

**Debidue Beach
Year 3 Annual Survey**

**2025
MONITORING REPORT**



Prepared for
DeBordieu Colony Community Association
Georgetown, South Carolina

COASTAL SCIENCE & ENGINEERING



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2025 YEAR 3 ANNUAL BEACH SURVEY DEBIDUE BEACH, GEORGETOWN COUNTY (SC)

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[CSE 2566]
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1.0 INTRODUCTION

This report is prepared following the successful completion of a beach restoration and groin construction project at Debidue Beach. The project was sponsored by The DeBordieu Colony Community Association (DCCA) and was completed between January and July 2022. Nourishment included the placement of 718,246 cubic yards (cy) of sand over ~8,500 linear feet (lf) of beach between Station 100+00 (north end of ‘Hobcaw Tract’) and Station 185+00 (north boundary of DeBordieu Colony). Two ~300-foot (ft) long groins and one ~400 ft groin were installed along the southern ~2,000 lf of DeBordieu Colony. The sand was excavated by cutterhead dredge from a borrow area located approximately two (2) miles offshore due southeast (SE) of DeBordieu Colony.

Project permits require certain monitoring efforts to evaluate project performance and impacts. This includes beach surveys to determine the rates of shoreline accretion and erosion along the entire length of Debidue Beach, aerial photography, and environmental monitoring. Permits also require specific evaluation of erosion rates along the area south of the newly constructed groins.

The present agreement between Coastal Science & Engineering (CSE) and the DCCA calls for monitoring surveys encompassing the project permit requirements for the first three years following construction (Fig 1.1). Annual technical reports summarizing the prior year’s monitoring efforts will be assembled and submitted to the community and regulatory agencies. This report outlines the findings of the Year 3 post-project survey.

	90 Days Before Project	Post-project within 30 Days	Post-project After 3 Months	Post-project After 6 Months	Post-project After 9 Months	Year 1 Post-project	Year 2 Post-project	Year 3 Post-project	Year 4 Post-project	Year 5 Post-project	Year 6 Post-project	Year 7 Post-project	Year 8 Post-project	Year 9 Post-project	Year 10 Post-project	After Major Events
Beach Profile	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	
Post-storm Surveys																X
Bathymetric Surveys of the Borrow Area	X	X				X		X			X					
Beach Sediment Samples	X	X														
Borrow Area Surficial Sediment	X	X				X		X			X					
Aerial Photographs	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	
Compaction of the Renourished Beach		X				X*	X*	X*								
Escarpment Formation Along the Renourished Beach		X				X*	X*	X*								
Lighting Surveys (2)						X										

*30 days prior to May 1 for three subsequent years

FIGURE 1.1. Summary of pre- and post-construction physical monitoring required under the permits for the 2022 DeBordieu Beach Nourishment and Groin Construction Project. Pre- and immediate post-project data collection have been completed (green). Items in red and black will be completed at the designated time after project construction.

This report includes the following:

- Summary of the project setting, purpose, and project description
- Summary of historical beach processes and rationale for the project
- Summary of surveys and as-built conditions
- Summary of sediment analysis
- Summary of regulatory compliance measures
- Project photos
- Maintenance recommendations

1.1 Project At-a-Glance

Nourishment

Design quantity of 650,000 cubic yards (cy) placed over 8,500 linear feet (lf) of beach between February and May 2022:

Placement Quantity

718,246 cy — Includes extra (non-pay) sand provided by Marinex to maintain a construction pad around the groins during construction.

Nourishment Cost

\$11,215,000 — Includes \$2,500,000 for mobilization and demobilization and an average of \$13.41 per cubic yard for 650,000 cy, and a change order decrease of \$60,000 due to delayed start of construction (offsets the groin change order).

Groin Construction

- Three (3) new composite sheet pile groins (Groin #1 – 300 ft long; Groin #2 – 400 ft long, Groin #3 – 300 ft long)
- 5,000 tons of armor stone
- 14,200 square feet of marine mattress
- 1,000 lf pre-cast concrete caps (10 ft x 2.6 ft x 1.0 ft)
- 1,000 lf of composite (CMI UC-95) sheet pile
- Completed between January and July 2022

Groin Cost — \$2,735,000 (including a \$60,000 change order for delays in starting nourishment)

Total Project Cost — \$13,950,000 (lump sum - fixed price)

2.0 SETTING, CAUSE OF EROSION, AND PRIOR PROJECTS

DeBordieu Colony comprises ~8,000 lf of shoreline in the center of the 5-mile-long Debidue Beach between Pawleys Inlet and North Inlet. The beach and inlets have been studied in detail since the 1970s (eg – Finley 1975; Williams and Gresham 1976; Kana 1977; Nummedal and Humphries 1978; Zarillo Ward, and Hayes 1985; CSE 1989; CSE Baird 1996; ATM 2008; CSE 2015; CSE 2017a).

2.1 Causes and Rates of Erosion

Prior studies have proved that the Debidue Island shoreline is generally stable at the north end and highly erosional at the south end. This relates to the fact that North Inlet and associated inlets dating to the 1700s have left a broad bulge in the shoreline from the south half of DeBordieu Colony to the neck of Debidue Spit (south end of the Hobcaw Tract). Erosion rates along north DeBordieu Colony are negligible, whereas shoreline recession at the south end of the community has exceeded 10 ft/yr for nearly a century (Kana et al 1985). Historical changes at the south end of Debidue Island and North Inlet are illustrated in Figures 2.1 and 2.2.

Debidue Beach is broadly ‘S-shaped,’ as illustrated in Figure 2.3, because prior inlets from the 1800s and early 1900s left large deposits of sand offshore. In fact, the shoreline grew seaward through the early 20th Century (Fig 2.1). These relict deltas produced the initial bulge in the shoreline, but once the inlets closed or migrated to present-day North Inlet, the ‘salient’ in the shoreline became a focus of wave attack. For the past 80 years, Debidue Beach has been reshaping toward a more stable equilibrium form—the arcuate ‘C-shape’ that characterizes stable coasts like the Grand Strand. Stable shorelines tend to be bounded at the ends by rocky headlands, stabilized inlets, or natural inlets that remain positionally stable (Kana 2011). Until a broad arcuate shape ensues (Silvester and Hsu 1993), portions of Debidue Beach will remain unstable and erosional.

Shorelines recede when there is a loss of volume in the beach zone. Sand enters the Debidue Island littoral system at Pawleys Inlet and leaves the Island at North Inlet. A study by CSE-Baird (1996) showed that the island lost 2.5 million cy between 1939 and 1992 (~50,000 cy/yr). Nearly all this loss occurred along Baruch Foundation property at the island's south end. DeBordieu Colony's erosion problem largely stems from sand losses along Hobcaw, which draw off DeBordieu Beach sand. In this context, the DCCA has sought solutions for maintaining the beach and addressing the cause of the problem. As early as 1970, groins were installed along the Hobcaw Tract by the original DeBordieu Colony developer in coordination with the Baruch Foundation to slow the loss of sand to North Inlet. In hindsight, the concept was sound, but the timber groins were poorly designed and not maintained (see CSE 2015 for discussion). Other beach maintenance and shore protection measures were implemented following the failure of the Hobcaw groins.

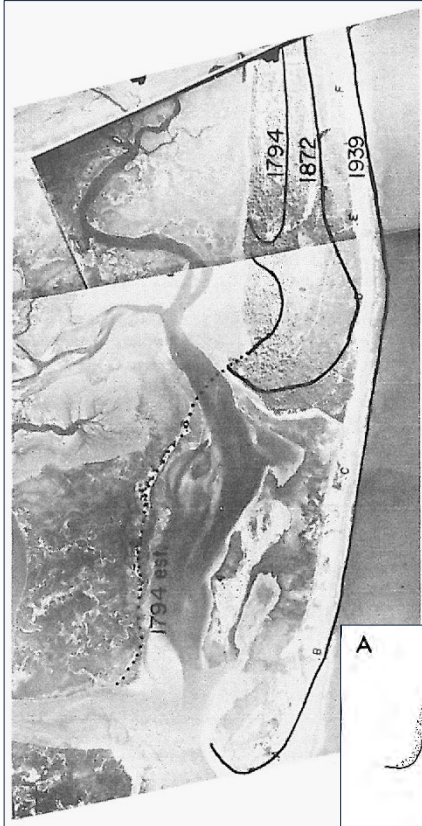
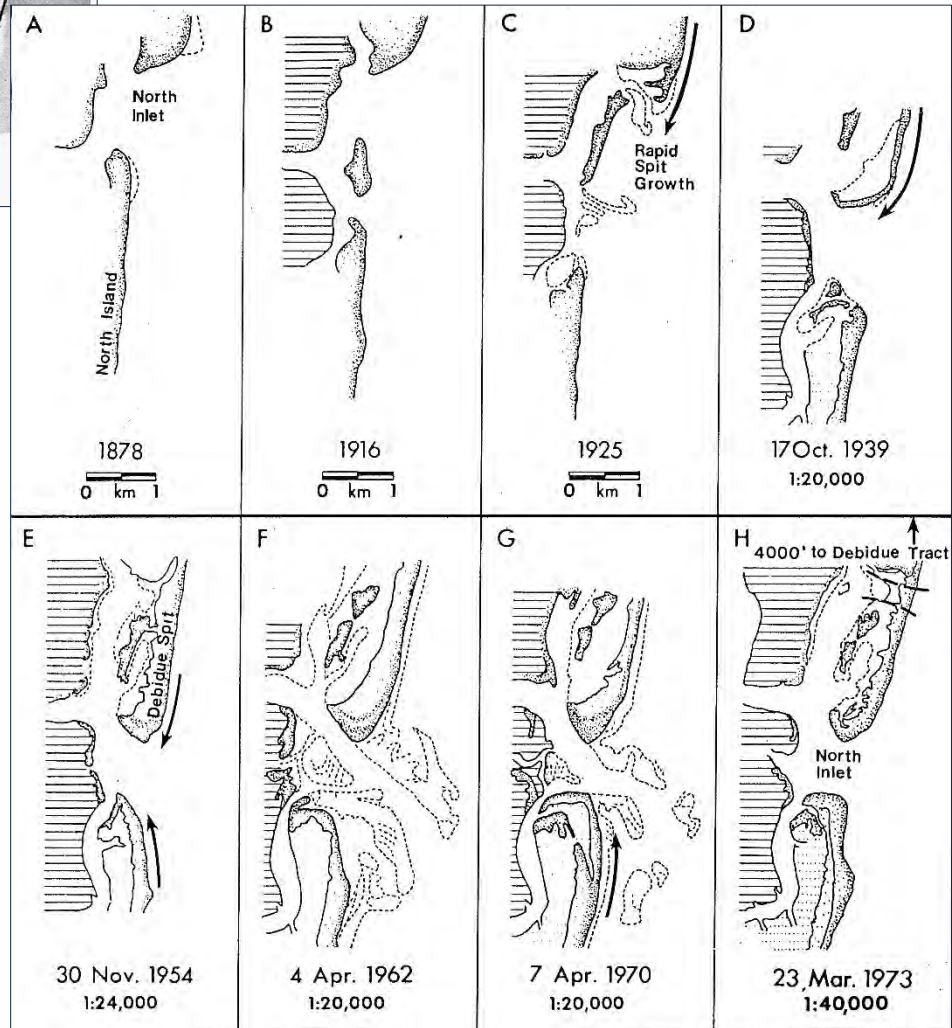
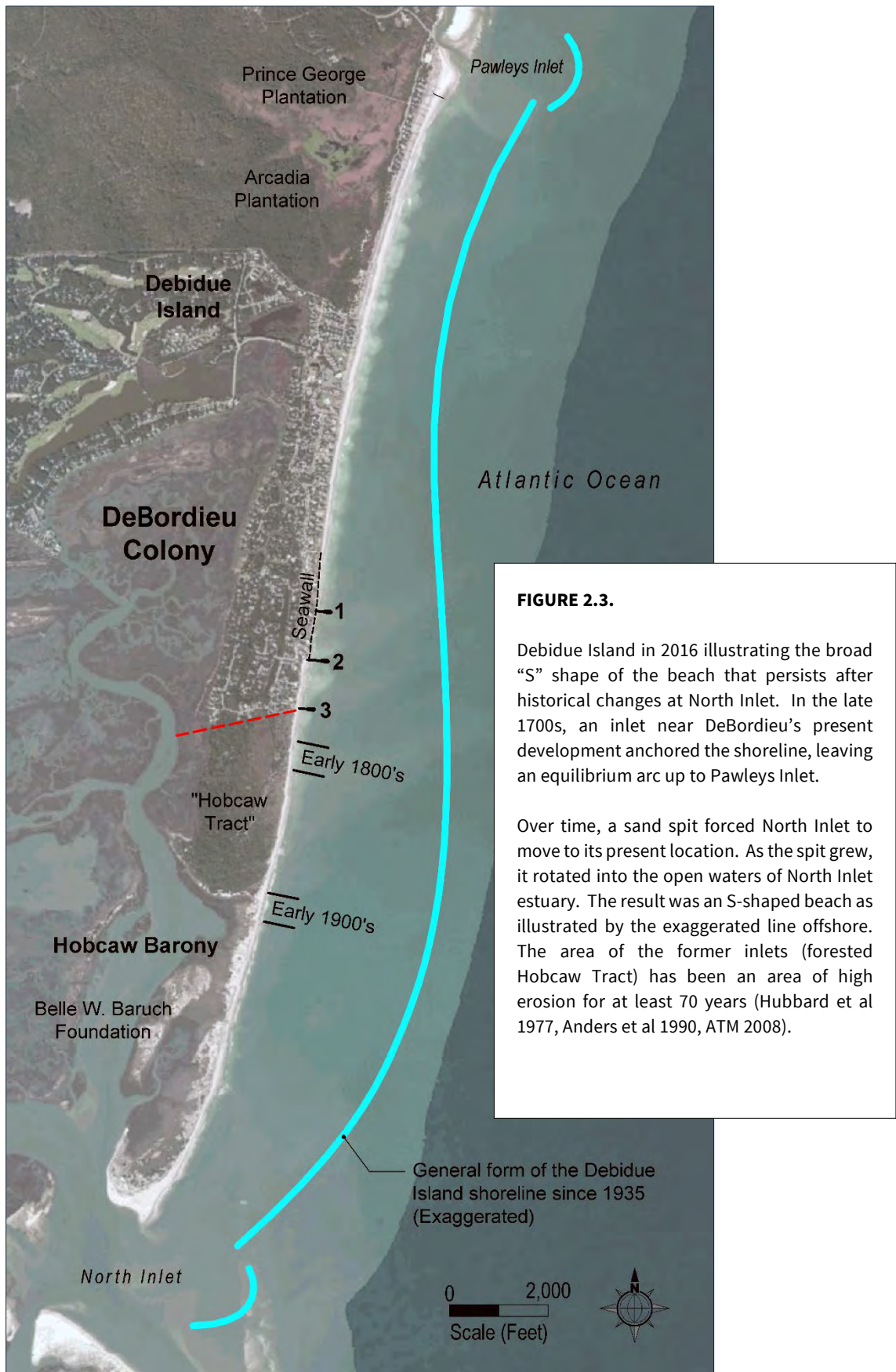


FIGURE 2.1 (left). Historical aerial image (1975) of south Debidue Beach showing approximate locations of earlier shorelines and inlets along the Hobcaw Tract. From the mid-1800s to the 1930s, the south end of Debidue Beach built seaward. [Source: Williams & Gresham 1976]

FIGURE 2.2 (below). Historical changes at North Inlet between 1878 (probably 1872) and 1973 showing the most rapid growth of Debidue Spit occurred between 1925 and 1939. The “Debidue Tract” (ie - DeBordieu Colony) begins ~4,000 ft north of the inlet’s northernmost position. Dashed lines on sketch map “H” show the approximate Hurricane *Hugo* breach point at the southern limit of maritime forest where the spit is narrow. [Adapted from Zarillo et al 1985]





2.2 Prior Shore Protection Measures

The DeBordieu Colony community has implemented various shore protection measures along the oceanfront since the early 1970s (Table 2.1). CSE (2023) provides a detailed history of prior nourishment efforts at DeBordieu Colony. Including the 2022 project, DCCA has added over 2,300,000 cy of sand to the beach at a cost of ~\$28,000,000 (unadjusted dollars).

TABLE 2.1. Shore protection measures along Debidue Beach: 1970 to 2015. [Sources: CSE (1989, 1995), ATM (2008), DCCA files] *Includes various adjustments/credits under each contract but not certain soft costs budgeted by DCCA.

SHORE PROTECTION MEASURES ALONG DEBIDUE BEACH (SC) 1970–2025	
Year	Work Performed
~ 1970	Construction of two groins along Hobcaw ~2,500–3,100 ft south of DeBordieu.
~1975–1980	Almost yearly sand scraping of the beach to rebuild the foredune at the south end.
1981	Construction of a ~4,500-ft-long timber bulkhead to retain sand and protect houses at the south end; terminates 1,000 ft north of the DeBordieu/Hobcaw property line.
~1986	Artificial dune and ‘20-year’ setback for houses in the ~1,000-ft beach segment south of the bulkhead (‘Ocean Green’).
~1989	Reconstruction of ~800–1,000 ft of bulkhead at the south end after Hurricane <i>Hugo</i> .
1990	DeBordieu’s first beach nourishment project using inland (community) sand and placement by trucks — 191,693 cy @ (~)\$862,600.
1998	DeBordieu’s second beach nourishment project using inland (community) sand and placement by trucks — 262,386 cy @ (~)\$950,000.
2006	DeBordieu’s third beach nourishment project using offshore sand and placement by dredge — 588,633 cy @ (~)\$5,590,431.*
2015	DeBordieu’s fourth beach nourishment project using offshore sand and placement by dredge — 648,318 cy @ (~)\$9,500,000.*
2022	DeBordieu’s fifth beach nourishment project using offshore sand and placement by dredge –650,000 cy @ \$11,215,000 and installation of 3 groins @ \$2,735,000.

[*The term “seawall” or wall may be substituted for bulkhead in other parts of this report in recognition of common usage within the community.]

3.0 PERMITTING, BIDS, AND IMPLEMENTATION

The DeBordieu nourishment and groin construction project was completed under Federal and State Permit No. SAC 2017-01795. The project involved the installation of three groins (#1, #2, #3 from north to south) at the southern end of DeBordieu Colony ~2 miles from North Inlet (see Fig 3.1). Groin #1 and Groin #3 were ~300 ft long, and Groin #2 extended ~400 ft long with groin spacing of ~1,000 ft. Groin construction followed beach nourishment by dredge using an offshore borrow area situated ~2 miles due east of North Inlet. The total nourishment volume contracted was ~650,000 cy.

Each groin was a sheet-pile-type structure with precast concrete caps (Fig 3.2). The groins incorporated armor stone scour protection around the head and 60–80 ft along the trunk. Armor stone extended out to 25 ft from the groin cap and was placed on gabion geotextile mattresses, leaving the stone crest elevation close to the cap elevation. Groin #3 incorporated additional scour protection extending ~220 ft along the downcoast side of the trunk to reduce wave reflection toward the Hobcaw Tract upon exposure of the structure.

The basic groin design was similar to new groins constructed at Hunting Island under P/N 2005-1W-129P and at Folly Beach County Park under P/N 2012-237-2IG (Fig 3.2). The Hunting Island groins constructed in 2006–2007 were an average of ~450 ft long. The Folly Beach groin was ~750 ft long. Overall, the Hunting Island groins are most similar to the structures placed at DeBordieu Colony.

3.1 Permits and Appeals

The state of South Carolina permitted the DeBordieu Nourishment and Groin Construction project on 24 January 2019 (P/N 2017-01795) after being placed on public notice on 31 November 2017. The permit stipulated certain monitoring and mitigation of downcoast erosion if a threshold rate of 8.1 cy/ft/yr is exceeded along the Hobcaw Tract (Reach 4). This erosion rate was related to historical (pre-nourishment) land losses averaging approximately 1.0 acres per year along the 4,180 ft length of Hobcaw.

