FINAL OYSTER REEF MITIGATION PLAN

FOR THE

PROPOSED MAT PLACEMENT ON THE 24-INCH FLORIDA GAS TRANSMISSION PIPELINE

Located in

Galveston Bay, Chambers & Galveston County, Texas

Prepared for:

Florida Gas Transmission Company, LLC

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BW Project No: 2658.01

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INTRODUCTION AND BACKGROUND

Florida Gas Transmission Company, LLC (FGT) presents this Final Oyster Mitigation Plan (Plan) for the Proposed Mat Placement on the 24-Inch Florida Gas Transmission Pipeline (Project). This document presents information derived from agency coordination, landowner consent, and comprehensive oyster reef and marine resource surveys.

The Project is situated in Galveston Bay, between Smith Point and San Leon in Galveston and Chambers Counties, Texas (Appendix A). The 24-Inch Florida Gas Transmission Pipeline is currently buried beneath one of the busiest coastal waterways in the world, the Houston Ship Channel. Various bay processes have caused the bedding material, laid on top of the pipeline during construction, to be removed and carried away, leaving portions of the pipeline partially exposed or with minimal cover. The objective of the Project is to place articulated concrete matting on top of the existing pipeline to protect it from potential structural damage that could be inflicted by passing ships, commercial oyster dredging operations, or natural erosional disturbances due to shallow cover.

In order to facilitate the placement of the mats and ensure environmental impacts are minimized, avoided, and appropriately compensated for, BIO-WEST, Inc. (BIO-WEST) conducted a marine resource survey to identify oyster reefs in the area of impact. This mitigation plan utilizes the results of these surveys and proposes a plan of action to appropriately compensate for the impacts to oyster reefs that may be impacted by the proposed project.

BIO-WEST conducted a marine resource survey, including remote sensing, data processing, and physical investigation of the existing project corridor from October 13 to 18, 2019. Physical investigations included one square meter ($1m^2$) diver quadrats, 30-second dredge tows, and manual poling at representative areas subject to potential impacts in order to determine if live oysters are present.

Based on the information collected during the marine resources survey and ground truthing efforts, BIO-WEST identified that a total of 2.50 acres of oyster reef would be impacted as a result of this project (Appendix B), including 0.20 acres within private oyster leases areas and 2.30 acres in areas open to public harvesting. The center of the project corridor is approximately 29.494249°, -94.849420°.

The following mitigation plan has been presented in support of compliance with Section 404 and Section 10 of the Clean Water Act as outlined in 33 CFR 325 and 332.

1.0 GOALS AND OBJECTIVES

The goal of this Plan is to provide successful compensatory mitigation for unavoidable impacts to **2.30 acres of oyster reef** currently open to public oyster harvesting. The remaining 0.20 acres of oyster reef within the impact area are located within several private lease areas; the applicant will work with these private lease holders to accomplish separate mitigation for these specific areas.

The applicant will accomplish this by creating artificial oyster reef habitat at a suitable nearby location with comparable bottom substrate characteristics. Proposed actions will ensure successful compensation to mitigate all permanent and temporary ecological loss and provide a sustainable structure for oyster recruitment.

The objectives of this oyster mitigation plan will be to:

1. Provide in-kind mitigation that mimics local marine resources
2. Enhance and restore ecological function as quickly as practicable
3. Provide a structure that meets or exceeds the morphology of the impacted reef
4. Document ecological success

2.0 MITIGATION CREDIT DETERMINATION

Impacts are proposed to approximately 2.30 acres of existing oyster reefs on public grounds based on the extent of all oysters present and not necessarily the abundance and density of active, live reefs. Marine resource investigations confirmed that these existing reefs consist of small scattered shell hash, with no large aggregate substrate (i.e. cultch) for attachment and minimal numbers of live oysters. This characterization was determined by several methodologies including physical poling, oyster dredge tows, diver quadrat sampling, and a review of side-scan sonar imagery (see Appendix B for detailed information)

As described in greater detail later in Section 3.0, a comprehensive investigation of local oyster reef communities was performed. Results of this intensive effort conclusively determined the existing oyster reefs would likely be characterized as either low-profile reefs or scattered oyster shell hash with individual oysters occurring at varying densities. Figures in Appendix B presents the outline of existing oyster reef communities over substrate elevations which are shaded based according to depth.

In previous discussions with the Texas Parks and Wildlife Department (TPWD), a ratio of one acre of oyster reef impact to one acre of sustainable cultch material was considered to be acceptable compensatory mitigation. The logic supporting this 1:1 ratio has been assessed from an ecological and structural perspective. In addition, the mitigation reef will be constructed to strategically coincide with local oyster spawning activities to increase recruitment potential and promote immediate colonization. Structurally, impacted oyster reef is very low profile and does not occupy 100% coverage of the overall 2.30 acres delineated in public harvest areas.

3.0 PROJECT IMPACT (BASELINE) INFORMATION

Galveston Bay is a large, relatively shallow estuarine bay system that is heavily dissected by an extensive network of deeper (15 to 45 feet) navigational ship channels. The largest physiographic feature in Galveston Bay are natural and anthropogenic oyster reefs, with the exception of navigational ship channels and the Mid Bay constriction caused by Redfish Bar. The remainder of benthic habitat in Galveston Bay consists of sand, mud, silt, and clay particles, and shell. While seagrass habitats are present in Galveston Bay, they are found primarily in the West Galveston Bay, not near the Project.

A total of 450.75 acres of potential oyster reef or suitable bottom type were identified during BIO-WEST's marine resources surveys within the 1,200-acre survey area (Appendix B). However, only the 2.30 acres of publicly accessible oyster reefs are located within the proposed protection matting footprint and subject to direct, permanent impacts. Therefore, **FGT proposes to mitigate for 2.30 acres** of existing oyster reef resources.

The project area occurs in the central Galveston Bay complex within the lower San Jacinto River basin watershed. Major contributing freshwater sources into this upper estuary include the San Jacinto River, Buffalo Bayou, Clear Creek, Trinity River, Lake Anahuac, and Greens Bayou along with a myriad of smaller local drainages. These systems converge and enter into Galveston and Trinity Bay complex and share similar hydrologic characteristics as identified by the Texas Commission on Environmental Quality (TCEQ) designated water quality standard segments. The project area occurs within the TCEQ water quality segment identified as Lower Galveston Bay (Segment 2439OW) just south of the Upper Galveston Bay (Segment 2421) boundary. Based on investigations outlined in the Galveston Bay National Estuary Program (1994), these regions often exhibit similar water quality parameters. Acknowledging there are infinite environmental influences and combinations thereof that can dictate oyster health; temperature and salinity are often selected as rudimentary parameters to evaluate. Based on long term averages (1950 to 1991), the project vicinity (potentially impacted reef and mitigation area) supports an average summer water temperature of 30ºC (86ºF) and average salinities of the same time period of 15 parts per thousand (ppt)in the middle of Galveston Bay (Castiglione *et al*., 1990). Based on these remedial parameters, conditions appear to be well within the range to support healthy oyster populations (Kennedy *et al*., 1996; Butler, 1954; Gunter, 1954, and Galtsoff, 1964).

Aside from trying to predict oyster health and sustainability based on a few limited parameters, the presence of oysters themselves provides a much more defendable prediction of suitability. Over the past few years, BIO-WEST has completed remote sensing surveys for over 3,500 acres of Galveston Bay within the immediate project vicinity, by imaging benthic habitats, recording bathymetry data, and conducting oyster investigations. These surveys occurred in local embayments adjacent to the Houston Ship Channel (HSC), including Trinity Bay, Double Bayou, Barbours Cut, Tabbs Bay, Upper San Jacinto Bay, Scott's Bay, Burnet Bay, and Crystal Bay, and resulted in the identification of over 725 acres of oyster reef communities; most of which have never been documented in such detail. Data collected during these surveys included documentation of oyster size class, oyster health (physical observation and dermo analysis), associated reef organisms and reef morphology (based on shape and detailed bathymetric contours). Results of this data review identified the existence of well-established oyster reef communities currently, or once supporting, all life stages of oysters. It is BIO-WEST's opinion that these types of low-profile oyster reefs are relatively common through Galveston Bay as well as in the many side-bays adjacent to the HSC and are a direct result of consistent hydrology and protection from sediment smothering often experienced in open bay habitats during extreme hurricane events.

Oyster health and consequential size class will fluctuate based on many biotic and abiotic variables. However, it is critical the reef structure itself remains intact to recruit new oysters under suitable conditions. Based on BIO-WEST's detailed investigations of over 3,500 acres of adjacent benthic

habitats, our data shows that this region of the middle of Galveston Bay is viable and dominated in low-relief oyster reefs, with almost all reef structures lying less than 1.5-feet higher surrounding non-suitable substrates. The figures in Appendix A illustrate the outline of existing oyster reef communities over substrate elevations which are shaded based according to depth; deeper water depths are depicted in darker blues, while shallow areas are lighter shades.

The success of building an artificial oyster reef is dependent upon many factors, but fundamentally begins with favorable water quality conditions (biotic and abiotic), proper cultch material, and accurate timing to recruit new oysters. This has been demonstrated over decades in the commercial oyster harvesting industry's restoration efforts as well as on-going reef mitigation projects.

3.1 Baseline Survey

In October 2019, BIO-WEST conducted an oyster reef survey according to protocols accepted by the U.S. Fish and Wildlife Service (USFWS), TPWD, and National Marine Fisheries Service (NMFS) as of the date of survey. A copy of the final report is included presented in Appendix E.

3.2 Verification of Baseline Survey

On October 18, 2019, BIO-WEST ecologists conducted a ground truthing investigation of the 450.75 acres of potential oyster reefs within the project area to confirm current conditions and further characterize the existing oyster communities. Six, one-m^2 diver quadrat sampling events were conducted in conjunction with pulling 11, 30-second oyster dredge tows; water quality data was also recorded for *in-situ* observations at each diver quadrat location. Contents of each oyster dredge tow and quadrat were photographed and enumerated. The total length of each oyster was measured in millimeters (mm), and classified by life history stage. Life history stages were grouped into spat oysters (0-24 mm), seed oysters (25-74 mm) and sack oysters (75 mm and greater). Appendix B includes water bottom characterization analysis, representative photographs, oyster tow data and diver quadrat datasheets, and a water quality datasheet, respectively.

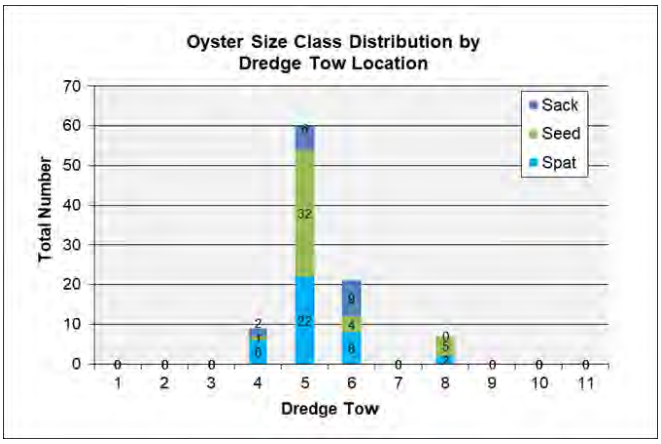

Figure 1: Size Class Distribution by Dredge Tow Location

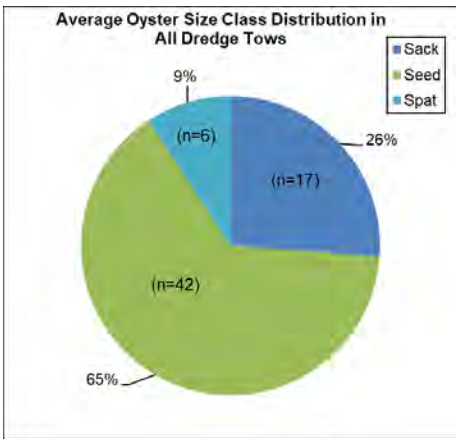

Figure 2: Average Size Class Distribution Across All Dredge Tows

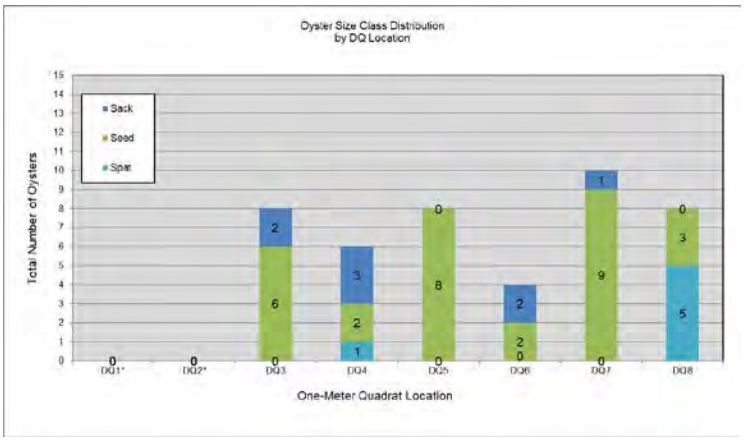

Figure 3: Size Class Distribution by Diver Quadrat Location

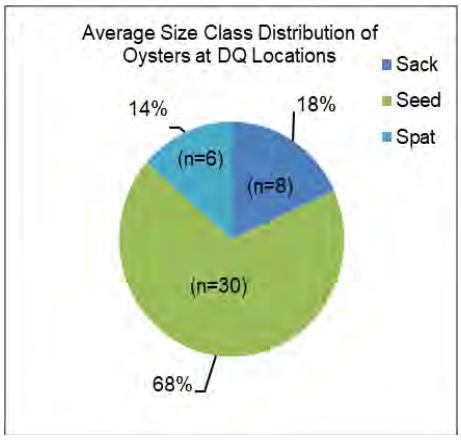

Figure 4: Average Size Class Distribution Across All Diver Quadrats

In summary, a total of 65 live oysters were enumerated from 11 dredge tows within potential oyster reefs in the project corridor (Figure 1). Only four dredge tows (Tows 04, 05, 06, and 08) collected live oysters along with associated organisms. Both soft and firm mud was noted at the remaining dredge tow locations. As depicted in Figure 2, oysters collected were dominated by seed oysters (65%; n=42), followed by sack oysters (26%; n=17) and spat oysters (9%, n=6) (Figure 4-2).

Additionally, a total of 44 live oysters were documented in six diver quadrat sampling locations (Figure 3). As indicated in Figure 4, the average of all quadrat samples indicated a population density of 6.2 individuals per square meter, with the oyster size class distribution seed oysters (68%; n=30), followed by sack oysters (18%; n=8), and spat oysters (14%; n=6). Water quality measurements were recorded from both surface and bottom depth profiles at each diver quadrat sample location to document current conditions.

Water quality measurements were recorded from six depth profiles, at the surface and bottom of the water column, to document current conditions. These measurements were used in comparison with the water quality observed at the proposed mitigation location to assess the suitability of the ambient aquatic conditions for the relocation of oysters.

Table 1: Water Quality Results – Proposed Impact Site

Parameter	Average	
	Surface	Bottom
Sample Depth (ft)	0.6	10.7
Water Temperature (°C)	21.5	22.4
Conductivity (mS/cm)	15.4	24.8
Salinity (‰)	8.7	15.1
DO (mg/L)	10.01	8.65
pH	8.3	8.3

To note, water quality parameters are considered a real time measurement and represent a “snapshot” in time. Long term water quality measurements were not taken for this project, as Galveston Bay represents a large and diverse ecosystem and changing climatic, weather, freshwater inflows, and tides continually alter these parameters.

3.2.1 Mitigation Site Selection Criteria

Oyster reef mitigation location alternatives were evaluated to identify the most feasible option to ensure a successful project. Location criteria considered were based on two sequential screening efforts, intuitively identified as Level 1 and Level 2.

Level 1 Screening Criteria

The first screening level consisted of an overview to help identify general locations based on readily-available information and desktop review. The Level 1 screening effort used to identify a placement area included the following location criteria:

- Occurs within vicinity of impact area (subjective assessment)
- Does not occur within an existing pipeline or infrastructure easement or right-of-way
- Adequate (or better) hydrology and water quality
- Avoids obvious construction constraints
- Limits exploitation of public harvesting to the greatest extent practicable

Additionally, Level 1 screening included intensive coordination and feedback from various resource agencies, including Texas Parks and Wildlife Department (TPWD) and the U.S. Fish and Wildlife Service (USFWS). Through these efforts, BIO-WEST was able to obtain various databases and previous survey results that helped guide mitigation site selection. Figures and exhibits depicting these various sources are included in Appendix A.

Level 2 Screening Criteria

Using results of the Level 1 screening effort and concurrence from TPWD, a detailed marine resource investigation was required to collect location-specific information. This field investigation consisted of a remote sensing survey over a large, 500-ac area to collect water bottom imagery using side-scan sonar (SSS), survey grade fathometer, and sub-bottom profiler (SBP). Following survey efforts, BIO-WEST coordinated with TPWD staff to refine a potential mitigation and then utilized diver quadrats to ground-truth all water bottom types within a selected 10-ac area were to provide a comprehensive data set and evaluate the suitability for mitigation. Once collected, Level 2 screening evaluations were identified and consisted of the following location criteria:

- Supports adequate depth for construction (subjective based on construction technique)
- Suitable for oyster development (existing oyster reefs in vicinity)
- Adequate substrate suitable to support weight of cultch material
- Avoids submerged infrastructure (i.e. pipelines, undocumented hazards, etc.)
- Avoids existing resources from construction and access
- Avoids future development
- Enhances and restores previously identified or historical reefs that are not currently productive

All Level 2 screening efforts followed the May 2020 TPWD Oyster Survey Protocols.

4.0 MITIGATION SITE SELECTION

4.1.1 Level 1 Screening

Based on Level 1 screening criteria and previous efforts the proposed mitigation site will be similar in ground bottom substrate to the reef structures proposed to be impacted. In an effort to mimic additional water quality conditions in an open bay environment, a general location in close proximity (less than 2.5 miles) from proposed project impacts was selected for mitigation reef creation after discussions with the USACE and TPWD. The survey corridor for a proposed mitigation area is presented in Appendix A, Figure 2.

4.1.2 Level 2 Screening

4.1.2.1 Mitigation Site Remote Sensing Surveys

Between October 13 and November 9, 2020, BIO-WEST conducted a comprehensive marine resource survey within a 500-ac mitigation survey area centered. As part of the in-depth marine resources survey, BIO-WEST conducted remote sensing surveys in order to map the location and extent of potential marine resources. Remote sensing survey techniques included the use of a global positioning system (GPS), SSS, SBP, and fathometer. Once complete, BIO-WEST processed the SSS imagery and fathometer bathymetry into a usable database and evaluated multiple areas for potential mitigation based on the screening criteria listed above.

The SSS imagery, as detailed in Appendix A, Figure 3.3, appears to depicted several large areas of moderately hard to hard-bottom returns within the 500-ac survey area. Two large areas, one to the east, and one to the southwest, were classified as the most likely areas to contain living, viable oyster reef habitats. In an effort to minimize impacts to existing reefs, these areas were eliminated as options for reef construction. However, as their potential for spat sources, siting near or adjacent to these areas was judged to be beneficial for project success. Therefore, BIO-WEST ecologist evaluated conditions in the immediate areas of these potential living reefs locations.

BIO-WEST further evaluated the SSS imagery in conjunction with processed bathymetry and other visual details in the mosaic, and estimated that a large portion of the eastern leg of the survey area contained moderately hard to hard substrate with a moderate percentage of open, interstitial sands and silty sands. If proved true during diver quadrat sampling, these areas likely represent historical and/or degraded reefs that were overharvested. Based on coordination with TPWD at multiple stages through the mitigation process, BIO-WEST determined that highly degraded reef areas next to potential living reefs would be ideal candidates for restoration and enhancement activities.

BIO-WEST provided the results of the SSS imagery, bathymetry and the proposed 9-ac ground truthing area to TPWD for review,

4.1.2.2 Mitigation Site Sampling and Characterization

The second phase of the marine natural resources survey involved a physical investigation of the remote sensing survey results to confirm the presence of any oyster reef communities and document environmental conditions. Physical investigation techniques included diver quadrat sampling within the 9-ac ground-truthing area and collection of water quality parameters. All biological survey efforts were conducted under BIO-WEST's current TPWD Scientific Collection Permit.

Per the May 2020 TPWD Oyster Survey Protocols, BIO-WEST utilized 36, ¼ square-meter quadrat sampling to confirm SSS signatures within the 9-ac ground-truthing area. Compared to the diver quadrats

used during the original 2019 project site survey, the results of each quadrat within ground-truthing area indicated that the hard-bottom signatures observed on the SSS imagery consisted entirely of scattered shell hash covered by an approximately two-inch (in) thick layer of silty sand. Only five live oysters were documented within all 36 sample locations. Sample Location 1.1 contained one seed sized oyster, Sample Location 3.1 contained one live oyster, and Sample Location 6.1 contained three sack sized oysters.

Standard water quality parameters were also collected during diver quadrat sampling. Water depths within the sample sites ranged from 6.8 to 7.8 feet below mean lower low water (MLLW), with an average depth of 7.2 ft, similar to the average depths within the project site. In addition to an overall water quality characterization, stratified sampling was conducted to document any variation that may occur within the water column. The average of each water quality parameter by column depth (surface and bottom) was calculated and presented in Table 2.

Table 2: Water Quality Results – Proposed Mitigation Site

Parameter	Average	
	Surface	Bottom
Sample Depth (ft)	3.0	8.0
Water Temperature (°C)	20.30	20.33
Conductivity (mS/cm)	60.29	60.17
Salinity (‰)	11.00	11.00
DO (mg/L)	10.25	10.37
pH	7.5	7.5

5.0 MITIGATION WORK PLAN

The following subsections describe the oyster reef mitigation work plan fundamentals that will be implemented for the Project. This section of the Plan considers other permitted, constructed, and successful projects within the Galveston Bay area.

5.1 Geographic Boundaries of the Project

All mitigation impact areas are illustrated in Appendix B, Exhibit 1 through 3. As a result of multiple consultations with TPWD staff during planning and survey efforts, a general mitigation area in close proximity to the project corridor was identified and determined to be the most practical site for oyster reef mitigation.

5.2 Construction Design

The mitigation work plan proposes to place adequate cultch material at the proposed location in Galveston Bay to cover a minimum footprint of 2.30 acres. The shape of the mitigation reef will be approximately 475 ft by 210 ft, with the elongated axis situated perpendicular (northeast to southwest) to ambient currents into and out of Galveston Bay, estimated to be northwest to southeast. This placement will allow for more edge exposure to currents and assist with oyster pseudofecal waste removal.

Based on BIO-WEST's experience with similar projects under similar circumstances, the substrate at the proposed mitigation area should be similar to the proposed impact area and consist of hard or suitable bottom types with a light to medium density shell hash layer. Since the proposed mitigation site contained suitable material capable of supporting a new reef, no geotextile fabric is currently proposed. However, during construction, if the contractor determines a layer of geotextile fabric is needed, FGT will install one.

Oyster larvae require clean, hard, stable surfaces, such as rock or oyster shell, for settling (Kennedy, et al., 1996). Proposed reef construction material will be composed of one or more of the following components, depending on availability, pricing, and installation logistics:

- Limestone
- Crushed concrete rubble
- River rock
- Other suitable substrate as deemed acceptable by, and coordinated with, TPWD, prior to installation.

If crushed concrete is used, care will be taken to ensure it is free of debris, rebar, or other materials not suitable for placement. The dominant material rock size will not exceed five inches in diameter. Proper sloping for stability will be determined for the specific cultch material used, but is nominally identified at a 2:1 (horizontal:vertical) side slope ratio (Appendix B, Exhibits 2 and 3).

Oyster mitigation reef elevations will be comparable to surrounding natural reefs. The result of this screening effort and benthic habitat surveys of over 500 ac within the surrounding project vicinity concluded that natural reefs in the surveyed area exhibit a relief of less than twelve inches, and are often not discernible from uninhabited adjacent elevations. To note, the approved mitigation reef location will likely occur within water depths identified between 6 and 8 ft below MLLW to mimic existing reef locations. Therefore, reef height will be considered and evaluated further to avoid impairment to local marine navigation.

To account for these variables, the applicant proposes to place cultch material to a target height of six (6) inches above the adjacent water bottom elevations. Although the **applicant anticipates installing approximately 2,225 cubic yards (CY)** of suitable cultch material to reach this height, the final volume of reef material is unknown at this time. Final material volume calculations will be provided to the USACE prior to the start of construction on the mitigation site.

Due to the minimal number of live oysters (five total) on the viable oyster habitat area proposed to be impacted, the potential spat sources in the mitigation site area, and the potential safety and operational concerns associated with dredging live oysters across an active natural pipeline with shallow to minimal existing cover, no oyster relocation efforts are proposed for mitigation.

5.3 Construction Methodology

Using the information collected during previous site investigations (SSS imagery, bathymetry, and SBP data), BIO-WEST identified existing oyster reefs and adequate water depths within 2.5 miles of the project corridor and has provided nonintrusive construction ingress and egress routes using existing channels and industrial docks in the Dickinson Bayou area. For precautionary measures, construction contractors will be made aware of surrounding nearby oyster reefs which will be identified prior to construction. Marine construction activities will be monitored to ensure that prop wash will not occur. On-site marine construction equipment will include shallow-draft tugs and barges that will be loaded to draft no more than eight feet. This will be accomplished by moderately loading the barges and using aluminum crew-boats equipped with outboards to push barges if necessary. Using this equipment, the contractor will utilize short pathways that avoid disturbance to any existing oyster reefs.

Prior to mobilizing construction equipment, the mitigation reef placement area will be navigated to using survey-grade GPS and clearly marked with PVC or cane poles. Cultch material will then be off-loaded using a long-reach track hoe or similar machine mounted on the barge that will gently off-load materials on the bottom. If determined during the first load, the construction contractor will place geotextile material on the bay bottom to ensure the entire footprint of the cultch material will be supported.

5.4 Timing and Sequence

Seasonal timing will play a role in mitigation success; therefore, construction will occur within a time period immediately preceding oyster spawning season. Spawning is triggered mostly by temperature above 20^{o}C for normal spawn and above 25^{o}C for mass spawning (Pattillo et al., 1997). In the Gulf of Mexico, oysters spawn from late March to early October (Shumway, 1996). In addition to temperature, salinities above five parts per thousand (ppt) will be targeted. Construction timing will target peak oyster spawning periods anticipated in May and September and subsequent to permit issuance by the USACE. Proposed construction activities for the Project are planned to be conducted under a single mobilization. The timing of cultch material placement will be closely monitored so that minimal time passes before larval attachment, preventing excessive periods that could lead to silt deposition and inhabitance of fouling organisms.

5.5 Other Elements Considered

No other mitigation work plan elements listed in 40 CFR 230.94(c)(7), such as source of water or methods to establish the desired plan community, are applicable to the Project.

5.6 Summary

The following bulleted list provides a summary of the aforementioned details:

- Place mitigation reef at a location to be determined but less than 0.50 miles from impact site.
- Reef footprint minimum 2.30 acres (approximately 475 ft x 210 ft) elongation placed perpendicular to current.
- Place underlayment of geotextile fabric (if needed).
- Construct to and maintain a 6-inch above bottom elevation with 2:1 side slopes.
- Construction timing will target peak oyster spawn.

6.0 SITE PROTECTION AND MAINTENANCE

The Project area is located on submerged lands within the middle of Galveston Bay. In 1927 House Bill 1642 created the Port of Houston Authority (POHA) to regulate "All islands and lands owned by the State of Texas, together with all lands lying and being situated under the waters of Galveston Bay, as now or hereafter located, is hereby granted to the authority" (TX HB1642, 2013). Proper leasing information has been obtained and secured from the PHA.

Natural resource use or impact is subject to regulation by various governmental agencies including but not limited to TPWD, TXDSHS, USACE, NMFS, and the U.S. Environmental Protection Agency (USEPA). Any activity impacting the resources regulated by those agencies within the proposed mitigation area would be regulated by these governmental agencies. According to the Classification of Shellfish Harvesting Areas of Galveston Bay map provided by TXDSHS Seafood and Aquatic Life Group (2020), Galveston Bay includes areas classified as Approved, Conditionally Approved, Prohibited, and Restricted for shellfish harvesting. The proposed impact area is located within the Approved TX-5 and Conditionally Approved TX-6 areas of Galveston Bay, while the proposed mitigation site is located in a Conditionally Approved TX-6 area. The Conditionally Approved designation at the mitigation site will allow TPWD staff the flexibility to protect the newly created area in both the short term (0 to 5 years) and long term (5+ years) periods as needed, while still providing a public shellfish harvesting area.

Additional protection would also occur under Section 404 and Section 10 of the Clean Water Act regulating dredging and/or fill into waters of the U.S., including wetlands, tidal waters, and special aquatic sites, such as oyster reefs, which would be resultant of the mitigation project.

A minimum relief of six inches will be maintained for the duration of monitoring period to demonstrate structural integrity of the artificial reef. Based on the observations of post-construction monitoring of oyster reef restoration for similar projects under similar conditions, natural spat colonization and substantial growth is expected on its own. The substrate should develop into a self-sufficient mature oyster reef community expected in two to three years and similar to other local oyster restoration projects.

It is possible for future natural phenomena or *force majeure*, such as a major storm or hurricane, to cover the mitigated area along with surrounding natural reefs with translocated sediments. Although this is plausible, it is not suspected to be likely due to limited wind fetch and natural shoreline protection. However, should such an event occur within the five-year post-construction monitoring period, success will be measured by comparing the mitigation reef to one or more reference reef(s). Prior to approval, the applicant will select an appropriately sized natural reference reef within three miles of the proposed mitigation reef, for comparison and analysis purposes at each monitoring event.

7.0 ECOLOGICAL PERFORMANCE STANDARDS

The objective of this mitigation is to construct a 2.30-acre consolidated reef habitat structure in order to compensate for unavoidable impacts to publicly accessible reefs that would be impacted by the proposed Project. The applicant assumes the remaining 0.20 acres of oyster reef within the project footprint will be self-mitigated through negotiations with the private lease holders.

Performance standard criteria must meet better or same recruitment and survival as the reference reef. The mitigation will occur at a suitable location with at a one-to-one acreage ratio (quantitative). As discussed in Section 3.0, substrate density being impacted is less than the 100 percent consolidated substrate coverage proposed at the mitigation location (qualitative). Mitigation activities will be defined as successful by the following criterion.

Preliminary planning SSS was collected by BIO-WEST during the October 2020, marine resource survey. A repeat of this remote sensing survey will be conducted immediately following reef construction at both the mitigation reef and reference reef. This survey will document structural integrity standards have been met by providing georectified imagery and detailed bathymetry to depict area and relief at both sites. The data collected from the mitigation area will be compiled into ArcGIS® data layers for mapping and spatial analysis. Reef acreage will be quantified in order to determine the total amount of habitat created.

Functional endpoints will be used to determine whether qualitative criteria are met, and the mitigation efforts are successful by assessing for similarities in oyster size class and density between the mitigation reef and nearby reference reef(s). Prior to approval, the applicant will select an appropriately sized natural reference reef within 3.0 miles of the proposed mitigation reef, for comparison and analysis purposes at each monitoring event.

Oyster growth success will be measured by divers, following TPWD protocol, using one-m^2 quadrats at three locations on both the mitigation site and reference reef. Oysters will be enumerated and oyster population densities will be extrapolated. Additional information that will be collected during monitoring efforts and reported includes:

- Total length of each oyster
- Number and percentages of live and dead oysters
- Density of live oysters
- Spat recruitment and survival
- Associated reef organisms

8.0 MONITORING PLAN

Monitoring of the preferred oyster reef mitigation site would be assessed pre- and post-creation to assess the success of the Project mitigation goals and objectives. Criteria for mitigation success would include structural and functional assessments as described below.

The structural component is the creation of 2.30 acres of consolidated oyster reef habitat at a minimum of 6-inches of vertical relief from surrounding areas. An initial assessment will be conducted within five days of construction completion but prior to construction crew departure, using side-scan sonar and detailed bathymetry to ensure design criteria has been met. Subsequent to this, another structural component assessment will be conducted 60 days post construction. A repeat of this effort will be conducted annually (spring) thereafter for five years to demonstrate structural success and sustainability. Results of these surveys will be used to create geo-rectified water bottom imagery and detailed depth contours, which will be presented as hardcopy maps.

The functional assessment will be accomplished by comparing oyster community characteristics between the mitigation reef and a nearby reference reef. The reference reef is located within 3.0 miles of the mitigation reef as approved by USACE. Assessment criteria will evaluate similarities in oyster size class and density as well as associated reef organisms between the mitigation reef and reference reef(s), similar to the diver quadrat sampling utilized in Appendix B. Oyster growth success will be assessed using diver-assisted one-m^2 quadrats at three locations on both the mitigation site and reference reef(s). The initial assessment will occur 60 days after construction, followed by bi-annual monitoring (spring and fall) of the constructed reef and a reference reef for a total of five years. Monitoring will continue for the five-year period regardless of performance standard success and oyster recruitment. Table 8-1 below provides a summary of monitoring activities.

Table 3: Mitigation Monitoring Schedule

Monitoring Schedule		Assessment Criteria	
		Structural	Functional
Immediately After Construction		X	--
60 Days Post Construction		X	X
Year 1	Spring	X	X
	Fall	--	X
Year 2	Spring	X	X
	Fall	--	X
Year 3	Spring	X	X
	Fall	--	X
Year 4	Spring	X	X
	Fall	--	X
Year 5	Spring	X	X
	Fall	--	X

9.0 LONG-TERM MANAGEMENT PLAN

The Applicant anticipates that after five years of monitoring and meeting the performance standards described above, the mitigation oyster reef will be self-sustaining. After the mitigation efforts for the Project have been demonstrated successful and approved by the USACE and FGT is released from any and all future liabilities, management of the area would be returned to the owners and regulators of Galveston Bay. The mitigation reef should result in an active oyster reef community which will provide important environmental services for the Galveston Bay system. As such, this benthic resource will be incorporated into existing environmental agency monitoring and regulations. These various governmental agencies include, but are not limited to TPWD, POHA, TXDSHS, USACE, NMFS, and USEPA.

10.0 ADAPTIVE MANAGEMENT PLAN

Any time during the post-construction monitoring period, if the success of this mitigation plan appears to not be meeting the success performance standard criteria, the permittee will notify USACE District Engineer as soon as possible. If such a circumstance occurs, the mitigation plan can be evaluated and measures pursued to address deficiencies of the mitigation. Potential adaptations to the mitigation plan may require the addition of cultch material in the event the reef height is not met. Discussions on meeting the success criteria will be included in each monitoring report. Performance standard criteria should meet better or same recruitment and survival as reference reef.

11.0 FINANCIAL ASSURANCES

FGT has a long and proven track record of successfully participating in and funding mitigation as part of other sponsored projects. FGT has multiple coastal based pipelines and other projects throughout Gulf Coast Region. The requested activity and mitigation efforts will be funded in full by FGT and grant funds will not be used. FGT has the technical and financial capability to deliver the cultch material and create an oyster mitigation reef, which meets or exceeds the current existing reef structure(s) measurable related to oysters. In order to complete the mitigation as proposed, a POHA Construction Permit will be required and will financially tie FGT to the mitigation project, ensuring long-term fiscal responsibility.

At this time, long term financial backing of the proposed oyster reef mitigation project is not proposed. The Applicant has agreed to address any construction design complications and all performance standard deficiencies during the proposed five-year monitoring period. During this time, the Applicant will communicate with the USACE in order to ensure a successful mitigation project which meets the described success criteria.

12.0 REPORTING

The proposed construction activities are anticipated to begin in 2Q, 2021; however, the mitigation construction timeline will be dependent on the approval and issuance of the permit.

An initial assessment of both the mitigation reef and reference reef(s) will be conducted within five days of construction completion, but prior to construction crew departure, using side-scan sonar and detailed bathymetry to ensure design criteria has been met. Results of these surveys will be used to create georectified water bottom imagery and detailed depth contours, which will be presented as hardcopy. This information will be submitted to the USACE within 30 days of survey efforts.

Within 60 days following the completion of construction activities, a functional assessment will be conducted to document oyster recruitment and adequately characterized the benthic community. This effort will be repeated bi-annually (spring and fall) thereafter for five years, equating to twelve monitoring efforts. Details of this schedule are presented in Section 8.0. Results of these monitoring efforts will be summarized into a monitoring report with adequate tables, graphs and associated photo documentation. Reports will be provided to the USACE within 90 days following each effort.

Each annual monitoring report will be provided to USACE and TPWD for review upon completion. Reports will list the monitoring requirements, performance standards, and evaluate whether the compensatory mitigation site is successfully achieving the approved performance standards or trending toward success. Summary data will be provided to substantiate the success and/or potential challenges associated with the Project Plan. Photo documentation will be provided to support the findings. Maps will be provided indicating the location of transects, sampling data points, and/or other pertinent features. Tables will be presented to include number of live and dead oysters in three size classes and be compared to reference reef in bi-annual monitoring reports during spring and fall seasons. A general conclusion statement will be included describing the condition of the compensatory mitigation site. All monitoring reports will be submitted to the USACE and TPWD for a period of no shorter than five years, regardless of oyster recruitment and/or meeting of performance standards.

