March 2023
Beneficial Use Master Plan—
Texas GLO Regions 3 and 4

Beneficial Use Master Plan—Texas GLO Regions 3 and 4, Contract #21-155-005-C877—Final Report

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Prepared for
Texas General Land Office
Coastal Management Program

Prepared by
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Port of Corpus Christi Authority
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Texas Department of Transportation

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ABBREVIATIONS

ANWR	Aransas National Wildlife Refuge
BODR	basis of design report (60% design memorandum)
BU	beneficial use of dredged material
CCSC	Corpus Christi Ship Channel
CMP	Coastal Management Program
DMPA	Dredged material placement area
DU	Ducks Unlimited
E&D	engineering and design
EPA	U.S. Environmental Protection Agency
Final Report	*Beneficial Use Master Plan—Texas GLO Regions 3 and 4, Contract #21-155-005-C877 Final Report*
GIWW	Gulf Intracoastal Waterway
GLO	Texas General Land Office
N/A	not applicable
NAVD88	North American Vertical Datum of 1988
NOAA	National Oceanic and Atmospheric Administration
ODMDS	ocean dredged material disposal site
PINS	Padre Island National Seashore
PCCA	Port of Corpus Christi Authority
Project	Lower Texas Coast Beneficial Use Master Planning Project
Project Team	Ducks Unlimited; the Port of Corpus Christi Authority; Anchor QEA, LLC; Sarosdy Consulting; and the Texas Department of Transportation
PSM	Project of Special Merit
RRC	Railroad Commission of Texas
SAV	submerged aquatic vegetation
TCRMP	Texas Coastal Resiliency Master Plan
Tier 1 project	high-priority project in TCRMP
TPWD	Texas Parks and Wildlife Department
USACE	U.S. Army Corps of Engineers
USFWS	U.S. Fish and Wildlife Service

Executive Summary

This *Beneficial Use Master Plan—Texas GLO Regions 3 and 4, Contract #21-155-005-C877 Final Report* (Final Report) describes the work performed on the Beneficial Use Master Plan—Texas GLO Regions 3 and 4 Project (Project) by Ducks Unlimited (DU); the Port of Corpus Christi Authority (PCCA); Anchor QEA, LLC; Sarosdy Consulting; and the Texas Department of Transportation (Project Team) for the Coastal Management Program (CMP) of the Texas General Land Office (GLO) pursuant to a Cycle 26 Project of Special Merit (PSM) grant, GLO contract No. 21-155-005-C877.

A range of coastal restoration projects that require placing fill material call for large amounts of suitable sediment. These projects include the creation and restoration of wetlands, bird islands, tidal flats, and seagrass habitats, and the renourishment of beaches. The search for suitable sediment within reasonable proximity poses a major challenge to those implementing these coastal restoration projects. Material dredged from navigation channels provides a potentially abundant source of sediment for restoration projects. The beneficial use of dredged material (BU) for restoration of wetlands, bird islands, tidal flats, and seagrasses and renourishment of beaches combines the need for sediment with the placement needs of navigation dredgers.

Projects involving BU require long-range planning and often involve complex land use, permitting, scheduling, and funding issues. Natural resource agencies have recognized the value of planning for BU projects years in advance to ensure their eventual successful implementation.

The intent of the Project Team's effort was to identify and advance potential BU project sites that were not already underway. Accordingly, appropriate sites for this project are those that require the initiation of engineering and design (E&D) efforts to begin the process of readying such sites to receive dredged material. There are ongoing BU efforts in this area with proposed BU sites not included in the Project. Those sites were already being worked on by others and had advanced to a point where this Project's efforts would not have been additive.

The grant objective for the Project calls for the final selection of five sites from GLO Planning Regions 3 and 4 where BU could feasibly restore wetlands, tidal flats, and seagrasses; build bird islands; renourish beaches; or implement other coastal restoration projects. When PCCA joined the Project as a partner and provided financial support, this objective was increased to seven final sites. The Project Team selected the seven sites after receiving input from stakeholders and natural resource agencies, then preparing a basis of design report (60% design memorandum; BODR) to document the E&D process and a permit package for each site.

Collectively, the Project Team coordinated three sets of stakeholder meetings (two meetings per set, one for each region) with state and federal resource agencies, nongovernmental organizations, academia, consultants, and local officials in each region to solicit information about potential BU sites. Based on stakeholder input, GLO feedback, publicly available data, and professional judgment, the Project Team developed 10% designs for 18 sites in GLO Planning Regions 3 and 4 and 2 GLO-approved sites in GLO Planning Region 2. The 10% designs appear as Appendix A. Note that the grant objective was for 16 sites for 10% designs, but due to PCCA's partnership, we were able to include 4 additional sites at the 10% design stage.

After completion of the 10% designs, 11 of the designs were selected to advance to the 30% design stage. The grant objective was eight sites, but PCCA's partnership enabled the Project Team to include three additional sites at the 30% design stage. The 30% designs appear as Appendix B.

Six of the sites with 30% designs were chosen to advance to the 60% design stage for BODRs and permit application packages. Note that Pelican Island (M3) was selected for 30% design, but due to potential conflicts with future U.S. Army Corps of Engineers (USACE) projects, this site was not selected to continue to the 60% design phase. One site, M10, was not included in either the 10% or 30% design phases but was added to replace M3 at the 60% level, bringing the total to seven 60% design BODRs and permit application packages. The grant objective was five sites, but PCCA's partnership enabled the Project Team to include two additional sites at the 60% design level. The seven BODRs appear in Appendix C.

The seven sites selected for BODRs are as follows, in alphabetical order:

- Causeway Bird Island (bird island project located in Region 3)
- Dagger Island (wetlands and seagrass restoration project located in Region 3)
- Feeder Berm North of Fish Pass (beach renourishment project located in Region 3)
- Little Bird Island North (bird island project located in Region 2)
- M10 (wetlands restoration project located in Region 3)
- PA9-S (wetlands restoration project located in Region 3)
- Rabbit Island South Bird Island (bird island and seagrass restoration project located in Region 4)

The 60% designs in the BODRs and the permit application packages provide a basis for dredging sponsors and habitat restoration advocates to advance BU projects for years to come on the Lower Texas Coast.

1 Introduction

This *Beneficial Use Master Plan—Texas GLO Regions 3 and 4, Contract #21-155-005-C877 Final Report* (Final Report) describes the work performed on the Beneficial Use Master Plan—Texas GLO Regions 3 and 4 Project (Project) by Ducks Unlimited (DU); the Port of Corpus Christi Authority (PCCA); Anchor QEA, LLC; Sarosdy Consulting; and the Texas Department of Transportation (Project Team) for the Coastal Management Program (CMP) pursuant to a Cycle 26 Project of Special Merit (PSM) grant, Texas General Land Office (GLO) contract No. 21-155-005-C877.

A range of coastal restoration projects that require placing fill material call for large amounts of suitable sediment. These projects include the creation and restoration of wetlands, bird islands, tidal flats, and seagrass habitats, and the renourishment of beaches. The search for suitable sediment within reasonable proximity poses a major challenge to those implementing these coastal restoration projects.

Material dredged from navigation channels provides a potentially abundant source of sediment for restoration projects. The beneficial use of dredged material (BU) for restoration of wetlands, bird islands, tidal flats, and seagrasses and renourishment of beaches combines the need for sediment with the placement needs of navigation dredgers.

Projects involving BU require long-range planning and often involve complex land use, permitting, scheduling, and funding issues. Natural resource agencies have recognized the value of planning for BU projects years in advance to ensure their eventual successful implementation.

The intent of the Project Team's effort was to identify and advance potential BU project sites not already underway. Accordingly, appropriate sites for this project are those that require the initiation of E&D efforts to begin the process of readying such sites to receive dredged material. There are ongoing BU efforts in this area with proposed BU sites not included in the Project. Those sites were already being worked on by others and had advanced to a point where this Project's efforts would not have been additive. An example of such a site is the Texas Parks and Wildlife Department's (TPWD's) Dagger Island in Redfish Bay. TPWD's Dagger Island site is located northeast of Dagger Island and is a distinct project from the Dagger Island site included as a part of this planning and design effort located southwest of Dagger Island. TPWD's Dagger Island is a 30-acre site that can accommodate up to 130,000 yards of dredged material. The site has a constructed containment levee and riprap protection of the levee and is fully permitted to receive dredged material. TPWD is the lead on that site and is looking for partnership opportunities to coordinate nearby dredging operations with placement into its Dagger Island site.

DU proposed a master planning effort for the beneficial use of dredged material (BU) in GLO Planning Regions 3 and 4 as a PSM for Cycle 26 of GLO's CMP Grant Program in 2021. The PSM grants are funded by revenue sharing received by Texas through the Gulf of Mexico Energy Security Act; no match funding is required. The CMP awarded the PSM grant to DU, which then added PCCA as a Project Team partner, to develop a BU Master Plan for Texas GLO Regions 3 and 4. PCCA contributed to the Project by providing in-kind assistance and financial support for planning as described below.

The grant objective for the Project calls for the final selection of five sites from Regions 3 and 4 where BU could feasibly restore wetlands, build bird islands, renourish beaches, or implement other coastal restoration projects. When PCCA joined the Project as a partner and provided financial support, this objective was increased to seven final sites. It should be noted that the sites supported by PCCA did not need the same GLO approvals as the five sites supported by the grant. The Project Team selected the seven sites after soliciting and receiving input from stakeholders and natural resource agencies, then preparing a basis of design report (60% design memorandum; BODR) to document engineering and design (E&D) and permit packages for each site. PCCA provided financial support for E&D and permit packages for two of the seven sites.

Implementation of the Project consisted of the following two phases: 1) site selection; and 2) site planning. This Final Report describes activities and decision-making that went into each Project phase. The appendices to this Final Report include the following supporting documentation: 1) 10% design memoranda (Appendix A); 2) 30% design memoranda (Appendix B); and 3) BODRs (Appendix C).

2 Project Kickoff

The Project Team held its initial meeting online on May 24, 2021. Todd Merendino, Project lead for DU, provided background on the CMP PSM grant and its requirements. The Project Team articulated the objectives for the Project as follows:

- Create and restore degrading coastal habitats.
- Establish sites for placement of dredged material to reduce reliance on existing dredged material placement areas (DMPAs).
- Improve coastal resiliency of the natural and built environment.

To accomplish these objectives, the Project Team planned to perform the following tasks:

- Stakeholder outreach and coordination
- Identification and selection of BU sites
- 10% designs and cost estimates for up to 16 BU sites, with PCCA's partnership enabling an additional 4 sites to be included, bringing the total to 20 sites
- 30% designs and cost estimates for up to eight BU sites, with PCCA's partnership enabling an additional three sites to be included, bringing the total to 11 sites
- 60% designs, cost estimates, and permit application packages for up to five BU sites, with PCCA's partnership enabling an additional two sites to be included, bringing the total to seven sites

The Project Team discussed hosting a series of stakeholder meetings to get feedback on possible site locations for BU projects involving persons interested in each of the two GLO Planning Regions.

3 Key Resources

To inform its process of recommending BU sites for this Project, the Project Team reviewed several existing technical resources. This section describes the resources and discusses how each informed the process of determining site suitability.

3.1 Texas Coastal Resiliency Master Plan

The TGLO's 2019 Texas Coastal Resiliency Master Plan (TCRMP) is a framework for conserving and enhancing the natural and manufactured coastal environment to adapt to existing and expected vulnerabilities and hazards. The TCRMP consists of 123 high-priority projects (Tier 1 projects) that would implement its overall goals. The proposed projects were identified through a planning process that involved federal and state natural resource agency staff, as well as numerous coastal experts and stakeholders.

During the site assessment and selection process, the Project Team worked with the GLO TCRMP program to keep them informed of the ongoing Project work. In an online meeting on January 24, 2022, the Project Team and TCRMP staff and their consultants explored whether one or more of the selected sites could be included as Tier 1 projects in the upcoming 2023 update of the TCRMP. The Project Team expects many of the sites will be included in the TCRMP as Tier 1 projects.

3.2 Beneficial Use Guidance Documents

The USACE and U.S. Environmental Protection Agency (EPA) have published documents providing detailed guidance on BU. In 2007, USACE and EPA published a manual to assist in planning and implementing BU projects (EPA and USACE 2007). USACE published a comprehensive dredging engineering manual in 2015 that includes extensive guidance on BU projects (USACE 2015). These documents helped guide planning and design of the sites.

3.3 Status and Trends of Wetlands

The U.S. Fish and Wildlife Service (USFWS) published a status and trends report for Texas Coastal Wetlands in 1997 (Moulton et al. 1997). This report was used to understand the regional distribution of wetlands and the regional distribution and regional causes of wetland losses.

3.4 USACE Consistency Determinations for Texas Coastal Maintenance Dredging Activities for the Texas Coastal Management Program

The CMP was initially approved by the National Oceanic and Atmospheric Administration (NOAA) in 1997. To engage in dredging activities on the Texas coast, USACE was required to determine that those activities are consistent with the CMP's goals and policies. To make these consistency determinations, USACE did a thorough analysis of its maintenance dredging operations and released a series of detailed consistency determinations that include valuable historical data relevant to many potential BU sites on the Texas coast (USACE 1999). These documents provided historical information on dredging frequency, sediment volumes, and sediment characteristics by reach.

3.5 USACE Environmental Impact Statement for Dredging the Texas Portion of the GIWW (1975)

The original locations and characteristics of the permitted DMPAs along the Gulf Intracoastal Waterway (GIWW) were described in USACE (1975). This report also has an in-depth description of the GIWW itself. The locations of these DMPAs were obtained in GIS format and used to measure distances between dredging locations and DMPAs and to help identify potential BU sites.

3.6 USACE Final Environmental Impact Statement (2003)

Dredging activities, environmental impacts, and a dredged material management plan for Laguna Madre were documented in USACE (2003). This document provided additional information on dredging frequency, sediment volumes, and sediment characteristics by reach.

4 Site Selection

The Project Team's goal was to create a list of potentially suitable sites and a list of seven sites for 60% design and permit application packages. To achieve this goal, the Project Team worked with stakeholders to identify a longer list of potential sites to be evaluated.

4.1 Initial Site Suggestions

The Project Team solicited input from stakeholders in generating an initial list of sites for consideration. The Project Team considered suggestions for a variety of project types, including wetlands restoration, bird islands, beach renourishment (including feeder berms), shoreline stabilization, tidal flats, and seagrass restoration. PCCA contributed to this list of potential projects based on its ongoing interest in BU because of its dredging activities.

4.2 Initial Stakeholder Input

On June 28, 2021, the Project Team held an online meeting with stakeholders to obtain input regarding potential BU projects for Region 4. A similar meeting for Region 3 was held online on June 29, 2021. The meetings began with a presentation on the purpose of the Project, followed by a discussion period during which participants suggested a total of 79 candidate sites for restoration. These meetings yielded valuable feedback the Project Team used to begin the evaluation and selection process for the sites.

4.3 Analysis of Potential Sites

The Project Team advanced the selection process through several activities. These included using GIS tools, studying known environmental issues that might affect permitting at specific sites, and exploring possible "fatal flaws" that might render otherwise suitable sites infeasible. The Project Team synthesized these evaluations into a selection decision matrix that helped to prioritize among the various sites.

4.3.1 Tools Used in the Selection Process

The Project Team used Google Earth and GIS to analyze and select sites for potential planning. Some of the data used to inform GIS analysis during the process included TPWD seagrass (TPWD 2023), GLO oyster (GLO 2021a), GLO pipeline (GLO 2021b), Railroad Commission of Texas (RRC) well information (RRC 2023), NOAA bathymetry (NOAA 2023), Triton Habitat surveys, DU surveys, Bureau of Economic Geology shoreline (BEG 2023), and a T. Baker Smith bathymetry survey. Project Team members consulted these tools during discussions with stakeholders.

4.3.2 Sediment Volumes

The Project Team assembled public data available at the time to determine approximate volumes of sediment that might be available from a particular cycle of maintenance dredging. Dredged material volumes vary and are difficult to predict, but historical data to inform the potential annual sediment volume in each area were obtained from the following sources:

- Preliminary consistency assessment prepared by USACE in the late 1990s (USACE 1999) in which the average annual quantity of sediment going into each DMPA is provided, along with the channel segment from which the sediment is sourced
- Information provided orally by USACE staff to members of the Project Team (Jones 2022; Kinman 2022)

4.3.3 Permitting Considerations

The Project Team looked at possible impediments to permitting potential BU sites. For example, several potential sites have significant seagrass beds within their boundaries. The presence of seagrass often precludes activities that will bury the seagrass, such as dredged material placement. Project Team members consulted the publicly available seagrass database for the Texas coast to evaluate whether potential sites were likely to have seagrass (TPWD 2023).

Oysters create a similar impediment to permitting, and the Project Team searched available data sources and discussed oyster beds with Texas Parks and Wildlife Department (TPWD) staff to identify areas where significant oyster populations may occur (GLO 2023).

4.3.4 Fatal Flaws

Sometimes an issue presents difficulties that outweigh the potential benefits of other factors. For example, a site may appear suitable, but a pipeline easement owner may refuse to allow access. An issue such as this was considered a fatal flaw that eliminated a site from further consideration. The Project Team analyzed each potential site with an eye to such fatal flaws.

4.3.5 Evaluation Process

The Project Team assessed each potential site according to the following general criteria related to site suitability:

- Protection from development
- Already a Tier 1 project
- Already a project of interest to natural resource agencies or previously studied
- Included in an existing plan
- Has a feasible source of sediment (distance, access, etc.)

- No major impediments to permitting based on sensitive habitats or threatened or endangered species
- Sediment source expected to have acceptably low levels of contaminants
- Long-term sustainability
- Contribution to community resilience
- Property ownership
- No known fatal flaws

The Project Team then categorized the suggested potential sites by project types, including bird islands, wetlands restoration, shoreline stabilization, beach renourishment (including feeder berms), tidal flats, and seagrass restoration. Within each project type, the Project Team evaluated the sites according to the criteria discussed in the following sections.

4.3.5.1 Bird Island

To evaluate whether a site was a viable bird island site, the Project Team assessed whether the site was acceptable in terms of distance from shore, water depth, direction from shore, substrate bearing capacity, distance from sand source, sand grain size suitable for target area, low wave energy, proximity to deeper water, and a pre-existing bird island at the same or nearby location.

4.3.5.2 Wetlands

To evaluate whether a site was a viable wetlands restoration site, the Project Team assessed whether there was a pre-existing degraded wetland on the site and the likely cause of the degradation. To evaluate if a site was a viable wetland creation site, the Project Team assessed water depth, fetch, and presence of shoreline protection or suitability to construct shoreline protection.

4.3.5.3 Beach Renourishment (Including Feeder Berms)

To evaluate whether a site was a viable beach renourishment site, the Project Team assessed whether the available sediment includes sufficient beach quality sand, whether the new beach profile would vary significantly from the existing profile, whether there is public access to the beach, and the extent and severity of existing beach erosion. To evaluate whether a site was viable for a feeder berm for beach renourishment, the Project Team assessed whether the water depth was suitable, whether the available sediment contained beach quality sand, and whether the currents were suitable for a feeder berm.

4.3.5.4 Tidal Flats

To evaluate whether a site was viable for tidal flat restoration, the Project Team assessed whether there was a pre-existing degraded tidal flat on the site and the likely cause of the degradation (e.g., relative sea level rise). Also, the Project Team evaluated if the available sediment is a suitable grain size, whether the currents are suitable, and whether the wave energy is low enough.

4.3.5.5 Seagrass Restoration

To evaluate whether a site was suitable for seagrass restoration, the Project Team assessed whether the depth, grain size, currents, water quality, and salinity were suitable, and whether seagrasses already grow near the proposed site,

4.3.5.6 Shoreline Stabilization

To determine whether a site was suitable for shoreline stabilization, the Project Team assessed the existing erosion rate, whether shoreline protection exists, and whether the Project would benefit from new work material, which is often more resistant to erosion than maintenance material.

In addition to the criteria, the Project Team relied on information from other resources, reports, and data collections, as well as professional judgment in ranking the sites. Based on these considerations, the Project Team arrived at a list of eight GLO-approved potential sites for Region 2 (all of which are close to the border with Region 3), 58 potential sites for Region 3, and 13 potential sites for Region 4.

4.4 Second Set of Stakeholder Meetings

On August 16, 2021, the Project Team held a second online stakeholder meeting for Region 3, with a similar meeting for Region 4 held on August 20, 2021. The Region 3 meeting featured 66 potential project sites, including the 8 from Region 2, while the Region 4 meeting featured 13 potential project sites. The meetings yielded additional valuable feedback on a variety of considerations. The Project Team incorporated this feedback into a second round of prioritization for the suggested sites in each region.

Based on the input from the second stakeholder meetings and further evaluation, the Project Team ranked the proposed sites as high, medium, and low. Those sites ranked low were eliminated from consideration, and those ranked medium were analyzed in comparison to those ranked high to aid in decision-making. Following that process, the Project Team facilitated a discussion with GLO staff on October 7, 2022, to discuss advantages and disadvantages of several sites. Based on the collected information, the Project Team selected the following 20 sites for 10% design memoranda (of which PCCA provided in-kind assistance for four). The following 10% design memoranda are attached to this Final Report as Appendix A:

- Aransas National Wildlife Refuge (ANWR) Long Lake Marsh and Channel (wetlands restoration, Region 3)
- ANWR Matagorda Island West Marsh (wetlands restoration, Region 2)
- Causeway Bird Island (bird island, Region 3)
- Dagger Island (wetlands restoration, Region 3)
- DMPA #187 Padre Island National Seashore (PINS) Bird Island (bird island, Region 3)
- DMPA #192 PINS Bird Island (bird island, Region 3)

- DMPA #214 Bird Island (bird island, Region 4)
- Feeder Berm North of Fish Pass (beach renourishment via feeder berm, Region 3)
- Fulton Beach Road Protection and Marsh (shoreline stabilization, Region 3)
- Key Allegro Island (wetlands restoration, Region 3)
- Little Bird Island North (bird island, Region 2)
- Nueces Delta (wetlands restoration, Region 3)
- PA9-S (wetlands restoration, Region 3)
- Packery Flats (tidal flats, Region 3)
- Pelican Island (M3; wetlands restoration, Region 3)
- Ransom Point (wetlands restoration, Region 3)
- Portland Nueces Bay Marsh (wetlands restoration, Region 3)
- Rabbit Island South Bird Island (bird island, Region 4)
- Rockport Beach (beach renourishment, Region 3)
- Sunset Lake (seagrass restoration, Region 3)

A map showing the location of each of the 20 sites appears as Figure 1.

4.5 Further Prioritization

During the remainder of 2021 and in spring 2022, the Project Team continued to gather data and evaluate the 20 10% sites. Team members again ranked the sites as high, medium, and low. Sites ranked low were eliminated from consideration, and those ranked medium were analyzed in comparison to those ranked high to aid in decision-making. Following that process, the Project Team selected the following 11 sites for 30% design memoranda (of which PCCA provided in-kind assistance for three). The following 30% design memoranda are attached to this Final Report as Appendix B:

- Causeway Bird Island (bird island, Region 3)
- Dagger Island (wetlands restoration, Region 3)
- DMPA #214 Bird Island (bird island, Region 4)
- Feeder Berm North of Fish Pass (beach renourishment via feeder berm, Region 3)
- Little Bird Island North (bird island, Region 2)
- Nueces Delta (wetlands restoration, Region 3)
- PAS-9 (wetlands restoration, Region 3)
- Pelican Island (M3; wetlands restoration, Region 3)
- Portland Nueces Bay Marsh (wetlands restoration, Region 3)
- Rabbit Island South Bird Island (bird island, Region 4)
- Rockport Beach (beach restoration, Region 3)

4.6 Final Set of Stakeholder Meetings

The Project Team held an online stakeholder meeting on June 8, 2022, to discuss sites in Region 4. The Project Team also held an in-person and online hybrid stakeholder meeting on June 14, 2022, at the PCCA offices in Corpus Christi to discuss sites in Region 3. At these meetings, the Project Team presented information about the 11 sites advanced to the 30% design level and invited feedback, which was used in the further prioritization of sites.

4.7 Final Site Selection

Following further analysis and evaluation of input from the third set of stakeholder meetings, the Project Team selected seven sites for BODRs. Note that Pelican Island (M3) was removed from consideration due to potential conflicts with USACE dredged material placement activities. One of the 60% sites is M10, which did not receive a 10% or 30% design memorandum but was selected as an alternative to Pelican Island (M3) after discussions with USACE and concurrence from GLO. M10 is a similar marsh creation site near Pelican Island (M3). PCCA provided financial support to the design of two of the 60% sites, Dagger Island and Feeder Berm North of Fish Pass:

- Causeway Bird Island (bird island, Region 3)
- Dagger Island (wetlands restoration, Region 3)
- Feeder Berm North of Fish Pass (beach renourishment via feeder berm, Region 3)
- Little Bird Island North (bird island, Region 2)
- M10 (wetlands restoration, Region 3)
- PA9-S (wetlands restoration, Region 3)
- Rabbit Island South Bird Island (bird island, Region 4)

The Project Team prepared a BODR for each of the seven sites, which are attached to this Final Report as Appendix C. Table 1 includes information about the 20 sites selected for 10% designs, including location, project type, site area, sediment volumes, possible sediment sources, the ultimate design level reached, and estimated costs. Eleven of those sites received 30% designs, and seven sites were finally selected for 60% design (including M10, which was not considered for 10% or 30% design but was substituted for Pelican Island).

Table 1
E&D Summary for 20 Selected Sites

Site	Latitude/ Longitude	Project Type	Estimated Site Area (acres)	Estimated Sediment Volume Capacity (cubic yards)	Possible Sediment Sources (Proximity)	Design Level	High-End Estimated Project Cost (Including 50% Contingency)
10% Design Only							
ANWR Long Lake Marsh and Channel	28.1921949/ -96.853553	Wetlands restoration	6	16,000	GIWW (adjacent)	10% memorandum	$1.1 million
ANWR Matagorda Island West Marsh	28.1591535/ -96.797151	Wetlands restoration	26	80,000	Derelict USFWS/Wynn Channel (adjacent)	10% memorandum	$12.2 million
DMPA #187 PINS Bird Island	27.4537991/ -97.331117	Bird Island	7	75,000	DMPA 187 (same site)/SMPAs (1.0–2.0 miles)/GIWW (adjacent)	10% memorandum	$2.6 million
DMPA #192 PINS Bird Island	27.4153258/ -97.358134	Bird island	9	90,000	DMPA 192 (same site)/DMPAs (1 mile)/GIWW (adjacent)	10% memorandum	$3.0 million
Fulton Beach Road Protection and Marsh	28.0752514/ -97.036944	Shoreline stabilization	25	470,000	GIWW (2.5 miles)	10% memorandum	$21.3 million
Key Allegro Island	28.0411649/ -97.020536	Wetlands restoration	17	240,000	GIWW (adjacent)/Key Allegro canals (adjacent)	10% memorandum	$37.8 million
Packery Flats	27.6276304/ -97.214139	Tidal flat restoration	7	24,000	GIWW (2 miles)/residential canals (nearby)	10% memorandum	$1.1 million
Ransom Point	27.8491752/ -97.136234	Wetlands restoration	16	100,000	CCSC (1.5 miles)	10% memorandum	$2.6 million

Site	Latitude/ Longitude	Project Type	Estimated Site Area (acres)	Estimated Sediment Volume Capacity (cubic yards)	Possible Sediment Sources (Proximity)	Design Level	High-End Estimated Project Cost (Including 50% Contingency)
Sunset Lake	27.8673349/ -97.332285	Wetlands restoration	63	398,430	La Quinta Channel Extension (3 miles)/ La Quinta Terminal (3 miles)	10% memorandum	$11.6 million
30% Design							
DMPA #214 Bird Island	27.3737999/ -97.372497	Bird island	7	204,000	DMPA 214 (same site)/ DMPA 213 (0.25 mile)/GIWW (adjacent)	10% and 30% memoranda	$5.1 million
Nueces Delta	27.8650203/ -97.51888	Wetlands restoration	18	180,000	CCSC Inner Harbor (2 miles)	10% and 30% memoranda	$12.2 million
Pelican Island (M3)	27.8197073/ -97.153416	Wetlands restoration	260	2.100,000	CCSC (adjacent)/ La Quinta Channel (4 miles)	10% and 30% memoranda; ruled out by USACE[1]; replaced by M10	$39.5 million
Portland Nueces Bay Marsh	27.8743355/ -97.331946	Wetlands restoration	40	410,000	La Quinta Channel Extension (3 miles)/ La Quinta Terminal (3 miles)	10% and 30% memoranda	$19.5 million
Rockport Beach	28.0292186/ -97.038013	Beach nourishment	N/A	N/A	GIWW (2.5 miles)/DMPAs (1.6–2.8 miles)	10%, and 30% memoranda	N/A: Project unneeded as site self-mitigated
BODR							
Causeway Bird Island	27.8417226/ -97.376733	Bird island	16	106,000	Rincon Canal (adjacent)/CCSC (2.25 miles)	10%, 30%, and 60% memoranda	$2.0 million
Dagger Island	27.8290736/ -97.183444	Wetlands restoration	33	260,000	CCSC (adjacent)/ La Quinta Channel (2.5 miles)	10%, 30%, and 60% memoranda	$8.3 million

Site	Latitude/ Longitude	Project Type	Estimated Site Area (acres)	Estimated Sediment Volume Capacity (cubic yards)	Possible Sediment Sources (Proximity)	Design Level	High-End Estimated Project Cost (Including 50% Contingency)
Feeder Berm North of Fish Pass	27.6936736/ -97.152511	Feeder berm	75	500,000	Corpus Christi Entrance Channel (13 miles)/ Corpus Christi ODMDS (11 miles)	10%, 30%, and 60% memoranda	$5.6 million
Little Bird Island North	28.2931587/ -96.697227	Bird island	8	202,000	GIWW (adjacent)	10%, 30%, and 60% memoranda	$11.6 million
M10	27.8094331/ -97.209519	Wetlands restoration	840	20,000,000	Harbor Island (9 miles)/CCSC (adjacent)/La Quinta Channel (adjacent)	60% memorandum; replaced Pelican Island	$187.1 million
PA9-S	27.8149366/ -97.184385	Wetlands restoration	220	4,000,000	CCSC (adjacent)/ La Quinta Channel (2 miles)	10%, 30%, and 60% memoranda	$39.2 million
Rabbit Island South Bird Island	27.2457833/ -97.41439	Bird island	10	135,000	GIWW relict new work material (nearby)/GIWW (adjacent)	10%, 30%, and 60% memoranda	$4.2 million

Note:

1. Pelican Island (M3) consists of two DMPAs (DMPAs #8 and #9) expected to be used indefinitely by USACE. They are not bermed islands; rather, dredged material is discharged onto the islands and typically disperses to the south side of the islands. Based on the existing rookery use of the island and existing maintenance material placement by USACE, USACE staff were not supportive of a BU site on the south side of the island.

The following summaries are brief descriptions of the selected sites for BODRs arranged in alphabetical order.

4.7.1 Causeway Bird Island

The site of this bird island restoration project is the historic Causeway Bird Island located approximately 0.1 mile northeast of Rincon Canal and 2.3 miles north of the Corpus Christi Ship Channel (CCSC; latitude 27.8417226; longitude -97.376733; Figure 2). The size of the site is up to 16 acres. Likely sediment sources include the Rincon Canal and CCSC. The site is an active rookery that currently supports thousands of nesting pairs of colonial waterbirds. (CBBEP 2020).

4.7.2 Dagger Island

The site of this wetland restoration project is 0.4 mile north of the CCSC and 0.1 mile east of the GIWW and located between Redfish Cove and the CCSC (latitude 27.8290736; longitude -97.183444; Figure 3). The size of the site is up to 33 acres. The likely sediment source is the CCSC. The CCSC yields a variable volume of sediment during its annual dredging cycle that may make it the primary borrow source.

4.7.3 Feeder Berm North of Fish Pass

The site of this feeder berm project is located approximately 1.0 mile northeast of Fish Pass (latitude 27.6936736; longitude -97.152511; Figure 4). The size of the feeder berm is up to 75 acres. The likely sediment source is the Corpus Christi Entrance Channel, located 13 miles north of the site. PCCA proposes to deepen and extend the Entrance Channel, resulting in the dredging of 29.3 million cubic yards of sand from new work and maintenance over a 10-year period. The feeder berm will likely deposit sediment on landward beaches that suffer from heavy erosion. Additional modeling will need to be done in further design phases to confirm the feasibility of the project.

4.7.4 Little Bird Island North

The site of this bird island creation project is 0.7 mile northeast of the existing Little Bird Island (latitude 28.2931587; longitude -96.697227; Figure 5). The size of the project is up to 8 acres. The likely sediment source is inside the site itself, as well as dredged material from the GIWW and Channel to Victoria. USACE has historically performed periodic dredging in the nearby GIWW and the Channel to Victoria. Sensitive oyster habitat is located near the project area, and seagrass habitat needs to be evaluated more closely to advance the project beyond the 60% phase of the design.

4.7.5 M10

The site of this wetland creation project is approximately 0.25 mile south of the CCSC and <500 feet west of the GIWW near Ingleside in Corpus Christi Bay (latitude 27.8094331; longitude -97.209519; Figure 6). The size of the project is up to 840 acres. The likely sediment sources for the project include the borrow area at Harbor Island and the CCSC. The volume of material in situ at Harbor Island is approximately 5.5 million cubic yards, which could provide most of the sediment needed for Phase 1 of the project (berm construction). Adjacent to the site is DMPA #10. Although it is not anticipated that the site will interfere with ongoing USACE operations, further evaluation will occur in subsequent design phases to confirm the feasibility of this project. One active gas well that will need to be considered in further design phases is located within the site’s boundaries. The need for site-specific utility locations prior to construction will also be determined during subsequent design phases

4.7.6 PA9-S

The site of this wetland creation project is the existing PA9-S island, which is a DMPA located approximately 0.5 mile east of the GIWW and 0.4 mile south of the CCSC and between the existing M10 island and Pelican Island (latitude 27.8149366; longitude -97.184385; Figure 7). The size of the project is up to 220 acres. The likely sediment source is suitable material excavated from the site itself and dredged material from the CCSC. There are many pipelines and several plugged wells in the area. The need for site-specific utility locations prior to construction will be determined during subsequent design phases.

4.7.7 Rabbit Island South Bird Island

The site of this bird island restoration project is approximately 0.32 mile east of the GIWW and between DMPAs #199 and #200 (latitude 27.2457833; longitude -97.41439; Figure 8). The size of the project is up to 10 acres. The likely sediment source is relict new work material existing inside the site and GIWW. The location has some dense seagrass nearby, so further analysis of this sensitive habitat will be conducted in subsequent design phases.

5 Site Planning

5.1 Overview

Anchor QEA led the E&D for 16 of the 20 10% sites, and PCCA led E&D for 4 sites at the 10% level. The analysis, planning, and E&D approaches were similar across all 20 sites, although the analysis differed for different project types. The details of the E&D for each site are included in the respective design memoranda, which can be found in Appendices A, B, and C.

The following discussion sets forth the information and analysis applicable to all 20 sites.

5.2 Design Objectives

The design objectives vary by project type, and this section details the objectives that guided the planning for each identified project type.

Beach renourishment. The design objectives for beach renourishment are as follows:

- Develop a preliminary vision based on available data for the site that includes the following:
  - Beach to be renourished
  - Potential sediment source(s)
- Delineate conceptual footprints for proposed BU placement.
- Identify key sensitive habitats and construction considerations in the site's vicinity.
- Estimate fill volumes for the proposed BU footprints.
- Identify data gaps to be addressed in subsequent design phases.
- Provide preliminary cost estimates.

Beach renourishment via feeder berm. The design objectives for beach renourishment via feeder berm are as follows:

- Develop a preliminary vision based on available data for the site that includes the following:
  - Beach to be renourished
  - Potential sediment source(s)
- Delineate conceptual footprints for proposed BU placement, in part based on an evaluation of the depth of closure.
- Identify key sensitive habitats and construction considerations in the site's vicinity.
- Estimate fill volumes for the proposed BU footprints.
- Determine a berm shape and location that avoids increasing wave erosion on existing beaches.
- Identify data gaps to be addressed in subsequent design phases.
- Provide preliminary cost estimates.

Bird island creation and restoration. The design objectives for bird island creation and restoration are as follows:

- Develop a preliminary vision based on available data for the site that includes the following:
  - Habitat to be created or restored
  - Potential sediment source(s)
  - Approaches to minimize long-term maintenance costs, while providing adequate erosion protection and containment
- Delineate conceptual footprints for proposed BU placement.
- Identify key sensitive habitats and construction considerations in the site's vicinity.
- Estimate fill volumes for the proposed BU footprints.
- Examine key rookery species in the region.
- Identify data gaps to be addressed in subsequent design phases.
- Provide preliminary cost estimates.

Seagrass restoration. The design objectives for seagrass restoration are as follows:

- Develop a preliminary vision based on available data for the site that includes the following:
  - Habitat to be created or restored
  - Potential sediment source(s)
  - Approaches to minimize long-term maintenance costs
- Delineate conceptual footprints for proposed BU placement.
- Identify key sensitive habitats and construction consideration in the vicinity of the site.
- Estimate fill volumes for the proposed BU footprints.
- Identify data gaps to be addressed in subsequent design stages.
- Provide preliminary cost estimates.

Tidal flats restoration. The design objectives for tidal flats restoration are as follows:

- Develop a preliminary vision based on available data for the site that includes the following:
  - Habitat to be created or restored
  - Potential sediment source(s)
  - Approaches to minimize long-term maintenance costs
- Delineate conceptual footprints for proposed BU placement.
- Identify key sensitive habitats and construction consideration in the vicinity of the site.
- Estimate fill volumes for the proposed BU footprints.
- Identify data gaps to be addressed in subsequent design stages.
- Provide preliminary cost estimates.

Wetlands Creation and Restoration. The design objectives for wetlands creation and restoration are as follows:

- Develop a preliminary vision based on available data for the site that includes the following:
  - Habitat to be created or restored
  - Potential sediment source(s)
  - Approaches to minimize long-term maintenance costs, while providing adequate erosion protection and containment
- Delineate conceptual footprints for proposed BU placement.
- Identify key sensitive habitats and construction considerations in the site's vicinity.
- Estimate fill volumes for the proposed BU footprints.
- Evaluate existing wetlands conditions to inform restoration target wetlands elevation ranges.
- Identify data gaps to be addressed in subsequent design phases.
- Provide preliminary cost estimates.

5.3 Data Review and Collection

In preparing the design memoranda, the Project Team gathered and evaluated information provided by the following data sources for each site:

- NOAA Data Access Viewer (NOAA 2023)
- GLO Coastal Resources Mapping Viewer (GLO 2023)
- TPWD Seagrass Viewer (TPWD 2023)
- RRC Public GIS Viewer (RRC 2023)
- Texas Historical Commission (THC) Historic Sites Atlas (THC 2023)

5.3.1 Horizontal and Vertical Datums

Anchor QEA and PCCA consulted the NOAA active tidal stations proximate to their respective sites to obtain tidal datums and water level data. These stations contain tidal datums established from the present epoch (1983 to 2001). These tidal datums were used to inform the vertical datums used in the designs. The horizontal datums used for each site are either Texas State Plane South Central Zone or Texas State Plane South Zone, North American Datum of 1983 in U.S. survey feet. For all sites, the vertical datum used was the North American Vertical Datum of 1988 (NAVD88). Details on the vertical and horizontal datums used for each site are set forth in each respective BODR (Appendix C).

5.3.2 Surveying

The elevations at each site were physically surveyed as follows:

- DU performed bathymetric and topographic surveys during the 30% design stage in March and April 2022 for Causeway Bird Island, Little Bird Island North, PA9-S, Pelican Island (M3), Nueces Delta, DMPA #214 Bird Island, and Rabbit Island South Bird Island.
- Naismith Marine Services performed a bathymetric survey as a part of an earlier, unrelated design effort for M10 in October 2019.
- T. Baker Smith performed a bathymetric survey during the 30% design stage of Feeder Berm North of Fish Pass in March 2022.
- Triton Environmental Solutions performed bathymetric and topographic surveys during the 30% design stage of Dagger Island and Portland Nueces Bay Marsh in March and April 2022.

These surveys provide varying levels of detail and are of various ages. Bathymetry and topography data gaps may remain for the various sites and will be addressed during subsequent design as described in each site's respective BODR (Appendix C).

5.3.3 SAV and Oyster Locations

The TPWD Seagrass Viewer was used to locate submerged aquatic vegetation (SAV) observed in the vicinity of each site (TPWD 2023). This viewer combines SAV data from TPWD, NOAA, and the Texas Commission on Environmental Quality.

The GLO Coastal Resources Mapping Viewer was also used to identify areas in and around the sites designated as oyster habitat (GLO 2023). Observations concerning potential oyster habitat are discussed in each site summary.

DU conducted visual seagrass and oyster surveys for Pelican Island (M3), PA9-S, Rabbit Island South Bird Island, Causeway Bird Island, Little Bird Island North, DMPA #214 Bird Island, and Nueces Delta. Observations from these surveys were used to inform designs and permit application packages for each site.

Triton Environmental Solutions conducted aquatic-sensitive resources and Waters of the United States surveys for Portland Nueces Bay Marsh and Dagger Island. These surveys included topographic and bathymetric data, habitat and wetland delineation, and sensitive habitat identification. Detailed information on these surveys are included in the reports from Triton Environmental Solutions referenced in each site's respective BODR (Appendix C).

Additional site-specific sensitive habitat surveys may be performed during the final design phase or before construction if required by regulatory agencies for an individual site.

5.3.4 Location of Utilities

RRC maintains an oil and gas pipeline and well database (RRC 2023). Information about the location of utilities is discussed in each site summary. Further delineation of pipeline easements and restrictions and more precise utility locations will likely need to be developed during the final design stage of a site before construction, as described in the BODR for each site where utilities are known to be present. Contractors will also be required to call the national 811 "Call Before You Dig" hotline for all sites to confirm the location or absence of utilities on site before beginning construction. A magnetometer survey and additional measures may also be required by regulatory agencies to supplement information on utility locations.

5.3.5 Habitat Information

The specific habitat of each site is discussed in the respective BODR in Appendix C.

5.3.5.1 Desktop Cultural Resources Survey

The THC Historic Sites Atlas Database was queried with site-specific search terms for each site (THC 2023). The results of the queries are discussed in each BODR in Appendix C.

5.3.5.2 Beneficial Use Source Material

During the design process, dredged material from routinely dredged adjacent waterways, as well as dredged material from nearby potential dredging projects, was provisionally identified for several sites based on historical records (USACE 1999), communication with USACE (Jones 2022), and communication with stakeholders. The availability, volume, physical characteristics, and quality of the dredged material will be determined during final design and permitting. The sites were designed such that the projects could accept dredged material with a variety of grain sizes, where possible. This was done to maximize the potential pool of beneficial use source material sources.

5.3.6 10% Design

Twenty sites were selected for 10% design memoranda based on stakeholder input and publicly available data, as well as the Project Team's analysis of various factors relating to project success. The 10% design memoranda are found in Appendix A.

5.3.7 30% Design

The list of 20 sites selected for 10% design was narrowed by the Project Team based on further stakeholder input and a more intensive analysis of potential success factors for each project type. Of the 20 sites selected for 10% design, the Project Team selected 11 and prepared a 30% design memorandum for each site. The 30% design memoranda are found in Appendix B.

5.3.8 60% Design

The final list of seven sites selected for 60% design was developed by further refining and narrowing the list of 30% design sites, with one additional site added as described in Section 4.7. This section describes common design considerations that factored into the 60% design process.

5.3.8.1 Target Elevations

The placement of dredged material at each site involves filling the designated areas to certain target elevations. Determination of the target elevation at each location is based on many factors, including analysis of surveyed existing elevations, aerial imagery, nearby sites with similar habitat in good condition, and final elevations of previously constructed successful similar projects.

5.3.8.2 Containment Details

Most designs include some form of containment to hold the deposited dredged material in place while it dewaters and consolidates into a more stable mass. Containment structures may be constructed with rock, imported fill material, in situ site material, suitable dredged material, or a combination of these. Other containment materials or structures may be considered during advancement of the design. Some sites were designed to have armored containment, which can be expected to be fairly resistant to erosion, while other sites were designed with unarmored containment. While unarmored containment is more susceptible to erosion, it is also much less costly. The containment design may be modified during final design based on additional data collection (e.g., the character of the subgrade where the containment will be built) and the cost preferences of the project proponent.

The dredged material is assumed to be placed using hydraulic methods. This means material will be pumped into the placement areas in a slurry entrained with large volumes of water. The containment, where appropriate, will be designed such that the entrained sediment will settle out of the slurry inside the placement areas, and the excess clean water will run out of the placement areas. For the placement areas to drain properly, weir structures may need to be constructed within the containment structures. The use and location of weir structures will depend on the physical properties of the BU material, the slurry characteristics, and the type of containment used. These details will be determined during a subsequent design phase.

5.3.8.3 Wetlands Fill Design

For wetlands restoration projects, wetlands fill design will depend on each site's characteristics and the method of fill placement. These methods are discussed in each site's BODR. Target elevations may be adjusted during final design based on new information, such as previously constructed successful wetlands creation projects and new vegetation data, as available.

The main design elements evaluated for a wetlands restoration site are as follows:

- Site location
- Wetlands size and shape
- Containment and erosion protection
- Constructability
- Planting and natural recruitment of vegetation
- Performance expectations
- Site construction cost estimates
- Expected ecosystem benefits
- Data and information gaps that need to be filled to advance the design to a subsequent phase

5.3.8.4 Bird Island Design

Bird island projects use dredged material and containment structures to create or restore rookery islands in regions with degrading bird habitat. Stabilizing the shorefront and attenuating wave energy are key to protecting these islands from erosion.

The main design elements evaluated for bird island design are as follows:

- Site location
- Rookery island size and shape
- Containment and erosion protection
- Constructability
- Planting and natural recruitment of vegetation
- Performance expectations
- Site construction cost estimates
- Expected ecosystem benefits
- Data and information gaps that need to be filled to advance the design to a subsequent phase

5.3.8.5 Feeder Berm Design

Feeder berms are nearshore berms typically placed as elongate bars or mounds between the location where the depth of closure occurs and the shoreline. Placement in water deeper than the depth of closure would likely result in no meaningful transport of sediments to the shoreline. Placement in very shallow water is difficult and, hence, costly. Feeder berms can be the preferred BU method for beach renourishment due to less-strict grain size requirements (with a goal for sands to erode into the littoral zone to renourish beaches, while fines are dispersed offshore), as well as generally being less costly to build, easier to construct, and having less environmental impact to beach nesting than direct beach placement (Brutsché et al. 2019). Along with the benefits, dredged material placement within a feeder berm may have potential unintended impacts. Some of the unintended impacts may include the following:

- Uneven distribution of material along the beach due to natural processes that may be difficult to predict
- Uneven eroding of the berm, leading to wave focusing due to refraction
- Transport of dredged material in the longshore direction, which could place sediment in an unintended adjacent area.

For these reasons, it is important to have a detailed understanding of the wind, wave, and hydrodynamic conditions for the site.

The main design elements evaluated for the feeder berm sites are as follows:

- Site location
- Size and shape
- Constructability
- Performance expectations
- Site construction cost estimates
- Expected ecosystem benefits
- Data and information gaps that need to be filled to advance the design to a subsequent phase

5.3.8.6 Geotechnical Considerations

Designing to accommodate geotechnical characteristics of the subgrade in each restoration area is key to the success of the restoration. Soft subgrades may require special consideration when designing and constructing containment berms and when evaluating the long-term performance of restoration fill elevations. Subgrade settlement will also affect final elevations and dredged material capacity within the contained footprint. For restoration projects that rely on a targeted long-term elevation range, understanding geotechnical conditions at the site is an important design component.

There is little existing geotechnical information for the seven sites. Where such information is available, it is discussed in the BODR for each site. Where geotechnical data gaps have been identified, such data gaps are discussed in the BODR, and site cost estimates include the effort required to collect and evaluate geotechnical data.