The state permit was appealed by the SC Environmental Law Project (SCELP) on behalf of the Baruch Foundation and SC Coastal Conservation League (SCCCL) (Docket No. 19-ALJ-07-0088-CC). The DCCA and Baruch Foundation subsequently reached a settlement in April 2020, whereby the mitigation for downcoast impacts was revised. The southernmost groin was to be shifted landward and northward, while the erosion threshold was reduced to 6.0 cy/ft/yr (computed as a running average) roughly over the length of Reaches 2 and 3. SCDHEC-OCRM (now known as SC Department of Environmental Services – Bureau of Coastal Management – SCDES-BCM) issued an amended permit on 15 April 2020, incorporating the agreed-upon changes, and the Baruch Foundation was dropped from the lawsuit. The appeal by SCELP on behalf of SCCCL proceeded under Docket No. 19-ALJ-07-0088-CC.

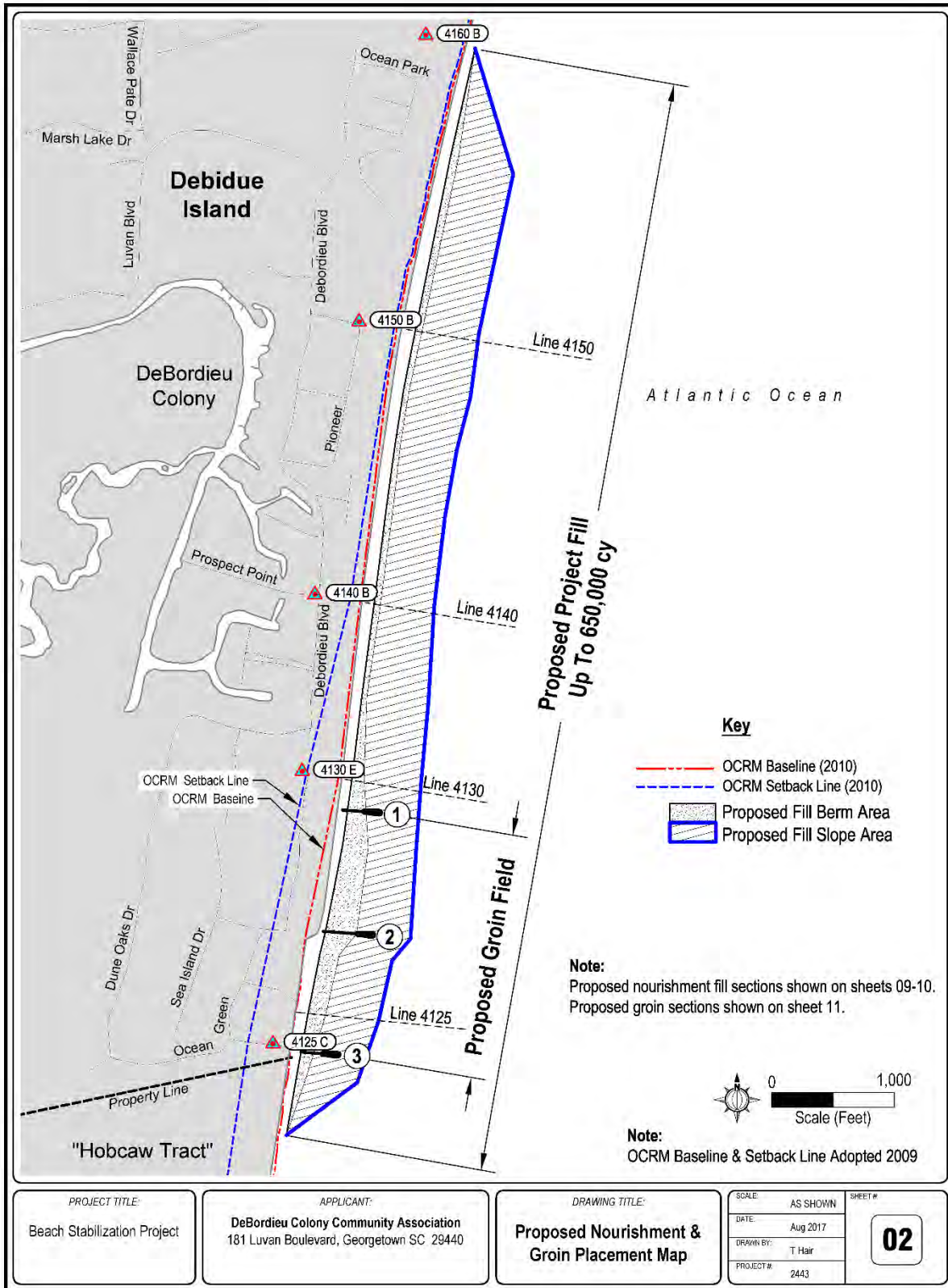


FIGURE 3.1. Project plan for DeBordieu as presented in the permit application in 2017. The location of Groin #3 was modified by a minor amount following review by the Baruch Foundation, owners of the Hobcaw Tract.

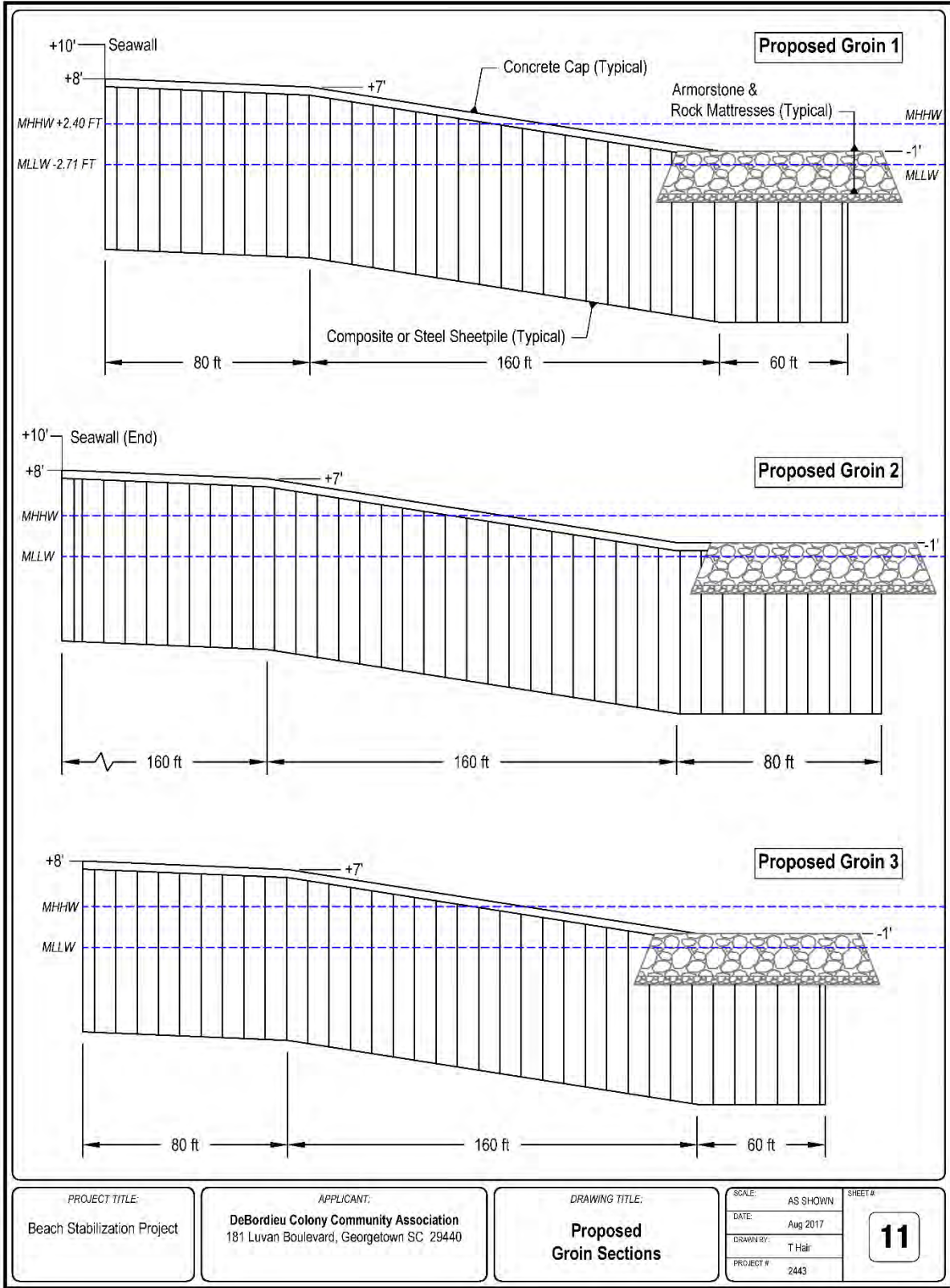


FIGURE 3.2. Groin profiles for the DeBordieu project as presented in the permit application.

The lawsuit was heard in the SC Administrative Law Court in Columbia on 24–26 August 2020. The court issued the Final Order on 15 January 2021, finding in favor of DCCA and upholding the SCDES-BCM permit for the project. After the decision, the USACE issued the federal permit for the project on 23 March 2021.

3.2 Contract Negotiations and Bids

The DCCA received a proposal on 1 April 2021 from Marinex Construction Inc., whereby the company would complete the DeBordieu nourishment and a planned 460,000 cy project at nearby Litchfield Beach for ~\$19,909,900. The DeBordieu cost would be \$11,472,500. Combining the two projects was considered advantageous because mobilization represents a significant part of dredge costs. The DCCA board elected to accept a modified bid of \$13.50/cy and \$2,500,000 for mobilization, subject to any stay being lifted so that construction could proceed, albeit at some risk of a higher court overturning the permit. On 30 September 2021, the DCCA contracted with Marinex to construct 650,000 cy.

The groin construction project was bid on 17 August 2021. Three bids were received, ranging from \$3,810,150 (Blue Tide Construction) to ~\$3,030,330 (Crowder Construction) to \$2,675,000 (SJ Hamill). CSE’s opinion of probable costs presented to the DCCA in July 2021 was \$2,797,000. CSE issued an award recommendation to the DCCA for the SJ Hamill proposal on 18 August. On 8 October 2021, the DCCA signed an agreement with SJ Hamill Construction Company LLC to construct three groins along the south end of DeBordieu Beach.

Construction was anticipated to start in December 2021, but was delayed a few months while Marinex completed another project. The groin contractor began fabricating the caps off-site in late Fall 2021 for timely delivery along with quarry stone, composite sheets, and related materials. SJ Hamill started mobilizing groin materials to DeBordieu on 3 January 2022. Marinex initiated dredge pipeline mobilization on 24 February. CSE issued two change orders in Spring 2022. An initial change order, dated 4 February, provided a time extension from 31 March to 30 April for final completion. Subsequently, CSE coordinated with SCDES-BCM and USACE for an extension consistent with SCDES-BCM permit Condition #1 and USACE Condition C, which allowed work through 30 June. All equipment was off the beach by 10 June 2022.

3.3 Baseline

CSE established a construction baseline to use as a spatial reference for construction and future monitoring. The baseline was oriented from south to north, with the start position located at the end of Debidue Spit near North Inlet and stationing increasing to the north (Fig 3.3). The project area spanned from Station 100+00, about 500 ft south of Groin #3, along the Hobcaw Tract to Station 185+00 at the north boundary of DeBordieu Colony. The three groins were installed near

Station 125+00 (Groin #1), Station 115+00 (Groin #2), and Station 105+25 (Groin #3). The construction drawings illustrate the groins' position and general alignment (Fig 3.1).

The baseline was designed to accommodate future monitoring efforts. This includes a minimum of three profiles between groins and sufficient spatial resolution to meet permit-required specifications. A total of 65 profiles are incorporated into the project monitoring regime, with profiles spaced at 200-foot (ft) intervals along the south end of DeBordieu and 500-ft intervals along the remainder of the beach. Figure 3.3 provides a map showing baseline stationing and reach limits for the analysis included herein. Prior surveys along DeBordieu Beach occupied profiles established by SCDES-BCM and were spaced ~1,000–2,000 ft apart. The difference between survey stations results in minor differences in volume calculations reported in prior studies.

For post-construction monitoring, CSE combines beach profiles for areas based on morphological features, community boundaries, or structures to assess regional volume changes along the beach (referred to as Reaches). Reach boundaries have been adjusted from previous reports to account for the newly installed groins and areas of particular interest identified in project permits. Reaches were created for each groin, which will aid in determining the effective sand-trapping performance of each groin. They are identified as follows:

1	Spit Reach	6,000 lf	Stations 0+00 – 60+00
2	South Hobcaw	2,800 lf	Stations 60+00 – 88+00
3	North Hobcaw	1,800 lf	Stations 88+00 – 106+00
4	South Groin	1,000 lf	Stations 106+00 – 116+00
5	Center Groin	1,000 lf	Stations 116+00 – 126+00
6	North Groin	1,400 lf	Stations 126+00 – 140+00
7	North DeBordieu	4,500 lf	Stations 140+00 – 185+00
8	Arcadia	3,000 lf	Stations 185+00 – 215+00
9	Prince George	2,000 lf	Stations 215+00 – 235+00



FIGURE 3.3. Station and Reach map for the DeBordieu Colony Beach Monitoring Program.

The surveys presented in this report were conducted by RTK-GPS (Trimble™ R12 GNSS). The second annual survey was completed in July 2024. Profiles along Debidue Beach were surveyed perpendicular to the shoreline azimuth from control points to a minimum of -15 ft NAVD (the normal limit of measurable elevation change in this setting, known as the ‘depth of closure’) or at least 2,000 ft from the baseline. Surveys were conducted by combining a land-based survey and a bathymetric survey. Land surveys were accomplished using the RTK-GPS between the foredune and low-tide wading depth [roughly -5 ft NAVD]. Bathymetric work was performed at high tide via RTK-GPS combined with a precision echo-sounder mounted on CSE’s shallow-draft boat, the RV *Southern Echo*. Figure 3.4 shows the relationship between the survey datum (referencing NAVD) and various tide levels.

CSE computed the ‘unit volume’ of sand in each profile within prescribed contour intervals or cross-shore positions. Unit volumes are the amount of sand (in cubic yards – cy) contained in a one-foot length of beach (ie – cy/ft) between the foredune or some reference backshore limit and a particular depth offshore. These measurements consider the variability of the shape of the profile, yielding an objective quantity to compare one section of beach with another. The difference in unit volume at a profile line from one survey to another provides a measure of change at that location. CSE extrapolates results at each station over the applicable shoreline length to estimate net volumes gained or lost over time. When extrapolated over multiple lines, the results offer aggregate volumes by reach.

CSE reviewed the comparative data and plotted profiles to selected standard reference depths for volume calculations. Nearly all the significant change in bottom elevation occurs above -15 ft NAVD (Barrineau et al 2019). Consistent with prior studies, CSE adopted this contour for ‘closure depth,’ representing the seaward limit of measurable elevation change for a particular time period. This reference depth is an indication of the outer limit of the active littoral zone where beach sands are moving from year to year.

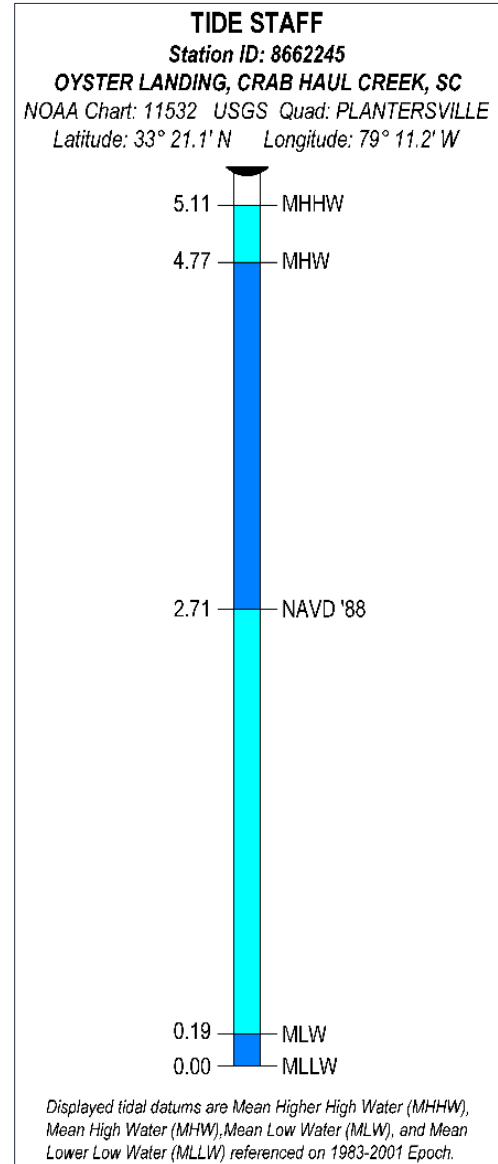


FIGURE 3.4. Relationship of MHHW and MLLW to NAVD’88 (North American Vertical Datum of 1988), which FEMA uses as a reference for flood zones and minimum floor elevations of houses along the coast.

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4.0 RESULTS

The monitoring results presented herein focus on the beach condition in July 2025 relative to the 2022 pre- and post-project conditions. The narrative descriptions of volume changes will focus on changes since the 2022 project, as well as those measured between July 2024 and July 2025. Note that the survey was completed about a week after Tropical Storm *Chantal* impacted northern South Carolina. The storm likely eroded some of the upper beach along DeBordieu Colony and led to higher than typical erosion rates, as will be discussed in later sections.

Results are presented, ranging from large-scale changes to the performance of individual profiles. For most of the analysis, Reaches 1 and 9 are excluded from regional volume calculations. These areas are influenced by inlet and overwash processes, so measured changes may not directly relate to prevailing sediment transport patterns occurring along other portions of the beach.

CSE measured 646,045 cy of sand added to the project area between January 2022 and May 2022. This quantity differs from the contract amount (650,000 cy) because it includes natural background changes, and is generated using different profiles from those used for construction payment surveys.

The project area lost ~83,760 cy between July 2024 and July 2025. This is equivalent to an annualized loss rate of ~87,520 cy per year (cy/yr). This value is relatively lower than Year 1 (loss of ~101,000 cy), but higher than Year 2 (loss of ~62,000 cy). Erosion rates typically decrease over time following renourishment projects, as the fill template adjusts to natural wave and wind conditions. Higher erosion rates this year are assumed to be due to weather conditions over the past year and impacts of Tropical Storm *Chantal* (it is likely that there would be some natural recovery of the beach in the weeks following the storm as sand shifts back into the upper beach area). The project area has lost ~246,870 cy since May 2022, which represents ~40% of the nourishment volume (Fig 4.1). Table 4.1 provides volume changes across individual reaches since the project was constructed. A complete set of volumetric changes above -15 ft NAVD and +2.05 ft NAVD is provided in Appendix A, and data sheets of individual profiles are in Appendix B.

4.1 Reach 1 - The Spit

The Spit (Reach 1) represents the 6,000 lf south of the upland Hobcaw area (Stations 0+00 – 60+00). It is characterized by a narrow, low-relief barrier ridge backed by marsh (Fig 4.2). Sandy overwash deposits atop buried marsh mud are widespread, indicating long-term erosion and landward recession of the shoreline (CSE 2017a). This erosion results from the natural loss of inlet delta sand from North Inlet.

Channels draining through North Inlet were located at the north end of the spit (adjacent to South Hobcaw) as recently as 1925. Between 1925 and 1934, those channels closed, and the primary channel has generally remained near its present location ever since. More information is provided below.

North Inlet has a strong influence on the southern portion of the reach. A persistent underwater bar connects the outer inlet delta to the beach, ~2,500 lf north of the tip of the spit. This bar shifts in position and elevation and can provide sand to the beach at the attachment site. Despite the periodic influx of sand from this bar, the reach is vulnerable to breaching during a major storm.

TABLE 4.1. Beach volume changes for each monitoring reach and areas of interest. Volumes calculated to -15 ft NAVD.