13.0 REFERENCES

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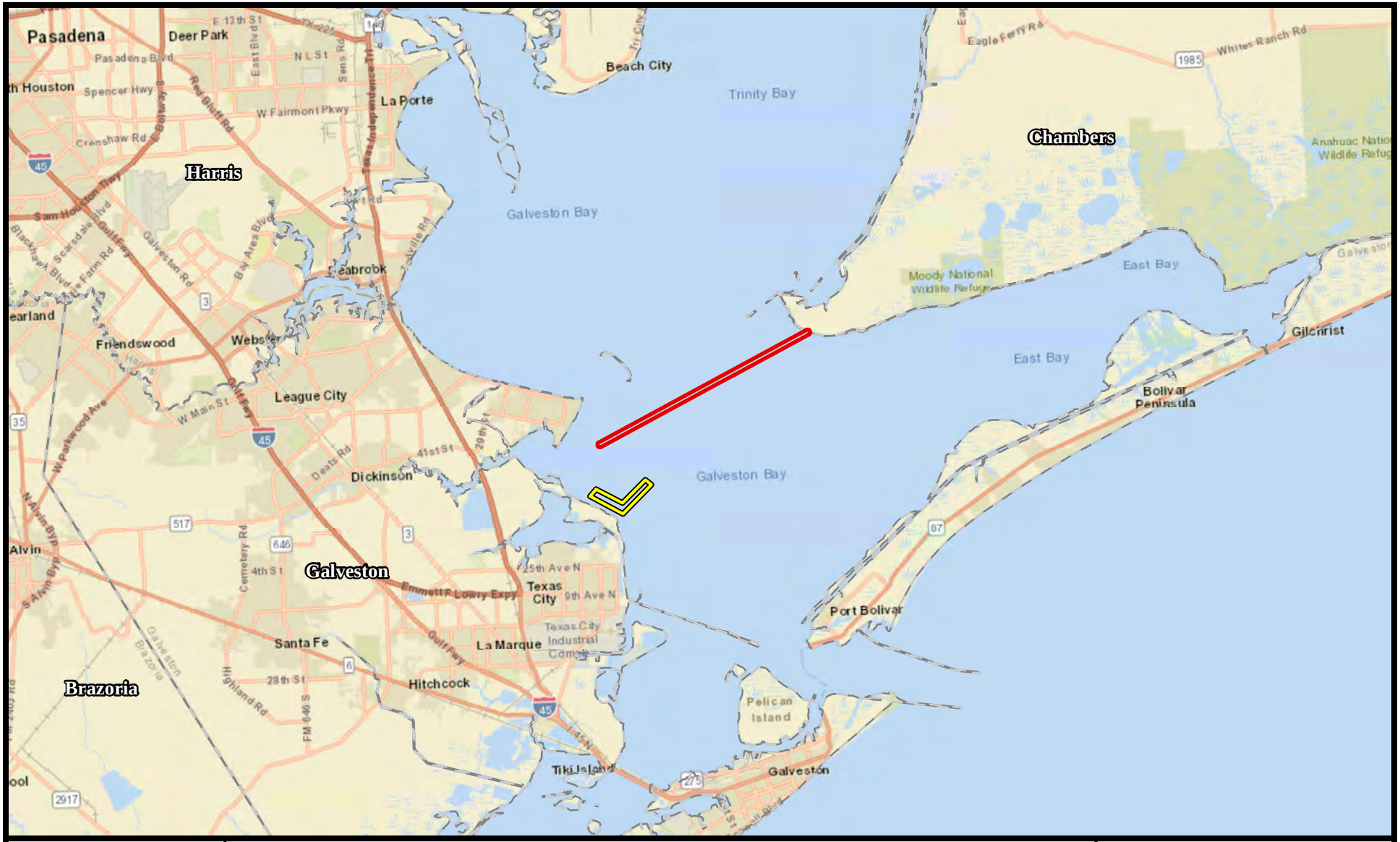
TX HB1642 § 3 Sec. 5007.004. (Revised 2013)

Appendix A

Project Figures and Exhibits



Florida Gas Transmission Company, LLC.

Figure 1.0
Vicinity
Galveston & Chambers Counties, Texas

Project: Oyster Mitigationg Sites - FGT Galveston Bay Pipeline	Project No: 2658.01	Date Drawn: 11/12/2020	Source: ESRI World Street Map	Scale: 1 in = 5 miles	Projection: NAD 1983 StatePlane Texas South Central FIPS 4204 Feet	Drawn by: JG

Legend

- Mitigation Survey Corridor
- Pipeline Survey Corridor
- County Boundary

Miles
0 0.625 1.25 2.5

N

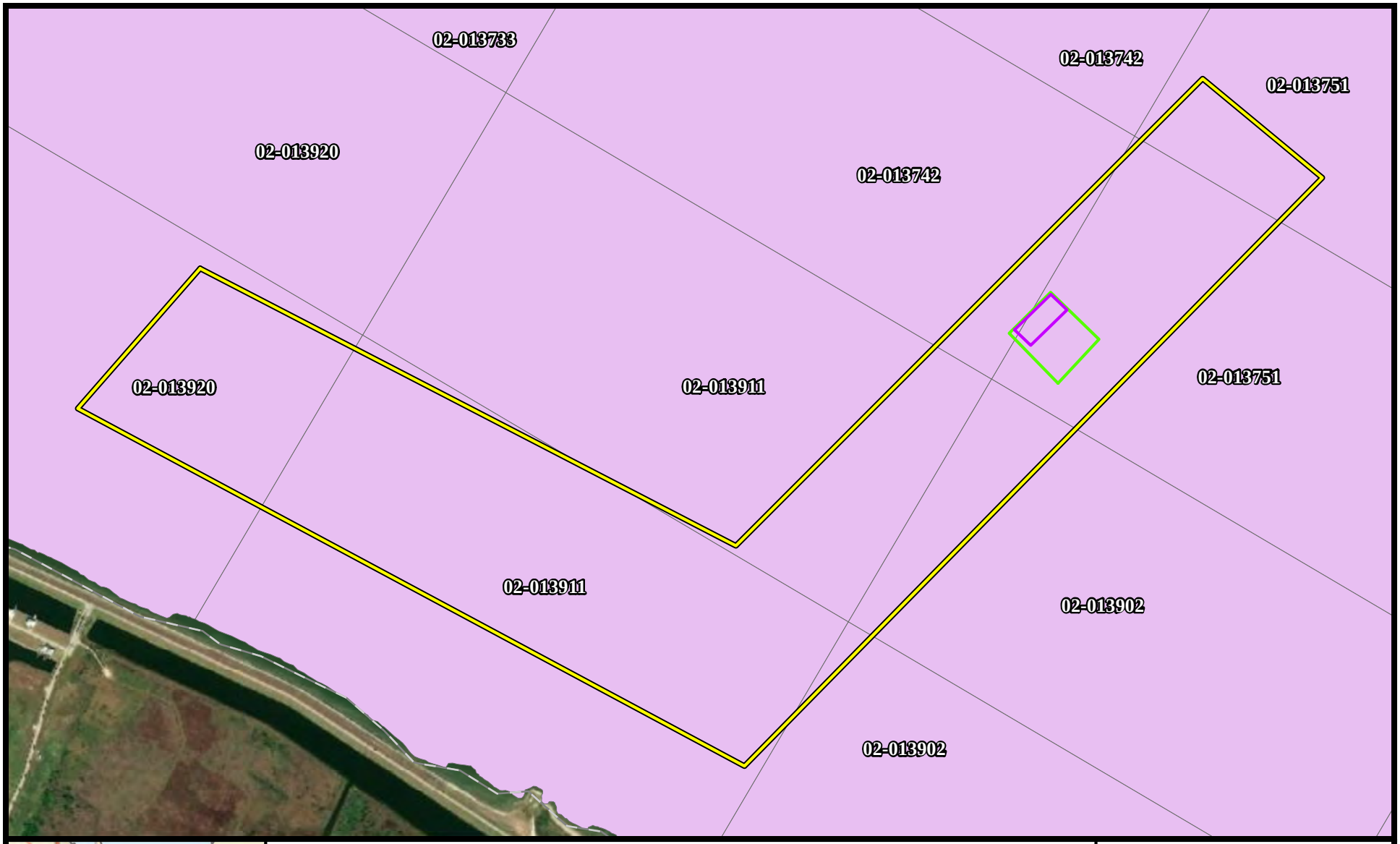
Additional Information on BIO-WEST's October 2019 Oyster Reef Survey and Report for the Proposed Mat Placement on the 24-in Florida Gas Transmission Pipeline is located in Appendix E.

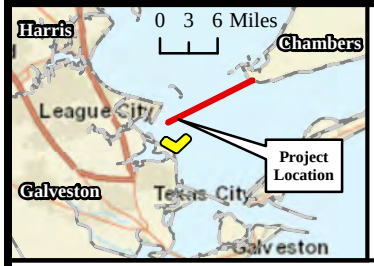
Prepared by: BIO-WEST

Florida Gas Transmission Company, LLC.

Figure 2.0
Location
Galveston & Chambers Counties, Texas

Project: Oyster Mitigationg Sites - FGT Galveston Bay Pipeline	Project No: 2658.01	Date Drawn: 11/12/2020	Source: ESRI Imagery	Scale: 1 in = 1.25 miles	Projection: NAD 1983 StatePlane Texas South Central FIPS 4204 Feet	Drawn by: JG





Legend

- Mitigation Site
- Mitigation Survey Corridor
- Ground-truthing Area
- GLO State Submerged Tracts

Feet
0 650 1,300 2,600

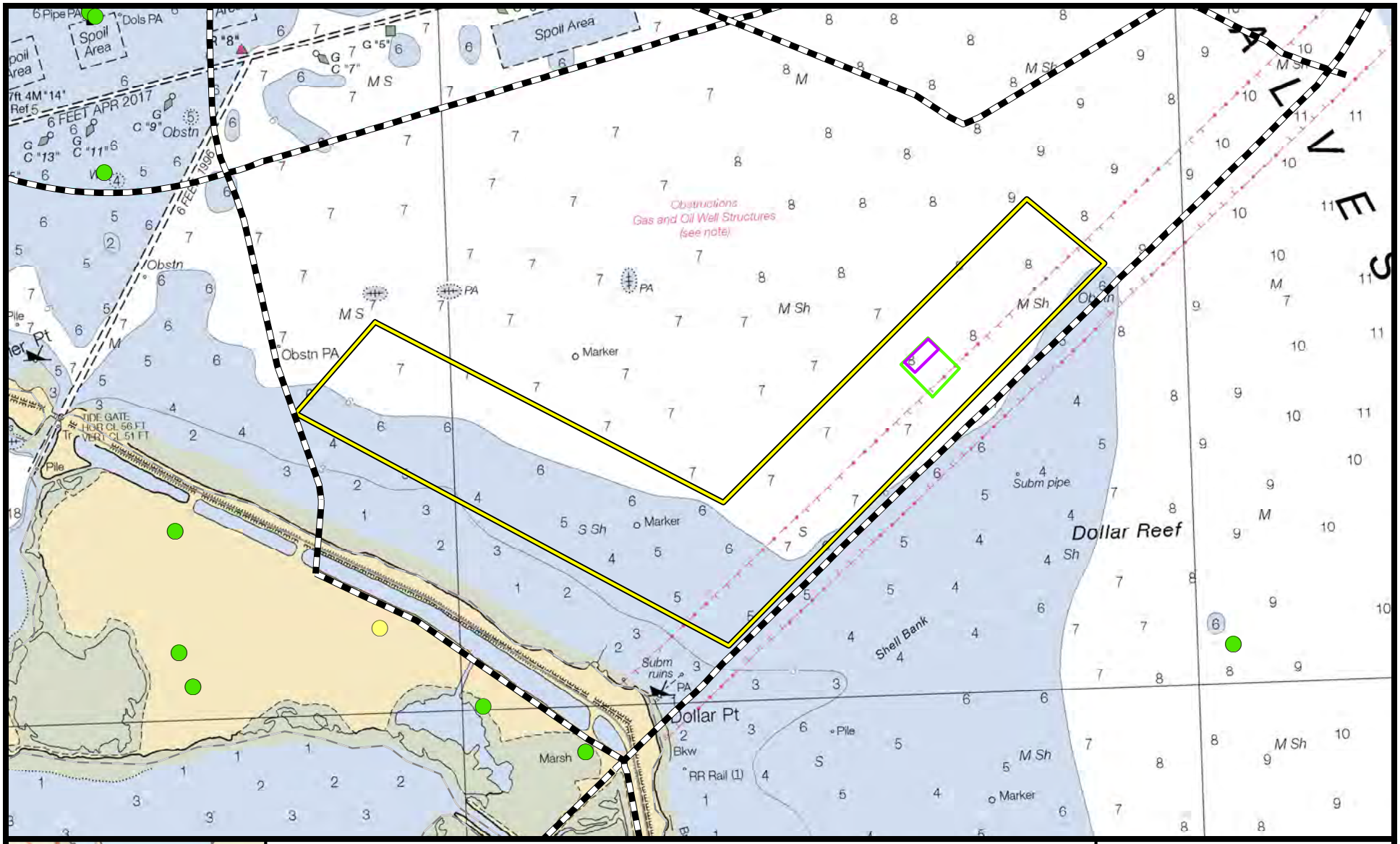
N

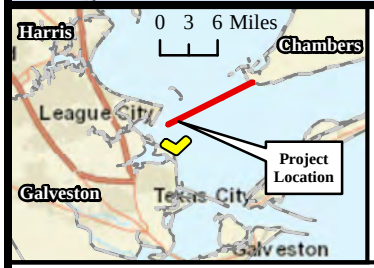
Prepared by: BIO-WEST

Florida Gas Transmission Company, LLC.

Figure 3.0
Screening Level I POHA/GLO Submerged Lands - Mitigation Site
Galveston & Chambers Counties, Texas

Project: Oyster Mitigationg Sites - FGT Galveston Bay Pipeline	Project No: 2658.01	Date Drawn: 11/13/2020	Source: NOAA RNC	Scale: 1 in = 1,300 feet	Projection: NAD 1983 StatePlane Texas South Central FIPS 4204 Feet	Drawn by: JG





Legend

- Mitigation Site
- Mitigation Survey Corridor
- TX RRC Surface Wells
- TX RRC Bottom Wells
- TX RRC Pipelines
- Ground-truthing Area

0 1,000 2,000 4,000 Feet

N

Prepared by: BIO-WEST

Florida Gas Transmission Company, LLC.

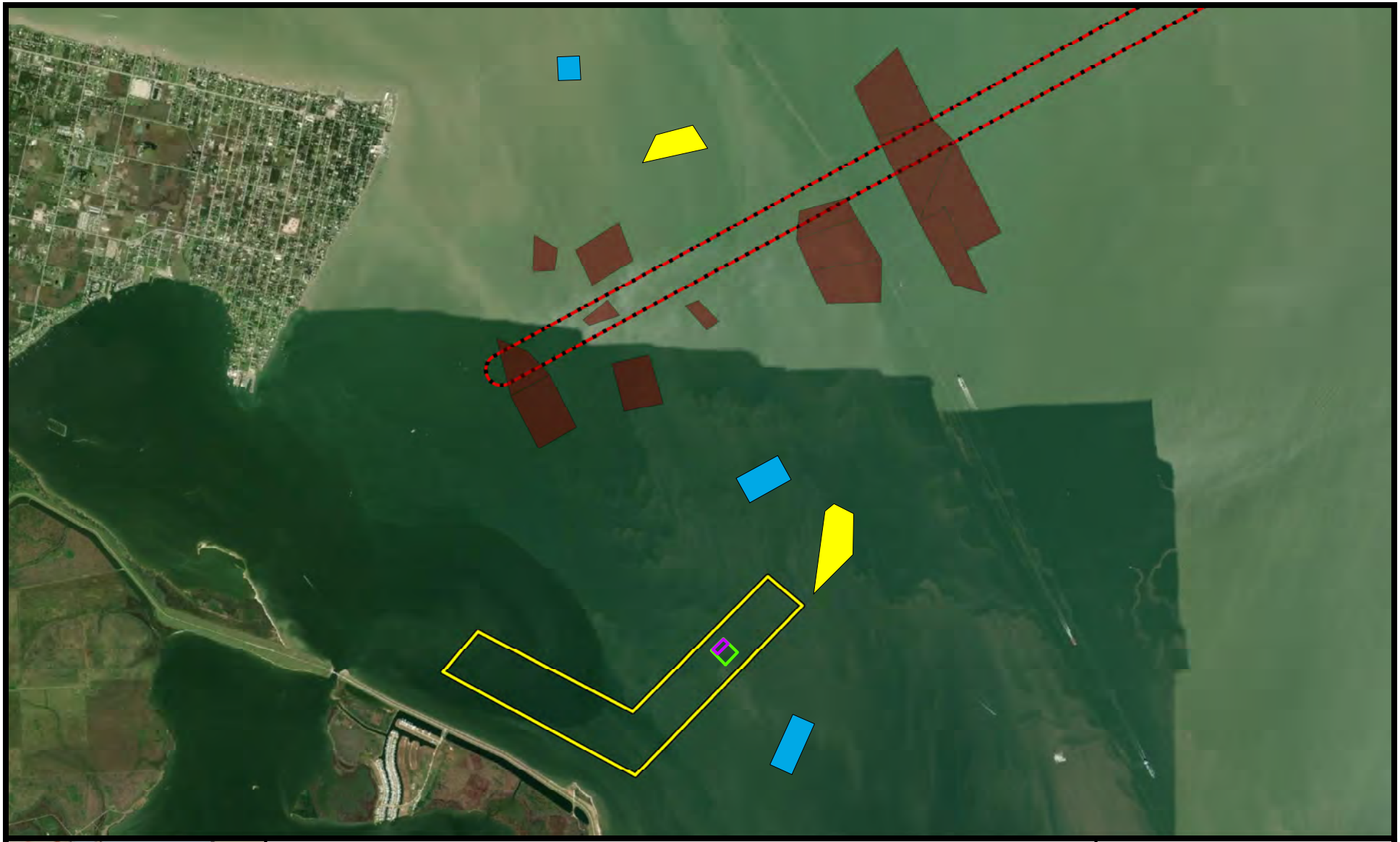
Figure 3.1

Screening Level I

Public Databases - Mitigation Site

Galveston & Chambers Counties, Texas

Project: Oyster Mitigationg Sites - FGT Galveston Bay Pipeline	Project No: 2658.01	Date Drawn: 11/12/2020	Source: NOAA RNC	Scale: 1 in = 2,000 feet	Projection: NAD 1983 StatePlane Texas South Central FIPS 4204 Feet	Drawn by: JG



Legend

- Mitigation Site
- Mitigation Survey Corridor
- TPWD Restoration Sites
- TPWD Restoration Permits under Review
- Private Oyster Leases
- Pipeline Survey Corridor
- Ground-truthing Area

Feet
0 2,250 4,500 9,000

N

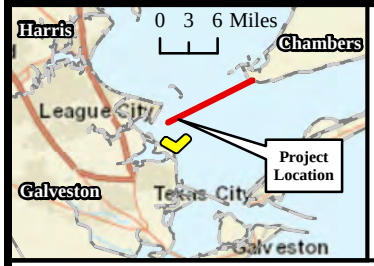
Prepared by: BIO-WEST

Florida Gas Transmission Company, LLC.

Figure 3.2

Screening Level I
TPWD Coordination - Mitigation Site
Galveston & Chambers Counties, Texas

Project: Oyster Mitigationg Sites - FGT Galveston Bay Pipeline	Project No: 2658.01	Date Drawn: 11/12/2020	Source: NOAA RNC	Scale: 1 in = 4,500 feet	Projection: NAD 1983 StatePlane Texas South Central FIPS 4204 Feet	Drawn by: JG



Legend

- Mitigation Site
- Mitigation Survey Corridor
- Ground-truthing Area
- 1-ft Contours*
- TPWD Restoration Sites
- TPWD Restoration Permits under Review

Feet
0 650 1,300 2,600

N

**Bathymetric corrections were performed with verified NOAA Water Level data. Contours were generated by interpolation of point measurments, and should not be used for engineering purposes*

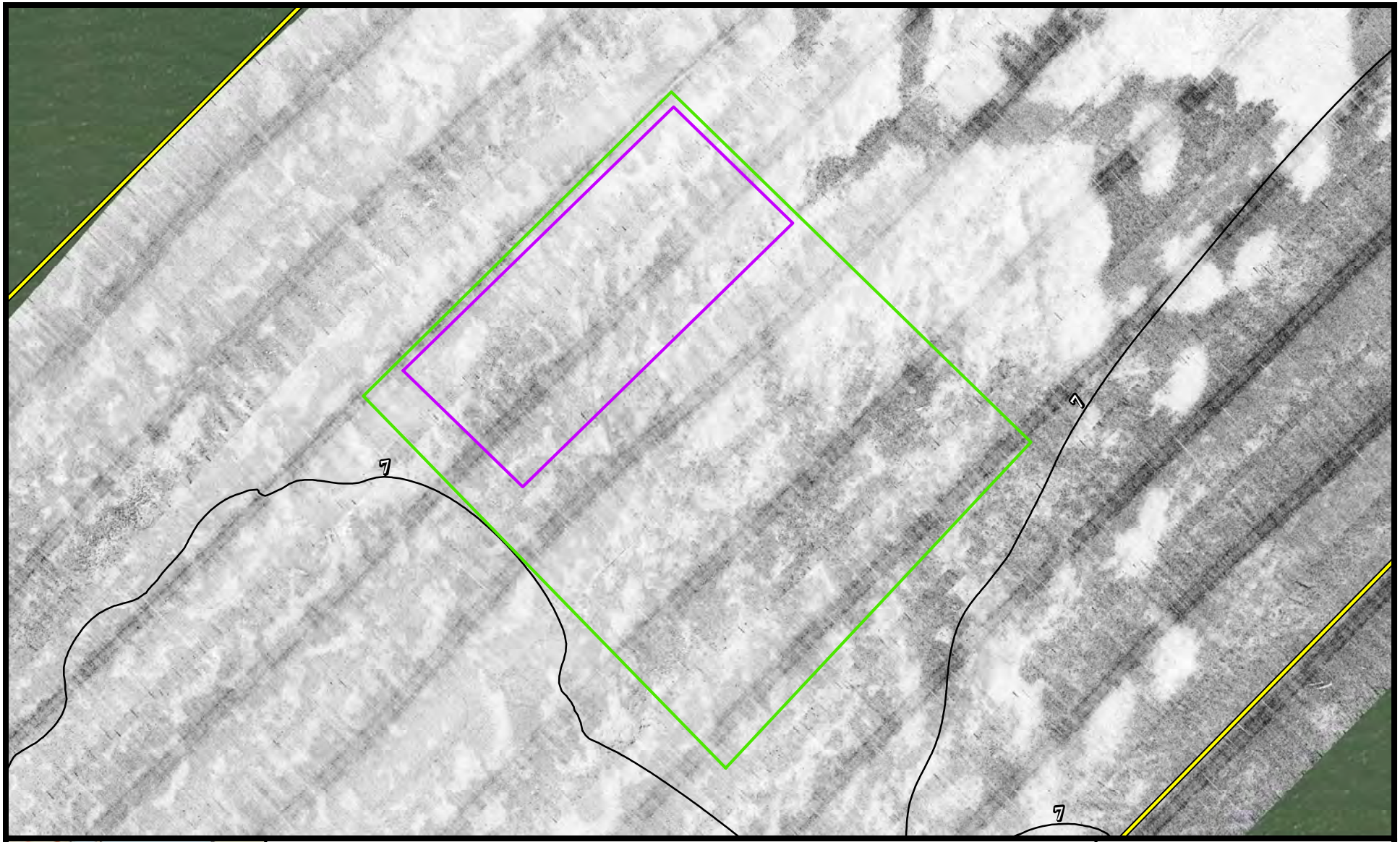
Prepared by: BIO-WEST

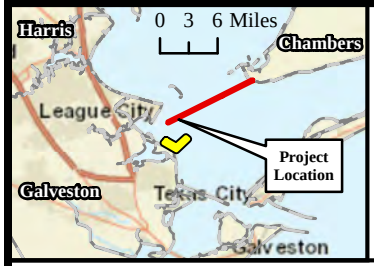
Florida Gas Transmission Company, LLC.

Figure 3.3

Screening Level II Survey
Mitigation Site
Galveston & Chambers Counties, Texas

Project: Oyster Mitigationg Sites - FGT Galveston Bay Pipeline	Project No: 2658.01	Date Drawn: 11/12/2020	Source: NOAA RNC	Scale: 1 in = 1,300 feet	Projection: NAD 1983 StatePlane Texas South Central FIPS 4204 Feet	Drawn by: JG





Legend

- Mitigation Site
- Mitigation Survey Corridor
- 1-ft Contours*
- Ground-truthing Area

0 75 150 300 Feet

N

**Bathymetric corrections were performed with verified NOAA Water Level data. Contours were generated by interpolation of point measurments, and should not be used for engineering purposes*

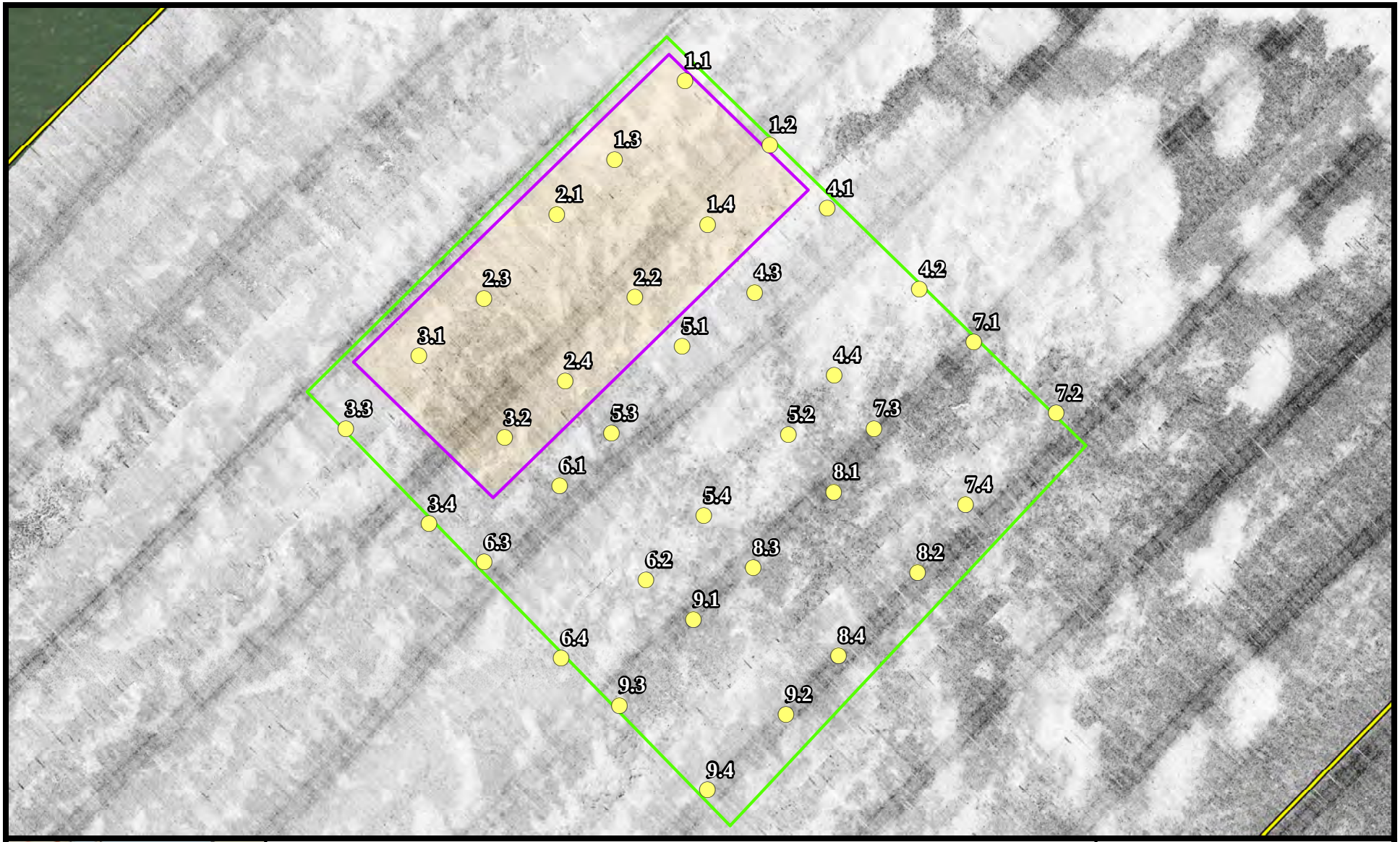
Prepared by: BIO-WEST

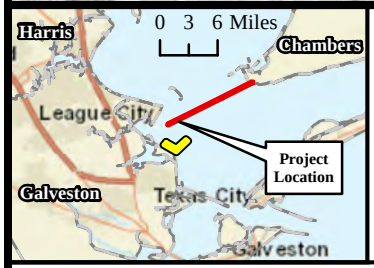
Florida Gas Transmission Company, LLC.

Figure 3.4

Screening Level II Survey
Mitigation Site Selection
Galveston & Chambers Counties, Texas

Project: Oyster Mitigationg Sites - FGT Galveston Bay Pipeline	Project No: 2658.01	Date Drawn: 11/12/2020	Source: NOAA RNC	Scale: 1 in = 175 feet	Projection: NAD 1983 StatePlane Texas South Central FIPS 4204 Feet	Drawn by: JG





Legend

- Mitigation Site
- Mitigation Survey Corridor
- Viable Oyster Habitat
- Sample Locations
- Ground-truthing Area

0 75 150 300 Feet

N

**Bathymetric corrections were performed with verified NOAA Water Level data. Contours were generated by interpolation of point measurments, and should not be used for engineering purposes*

Prepared by: BIO-WEST

Florida Gas Transmission Company, LLC.

Figure 3.5

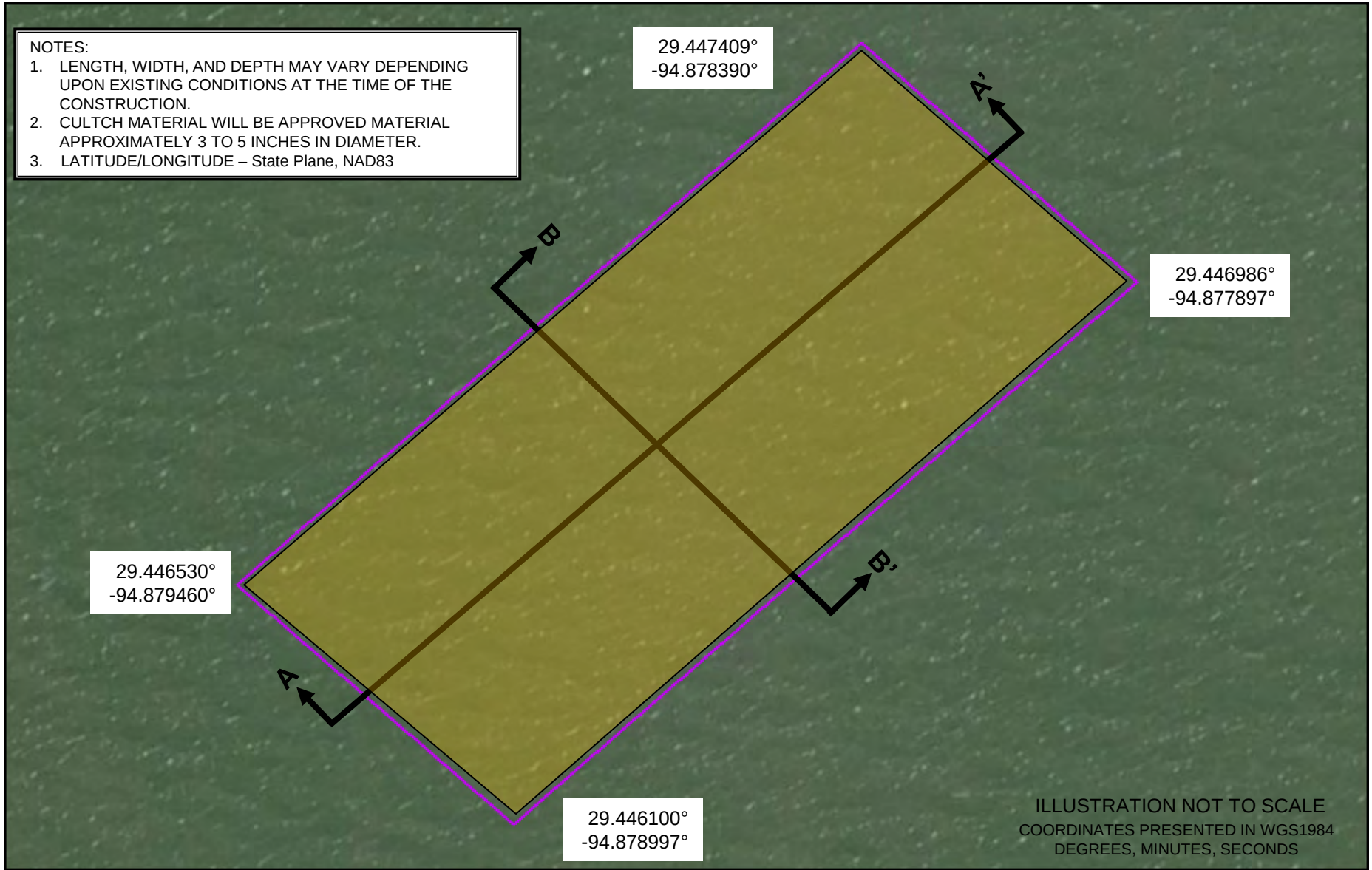
Screening Level II Sampling Mitigation Site

Galveston & Chambers Counties, Texas

Project: Oyster Mitigationg Sites - FGT Galveston Bay Pipeline	Project No: 2658.01	Date Drawn: 11/12/2020	Source: NOAA RNC	Scale: 1 in = 150 feet	Projection: NAD 1983 StatePlane Texas South Central FIPS 4204 Feet	Drawn by: JG

Appendix B

Proposed Mitigation Site Plan and Cross-Sections



Prepared by:

BIO-WEST

USACE SWG-2019-00406
PROPOSED REEF MITIGATION PROJECT
Exhibit 1a - Plan View
Galveston Bay, TEXAS

Prepared for:

Florida Gas Transmission Company, LLC

Project No: 2658	Date: 10/19/2020	County: Chambers and Galveston, TX
Scale: NTS	Drawn By: MEC	

NOTES:
1. LENGTH, WIDTH, AND DEPTH MAY VARY DEPENDING UPON EXISTING CONDITIONS AT THE TIME OF THE CONSTRUCTION.
2. CULTCH MATERIAL WILL BE APPROVED MATERIAL APPROXIMATELY 3 TO 5 INCHES IN DIAMETER.
3. LATITUDE/LONGITUDE – State Plane, NAD83

ILLUSTRATION NOT TO SCALE
COORDINATES PRESENTED IN WGS1984
DEGREES, MINUTES, SECONDS

Prepared by:

BIO-WEST

USACE SWG-2019-00406
PROPOSED REEF MITIGATION PROJECT
Exhibit 1b - Plan View
Galveston Bay, TEXAS

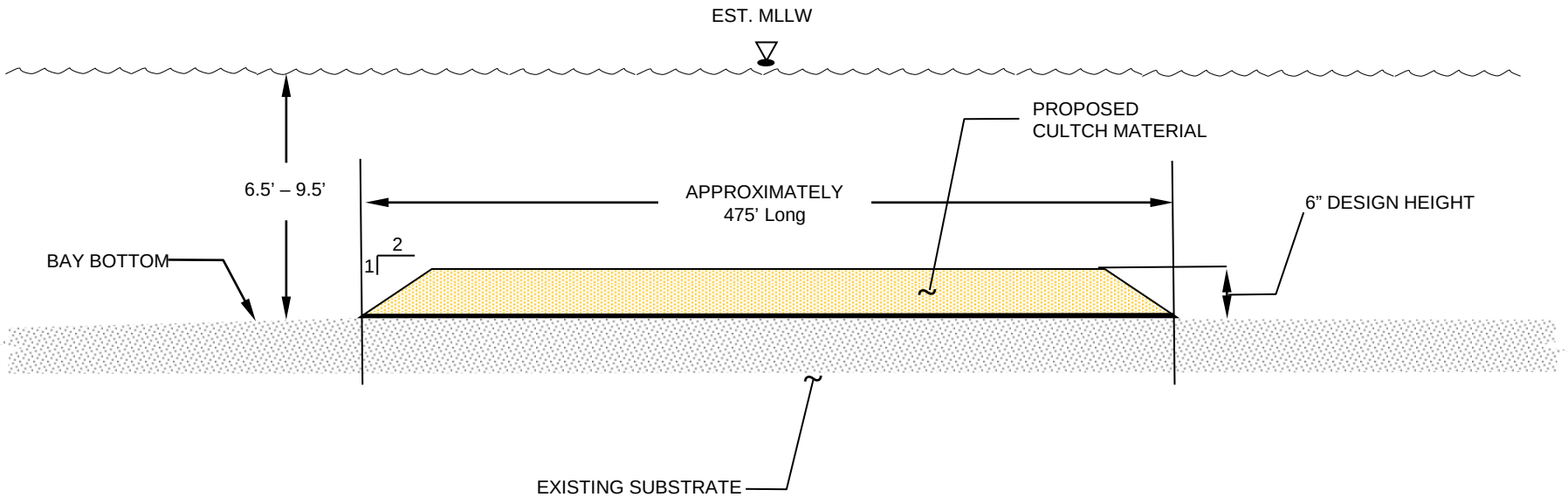
Prepared for:

Florida Gas Transmission Company, LLC

Project No: 2658	Date: 10/19/2020	County: Chambers and Galveston, TX
Scale: NTS	Drawn By: MEC	

WATER LEVEL OBTAINED FROM
PRELIMINARY RESOURCE SURVEY
TIDALLY CORRECTED TO NOAA TIDE
STATION 8770613 MORGANS POINT, TX

NOTES:
1. LENGTH, WIDTH, AND DEPTH MAY VARY DEPENDING UPON EXISTING CONDITIONS AT THE TIME OF THE CONSTRUCTION.
2. CULTCH MATERIAL WILL BE APPROVED MATERIAL APPROXIMATELY 3 TO 5 INCHES IN DIAMETER.
3. WIDTH WILL BE APPROXIMATELY 210'.



SECTION A – A'
N.T.S.

ILLUSTRATION NOT TO SCALE
COORDINATES PRESENTED IN WGS1984
DEGREES, MINUTES, SECONDS

Prepared by:
BIO-WEST

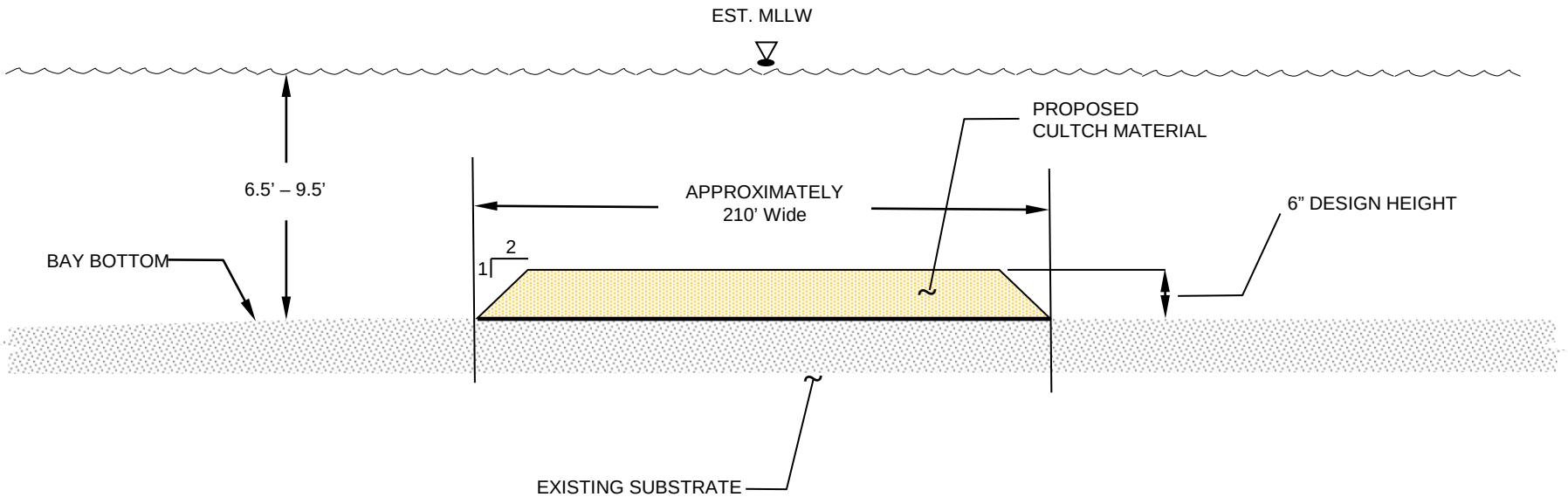
USACE SWG-2019-00406
PROPOSED REEF MITIGATION PROJECT
Exhibit 2 - Typical Cross-Section
Galveston Bay, TEXAS

Prepared for:
Florida Gas Transmission Company, LLC

Project No: 2658	Date: 10/19/2020	County: Chambers and Galveston, TX
Scale: NTS	Drawn By: MEC	File: Typical Reef_X-sect

WATER LEVEL OBTAINED FROM
PRELIMINARY RESOURCE SURVEY
TIDALLY CORRECTED TO NOAA TIDE
STATION 8770613 MORGANS POINT, TX

NOTES:
1. LENGTH, WIDTH, AND DEPTH MAY VARY DEPENDING UPON EXISTING CONDITIONS AT THE TIME OF THE CONSTRUCTION.
2. CULTCH MATERIAL WILL BE APPROVED MATERIAL APPROXIMATELY 3 TO 5 INCHES IN DIAMETER.
3. LENGTH WILL BE APPROXIMATELY 475'.