Geotechnical information regarding the source material for each site will be evaluated upon identification of the dredged material source(s) for each project. The geotechnical properties of the material will inform construction considerations such as whether the material can be used for containment and the anticipated consolidation (settlement) of the material after placement. The preparation of final design is expected to require the collection of additional geotechnical data at many, if not all, of the sites.

5.3.9 Relative Sea Level Rise Considerations

Relative sea level rise is a factor that may impact each site over the long term. One strategy to mitigate relative sea level rise could be to place material to higher elevations in preparation for higher relative sea levels and tidal ranges in the future. This strategy, however, could result in reduced short-term habitat benefits. For example, if the target habitat is intertidal wetlands, then placement at a higher elevation will not provide the desired habitat until sea level rise results in the site becoming intertidal at an uncertain time in the future. Conversely, bird islands can be built taller, and the designs call for sufficient elevation to remain emergent even after decades of sea level rise. (See the BODRs in Appendix C for details). Other strategies could include consideration of stronger wind and wave forces or modifications to the top elevation of containment structures in anticipation of different climatological effects on the restoration. To the extent that Project proponents will wish to consider relative sea level rise, additional evaluations would need to be conducted in a future design phase for the sites where this becomes a specific design consideration.

5.3.10 Project Construction Costs

The estimated Project construction costs include additional data collection, permitting, design, and engineering costs for advancing the design to the construction phase; preconstruction and as-built surveys; mobilization; demobilization; equipment; materials; construction of the containment; placement of dredged material; vegetative planting; and management of the site after construction. A high-end estimated cost was prepared by applying a contingency of 50% to accommodate data gaps, inflation, rising fuel costs, and potential changes in the final design. Assumptions were made concerning material quantities, material types, and means and methods of constructing containment berms for the dredged material within the placement areas. These items and their respective costs will be further detailed as each design advances.

These costs represent the estimated incremental costs, which are over and above USACE's costs to dredge and place material according to the federal standard. For example, under this assumption, USACE would pay the typical mobilization, demobilization, dredging, and placement costs for a local maintenance dredging project, and only the incremental costs associated with extra mobilization, pumping, and placement for BU site construction is included. The total incremental cost estimated for the construction is shown in each BODR included in Appendix C.

The estimates were developed using current and generally accepted engineering cost estimating methods. The estimates are based on assumptions concerning future events, and actual costs will likely vary from these estimates because of known and unknown factors including, but not limited to, changes in general economic and business conditions, site conditions unknown at the time the estimates were developed, future changes in site conditions, regulatory or enforcement policy changes, final design, and delays in performance.

5.3.11 Permitting

5.3.11.1 Permit Application Packages

Texas does not have a state-level permitting requirement for coastal projects. Project proponents will comply with state law affecting implementation of the construction projects under the jurisdiction of state natural resource agencies coordinated through the USACE permitting process.

For six of the sites, the Project Team completed an application for a permit under USACE Nationwide Permit 27: Aquatic Habitat Restoration, Enhancement, and Establishment Activities. (See 86 Federal Register 73576 through 73578 [December 27, 2021]). For the seventh site (Feeder Berm North of Fish Pass), the Project Team prepared an individual USACE permit application.

5.3.11.2 Potential Permit Applicants

The permit packages are designed for use by potential permit applicants, who will vary by project. All the sites are completely or partially on submerged land owned by the state or a navigation district. Only one of the sites, Dagger Island, is directly adjacent to private land. The Project Team has discussed the potential project with the landowners, who support it.

It is anticipated that conservation organizations may work with the public and private landowners to complete the BU projects through conservation easements and similar arrangements. If so, such an organization would be the Project proponent and thus the applicant for the USACE permit. It is also anticipated that PCCA may wish to pursue implementation of one or more of the sites and would thus be the USACE permit applicant.

6 60% Design Site Summaries

Aided by the data analysis, the Project Team delivered 60% design memoranda for seven sites. This section includes a summary of the BODR for each site. The 10% and 30% memoranda and BODRs for each site appear in the appendices.

6.1.1 Causeway Bird Island

The proposed site is the historical Causeway Bird Island, approximately 0.1 mile northeast of Rincon Canal and 2.3 miles north of the CCSC (Figure 2). The island has an average elevation of 0.42 foot NAVD88 and is surrounded by a recently constructed breakwater.

The proposed design will result in a 16-acre bird island and accommodate approximately 106,000 cubic yards of material. The proposed design for the site consists of placing dredged material to varying elevations within the protected area behind the breakwater to promote a variety of habitats.

The site is an active rookery that supports thousands of nesting pairs of colonial waterbirds (CBBEP 2020), and habitat restoration at the site will support increased colonial waterbird presence.

The existing breakwater at the site will serve as containment and to protect the proposed site from wake erosion and wind-generated waves.

The high-end cost estimate for construction of the project is $2 million, including a 50% contingency. The complete BODR for Causeway Bird Island appears in Appendix C.

6.1.2 Dagger Island

The proposed site is located 0.4 mile north of the CCSC and 0.1 mile east of the GIWW and located between Redfish Cove and the CCSC (Figure 3). The site partially overlaps with existing DMPA #162. The average elevation of the site is -0.2 foot NAVD88.

The proposed design will construct approximately 28 acres of low and high marsh and 5.3 acres of seagrass habitat in what is currently open water areas of the site. The proposed design consists of fill extending to the edge of existing vegetation or to the edge of the constructed containment berm. Sediment will be placed within a range of elevations to create a variety of habitats. The estimated fill volume for the site is 260,000 cubic yards.

A 4,000-linear-foot containment berm will be designed to contain and protect the dredged materials and future wetlands from edge erosion.

The high-end cost estimate for construction of the project is $8.3 million, including a 50% contingency. The complete BODR for Dagger Island appears in Appendix C.

6.1.3 Feeder Berm North of Fish Pass

The location of the site is approximately 1.0 mile northeast of Fish Pass and 13 miles from the CCSC (Figure 4). The proposed feeder berm site is in an area with average elevations ranging from -10 to -15 feet NAVD88. The adjacent longshore area that is in an erosional environment extends from north of Fish Pass to the Port Aransas Jetties (12 miles northeast of the site; BEG 2023).

The proposed design will construct a berm with an area of up to 75 acres. The berm constructed at the site will be oriented parallel to the shore. The fill volume of the site will be approximately 500,000 cubic yards. The berm is intended to renourish adjacent beaches with its sediment.

No containment will be required for this project.

The high-end cost estimate for construction of the project is $5.6 million, including a 50% contingency. The complete BODR for Feeder Berm North of Fish Pass appears as Appendix C.

6.1.4 Little Bird Island North

The location of the site is 0.7 mile northeast of the existing Little Bird Island and 0.25 mile northwest of the GIWW (Figure 5). This location is 50 feet from existing oyster habitat to the north and northwest of the site, 100 feet from existing oyster habitat to the west and southwest of the site, and 150 feet from USACE DMPA #122. The average seabed elevation at the site is -3.5 feet NAVD88.

The proposed design envisions construction of a bird island of approximately 8 acres that is ovular in shape. The site will be filled with dredged material up to +5.0 feet NAVD88 toward the center of the site. The site will accommodate a volume of approximately 202,000 cubic yards of material.

The proposed site is approximately 1.75 miles from the nearest shoreline. This distance is greater than the 0.5-mile distance identified for minimizing predator access to rookery islands (Stanzel 2018).

An armored containment berm and a 200-foot-long rock sill will be constructed to protect the island from erosive forces, while allowing the island to slope gently to sea level in the vicinity of the sill. The berm and sill will provide a hard substrate for oyster colonization.

The high-end cost estimate for construction of the project is $11.6 million, including a 50% contingency. The complete BODR for Little Bird Island North appears as Appendix C.

6.1.5 M10

The location of the site is 0.25 mile south of the CCSC and 500 feet west of the GIWW near Ingleside in Corpus Christi Bay (Figure 6). The site is directly adjacent to DMPA #10, an upland placement area. Thus, additional coordination with USACE will be required. The site has an average seabed elevation of -10.0 feet NAVD88.

The proposed design will construct up to 840 acres, with 760 acres as wetlands fill and 80 acres as containment dikes, with a required fill volume of approximately 20 million cubic yards of material. Multiple maintenance dredging events will be needed to fill the site, or material from upcoming new work could potentially fulfill the required volume. The wetlands on the site will be a mix of low and high marsh.

Three dikes will be constructed to contain and protect the dredged material. Additional armoring may be determined necessary in further design phases.

The high-end cost estimate for construction of the project is $187.1 million, including a 50% contingency. The complete BODR for M10 appears as Appendix C.

6.1.6 PA9-S

The existing PA9-S island is a DMPA located approximately 0.5 mile east of the GIWW and 0.4 mile south of the CCSC and between the existing M10 island and Pelican Island (M3; Figure 7). The proposed site will expand the southern footprint of the existing PA9-S island. Discussion with USACE staff indicates the project will not interfere with ongoing dredged material placement operations (Kinman 2022). The average seabed elevation of the site footprint is -7.0 feet NAVD88.

The proposed design will construct approximately 220 acres and create up to 172 acres of wetlands in what is currently open-water areas of the site. The site will support a range of low and high wetlands habitat. The required fill volume is approximately 4 million cubic yards.

An 8,000-foot-long sand containment berm will be constructed to create capacity, protect the placed dredged material, and create intertidal habitats protected from erosion.

The high-end cost estimate for construction of the project is $39.2 million, including a 50% contingency. The complete BODR for PA9-S appears as Appendix C.

6.1.7 Rabbit Island South Bird Island

The location of the site is approximately 0.2 mile east of the GIWW and between DMPAs #199 and #200 (Figure 8). The average seabed elevation of the site averages -1.4 feet NAVD88.

The site is approximately 0.7 mile from the nearest shoreline. The distance is greater than the 0.5-mile distance identified for minimizing predator access to rookery islands (Stanzel 2018).

The proposed design will construct a rookery island of approximately 10 acres. The site will be filled to an elevation of +5.0 feet NAVD88 and will be approximately elliptical in shape. A seagrass shelf will be constructed along the east side of the island. The required fill volume for the island and shelf is approximately 135,000 cubic yards of material.

A containment berm will be constructed around the site to confine the dredged material, reduce the potential impacts to adjacent seagrass habitat, and reduce erosion.

The high-end cost estimate for construction of the project is $4.2 million, including a 50% contingency. The complete BODR for Rabbit Island South Bird Island appears as Appendix C.

7 Conclusion

In recent years, BU has become increasingly important as a tool for coastal restoration and resiliency. Relative sea level rise, erosion, and subsidence are causing coastal land loss on a massive scale. The demand for sediment to mitigate this loss is high, as is the cost of transporting and placing fill material where it is needed. The dredging of navigational channels produces millions of cubic yards of material on the U.S. coast annually, and the dredged materials are sediments that can be used to combat land loss. The BU for wetland and bird island restoration and beach renourishment combines the need for sediment with the need for disposal locations. Projects involving beneficial use require long-range planning and often involve complex land use, permitting, scheduling, and funding issues. Natural resource agencies have recognized the value of planning for BU projects years in advance to ensure their eventual successful implementation. Thus, the planning produced by this Project creates valuable resources for dredging sponsors and habitat restoration advocates to employ in advancing BU projects for years to come on the Lower Texas Coast.

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Figures

LEGEND:

Beneficial Use Site

Level of Design Completed

- 10% Only
- 10% and 30%
- 60% Only
- 10%, 30%, and 60%

NOTE:
1. Basemap from Esri

PINS: Padre Island National Seashore

Publish Date: 2023/02/28, 3:40 PM | User: jquinley
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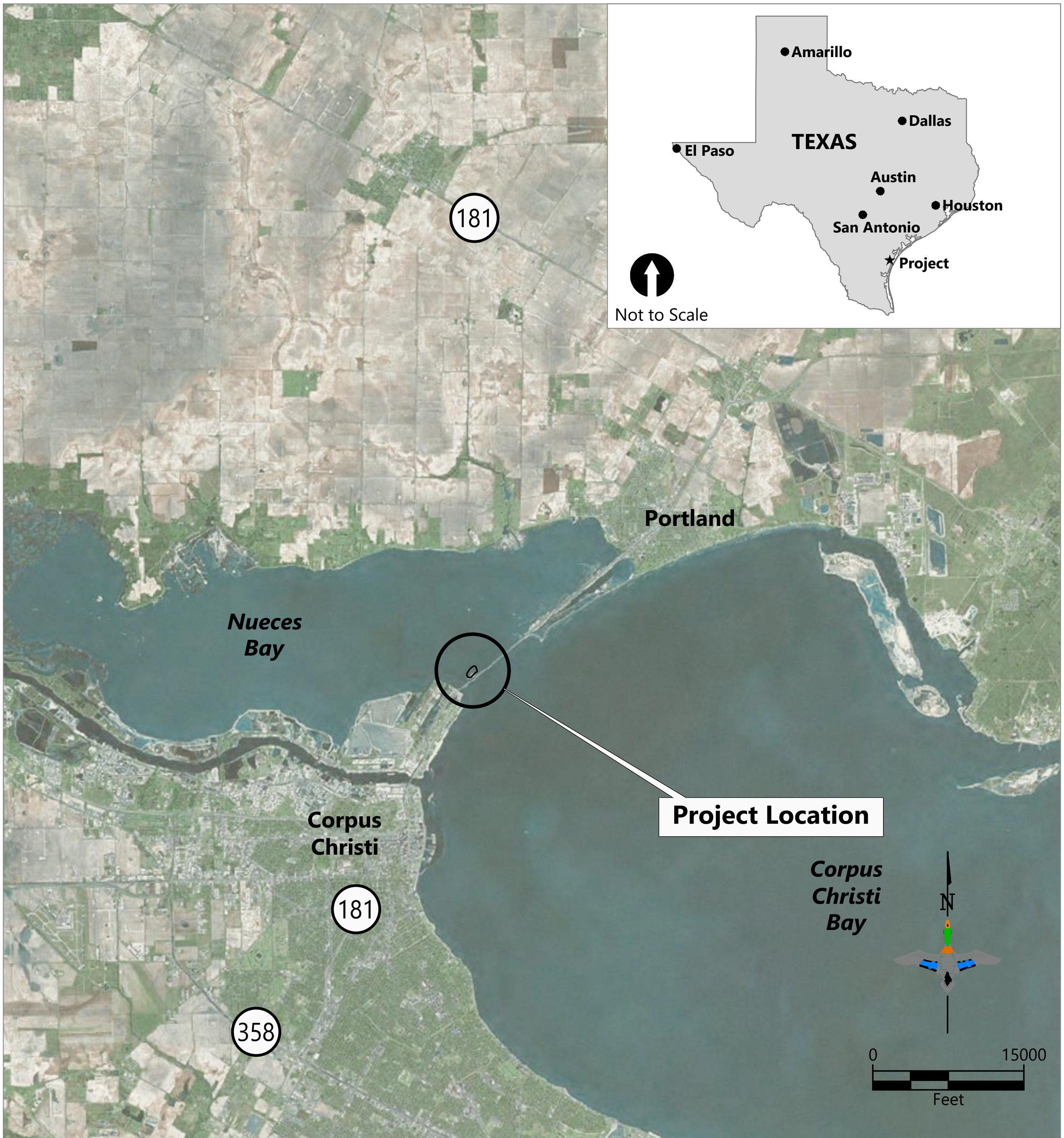
ANCHOR QEA

Figure 1
Beneficial Use Site Locations and Design Status

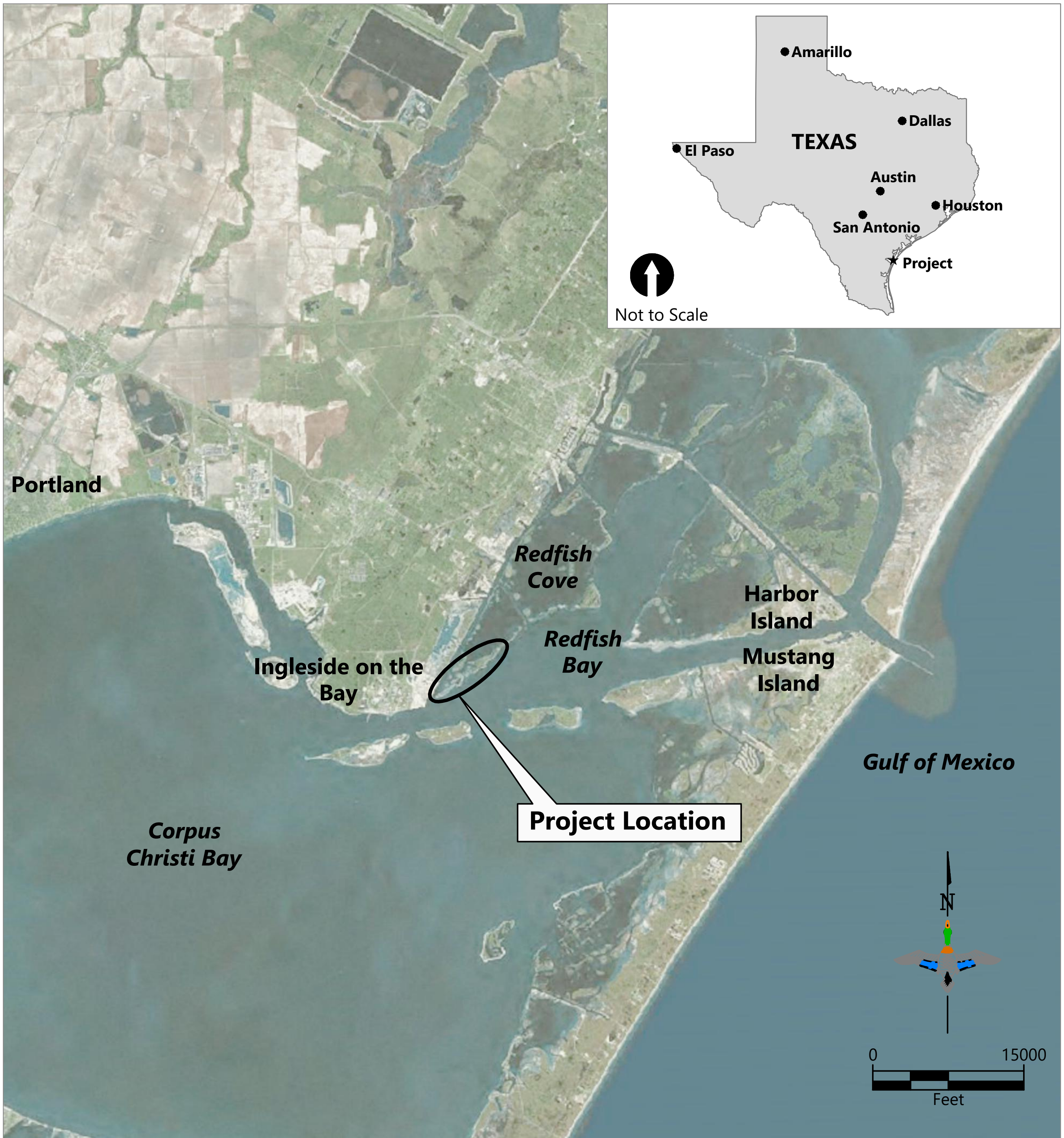


SOURCE: Aerial provided by Bing Maps.
HORIZONTAL DATUM: Texas State Plane South Zone, North American Datum of 1983, U.S. Survey Feet

Publish Date: 2022/09/29 4:33 PM | User: mpratschner
Filepath: K:\Projects\2018-PCCA Beneficial Use\CAUSEWAY BIRD ISLAND\2018 RP-001 VIC MAP.dwg Figure 1

ANCHOR QEA

Figure 2
Project Vicinity: Causeway Bird Island



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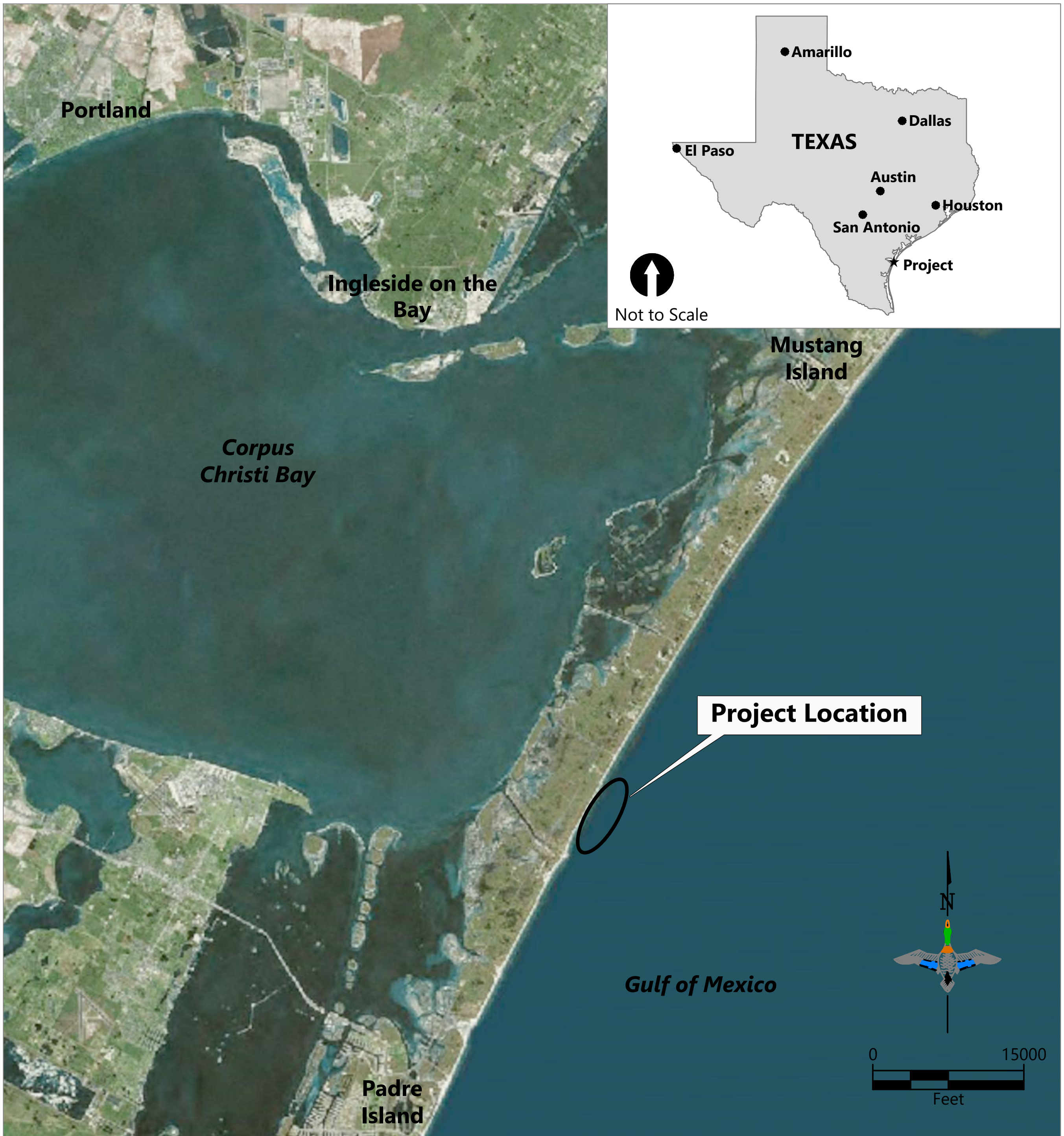
HORIZONTAL DATUM: Texas State Plane South Zone, North American Datum of 1983, U.S. Survey Feet

Publish Date: 2023/02/28 3:25 PM | User: mpratschner
Filepath: K:\Projects\2018-PCCA Beneficial Use\DAGGER ISLAND\2018 RP-001 VIC MAP.dwg Figure 3

Figure 3
Project Vicinity: Dagger Island



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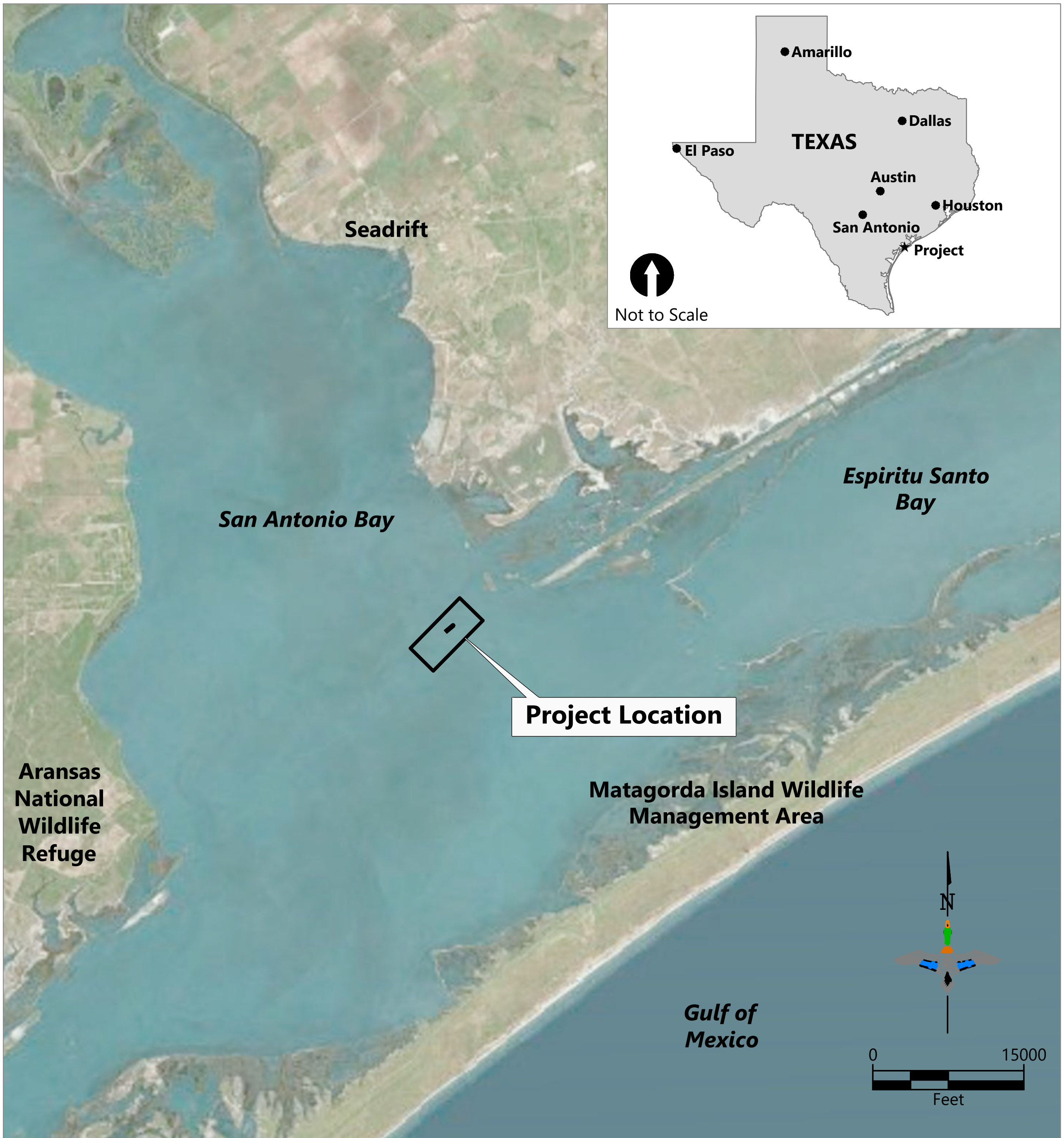
Filepath: K:\Projects\2018-PCCA Beneficial Use\FISH PASS\2018 RP-001 VIC MAP FBNFP.dwg Figure 1

ANCHOR QEA

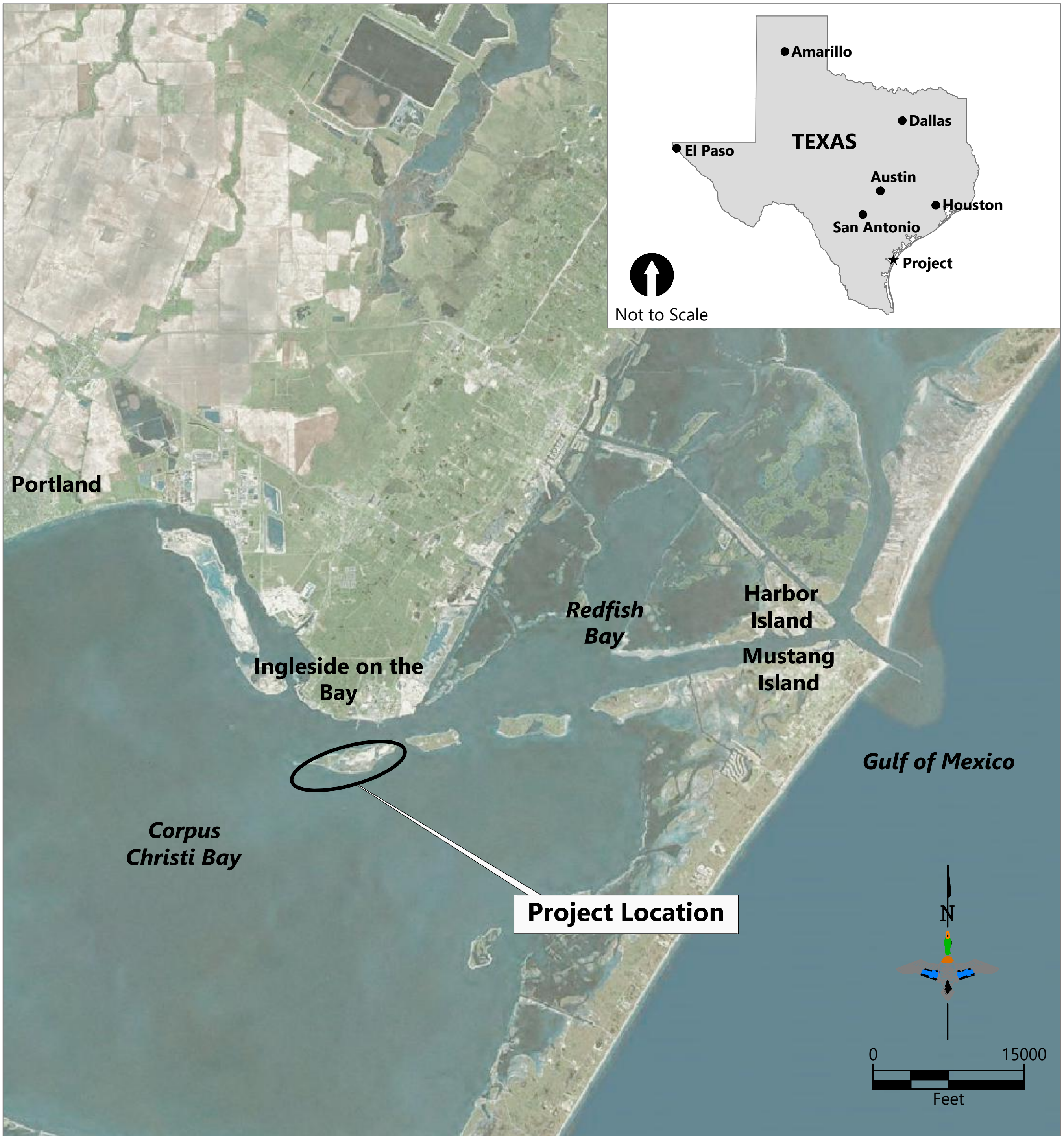
Figure 4
Project Vicinity: Feeder Berm North of Fish Pass



SOURCE: AERIAL IMAGE ©2022 MICROSOFT BING, MICROSOFT CORPORATION EARTHSTAR GEOGRAPHICS.
HORIZONTAL DATUM: TEXAS STATE PLANE SOUTH ZONE, NORTH AMERICAN DATUM OF 1983, U.S. SURVEY FEET

Publish Date: 2022/09/14 9:21 AM | User: psciaba
Filepath: K:\Projects\2018-PCCA Beneficial Use\Little BIrd Island North\2018 RP-002 DMMP Attach - Vicinity Map.dwg Figure 1

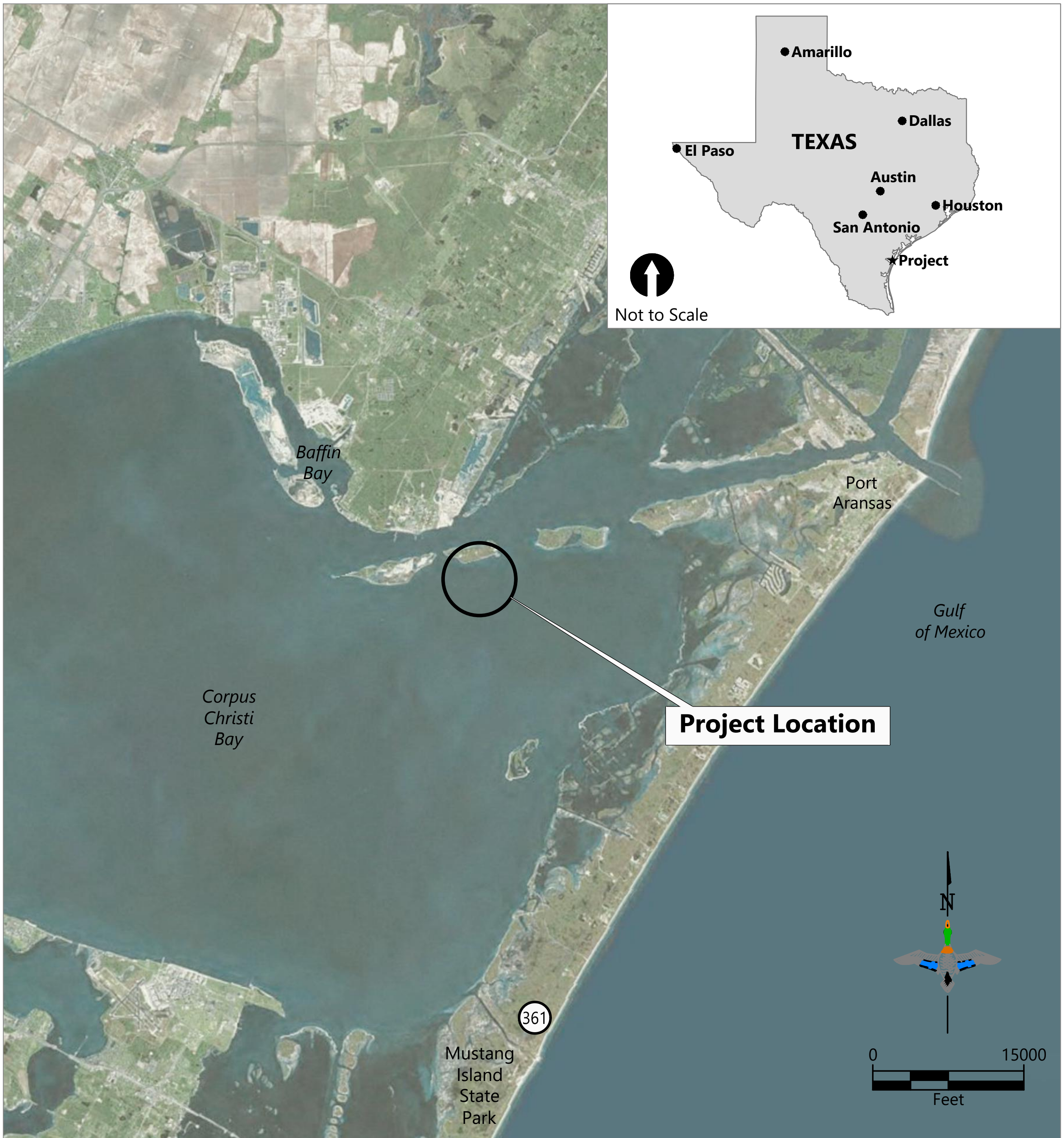
Figure 5
Project Vicinity: Little Bird Island North



SOURCE: Aerial provided by Bing Maps.
HORIZONTAL DATUM: Texas State Plane South Zone, North American Datum of 1983, U.S. Survey Feet

Publish Date: 2022/12/15 8:52 AM | User: mpratschner
Filepath: K:\Projects\2018-PCCA Beneficial Use\M10\2018 RP-001 VIC MAP_M10.dwg Figure 1_M10

Figure 6
Project Vicinity: M10



SOURCE: Aerial provided by Bing Maps.
HORIZONTAL DATUM: Texas State Plane South Zone, North American Datum of 1983, U.S. Survey Feet

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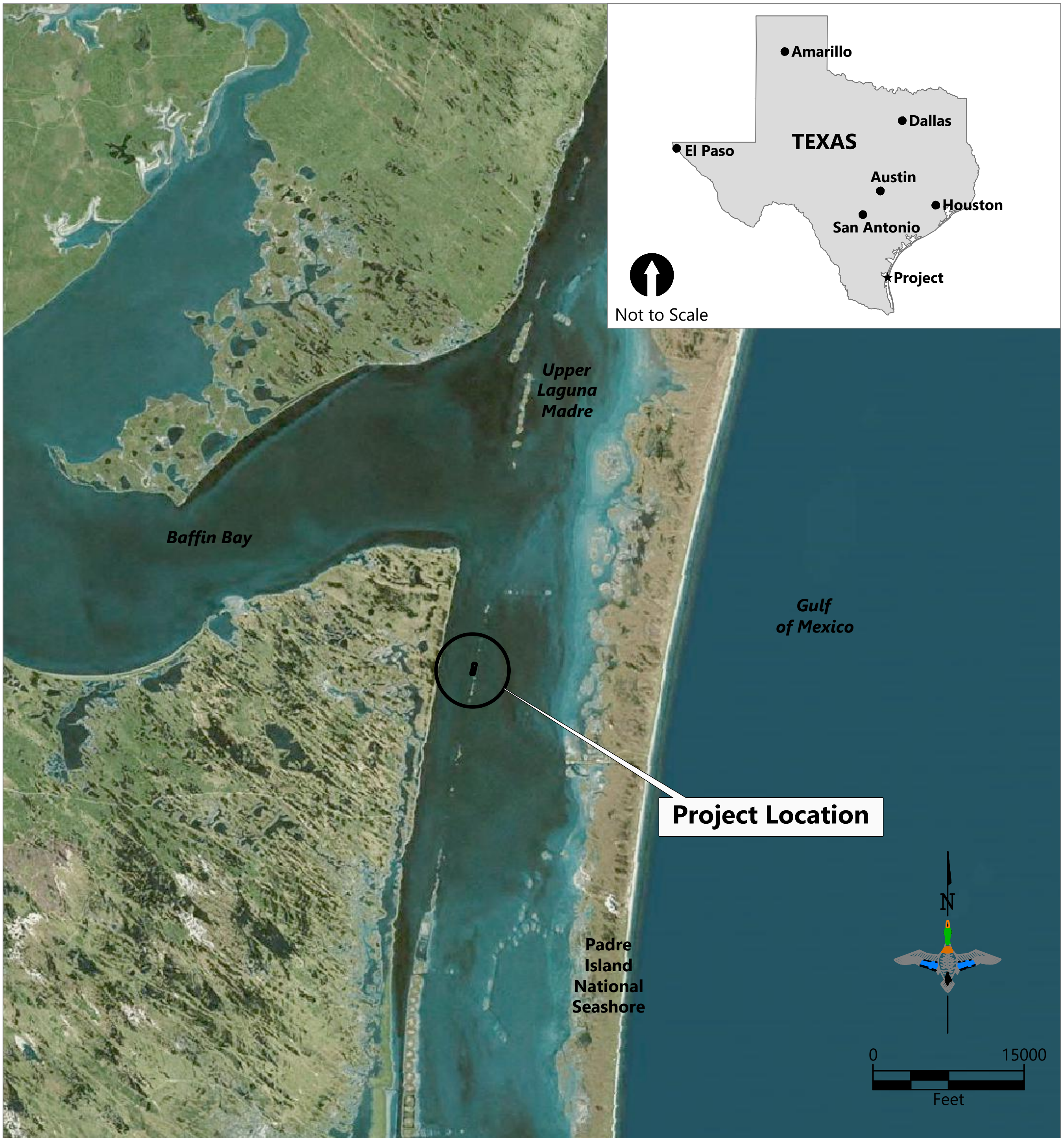
Filepath: K:\Projects\2018-PCCA Beneficial Use\PA9-S\2018 RP-001 VIC MAP.dwg Figure 1

Figure 7
Project Vicinity: PA9-S



SOURCE: Aerial provided by Bing Maps.
HORIZONTAL DATUM: Texas State Plane South Zone, North American Datum of 1983, U.S. Survey Feet

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Filepath: K:\Projects\2018-PCCA Beneficial Use\RABBIT ISLAND SOUTH\2018 RP-002 DMMP Attach - Vicinity Map.dwg Figure 1

ANCHOR QEA

Figure 8
Project Vicinity: Rabbit Island South

Appendix A
10% Design Memoranda

Memorandum

January 31, 2022

To: Melissa McCutcheon, Texas General Land Office

From: Todd Merendino, Ducks Unlimited
Sarah Garza, Harrison McNeil, and Yvonne Dives-Gomez, Port of Corpus Christi Authority
John Laplante, Dan Opdyke, Ray Newby, Adrienne Accardi, Alexander Freddo, and Hayden Smith, Anchor QEA, LLC
Jane Sarosdy, Sarosdy Consulting, Inc.

Re: ANWR Long Lake Marsh and Channel 10% Design Memorandum

Introduction

This 10% design memorandum describes design criteria and assessments associated with the proposed Aransas National Wildlife Refuge (ANWR) Long Lake Marsh and Channel site (Site), located in Texas General Land Office (GLO) Planning Region 3 of the Texas coast just northwest of Sundown Bay in Aransas County, Texas (Figure 1).

Project Background

GLO awarded a Coastal Management Program Project of Special Merit grant (funded through the Gulf of Mexico Energy Security Act) to Ducks Unlimited, Inc. (DU), to identify priority locations and develop 10% designs and opinions of probable construction costs for at least 16 sites in GLO Planning Regions 3 and 4 of the Texas coast for the beneficial use of dredged material (BU). For this project, sites in Matagorda Island, which is adjacent to the border with Region 3, are also eligible, as approved by GLO. The project team is led by DU and Port of Corpus Christi Authority (PCCA) and includes Anchor QEA, LLC; Sarosdy Consulting, Inc.; and the Texas Department of Transportation. In addition to the 16 sites identified and prioritized, PCCA will provide additional resources to bring forward more site designs for review if the site prioritization and selection so warrants. The project team coordinated two online stakeholder meetings in each region to receive information about potential BU sites. Based on stakeholder input, GLO feedback, publicly available data, and professional judgment, the project team selected the Site as one of the 16 sites for 10% design development and cost estimation.

ANWR Long Lake Marsh and Channel is an area of marsh located on United States Fish and Wildlife Service land approximately 0.5 mile northwest of the Gulf Intracoastal Waterway (GIWW) and north of Sundown Bay in Aransas County, Texas. This area was selected because the existing straight channel allows undesirably high rates of water flow, which is contributing to interior marsh deterioration. The addition of dredged material will reduce flow and elevate open-water areas to promote healthy marsh conditions.

Project Objectives

Frequent dredging is needed to develop and maintain Texas ship channels. The dredged material must be deposited in dredged material placement areas (DMPAs), and many of the existing DMPAs along the Texas coast are nearing capacity. Resource agencies and stakeholders have long advocated using dredged material beneficially to create and restore wetlands and bird islands, nourish beaches, and counteract land loss. Historically, BU projects are difficult to manage because they are multi-year, multi-faceted undertakings in which different organizations manage dredging schedules, funding, project design, permitting, and construction activities. To help address these issues, the objectives of this project include the following:

- Create and restore degrading coastal habitats.
- Establish sites for placement of dredged material to reduce reliance on existing DMPAs.
- Improve coastal resiliency of the natural and built environment.
- Reduce shoaling in the GIWW and other ship channels.

To accomplish these objectives, the project includes the following tasks:

- Stakeholder outreach and coordination
- Identification and selection of BU sites
- 10% designs and cost estimates for at least 16 BU sites
- 30% designs for at least eight BU sites
- 60% designs, cost estimates, and permit application packages for at least five BU sites

This memorandum documents the 10% design and cost estimate for one of the selected sites.

Design Objectives

This Site will be designed to beneficially use dredged material to create and restore marsh habitat in a region with degrading marsh. The design will use material dredged from navigation channels during routine maintenance, thus reducing the volume of such material that will need to be placed in existing open-bay or upland DMPAs. This 10% design is based upon publicly available datasets; no field work was conducted for this phase of the project.

Design objectives include the following:

- Develop a preliminary vision based on available data for the Site that includes the following:
  - Habitat to be created or restored

  - Potential sediment source(s)
  - Approaches to minimize long-term maintenance costs
- Delineate conceptual footprints for proposed BU placement.
- Identify key sensitive habitats and construction considerations in the vicinity of the Site.
- Estimate fill volumes for the proposed BU footprints.
- Identify data gaps to be addressed in subsequent design stages.
- Provide preliminary cost estimates.

Existing Data Review

Horizontal and Vertical Datums

The horizontal datum used for the Site is the Texas State Plane Zone 4, North American Datum of 1983 (NAD83), in U.S. survey feet. The primary vertical datum used for the Site is the North American Vertical Datum of 1988 (NAVD88). The National Oceanic and Atmospheric Administration (NOAA) maintains an active tide gauge within the vicinity of the Site. The NOAA Aransas Wildlife Refuge Station 8774230 is 4.5 miles northeast of the Site. This station collects and records real-time tide information dating back to 2012. The vertical datums from this station that will be used for the Site are shown in Table 1.

Table 1
NOAA Aransas Wildlife Refuge Station 8774230 Tidal Gauge Displaying NAVD88 Tidal Datums

Tidal Datums	Elevation (feet NAVD88)
MHHW	1.28
MHW	1.28
MSL	1.12
MLW	0.95
MLLW	0.95

Notes:
MHHW: mean higher high water
MHW: mean high water
MLLW: mean lower low water
MLW: mean low water
MSL: mean sea level

Meteorological, Ocean, and Wave Data

Wind and Waves

The United States Army Corps of Engineers (USACE) Wave Information Studies (WIS) provides a national resource of long-term wavefield climatologies for U.S. coastal waters that synthesizes observations, multi-decade hindcasts, and storm event archives (USACE 2021). The WIS station closest to the Site is Station 73042, just offshore on the Gulf side of Matagorda Island in the Gulf of Mexico. Because the station is located offshore, the wave data are not applicable to this project design. However, the project team considers the wind data to be representative of the winds experienced at the Site. Figure 2 summarizes wind data from January 1, 1980, through December 31, 2014. The data indicate that the predominant wind direction is from the southeast, with significant winds also coming from the north, northeast, east, and south.

The Site resides on the Aransas National Wildlife Refuge and does not have a significant fetch direction. This is expected to be a low wave-energy environment; however, wave analysis of the direction and frequency of expected significant wave heights will need to be conducted in subsequent phases of design to confirm this assumption.

Wake Erosion

The GIWW is approximately 0.5 mile south of the Site. Potential wake erosion from vessels transiting the GIWW is not expected to be a design consideration because of existing land barriers. However, there is recreational vessel traffic through the existing channel and marsh. An analysis of the erosive effects of vessel traffic will be conducted during subsequent phases of design to better understand the extent of the present and future vessel-induced erosion of the channel and marsh.

Bathymetry

The NOAA National Centers for Environmental Information continuously updated digital elevation model for the Texas Coast (NOAA 2021) was used to obtain bathymetry data for the Site. The typical water depths for the Site are expected to be 1 to 5 feet with a mudline elevation that averages 0.86 foot NAVD88.

Utilities and Infrastructure

The Railroad Commission of Texas public GIS viewer (RRC 2021) was used to identify utilities and pipelines near the Site. No utilities or pipelines were identified near the Site. The need for Site-specific utility locations prior to construction will be determined during subsequent design stages. No other infrastructure has been identified in the vicinity of the project Site.

Desktop Cultural Resources Survey

A search of cultural resources records in the Texas Historical Commission Atlas Database was completed for the Site between November 29 and December 30, 2021. This search revealed that no archaeological surveys have been conducted and no archaeological sites have been identified within the preliminary proposed placement site boundary (THC 2021).