DeBordieu Colony Volumes to -15 ft NAVD			Unit Vol Change Since Previous (cy/ft)							Total Volume Change Since Previous (cy)						Change Since Project (May 2022) (cy)	
Reach	Stations	Length (ft)	May-22	Aug-22	Oct-22	Feb-23	Jun-23	Jul-24	Jul-25	May-22	Aug-22	Oct-22	Feb-23	Jun-23	Jul-24	Jul-25	Jul-25
1 Spit	0+00 - 60+00	6,000	2.8	-1.6	-8.5	-5.4	1.2	-10.5	-10.0	17,057	-9,598	-50,924	-32,692	6,967	-62,712	-59,786	-208,744
2 South Hobcaw	60+00 - 88+00	2,800	-4.8	5.6	-11.0	-0.8	-1.0	-10.9	-12.5	-13,366	15,562	-30,803	-2,238	-2,680	-30,465	-35,134	-85,757
3 North Hobcaw	88+00 - 106+00	1,800	33.1	11.7	-1.5	-6.1	1.7	-19.0	-19.6	59,551	21,036	-2,749	-10,950	2,986	-34,199	-35,215	-59,090
4 South Groin	106+00 - 116+00	1,000	189.0	-26.3	-11.8	-10.9	-4.9	-9.1	-12.3	189,011	-26,288	-11,805	-10,923	-4,908	-9,120	-12,295	-75,338
5 Center Groin	116+00 - 126+00	1,000	171.8	-20.5	-5.2	-4.0	-2.7	-9.4	-13.0	171,799	-20,468	-5,205	-4,025	-2,681	-9,393	-13,038	-54,810
6 North Groin	126+00 - 140+00	1,400	106.4	-9.0	-11.6	-0.6	-1.5	-6.9	-11.7	148,915	-12,670	-16,286	-862	-2,061	-9,637	-16,335	-57,851
7 North DeBordieu	140+00 - 185+00	4,500	20.2	5.0	1.4	-1.6	-0.4	-5.3	-7.4	91,053	22,614	6,356	-7,177	-1,638	-23,775	-33,079	-36,698
8 Arcadia	185+00 - 215+00	3,000	-4.0	2.3	-1.3	-4.5	-3.2	4.1	-5.7	-11,907	6,797	-3,841	-13,606	-9,605	12,169	-17,130	-25,216
9 Prince George*	215+00 - 235+00	2,000	7.0	-18.5	-0.3	3.1	4.8	36.3	51.4	10,525	27,794	-523	4,648	7,234	54,383	77,088	170,623
2022 Nourishment Fill Area	100+00 - 185+00	8,500	76.0	-4.0	-3.5	-3.3	-1.1	-7.3	-9.9	646,046	-33,846	-30,000	-27,785	-9,515	-61,962	-83,758	-248,866
Groin Area (4-6)	106+00-140+00	3,400	149.9	-17.5	-9.8	-4.7	-2.8	-8.3	-12.3	509,725	-59,426	-33,295	-15,810	-9,650	-28,151	-41,688	-187,999
Hobcaw (2-3)	60+00 - 106+00	4,600	10.0	8.0	-7.3	-2.9	0.1	-14.1	-15.3	46,184	36,598	-33,552	-13,187	306	-64,684	-70,349	-144,847
Total 2-8	60+00 - 215+00	15,500	41.0	0.4	-4.2	-3.2	-1.3	-6.7	-10.5	635,055	6,584	-64,332	-49,780	-20,586	-104,421	-162,226	-384,761
Total 1-9	0+00 - 230+00	23,000	28.8	1.1	-5.0	-3.4	-0.3	-4.9	-6.3	662,636	24,779	-115,778	-77,824	-6,385	-112,750	-144,924	-432,882

*Stations 215+00-230+00

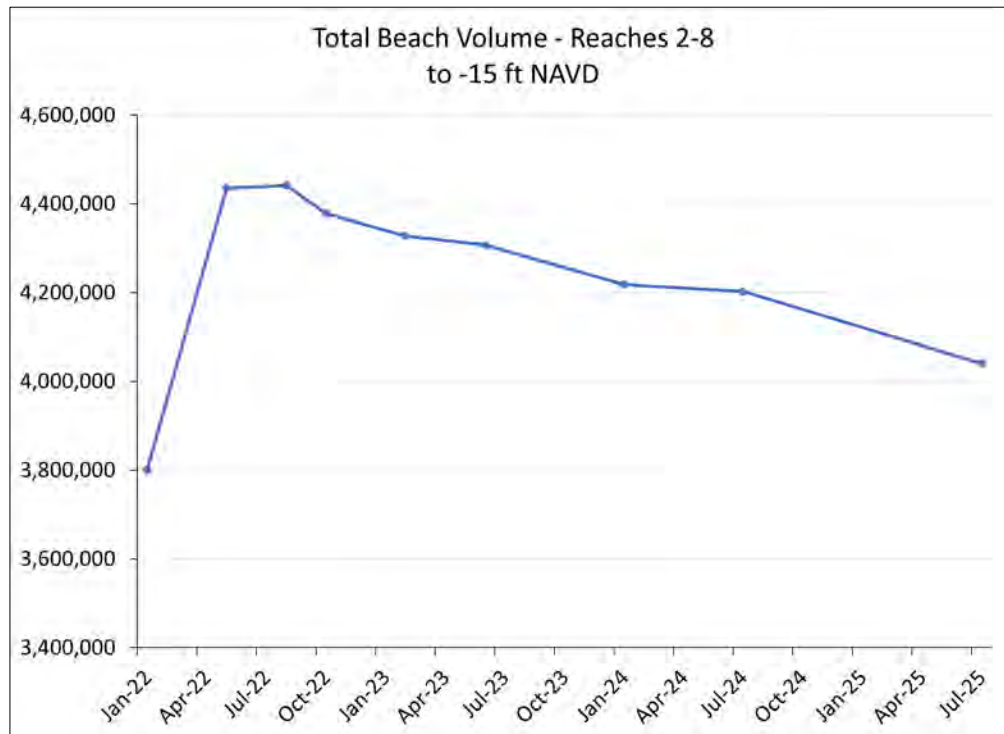


FIGURE 4.1. Total beach volume for Debidue Beach, including the Hobcaw Tract and Arcadia. The Spit is not included, as volumetric changes along that reach are more influenced by North Inlet than the adjacent reaches.



FIGURE 4.2. July 2025 aerial images of the south spit reach. Incipient vegetation is growing on the washover berm created during Hurricane *Ian* (30 Sep 2022). This area remains susceptible to breaching and overwash during storm events, despite this initial recovery following *Ian*'s impacts. Shoal attachment to Station 0+00 (lower).



At the north end of the reach, a depression adjacent to Debidue Creek is the only physical remnant of the pre-1934 position of North Inlet. This depression has filled with beach sand over time, but remains vulnerable to overwash with a horizontal distance of just a couple hundred feet between the marsh-side mean high water (MHW) and ocean-side MHW (see Fig 4.2, Fig 4.3). Overwash deposits from a number of storms (most notably Hurricane *Ian* and the December 2023 nor'easter) nearly reached the creek bank, and one of the 2022–2023 winter storms brought beach sand to below MHW on the marsh side for the first time since surveys began.

The Spit Reach gained 17,000 cy of sand from January to May 2022 but has been moderately erosional since the project, losing a total of ~208,740 cy (–34.8 cy/ft) between May 2022 and July 2025. Losses were greatest from August 2022 to October 2022, when Hurricane *Ian* overwashed the area, and from June 2023 to January 2024, due to the impact of a pair of nor'easters. Erosion was initially greater along the northern half of the reach from May 2022 through October 2022, but has shifted such that the greatest losses from June 2023 to July 2025 occurred along the southernmost ~2,000 lf (Fig 4.4). However, the southernmost end of the reach has gained sediment due to periodic shoal attachments (fig 4.2).

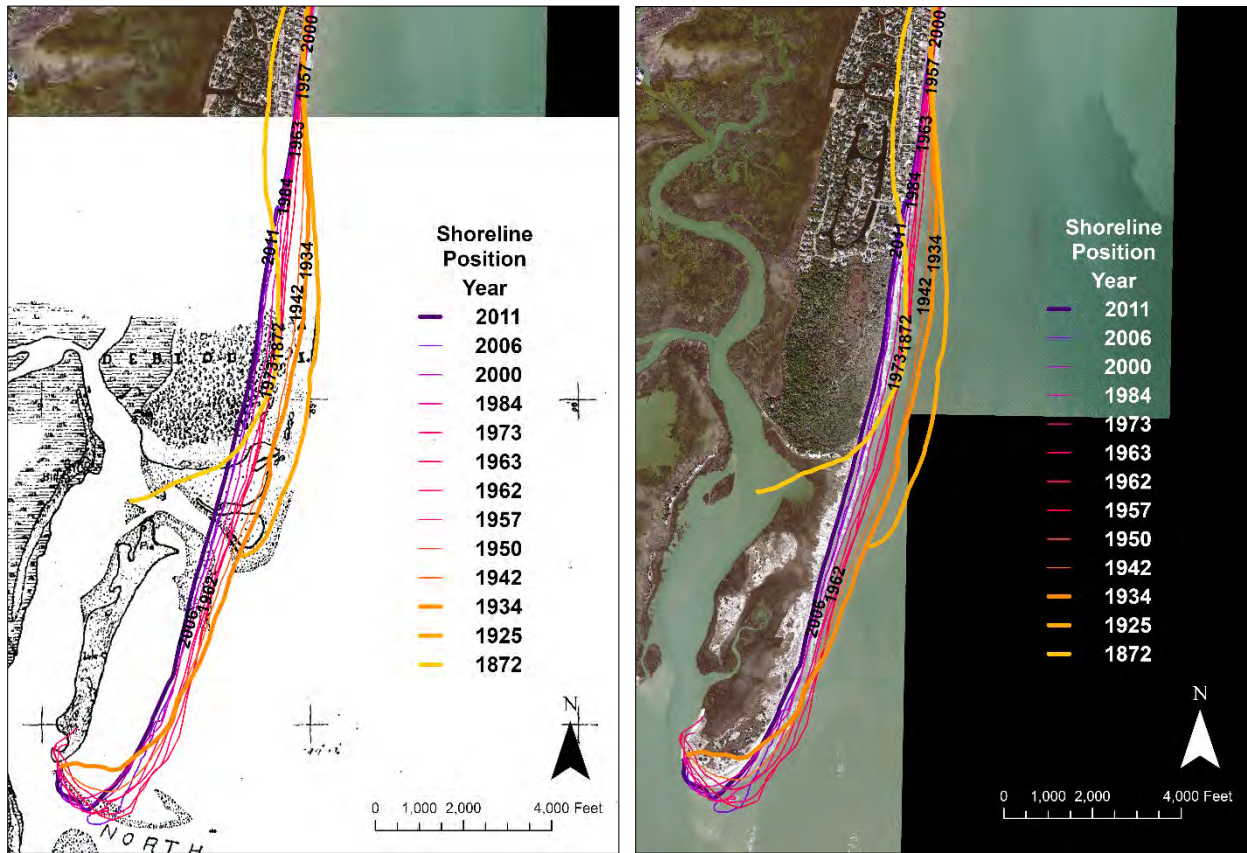


FIGURE 4.3. [LEFT] A large channel associated with North Inlet was located along the boundary between South Hobcaw and Debidue Spit until as recently as 1925. Between 1934 and 1942, rapid shoaling and spit extension of the northern portions of North Inlet displaced the primary channel southward to its approximate current position [RIGHT].

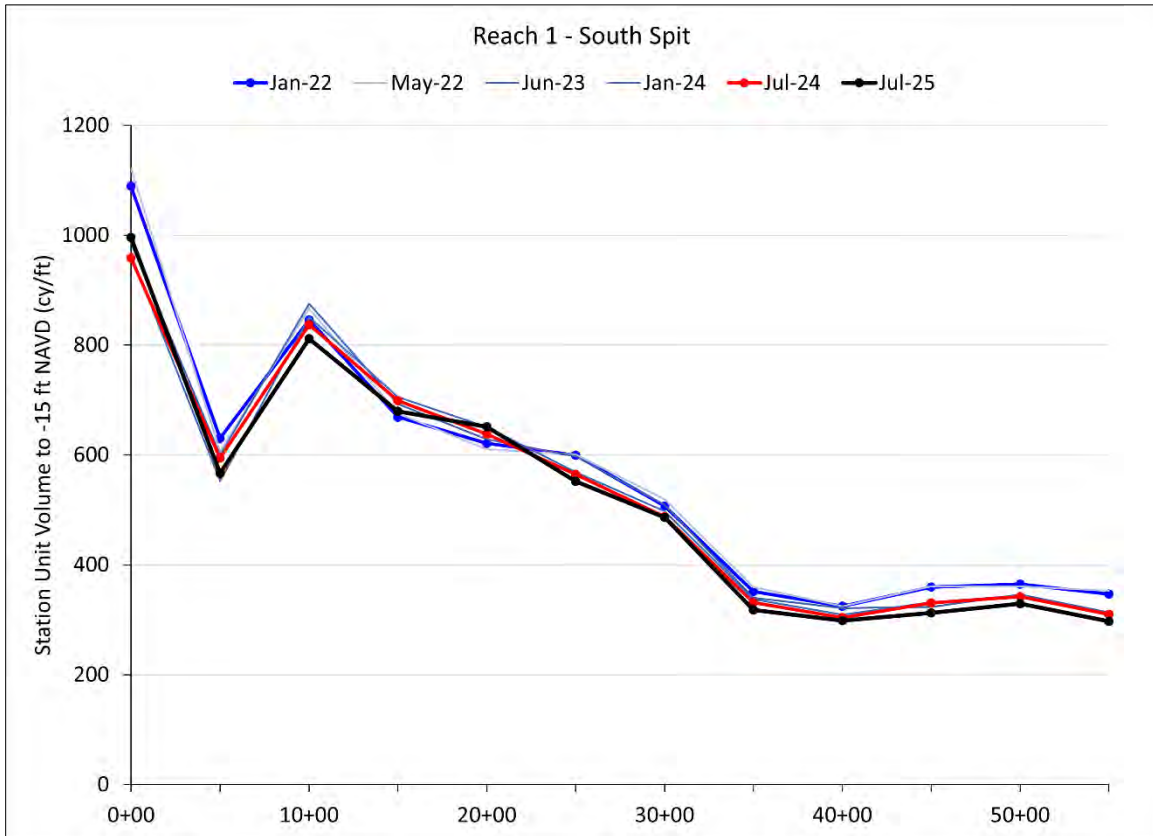


FIGURE 4.4. Volume changes through July 2025 along Reach 1. These changes are strongly influenced by North Inlet and do not appear to be related to similar changes along the project area.

Profiles show that stations north of Line 20 were overwashed during Hurricane *Ian* and, although some accretion has been observed since, remain under the maximum wave runup elevation for a 5-year storm (Fig 4.5 upper). Maximum berm elevation at stations 55+00 and 60+00 at the north end only reaches ~+7 ft NAVD (see Fig 4.2, Fig 4.5 lower). This elevation is exceeded by wave runup several times a year.

As a result, the area is susceptible to overwash during minor storm events or even spring tides occurring during periods of strong onshore winds. Under moderate to severe conditions (eg – Saffir-Simpson Category 3 or higher hurricane striking at high tide), this area will likely breach and form a channel connecting Debidue Creek with the ocean (see Figs 4.2, 4.3, 4.6). At that point, it may be difficult to prevent a more permanent breach and partial relocation of channels associated with North Inlet. Such conditions will likely cause sand to be siphoned away from the beach and into the marsh. As erosion continues and more sand is removed from the system, the rate of landward migration along Debidue Spit will increase. This would constitute a major shift in sediment budgets along adjacent beaches, and trigger increased erosion rates along Reaches 1–3.

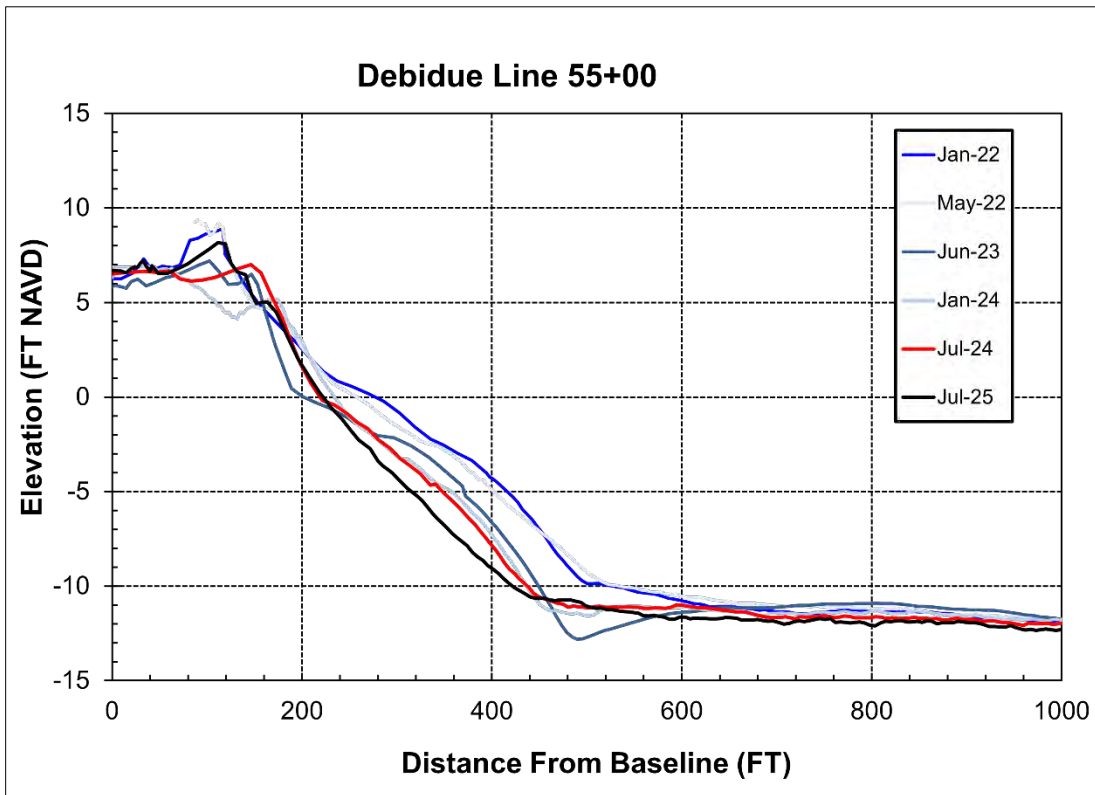
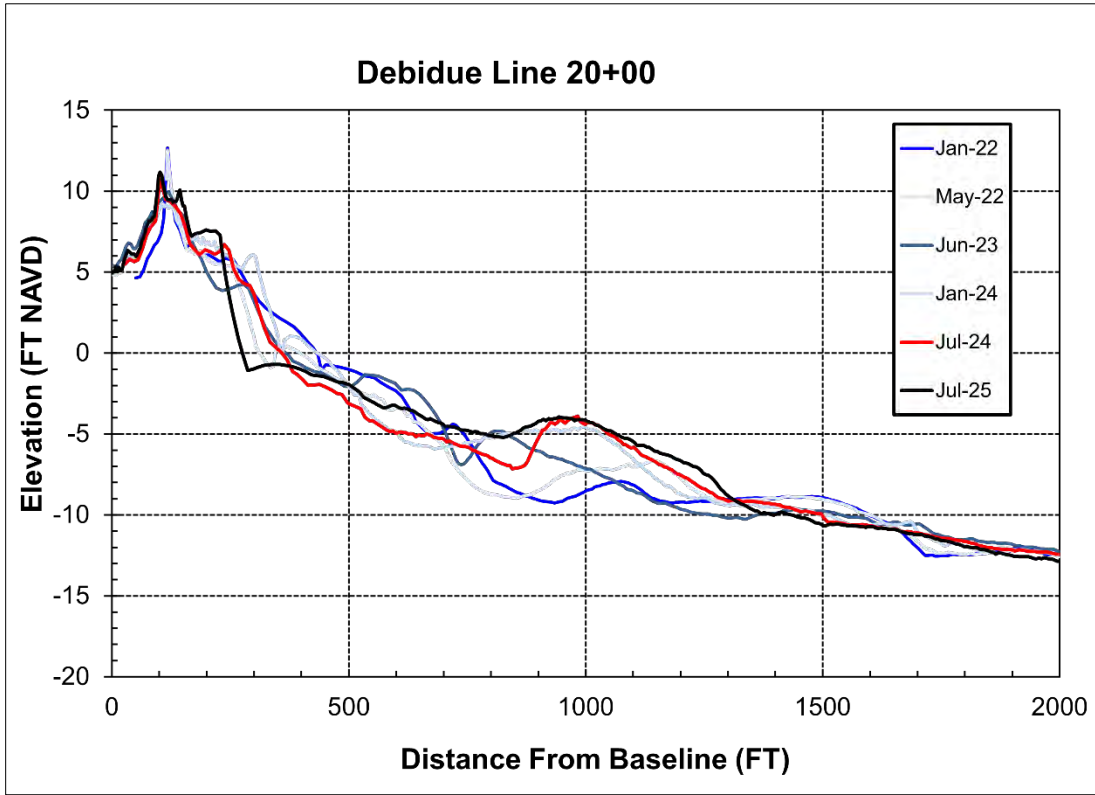


FIGURE 4.5. Beach profiles as measured along selected portions of Debidue Spit.