SECTION B – B'
N.T.S.

ILLUSTRATION NOT TO SCALE
COORDINATES PRESENTED IN WGS1984
DEGREES, MINUTES, SECONDS

Prepared by:
BIO-WEST

USACE SWG-2019-00406
PROPOSED REEF MITIGATION PROJECT
Exhibit 3 - Typical Cross-Section
Galveston Bay, TEXAS

Prepared for:
Florida Gas Transmission Company, LLC

Project No: 2658	Date: 10/19/2020	County: Chambers and Galveston, TX
Scale: NTS	Drawn By: MEC	File: Typical Reef_X-sect

Appendix C

Proposed Mitigation Site Sample Data

OYSTER RECRUITMENT STUDY

Observers: B.Whitney, K.Altimore, C. Vecera
Date: 11/6/2020
Sample Location: 1.1
Weather Conditions: Sunny
Water Conditions: Choppy
Sample Type: Diver Collected

Size		Group	Live Oyster Count	Box Oyster Count[1]	Dead Oyster Count	Invertebrate Predators/Fouling Organisms
Spat Oysters	0-4mm	0				**Barnacles**
	5-9mm	1				None
	10-14mm	2				
	15-19mm	3				
	20-24mm	4				
Seed Oysters	25-29mm	5				**Algae**
	30-34mm	6		1		None
	35-39mm	7				
	40-44mm	8				
	45-49mm	9				
	50-54mm	10				**Bryozoans**
	55-59mm	11				None
	60-64mm	12				
	65-69mm	13				
	70-74mm	14				
Sack Oysters	75-79mm	15				**Hooked Mussels**
	80-84mm	16				None
	85-89mm	17				
	90-94mm	18				
	95-99mm	19				
	100-104mm	20				**Oyster Drills**
	105-109mm	21				None
	110-114mm	22				
	115-119mm	23				
	120-124mm	24				
	125-129mm	25				**Polychaetes**
	130-134mm	26				None
	135-139mm	27				
	140-144mm	28				
	145-149mm	29				
	150-154mm	30				**Serpulid Worms**
	155-159mm	31				None
	160-164mm	32				
	165-169mm	33				
	170-174mm	34				
	175-179mm	35				**Crabs**
	180-184mm	36				None
	185-189mm	37				
	190-194mm	38				
	195-199mm	39				
	>200mm	40+				

[1] - Recently dead (determined by the number of fouling organisms) oysters if both valves remain intact and also recently dead single valves.

OYSTER RECRUITMENT STUDY

Observers:	B.Whitney, K.Altimore, C. Vecer	Weather Conditions:	Sunny
Date:	11/6/2020	Water Conditions:	Choppy
Sample Location:	1.2	Sample Type:	Diver Collected

Size		Group	Live Oyster Count	Box Oyster Count[1]	Dead Oyster Count	Invertebrate Predators/Fouling Organisms
Spat Oysters	0-4mm	0				**Barnacles**
	5-9mm	1				None
	10-14mm	2				
	15-19mm	3				
	20-24mm	4				
Seed Oysters	25-29mm	5				**Algae**
	30-34mm	6				None
	35-39mm	7				
	40-44mm	8				
	45-49mm	9				
	50-54mm	10				**Bryozoans**
	55-59mm	11				None
	60-64mm	12				
	65-69mm	13				
	70-74mm	14				
Sack Oysters	75-79mm	15				**Hooked Mussels**
	80-84mm	16				None
	85-89mm	17				
	90-94mm	18				
	95-99mm	19				
	100-104mm	20				**Oyster Drills**
	105-109mm	21				None
	110-114mm	22				
	115-119mm	23				
	120-124mm	24				
	125-129mm	25				**Polychaetes**
	130-134mm	26				None
	135-139mm	27				
	140-144mm	28				
	145-149mm	29				
	150-154mm	30				**Serpulid Worms**
	155-159mm	31				None
	160-164mm	32				
	165-169mm	33				
	170-174mm	34				
	175-179mm	35				**Crabs**
	180-184mm	36				None
	185-189mm	37				
	190-194mm	38				
	195-199mm	39				
	>200mm	40+				

[1] - Recently dead (determined by the number of fouling organisms) oysters if both valves remain intact and also recently dead single valves.

OYSTER RECRUITMENT STUDY

Observers:	B.Whitney, K.Altimore, C. Vecer	Weather Conditions:	Sunny
Date:	11/6/2020	Water Conditions:	Choppy
Sample Location:	1.3	Sample Type:	Diver Collected

Size		Group	Live Oyster Count	Box Oyster Count[1]	Dead Oyster Count	Invertebrate Predators/Fouling Organisms
Spat Oysters	0-4mm	0				**Barnacles**
	5-9mm	1				None
	10-14mm	2				
	15-19mm	3				
	20-24mm	4				
Seed Oysters	25-29mm	5				**Algae**
	30-34mm	6				None
	35-39mm	7				
	40-44mm	8				
	45-49mm	9				
	50-54mm	10				**Bryozoans**
	55-59mm	11				None
	60-64mm	12				
	65-69mm	13				
	70-74mm	14				
Sack Oysters	75-79mm	15				**Hooked Mussels**
	80-84mm	16				None
	85-89mm	17				
	90-94mm	18				
	95-99mm	19				
	100-104mm	20				**Oyster Drills**
	105-109mm	21				None
	110-114mm	22				
	115-119mm	23				
	120-124mm	24				
	125-129mm	25				**Polychaetes**
	130-134mm	26				None
	135-139mm	27				
	140-144mm	28				
	145-149mm	29				
	150-154mm	30				**Serpulid Worms**
	155-159mm	31				None
	160-164mm	32				
	165-169mm	33				
	170-174mm	34				
	175-179mm	35				**Crabs**
	180-184mm	36				None
	185-189mm	37				
	190-194mm	38				
	195-199mm	39				
	>200mm	40+				

[1] - Recently dead (determined by the number of fouling organisms) oysters if both valves remain intact and also recently dead single valves.

OYSTER RECRUITMENT STUDY

Observers:	B.Whitney, K.Altimore, C. Vecer	Weather Conditions:	Sunny
Date:	11/6/2020	Water Conditions:	Choppy
Sample Location:	1.4	Sample Type:	Diver Collected

Size		Group	Live Oyster Count	Box Oyster Count[1]	Dead Oyster Count	Invertebrate Predators/Fouling Organisms
Spat Oysters	0-4mm	0				**Barnacles**
	5-9mm	1				None
	10-14mm	2				
	15-19mm	3				
	20-24mm	4				
Seed Oysters	25-29mm	5				**Algae**
	30-34mm	6				None
	35-39mm	7				
	40-44mm	8				
	45-49mm	9				
	50-54mm	10				**Bryozoans**
	55-59mm	11				None
	60-64mm	12				
	65-69mm	13				
	70-74mm	14				
Sack Oysters	75-79mm	15				**Hooked Mussels**
	80-84mm	16				None
	85-89mm	17				
	90-94mm	18				
	95-99mm	19				
	100-104mm	20				**Oyster Drills**
	105-109mm	21				None
	110-114mm	22				
	115-119mm	23				
	120-124mm	24				
	125-129mm	25				**Polychaetes**
	130-134mm	26				None
	135-139mm	27				
	140-144mm	28				
	145-149mm	29				
	150-154mm	30				**Serpulid Worms**
	155-159mm	31				None
	160-164mm	32				
	165-169mm	33				
	170-174mm	34				
	175-179mm	35				**Crabs**
	180-184mm	36				None
	185-189mm	37				
	190-194mm	38				
	195-199mm	39				
	>200mm	40+				

[1] - Recently dead (determined by the number of fouling organisms) oysters if both valves remain intact and also recently dead single valves.

OYSTER RECRUITMENT STUDY

Observers: B.Whitney, K.Altimore, C. Vecera
Date: 11/6/2020
Sample Location: 2.3
Weather Conditions: Sunny
Water Conditions: Choppy
Sample Type: Diver Collected

Size		Group	Live Oyster Count	Box Oyster Count[1]	Dead Oyster Count	Invertebrate Predators/Fouling Organisms
Spat Oysters	0-4mm	0				**Barnacles**
	5-9mm	1				None
	10-14mm	2				
	15-19mm	3				
	20-24mm	4				
Seed Oysters	25-29mm	5				**Algae**
	30-34mm	6				None
	35-39mm	7				
	40-44mm	8				
	45-49mm	9				
	50-54mm	10				**Bryozoans**
	55-59mm	11				None
	60-64mm	12				
	65-69mm	13				
	70-74mm	14				
Sack Oysters	75-79mm	15				**Hooked Mussels**
	80-84mm	16				None
	85-89mm	17				
	90-94mm	18				
	95-99mm	19				
	100-104mm	20				**Oyster Drills**
	105-109mm	21				None
	110-114mm	22				
	115-119mm	23				
	120-124mm	24				
	125-129mm	25				**Polychaetes**
	130-134mm	26				None
	135-139mm	27				
	140-144mm	28				
	145-149mm	29				
	150-154mm	30				**Serpulid Worms**
	155-159mm	31				None
	160-164mm	32				
	165-169mm	33				
	170-174mm	34				
	175-179mm	35				**Crabs**
	180-184mm	36				None
	185-189mm	37				
	190-194mm	38				
	195-199mm	39				
	>200mm	40+				

[1] - Recently dead (determined by the number of fouling organisms) oysters if both valves remain intact and also recently dead single valves.

OYSTER RECRUITMENT STUDY

Observers: B.Whitney, K.Altimore, C. Vecera
Date: 11/6/2020
Sample Location: 2.1
Weather Conditions: Sunny
Water Conditions: Choppy
Sample Type: Diver Collected

Size		Group	Live Oyster Count	Box Oyster Count[1]	Dead Oyster Count	Invertebrate Predators/Fouling Organisms
Spat Oysters	0-4mm	0				**Barnacles**
	5-9mm	1				None
	10-14mm	2				
	15-19mm	3				
	20-24mm	4				
Seed Oysters	25-29mm	5				**Algae**
	30-34mm	6				None
	35-39mm	7				
	40-44mm	8				
	45-49mm	9				
	50-54mm	10				**Bryozoans**
	55-59mm	11				None
	60-64mm	12				
	65-69mm	13				
	70-74mm	14				
Sack Oysters	75-79mm	15				**Hooked Mussels**
	80-84mm	16				None
	85-89mm	17				
	90-94mm	18				
	95-99mm	19				
	100-104mm	20				**Oyster Drills**
	105-109mm	21				None
	110-114mm	22				
	115-119mm	23				
	120-124mm	24				
	125-129mm	25				**Polychaetes**
	130-134mm	26				None
	135-139mm	27				
	140-144mm	28				
	145-149mm	29				
	150-154mm	30				**Serpulid Worms**
	155-159mm	31				None
	160-164mm	32				
	165-169mm	33				
	170-174mm	34				
	175-179mm	35				**Crabs**
	180-184mm	36				None
	185-189mm	37				
	190-194mm	38				
	195-199mm	39				
	>200mm	40+				

[1] - Recently dead (determined by the number of fouling organisms) oysters if both valves remain intact and also recently dead single valves.

OYSTER RECRUITMENT STUDY

Observers: B.Whitney, K.Altimore, C. Vecera
Date: 11/6/2020
Sample Location: 2.2
Weather Conditions: Sunny
Water Conditions: Choppy
Sample Type: Diver Collected

Size		Group	Live Oyster Count	Box Oyster Count[1]	Dead Oyster Count	Invertebrate Predators/Fouling Organisms
Spat Oysters	0-4mm	0				**Barnacles**
	5-9mm	1				None
	10-14mm	2				
	15-19mm	3				
	20-24mm	4				
Seed Oysters	25-29mm	5				**Algae**
	30-34mm	6				None
	35-39mm	7				
	40-44mm	8				
	45-49mm	9				
	50-54mm	10				**Bryozoans**
	55-59mm	11				None
	60-64mm	12				
	65-69mm	13				
	70-74mm	14				
Sack Oysters	75-79mm	15				**Hooked Mussels**
	80-84mm	16				None
	85-89mm	17				
	90-94mm	18				
	95-99mm	19				
	100-104mm	20				**Oyster Drills**
	105-109mm	21				None
	110-114mm	22				
	115-119mm	23				
	120-124mm	24				
	125-129mm	25				**Polychaetes**
	130-134mm	26				None
	135-139mm	27				
	140-144mm	28				
	145-149mm	29				
	150-154mm	30				**Serpulid Worms**
	155-159mm	31				None
	160-164mm	32				
	165-169mm	33				
	170-174mm	34				
	175-179mm	35				**Crabs**
	180-184mm	36				None
	185-189mm	37				
	190-194mm	38				
	195-199mm	39				
	>200mm	40+				

[1] - Recently dead (determined by the number of fouling organisms) oysters if both valves remain intact and also recently dead single valves.

OYSTER RECRUITMENT STUDY

Observers:	B.Whitney, K.Altimore, C. Vecer	Weather Conditions:	Sunny
Date:	11/6/2020	Water Conditions:	Choppy
Sample Location:	2.4	Sample Type:	Diver Collected

Size		Group	Live Oyster Count	Box Oyster Count[1]	Dead Oyster Count	Invertebrate Predators/Fouling Organisms
Spat Oysters	0-4mm	0				**Barnacles**
	5-9mm	1				None
	10-14mm	2				
	15-19mm	3				
	20-24mm	4				
Seed Oysters	25-29mm	5				**Algae**
	30-34mm	6				None
	35-39mm	7				
	40-44mm	8				
	45-49mm	9				
	50-54mm	10				**Bryozoans**
	55-59mm	11				None
	60-64mm	12				
	65-69mm	13				
	70-74mm	14				
Sack Oysters	75-79mm	15				**Hooked Mussels**
	80-84mm	16				None
	85-89mm	17				
	90-94mm	18				
	95-99mm	19				
	100-104mm	20				**Oyster Drills**
	105-109mm	21				None
	110-114mm	22				
	115-119mm	23				
	120-124mm	24				
	125-129mm	25				**Polychaetes**
	130-134mm	26				None
	135-139mm	27				
	140-144mm	28				
	145-149mm	29				
	150-154mm	30				**Serpulid Worms**
	155-159mm	31				None
	160-164mm	32				
	165-169mm	33				
	170-174mm	34				
	175-179mm	35				**Crabs**
	180-184mm	36				None
	185-189mm	37				
	190-194mm	38				
	195-199mm	39				
	>200mm	40+				

[1] - Recently dead (determined by the number of fouling organisms) oysters if both valves remain intact and also recently dead single valves.

OYSTER RECRUITMENT STUDY

Observers:	B.Whitney, K.Altimore, C. Vecer	Weather Conditions:	Sunny
Date:	11/6/2020	Water Conditions:	Choppy
Sample Location:	3.1	Sample Type:	Diver Collected

Size		Group	Live Oyster Count	Box Oyster Count[1]	Dead Oyster Count	Invertebrate Predators/Fouling Organisms
Spat Oysters	0-4mm	0				**Barnacles**
	5-9mm	1				None
	10-14mm	2				
	15-19mm	3				
	20-24mm	4				
Seed Oysters	25-29mm	5				**Algae**
	30-34mm	6				None
	35-39mm	7				
	40-44mm	8				
	45-49mm	9				
	50-54mm	10				**Bryozoans**
	55-59mm	11				None
	60-64mm	12				
	65-69mm	13				
	70-74mm	14				
Sack Oysters	75-79mm	15				**Hooked Mussels**
	80-84mm	16		1		None
	85-89mm	17				
	90-94mm	18				
	95-99mm	19				
	100-104mm	20				**Oyster Drills**
	105-109mm	21				None
	110-114mm	22				
	115-119mm	23				
	120-124mm	24				
	125-129mm	25				**Polychaetes**
	130-134mm	26				None
	135-139mm	27				
	140-144mm	28				
	145-149mm	29				
	150-154mm	30				**Serpulid Worms**
	155-159mm	31				None
	160-164mm	32				
	165-169mm	33				
	170-174mm	34				
	175-179mm	35				**Crabs**
	180-184mm	36				None
	185-189mm	37				
	190-194mm	38				
	195-199mm	39				
	>200mm	40+				

[1] - Recently dead (determined by the number of fouling organisms) oysters if both valves remain intact and also recently dead single valves.

OYSTER RECRUITMENT STUDY

Observers:	B.Whitney, K.Altimore, C. Vecer	Weather Conditions:	Sunny
Date:	11/6/2020	Water Conditions:	Choppy
Sample Location:	3.2	Sample Type:	Diver Collected

Size		Group	Live Oyster Count	Box Oyster Count[1]	Dead Oyster Count	Invertebrate Predators/Fouling Organisms
Spat Oysters	0-4mm	0				**Barnacles**
	5-9mm	1				None
	10-14mm	2				
	15-19mm	3				
	20-24mm	4				
Seed Oysters	25-29mm	5				**Algae**
	30-34mm	6				None
	35-39mm	7				
	40-44mm	8				
	45-49mm	9				
	50-54mm	10				**Bryozoans**
	55-59mm	11				None
	60-64mm	12				
	65-69mm	13				
	70-74mm	14				
Sack Oysters	75-79mm	15				**Hooked Mussels**
	80-84mm	16				None
	85-89mm	17				
	90-94mm	18				
	95-99mm	19				
	100-104mm	20				**Oyster Drills**
	105-109mm	21				None
	110-114mm	22				
	115-119mm	23				
	120-124mm	24				
	125-129mm	25				**Polychaetes**
	130-134mm	26				None
	135-139mm	27				
	140-144mm	28				
	145-149mm	29				
	150-154mm	30				**Serpulid Worms**
	155-159mm	31				None
	160-164mm	32				
	165-169mm	33				
	170-174mm	34				
	175-179mm	35				**Crabs**
	180-184mm	36				None
	185-189mm	37				
	190-194mm	38				
	195-199mm	39				
	>200mm	40+				

[1] - Recently dead (determined by the number of fouling organisms) oysters if both valves remain intact and also recently dead single valves.

OYSTER RECRUITMENT STUDY

Observers: B.Whitney, K.Altimore, C. Vecera
Date: 11/6/2020
Sample Location: 3.3
Weather Conditions: Sunny
Water Conditions: Choppy
Sample Type: Diver Collected

Size		Group	Live Oyster Count	Box Oyster Count[1]	Dead Oyster Count	Invertebrate Predators/Fouling Organisms
Spat Oysters	0-4mm	0				**Barnacles**
	5-9mm	1				None
	10-14mm	2				
	15-19mm	3				
	20-24mm	4				
Seed Oysters	25-29mm	5				**Algae**
	30-34mm	6				None
	35-39mm	7				
	40-44mm	8				
	45-49mm	9				
	50-54mm	10				**Bryozoans**
	55-59mm	11				None
	60-64mm	12				
	65-69mm	13				
	70-74mm	14				
Sack Oysters	75-79mm	15				**Hooked Mussels**
	80-84mm	16				None
	85-89mm	17				
	90-94mm	18				
	95-99mm	19				
	100-104mm	20				**Oyster Drills**
	105-109mm	21				None
	110-114mm	22				
	115-119mm	23				
	120-124mm	24				
	125-129mm	25				**Polychaetes**
	130-134mm	26				None
	135-139mm	27				
	140-144mm	28				
	145-149mm	29				
	150-154mm	30				**Serpulid Worms**
	155-159mm	31				None
	160-164mm	32				
	165-169mm	33				
	170-174mm	34				
	175-179mm	35				**Crabs**
	180-184mm	36				None
	185-189mm	37				
	190-194mm	38				
	195-199mm	39				
	>200mm	40+				

[1] - Recently dead (determined by the number of fouling organisms) oysters if both valves remain intact and also recently dead single valves.

OYSTER RECRUITMENT STUDY

Observers:	B.Whitney, K.Altimore, C. Vecer	Weather Conditions:	Sunny
Date:	11/6/2020	Water Conditions:	Choppy
Sample Location:	3.4	Sample Type:	Diver Collected

Size		Group	Live Oyster Count	Box Oyster Count[1]	Dead Oyster Count	Invertebrate Predators/Fouling Organisms
Spat Oysters	0-4mm	0				**Barnacles**
	5-9mm	1				None
	10-14mm	2				
	15-19mm	3				
	20-24mm	4				
Seed Oysters	25-29mm	5				**Algae**
	30-34mm	6				None
	35-39mm	7				
	40-44mm	8				
	45-49mm	9				
	50-54mm	10				**Bryozoans**
	55-59mm	11				None
	60-64mm	12				
	65-69mm	13				
	70-74mm	14				
Sack Oysters	75-79mm	15				**Hooked Mussels**
	80-84mm	16				None
	85-89mm	17				
	90-94mm	18				
	95-99mm	19				
	100-104mm	20				**Oyster Drills**
	105-109mm	21				None
	110-114mm	22				
	115-119mm	23				
	120-124mm	24				
	125-129mm	25				**Polychaetes**
	130-134mm	26				None
	135-139mm	27				
	140-144mm	28				
	145-149mm	29				
	150-154mm	30				**Serpulid Worms**
	155-159mm	31				None
	160-164mm	32				
	165-169mm	33				
	170-174mm	34				
	175-179mm	35				**Crabs**
	180-184mm	36				None
	185-189mm	37				
	190-194mm	38				
	195-199mm	39				
	>200mm	40+				

[1] - Recently dead (determined by the number of fouling organisms) oysters if both valves remain intact and also recently dead single valves.

OYSTER RECRUITMENT STUDY

Observers:	B.Whitney, K.Altimore, C. Vecer	Weather Conditions:	Sunny
Date:	11/6/2020	Water Conditions:	Choppy
Sample Location:	4.1	Sample Type:	Diver Collected

Size		Group	Live Oyster Count	Box Oyster Count[1]	Dead Oyster Count	Invertebrate Predators/Fouling Organisms
Spat Oysters	0-4mm	0				**Barnacles**
	5-9mm	1				None
	10-14mm	2				
	15-19mm	3				
	20-24mm	4				
Seed Oysters	25-29mm	5				**Algae**
	30-34mm	6				None
	35-39mm	7				
	40-44mm	8				
	45-49mm	9				
	50-54mm	10				**Bryozoans**
	55-59mm	11				None
	60-64mm	12				
	65-69mm	13				
	70-74mm	14				
Sack Oysters	75-79mm	15				**Hooked Mussels**
	80-84mm	16				None
	85-89mm	17				
	90-94mm	18				
	95-99mm	19				
	100-104mm	20				**Oyster Drills**
	105-109mm	21				None
	110-114mm	22				
	115-119mm	23				
	120-124mm	24				
	125-129mm	25				**Polychaetes**
	130-134mm	26				None
	135-139mm	27				
	140-144mm	28				
	145-149mm	29				
	150-154mm	30				**Serpulid Worms**
	155-159mm	31				None
	160-164mm	32				
	165-169mm	33				
	170-174mm	34				
	175-179mm	35				**Crabs**
	180-184mm	36				None
	185-189mm	37				
	190-194mm	38				
	195-199mm	39				
	>200mm	40+				

[1] - Recently dead (determined by the number of fouling organisms) oysters if both valves remain intact and also recently dead single valves.

OYSTER RECRUITMENT STUDY

Observers:	B.Whitney, K.Altimore, C. Vecer	Weather Conditions:	Sunny
Date:	11/6/2020	Water Conditions:	Choppy
Sample Location:	4.2	Sample Type:	Diver Collected

Size		Group	Live Oyster Count	Box Oyster Count[1]	Dead Oyster Count	Invertebrate Predators/Fouling Organisms
Spat Oysters	0-4mm	0				**Barnacles**
	5-9mm	1				None
	10-14mm	2				
	15-19mm	3				
	20-24mm	4				
Seed Oysters	25-29mm	5				**Algae**
	30-34mm	6				None
	35-39mm	7				
	40-44mm	8				
	45-49mm	9				
	50-54mm	10				**Bryozoans**
	55-59mm	11				None
	60-64mm	12				
	65-69mm	13				
	70-74mm	14				
Sack Oysters	75-79mm	15				**Hooked Mussels**
	80-84mm	16				None
	85-89mm	17				
	90-94mm	18				
	95-99mm	19				
	100-104mm	20				**Oyster Drills**
	105-109mm	21				None
	110-114mm	22				
	115-119mm	23				
	120-124mm	24				
	125-129mm	25				**Polychaetes**
	130-134mm	26				None
	135-139mm	27				
	140-144mm	28				
	145-149mm	29				
	150-154mm	30				**Serpulid Worms**
	155-159mm	31				None
	160-164mm	32				
	165-169mm	33				
	170-174mm	34				
	175-179mm	35				**Crabs**
	180-184mm	36				None
	185-189mm	37				
	190-194mm	38				
	195-199mm	39				
	>200mm	40+				

[1] - Recently dead (determined by the number of fouling organisms) oysters if both valves remain intact and also recently dead single valves.

OYSTER RECRUITMENT STUDY

Observers:	B.Whitney, K.Altimore, C. Vecer	Weather Conditions:	Sunny
Date:	11/6/2020	Water Conditions:	Choppy
Sample Location:	4.3	Sample Type:	Diver Collected

Size		Group	Live Oyster Count	Box Oyster Count[1]	Dead Oyster Count	Invertebrate Predators/Fouling Organisms
Spat Oysters	0-4mm	0				**Barnacles**
	5-9mm	1				None
	10-14mm	2				
	15-19mm	3				
	20-24mm	4				
Seed Oysters	25-29mm	5				**Algae**
	30-34mm	6				None
	35-39mm	7				
	40-44mm	8				
	45-49mm	9				
	50-54mm	10				**Bryozoans**
	55-59mm	11				None
	60-64mm	12				
	65-69mm	13				
	70-74mm	14				
Sack Oysters	75-79mm	15				**Hooked Mussels**
	80-84mm	16				None
	85-89mm	17				
	90-94mm	18				
	95-99mm	19				
	100-104mm	20				**Oyster Drills**
	105-109mm	21				None
	110-114mm	22				
	115-119mm	23				
	120-124mm	24				
	125-129mm	25				**Polychaetes**
	130-134mm	26				None
	135-139mm	27				
	140-144mm	28				
	145-149mm	29				
	150-154mm	30				**Serpulid Worms**
	155-159mm	31				None
	160-164mm	32				
	165-169mm	33				
	170-174mm	34				
	175-179mm	35				**Crabs**
	180-184mm	36				None
	185-189mm	37				
	190-194mm	38				
	195-199mm	39				
	>200mm	40+				

[1] - Recently dead (determined by the number of fouling organisms) oysters if both valves remain intact and also recently dead single valves.

OYSTER RECRUITMENT STUDY

Observers:	B.Whitney, K.Altimore, C. Vecer	Weather Conditions:	Sunny
Date:	11/6/2020	Water Conditions:	Choppy
Sample Location:	4.4	Sample Type:	Diver Collected

Size		Group	Live Oyster Count	Box Oyster Count[1]	Dead Oyster Count	Invertebrate Predators/Fouling Organisms
Spat Oysters	0-4mm	0				**Barnacles**
	5-9mm	1				None
	10-14mm	2				
	15-19mm	3				
	20-24mm	4				
Seed Oysters	25-29mm	5				**Algae**
	30-34mm	6				None
	35-39mm	7				
	40-44mm	8				
	45-49mm	9				
	50-54mm	10				**Bryozoans**
	55-59mm	11				None
	60-64mm	12				
	65-69mm	13				
	70-74mm	14				
Sack Oysters	75-79mm	15				**Hooked Mussels**
	80-84mm	16				None
	85-89mm	17				
	90-94mm	18				
	95-99mm	19				
	100-104mm	20				**Oyster Drills**
	105-109mm	21				None
	110-114mm	22				
	115-119mm	23				
	120-124mm	24				
	125-129mm	25				**Polychaetes**
	130-134mm	26				None
	135-139mm	27				
	140-144mm	28				
	145-149mm	29				
	150-154mm	30				**Serpulid Worms**
	155-159mm	31				None
	160-164mm	32				
	165-169mm	33				
	170-174mm	34				
	175-179mm	35				**Crabs**
	180-184mm	36				None
	185-189mm	37				
	190-194mm	38				
	195-199mm	39				
	>200mm	40+				

[1] - Recently dead (determined by the number of fouling organisms) oysters if both valves remain intact and also recently dead single valves.

OYSTER RECRUITMENT STUDY

Observers: B.Whitney, K.Altimore, C. Vecera
Date: 11/6/2020
Sample Location: 5.1
Weather Conditions: Sunny
Water Conditions: Choppy
Sample Type: Diver Collected

Size		Group	Live Oyster Count	Box Oyster Count[1]	Dead Oyster Count	Invertebrate Predators/Fouling Organisms
Spat Oysters	0-4mm	0				**Barnacles**
	5-9mm	1				None
	10-14mm	2				
	15-19mm	3				
	20-24mm	4				
Seed Oysters	25-29mm	5				**Algae**
	30-34mm	6				None
	35-39mm	7				
	40-44mm	8				
	45-49mm	9				
	50-54mm	10				**Bryozoans**
	55-59mm	11				None
	60-64mm	12				
	65-69mm	13				
	70-74mm	14				
Sack Oysters	75-79mm	15				**Hooked Mussels**
	80-84mm	16				None
	85-89mm	17				
	90-94mm	18				
	95-99mm	19				
	100-104mm	20				**Oyster Drills**
	105-109mm	21				None
	110-114mm	22				
	115-119mm	23				
	120-124mm	24				
	125-129mm	25				**Polychaetes**
	130-134mm	26				None
	135-139mm	27				
	140-144mm	28				
	145-149mm	29				
	150-154mm	30				**Serpulid Worms**
	155-159mm	31				None
	160-164mm	32				
	165-169mm	33				
	170-174mm	34				
	175-179mm	35				**Crabs**
	180-184mm	36				None
	185-189mm	37				
	190-194mm	38				
	195-199mm	39				
	>200mm	40+				

[1] - Recently dead (determined by the number of fouling organisms) oysters if both valves remain intact and also recently dead single valves.

OYSTER RECRUITMENT STUDY

Observers:	B.Whitney, K.Altimore, C. Vecer	Weather Conditions:	Sunny
Date:	11/6/2020	Water Conditions:	Choppy
Sample Location:	5.2	Sample Type:	Diver Collected

Size		Group	Live Oyster Count	Box Oyster Count[1]	Dead Oyster Count	Invertebrate Predators/Fouling Organisms
Spat Oysters	0-4mm	0				**Barnacles**
	5-9mm	1				None
	10-14mm	2				
	15-19mm	3				
	20-24mm	4				
Seed Oysters	25-29mm	5				**Algae**
	30-34mm	6				None
	35-39mm	7				
	40-44mm	8				
	45-49mm	9				
	50-54mm	10				**Bryozoans**
	55-59mm	11				None
	60-64mm	12				
	65-69mm	13				
	70-74mm	14				
Sack Oysters	75-79mm	15				**Hooked Mussels**
	80-84mm	16				None
	85-89mm	17				
	90-94mm	18				
	95-99mm	19				
	100-104mm	20				**Oyster Drills**
	105-109mm	21				None
	110-114mm	22				
	115-119mm	23				
	120-124mm	24				
	125-129mm	25				**Polychaetes**
	130-134mm	26				None
	135-139mm	27				
	140-144mm	28				
	145-149mm	29				
	150-154mm	30				**Serpulid Worms**
	155-159mm	31				None
	160-164mm	32				
	165-169mm	33				
	170-174mm	34				
	175-179mm	35				**Crabs**
	180-184mm	36				None
	185-189mm	37				
	190-194mm	38				
	195-199mm	39				
	>200mm	40+				

[1] - Recently dead (determined by the number of fouling organisms) oysters if both valves remain intact and also recently dead single valves.

OYSTER RECRUITMENT STUDY

Observers: B.Whitney, K.Altimore, C. Vecera
Date: 11/6/2020
Sample Location: 5.3
Weather Conditions: Sunny
Water Conditions: Choppy
Sample Type: Diver Collected

Size		Group	Live Oyster Count	Box Oyster Count[1]	Dead Oyster Count	Invertebrate Predators/Fouling Organisms
Spat Oysters	0-4mm	0				**Barnacles**
	5-9mm	1				None
	10-14mm	2				
	15-19mm	3				
	20-24mm	4				
Seed Oysters	25-29mm	5				**Algae**
	30-34mm	6				None
	35-39mm	7				
	40-44mm	8				
	45-49mm	9				
	50-54mm	10				**Bryozoans**
	55-59mm	11				None
	60-64mm	12				
	65-69mm	13				
	70-74mm	14				
Sack Oysters	75-79mm	15				**Hooked Mussels**
	80-84mm	16				None
	85-89mm	17				
	90-94mm	18				
	95-99mm	19				
	100-104mm	20				**Oyster Drills**
	105-109mm	21				None
	110-114mm	22				
	115-119mm	23				
	120-124mm	24				
	125-129mm	25				**Polychaetes**
	130-134mm	26				None
	135-139mm	27				
	140-144mm	28				
	145-149mm	29				
	150-154mm	30				**Serpulid Worms**
	155-159mm	31				None
	160-164mm	32				
	165-169mm	33				
	170-174mm	34				
	175-179mm	35				**Crabs**
	180-184mm	36				None
	185-189mm	37				
	190-194mm	38				
	195-199mm	39				
	>200mm	40+				

[1] - Recently dead (determined by the number of fouling organisms) oysters if both valves remain intact and also recently dead single valves.

OYSTER RECRUITMENT STUDY

Observers:	B.Whitney, K.Altimore, C. Vecer	Weather Conditions:	Sunny
Date:	11/6/2020	Water Conditions:	Choppy
Sample Location:	5.4	Sample Type:	Diver Collected

Size		Group	Live Oyster Count	Box Oyster Count[1]	Dead Oyster Count	Invertebrate Predators/Fouling Organisms
Spat Oysters	0-4mm	0				**Barnacles**
	5-9mm	1				None
	10-14mm	2				
	15-19mm	3				
	20-24mm	4				
Seed Oysters	25-29mm	5				**Algae**
	30-34mm	6				None
	35-39mm	7				
	40-44mm	8				
	45-49mm	9				
	50-54mm	10				**Bryozoans**
	55-59mm	11				None
	60-64mm	12				
	65-69mm	13				
	70-74mm	14				
Sack Oysters	75-79mm	15				**Hooked Mussels**
	80-84mm	16				None
	85-89mm	17				
	90-94mm	18				
	95-99mm	19				
	100-104mm	20				**Oyster Drills**
	105-109mm	21				None
	110-114mm	22				
	115-119mm	23				
	120-124mm	24				
	125-129mm	25				**Polychaetes**
	130-134mm	26				None
	135-139mm	27				
	140-144mm	28				
	145-149mm	29				
	150-154mm	30				**Serpulid Worms**
	155-159mm	31				None
	160-164mm	32				
	165-169mm	33				
	170-174mm	34				
	175-179mm	35				**Crabs**
	180-184mm	36				None
	185-189mm	37				
	190-194mm	38				
	195-199mm	39				
	>200mm	40+				

[1] - Recently dead (determined by the number of fouling organisms) oysters if both valves remain intact and also recently dead single valves.

OYSTER RECRUITMENT STUDY

Observers: B.Whitney, K.Altimore, C. Vecera
Date: 11/6/2020
Sample Location: 6.1
Weather Conditions: Sunny
Water Conditions: Choppy
Sample Type: Diver Collected

Size		Group	Live Oyster Count	Box Oyster Count[1]	Dead Oyster Count	Invertebrate Predators/Fouling Organisms
Spat Oysters	0-4mm	0				**Barnacles**
	5-9mm	1				None
	10-14mm	2				
	15-19mm	3				
	20-24mm	4				
Seed Oysters	25-29mm	5				**Algae**
	30-34mm	6				None
	35-39mm	7				
	40-44mm	8				
	45-49mm	9				
	50-54mm	10				**Bryozoans**
	55-59mm	11				None
	60-64mm	12				
	65-69mm	13				
	70-74mm	14				
Sack Oysters	75-79mm	15				**Hooked Mussels**
	80-84mm	16				None
	85-89mm	17				
	90-94mm	18				
	95-99mm	19				
	100-104mm	20		1		**Oyster Drills**
	105-109mm	21	1			None
	110-114mm	22				
	115-119mm	23				
	120-124mm	24				
	125-129mm	25				**Polychaetes**
	130-134mm	26	1			None
	135-139mm	27				
	140-144mm	28				
	145-149mm	29				
	150-154mm	30				**Serpulid Worms**
	155-159mm	31				None
	160-164mm	32				
	165-169mm	33				
	170-174mm	34				
	175-179mm	35				**Crabs**
	180-184mm	36				None
	185-189mm	37				
	190-194mm	38				
	195-199mm	39				
	>200mm	40+				

[1] - Recently dead (determined by the number of fouling organisms) oysters if both valves remain intact and also recently dead single valves.