Sensitive Habitat

GLO oyster habitat GIS data (GLO 2021) indicate that there is no oyster habitat identified within or adjacent to the Site. According to Texas Parks and Wildlife Department (TPWD) seagrass data (TPWD 2021), there are no seagrasses mapped within or adjacent to the Site location. Because the sensitive habitat data are not recent, surveys will likely need to be conducted during a subsequent phase of design to evaluate the presence and extents of sensitive habitat to confirm or update the understanding of sensitive habitat in the vicinity of the Site.

Beneficial Use Source Material

One potential source of dredged material is the GIWW, located adjacent to the Site. Based on Coastal Consistency Determinations from USACE, USACE has historically performed maintenance dredging on the GIWW near the Site (USACE 1999). Continued dredging has recently been confirmed by USACE (Jones 2021). The identified DMPAs used by USACE adjacent to the Site and their associated historical average annual quantity of dredged material, distance from the Site, and channel segments are shown in Table 2. The average grain size and grain type percentages are shown in Table 3. This informs the quantity and characteristics of dredged material that may be available during a dredging cycle. For example, the Site will be designed such that the clay and fines, which constitute a relatively high percentage of nearby sediment, will not be lost to the water column during placement.

Table 2
USACE DMPA Areas Adjacent to the Site

DMPA No.	GIWW Channel Station	Distance from Site (miles)	Average Annual Dredging Quantity (cy)
128	775+000-785+000	2.5	353,202
129	785+000-802+000	1.5	318,787
130	802+000-817+000	1.5	121,141

Notes:
Source: USACE 1999
cy: cubic yard

Table 3
Typical Sediment Characteristics from San Antonio Bay to Aransas Bay

Sediment Characteristics
D_{50} (mm) < 0.068
38.2% sand
27.6% silt
34.3% clay

Notes:
Source: USACE 1999
D_{50}: median grain size
mm: millimeter

Marsh Vegetation Elevation Ranges

Typical habitat ranges for relevant marsh vegetation were determined based on site vegetation surveys conducted by DU at the Lower Neches Wildlife Management Area Old River Unit, Texas Point National Wildlife Refuge (NWR), McFaddin NWR Willow Lake Terraces, Anahuac NWR Roberts Mueller Tract, Schicke Point, Guadalupe River Old Delta, and Goose Island State Park Cells sites located in GLO Planning Regions 1 and 2 of the Texas coast. This is shown in Table 4.

Table 4
Typical Elevations for Target Marsh Vegetation

Species	Elevation (feet MSL)	Elevation (feet NAVD88)
Spartina patens	0.25 to 1	1.37 to 2.12
Spartina alterniflora	0 to 0.75	1.12 to 1.87

10% Design

The main design features that are critical for marsh success are as follows:

- Site location
- Marsh size and shape
- Containment and erosion protection
- Planting and natural recruitment of vegetation

These design features are evaluated in this memorandum for the preliminary Site design.

Site Location

The proposed location of the Site is approximately 0.5 mile northwest of the GIWW. The Site is located along the existing approximately 50- to 70-foot-wide and 3,000-foot-long straight channel, as well as within two open-water ponds within the Aransas National Wildlife Refuge (Figure 1).

The average mudline elevation within the footprint of the Site is 0.86 foot NAVD88 (-0.09 foot mean lower low water). A shallow water channel leads up to the Site, restricting access to shallow draft vessels. Bathymetric surveys will need to be conducted during subsequent design phases to better define Site dimensions and material capacity.

Size and Shape

Based on the plan to fill the straight channel to reduce flow while still providing boat access into side channels, the project team proposes that the area of the Site be 6 acres. Due to expected mounding and subsequent consolidation and settlement of the placed material, the Site will be created with dredged material placed to an elevation of +2.5 feet NAVD88 to eventually settle at the upper end of *Spartina patens* and *Spartina alterniflora* elevation range. The elevation of dredged material fill could be adjusted at further stages of design, depending on the physical properties of the dredged material or if other target species and their specific requirements are identified. The Site will consist of dredged material filling the straight channel from just above the southern side channel entrance to just south of the northern side channel entrance, as shown in Figure 1.

The seagrass data from TPWD (2021) show that there is not currently sensitive seagrass habitat within the Site footprint; however, the data are not recent and seagrasses may have migrated into the proposed placement area. The location of seagrasses will need to be determined through field surveys during subsequent stages of design.

Fill material could be obtained from the GIWW, as described in Table 2. It is predicted that the required dried fill volume will be approximately 16,000 cubic yards (cy), with 4,400 cy of that amount being due to settlement. This value assumes 1 foot of foundation compression for every 3 feet of fill and does not consider bulking. Geotechnical data will likely need to be collected during a subsequent design phase to further evaluate the expected foundation compression and the expected bulking of dredged material.

Containment and Erosion Protection

The Site is nestled between marsh on its northeast and southwest sides, which will serve as protection from generated wind waves and wake erosion from the GIWW. Further analysis will need to be conducted on the effects of recreational vessel traffic within the marsh channels on the Site, but armoring is not expected to be needed. Temporary containment will be needed around the fill to allow the material to dewater and consolidate. Environmental controls such as turbidity curtains, hay bales, or similar measures may be able to provide the temporary containment of material that will be needed during construction to contain fines placed at the Site.

A flow restriction structure may need to be constructed at the southern end of the side channel to prevent erosion of the marsh interior. This potential weir or culvert structure will need to be evaluated and designed based on hydrodynamic modeling during subsequent design phases.

Planting and Natural Recruitment of Vegetation

Based on stakeholder input and cost considerations, the project team determined that hydroseeding the edge of the marsh will be the most effective method for vegetating the marsh. Natural vegetation recruitment will then be allowed to proceed from the edge of the marsh inward. If the outcome is unsatisfactory (e.g., if the marsh has a lower-than-expected density of vegetation or if undesirable species of vegetation have begun growing within the Site), an adaptive management program can be instituted to modify the vegetation. Table 4 shows some of the targeted vegetation and their preferred habitat elevations.

Site Construction Cost Estimates

Construction costs were estimated for the design outlined in the previous sections. The estimated costs include permitting, 100% design, engineering costs for advancing the design to the construction phase, pre-construction and as-built surveys, mobilization, materials, and hydroseeding of the marsh. These costs represent the estimated incremental costs, i.e., those costs over and above USACE's least cost and environmentally acceptable dredged material and placement alternative. Table 5 shows a line-item list of each costing parameter and the total cost estimated for construction.

Table 5
Opinion of Probable Construction Cost to 100% Project Completion

Item	Quantity	Unit	Unit Price	Total
Pre-Construction Survey	1	LS	$ 30,000.00	$ 30,000.00
Incremental Dredging Cost (1-mile pipeline)	16,000	cy	$ 5.00	$ 80,000.00
Hydroseeding (10-foot swath along perimeter)[1]	76,000	sf	$ 0.20	$ 20,000.00
Flow Restriction Structure	1	LS	$ 120,000	$ 120,000.00
Post-Construction Survey (topography/ bathymetry)	1	LS	$ 30,000.00	$ 30,000.00
Post-Construction Survey (aerials)	1	LS	$ 10,000.00	$ 10,000.00
Navigational Aids	2	Each	$ 4,000.00	$ 8,000.00
Subtotal[1]			**Sum**	**$ 300,000.00**
Incremental Mobilization and Demobilization[1]	1	LS	$ 40,000.00	$ 40,000.00
Construction Total			**Sum**	**$ 340,000.00**
100% Engineering and Design[1]	1	25%	$ 90,000.00	$ 90,000.00
Permitting	1	Each	$ 100,000.00	$ 100,000.00
Construction Management[1]	1	15%	$ 50,000.00	$ 50,000.00
Post-Construction Management	12	Month	$ 10,000.00	$ 120,000.00
Project Subtotal[2]			**Sum**	**$ 700,000.00**
-30% Contingency[2]	1	30%	$210,000.00	$ 200,000.00
+50% Contingency[2]	1	50%	$ 350,000.00	$ 400,000.00
Low-End Project Estimated Cost[2]			**Total Sum**	$ 500,000.00
High-End Total Project Estimated Cost[2]			**Total Sum**	**$1,100,000.00**

Notes:
Costs were determined based upon publicly available datasets; no field work was conducted for this phase of the project.
1. Rounded to the nearest $10,000.
2. Rounded to the nearest $100,000.

LS: lump sum
sf: square foot

The costs vary from $500,000 to $1.1 million, depending on the level of contingency allocated to the project cost.

The estimates are developed using current and generally accepted engineering cost estimating methods and are based on assumptions concerning future events. Actual costs may be affected by known and unknown risks including, but not limited to, changes in general economic business conditions, Site conditions that were unknown at the time the estimates were performed, future

changes in Site conditions, regulatory or enforcement policy changes, and delays in performance. Actual costs may vary from these estimates.

Ecosystem Benefits Expected

Creation of the Site is expected to have positive benefits on the regional ecosystem. The marsh restoration is expected to add 2.5 acres of marsh habitat to the regional ecosystem. This region is also experiencing degrading marsh due to the flow from the straight channel. Filling the straight channel with dredged material will reduce future erosion in the surrounding marsh, supporting a more resilient and healthy marsh.

Future Work

Of the sites selected for 10% designs in this project, at least eight will be selected for 30% designs, and at least five of those will subsequently be selected for 60% designs and cost estimates. No fatal flaws have been identified in this 10% design effort. Should this Site be selected for additional design efforts, it can be expected that some aspects of the design in this memorandum will be modified and, as appropriate, improved. As previously mentioned, it is possible that in each phase additional designs will be provided toward this project because of the partnership on this project between DU and PCCA.

References

GLO (Texas General Land Office), 2021. Layer: Oyster Habitat (ID: 57). ArcGIS REST Services Directory. Accessed November 23, 2021. Available at: https://cgis.glo.texas.gov/arcgis/rest/services/RMC/RMC_Sensitive_Area/MapServer/57.

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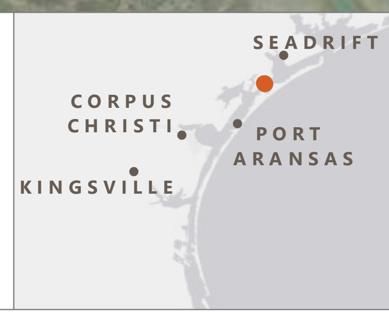
USACE, 2021. Wind Rose. Wave Information Studies. U.S. Army Engineer Research & Development Center. Accessed November 1, 2021. Downloaded from: http://frf.usace.army.mil/wis/data.

Figures

LEGEND:

- Culvert
- ANWR Long Lake Marsh and Channel Site
- Seagrass



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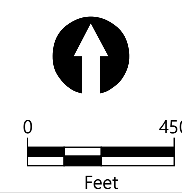

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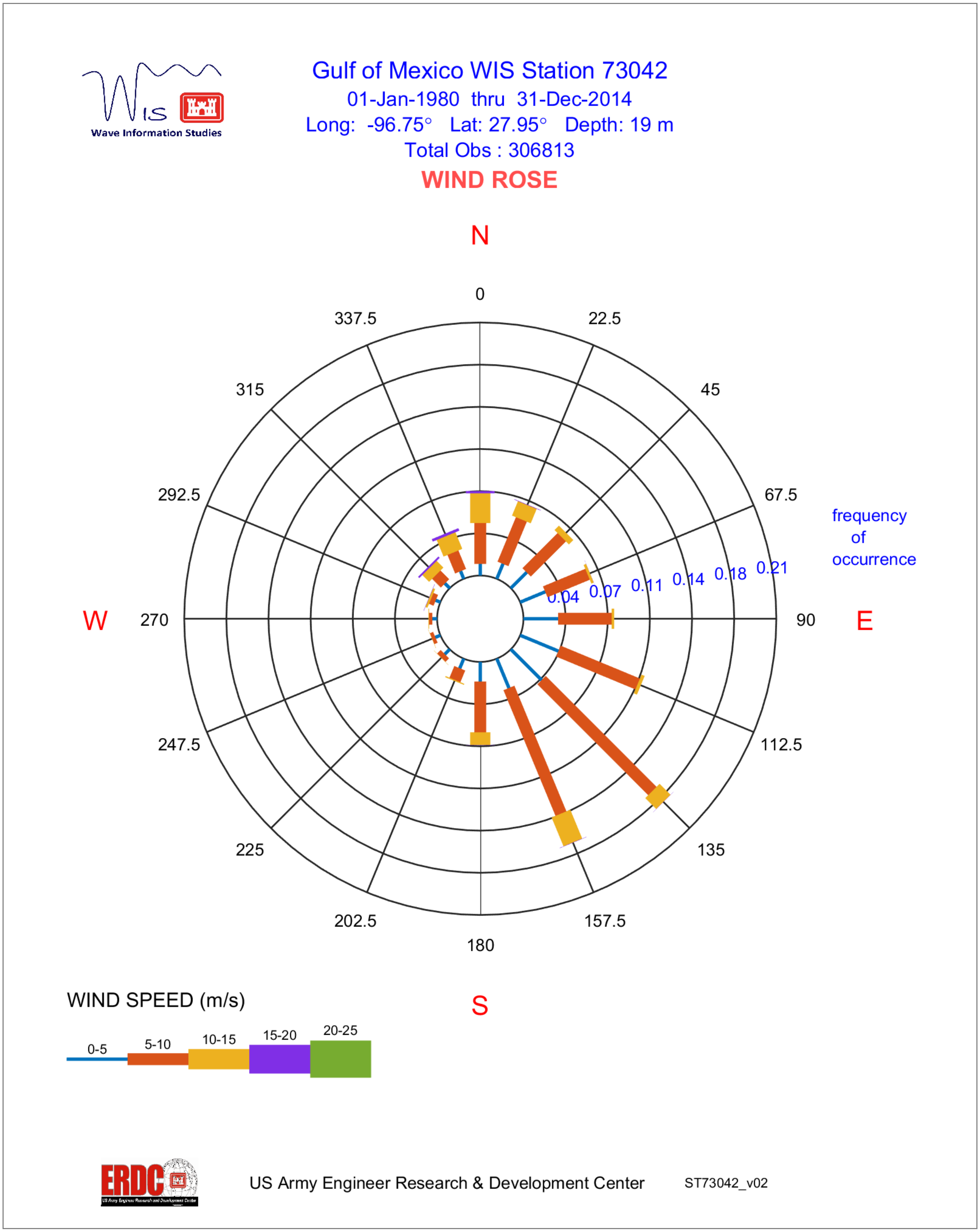
ANCHOR QEA

Figure 1
ANWR Long Lake Marsh and Channel Plan View
ANWR Long Lake Marsh and Channel 10% Design Memorandum
Texas Lower Coast Beneficial Use



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ANCHOR QEA

Figure 2
Historical Wind Data for USACE WIS Station 73042
ANWR Long Lake Marsh and Channel 10% Design Memorandum
Texas Lower Coast Beneficial Use

Memorandum

January 31, 2022

To: Melissa McCutcheon, Texas General Land Office

From: Todd Merendino, Ducks Unlimited, Inc.
Sarah Garza, Harrison McNeil, and Yvonne Dives-Gomez, Port of Corpus Christi Authority
John Laplante, Dan Opdyke, Ray Newby, Adrienne Accardi, Alexander Freddo, and
Hayden Smith, Anchor QEA, LLC
Jane Sarosdy, Sarosdy Consulting, Inc.

Re: ANWR Matagorda Island West Marsh 10% Design Memorandum

Introduction

This 10% design memorandum describes design criteria and assessments associated with the proposed Aransas National Wildlife Refuge (ANWR) Matagorda Island West Marsh site (Site), located in Texas General Land Office (GLO) Planning Region 2 of the Texas coast in Mesquite Bay in Calhoun County, Texas (Figures 1 and 2).

Project Background

GLO awarded a Coastal Management Program Project of Special Merit grant (funded through the Gulf of Mexico Energy Security Act) to Ducks Unlimited, Inc. (DU), to identify priority locations and develop 10% designs and opinions of probable construction costs for at least 16 sites in GLO Planning Regions 3 and 4 of the Texas coast for the beneficial use of dredged material (BU). For this project, sites in Matagorda Island, which is adjacent to the border with Region 3, are also eligible, as approved by GLO. The project team is led by DU and Port of Corpus Christi Authority (PCCA) and includes Anchor QEA, LLC; Sarosdy Consulting, Inc.; and the Texas Department of Transportation. In addition to the 16 sites identified and prioritized, PCCA will provide additional resources to bring forward more site designs for review if the site prioritization and selection so warrants. The project team coordinated two online stakeholder meetings in each region to receive information about potential BU sites. Based on stakeholder input, GLO feedback, publicly available data, and professional judgment, the project team selected the Site as one of the 16 sites for 10% design development and cost estimation.

ANWR Matagorda Island West Marsh is an area of marsh located on U.S. Fish and Wildlife Service (USFWS) land approximately 5 miles southeast of the Gulf Intracoastal Waterway (GIWW) and directly adjacent to the USFWS/Wynn Channel in Mesquite Bay in Calhoun County, Texas, which has shoaled due to lack of maintenance dredging activity. This Site was selected due to USFWS plans to restore the derelict USFWS/Wynn Channel to their South Dock on Matagorda Island, which will provide dredged material that can be beneficially placed on the Site to restore degrading marsh habitat.

Project Objectives

Frequent dredging is needed to develop and maintain Texas ship channels. The dredged material must be deposited in dredged material placement areas (DMPAs), and many of the existing DMPAs along the Texas coast are nearing capacity. Resource agencies and stakeholders have long advocated using dredged material beneficially to create and restore wetlands and bird islands, nourish beaches, and counteract land loss. Historically, BU projects are difficult to manage because they are multi-year, multi-faceted undertakings in which different organizations manage dredging schedules, funding, project design, permitting, and construction activities. To help address these issues, the objectives of this project include the following:

- Create and restore degrading coastal habitats.
- Establish sites for placement of dredged material to reduce reliance on existing DMPAs.
- Improve coastal resiliency of the natural and built environment.
- Reduce shoaling in the GIWW and other ship channels.

To accomplish these objectives, the project includes the following tasks:

- Stakeholder outreach and coordination
- Identification and selection of BU sites
- 10% designs and cost estimates for at least 16 BU sites
- 30% designs for at least eight BU sites
- 60% designs, cost estimates, and permit application packages for at least five BU sites

This memorandum documents the 10% design and cost estimate for one of the selected sites.

Design Objectives

This Site will be designed to beneficially use dredged material to restore marsh habitat in a region with degrading marsh. The design will use material dredged from dredging of the nearby derelict USFWS/Wynn Channel in Mesquite Bay. This 10% design is based upon publicly available datasets; no field work was conducted for this phase of the project.

Design objectives include the following:

- Develop a preliminary vision based on available data for the Site that includes the following:
  - Habitat to be created or restored
  - Potential sediment source(s)

  - Approaches to minimize long-term maintenance costs
- Delineate conceptual footprints for proposed BU placement.
- Identify key sensitive habitats and construction considerations in the vicinity of the Site.
- Estimate fill volumes for the proposed BU footprints.
- Identify data gaps to be addressed in subsequent design stages.
- Provide preliminary cost estimates.

Existing Data Review

Horizontal and Vertical Datums

The horizontal datum used for the Site is the Texas State Plane Zone 4, North American Datum of 1983 (NAD83), in U.S. survey feet. The primary vertical datum used for the Site is the North American Vertical Datum of 1988 (NAVD88). The National Oceanic and Atmospheric Administration (NOAA) maintains an active tide gauge within the vicinity of the Site. The NOAA Aransas Wildlife Refuge Station 8774230 is 7 miles north of the Site. This station collects and records real-time tide information dating back to 2012. The vertical datums from this station that will be used for the Site are shown in Table 1.

Table 1
NOAA Aransas Wildlife Refuge Station 8774230 Tidal Gauge Displaying NAVD88 Tidal Datums

Tidal Datums	Elevation (feet NAVD88)
MHHW	1.28
MHW	1.28
MSL	1.12
MLW	0.95
MLLW	0.95

Notes:
MHHW: mean higher high water
MHW: mean high water
MLLW: mean lower low water
MLW: mean low water
MSL: mean sea level

Meteorological, Ocean, and Wave Data

Wind and Waves

The United States Army Corps of Engineers Wave Information Studies (WIS) provides a national resource of long-term wavefield climatologies for U.S. coastal waters that synthesizes observations, multi-decade hindcasts, and storm event archives (USACE 2021). The WIS station closest to the Site is

Station 73042, just offshore on the Gulf side of Matagorda Island in the Gulf of Mexico. Because the station is located offshore, the wave data are not applicable to this project design. However, the project team considers the wind data to be representative of the winds experienced at the Site. Figure 3 summarizes wind data from January 1, 1980, through December 31, 2014. The data indicate that the predominant wind direction is from the southeast, with significant winds also coming from the north, northeast, east, and south.

The Site resides on Matagorda Island and is sheltered from the predominant southeast wind direction. On the north side of the Site, there is a 0.75-mile fetch distance north where high winds and wind-generated waves will be expected during the winter months. Due to the fetch in the northern direction, the Site is anticipated to occasionally be in a high wave-energy environment. A wave analysis of the direction and frequency of expected significant wave heights will be conducted in subsequent phases of design.

Wake Erosion

The GIWW is approximately 5 miles northwest of the Site. Potential wake erosion from vessels transiting the GIWW is not expected to be a design consideration. However, vessels transiting the USFWS/Wynn Channel could introduce wake erosion. The project team considers that wake erosion will not be the driving erosive wave condition for this design because ship traffic in the USFWS/Wynn Channel, once restored, is expected to be infrequent and consist of relatively small vessels. Hence, wakes are not expected to produce the same level of erosion risk as wind-generated waves. An analysis of expected vessel traffic will need to be conducted during subsequent design phases. The proposed armoring will be designed to resist wind- and vessel-generated erosive forces, taking into account the Site's proximity to sporadic shallow oyster reef and seagrass habitat on the northern shoreline.

Bathymetry

The NOAA National Centers for Environmental Information continuously updated digital elevation model for the Texas coast (NOAA 2021) was used to obtain bathymetry data for the Site. The Site has a relatively nonuniform seabed elevation ranging from 4.8 to -1.25 feet NAVD88 with an average seabed elevation of 1.1 feet NAVD88.

Utilities and Infrastructure

The Railroad Commission of Texas public GIS viewer (RRC 2021) was used to identify utilities and pipelines near the Site. No utilities or pipelines were identified near the Site. The need for Site-specific utility locations prior to construction will be determined during subsequent design stages. No other infrastructure has been identified in the vicinity of the project Site.

Desktop Cultural Resources Survey

A search of cultural resources records in the Texas Historical Commission Atlas Database was completed for the Site between November 29 and December 30, 2021. This search revealed that no archaeological surveys have been conducted and no archaeological sites have been identified within the preliminary proposed placement site boundary (THC 2021).

Sensitive Habitat

Based on GLO oyster habitat GIS data (GLO 2021), oyster habitat has been identified on the northwestern tip of the Site. According to Texas Parks and Wildlife Department seagrass data (TPWD 2021), patchy seagrass habitat is mapped within the Site and on the north and west shorelines. Because the sensitive habitat data are not recent, surveys will likely need to be conducted during a subsequent phase of design to evaluate the presence and extents of sensitive habitat to confirm or update the understanding of sensitive habitat in the vicinity of the Site.

Beneficial Use Source Material

The main source of material for the Site will come from the dredging of the derelict USFWS/Wynn Channel directly adjacent to the Site. This channel extends from the GIWW to the bayside of Matagorda Island, with a side channel leading to the south dock of their facility on Matagorda Island.

USFWS has expressed future desires to maintenance dredge this shoaled channel; however, because there is no current design for the channel, a preliminary analysis was conducted on the possible potential volume of dredged material that may be available from the dredging of the channel from the south dock of the USFWS facility to the GIWW with the following assumptions:

- The channel will be 20 feet wide and 21,000 feet long.
- The elevations of the cut will be either -3 feet, -6, feet, -8 feet, -10 feet, or -14 feet NAVD88.
- The channel will have 1-horizontal-to-3-vertical (1H:3V) side slopes.

Table 2 shows the results of the volume analysis.

Table 2
Preliminary Volumes for USFWS/Wynn Channel

Elevation of Channel Footprint (feet NAVD88)	Width of Channel (feet)	Footprint Volume (cy)	Side Slope Volume (cy)	Total Volume (cy)
-3	20	5,941	173	6,114
-6	20	49,290	11,941	61,232
-8	20	79,552	31,105	110,657
-10	20	109,893	59,357	169,250
-14	20	170,846	143,462	314,307

Notes:
Volumes are estimated for the section of the channel extending from the USFWS facility south dock to the GIWW and do not include the portion of the channel extending into the Gulf of Mexico (i.e., Cedar Bayou).
cy: cubic yard

Marsh Vegetation Elevation Ranges

Typical habitat ranges for relevant marsh vegetation were determined based on site vegetation surveys conducted by DU at the Lower Neches Wildlife Management Area Old River Unit, Texas Point National Wildlife Refuge (NWR), McFaddin NWR Willow Lake Terraces, Anahuac NWR Roberts Mueller Tract, Schicke Point, Guadalupe River Old Delta, and Goose Island State Park Cells sites located in GLO Planning Regions 1 and 2 of the Texas coast. This is shown in Table 3.

Table 3
Typical Elevations for Target Marsh Vegetation

Species	Elevation (feet MSL)	Elevation (feet NAVD88)
Spartina patens	0.25 to 1	1.37 to 2.12
Spartina alterniflora	0 to 0.75	1.12 to 1.87

10% Design

The main design features that are critical for marsh success are as follows:

- Site location
- Marsh size and shape
- Erosion protection
- Planting and natural recruitment of vegetation

These design features are evaluated in this memorandum for the preliminary Site design.

Site Location

The proposed location of the Site is approximately 5 miles southeast of the GIWW and directly adjacent to the derelict USFWS/Wynn Channel. The Site consists of a degrading marsh on Matagorda Island behind an existing earthen dike that is failing in several locations (Figure 2).

The average elevation within the footprint of the Site is 1 foot NAVD88 (0.05 foot mean lower low water) but contains many areas of lower elevations with open water. The Site is directly adjacent to the USFWS facility and docks, so construction equipment should have direct access over land from that location. Bathymetric and topographic surveys will need to be conducted during subsequent design phases to better define Site dimensions and material needs.

Size and Shape

Assuming a channel footprint of -8 feet NAVD88, the resulting available dredged material as shown in Table 2, and the extents of the existing marsh, the project team proposes that the area of the Site be approximately 26 acres. Due to expected mounding of the placed material, the Site will be created with dredged material placed to an elevation of +2.0 feet NAVD88, which will be at the upper end of the suitable habitat range for *Spartina patens* and *Spartina alterniflora*. The elevation of dredged material fill could be adjusted at further stages of design, depending on the physical properties of the dredged material or if other target species and their specific requirements are identified, as well as to create channels and lagoons within the Site. The Site will consist of fill placed within the existing marsh footprint to bring open-water and low-lying, degraded areas up to healthy marsh elevation. The location of seagrasses will need to be determined through field surveys during subsequent stages of design. The footprint of the Site may change depending on the results of seagrass surveys. Environmental controls such as turbidity curtains may be needed during construction to contain fines placed at the Site.

Fill material could be obtained from the GIWW or from material dredged out of the derelict USFWS/Wynn Channel, as described in Table 2. It is predicted that the required consolidated fill volume will be approximately 80,000 cubic yards (cy), with 20,000 cy being from settled volume. This value assumes 1 foot of foundation compression for every 3 feet of fill and does not consider bulking. By assuming the USFWS/Wynn Channel will be dredged to -8 feet NAVD88, there is expected to be enough dredged material to build the proposed Site. The Site size and shape will need to be refined based on the expected dredged material availability from the USFWS/Wynn Channel dredging. Geotechnical data will likely need to be collected during a subsequent design phase to further evaluate the expected foundation compression and the expected bulking of dredged material.

Erosion Protection

Based on the fetch in the northern wind direction and the deteriorated and inadequate condition of the existing earthen dike, the project team proposes armoring for the Site consisting of an offshore segmented breakwater that will mitigate erosion to the marsh. The breakwater will be composed of armor stone constructed on an existing -1-foot-NAVD88 grade. The breakwater will contain 3H:1V seaward and landward side slopes connected by a 4-foot-wide crest. The construction height of the crest will be +4.5 feet NAVD88. The exact width will be dependent on the existing grade, but assuming -1 foot NAVD88, the breakwater base width will be 28 feet. Figure 4 depicts a typical cross section of the breakwater. The proposed breakwater alignment will be broken into two main segments: one 0.5-mile segment on the north side of the Site and one 0.25-mile segment on the west side of the Site. Each of the breakwaters will be further segmented to allow tidal exchange. The size of the armor stone, spacing between, and final cross-sectional dimensions of the breakwaters will need to be determined and refined, respectively, through modeling and analysis during a subsequent phase of design.

Shallow water conditions surrounding the breakwaters (-1 to -2 feet NAVD88) will likely require marsh buggies to stack and shape armor stone during construction of the breakwater.

Planting and Natural Recruitment of Vegetation

Based on stakeholder input and cost considerations, the project team determined that planting may not be needed for the Site. Rather, natural recruitment of vegetation from within the existing marsh will be allowed to proceed. If the outcome is unsatisfactory, for example, if the marsh has a lower-than-expected density of vegetation or if undesirable species of vegetation are present, an adaptive management program can be instituted to modify the vegetation. Table 3 shows some of the targeted vegetation and their preferred habitat elevations.

Site Construction Cost Estimates

Construction costs were estimated for the design outlined in the previous sections. The estimated costs include permitting, 100% design, engineering costs for advancing the design to the construction phase, pre-construction and as-built surveys, mobilization, materials, and construction of the breakwater. These costs represent the estimated incremental costs; i.e., those costs over and above USFWS's costs to dredge the channel. Table 4 shows a line-item list of each costing parameter and the total cost estimated for construction.

Table 4
Opinion of Probable Construction Cost to 100% Project Completion

Item	Quantity	Unit	Unit Price	Total
Pre-Construction Survey	1	LS	$ 30,000.00	$ 30,000.00
Geotextile Fabric[1]	15,000	sy	$ 15.00	$ 230,000.00
Stone (bedding and armoring)	30,000	cy	$ 200.00	$ 6,000,000.00
Incremental Dredging Cost (2-mile pipeline)	80,000	cy	$ 0	$ 0
Post-Construction Survey (topography/ bathymetry)	1	LS	$ 30,000.00	$ 30,000.00
Post-Construction Survey (Aerials)	1	LS	$ 10,000.00	$ 10,000.00
Navigational Aids	8	Each	$ 4,000.00	$ 32,000.00
Subtotal[1]			**Sum**	**$ 6,330,000.00**
Non-Dredging Mobilization[1]	1	5%	$ 320,000.00	$ 320,000.00
Construction Total[2]			**Sum**	**$ 6,700,000.00**
Engineering and Design[2]	1	10%	$ 700,000.00	$ 700,000.00
Permitting	1	Each	$ 100,000.00	$ 100,000.00
Construction Management[2]	1	8%	$ 500,000.00	$ 500,000.00
Post-Construction Management	12	Month	$ 10,000.00	$ 120,000.00
Project Subtotal[2]			**Sum**	**$ 8,100,000.00**
-30% Contingency[2]	1	30%	$2,400,000.00	$ 2,400,000.00
+50% Contingency[2]	1	50%	$4,100,000.00	$ 4,100,000.00
Low-End Total Project Estimated Cost[2]			**Total Sum**	**$ 5,700,000.00**
High-End Total Project Estimated Cost[2]			**Total Sum**	**$ 12,200,000.00**

Notes:
Costs were determined based upon publicly available datasets; no field work was conducted for this phase of the project.
Incremental dredging cost assumes USFWS will use the DMPA at the north end of Wynn Channel. This DMPA is equidistant from the channel on average from the Site. Due to this, it was assumed that there will be no incremental dredging costs.

1. Rounded to the nearest $10,000.
2. Rounded to the nearest $100,000.

LS: lump sum
sy: square yard

The costs vary from $5.7 million to $12.2 million, depending on the level of contingency allocated to the project cost. Cost savings may be realized by further analysis and modeling of wind and wave conditions during subsequent design phases and refining the level of armoring. At this level of design, it was deemed appropriate to assume a conservative rock breakwater will be needed; however, during subsequent design and analysis, it may be determined that less costly armoring alternatives, such as earthen berms, may be sufficient. Using alternatives could significantly reduce project costs.

The estimates are developed using current and generally accepted engineering cost estimating methods and are based on assumptions concerning future events. Actual costs may be affected by known and unknown risks including, but not limited to, changes in general economic business conditions, Site conditions that were unknown at the time the estimates were performed, future changes in Site conditions, regulatory or enforcement policy changes, and delays in performance. Actual costs may vary from these estimates.

Ecosystem Benefits Expected

Creation of the Site is expected to have positive benefits on the regional ecosystem. The marsh restoration is expected to add over 26 acres of marsh habitat to the regional ecosystem. This region is also experiencing degrading marsh habitats (Prieto 2021), and the constructed breakwater will improve the resilience of the existing and created marsh.

Future Work

Of the sites selected for 10% designs in this project, at least eight will be selected for 30% designs, and at least five of those will subsequently be selected for 60% designs and cost estimates. No fatal flaws have been identified in this 10% design effort. Should this Site be selected for additional design efforts, it can be expected that some aspects of the design in this memorandum will be modified and, as appropriate, improved. In particular, field monitoring to identify the presence and extent of seagrasses will be important to confirm the viability of this project and the spatial extent of marsh creation. As previously mentioned, it is possible that in each phase additional designs will be provided toward this project because of the partnership on this project between DU and PCCA.

References

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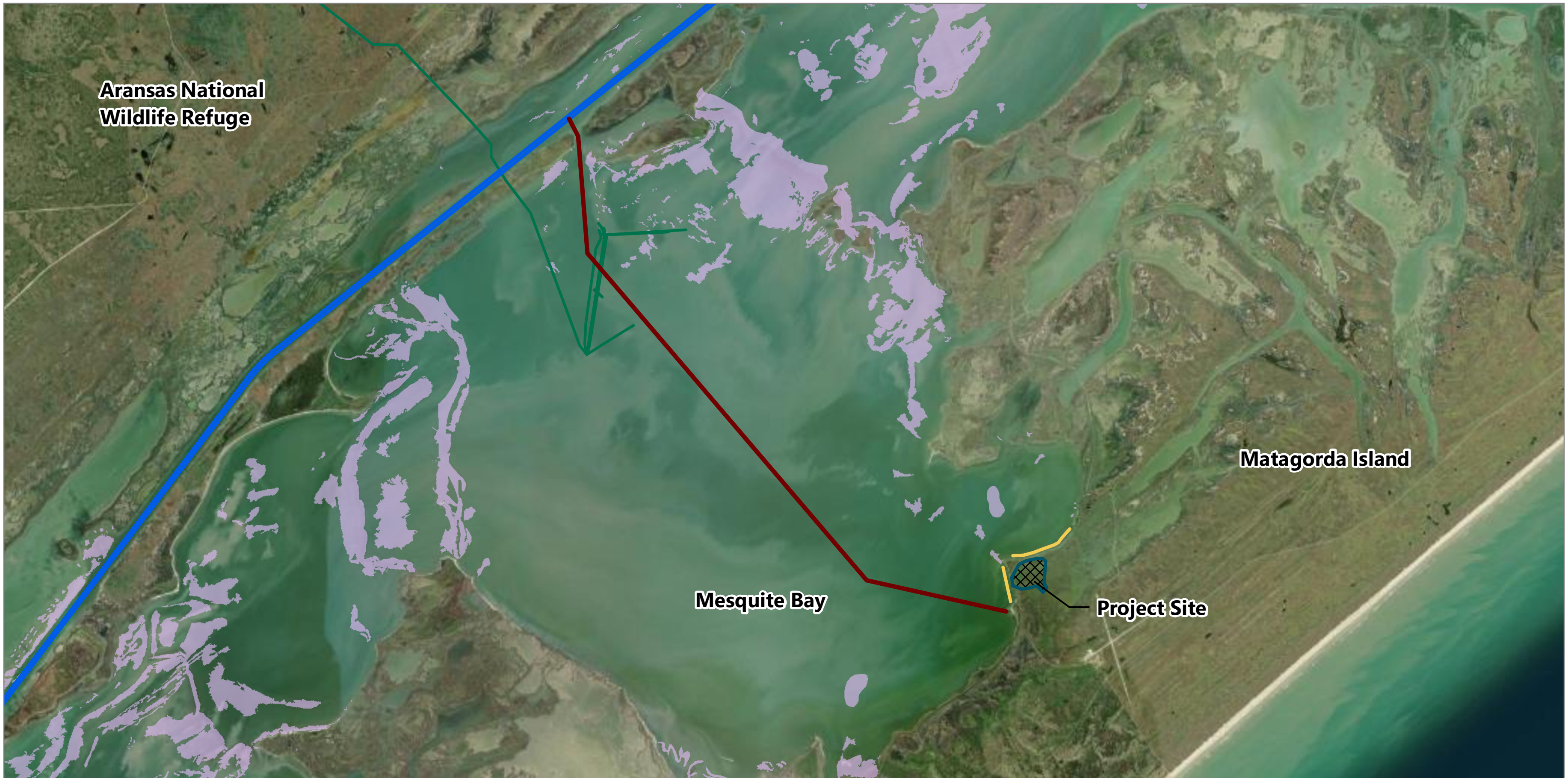
Figures



LEGEND:

- Approximated USFWS/Wynn Channel
- Breakwater
- Pipeline
- Gulf Intracoastal Waterway
- ANWR Matagorda Island West Marsh Site
- Oyster Habitat

NOTE:
Aerial imagery is from Esri basemaps

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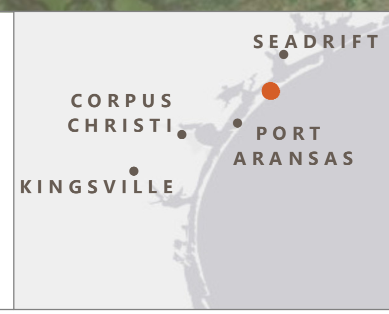
ANCHOR QEA

Figure 1
Approximate USFWS/Wynn Channel Plan View
ANWR Matagorda Island West Marsh 10% Design Memorandum
Texas Lower Coast Beneficial Use

LEGEND:

- Approximated USFWS/Wynn Channel
- Breakwater
- ANWR Matagorda Island West Marsh Site
- Seagrass
- Oyster Habitat



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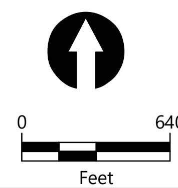

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ANCHOR QEA

Figure 2
ANWR Matagorda Island West Marsh Plan View
ANWR Matagorda Island West Marsh 10% Design Memorandum
Texas Lower Coast Beneficial Use

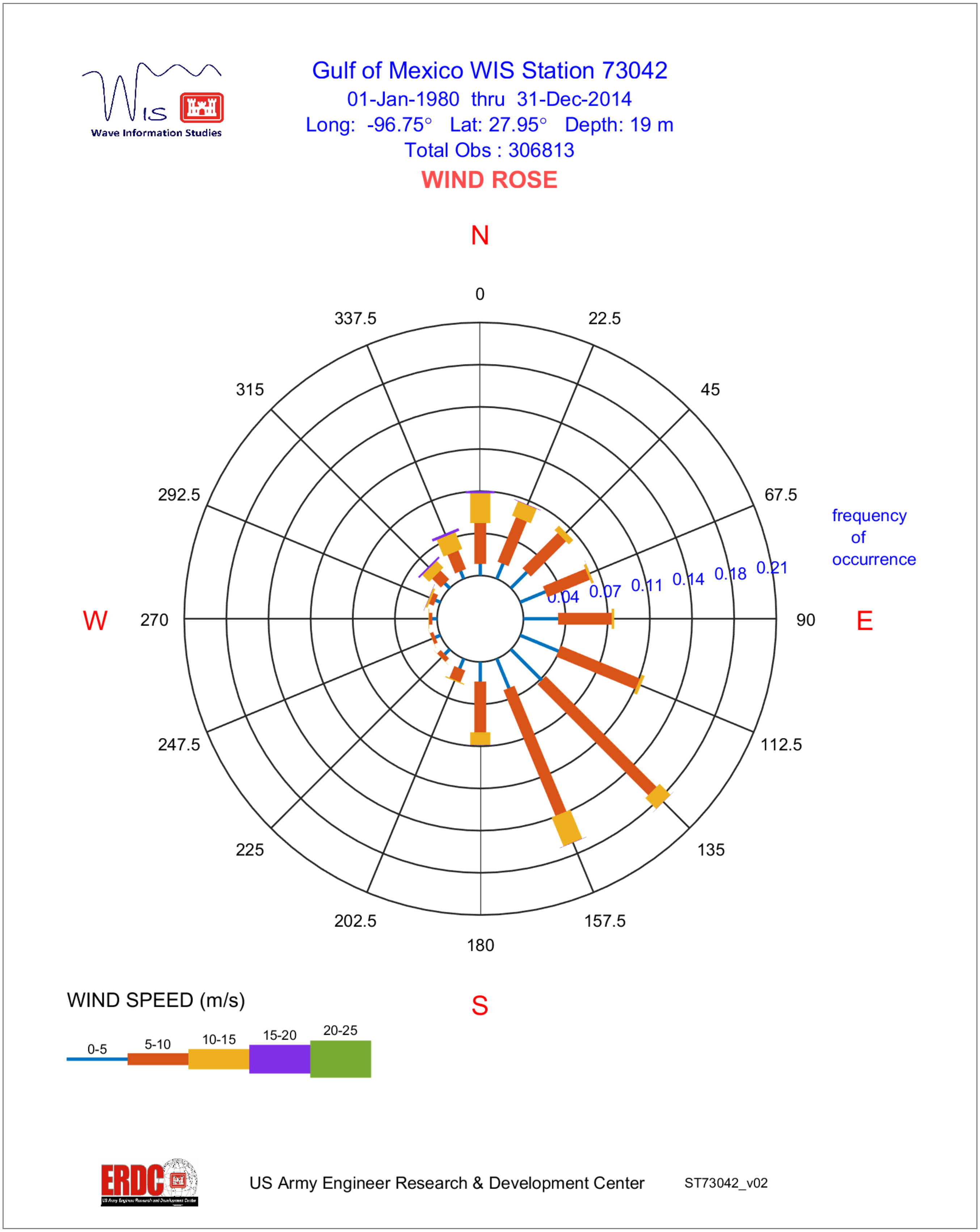

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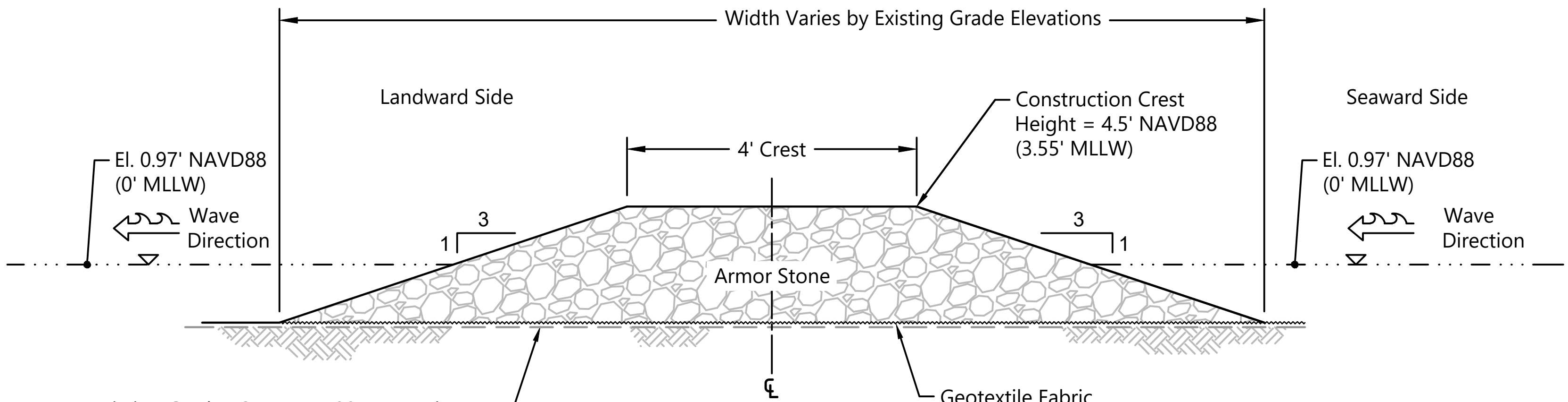
Figure 3
Historical Wind Data for USACE WIS Station 73042
ANWR Matagorda Island West Marsh 10% Design Memorandum
Texas Lower Coast Beneficial Use



Section A-A' Typical Breakwater
Not to Scale

VERTICAL DATUM: North American Vertical Datum of 1988 (NAVD88)

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Filepath: K:\Projects\1942-Ducks Unlimited\Little Bird Island\Little Bird Island North 10% Design\1942-RP-002 ANWR Matagorda Section.dwg Figure 4

ANCHOR QEA

Figure 4
Section A-A' Typical Breakwater

ANWR Matagorda Island West Marsh 10% Design Memorandum
Texas Lower Coast Beneficial Use

Memorandum

January 31, 2022

To: Melissa McCutcheon, Texas General Land Office

From: Todd Merendino, Ducks Unlimited, Inc.
Sarah Garza, Harrison McNeil, and Yvonne Dives-Gomez, Port of Corpus Christi Authority
John Laplante, Dan Opdyke, Ray Newby, Adrienne Accardi, Alexander Freddo, and Hayden Smith, Anchor QEA, LLC
Jane Sarosdy, Sarosdy Consulting, Inc.

Re: Causeway Bird Island 10% Design Memorandum

Introduction

This 10% design memorandum describes design criteria and assessments associated with the proposed Causeway Bird Island site (Site), located in Texas General Land Office (GLO) Planning Region 3 of the Texas coast in Nueces Bay in Nueces County, Texas (Figure 1).

Project Background

GLO awarded a Coastal Management Program Project of Special Merit grant (funded through the Gulf of Mexico Energy Security Act) to Ducks Unlimited, Inc. (DU), to identify priority locations and develop 10% designs and opinions of probable construction costs for at least 16 sites in GLO Planning Regions 3 and 4 of the Texas coast for the beneficial use of dredged material (BU). The project team is led by DU and Port of Corpus Christi Authority (PCCA) and includes Anchor QEA, LLC; Sarosdy Consulting, Inc.; and the Texas Department of Transportation. In addition to the 16 sites identified and prioritized, PCCA will provide additional resources to bring forward more site designs for review if the site prioritization and selection so warrants. The project team coordinated two online stakeholder meetings in each region to receive information about potential BU sites. Based on stakeholder input, GLO feedback, publicly available data, and professional judgment, the project team selected the Site as one of the 16 sites for 10% design development and cost estimation.

Conservationists have identified the Nueces Bay rookery islands as an important location for protecting and restoring bird habitat (CBBEP 2020a; Hackney et al. 2016). Causeway Bird Island is an island located on state-owned submerged land approximately 0.1 mile northeast of the Rincon Canal and 2.25 miles north of the Corpus Christi Ship Channel (CCSC) in Nueces Bay in Nueces County, Texas. This area was selected because offshore breakwaters are under construction to protect the existing island, and placement of dredged material between the breakwaters and the existing island will increase bird habitat. Placement of material has not yet been designed and is the subject of this design. The Site is ideal for restoration because of its proximity to sediment sources in the Rincon Canal and CCSC, proximity to nearby potential bird foraging areas, and ongoing construction of protective breakwaters.

Project Objectives

Frequent dredging is needed to develop and maintain Texas ship channels. The dredged material must be deposited in dredged material placement areas (DMPAs), and many of the existing DMPAs along the Texas coast are nearing capacity. Resource agencies and stakeholders have long advocated using dredged material beneficially to create and restore wetlands and bird islands, nourish beaches, and counteract land loss. Historically, BU projects are difficult to manage because they are multi-year, multi-faceted undertakings in which different organizations manage dredging schedules, funding, project design, permitting, and construction activities. To help address these issues, the objectives of this project include the following:

- Create and restore degrading coastal habitats.
- Establish sites for placement of dredged material to reduce reliance on existing DMPAs.
- Improve coastal resiliency of the natural and built environment.
- Reduce shoaling in the GIWW and other ship channels.

