Hull Springs Farm, Westmoreland County

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

9.1 Site Background

Hull Springs Farm in located in Westmoreland County, Virginia and belongs to Longword University (Figure 9-1). It is located at the confluence of Glebe Creek and Aimes Creek, both tributaries to the Lower Machodoc Creek. Lower Machodoc feeds into the Potomac River. It occurs on a peninsula and is surrounded by water on three sides. The long-term rate of change between 1937 and 2017 is very low (<-1 ft/yr) along the eastern side of the peninsula and shows accretion due to the sill construction on the western end (Figure 9-2). In 1937 and 1969, a sand spit occurred at the mouth of Glebe Creek (Figure 9-3). This created a low fetch environment (about 0.5 miles) for Hull Springs Farm. Once the spit eroded, as shown by the 1994 shoreline, the fetch increased to 1.5 miles as the farm faces northeast directly out the mouth of Glebe Creek.

In 2006, the shoreline had an undercut high bank with an eroding base of bank and narrow fringe marsh adjacent to the farmhouse and 400-year-old historic oak tree (Figure 9-4). The bank decreases in elevation to the north and becomes a low bank with old concrete bulkhead (Figure 9-5). The end of the bulkhead is being flanked. This shoreline was part of the Lower Machodoc Shoreline Management Plan (Figure 9-6) created by Longwood University and the Northern Neck Planning Commission to provide guidance to homeowners on where living shorelines could be constructed. According to that document, the site qualified for an H-2 recommendation, marsh fringe with sill.

A conceptual design was created by Shoreline Studies Program (Figure 9-7) and typical cross-sections were drawn by Bayshore Design for the permit application (Figure 9-8 and 9-9). Two low sills were designed to protect the upland bank and create a marsh. The sill was designed to be higher and narrower on the ends at 2 ft wide and +2 ft MLW as shown by typical cross-sections AA and DD. In front of the existing concrete bulkhead, the sill is lower and wider (+1 ft MLW and 5 ft wide) as shown on section BB. The tide range at the site is 1.8 ft so the ends of the sill extend above MHW, but the middle of the sill is intertidal (Figure 9-8). Cobble was placed in the gaps to prevent sand salient formation as shown on typical section CC. The cobble extended from +3 ft MLW to 13 ft riverward of MLW (Figure 9-9).

Due to Tropical Storm Ernesto in 2006, the base of bank was significantly impacted, and the nature of the long-term erosion was dramatically revealed. The wave-cut bank scarp from the storm was 6 ft high and eroded 1 to 2 ft in some areas (Hardaway et al., 2017). It was evident that the proposed sill was not sufficient for immediate protection of the base of bank since continued erosion would threaten the old oak tree on top of the bank. The design was modified to include a stone revetment in the vicinity of, and adjacent to, the old oak to ensure that the historic tree on top of the bank was not impacted by bank erosion during storms (Figure 9-9).

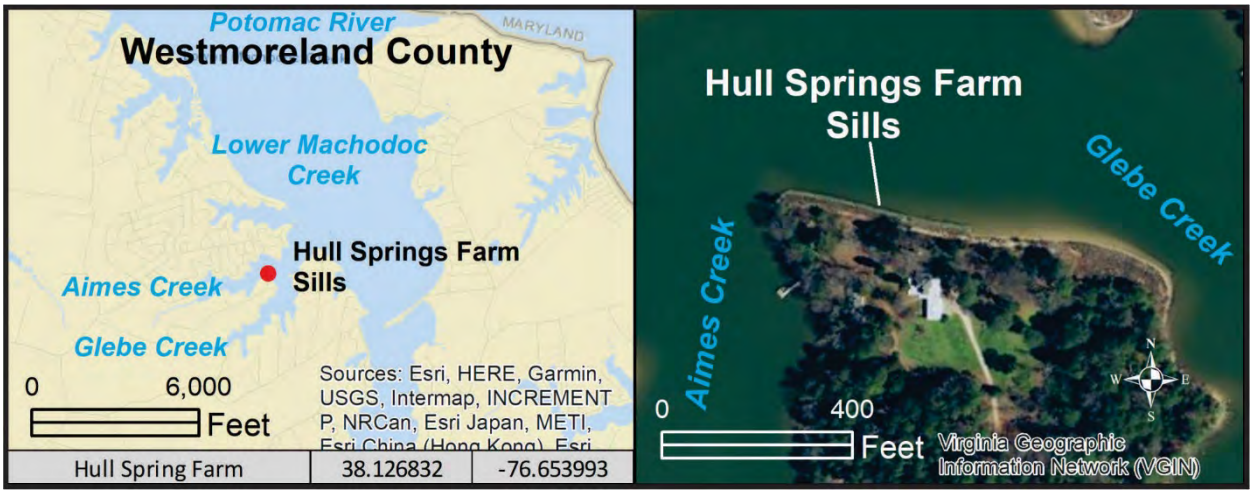

Figure 9-1. Location of Haven Beach living shoreline breakwater shore protection system.

