LIVE OAK POINT LIVING SHORELINES

2024 (Fall) Project and Reference Site Monitoring Report

USACE Permit No.:	SAJ-2011-00287
FDEP Permit No.:	0387876-001-EI-66
Permittee:	Northwest Florida Water Management District 81 Water Management Drive Havana, FL 32333-4712 POC: Robert Lide (robertlide@nwfwater.com)
Entity Conducting Monitoring: (Vegetation Only; All Other Monitoring Conducted by NWFWMD Staff)	Choctawhatchee Basin Alliance of Northwest Florida State College 109 South Greenway Trail Santa Rosa Beach, FL 32459-5415 POC: Rachel Gwin (gwinr@nwfsc.edu)
Project Location:	Live Oak Point Salt Marsh 30.43° North, -86.25° West (Project Site) 30.42° North, -86.27° West (Reference Site) Approximately 2 ½ Miles NW of Santa Rosa Beach Walton County, Florida

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Synopsis

Live Oak Point contains the largest salt marsh system (approximately 1,000 acres) in Choctawhatchee Bay. However, its ecological integrity and long-term survival has been threatened by ongoing erosion and shoreline retreat. Analysis of historic aerials indicates that, since 1941, the salt marsh has retreated up to 300 FT along the northern edge. In situ measurements and analysis of recent digital orthophoto quads (DOQs) show that, prior to construction of breakwaters in 2021 – 2022, shoreline retreat averaged >4 FT per year.

The objectives of the Live Oak Point Living Shorelines (LOPLS) project are 1) halting loss of salt marsh habitat at Live Oak Point, 2) restoring salt marsh habitat in a strip parallel to the current shoreline protected by limerock breakwaters, and 3) enhancing existing salt marsh habitat via improved buffers. To achieve these objectives, a living shoreline is being implemented along the northern edge of the Live Oak Point salt marsh.[1] Initial observations strongly suggest that, where breakwaters have been constructed, trajectories have been established that will result in all objectives being achieved.

New construction of approximately 3,680 FT of limerock breakwaters has been implemented at the project site (completed Fall 2022). An additional 990± FT of shoreline will be protected by "Oyster Castle" concrete blocks (construction with "Oyster Castle" blocks began October 2024 and is anticipated to be completed no later than Spring 2025). Several limerock breakwater segments with excessive settling into mucky sediments were rehabbed with additional rock in October/November 2024. Plantings of salt marsh vegetation (*Spartina patens, Juncus roemarianus, Spartina alterniflora*) have been implemented along approximately 1,000 FT of shoreline, with additional plantings scheduled for 2025. Experience gained at LOPLS has demonstrated that planting prior to completion of breakwater segments is generally not successful with plants highly susceptible to washout. Barring unforeseen events (e.g., major storms; lack of available plants), full completion of this project is anticipated in 2025.

The Live Oak Point Living Shorelines project is a component of the Northwest Florida Water Management District (NWFWMD) In-Lieu Fee (ILF) mitigation program (USACE Permit SAJ-2011-00287) and is expected to generate, upon full completion, 2.61 estuarine mitigation credits. Any credit generated will be reserved for the sole use by the Florida Department of Transportation (FDOT).

[1] The NWFWMD has contracted with the Choctawhatchee Basin Alliance of Northwest Florida State College (CBA) to implement the Live Oak Point Living Shorelines project. Limerock breakwaters (approximately 3,680± FT, including planned gaps between breakwater segments) were constructed 2021 – 2022. "Oyster Castle" blocks are being used to complete approximately 990± FT of shoreline where limerock breakwaters were not able to be constructed due to the requirement to avoid impacts to submerged aquatic vegetation (SAV). "Oyster Castle" blocks can be precisely placed and more easily avoid causing impacts to SAV. Construction with "Oyster Castles" began October 2024. Planting of supplemental marsh species in appropriate areas will resume in Spring 2025. Full project completion is anticipated in 2025.

This 2024 (Fall) Project and Reference Site Monitoring Report has been developed to comply with federal and state monitoring requirements. It is the seventh monitoring report for the reference site and the third monitoring report for the project area (monitoring of the project area, as planned, commenced after limerock breakwater construction was completed and substantial planting of salt marsh vegetation had occurred). Parameters for the Fall 2024 project and reference site monitoring are vegetation cover, sediment accretion, panoramic and general photo documentation. The reference site has similar geomorphology, tidal range, elevations, and vegetation community structure when compared with the project site (the reference site is located approximately 3,000 FT southwest of the project site).

Results of the Fall 2024 vegetation monitoring indicate strong similarity between the project site and the reference site. The Sorensen's Similarity Index comparing the project site with the reference site is 0.92 (1 = perfect similarity; 0 = no similarity). Vegetation diversity is limited at both sites (Simpson's Diversity Index at the Project Site = 0.70; Simpson's Diversity Index at the Reference Site = 0.69).[2] At both the project and reference sites, the low marsh is dominated by *Spartina alterniflora*, the mid marsh is dominated by *Spartina patens*, and the high marsh is dominated by *Juncus roemerianus*). At the project site, sediment is generally accumulating behind the newly constructed breakwaters, with *Spartina alterniflora* expanding in places. Oyster colonies are rapidly becoming established on the breakwaters and submerged aquatic vegetation (SAV), primarily *Halodule wrightii*, has moved in behind breakwaters in multiple locations.

Planted vegetation has generally done well in locations protected by limerock breakwaters. However, where breakwaters are absent (i.e., where breakwaters were not constructed due to SAV-avoidance concerns), planted vegetation has generally washed out. Expectations that multiple rows of sandbag plantings (i.e., sandbags with three vegetation plugs per bag) would be sufficient to stop erosion where breakwaters were not constructed were not realized. Corrective measures are being implemented making use of "Oyster Castle" blocks along approximately 990± FT of shoreline where limerock breakwaters were not constructed.[3]

All monitoring reports for the Live Oak Point Living Shorelines project site and reference site are posted at https://www.nwfwater.com/Water-Resources/Regional-Wetland-Mitigation-Program/Regional-Mitigation-Plan/NWFWMD-Mitigation-Sites/Choctawhatchee-Watershed-Mitigation-Sites/Live-Oak-Peninsula-ILF/Living-Shorelines or any successor website.

[2] A Simpson's Diversity Index of 0 = infinite diversity; a Simpson's Diversity Index of 1 = no diversity.

[3] Because of the geometries of "Oyster Castles," they can be positioned more precisely with less potential of disturbance to nearby SAV when compared to lose limerock. Breakwater construction using "Oyster Castle" blocks began October 2024 and is expected to be completed by Spring 2025.