To accomplish these objectives, the project includes the following tasks:

- Stakeholder outreach and coordination
- Identification and selection of BU sites
- 10% designs and cost estimates for at least 16 BU sites
- 30% designs for at least eight BU sites
- 60% designs, cost estimates, and permit application packages for at least five BU sites

This memorandum documents the 10% design and cost estimate for one of the selected sites.

Design Objectives

This Site will be designed to beneficially use dredged material to restore a rookery island in a region with degrading coastal bird habitat. The design will potentially use material dredged from the CCSC Channel Improvement Project and from CCSC and Rincon Canal maintenance dredging, thus reducing the volume of such material that will need to be placed in existing open-bay or upland DMPAs. This 10% design is based upon publicly available datasets; no field work was conducted for this phase of the project.

Design objectives include the following:

- Develop a preliminary vision based on available data for the Site that includes the following:
  - Habitat to be created or restored
  - Potential sediment source(s)
  - Approaches to minimize long-term maintenance costs
- Delineate conceptual footprints for proposed BU placement.
- Identify key sensitive habitats and construction considerations in the vicinity of the Site.
- Estimate fill volumes for the proposed BU footprints.
- Identify data gaps to be addressed in subsequent design stages.
- Provide preliminary cost estimates.

Existing Data Review

Horizontal and Vertical Datums

The horizontal datum used for the Site is the Texas State Plane Zone 5, North American Datum of 1983 (NAD83) in U.S. survey feet. The primary vertical datum used for the Site is the North American Vertical Datum of 1988 (NAVD88). The National Oceanic and Atmospheric Administration (NOAA) maintains an active tide gauge within the vicinity of the Site. The NOAA USS Lexington, Corpus Christi Bay, TX Station 8775296 is 2 miles southwest of the proposed island. This station collects and records real-time tide information dating back to 2004. The vertical datums from this station that will be used for the Site are shown in Table 1.

Table 1
NOAA USS Lexington, Corpus Christi Bay, TX Station 8775296 Tidal Gauge Displaying NAVD88 Tidal Datums

Tidal Datums	Elevation (feet NAVD88)
MHHW	1.02
MHW	1.01
MSL	0.76
MLW	0.43
MLLW	0.42

Notes:
MHHW: mean higher high water
MHW: mean high water
MLLW: mean lower low water
MLW: mean low water
MSL: mean sea level

Meteorological, Ocean, and Wave Data

Wind and Waves

The United States Army Corps of Engineers (USACE) Wave Information Studies (WIS) provides a national resource of long-term wavefield climatologies for U.S. coastal waters that synthesizes observations, multi-decade hindcasts, and storm event archives (USACE 2021). The WIS station closest to the Site is Station 73039, just offshore on the Gulf side of Mustang Island in the Gulf of Mexico. Because the station is located offshore, the wave data are not applicable to this project design. However, the project team considers the wind data to be representative of the winds experienced at the Site. Figure 2 summarizes wind data from January 1, 1980, through December 21, 2014. The data indicate that the predominant wind direction is from the southeast, with significant winds also coming from the north, northeast, east, and south.

A breakwater that will surround the existing island is under construction. That breakwater is expected to minimize impacts of wind waves to the Site, causing the Site to be a low wave-energy environment.

Wake Erosion

The Rincon Canal is approximately 0.1 mile southwest of the Site, and the CCSC is approximately 2.25 miles south of the Site. Potential wake from vessels transiting the Rincon Canal is expected; however, the breakwater is expected to mitigate the impacts of those wakes.

Bathymetry

The NOAA National Centers for Environmental Information continuously updated digital elevation model for the Texas Coast (NOAA 2021) and Coastal Bend Bays & Estuaries Program (CBBEP 2020b) survey data were used to obtain bathymetry data for the Site. The Site has a non-uniform seabed elevation that averages 0.5 foot NAVD88.

Utilities and Infrastructure

The Railroad Commission of Texas public GIS viewer (RRC 2021) was used to identify utilities and pipelines near the Site. No utilities or pipelines were identified near the Site. The need for Site-specific utility locations prior to construction will be determined during subsequent design stages.

U.S. Highway 181 is immediately adjacent to the Site. U.S. Highway 181 is an elevated causeway, and protection of the highway foundations will need to be considered in subsequent phases of design.

Desktop Cultural Resources Survey

A search of cultural resources records in the Texas Historical Commission Atlas Database was completed for the Site between November 29 and December 30, 2021. This search revealed that no archaeological surveys have been conducted and no archaeological sites have been identified within the preliminary proposed placement site boundary (THC 2021).

Sensitive Habitat

GLO oyster habitat GIS data (GLO 2021) indicate that there is no oyster habitat identified within the Site; however, there is oyster habitat identified more than 200 feet beyond the extent of the Site, past the existing breakwater to the west of the Site footprint. According to Texas Parks and Wildlife Department seagrass data (TPWD 2021), there are no seagrasses mapped within or adjacent to the Site location. Because the sensitive habitat data are not recent, surveys will likely need to be conducted during a subsequent phase of design to evaluate the presence and extents of sensitive habitat to confirm or update the understanding of sensitive habitat in the vicinity of the Site.

Bird Species

The U.S. Fish and Wildlife Service (USFWS) Information for Planning and Consultation (IPaC) tool was used to identify listed species and migratory birds within a 480-square-mile region around Nueces and Corpus Christi Bay (USFWS 2021). Table 2 includes some of the protected and migratory bird species that are present near the Site and their preferred habitat as explained in Audubon's field guide (Audubon 2021a). At this time, no target species, or list of species, have been identified for the Site.

Table 2
USFWS IPaC Species Information

Species	Status	Preferred Habitat[1]
Whooping Crane (*Grus americana*)	Endangered	Prairie pools, marshes, and coastal marshes
Piping Plover (*Charadrius melodus*)	Threatened	Sand beach dunes and expansive sand or mudflats
Red Knot (*Calidris canutus*)	Threatened	Mudflats, tidal zones, and sandy beaches
American Oystercatcher (*Haematopus palliatus*)	Migratory	Strictly coastal; dunes, islands in salt marsh, dredge spoil islands, sandy beaches, and tidal mudflats
Black Skimmer (*Rynchops niger*)	Migratory	Sandy islands, shell beaches, open beaches, lagoons, estuaries, inlets, and sheltered bays
Brown Pelican (*Pelecanus occidentalis*)	Migratory	Bare, rocky, mangrove or tree-covered islands; salt bays, beaches, and oceans

Species	Status	Preferred Habitat[1]
Gull-Billed Tern (*Gelochelidon nilotica*)	Migratory	Beaches, islands, salt marshes, fields, and coastal bays
Marbled Godwit (*Limosa fedoa*)	Migratory	Northern Great Plains, native prairie with marshes or ponds, pools, shores, marshes, and tidal flats
Reddish Egret (*Egretta rufescens*)	Migratory	Red mangrove swamps, arid coastal islands covered with thorny brush, coastal tidal flats, salt marshes, and lagoons
Ring-Billed Gull (*Larus delawarensis*)	Migratory	On ground near water with sparse plant growth, lakes, bays, coasts, piers, dumps, and plowed fields
Royal Tern (*Thalasseus maximus*)	Migratory	Low-lying sandy islands, coasts, lagoons, salt bays, and estuaries
Wilson's Plover (*Charadrius wilsonia*)	Migratory	Dry part of beach, near conspicuous object, coastal regions, open beaches, tidal flats, estuaries, and sandy islands

Notes:

1. Habitat information is from the Audubon field guide (Audubon 2021a) and includes preferred nesting and general habitat.

USFWS IPaC information (USFWS 2021) is provided for a 480-square-mile region around Nueces Bay and Corpus Christi Bay highlighting endangered, threatened, and migratory birds and their preferred habitat.

Erosion

Google Earth imagery from 2011 to 2020 indicates that Causeway Bird Island has deteriorated from erosional forces, and the Site is at high risk to erosional forces such as wave energy and relative sea level rise (CBBEP 2020a). The risk of erosion will be greatly reduced following completion of the breakwater.

Beneficial Use Source Material

Potential sources of dredged material are the Rincon Canal, located adjacent to the Site, and the CCSC, located 2.25 miles away. Based on Coastal Consistency Determinations from USACE, USACE has historically performed maintenance dredging on the CCSC near the Site (USACE 1999). Continued dredging has recently been confirmed by USACE (Jones 2021). The identified DMPAs used by USACE adjacent to the Site, historical average annual quantity of dredged material, distance from the Site, and channel segments are shown in Table 3. The average grain size and grain type percentages are shown in Table 4. This informs the quantity and characteristics of dredged material that may be available during a dredging cycle. For example, the Site will be designed such that the silt and clay, which constitutes a relatively high percentage of nearby sediment, will not be lost to the water column during placement.

Table 3
USACE DMPA Areas Adjacent to the Site

DMPA No.	Channel Segment (Station)	Distance from Site (miles)	Average Annual Dredging Quantity (cy)
16A	LaQuinta Junction to Beacon 82 (800+00-900+00)	4.8	91,000
16B	LaQuinta Junction to Beacon 82 (800+00-900+00)	4.2	92,000
17A	LaQuinta Junction to Beacon 82 (900+00-1050+00)	3.6	107,000
17B	LaQuinta Junction to Beacon 82 (900+00-1050+00)	3.2	296,000
1	Beacon 82 to Viola Turning Basin (1050+00-1231+00)	2.2	309,000
Rincon	Beacon 82 to Viola Turning Basin (1050+00-1231+00)	1.8	309,000
3B	Beacon 82 to Viola Turning Basin (1231+00-1455+00)	3.6	0
3C	Beacon 82 to Viola Turning Basin (1231+00-1455+00)	6	22,000

Notes:
Source: USACE 1999.
cy: cubic yard
N/A: not applicable

Table 4
Typical Sediment Characteristics from the LaQuinta Junction to Beacon 82 and from Beacon 82 to the Viola Turning Basin

Sediment Characteristics from the LaQuinta Junction - Beacon 82 (550+00 to 1050+00)	Sediment Characteristics from the Beacon 82 - Viola Turning Basin 1050+00 to 1550+00)
D_{50} (mm) = 0.020	D_{50} = 0.047
8.5% Sand	24.4% Sand
54.5% Silt	40.6% Silt
37.1% Clay	35.1% Clay

Notes:
Source: USACE 1999
D_{50}: median grain size
mm: millimeter

Source material could also potentially come from the CCSC Channel Improvement Project. Further information will need to be collected to determine quantities of usable dredged material from this source. Due to the proximity of the Site to these sediment sources, this Site should allow for lower construction costs compared to more remote potential bird island sites.

10% Design

The main design features that are critical for rookery island success are as follows:

- Site location
- Island size and shape
- Containment and erosion protection
- Planting and natural recruitment of vegetation

These design features are evaluated in this memorandum for the preliminary Site design.

Site Location

The proposed location of the Site is approximately 0.1 mile northeast of Rincon Canal and 2.25 miles north of the CCSC. The Site has a surrounding breakwater that is under construction and is anticipated to beneficially use dredged maintenance material from the CCSC and Rincon Channel, as well as potential material from the CCSC Channel Improvement Project. The placement of material on the Site is advantageous because the breakwater will shelter the dredged material from erosive forces. The Site is not in the vicinity of sensitive habitat. Although the Site is somewhat closer to shore than the desired 0.5-mile distance identified for minimizing predator access to rookery islands (Stanzel 2018), it is an active rookery that supports thousands of nesting pairs of colonial waterbirds (CBBEP 2020a).

The Site is located on the historical Causeway Bird Island, which provides an average elevation of approximately +0.5 feet NAVD88. Being located on an existing island also provides beneficial constructability conditions with slopes extending down to approximately -9 feet NAVD88 on the southwest side of the Site for construction access. Bathymetric surveys will need to be conducted during subsequent design phases to better define Site dimensions and material needs.

Size and Shape

Based on the existing size of the island and planned breakwater layout, the project team proposes that the area of the Site be approximately 16 acres. The Site will be created with dredged material placed to an elevation of +3.5 feet NAVD88. The Site will be filled to extend from the center out to the inside edge of the breakwater. It has been assumed that the breakwater has been designed and located so that loads from the breakwater are not imparted on the existing causeway foundations and, therefore, that any loads from new fill behind the breakwater will also not be imparted on the existing causeway foundations. This assumption will be revisited and reevaluated during a subsequent phase of design.

This shape of fill was selected to promote natural recruitment of vegetation and provide habitat for a range of bird species. The elevation of dredged material fill could be adjusted at further stages of design depending on the physical properties of the dredged material or if target bird species and their specific requirements are identified. It is expected that environmental controls such as turbidity curtains will be needed during construction to contain finer sediment placed during construction.

Fill material could be obtained from Rincon Canal or the CCSC, as described in Table 3. It is predicted that the required fill volume will be approximately 110,000 cubic yards (cy), with approximately 30,000 cy being settled volume. This value assumes 1 foot of foundation compression for every 3 feet of fill and does not consider bulking. Geotechnical data will likely need to be collected during a subsequent design phase to further evaluate the expected foundation compression and the expected bulking of dredged material.

Containment and Erosion Protection

It is expected that the breakwater that is under construction will serve as protection from wind waves and wake erosion at the Site. The breakwater will be constructed before the fill material, helping to confine dredged slurry within the breakwater. Marsh excavators are assumed to be used to shape the dredged material behind the breakwater.

Planting and Natural Recruitment of Vegetation

Based on stakeholder input and cost considerations, the project team determined that planting may not be needed for the Site. Rather, natural vegetation recruitment will be allowed to proceed. If the outcome is unsatisfactory (e.g., if the island has lower-than-expected use by desired bird species), an adaptive management program can be instituted to modify the vegetation. Table 2 shows some of the listed and migratory birds and their preferred habitats. At further design stages, this list could be used to modify elevations within the Site to promote the preferred habitat of desired bird species.

Site Construction Cost Estimates

Construction costs were estimated for the design outlined in the previous sections. The estimated costs include permitting, 100% design, engineering costs for advancing the design to the construction phase, pre-construction and as-built surveys, mobilization, and materials. These costs represent the estimated incremental costs; i.e., those costs over and above USACE's least cost and environmentally acceptable dredged material and placement alternative. Table 5 shows a line-item list of each costing parameter and the total cost estimated for construction.

Table 5
Opinion of Probable Construction Cost to 100% Project Completion

Item	Quantity	Unit	Unit Price	Total
Pre-Construction Survey	1	LS	$ 30,000.00	$ 30,000.00
Incremental Dredging Cost (1-mile pipeline)	110,000	cy	$ 10.00	$ 1,100,000.00
Post-Construction Survey (topography/ bathymetry)	1	LS	$ 30,000.00	$ 30,000.00
Post-Construction Survey (aerials)	1	LS	$ 10,000.00	$ 10,000.00
Subtotal[1]			**Sum**	**$ 1,200,000.00**
Incremental Mobilization and Demobilization[2]	1	5%	$ 60,000.00	$ 60,000.00
Construction Total[1]			**Sum**	**$ 1,300,000.00**
100% Engineering and Design[1]	1	10%	$ 100,000.00	$ 100,000.00
Permitting	1	Each	$ 100,000.00	$ 100,000.00
Construction Management[1]	1	8%	$ 100,000.00	$ 100,000.00
Post-Construction Management	12	Month	$ 10,000.00	$ 120,000.00
Project Subtotal[1]			**Sum**	**$ 1,700,000.00**
-30% Contingency[1]	1	30%	$ 500,000.00	$ 500,000.00
+50% Contingency[1]	1	50%	$ 900,000.00	$ 900,000.00
Low-End Total Project Estimated Cost[1]			**Total Sum**	**$ 1,200,000.00**
High-End Total Project Estimated Cost[1]			**Total Sum**	**$ 2,600,000.00**

Notes:
Costs were determined based upon publicly available datasets; no field work was conducted for this phase of the project.
1. Rounded to the nearest $100,000.
2. Rounded to the nearest $10,000.
LS: lump sum

The costs vary from $1.2 million to $2.6 million, depending on the level of contingency allocated to the project cost.

The estimates are developed using current and generally accepted engineering cost estimating methods and are based on assumptions concerning future events. Actual costs may be affected by known and unknown risks including, but not limited to, changes in general economic business conditions, Site conditions that were unknown at the time the estimates were performed, future changes in Site conditions, regulatory or enforcement policy changes, and delays in performance. Actual costs may vary from these estimates.

Ecosystem Benefits Expected

Restoration of the Site is expected to have positive benefits on the regional ecosystem and will more than double the habitat for the herons, egrets, terns, skimmers, and pelicans that currently reside on the island (CBBEP 2020c).

Future Work

Of the sites selected for 10% designs in this project, at least eight will be selected for 30% designs, and at least five of those will subsequently be selected for 60% designs and cost estimates. No fatal flaws have been identified in this 10% design effort. Should this Site be selected for additional design efforts, it can be expected that some aspects of the design in this memorandum will be modified and, as appropriate, improved. As previously mentioned, it is possible that in each phase additional designs will be provided toward this project because of the partnership on this project between DU and PCCA.

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Figures

LEGEND:

- U.S. Highway
- Planned Breakwater
- Rincon Canal
- Causeway Bird Island Site
- Oyster Habitat

NOTE:
Aerial imagery is from Esri basemaps

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Feet

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ANCHOR QEA

Figure 1
Causeway Bird Island Plan View
Causeway Bird Island 10% Design Memorandum
Texas Lower Coast Beneficial Use

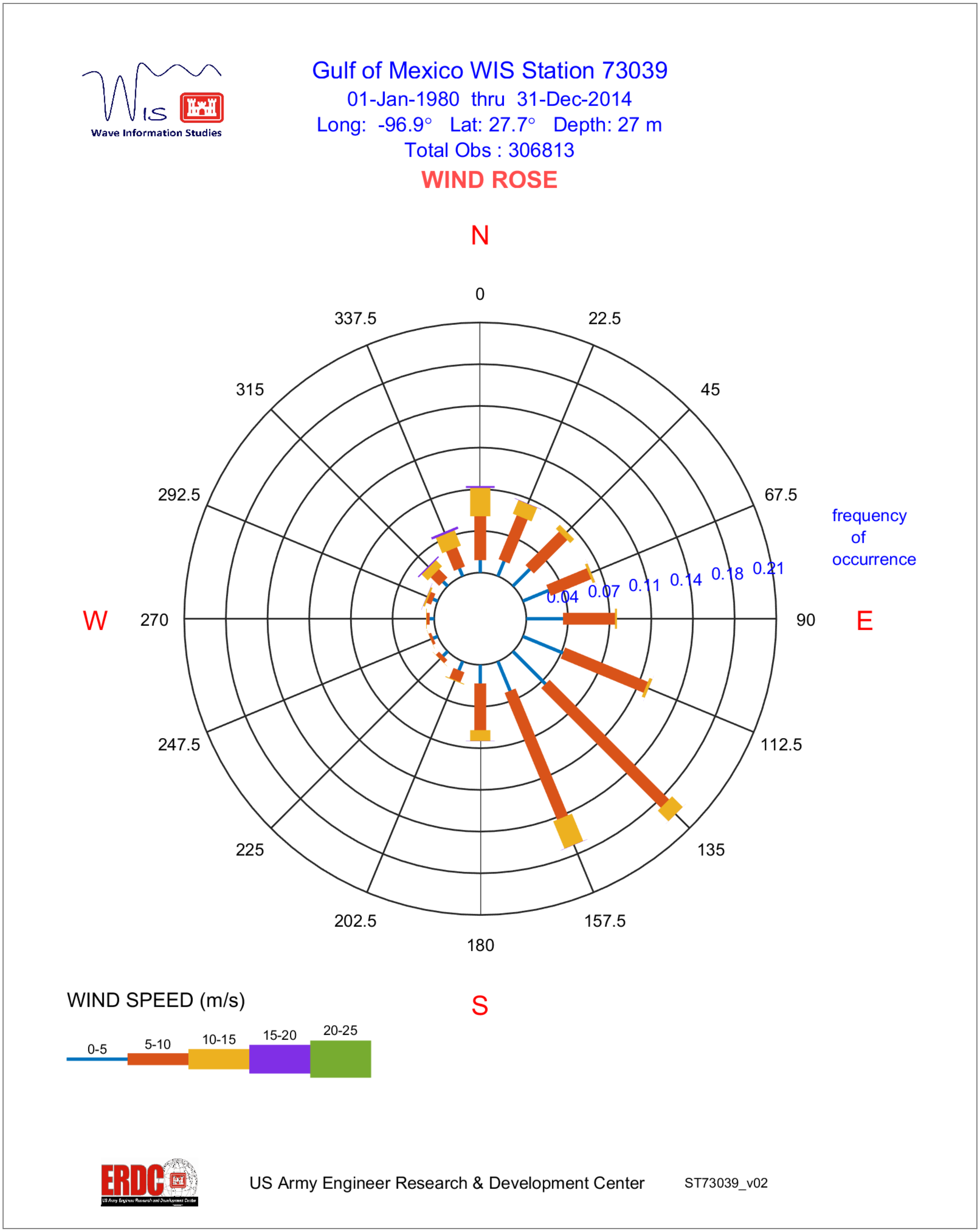

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Figure 2
Historical Wind Data for USACE WIS Station 73039
Causeway Bird Island 10% Design Memorandum
Texas Lower Coast Beneficial Use

Memorandum

January 31, 2022

To: Melissa McCutcheon, Texas General Land Office

From: Todd Merendino, Ducks Unlimited
Sarah Garza, Harrison McNeil, and Yvonne Dives-Gomez, Port of Corpus Christi Authority
John Laplante, Dan Opdyke, Ray Newby, Adrienne Accardi, Alexander Freddo, and
Hayden Smith, Anchor QEA, LLC
Jane Sarosdy, Sarosdy Consulting, Inc.

Re: Dagger Island 10% Design Memorandum

Introduction

This 10% design memorandum describes design criteria and assessments associated with the proposed Dagger Island site (Site), located in Texas General Land Office (GLO) Planning Region 3 of the Texas coast in Redfish Bay in Ingleside, Texas (Figure 1).

Project Background

GLO awarded a Coastal Management Program Project of Special Merit grant (funded through the Gulf of Mexico Energy Security Act) to Ducks Unlimited, Inc. (DU), to identify priority locations and develop 10% designs and opinions of probable construction costs for at least 16 sites in GLO Planning Regions 3 and 4 of the Texas coast for the beneficial use of dredged material (BU). To assist in this endeavor, the Port of Corpus Christ Authority (PCCA) has committed to provide in-kind services to advance several additional BU sites in tandem with the aforementioned scope. The project team is led by DU and PCCA and includes Anchor QEA, LLC; Sarosdy Consulting, Inc.; and the Texas Department of Transportation. In addition to the 16 sites identified and prioritized, PCCA will provide additional resources to bring forward more site designs for review if the site prioritization and selection so warrants. The project team coordinated two online stakeholder meetings to receive information about potential BU sites. Ultimately the project team did not select this site as part of the 16 sites for 10% design. However, based on stakeholder input, GLO feedback, publicly available data, and professional judgment, PCCA selected the Site to advance to the 10% design development and cost estimation.

The existing Dagger Island is located in Redfish Bay, Aransas Pass, Nueces County, Texas, approximately 0.6 mile east of the Gulf Intracoastal Waterway (GIWW) and 0.7 mile north of the

Corpus Christi Ship Channel (CCSC). The island is in GLO State Tract 352 Unit, pooling agreement 3171, which includes private lands, but the BU project described in this memorandum is proposed to be on state-owned submerged land to the southwest and northeast of the island (GLO 2022). Restoration and creation of upland breakwater levees adjacent to remnant landmasses to the southeast and northwest of Dagger Island will convert some open water to landmass and provide protection to approximately 700 acres of protected seagrass in Redfish Bay. The Site was selected due to the erosion of shoreline from hurricanes, storm surge, and wave energy caused by winds and large vessel traffic on the CCSC.

Project Objectives

Frequent dredging is needed to develop and maintain Texas ship channels. The dredged material must be deposited in dredged material placement areas (DMPAs), and many of the existing DMPAs along the Texas coast are nearing capacity. Resource agencies and stakeholders have long advocated using dredged material beneficially to create and restore wetlands and bird islands, nourish beaches, and counteract land loss. Historically, BU projects are difficult to manage because they are multi-year, multi-faceted undertakings in which different organizations manage dredging schedules, funding, project design, permitting, and construction activities. To help address these issues, the objectives of this project include the following:

- Create and restore degrading coastal habitats.
- Establish sites for disposal of dredged material to reduce reliance on existing DMPAs.
- Improve coastal resiliency of the natural and built environment.
- Reduce shoaling in the GIWW and other ship channels.

To accomplish these objectives, the project includes the following tasks:

- Stakeholder outreach and coordination
- Identification and selection of BU sites
- 10% designs and cost estimates for at least 16 BU sites
- 30% designs for at least eight BU sites
- 60% designs, cost estimates, and permit application packages for at least five BU sites

This memorandum documents the 10% design and cost estimate for one of the selected sites.

Design Objectives

This Site will be designed to beneficially use dredged material to restore natural washouts and eroded landmasses; thereby protecting sensitive seagrass habitat in the region. The design will use material dredged from the CCSC during future deepening projects and routine maintenance, thus reducing the volume of such material placed in existing open-bay or upland DMPAs. This 10% design is based upon publicly available datasets; no field work was conducted for this phase of the project.

Design objectives include the following:

- Develop a preliminary vision based on available data for the Site that includes the following:
  - Habitat to be created or restored
  - Potential sediment source(s)
  - Approaches to minimize long-term maintenance costs
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- Identify key sensitive habitats and construction considerations in the vicinity of the Site.
- Estimate fill volumes for the proposed BU footprints.
- Identify data gaps to be addressed in subsequent design stages.
- Provide preliminary cost estimates.

Existing Data Review

Horizontal and Vertical Datums

The horizontal datum used for the Site is the Texas State Plane Zone 5, North American Datum of 1983 (NAD83), in U.S. survey feet. The primary vertical datum used for the Site is the North American Vertical Datum of 1988 (NAVD88). The National Oceanic and Atmospheric Administration (NOAA) maintains an active tide gauge within the vicinity of the Site. The NOAA Ingleside, MODA Station 8775283 (Ingleside station), which is 2 miles to the southwest of the Site, does not provide NAVD88 vertical datums, so the NOAA Port Aransas, TX Station 8775237, which is 6.5 miles east of the Site, was used to convert the Ingleside station mean lower low water (MLLW) tidal datum to NAVD88. These stations collect and record real-time tide information dating back to 2002 and 1989, respectively. The converted vertical datums from the Ingleside station that will be used for the Site are shown in Table 1.

Table 1
NOAA Port Aransas, TX Station 8775237 Tidal Gauge Displaying NAVD88 Tidal Datums

Tidal Datums	Elevation (feet NAVD88)
MHHW	0.55
MHW	0.54
MSL	0.24
MLW	-0.15
MLLW	-0.15

Notes:
MHHW: mean higher high water
MHW: mean high water
MLW: mean low water
MSL: mean sea level

Meteorological, Ocean, and Wave Data

Wind and Waves

The United States Army Corps of Engineers (USACE) Wave Information Studies (WIS) provides a national resource of long-term wavefield climatologies for U.S. coastal waters that synthesizes observations, multi-decade hindcasts, and storm event archives (USACE 2021). The WIS station closest to the Site is Station 73039, just offshore on the Gulf side of Port Aransas, Texas, in the Gulf of Mexico. Because the station is located offshore, the wave data are not applicable to this Site and were not used. However, the project team considers the wind data to be representative of the winds experienced at the Site. Figure 2 summarizes wind data from January 1, 1980, through December 31, 2014. The data indicate that the predominant wind direction is from the southeast, with significant winds also coming from the north, northeast, east, and south.

There is a 1.2-mile fetch between Dagger Island and Pelican Island, the closest landmass, in the predominant southeast wind direction. Due to the fetch, the Site is anticipated to be in a high wave-energy environment. A wave analysis of the direction and frequency of expected significant wave heights will be conducted in subsequent phases of design.

Wake Erosion

The CCSC is approximately 0.7 mile south of the Site. Potential wake erosion from natural wind-generated wave climate and vessels transiting the CCSC is expected to be a design consideration. The proposed armoring will be designed to resist wind- and vessel-generated erosive forces. An analysis of the erosive effects of vessel traffic will be conducted during subsequent stages of design to better understand the extent of vessel-induced erosion on the Site.

Bathymetry

The NOAA National Centers for Environmental Information continuously updated digital elevation model for the Texas coast (NOAA 2021) was used to obtain bathymetry data for the Site. The Site has a relatively uniform depth that averages -1.53 feet NAVD88.

Utilities

The Railroad Commission of Texas public GIS viewer (RRC 2021) was used to identify utilities near the Site. Two submerged natural gas pipelines were found in the northeast section of the Site: Cinco Natural Resources Corporation and Enbridge Pipelines (TX Intra) LP. Two oil wells and several plugged oil and gas wells were found in the Site vicinity. These utilities are submerged. No dredging activities will occur in the Site; therefore, it is not anticipated that these pipelines or wells will affect the design or constructability of the Site. The need for Site-specific utility locations prior to construction will be determined during subsequent design stages. No other infrastructure has been identified in the vicinity of the project.

Desktop Cultural Resources Survey

A search of cultural resources records in the Texas Historical Commission Atlas Database (THC 2021) was completed on December 21, 2021. This search revealed that no sites have been identified within the Site. Two cultural resources were identified approximately 3 miles northwest and southwest of the Site: the Ingleside on the Bay Historical Society/Museum and a marker for the Late Pleistocene Ingleside Fauna. The proposed project will not affect these resources in any way.

Sensitive Habitat

GLO oyster habitat GIS data (GLO 2021) indicate that there is no oyster habitat identified within or adjacent to the Site. According to Texas Parks and Wildlife Department seagrass data (TPWD 2021), there are approximately 700 acres of seagrass mapped behind the Site west, southwest, and northwest in Redfish Cove and approximately 100 acres of seagrass mapped east and southeast of the Site. Surveys will likely need to be conducted during a subsequent phase of design to evaluate the presence and extents of sensitive habitat.

Erosion

Since 1956, the southern section of Dagger Island has lost over 89 acres of land, and the northernmost section of Dagger Island has lost over 35 acres of land, due to erosion from both natural and human causes (Silva 2021). The natural causes of shoreline erosion include the predominant southeast winds, storm events, and decades of sea level rise accompanied by subsidence. Direct human impacts contributing to the erosion include high-energy ship wakes caused by vessels traveling down the CCSC (Silva 2021).

Beneficial Use Source Material

A potential source of dredged material is the CCSC, located adjacent to the Site. Based on Coastal Consistency Determinations from USACE, USACE has historically performed maintenance dredging on the GIWW near the Site (USACE 1999). Continued dredging has recently been confirmed by USACE (Jones 2021). The identified DMPAs used by USACE adjacent to the Site and their average annual quantity of dredged material, distance from the Site, and channel segments are shown in Table 2. The average grain size and grain type percentages are shown in Table 3. This informs the quantity and characteristics of dredged material that may be available during a dredging cycle. For example, the Site will be designed such that the silt and clay, which constitute a relatively high percentage of nearby sediment, will be sheltered from erosive forces.

Table 2
USACE DMPA Areas Adjacent to the Site

DMPA No.	Channel Segment (station)	Distance from Site (miles)	Average Annual Dredging Quantity (cy)
156	946+000-950+000	3.00	47,840
157	950+000-960+000	2.25	88,586
158	956+000-960+500	1.40	77,905
159	960+500-963+000	0.90	41,125
160	963+000-967+000	0.70	56,880
161	967+000-971+000	1.10	48,330
162	971+000-978+000	1.75	78,480

Notes:
Source: USACE 1999.
cy: cubic yard

Table 3
Typical Grain Size Across Redfish Bay

Sediment Characteristics
D_{50} (mm) < 0.044
27.6% sand
33.6% silt
38.8% clay

Notes:
Source: USACE 1999
D_{50}: median grain size
mm: millimeter

10% Design

The main design features that are critical for island success are as follows:

- Site location
- Site size and shape
- Containment and erosion protection
- Planting and natural recruitment of vegetation

These design features are evaluated in this memorandum for the preliminary Site design.

Site Location

The proposed Site location is approximately 0.72 mile north of the CCSC, 2 miles southwest of the completed Ransom Point project, and 0.33 mile southwest of an existing Dagger Island project. The Site is located between Redfish Cove and the south end of Redfish Bay (Figure 1).

The average water depth surrounding the Site is 0.35 foot NAVD88 (0.20 foot MLLW). Bathymetric surveys will need to be conducted during subsequent design phases to better define Site dimensions and material needs.

Size and Shape

Based on availability of sediment, a cost analysis, and stakeholder feedback, the project team proposes that the area of the Site be a total of 47 acres; 32 acres would extend from the south end of the island and 15 acres from the north end of the island, providing protection where washouts have occurred. The Site would be created with dredged material placed to elevations of +5.85 feet NAVD88 at a 4-horizontal-to-1-vertical (4H:1V) slope. The south Site would consist of fill placed in an approximate 32-acre area that extends approximately 2,700 linear feet southwest from the southern end of the island. The north Site would consist of fill material placed in an approximate 15-acre area and extend approximately 3,300 linear feet northeast from the north end of the island. Site widths will vary. The sides of each extension facing southeast, south, and east will be armored to prevent erosion from wave action and wind energy. The elevation of dredged material fill could be adjusted at further stages of design, depending on the physical properties of the dredged material.

Fill material could be obtained from the CCSC as described in Table 3. It is predicted that the required dried fill volume will be approximately 470,000 cubic yards (cy). Geotechnical data will likely need to be collected during a subsequent design phase to further evaluate the expected foundation compression and the expected bulking of dredged material.

Erosion Protection

Based on the fetch in the predominant southeast wind direction and potential risk of wake erosion, the project team proposes armoring for the Site consisting of riprap revetment that will mitigate erosion to the Site and contain the dredged material (Figure 3). Riprap will be placed to +5.85 feet NAVD88 at a 4H:1V seaward/east slope and a 10H:1V leeward/west slope. With naturally shallow bathymetry surrounding the west and northwest of the Site and the predominantly southeast wind direction, it is expected that this area will have adequate protection from wind and wave impacts. Another option is to construct the Site as a sacrificial beach without armoring.

Planting and Natural Recruitment of Vegetation

Based on stakeholder input and cost considerations, the project team determined that planting may not be needed for the Site. Rather, natural vegetation recruitment will be allowed to proceed. If the outcome is unsatisfactory, an adaptive management program can be instituted to modify the vegetation.

Site Construction Cost Estimates

Construction costs were estimated for the design outlined in the previous sections. The estimated costs include permitting, 100% design, engineering costs for advancing the design to the construction phase, pre-construction and as-built surveys, mobilization, and materials. These costs represent the estimated incremental costs; i.e., those costs over and above USACE's least cost and environmentally acceptable dredged material and disposal alternative. Table 4 shows a line-item list of each costing parameter and the total cost estimated for construction.

Table 4
Opinion of Probable Construction Cost to 100% Project Completion

Item	Quantity	Unit	Unit Price	Total
Pre-Construction Survey	1	LS	$ 30,000.00	$ 30,000.00
Stone (armoring)[1,2]	17,820	cy	$ 200.00	$ 3,600,000.00
Incremental Dredging Cost (1-mile pipeline)	470,000	cy	$ 5.00	$ 2,350,000.00
Post-Construction Survey (topography/ bathymetry)	1	LS	$ 30,000.00	$ 30,000.00
Pos-Construction Survey (aerials)	1	LS	$ 10,000.00	$ 10,000.00
Subtotal[2]			**Sum**	**$ 6,000,000.00**
Incremental Mobilization[2]	1	5%	$ 300,000.00	$ 300,000.00
Construction Total[2]			**Sum**	**$ 6,300,000.00**
100% Engineering and Design[2]	1	10%	$ 600,000.00	$ 600,000.00
Permitting	1	Each	$ 100,000.00	$ 100,000.00
Construction Management[2]	1	8%	$ 500,000.00	$ 500,000.00
Post-Construction Management	12	Month	$ 10,000.00	$ 120,000.00
Project Subtotal[2]			**Sum**	**$ 7,600,000.00**
-30% Contingency[2]	1	30%	$ 1,900,000.00	$ 2,300,000.00
+50% Contingency[2]	1	50%	$ 3,200,000.00	$ 3,800,000.00
Low-End Total Project Estimated Cost[2]			**Total Sum**	**$ 5,300,000.00**
High-End Total Project Estimated Cost[2]			**Total Sum**	**$ 11,400,000.00**

Notes:
Costs were determined based upon publicly available datasets; no field work was conducted for this phase of the project.
1. Future analysis will determine if a lesser quantity of stone can be used if height varies.
2. Rounded to the nearest $100,000.

LS: lump sum

The costs vary from $5.3 million to $11.4 million, depending on the level of contingency allocated to the project cost. Cost savings may be realized if levee height varies and a lesser amount of stone is used or by constructing the Site as a sacrificial beach and removing armoring from the design.

The estimates are developed using current and generally accepted engineering cost estimating methods and are based on assumptions concerning future events. Actual costs may be affected by known and unknown risks including, but not limited to, changes in general economic business conditions, Site conditions that were unknown at the time the estimates were performed, future changes in Site conditions, regulatory or enforcement policy changes, and delays in performance. Actual costs may vary from these estimates.

Ecosystem Benefits Expected

Creation of the Site is expected to have positive benefits on the regional ecosystem. The Site will protect seagrass in the area and thereby allow for continued nursery areas for fish and other marine organisms and food sources for other wildlife. The protected seagrass site will continue to provide improved water quality through nutrient uptake and retention and sediment trapping.

Future Work

Of the sites selected for 10% designs in this project, at least eight will be selected for 30% designs, and at least five of those will subsequently be selected for 60% designs and cost estimates. No fatal flaws have been identified in this 10% design effort. Should this Site be selected for additional design efforts, it can be expected that some aspects of the design in this memorandum will be modified and, as appropriate, improved. As previously mentioned, it is possible that in each phase additional designs will be provided toward this project because of the partnership on this project between DU and PCCA.

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Figures

Path: H:\Environmental\Duck Unlimited Beneficial Use Project\DU Beneficial Use Sites\DU Beneficial Use Sites.aprx Date Saved: 1/26/2022 10:23 AM User: hmcneil

Legend

Dagger Island

BU Type

- Shoreline Stablization
- TPWD Seagrass
- Oyster Habitat

Railroad Commission Pipelines

Status

- Abandoned
- In-Service

PORTCORPUSCHRISTI

Figure 1
Location Map

Dagger Island - Shoreline Stabilization
10% Design Memorandum
Texas Lower Coast Beneficial Use

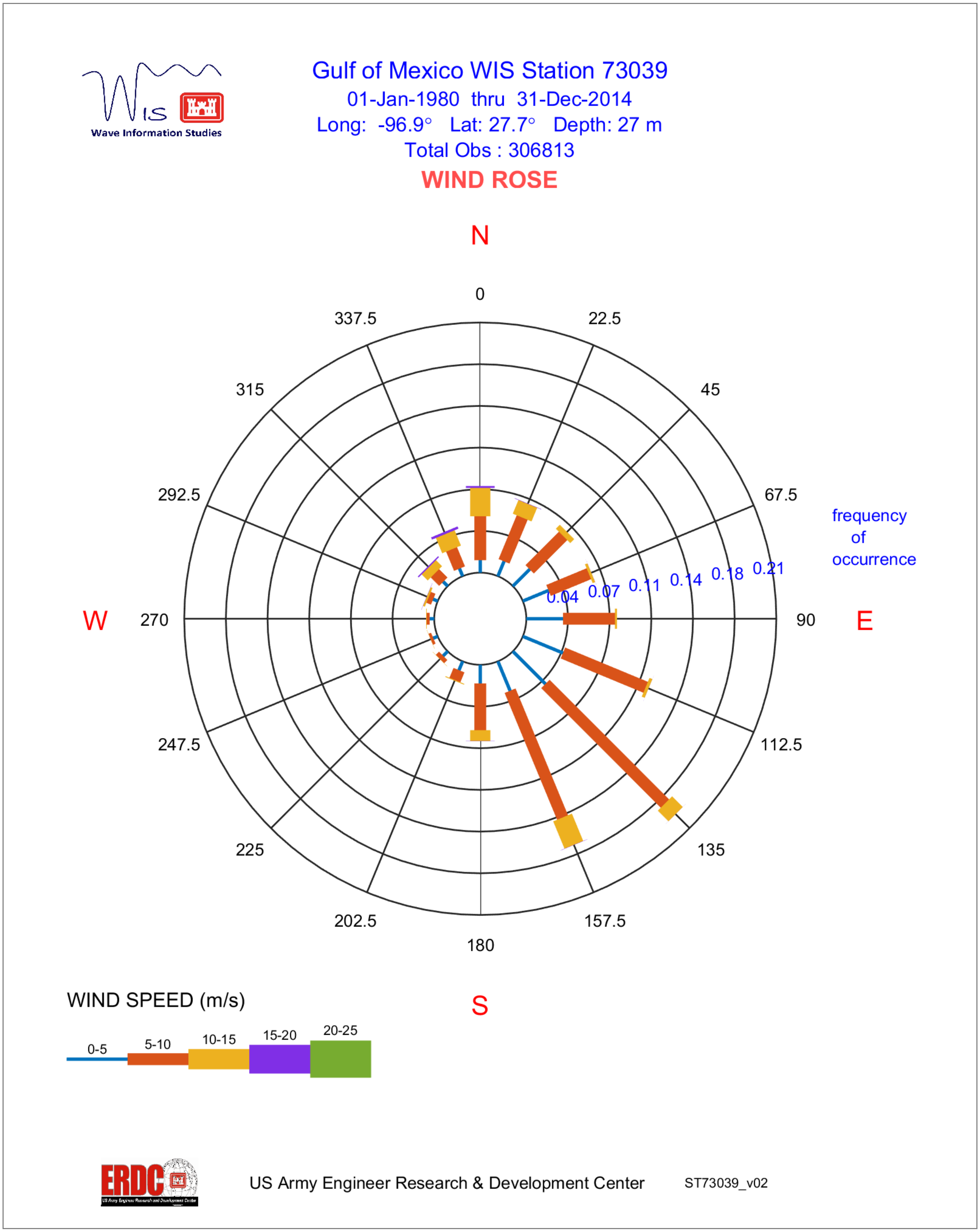

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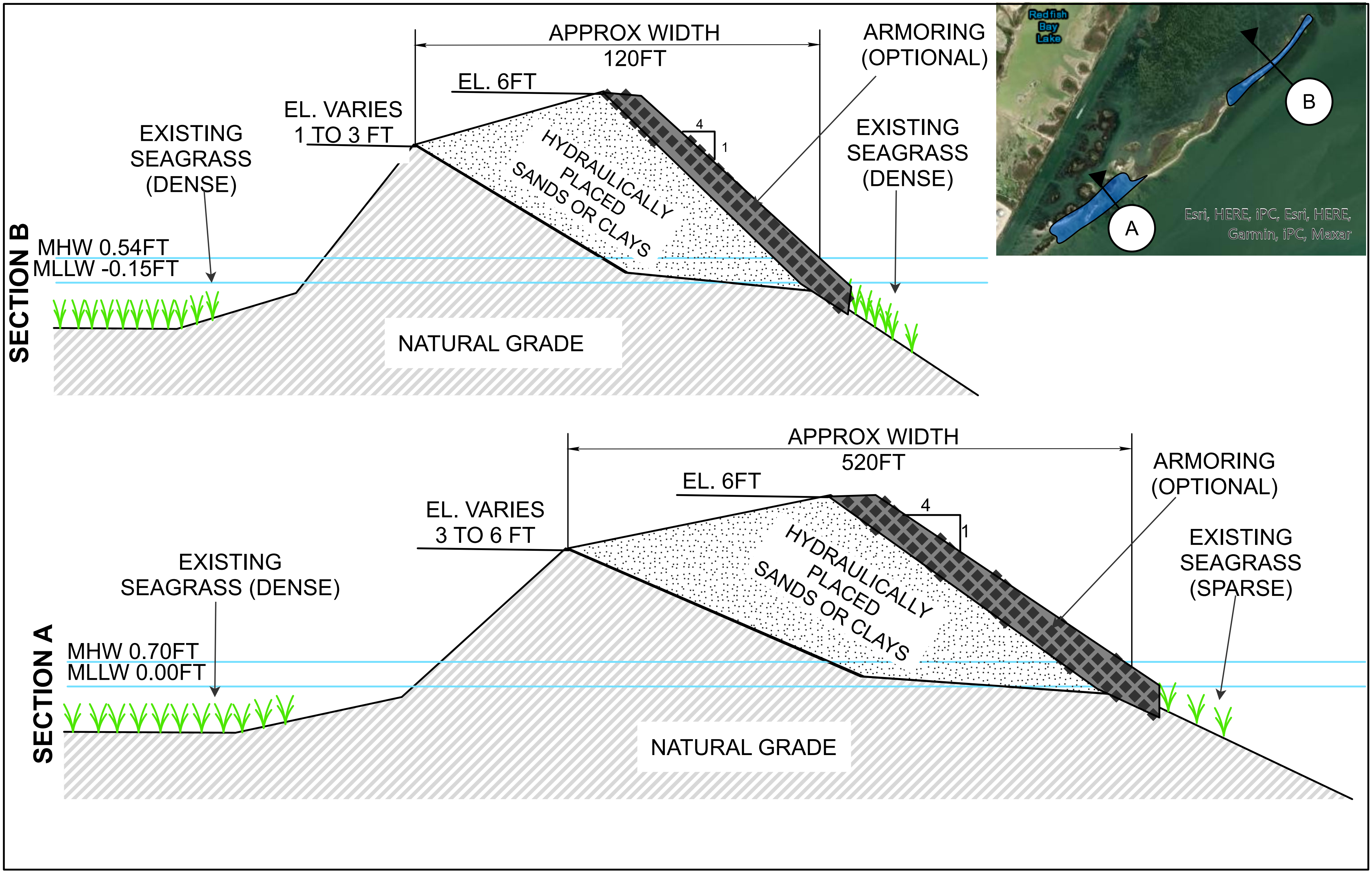
Figure 2
Historical Wind Data for USACE WIS Station 73039



These drawing are conceptual intended for planning purposes only.
These drawings are not intended to be used for engineer, construction, surveying or bidding documents. These drawings are not to scale.
Vertical datum NAVD88

PORTCORPUSCHRISTI

Figure 3
Cross Sections

Dagger Island 10% Design Memorandum
Texas Lower Coast Beneficial Use

Memorandum

January 31, 2022

To: Melissa McCutcheon, Texas General Land Office

From: Todd Merendino, Ducks Unlimited, Inc.
Sarah Garza, Harrison McNeil, and Yvonne Dives-Gomez, Port of Corpus Christi Authority
John Laplante, Dan Opdyke, Ray Newby, Adrienne Accardi, Alexander Freddo, and Hayden Smith, Anchor QEA, LLC
Jane Sarosdy, Sarosdy Consulting, Inc.

Re: DMPA #187 PINS Bird Island 10% Design Memorandum

Introduction

This 10% design memorandum describes design criteria and assessments associated with the proposed Dredged Material Placement Area (DMPA) #187 Padre Island National Seashore (PINS) Bird Island site (Site), located in Texas General Land Office (GLO) Planning Region 3 of the Texas coast in the Upper Laguna Madre in Kleberg County, Texas (Figure 1).