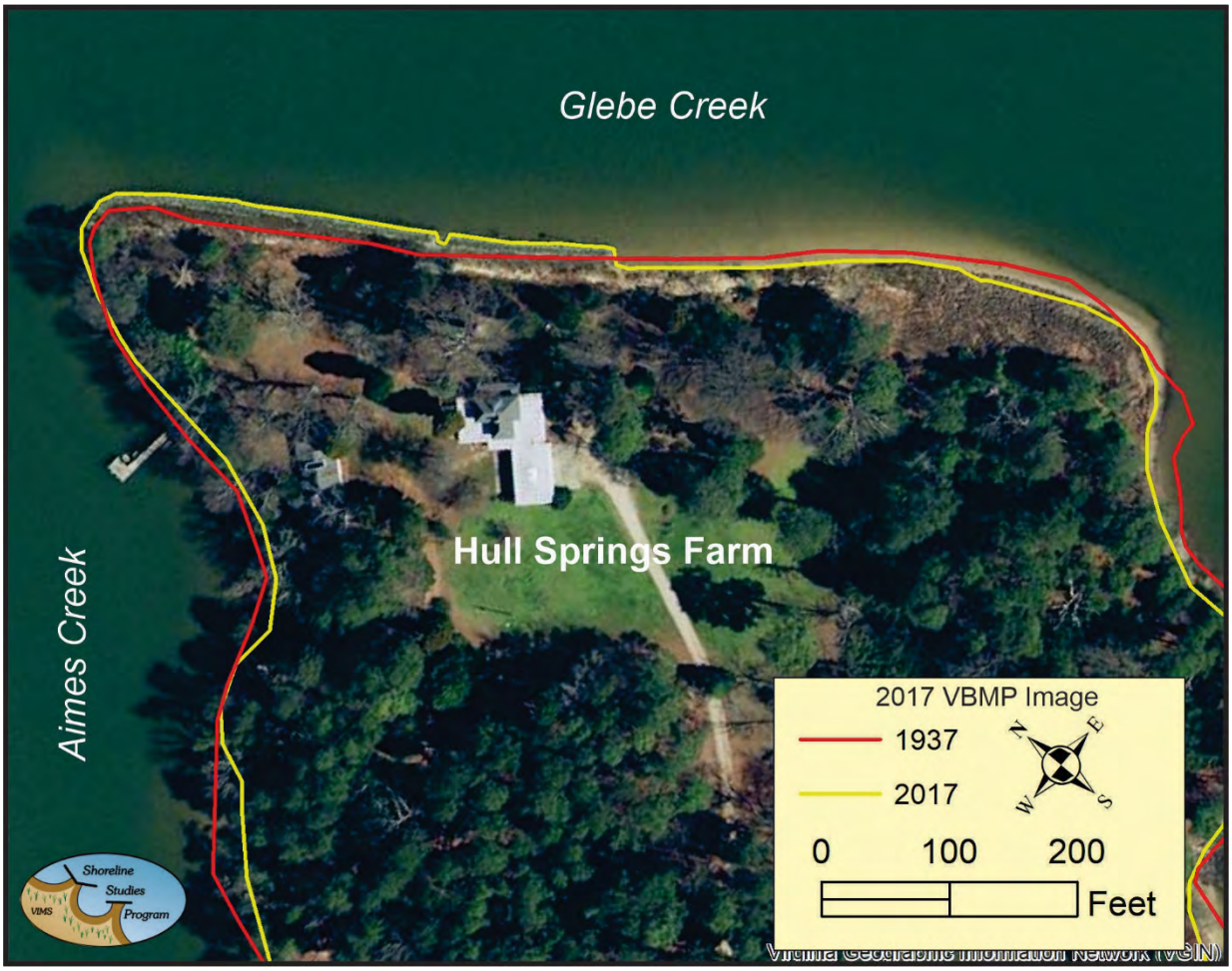

Figure 9-2. Shore change between 1937 and 2017 at Hull Springs Farm. Digitized shorelines from the SSP shoreline change database.

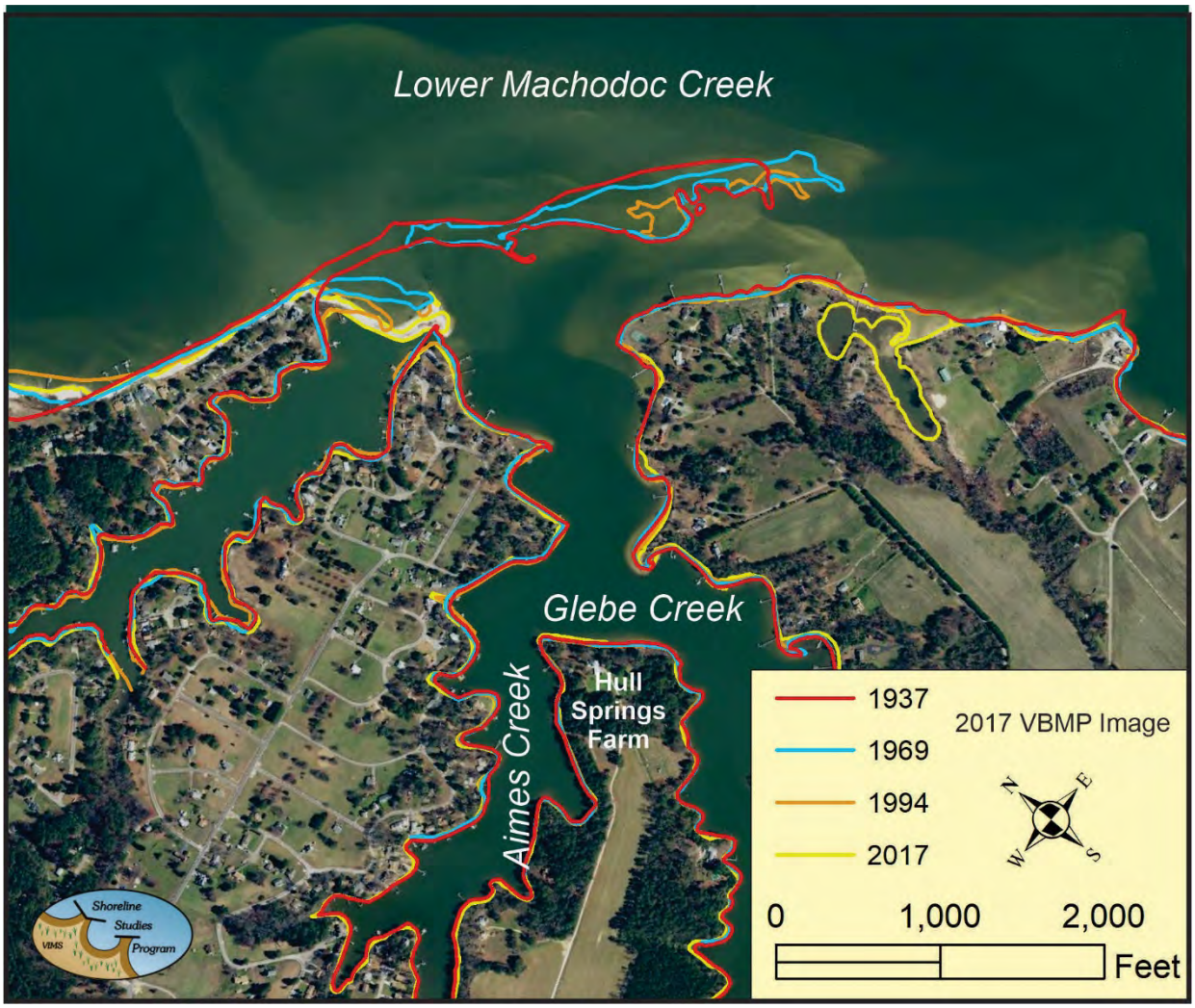

Figure 9-3. Digitized shorelines in 1937, 1969, 1994, and 2017 along the Lower Machodoc Creek and tributaries. The sand spit that occurred across the mouth of Glebe Creek in 1937 and 1969 had eroded away by 1994 increasing the fetch at Hull Springs Farm. Digitized shorelines from the SSP shoreline change database.