FIGURE 4.6. The low overwashed spit south of the Hobcaw Tract along the northern portions of Debidue Spit is exceptionally low and narrow as of July 2025 (shown in image above). A future breach is highly likely in the next few years and will represent a major shift in ‘natural’ background patterns of sediment transport along this portion of Debidue Beach.

4.2 Reach 2 – South Hobcaw

The South Hobcaw Reach (Reach 2) extends 2,800 lf between stations 60+00 and 88+00 (see Fig 3.3). It includes the southern portion of the beach fronting the upland/vegetated area north of the spit (Fig 4.7). It was identified as part of the monitoring area under SCDES-BCM’s permit conditions for post-project monitoring (along with Reach 3 – North Hobcaw). Multiple studies have documented erosion rates along the Hobcaw area (including Reach 3) to be at or greater than 10 cy/ft per year (ATM 2008, CSE 2017a).

Reach 2 was not filled during the 2022 project. It had a modest gain of sand in the first quarter post-project survey (+5.6 cy/ft) (see Table 4.1) but lost 11.0 cy/ft (30,800 cy) during the second quarter, largely due to the impacts of Hurricane *Ian* and the aforementioned overwash. This storm resulted in ~40 ft of dune recession, complete loss of the primary dune, and exposed relict marsh deposits on the beach.

Outside of the impacts triggered during *Ian*, the reach was stable over Year 1 from May 2022 to June 2023. From July 2024 to July 2025, the reach lost 35,130 cy (–12.5 cy/ft) and shows a net loss of 85,760 cy (–18.1 cy/ft) since May 2022. The low overwash portion of the spit south of Reach 2 discussed above extends into the southernmost ~1,000 ft of the reach, and draws volume away from the rest of the reach (Fig 4.9, see Fig 4.5 lower). This results in a gradient in erosion and accretion along the reach, such that the southern profiles have lost significantly more volume than the northern profiles.



FIGURE 4.7. The South Hobcaw Reach extends from the northern end of Debidue Spit (foreground) to approximately 1,700 ft south of the southernmost groin (highlight).

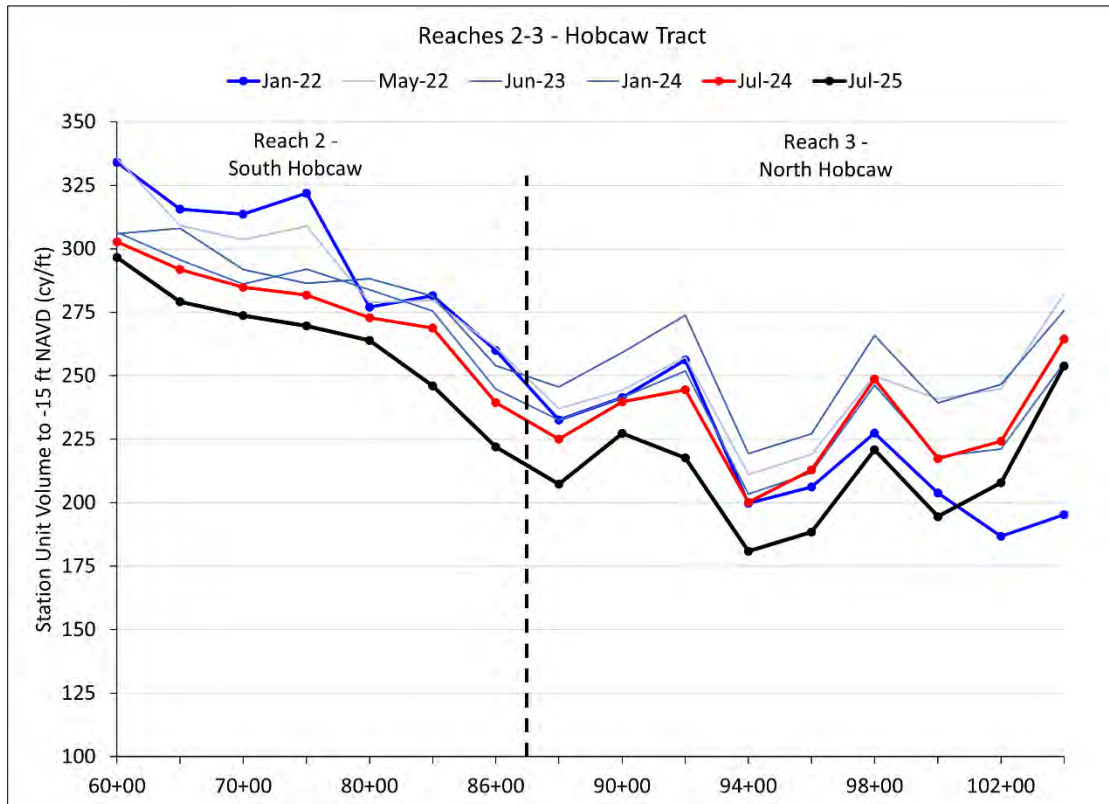


FIGURE 4.8. Volume changes along Reaches 2 and 3 from pre-project condition to July 2025. Volume increases observed along Reach 3 are due to sand spreading southward from the project area, while volume decreases along Reach 2 are related to overwash along Debidue Spit.

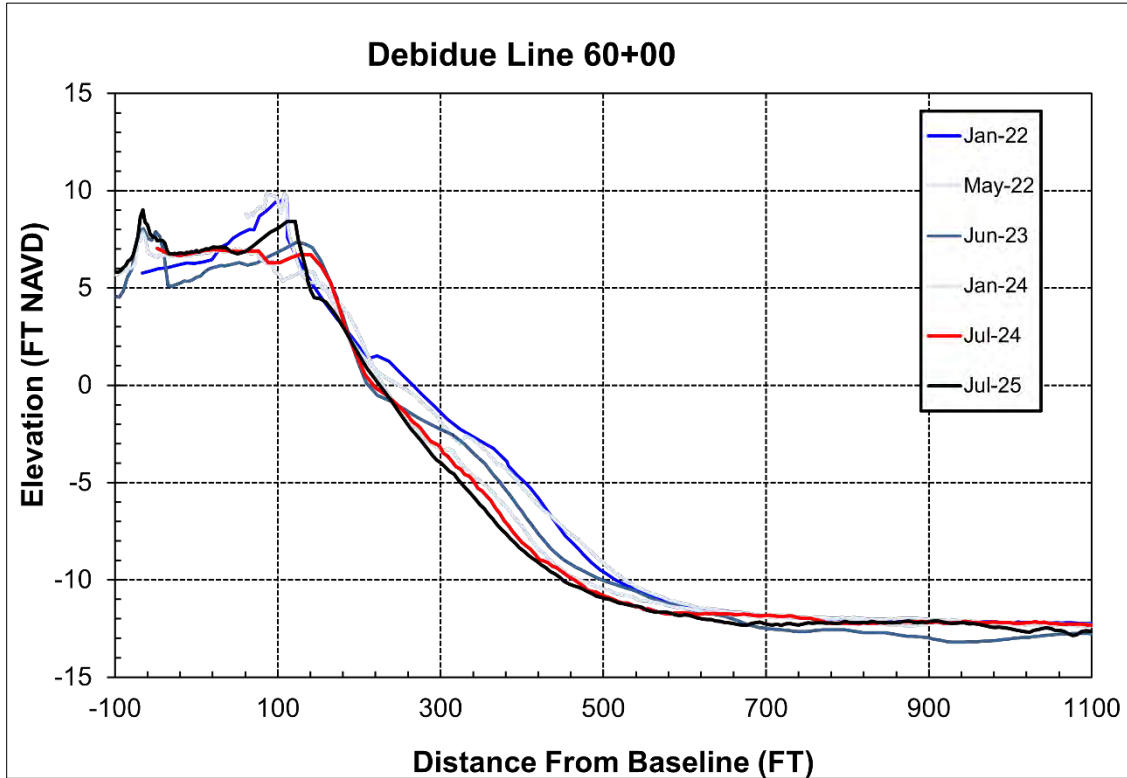


FIGURE 4.9. Overwash in the vicinity of Station 60+00 reduced the foredune crest elevation from ~12 ft NAVD in May 2022 to ~7 ft NAVD as of July 2025. This portion of the island is susceptible to continued overwash during future storm events, and may breach in the next several years. Such a change would be the result of natural background erosion and shifting hydraulics around North Inlet, rather than any acute impacts from the Debidue project.

Overall, the reach lost ~85,760 cy of sand since project completion in May 2022. This equates to an average annual erosion rate of 9.6 cy/ft per year, slightly lower than the historic rate despite the impacts of Hurricane *Ian* and the January 2024 nor'easter. Excess sand from the 2022 nourishment should continue to feed the beach and maintain lower erosion rates, but the volume of sand lost to overwash at the southern end of the reach could outstrip the incoming nourishment sand. This is especially true if a storm-induced breach occurs.

4.3 Reach 3 - North Hobcaw

The North Hobcaw Reach (Reach 3) includes 1,800 lf (between stations 88+00 to 104+00) of beach south of the DeBordieu Colony community, and is immediately downdrift of the southernmost groin installed in 2022 (Fig 4.10). It is similar in character to Reach 2 in that both exhibit historical erosion rates of ~10 cy/ft per year; however, Reach 1 is less susceptible to overwash and inundation (CSE 2017a). Situated downdrift of the new groins, this area has the most potential to be influenced by sand-trapping at the groins. The 2022 project placed sand in Reach 3 as an initial mitigation for immediate post-project impacts. Additionally, excess sand was placed in the groin field so that the trapping capacity of the groins was exceeded, and sand would feed downdrift areas.



FIGURE 4.10. The North Hobcaw Reach extends from the central portion of the Hobcaw Tract (approximately 1,800 ft south of the southernmost groin) to the southernmost groin (highlight).

The 2022 nourishment project included a taper section that extended ~400 ft into Reach 3. The design called for ~20,000 cy of material to be placed south of Groin #3; however, CSE measured ~60,000 cy of total sand gained between January and May 2022. Excess sand quickly spread into the area during project construction, as southerly sediment transport continuously moved nourishment sand from the southern and central portions of the project area. Sand losses to downcoast areas are common during projects, as natural transport occurs during weather and mechanical delays.

Measured change rates along Reach 3 have been moderate over the course of Year 1 following project completion, with accretion measuring ~10,320 cy (+5.7 cy/ft) from May 2022 to June 2023. Reach 3 was heavily impacted in Year 2 following project completion by the December 2023 and January 2024 nor'easters; measured losses between June 2023 and January 2024 were ~34,500 cy (-19.1 cy/ft).

Overall, Year 3 (July 2024 to July 2025) volume changes consist of erosion of 35,210 cy (-19.6 cy/ft). Towards the southern end of the reach, the berm reduces back to the pre-project condition (Fig 4.11). The beach remains ~100 ft wider at Station 104+00, just south of Groin #3 (Fig 4.12). Ground photos show little dune growth, but a wide sandy beach that should help feed the dune in the future.

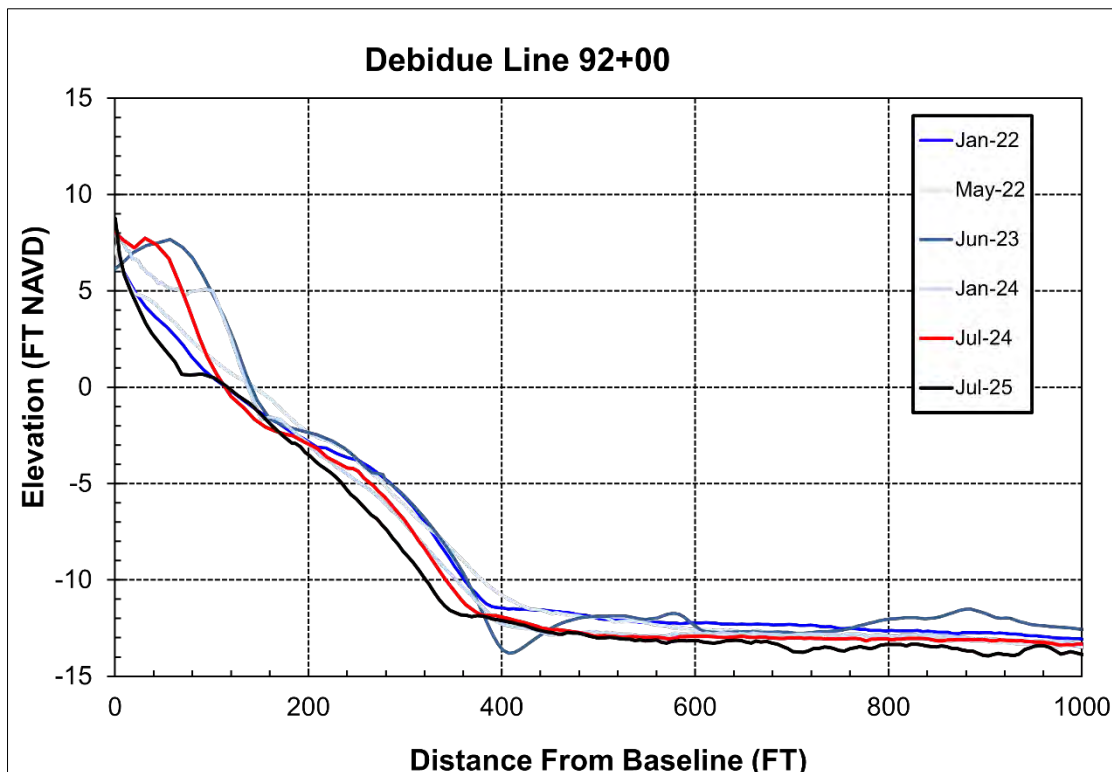


FIGURE 4.11. Toward the southern end of North Hobcaw, the berm reduces back to the pre-project condition.

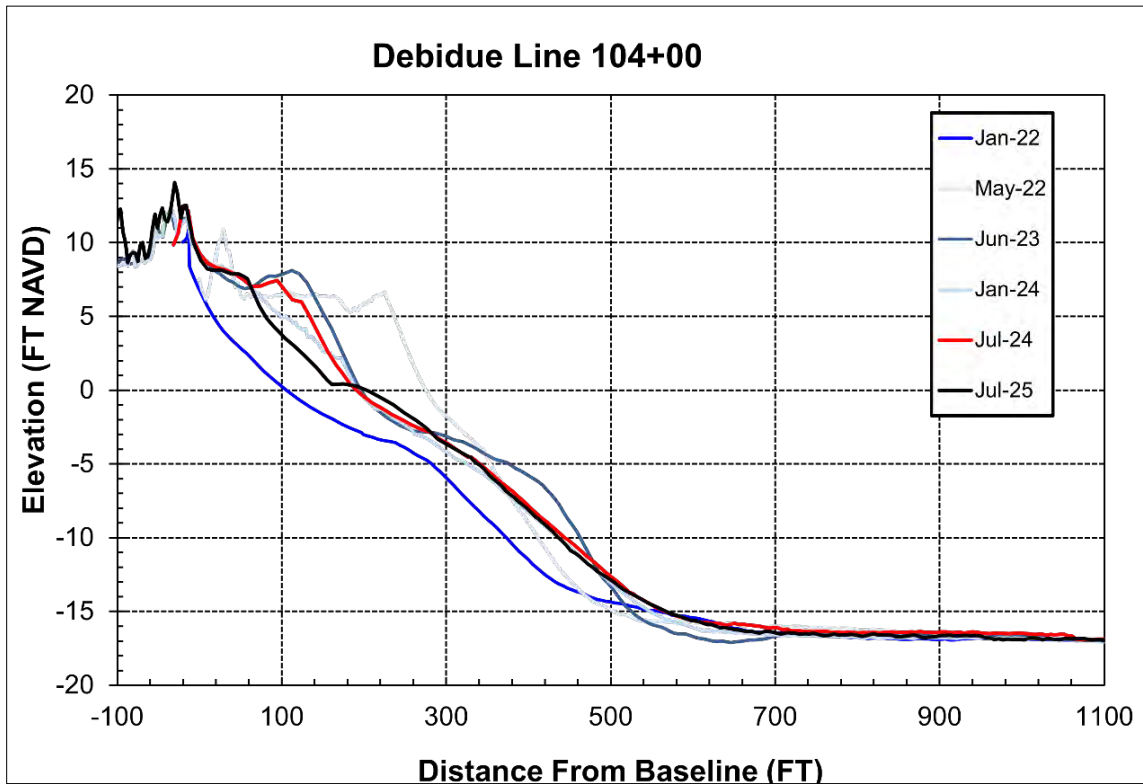


FIGURE 4.12. Beach widths along North Hobcaw remain considerably larger than the pre-project condition (January 2022, above) and continue to hold steady at ~100 ft wider as of July 2025.

4.4 Reach 4 – South Groin

The South Groin Reach (Reach 4) includes 1,000 lf between groins #2 and #3, between stations 106+00 and 114+00 along the Ocean Green area (Fig 4.13). In recent years, the shoreline along this reach has been set landward of the upcoast shoreline to the north, as it is immediately downcoast of the seawall. The lack of sand supply from the upcoast area has affected the reach when the wall is exposed. Several properties had little to no dune protection before the 2022 nourishment, especially following storm events.

The 2022 nourishment added 189,000 cy of sand to the reach, which is an average fill density of 189 cy/ft. This increased the dry sand beach width by ~300 ft and included a new dune constructed at ~13 ft NAVD. Excess sand was placed within the reach to facilitate groin construction, especially towards the north end.

Unit volume changes along Reach 4 decreased through each of the quarterly surveys collected during Year 1. From May 2022 to June 2023, the reach lost 53,920 cy (53.92 cy/ft). From June 2023 to July 2024, the reach lost 9,120 cy (-9.1 cy/ft). In Year 3, from July 2024 to July 2025, Reach 4 has lost 12,290 cy (-12.3cy/ft). Reach 4 lost a total of ~75,340 cy (75.3 cy/ft) since the project, and holds ~113,670 cy (113.7 cy/ft) more sand than the pre-project condition.



FIGURE 4.13. Reach 4 extends from the southernmost groin (background) to the central groin (foreground).

Losses have been most significant towards the northern end of the reach (near Access #12). Overall, the reach lost an average of 36% of the nourishment fill from May 2022 to July 2025. The northern stations have lost up to 91.2 cy/ft, while the southern end of Reach 4 has only lost 44.3 cy/ft. Erosion has generally been restricted to the upper wet-sand beach and shallow underwater zone above ~-5 ft NAVD (Fig 4.15). The toe of the profile (between ~-5 ft and ~-15 ft NAVD) has remained in a similar position, creating a shallower beach slope compared to the relatively steep slope present following construction.