Project Background

GLO awarded a Coastal Management Program Project of Special Merit grant (funded through the Gulf of Mexico Energy Security Act) to Ducks Unlimited, Inc. (DU), to identify priority locations and develop 10% designs and opinions of probable construction costs for at least 16 sites in GLO Planning Regions 3 and 4 of the Texas coast for the beneficial use of dredged material (BU). The project team is led by DU and Port of Corpus Christi Authority (PCCA) and includes Anchor QEA, LLC; Sarosdy Consulting, Inc.; and the Texas Department of Transportation. In addition to the 16 sites identified and prioritized, PCCA will provide additional resources to bring forward more site designs for review if the site prioritization and selection so warrants. The project team coordinated two online stakeholder meetings in each region to receive information about potential BU sites. Based on stakeholder input, GLO feedback, publicly available data, and professional judgment, the project team selected the Site as one of the 16 sites for 10% design development and cost estimation.

Conservationists have identified the Laguna Madre as an important location for creating and restoring bird habitat (CBBEP 2020). The Site will be located inside the United States Army Corps of Engineers (USACE) DMPA #187 on U.S. National Park Service (NPS)-owned submerged land approximately 0.25 mile east of the Gulf Intracoastal Waterway (GIWW) in the Upper Laguna Madre in Kleberg County, Texas. During the initial dredging of the GIWW, relict sidecasted new work dredged material was left along the edge of the channel. The Site is expected to take advantage of this unique opportunity for mining favorable rookery island material in the area. This area was selected because of the identified need for secure and stable rookery island habitat in the region, its proximity to a sediment source in the existing DMPAs, its proximity to potential bird foraging areas, and its sufficient distance from upland-based predators.

Project Objectives

Frequent dredging is needed to develop and maintain Texas ship channels. The dredged material must be deposited in DMPAs, and many of the existing DMPAs along the Texas coast are nearing capacity. Resource agencies and stakeholders have long advocated using dredged material beneficially to create and restore wetlands and bird islands, nourish beaches, and counteract land loss. Historically, BU projects are difficult to manage because they are multi-year, multi-faceted undertakings in which different organizations manage dredging schedules, funding, project design, permitting, and construction activities. To help address these issues, the objectives of this project include the following:

- Create and restore degrading coastal habitats.
- Establish sites for placement of dredged material to reduce reliance on existing DMPAs.
- Improve coastal resiliency of the natural and built environment.
- Reduce shoaling in the GIWW and other ship channels.

To accomplish these objectives, the project includes the following tasks:

- Stakeholder outreach and coordination
- Identification and selection of BU sites
- 10% designs and cost estimates for at least 16 BU sites
- 30% designs for at least eight BU sites
- 60% designs, cost estimates, and permit application packages for at least five BU sites

This memorandum documents the 10% design and cost estimate for one of the selected sites.

Design Objectives

This Site will be designed to beneficially use dredged material to create a rookery island in a region with degrading coastal bird habitat. During the initial dredging of the GIWW, relict sidecasted new work dredged material was left along the edge of the channel. The relict new work materials in this region that remain from the original construction of the GIWW are considered to have superior structural properties relative to maintenance dredged material (Morton et al. 2001), and hence are the target sediment source for this design. The Site is expected to take advantage of this unique opportunity for mining favorable rookery island material in the area and use material dredged from existing relict new work material inside the surrounding DMPAs, thus increasing dredged material placement capacity in the DMPAs. Although this project is not proposed to use maintenance dredged material, it can still be considered a BU project because it is expected to take advantage of dredging equipment for which the mobilization and demobilization costs are paid by USACE. This 10% design is based upon publicly available datasets; no field work was conducted for this phase of the project.

Design objectives include the following:

- Develop a preliminary vision based on available data for the Site that includes the following:
  - Habitat to be created or restored
  - Potential sediment source(s)
  - Approaches to minimize long-term maintenance costs
- Delineate conceptual footprints for proposed BU placement.
- Identify key sensitive habitats and construction considerations in the vicinity of the Site.
- Estimate fill volumes for the proposed BU footprints.
- Identify data gaps to be addressed in subsequent design stages.
- Provide preliminary cost estimates.

Existing Data Review

Horizontal and Vertical Datums

The horizontal datum used for the Site is the Texas State Plane Zone 5, North American Datum of 1983 (NAD83) in U.S. survey feet. The primary vertical datum used for the Site is the North American Vertical Datum of 1988 (NAVD88). The National Oceanic and Atmospheric Administration (NOAA) maintains an active tide gauge within the vicinity of the Site. The NOAA South Bird Island, TX Station 8776139 is 2 miles north of the Site; however, this station only provides NAVD88 and mean sea level (MSL) vertical datums. The next closest station that contains the necessary tidal datums is Packery Channel, TX Station 8775792 (Packery Channel station), 13 miles north of the Site. There is a 0.02-foot difference in the MSL tidal datum between the stations, so the tidal datum from the Packery Channel station was assumed accurate for this level of analysis. The Packery Channel station collects and records real-time tide information dating back to 1990. The vertical datums from this station that will be used for the Site are shown in Table 1.

Table 1
NOAA Packery Channel, TX Station 8775792 Tidal Gauge Displaying NAVD88 Tidal Datums

Tidal Datums	Elevation (feet NAVD88)
MHHW	0.79
MHW	0.79
MSL	0.59
MLW	0.36
MLLW	0.37

Notes:
MHHW: mean higher high water
MHW: mean high water
MLLW: mean lower low water
MLW: mean low water

Meteorological, Ocean, and Wave Data

Wind and Waves

The USACE Wave Information Studies (WIS) provides a national resource of long-term wavefield climatologies for U.S. coastal waters that synthesizes observations, multi-decade hindcasts, and storm event archives (USACE 2021). The WIS station closest to the Site is Station 73036, just offshore on the Gulf side of North Padre Island in the Gulf of Mexico. Because the station is located offshore, the wave data are not applicable to this project design. However, the project team considers the wind data to be representative of the winds experienced at the Site. Figure 2 summarizes wind data from January 1, 1980, through December 31, 2014. The data indicate that the predominant wind direction is from the southeast, with significant winds also coming from the north, northeast, east, and south.

There is a 0.75-mile fetch between the Site and North Padre Island, the closest land mass in the predominant southeast wind direction. Due to the fetch and surrounding water depths, the Site is anticipated to be in a high wave-energy environment. A wave analysis of the direction and frequency of expected significant wave heights will be conducted in subsequent phases of design.

Wake Erosion

The GIWW is approximately 0.25 mile west of the Site. Potential wake erosion from vessels transiting the GIWW is expected to be a design consideration. The proposed armoring will be designed to resist wind- and vessel-generated erosive forces. An analysis of the erosive effects of vessel traffic will be conducted during subsequent stages of design to better understand the extent of vessel-induced erosion on the Site.

Bathymetry

The NOAA National Centers for Environmental Information continuously updated digital elevation model for the Texas Coast (NOAA 2021) was used to obtain bathymetry data for the Site. The Site has a relatively uniform seabed elevation that averages -0.1 foot NAVD88.

Utilities and Infrastructure

The Railroad Commission of Texas public GIS viewer (RRC 2021) was used to identify utilities and pipelines near the Site. No utilities or pipelines were identified near the Site. The need for Site-specific utility locations prior to construction will be determined during subsequent design stages. No other infrastructure has been identified in the vicinity of the project Site.

Desktop Cultural Resources Survey

A search of cultural resources records in the Texas Historical Commission Atlas Database was completed for the Site between November 29 and December 30, 2021. This search revealed that no archaeological surveys have been conducted and no archaeological sites have been identified within the preliminary proposed placement site boundary (THC 2021).

Sensitive Habitat

GLO oyster habitat GIS data (GLO 2021) indicate that there is no oyster habitat identified within or adjacent to the Site. According to Texas Parks and Wildlife Department (TPWD) seagrass data (TPWD 2021), there are suspected seagrasses on all sides of the Site. Because the sensitive habitat data are not recent, surveys will likely need to be conducted during a subsequent phase of design to evaluate the presence and extents of sensitive habitat to confirm or update the understanding of sensitive habitat in the vicinity of the Site.

Bird Species

The U.S. Fish and Wildlife Service (USFWS) Information for Planning and Consultation (IPaC) tool was used to identify listed species and migratory birds within a 460-square-mile region around Baffin Bay and a portion of North Padre Island (USFWS 2021). Table 2 includes some of the protected and migratory bird species that are present near the Site and their preferred habitat as explained in Audubon’s field guide (Audubon 2021a). At this time, no target species, or list of species, has been identified for the Site.

Table 2
USFWS IPaC Species Information

Species	Status	Preferred Habitat[1]
Whooping Crane (*Grus americana*)	Endangered	Prairie pools, marshes, and coastal marshes
Piping Plover (*Charadrius melodus*)	Threatened	Sand beach dunes and expansive sand or mudflats
Red Knot (*Calidris canutus*)	Threatened	Mudflats, tidal zones, and sandy beaches
American Oystercatcher (*Haematopus palliatus*)	Migratory	Strictly coastal; dunes, islands in salt marsh, dredge spoil islands, sandy beaches, and tidal mudflats
Black Skimmer (*Rynchops niger*)	Migratory	Sandy islands, shell beaches, open beaches, lagoons, estuaries, inlets, and sheltered bays
Brown Pelican (*Pelecanus occidentalis*)	Migratory	Bare, rocky, mangrove or tree-covered islands; salt bays, beaches, and oceans
Gull-Billed Tern (*Gelochelidon nilotica*)	Migratory	Beaches, islands, salt marshes, fields, and coastal bays
Marbled Godwit (*Limosa fedoa*)	Migratory	Northern Great Plains, native prairie with marshes or ponds, pools, shores, marshes, and tidal flats
Reddish Egret (*Egretta rufescens*)	Migratory	Red mangrove swamps, arid coastal islands covered with thorny brush, coastal tidal flats, salt marshes, and lagoons
Ring-Billed Gull (*Larus delawarensis*)	Migratory	On ground near water with sparse plant growth, lakes, bays, coasts, piers, dumps, and plowed fields
Royal Tern (*Thalasseus maximus*)	Migratory	Low-lying sandy islands, coasts, lagoons, salt bays, and estuaries
Wilson's Plover (*Charadrius wilsonia*)	Migratory	Dry part of beach, near conspicuous object, coastal regions, open beaches, tidal flats, estuaries, and sandy islands

Notes:
1. Habitat information is from the Audubon field guide (Audubon 2021a) and includes preferred nesting and general habitat.
USFWS IPaC information (USFWS 2021) is provided for a 460-square-mile region around Baffin Bay and a portion of North Padre Island highlighting endangered, threatened, and migratory birds and their preferred habitat.

Erosion

Google Earth imagery from 2011 to 2020 indicates that the Site is deteriorating from erosional forces. This is consistent with documentation from the Coastal Bend Bays & Estuaries Program, which notes that the North Padre Island shorelines are at high risk due to erosional forces such as wave energy and relative sea level rise (CBBEP 2020).

Beneficial Use Source Material

The proposed source material for the Site will consist of existing relict new work dredged material currently inside of DMPA #187. The Site is also approximately 1 mile from DMPA #186 and 2 miles from DMPA #188, and dredged relic material from either of these areas could also be used, albeit at a higher unit cost than currently assumed. The material located in the Laguna Madre placement areas came from material dredged from deltaic deposits of Pleistocene Beaumont Formation or the Holocene Rio Grande delta during the original dredging of the GIWW and has been shown to be more stable than recent maintenance dredged material (Morton et al. 2001). Further information will need to be collected to determine more precise composition and available quantities of dredged material from these sources.

10% Design

The main design features that are critical for rookery island success are as follows:

- Site location
- Island size and shape
- Containment and erosion protection
- Planting and natural recruitment of vegetation

These design features are evaluated in this memorandum for the preliminary Site design.

Site Location

The proposed location of the Site is approximately 0.25 mile east of the GIWW and inside of DMPA #187. The Site's location was selected to avoid encroaching on PINS land outside of the DMPA (DMPA #187 is on PINS land, but USACE has prior authorization to discharge dredged material, so the project team assumes that it will be easier to get permission from PINS to build within DMPA #187 than outside of it). TPWD seagrass data (TPWD 2021) show that there are seagrasses withing the Site footprint and within the proposed excavation areas. The data are not recent, and new seagrass survey data will be needed to determine what impacts on seagrass the project may have.

The proposed Site is approximately 0.5 mile from the nearest shoreline. This distance is coincident with a 0.5-mile distance identified for minimizing predator access to rookery islands (Stanzel 2018).

The Site is located on an existing mound of relict new work material inside of DMPA #187 that provides shallow water with seabed elevations of approximately -0.1 foot NAVD88 (+0.27 foot mean lower low water). Because the Site is inside a DMPA, relict new work material existing inside can be rearranged to construct the rookery island. It is anticipated that access channels will need to be constructed for dredgers to access the material inside the DMPAs. Bathymetric surveys will need to be conducted during subsequent design phases to better define Site dimensions and material needs.

Size and Shape

Based on availability of sediment, a cost analysis, and stakeholder feedback, the project team proposes that the area of the Site be 7 acres. The Site will be created with dredged material placed to an elevation of +3.8 feet NAVD88. The Site will be approximately rectangular in shape with a high-density relict clay berm on all sides to protect the island from wind- and vessel-generated waves, as shown in Figure 1. This shape of fill was selected to promote natural recruitment of vegetation and provide habitat for a range of bird species. The elevation of dredged material fill could be adjusted at further stages of design depending on the physical properties of the dredged material or if target bird species and their specific requirements are identified to be different from these assumptions. It is expected that environmental controls such as turbidity curtains and temporary containment of material will be needed during construction to contain finer sediment placed during construction.

Fill material could be obtained from existing relict material in DMPA #187. It is predicted that the required fill volume will be approximately 75,000 cubic yards (cy), with approximately 20,000 cy being settled volume. This value assumes 1 foot of foundation compression for every 3 feet of fill and does not consider bulking. Geotechnical data will likely need to be collected during a subsequent design phase to further evaluate the expected foundation compression and the expected bulking of dredged material.

Containment and Erosion Protection

Based on the fetch in the predominant southeast wind direction and potential risk of wake erosion, the project team proposes containment for the Site consisting of an unarmored berm that will mitigate erosion to the rookery island and contain the dredged material. The berm will be composed of higher density clay constructed on an existing approximate -0.5-foot-NAVD88 grade. The berm will contain a 4-horizontal-to-1-vertical (4H:1V) seaward side slope and a 3H:1V landward side slope connected by a 12-foot-wide crest. The construction height of the crest will be +3.8 feet NAVD88. The exact width will be dependent on the existing grade, but assuming -0.5 foot NAVD88, the berm base width will be approximately 43 feet. Figure 3 depicts a typical cross section of the berm. The final cross-sectional dimensions and slopes of the berm will need to be determined and refined, respectively, through modeling and analysis of the sediment characteristics of the dredged material and the berm subgrade during a subsequent phase of design.

The berm will be constructed from relict sidecasted new work material removed from the nearby shallows before the island is constructed. As shown in Figure 3, the fill material will be directly contained by the berm. Confining the dredged fill material within the berm will reduce potential impacts to adjacent seagrass habitat. Elevations at the center and southwest location of the Site lie shallower than the -1-foot-NAVD88 contour, and it is assumed that marsh buggies will be used to build and shape the berm. The berm is proposed with a 4H:1V seaward slope to allow wildlife access into the Site. A 4H:1V slope will also improve slope stability and reduce wave energy compared to steeper berm slopes.

Planting and Natural Recruitment of Vegetation

Based on stakeholder input and cost considerations, the project team determined that planting may not be needed for the Site. Rather, natural vegetation recruitment will be allowed to proceed. If the outcome is unsatisfactory (e.g., if the island has lower-than-expected use by desired bird species), an adaptive management program can be instituted to modify the vegetation. Table 2 shows some of the listed and migratory birds and their preferred habitats. At further design stages, this list could be used to modify elevations within the Site to promote the preferred habitat of desired bird species.

Site Construction Cost Estimates

Construction costs were estimated for the design outlined in the previous sections. The estimated costs include permitting, 100% design, engineering costs for advancing the design to the construction phase, pre-construction and as-built surveys, incremental mobilization and demobilization (i.e., over and above USACE's mobilization and demobilization costs for dredging the GIWW), materials, and construction of the berm. Table 3 shows a line-item list of each costing parameter and the total cost estimated for construction.

Table 3
Opinion of Probable Construction Cost to 100% Project Completion

Item	Quantity	Unit	Unit Price	Total
Pre-Construction Survey	1	LS	$ 30,000.00	$ 30,000.00
Bird Island Berm and Internal Fill Excavation[1]	75,000	cy	$ 10.00	$ 750,000.00
Marsh Buggy Fill Maintenance[2]	23	Days	$ 2,500.00	$ 60,000.00
Post-Construction Survey (topography/ bathymetry)	1	LS	$ 30,000.00	$ 30,000.00
Post-Construction Survey (aerials)	1	LS	$ 10,000.00	$ 10,000.00
Navigational Aids[2]	4	Each	$ 4,000.00	$ 20,000.00
Subtotal[3]			**Sum**	**$ 900,000.00**
Incremental Mobilization and Demobilization[3,4]	1	LS	$ 400,000.00	$ 400,000.00
Construction Total[3]			**Sum**	**$ 1,300,000.00**
100% Engineering and Design[3]	1	10%	$ 100,000.00	$ 100,000.00
Permitting	1	Each	$ 100,000.00	$ 100,000.00
Construction Management[3]	1	8%	$ 100,000.00	$ 100,000.00
Post-Construction Management	12	Month	$ 10,000.00	$ 120,000.00
Project Subtotal[3]			**Sum**	**$ 1,700,000.00**
-30% Contingency[3]	1	30%	$ 500,000.00	$ 500,000.00
+50% Contingency[3]	1	50%	$ 900,000.00	$ 900,000.00
Low-End Total Project Estimated Cost[3]			**Total Sum**	**$ 1,200,000.00**
High-End Total Project Estimated Cost[3]			**Total Sum**	**$ 2,600,000.00**

Notes:
Costs were determined based upon publicly available datasets; no field work was conducted for this phase of the project.
1. Cost is based on the incremental cost of diverting dredging equipment from the GIWW to excavation areas.
2. Rounded to the nearest $10,000.
3. Rounded to the nearest $100,000.
4. Cost is based on mobilizing equipment above what is required for dredging the GIWW (i.e., marsh buggies).

LS: lump sum

The costs vary from $1.2 million to $2.6 million, depending on the level of contingency allocated to the project cost.

This 10% design represents a bird island near the upper range of bird island sizes desired, based on stakeholder input. Future cost constraints may limit the island size that is ultimately constructed, but at this level of design, it was decided to consider a site near the upper end of the range identified by stakeholders.

The estimates are developed using current and generally accepted engineering cost estimating methods and are based on assumptions concerning future events. Actual costs may be affected by known and unknown risks including, but not limited to, changes in general economic business conditions, Site conditions that were unknown at the time the estimates were performed, future changes in Site conditions, regulatory or enforcement policy changes, and delays in performance. Actual costs may vary from these estimates.

Ecosystem Benefits Expected

Creation of the Site is expected to have positive benefits on the regional ecosystem. Green Island, an 80-acre rookery island located in the Lower Laguna Madre, was used to approximate the ecological benefits for the Site. From 2011 to 2015, Green Island averaged approximately 1,000 breeding pairs of birds per year across three species that are listed in Table 2 (Audubon 2021b). Adjusting for the acreage of the rookery island, the Site may be expected to create habitat for approximately 90 breeding pairs for three species of birds per year.

Due to the location of seagrass habitat adjacent to the Site, dredging of surrounding relict material during construction could result in surrounding water depths that are conducive to further seagrass colonization. This could increase the existing seagrass habitat in the regional ecosystem.

Future Work

Of the sites selected for 10% designs in this project, at least eight will be selected for 30% designs, and at least five of those will subsequently be selected for 60% designs and cost estimates. No fatal flaws have been identified in this 10% design effort. Should this Site be selected for additional design efforts, it can be expected that some aspects of the design in this memorandum will be modified and, as appropriate, improved. For example, the Site is currently proposed to be within the DMPA. This may cause concerns with USACE (although, as an uncontained DMPA, it theoretically has infinite capacity). Moving the Site to outside of the DMPA may be advantageous from the perspective of USACE and may provide more opportunity to be distant from seagrasses but may also raise challenges with constructing a restoration site on PINS property. Obtaining explicit agreement from either USACE or NPS or both on a Site footprint will be important for moving forward. As previously mentioned, it is possible that in each phase additional designs will be provided toward this project because of the partnership on this project between DU and PCCA.

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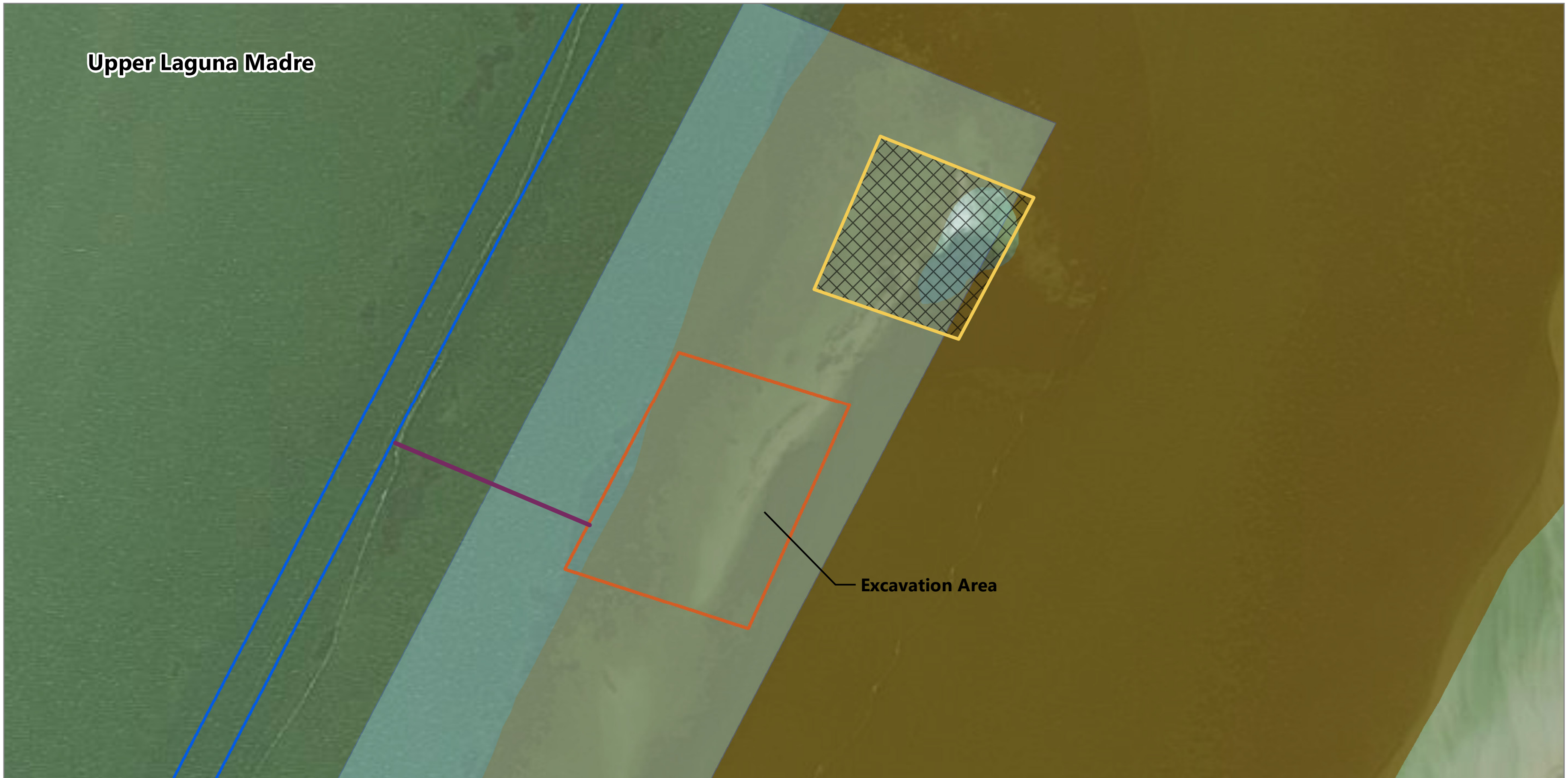
Figures



LEGEND:

- Dredging Access Channel
- Berm
- Gulf Intracoastal Waterway
- DMPA #187 PINS Bird Island Site
- USACE Active Open Water Dredged Material Placement Area
- Excavation Area
- Seagrass

NOTE:
Aerial imagery is from Esri basemaps

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Feet

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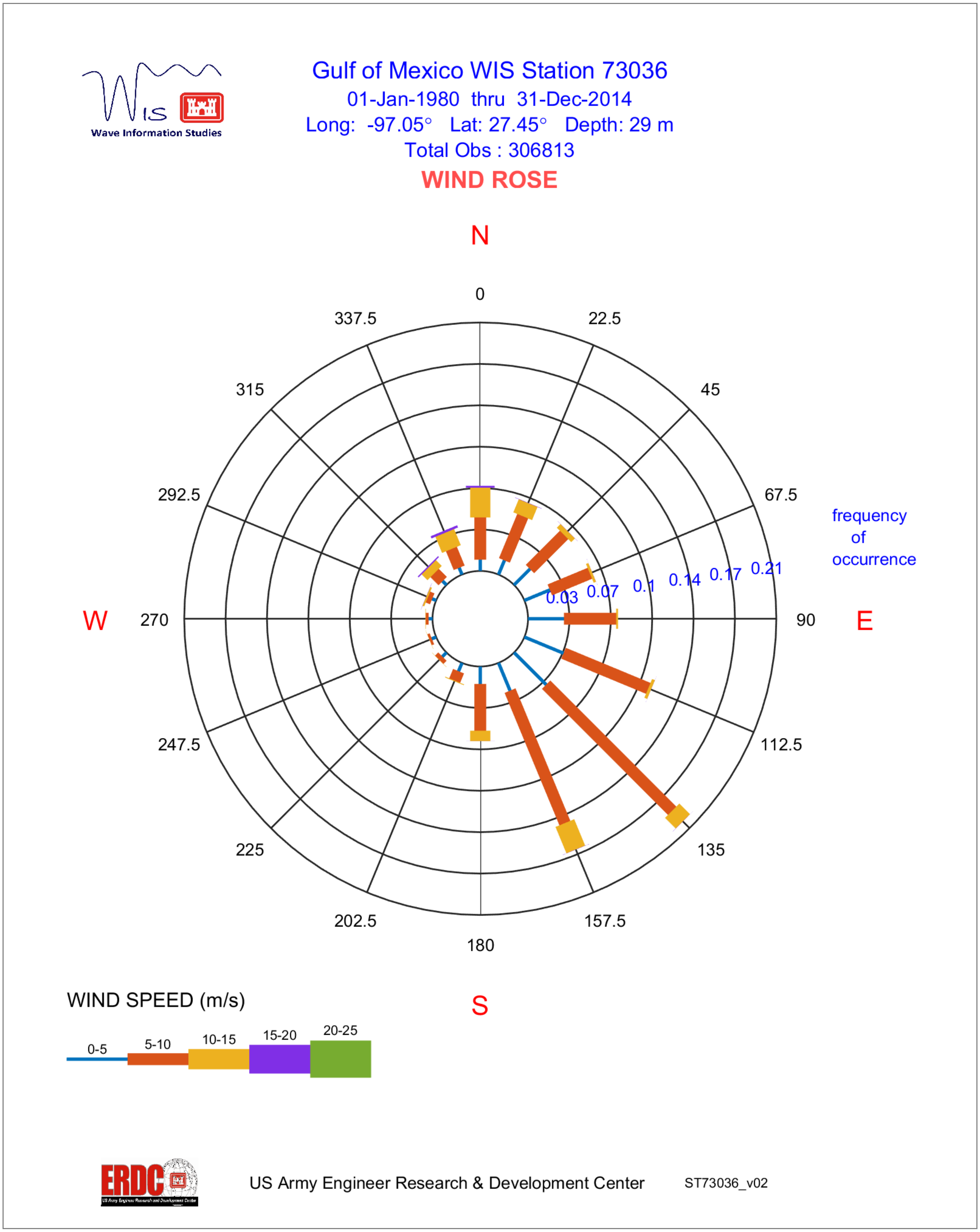
ANCHOR QEA

Figure 1
DMPA #187 PINS Bird Island Plan View
DMPA #187 PINS Bird Island 10% Design Memorandum
Texas Lower Coast Beneficial Use



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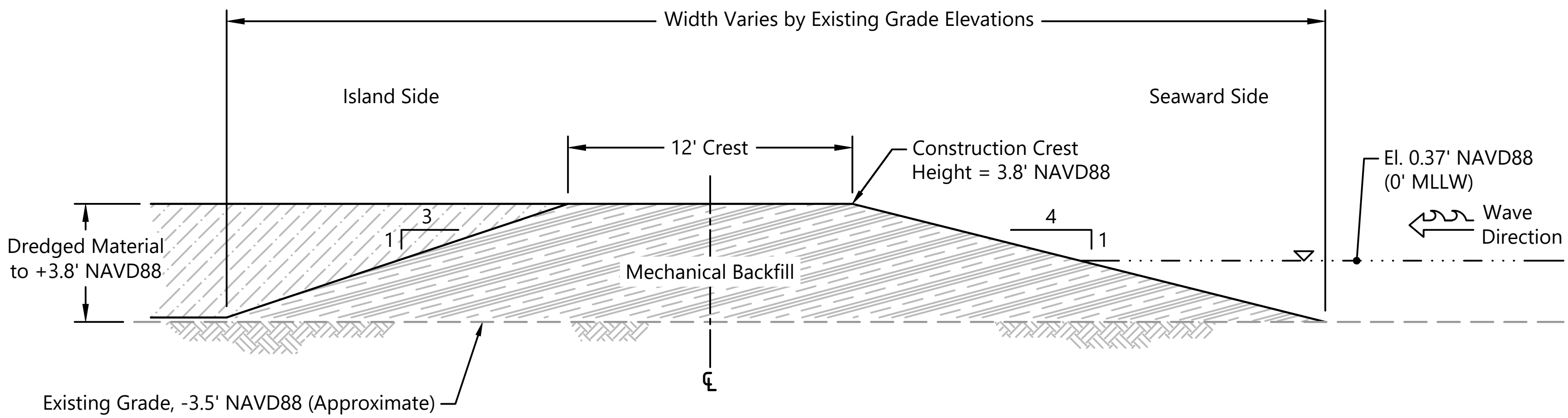
ANCHOR QEA

Figure 2
Historical Wind Data for USACE WIS Station 73036
DMPA #187 PINS Bird Island 10% Design Memorandum
Texas Lower Coast Beneficial Use



Section A-A' Typical Berm
Not to Scale

VERTICAL DATUM: North American Vertical Datum of 1988 (NAVD88)

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Filepath: K:\Projects\1942-Ducks Unlimited\Little Bird Island\Little Bird Island North 10% Design\1942-RP-003 LITTLE BIRD BERM #187.dwg Figure 3

ANCHOR QEA

Figure 3
Section A-A' Typical Berm

Memorandum

January 31, 2022

I To: Melissa McCutcheon, Texas General Land Office

From: Todd Merendino, Ducks Unlimited
Sarah Garza, Harrison McNeil, and Yvonne Dives-Gomez, Port of Corpus Christi Authority
John Laplante, Dan Opdyke, Ray Newby, Adrienne Accardi, Alexander Freddo, and Hayden Smith, Anchor QEA, LLC
Jane Sarosdy, Sarosdy Consulting, Inc.

Re: DMPA #192 PINS Bird Island 10% Design Memorandum

Introduction

This 10% design memorandum describes design criteria and assessments associated with the proposed Dredged Material Placement Area (DMPA) #192 Padre Island National Seashore (PINS) Bird Island site (Site), located in Texas General Land Office (GLO) Planning Region 3 of the Texas coast in the Upper Laguna Madre just outside of Baffin Bay in Kleberg County, Texas (Figure 1).

Project Background

GLO awarded a Coastal Management Program Project of Special Merit grant (funded through the Gulf of Mexico Energy Security Act) to Ducks Unlimited, Inc. (DU), to identify priority locations and develop 10% designs and opinions of probable construction costs for at least 16 sites in GLO Planning Regions 3 and 4 of the Texas coast for the beneficial use of dredged material (BU). The project team is led by DU and Port of Corpus Christi Authority (PCCA) and includes Anchor QEA, LLC; Sarosdy Consulting, Inc.; and the Texas Department of Transportation. In addition to the 16 sites identified and prioritized, PCCA will provide additional resources to bring forward more site designs for review if the site prioritization and selection so warrants. The project team coordinated two online stakeholder meetings in each region to receive information about potential BU sites. Based on stakeholder input, GLO feedback, publicly available data, and professional judgment, the project team selected the Site as one of the 16 sites for 10% design development and cost estimation.

Conservationists have identified the Laguna Madre as an important location for creating and restoring bird habitat (CBBEP 2020). The Site will be located inside of the United States Army Corps of Engineers (USACE) DMPA #192 on U.S. National Park Service (NPS)-owned submerged land approximately 0.2 mile east of the Gulf Intracoastal Waterway (GIWW) in the Upper Laguna Madre just outside of Baffin Bay in Kleberg County, Texas. This area was selected because of the identified need for secure and stable rookery island habitat in the region, its proximity to a sediment source in the existing DMPAs, its proximity to potential bird foraging areas, and its sufficient distance from upland-based predators.

Project Objectives

Frequent dredging is needed to develop and maintain Texas ship channels. The dredged material must be deposited in DMPAs, and many of the existing DMPAs along the Texas coast are nearing capacity. Resource agencies and stakeholders have long advocated using dredged material beneficially to create and restore wetlands and bird islands, nourish beaches, and counteract land loss. Historically, BU projects are difficult to manage because they are multi-year, multi-faceted undertakings in which different organizations manage dredging schedules, funding, project design, permitting, and construction activities. To help address these issues, the objectives of this project include the following:

- Create and restore degrading coastal habitats.
- Establish sites for placement of dredged material to reduce reliance on existing DMPAs.
- Improve coastal resiliency of the natural and built environment.
- Reduce shoaling in the GIWW and other ship channels.

To accomplish these objectives, the project includes the following tasks:

- Stakeholder outreach and coordination
- Identification and selection of BU sites
- 10% designs and cost estimates for at least 16 BU sites
- 30% designs for at least eight BU sites
- 60% designs, cost estimates, and permit application packages for at least five BU sites

This memorandum documents the 10% design and cost estimate for one of the selected sites.

Design Objectives

This Site will be designed to beneficially use dredged material to create a rookery island in a region with degrading coastal bird habitat. During the initial dredging of the GIWW, relict sidecasted new work dredged material was left along the edge of the channel. The relict sidecasted new work materials in this region that remain from the original construction of the GIWW are considered to have superior structural properties relative to maintenance dredged material (Morton et al. 2001), and hence are the target sediment source for this design. The Site is expected to take advantage of this unique opportunity for mining favorable rookery island material in the area and use material dredged from existing relict new work material inside the surrounding DMPAs, thus increasing dredged material placement capacity in the DMPAs. Although this project is not proposed to use maintenance dredged material, it can still be considered a BU project because it is expected to take advantage of dredging equipment for which the mobilization and demobilization costs are paid by USACE. This 10% design is based upon publicly available datasets; no field work was conducted for this phase of the project.

Design objectives include the following:

- Develop a preliminary vision based on available data for the Site that includes the following:
  - Habitat to be created or restored
  - Potential sediment source(s)
  - Approaches to minimize long-term maintenance costs
- Delineate conceptual footprints for proposed BU placement.
- Identify key sensitive habitats and construction considerations in the vicinity of the Site.
- Estimate fill volumes for the proposed BU footprints.
- Identify data gaps to be addressed in subsequent design stages.
- Provide preliminary cost estimates.

Existing Data Review

Horizontal and Vertical Datums

The horizontal datum used for the Site is the Texas State Plane Zone 5, North American Datum of 1983 (NAD83) in U.S. survey feet. The primary vertical datum used for the Site is the North American Vertical Datum of 1988 (NAVD88). The National Oceanic and Atmospheric Administration (NOAA) maintains an active tide gauge within the vicinity of the Site. The NOAA Baffin Bay, TX Station 8776604 is 6.3 miles south of the Site; however, this station only provides NAVD88 and mean sea level (MSL) vertical datums. The next closest station that contains the necessary tidal datums is Packery Channel, TX Station 8775792 (Packery Channel station), 19.5 miles north of the Site. There is a 0.11-foot difference in the MSL tidal datum between the stations, so the tidal datums from the Packery Channel station were assumed accurate for this level of analysis. The Packery Channel station collects and records real-time tide information dating back to 1990. The vertical datums from this station that will be used for the Site are shown in Table 1.

Table 1
NOAA Packery Channel, TX Station 8775792 Tidal Gauge Displaying NAVD88 Tidal Datums

Tidal Datums	Elevation (feet NAVD88)
MHHW	0.79
MHW	0.79
MSL	0.59
MLW	0.36
MLLW	0.37

Notes:
MHHW: mean higher high water
MHW: mean high water
MLLW: mean lower low water
MLW: mean low water

Meteorological, Ocean, and Wave Data

Wind and Waves

The USACE Wave Information Studies (WIS) provides a national resource of long-term wavefield climatologies for U.S. coastal waters that synthesizes observations, multi-decade hindcasts, and storm event archives (USACE 2021). The WIS station closest to the Site is Station 73036, just offshore on the Gulf side of North Padre Island in the Gulf of Mexico. Because the station is located offshore, the wave data are not applicable to this project design. However, the project team considers the wind data to be representative of the winds experienced at the Site. Figure 2 summarizes wind data from January 1, 1980, through December 31, 2014. The data indicate that the predominant wind direction is from the southeast, with significant winds also coming from the north, northeast, east, and south.

There is a 1-mile fetch between the Site and North Padre Island, the closest land mass in the predominant southeast wind direction. Due to the fetch and surrounding water depths, the Site is anticipated to be in a high wave-energy environment. A wave analysis of the direction and frequency of expected significant wave heights will be conducted in subsequent phases of design.

Wake Erosion

The GIWW is approximately 0.2 mile west of the Site. Potential wake erosion from vessels transiting the GIWW is expected to be a design consideration. The proposed armoring will be designed to resist wind- and vessel-generated erosive forces. An analysis of the erosive effects of vessel traffic will be conducted during subsequent stages of design to better understand the extent of vessel-induced erosion on the Site.

Bathymetry

The NOAA National Centers for Environmental Information continuously updated digital elevation model for the Texas Coast (NOAA 2021) was used to obtain bathymetry data for the Site. The Site has a relatively uniform seabed elevation that averages -0.1 foot NAVD88.

Utilities and Infrastructure

The Railroad Commission of Texas public GIS viewer (RRC 2021) was used to identify utilities and pipelines near the Site. No utilities or pipelines were identified near the Site. The need for Site-specific utility locations prior to construction will be determined during subsequent design stages. No other infrastructure has been identified in the vicinity of the project Site.

Desktop Cultural Resources Survey

A search of cultural resources records in the Texas Historical Commission Atlas Database was completed for the Site between November 29 and December 30, 2021. This search revealed that no archaeological surveys have been conducted and no archaeological sites have been identified within the preliminary proposed placement site boundary (THC 2021).

Sensitive Habitat

GLO oyster habitat GIS data (GLO 2021) indicate that there is no oyster habitat identified within or adjacent to the Site. According to Texas Parks and Wildlife Department (TPWD) seagrass data (TPWD 2021), there are suspected seagrasses on all sides of the Site. Because the sensitive habitat data are not recent, surveys will likely need to be conducted during a subsequent phase of design to evaluate the presence and extents of sensitive habitat to confirm or update the understanding of sensitive habitat in the vicinity of the Site.

Bird Species

The U.S. Fish and Wildlife Service (USFWS) Information for Planning and Consultation (IPaC) tool was used to identify listed species and migratory birds within a 460-square-mile region around Baffin Bay and a portion of North Padre Island (USFWS 2021). Table 2 includes some of the protected and migratory bird species that are present near the Site and their preferred habitat as explained in Audubon’s field guide (Audubon 2021a). At this time, no target species, or list of species, has been identified for the Site.

Table 2
USFWS IPaC Species Information

Species	Status	Preferred Habitat[1]
Whooping Crane (*Grus americana*)	Endangered	Prairie pools, marshes, and coastal marshes
Piping Plover (*Charadrius melodus*)	Threatened	Sand beach dunes and expansive sand or mudflats
Red Knot (*Calidris canutus*)	Threatened	Mudflats, tidal zones, and sandy beaches
American Oystercatcher (*Haematopus palliatus*)	Migratory	Strictly coastal; dunes, islands in salt marsh, dredge spoil islands, sandy beaches, and tidal mudflats
Black Skimmer (*Rynchops niger*)	Migratory	Sandy islands, shell beaches, open beaches, lagoons, estuaries, inlets, and sheltered bays
Brown Pelican (*Pelecanus occidentalis*)	Migratory	Bare, rocky, mangrove or tree-covered islands; salt bays, beaches, and oceans
Gull-Billed Tern (*Gelochelidon nilotica*)	Migratory	Beaches, islands, salt marshes, fields, and coastal bays
Marbled Godwit (*Limosa fedoa*)	Migratory	Northern Great Plains, native prairie with marshes or ponds, pools, shores, marshes, and tidal flats
Reddish Egret (*Egretta rufescens*)	Migratory	Red mangrove swamps, arid coastal islands covered with thorny brush, coastal tidal flats, salt marshes, and lagoons
Ring-Billed Gull (*Larus delawarensis*)	Migratory	On ground near water with sparse plant growth, lakes, bays, coasts, piers, dumps, and plowed fields
Royal Tern (*Thalasseus maximus*)	Migratory	Low-lying sandy islands, coasts, lagoons, salt bays, and estuaries
Wilson's Plover (*Charadrius wilsonia*)	Migratory	Dry part of beach, near conspicuous object, coastal regions, open beaches, tidal flats, estuaries, and sandy islands

Notes:
1. Habitat information is from the Audubon field guide (Audubon 2021a) and includes preferred nesting and general habitat.
USFWS IPaC information (USFWS 2021) is provided for a 460-square-mile region around Baffin Bay and a portion of North Padre Island highlighting endangered, threatened, and migratory birds and their preferred habitat.

Erosion

Google Earth imagery from 2011 to 2020 indicates that the Site is deteriorating from erosional forces. This is consistent with documentation from the Coastal Bend Bays & Estuaries Program (CBBEP), which notes that the North Padre Island shorelines are at high risk due to erosional forces such as wave energy and relative sea level rise (CBBEP 2020).

Beneficial Use Source Material

The proposed source material for the Site will consist of existing relict sidecasted new work dredged material currently inside of DMPA #192. The Site is also approximately 1 mile from DMPA #191 and

DMPA #193, and dredged relic material from either of these areas could also be used, albeit at a higher unit cost than currently assumed. The material located in the Laguna Madre placement areas came from material dredged from deltaic deposits of Pleistocene Beaumont Formation or the Holocene Rio Grande delta during the original dredging of the GIWW and has been shown to be more stable than recent maintenance dredged material (Morton et al. 2001). Further information will need to be collected to determine more precise composition and available quantities of dredged material from these sources.

10% Design

The main design features that are critical for rookery island success are as follows:

- Site location
- Island size and shape
- Containment and erosion protection
- Planting and natural recruitment of vegetation

These design features are evaluated in this memorandum for the preliminary Site design.

Site Location

The proposed location of the Site is approximately 0.2 mile east of the GIWW and inside of DMPA #192. The Site's location was selected to avoid encroaching on PINS land outside of the DMPA (DMPA #192 is on PINS land, but USACE has prior authorization to discharge dredged material, so the project team assumes that it will be easier to get permission from PINS to build within DMPA #192 than outside of it). TPWD seagrass data (TPWD 2021) show that there are seagrasses within the Site footprint and within the proposed excavation areas. The data are not recent, and new seagrass survey data will be needed to determine what impacts on seagrass the project may have.

The proposed Site is approximately 0.8 mile from the nearest shoreline. This distance is greater than the 0.5-mile distance identified for minimizing predator access to rookery islands (Stanzel 2018).

The Site is located on an existing mound of relict new work material inside of DMPA #192 that provides shallow water with seabed elevations of approximately -0.1 foot NAVD88 (+0.27 foot mean lower low water). Because the Site is inside a DMPA, relict new work material existing inside can be rearranged to construct the rookery island. It is anticipated that access channels will need to be constructed for dredgers to access the material inside the DMPAs. There is further shallow relict material with a seabed elevation above -1-foot NAVD88 immediately spanning the east side of the Site that is anticipated to act as a natural wave-energy dissipator and reduce erosive forces. Bathymetric surveys will need to be conducted during subsequent design phases to better define Site dimensions and material needs.

Size and Shape

Based on availability of sediment, a cost analysis, and stakeholder feedback, the project team proposes that the area of the Site be 9 acres. The Site will be created with dredged material placed to an elevation of +3.8 feet NAVD88. The Site will be approximately rectangular in shape with a high-density relict clay berm on all sides to protect the island from wind- and vessel-generated waves, as shown in Figure 1. This shape of fill was selected to promote natural recruitment of vegetation and provide habitat for a range of bird species. The elevation of dredged material fill could be adjusted at further stages of design depending on the physical properties of the dredged material or if target bird species and their specific requirements are identified to be different from these assumptions. It is expected that environmental controls such as turbidity curtains and temporary containment of material will be needed during construction to contain finer sediment placed during construction.

Fill material could be obtained from existing relict material in DMPA #192. It is predicted that the required fill volume will be approximately 90,000 cubic yards (cy), with approximately 25,000 cy being settled volume. This value assumes 1 foot of foundation compression for every 3 feet of fill and does not consider bulking. Geotechnical data will likely need to be collected during a subsequent design phase to further evaluate the expected foundation compression and the expected bulking of dredged material.

Containment and Erosion Protection

Based on the fetch in the predominant southeast wind direction and potential risk of wake erosion, the project team proposes containment for the Site consisting of an unarmored berm that will mitigate erosion to the rookery island and contain the dredged material. The berm will be composed of higher density clay constructed on an existing -0.5-foot-NAVD88 grade. The berm will contain a 4-horizontal-to-1-vertical (4H:1V) seaward side slope and a 3H:1V landward side slope connected by a 12-foot-wide crest. The construction height of the crest will be +3.8 feet NAVD88. The exact width will be dependent on the existing grade, but assuming -0.5 foot NAVD88, the berm base width will be 43 feet. Figure 3 depicts a typical cross section of the berm. The final cross-sectional dimensions and slopes of the berm will need to be determined and refined, respectively, through modeling and analysis of the sediment characteristics of the dredged material and the berm subgrade during a subsequent phase of design.

The berm will be constructed from relict sidecasted new work material removed from the nearby shallows before the island is constructed. As shown in Figure 3, the fill material will be directly contained by the berm. Confining the dredged fill material within the berm will reduce potential impacts to adjacent seagrass habitat. Elevations at the center and south location of the Site lie shallower than the -1-foot-NAVD88 contour, and it is assumed that marsh buggies will be used to stack and shape the berm. The berm is proposed with a 4H:1V seaward slope to allow wildlife access into the Site. A 4H:1V slope will also improve slope stability and reduce wave energy compared to steeper berm slopes. With naturally shallow bathymetry surrounding the northeast and east sides of the Site and the predominantly southeast wind direction, it is expected the east side of the island will have additional natural protection from wind and wave impacts.

Planting and Natural Recruitment of Vegetation

Based on stakeholder input and cost considerations, the project team determined that planting may not be needed for the Site. Rather, natural vegetation recruitment will be allowed to proceed. If the outcome is unsatisfactory (e.g., if the island has lower-than-expected use by desired bird species), an adaptive management program can be instituted to modify the vegetation. Table 2 shows some of the listed and migratory birds and their preferred habitats. At further design stages, this list could be used to modify elevations within the Site to promote the preferred habitat of desired bird species.

Site Construction Cost Estimates

Construction costs were estimated for the design outlined in the previous sections. The estimated costs include permitting, 100% design, engineering costs for advancing the design to the construction phase, pre-construction and as-built surveys, incremental mobilization and demobilization (i.e., over and above USACE's mobilization and demobilization costs for dredging the GIWW), materials, and construction of the berm. Table 3 shows a line-item list of each costing parameter and the total cost estimated for construction.