OYSTER RECRUITMENT STUDY

Observers:	B.Whitney, K.Altimore, C. Vecer	Weather Conditions:	Sunny
Date:	11/6/2020	Water Conditions:	Choppy
Sample Location:	6.2	Sample Type:	Diver Collected

Size		Group	Live Oyster Count	Box Oyster Count[1]	Dead Oyster Count	Invertebrate Predators/Fouling Organisms
Spat Oysters	0-4mm	0				**Barnacles**
	5-9mm	1				None
	10-14mm	2				
	15-19mm	3				
	20-24mm	4				
Seed Oysters	25-29mm	5				**Algae**
	30-34mm	6				None
	35-39mm	7				
	40-44mm	8				
	45-49mm	9				
	50-54mm	10				**Bryozoans**
	55-59mm	11				None
	60-64mm	12				
	65-69mm	13				
	70-74mm	14				
Sack Oysters	75-79mm	15				**Hooked Mussels**
	80-84mm	16				None
	85-89mm	17				
	90-94mm	18				
	95-99mm	19				
	100-104mm	20				**Oyster Drills**
	105-109mm	21				None
	110-114mm	22				
	115-119mm	23				
	120-124mm	24				
	125-129mm	25				**Polychaetes**
	130-134mm	26				None
	135-139mm	27				
	140-144mm	28				
	145-149mm	29				
	150-154mm	30				**Serpulid Worms**
	155-159mm	31				None
	160-164mm	32				
	165-169mm	33				
	170-174mm	34				
	175-179mm	35				**Crabs**
	180-184mm	36				None
	185-189mm	37				
	190-194mm	38				
	195-199mm	39				
	>200mm	40+				

[1] - Recently dead (determined by the number of fouling organisms) oysters if both valves remain intact and also recently dead single valves.

OYSTER RECRUITMENT STUDY

Observers: B.Whitney, K.Altimore, C. Vecera
Date: 11/6/2020
Sample Location: 6.3
Weather Conditions: Sunny
Water Conditions: Choppy
Sample Type: Diver Collected

Size		Group	Live Oyster Count	Box Oyster Count[1]	Dead Oyster Count	Invertebrate Predators/Fouling Organisms
Spat Oysters	0-4mm	0				**Barnacles**
	5-9mm	1				None
	10-14mm	2				
	15-19mm	3				
	20-24mm	4				
Seed Oysters	25-29mm	5				**Algae**
	30-34mm	6				None
	35-39mm	7				
	40-44mm	8				
	45-49mm	9				
	50-54mm	10				**Bryozoans**
	55-59mm	11				None
	60-64mm	12				
	65-69mm	13				
	70-74mm	14				
Sack Oysters	75-79mm	15				**Hooked Mussels**
	80-84mm	16				None
	85-89mm	17				
	90-94mm	18				
	95-99mm	19				
	100-104mm	20				**Oyster Drills**
	105-109mm	21				None
	110-114mm	22				
	115-119mm	23				
	120-124mm	24				
	125-129mm	25				**Polychaetes**
	130-134mm	26				None
	135-139mm	27				
	140-144mm	28				
	145-149mm	29				
	150-154mm	30				**Serpulid Worms**
	155-159mm	31				None
	160-164mm	32				
	165-169mm	33				
	170-174mm	34				
	175-179mm	35				**Crabs**
	180-184mm	36				None
	185-189mm	37				
	190-194mm	38				
	195-199mm	39				
	>200mm	40+				

[1] - Recently dead (determined by the number of fouling organisms) oysters if both valves remain intact and also recently dead single valves.

OYSTER RECRUITMENT STUDY

Observers:	B.Whitney, K.Altimore, C. Vecer	Weather Conditions:	Sunny
Date:	11/6/2020	Water Conditions:	Choppy
Sample Location:	6.4	Sample Type:	Diver Collected

Size		Group	Live Oyster Count	Box Oyster Count[1]	Dead Oyster Count	Invertebrate Predators/Fouling Organisms
Spat Oysters	0-4mm	0				**Barnacles**
	5-9mm	1				None
	10-14mm	2				
	15-19mm	3				
	20-24mm	4				
Seed Oysters	25-29mm	5				**Algae**
	30-34mm	6				None
	35-39mm	7				
	40-44mm	8				
	45-49mm	9				
	50-54mm	10				**Bryozoans**
	55-59mm	11				None
	60-64mm	12				
	65-69mm	13				
	70-74mm	14				
Sack Oysters	75-79mm	15				**Hooked Mussels**
	80-84mm	16				None
	85-89mm	17				
	90-94mm	18				
	95-99mm	19				
	100-104mm	20				**Oyster Drills**
	105-109mm	21				None
	110-114mm	22				
	115-119mm	23				
	120-124mm	24				
	125-129mm	25				**Polychaetes**
	130-134mm	26				None
	135-139mm	27				
	140-144mm	28				
	145-149mm	29				
	150-154mm	30				**Serpulid Worms**
	155-159mm	31				None
	160-164mm	32				
	165-169mm	33				
	170-174mm	34				
	175-179mm	35				**Crabs**
	180-184mm	36				None
	185-189mm	37				
	190-194mm	38				
	195-199mm	39				
	>200mm	40+				

[1] - Recently dead (determined by the number of fouling organisms) oysters if both valves remain intact and also recently dead single valves.

OYSTER RECRUITMENT STUDY

Observers:	B.Whitney, K.Altimore, C. Vecer	Weather Conditions:	Sunny
Date:	11/6/2020	Water Conditions:	Choppy
Sample Location:	7.1	Sample Type:	Diver Collected

Size		Group	Live Oyster Count	Box Oyster Count[1]	Dead Oyster Count	Invertebrate Predators/Fouling Organisms
Spat Oysters	0-4mm	0				**Barnacles**
	5-9mm	1				None
	10-14mm	2				
	15-19mm	3				
	20-24mm	4				
Seed Oysters	25-29mm	5				**Algae**
	30-34mm	6				None
	35-39mm	7				
	40-44mm	8				
	45-49mm	9				
	50-54mm	10				**Bryozoans**
	55-59mm	11				None
	60-64mm	12				
	65-69mm	13				
	70-74mm	14				
Sack Oysters	75-79mm	15				**Hooked Mussels**
	80-84mm	16				None
	85-89mm	17				
	90-94mm	18				
	95-99mm	19				
	100-104mm	20				**Oyster Drills**
	105-109mm	21				None
	110-114mm	22				
	115-119mm	23				
	120-124mm	24				
	125-129mm	25				**Polychaetes**
	130-134mm	26				None
	135-139mm	27				
	140-144mm	28				
	145-149mm	29				
	150-154mm	30				**Serpulid Worms**
	155-159mm	31				None
	160-164mm	32				
	165-169mm	33				
	170-174mm	34				
	175-179mm	35				**Crabs**
	180-184mm	36				None
	185-189mm	37				
	190-194mm	38				
	195-199mm	39				
	>200mm	40+				

[1] - Recently dead (determined by the number of fouling organisms) oysters if both valves remain intact and also recently dead single valves.

OYSTER RECRUITMENT STUDY

Observers:	B.Whitney, K.Altimore, C. Vecer	Weather Conditions:	Sunny
Date:	11/6/2020	Water Conditions:	Choppy
Sample Location:	7.2	Sample Type:	Diver Collected

Size		Group	Live Oyster Count	Box Oyster Count[1]	Dead Oyster Count	Invertebrate Predators/Fouling Organisms
Spat Oysters	0-4mm	0				**Barnacles**
	5-9mm	1				None
	10-14mm	2				
	15-19mm	3				
	20-24mm	4				
Seed Oysters	25-29mm	5				**Algae**
	30-34mm	6				None
	35-39mm	7				
	40-44mm	8				
	45-49mm	9				
	50-54mm	10				**Bryozoans**
	55-59mm	11				None
	60-64mm	12				
	65-69mm	13				
	70-74mm	14				
Sack Oysters	75-79mm	15				**Hooked Mussels**
	80-84mm	16				None
	85-89mm	17				
	90-94mm	18				
	95-99mm	19				
	100-104mm	20				**Oyster Drills**
	105-109mm	21				None
	110-114mm	22				
	115-119mm	23				
	120-124mm	24				
	125-129mm	25				**Polychaetes**
	130-134mm	26				None
	135-139mm	27				
	140-144mm	28				
	145-149mm	29				
	150-154mm	30				**Serpulid Worms**
	155-159mm	31				None
	160-164mm	32				
	165-169mm	33				
	170-174mm	34				
	175-179mm	35				**Crabs**
	180-184mm	36				None
	185-189mm	37				
	190-194mm	38				
	195-199mm	39				
	>200mm	40+				

[1] - Recently dead (determined by the number of fouling organisms) oysters if both valves remain intact and also recently dead single valves.

OYSTER RECRUITMENT STUDY

Observers:	B.Whitney, K.Altimore, C. Vecer	Weather Conditions:	Sunny
Date:	11/6/2020	Water Conditions:	Choppy
Sample Location:	7.3	Sample Type:	Diver Collected

	Size	Group	Live Oyster Count	Box Oyster Count[1]	Dead Oyster Count	Invertebrate Predators/Fouling Organisms
Spat Oysters	0-4mm	0				**Barnacles**
	5-9mm	1				None
	10-14mm	2				
	15-19mm	3				
	20-24mm	4				
Seed Oysters	25-29mm	5				**Algae**
	30-34mm	6				None
	35-39mm	7				
	40-44mm	8				
	45-49mm	9				
	50-54mm	10				**Bryozoans**
	55-59mm	11				None
	60-64mm	12				
	65-69mm	13				
	70-74mm	14				
Sack Oysters	75-79mm	15				**Hooked Mussels**
	80-84mm	16				None
	85-89mm	17				
	90-94mm	18				
	95-99mm	19				
	100-104mm	20				**Oyster Drills**
	105-109mm	21				None
	110-114mm	22				
	115-119mm	23				
	120-124mm	24				
	125-129mm	25				**Polychaetes**
	130-134mm	26				None
	135-139mm	27				
	140-144mm	28				
	145-149mm	29				
	150-154mm	30				**Serpulid Worms**
	155-159mm	31				None
	160-164mm	32				
	165-169mm	33				
	170-174mm	34				
	175-179mm	35				**Crabs**
	180-184mm	36				None
	185-189mm	37				
	190-194mm	38				
	195-199mm	39				
	>200mm	40+				

[1] - Recently dead (determined by the number of fouling organisms) oysters if both valves remain intact and also recently dead single valves.

OYSTER RECRUITMENT STUDY

Observers:	B.Whitney, K.Altimore, C. Vecer	Weather Conditions:	Sunny
Date:	11/6/2020	Water Conditions:	Choppy
Sample Location:	7.4	Sample Type:	Diver Collected

Size		Group	Live Oyster Count	Box Oyster Count[1]	Dead Oyster Count	Invertebrate Predators/Fouling Organisms
Spat Oysters	0-4mm	0				**Barnacles**
	5-9mm	1				None
	10-14mm	2				
	15-19mm	3				
	20-24mm	4				
Seed Oysters	25-29mm	5				**Algae**
	30-34mm	6				None
	35-39mm	7				
	40-44mm	8				
	45-49mm	9				
	50-54mm	10				**Bryozoans**
	55-59mm	11				None
	60-64mm	12				
	65-69mm	13				
	70-74mm	14				
Sack Oysters	75-79mm	15				**Hooked Mussels**
	80-84mm	16				None
	85-89mm	17				
	90-94mm	18				
	95-99mm	19				
	100-104mm	20				**Oyster Drills**
	105-109mm	21				None
	110-114mm	22				
	115-119mm	23				
	120-124mm	24				
	125-129mm	25				**Polychaetes**
	130-134mm	26				None
	135-139mm	27				
	140-144mm	28				
	145-149mm	29				
	150-154mm	30				**Serpulid Worms**
	155-159mm	31				None
	160-164mm	32				
	165-169mm	33				
	170-174mm	34				
	175-179mm	35				**Crabs**
	180-184mm	36				None
	185-189mm	37				
	190-194mm	38				
	195-199mm	39				
	>200mm	40+				

[1] - Recently dead (determined by the number of fouling organisms) oysters if both valves remain intact and also recently dead single valves.

OYSTER RECRUITMENT STUDY

Observers:	B.Whitney, K.Altimore, C. Vecer	Weather Conditions:	Sunny
Date:	11/6/2020	Water Conditions:	Choppy
Sample Location:	8.1	Sample Type:	Diver Collected

Size		Group	Live Oyster Count	Box Oyster Count[1]	Dead Oyster Count	Invertebrate Predators/Fouling Organisms
Spat Oysters	0-4mm	0				**Barnacles**
	5-9mm	1				None
	10-14mm	2				
	15-19mm	3				
	20-24mm	4				
Seed Oysters	25-29mm	5				**Algae**
	30-34mm	6				None
	35-39mm	7				
	40-44mm	8				
	45-49mm	9				
	50-54mm	10				**Bryozoans**
	55-59mm	11				None
	60-64mm	12				
	65-69mm	13				
	70-74mm	14				
Sack Oysters	75-79mm	15				**Hooked Mussels**
	80-84mm	16				None
	85-89mm	17				
	90-94mm	18				
	95-99mm	19				
	100-104mm	20				**Oyster Drills**
	105-109mm	21				None
	110-114mm	22				
	115-119mm	23				
	120-124mm	24				
	125-129mm	25				**Polychaetes**
	130-134mm	26				None
	135-139mm	27				
	140-144mm	28				
	145-149mm	29				
	150-154mm	30				**Serpulid Worms**
	155-159mm	31				None
	160-164mm	32				
	165-169mm	33				
	170-174mm	34				
	175-179mm	35				**Crabs**
	180-184mm	36				None
	185-189mm	37				
	190-194mm	38				
	195-199mm	39				
	>200mm	40+				

[1] - Recently dead (determined by the number of fouling organisms) oysters if both valves remain intact and also recently dead single valves.

OYSTER RECRUITMENT STUDY

Observers:	B.Whitney, K.Altimore, C. Vecer	Weather Conditions:	Sunny
Date:	11/6/2020	Water Conditions:	Choppy
Sample Location:	8.2	Sample Type:	Diver Collected

Size		Group	Live Oyster Count	Box Oyster Count[1]	Dead Oyster Count	Invertebrate Predators/Fouling Organisms
Spat Oysters	0-4mm	0				**Barnacles**
	5-9mm	1				None
	10-14mm	2				
	15-19mm	3				
	20-24mm	4				
Seed Oysters	25-29mm	5				**Algae**
	30-34mm	6				None
	35-39mm	7				
	40-44mm	8				
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	50-54mm	10				**Bryozoans**
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	155-159mm	31				None
	160-164mm	32				
	165-169mm	33				
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	175-179mm	35				**Crabs**
	180-184mm	36				None
	185-189mm	37				
	190-194mm	38				
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	>200mm	40+				

[1] - Recently dead (determined by the number of fouling organisms) oysters if both valves remain intact and also recently dead single valves.

OYSTER RECRUITMENT STUDY

Observers:	B.Whitney, K.Altimore, C. Vecer	Weather Conditions:	Sunny
Date:	11/6/2020	Water Conditions:	Choppy
Sample Location:	8.3	Sample Type:	Diver Collected

Size		Group	Live Oyster Count	Box Oyster Count[1]	Dead Oyster Count	Invertebrate Predators/Fouling Organisms
Spat Oysters	0-4mm	0				**Barnacles**
	5-9mm	1				None
	10-14mm	2				
	15-19mm	3				
	20-24mm	4				
Seed Oysters	25-29mm	5				**Algae**
	30-34mm	6				None
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	155-159mm	31				None
	160-164mm	32				
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	170-174mm	34				
	175-179mm	35				**Crabs**
	180-184mm	36				None
	185-189mm	37				
	190-194mm	38				
	195-199mm	39				
	>200mm	40+				

[1] - Recently dead (determined by the number of fouling organisms) oysters if both valves remain intact and also recently dead single valves.

OYSTER RECRUITMENT STUDY

Observers:	B.Whitney, K.Altimore, C. Vecer	Weather Conditions:	Sunny
Date:	11/6/2020	Water Conditions:	Choppy
Sample Location:	8.4	Sample Type:	Diver Collected

Size		Group	Live Oyster Count	Box Oyster Count[1]	Dead Oyster Count	Invertebrate Predators/Fouling Organisms
Spat Oysters	0-4mm	0				**Barnacles**
	5-9mm	1				None
	10-14mm	2				
	15-19mm	3				
	20-24mm	4				
Seed Oysters	25-29mm	5				**Algae**
	30-34mm	6				None
	35-39mm	7				
	40-44mm	8				
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	50-54mm	10				**Bryozoans**
	55-59mm	11				None
	60-64mm	12				
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Sack Oysters	75-79mm	15				**Hooked Mussels**
	80-84mm	16				None
	85-89mm	17				
	90-94mm	18				
	95-99mm	19				
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	105-109mm	21				None
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	155-159mm	31				None
	160-164mm	32				
	165-169mm	33				
	170-174mm	34				
	175-179mm	35				**Crabs**
	180-184mm	36				None
	185-189mm	37				
	190-194mm	38				
	195-199mm	39				
	>200mm	40+				

[1] - Recently dead (determined by the number of fouling organisms) oysters if both valves remain intact and also recently dead single valves.

OYSTER RECRUITMENT STUDY

Observers:	B.Whitney, K.Altimore, C. Vecer	Weather Conditions:	Sunny
Date:	11/6/2020	Water Conditions:	Choppy
Sample Location:	9.1	Sample Type:	Diver Collected

Size		Group	Live Oyster Count	Box Oyster Count[1]	Dead Oyster Count	Invertebrate Predators/Fouling Organisms
Spat Oysters	0-4mm	0				**Barnacles**
	5-9mm	1				None
	10-14mm	2				
	15-19mm	3				
	20-24mm	4				
Seed Oysters	25-29mm	5				**Algae**
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	>200mm	40+				

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OYSTER RECRUITMENT STUDY

Observers:	B.Whitney, K.Altimore, C. Vecer	Weather Conditions:	Sunny
Date:	11/6/2020	Water Conditions:	Choppy
Sample Location:	9.2	Sample Type:	Diver Collected

Size		Group	Live Oyster Count	Box Oyster Count[1]	Dead Oyster Count	Invertebrate Predators/Fouling Organisms
Spat Oysters	0-4mm	0				**Barnacles**
	5-9mm	1				None
	10-14mm	2				
	15-19mm	3				
	20-24mm	4				
Seed Oysters	25-29mm	5				**Algae**
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OYSTER RECRUITMENT STUDY

Observers:	B.Whitney, K.Altimore, C. Vecer	Weather Conditions:	Sunny
Date:	11/6/2020	Water Conditions:	Choppy
Sample Location:	9.3	Sample Type:	Diver Collected

Size		Group	Live Oyster Count	Box Oyster Count[1]	Dead Oyster Count	Invertebrate Predators/Fouling Organisms
Spat Oysters	0-4mm	0				**Barnacles**
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OYSTER RECRUITMENT STUDY

Observers:	B.Whitney, K.Altimore, C. Vecer	Weather Conditions:	Sunny
Date:	11/6/2020	Water Conditions:	Choppy
Sample Location:	9.4	Sample Type:	Diver Collected

Size		Group	Live Oyster Count	Box Oyster Count[1]	Dead Oyster Count	Invertebrate Predators/Fouling Organisms
Spat Oysters	0-4mm	0				**Barnacles**
	5-9mm	1				None
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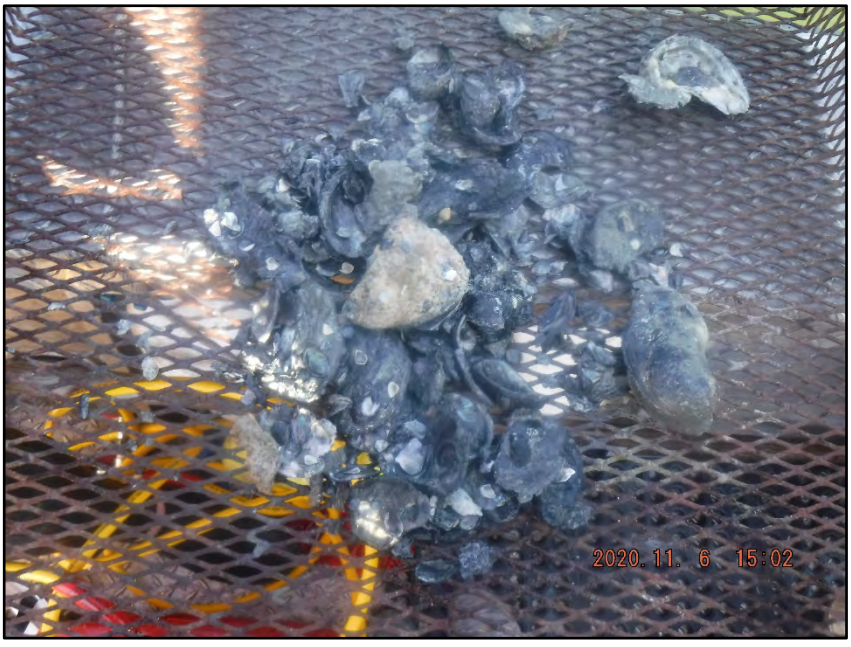
	175-179mm	35				**Crabs**
	180-184mm	36				None
	185-189mm	37				
	190-194mm	38				
	195-199mm	39				
	>200mm	40+				

[1] - Recently dead (determined by the number of fouling organisms) oysters if both valves remain intact and also recently dead single valves.

Appendix D

Proposed Mitigation Site Photolog

Photograph 1: Sample Location 2.1.



Photograph 2: Sample Location 3.1

Photograph 3: Sample Location 4.1.

Photograph 4: Sample Location 5.1

Photograph 5: Sample Location 6.1.

Photograph 6: Sample Location 8.2

Photograph 7: Proposed Mitigation Site

Photograph 8: View of BIO-WEST divers conducting surveys

Appendix E

2019 Oyster Reef Survey Report (BIO-WEST)

OYSTER REEF SURVEY
FOR
PROPOSED MAT PLACEMENT ON THE 24-INCH FLORIDA GAS TRANSMISSION PIPELINE

Located in
Galveston and Chambers Counties, Texas

Prepared for:
Florida Gas Transmission Company, LLC
1300 Main Street
Houston, Texas 77002

Prepared by:

BIO-WEST
1018 Frost Street
Rosenberg, Texas 77471

October 2019

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1.0 INTRODUCTION

At the request of Florida Gas Transmission Company, LLC (applicant), BIO-WEST, Inc. (BIO-WEST) conducted oyster reef surveys and water bottom characterization assessments to assist Submar, the applicant's permitting agent, in determining potential impacts associated with proposed mat placement and protection activities on an existing 24-inch natural gas transmission pipeline (project) in Galveston Bay in Galveston and Chambers Counties, Texas (Figure 1). For this effort, BIO-WEST surveyed a 1,000-foot corridor centered on a 100-ft wide construction footprint for approximately nine miles of existing pipeline easement between San Leon, Texas and Smith Point, Texas. The final survey corridor totaled approximately 1,200 acres (Figure 1 and 2 in Appendix A).

BIO-WEST employed a variety of survey methods to map potential oyster reefs and characterize existing bottom types in support of on-going Clean Water Act Section 404 permitting requirements. Survey methodology was based on previous efforts approved by the Texas Parks and Wildlife Department (TPWD), Louisiana Department of Wildlife and Fisheries (LDWF), U.S. Fish and Wildlife Service (USFWS), and National Marine Fisheries Service (NMFS).

BIO-WEST conducted this oyster reef investigations in two phases: remote sensing survey and physical investigation. Remote sensing survey techniques included the use of a global positioning system (GPS), side-scan sonar (SSS), manual poling, and acoustic depth soundings, that were processed and presented in a geographic information system (GIS) geo-database. Physical investigations included water quality parameter collection, oyster dredging, and diver square meter (m^2) quadrat sampling. Physical investigations served to establish site conditions, verify remote sensing survey results, provide biological information, confirm reef boundaries, and determine oyster density and abundance.

Along with data files for analysis, maps depicting current reef locations and bathymetric contours were produced (Appendix A). BIO-WEST conducted the remote sensing survey efforts between October 13 and 15, 2019, and physical investigation followed shortly after on October 18, 2019, once the remote sensing data was process and finalized. The survey efforts were conducted under BIO-WEST's current TPWD Scientific Collection Permit. This report provides the methodology and results describing the location and extent of oyster reefs within the 1,100-ft survey corridor across Galveston Bay.

2.0 METHODOLOGY

2.1 Remote Sensing Survey

BIO-WEST conducted remote sensing surveys in order to map the location and extent of potential marine natural resources within the project corridor. Field efforts consisted of SSS surveys, data processing, and water bottom characterization by manual poling of potential oyster reefs.

2.1.1 Side-Scan Sonar

Equipment for this survey consisted of an EdgeTech® Chirp 900 kilohertz (kHz) SSS sensor "towfish", topside processor; with DISCOVER acquisition software, a Teledyne Odom Hydrographic, Inc. Hydrotrac™ 200 kHz single beam echo sounder (fathometer), and a Hemisphere® VS111 differentially-corrected global positioning system (DGPS) receiver. Vessel guidance, position, and data logging were accomplished with Trimble® HYDROpro™ Navigation software. Figure 1 provides an illustration depicting equipment layout on the survey vessel.

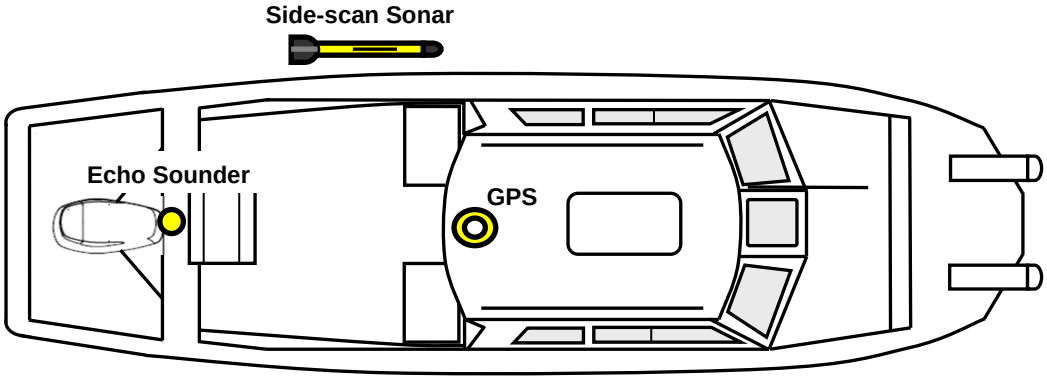


Figure 1. Equipment layout for the survey vessel.

The SSS topside processor recorded acoustic imagery in continuous streams while embedding sensor position information, vessel course, and vessel speed from the DGPS receiver. The survey vessel was guided along predetermined transects spaced 131 feet (40 meters) apart. SSS imagery was recorded along these transects, resulting in 100 percent overlap of the majority of sonar data. This spacing was chosen to ensure optimum image quality and to provide 112 evenly spaced transects within the 1,100-foot (~330-meter) survey corridor.

Depth soundings were collected in a narrow beam directly below a transducer affixed to the survey vessel. This data set was collected as a bathymetric record in the navigation software and was associated with positional information at a rate of once per second. The bathymetric record was used to create contours that aid with SSS interpretation. Positional information from the DGPS for the survey vessel and each instrument sensor was collected at a rate of one reading per second. Instrument off-set distances from the DGPS antenna were incorporated into the positional record to increase accuracy. Vessel speed during the survey averaged 4.0 knots (4.6 miles per hour) providing in line data point 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 towfish and draft for the navigation vessels. Field notes were maintained and photographs were collected in order to document the survey and assist with subsequent data processing.

2.1.2 Data Processing

Side scan sonar data sets were recorded and exported from Edgetech, Inc. DISCOVER acquisition software. The data sets were then processed to produce remote sensing imagery. A single mosaic image was created from individual survey lines utilizing Chesapeake Technology, Inc. SonarWiz 7.0® processing software. To provide a clear and accurate image, the sonar imagery was calibrated using empirical gain normalization for contrast and clarity. The imagery was then modified to remove extraneous data such as the nadir region (the area directly below the towfish) and water column interference. Following this process, the imagery was combined using embedding positional data to create a single geo-rectified mosaic at a resolution of 0.10 feet per pixel. This high-resolution imagery was used to remotely delineate oyster reef and seagrass bed locations with verified data from the physical investigation phase.

Bathymetric data was exported from the navigation software and tidally-corrected to the mean low water (MLW) datum using preliminary data from Texas Coastal Ocean Observation Network (TCOON), part of the Division of Near Shore Research (DNR). The TCOON website offers this disclaimer: *The data described below have been collected by automated equipment and are furnished "as is" DNR makes no warranties (including no warranties as to merchantability or fitness) either expressed or implied with respect to the data or their fitness for any specific application."* After tidal correction, depth measurements were processed through a smoothing algorithm to eliminate outliers, and bathymetric contours were created at 0.5-ft (0.3048-meter) intervals using ESRI™ ArcMap® Pro.

All remote sensing data and imagery was imported into an ESRI™ ArcMap® Pro GIS geo-database. The geo-database provides, among other tools, data organization, geospatial analyses capability, multiple presentation of data, and layering with other GIS spatial data. Data can be extracted from the database as individual shape files or for viewing in other geospatial formats such as Google Earth™.

2.2 Physical Investigation

The physical investigation was conducted both concurrently with, and after the remote sensing survey. Concurrent with the remote sensing survey, a substrate characterization was performed by manually probing the bottom with a wooden pole where depths allowed. Once the dataset was processed, BIO-WEST biologists also pulled a modified oyster dredge to confirm substrate characteristics and determine potential presence/absences of oyster reefs or suitable substrate. In addition, current water quality conditions were documented at each diver quadrat location. The following sections provide a detailed description of each physical investigation effort.

2.2.1 Substrate Characterization

Initial ground-truthing efforts and water bottom poling were conducted in conjunction with the SSS surveys via linear transects from October 13 to 15, 2019. In addition to utilizing previous survey experience, field personnel reviewed the descriptions of each water bottom type and category in order to establish a clear understanding of, and consistency in, collecting water bottom poling data. Bottom characterizations were completed according to the bottom characterization table included in Table 1 below.

Linear poling transects were plotted electronically on a 40-m^2 grid created in ESRI™ ArcMap® Pro and loaded into the on-board navigation software. The navigation software was also used for the SSS transect recording, allowing the poling points to be plotted directly along individual transects. Poling occurred on transect lines as close to the center of each grid square as possible. Using a

1.5-inch diameter wooden pole with sounding indicator, water bottom types were distinguished based on the density and resistance of the substrate. Identified water bottom types were considered representative of each grid square. Replicate probes were conducted in order to further verify water bottom types in relation to central poling points. In locations where depths exceeded the feasibility of poling, water bottoms types were interpreted from surrounding water bottoms types, oyster dredge tows, diver quadrats, depth contouring, and SSS imagery.

Data points were recorded in the navigation software and the water bottom types in a BIO-WEST field notebook according to a coding scheme developed for each water bottom category. Water bottom types are provided in Table 1.

Table 1: Water bottom classifications

Water Bottom Type	Water Bottom Categories	Brief Description
Type I	Soft Mud	Soft, slushy mud – would not support small pieces of reef material
Type II	Moderately Firm Mud	Bottom that would support small pieces of reef material
	Firm Mud or Sand	Compact muddy or sandy substrate
	Buried Substrate	Firm substrate buried under soft sediment layer
Type III	Exposed Scattered Hard Substrate	Single or scattered low profile hard substrates such as shell, limestone, or concrete aggregate
	Exposed Continuous Substrate	Continuous low-profile hard substrate such as shell, #57 limestone, or #57 concrete aggregate
Type IV	Submerged Aquatic Vegetation (SAV)	Submerged Grasses
Type V	Natural Reef	Exposed substrate exhibiting exaggerated vertical relief in relation to surrounding water bottoms
	Artificial Reef	
	Identified targets	Ferrous or non-ferrous objects not attributable to artificial reef deployment

2.2.2 Oyster Dredge Tows

After completion of the remote sensing phase of the survey, an SSS mosaic was created and used to guide dredge tows and diver quadrats (see Section 2.2.3). Oyster dredge tows were conducted throughout the survey area at targeted locations identified in the SSS imagery as potential reef locations, as well as areas that appeared to be mud, sand, or scattered shell. Sample sites were selected to:

- Verify substrate and suspected oyster reef signatures
- Identify unknown SSS signatures
- Provide the greatest amount of spatial coverage possible throughout the entire project area where oyster reefs were suspected

Each dredge tow consisted of a 30-second linear tow within the project corridor using a BIO-WEST custom fabricated steel-frame oyster dredge. The dimensions of the tow are 33 inches

(80 centimeters) long by 18 inches (47 centimeters) wide by 11 inches (29 centimeters) deep with a 0.5-inch (1.3 centimeters) wire mesh lined collection basket to retain small shell hash and bivalve/benthic species. Upon retrieval of each tow, contents were described and photo documented (pre- and post-rinse). Oysters collected were sorted according to size class and counted. For this survey, oysters were sorted by spat (< one inch or 25 mm), seed (one to three inches or 25 to 75 mm) or sack (> three inches or 75 mm) size classes.

2.2.3 Diver Quadrats

Square-meter diver quadrat (DQ) samples were conducted with the aid of surface-supplied air and a BIO-WEST custom-fabricated oyster sampling basket. The sampling basket measures one-third of a square-meter with three, one-third square-meter quadrat frames which fold down (from three sides of the basket) for a total sample size of one square-meter. This sampling technique allows for work in turbid aquatic environments, where collecting is accomplished exclusively by tactile feel.

Oysters collected within each DQ were counted, measured, and photographed according to established sampling protocol. Oysters were then categorized as live, dead, and box. Box oysters were defined as those that are "recently dead," as determined by the number of fouling organisms present and possess intact valves. Within each of these three categories, oysters were measured and recorded in five mm increments and grouped according to the size class to which they belonged: spat (0 to 24 mm), seed (25 to 74 mm), and sack (>75 mm). Oysters and reef substrate were then returned to the water at each DQ.

2.2.4 Water Quality

For each DQ, BIO-WEST biologists also documented water quality parameters to characterize ambient water conditions over potential reef locations. Using a YSI® 6920 multi-parameter water quality data sonde, water quality parameters were collected approximately 0.5 feet below the water's surface and approximately one foot above the bottom. The parameters measured included temperature (^{o}C), specific conductivity (mS/cm^{3}), salinity (‰), dissolved oxygen (DO) (mg/L), and pH (su). Raw water depths (feet), measured by a non-vented strain gauge on the YSI, also were collected. These parameters were measured to verify the suitability for live oyster reef communities within and adjacent to the project corridor.

3.0 RESULTS

3.1 Remote Sensing Survey

Remote sensing survey results indicated the presence of both large and small collective and independent oyster reefs within the majority of the project corridor within Galveston Bay. These underwater signatures were then used to determine the location and direction of oyster dredge tows and diver quadrats during the physical investigation phase. Bathymetric contours were created from depth soundings recorded during the survey. Although subtle throughout the project area, these contours supported the relief associated with each oyster reef present. Maps depicting each reef location, the associated depth contours for each reef, and both dredge tow and DQ sample locations are presented in Appendix A.

3.2 Physical Investigation

3.2.1 Substrate Characterization

Substrate and water bottoms within the project corridor were characterized through an analysis of linear poling transects, SSS imagery, and bathymetric survey data. Substrate classifications are illustrated on Figure 4.0 of in Appendix A as a grid that is color-coded to represent the water bottom categories reference above in Table 1. Poling was generally conducted when at depths shallower than 12 feet; when the water depth was too great to manually pole the water bottom, water bottoms types were interpolated from surrounding water bottoms types, oyster dredge and driver quadrat sampling, depth contouring, and SSS imagery.

Additionally, direct observations of water bottom types were made during the dredge tows and diver quadrat sampling efforts. Dredge tows generally revealed a firm mud along the tow route when live oysters were not encountered. Bottom samples taken during quadrat sampling revealed fine to medium sized shell hash at all DQ locations. AS observed in the photograph log in Appendix B, shell hash size ranged from ¼ inch to 1.5 inches long, and was generally oblong or square. Larger shell pieces were infrequent and only one live oyster cluster with multiple sack oysters was recovered in DQ6.

3.2.2 Oyster Dredge Tows

A total of 11 dredge tow sample sites were selected within the project corridor based upon SSS imagery. Due to a lack of survey permission on private oyster lease areas, all 11 dredge tow locations were located on publicly accessible potential oyster reefs.

Four of the 11 dredge tows collected 65 total live eastern oysters (*Crassostrea virginica*) along with associated organisms. Oysters collected in dredge tows were dominated by seed oysters (65%; n=42), followed by sack oysters (26%; n=17) and spat oysters (9%, n=6). See Figures 2 and 3 for additional information.

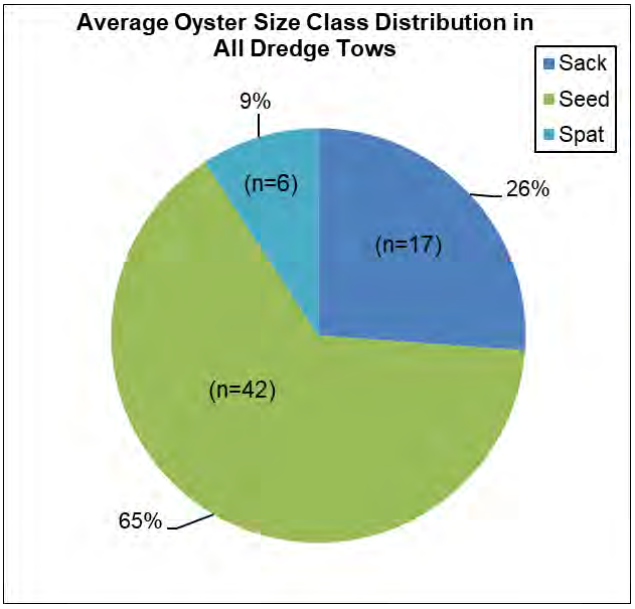


Figure 2. Live oyster size class distribution in all dredge tows.

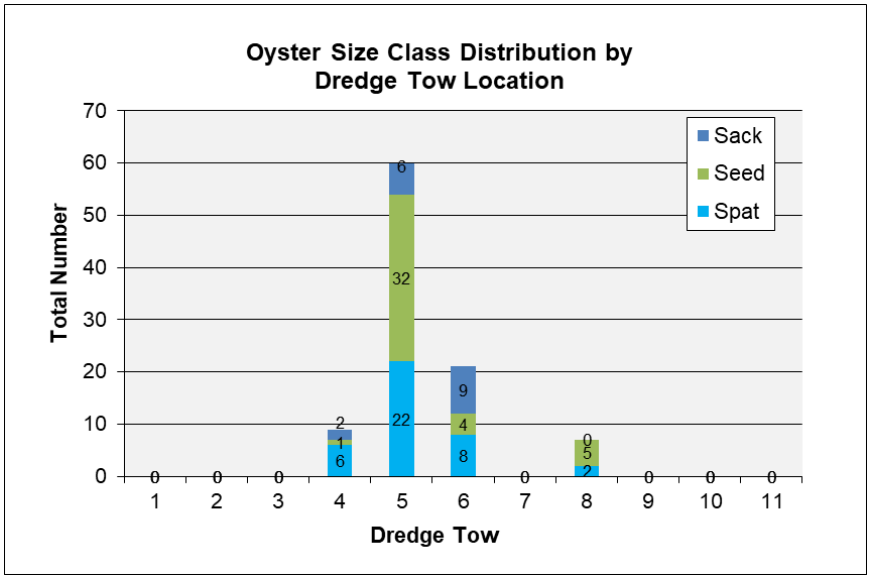


Figure 3. Live oyster size class by dredge tow.