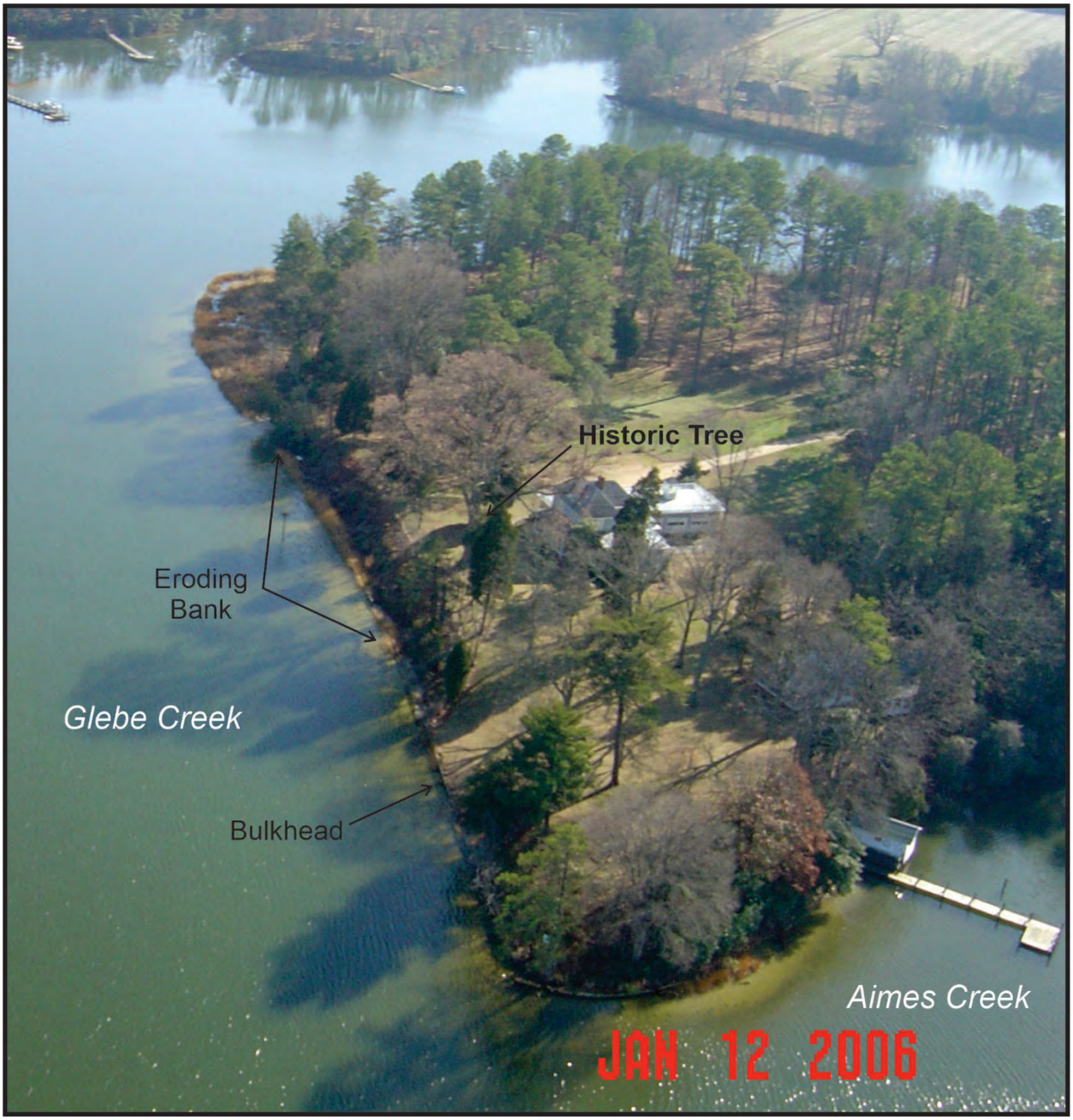

Figure 9-4. Aerial photo of the peninsula that Hull Springs Farm sits on. The shoreline has a high eroding bank and a failing bulkhead. The historic tree was a key part of the project design. Photo credit: Shoreline Studies Program, VIMS.

Figure 9-4. Ground photos of the Hull Springs Farm shoreline. Top: the western section of shoreline has a failing bulkhead; Bottom: Post Ernesto: the center section of the peninsula has an eroding base of bank and a fringe marsh. Photo credit: Shoreline Studies Program, VIMS.