The constructed dune withstood a nor'easter in January 2024. In addition, DCCA-sponsored plantings in spring 2023 have successfully accelerated dune growth (Fig 4.16). These changes enhance the resiliency and habitat function of the dune ecosystem in this area, which is a significant improvement over the pre-project conditions when this reach was primarily backed by a timber bulkhead.

Groin #3 became more exposed in 2025, with most of the slope section cap visible. (Fig 4.17). No discernible fillet was present to suggest a dominant sediment transport direction, indicating that more sand is present in the area than the groin is capable of trapping. At Groin #2, most of the structure is exposed, including the seaward portion of the berm section. Vertical exposure was up to ~3 ft, with higher exposure on the south side of the groin. (Fig 4.18). A slight asymmetry in the MLW contour at Groin #2 suggests northerly (south-to-north) sediment transport around July 2024.

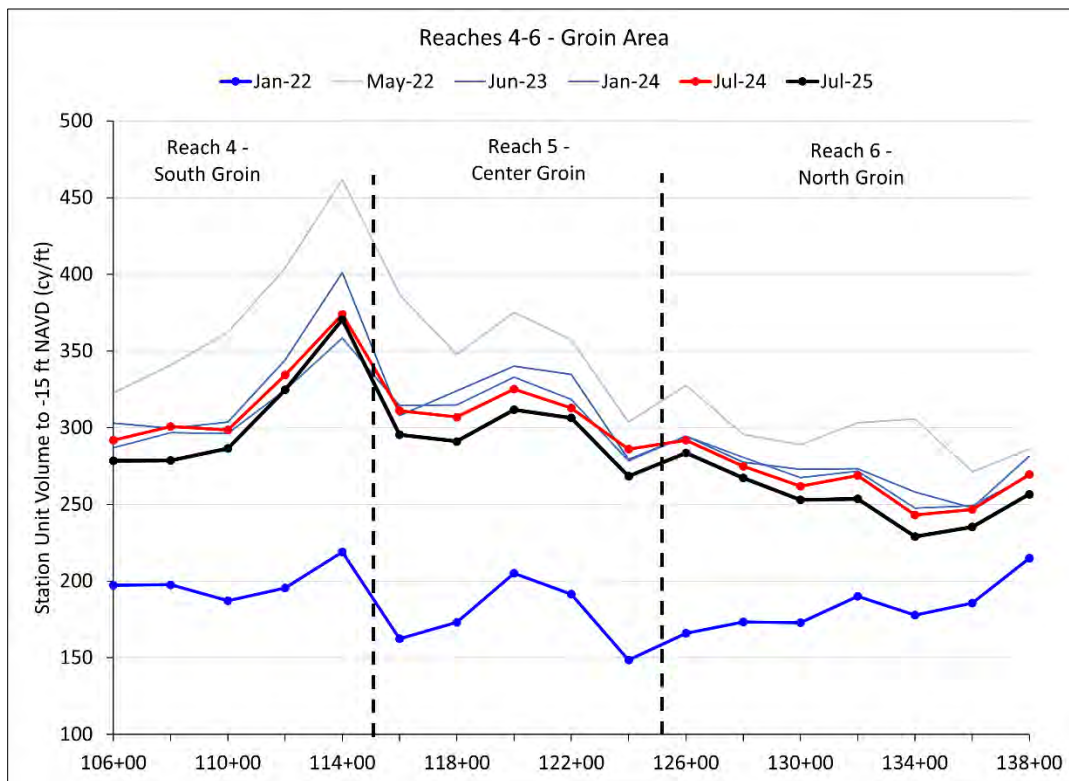


FIGURE 4.14. Volume changes along Reaches 4–6 from January 2022 to July 2025. These portions of the fill template received the greatest volumes of nourishment sand, and have exhibited some of the highest rates of erosion in Year 3 as the fill equilibrates to background wave and wind conditions.

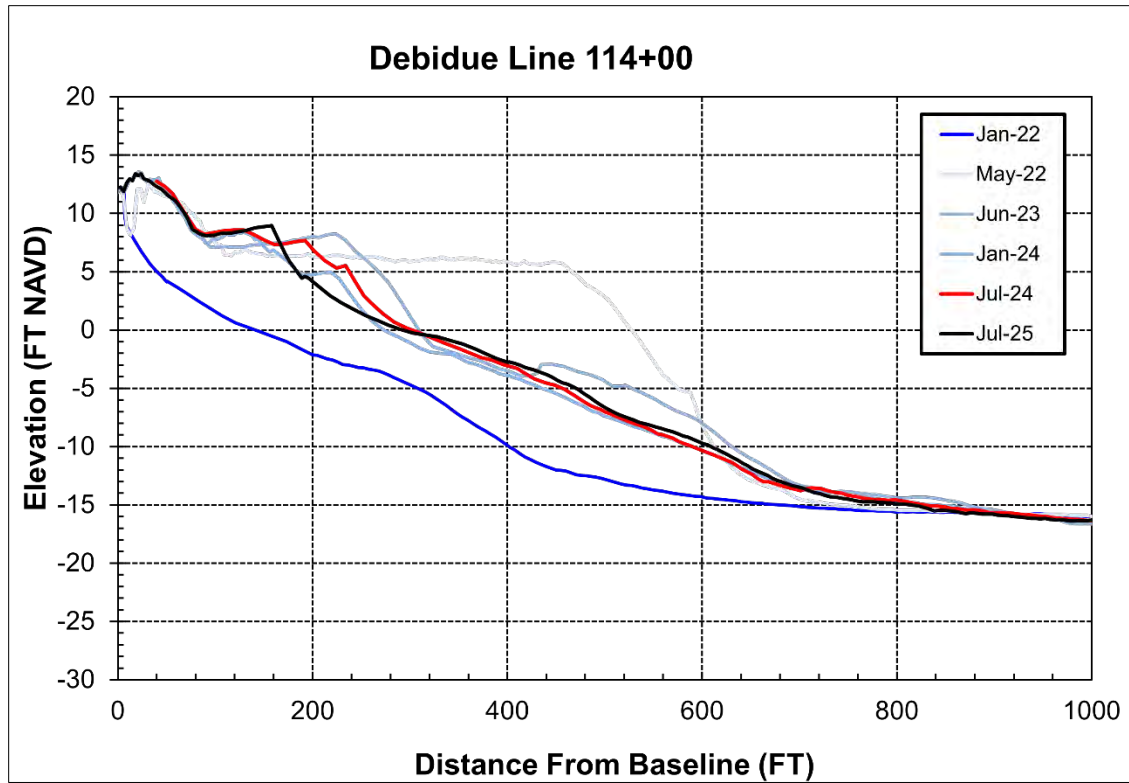
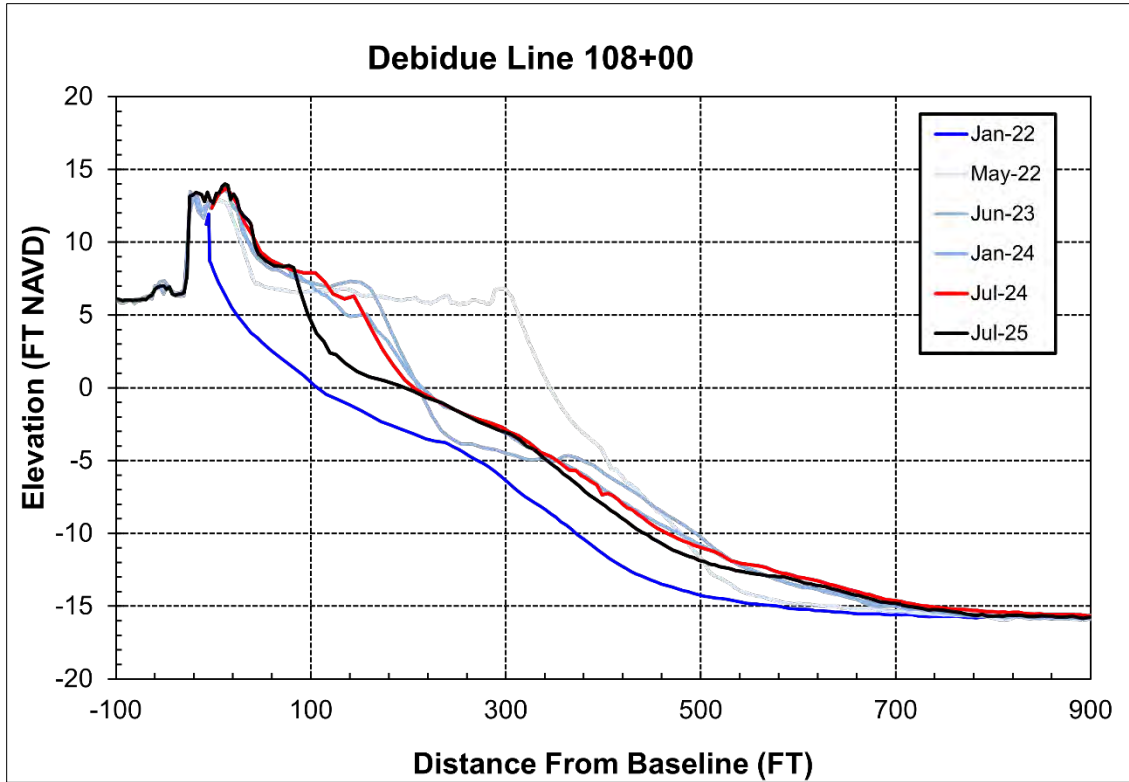


FIGURE 4.15. Beach profiles as measured along selected portions of Reach 4. Beach widths along the southern end [UPPER] and northern end [LOWER] of Reach 4 remain considerably larger than the pre-project condition.



FIGURE 4.16. July 2025—Dunes showing robust health and resilience following DCCA planting efforts.



FIGURE 4.17. Groin #3 oblique aerial, July 2025. Much of the structure exposed above MLW.



FIGURE 4.18. Groin #2 oblique aerial, July 2025. Much of the structure exposed above MLW.

4.5 Reach 5 – Center Groin

The Center Groin Reach extends 1,000 lf between stations 115+00 through 125+00 (Groins #1 and #2) (Fig 4.19). It includes the southern 1,000 ft of seawall, which has historically been the most exposed portion of the wall. It is also the area most vulnerable to erosion following prior renourishment efforts. After the 2015 nourishment, the southern end of the seawall was exposed by September 2017 due to the impacts of hurricanes *Matthew* (2016) and *Irma* (2017). Houses along this area are offset seaward relative to the South Groin Reach because they were built with a “20-year” setback (Table 2.1).

The 2022 project added ~171,800 cy (171.8 cy/ft) of sand to the reach. More sand was placed near Groin #2 due to the need to create a wider sand platform for construction and the critically eroded condition of the beach. Nourishment included a dune with a crest elevation of +13 ft NAVD that buried the seawall by a minimum of 2 ft. The dry beach width increased by approximately 300 ft during nourishment (before fill adjustment), and remains 100 to 150 ft wide as of July 2025 (Fig 4.19).

As in the other project reaches, Reach 5 experienced decreasing rates of erosion over the course of Year 1 following project completion (see Fig 4.14). Overall, ~54,810 cy (-54.8 cy/ft) of sand has been lost from May 2022 to July 2025.

Over the course of Year 3 (July 2024 to July 2025), the reach lost ~13,040 cy (-13.0 cy/ft)—a considerable improvement from the Year 1 trends. Within the reach, all the stations lost an average of 13.8 cy/ft last year. The reach currently holds 116,990 cy more sand than the pre-project condition, which is 66% of the nourishment volume.



FIGURE 4.19. Reach 5 extends from the central groin (background) to the northernmost groin (foreground).

Profiles show that sand has shifted higher along the berm, and the dune experienced significant growth in 2025 as sand fencing accumulates wind-blown sand along the toe of the dune. (Fig 4.20 upper). This has flattened the slope of the beach closer to the pre-project condition (Fig 4.20 lower). As of July 2025, all of the cap sections of Groin #1 were exposed above MLW (Fig 4.21).

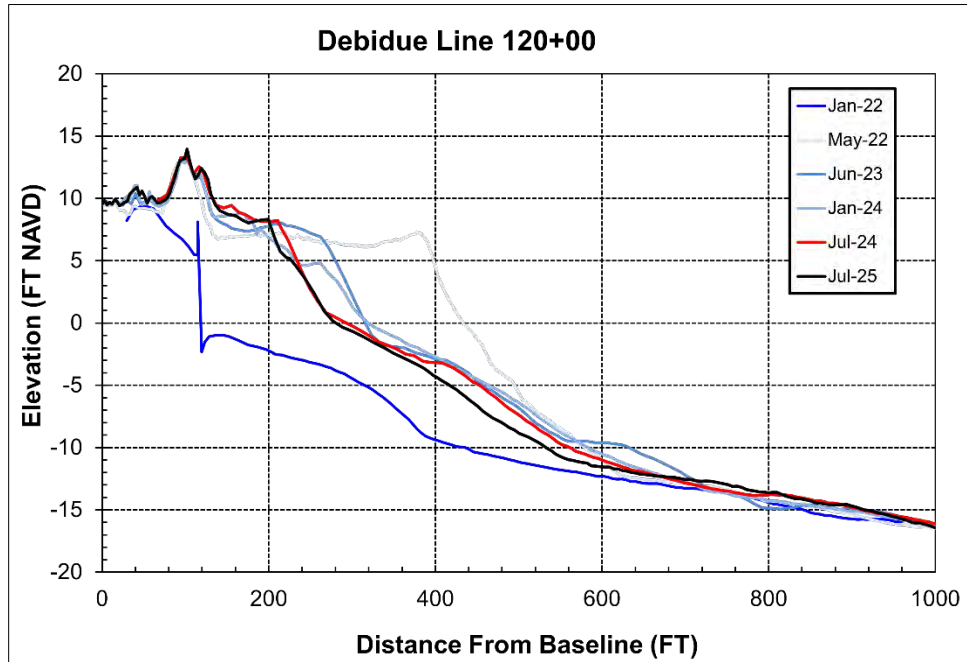


FIGURE 4.20. Between May 2022 and July 2025, the berm width in Reach 5 decreased by nearly 200 ft but these losses were partially balanced by volume increases along the submerged portion of the profile. Beach widths remain over 100 ft greater than the pre-project condition as of July 2025.



FIGURE 4.21. Groin #1 oblique aerial, July 2025. Much of the structure remains buried above MHW, allowing beach access alongshore at all tides.

4.6 Reach 6 – North Groin

The North Groin Reach (Reach 6) extends 1,400 lf between stations 126+00 and 140+00. It includes the area from Groin #1 north to a point between beach accesses 6 and 7 (Fig 4.22). While generally in better condition than Reach 5, most of this area had exposed seawall and limited beach access before the 2022 project. This reach, situated upcoast of the northernmost groin, will benefit from sand trapping of Groin #1 during the predominantly southern sediment transport observed at DeBordieu Beach.

Reach 6 gained 148,900 cy (106.4 cy/ft) of sand during the 2022 nourishment. Fill was tapered to the north, with the southern station gaining up to 161 cy/ft (Station 126+00) and the northern station receiving 71.1 cy/ft. Nourishment increased the beach width by ~250 ft at the southern end and ~200 ft at the north end. Year 1 erosion rates quickly decreased following project completion; the net Year 1 loss was ~32,000 cy (22.8 cy/ft), with 20.7 cy/ft lost in the first six months following the post-dredge surveys.

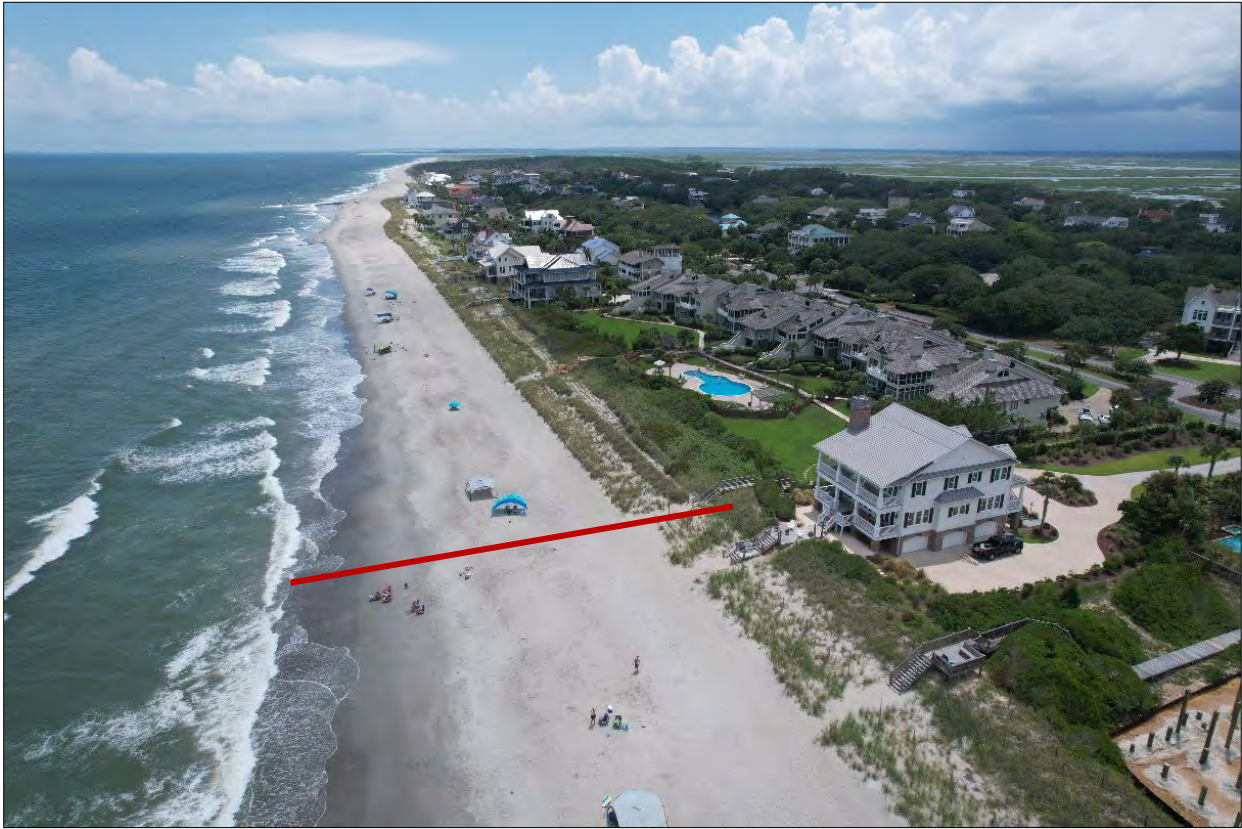


FIGURE 4.22. Reach 6 extends from the north groin (background) to Station 140+00 (foreground, highlight).

Reach 6 lost a total of ~16,330 cy (-11.7 cy/ft) of sand in Year 3. It currently holds 91,060 cy (65.0 cy/yr) more sand than the pre-project condition and retains 61% of the nourishment fill. The reach was fairly stable during Year 3 compared to the other two groin reaches. Ground photographs taken in July 2025 document vegetation recovery following Hurricane *Ian*, which at least momentarily exceeded the foredune crest elevation between the center and north groins (Fig 4.23 upper).

Although the southern portions of the reach received more nourishment sand, the greatest losses in Year 3 were measured near profiles 132+00 and 134+00. These two stations lost an average of ~63 cy/ft from May 2022 to July 2025, twice the average volume loss at the other five stations over the same period. Profiles and aerial images in this area show a shallow trough in the lower swash, as well as an offset in the post-project seaward limit of dune vegetation. This offset was part of the project design, as the fill template was tied into the pre-existing dune north of this area, and a new dune was sculpted south of this area. Following rapid erosion associated with the adjustment of the nourishment fill, the erosion of these stations has been consistent with other areas of the reach.