When analyzed by individual dredge tow, live oyster size class only occurred at Tows 04, 05, 06, and 08 (Figure 3). Two of the seven remaining dredge tows (Tows 01 and 07) contained only one dead box oyster and broken shell, while the last five tows (02, 03, 09, 10 and 11) contained no live or dead oysters at all. Associated reef organisms were also found in some dredge tow samples, including barnacles (*Balanus* sp.), serpulid worms (*Hydroides dianthus*), and hooked mussels (*Ischadium recurvum*). Oyster dredge tow data sheets are provided in Appendix C and photographs of each individual tow are in Appendix B.

3.2.3 Diver Quadrats

A total of six DQ were sampled during survey efforts. Sample locations were randomly selected based on the results of the SSS mosaic. A map depicting sample site locations is included in Appendix A; representative photos of the sampling are presented in Appendix B; and digital

copies of field data sheets are presented in Appendix D. To note, eight DQ locations were initially proposed for this project; however, location DQ1 and DQ2 were located over private oyster leases and, as of the date of this report, survey permission has not been granted to sample both locations. Therefore, the dataset obtained from diver quadrat sampling should be indicative of all public oyster reefs within the project corridor.

All DQ locations possessed live eastern oysters along with anticipated communal reef organisms. A cumulative total of 44 live oysters were documented in all DQ locations. The average of all quantitative samples collected indicated a population density of 6.2 individuals per square meter. The average oyster size class distribution was dominated by seed oysters (68%; n=30), followed by sack oysters (18%; n=8), and spat oysters (14%; n=6).

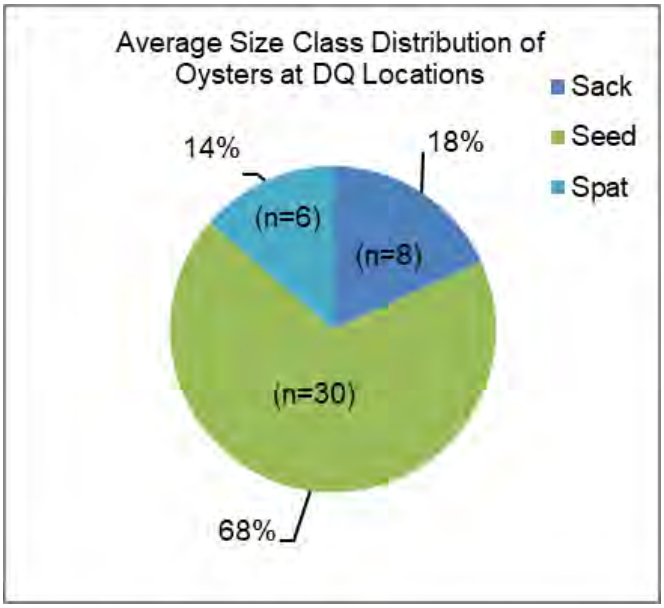


Figure 4. Live oyster size class distribution in all DQ locations

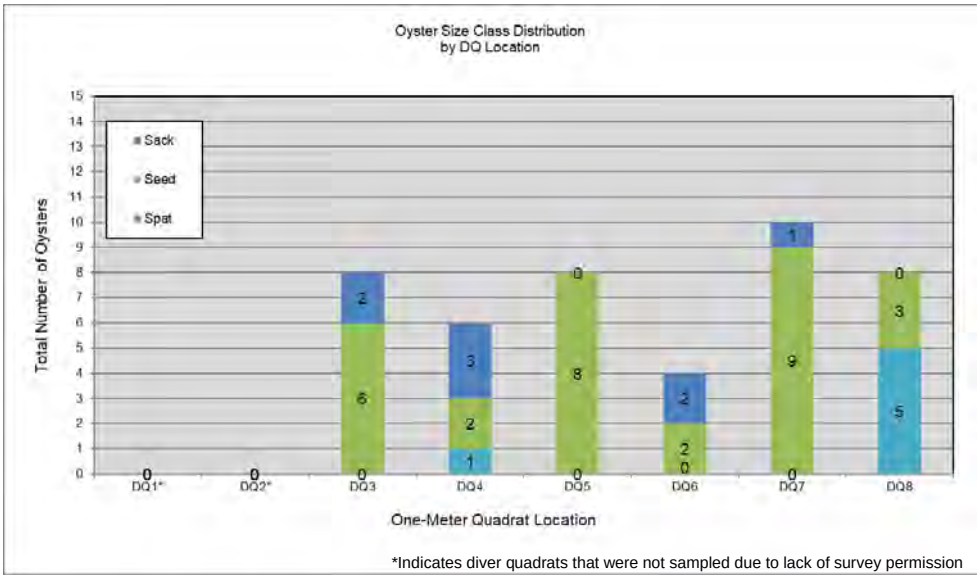


Figure 5. Live oyster size class by DQ Location

In addition to the eastern oyster, other communal reef organisms were observed among and attached to the cultch material, with the most abundant organisms being barnacles, hooked mussels, and serpulid worms.

3.2.4 Water Quality

Standard water quality parameters were collected in Galveston Bay during quadrat sampling. Water depths within the sample sites ranged from 10.1 to 11.9 feet below MLW, with an average depth of 11.1 ft. In addition to an overall water quality characterization, stratified sampling was conducted to document any variation that may occur within the water column. The average of each water quality parameter by column depth (surface to bottom) was calculated and presented in Table 2. Additional information on water depth, temperature, salinity, conductivity, DO, and pH were collected and are provided in Appendix E.

Table 2: Water quality results

Parameter	Average	
	Surface	Bottom
Sample Depth (ft)	0.6	10.7
Water Temperature (°C)	21.5	22.4
Conductivity (mS/cm)	15.4	24.8
Salinity (‰)	8.7	15.1
DO (mg/L)	10.01	8.65
pH	8.3	8.3

4.0 DISCUSSION

BIO-WEST completed an oyster reef assessment and survey between October 13 and 18, 2019. Based on the results of the remote sensing survey and physical investigations, it is BIO-WEST's professional opinion that approximately 2.50 acres of oyster reefs within the project corridor may be impacted by the proposed placement of protection mats along the existing pipeline. Of this approximately **2.50** acres of potential reef, approximately **0.20** acres was located over private oyster leases and **2.30** acres was located over oyster reefs open to public harvesting.

Oyster size class distribution data at six diver quadrat locations correlated strongly to the 11 dredge tows, with seed class (one to three inches long) oysters averaging 66.5% of all total live oysters observed. Sack and spat oysters exhibited a strong correlation between the dataset as well, averaging 22% and 11.5% respectively of all live oysters observed.

This data suggests that all public accessible reefs within the project corridor exhibit a similar structure and composition, as evidenced by a lack of new recruitment in the spat age cohort, a relative lack of reproduction-class oyster in the sack cohort, a dominant mix of seed-class oysters, and a lack of clustered or immobile substrate. Additionally, the results of both physical investigation methods indicated that live oysters, when encountered, were generally single individuals with few to no clusters and little to no attachment to the substrate. Water quality measurements also revealed an average salinity level of 8.7 ppt at the surface and 15.1 ppt at the bottom in Galveston Bay, indicating a freshwater lens and lack of water column mixing. The dominant substrate throughout publicly accessible reefs was shell hash with fine to medium particle sizes and high mobility rates, further reinforcing the observed size classes.

All of these observations would indicate that the public oyster reefs overlaying the existing pipeline are low quality and have likely been overharvested, leading to decreased productivity, increased susceptibility to predation, and decreased resiliency. Specific information on the location and composition of reefs within the proposed project area is included in Appendix A.

It should be noted that no dredge tows or diver quadrat sampling was conducted over the private lease areas within the project corridor due to a lack of survey permission at the time of field efforts.

BIO-WEST greatly appreciates the opportunity to provide the subject marine environmental support, and acknowledges that the data presented here has been summarized to address environmental concerns as depicted in succinct illustrations and text. If additional information is requested, BIO-WEST welcomes the opportunity to discuss these findings in greater detail and provide any additional support sought.

5.0 REFERENCES

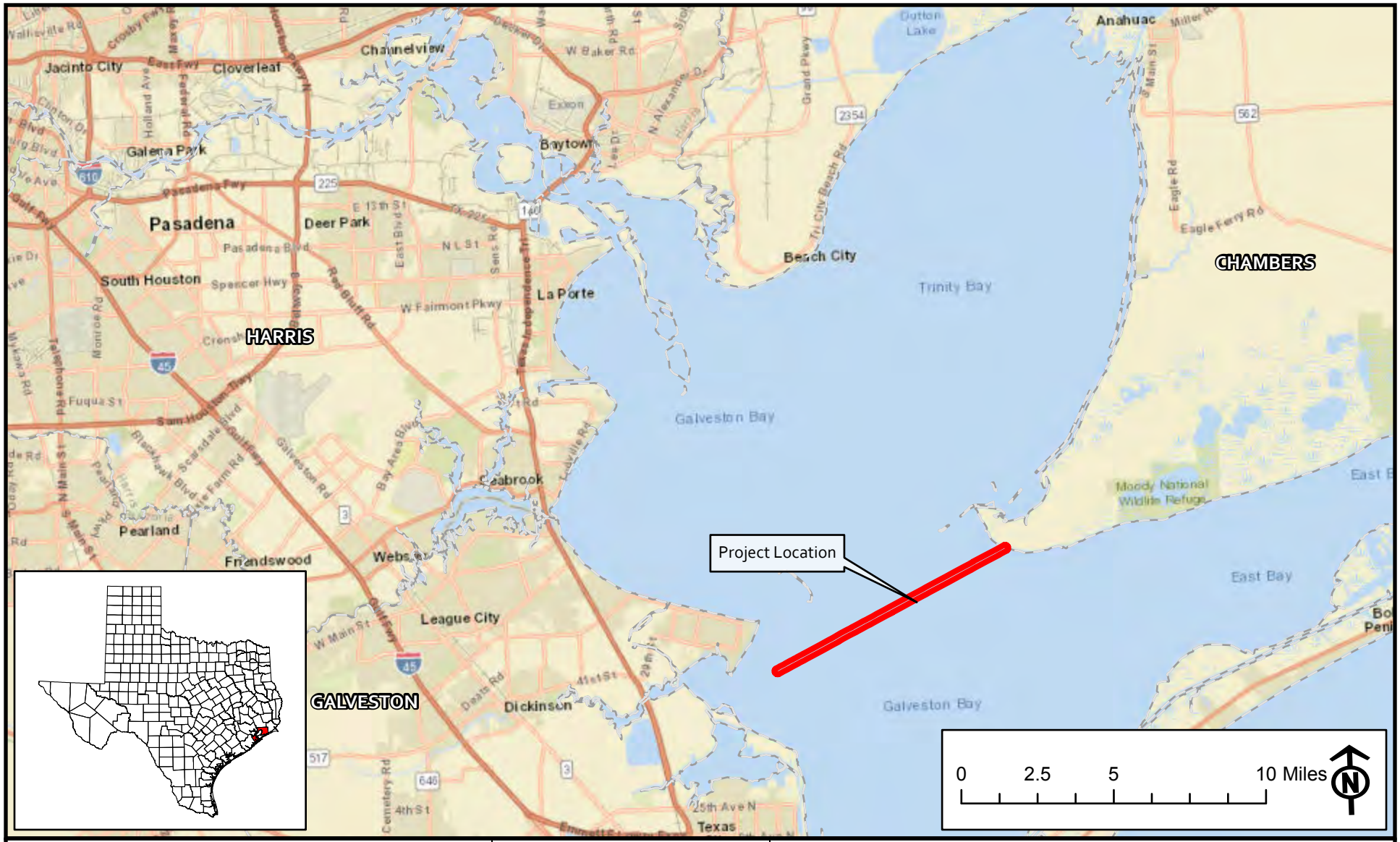
Mackin, J.G. and S.H. Hopkins. 1961. Studies on Oyster Mortality in Relation to Natural Environments and to Oil Fields in Louisiana. Publication of the Marine Institute for Marine Science, The University of Texas 7: 1-131.

Patillo, M. E., Czapla, T. E., Nelson, D. M, and Monaco, M. E. 1997. Distribution and Abundance of Fishes and Invertebrates in Gulf of Mexico Estuaries, Volume II: Data Summaries. ELMR Rep. No. 11. NOAA/NOS Strategic Environmental Assessments Division, Rockville, MD. 377 p.

Shumway, S.E. 1996. Natural and Environmental Factors. V. S. Kennedy et al, ed. The Eastern Oyster *Crassostrea virginica*. Maryland Sea Grant College. Pp. 467 – 513.

Appendix A

Marine Natural Resource Maps



Legend

- Project Location
- County Boundary
- Highway
- Road

Prepared for:

Florida Gas Transmission Company, LLC.

Prepared by:

BIO-WEST

Figure 1.0 - Vicinity Map

Proposed Mat Placement - 24-inch Florida Gas Transmission Line
Galveston and Chambers Counties, Texas

Project No: 2658	Drawn by: G.B.	Map Date: 10/23/2019	Scale: 1 in = 5 miles
Projection: NAD83 State Plane TX South Central		Basemap Source: ESRI World Street Map	

Legend

Survey Corridor

County Boundary

Prepared for:

Florida Gas Transmission Company, LLC.

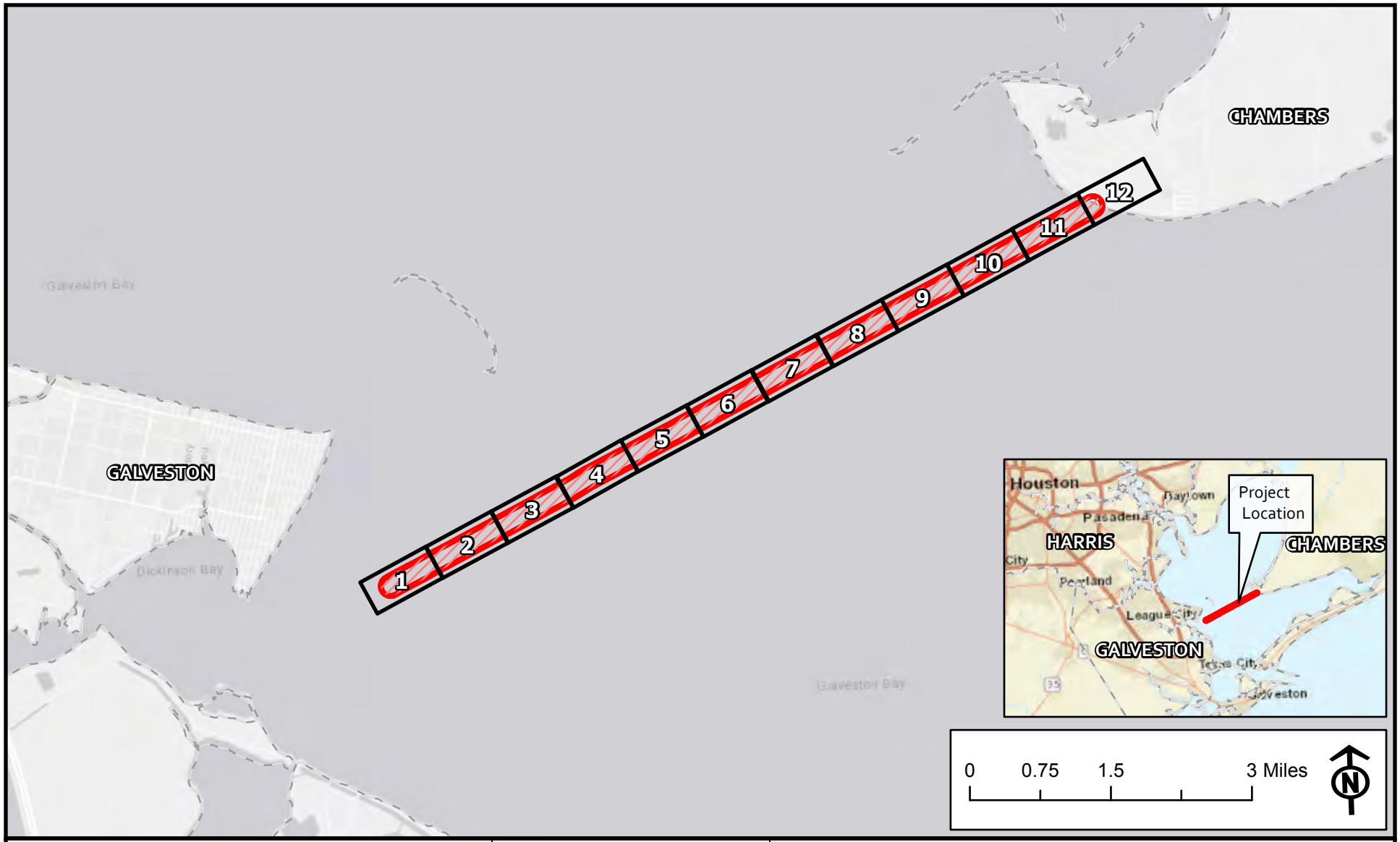
Prepared by:

BIO-WEST

Figure 2.0 - Location Map

Proposed Mat Placement - 24-inch Florida Gas Transmission Line
Galveston and Chambers Counties, Texas

Project No: 2658	Drawn by: G.B.	Map Date: 10/23/2019	Scale: 1 in = 1.5 miles
Projection: NAD83 State Plane TX South Central		Basemap Source: ESRI Imagery	



Legend

- Survey Corridor
- County Boundary
- Map Sheet Index

Prepared for:

Florida Gas Transmission Company, LLC.

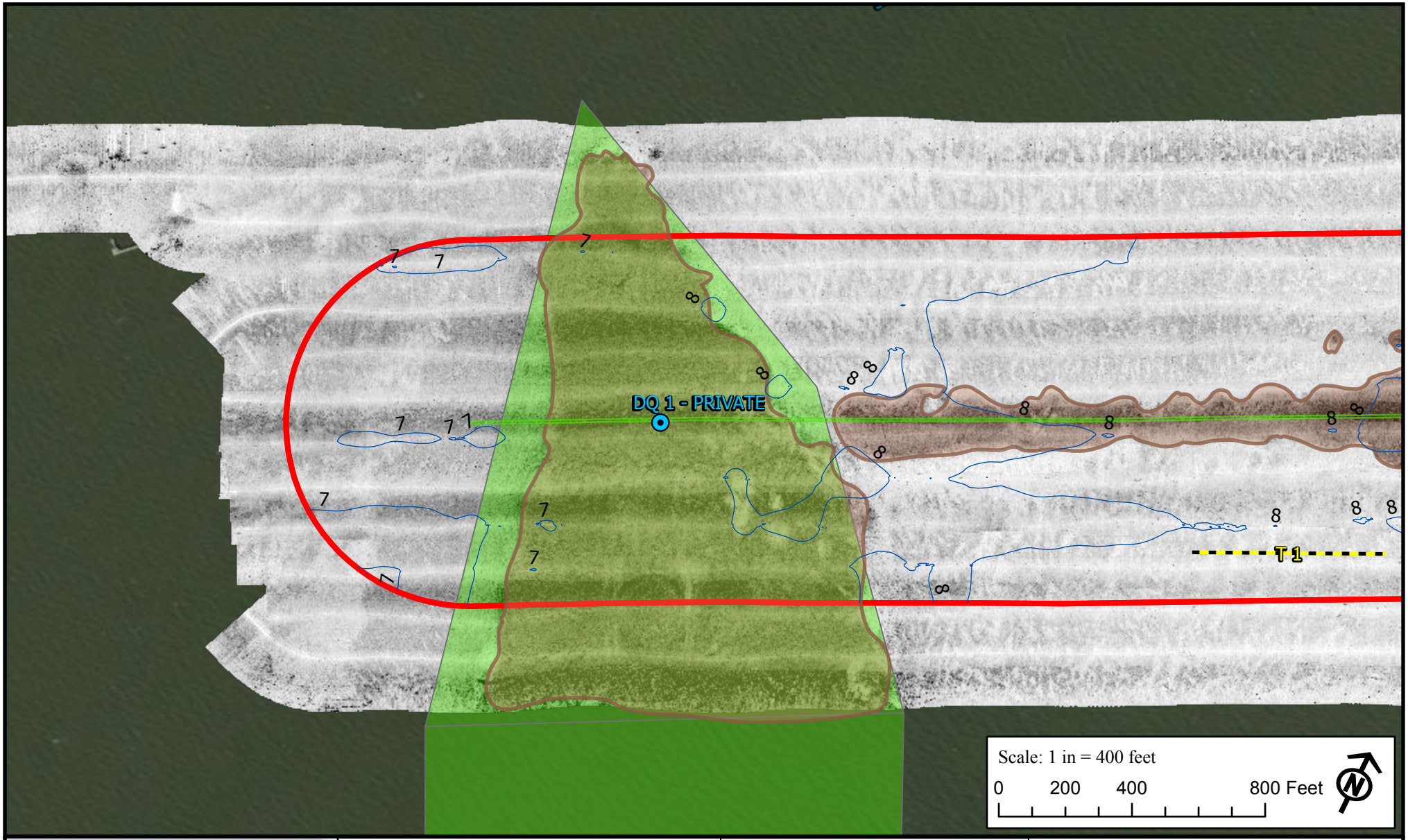
Prepared by:

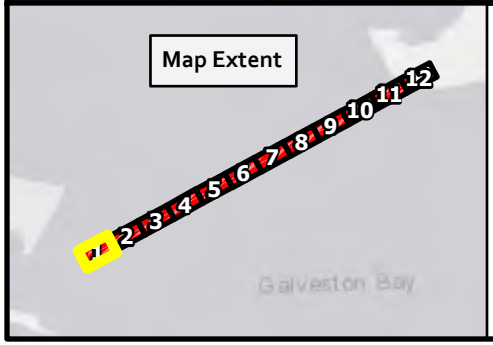
BIO-WEST

Figure 3.0 - Natural Resource Map Sheep Index

Proposed Mat Placement - 24-inch Florida Gas Transmission Line Galveston and Chambers Counties, Texas

Project No: 2658	Drawn by: G.B.	Map Date: 10/23/2019	Scale: 1 in = 1.5 miles
Projection: NAD83 State Plane TX South Central		Source: ESRI World Light Gray Canvas Base	





Legend

- Survey Corridor
- Oyster Reef
- 1.0-ft Depth Contour*
- Diver Quadrat (DQ) Sample
- Dredge Tow Path
- Protection Mat Areas
- Oyster Leases

**Bathymetric corrections were performed with preliminary NOAA Water Level data. Contours were generated by interpolation of point measurements, and should not be used for engineering purposes.*

Prepared for:

Florida Gas Transmission Company, LLC.

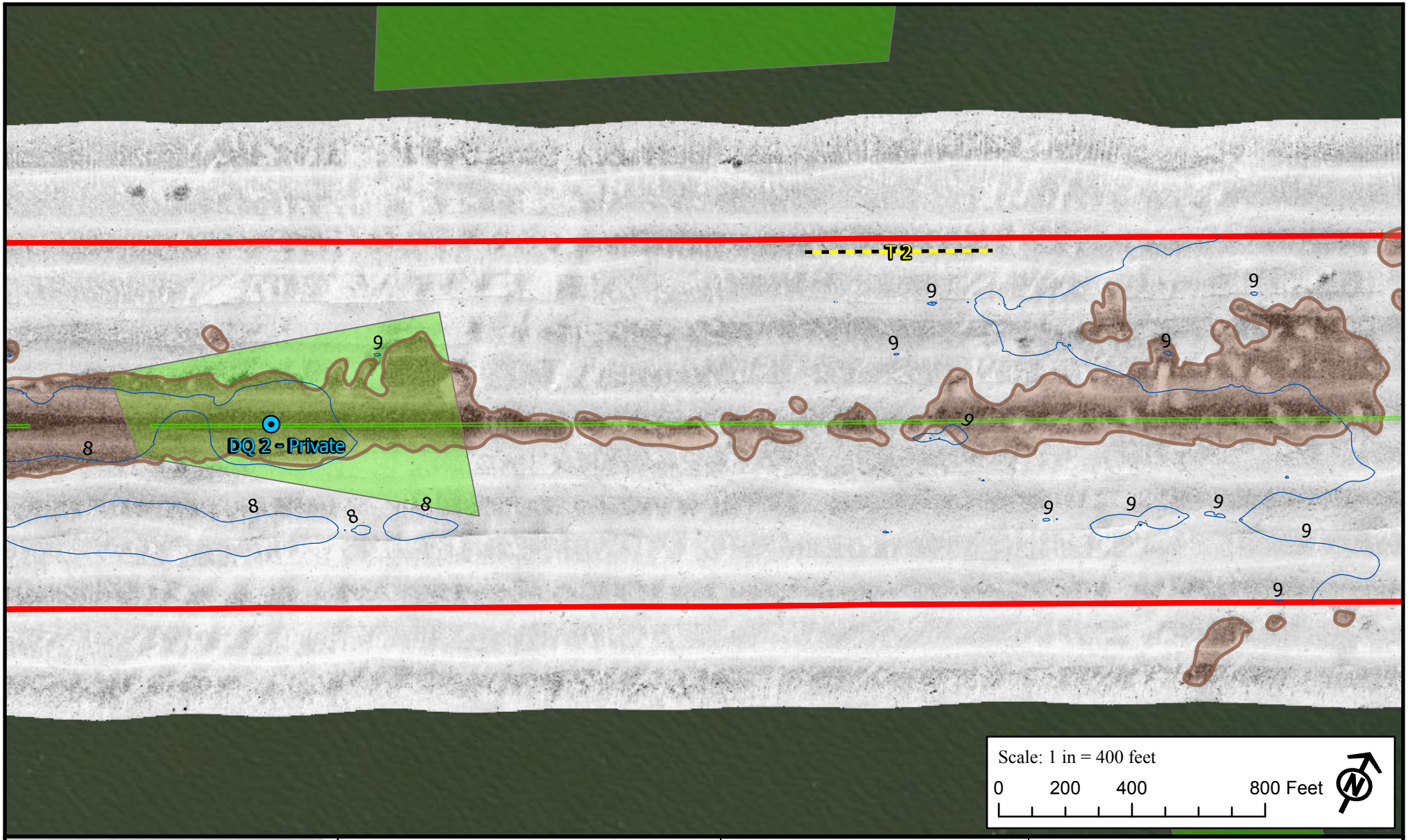
Prepared by:

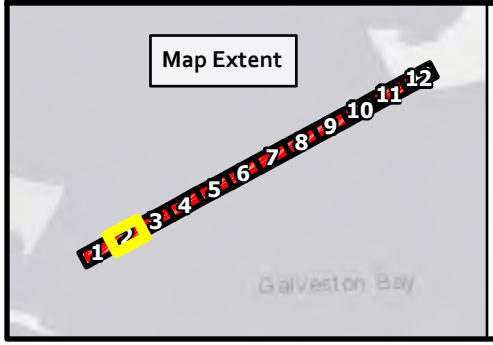
BIO-WEST

Figure 3.1
Marine Natural Resources Map
Sheet 1 of 12

Galveston and Chambers Counties, Texas

Proposed Mat Placement - 24-inch Florida Gas Transmission Line, Galveston and Chambers Counties, Texas	
Project No: 2658	Source: ESRI World Imagery
Drawn by: G. Busch	Map Date: 10/23/2019
Projection: NAD83 State Plane TX South Central	





Legend

- Survey Corridor
- Oyster Reef
- 1.0-ft Depth Contour*
- Diver Quadrat (DQ) Sample
- Dredge Tow Path
- Protection Mat Areas
- Oyster Leases

**Bathymetric corrections were performed with preliminary NOAA Water Level data. Contours were generated by interpolation of point measurements, and should not be used for engineering purposes.*

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Florida Gas Transmission Company, LLC.

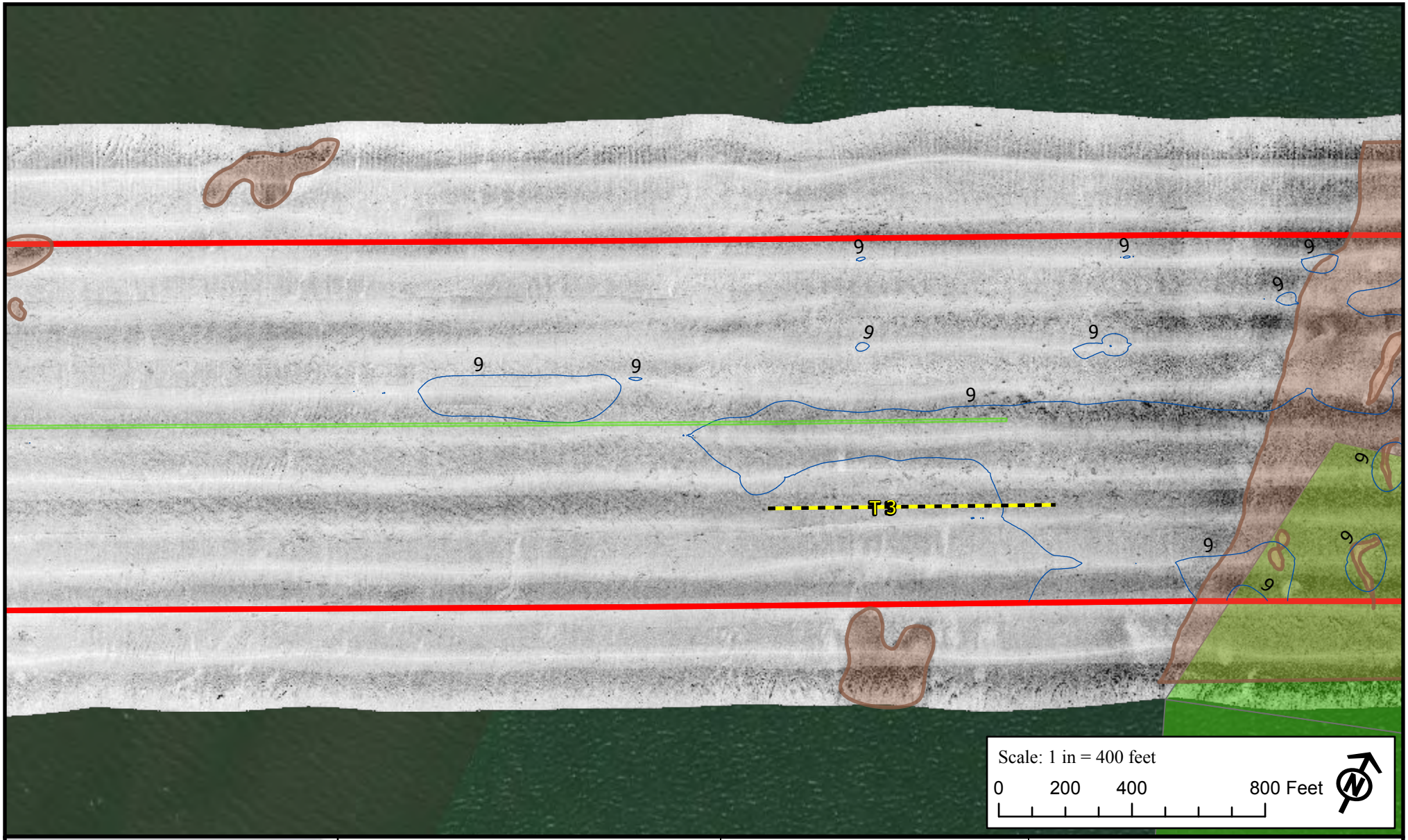
Prepared by:

BIO-WEST

Figure 3.2
Marine Natural Resources Map
Sheet 2 of 12

Galveston and Chambers Counties, Texas

Proposed Mat Placement - 24-inch Florida Gas Transmission Line, Galveston and Chambers Counties, Texas	
Project No: 2658	Source: ESRI World Imagery
Drawn by: G. Busch	Map Date: 10/23/2019
Projection: NAD83 State Plane TX South Central	



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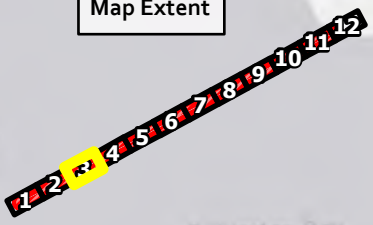

Legend

- Survey Corridor
- Oyster Reef
- 1.0-ft Depth Contour*
- Dredge Tow Path
- Protection Mat Areas
- Oyster Leases

**Bathymetric corrections were performed with preliminary NOAA Water Level data. Contours were generated by interpolation of point measurements, and should not be used for engineering purposes.*

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Florida Gas Transmission Company, LLC.

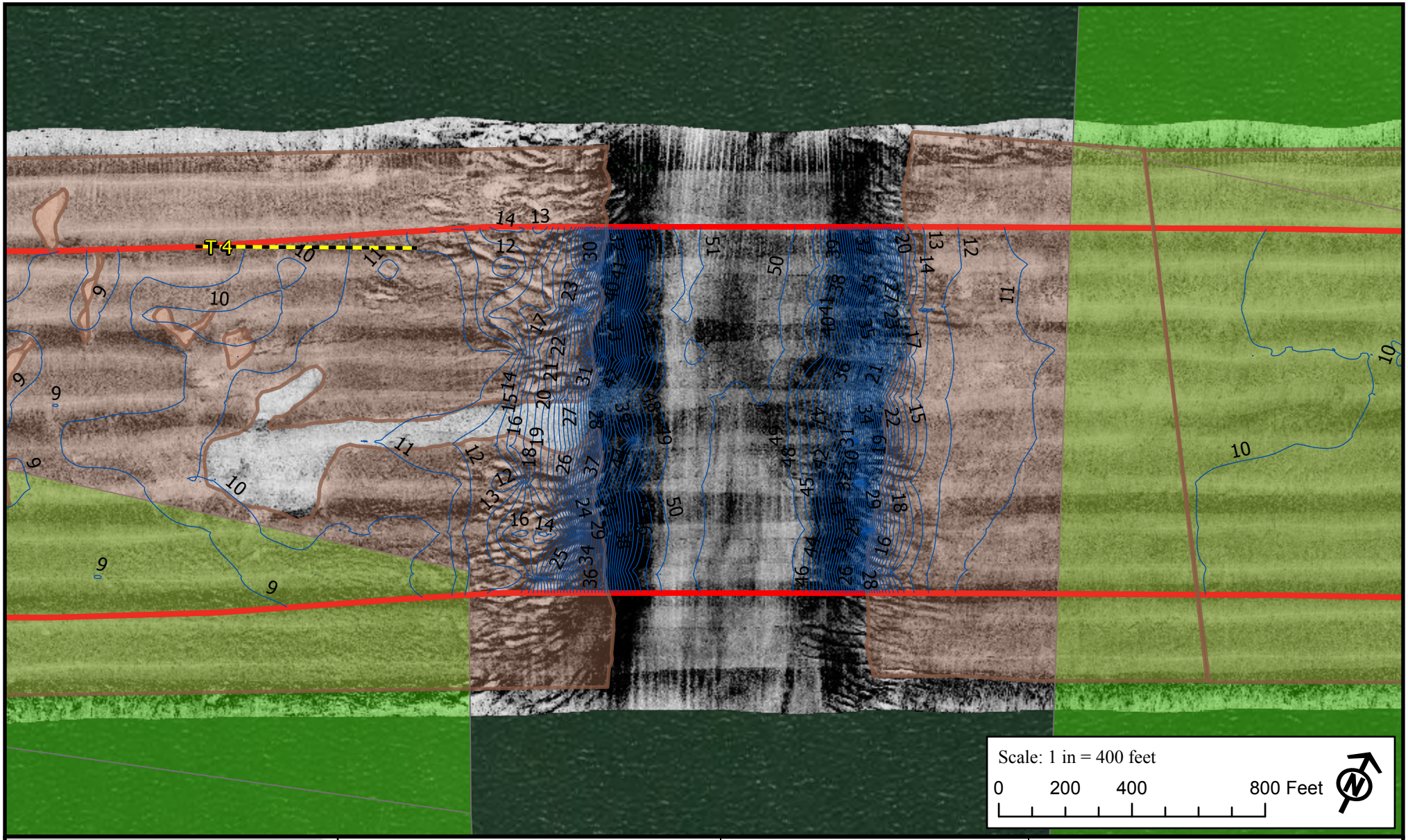
Prepared by:

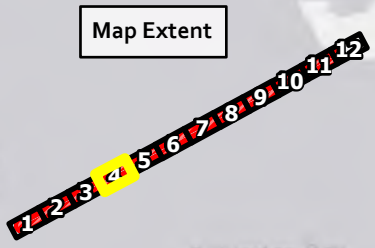
BIO-WEST

Figure 3.3
Marine Natural Resources Map
Sheet 3 of 12

Galveston and Chambers Counties, Texas

Proposed Mat Placement - 24-inch Florida Gas Transmission Line, Galveston and Chambers Counties, Texas	
Project No: 2658	Source: ESRI World Imagery
Drawn by: G. Busch	Map Date: 10/23/2019
Projection: NAD83 State Plane TX South Central	





Legend

- Survey Corridor
- Oyster Reef
- 1.0-ft Depth Contour*
- Dredge Tow Path
- Protection Mat Areas
- Oyster Leases

**Bathymetric corrections were performed with preliminary NOAA Water Level data. Contours were generated by interpolation of point measurements, and should not be used for engineering purposes.*

Prepared for:

Florida Gas Transmission Company, LLC.