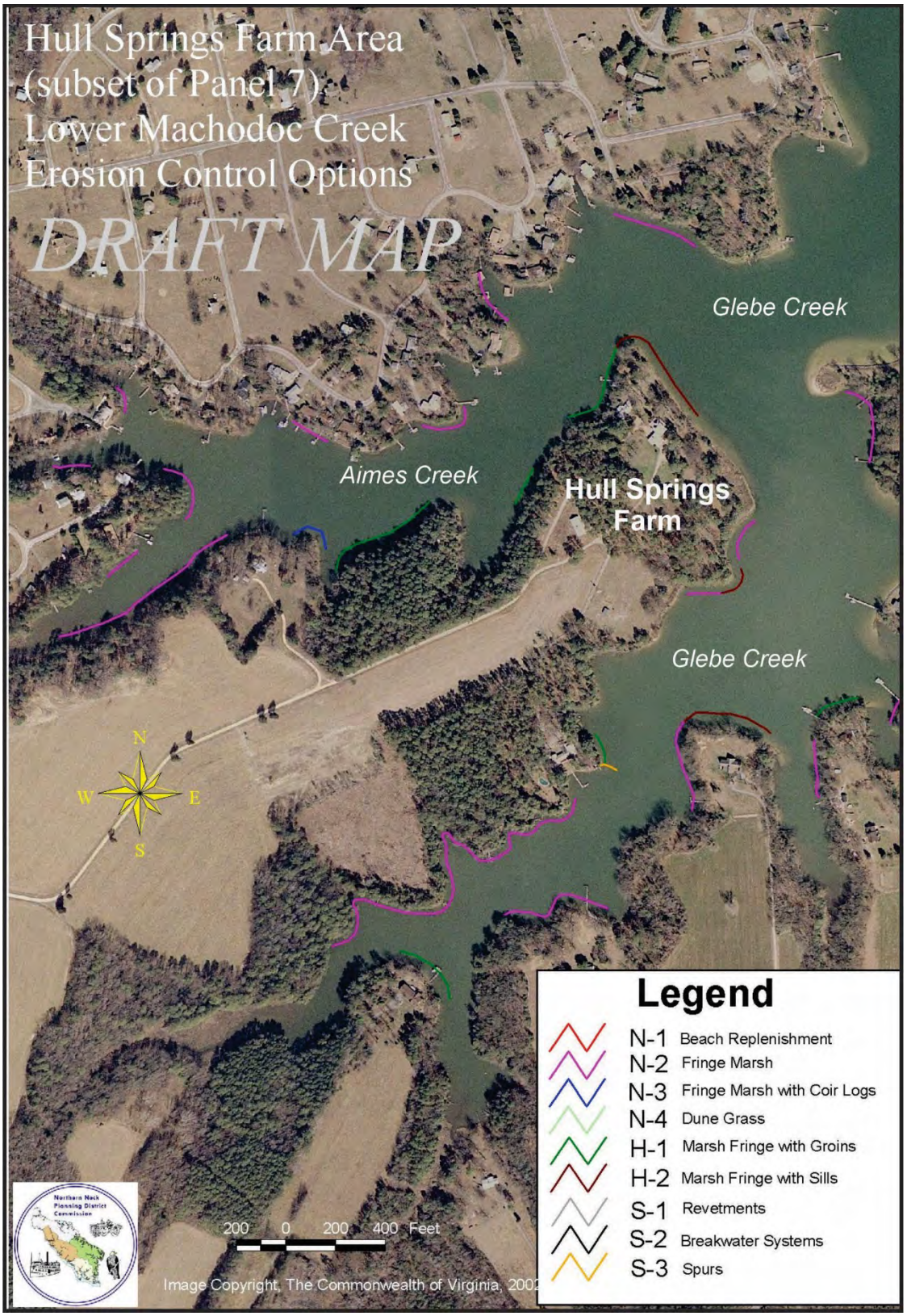

Figure 9-6. Lower Machodoc Creek Living Shoreline Management Plan created by the Northern Neck Planning District Commission.

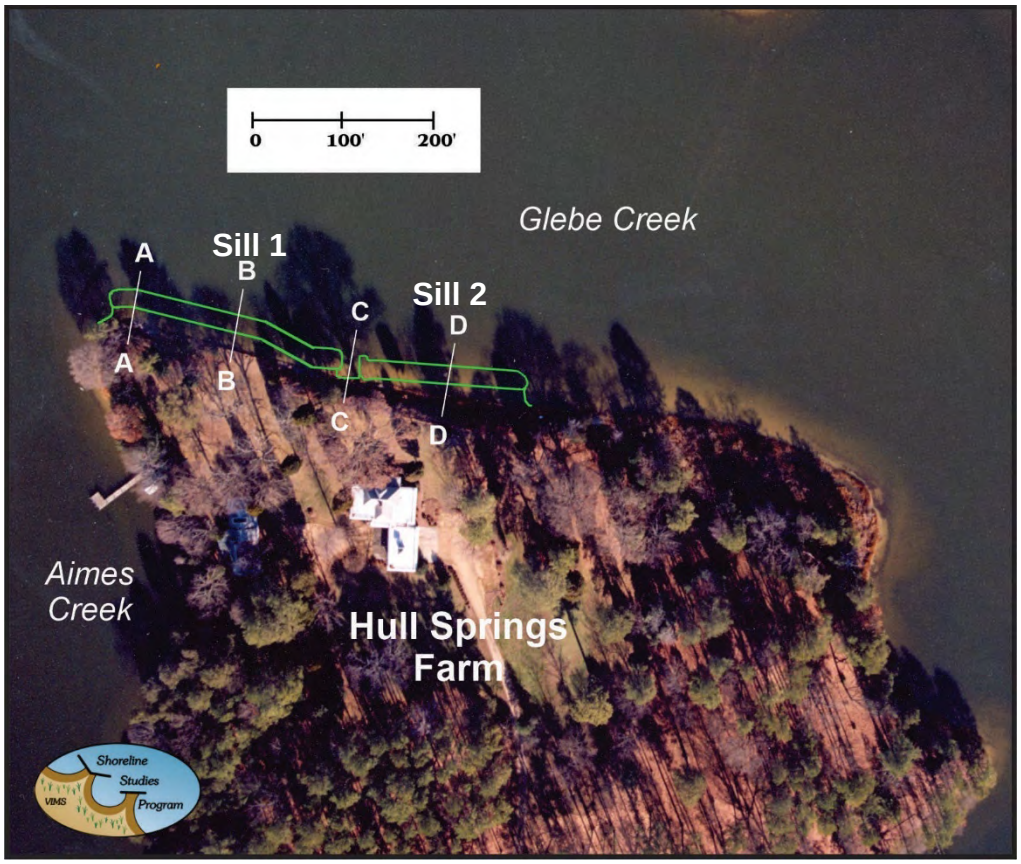

Figure 9-7. Conceptual plan for Hull Springs Farm shown in green and the location of the typical cross-sections used in the permit drawings.