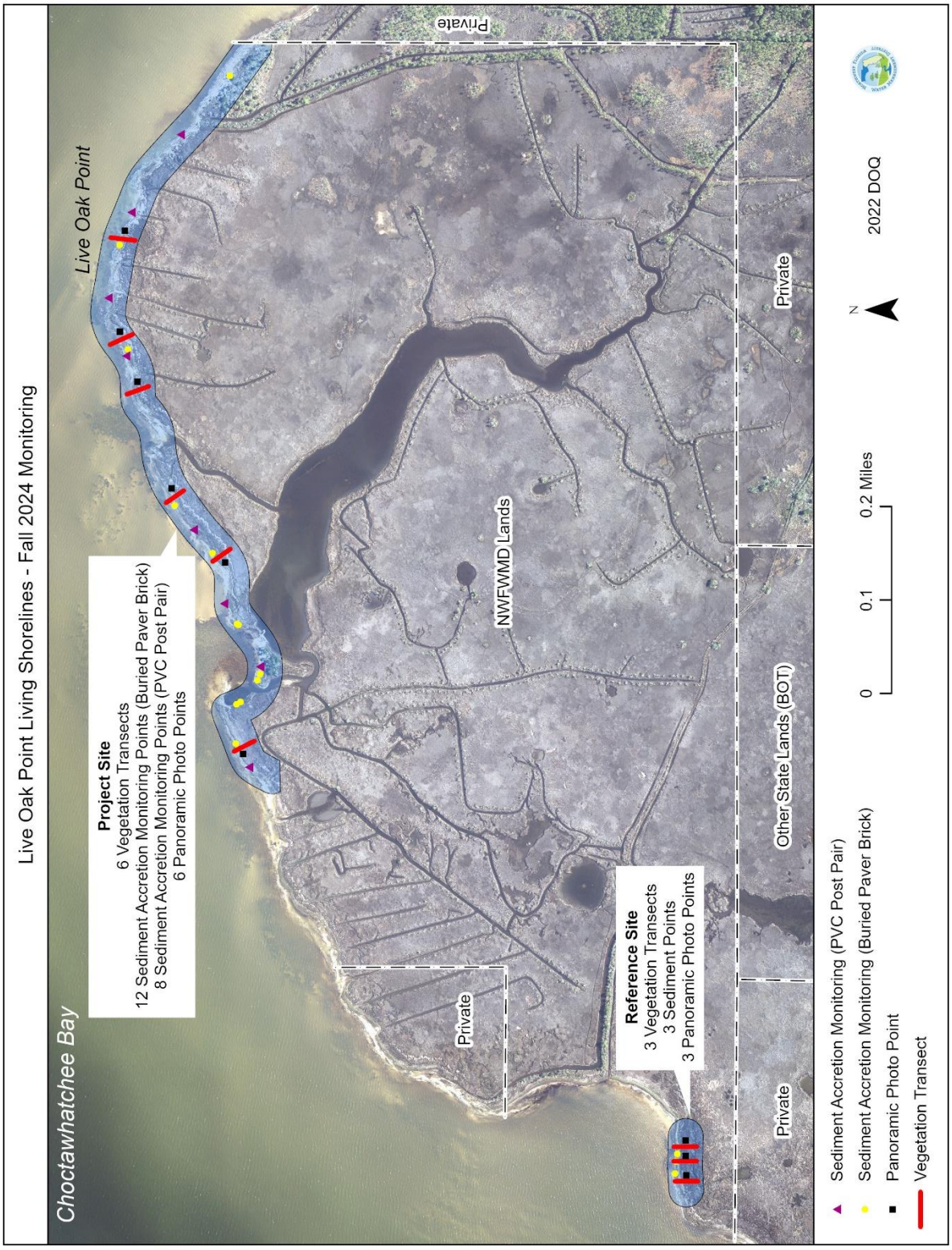

Figure 1. Fall 2024 Monitoring Overview

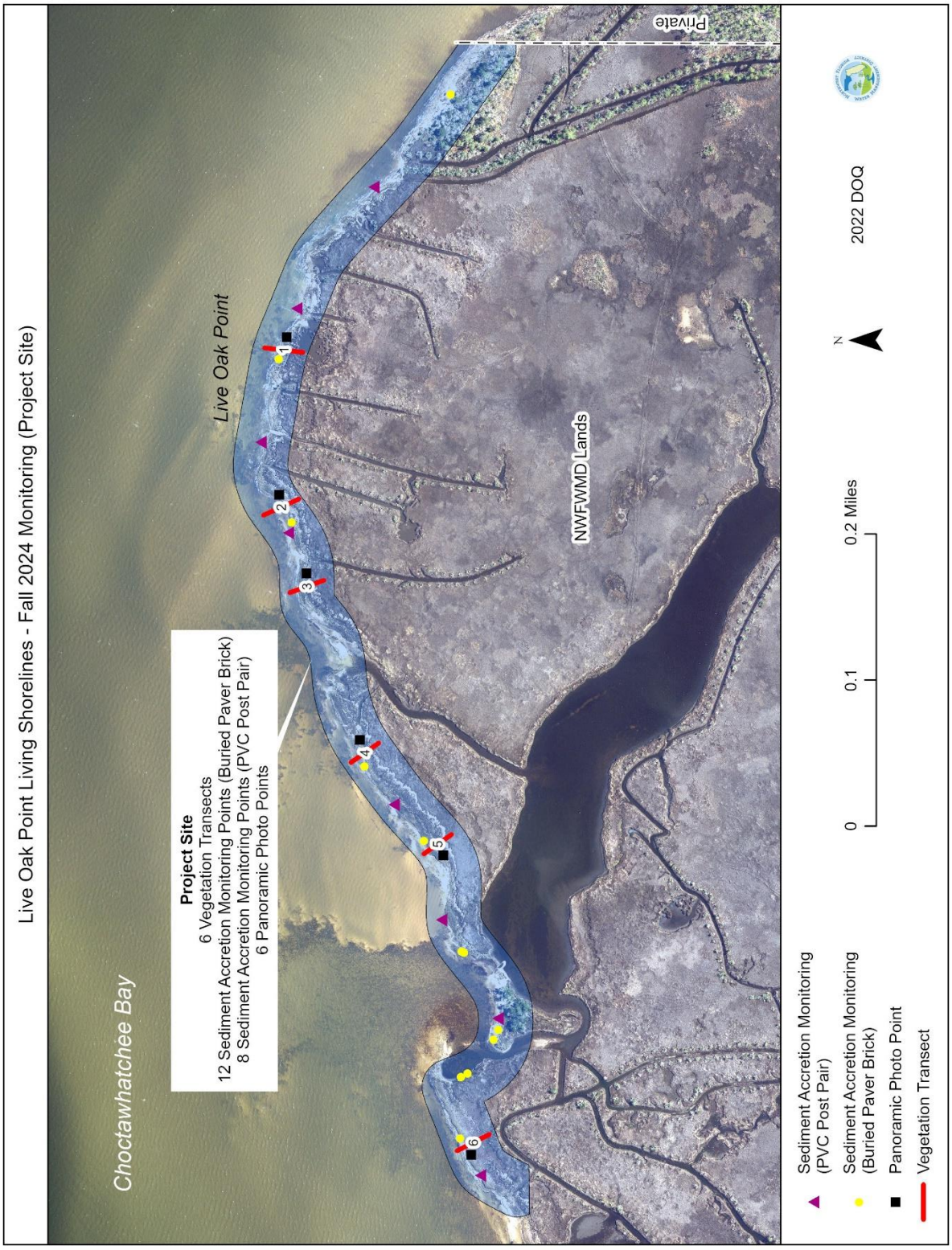

Figure 2. Fall 2024 Project Site Monitoring

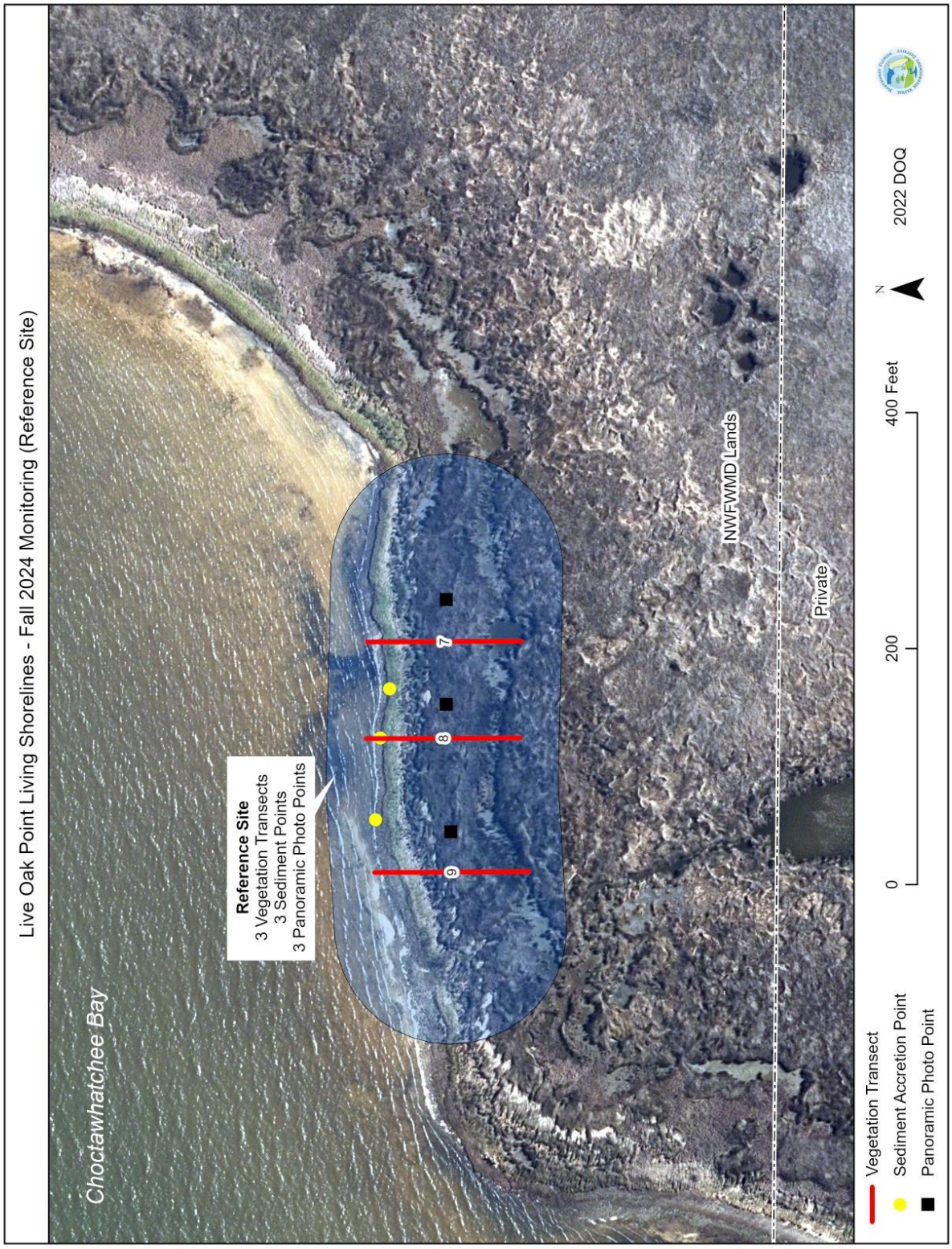

Figure 3. Fall 2024 Reference Site Monitoring

Vegetation Monitoring

Vegetation cover at the project site and reference site was quantitatively measured on 10/23/2024 using a modified Daubenmire method.[4] Three (3) transects of variable length were previously established in the reference area and six (6) transects of variable length were previously established in the project area (Figures 2 and 3). Each transect began in the low marsh and extended into the high marsh (Figure 4). Twelve (12) 0.5-meter square (0.25m^2) quadrats were sampled along each transect. Four (4) quadrats were located in the low marsh, four (4) in the mid marsh, and four (4) in the high marsh. All plant species were identified in each quadrat. Percent cover of vegetation by species and bare ground was visually estimated.

No exotic or invasive plants were present in any transect. Data collected on 10/23/2024 indicate that, at both the project site and reference site, the low marsh is dominated by *Spartina alterniflora*, the mid marsh by *Spartina patens*, and the high marsh by *Juncus roemerianus*.

Average percent cover of live vegetation (derived from vegetation transects) for the low marsh was 50% at the project site compared with 68% for the reference site; for the mid marsh was 70% at the project site compared with 91% for the reference site; and for the high marsh was 60% at the project site compared with 72% for the reference site.

Table 1. Percent Cover of Vegetation (Fall 2024; Project Site versus Reference Site)

		Project Site	**Reference Site**
Low Marsh	Live Vegetation	50%	68%
	Bare Ground / Duff / Dead Vegetation	50%	32%
Mid Marsh	Live Vegetation	70%	91%
	Bare Ground / Duff / Dead Vegetation	30%	9%
High Marsh	Live Vegetation	60%	72%
	Bare Ground / Duff / Dead Vegetation	40%	28%

[4] Daubenmire, Rexford. 1959. A Canopy-coverage method of vegetational analysis. Northwest Science 33:43-64.

