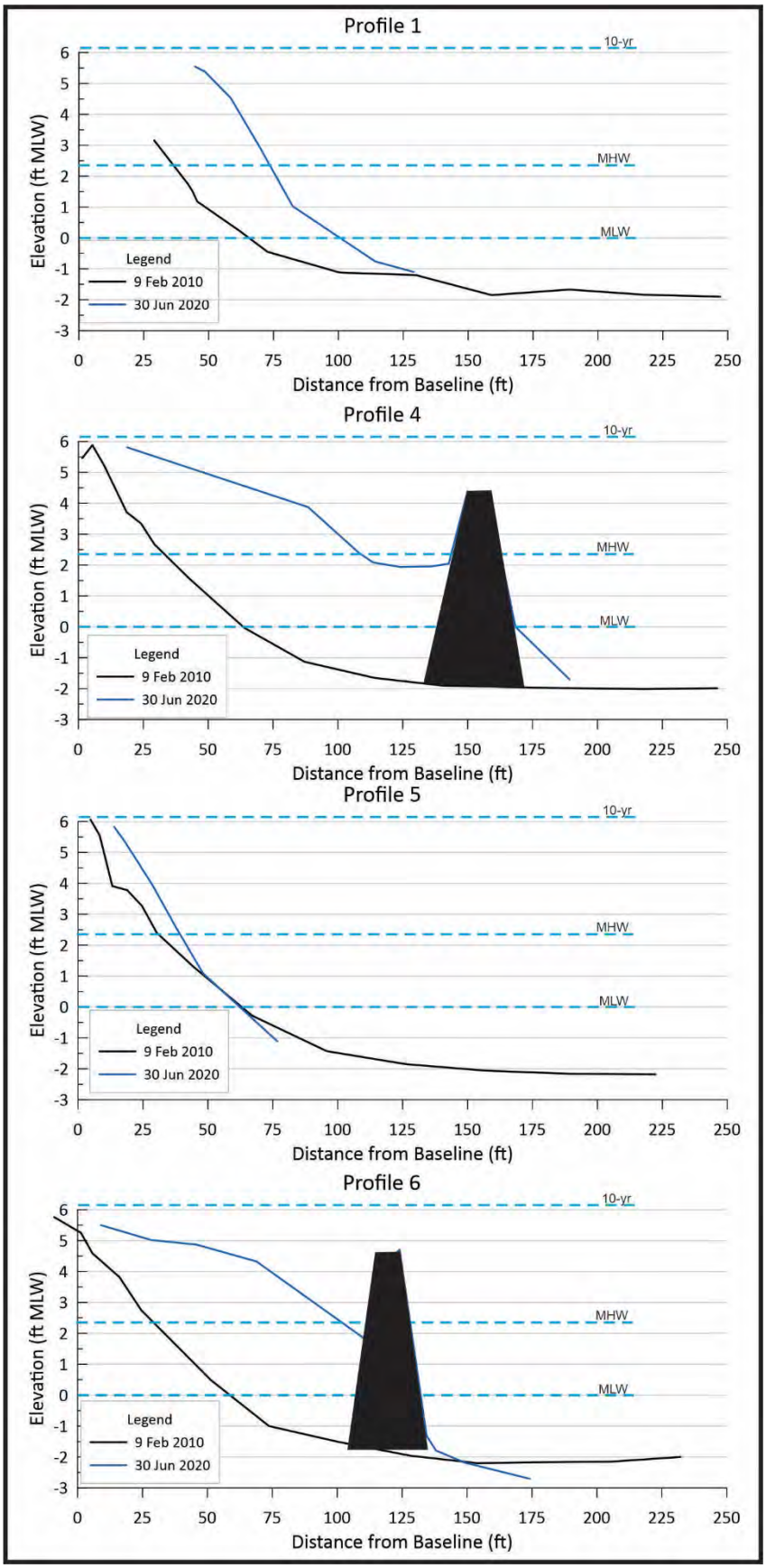

Figure 6-16. Profile data taken in February 2010 (pre-construction, VHB survey) and in June 2020 by SSP.