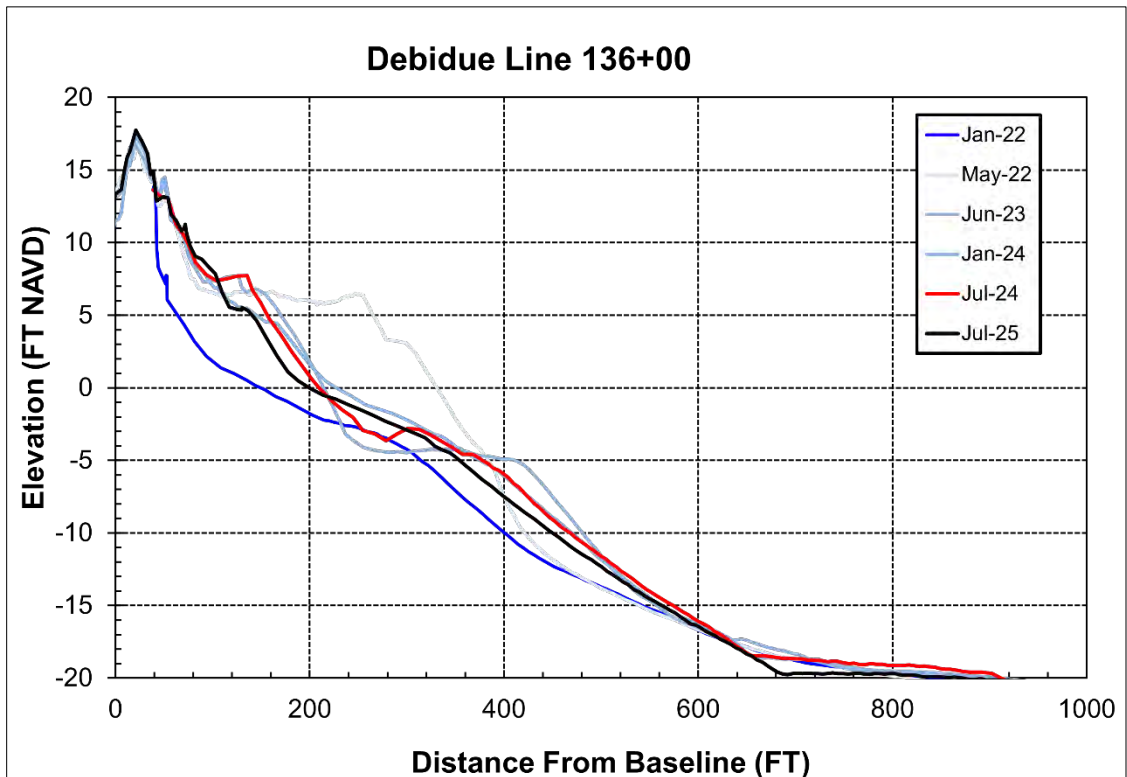


FIGURE 4.23. Beach widths remain significantly higher along Reach 6 than the pre-project condition as of July 2025, which should help these grasses re-establish naturally over the next couple of years.

4.7 Reach 7 - North DeBordieu

Reach 7 spans 4,500 ft of beach from the northern beach access to approximately 993 DeBordieu Blvd (stations 140+00 to 185+00). This area has historically been more stable than the southern end of the beach, and maintained a healthy dune field seaward of properties before the 2022 nourishment. Lower erosion rates and a healthier pre-project beach condition allowed for lower fill volumes to be placed along this stretch during the project. Additionally, CSE expected a portion of the sand placed around the groin area to shift to the north.

Approximately 89,700 cy of sand was added during the 2022 nourishment, and beach width increased 50–100 ft along most of the reach. Lateral spreading of the nourishment sand from the adjacent project areas resulted in Reach 7 gaining sand for the first six months following project completion. These gains, along with the lateral spreading of sand north from the groins, resulted in the reach containing 20,000 cy more sand in June 2023 (Year 1 post-project) than in May 2022 (post-project).

From July 2024 to July 2025, the reach lost 33,080 cy (–7.4 cy/ft). The reach has lost ~36,670 cy (–8.2 cy/ft) relative to the post-project condition. There is still 54,350 cy (12.1 cy/ft) more sand than the pre-project condition (60% of the nourishment sand remains) (Fig 4.25).

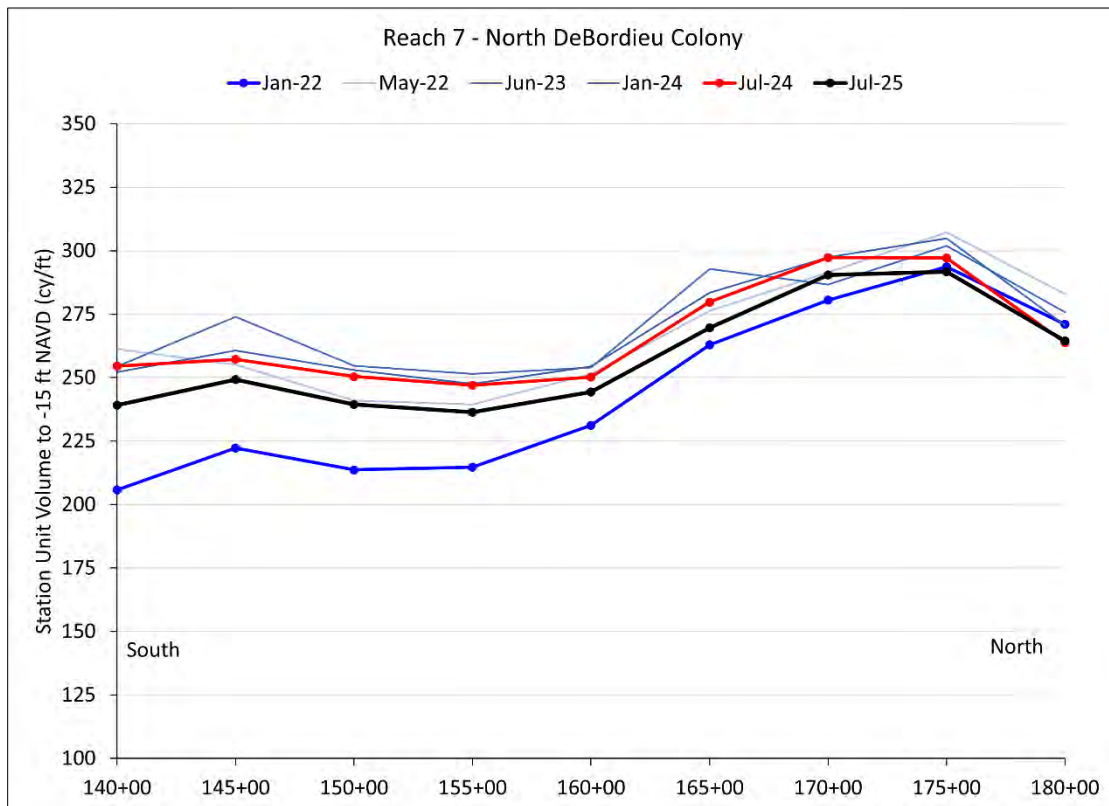


FIGURE 4.24. Volume changes from January 2022 to July 2025 along Reach 7.

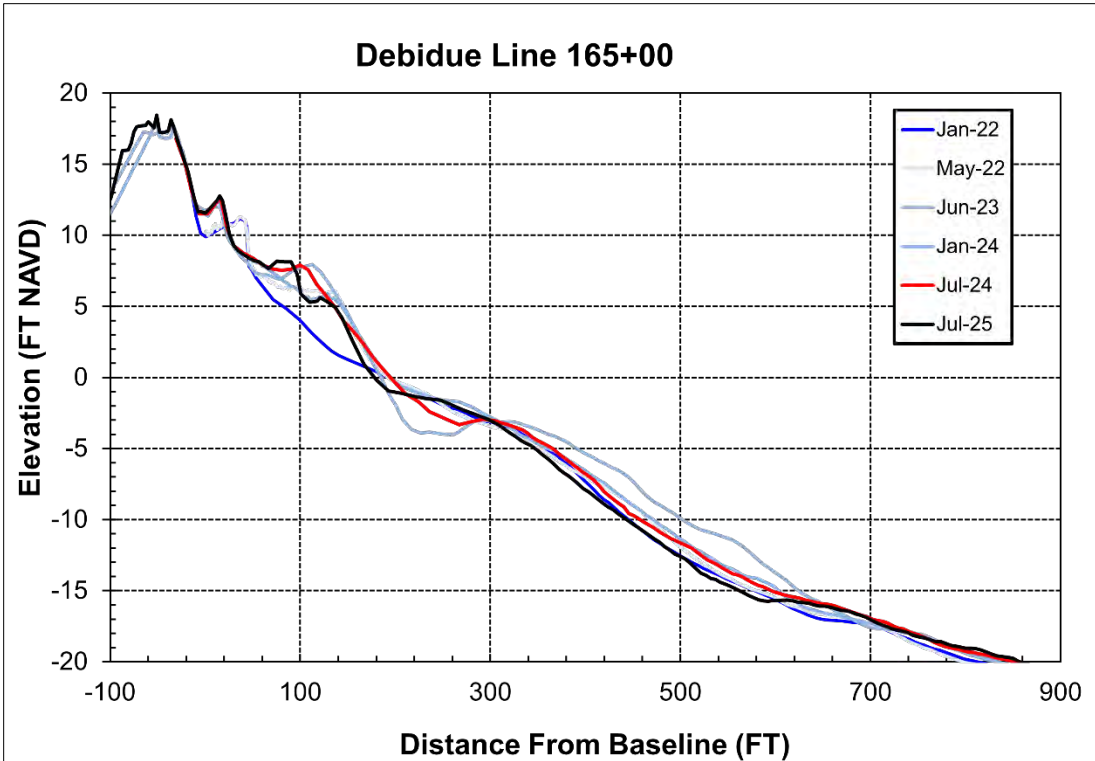


FIGURE 4.25. Ground photograph looking north taken in July 2025 at Station 165+00, along with profile showing pre- and post-project elevations at this location.

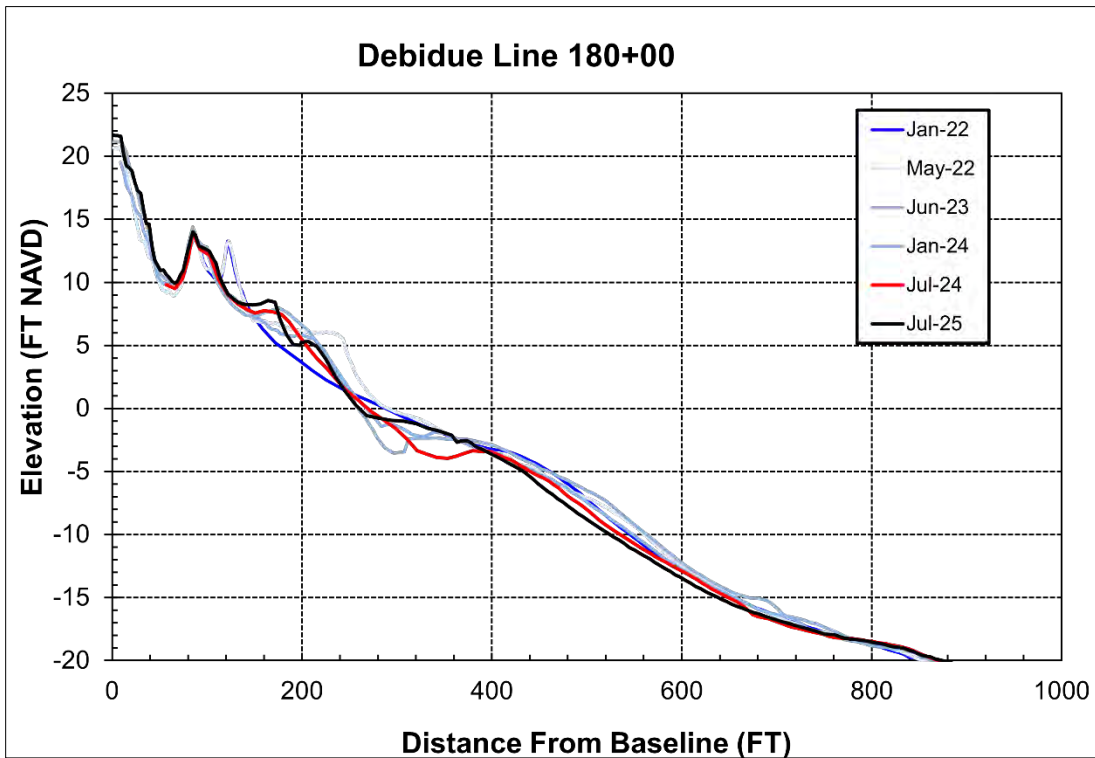


FIGURE 4.26. Ground photograph looking north at Reach 7, taken in July 2025 at Station 180+00, along with a profile showing pre- and post-project elevations at this location.

4.8 Reach 8 - Arcadia

Arcadia (Reach 8) extends 3,000 ft along the beach between the developed DeBordieu Colony and Prince George. There are no oceanfront structures along this section of the beach (Fig 4.27). This area has not been included in prior nourishment efforts sponsored by DeBordieu Colony; however, it has benefited from sand spreading laterally from the prior projects. The reach has been stable for the past 20 years, with the only significant erosional episodes associated with storm impacts.

Reach 8 lost ~11,900 cy (4.0 cy/ft) during the construction period and lost ~20,300 cy (6.8 cy/t) from May 2022 to June 2023, but gained 12,200 cy (4.1 cy/ft) of sand from June 2023 to July 2024. Reach 8 lost 17,130 cy (-5.7 cy/ft) of sand during survey Year 3 (July 2024 and July 2025). As of July 2025, Reach 8 lost ~25,220 cy (-8.4 cy/ft) of sand relative to May 2022.



FIGURE 4.27. Reach 8 extends from the north end of the fill template (background, highlight) to Station 215+00 (foreground).

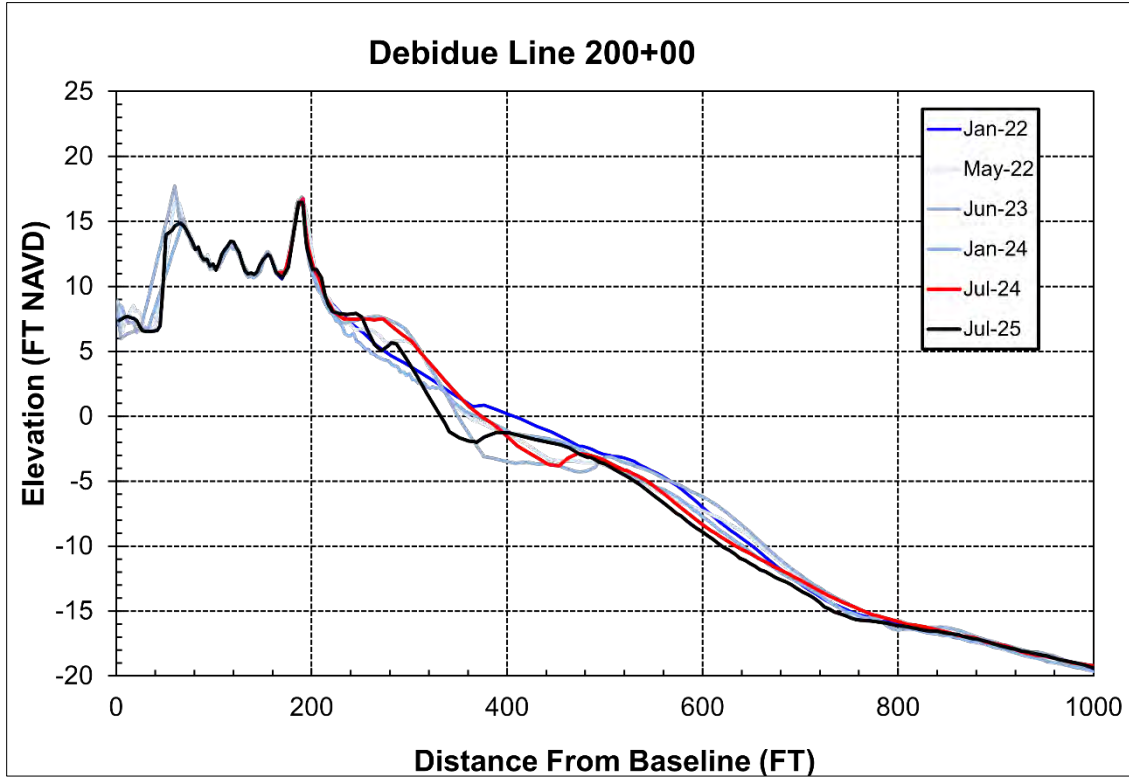


FIGURE 4.28. Ground photograph looking north in the middle of Reach 8 taken in July 2025 at Station 200+00, along with profile showing pre- and post-project elevations at this location.

4.9 Reach 9 – Prince George

The Prince George Reach spans 2,000 lf between stations 215+00 and 235+00, and fronts the Prince George Development. The north end of the reach abuts Pawleys Inlet, which has historically migrated north and south. Southerly migration of the creek led to the installation of a revetment fronting the road. Property owners recently installed additional revetment sections in the past 1–2 years. The majority of properties are well set back from the normal high tide line, with the exception being properties adjacent to the inlet (Fig 4.29).

This section of the beach has been accretional since project completion, gaining a total of 170,620 cy (113.7 cy/ft) of sand over the past three years (including 77,090 cy in the past year). Significant accretion along portions of Prince George is related to the southerly migration of Pawleys Inlet, which has migrated several hundred feet south in recent years. The inlet delta creates a ‘bulge’ of sand south of the inlet channel, which widens the beach and adds sand to the underwater profile. Over the past year, the inlet channel has migrated south to a point where the channel is seaward of beachfront properties and within the survey area. This is reflected in the high sand loss measured at Station 230+00, which was intersected by the channel in July 2025 (Fig 4.31).



FIGURE 4.29. Reach 9 extends along the developed portion of the Prince George Tract from the southernmost structure (foreground left) to Pawleys Inlet (background right). As of July 2025, Pawleys inlet had moved south into the developed portion of Prince George.

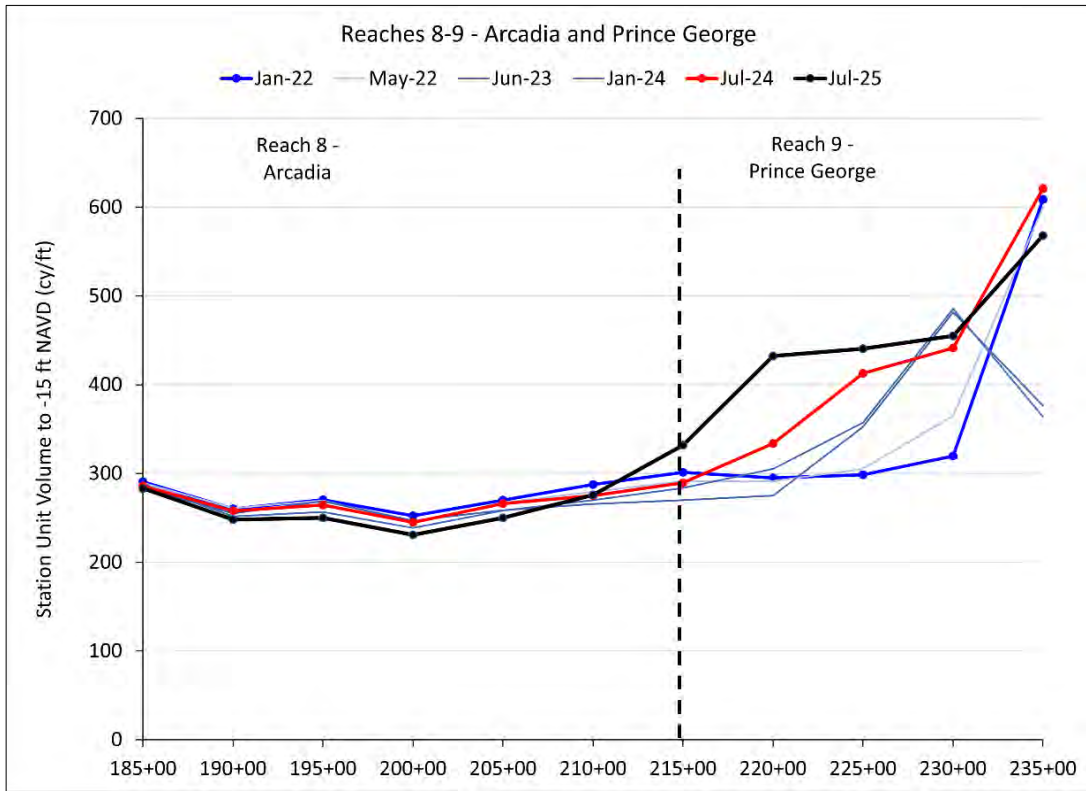


FIGURE 4.30. Volume changes along Reaches 8 and 9 from January 2022 to July 2025. Changes observed along Reach 9 are related to dynamics involving Pawleys Inlet rather than the DeBordieu nourishment project.