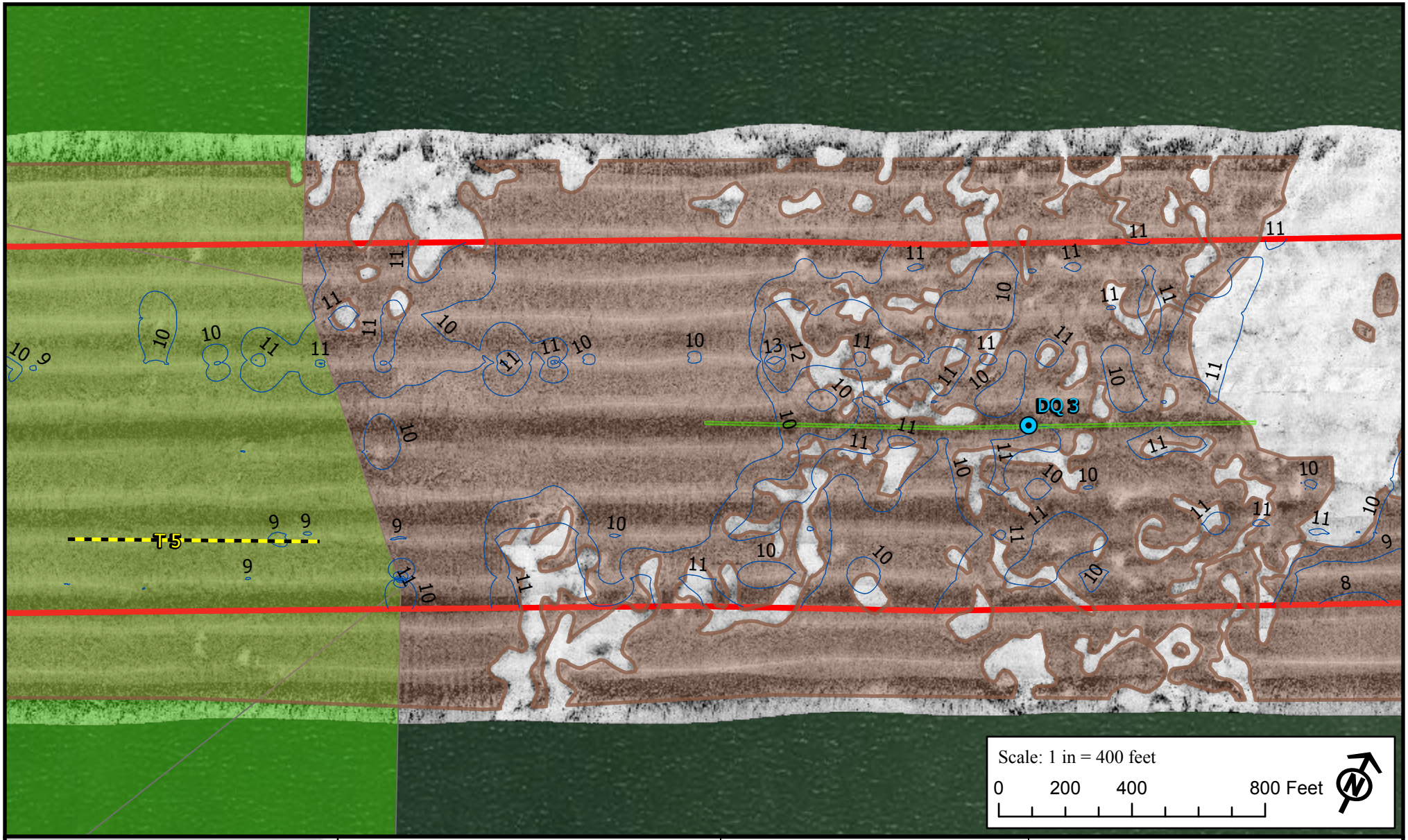
Prepared by:

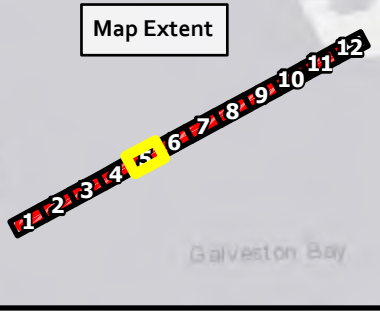
BIO-WEST

Figure 3.4
Marine Natural Resources Map
Sheet 4 of 12

Galveston and Chambers Counties, Texas

Proposed Mat Placement - 24-inch Florida Gas Transmission Line, Galveston and Chambers Counties, Texas	
Project No: 2658	Source: ESRI World Imagery
Drawn by: G. Busch	Map Date: 10/23/2019
Projection: NAD83 State Plane TX South Central	





Legend

- Survey Corridor
- Oyster Reef
- 1.0-ft Depth Contour*
- Diver Quadrat (DQ) Sample
- Dredge Tow Path
- Protection Mat Areas
- Oyster Leases

**Bathymetric corrections were performed with preliminary NOAA Water Level data. Contours were generated by interpolation of point measurements, and should not be used for engineering purposes.*

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Florida Gas Transmission Company, LLC.

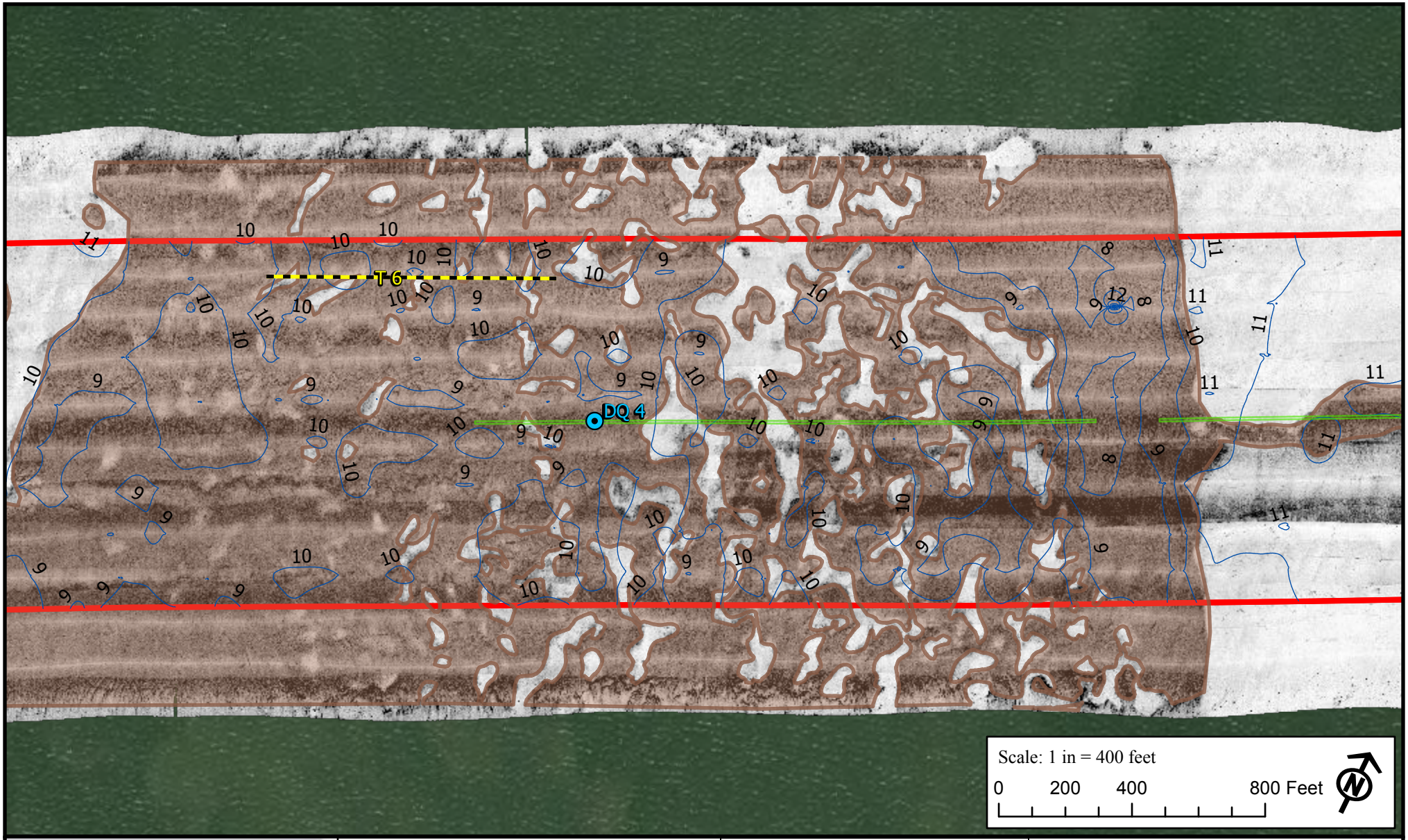
Prepared by:

BIO-WEST

Figure 3.5
Marine Natural Resources Map
Sheet 5 of 12

Galveston and Chambers Counties, Texas

Proposed Mat Placement - 24-inch Florida Gas Transmission Line, Galveston and Chambers Counties, Texas	
Project No: 2658	Source: ESRI World Imagery
Drawn by: G. Busch	Map Date: 10/23/2019
Projection: NAD83 State Plane TX South Central	



Map Extent

Galveston Bay

Legend

- Survey Corridor
- Oyster Reef
- 1.0-ft Depth Contour*
- Diver Quadrat (DQ) Sample
- Dredge Tow Path
- Protection Mat Areas
- Oyster Leases

**Bathymetric corrections were performed with preliminary NOAA Water Level data. Contours were generated by interpolation of point measurements, and should not be used for engineering purposes.*

Prepared for:

Florida Gas Transmission Company, LLC.

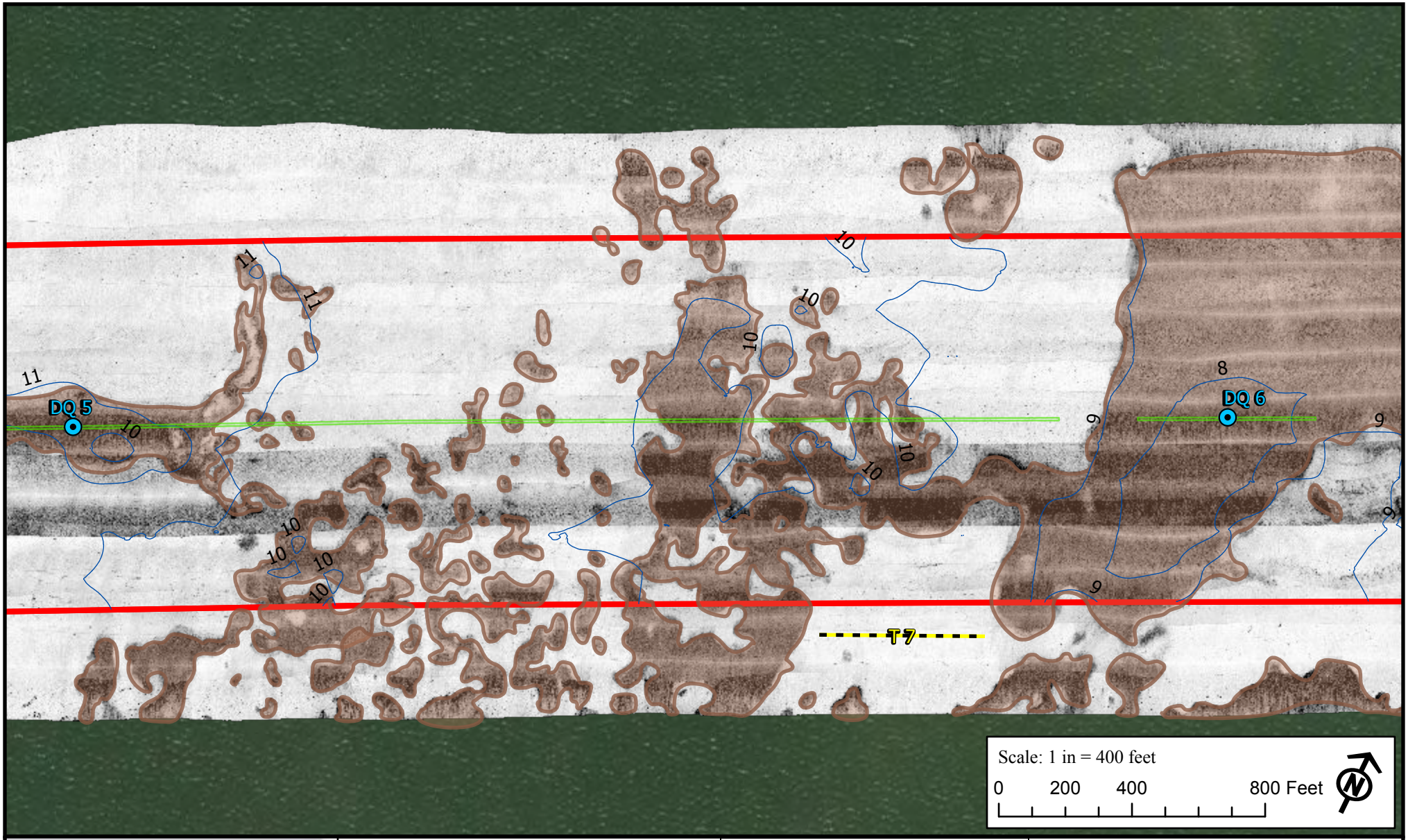
Prepared by:

BIO-WEST

Figure 3.6
Marine Natural Resources Map
Sheet 6 of 12

Galveston and Chambers Counties, Texas

Proposed Mat Placement - 24-inch Florida Gas Transmission Line, Galveston and Chambers Counties, Texas	
Project No: 2658	Source: ESRI World Imagery
Drawn by: G. Busch	Map Date: 10/23/2019
Projection: NAD83 State Plane TX South Central	



Map Extent

Galveston Bay

Legend

- Survey Corridor
- Oyster Reef
- 1.0-ft Depth Contour*
- Diver Quadrat (DQ) Sample
- Dredge Tow Path
- Protection Mat Areas
- Oyster Leases

**Bathymetric corrections were performed with preliminary NOAA Water Level data. Contours were generated by interpolation of point measurements, and should not be used for engineering purposes.*

Prepared for:

Florida Gas Transmission Company, LLC.

Prepared by:

BIO-WEST

Figure 3.7
Marine Natural Resources Map
Sheet 7 of 12

Galveston and Chambers Counties, Texas

Proposed Mat Placement - 24-inch Florida Gas Transmission Line, Galveston and Chambers Counties, Texas	
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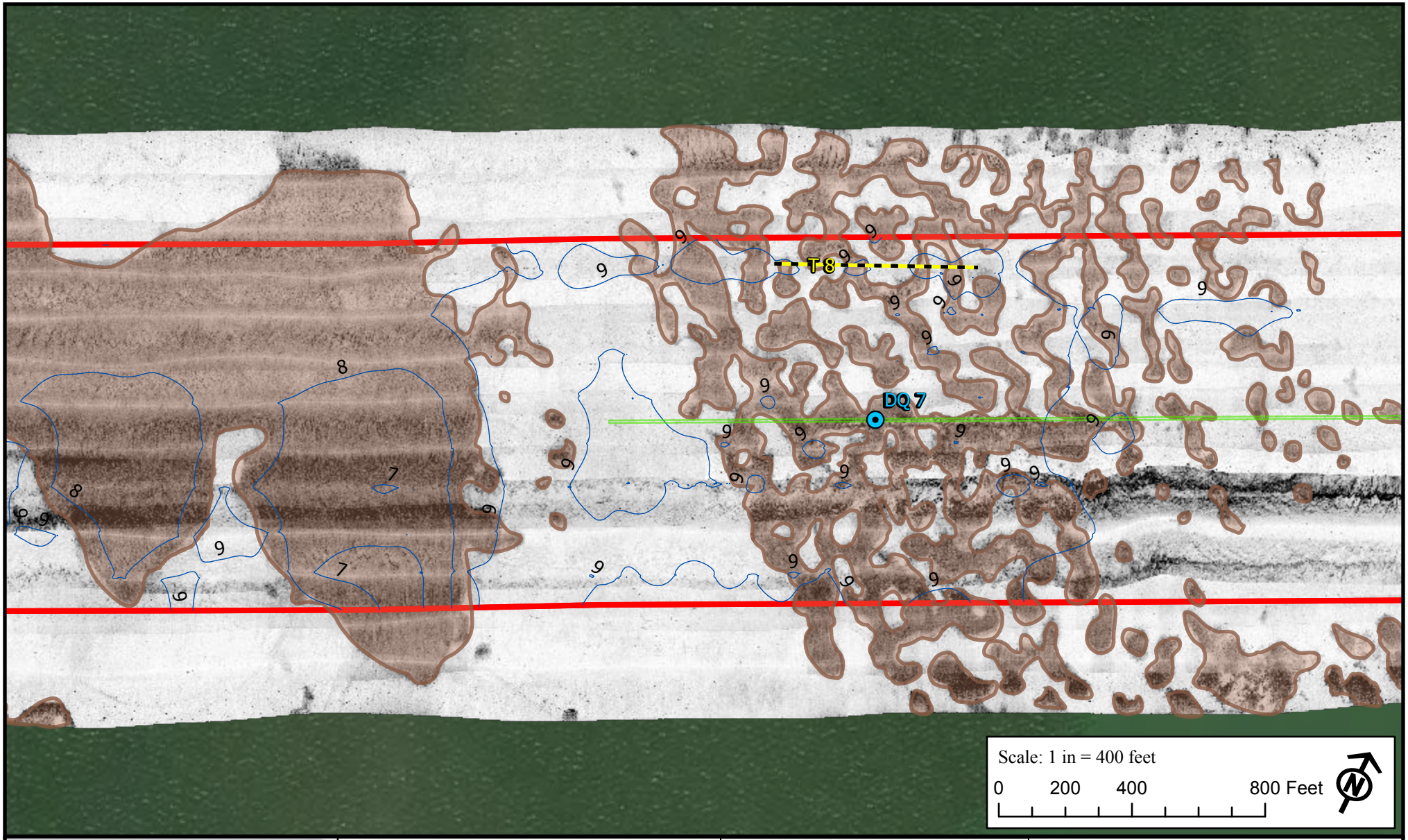
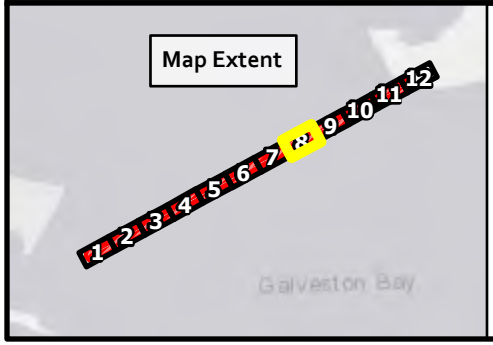
Drawn by: G. Busch	Map Date: 10/23/2019
Projection: NAD83 State Plane TX South Central	





Legend

- Survey Corridor
- Oyster Reef
- 1.0-ft Depth Contour*
- Diver Quadrat (DQ) Sample
- Dredge Tow Path
- Protection Mat Areas
- Oyster Leases

**Bathymetric corrections were performed with preliminary NOAA Water Level data. Contours were generated by interpolation of point measurements, and should not be used for engineering purposes.*

Prepared for:

Florida Gas Transmission Company, LLC.

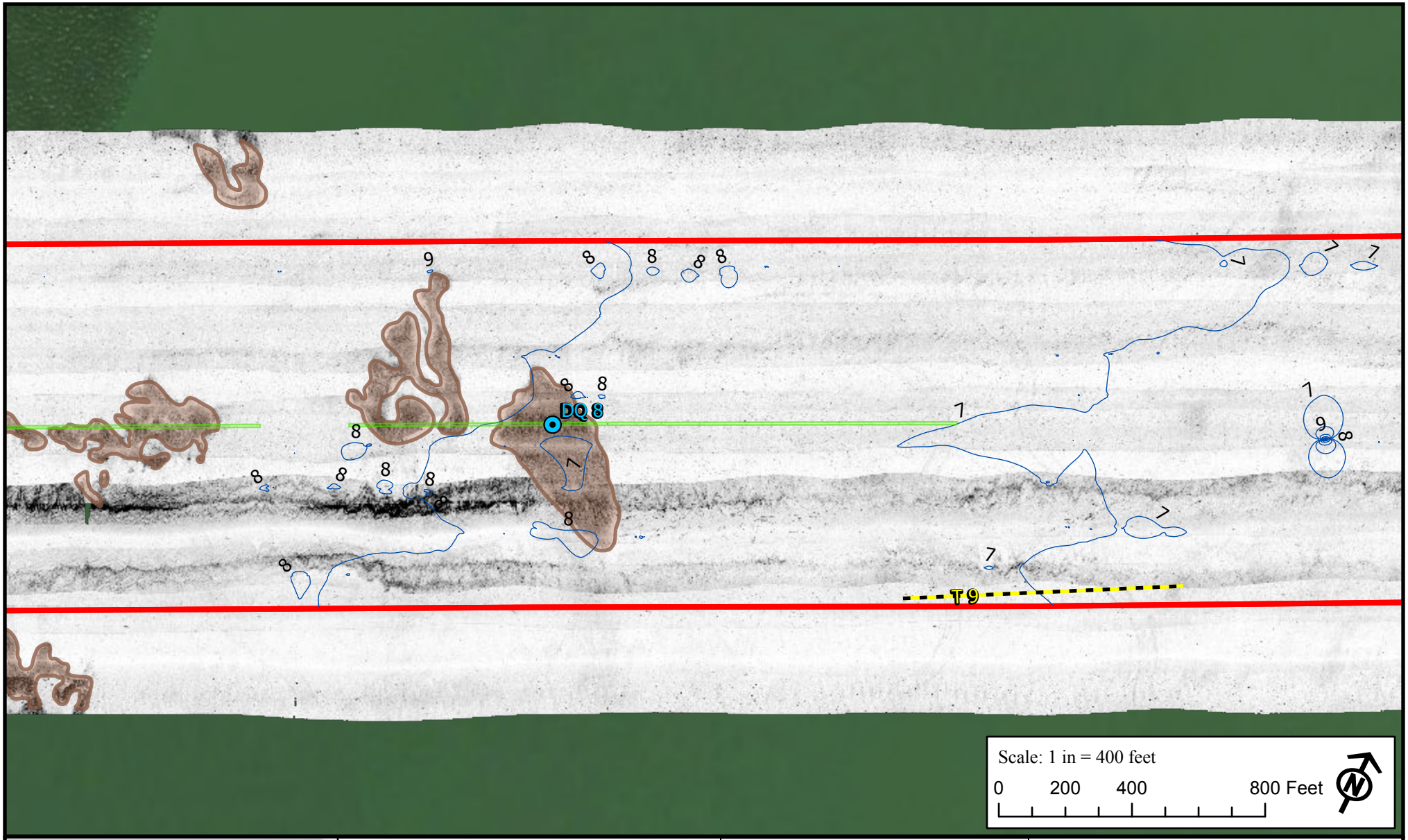
Prepared by:

BIO-WEST

Figure 3.8
Marine Natural Resources Map
Sheet 8 of 12

Galveston and Chambers Counties, Texas

Proposed Mat Placement - 24-inch Florida Gas Transmission Line, Galveston and Chambers Counties, Texas	
Project No: 2658	Source: ESRI World Imagery
Drawn by: G. Busch	Map Date: 10/23/2019
Projection: NAD83 State Plane TX South Central	



Map Extent

1 2 3 4 5 6 7 8 9 10 11 12

Galveston Bay

Legend

- Survey Corridor
- Oyster Reef
- 1.0-ft Depth Contour*
- Diver Quadrat (DQ) Sample
- Dredge Tow Path
- Protection Mat Areas
- Oyster Leases

**Bathymetric corrections were performed with preliminary NOAA Water Level data. Contours were generated by interpolation of point measurements, and should not be used for engineering purposes.*

Prepared for:

Florida Gas Transmission Company, LLC.

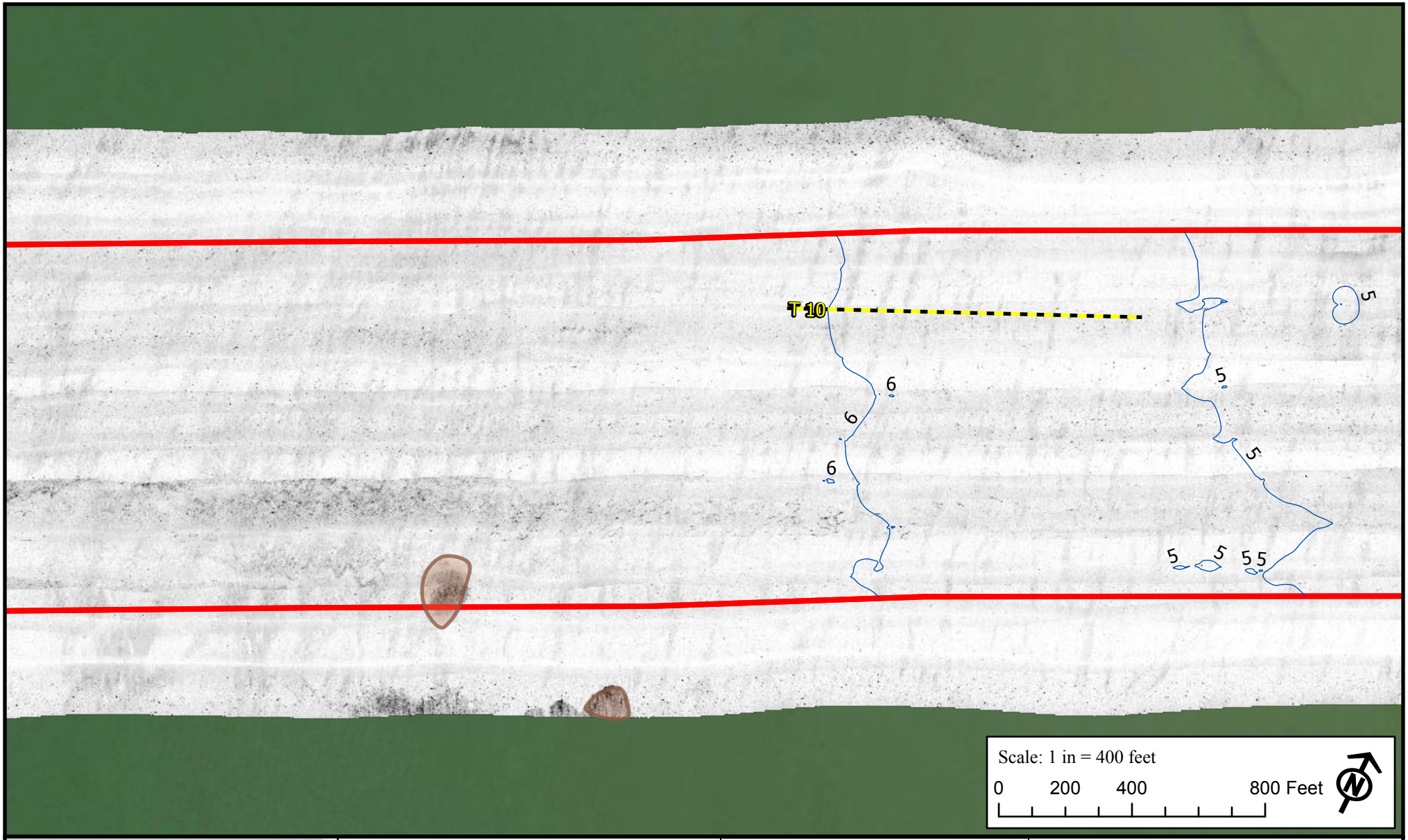
Prepared by:

BIO-WEST

Figure 3.9
Marine Natural Resources Map
Sheet 9 of 12

Galveston and Chambers Counties, Texas

Proposed Mat Placement - 24-inch Florida Gas Transmission Line, Galveston and Chambers Counties, Texas	
Project No: 2658	Source: ESRI World Imagery
Drawn by: G. Busch	Map Date: 10/23/2019
Projection: NAD83 State Plane TX South Central	



Map Extent

Galveston Bay

Legend

- Survey Corridor
- Oyster Reef
- 1.0-ft Depth Contour*
- Dredge Tow Path
- Protection Mat Areas
- Oyster Leases

**Bathymetric corrections were performed with preliminary NOAA Water Level data. Contours were generated by interpolation of point measurements, and should not be used for engineering purposes.*

Prepared for:

Florida Gas Transmission Company, LLC.

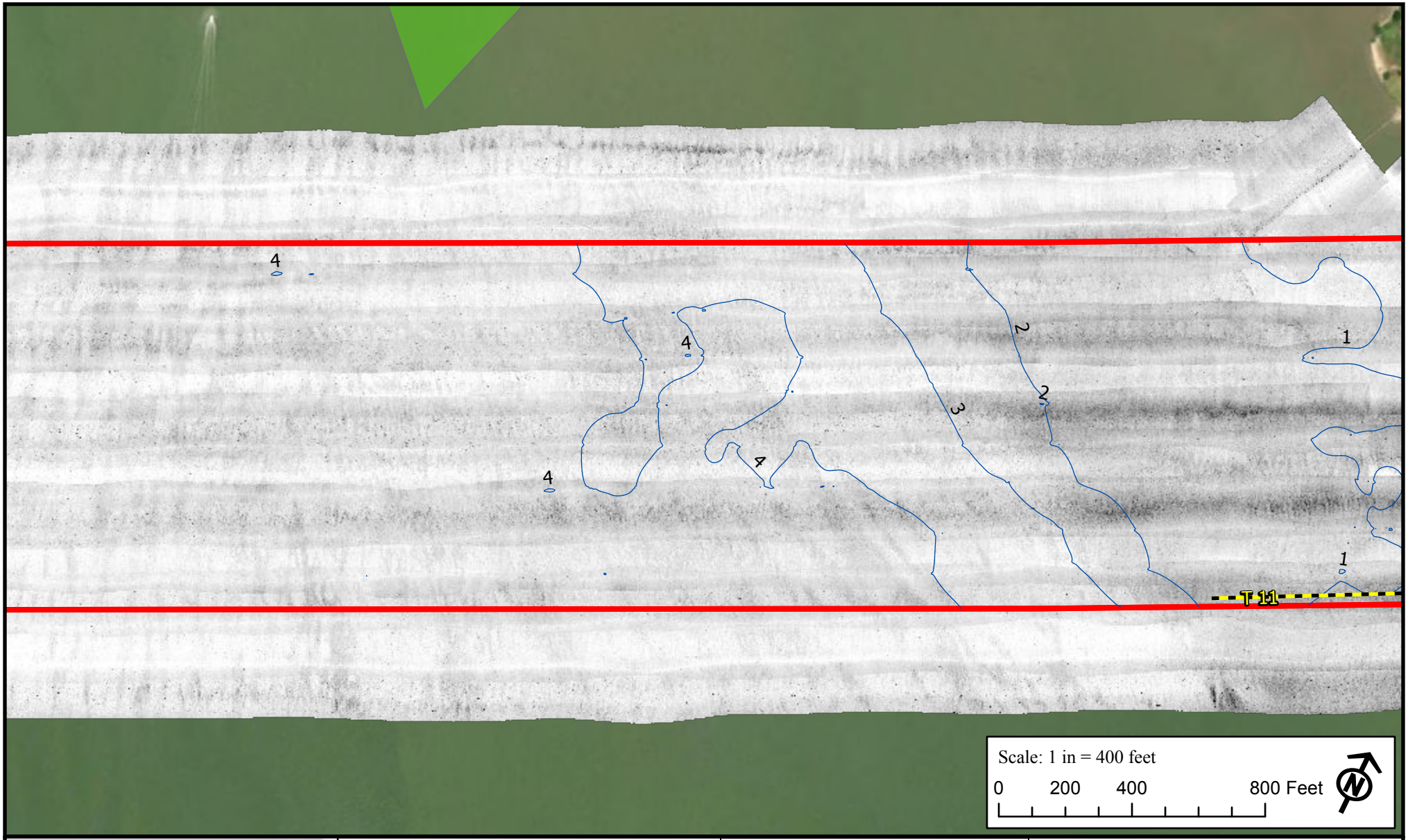
Prepared by:

BIO-WEST

Figure 3.10
Marine Natural Resources Map
Sheet 10 of 12

Galveston and Chambers Counties, Texas

Proposed Mat Placement - 24-inch Florida Gas Transmission Line, Galveston and Chambers Counties, Texas	
Project No: 2658	Source: ESRI World Imagery
Drawn by: G. Busch	Map Date: 10/23/2019
Projection: NAD83 State Plane TX South Central	



Legend

- Survey Corridor
- 1.0-ft Depth Contour*
- Dredge Tow Path
- Protection Mat Areas
- Oyster Leases

ETC_Galveston_Bay
RGB
Red: Band_1

**Bathymetric corrections were performed with preliminary NOAA Water Level data. Contours were generated by interpolation of point measurements, and should not be used for engineering purposes.*

Prepared for:

Florida Gas Transmission Company, LLC.

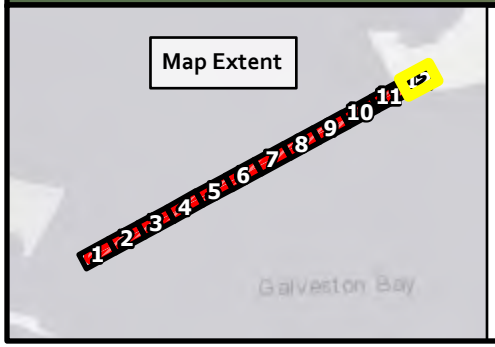
Prepared by:

BIO-WEST

Figure 3.11
Marine Natural Resources Map
Sheet 11 of 12

Galveston and Chambers Counties, Texas

Proposed Mat Placement - 24-inch Florida Gas Transmission Line, Galveston and Chambers Counties, Texas	
Project No: 2658	Source: ESRI World Imagery
Drawn by: G. Busch	Map Date: 10/23/2019
Projection: NAD83 State Plane TX South Central	



Legend

- Survey Corridor
- 1.0-ft Depth Contour*
- Dredge Tow Path
- Protection Mat Areas
- Oyster Leases

ETC_Galveston_Bay
RGB
Red: Band_1

**Bathymetric corrections were performed with preliminary NOAA Water Level data. Contours were generated by interpolation of point measurements, and should not be used for engineering purposes.*

Prepared for:

Florida Gas Transmission Company, LLC.

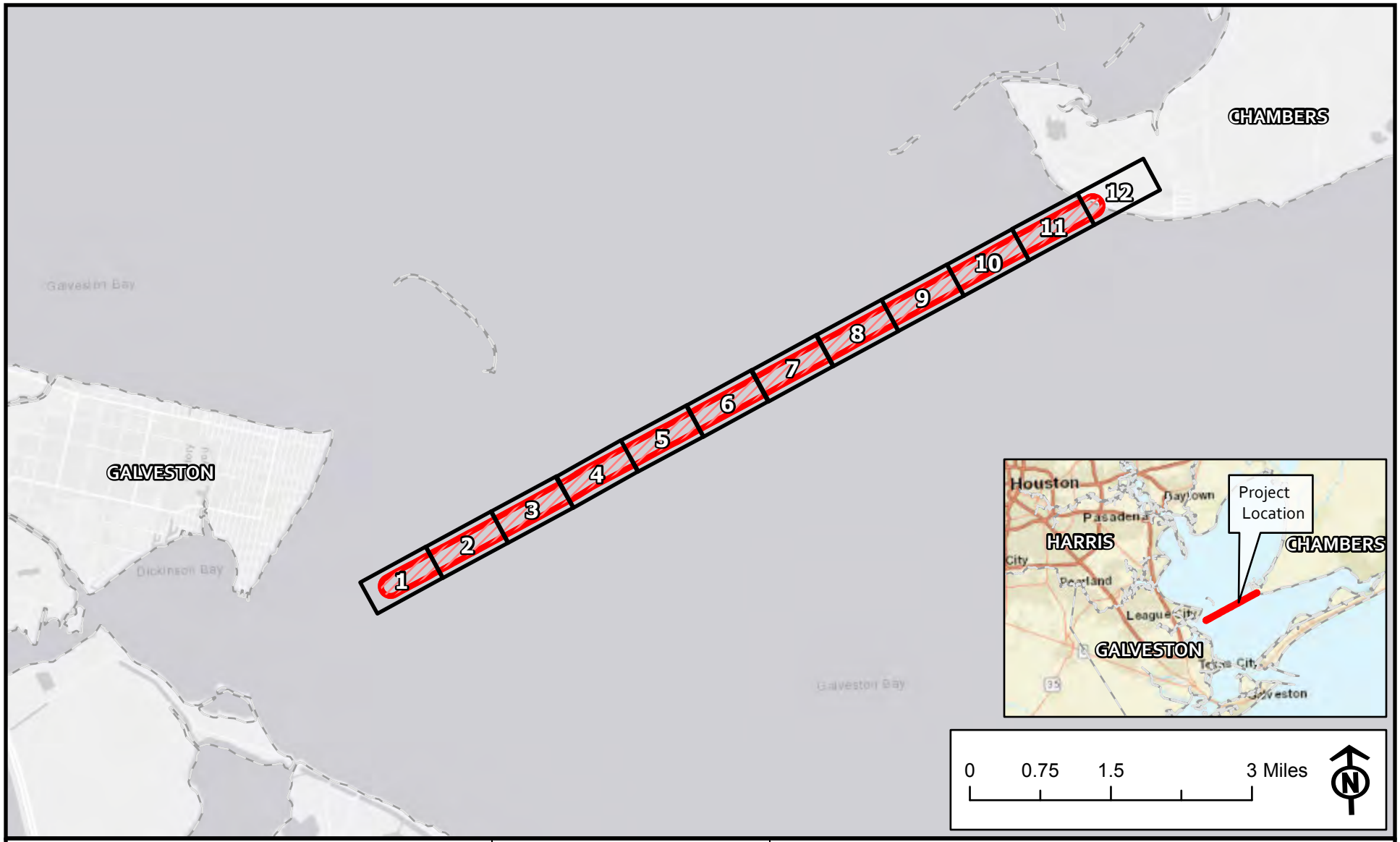
Prepared by:

BIO-WEST

Figure 3.12
Marine Natural Resources Map
Sheet 12 of 12

Galveston and Chambers Counties, Texas

Proposed Mat Placement - 24-inch Florida Gas Transmission Line, Galveston and Chambers Counties, Texas	
Project No: 2658	Source: ESRI World Imagery
Drawn by: G. Busch	Map Date: 10/23/2019
Projection: NAD83 State Plane TX South Central	



Legend

- Survey Corridor
- County Boundary
- Map Sheet Index

Prepared for:

Florida Gas Transmission Company, LLC.

