TECHNICAL MEMORANDUM

TO:	Bill Balboa, Executive Director, Matagorda Bay Foundation
FROM:	Matthew Chastain, Sabrina Thiels, Mike Page Compass Environmental Solutions, LLC
DATE:	June 19, 2026
SUBJECT:	**Benthic Habitat Mapping Technical Memorandum and Deliverables**

BENTHIC HABITAT MAPPING OVERVIEW

This technical memorandum is not a formal contractual obligation but rather is being provided as an internal correspondence and informational overview/outline of activities associated with Compass Environmental Solutions, LLC's (COMPASS's) benthic habitat mapping component of the overall Central Matagorda Bay Ecosystem Assessment. The technical memorandum is being provided to facilitate any annual or final reporting to be prepared later by the project team.

<u>Side Scan Sonar and Bathymetry</u>

COMPASS conducted a comprehensive acoustic remote sensing survey to map benthic marine resources within the designated area of Matagorda Bay. As part of this comprehensive effort, COMPASS completed side-scan sonar (SSS) and bathymetric surveying of approximately 97,300 acres to map benthic habitats (e.g. oyster reefs, seagrasses, and open bay bottom) and water depths.

Equipment for this survey consisted of a Hemisphere® VS111 differentially corrected global positioning system (DGPS) receiver; an EdgeTech® 4125 Chirp 400/900 kilohertz (kHz) side-scan sonar (SSS) sensor (towfish) and topside processor with DISCOVER™ acquisition software; and a Teledyne Odom Hydrographic, Inc. E20™ 200 kHz single beam echo sounder with 10° transducer. Vessel guidance, and position and data logging were accomplished with a navigation processor utilizing Chesapeake Technology, Inc. SonarWiz™ ver. 7.9.2 navigation and acquisition software. Positional information for the survey vessel and each instrument sensor, via layback calculations, was stored in the navigation processor at a rate of one reading per second. Echo sounder depth data was also recorded in the navigation processor at one reading per second. Vessel speed during the survey averaged 4.0 knots (4.6 miles per hour; 7.4 kilometers per hour), providing in-line data spacing of approximately 6.8 feet (2.1 meters). A minimum water depth of 2.5 feet (0.76 meters) was required to provide adequate depth for the SSS towfish and draft for the navigation vessels. To ensure imagery for 150+ percent coverage of the project area with appropriate depths, survey transects were spaced between 40- and 60-meter intervals, depending on the location in the bay, weather patterns, reference landmarks, transducer range settings, and documented water depths.

COMPASS utilized Chesapeake Technology, Inc. SonarWiz™ ver. 7.9.2 for SSS processing. The typical project workflow included data collection, download and correction, and post-processing through the respective programs. For SSS, the raw files (e.g. .jsf for Edgetech Technology equipment) were downloaded to a processing computer and imported using a variety of settings specific to each project, including scalar factor, compression rate, and soundwave velocity. Once imported, each file was bottom-tracked to correct for anomalies and interference. To determine the appropriate gain settings based on project specific constraints, COMPASS selected one or two test files to run through each setting and analyzed the results. Once a specific gain setting was selected for a group of files, it was applied to all files to produce a final mosaic. Final editing included color palette selection, file ordering, organization, and export. The sonar imagery was designed to depict any features located on the surface of the bay bottom or substrate (Figure 1). Once processed, this geo-rectified imagery was used to help identify marine natural resources as well as other anthropogenic features found of the bottom.