Simpson's Diversity Index ($D = 1 - \sum (P)^2$; where P = percent cover for a given species)[5] was similar at both the project site (D = 0.70 and the reference site (D = 0.69) and indicates limited species diversity consistent with typical saltmarsh habitat in Choctawhatchee Bay.[6]

Table 2. Simpson's Diversity Index (Fall 2024)

Species	**Project Site**		**Reference Site**	
	Percent Cover (P)	**P^2**	**Percent Cover (P)**	**P^2**
Atriplex pentandra (Saltbush)	0.007	0.000048	0.0004	0.0000001
Distichlis spicata (Saltbush)	0.024	0.000589	0.081	0.006502
Hadodule wrightii (Shoalweed)	0.035	0.001202	Not Present	Not Present
Juncus roemerianus (Needle Rush)	0.381	0.145125	0.223	0.049650
Schoenoplectus pungens (Threesquare Bulrush)	0.001	0.000001	0.024	0.000564
Spartina alterniflora (Smooth Cordgrass)	0.242	0.058464	0.215	0.046029
Spartina patens (Saltmeadow Cordgrass)	0.310	0.096235	0.458	0.209657
Total	1.000	0.3017	1.000	0.312402
Simpson's Diversity Index (D) = 1 - ∑ $(P)^2$	0.70		0.69	

Sorensen's Similarity Index (SI = 2C / A + B; where A = the number of species at the project site, B = the number of species at the reference site, and C = the number of species common to both

[5] Simpson, E.H. 1949. Measurement of Diversity. Nature, 163:688.

[6] Percent cover of bare ground, duff, and dead vegetation excluded from Simpson's Diversity Index (D) calculations; D = 0 indicates infinite diversity and D = 1 indicates zero diversity.

sites)[7] was 0.92, indicating strong species composition similarity between the project site and reference site.

Table 3. Sorensen's Similarity Index (Fall 2024; Project Site and Reference Site)

A = Number of Species at Project Site	7
B = Number of Species at Reference Site	6
C = Number of Species in Common Between Project Site and Reference Site	6
Sorensen's Similarity Index (SI) = 2C / (A + B) = 2(6) / (7 + 6) = 12 / 13 = 0.92	

[7] Sorensen, T. 1948. A method of establishing groups of equal amplitude in plant sociology based on similarity of species and its application to analyses of the vegetation on Danish commons. Kongelige Danske Videnskabernes Selskab. 5 (4): 1–34.

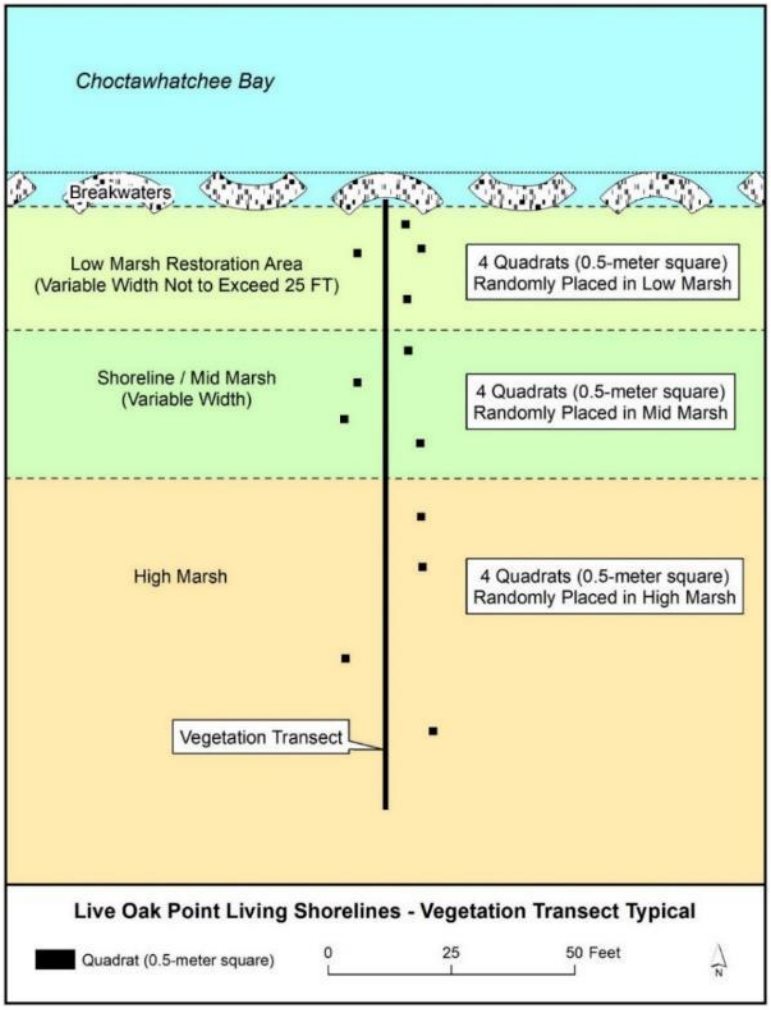

Figure 4. Vegetation Transect Sampling Design (Breakwaters Not Present at Reference Site)

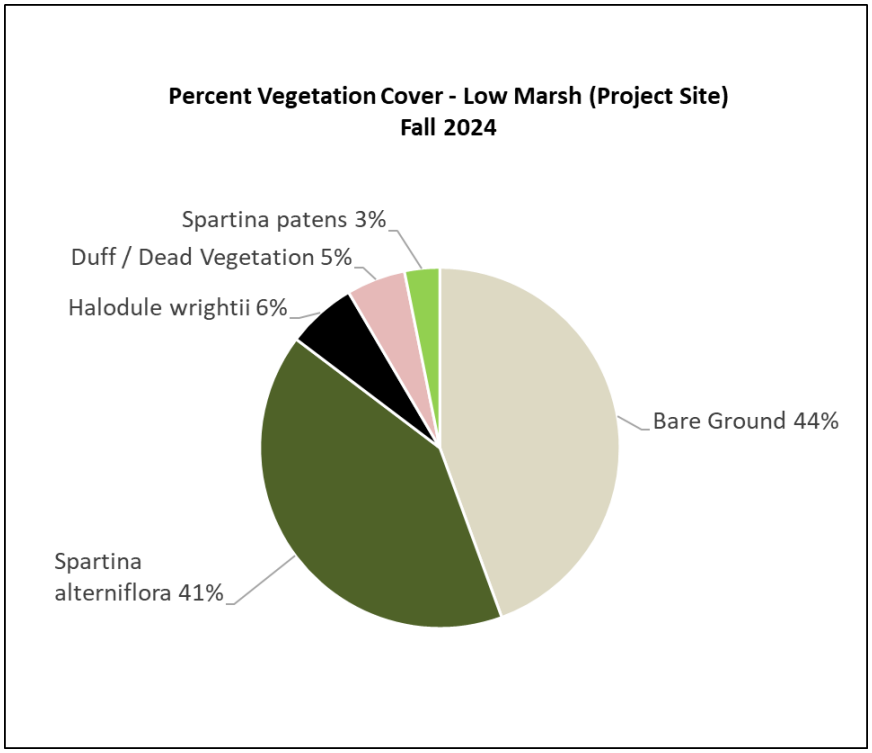

Figure 5. Project Site Low Marsh Vegetation (Average of Transects T1 - T6)