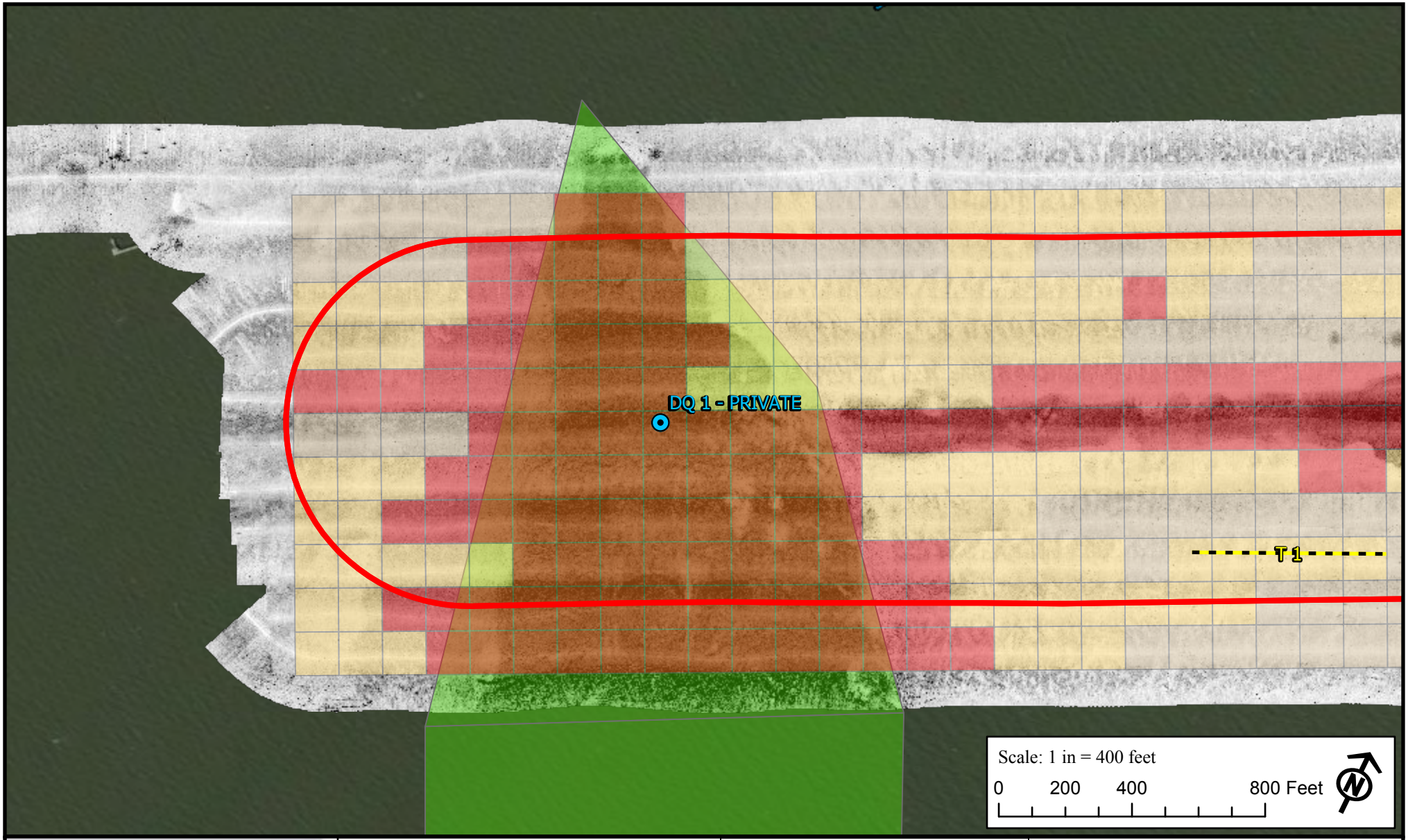
Prepared by:

BIO-WEST

Figure 4.0 - Bottom Characterization Map Sheep Index

Proposed Mat Placement - 24-inch Florida Gas Transmission Line Galveston and Chambers Counties, Texas

Project No: 2658	Drawn by: G.B.	Map Date: 10/23/2019	Scale: 1 in = 1.5 miles
Projection: NAD83 State Plane TX South Central		Source: ESRI World Light Gray Canvas Base	



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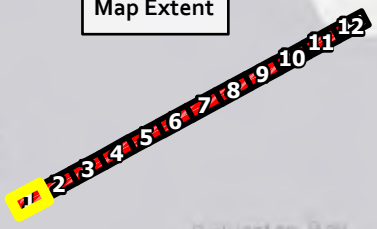


Legend

- Diver Quadrat (DQ) Sample
- Dredge Tow Path
- Survey Corridor
- Oyster Leases

Bottom Type

- Not Sampled
- Soft Mud
- Firm Mud
- Reef/Oysters

Prepared for:

Florida Gas Transmission Company, LLC.

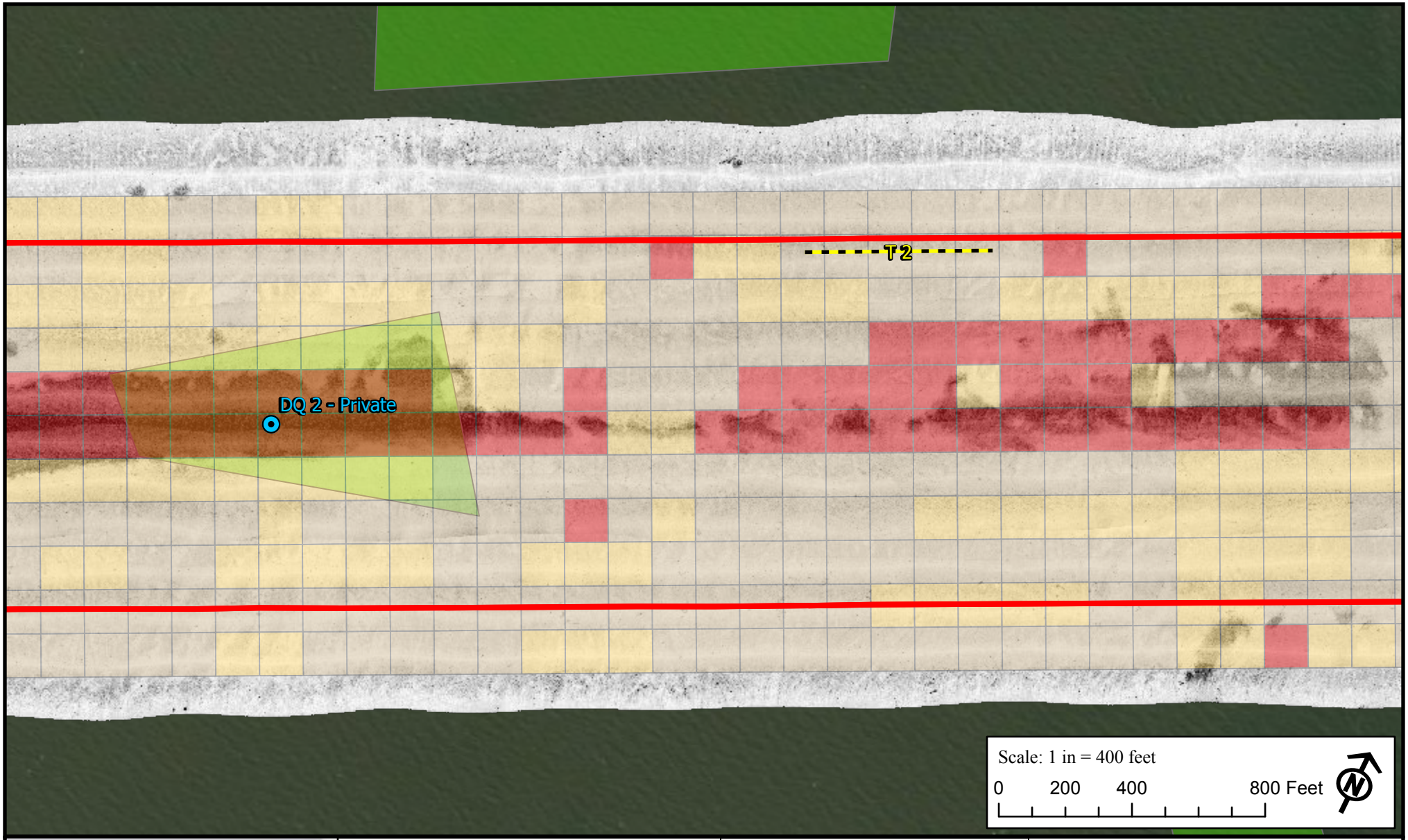
Prepared by:

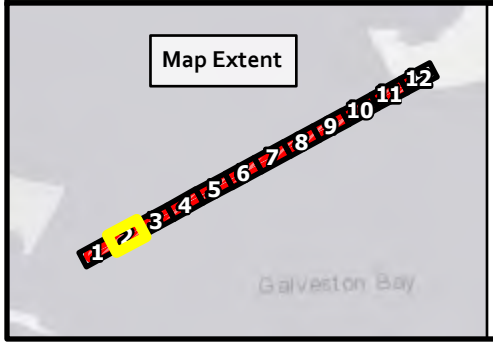
BIO-WEST

Figure 4.1
Bottom Characterization Map
Sheet 1 of 12

Galveston and Chambers Counties, Texas

Proposed Mat Placement - 24-inch Florida Gas Transmission Line, Galveston and Chambers Counties, Texas	
Project No: 2658	Source: ESRI World Imagery
Drawn by: G. Busch	Map Date: 10/23/2019
Projection: NAD83 State Plane TX South Central	





Legend

- Diver Quadrat (DQ) Sample
- Dredge Tow Path
- Survey Corridor
- Oyster Leases

Bottom Type

- Not Sampled
- Soft Mud
- Firm Mud
- Reef/Oysters

Prepared for:

Florida Gas Transmission Company, LLC.

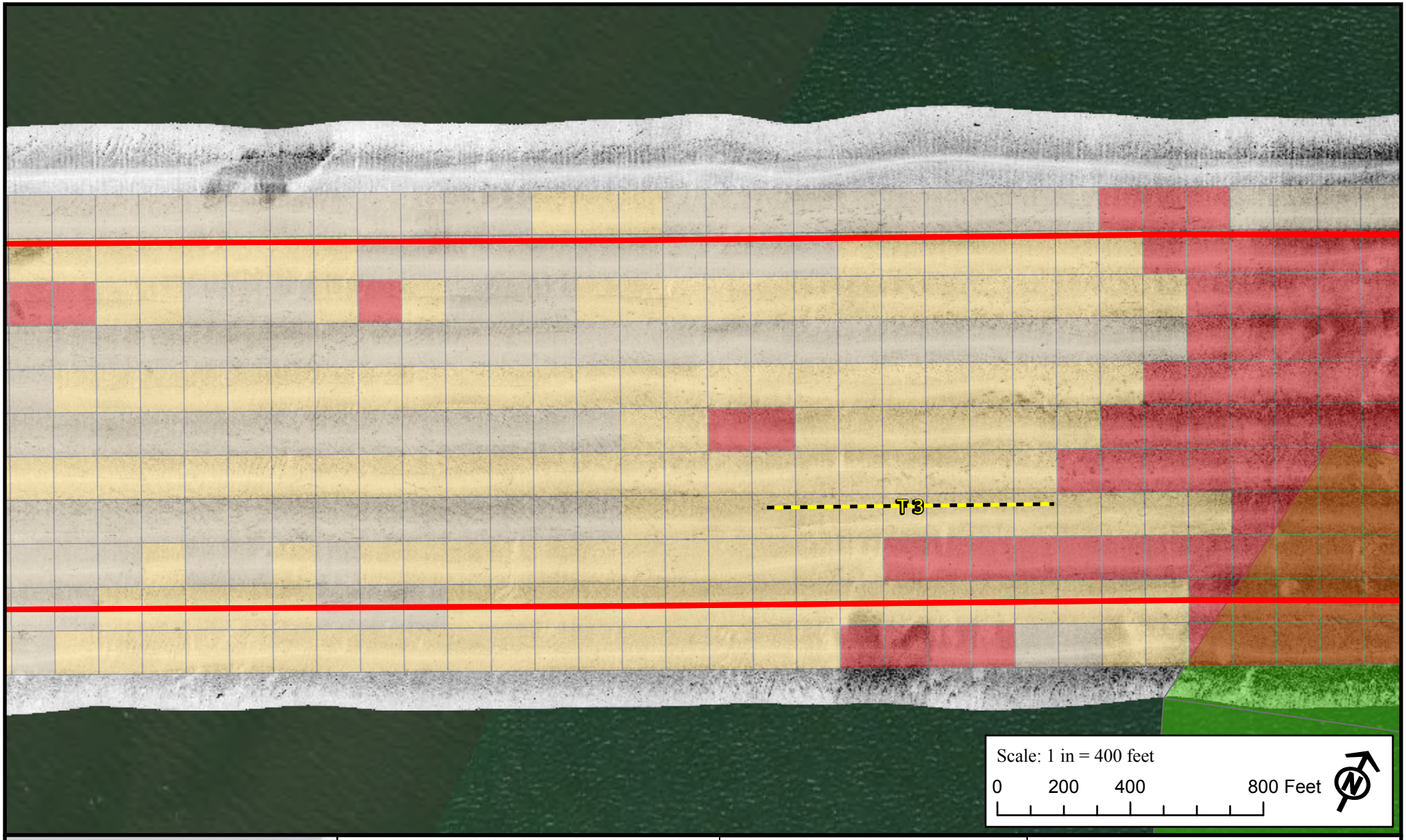
Prepared by:

BIO-WEST

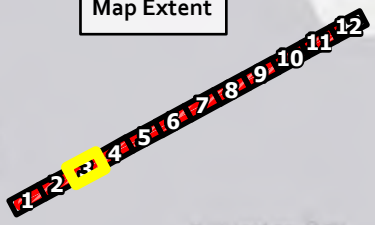
Figure 4.2
Bottom Characterization Map
Sheet 2 of 12

Galveston and Chambers Counties, Texas

Proposed Mat Placement - 24-inch Florida Gas Transmission Line, Galveston and Chambers Counties, Texas	
Project No: 2658	Source: ESRI World Imagery
Drawn by: G. Busch	Map Date: 10/23/2019
Projection: NAD83 State Plane TX South Central	



Map Extent



Legend

- Diver Quadrat (DQ) Sample
- Dredge Tow Path
- Survey Corridor
- Oyster Leases

Bottom Type

- Not Sampled
- Soft Mud
- Firm Mud
- Reef/Oysters

Prepared for:

Florida Gas Transmission Company, LLC.

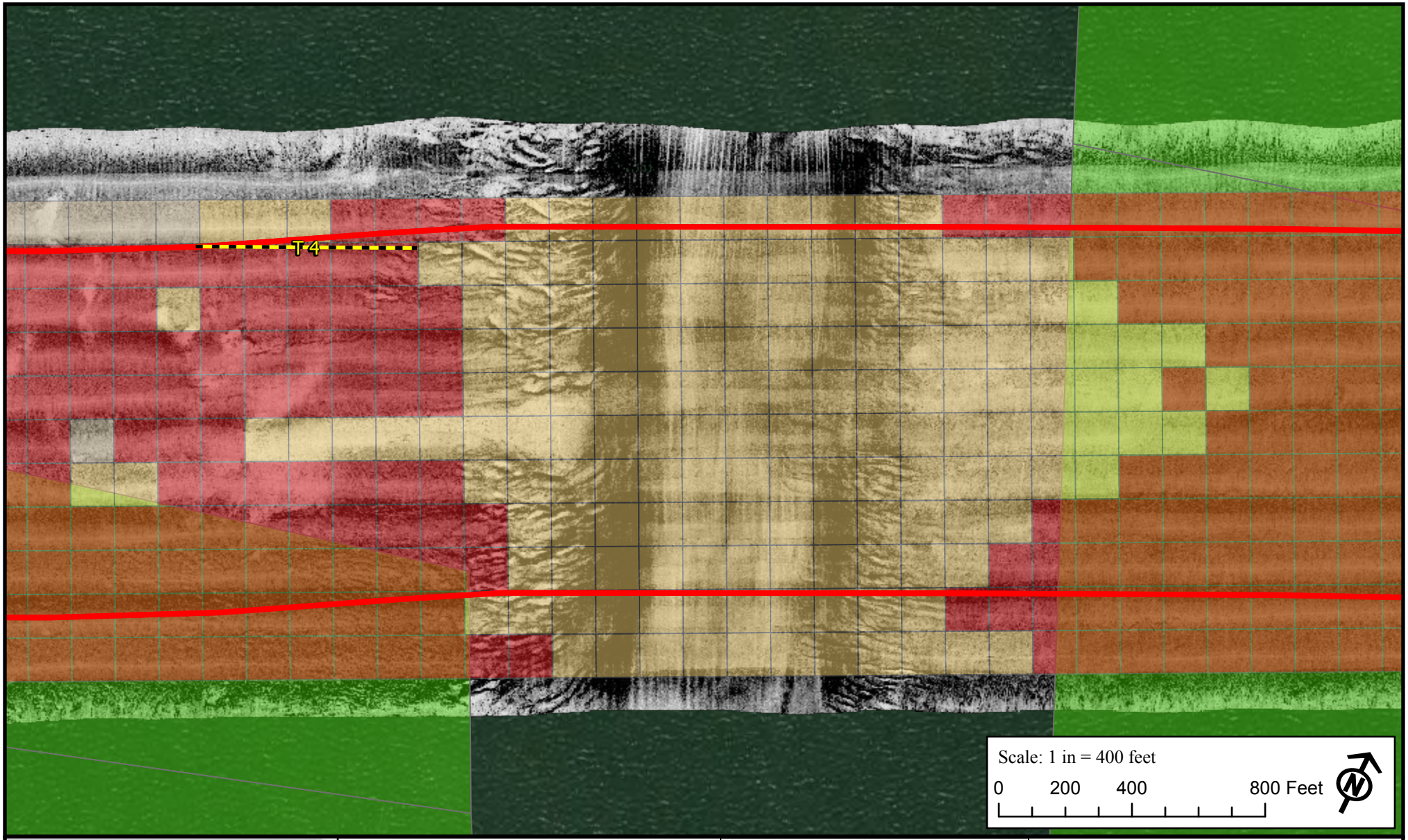
Prepared by:

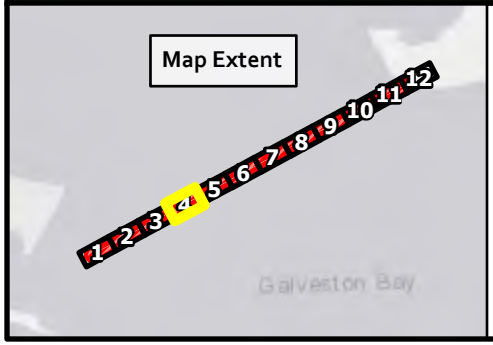
BIO-WEST

Figure 4.3
Bottom Characterization Map
Sheet 3 of 12

Galveston and Chambers Counties, Texas

Proposed Mat Placement - 24-inch Florida Gas Transmission Line, Galveston and Chambers Counties, Texas	
Project No: 2658	Source: ESRI World Imagery
Drawn by: G. Busch	Map Date: 10/23/2019
Projection: NAD83 State Plane TX South Central	





Legend

- Diver Quadrat (DQ) Sample
- Dredge Tow Path
- Survey Corridor
- Oyster Leases

Bottom Type

- Not Sampled
- Soft Mud
- Firm Mud
- Reef/Oysters

Prepared for:

Florida Gas Transmission Company, LLC.

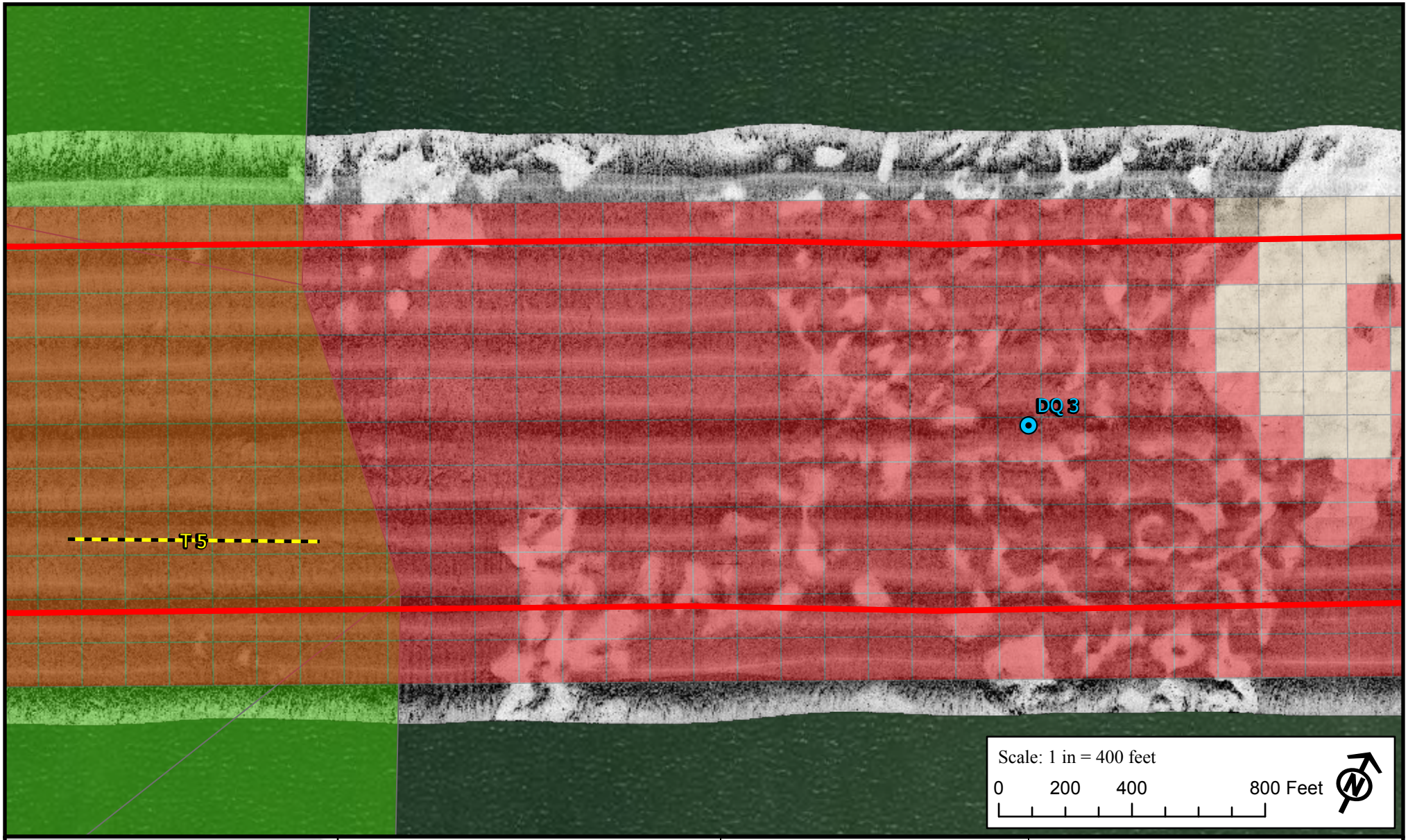
Prepared by:

BIO-WEST

Figure 4.4
Bottom Characterization Map
Sheet 4 of 12

Galveston and Chambers Counties, Texas

Proposed Mat Placement - 24-inch Florida Gas Transmission Line, Galveston and Chambers Counties, Texas	
Project No: 2658	Source: ESRI World Imagery
Drawn by: G. Busch	Map Date: 10/23/2019
Projection: NAD83 State Plane TX South Central	



Legend

- Diver Quadrat (DQ) Sample
- Dredge Tow Path
- Survey Corridor
- Oyster Leases

Bottom Type

- Not Sampled
- Soft Mud
- Firm Mud
- Reef/Oysters

Prepared for:

Florida Gas Transmission Company, LLC.

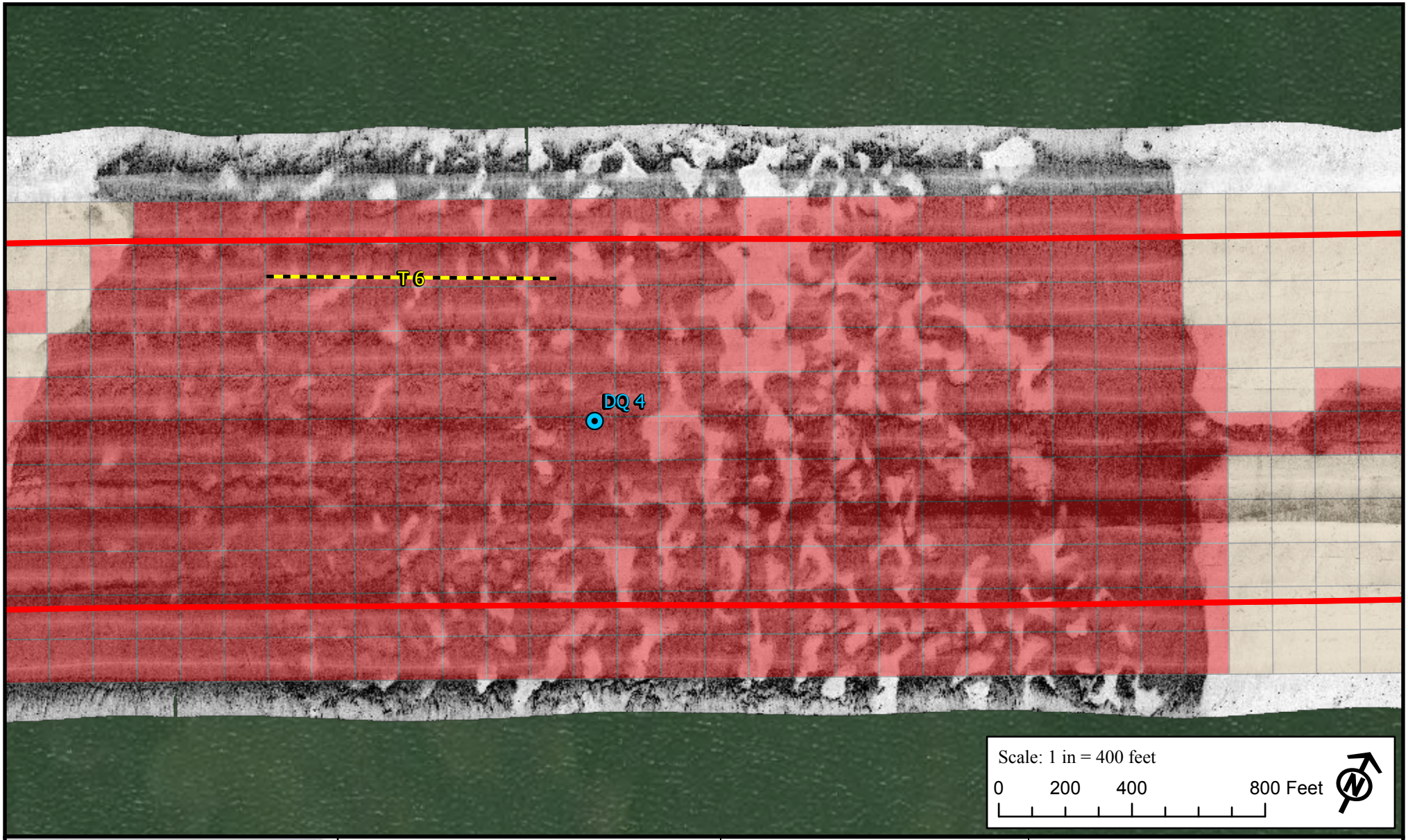
Prepared by:

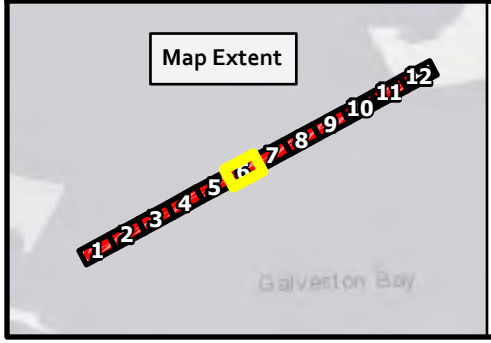
BIO-WEST

Figure 4.5
Bottom Characterization Map
Sheet 5 of 12

Galveston and Chambers Counties, Texas

Proposed Mat Placement - 24-inch Florida Gas Transmission Line, Galveston and Chambers Counties, Texas	
Project No: 2658	Source: ESRI World Imagery
Drawn by: G. Busch	Map Date: 10/23/2019
Projection: NAD83 State Plane TX South Central	





Legend

- Diver Quadrat (DQ) Sample
- Dredge Tow Path
- Survey Corridor
- Oyster Leases

Bottom Type

- Not Sampled
- Soft Mud
- Firm Mud
- Reef/Oysters

Prepared for:

Florida Gas Transmission Company, LLC.

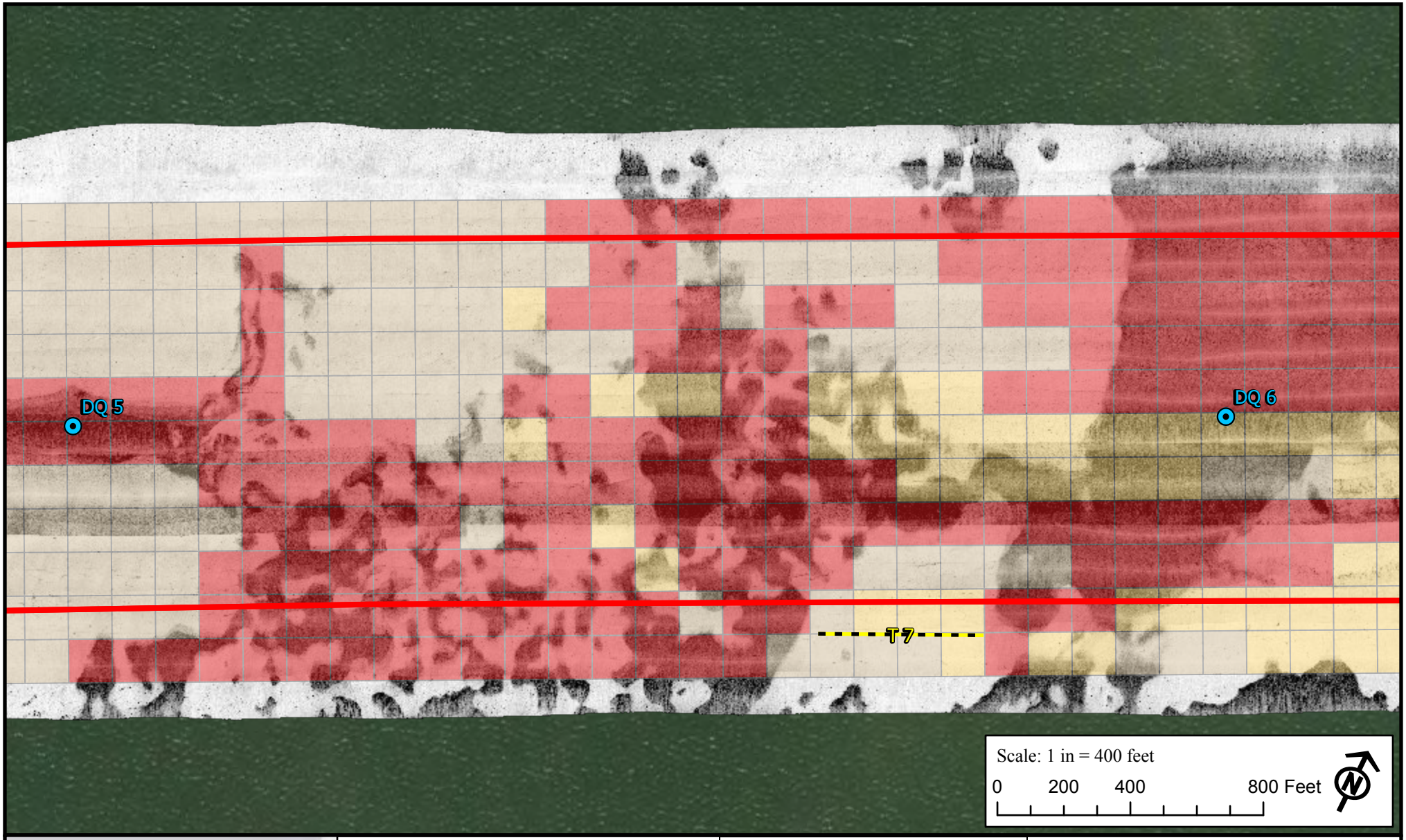
Prepared by:

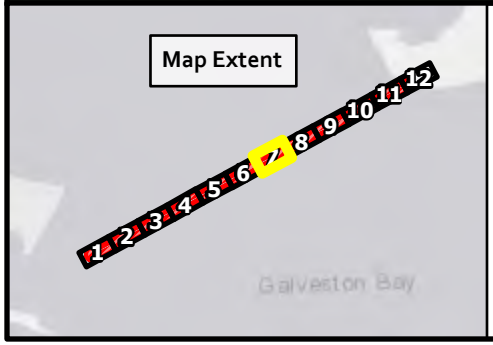
BIO-WEST

Figure 4.6
Bottom Characterization Map
Sheet 6 of 12

Galveston and Chambers Counties, Texas

Proposed Mat Placement - 24-inch Florida Gas Transmission Line, Galveston and Chambers Counties, Texas	
Project No: 2658	Source: ESRI World Imagery
Drawn by: G. Busch	Map Date: 10/23/2019
Projection: NAD83 State Plane TX South Central	





Legend

- Diver Quadrat (DQ) Sample
- Dredge Tow Path
- Survey Corridor
- Oyster Leases

Bottom Type

- Not Sampled
- Soft Mud
- Firm Mud
- Reef/Oysters

Prepared for:

Florida Gas Transmission Company, LLC.

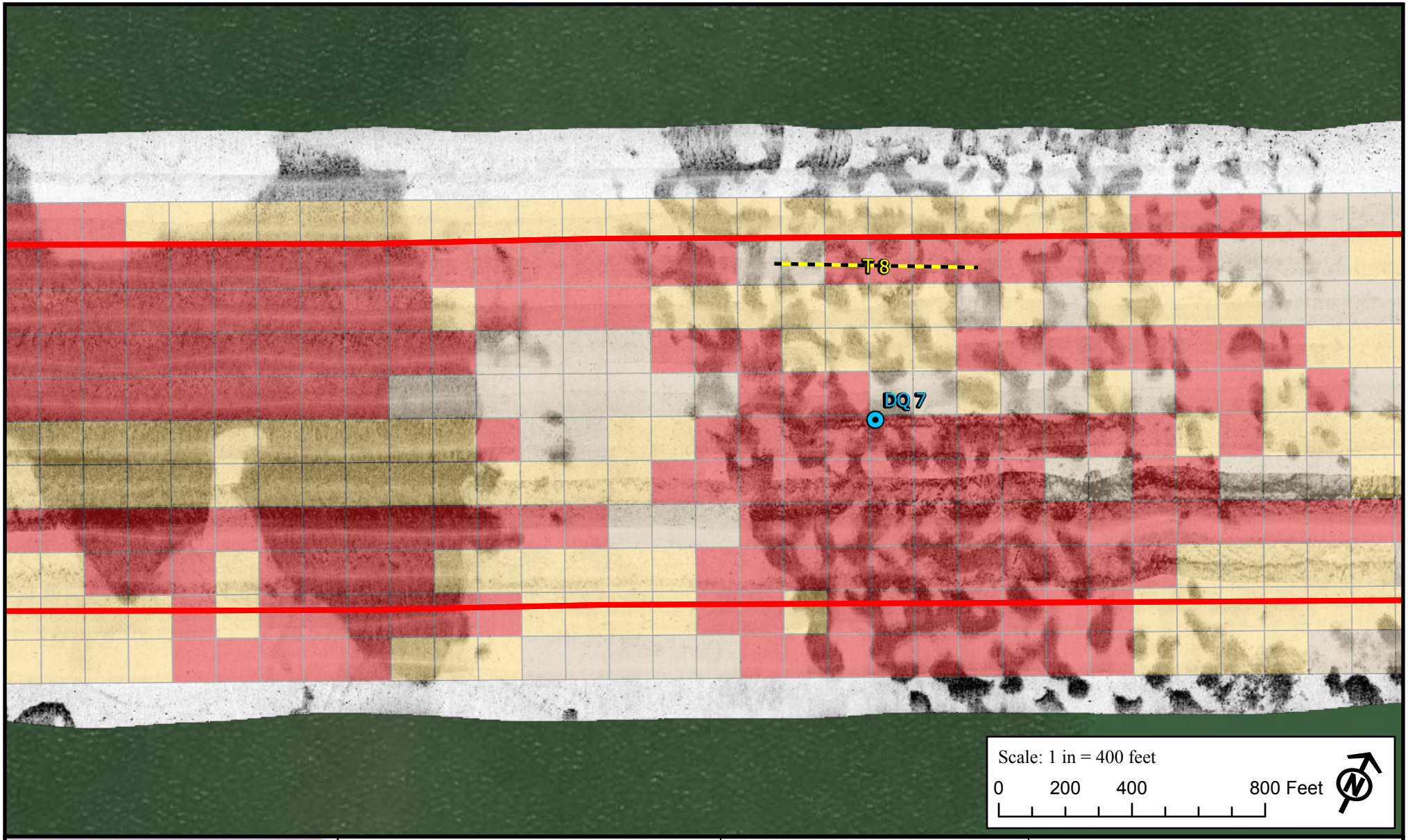
Prepared by:

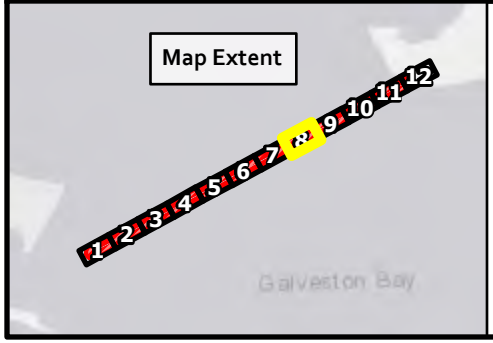
BIO-WEST

Figure 4.7
Bottom Characterization Map
Sheet 7 of 12

Galveston and Chambers Counties, Texas

Proposed Mat Placement - 24-inch Florida Gas Transmission Line, Galveston and Chambers Counties, Texas	
Project No: 2658	Source: ESRI World Imagery
Drawn by: G. Busch	Map Date: 10/23/2019
Projection: NAD83 State Plane TX South Central	





Legend

- Diver Quadrat (DQ) Sample
- Dredge Tow Path
- Survey Corridor
- Oyster Leases

Bottom Type

- Not Sampled
- Soft Mud
- Firm Mud
- Reef/Oysters

Prepared for:

Florida Gas Transmission Company, LLC.