Table 3
Opinion of Probable Construction Cost to 100% Project Completion

Item	Quantity	Unit	Unit Price	Total
Pre-Construction Survey	1	LS	$ 30,000.00	$ 30,000.00
Bird Island Berm and Internal Fill Excavation[1]	90,000	cy	$ 10.00	$ 900,000.00
Marsh Buggy Fill Maintenance	28	Days	$ 2,500.00	$ 70,000.00
Post-Construction Survey (topography/ bathymetry)	1	LS	$ 30,000.00	$ 30,000.00
Post-Construction Survey (aerials)	1	LS	$ 10,000.00	$ 10,000.00
Navigational Aids[2]	4	Each	$ 4,000.00	$ 20,000.00
Subtotal[3]			**Sum**	**$ 1,100,000.00**
Incremental Mobilization and Demobilization[3,4]	1	LS	$ 400,000.00	$ 400,000.00
Construction Total[3]			**Sum**	**$ 1,500,000.00**
100% Engineering and Design[3]	1	10%	$ 200,000.00	$ 200,000.00
Permitting	1	Each	$ 100,000.00	$ 100,000.00
Construction Management[3]	1	8%	$ 100,000.00	$ 100,000.00
Post-Construction Management	12	Month	$ 10,000.00	$ 120,000.00
Project Subtotal[3]			**Sum**	**$ 2,000,000.00**
-30% Contingency[3]	1	30%	$ 600,000.00	$ 600,000.00
+50% Contingency[3]	1	50%	$1,000,000.00	$ 1,000,000.00
Low-End Total Project Estimated Cost[3]			**Total Sum**	**$ 1,400,000.00**
High-End Total Project Estimated Cost[3]			**Total Sum**	**$ 3,000,000.00**

Notes:
Costs were determined based upon publicly available datasets; no field work was conducted for this phase of the project.
1. Cost is based on incremental cost of diverting dredging equipment from GIWW to excavation areas.
2. Rounded to the nearest $10,000.
3. Rounded to the nearest $100,000.
4. Cost is based on mobilizing equipment above what is required for dredging the GIWW (i.e., marsh buggies).

LS: lump sum

The costs vary from $1.4 million to $3 million, depending on the level of contingency allocated to the project cost.

This 10% design includes a bird island on the upper range of bird island sizes desired, based on stakeholder input. Future cost constraints may limit the island size that is ultimately constructed, but at this level of design, it was decided to consider a site on the upper end of the range identified by stakeholders.

The estimates are developed using current and generally accepted engineering cost estimating methods and are based on assumptions concerning future events. Actual costs may be affected by known and unknown risks including, but not limited to, changes in general economic business conditions, Site conditions that were unknown at the time the estimates were performed, future changes in Site conditions, regulatory or enforcement policy changes, and delays in performance. Actual costs may vary from these estimates.

Ecosystem Benefits Expected

Creation of the Site is expected to have positive benefits on the regional ecosystem. Green Island, an 80-acre rookery island located in the adjacent Laguna Madre, was used to approximate the ecological benefits for the Site. From 2011 to 2015, Green Island averaged approximately 1,000 breeding pairs of birds per year across three species that are listed in Table 2 (Audubon 2021b). Adjusting for the acreage of the rookery island, the Site may be expected to create habitat for approximately 115 breeding pairs for three species of birds per year.

Due to the location of seagrass habitat adjacent to the Site, dredging of surrounding relict material during construction could result in surrounding water depths that are conducive to further seagrass colonization. This could increase the existing seagrass habitat in the regional ecosystem.

Future Work

Of the sites selected for 10% designs in this project, at least eight will be selected for 30% designs, and at least five of those will subsequently be selected for 60% designs and cost estimates. No fatal flaws have been identified in this 10% design effort. Should this Site be selected for additional design efforts, it can be expected that some aspects of the design in this memorandum will be modified and, as appropriate, improved. For example, the Site is currently proposed to be within the DMPA. This may cause concerns with USACE (although, as an uncontained DMPA, it theoretically has infinite capacity). Moving the Site to outside of the DMPA would avoid any potential for decreasing capacity for dredged material within the DMPA, which may be advantageous from the perspective of USACE. Moving the Site outside of the DMPA may also provide more opportunity to be distant from seagrasses but may raise challenges with constructing a restoration site on PINS property. Obtaining explicit agreement from either USACE or NPS or both on a Site footprint will be important for moving forward. As previously mentioned, it is possible that in each phase additional designs will be provided toward this project because of the partnership on this project between DU and PCCA.

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Figures

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Figure 1
DMPA #192 PINS Bird Island Plan View
DMPA #192 PINS Bird Island 10% Design Memorandum
Texas Lower Coast Beneficial Use

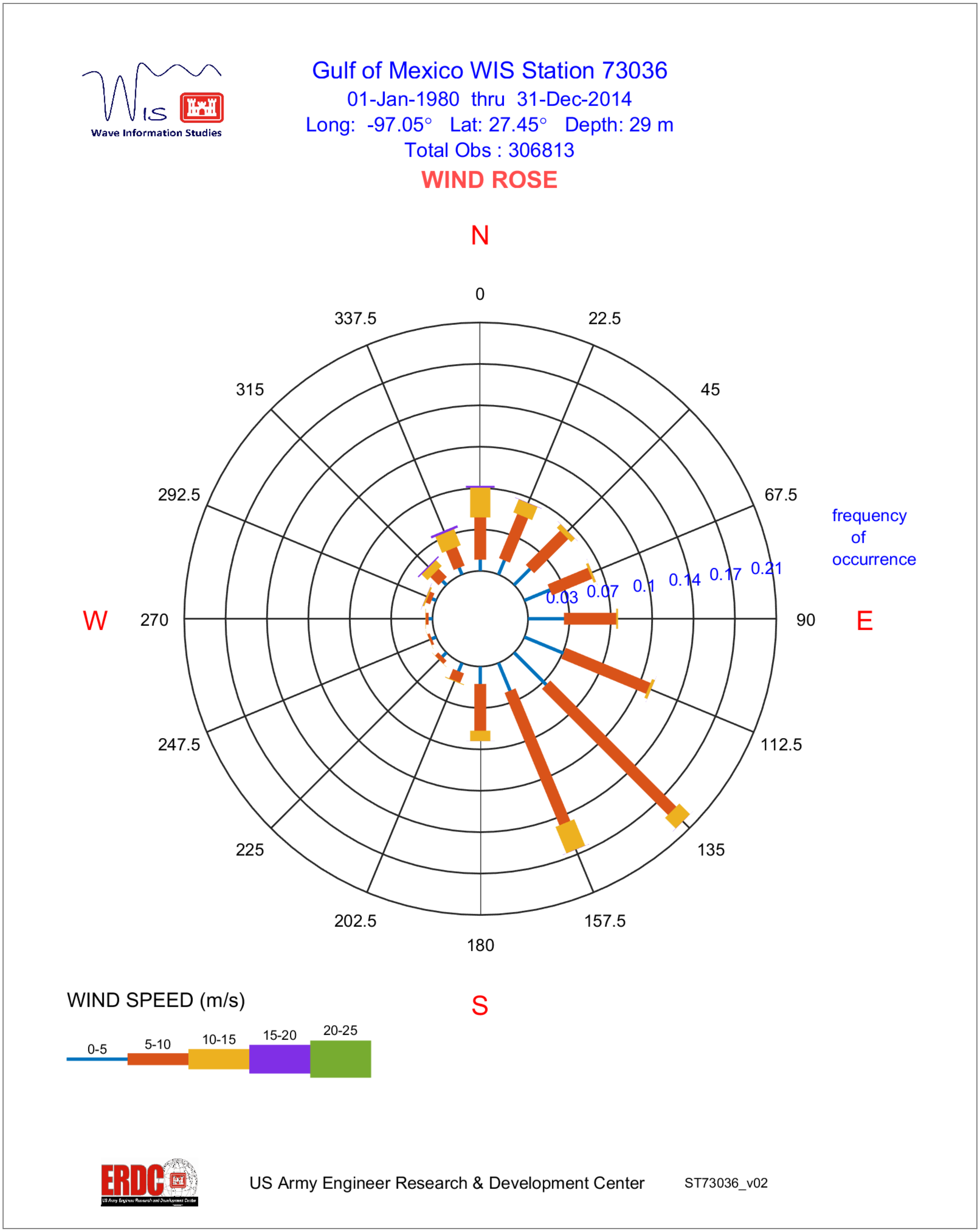

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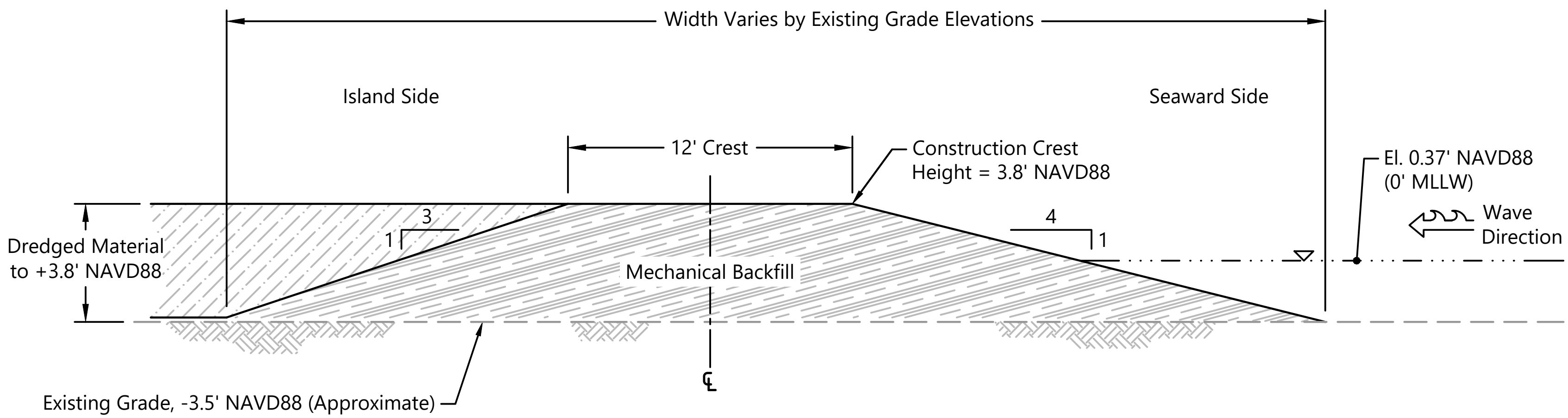
Figure 2
Historical Wind Data for USACE WIS Station 73036
DMPA #192 PINS Bird Island 10% Design Memorandum
Texas Lower Coast Beneficial Use



Section A-A' Typical Berm
Not to Scale

VERTICAL DATUM: North American Vertical Datum of 1988 (NAVD88)

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Filepath: K:\Projects\1942-Ducks Unlimited\Little Bird Island\Little Bird Island North 10% Design\1942-RP-003a LITTLE BIRD BERM #192.dwg Figure 3

ANCHOR QEA

Figure 3
Section A-A' Typical Berm

DMPA #192 PINS Bird Island 10% Design Memorandum
Texas Lower Coast Beneficial Use

Memorandum

January 31, 2022

To: Melissa McCutcheon, Texas General Land Office

From: Todd Merendino, Ducks Unlimited
Sarah Garza, Harrison McNeil, and Yvonne Dives-Gomez, Port of Corpus Christi Authority
John Laplante, Dan Opdyke, Ray Newby, Adrienne Accardi, Alexander Freddo, and Hayden Smith, Anchor QEA, LLC
Jane Sarosdy, Sarosdy Consulting, Inc.

Re: DMPA #214 Bird Island 10% Design Memorandum

Introduction

This 10% design memorandum describes design criteria and assessments associated with the proposed Dredged Material Placement Area (DMPA) #214 Bird Island site (Site), located in Texas General Land Office (GLO) Planning Region 4 of the Texas coast in the Lower Laguna Madre in Kenedy County, Texas (Figure 1).

Project Background

GLO awarded a Coastal Management Program Project of Special Merit grant (funded through the Gulf of Mexico Energy Security Act) to Ducks Unlimited, Inc. (DU), to identify priority locations and develop 10% designs and opinions of probable construction costs for at least 16 sites in GLO Planning Regions 3 and 4 of the Texas coast for the beneficial use of dredged material (BU). The project team is led by DU and Port of Corpus Christi Authority (PCCA) and includes Anchor QEA, LLC; Sarosdy Consulting, Inc.; and the Texas Department of Transportation. In addition to the 16 sites identified and prioritized, PCCA will provide additional resources to bring forward more site designs for review if the site prioritization and selection so warrants. The project team coordinated two online stakeholder meetings in each region to receive information about potential BU sites. Based on stakeholder input, GLO feedback, publicly available data, and professional judgment, the project team selected the Site as one of the 16 sites for 10% design development and cost estimation.

Conservationists have identified the Laguna Madre as an important location for creating and restoring bird habitat (CBBEP 2020). The Site is a small island located on state-owned submerged land approximately 0.25 mile east of the Gulf Intracoastal Waterway (GIWW) in the Laguna Madre in Kenedy County, Texas. It lies between two United States Army Corps of Engineers (USACE) DMPAs

(#213 and #214) and is likely in the vicinity of seagrasses. This area was selected because of the identified need for secure and stable rookery island habitat in the region, its proximity to a sediment source in the existing DMPAs, its proximity to potential bird foraging areas, and its sufficient distance from upland-based predators.

Project Objectives

Frequent dredging is needed to develop and maintain Texas ship channels. The dredged material must be deposited in DMPAs, and many of the existing DMPAs along the Texas coast are nearing capacity. Resource agencies and stakeholders have long advocated using dredged material beneficially to create and restore wetlands and bird islands, nourish beaches, and counteract land loss. Historically, BU projects are difficult to manage because they are multi-year, multi-faceted undertakings in which different organizations manage dredging schedules, funding, project design, permitting, and construction activities. To help address these issues, the objectives of this project include the following:

- Create and restore degrading coastal habitats.
- Establish sites for placement of dredged material to reduce reliance on existing DMPAs.
- Improve coastal resiliency of the natural and built environment.
- Reduce shoaling in the GIWW and other ship channels.

To accomplish these objectives, the project includes the following tasks:

- Stakeholder outreach and coordination
- Identification and selection of BU sites
- 10% designs and cost estimates for at least 16 BU sites
- 30% designs for at least eight BU sites
- 60% designs, cost estimates, and permit application packages for at least five BU sites

This memorandum documents the 10% design and cost estimate for one of the selected sites.

Design Objectives

This Site will be designed to beneficially use dredged material to create a rookery island in a region with degrading coastal bird habitat. During the initial dredging of the GIWW, relict sidecasted new work dredged material was left along the edge of the channel. The relict sidecasted new work materials in this region that remain from the original construction of the GIWW are considered to have superior structural properties relative to maintenance dredged material (Morton et al. 2001), and hence are the target sediment source for this design. The Site is expected to take advantage of this unique opportunity for mining favorable rookery island material in the area and use material dredged from existing relict new work material inside the surrounding DMPAs, thus increasing dredged material placement capacity in the DMPAs. Although this project is not proposed to use maintenance dredged material, it can still be considered a BU project because it is expected to take advantage of dredging equipment for which the mobilization and demobilization costs are paid by USACE. This 10% design is based upon publicly available datasets; no field work was conducted for this phase of the project.

Design objectives include the following:

- Develop a preliminary vision based on available data for the Site that includes the following:
  - Habitat to be created or restored
  - Potential sediment source(s)
  - Approaches to minimize long-term maintenance costs
- Delineate conceptual footprints for proposed BU placement.
- Identify key sensitive habitats and construction considerations in the vicinity of the Site.
- Estimate fill volumes for the proposed BU footprints.
- Identify data gaps to be addressed in subsequent design stages.
- Provide preliminary cost estimates.

Existing Data Review

Horizontal and Vertical Datums

The horizontal datum used for the Site is the Texas State Plane Zone 5, North American Datum of 1983 (NAD83) in U.S. survey feet. The primary vertical datum used for the Site is the North American Vertical Datum of 1988 (NAVD88). The National Oceanic and Atmospheric Administration (NOAA) maintains an active tide gauge within the vicinity of the Site. The NOAA Rincon Del San Jose, Texas, Station 8777812 is 5.25 miles north of the Site, however, this station only provides NAVD88 and mean sea level (MSL) vertical datums. The next closest station that contains the necessary tidal datums is Packery Channel, TX Station 8775792 (Packery Channel station), 64 miles north of the Site. There is a 0.16-foot difference in the MSL tidal datum between the stations, so the tidal datums from the Packery Channel station were assumed to be accurate for this level of analysis. The Packery Channel station collects and records real-time tide information dating back to 1990. The vertical datums from this station that will be used for the Site are shown in Table 1.

Table 1
NOAA Packery Channel, TX Station 8775792 Tidal Gauge Displaying NAVD88 Tidal Datums

Tidal Datums	Elevation (feet NAVD88)
MHHW	0.79
MHW	0.79
MSL	0.59
MLW	0.36
MLLW	0.37

Notes:
MHHW: mean higher high water
MHW: mean high water
MLLW: mean lower low water
MLW: mean low water

Meteorological, Ocean, and Wave Data

Wind and Waves

The USACE Wave Information Studies (WIS) database provides a national resource of long-term wavefield climatologies for U.S. coastal waters that synthesizes observations, multi-decade hindcasts, and storm event archives (USACE 2021). The WIS station closest to the Site is Station 73027, just offshore on the Gulf side of North Padre Island in the Gulf of Mexico. Because the station is located offshore, the wave data are not applicable to this project design. However, the project team considers the wind data to be representative of the winds experienced at the Site. Figure 2 summarizes wind data from January 1, 1980, through December 31, 2014. The data indicate that the predominant wind direction is from the southeast, with significant winds also coming from the north, northeast, east, and south.

There is a 3-mile fetch between the Site and North Padre Island, the closest land mass in the predominant southeast wind direction. Due to the fetch and surrounding water depths, the Site is anticipated to be in a high wave energy environment. A wave analysis of the direction and frequency of expected significant wave heights will be conducted in subsequent phases of design.

Wake Erosion

The GIWW is approximately 0.25 mile west of the Site. Potential wake erosion from vessels transiting the GIWW is expected to be a design consideration. The proposed armoring will be designed to resist wind- and vessel-generated erosive forces. An analysis of the erosive effects of vessel traffic will be conducted during subsequent stages of design to better understand the extent of vessel-induced erosion on the Site.

Bathymetry

The NOAA National Centers for Environmental Information continuously updated digital elevation model for the Texas Coast (NOAA 2021) was used to obtain bathymetry data for the Site. The Site has an existing shallow mound seabed elevation that averages -0.59 foot NAVD88 and slopes down to a bay bottom of approximately -6.0 feet NAVD88.

Utilities and Infrastructure

The Railroad Commission of Texas public GIS viewer (RRC 2021) was used to identify utilities and pipelines near the Site. No utilities or pipelines were identified near the Site. The need for Site-specific utility locations prior to construction will be determined during subsequent design stages. No other infrastructure has been identified in the vicinity of the project Site.

Desktop Cultural Resources Survey

A search of cultural resources records in the Texas Historical Commission Atlas Database was completed for the Site between November 29 and December 30, 2021. This search revealed that no archaeological surveys have been conducted and no archaeological sites have been identified within the preliminary proposed placement site boundary (THC 2021).

Sensitive Habitat

GLO oyster habitat GIS data (GLO 2021) indicate that there is no oyster habitat identified within or adjacent to the Site. According to Texas Parks and Wildlife Department seagrass data (TPWD 2021), there are suspected seagrasses on all sides of the Site except the north side, and there are suspected seagrasses 0.2 mile north within DMPA #213. Because the sensitive habitat data are not recent, surveys will likely need to be conducted during a subsequent phase of design to evaluate the presence and extents of sensitive habitat to confirm or update the understanding of sensitive habitat in the vicinity of the Site.

Bird Species

The U.S. Fish and Wildlife Service (USFWS) Information for Planning and Consultation (IPaC) tool was used to identify listed species and migratory birds within a 525-square-mile region around North Padre Island and the Laguna Madre Region (USFWS 2021). Table 2 includes some of the protected and migratory bird species that are present near the Site and their preferred habitat as explained in Audubon’s field guide (Audubon 2021a). At this time, no target species, or list of species, has been identified for the Site.

Table 2
USFWS IPaC Species Information

Species	Status	Preferred Habitat[1]
Whooping Crane (*Grus americana*)	Endangered	Prairie pools, marshes, and coastal marshes
Piping Plover (*Charadrius melodus*)	Threatened	Sand beach dunes and expansive sand or mudflats
Red Knot (*Calidris canutus*)	Threatened	Mudflats, tidal zones, and sandy beaches
American Oystercatcher (*Haematopus palliatus*)	Migratory	Strictly coastal; dunes, islands in salt marsh, dredge spoil islands, sandy beaches, and tidal mudflats
Black Skimmer (*Rynchops niger*)	Migratory	Sandy islands, shell beaches, open beaches, lagoons, estuaries, inlets, and sheltered bays
Brown Pelican (*Pelecanus occidentalis*)	Migratory	Bare, rocky, mangrove or tree-covered islands; salt bays, beaches, and oceans
Gull-Billed Tern (*Gelochelidon nilotica*)	Migratory	Beaches, islands, salt marshes, fields, and coastal bays
Marbled Godwit (*Limosa fedoa*)	Migratory	Northern Great Plains, native prairie with marshes or ponds, pools, shores, marshes, and tidal flats
Reddish Egret (*Egretta rufescens*)	Migratory	Red mangrove swamps, arid coastal islands covered with thorny brush, coastal tidal flats, salt marshes, and lagoons
Ring-Billed Gull (*Larus delawarensis*)	Migratory	On ground near water with sparse plant growth, lakes, bays, coasts, piers, dumps, and plowed fields
Royal Tern (*Thalasseus maximus*)	Migratory	Low-lying sandy islands, coasts, lagoons, salt bays, and estuaries
Wilson's Plover (*Charadrius wilsonia*)	Migratory	Dry part of beach, near conspicuous object, coastal regions, open beaches, tidal flats, estuaries, and sandy islands

Notes:

1. Habitat information is from the Audubon field guide (Audubon 2021a) and includes preferred nesting and general habitat.

USFWS IPaC information (USFWS 2021) is provided for a 525-square-mile region around North Padre Island and the Laguna Madre highlighting endangered, threatened, and migratory birds and their preferred habitat.

Erosion

Google Earth imagery from 2011 to 2020 indicates that the Site is deteriorating from erosional forces. This is consistent with documentation from the Coastal Bend Bays & Estuaries Program, which notes that the North Padre Island shorelines are at high risk due to erosional forces such as wave energy and relative sea level rise (CBBEP 2020).

Beneficial Use Source Material

The proposed source material for DMPA #214 Bird Island will consist of existing relict sidecasted new work dredged material currently inside of DMPAs #213 and #214, approximately 0.25 mile away.

The material located in the Laguna Madre placement areas came from material dredged from deltaic deposits of Pleistocene Beaumont Formation or the Holocene Rio Grande delta during the original dredging of the GIWW and has been shown to be more stable than recent maintenance dredged material (Morton et al. 2001). Further information will need to be collected to determine more precise composition and available quantities of dredged material from these sources.

10% Design

The main design features that are critical for rookery island success are as follows:

- Site location
- Island size and shape
- Containment and erosion protection
- Planting and natural recruitment of vegetation

These design features are evaluated in this memorandum for the preliminary Site design.

Site Location

The proposed Site location is approximately 0.25 mile east of the GIWW, between DMPAs #213 and #214, and is in the vicinity of seagrass habitat (TPWD 2021). However, the Site's specific location was selected to avoid encroaching on those areas. Because the Site is between two DMPAs, relict new work material existing inside the nearby DMPAs can be dredged to construct the rookery island while also increasing the DMPAs' capacity for dredged material. It is anticipated that access channels will need to be constructed for dredgers to access the material inside the DMPAs.

The proposed Site is approximately 1 mile from the nearest shoreline. This distance is greater than the 0.5-mile distance identified for minimizing predator access to rookery islands (Stanzel 2018).

The Site is located on a mounded area of relict sidecasted new work material from the original dredging of the GIWW that provides shallow water with a seabed elevation that averages -0.6 foot NAVD88 (-0.23 foot mean lower low water). Being located on an existing high point provides beneficial constructability conditions with typical seabed elevations of approximately -6 feet NAVD88 surrounding the Site for construction access. Bathymetric surveys will need to be conducted during subsequent design phases to better define Site dimensions and material needs.

Size and Shape

Based on availability of sediment, a cost analysis, and stakeholder feedback, the project team proposes that the area of the Site be 7 acres. The Site will be created with dredged material placed to an elevation of +3.8 feet NAVD88. The Site will be shaped to reside on the existing high point mound, and its perimeter will extend down to the -2-foot-NAVD88 contour. A high-density relict clay berm on all sides will be constructed to protect the island from wind- and vessel-generated waves and can be seen in Figure 1. This shape of fill was selected to promote natural recruitment of vegetation and provide habitat for a range of bird species. The elevation of dredged material fill could be adjusted at further stages of design depending on the physical properties of the dredged material or if target bird species and their specific requirements are identified to be different from these assumptions. It is expected that environmental controls such as turbidity curtains and temporary containment of material will be needed during construction to contain finer sediment placed during construction.

Fill material could be obtained from existing relict material in DMPA #213 and DMPA #214. It is predicted that the required fill volume will be approximately 95,000 cubic yards (cy), with approximately 30,000 cy being settled volume. This value assumes 1 foot of foundation compression for every 3 feet of fill and does not consider bulking. Geotechnical data will likely need to be collected during a subsequent design phase to further evaluate the expected foundation compression and the expected bulking of dredged material.

Containment and Erosion Protection

Based on the fetch in the predominant southeast wind direction and potential risk of wake erosion, the project team proposes containment for the Site consisting of an unarmored berm that will mitigate erosion to the rookery island and contain the dredged material. The berm will be composed of higher density clay and constructed on an existing -2-foot-NAVD88 grade. The berm will include a 4-horizontal-to-1-vertical (4H:1V) seaward side slope and a 3H:1V landward side slope connected by a 12-foot-wide crest. The construction height of the crest will be +3.8 feet NAVD88. The exact width will be dependent on the existing grade, but assuming -2.0 feet NAVD88, the berm base width will be approximately 57 feet. Figure 3 depicts a typical cross section of the berm. The final cross-sectional dimensions and slopes of the berm will need to be determined and refined, respectively, through modeling and analysis of the sediment characteristics of the dredged material and the berm subgrade during a subsequent phase of design.

The berm will be constructed from relict sidecasted new work material removed from the nearby DMPAs before the island is constructed. As shown in Figure 3, the fill material will be directly contained by the berm. Confining the dredged fill material within the berm will reduce potential impacts to adjacent seagrass habitat. Elevations at the center and south location of the Site lie within the -1-foot-NAVD88 contour, and it is assumed that marsh buggies will be used to stack and shape the berm. The berm is proposed with a 4H:1V seaward slope to allow wildlife access into the Site. A 4H:1V slope will also improve slope stability and reduce wave energy compared to steeper berm slopes.

Planting and Natural Recruitment

Based on stakeholder input and cost considerations, the project team determined that planting may not be needed for the Site. Rather, natural vegetation recruitment will be allowed to proceed. If the outcome is unsatisfactory (e.g., if the island has lower-than-expected use by desired bird species), an adaptive management program can be instituted to modify the vegetation. Table 2 shows some of the listed and migratory birds and their preferred habitats. At further design stages, this list could be used to modify elevations within the Site to promote the preferred habitat of desired bird species.

Site Construction Cost Estimates

Construction costs were estimated for the design outlined in the previous sections. The estimated costs include permitting, 100% design, engineering costs for advancing the design to the construction phase, pre-construction and as-built surveys, incremental mobilization and demobilization (i.e., over and above USACE's mobilization and demobilization costs for dredging the GIWW), materials, and construction of the berm. Table 3 shows a line-item list of each costing parameter and the total cost estimated for construction.

Table 3
Opinion of Probable Construction Cost to 100% Project Completion

Item	Quantity	Unit	Unit Price	Total
Pre-Construction Survey	1	LS	$ 30,000.00	$ 30,000.00
Bird Island Berm and Internal Fill Excavation[1]	95,000	cy	$ 10.00	$ 950,000.00
Marsh Buggy Fill Maintenance[2]	25	days	$ 2,500.00	$ 60,000.00
Post-Construction Survey (topography/ bathymetry)	1	LS	$ 30,000.00	$ 30,000.00
Post-Construction Survey (aerials)	1	LS	$ 10,000.00	$ 10,000.00
Navigational Aids[2]	4	Each	$ 4,000.00	$ 20,000.00
Subtotal[3]			**Sum**	**$ 1,100,000.00**
Incremental Mobilization and Demobilization[3,4]	1	LS	$ 400,000.00	$ 400,000.00
Construction Total[3]			**Sum**	**$ 1,500,000.00**
100% Engineering and Design[3]	1	10%	$ 200,000.00	$ 200,000.00
Permitting	1	Each	$ 100,000.00	$ 100,000.00
Construction Management[3]	1	8%	$ 100,000.00	$ 100,000.00
Post-Construction Management	12	Month	$ 10,000.00	$ 120,000.00
Project Subtotal[3]			**Sum**	**$ 2,000,000.00**
-30% Contingency[3]		30%	$ 600,000.00	$ 600,000.00
+50% Contingency[3]	1	50%	$1,000,000.00	$ 1,000,000.00
Low-End Project Estimated Cost[3]			**Total Sum**	**$ 1,400,000.00**
High-End Total Project Estimated Cost[3]			**Total Sum**	**$ 3,000,000.00**

Notes:
Costs were determined based upon publicly available data sets; no field work was conducted for this phase of the project.

1. Cost is based on incremental cost of diverting dredging equipment from GIWW to excavation areas.
2. Rounded to the nearest $10,000.
3. Rounded to the nearest $100,000.
4. Cost is based on mobilizing equipment above what is required for dredging the GIWW (i.e., marsh buggies).

LS: lump sum
sy: square yard

The costs vary from $1.4 million to $3 million, depending on the level of contingency allocated to the project cost.

This 10% design represents a bird island near the upper range of bird island sizes desired, based on stakeholder input. Future cost constraints may limit the island size that is ultimately constructed, but at this level of design, it was decided to consider a site on the upper end of the range identified by stakeholders.

The estimates are developed using current and generally accepted engineering cost estimating methods and are based on assumptions concerning future events. Actual costs may be affected by known and unknown risks including, but not limited to, changes in general economic business conditions, Site conditions that were unknown at the time the estimates were performed, future changes in Site conditions, regulatory or enforcement policy changes, and delays in performance. Actual costs may vary from these estimates.

Ecosystem Benefits Expected

Creation of the Site is expected to have positive benefits on the regional ecosystem. Green Island, an 80-acre rookery island located in the adjacent Laguna Madre, was used to approximate the ecological benefits for the Site. From 2011 to 2015, Green Island averaged approximately 1,000 breeding pairs of birds per year across three species that are listed in Table 2 (Audubon 2021b). Adjusting for acreage of rookery island, the Site may be expected to create habitat for approximately 90 breeding pairs for three species of birds per year.

Due to the location of seagrass habitat adjacent to the Site, dredging of surrounding relict material during construction could result in surrounding water depths that are conducive to further seagrass colonization. This could increase the existing seagrass habitat in the regional ecosystem.

Future Work

Of the sites selected for 10% designs in this project, at least eight will be selected for 30% designs, and at least five of those will subsequently be selected for 60% designs and cost estimates. No fatal flaws have been identified in this 10% design effort. Should this Site be selected for additional design efforts, it can be expected that some aspects of the design in this memorandum will be modified and, as appropriate, improved. As previously mentioned, it is possible that in each phase additional designs will be provided toward this project because of the partnership on this project between DU and PCCA.

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Figures

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ANCHOR QEA

Figure 1
DMPA #214 Bird Island Plan View
DMPA #214 Bird Island 10% Design Memorandum
Texas Lower Coast Beneficial Use

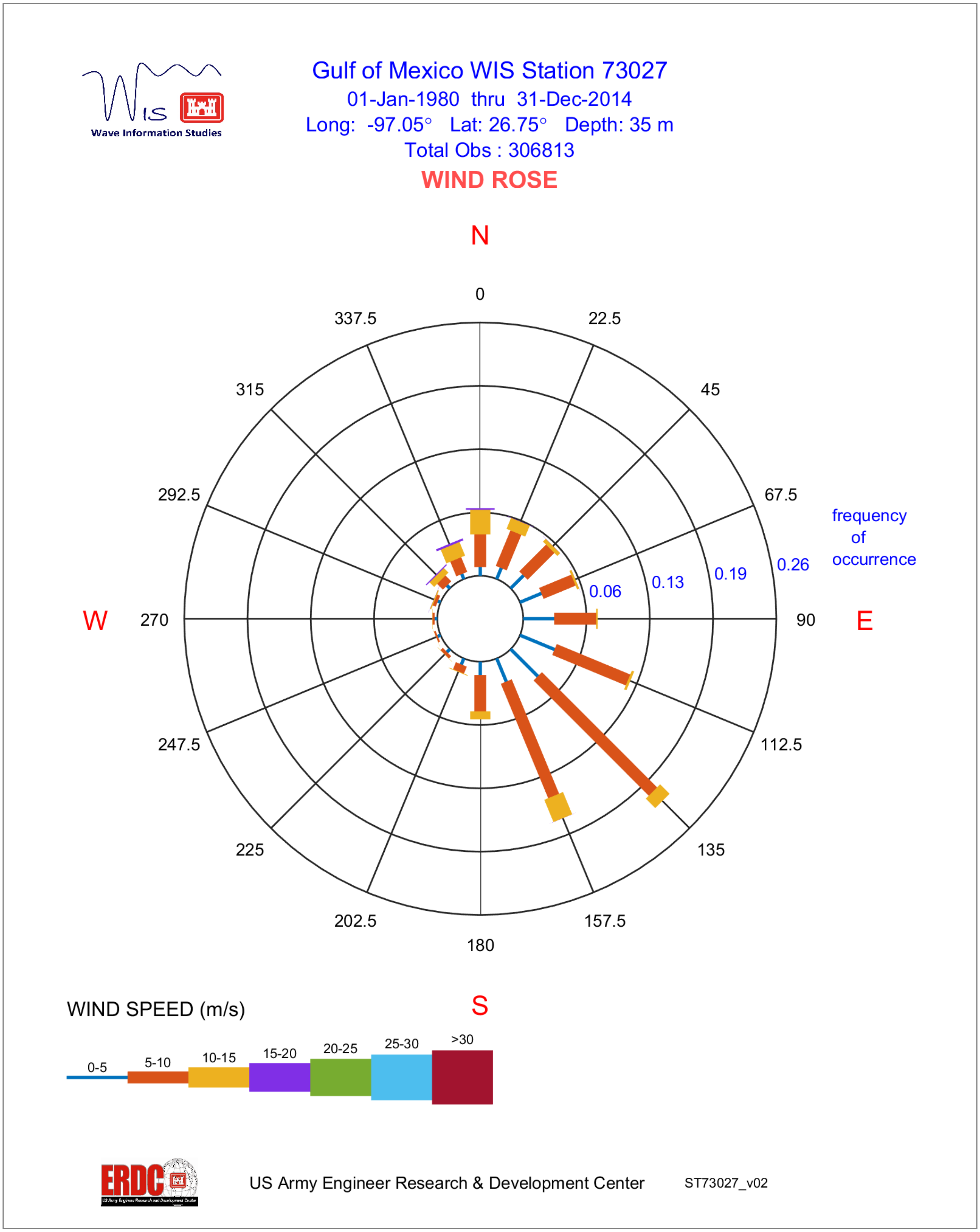

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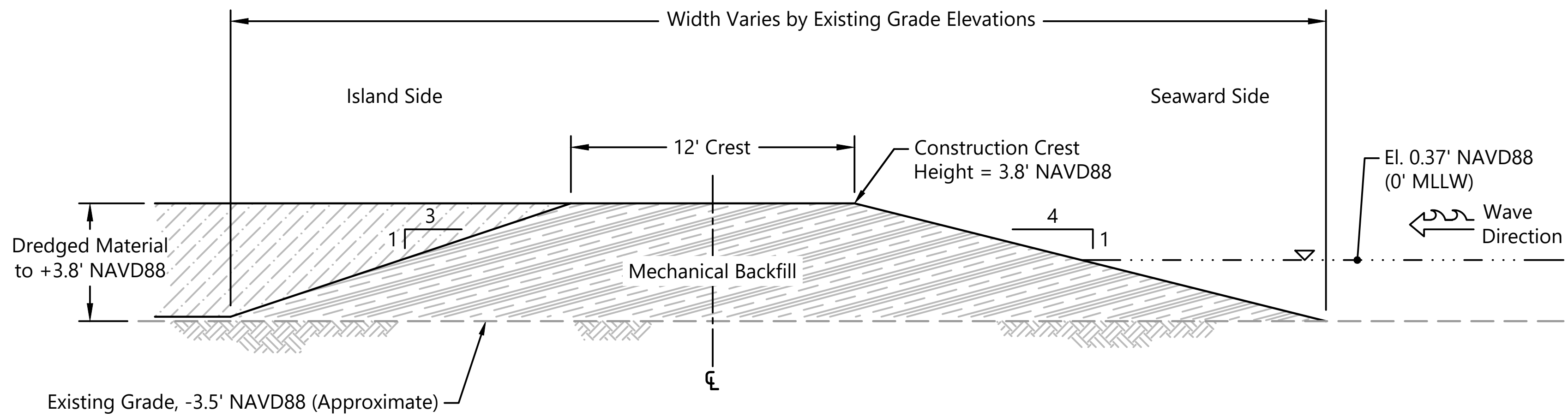
Figure 2
Historical Wind Data for USACE WIS Station 73027
DMPA #214 Bird Island 10% Design Memorandum
Texas Lower Coast Beneficial Use



Section A-A' Typical Berm

Not to Scale

VERTICAL DATUM: North American Vertical Datum of 1988 (NAVD88)

Memorandum

January 31, 2022

To: Melissa McCutcheon, Texas General Land Office

From: Todd Merendino, Ducks Unlimited
Sarah Garza, Harrison McNeil, and Yvonne Dives-Gomez, Port of Corpus Christi Authority
John Laplante, Dan Opdyke, Ray Newby, Adrienne Accardi, Alexander Freddo, and Hayden Smith, Anchor QEA, LLC
Jane Sarosdy, Sarosdy Consulting, Inc.

Re: Feeder Berm North of Fish Pass 10% Design Memorandum

Introduction

This 10% design memorandum describes design criteria and assessments associated with the proposed Feeder Berm North of Fish Pass site (Site), located in Texas General Land Office (GLO) Planning Region 3 of the Texas coast, in the Gulf of Mexico near Mustang Island, Nueces County, Texas (Figure 1).

Project Background

GLO awarded a Coastal Management Program Project of Special Merit grant (funded through the Gulf of Mexico Energy Security Act) to Ducks Unlimited, Inc. (DU), to identify priority locations and develop 10% designs and opinions of probable construction costs for at least 16 sites in GLO Planning Regions 3 and 4 of the Texas coast for the beneficial use of dredged material (BU). To assist in this endeavor, the Port of Corpus Christ Authority (PCCA) has committed to provide in-kind services to advance several additional BU sites in tandem with the aforementioned scope. The project team is led by DU and PCCA and includes Anchor QEA, LLC; Sarosdy Consulting, Inc.; and the Texas Department of Transportation. In addition to the 16 sites identified and prioritized, PCCA will provide additional resources to bring forward more site designs for review if the site prioritization and selection so warrants. The project team coordinated two online stakeholder meetings to receive information about potential BU sites. Ultimately the project team did not select this site as part of the 16 sites for 10% design. However, based on stakeholder input, GLO feedback, publicly available data, and professional judgment, PCCA selected the Site to advance to the 10% design development and cost estimation.

Beaches provide economic value to humans as well as habitat for breeding and foraging wildlife (Marbán 2019). The beaches along the Texas coast, especially Mustang Island, serve as a habitat for threatened and endangered species, including all five species of sea turtles (green sea turtle [*Chelonia mydas*], hawksbill sea turtle [*Eretmochelys imbricata*], Kemp's ridley sea turtle [*Lepidochelys kempii*], leatherback sea turtle [*Dermochelys coriacea*], and loggerhead sea turtle [*Caretta caretta*]), the piping plover (*Charadrius melodus*), and the red knot (*Calidris canutus*) (USFWS 2021; NPS 2022). Hurricane Hanna resulted in more damage to the area bay and Gulf beaches than Hurricane Harvey. This increased erosion of the Gulf beaches continued throughout 2020 as a result of a record-breaking storm season (McKenna 2014). Gulf beach erosion directly reduces available habitat for threatened and endangered sea turtles and avian species. Fish Pass is a relict channel on Mustang Island located approximately 13 miles south of the Port Aransas jetties and approximately 5 miles north of the Packery Channel jetties. Although once a source of hydrologic exchange between the Gulf of Mexico and Corpus Christi Bay, the pass has shoaled over time. Conversations with Deidre Williams of the Conrad Blucher Institute identified an area north of Fish Pass to be an ideal location for a feeder berm (Williams 2021). The proposed berm would nourish eroding beaches over time as a result of natural processes driven by prevailing southeast winds and resulting nearshore currents.

Project Objectives

Frequent dredging is needed to develop and maintain Texas ship channels. The dredged material must be deposited in dredged material placement areas (DMPAs), and many of the existing DMPAs along the Texas coast are nearing capacity. Resource agencies and stakeholders have long advocated using dredged material beneficially to create and restore wetlands and bird islands, nourish beaches, and counteract land loss. Historically, BU projects are difficult to manage because they are multi-year, multi-faceted undertakings in which different organizations manage dredging schedules, funding, project design, permitting, and construction activities. To help address these issues, the objectives of this project include the following:

- Create and restore degrading coastal habitats.
- Establish sites for disposal of dredged material to reduce reliance on existing DMPAs.
- Improve coastal resiliency of the natural and built environment.
- Reduce shoaling in the GIWW and other ship channels.

To accomplish these objectives, the project includes the following tasks:

- Stakeholder outreach and coordination
- Identification and selection of BU sites
- 10% designs and cost estimates for at least 16 BU sites
- 30% designs for at least eight BU sites
- 60% designs, cost estimates, and permit application packages for at least five BU sites

This memorandum documents the 10% design and cost estimate for one of the selected sites.

Design Objectives

This Site will be designed to beneficially use dredged material to create a feeder berm in a region with coastal and beach erosion. The design will use material dredged from navigation channels during routine maintenance or new work from future PCCA projects, thus reducing the volume of such material placed in existing open-bay or upland DMPAs. This 10% design is based upon publicly available datasets; no fieldwork was conducted for this phase of the project.

Design objectives include the following:

- Develop a preliminary vision based on available data for the Site that includes the following:
  - Habitat to be created or restored
  - Potential sediment source(s)
  - Approaches to minimize long-term maintenance costs
- Delineate conceptual footprints for proposed BU placement.
- Identify key sensitive habitats and construction considerations in the vicinity of the Site.
- Estimate fill volumes for the proposed BU footprints.
- Identify data gaps to be addressed in subsequent design stages.
- Provide preliminary cost estimates.

Existing Data Review

Horizontal and Vertical Datums

The horizontal datum used for the Site is the Texas State Plane Zone 5, North American Datum of 1983 (NAD83), in U.S. survey feet. The primary vertical datum used for the Site is the North American Vertical Datum of 1988 (NAVD88). The National Oceanic and Atmospheric Administration (NOAA) maintains an active tide gauge within the vicinity of the Site. The NOAA Bob Hall Pier Station 8775870 is approximately 8 miles southwest of the proposed feeder berm. This station collects and records real-time tide information dating back to 1983. The vertical datums from this station that will be used for the Site are shown in Table 1.

Table 1
NOAA Bob Hall Pier Station 8775870 Tidal Gauge Displaying NAVD88 Tidal Datums

Tidal Datums	Elevation (feet NAVD88)
MHHW	1.13
MHW	1.04
MSL	0.43
MLW	-0.28
MLLW	-0.50

Notes:
MHHW: mean higher high water
MHW: mean high water
MLLW: mean lower low water
MLW: mean low water
MSL: mean sea level

Meteorological, Ocean, and Wave Data

Wind and Waves

The United States Army Corps of Engineers (USACE) Wave Information Studies (WIS) provides a national resource of long-term wavefield climatologies for U.S. coastal waters that synthesizes observations, multi-decade hindcasts, and storm event archives (USACE 2021). The WIS station closest to the Site is Station 73039, just offshore on the Gulf side of Mustang Island in the Gulf of Mexico. The project team considers the wind and wave data to be representative of the wind and wave climatologies experienced at the Site for this stage of design. Figure 2 summarizes wind and wave data from January 1, 1980, through December 31, 2014. The data indicate that the predominant wind direction is from the southeast, with significant winds also coming from the north, northeast, east, and south.

The fetch at the Site stretches across the Gulf of Mexico in the predominant southeast wind direction. Due to the fetch, the Site is anticipated to be in a high wave-energy environment. A wave analysis of the direction and frequency of expected significant wave heights will be conducted in subsequent phases of design.

Wake Erosion

There are no existing navigation channels in the proximity of the Site. The project team does not anticipate that wake erosion from passing vessels will affect this project.

Bathymetry

The NOAA National Centers for Environmental Information continuously updated digital elevation model for the Texas Coast (NOAA 2021) was used to obtain bathymetry data for the Site. The water depth at the Site varies from -10 to -15 feet NAVD88.

Utilities

The Railroad Commission of Texas public GIS viewer (RRC 2021) was used to identify utilities and pipelines near the Site. One pipeline was found: a natural gas offshore gathering pipeline operated by TR Offshore, LLC, located approximately 2.2 miles east of Fish Pass (Figure 3). It is not anticipated that this pipeline will affect the design or constructability of the Site. The need for Site-specific utility locations prior to construction will be determined during subsequent design stages.

Desktop Cultural Resources Survey

A search of cultural resources records in the THC Atlas Database (THC 2021) was completed on December 29, 2021. This search revealed that no cultural resources surveys have been conducted and no cultural resources sites have been identified within the Site.

Sensitive Habitat

GLO oyster habitat GIS data (GLO 2021) indicates that there is no oyster habitat located within or adjacent to the Site. According to Texas Parks and Wildlife Department seagrass data (TPWD 2021), there are no seagrasses mapped within or adjacent to the Site. However, surveys will likely need to be conducted during a subsequent phase of design to evaluate the presence and extent of sensitive habitat.

Erosion

According to the Bureau of Economic Geology at the University of Texas, coastal erosion between Fish Pass and the Port Aransas jetties varies from 0 to 3.35 feet per year (BEG 2019). This erosion is believed to be the result of a combination of coastal storms, sea level rise, and wind-wave action from the Gulf of Mexico.

Beneficial Use Source Material

One potential source of dredged material is the Corpus Christi Entrance Channel, located 13 miles north of the Site. PCCA has proposed to deepen and extend the Entrance Channel, resulting in the dredging of 17.1 million cubic yards (cy) of clay and 29.2 million cy of sand from new work and maintenance over a 10-year period. PCCA is proposing to place this material at a combination of previously authorized facilities as well as a number of proposed BU sites. These BU sites include multiple feeder berms north of the proposed Site.

The Site is also approximately 13 miles from the new work and 11 miles from the Corpus Christi Ocean Dredged Material Disposal Sites (ODMDSs). These ODMDSs are approved locations for placement offshore placement of dredged material. If the ODMDSs currently contain suitable material, they could be used as a secondary source for mining dredged material and transporting it to the Site via scows for placement.

10% Design

The main design features that are critical for feeder berm success are as follows:

- Site location
- Size and shape
- Containment and erosion protection
- Planting and natural recruitment

These design features are evaluated in this memorandum for the preliminary Site design.

Site Location

The proposed location of the Site is approximately 1.0 mile northeast of Fish Pass. The Site is located in the nearshore environment of the Gulf of Mexico and is subject to ongoing wind and wave action. The Site is located approximately 0.25 mile from the mean high water line. The location of the proposed feeder berm will allow for gradual beach nourishment to a portion of the eroding beaches on Mustang Island. The location of the Site will also not interfere with feeder berms already proposed north of the proposed project.