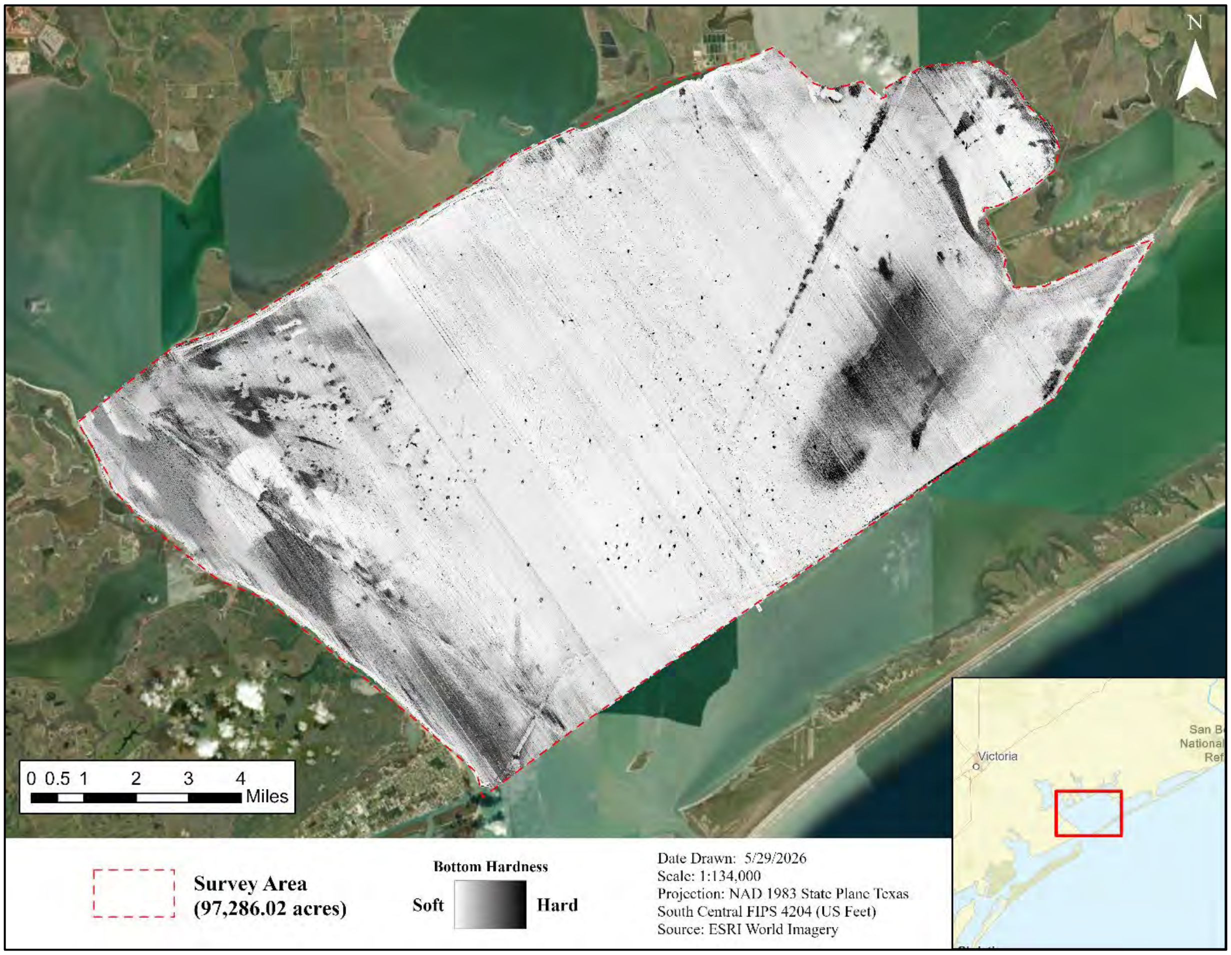

Figure 1. Side Scan Sonar Imagery for Project Area.

Bathymetry

For bathymetry, raw x,y,z data was exported via Chesapeake Technology, Inc. SonarWiz™ ver. 7.9.2 to either excel or .csv file types for processing and correction in ESRI® ArcGIS Pro™ 3.5.3. The bathymetry dataset was tidally corrected via the closest tidal station from NOAA Tides and Currents database. The data can be exported into a GIS format for projection (Figure 2) via contour lines, or other formats.