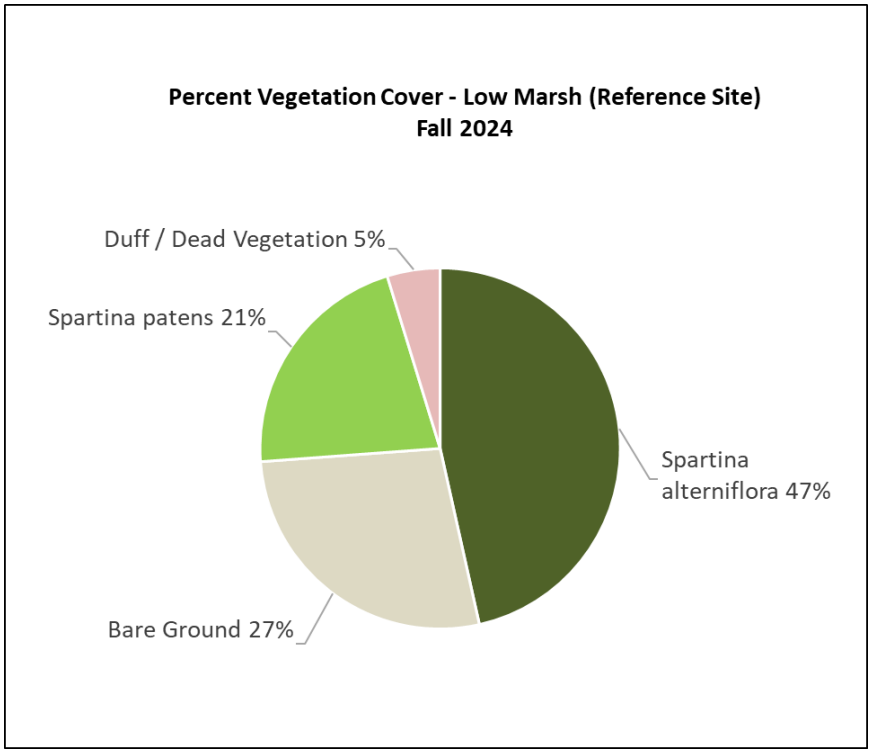

Figure 6. Reference Site Low Marsh Vegetation (Average of Transects T7 - T9)

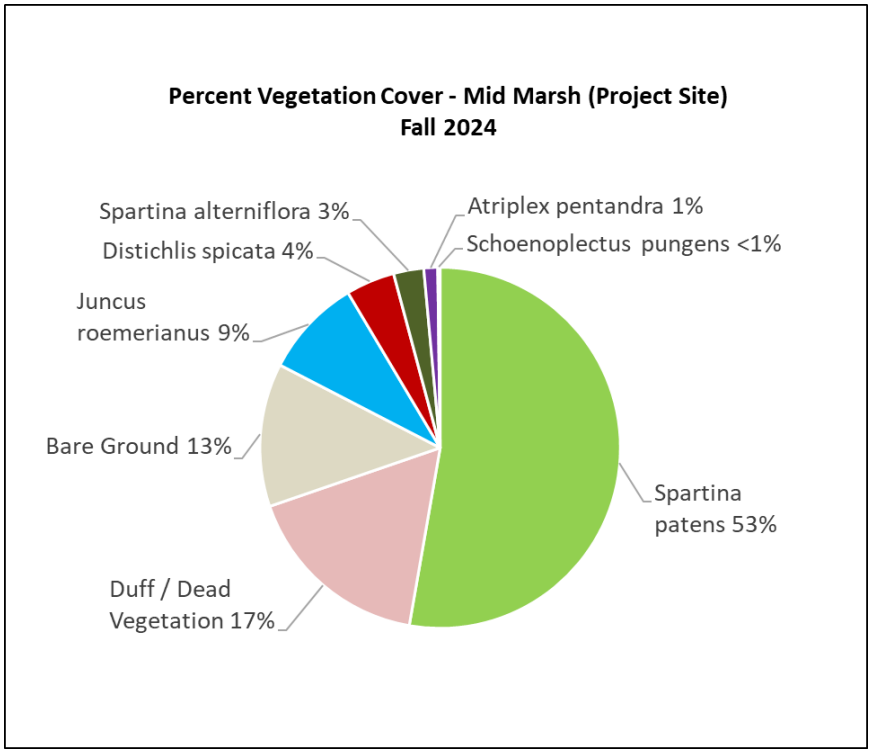

Figure 7. Project Site Mid Marsh Vegetation (Average of Transects T1 - T6)

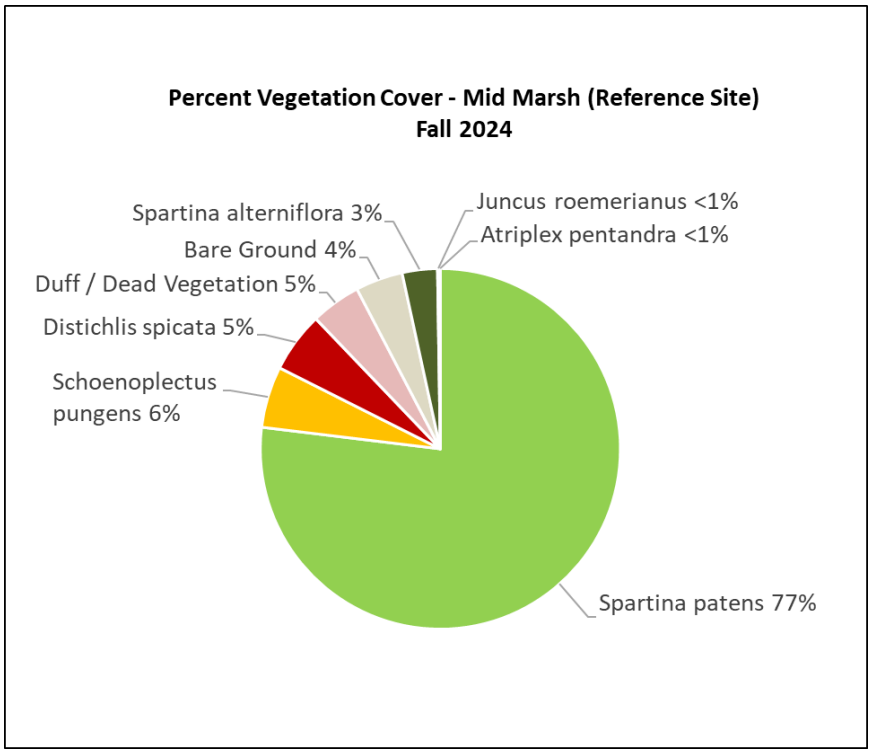

Figure 8. Reference Site Mid Marsh Vegetation (Average of Transects T7 - T9)