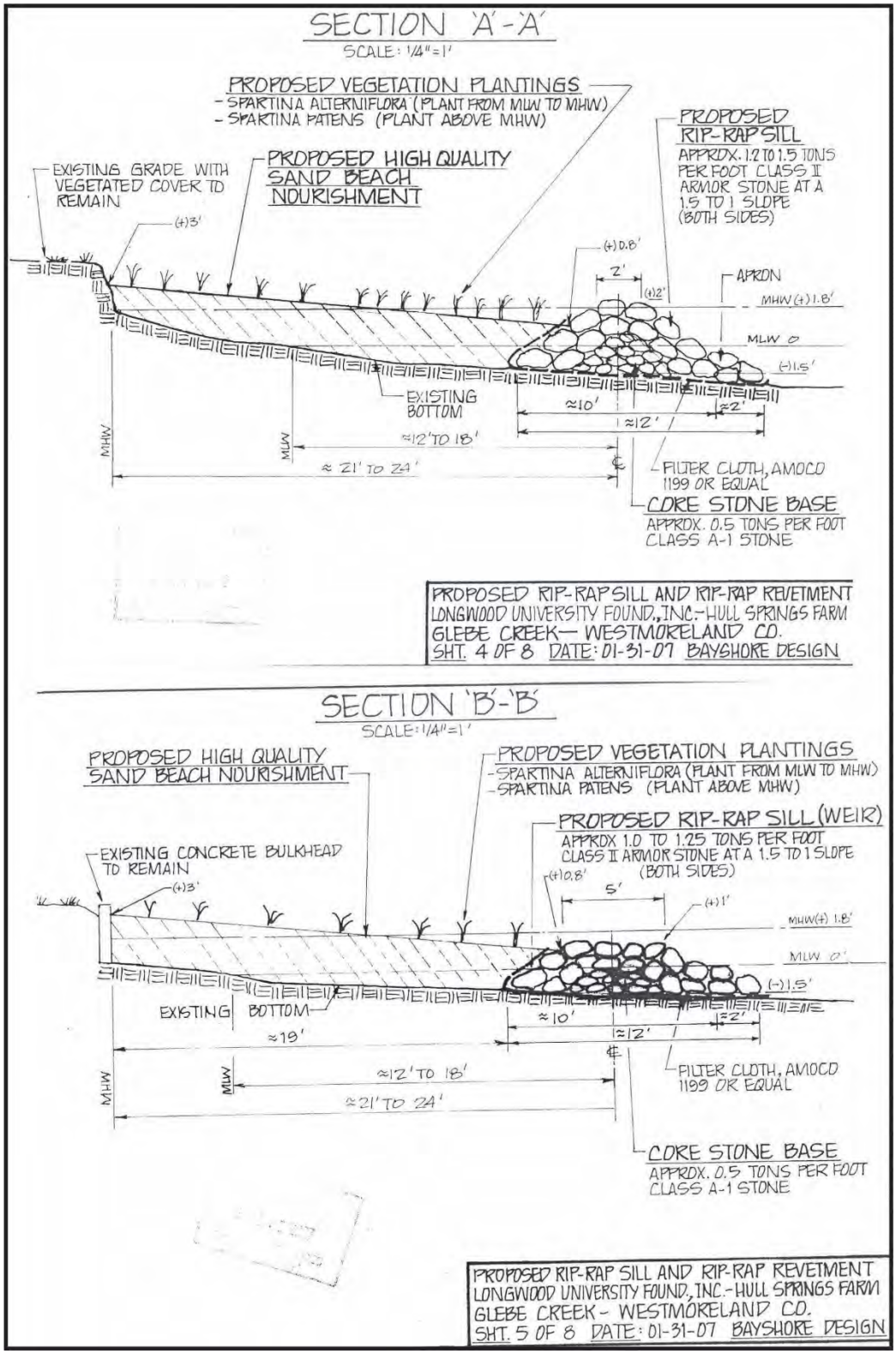

Figure 9-8. Typical cross-sections AA and BB for the living shoreline project at Hull Springs Farm. AA is the westernmost section. BB shows the sill along with the existing concrete bulkhead. Cross-sections courtesy of Bayshore Design.

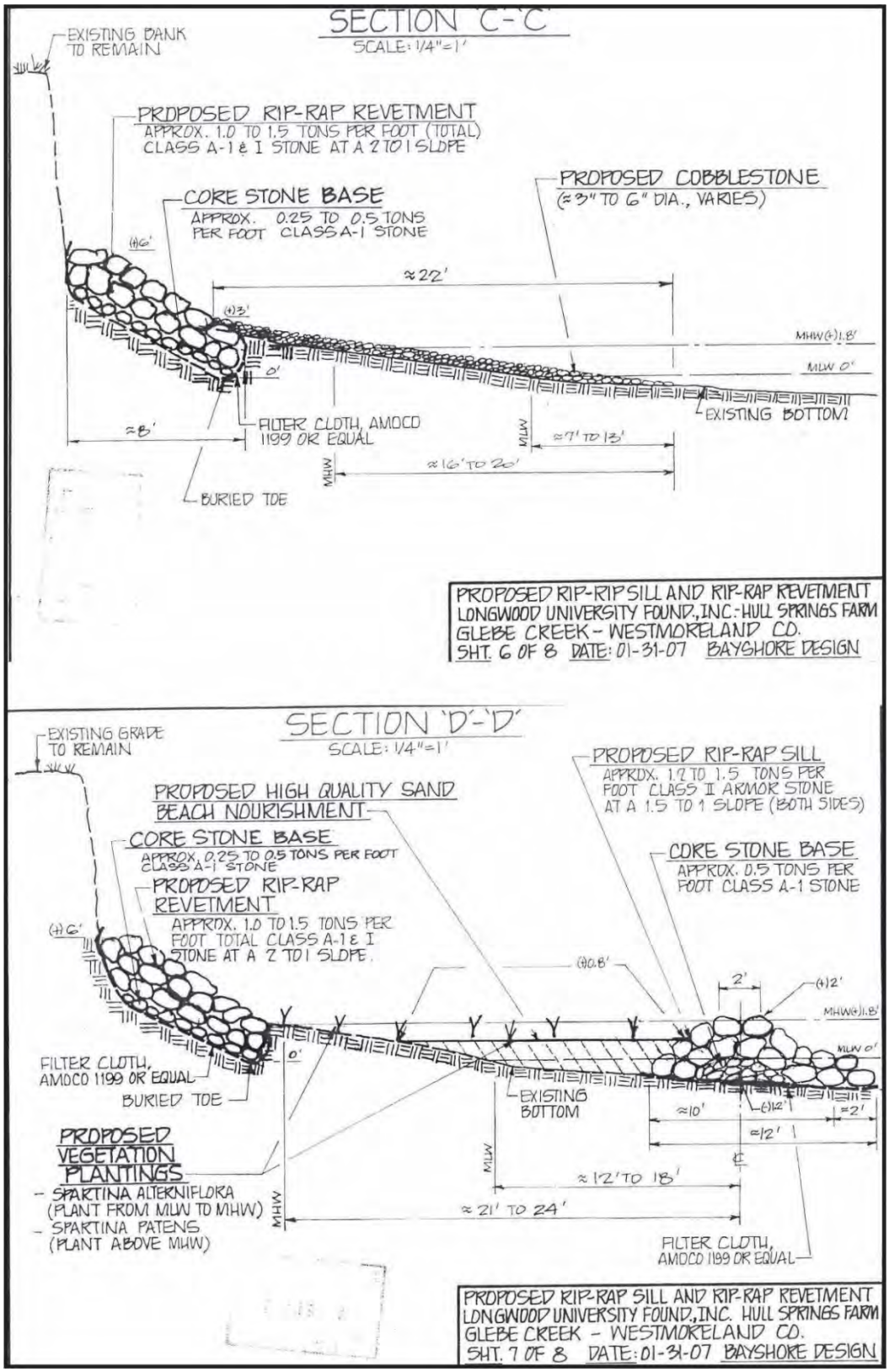

Figure 9-9. Typical cross-sections for the Hull Springs Farm Living Shoreline project. CC shows the cobble gap, and DD shows the revetment at the base of bank as well as the sill. Cross-sections courtesy of Bayshore Design.