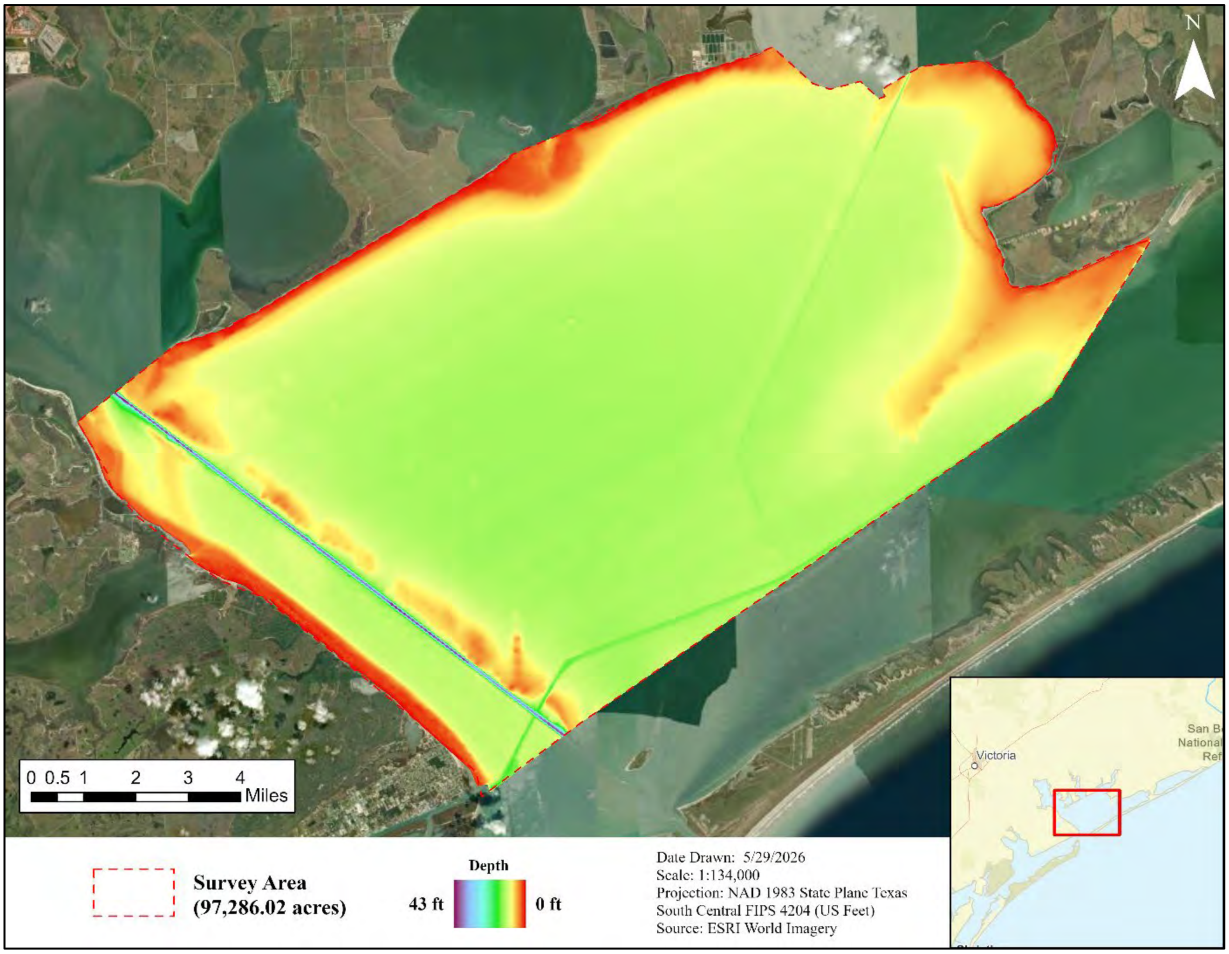

Figure 2. Bathymetry Imagery for Project Area.

<u>Potential Oyster Habitat</u>

During and after completion of the remote sensing phase of the survey, the SSS data was processed and a high-resolution mosaic created to guide field verification sampling. A draft map of potential oyster habitat was compiled through geospatial imagery classification of the SSS imagery using training samples of known oyster reefs (Figure 3), as well as heads-up digitization of known reef areas, resulting in approximately 8,300 acres of potential oyster reef habitat. While high reflectance values in the imagery may indicate hard substrates such as oyster reef and shell hash, similar reflectance values are also generated by rock, dredged channel and pipeline reinforcements and pilings, compact sandstone, shipwrecks, and other materials which are less likely to foster oyster growth, so systematic field verification was required to distinguish regions of potential habitat from less hospitable oyster zones.

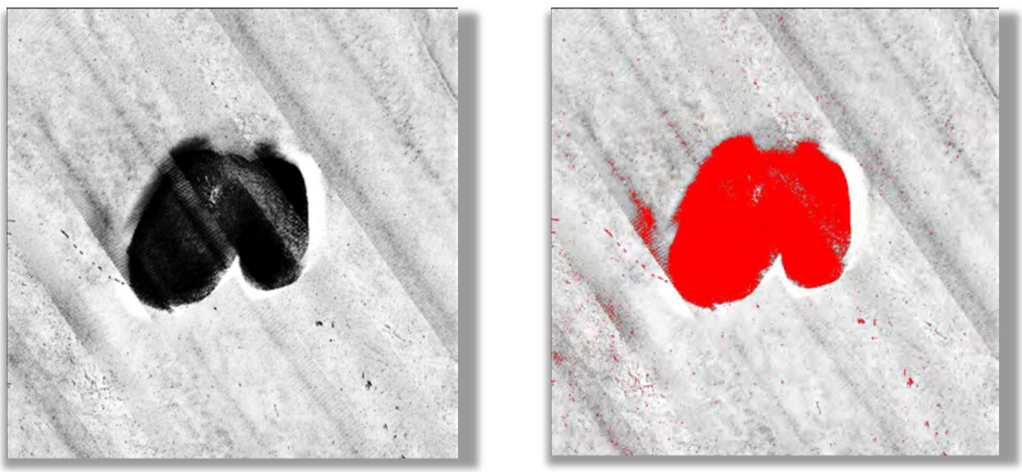

Figure 3. High reflectance bottom scans from side scan sonar (left) and isolated through imagery classification (right).

Oyster Field Verification Sampling

COMPASS conducted physical investigations specific to potential oyster reef habitat to verify SSS results and collect limited biological resource information.