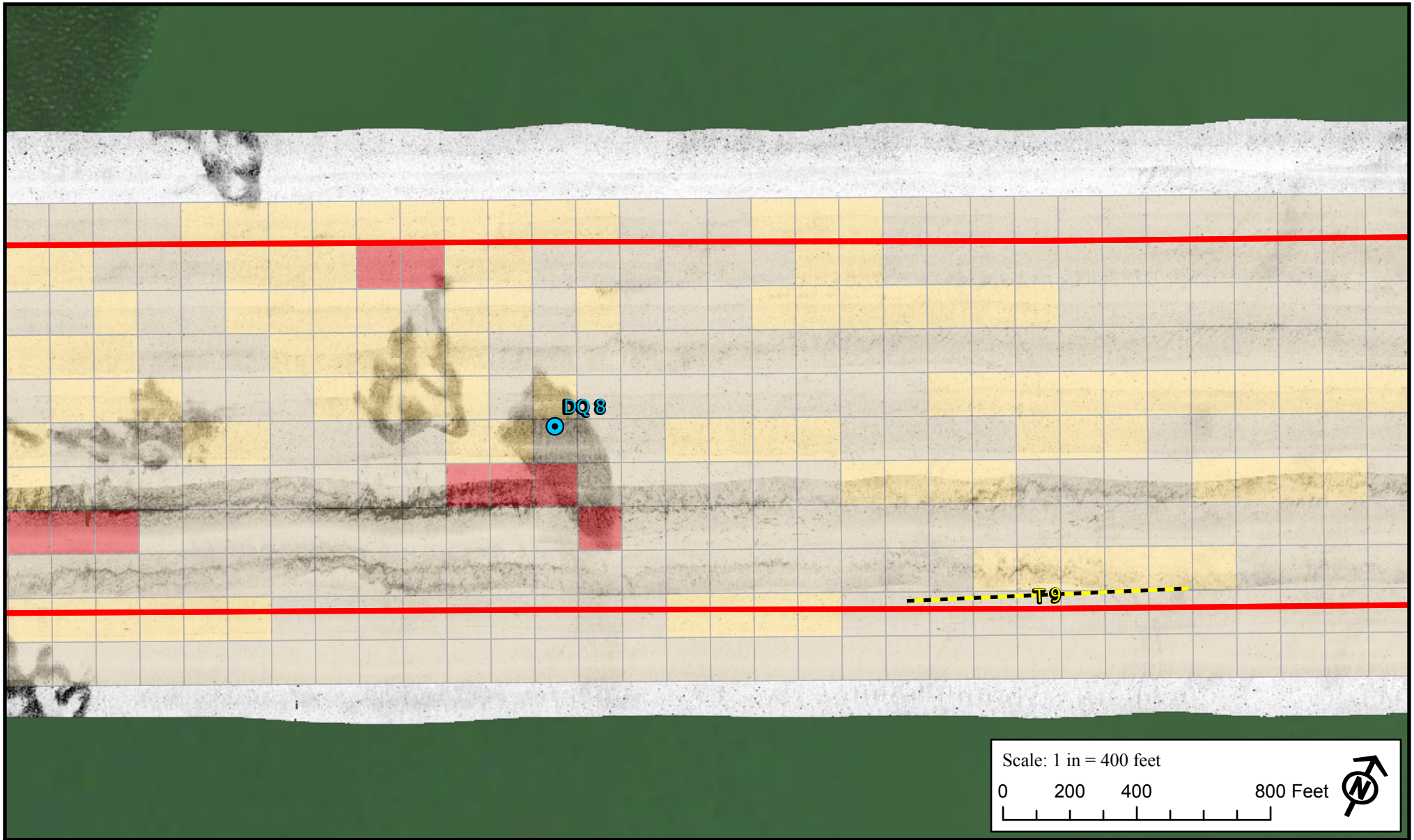
Prepared by:

BIO-WEST

Figure 4.8
Bottom Characterization Map
Sheet 8 of 12

Galveston and Chambers Counties, Texas

Proposed Mat Placement - 24-inch Florida Gas Transmission Line, Galveston and Chambers Counties, Texas	
Project No: 2658	Source: ESRI World Imagery
Drawn by: G. Busch	Map Date: 10/23/2019
Projection: NAD83 State Plane TX South Central	



Legend

- Diver Quadrat (DQ) Sample
- Dredge Tow Path
- Survey Corridor
- Oyster Leases

Bottom Type

- Not Sampled
- Soft Mud
- Firm Mud
- Reef/Oysters

Prepared for:

Florida Gas Transmission Company, LLC.

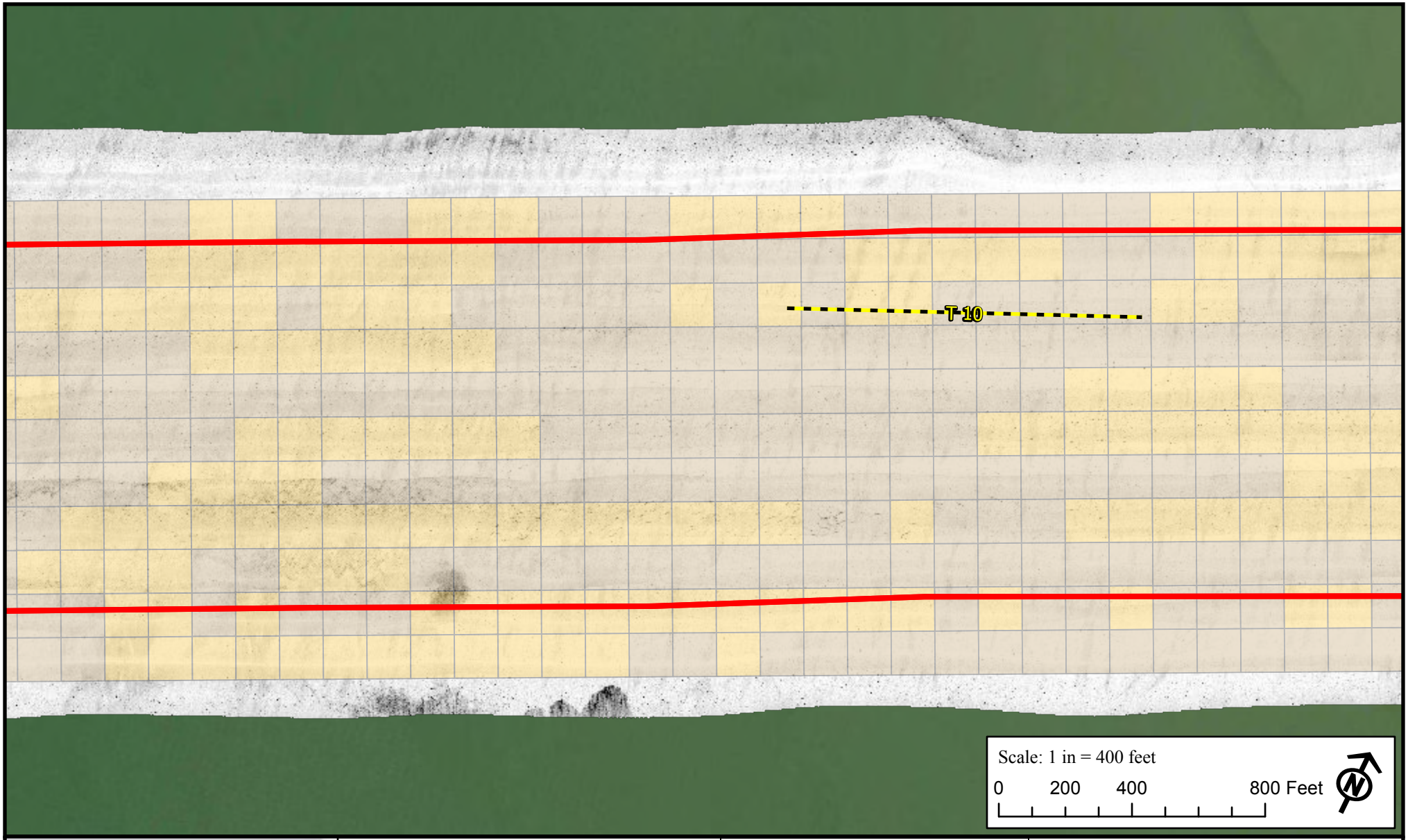
Prepared by:

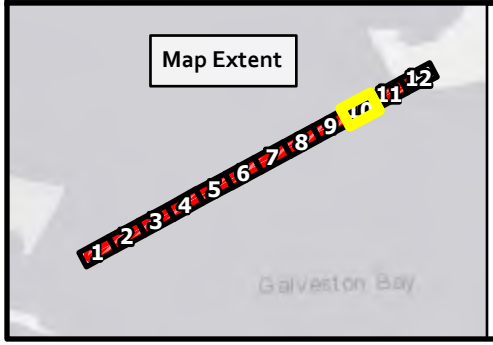
BIO-WEST

Figure 4.9
Bottom Characterization Map
Sheet 9 of 12

Galveston and Chambers Counties, Texas

Proposed Mat Placement - 24-inch Florida Gas Transmission Line, Galveston and Chambers Counties, Texas	
Project No: 2658	Source: ESRI World Imagery
Drawn by: G. Busch	Map Date: 10/23/2019
Projection: NAD83 State Plane TX South Central	





Legend

- Diver Quadrat (DQ) Sample
- Dredge Tow Path
- Survey Corridor
- Oyster Leases

Bottom Type

- Not Sampled
- Soft Mud
- Firm Mud
- Reef/Oysters

Prepared for:

Florida Gas Transmission Company, LLC.

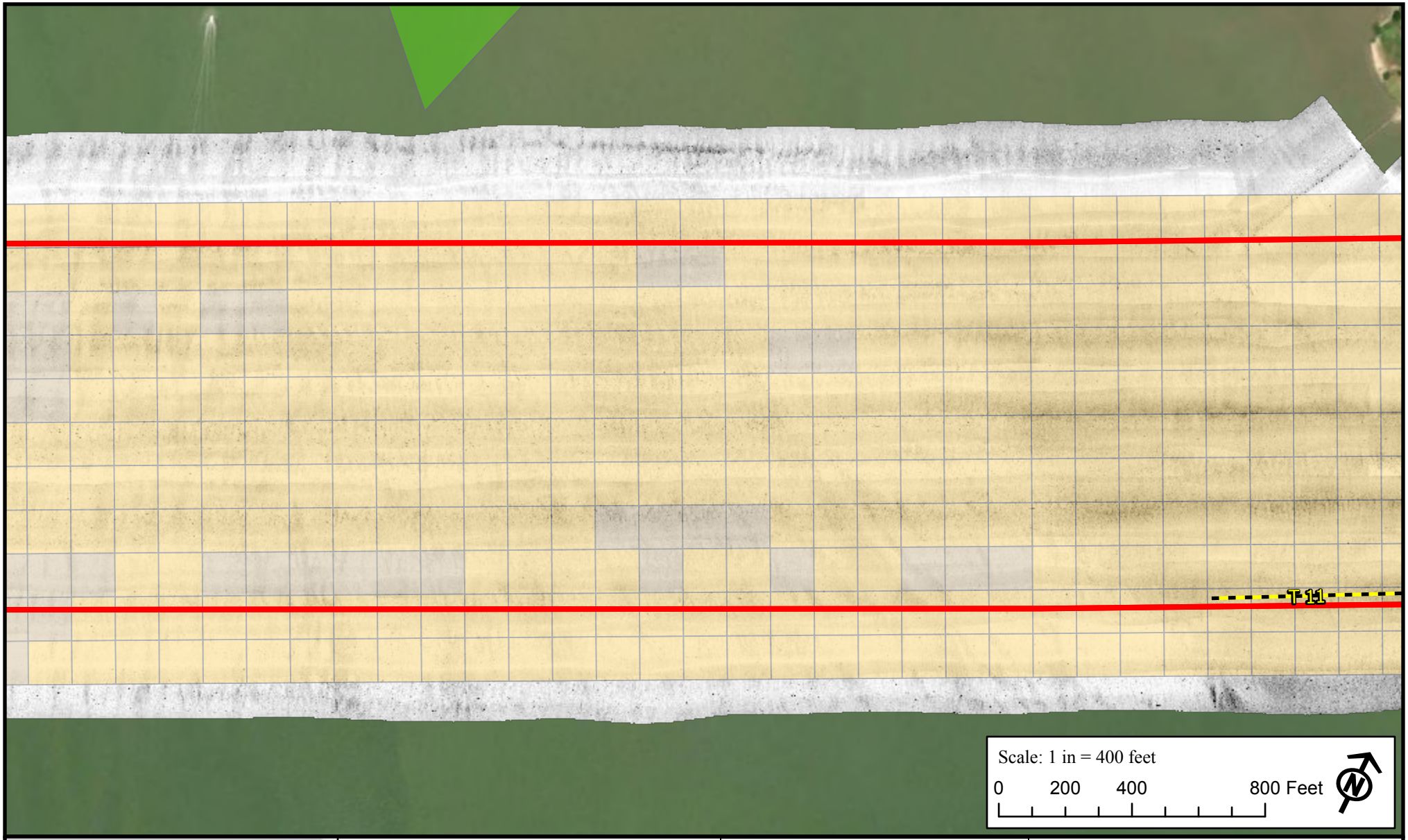
Prepared by:

BIO-WEST

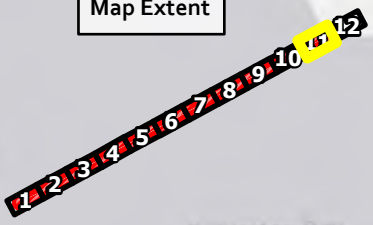
Figure 4.10
Bottom Characterization Map
Sheet 10 of 12

Galveston and Chambers Counties, Texas

Proposed Mat Placement - 24-inch Florida Gas Transmission Line, Galveston and Chambers Counties, Texas	
Project No: 2658	Source: ESRI World Imagery
Drawn by: G. Busch	Map Date: 10/23/2019
Projection: NAD83 State Plane TX South Central	



Map Extent



Legend

- Diver Quadrat (DQ) Sample
- Dredge Tow Path
- Survey Corridor
- Oyster Leases

Bottom Type

- Not Sampled
- Soft Mud
- Firm Mud
- Reef/Oysters

Prepared for:

Florida Gas Transmission Company, LLC.

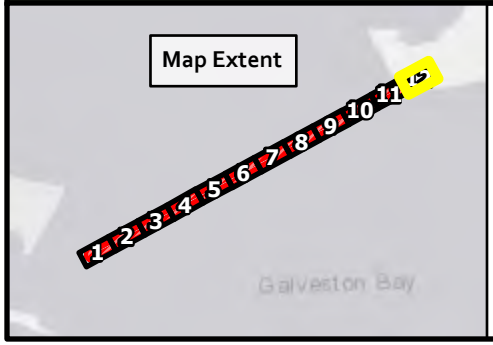
Prepared by:

BIO-WEST

Figure 4.11
Bottom Characterization Map
Sheet 11 of 12

Galveston and Chambers Counties, Texas

Proposed Mat Placement - 24-inch Florida Gas Transmission Line, Galveston and Chambers Counties, Texas	
Project No: 2658	Source: ESRI World Imagery
Drawn by: G. Busch	Map Date: 10/23/2019
Projection: NAD83 State Plane TX South Central	



Legend

- Diver Quadrat (DQ) Sample
- Dredge Tow Path
- Survey Corridor
- Oyster Leases

Bottom Type

- Not Sampled
- Soft Mud
- Firm Mud
- Reef/Oysters

Prepared for:

Florida Gas Transmission Company, LLC.

Prepared by:

BIO-WEST

Figure 4.12
Bottom Characterization Map
Sheet 12 of 12

Galveston and Chambers Counties, Texas

Proposed Mat Placement - 24-inch Florida Gas Transmission Line, Galveston and Chambers Counties, Texas	
Project No: 2658	Source: ESRI World Imagery
Drawn by: G. Busch	Map Date: 10/23/2019
Projection: NAD83 State Plane TX South Central	

Appendix B

Photograph Log of Field Surveys

Photo 1: Dredge Tow #01 – pre-rinse.

Photo 2: Dredge Tow #01 – post-rinse.

OYSTER REEF SURVEYS
PROPOSED MAT PLACEMENT ON THE 24-INCH PIPELINE
Galveston and Chambers County, Texas

Project No: 2658	BIO-WEST 1018 Frost Street, Rosenberg, Texas 77471
Photo Date: 10/22/19	

Photo 3: Dredge Tow #02 – pre-rinse.

Photo 4: Dredge Tow #02 – post-rinse.

OYSTER REEF SURVEYS
PROPOSED MAT PLACEMENT ON THE 24-INCH PIPELINE
Galveston and Chambers County, Texas

Project No: 2658	BIO-WEST
Photo Date: 10/22/19	1018 Frost Street, Rosenberg, Texas 77471

Photo 5: Dredge Tow #03 – pre-rinse.

Photo 6: Dredge Tow #03 – post-rinse.

Photo 7: Dredge Tow #04 – pre-rinse.

Photo 8: Dredge Tow #04 – post-rinse.

OYSTER REEF SURVEYS
PROPOSED MAT PLACEMENT ON THE 24-INCH PIPELINE
Galveston and Chambers County, Texas

Project No: 2658	BIO-WEST
Photo Date: 10/22/19	1018 Frost Street, Rosenberg, Texas 77471

Photo 9: Dredge Tow #05 – pre-rinse.

Photo 10: Dredge Tow #05 – post-rinse.

OYSTER REEF SURVEYS
PROPOSED MAT PLACEMENT ON THE 24-INCH PIPELINE
Galveston and Chambers County, Texas

Project No: 2658	BIO-WEST 1018 Frost Street, Rosenberg, Texas 77471
Photo Date: 10/22/19	

Photo 11: Dredge Tow #06 – pre-rinse.

Photo 12: Dredge Tow #06 – post-rinse.

Photo 13: Dredge Tow #07 – pre-rinse.

Photo 14: Dredge Tow #07 – post-rinse.

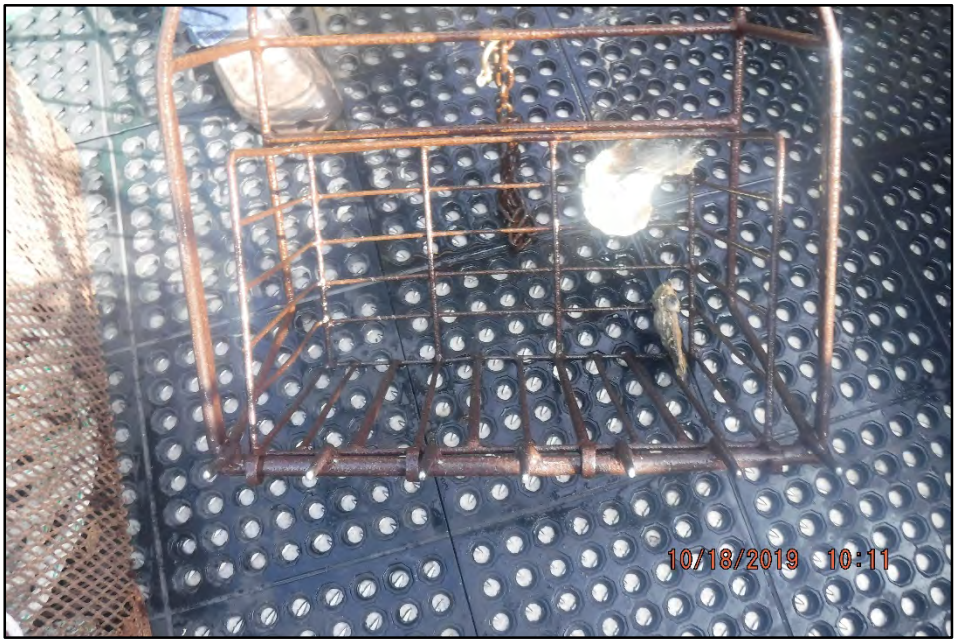


Photo 15: Dredge Tow #08 – pre-rinse.

Photo 16: Dredge Tow #08 – post-rinse.

Photo 17: Dredge Tow #09 – pre-rinse.

Photo 18: Dredge Tow #09 – post-rinse.

Photo 19: Dredge Tow #10 – pre-rinse.

Photo 20: Dredge Tow #10 – post-rinse.

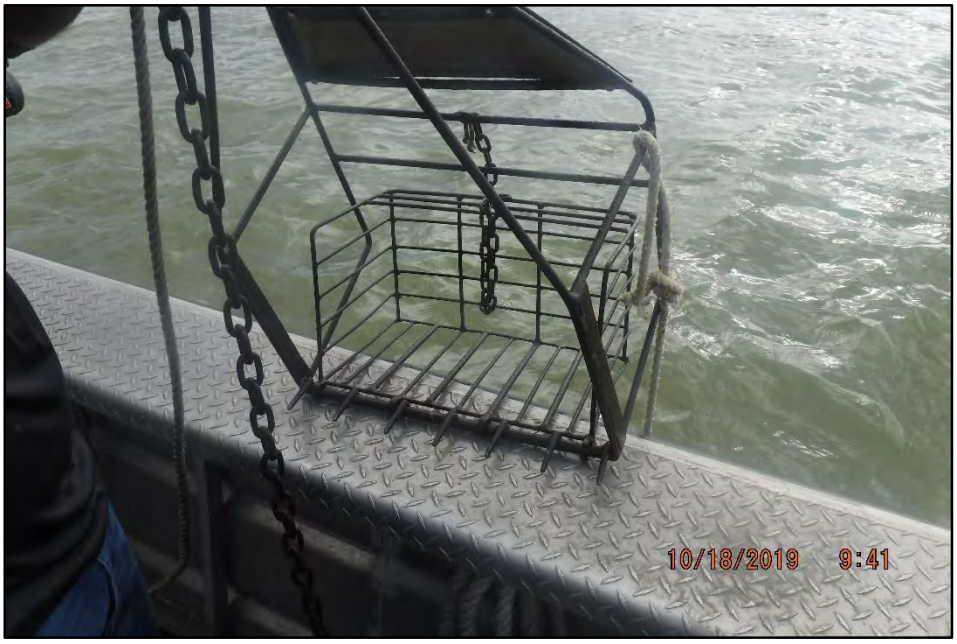


Photo 21: Dredge Tow #11 – pre-rinse.

Photo 22: Dredge Tow #11 – post-rinse.

Photo 25: Diver Quadrat #03 – pre-rinse.

Photo 26: Diver Quadrat #03 – post-rinse.

Photo 27: Diver Quadrat #04 – pre-rinse.

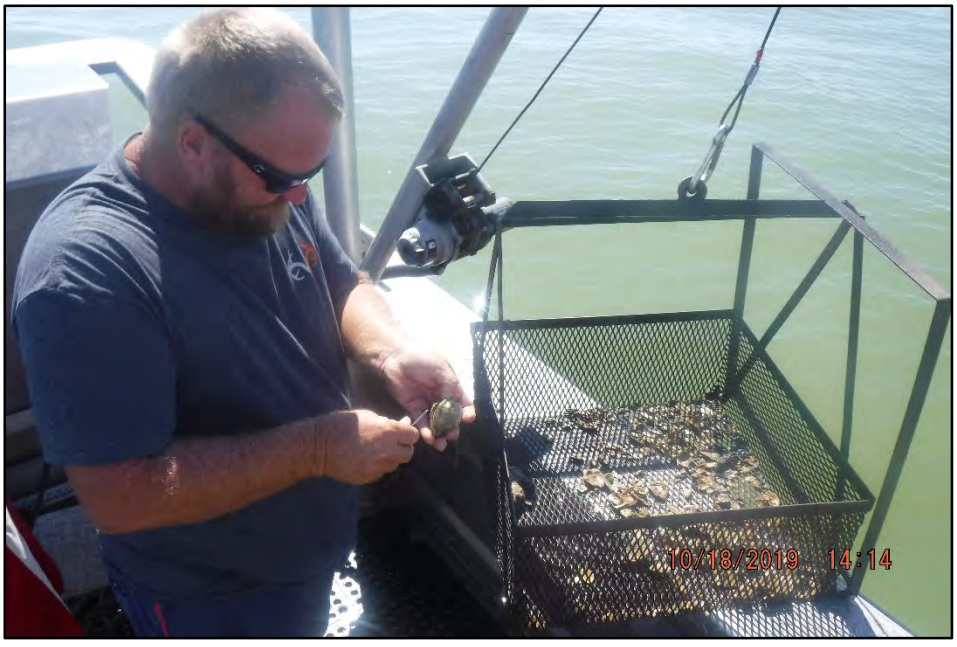


Photo 28: Diver Quadrat #04 – BIO-WEST biologists measuring and classifying individual oysters.

Photo 29: Diver Quadrat #05 – post-rinse.

Photo 30: Diver Quadrat #05 – post-rinse illustrating the shell hash bottom type that was consistent throughout the project corridor.

OYSTER REEF SURVEYS PROPOSED MAT PLACEMENT ON THE 24-INCH PIPELINE Galveston and Chambers County, Texas	
Project No: 2658	BIO-WEST 1018 Frost Street, Rosenberg, Texas 77471
Photo Date: 10/22/19	

Photo 31: Diver Quadrat #06 – post-rinse.

Photo 32: Diver Quadrat #06 – post-rinse illustrating a typical live oyster cluster observed during diver quadrat sampling.

Photo 33: Diver Quadrat #07 – post-rinse.

Photo 34: Diver Quadrat #07 – post-rinse illustrating typical single live oysters observed throughout the project corridor. Individuals such as these were the dominate form of living oyster.

OYSTER REEF SURVEYS PROPOSED MAT PLACEMENT ON THE 24-INCH PIPELINE Galveston and Chambers County, Texas	
Project No: 2658	BIO-WEST 1018 Frost Street, Rosenberg, Texas 77471
Photo Date: 10/22/19	

Photo 35: Diver Quadrat #08 – pre-rinse.

Photo 36: Diver Quadrat #08 – post-rinse.

Appendix C

Oyster Dredge Tow Data Sheet

Project: 2658 ETC Galveston Bay Pipeline

Sample Type: 30-second Dredge Tows

Field Personnel: M. Chastain, C. Shannon, D. Williamson

Date: 10/18/2019

(F=Few C=Common A=Abundant)					Oysters									Associated Organisms									Notes
Dredge Tow	Time (24 hr)		Photographs		Sack	Seed	Spat (live)	Spat (dead)	Single valve	Double valve	Box	Broken Shell	Shell Hash	Rangia (live)	Rangia (dead)	Barn-acles	Serp. Worms	Hooked Mussel	Boring Sponge	Boring Clams	Algae	Mud	
	Start	End	Pre-rinse	Post-rinse																			
T11	9:29	9:30	_6195	_6196																		X	
T10	9:36	9:37	_6197	_6198																		X	
709	9:45	9:45	_6199	_6200																		X	
T08	9:55	9:55	_6203	_6204	0	1	5	0	2								C						
T07	10:07	10:08	_6205	_6206								3										X	
T06	15:15	15:16	_6250	_6251	9	20	4		8		3					A	A	A					
T05	14:56	14:56	_6246	_6247	6	9	32		22	2						C	C	C					
T04	14:48	14:49	_6244	_6245	2	15	1		6	8						C	C	C					
T03	14:42	14:43	_6242	_6243																		X	
T02	14:27	14:28	_6239	_6240																		X	
T01	14:22	14:21	_6237	_6238							1											X	

Appendix D

Diver Quadrat Data Sheets

SPRING 2019 MONITORING

Observers: M. Chastain, C. Shannon, D. Williamsor
Date: 10/18/2019
Sample Location: DQ3

Weather Conditions: Sunny
Water Conditions: Mild Chop, Turbid
Sample Type: SCUBA Quadrat

Size		Group	Live Oyster Count	Box Oyster Count[1]	Dead Oyster Count	Invertebrate Predators/Fouling Organisms
Spat Oysters	0-4mm	0				**Barnacles**
	5-9mm	1				COMMON
	10-14mm	2				
	15-19mm	3				
	20-24mm	4				
Seed Oysters	25-29mm	5				**Algae**
	30-34mm	6	1			NA
	35-39mm	7	2			
	40-44mm	8				
	45-49mm	9				
	50-54mm	10	1		1	**Bryozoans**
	55-59mm	11				NA
	60-64mm	12	1		1	
	65-69mm	13	1		1	
	70-74mm	14			1	
Sack Oysters	75-79mm	15			1	**Hooked Mussels**
	80-84mm	16			1	COMMON
	85-89mm	17	1			
	90-94mm	18	1		1	
	95-99mm	19			2	
	100-104mm	20				**Oyster Drills**
	105-109mm	21				NA
	110-114mm	22				
	115-119mm	23				
	120-124mm	24				
	125-129mm	25				**Polychaetes**
	130-134mm	26				NA
	135-139mm	27				
	140-144mm	28				
	145-149mm	29				
	150-154mm	30				**Serpulid Worms**
	155-159mm	31				COMMON
	160-164mm	32				
	165-169mm	33				
	170-174mm	34				
	175-179mm	35				**Crabs**
	180-184mm	36				FEW
	185-189mm	37				
	190-194mm	38				
	195-199mm	39				
	>200mm	40+				

[1] - Recently dead (determined by the number of fouling organisms) oysters if both valves remain intact and also recently dead single valves.

SPRING 2019 MONITORING

Observers: M. Chastain, C. Shannon, D. Williamsor
Date: 10/18/2019
Sample Location: DQ4

Weather Conditions: Sunny
Water Conditions: Mild Chop, Turbid
Sample Type: SCUBA Quadrat

Size		Group	Live Oyster Count	Box Oyster Count[1]	Dead Oyster Count	Invertebrate Predators/Fouling Organisms
Spat Oysters	0-4mm	0				**Barnacles**
	5-9mm	1	1			COMMON
	10-14mm	2				
	15-19mm	3				
	20-24mm	4				
Seed Oysters	25-29mm	5				**Algae**
	30-34mm	6				NA
	35-39mm	7				
	40-44mm	8				
	45-49mm	9				
	50-54mm	10				**Bryozoans**
	55-59mm	11			1	NA
	60-64mm	12	1		1	
	65-69mm	13			2	
	70-74mm	14	1			
Sack Oysters	75-79mm	15				**Hooked Mussels**
	80-84mm	16	2		1	COMMON
	85-89mm	17				
	90-94mm	18				
	95-99mm	19				
	100-104mm	20				**Oyster Drills**
	105-109mm	21				NA
	110-114mm	22	1			
	115-119mm	23				
	120-124mm	24				
	125-129mm	25				**Polychaetes**
	130-134mm	26				NA
	135-139mm	27				
	140-144mm	28				
	145-149mm	29				
	150-154mm	30				**Serpulid Worms**
	155-159mm	31				COMMON
	160-164mm	32				
	165-169mm	33				
	170-174mm	34				
	175-179mm	35				**Crabs**
	180-184mm	36				FEW
	185-189mm	37				
	190-194mm	38				
	195-199mm	39				
	>200mm	40+				

[1] - Recently dead (determined by the number of fouling organisms) oysters if both valves remain intact and also recently dead single valves.

SPRING 2019 MONITORING

Observers: M. Chastain, C. Shannon, D. Williamsor
Date: 10/18/2019
Sample Location: DQ5

Weather Conditions: Sunny
Water Conditions: Mild Chop, Turbid
Sample Type: SCUBA Quadrat

Size		Group	Live Oyster Count	Box Oyster Count[1]	Dead Oyster Count	Invertebrate Predators/Fouling Organisms
Spat Oysters	0-4mm	0				**Barnacles**
	5-9mm	1				COMMON
	10-14mm	2				
	15-19mm	3				
	20-24mm	4				
Seed Oysters	25-29mm	5				**Algae**
	30-34mm	6	1			FEW
	35-39mm	7	1			
	40-44mm	8	2			
	45-49mm	9				
	50-54mm	10			1	**Bryozoans**
	55-59mm	11			1	NA
	60-64mm	12	2		1	
	65-69mm	13	1			
	70-74mm	14	1		3	
Sack Oysters	75-79mm	15				**Hooked Mussels**
	80-84mm	16			1	COMMON
	85-89mm	17				
	90-94mm	18			1	
	95-99mm	19				
	100-104mm	20				**Oyster Drills**
	105-109mm	21			1	NA
	110-114mm	22				
	115-119mm	23				
	120-124mm	24				
	125-129mm	25				**Polychaetes**
	130-134mm	26				NA
	135-139mm	27				
	140-144mm	28				
	145-149mm	29				
	150-154mm	30				**Serpulid Worms**
	155-159mm	31				COMMON
	160-164mm	32				
	165-169mm	33				
	170-174mm	34				
	175-179mm	35				**Crabs**
	180-184mm	36				FEW
	185-189mm	37				
	190-194mm	38				
	195-199mm	39				
	>200mm	40+				

[1] - Recently dead (determined by the number of fouling organisms) oysters if both valves remain intact and also recently dead single valves.

SPRING 2019 MONITORING

Observers: M. Chastain, C. Shannon, D. Williamsor
Date: 10/18/2019
Sample Location: DQ6

Weather Conditions: Sunny
Water Conditions: Mild Chop, Turbid
Sample Type: SCUBA Quadrat

Size		Group	Live Oyster Count	Box Oyster Count[1]	Dead Oyster Count	Invertebrate Predators/Fouling Organisms
Spat Oysters	0-4mm	0				**Barnacles**
	5-9mm	1				FEW
	10-14mm	2				
	15-19mm	3				
	20-24mm	4				
Seed Oysters	25-29mm	5				**Algae**
	30-34mm	6				COMMON
	35-39mm	7				
	40-44mm	8				
	45-49mm	9				
	50-54mm	10				**Bryozoans**
	55-59mm	11	2			NA
	60-64mm	12			3	
	65-69mm	13			2	
	70-74mm	14			4	
Sack Oysters	75-79mm	15				**Hooked Mussels**
	80-84mm	16	2			COMMON
	85-89mm	17				
	90-94mm	18			2	
	95-99mm	19				
	100-104mm	20				**Oyster Drills**
	105-109mm	21				NA
	110-114mm	22				
	115-119mm	23				
	120-124mm	24				
	125-129mm	25				**Polychaetes**
	130-134mm	26				NA
	135-139mm	27				
	140-144mm	28				
	145-149mm	29				
	150-154mm	30				**Serpulid Worms**
	155-159mm	31				FEW
	160-164mm	32				
	165-169mm	33				
	170-174mm	34				
	175-179mm	35				**Crabs**
	180-184mm	36				NA
	185-189mm	37				
	190-194mm	38				
	195-199mm	39				
	>200mm	40+				

[1] - Recently dead (determined by the number of fouling organisms) oysters if both valves remain intact and also recently dead single valves.

SPRING 2019 MONITORING

Observers: M. Chastain, C. Shannon, D. Williamsor
Date: 10/18/2019
Sample Location: DQ7

Weather Conditions: Sunny
Water Conditions: Mild Chop, Turbid
Sample Type: SCUBA Quadrat

Size		Group	Live Oyster Count	Box Oyster Count[1]	Dead Oyster Count	Invertebrate Predators/Fouling Organisms
Spat Oysters	0-4mm	0				**Barnacles**
	5-9mm	1				FEW
	10-14mm	2				
	15-19mm	3				
	20-24mm	4				
Seed Oysters	25-29mm	5	1			**Algae**
	30-34mm	6	1			NA
	35-39mm	7				
	40-44mm	8				
	45-49mm	9				
	50-54mm	10	1		1	**Bryozoans**
	55-59mm	11	1			NA
	60-64mm	12	1		1	
	65-69mm	13	3			
	70-74mm	14	1			
Sack Oysters	75-79mm	15				**Hooked Mussels**
	80-84mm	16				FEW
	85-89mm	17				
	90-94mm	18			1	
	95-99mm	19				
	100-104mm	20			1	**Oyster Drills**
	105-109mm	21				NA
	110-114mm	22			1	
	115-119mm	23				
	120-124mm	24				
	125-129mm	25				**Polychaetes**
	130-134mm	26				NA
	135-139mm	27			1	
	140-144mm	28	1			
	145-149mm	29				
	150-154mm	30				**Serpulid Worms**
	155-159mm	31			1	FEW
	160-164mm	32				
	165-169mm	33				
	170-174mm	34				
	175-179mm	35				**Crabs**
	180-184mm	36				NA
	185-189mm	37				
	190-194mm	38				
	195-199mm	39				
	>200mm	40+				

[1] - Recently dead (determined by the number of fouling organisms) oysters if both valves remain intact and also recently dead single valves.

SPRING 2019 MONITORING

Observers: M. Chastain, C. Shannon, D. Williamsor
Date: 10/18/2019
Sample Location: DQ8

Weather Conditions: Sunny
Water Conditions: Mild Chop, Turbid
Sample Type: SCUBA Quadrat

Size		Group	Live Oyster Count	Box Oyster Count[1]	Dead Oyster Count	Invertebrate Predators/Fouling Organisms
Spat Oysters	0-4mm	0	1			**Barnacles**
	5-9mm	1	2			MANY
	10-14mm	2	2			
	15-19mm	3				
	20-24mm	4				
Seed Oysters	25-29mm	5	2		2	**Algae**
	30-34mm	6				FEW
	35-39mm	7				
	40-44mm	8				
	45-49mm	9				
	50-54mm	10			2	**Bryozoans**
	55-59mm	11			1	NA
	60-64mm	12	1		3	
	65-69mm	13			1	
	70-74mm	14			2	
Sack Oysters	75-79mm	15			4	**Hooked Mussels**
	80-84mm	16			1	MANY
	85-89mm	17			2	
	90-94mm	18			3	
	95-99mm	19			1	
	100-104mm	20			1	**Oyster Drills**
	105-109mm	21			1	NA
	110-114mm	22				
	115-119mm	23				
	120-124mm	24				
	125-129mm	25			1	**Polychaetes**
	130-134mm	26			1	NA
	135-139mm	27				
	140-144mm	28				
	145-149mm	29				
	150-154mm	30				**Serpulid Worms**
	155-159mm	31				MANY
	160-164mm	32				
	165-169mm	33				
	170-174mm	34				
	175-179mm	35				**Crabs**
	180-184mm	36				NA
	185-189mm	37				
	190-194mm	38				
	195-199mm	39				
	>200mm	40+				

[1] - Recently dead (determined by the number of fouling organisms) oysters if both valves remain intact and also recently dead single valves.

Appendix E

Water Quality Data Sheet

Project: 2658 ETC Galveston Bay Pipeline Date: 10/18/2019

Water Quality

Field Personnel: M. Chastain, C. Shannon, D. Williamson

Weather: Sunny, slight breeze Wind speed/direction: 8-9 mph Tide Level (MLT): 1.3ft
Water conditions: Turbid Tide Times: (HT), 16:01 (LT) Tide Station Eagle Point

Sample	DQ8		DQ7		DQ6		DQ5	
	Surface	Bottom	Surface	Bottom	Surface	Bottom	Surface	Bottom
Time (24 hr)	10:30		11:15		11:40		12:20	
Date	10/18/2019		10/18/2019		10/18/2019		10/18/2019	
Water Depth (ft)	10.5		11.5		11.1		11.5	
Sample Depth (ft)	0.5	9.8	0.5	11.0	0.5	10.7	0.5	10.9
Water Temperature (°C)	20.89	22.18	21.43	22.44	21.58	22.58	21.41	22.39
Conductivity (mS/cm)	15.10	22.67	15.26	23.37	14.85	25.09	14.90	24.90
Salinity (‰)	8.81	13.75	8.92	14.15	8.75	15.30	8.66	15.17
DO (mg/L)	9.91	8.94	9.94	8.72	9.94	8.27	10.07	8.57
pH	8.09	8.10	8.42	8.33	8.40	8.36	8.40	8.30
Turbidity (NTU)	-	-	-	-	-	-	-	-

Weather: Sunny, slight breeze Wind speed/direction: 8-9 mph Tide Level (MLT): 1.3ft
Water conditions: Turbid Tide Times: (HT), 16:01 (LT) Tide Station Eagle Point

Sample	DQ4		DQ3		DQ2		DQ1	
	Surface	Bottom	Surface	Bottom	Surface	Bottom	Surface	Bottom
Time (24 hr)	13:51		13:32		-		-	
Date	10/18/2019		10/18/2019		-		-	
Water Depth (ft)	11.0		11.9		-		-	
Sample Depth (ft)	0.75	10.5	0.5	11.5	-	-	-	-
Water Temperature (°C)	21.71	22.40	21.65	22.58	-	-	-	-
Conductivity (mS/cm)	15.92	26.60	15.51	25.92	-	-	-	-
Salinity (‰)	8.62	16.01	8.60	15.95	-	-	-	-
DO (mg/L)	10.10	8.63	10.04	8.75	-	-	-	-
pH	8.37	8.20	8.30	8.24	-	-	-	-
Turbidity (NTU)	-	-	-	-	-	-	-	-