9.2 Site Performance

The Hull Springs Farm sill was built in late summer 2008 along about 300 ft of shoreline. It was built as designed with the sill built in front (waterside) of the revetment (Figure 9-10). The existing concrete bulkhead remained, and sand was filled to almost the top. The trees on the bank were limbed but not cut down. Low marsh (*Spartina alterniflora*) and high marsh (*Spartina patens*) grasses were planted on a 1.5 ft x1.5 ft spacing after the sand had a chance to equilibrate for several tidal cycles.

After about six months, the low marsh was growing well, but the high marsh was not as lush (Figure 9-11). The site was performing as designed six years after installation in 2015 (Figure 9-12). The low marsh behind sill 2 was lush. The bank had slumped covering the revetment, but it also was vegetated which provides additional protection. This historic tree, which was estimated to have started growing in 1595 CE, was well protected from erosion. The high marsh did not grow as well as the low marsh (Figure 9-13). Though scrub/shrub were starting to grow at the higher elevations, the *Spartina patens* that were planted were relatively sparse. This is likely due to overhanging trees that were beginning to shade the high marsh. At this point in time, no *Phragmites* occurred at the site.

The shoreline was surveyed on 19 November 2020 (Figure 9-14). No previous data could be located. The cross-sections are shown, and the revetment is highlighted in teal on the map. Generally, the position of MHW is closer to the base of the upland bank and MLW is on the sill structures. Figures 9-15 and 9-16 show the cross-sections of the profile data. Profiles 98 and 181 cross Sill 1. The bank height ranges from 11-13 ft MLW. The sill was built to design with a crest elevation of about +1.8 ft MLW (Figure 9-15). Profile 259 crosses the shore through the cobble gap (Figure 9-16). The base of the revetment is at about +2 ft MLW. The bank is at about +16 ft MLW behind Sill 2.

Twelve years after installation, the sill structure remains intact (Figure 9-17). In addition, the low marsh has nearly 100% coverage behind sill 1. The upper limit of *S. alterniflora* was measured at about +1.5 ft MLW. Two other marsh species have colonized into the site, black needle rush (*Juncus roemerianus*) and three-square bulrush (*Schoenoplectus pungens*). The upper limit of black needle rush was measured at +1.6 ft MLW. Tide range is 1.8 ft MLW. The high marsh has more vegetation than in previous years behind sill 1, but bare spots occur. The scrub/shrub has grown into the backshore in this area. The cobble gap is vegetation free and allows access to the water (Figure 9-18). However, with time, the invasion of *Phragmites* along parts of Sill 1 and Sill 2 forced the Longwood University to initiate an eradication program which killed much of the healthy marsh grass too (Figure 9-19). The backshore is bare in areas as the native vegetation tries to recolonize those areas. Still, most of the marsh away from this area is intact.

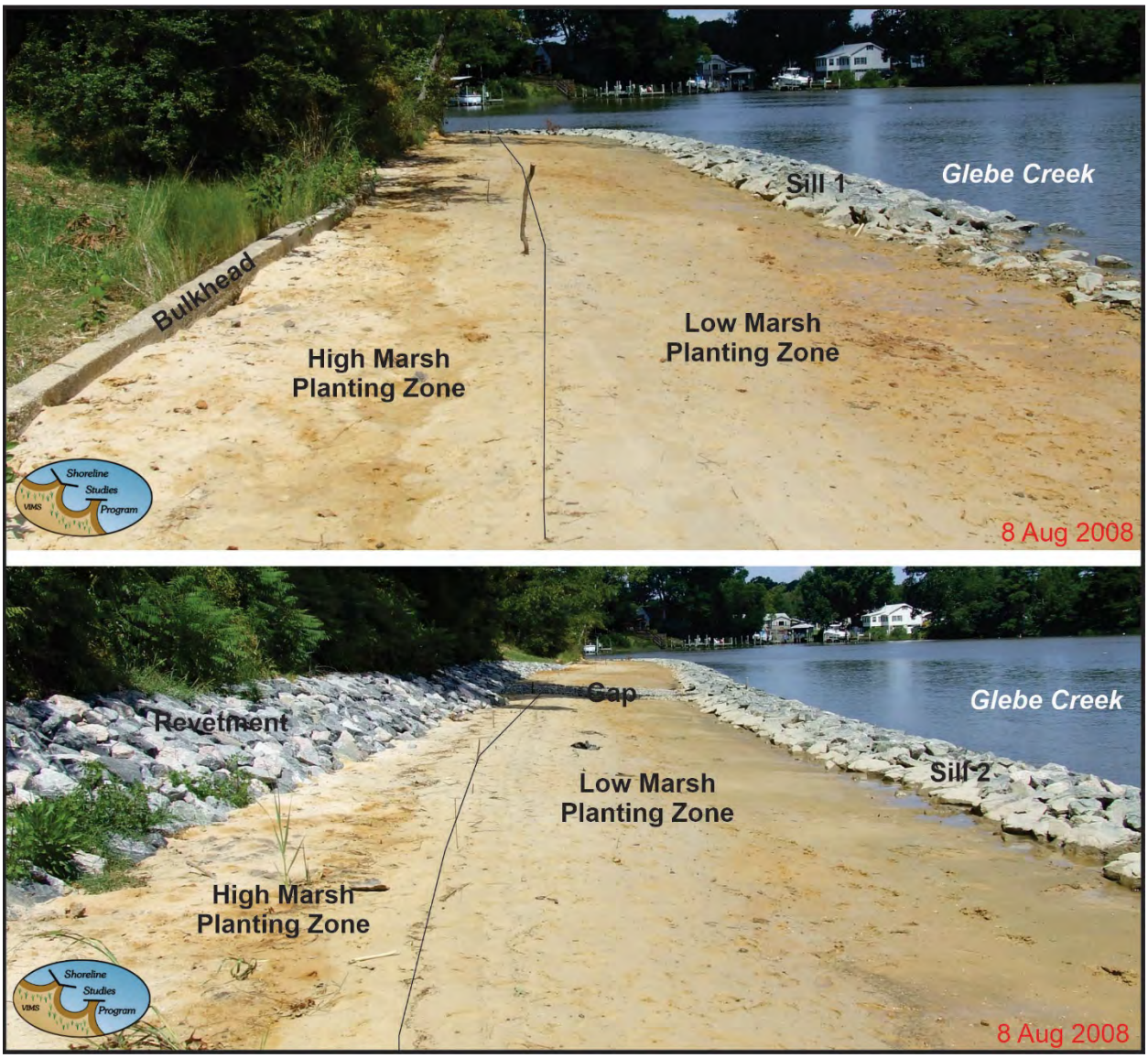

Figure 9-10. Post construction ground photos showing the low and high marsh planting zones. The marsh was planted soon after.