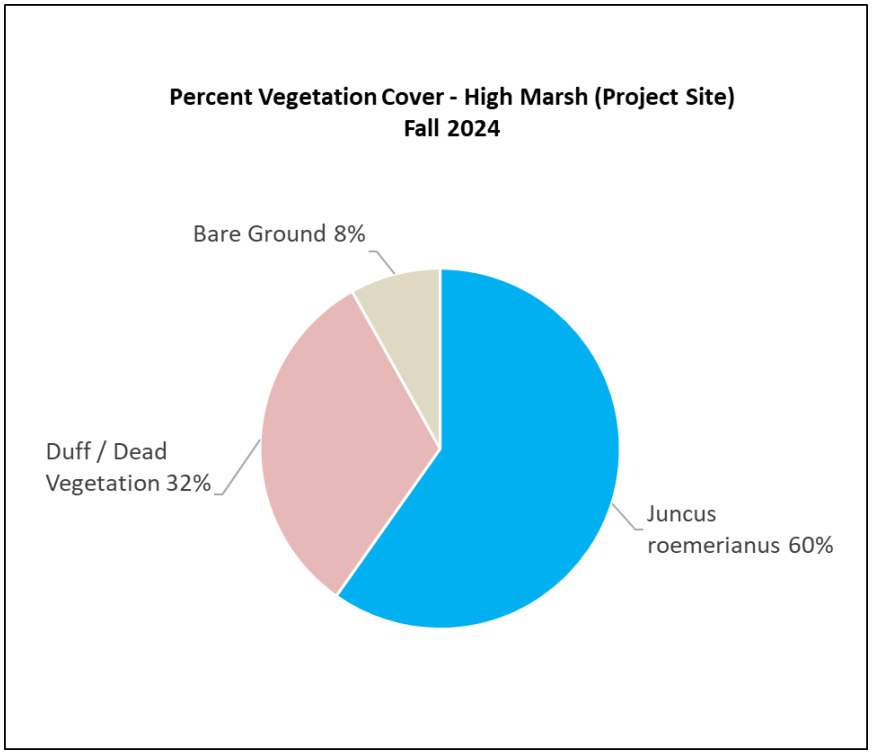

Figure 9. Project Site High Marsh Vegetation (Average of Transects T1 - T6)

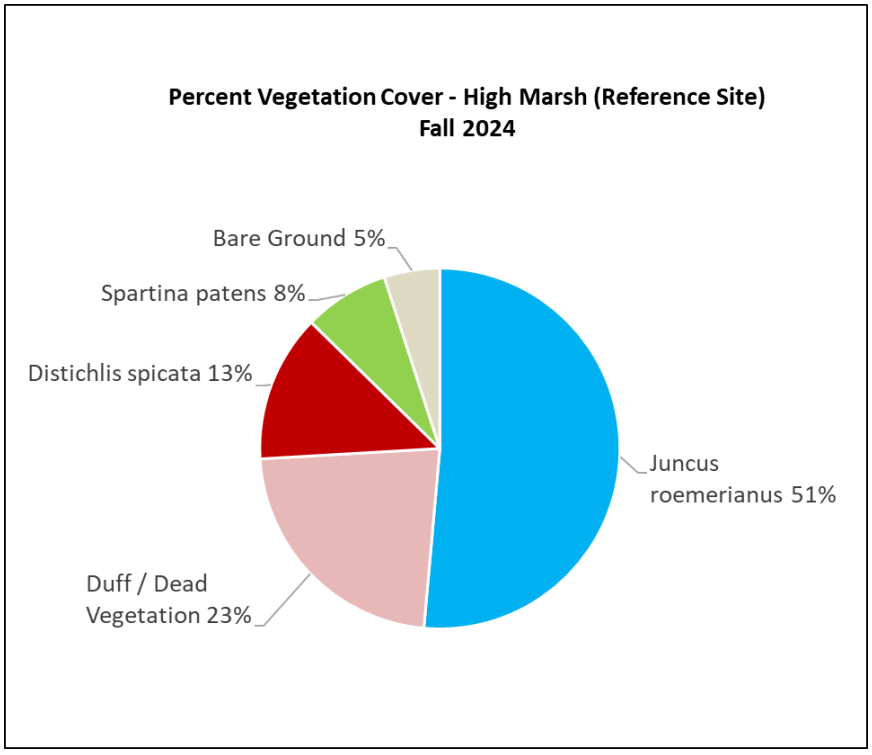

Figure 10. Reference Site High Marsh Vegetation (Average of Transects T7 - T9)

Table 4. Reference Site and Project Site Vegetation (Fall 2024) by Marsh Zone

Species	Project Site			Reference Site		
	Low Marsh	**Mid Marsh**	**High Marsh**	**Low Marsh**	**Mid Marsh**	**High Marsh**
Atriplex pentandra (Saltbush)	0%	1.25%	0%	0%	0.08%	0%
Bare Ground	44.32%	12.83%	8.13%	27.33%	4.25%	8.13%
Distichlis spicata (Saltgrass)	0%	4.38%	0%	0%	5.42%	0%
Duff / Dead Vegetation	5.29%	17.00%	32.08%	4.75%	4.50%	32.08%
Halodule wrightii (Shoalweed)	6.25%	0%	0%	0%	0%	0%
Juncus roemerianus (Needle Rush)	0%	8.88%	59.79%	0%	0.17%	59.79%
Schoenoplectus pungens (Threesquare Bulrush)	0%	0.21%	0%	0%	5.50%	0%
Spartina alterniflora (Smooth Cordgrass)	40.88%	2.71%	0%	46.50%	3.17%	0%
Spartina patens (Saltmeadow Cordgrass)	3.17%	52.75%	0%	21.42%	76.92%	0%

*Due to rounding, percentages may not sum to precisely 100%.