Methodology

The projected area was divided into uniform 10-acre square polygons, and 76 dredge squares (760 acres, or 9% of potential oyster habitat) were randomly selected for sampling. An additional 29 squares of "open" areas containing no delineated reef habitat were also sampled to verify absence of reef habitat for a total of 105 sampled sites containing 1,050 acres (Figure 4).

Between July 2025 and April 2026, COMPASS biologists conducted oyster dredge tows across the survey area at the targeted 10-acre square locations identified in the side-scan imagery as potential reef habitat or open locations. The sample site squares were loaded onto a GPS-enabled tablet which uses real time data to show current position in relation to the proposed sample squares. At each sample location, a custom oyster dredge was towed along random linear transects for approximately 30 seconds and retrieved (Figure 5). The dimensions of the dredge are 33 inches (80 cm) long by 18 inches (47 cm) wide by 11 inches (29 cm) deep with a 0.5-inch (1.3 cm) wire mesh lined collection basket to retain small shell hash and bivalve/benthic species.

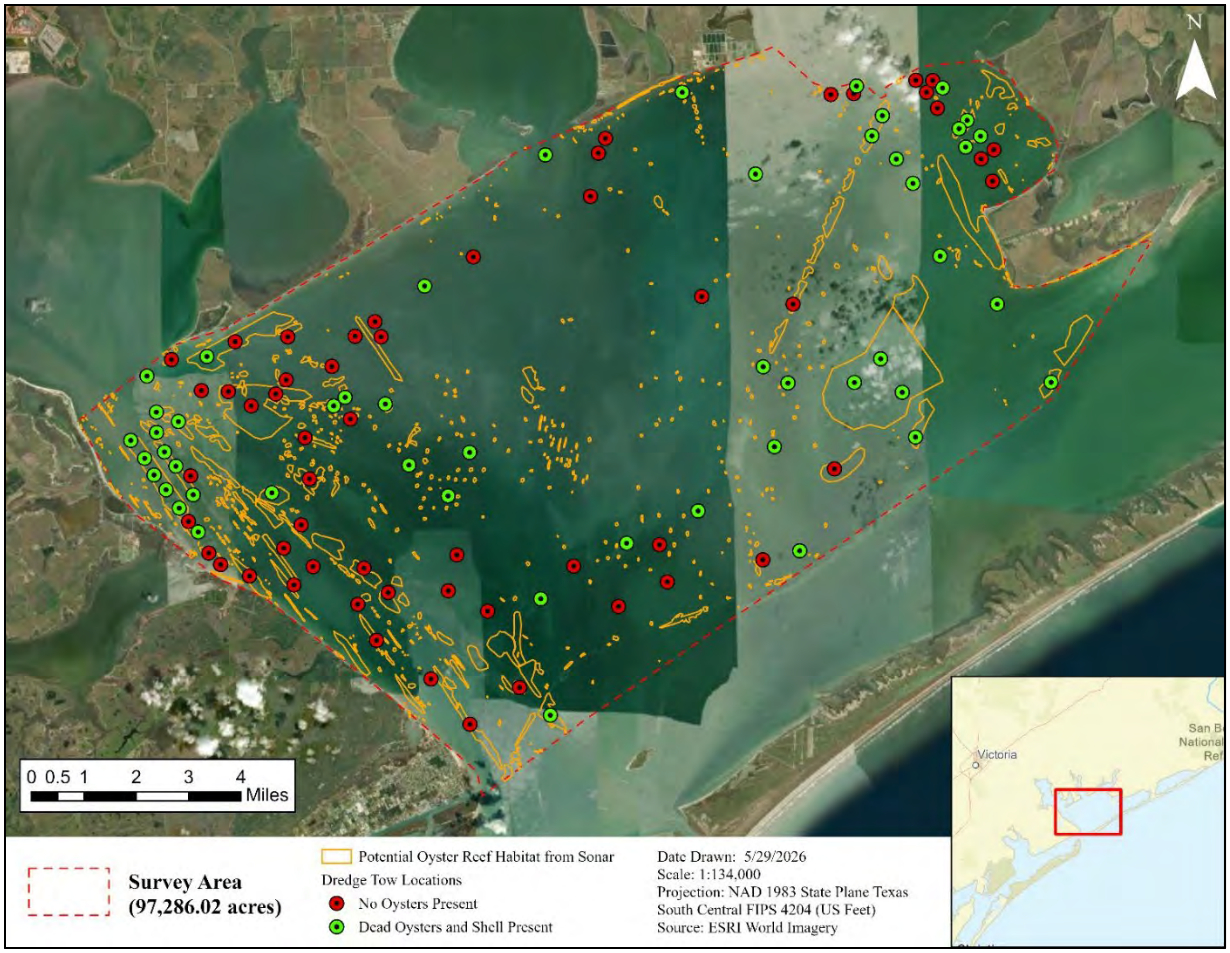

Figure 4. Oyster Reef Field Verification Sampling Locations.