The average water depth surrounding the Site varies from -10 to -15 feet NAVD88. This depth offers a suitable balance between cost and constructability. Deeper water provides easier access for construction equipment than does shallow water, but it also requires more dredged material to build to the target elevation. Bathymetric surveys will need to be conducted during subsequent design phases to better define Site dimensions and material needs.

Size and Shape

Based on the availability of sediment, a cost analysis, and stakeholder feedback, the project team proposes that the area of the Site be 75 acres. The Site would be created with dredged material placed to an elevation of -8 feet NAVD88. The Site would be rectangular in shape and oriented parallel to the shore, as shown in Figure 4. The linear shape of the Site would allow for maximized transport of sediment from the Site to the adjacent beach. The shape of the Site does not consider potential benefits to benthic or pelagic species because it would be designed to erode. The elevation of dredged material fill could be adjusted at further stages of design depending on the physical properties of the dredged material or further hydrodynamic modeling.

Fill material could be obtained from the Entrance Channel or either of the ODMDSs. It is predicted that the required dried fill volume will be approximately 483,300 cy. This value assumes 1 foot of foundation compression for every 3 feet of fill and does not consider bulking. Geotechnical data will likely need to be collected during a subsequent design phase to further evaluate the expected foundation compression and the expected bulking of dredged material.

Containment and Erosion Protection

Because the purpose of the Site is to erode, nourishing the adjacent beach, the project team does not propose to construct any permanent containment or erosion protection.

Planting and Natural Recruitment

Because the purpose of this Site does not include the creation of vegetated habitat, the project team does not propose any planting. Natural recruitment of any submerged aquatic vegetation is not anticipated due to the dynamic hydrologic conditions at the Site.

Site Construction Cost Estimates

Construction costs were estimated for the design outlined in the previous sections. The estimated costs include permitting, 100% design, engineering costs for advancing the design to the construction phase, pre-construction and as-built surveys, mobilization, materials, and construction of the breakwater. These costs represent the estimated incremental costs; i.e., those costs over and above USACE's least cost and environmentally acceptable dredged material and disposal alternative. Table 2 shows a line-item list of each costing parameter and the total cost estimated for construction.

Table 2
Opinion of Probable Construction Cost to 100% Project Completion

Item	Quantity	Unit	Unit Price	Total
Pre-Construction Survey	1	LS	$ 30,000.00	$ 30,000.00
Dredged Material Transport[1,2] (scows)	161	Trips[3]	$ 17,000.00	$ 2,700,000.00
Post-Construction Survey (topography/ bathymetry)	1	LS	$ 30,000.00	$ 30,000.00
Post-Construction Survey (aerials)	1	LS	$ 10,000.00	$ 10,000.00
Barge Mobilization/Demobilization[4]	2	each	$ 58,000.00	$ 120,000.00
Subtotal[2]			**Sum**	**$ 3,000,000.00**
Incremental Mobilization	1	5%	$ 150,000.00	$ 150,000.00
Construction Total			**Sum**	**$ 3,150,000.00**
100% Engineering and Design[2]	1	10%	$ 300,000.00	$ 300,000.00
Permitting	1	Each	$ 100,000.00	$ 100,000.00
Construction Management[2]	1	8%	$ 300,000.00	$ 300,000.00
Post-Construction Management	12	Month	$ 10,000.00	$ 120,000.00
Project Subtotal[2]			**Sum**	**$ 4,000,000.00**
-30% Contingency[2]	1	30%	$ 1,2020,000.00	$ 1,200,000.00
+50% Contingency[2]	1	50%	$ 2,000,000.00	$ 2,000,000.00
Low-End Project Estimated Cost[2]			**Total Sum**	**$ 2,800,000.00**
High-End Project Estimated Cost[2]			**Total Sum**	**$ 6,000,000.00**

Notes:
Costs were determined based upon publicly available datasets; no fieldwork was conducted for this phase of the project.
1. The estimate assumes dredge material will be transported via 3,000 cy capacity scows and placed mechanically.
2. Rounded to the nearest $100,000.
3. The estimate assumes one trip a day.
4. Rounded to the nearest $10,000.

LS: lump sum
sy: square yard

The costs vary from $2.8 million to $6 million, depending on the level of contingency allocated to the project cost. This 10% design is a simplified version of the feeder berms proposed by PCCA as part of the Corpus Christi Ship Channel (CCSC) Channel Improvement Project. The design may change due to further engineering analysis either through this effort or analysis of the project team.

The estimates are developed using current and generally accepted engineering cost estimating methods and are based on assumptions concerning future events. Actual costs may be affected by known and unknown risks including, but not limited to, changes in general economic business conditions, Site conditions that were unknown at the time the estimates were performed, future

changes in Site conditions, regulatory or enforcement policy changes, and delays in performance. Actual costs may vary from these estimates.

Ecosystem Benefits Expected

The creation of the Site is expected to have positive benefits on the local ecosystem. The beach nourishment combats erosion to the natural beach system along Mustang Island. This beach provides foraging, nesting, and breeding ground to federally protected species like the piping plover, red knot, and all five species of sea turtles.

Future Work

Of the sites selected for 10% designs in this project, at least eight will be selected for 30% designs, and at least five of those will subsequently be selected for 60% designs and cost estimates. No fatal flaws have been identified in this 10% design effort. Should this Site be selected for additional design efforts, it can be expected that some aspects of the design in this memorandum will be modified and, as appropriate, improved. As previously mentioned, it is possible that in each phase additional designs will be provided toward this project because of the partnership on this project between DU and PCCA.

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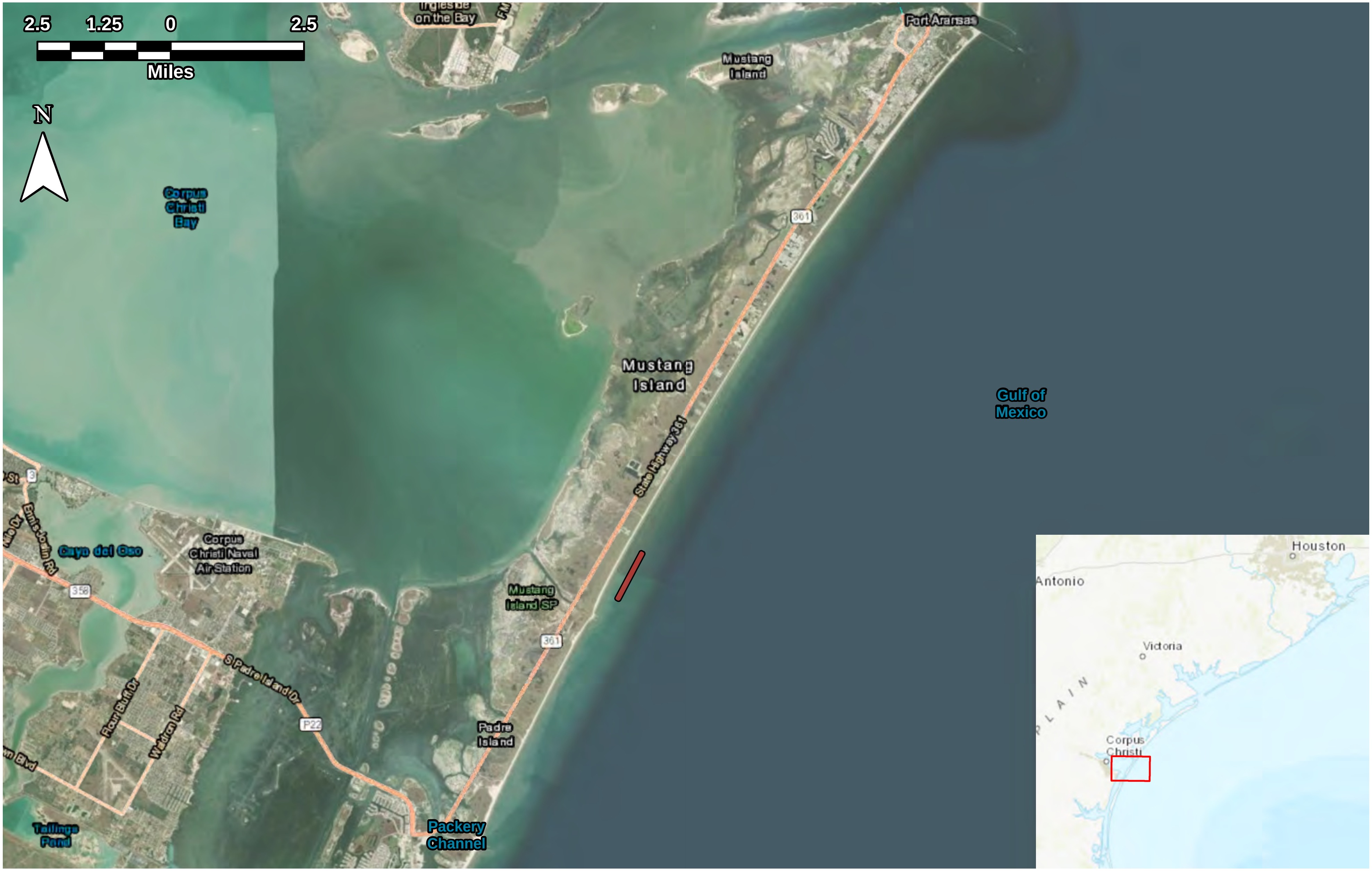
Figures



Legend

Layer

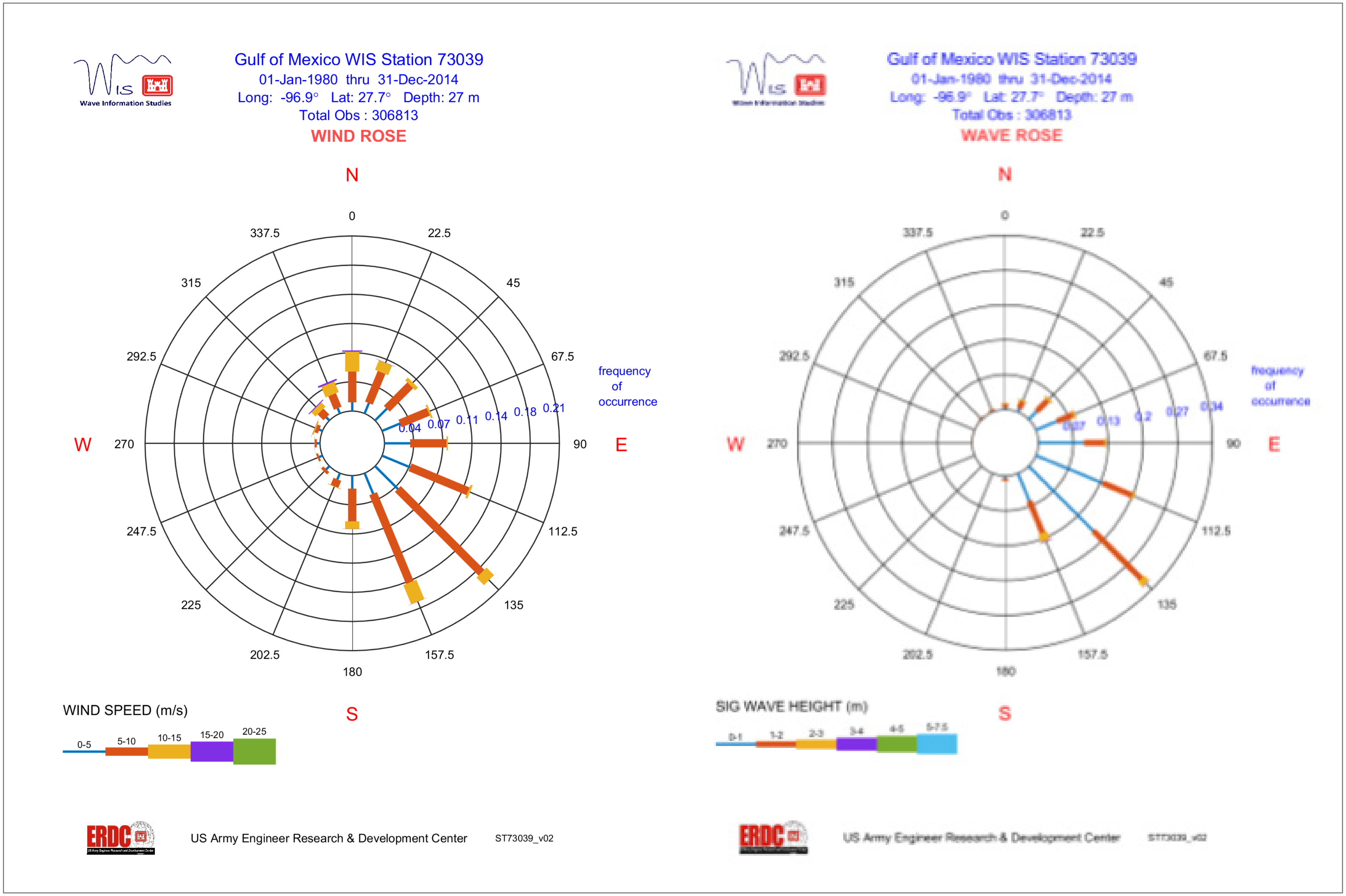
BU Type

Feeder Berm

PORTCORPUSCHRISTI

Figure 1
Location Map

Feeder Berm North of Fish Pass
10% Design Memorandum
Texas Lower Coast Beneficial Use



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ANCHOR QEA

Figure 2

Historical Wind and Wave Data for USACE WIS Station 73039

Feeder Berm North of Fish Pass 10% Design Memorandum

Texas Lower Coast Beneficial Use

Path: H:\Environmental\Duck Unlimited Beneficial Use Project\DU Beneficial Use Sites\DU Beneficial Use Sites.aprx Date Saved: 1/6/2022 1:43 PM User: hmcneil

Legend

Railroad Commission Pipelines

Status

Abandoned

In-Service

Feeder Berm

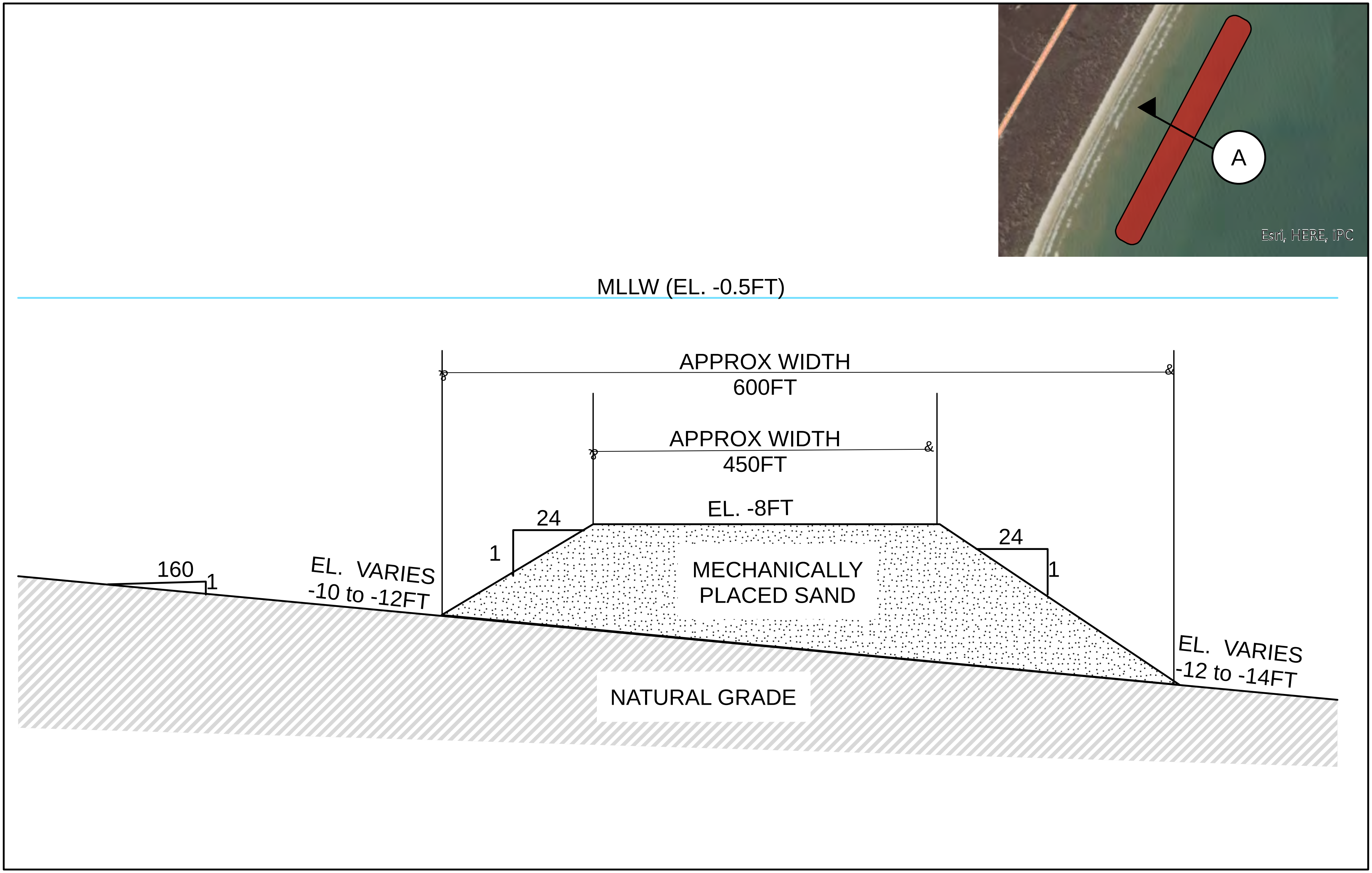
BU Type

Feeder Berm

PORTCORPUSCHRISTI

Figure 3
RRC Pipelines Map

Feeder Berm North of Fish Pass 10% Design Memorandum
Texas Lower Coast Beneficial Use



These drawing are conceptual intended for planning purposes only.
These drawings are not intended to be used for engineer, construction, surveying or bidding documents. These drawings are not to scale.

PORTCORPUSCHRISTI

Figure 4
Cross Sections

Feeder Berm North of Fish Pass 10% Design Memorandum
Texas Lower Coast Beneficial Use

Memorandum

January 31, 2022

To: Melissa McCutcheon, Texas General Land Office

From: Todd Merendino, Ducks Unlimited, Inc.
Sarah Garza, Harrison McNeil, and Yvonne Dives-Gomez, Port of Corpus Christi Authority
John Laplante, Dan Opdyke, Ray Newby, Adrienne Accardi, Alexander Freddo, and Hayden Smith, Anchor QEA, LLC
Jane Sarosdy, Sarosdy Consulting, Inc.

Re: Fulton Beach Rd Protection and Marsh 10% Design Memorandum

Introduction

This 10% design memorandum describes design criteria and assessments associated with the proposed Fulton Beach Road (Rd) Protection and Marsh site (Site), located in Texas General Land Office (GLO) Planning Region 3 of the Texas coast in Aransas Bay in Aransas County, Texas (Figure 1).

Project Background

GLO awarded a Coastal Management Program Project of Special Merit grant (funded through the Gulf of Mexico Energy Security Act) to Ducks Unlimited, Inc. (DU), to identify priority locations and develop 10% designs and opinions of probable construction costs for at least 16 sites in GLO Planning Regions 3 and 4 of the Texas coast for the beneficial use of dredged material (BU). The project team is led by DU and Port of Corpus Christi Authority (PCCA) and includes Anchor QEA, LLC; Sarosdy Consulting, Inc.; and the Texas Department of Transportation. In addition to the 16 sites identified and prioritized, PCCA will provide additional resources to bring forward more site designs for review if the site prioritization and selection so warrants. The project team coordinated two online stakeholder meetings in each region to receive information about potential BU sites. Based on stakeholder input, GLO feedback, publicly available data, and professional judgment, the project team selected the Site as one of the 16 sites for 10% design development and cost estimation.

The Site is approximately 300 feet east of Fulton Beach Rd and 2.5 miles west of the Gulf Intracoastal Waterway (GIWW) in Aransas Bay in Aransas County, Texas, on submerged land owned by the Aransas County Navigation District (ACND). Stakeholders have identified this as a location to create marsh using dredged material while also providing shoreline protection and public recreation.

Project Objectives

Frequent dredging is needed to develop and maintain Texas ship channels. The dredged material must be deposited in dredged material placement areas (DMPAs), and many of the existing DMPAs along the Texas coast are nearing capacity. Resource agencies and stakeholders have long advocated using dredged material beneficially to create and restore wetlands and bird islands, nourish beaches, and counteract land loss. Historically, BU projects are difficult to manage because they are multi-year, multi-faceted undertakings in which different organizations manage dredging schedules, funding, project design, permitting, and construction activities. To help address these issues, the objectives of this project include the following:

- Create and restore degrading coastal habitats.
- Establish sites for placement of dredged material to reduce reliance on existing DMPAs.
- Improve coastal resiliency of the natural and built environment.
- Reduce shoaling in the GIWW and other ship channels.

To accomplish these objectives, the project includes the following tasks:

- Stakeholder outreach and coordination
- Identification and selection of BU sites
- 10% designs and cost estimates for at least 16 BU sites
- 30% designs for at least eight BU sites
- 60% designs, cost estimates, and permit application packages for at least five BU sites

This memorandum documents the 10% design and cost estimate for one of the selected sites.

Design Objectives

This Site will be designed to beneficially use dredged material to create marsh habitat in a region with available sources of dredged material. The design will use material dredged from navigation channels during routine maintenance, such as the GIWW, thus reducing the volume of such material that will need to be placed in existing open-bay or upland DMPAs. This 10% design is based upon publicly available datasets; no field work was conducted for this phase of the project.

Design objectives include the following:

- Develop a preliminary vision based on available data for the Site that includes the following:
  - Habitat to be created or restored
  - Potential sediment source(s)
  - Approaches to minimize long-term maintenance costs
- Delineate conceptual footprints for proposed BU placement.
- Identify key sensitive habitats and construction considerations in the vicinity of the Site.
- Estimate fill volumes for the proposed BU footprints.

- Identify data gaps to be addressed in subsequent design stages.
- Provide preliminary cost estimates.

Existing Data Review

Horizontal and Vertical Datums

The horizontal datum used for the Site is the Texas State Plane Zone 4, North American Datum of 1983 (NAD83), in U.S. survey feet. The primary vertical datum used for the Site is the North American Vertical Datum of 1988 (NAVD88). The National Oceanic and Atmospheric Administration (NOAA) maintains an active tide gauge within the vicinity of the Site. The NOAA Rockport, TX Station 8774770 is 2.75 miles southwest of the proposed marsh restoration. This station collects and records real-time tide information dating back to 1948. The vertical datums from this station that will be used for the Site are shown in Table 1.

Table 1
NOAA Rockport, TX Station 8774770 Tidal Gauge Displaying NAVD88 Tidal Datums

Tidal Datums	Elevation (feet NAVD88)
MHHW	1.30
MHW	1.29
MSL	1.12
MLW	0.94
MLLW	0.93

Notes:
MHHW: mean higher high water
MHW: mean high water
MLLW: mean lower low water
MLW: mean low water
MSL: mean sea level

Meteorological, Ocean, and Wave Data

Wind and Waves

The United States Army Corps of Engineers (USACE) Wave Information Studies (WIS) provides a national resource of long-term wavefield climatologies for U.S. coastal waters that synthesizes observations, multi-decade hindcasts, and storm event archives (USACE 2021). The WIS station closest to the Site is Station 73042, just offshore on the Gulf side of Matagorda Island in the Gulf of Mexico. Because the station is located offshore, the wave data are not applicable to this project design. However, the project team considers the wind data to be representative of the winds experienced at the Site. Figure 2 summarizes wind data from January 1, 1980, through

December 31, 2014. The data indicate that the predominant wind direction is from the southeast, with significant winds also coming from the north, northeast, east, and south.

There is a 5-mile fetch between the Site and San Jose Island, the closest land mass in the predominant southeast wind direction. Due to the fetch and surrounding water depths, the Site is anticipated to be in a high wave-energy environment. A wave analysis of the direction and frequency of expected significant wave heights will be conducted in subsequent phases of design.

Wake Erosion

The GIWW is approximately 2.75 miles southeast of the Site, and the Key Allegro community canals are approximately 1 mile south of the Site. The GIWW is far enough that significant wake erosion is not expected. Potential wake erosion from recreational vessels is expected to be a design consideration. An analysis of the erosive effects of vessel traffic propwash analysis will be conducted during subsequent phases of design to better understand the extent of vessel-induced wake erosion on the Site. Given the large fetch distance to Matagorda Island, wind-generated waves are likely to be the dominant source of erosive forces to the project Site.

Bathymetry

The NOAA National Centers for Environmental Information continuously updated digital elevation model for the Texas Coast (NOAA 2021) and bathymetry data from Belaire Environmental, Inc. (Belaire 2016) were used to obtain bathymetry data for the Site. The seabed elevation of the Site north of Fulton Harbor ranges from 1 foot NAVD88 on the west side to -6 feet NAVD88 on the east side with an average seabed elevation of -3.5 feet NAVD88. The seabed elevation of the Site south of Fulton Harbor ranges from -2.5 feet NAVD88 on the west side to -6 feet NAVD88 on the east side with an average seabed elevation of -3.7 feet NAVD88.

Utilities and Infrastructure

The Railroad Commission of Texas public GIS viewer (RRC 2021) was used to identify utilities and pipelines near the Site. No utilities were found within the footprint of the Site, although there is a Lamar Oil & Gas, Inc., natural gas full well stream pipeline 0.7 mile east of the Site. It is not expected that this pipeline will have design or construction implications. The need for Site-specific utility locations prior to construction will be determined during subsequent design stages. No other infrastructure has been identified in the vicinity of the project Site.

Desktop Cultural Resources Survey

A search of cultural resources records in the Texas Historical Commission Atlas Database was completed for the Site between November 29 and December 30, 2021. This search revealed that no archaeological surveys have been conducted and no archaeological sites have been identified within the preliminary proposed placement site boundary (THC 2021).

Sensitive Habitat

Based on GLO oyster habitat GIS data (GLO 2021), oyster habitat has been identified approximately 0.1 mile east of the Site footprint north of Fulton Harbor. According to Texas Parks and Wildlife Department seagrass data (TPWD 2021), there are no seagrasses mapped within or adjacent to the Site location. Surveys will likely need to be conducted during a subsequent phase of design to evaluate the presence and extents of sensitive habitat to confirm or update the understanding of sensitive habitat in the vicinity of the Site.

Beneficial Use Source Material

A potential source of dredged material is the GIWW maintenance material, located 2.5 miles east of the Site. The Coastal Consistency Determinations from USACE indicate maintenance dredging on the GIWW near the Site (USACE 1999). Continued dredging has recently been confirmed by USACE (Jones 2021). The identified DMPAs used by USACE near the Site and their associated historical average annual quantity of dredged material, distance from the Site, and channel segments are shown in Table 2. The average grain size and grain type percentages are shown in Table 3. This informs the quantity and characteristics of dredged material that may be available during a dredging cycle.

Table 2
USACE DMPA Areas Adjacent to the Site

DMPA No.	Channel Segment (Station)	Distance from Site (miles)	Average Annual Dredging Quantity (cy)
135	860+000-868+500	2.8	206,158
136	868+500-876+000	2.5	178,704
137	876+000-883+000	2.7	146,321
138	883+000-891+000	3.4	125,624

Notes:
Source: USACE 1999.
cy: cubic yard

Table 3
Typical Sediment Characteristics Across Aransas Bay – Western Job

Sediment Characteristics
D_{50} (mm) < 0.028
15.7% sand
56.8% silt
27.5% clay

Notes:
Channel Segment: (860+000-900+000)
Source: USACE 1999
D_{50}: median grain size
mm: millimeter

Further information will need to be collected during a subsequent phase of design to evaluate the range of sediment characteristics for source materials.

Marsh Vegetation Elevation Ranges

Typical habitat ranges for relevant marsh vegetation were determined based on site vegetation surveys conducted by DU at the Lower Neches Wildlife Management Area Old River Unit, Texas Point National Wildlife Refuge (NWR), McFaddin NWR Willow Lake Terraces, Anahuac NWR Roberts Mueller Tract, Schicke Point, Guadalupe River Old Delta, and Goose Island State Park Cells sites located in GLO Planning Regions 1 and 2 of the Texas coast. This is shown in Table 4.

Table 4
Typical Elevations for Target Marsh Vegetation

Species	Elevation (feet MSL)	Elevation (feet NAVD88)
Spartina patens	0.25 to 1	1.37 to 2.12
Spartina alterniflora	0 to 0.75	1.12 to 1.87

10% Design

The main design features that are critical for marsh island success are as follows:

- Site location
- Marsh size and shape
- Containment and erosion protection
- Planting and natural recruitment of vegetation

These design features are evaluated in this memorandum for the preliminary Site design.

Site Location

The proposed location of the Site is approximately 300 feet east of Fulton and 2.5 miles west of the Gulf Intercoastal Waterway (GIWW) in Aransas Bay. Two islands are proposed, one north and one south of Fulton Harbor. The nearshore (west) edge of the islands will be 300 feet offshore to allow for water circulation around the island. This spacing provides enough distance from the shore to the levee to maintain adequate circulation for the marsh on the leeward side without requiring a prohibitively long pier length extending to the Site for public pedestrian access to the proposed wide-crested levees.

The average seabed elevation within the footprint of the Site is approximately -3.5 feet NAVD88 (-4.44 feet mean lower low water). Water depths of greater than 5 feet exist on the bayward (east) side of the Site, providing favorable conditions for construction access. Bathymetric surveys will need to be conducted during subsequent design phases to better define Site dimensions and material needs.

There are private piers with ACND leases that run adjacent to the Site. Further information will need to be obtained followed by coordination with ACND to determine how to avoid possible encroachment of private leases.

Size and Shape

Based on availability of sediment, a cost analysis, and stakeholder feedback, the project team proposes that the area of the Site be approximately 25 acres, with the north island containing about 13 acres of marsh and the south island containing about 12 acres of marsh. Due to expected mounding of the placed material, the Site will be created with dredged material placed to an elevation of +2.5 feet NAVD88, which will be at the upper end of the suitable habitat range for *Spartina patens* and *Spartina alterniflora*. The Site will consist of two islands contained by sand levees armored with articulated concrete block mattresses (ACBM) (Figure 1). On the west side of the islands, there will be circulation cuts in the levees allowing for tidal circulation into the constructed marshes. These openings will allow ingress and egress of organisms to the Site. This shape of fill was selected to promote natural recruitment of vegetation at varied elevations. The elevation of dredged material fill could be adjusted at further stages of design depending on the physical properties of the dredged material or if other target species and their specific requirements are identified. It is expected that environmental controls such as turbidity curtains may be needed during construction to contain fines placed at the Site.

Fill material will likely be obtained from the GIWW. It is predicted that the required fill volume will be approximately 470,000 cubic yards (cy), including capacity generated during excavation of sand to create the perimeter levee. The proposed levee for the Site is planned to be built with sand excavated from the Site. The required fill volume for the levees is estimated to be approximately 170,000 cy.

These quantities of fill and excavated sand assume 1 foot of foundation compression for every 3 feet of fill and do not consider bulking. Geotechnical data will likely need to be collected during a subsequent design phase to further evaluate the expected foundation compression and the expected bulking of dredged material, as well as to determine the suitability of site material to be used as fill for the levees. It is anticipated that the Site will be filled over several dredging events. A plan for filling the Site over several dredging events will be evaluated during subsequent design phases once the total quantity of dredged material is determined.

Containment and Erosion Protection

Based on the fetch in the predominant southeast wind direction and potential risk of wake erosion, the project team proposes containment and armoring for the Site consisting of two levees armored with ACBM surrounding both the north and south islands, which will mitigate erosion to the marsh and contain the dredged material. The levees will be composed of sand excavated from within the Site footprint. The levees will contain 5-horizontal-to-1-vertical (5H:1V) side slopes with a 12-foot-wide crest to allow recreational pedestrian traffic after construction. The constructed height of the crest will be +4.5 feet NAVD88. The exact width will be dependent on the existing grade, but assuming -3.5 feet NAVD88, the levee base width will be approximately 90 feet. The ACBM will be draped over the levee extending from the waterside toe of the levee to 2 feet below the fill elevation on the interior of the levee. Figure 3 depicts a typical cross section of the levee. The size of the ACBM and final cross-sectional dimensions of the levee will need to be determined and refined, respectively, through modeling and analysis during a subsequent phase of design. Sediment samples from the sediment located within the footprint will need to be collected to confirm the feasibility of using that sediment for levee construction.

The levee will be constructed before the dredged material is pumped to the Site. As shown in Figure 3, the fill material will be directly contained by the levee. Confining the dredged slurry within the levee will reduce potential impacts to adjacent oyster habitat. Water depths on the east side of the Site (greater than 5 feet) are expected to provide favorable conditions for construction access.

Three timber piers for pedestrian access to the levees are proposed for the Site; two piers will be constructed for the north island and one pier for the south island, as is shown in Figure 1. These piers will be designed with an elevation profile that will allow for small vessel access between the island and the mainland. Designs for these piers will need to be developed during subsequent designs.

Planting and Natural Recruitment

Based on stakeholder input and cost considerations, the project team determined that hydroseeding the edges of the marsh will be the most effective method for vegetating the marsh. Natural recruitment will then be allowed to proceed from the edge of the marsh inward. If the outcome is unsatisfactory (e.g., if the marsh has a lower-than-expected density of vegetation or if undesirable species of vegetation are present), an adaptive management program can be instituted to modify the vegetation. Table 4 shows some of the targeted vegetation and their preferred habitat elevations.

Site Construction Cost Estimates

Construction costs were estimated for the design outlined in the previous sections. The estimated costs include permitting, 100% design, engineering costs for advancing the design to the construction phase, pre-construction and as-built surveys, mobilization, materials, construction of the levee, and construction of the timber piers. These costs represent the estimated incremental costs; i.e., those costs over and above USACE's least cost and environmentally acceptable dredged material and disposal alternative. Table 5 shows a line-item list of each costing parameter and the total cost estimated for construction.

Table 5
Opinion of Probable Construction Cost to 100% Project Completion

Item	Quantity	Unit	Unit Price	Total
Pre-Construction Survey	1	LS	$ 30,000.00	$ 30,000.00
Incremental Dredging Cost (3-mile pipeline)[1]	470,000	cy	$ 15.00	$ 7,100,000.00
Excavator Fill Maintenance	7,000	lf	$ 100.00	$ 700,000.00
Articulated Concrete Block Mattress[1]	510,000	sf	$ 5.15	$ 2,600,000.00
Timber Pier Materials and Construction	1,000	lf	$ 600.00	$ 600,000.00
Hydroseeding[2]	140,000	sf	$ 0.20	$ 30,000.00
Post-Construction Survey (topography/ bathymetry)	1	LS	$ 30,000.00	$ 30,000.00
Post-Construction Survey (aerials)	1	LS	$ 10,000.00	$ 10,000.00
Navigational Aids[2]	14	Each	$ 4,000.00	$ 60,000.00
Subtotal[1]			**Sum**	**$ 11,200,000.00**
Incremental Mobilization	1	5%	$ 560,000.00	$ 560,000.00
Construction Total			**Sum**	**$ 11,800,000.00**
100% Engineering and Design[1]	1	10%	$ 1,200,000.00	$ 1,200,000.00
Permitting	1	Each	$ 100,000.00	$ 100,000.00
Construction Management[1]	1	8%	$ 900,000.00	$ 900,000.00
Post-Construction Management	24	Month	$ 10,000.00	$ 240,000.00
Project Subtotal[1]			**Sum**	**$ 14,200,000.00**
-30% Contingency[1]	1	30%	$ 4,300,000.00	$ 4,300,000.00
+50% Contingency[1]	1	50%	$ 7,100,000.00	$ 7,100,000.00
Low-End Project Estimated Cost[1]			**Total Sum**	**$ 9,900,000.00**
High-End Total Project Estimated Cost[1]			**Total Sum**	**$ 21,300,000.00**

Notes:
Costs were determined based upon publicly available datasets; no field work was conducted for this phase of the project.
1. Rounded to the nearest $100,000.
2. Rounded to the nearest $10,000.

lf: linear foot
LS: lump sum
sf: square foot

The costs vary from $9.9 million to $21.3 million, depending on the level of contingency allocated to the project cost. At this stage of design, a conservative level of armoring is proposed, and cost savings may be realized during subsequent phases of design by reducing the size of the armoring and containment levees based on the analysis and modeling of expected wind and wave conditions.

The estimates are developed using current and generally accepted engineering cost estimating methods and are based on assumptions concerning future events. Actual costs may be affected by known and unknown risks including, but not limited to, changes in general economic business conditions, Site conditions that were unknown at the time the estimates were performed, future changes in Site conditions, regulatory or enforcement policy changes, and delays in performance. Actual costs may vary from these estimates.

Ecosystem Benefits Expected

Creation of the Site is expected to have positive benefits on the regional ecosystem. The marsh restoration is expected to add 25 acres of low and high marsh habitat, bird roosting areas, and non-tidal ponds to the regional ecosystem. The armored island created at the Site will also provide resiliency to the adjacent shoreline. Stone used to build the breakwater could also be colonized by oysters, which have been identified within 500 feet of the Site (GLO 2021).

Future Work

Of the sites selected for 10% designs in this project, at least eight will be selected for 30% designs, and at least five of those will subsequently be selected for 60% designs and cost estimates. No fatal flaws have been identified in this 10% design effort. Should this Site be selected for additional design efforts, it can be expected that some aspects of the design in this memorandum will be modified and, as appropriate, improved. As previously mentioned, it is possible that in each phase additional designs will be provided toward this project because of the partnership on this project between DU and PCCA.

References

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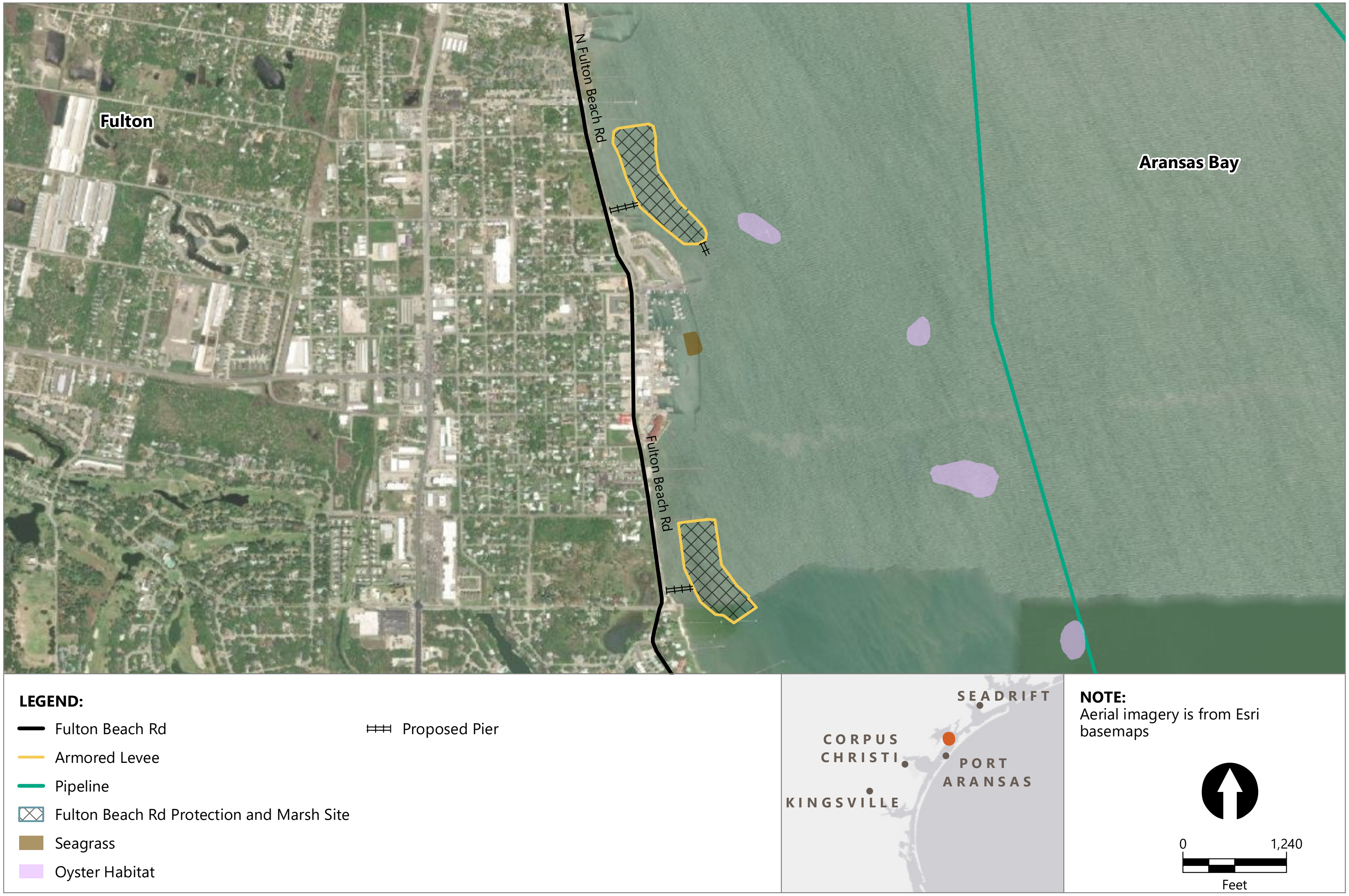
Figures



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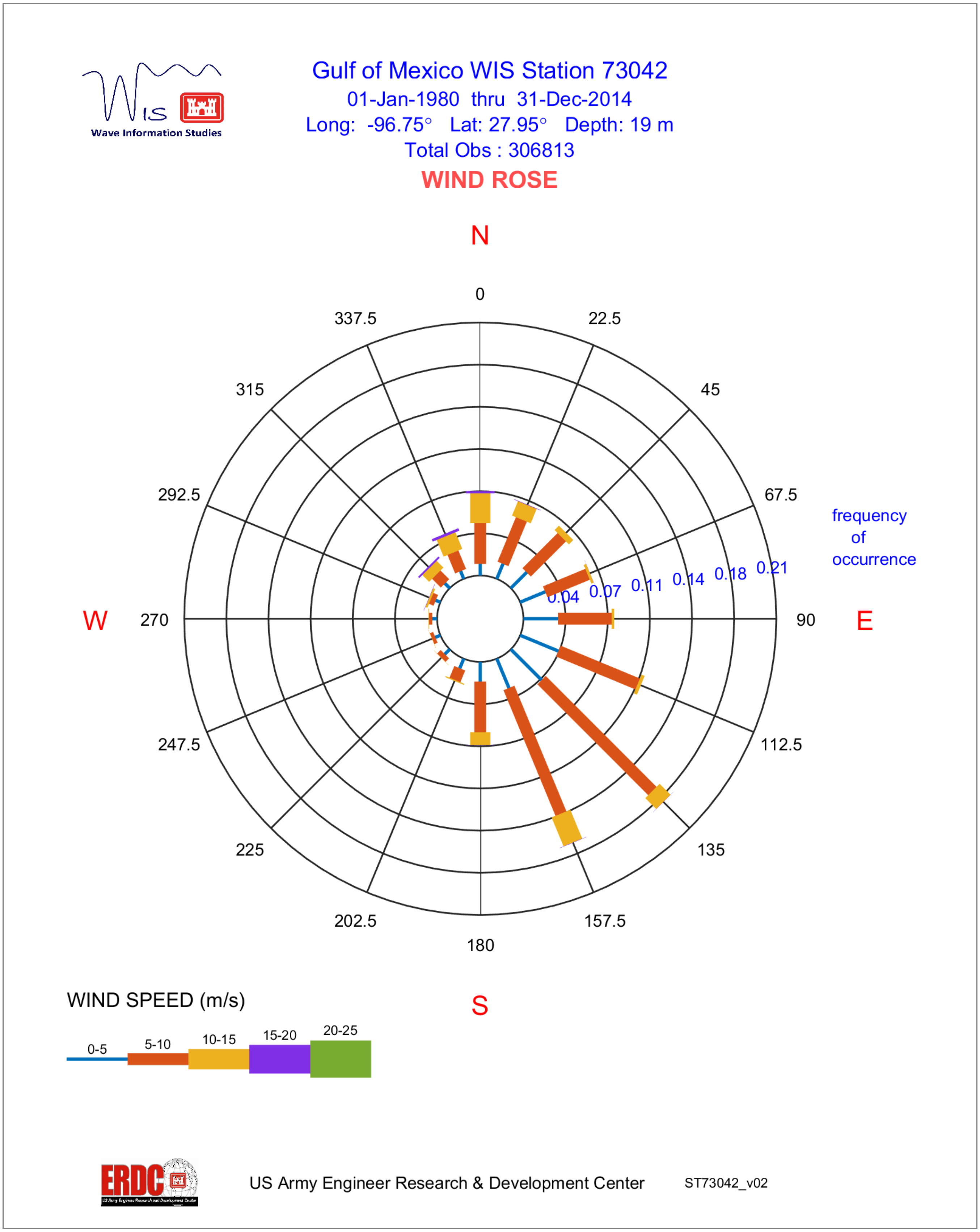
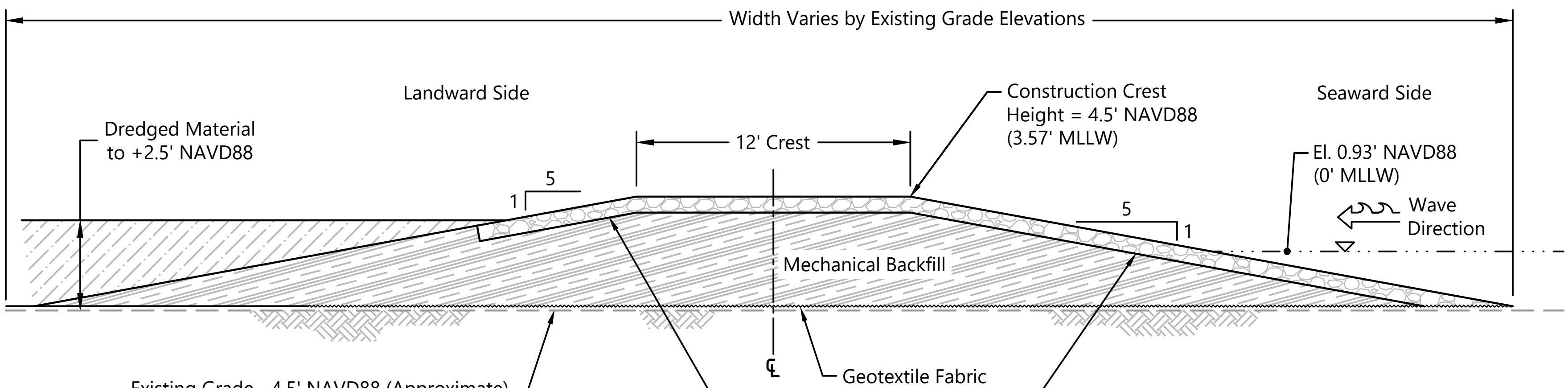
ANCHOR QEA

Figure 1
Fulton Beach Rd Protection and Marsh Plan View
Fulton Beach Rd Protection and Marsh 10% Design Memorandum
Texas Lower Coast Beneficial Use



ANCHOR QEA

Figure 2
Historical Wind Data for USACE WIS Station 73042
Fulton Beach Rd Protection and Marsh 10% Design Memorandum
Texas Lower Coast Beneficial Use



Section A-A' Typical Levee
Not to Scale

VERTICAL DATUM: North American Vertical Datum of 1988 (NAVD88)

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Filepath: K:\Projects\1942-Ducks Unlimited\Little Bird Island\Little Bird Island North 10% Design\1942-RP-006 FULTON BEACH.dwg Figure 3

ANCHOR QEA

Figure 3
Section A-A' Typical Levee

Fulton Beach Rd Protection and Marsh 10% Design Memorandum
Texas Lower Coast Beneficial Use

Memorandum

January 31, 2022

To: Melissa McCutcheon, Texas General Land Office

From: Todd Merendino, Ducks Unlimited, Inc.
Sarah Garza, Harrison McNeil, and Yvonne Dives-Gomez, Port of Corpus Christi Authority
John Laplante, Dan Opdyke, Ray Newby, Adrienne Accardi, Alexander Freddo, and Hayden Smith, Anchor QEA, LLC
Jane Sarosdy, Sarosdy Consulting, Inc.