Figure 9-11. Hull Springs Farm living shoreline after about 1 year. The elements were constructed as designed, and the low marsh has filled in well. Photo credit: Shoreline Studies Program, VIMS.

Figure 9-12. Hull Springs Farm about 6 years after construction. Top: Sill 2 has lush low marsh behind the structure, but the high marsh is not as vegetated. Bottom: The bank has slumped over the revetment. The sediment is vegetated which adds additional stability to the bank to protect the historic tree. Photo credit: Shoreline Studies Program, VIMS.

Figure 9-13. Hull Springs Farm about 6 years after construction. Top: The backshore where the upper marsh should be does not have as much grass vegetation as the low marsh. Bottom: The low marsh is doing well behind sill 1. Photo credit: Shoreline Studies Program, VIMS.

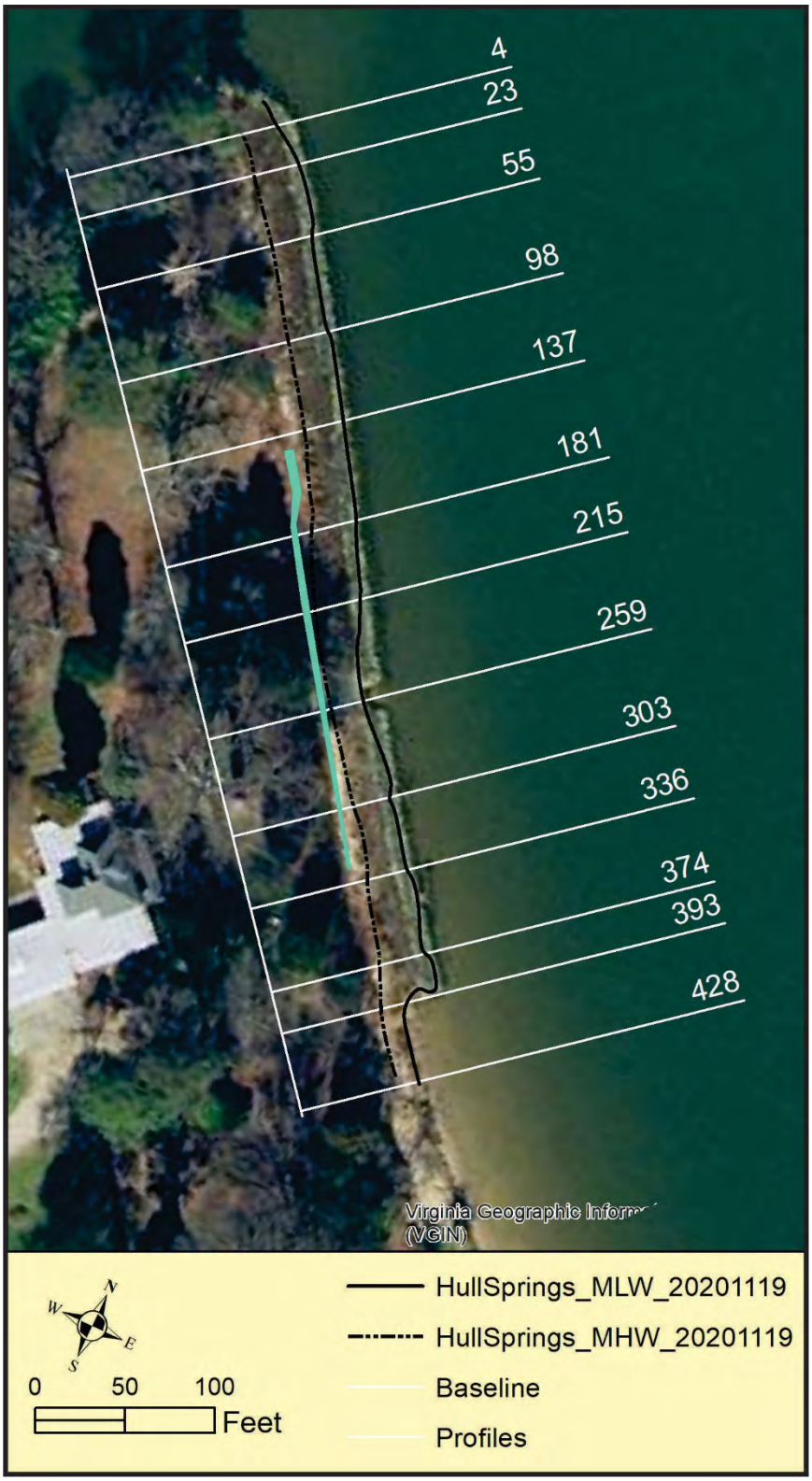

Figure 9-14. The position of MHW and MLW from the 2020 survey. Also shown are the profile cross-section locations. The location of the revetment is highlighted in green.