The collected contents were photo-documented (pre- and post-rinse) and described. Live oysters, oyster shell, shell hash, and reef material were noted to determine potential presence or absence of oyster reefs and suitable substrate. Also, any additional finds were noted including but not limited to rangia shells, barnacles, hook mussels, and worms.

Figure 5. Custom oyster dredge (left) and collected materials being rinsed (right).

Results

No live oysters or spat were found at any of the sampling sites during field verification. An additional 50 locations contained dead oysters, broken shells, shell hash, or other indicators of possible reef habitat. These sites are more uniformly dispersed across Matagorda Bay, from the northeastern corner down to the southwestern end of the bay. No oysters or possible habitat were detected at 55 sample sites. The following examples are provided to show the classification process from imagery to dredge haul. All sampling sites were classified using the descriptions in Table 1.

Substrate Category	**Category Description**
Category 1	Live oyster reef; hard or firm substrates
Category 2	Firm, hard, consolidated substrates with buried, partially buried, or exposed calcium-rich shell or other material; or historical, dead reef, or reef clusters
Category 3	Firm or soft muds and a lack of large sandy areas; buried and/or black shell
Category 4	Devoid of oysters, suitable habitat, or potentially favorable materials for reef establishment

Table 1: Substrate categories and descriptions

According to various state agencies such as Texas Parks and Wildlife Department (TPWD) (2020a and 2020b), and Louisiana Department of Wildlife and Fisheries (LDWF) 2012, living oyster reefs are characterized by dense, clustered, or semi-aggregated of living oysters, regardless of size class, over suitable hard or firm substrates. For the purpose of this classification, if appropriate substrate and attachment material and at least one live oyster were observed, the sample area would have been classified as Category 1.

Category 2: Viable Oyster Habitat
(Reference Sample Site 37)

According to the same agencies, this category exhibits a wider range of conditions and a variety of potential habitat structures and types, including the presence of live or dead shell greater than 25 mm in size on firm, hard, consolidated substrates; suitable buried, partially buried or exposed calcium-rich shell or other material (i.e. limestone, concrete, clam shell, etc.); or even historical or dead reef or reef clusters. Additionally, all of these potential habitat types would be considered viable habitat, regardless of the presence of live oysters, due to the reproductive cycle of the Eastern oyster. Outside enhancement and expansion of living reef areas, this category could potentially demonstrate the highest probability for oyster reef restoration and creation activities.

Category 3: Interspersed Firm Mud and Sand
(Reference Sample Site 46)

During the last century, a host of projects and anthropogenic influences have shaped and altered the substrate and bay bottom of various portions of Matagorda Bay. These projects have included the historical Intracoastal Waterway (prior to its current alignment), and multiple dredged ship and barge channels to access both Matagorda Island and shallower portions of Matagorda Bay. During these events, dredged spoil material was generally side-cast, resulting changes to the natural bay bottom habitats and a range of material classifications, including firm and soft muds and a general lack of large sandy areas. Additionally, buried and/or black shell and other similarly stained substrate was observed in this category. This category would potentially represent low to moderate success probability for oyster reef restoration and creation activities, and would need to be analyzed further for suitability.

Category 4: Open Bay Bottom
(Reference Sample Site 4)

Devoid of oysters, viable habitat, or potentially favorable materials for reef establishment, the majority of Matagorda Bay was classified as Category 4. While dredge tows, sampling efforts, and sonar analysis in this category revealed no oysters or suitable substrate, it did reveal the presence of various other bay features including underwater sand waves and ripples in the southern portion of the survey area, open bay flats and seagrass beds along the central portion, and unconsolidated silts/clays, especially around the Diversion Cut and near the lower Colorado River delta in the northeast. This category would potentially represent lowest probability of success for oyster reef restoration and creation activities.

The resulting map from this classification approach and subsequently applied analysis is presented in Figure 6. As we only performed limited verification sampling in open bay habitat, we did not classify the remainder of the bay as that particular habitat type (Category 4).