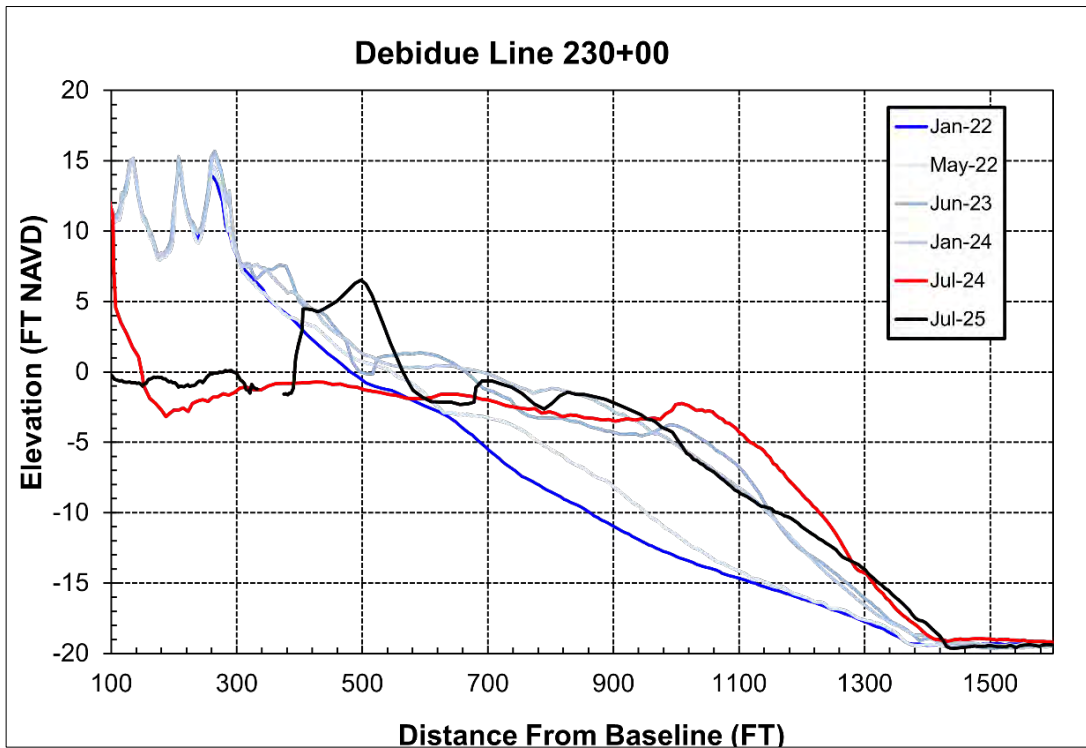


FIGURE 4.31. Considerable volume increases following project completion along the Prince George Reach are due to southerly deflection in the primary channel of Pawleys Inlet more than the Debidue project.

4.10 Volume Summary

The project area, spanning Reaches 4–7, lost a total of 83,760 cy (–9.9 cy/ft) cy in Year 3. This represents ~9.5% of the nourishment quantity and compares to a loss of 101,150 cy (11.9 cy/ft) in Year 1. Notably, the losses have mostly been restricted to the groin area, which was overfilled to provide construction access to the ends of the structures. Sand from this area has spread to the north and south, increasing beach volumes in the downdrift areas (Hobcaw Tract) and along the northern end of DeBordieu Colony (Fig 4.32).

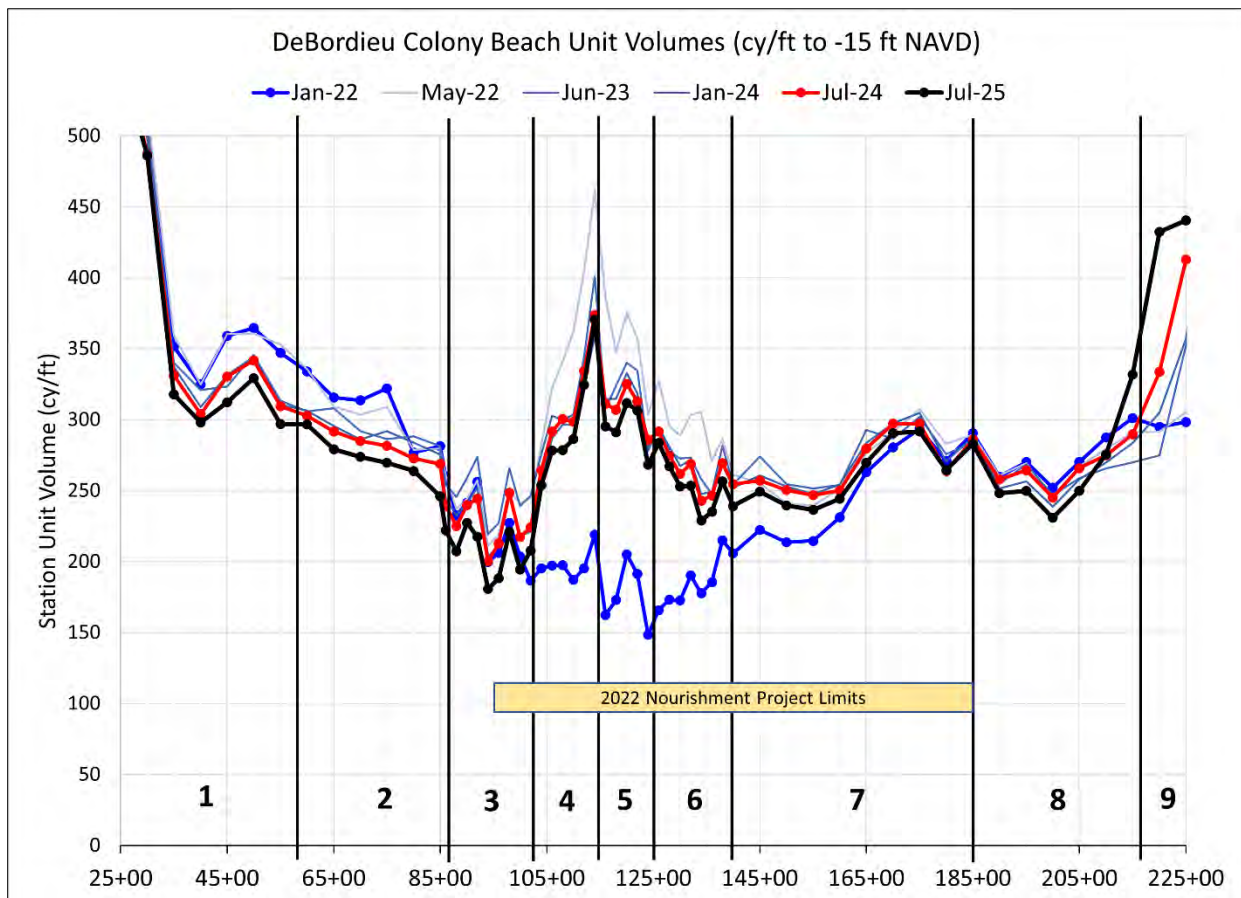


FIGURE 4.32. Pre- and post-project volume changes above –15 ft NAVD along all nine reaches monitored in connection with the 2022 project. Changes along Reaches 1, 2, and 9 are driven by inlet and shoal/bar dynamics associated with North and Pawleys Inlets, and do not yet exhibit any measurable changes that are definitively linked to the performance of the Debidue fill.

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5.0 GEOTECHNICAL SURVEYS

5.1 Bathymetry

CSE resurveyed the offshore borrow area in July 2025 and collected sediment samples to evaluate changes compared to the June 2023 and August 2022 surveys. Figure 5.1 shows the pre- and post-dredging bathymetry using a color-coded digital elevation model (DEM) developed from the field data collected at 100 ft line spacing. The pre-dredging DEM (4 April 2022) shows water depths of ~25–30 ft across the 288-acre borrow area. After dredging surveys show depths of around 30 ft within the cut areas (Fig 5.1). The typical cut depth was 3–4 ft, and approximately 115 acres (40%) of the borrow area was utilized. CSE resurveyed the borrow area in July 2023 using a multibeam sonar, which provides continuous high-resolution data. The data were used to prepare a series of DEMs. In July 2025, a single beam survey was conducted on 200 ft line spacing. However, it is important to note volumes measured from the higher-resolution multibeam data are necessarily a different measure than the older single-beam sonar (Fig 5.1). The July 2025 survey showed some changes in the borrow area with scouring compared to both the post-dredging survey and the Year 1 survey. The calculated differences in surface volumes over the entire borrow area are as follows:

2022	Pre-post Dredging	571,221 cy – Net Removal
2023	Post- to June 2023	13,264 cy – Net Additions
2025	June 2023 to July 2025	–25,356 cy – Net Deductions
	Net Change (2022 to 2025)	2.1% Scoured

5.2 Offshore Sediment

Mean grain size in the final borrow area for the project averaged 0.300 millimeters (mm) and generally ranged from ~0.25 mm to 0.45 mm, with shell content ranging from ~15 to 25%. Gravel-sized (or greater) sediment comprised <1% of the total borrow area, and fine-sized sediment was generally <1%. The similarity of the sand-size classes and shell content in sediment analyses for the recipient beach and the borrow areas suggested the sand would look and perform well once placed on the beach.

As part of the Year 3 survey, CSE collected 10 surficial sediment samples to evaluate the borrow area (Table 5.1). The average grain size of the borrow sediment was 0.374 mm. Shell content averaged about 13% in the borrow area. These values are in line with long-term average grain sizes and shell contents observed in and around Debidue, and indicate the seafloor substrate within dredged portions of the borrow area is not significantly different than before the project.

TABLE 5.1. Offshore sediment statistics for borrow area and control stations for Year 3 sampling efforts.

November Borrow Area Samples		Method of Moments						Folk Graphical Method					Fines	Granule	Gravel	Shell
		Mean	STD	Skew	Kurt	Mean	STD	Gmean	GSTD	GStd	Gskew	Gkurt				
Sample		φ				mm		φ					%			
Borrow Area	B 1	1.466	0.930	-0.469	3.358	0.362	0.525	1.417	0.925	0.925	0.073	0.977	0.0	2.6	0.0	15.5
	B 2	1.545	0.977	-0.480	2.488	0.343	0.508	1.448	1.043	0.970	-0.146	0.749	0.0	1.6	0.0	13.5
	B 3	2.195	0.810	-1.677	6.408	0.218	0.571	2.128	0.635	0.712	-0.450	1.360	0.0	1.0	0.0	10.6
	B 4	1.525	1.014	-0.586	3.055	0.348	0.495	1.452	1.005	1.005	-0.029	0.909	0.0	3.3	0.0	15.5
	B 5	1.333	1.004	-0.140	2.302	0.397	0.499	1.250	1.098	1.012	0.088	0.744	0.0	1.9	0.0	13.3
	B 6	1.060	0.727	-0.027	3.620	0.480	0.604	0.935	0.653	0.708	0.078	1.215	0.0	1.3	0.0	12.6
	B 7	2.048	0.749	-1.333	6.051	0.242	0.595	1.977	0.640	0.668	-0.238	1.047	0.0	0.9	0.0	6.9
	B 8	1.421	0.849	-0.722	4.126	0.374	0.555	1.378	0.793	0.824	0.017	1.194	0.0	2.7	0.0	17.5
	B 9	1.057	0.662	0.081	3.879	0.481	0.632	0.937	0.580	0.637	0.117	1.188	0.0	0.9	0.0	13.4
	B 10	1.008	0.722	0.196	3.586	0.497	0.606	0.877	0.648	0.706	0.144	1.225	0.0	1.1	0.0	11.0
Borrow Area Mean		1.466	0.844	-0.516	3.887	0.374	0.559	1.380	0.802	0.817	-0.034	1.061	0.0	1.7	0.0	13.0

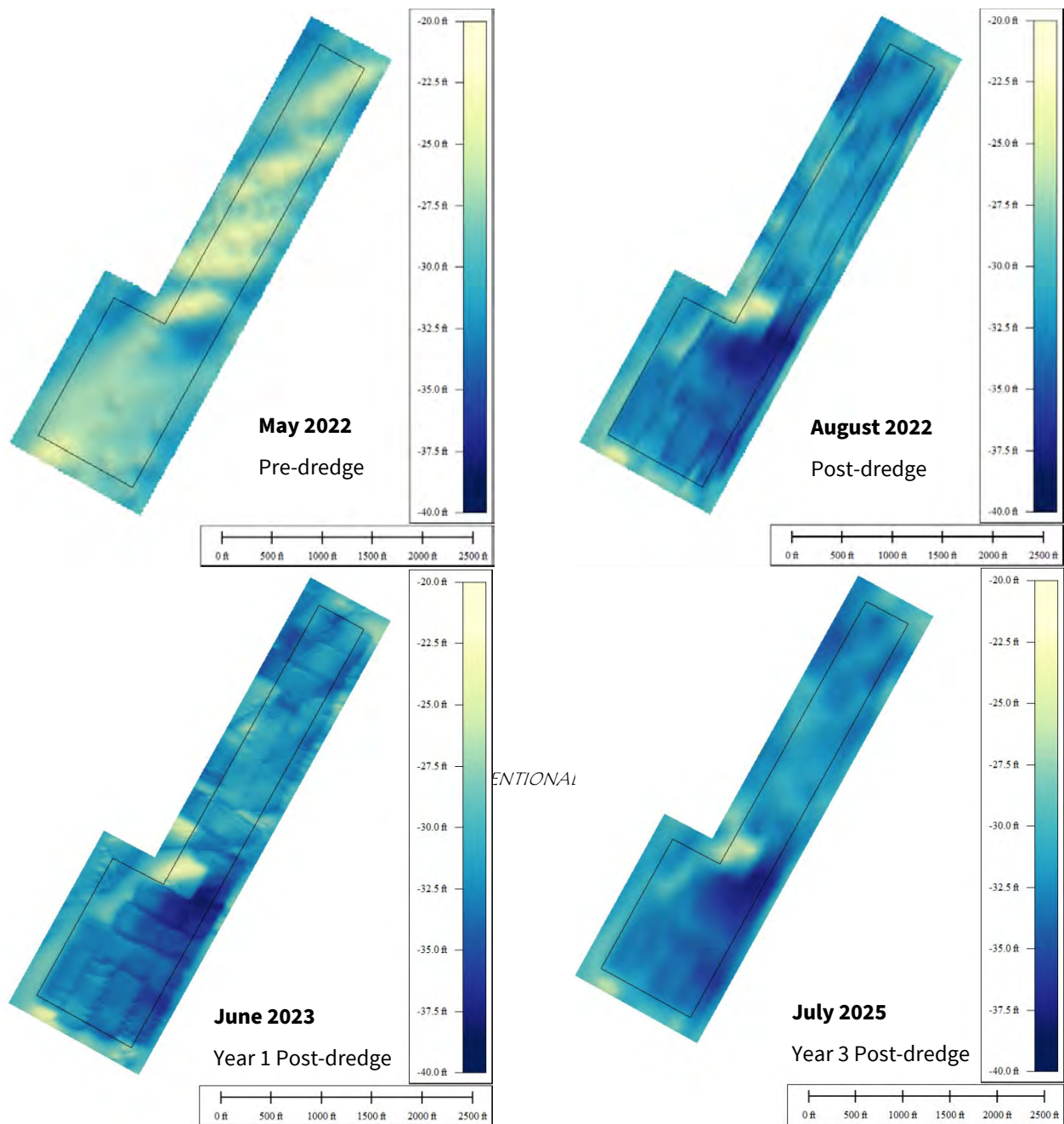


FIGURE 5.1. Borrow area bathymetry DEMs developed from raw survey data for pre-dredge (May 2022), post-dredge (August 2022), Year 1 post-dredging (June 2023), and Year 3 post-dredging (July 2025). The 2022 surveys were performed using single beam sonar at 100-ft line spacing. The 2023 data were collected by multi-beam sonar for continuous coverage of the bottom (~5 cm resolution). The 2025 data were collected by single beam sonar at 200-ft line spacing.

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6.0 Benthic Infauna Sampling

Benthic sampling will be updated at a later date. CSE was unable to complete benthic sampling in November when geotechnical sampling occurred. Benthic sampling will be conducted in the Spring of 2026 and will be included in a final amended version of this report.

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7.0 UPLAND AREAS ALONG THE HOBCAW TRACT

Amended special permit conditions for the 2022 project require monitoring and mitigating erosion along the Hobcaw Tract. Ongoing erosion rates are determined using the required annual survey data presented in Section 3, and specifically rely on two measures of change.

The first measure of erosion relies on the location of Mean High Water (MHW) within the Hobcaw Tract from the southernmost groin to 4,180 ft south of the southernmost groin. If the loss between year-to-year positions in the MHW contour attributable to the permitted groins exceeds 0.75 acres per year, mitigation will be required. MHW elevation is equal to 2.05 ft NAVD, taken from the datum established by NOAA at Oyster Landing in North Inlet. This measure monitors the landward migration of active beach area falling under state jurisdiction as a proxy for the loss of upland habitats along the Hobcaw Tract.

Annual measurement of the 2.05 ft NAVD contour is required in early summer each year and will be compared to a survey taken within one month before the beginning of the project. The pre-project survey was in January 2022; the same month work began on the groins. The Year 3 rate measured in July 2025 was -0.3 acres per year (Table 7.1). The position of the 2.05 ft NAVD contour from January 2022 (pre-project), Year 1 (June 2023), Year 2 (July 2024), and Year 3 (July 2025), shown in Figure 7.1, demonstrates that there has been no excessive erosion caused by the project along the Hobcaw Tract since project completion. Rather, the erosion observed along the southern Hobcaw Tract is a result of the natural overwash just south of the area, which has a tendency to shift the MHW contour landward (Figure 7.2).

The second measure of erosion is a volumetric change rate determined using the annual beach monitoring surveys. If the running average erosion rate from the southernmost groin to 1,600 ft south of the southernmost groin exceeds the rate of -6 cubic yards per foot per year (cy/ft/yr), and the erosion is attributable to the permitted groins, mitigation will be required. Mitigation will also be necessary if the running average erosion rate from 1,600 ft south of the southernmost groin to 4,180 ft south of the southernmost groin exceeds the rate of -6 cy/ft/yr and the erosion is not attributable to the permitted groins (Figure 7.3). The rates for the second erosion measure are determined using the annual survey in early summer each year. The running average erosion rates are calculated by determining the difference in volume between each survey and the January 2022 pre-dredge survey and dividing that volume by the time elapsed between each survey and January 2022. Volume changes from the southernmost groin to 1,600 ft south of the southernmost groin measured -1.6 cy/ft/yr from January 2022 to July 2025. Volume changes from 1,600 ft south of the southernmost groin to 4,180 ft south of the southernmost groin, measured -10.2 cy/ft/yr from January 2022 to July 2025 (Table 7.1).

TABLE 7.1. Acreage changes above MHW [UPPER], along with unit volume changes above -15 ft NAVD [LOWER] along Hobcaw Tract. These measures are the permit-required monitoring for downcoast impacts of the Debidue groins on Hobcaw Tract.