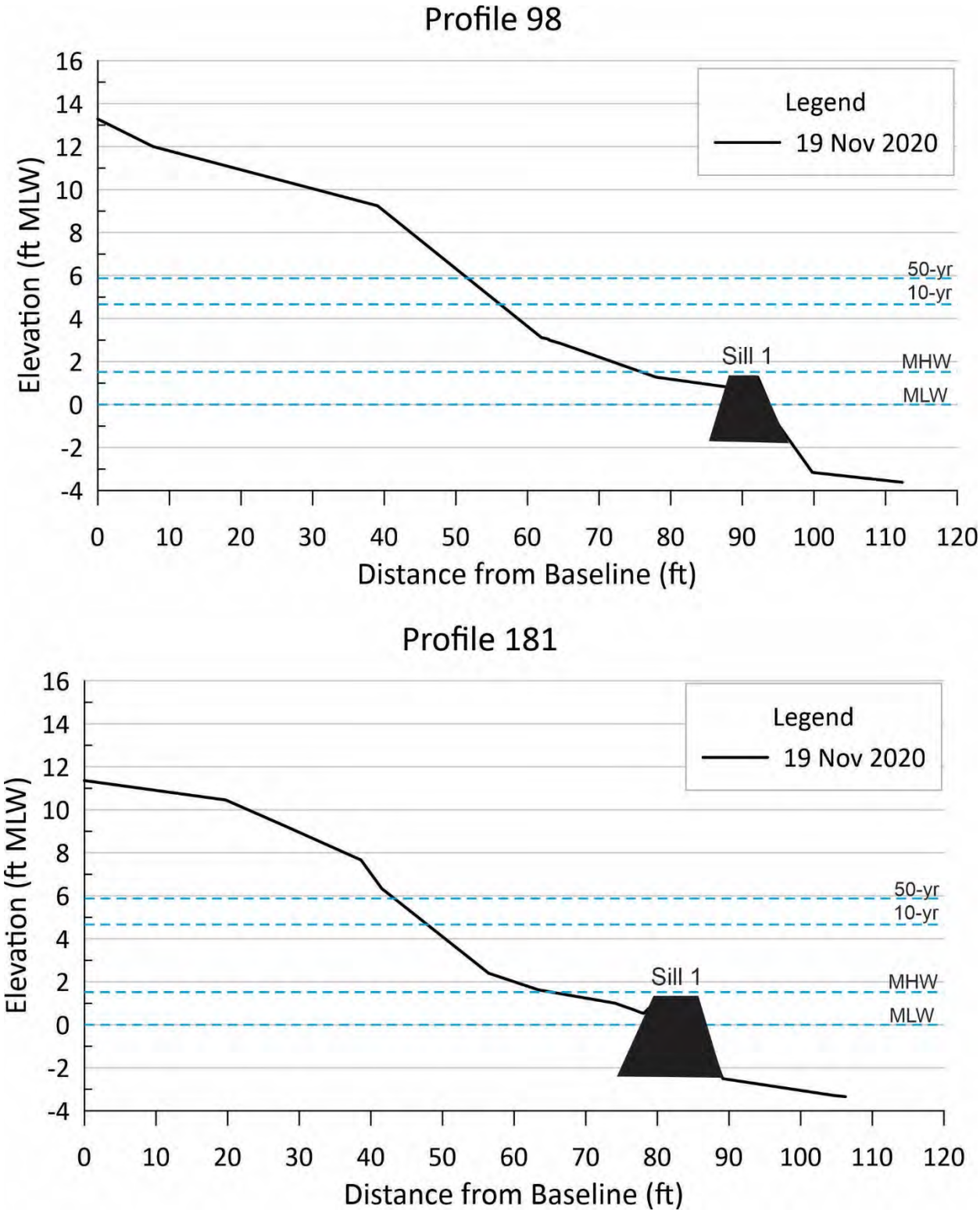

Figure 9-15. Profile cross-sections from Hull Springs Farm taken on 19 November 2020. Profiles 98 and 181 cross Sill 1.

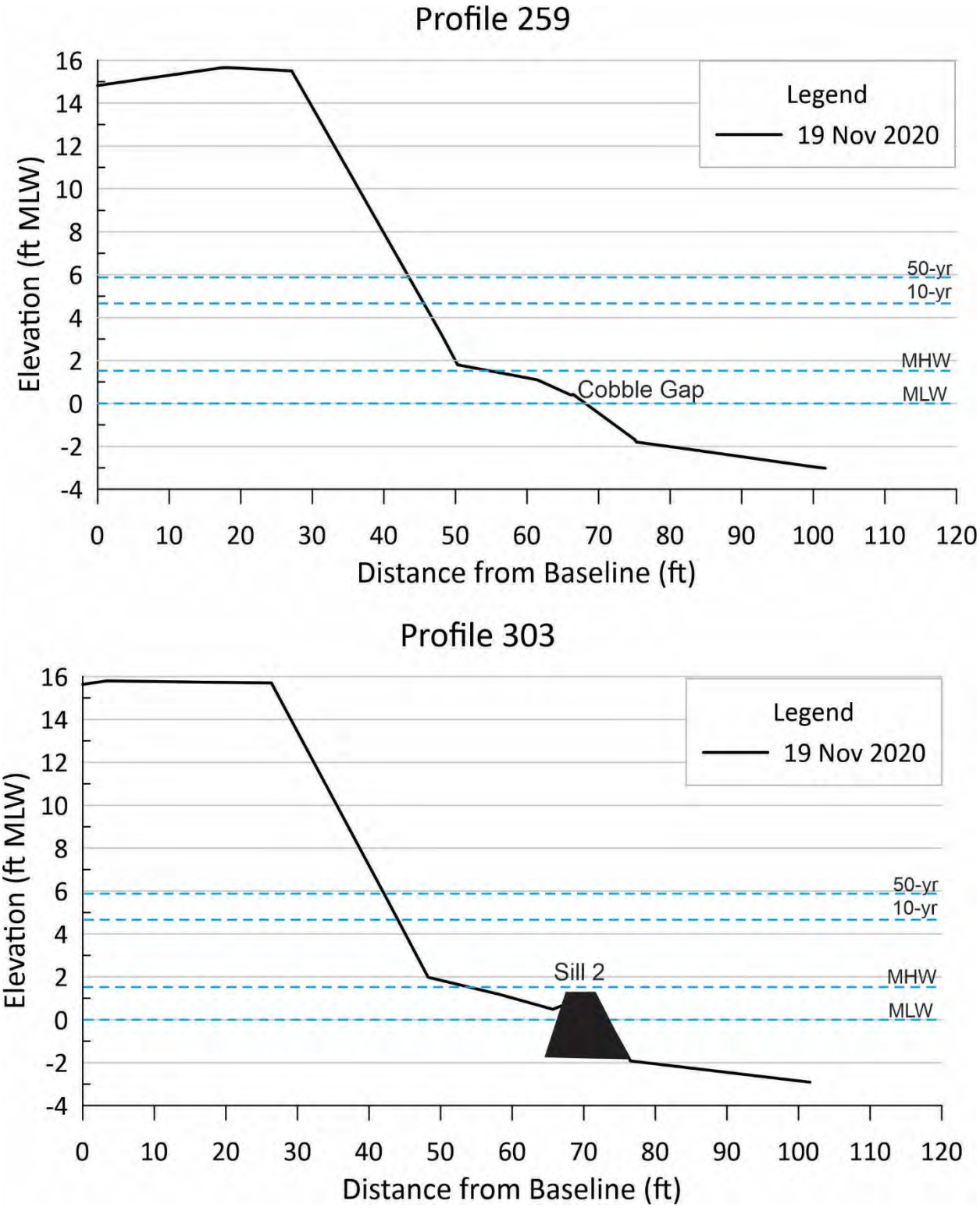

Figure 9-16. Profile cross-sections from Hull Springs Farm taken on 19 November 2020. Profile 259 crosses the cobble gap between Sills 1 and 2 and Profile 303 crosses Sill 2.

Figure 9-17. Ground photos of the site after 12 years showing the low marsh and high marsh areas of the sill. Photo credit: VIMS, Shoreline Studies Program.

Figure 9-18. Ground photo of the site showing the cobble sill gap. Photo credit: VIMS, Shoreline Studies Program.

Figure 9-19. Bare spots behind the sill where *Phragmites* was eradicated and native grasses have not grown back yet. Photo credit: VIMS, Shoreline Studies Program.