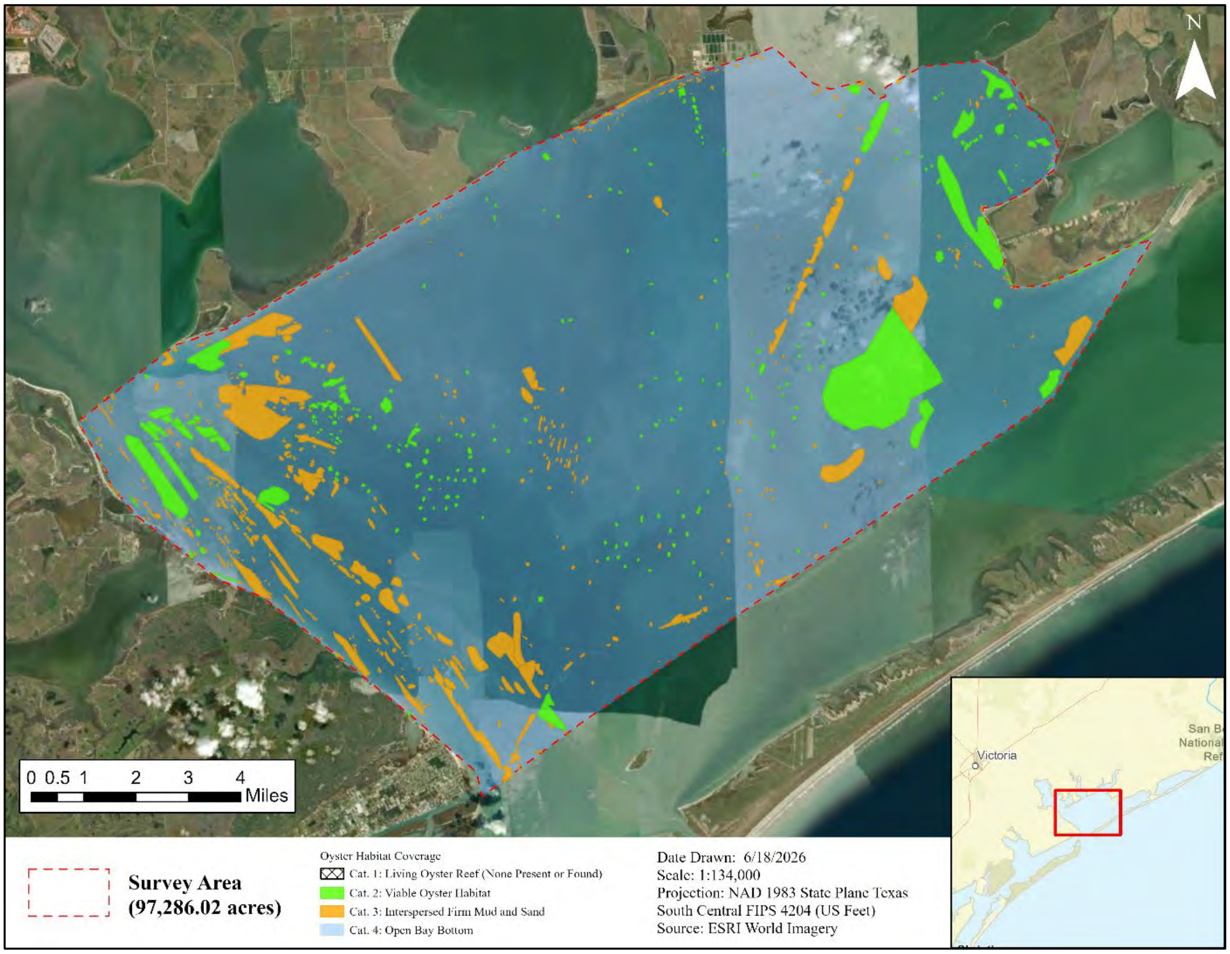

Figure 6. Oyster Reef and Viable Habitat Coverage.

Seagrass Habitat

Potential seagrass beds in the project area were delineated from benthic habitat imagery coupled with the most recent accessible high-resolution imagery with sufficient water clarity and minimal cloud cover (Google Earth Pro 7.3.3.7786, 10/23/2024, Matagorda Bay, Eye alt 11,194 feet, accessed 12/2/2025). A draft map of potential seagrass beds was generated through geospatial imagery classification of the true color imagery using training samples of visible seagrass beds in Matagorda Bay and was then cleaned to remove terrestrial vegetation with similar pixel values, yielding approximately 47.37 acres classified as seagrass.

Potential Seagrass Verification Sampling

COMPASS conducted physical investigations specific to seagrass habitat to verify SSS results and existing high-resolution imagery and collect limited biological resource information.

Methodology

The potential seagrass area is almost entirely within the southwest corner of Matagorda Bay and along the back side of the barrier island, and is similar to the area delineated as seagrass by TPWD in 2003. However, seagrass extent likely varies seasonally and annually depending on local salinity levels, freshwater inundation from major storms and other factors, so COMPASS biologists conducted verification sampling across the delineated region. Sampling sites were generated by two processes. The potential seagrass area was divided into 419 transects (Figure 7).