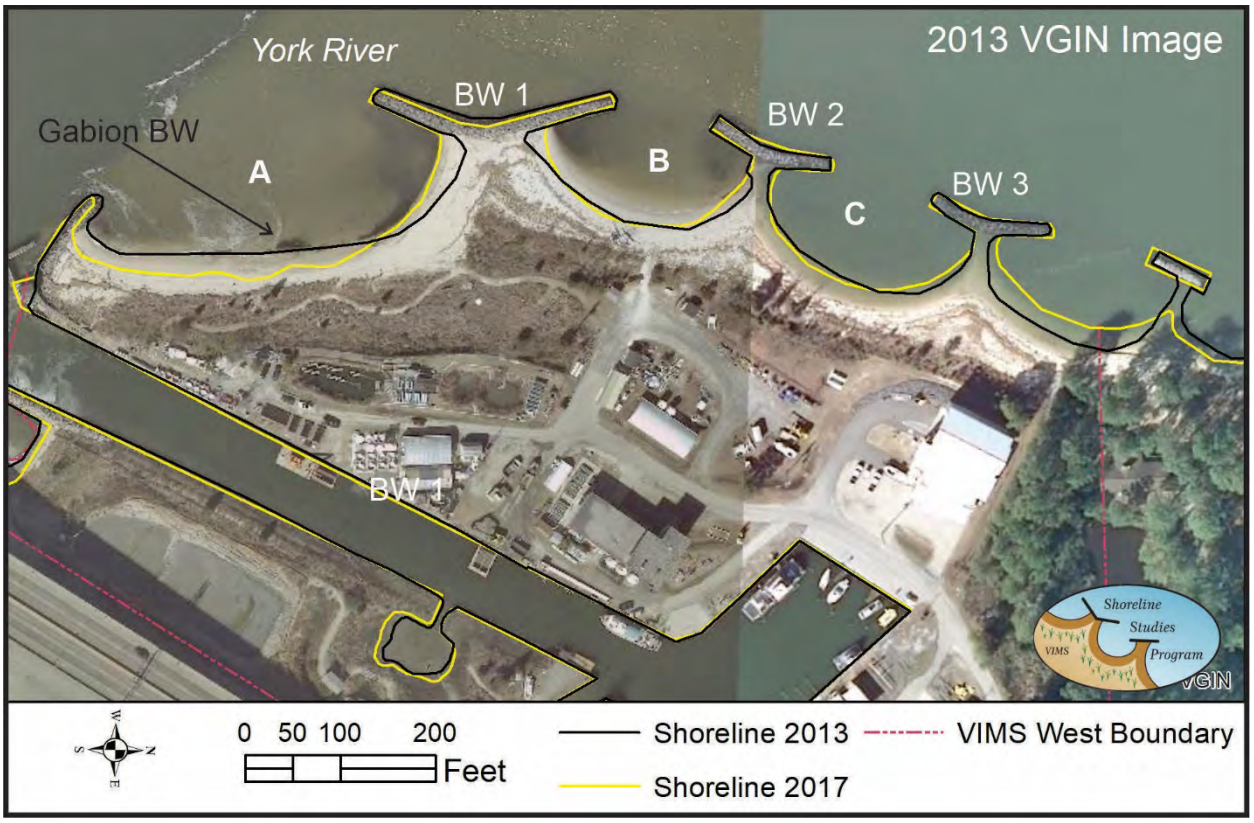

Figure 6-17. A 2013 VGIN photo showing the 2013 and 2017 digitized shorelines.

Figure 6-18. State of VIMS West in June 2020 about 9.5 years after construction. The structures are stable and the high and low marsh grasses are lush. SAV has colonized in the embayments. Photo credit: Shoreline Studies Program, VIMS.

Figure 6-19. Backshore vegetation is sparser at VIMS West although some shrubs have colonized the area after 9.5 years. Photo credit: Shoreline Studies Program, VIMS.