Sediment Accretion Monitoring

To estimate vertical sediment accretion in the existing marsh of the reference area and project area, fifteen sediment accretion monitoring points (i.e., buried paving bricks) were established, with systematic data collection beginning May 2023.[8] Each point, assigned a unique ID of SB1 through SB15, consists of a 4" x 7" concrete paving brick buried approximately 20± cm below the vegetated ground surface. Measurements are made by inserting a thin metal rod into the ground until it contacts the buried paving brick, retracting the rod, and then measuring the rod against a meter stick. By design, these points are located within the existing marsh and not within the marsh restoration zone (i.e., they are not placed in the area between the breakwaters and the existing marsh/shoreline).[9]

Use of buried markers (e.g., buried paving bricks) is commonly used to monitor sediment accretion in salt marsh habitat. Our experience at the Live Oak Point Living Shorelines project indicates that useful data will be generated in the centimeter resolution range. However, our experience indicates that the coarseness of data obtained from this technique will preclude obtaining definitive trends at millimeter resolutions. At face value, measurements from May 2023 to October 2024 indicate an annual accretion rate of 9.76 mm per year in the existing marsh at the reference site, whereas data from the project site indicate an annual loss of 11.27 mm per year in the existing marsh (Table 5). Visual observations, however, strongly suggest that vertical erosion is not occurring in the existing marsh at either the project site or the reference site. The unevenness of the marsh surface at the monitoring points, the potential for continued settling of soil after burial of the paving brick, and imprecise leveling of the buried paving brick, preclude measurement resolutions beyond the centimeter range.

Given the limitations of the buried markers (paver bricks) in the existing salt marsh, and to expand the monitoring to include the marsh restoration/marsh expansion zone located between breakwater segments and the current shoreline, eight additional monitoring stations using a different design were established on 11/25/2024. Referred to here as "PVC post pairs," each station (assigned a unique ID of SP1 through SP8) consists of two 2" DIA, SCH 40 PVC pipes (10-FT length) driven approximately 7 ½ FT into the underlying sandy sediments, placed approximately 7 FT apart, and forming a line approximately perpendicular to the existing shoreline. During monitoring events, a rigid cross bar (marked in 1-FT intervals) is temporarily placed on the two PVC posts. At each station, height from the bottom of the cross bar to the sediment surface is measured at six 1-FT intervals (decreasing height measurements over time indicate accretion of sediment).

[8] Earlier attempts at measuring sediment accretion either washed out or were vandalized.

[9] When monitoring protocols for this project were being developed to comply with permit conditions, it was initially decided not to place sediment accretion monitoring points within the zone between the breakwaters and existing marsh because of expected volatility in sediment accumulation and movement within this area. Sediment accretion monitoring has since been expanded to include the zone between the breakwaters and existing marsh.

Initial monitoring of the PVC post pairs within the marsh expansion zone (Table 6) was conducted on 11/25/2024, with repeat measurements taken on 12/16/2024 (22 days apart). Although too short a time interval to establish trends with any degree of confidence, initial data strongly suggest accumulation of sediment in the marsh expansion zone behind constructed breakwaters.[10] The average measured accretion of sediment, over 22 days (i.e., 11/25/2024 – 12/16/2024), for PVC post pairs placed behind existing breakwaters, was 1.8 cm (well above the rate of estimated sea level rise for northwest Florida). Over time, definitive trends within the marsh expansion zone are expected to be determined.

[10] PVC Post Pairs No. 1 – 5 and 8 are located behind breakwaters (either limerock breakwaters constructed in 2021 – 2022, or behind breakwaters constructed in 2024 using "Oyster Castles." PVC Post Pairs No. 6 & 7 are located in areas where breakwaters are planned to be constructed in early 2025.

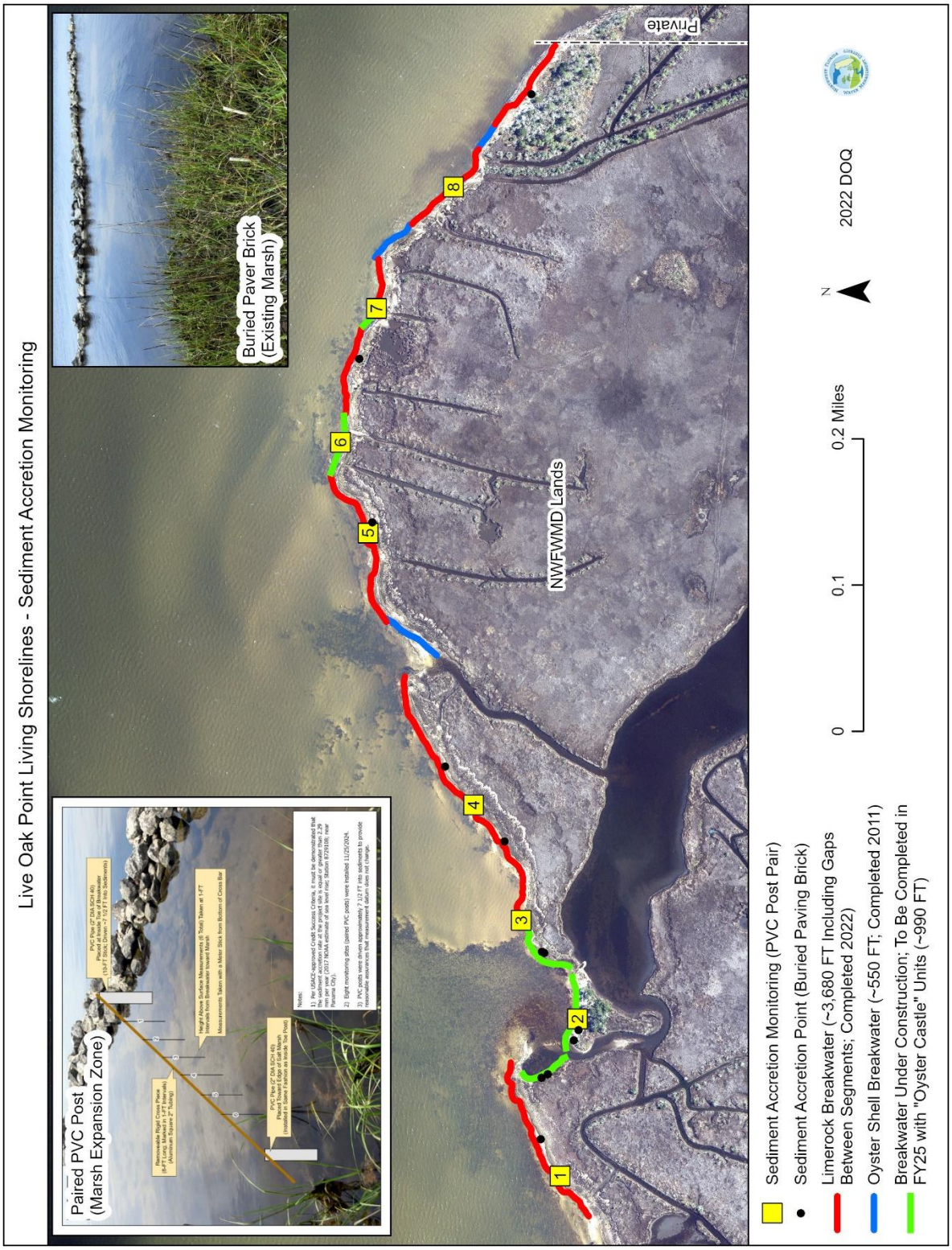

Figure 11. Sediment Accretion Monitoring at Project Site

Table 5. Vertical Sediment Accretion Monitoring (Buried Paver Brick; Existing Marsh)