	Station	Dist to Next	Distance to +2.05 ft NAVD								Change Since Jan-22 (ft)							Change Since Jan-22 (ac)																		
			Jan-22	May-22	Aug-22	Oct-22	Feb-23	Jun-23	Jan-24	Jul-24	Jul-25	May-22	Aug-22	Oct-22	Feb-23	Jun-23	Jan-24	Jul-24	Jul-25	May-22	Aug-22	Oct-22	Feb-23	Jun-23	Jan-24	Jul-24	Jul-25									
1,600 to 4,180 feet south	65+00	500	178.0	174.9	200.8	191.8	177.7	190.7	191.8	177.8	170.8	-3.1	25.9	-9.0	-14.1	13.0	1.0	-14.0	-7.2	-0.08	0.35	0.23	0.08	0.15	0.14	-0.05	-0.15									
	70+00	500	162.6	151.2	201.6	189.6	177.6	175.4	172.4	153.4	142.9	-11.4	50.4	-12.0	-12.0	-2.2	-3.0	-19.0	-19.7	-0.12	0.55	0.28	0.18	0.12	0.21	-0.09	-0.10									
	75+00	500	137.8	128.1	194.8	159.9	154.9	145.2	164.7	131.4	139.3	-9.8	66.8	-35.0	-5.0	-9.7	19.5	-33.3	1.4	-0.08	0.77	0.38	0.34	0.10	0.38	0.02	-0.16									
	80+00	500	111.6	107.4	189.5	155.3	153.0	122.2	150.6	122.2	82.5	-4.2	82.0	-34.1	-2.3	-30.9	28.5	-28.4	-29.1	-0.06	0.76	0.58	0.49	0.18	0.43	0.12	-0.38									
	85+00	100	83.6	76.7	137.5	140.6	127.9	104.4	119.5	93.5	46.9	-6.9	60.8	3.2	-12.8	-23.5	15.1	-26.0	-36.6	0.00	0.12	0.14	0.11	0.06	0.09	0.03	-0.08									
	86+00	200	84.0	87.5	130.6	150.9	136.6	117.6	127.6	95.9	53.1	3.6	43.1	20.3	-14.3	-19.0	10.0	-31.7	-30.9	0.03	0.21	0.34	0.25	0.18	0.22	0.07	-0.13									
1,600 feet south	88+00	200	82.0	89.8	126.4	163.3	138.3	127.2	133.7	99.2	55.9	7.7	36.7	36.8	-24.9	-11.1	6.5	-34.5	-26.1	0.04	0.22	0.37	0.26	0.20	0.22	0.08	-0.12									
	90+00	200	75.4	84.9	127.2	155.9	131.2	116.2	119.1	92.4	47.2	9.5	42.3	28.8	-24.7	-15.0	2.8	-26.7	-28.2	0.06	0.26	0.37	0.26	0.22	0.22	0.08	-0.12									
	92+00	200	72.6	87.4	133.0	155.2	129.1	125.6	123.3	91.6	50.1	14.8	46.6	22.2	-26.1	-3.5	-2.4	-31.7	-22.5	0.11	0.30	0.41	0.30	0.24	0.25	0.10	-0.09									
	94+00	200	71.2	106.4	143.7	166.3	144.6	124.8	130.1	97.8	52.4	35.2	37.3	22.6	-21.7	-19.8	5.3	-32.3	-18.9	0.23	0.35	0.44	0.35	0.26	0.25	0.13	-0.08									
	96+00	200	68.7	133.3	150.9	164.2	149.3	128.7	120.8	97.0	54.0	64.7	17.5	13.3	-14.9	-20.6	-7.9	-23.8	-14.7	0.34	0.39	0.45	0.37	0.28	0.23	0.12	-0.06									
	98+00	200	67.6	152.2	156.8	169.2	150.2	131.1	116.4	92.6	54.3	84.6	4.6	12.4	-19.0	-19.1	-14.7	-23.8	-13.3	0.44	0.46	0.50	0.40	0.32	0.25	0.14	-0.05									
100+00	200	64.8	173.9	176.7	179.9	156.0	140.3	126.7	103.0	56.0	109.1	2.8	3.2	-23.9	-15.7	-13.6	-23.7	-8.8	0.59	0.58	0.58	0.44	0.38	0.32	0.23	0.02										
102+00	200	66.0	212.6	206.2	203.2	165.7	156.3	142.8	126.0	83.6	146.7	-8.4	-3.0	-37.5	-9.4	-13.6	-16.8	17.7	0.78	0.72	0.70	0.55	0.47	0.43	0.36	0.20										
104+00	200	65.1	257.5	239.3	231.0	204.4	177.8	173.5	162.2	132.9	192.4	-18.2	-8.3	-26.6	-26.6	-4.3	-11.3	67.8	0.96	0.83	0.82	0.71	0.55	0.53	0.46	0.26										
Total Change (acres)																			3.23	6.89	6.89	5.09	3.70	4.17	1.80	-1.06										
Annualized Change (acres/year)																			9.82	11.86	8.80	4.87	2.61	1.21	0.72	-0.30										
	Station	Dist to Next	Unit Volume to -15 ft NAVD (cy/ft)								Total Volume Change Since Jan-22 (cy)							Annualized Unit Volume Change Since Jan-22 (cy/ft/yr)																		
			Jan-22	May-22	Aug-22	Oct-22	Feb-23	Jun-23	Jan-24	Jul-24	Jul-25	May-22	Aug-22	Oct-22	Feb-23	Jun-23	Jan-24	Jul-24	Jul-25	May-22	Aug-22	Oct-22	Feb-23	Jun-23	Jan-24	Jul-24	Jul-25									
1,600 to 4,180 feet south	65+00	500	315.6	309.1	304.8	299.4	300.0	308.0	295.6	291.8	279.1	-4,135	-4,955	-7,346	-7,902	-7,340	-11,900	-13,150	-19,111	-19.8	-18.6	-21.7	-15.0	-5.4	-10.2	-9.6	-10.4									
	70+00	500	313.7	303.6	304.7	300.5	297.7	291.9	286.1	284.9	273.7	-5,770	-3,103	-8,774	-9,755	-14,323	-14,380	-17,247	-23,061	-30.5	-15.5	-17.6	-15.2	-15.3	-14.0	-11.6	-11.4									
	75+00	500	322.0	308.9	318.5	300.0	298.9	286.4	292.0	281.8	269.7	-2,789	3,200	-5,240	-5,077	-6,095	-5,780	-11,104	-16,345	-39.7	-5.9	-29.3	-22.0	-25.1	-15.2	-16.2	-14.9									
	80+00	500	277.0	278.9	293.2	278.0	279.8	288.2	283.8	272.8	264.0	32	6,650	1,305	1,679	2,764	200	-4,223	-12,118	5.7	27.9	1.3	2.6	7.9	3.5	-1.7	-3.7									
	85+00	100	281.5	279.7	291.9	285.7	285.4	281.4	275.5	268.8	246.1	-33	972	36	-283	-306	-1,064	-1,664	-3,672	-5.4	17.9	5.7	3.8	-0.1	-3.0	-5.1	-10.1									
	86+00	200	260.0	261.1	269.1	256.5	250.4	254.0	244.7	239.4	222.0	565	2,595	1,107	312	704	-1,527	-2,809	-6,328	3.4	15.6	-4.7	-9.2	-4.2	-7.8	-8.3	-10.8									
1,600 feet south	88+00	200	232.6	237.1	249.5	247.2	245.3	245.6	232.6	225.1	207.3	741	2,823	3,279	2,535	3,082	-2	-919	-3,834	13.8	29.1	19.5	12.2	9.2	0.0	-3.0	-7.2									
	90+00	200	241.4	244.3	253.8	259.6	254.0	259.2	241.4	239.7	227.3	396	2,780	3,705	2,948	3,535	-446	-1,354	-5,267	8.7	21.3	24.3	12.1	12.5	0.0	-7.0	-4.0									
	92+00	200	256.3	257.4	271.7	275.1	273.1	273.8	251.8	244.4	217.7	1,243	4,480	4,419	3,689	3,719	.75	-1,139	-5,746	3.3	26.6	25.2	16.1	12.4	-2.2	-4.8	-11.0									
	94+00	200	199.7	211.1	229.2	225.1	219.8	219.4	203.4	200.2	180.9	2,413	6,275	5,680	4,556	4,058	926	711	-3,671	34.5	50.7	33.9	19.1	13.8	1.9	0.2	-5.4									
	96+00	200	206.2	219.0	239.5	237.7	231.8	227.2	211.8	212.9	188.4	3,529	7,187	7,155	5,866	5,937	2,442	2,787	-2,439	38.9	57.3	42.1	24.4	14.8	2.8	2.7	-5.1									
	98+00	200	227.4	249.9	266.0	267.5	260.5	265.8	246.2	248.6	220.8	5,961	8,699	8,427	6,919	7,397	3,331	3,479	-1,581	68.4	66.4	53.6	31.7	27.1	9.6	8.5	-1.9									
100+00	200	203.7	240.9	252.2	247.9	239.8	239.3	218.2	217.3	194.5	9,527	11,516	10,321	8,703	9,534	4,888	5,095	1,187	112.9	83.4	59.1	34.4	25.1	7.3	5.5	-2.6										
102+00	200	186.8	244.9	253.5	245.8	237.7	246.5	221.2	224.2	207.9	14,509	15,813	14,508	12,950	14,014	9,418	10,654	7,959	176.9	114.9	78.9	48.7	42.2	17.5	15.0	6.0										
104+00	200	195.3	282.2	286.7	281.3	273.8	275.7	255.1	264.5	253.8	21,231	20,904	20,343	18,721	18,699	14,929	16,361	13,953	264.4	157.4	115.0	75.0	56.7	30.3	27.8	16.6										
1600 to 4180 ft south			295.0	290.2	297.0	286.7	285.4	285.0	279.6	273.2	259.1	-12,131	5,360	-18,912	-21,027	-24,597	-34,451	-50,196	-80,636	-14.4	3.6	-11.1	-9.2	-7.0	-7.8	-8.7	-10.2									
1600 ft south			216.6	243.0	255.8	254.1	248.4	250.3	231.3	230.8	211.0	59,551	80,587	77,838	66,888	69,874	35,412	35,675	461	80.2	67.4	50.2	30.4	23.8	7.5	5.7	-1.6									

The rate of change within 1,600 ft of the southernmost groin is fully compliant with permit conditions. Although the rate of change between 1,600 ft and 4,180 ft south of the groins is nominally in excess of the erosion levels stated in the permit, an assessment of the changes by station along this portion of the island reveals the losses measured along the South Hobcaw beach are not attributable to the permitted groins but to overwash along Debidue Spit most recently initiated by Hurricane *Ian* and resulting shoreline adjustments. Positive volume changes closer to the groins demonstrate the erosion occurring farther south is not caused by the structures but is driven by natural changes along Debidue Spit.

The erosional hot spot that is occurring in Reaches 1 and 2 - as reflected on Figures 4.4, 4.8, and 4.32, and in the volume tables contained in Appendix A - is distinct from volume changes related to the project and 'natural' background conditions. If overwash events continue and result in a more permanent breach along Debidue Spit, the 'natural' background conditions along Hobcaw Tract will be fundamentally changed, irrespective of any downdrift impacts from the project. The Hobcaw Tract may see accelerated erosion immediately after a breach due to storm events or other natural or weather events, as the newly created channels and shoals draw off beach sand and equilibrate to wave and wind conditions. If a breach does occur, DCCA should engage with regulators to revisit the quantitative measures of shoreline change in the permit special conditions described above.

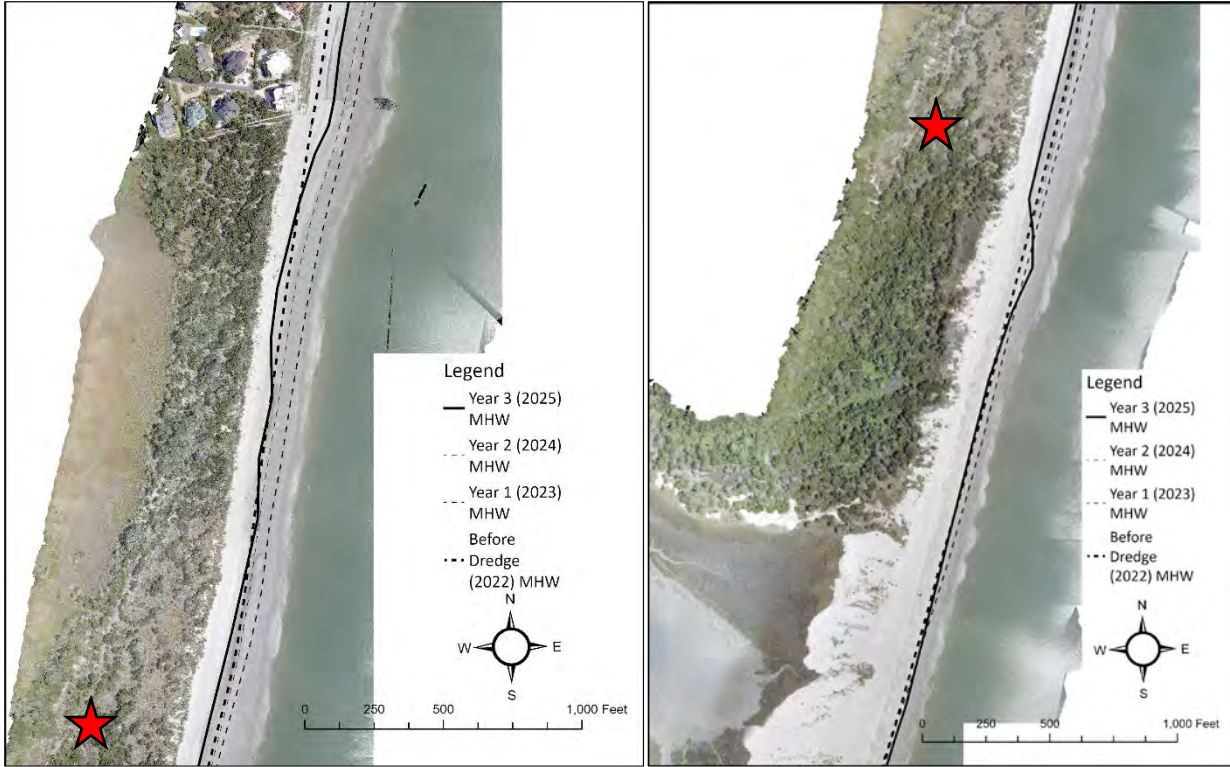


FIGURE 7.1. Position of the MHW (+2.05 ft NAVD) contour as measured in January 2022 (pre-project), June 2023 (one year post-project), July 2024 (two years post-project), and July 2025 (three years post-project).



FIGURE 7.2. A naturally occurring overwash area at the south end of the Hobcaw Tract is actively drawing sand off the beach and influencing year-to-year erosion rates along the southern end of the groin monitoring area of the project.

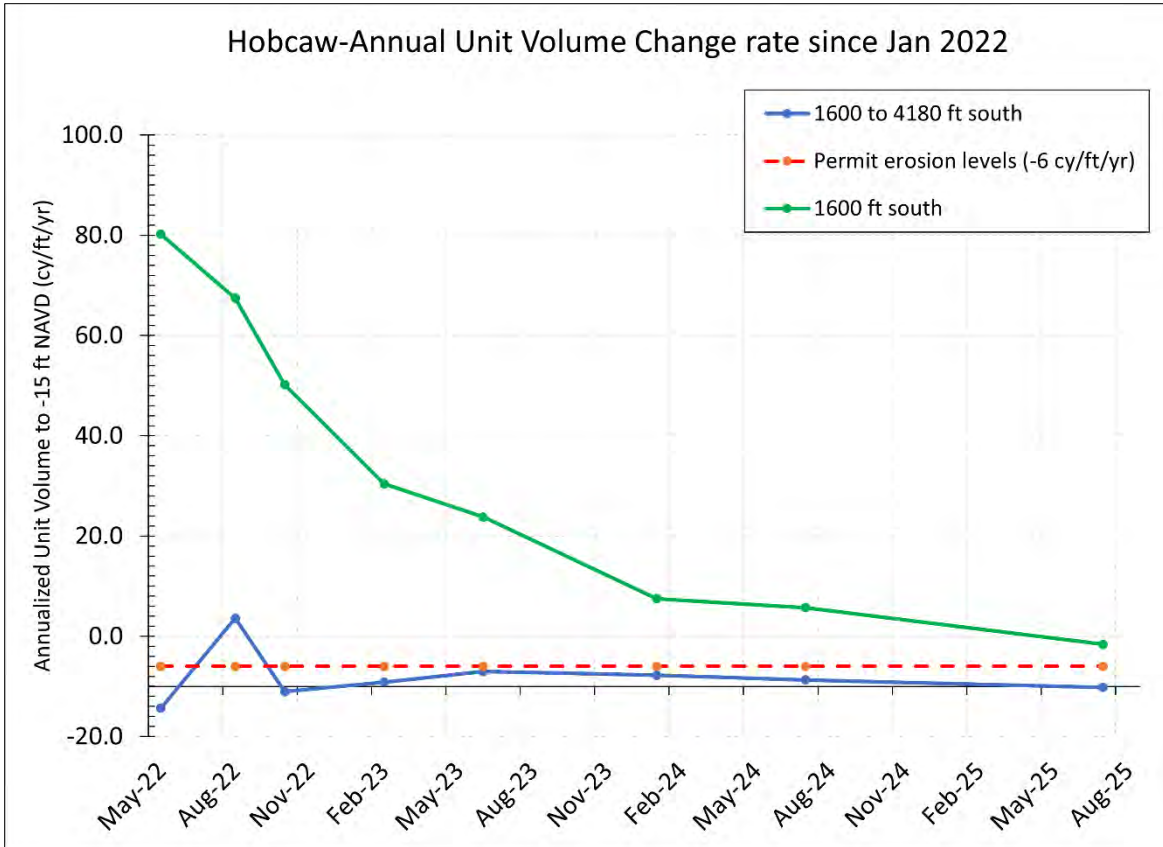


FIGURE 7.3. Annualized unit volume changes of the Hobcaw Tract since pre-project conditions (Jan 2022).

8.0 CONCLUSIONS

This report contains the results of the 2025 (Year 3) beach monitoring program following the 2022 beach restoration and groin construction project at Debidue Beach. The beach monitoring program tracks beach and borrow area volume changes, borrow area and beach sediment characteristics, benthic infauna population changes, and erosion rates along the Hobcaw Tract.

In that order, the results of each of these parts of the monitoring program are:

- **Project Area (beach) volume changes**

- The fill template lost 246,870 cy from May 2022 to July 2025. This represents ~38% of the project volume.
- More than 50% of these losses occurred between August 2022 and February 2023, when a direct hit from Hurricane *Ian* and multiple winter storms impacted the project area. Losses between June 2023 and July 2024 were negligible by comparison.

- **Erosion rates along Hobcaw Tract**

- From January 2022 to July 2025, the Hobcaw Tract lost 0.3 acres per year above 2.05 ft NAVD'88. Permit conditions require mitigation only if erosion exceeds -0.75 acres per year for two consecutive years.
- From July 2024 to July 2025, the Hobcaw Tract lost 1.6 cy/ft/yr within 1,600 ft south of the southernmost groin and lost 10.2 cy/ft/yr from 1,600 ft south of the groin to 4,180 ft south of the groin. Permit conditions require mitigation if the running average erosion rate from 1,600 to 4,180 ft south of the southernmost groin exceeds 6 cy/ft/yr and is attributable to the permitted groins.
- Although the erosion measured from 1,600 to 4,180 ft south of the groins exceeds 6 cy/ft/yr, it can be demonstrated that these changes are not attributable to the permitted groins; rather, these losses are attributed to overwash along Debidue Spit, drawing sand from South Hobcaw towards North Inlet.
- If these overwash events continue and result in a more permanent breach along Debidue Spit, the established background rates of erosion along this portion of the shoreline should be reevaluated to ensure the permitted project is not adjudged by erosion resulting from natural changes to the barrier island that are unrelated to the project.

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