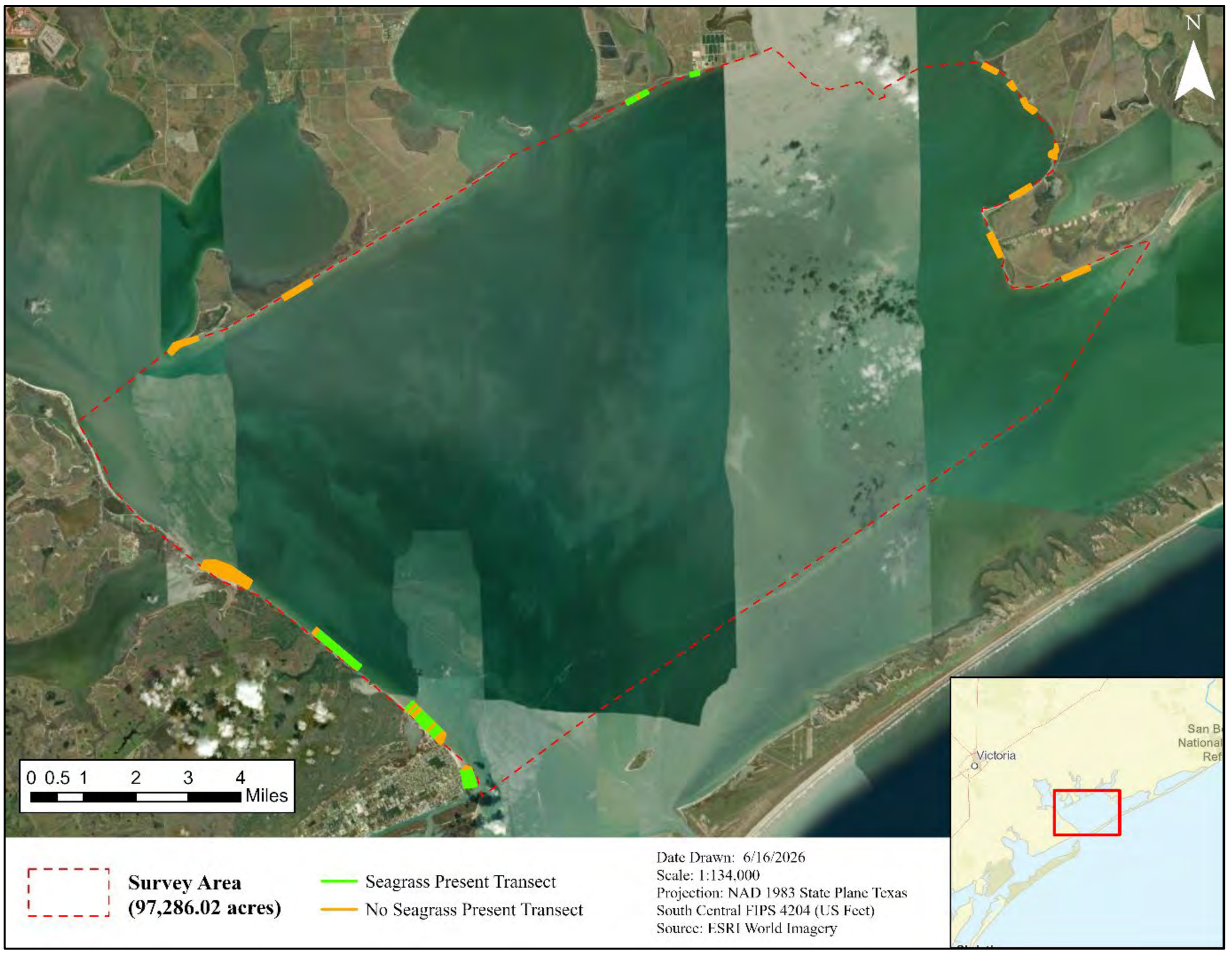

Figure 7. Seagrass Field Verification Sampling Locations and Transects.

Between December 2025, and July 2026, COMPASS biologists conducted seagrass sampling across the Matagorda Bay region. Sample sites were loaded onto a GPS-enabled tablet and Trimble GPS unit to navigate to sites and record precise sampling locations. At each transect, samples were collected at intervals along the transect using a one-meter square sampling plot and recording species presence, coverage across the plot, vegetation height, depth, and visibility.

Results

In total, 419 seagrass transects were sampled, with seagrass found within across 145 transects. Shoal grass (*Halodule beaudettei*) was the dominant species across the entire area. A few sites also contained large amounts of macroalgae and floating sargassum was collected at a single site near the channels at the southwestern most extent of Matagorda Bay.

Field sampling results were merged back into the potential seagrass beds derived from remote sensing and regions with no seagrass per sampling efforts were removed. Sites with seagrass were amended to reflect actual GPS locations of samples. The extent of seagrass beds was then divided into sections based on sampling sites, and species presence and density were generalized across that section based on species found at samples within the section and the mean density per square meter of these samples. As of June 19, 2026, seagrass beds across the Matagorda Bay study area were estimated to cover approximately 1,908 acres (Figure 9).