Site	Point	Average Depth Below Ground Surface (cm)						Average Change (2023 – 2024) in Ground Surface Elevation (cm)	Annualized Rate of Change (mm/yr)
		4 MAY 2023 (Julian Date) 2460068	**18 MAY 2023** (Julian Date) 2460082	**21 JLY 2023** (Julian Date) 2460146	**18 OCT 2023** (Julian Date) 2460235	**3 MAY 2024** (Julian Date) 2460434	**21 OCT 2024** (Julian Date) 2460598		
Reference Site	SB1	17.1	15.8	16.6	17.4	19.2	20.7	3.6	24.56
	SB2B	-	19.0	18.0	18.1	18.0	18.2	-0.7	-5.05
	SB3B	-	18.1	17.2	17.3	17.5	Missing	-	-
	Reference Site Average:	17.1	17.6	17.3	17.6	18.2	19.5	1.4	9.76
Project Site	SB4	21.2	-	21.4	21.1	20.7	19.5	-1.7	-11.94
	SB5	20.7	-	19.4	17.6	17.0	15.7	-5.0	-34.55
	SB6	17.3	-	16.9	16.8	16.3	16.2	-1.1	-7.58
	SB7	19.9	-	19.2	19.8	18.9	15.2	-4.7	-32.37
	SB8	24.5	-	24.1	23.8	23.9	Missing	-	-
	SB9	11.6	-	6.9	2.8	9.3	Missing	-	-
	SB10	27.0	-	27.2	25.7	25.6	25.2	-1.8	-12.40
	SB11	17.7	-	17.4	16.3	15.6	15.1	-2.6	-17.68
	SB12	8.3	-	10.0	8.5	4.9	7.6	-0.6	-4.36
	SB13	12.7	-	12.7	11.0	Exposed	Exposed	-	-
	SB14	15.0	-	14.9	14.5	14.5	14.3	-0.7	-4.82
	SB15	11.2	-	10.9	10.8	12.7	14.7	3.5	24.22
	Project Site Average:			16.8	15.7	16.3	15.9	-1.6	-11.27

Table 6. Vertical Sediment Accretion Monitoring (PVC Post Pairs; Marsh Expansion Area)

LOPLS: Sediment Accretion Monitoring (PVC Post Pairs)				
Sediment PVC Post Pair	Measurement Position	11/25/2024 (cm)	12/3/2024 (cm)	Surface Elevation Change (cm)
SP1	1FT	72.6	69.6	3.0
	2FT	72.5	69.4	3.1
	3FT	70.5	66.8	3.7
	4FT	68.2	66.8	1.4
	5FT	65.9	65.5	0.4
	6FT	64.7	65.0	-0.3
	AVG:	69.1	67.2	1.9
SP2	1FT	73.5	71.8	1.7
	2FT	75.9	70.5	5.4
	3FT	69.8	68.9	0.9
	4FT	72.6	70.8	1.8
	5FT	66.9	66.4	0.5
	6FT	66.8	65.8	1.0
	AVG:	70.9	69.0	1.9
SP3	1FT	88.9	89.1	-0.2
	2FT	90.6	89.2	1.4
	3FT	88.3	89.3	-1.0
	4FT	88.6	89.8	-1.2
	5FT	88.7	89.5	-0.8
	6FT	89.0	89.6	-0.6
	AVG:	89.0	89.4	-0.4
SP4	1FT	78.5	74.7	3.8
	2FT	79.4	75.6	3.8
	3FT	79.4	76.6	2.8
	4FT	81.5	77.6	3.9
	5FT	81.9	79.6	2.3
	6FT	84.1	81.0	3.1
	AVG:	80.8	77.5	3.3
SP5	1FT	86.1	78.0	8.1
	2FT	84.5	80.1	4.4
	3FT	86.2	80.6	5.6
	4FT	81.1	80.4	0.7
	5FT	80.7	80.1	0.6
	6FT	80.4	78.3	2.1
	AVG:	83.2	79.6	3.6
SP6	1FT	86.0	90.8	-4.8
	2FT	85.3	90.4	-5.1
	3FT	84.4	87.8	-3.4
	4FT	83.3	87.6	-4.3
	5FT	83.2	87.6	-4.4
	6FT	84.3	87.3	-3.0
	AVG:	84.4	88.6	-4.2
SP7	1FT	78.5	74.5	4.0
	2FT	79.5	73.5	6.0
	3FT	80.4	75.0	5.4
	4FT	80.2	75.8	4.4
	5FT	82.6	77.3	5.3
	6FT	80.4	79.4	1.0
	AVG:	80.3	75.9	4.3
SP8	1FT	86.1	87.9	-1.8
	2FT	87.0	87.2	-0.2
	3FT	87.8	87.0	0.8
	4FT	90.0	88.4	1.6
	5FT	92.3	90.3	2.0
	6FT	92.8	91.5	1.3
	AVG:	89.3	88.7	0.6
Average All Post Pairs:		80.9	79.5	1.4

Panoramic Photo Monitoring

Project Site Photo Photos

Figure 12. Project Site Photo Point T1 – 10/15/2024

Figure 13. Project Site Photo Point T2 – 10/15/2024

Figure 14. Project Site Photo Point T3 – 10/15/2024

Figure 15. Project Site Photo Point T4 – 10/15/2024

Figure 16. Project Site Photo Point T5 – 10/23/2024

Figure 17. Project Site Photo Point T6 – 10/23/2024

Reference Site Photos

Figure 18. Reference Site Photo Point T7 – 10/23/2024

Figure 19. Reference Site Photo Point T8 – 10/23/2024

Figure 20. Reference Site Photo Point T9 – 10/23/2024

Other Photo Documentation

Figure 21. Expansion of *Spartina alterniflora* Behind Limerock Breakwaters (12/16/2024)

Figure 22. Vegetation Monitoring (10/23/2024)

Figure 23. Breakwater Construction Using "Oyster Castles" (11/13/2024)


Figure 24. Newly Constructed Breakwater Segment Using "Oyster Castles" (11/13/2024)

Figure 25. Sediment Accretion Monitoring Station (Buried Paver Type) in Existing Marsh (12/16/2024)

Figure 26. Sediment Accretion Monitoring Station (PVC Post Pairs) Between Breakwater and Shore (12/16/2024)

Figure 27. Oyster Colonization on Breakwater (12/16/2024)

Figure 28. Sediment Accretion Behind Limerock Breakwater (12/16/2024)

Figure 29. Washout of Planted Vegetation Not Protected by Breakwaters