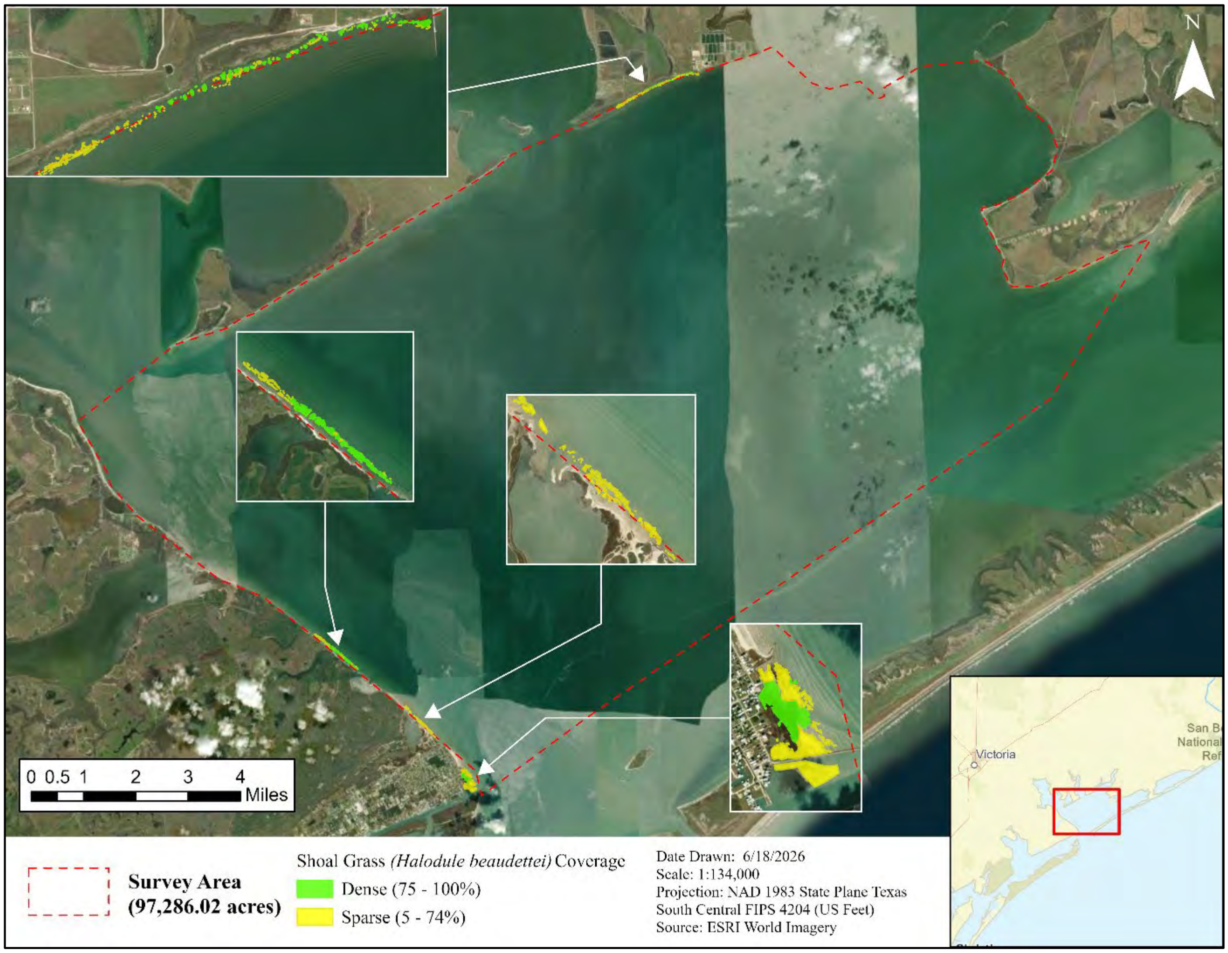

Figure 8. Seagrass Coverage within Project Area in 2026.

Summary

The information presented herein and data files attached regarding the benthic habitat mapping component of the project are considered Draft/Final. An overview text page Guide (at the conclusion of this memorandum) describes the data files and all pertinent mapping and raw imagery being submitted as the official benthic habitat mapping deliverable. Please contact Mike Page (GIS and Project Data Manager) directly for any mapping, projection or database questions. Please reach out to Matthew Chastain (Senior Project Manager) for clarification of methodology, results and/or Draft/Final deliverables.

References

Louisiana Department of Wildlife and Fisheries (LDWF). 2012. Sampling Protocol for Projects in Public Oyster Areas. Pp. 6. Rev. January 1, 2012

Texas Parks and Wildlife Department (TPWD), 2020a. Recommended Survey Protocols for Oyster Habitat for Permitting Review of Pipeline Installation Project in Deep Waters (>2.5 feet). pp. 4

Texas Parks and Wildlife Department (TPWD), 2020b. Recommended Survey Protocols for Oyster Habitat for Permitting Review of Non-Pipeline Dredging Projects in Deep Waters (>2.5 feet). Pp. 4.