Re: Key Allegro Island 10% Design Memorandum

Introduction

This 10% design memorandum describes design criteria and assessments associated with the proposed Key Allegro Island site (Site), located in Texas General Land Office (GLO) Planning Region 3 of the Texas coast in Aransas Bay in Aransas County, Texas (Figure 1).

Project Background

GLO awarded a Coastal Management Program Project of Special Merit grant (funded through the Gulf of Mexico Energy Security Act) to Ducks Unlimited, Inc. (DU), to identify priority locations and develop 10% designs and opinions of probable construction costs for at least 16 sites in GLO Planning Regions 3 and 4 of the Texas coast for the beneficial use of dredged material (BU). The project team is led by DU and Port of Corpus Christi Authority (PCCA) and includes Anchor QEA, LLC; Sarosdy Consulting, Inc.; and the Texas Department of Transportation. In addition to the 16 sites identified and prioritized, PCCA will provide additional resources to bring forward more site designs for review if the site prioritization and selection so warrants. The project team coordinated two online stakeholder meetings in each region to receive information about potential BU sites. Based on stakeholder input, GLO feedback, publicly available data, and professional judgment, the project team selected the Site as one of the 16 sites for 10% design development and cost estimation.

The Site is approximately 0.1 mile east of Key Allegro and 1 mile west of the Gulf Intracoastal Waterway (GIWW) in Aransas Bay in Aransas County, Texas. Stakeholders have identified a need for a placement location of the sediment located in the Key Allegro canal community. This material has historically been used for nourishment of Rockport Beach; however, Hurricane Harvey caused debris from the community to be deposited into the sediments of the canals, making it unsuitable material for beach placement. The Site was selected as an advantageous location for restoration due to the source of and need for placing debris-laden sediments (following removal of debris) from within the Key Allegro community canals. This Site is also relatively close to the GIWW, which could serve as another source of dredged material. Finally, the site is surrounded by naturally shallow mounds, which provide existing foundations that will require less sediment for construction.

Project Objectives

Frequent dredging is needed to develop and maintain Texas ship channels. The dredged material must be deposited in dredged material placement areas (DMPAs), and many of the existing DMPAs along the Texas coast are nearing capacity. Resource agencies and stakeholders have long advocated using dredged material beneficially to create and restore wetlands and bird islands, nourish beaches, and counteract land loss. Historically, BU projects are difficult to manage because they are multi-year, multi-faceted undertakings in which different organizations manage dredging schedules, funding, project design, permitting, and construction activities. To help address these issues, the objectives of this project include the following:

- Create and restore degrading coastal habitats.
- Establish sites for placement of dredged material to reduce reliance on existing DMPAs.
- Improve coastal resiliency of the natural and built environment.
- Reduce shoaling in the GIWW and other ship channels.

To accomplish these objectives, the project includes the following tasks:

- Stakeholder outreach and coordination
- Identification and selection of BU sites
- 10% designs and cost estimates for at least 16 BU sites
- 30% designs for at least eight BU sites
- 60% designs, cost estimates, and permit application packages for at least five BU sites

This memorandum documents the 10% design and cost estimate for one of the selected sites.

Design Objectives

This Site will be designed to beneficially use dredged material to create marsh habitat in a region with available sources of dredged material. The Site may use material dredged from the Key Allegro community canals, thus reducing the need for disposal of such material, e.g., in regional landfills. Also, the Site may use material dredged from navigation channels during routine maintenance, thus reducing the volume of such material that will need to be placed in existing open-bay DMPAs. This 10% design is based upon publicly available datasets; no field work was conducted for this phase of the project.

Design objectives include the following:

- Develop a preliminary vision based on available data for the Site that includes the following:
  - Habitat to be created or restored
  - Potential sediment source(s)
  - Approaches to minimize long-term maintenance costs
- Delineate conceptual footprints for proposed BU placement.
- Identify key sensitive habitats and construction considerations in the vicinity of the Site.
- Estimate fill volumes for the proposed BU footprints.
- Identify data gaps to be addressed in subsequent design stages.
- Provide preliminary cost estimates.

Existing Data Review

Horizontal and Vertical Datums

The horizontal datum used for the Site is the Texas State Plane Zone 4, North American Datum of 1983 (NAD83), in U.S. survey feet. The primary vertical datum used for the Site is the North American Vertical Datum of 1988 (NAVD88). The National Oceanic and Atmospheric Administration (NOAA) maintains an active tide gauge within the vicinity of the Site. The NOAA Rockport, TX Station 8774770 is 1.8 miles southwest of the proposed project. This station collects and records real-time tide information dating back to 1948. The vertical datums from this station that will be used for the Site are shown in Table 1.

Table 1
NOAA Rockport, TX Station 8774770 Tidal Gauge Displaying NAVD88 Tidal Datums

Tidal Datums	Elevation (feet NAVD88)
MHHW	1.30
MHW	1.29
MSL	1.12
MLW	0.94
MLLW	0.93

Notes:
MHHW: mean higher high water
MHW: mean high water
MLLW: mean lower low water
MLW: mean low water
MSL: mean sea level

Meteorological, Ocean, and Wave Data

Wind and Waves

The United States Army Corps of Engineers (USACE) Wave Information Studies (WIS) provides a national resource of long-term wavefield climatologies for U.S. coastal waters that synthesizes observations, multi-decade hindcasts, and storm event archives (USACE 2021). The WIS station closest to the Site is Station 73042, just offshore on the Gulf side of Matagorda Island in the Gulf of Mexico. Because the station is located offshore, the wave data are not applicable to this project design. However, the project team considers the wind data to be representative of the winds experienced at the Site. Figure 2 summarizes wind data from January 1, 1980 through December 31, 2014. The data indicate that the predominant wind direction is from the southeast, with significant winds also coming from the north, northeast, east, and south.

There is a 4-mile fetch between the Site and Matagorda Island, the closest land mass in the predominant southeast wind direction. The proposed breakwater is expected to limit erosion due to wind waves. Due to the fetch and surrounding water depths, the Site is anticipated to be in a high wave-energy environment. A wave analysis of the direction and frequency of expected significant wave heights will be conducted in subsequent phases of design.

Wake Erosion

The GIWW is approximately 1 mile west of the Site, and the Key Allegro community canals are approximately 0.1 mile west of the Site. The GIWW is far enough that significant wake erosion is not expected. Potential wake erosion from recreational vessels from Key Allegro is expected to be a design consideration. An analysis of the erosive effects of vessel traffic will be conducted during subsequent stages of design to better understand the extend of vessel induced erosion on the Site. An analysis of the erosive effects of vessel traffic will be conducted during subsequent stages of design to better understand the extent of vessel-induced erosion on the Site.

Bathymetry

The NOAA National Centers for Environmental Information continuously updated digital elevation model for the Texas Coast (NOAA 2021) was used to obtain bathymetry data for the Site. The Site has a seabed elevation that averages -4.5 feet NAVD88.

Utilities and Infrastructure

The Railroad Commission of Texas public GIS viewer (RRC 2021) was used to identify utilities and pipelines near the Site. No utilities or pipelines were found within the footprint of the Site, although there is a Lamar Oil & Gas, Inc. natural gas full well stream pipeline 0.25 mile east of the Site. It is not expected that this pipeline will have design or construction implications. The need for Site-specific utility locations prior to construction will be determined during subsequent design stages. No other infrastructure has been identified in the vicinity of the project Site.

Desktop Cultural Resources Survey

A search of cultural resources records in the Texas Historical Commission Atlas Database was completed for the Site between November 29 and December 30, 2021. This search revealed that one archaeological survey has been conducted in part of the proposed placement site area. No archaeological sites have been identified within the preliminary proposed placement site boundary (THC 2021).

Sensitive Habitat

GLO oyster habitat GIS data (GLO 2021) indicate that there is no oyster habitat identified within or adjacent to the Site. According to Texas Parks and Wildlife Department (TPWD) seagrass data (TPWD 2021), there are seagrasses mapped 300 feet west of the Site. Because the sensitive habitat data are not recent, surveys will likely need to be conducted during a subsequent phase of design to evaluate the presence and extents of sensitive habitat to confirm or update the understanding of sensitive habitat in the vicinity of the Site.

Beneficial Use Source Material

Potential sources of dredged material include the GIWW and Key Allegro community canals, located near the Site. The Coastal Consistency Determinations from USACE indicate maintenance dredging on the GIWW near the Site (USACE 1999). Continued dredging has recently been confirmed by USACE (Jones 2021). The identified DMPAs used by USACE near the Site and their associated historical average annual quantity of dredged material, distance from the Site, and channel segments are shown in Table 2. The average grain size and grain type percentages are shown in Table 3. This informs the quantity and characteristics of dredged material that may be available during a dredging cycle.

Table 2
USACE DMPA Areas Adjacent to the Site

DMPA No.	Channel Segment (Station)	Distance from Site (miles)	Average Annual Dredging Quantity (cy)
138	883+000-891+000	1.6	125,624
139	891+000-895+000	1.9	77,088
140	895+000-902+000	2.5	88,051
141	890+000-906+000	2.8	165,185

Notes:
Source: USACE 1999
cy: cubic yard

Table 3
Typical Sediment Characteristics Across Aransas Bay – Western Job

Sediment Characteristics
D_{50} (mm) < 0.028
15.7% sand
56.8% silt
27.5% clay

Notes:
Channel Segment: (860+000-900+000)
Source: USACE 1999
D_{50}: median grain size
mm: millimeter

In 2019, Belaire Environmental, Inc., surveyed the Key Allegro canal system. The survey showed that there were approximately 50,000 cubic yards (cy) that needed to be dredged from the canals (Rudellat 2021).

Additional information will need to be collected during a subsequent phase of design to further evaluate the sediment characteristics. Due to the proximity of the Site to these sediment sources, this Site should allow for lower construction costs compared to more remote potential marsh restoration sites.

Marsh Vegetation Elevation Ranges

Typical habitat ranges for relevant marsh vegetation were determined based on site vegetation surveys conducted by DU at the Lower Neches Wildlife Management Area Old River Unit, Texas Point

National Wildlife Refuge (NWR), McFaddin NWR Willow Lake Terraces, Anahuac NWR Roberts Mueller Tract, Schicke Point, Guadalupe River Old Delta, and Goose Island State Park Cells sites located in GLO Planning Regions 1 and 2 of the Texas coast. This is shown in Table 4.

Table 4
Typical Elevations for Target Marsh Vegetation

Species	Elevation (feet MSL)	Elevation (feet NAVD88)
Spartina patens	0.25 to 1	1.37 to 2.12
Spartina alterniflora	0 to 0.75	1.12 to 1.87

10% Design

The main design features that are critical for marsh island success are as follows:

- Site location
- Marsh size and shape
- Containment and erosion protection
- Planting and natural recruitment of vegetation

These design features are evaluated in this memorandum for the preliminary Site design.

Site Location

The proposed location of the Site is approximately 0.1 mile east of Key Allegro and 1 mile west of the GIWW (Figure 1).

The average bed elevation within the footprint of the Site is -4.5 feet NAVD88 (-5.4 feet mean lower low water). Water depths of greater than 5 feet surround the Site, providing favorable conditions for construction access. Bathymetric surveys will need to be conducted during subsequent design phases to better define Site dimensions and material quantity needs.

Size and Shape

Based on availability of sediment, a cost analysis, and stakeholder feedback, the project team proposes that the area of the Site be 17 acres. Due to expected mounding of the placed material, the Site will be created with dredged material placed to an elevation of +2.5 feet NAVD88, which will be at the upper end of the suitable habitat range for *Spartina patens* and *Spartina alterniflora*. The Site will be two circular fill areas armored with a single curved breakwater (Figure 1). In the north and south fill areas, there will be an opening to the Site that will allow for a natural angle of repose of the dredged material from +2.5 feet NAVD88 to the average bay bottom elevation of -4.5 feet NAVD88.

The open ends will allow ingress and egress of organisms to the Site. This shape of fill was selected to promote natural recruitment of vegetation at varied elevations. The elevation of dredged material fill could be adjusted at further stages of design depending on the physical properties of the dredged material or if other target species and their specific requirements are identified.

The seagrass data from TPWD show that there may be sensitive seagrass habitat 300 feet west of the Site; however, the data are not recent. The location of seagrasses will need to be determined through field surveys during subsequent stages of design. The footprint may change depending on the results of field surveys. It is expected that environmental controls such as turbidity curtains and temporary containment of material will be needed during construction to contain fines placed at the Site.

Fill material could be obtained from the GIWW or the Key Allegro canal system, as described in Table 2 It is predicted that the required fill volume will be approximately 240,000 cy, with approximately 65,000 cy being settled volume. This value assumes 1 foot of foundation compression for every 3 feet of fill and does not consider bulking. Geotechnical data will likely need to be collected during a subsequent design phase to further evaluate the expected foundation compression and the expected bulking of dredged material.

The Site can accept more volume than the estimated 50,000 cy that needs to be removed from the Key Allegro canal system and more than any of the individual DMPA annual estimated quantities shown in Table 2. It is anticipated that the Site will be filled over several dredging events, including potentially maintenance dredging events in the Key Allegro canal system. A plan for filling the Site over several dredging events will be evaluated during subsequent design phases once the total quantity of dredged material is determined.

If dredged material from the Key Allegro canal system is placed at the Site, debris will need to be removed from the sediment or, alternatively, it is possible that the dredged material could be placed and then capped by clean dredged material. These alternatives will need to be evaluated during subsequent design phases if material from the Key Allegro canal system is expected to be placed within the Site. Costs developed for this stage of design do not include special measures that may be needed to manage debris from the Key Allegro canal system.

Containment and Erosion Protection

Based on the fetch in the predominant southeast wind direction and potential risk of wake erosion, the project team proposes containment and armoring for the Site consisting of a breakwater that will mitigate erosion to the marsh and contain the dredged material. The breakwater will be composed of armor stone constructed on an existing -5-foot-NAVD88 grade. The breakwater will contain a 5-horizontal-to-1-vertical (5H:1V) seaward side slope and a 3H:1V landward side slope connected by a 10-foot-wide crest. The construction height of the crest will be +4.3 feet NAVD88. The exact width will be dependent on the existing grade, but assuming 5 feet NAVD88, the breakwater base width will be

84 feet. Figure 3 depicts a typical cross section of the breakwater. The size of the armor stone and final cross-sectional dimensions of the breakwater will need to be determined and refined, respectively, through modeling and analysis during a subsequent phase of design.

The breakwater will be constructed before the dredged material is pumped to the Site. As shown in Figure 3, the fill material will be directly contained by the breakwater. Confining the dredged slurry within the breakwater will reduce potential impacts to adjacent seagrass habitat. Water depths surrounding the Site (greater than 5 feet) are expected to provide favorable conditions for construction. The breakwater is proposed to surround most of the Site with an approximately 500-foot-wide opening to the west and an approximately 300-foot-wide opening to the east to allow aquatic organism and wildlife access into the Site, as shown in Figure 1. With Key Allegro approximately 0.1 mile to the west of the Site, a smaller opening on the east side of the Site, and the predominantly southeast wind direction, it is expected that the openings will have adequate protection from wind and wave impacts.

Planting and Natural Recruitment

Based on stakeholder input and cost considerations, the project team determined that hydroseeding the edges of the marsh will be the most effective method for vegetating the marsh. Natural recruitment will then be allowed to proceed from the edge of the marsh inward. If the outcome is unsatisfactory (e.g., if the marsh has a lower-than-expected density of vegetation or if undesirable species of vegetation are present), an adaptive management program can be instituted to modify the vegetation. Table 4 shows some of the targeted vegetation and their preferred habitat elevations.

Site Construction Cost Estimates

Construction costs were estimated for the design outlined in the previous sections. The estimated costs include permitting, 100% design, engineering costs for advancing the design to the construction phase, pre-construction and as-built surveys, mobilization, materials, hydroseeding, and construction of the breakwater. These costs represent the estimated incremental costs; i.e., those costs over and above USACE’s least cost and environmentally acceptable dredged material and disposal alternative. Table 5 shows a line-item list of each costing parameter and the total cost estimated for construction.

Table 5
Opinion of Probable Construction Cost to 100% Project Completion

Item	Quantity	Unit	Unit Price	Total
Pre-Construction Survey	1	LS	$ 30,000.00	$ 30,000.00
Geotextile Fabric[1]	33,000	sy	$ 15.00	$ 500,000.00
Stone (bedding and armoring)	92,000	cy	$ 200.00	$ 18,400,000.00
Incremental Dredging Cost (1-mile pipeline)[2]	240,288	cy	$ 5.00	$ 1,200,000.00
Hydroseeding[1]	90,000	sf	$ 0.20	$ 20,000.00
Post-Construction Survey (topography/ bathymetry)	1	LS	$ 30,000.00	$ 30,000.00
Post-Construction Survey (aerials)	1	LS	$ 10,000.00	$ 10,000.00
Navigational Aids	10	Each	$ 4,000.00	$ 40,000.00
Subtotal[2]			**Sum**	$ 20,200,000.00
Incremental Mobilization[2]	1	5%	$ 1,000,000.00	$ 1,000,000.00
Construction Total[2]			**Sum**	**$ 21,200,000.00**
100% Engineering and Design[2]	1	10%	$ 2,100,000.00	$ 2,100,000.00
Permitting	1	Each	$ 100,000.00	$ 100,000.00
Construction Management[2]	1	8%	$ 1,700,000.00	$ 1,700,000.00
Post-Construction Management	12	Month	$ 10,000.00	$ 120,000.00
Project Subtotal[2]			**Sum**	**$ 25,200,000.00**
-30% Contingency[2]	1	30%	$ 7,600,000.00	$ 7,600,000.00
+50% Contingency[2]	1	50%	$ 12,600,000.00	$ 12,600,000.00
Low-End Total Project Estimated Cost[2]			**Total Sum**	**$ 17,600,000.00**
High-End Total Project Estimated Cost[2]			**Total Sum**	**$ 37,800,000.00**

Notes:
Costs were determined based upon publicly available datasets; no field work was conducted for this phase of the project.

1. Rounded to the nearest $10,000.
2. Rounded to the nearest $100,000.

LS: lump sum
sf: square foot
sy: square yard

The costs vary from $17.6 million to $37.8 million, depending on the level of contingency allocated to the project cost. Cost savings may be realized by further analysis and modeling of wind and wave conditions during subsequent design phases and refining the level of armoring. This cost estimate may increase if material from the Key Allegro canals is used because this estimate does not include costs for removing debris.

This 10% design includes more capacity for dredged material than what was identified by the Key Allegro community. This decision was made to lengthen the life of the restoration project by having capacity for multiple dredging events from either or both of the GIWW or Key Allegro. Future cost constraints may limit the island size that is ultimately constructed, but at this level of design, it was decided to consider a larger Site constructed over several phases.

The estimates are developed using current and generally accepted engineering cost estimating methods and are based on assumptions concerning future events. Actual costs may be affected by known and unknown risks including, but not limited to, changes in general economic business conditions, Site conditions that were unknown at the time the estimates were performed, future changes in Site conditions, regulatory or enforcement policy changes, and delays in performance. Actual costs may vary from these estimates.

Ecosystem Benefits Expected

Creation of the Site is expected to have positive benefits on the regional ecosystem. The marsh restoration is expected to add 17 acres of marsh habitat to the regional ecosystem. The armored island created at the Site will also provide resiliency to the Key Allegro coastal community. Stone used to build the breakwater could also be colonized by oysters which have been identified within 1 mile of the Site (GLO 2021).

Future Work

Of the sites selected for 10% designs in this project, at least eight will be selected for 30% designs, and at least five of those will subsequently be selected for 60% designs and cost estimates. No fatal flaws have been identified in this 10% design effort. Should this Site be selected for additional design efforts, it can be expected that some aspects of the design in this memorandum will be modified and, as appropriate, improved. As previously mentioned, it is possible that in each phase additional designs will be provided toward this project because of the partnership on this project between DU and PCCA.

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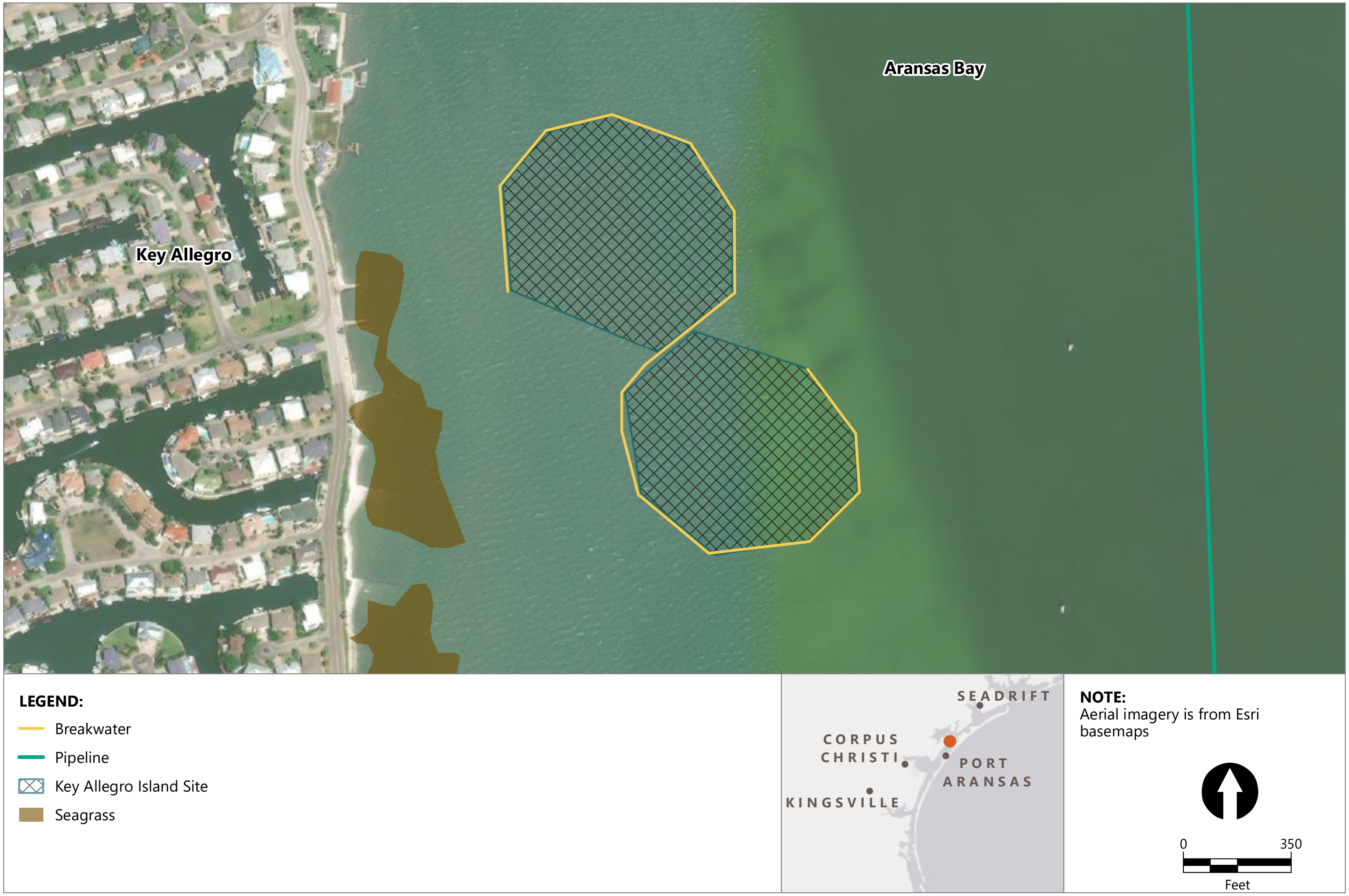
Figures



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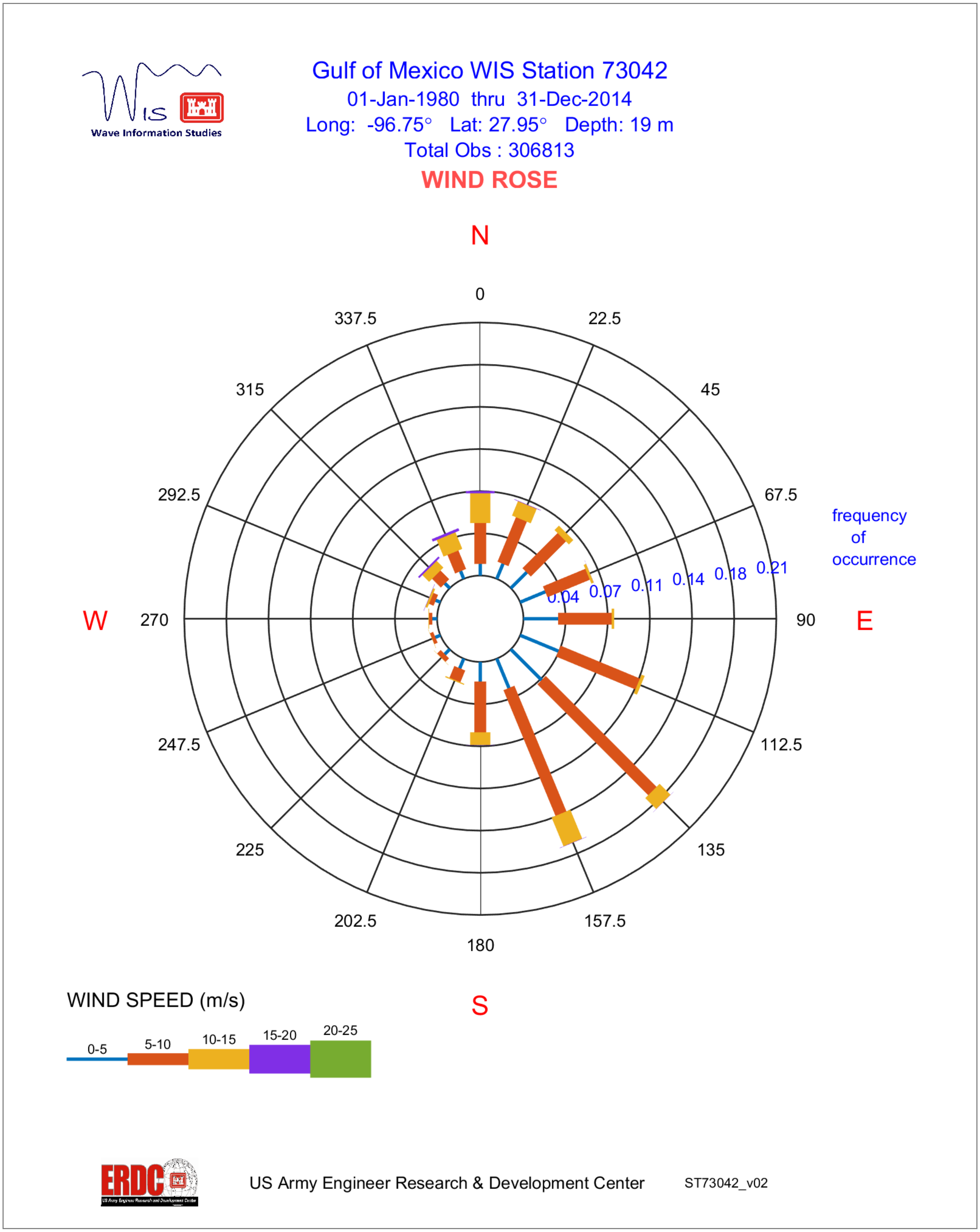
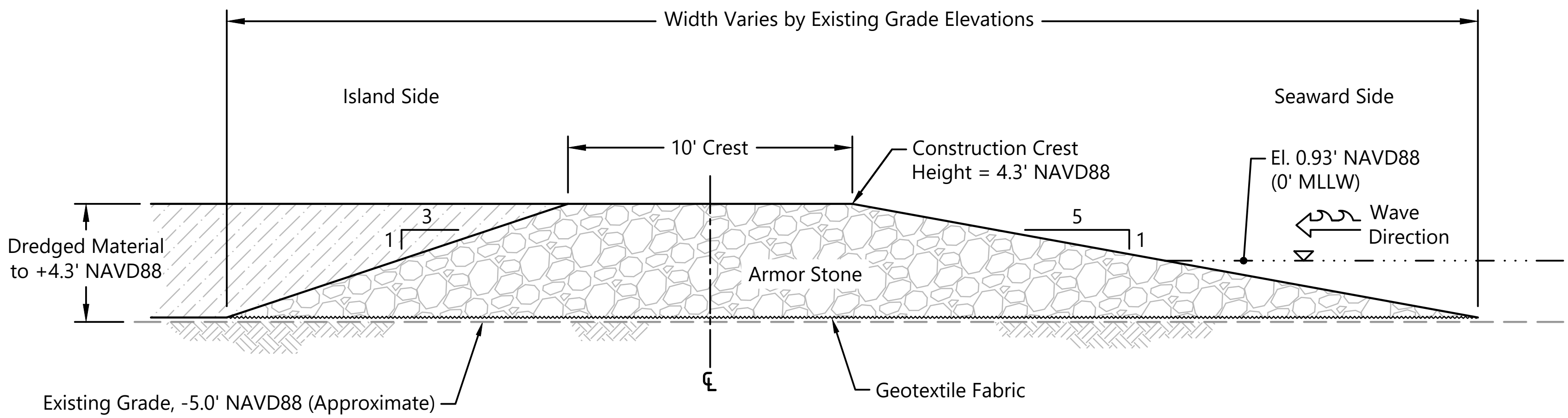
ANCHOR QEA

Figure 1
Key Allegro Island Plan View
Key Allegro Island 10% Design Memorandum
Texas Lower Coast Beneficial Use



Filepath: \\Fuji\Austin\D_drive\Projects\GLO\BU Lower Coast\Documents_Team\10pct Design Memos\Key Allegro Island\Figures\Figure 2_Key Allegro Island.docx

Figure 2
Historical Wind Data for USACE WIS Station 73042



Section A-A' Typical Breakwater
Not to Scale

VERTICAL DATUM: North American Vertical Datum of 1988 (NAVD88)

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Filepath: K:\Projects\1942-Ducks Unlimited\Little Bird Island\Little Bird Island North 10% Design\1942-RP-001b KEY ALLEGRO.dwg Figure 3

ANCHOR QEA

Figure 3
Section A-A' Typical Breakwater

Key Allegro Island 10% Design Memorandum
Texas Lower Coast Beneficial Use

Memorandum

January 31, 2022

To: Melissa McCutcheon, Texas General Land Office

From: Todd Merendino, Ducks Unlimited, Inc.
Sarah Garza, Harrison McNeil, and Yvonne Dives-Gomez, Port of Corpus Christi Authority
John Laplante, Dan Opdyke, Ray Newby, Adrienne Accardi, Alexander Freddo, and Hayden Smith, Anchor QEA, LLC
Jane Sarosdy, Sarosdy Consulting, Inc.

Re: Little Bird Island North 10% Design Memorandum

Introduction

This 10% design memorandum describes design criteria and assessments associated with the proposed Little Bird Island North site (Site), located in Texas General Land Office (GLO) Planning Region 2 of the Texas coast in San Antonio Bay in Calhoun County, Texas (Figure 1).

Project Background

GLO awarded a Coastal Management Program Project of Special Merit grant (funded through the Gulf of Mexico Energy Security Act) to Ducks Unlimited, Inc. (DU), to identify priority locations and develop 10% designs and opinions of probable construction costs for at least 16 sites in GLO Planning Regions 3 and 4 of the Texas coast for the beneficial use of dredged material (BU). Additionally, GLO approved potential inclusion of sites in San Antonio Bay, which is split by Region 2 and Region 3. The project team is led by DU and Port of Corpus Christi Authority (PCCA) and includes Anchor QEA, LLC; Sarosdy Consulting, Inc.; and the Texas Department of Transportation. In addition to the 16 sites identified and prioritized, PCCA will provide additional resources to bring forward more site designs for review if the site prioritization and selection so warrants. The project team coordinated two online stakeholder meetings to receive information about potential BU sites. Based on stakeholder input, GLO feedback, publicly available data, and professional judgment, the project team selected the Site as one of the 16 sites for 10% design development and cost estimation.

Conservationists have identified San Antonio Bay as an important location for creating and restoring bird habitat (CBBEP 2020; Hardegree 2014). Little Bird Island is a small island located on state-owned submerged land approximately 0.25 mile south of the Gulf Intercoastal Waterway (GIWW) in

San Antonio Bay in Calhoun County, Texas. However, the existing Little Bird Island is surrounded by oyster habitat and has limited natural protection from wave energy, making it an unfavorable location for restoration; therefore, the project team identified a different area for a new bird island nearby, but to the north of the GIWW (Little Bird Island North). This area was selected because of its proximity to a sediment source in the GIWW and to potential bird foraging areas, as well as its distance from upland-based predators and lack of immediately adjacent oyster habitat.

Project Objectives

Frequent dredging is needed to develop and maintain Texas ship channels. The dredged material must be deposited in dredged material placement areas (DMPAs), and many of the existing DMPAs along the Texas coast are nearing capacity. Resource agencies and stakeholders have long advocated using dredged material beneficially to create and restore wetlands and bird islands, nourish beaches, and counteract land loss. Historically, BU projects are difficult to manage because they are multi-year, multi-faceted undertakings in which different organizations manage dredging schedules, funding, project design, permitting, and construction activities. To help address these issues, the objectives of this project include the following:

- Create and restore degrading coastal habitats.
- Establish sites for disposal of dredged material to reduce reliance on existing DMPAs.
- Improve coastal resiliency of the natural and built environment.
- Reduce shoaling in the GIWW and other ship channels.

To accomplish these objectives, the project includes the following tasks:

- Stakeholder outreach and coordination
- Identification and selection of BU sites
- 10% designs and cost estimates for at least 16 BU sites
- 30% designs for at least eight BU sites
- 60% designs, cost estimates, and permit application packages for at least five BU sites

This memorandum documents the 10% design and cost estimate for one of the selected sites.

Design Objectives

This Site will be designed to beneficially use dredged material to create a rookery island in a region with degrading coastal bird habitat. The design will use material dredged from navigation channels during routine maintenance, thus reducing the volume of such material placed in existing open-bay or upland DMPAs. This 10% design is based upon publicly available datasets; no field work was conducted for this phase of the project.

Design objectives include the following:

- Develop a preliminary vision based on available data for the Site that includes the following:
  - Habitat to be created or restored
  - Potential sediment source(s)
  - Approaches to minimize long-term maintenance costs
- Delineate conceptual footprints for proposed BU placement.
- Identify key sensitive habitats and construction considerations in the vicinity of the Site.
- Estimate fill volumes for the proposed BU footprints.
- Identify data gaps to be addressed in subsequent design stages.
- Provide preliminary cost estimates.

Existing Data Review

Horizontal and Vertical Datums

The horizontal datum used for the Site is the Texas State Plane Zone 4, North American Datum of 1983 (NAD83), in U.S. survey feet. The primary vertical datum used for the Site is the North American Vertical Datum of 1988 (NAVD88). The National Oceanic and Atmospheric Administration (NOAA) maintains an active tide gauge within the vicinity of the Site. The NOAA Aransas Wildlife Refuge Station 8774230 is 8 miles southwest of the proposed island. This station collects and records real-time tide information dating back to 2012. The vertical datums from this station that will be used for the Site are shown in Table 1.

Table 1
NOAA Aransas Wildlife Refuge Station 8774230 Tidal Gauge Displaying NAVD88 Tidal Datums

Tidal Datums	Elevation (feet NAVD88)
MHHW	1.28
MHW	1.28
MSL	1.12
MLW	0.95
MLLW	0.95

Notes:
MHHW: mean higher high water
MHW: mean high water
MLLW: mean lower low water
MLW: mean low water
MSL: mean sea level

Meteorological, Ocean, and Wave Data

Wind and Waves

The United States Army Corps of Engineers (USACE) Wave Information Studies (WIS) provides a national resource of long-term wavefield climatologies for U.S. coastal waters that synthesizes observations, multi-decade hindcasts, and storm event archives (USACE 2021). The WIS station closest to the Site is Station 73046, just offshore on the Gulf side of Matagorda Island in the Gulf of Mexico. Because the station is located offshore, the wave data were not used. However, the project team considers the wind data to be representative of the winds experienced at the Site. Figure 2 summarizes wind data from January 1, 1980, through December 31, 2014. The data indicate that the predominant wind direction is from the southeast, with significant winds also coming from the north, northeast, east, and south.

There is a 5-mile fetch between Little Bird Island North and Matagorda Island, the closest land mass, in the predominant southeast wind direction. Due to the fetch, the Site is anticipated to be in a high wave-energy environment. A wave analysis of the direction and frequency of expected significant wave heights will be conducted in subsequent phases of design.

Wake Erosion

The GIWW is approximately 0.25 mile south of the Site. Potential wake erosion from vessels transiting the GIWW is expected to be a design consideration. However, the project team determined that wake erosion was not the driving erosive wave condition for this design because wakes are not expected to produce the same level of erosion risk as wind-generated waves. The proposed armoring will be designed to resist wind- and vessel-generated erosive forces, taking into account the Site's proximity to nearby shallow oyster reef habitat.

Bathymetry

The NOAA National Centers for Environmental Information continuously updated digital elevation model for the Texas Coast (NOAA 2021) was used to obtain bathymetry data for the Site. The Site has a relatively uniform depth that averages -3.5 feet NAVD88.

Utilities and Infrastructure

The Railroad Commission of Texas public GIS viewer (RRC 2021) was used to identify utilities and pipelines near the Site. One pipeline was found: a Houston Oil and Minerals Corporation natural gas pipeline located 1,200 feet southwest of the Site (Figure 1). It is not anticipated that this pipeline will affect the design or constructability of the Site. The need for Site-specific utility locations prior to construction will be determined during subsequent design stages. No other infrastructure has been identified in the vicinity of the project Site.

Desktop Cultural Resources Survey

A search of cultural resources records in the Texas Historical Commission Atlas Database was completed for the Site between November 29 and December 30, 2021. This search revealed that no archaeological surveys have been conducted and no archaeological sites have been identified within the preliminary proposed placement site boundary (THC 2021).

Sensitive Habitat

GLO oyster habitat GIS data (GLO 2021) indicates that oyster habitat is located approximately 100 to 500 feet southwest, west, northwest, north, and northeast of the Site. According to Texas Parks and Wildlife Department seagrass data (TPWD 2021), there are no seagrasses mapped within or adjacent to the Site location. Because the sensitive habitat data are not recent, surveys will likely need to be conducted during a subsequent phase of design to evaluate the presence and extents of sensitive habitat to confirm or update the understanding of sensitive habitat in the vicinity of the Site.

Bird Species

The U.S. Fish and Wildlife Service (USFWS) Information for Planning and Consultation (IPaC) tool was used to identify listed species and migratory birds within a 172-square-mile region around San Antonio Bay (USFWS 2021). Table 2 includes some of the protected and migratory bird species that are present near the Site and their preferred habitat as explained in Audubon's field guide (Audubon 2021a). At this time, no target species, or list of species, has been identified for the Site.

Table 2
USFWS IPaC Species Information

Species	Status	Preferred Habitat[1]
Whooping Crane (*Grus americana*)	Endangered	Prairie pools, marshes, and coastal marshes
Piping Plover (*Charadrius melodus*)	Threatened	Sand beach dunes and expansive sand or mudflats
Red Knot (*Calidris canutus*)	Threatened	Mudflats, tidal zones, and sandy beaches
American Oystercatcher (*Haematopus palliatus*)	Migratory	Strictly coastal; dunes, islands in salt marsh, dredge spoil islands, sandy beaches, and tidal mudflats
Black Skimmer (*Rynchops niger*)	Migratory	Sandy islands, shell beaches, open beaches, lagoons, estuaries, inlets, and sheltered bays
Brown Pelican (*Pelecanus occidentalis*)	Migratory	Bare, rocky, mangrove or tree-covered islands; salt bays, beaches, and oceans
Gull-Billed Tern (*Gelochelidon nilotica*)	Migratory	Beaches, islands, salt marshes, fields, and coastal bays
Marbled Godwit	Migratory	Northern Great Plains, native prairie with marshes or ponds,

Species	Status	Preferred Habitat[1]
(*Limosa fedoa*)		pools, shores, marshes, and tidal flats
Reddish Egret (*Egretta rufescens*)	Migratory	Red mangrove swamps, arid coastal islands covered with thorny brush, coastal tidal flats, salt marshes, and lagoons
Ring-Billed Gull (*Larus delawarensis*)	Migratory	On ground near water with sparse plant growth, lakes, bays, coasts, piers, dumps, and plowed fields
Royal Tern (*Thalasseus maximus*)	Migratory	Low-lying sandy islands, coasts, lagoons, salt bays, and estuaries
Wilson's Plover (*Charadrius wilsonia*)	Migratory	Dry part of beach, near conspicuous object, coastal regions, open beaches, tidal flats, estuaries, and sandy islands

Notes:

1. Habitat information is from the Audubon field guide (Audubon 2021a) and includes preferred nesting and general habitat.

USFWS IPaC information (USFWS 2021) is provided for a 172-square-mile region around San Antonio Bay highlighting endangered, threatened, and migratory birds and their preferred habitat.

Erosion

Data from 1982 to 2013 (Paine et al. 2016) indicate that the San Antonio Bay shoreline near the Site has been an erosional environment with some areas experiencing greater than 1 meter of erosion per year.

Beneficial Use Source Material

One potential source of dredged material is the GIWW, located adjacent to the Site. Based on Coastal Consistency Determinations from USACE, USACE has historically performed maintenance dredging on the GIWW near the Site (USACE 1999). Continued dredging has recently been confirmed by USACE (Jones 2021). The identified DMPAs used by USACE adjacent to the Site and their associated historical average annual quantity of dredged material, distance from the Site, and channel segments are shown in Table 3. The average grain size and grain type percentages are shown in Table 4. This informs the quantity and characteristics of dredged material that may be available during a dredging cycle. For example, the Site will be designed such that the clay, which constitutes a relatively high percentage of nearby sediment, will be sheltered from erosive forces.

Table 3
USACE DMPA Areas Adjacent to the Site

DMPA No.	GIWW Channel Station	Distance from Site (miles)	Average Annual Dredging Quantity (cy)
121A	715+000 to 730+000	1.5	117,587
122	730+000 to 740+000	0.1	178,917
123	740+000 to 750+000	2	171,561
124	750+000 to 760+000	3.5	153,899
125	760+000 to 770+000	5	173,696

Notes:
Source: USACE 1999.
cy: cubic yard

Table 4
Typical Sediment Characteristics Across GIWW in San Antonio Bay

Sediment Characteristics
D_{50} (mm) < 0.016
14.3% sand
35.7% silt
50.0% clay

Notes:
Source: USACE 1999
D_{50}: median grain size
mm: millimeter

The Site is also approximately 1 mile from the intersection with the Channel to Victoria, and dredged material from that channel could also be used. Further information will need to be collected to determine average annual quantities for dredged material from this source, should the GIWW not be suitable. Due to the proximity of the Site to these sediment sources, this Site should allow for lower construction costs compared to more remote potential bird island sites.

10% Design

The main design features that are critical for rookery island success are as follows:

- Site location
- Island size and shape

- Containment and erosion protection
- Planting and natural recruitment of vegetation

These design features are evaluated in this memorandum for the preliminary Site design.

Site Location

The proposed location of the Site is approximately 0.7 mile northeast of the existing Little Bird Island and is located between oyster habitat and USACE DMPA #122 to avoid encroaching on those areas. Because the Site is in the vicinity of oysters to the north, west, and east, it is likely that oysters will colonize the planned rock breakwater, thereby providing additional ecological benefits. In addition, the shallow depths and the surrounding oyster reefs will shelter the Site from erosive forces.

Locating the Site 0.25 mile northwest of the GIWW (see Figure 1) is advantageous because the prevailing southeast winds will transport sediment eroded from the island away from the GIWW. In addition, the proposed Site is approximately 1.75 miles from the nearest shoreline. This distance is well above the 0.5-mile distance identified for minimizing predator access to rookery islands (Stanzel 2018).

The average water depth surrounding the Site is -3.5 feet NAVD88 (-4.45 feet mean lower low water [MLLW]). This depth offers a suitable balance between cost and constructability. Deeper water provides easier access for construction equipment than does shallow water, but it also requires more dredged material and armor stone to build to the target elevation. Bathymetric surveys will need to be conducted during subsequent design phases to better define Site dimensions and material needs.

Size and Shape

Based on availability of sediment, a cost analysis, and stakeholder feedback, the project team proposes that the area of the Site be 8 acres. The Site will be created with dredged material placed to an elevation of +4.0 feet NAVD88. The Site will be rectangular in shape with armoring on three of the four sides (northeast, northwest, and southeast), as shown in Figure 1. The open end of the Site will allow for a natural angle of repose of the dredged material from +4.0 feet NAVD88 to the average bay bottom depth of -3.5 feet NAVD88. This open end will also allow ingress and egress of organisms to the Site. This shape of fill was selected to promote natural recruitment of vegetation at varied elevations and provide habitat for a range of bird species. The elevation of dredged material fill could be adjusted at further stages of design depending on the physical properties of the dredged material or if target bird species and their specific requirements are identified. It is expected that temporary containment of material on the open end will be needed during construction to allow for material dewatering.

Fill material could be obtained from the GIWW or the nearby channel to Victoria, as described in Table 3. It is predicted that the required dried fill volume will be approximately 130,000 cubic yards (cy). This value assumes 1 foot of foundation compression for every 3 feet of fill and does not consider bulking. Geotechnical data will likely need to be collected during a subsequent design phase to further evaluate the expected foundation compression and the expected bulking of dredged material.

Containment and Erosion Protection

Based on the fetch in the predominant southeast wind direction and potential risk of wake erosion, the project team proposes containment and armoring for the Site consisting of a breakwater that will mitigate erosion to the rookery island and contain the dredged material. The breakwater will be composed of armor stone constructed on an existing -3.5-foot-NAVD88 grade. The breakwater will contain a 5-horizontal-to-1-vertical (5H:1V) seaward side slope and a 3H:1V landward side slope connected by a 10-foot-wide crest. The construction height of the crest will be +4.0 feet NAVD88. The exact width will be dependent on the existing grade, but assuming -3.5 feet NAVD88, the breakwater base width will be 70 feet. Figure 3 depicts a typical cross section of the breakwater. The size of the armor stone and final cross-sectional dimensions of the breakwater will need to be determined and refined, respectively, through modeling and analysis during a subsequent phase of design.

The breakwater will be constructed before the dredged material is pumped to the Site. As shown in Figure 3, the fill material will be directly contained by the breakwater. Confining the dredged slurry within the breakwater will reduce potential impacts to adjacent oyster habitat. Water depths surrounding the Site (-3.5 feet NAVD88) will likely require light load transport of armor stone during construction of the breakwater. Marsh excavators will likely be used to stack and shape the breakwater. The breakwater is proposed to surround most of the Site with an approximately 600-foot-wide opening to the southwest to allow aquatic organism and wildlife access into the Site. With naturally shallow bathymetry surrounding the southwest and west sides of the Site and the predominantly southeast wind direction, it is expected that the opening will have adequate protection from wind and wave impacts.

Planting and Natural Recruitment of Vegetation

Based on stakeholder input and cost considerations, the project team determined that planting may not be needed for the Site. Rather, natural vegetation recruitment will be allowed to proceed. If the outcome is unsatisfactory, (e.g., if the island has lower-than-expected use by desired bird species), an adaptive management program can be instituted to modify the vegetation. Table 2 shows some of the listed and migratory birds and their preferred habitats. At further design stages, this list could be used to modify elevations within the Site to promote the preferred habitat of desired bird species.

Site Construction Cost Estimates

Construction costs were estimated for the design outlined in the previous sections. The estimated costs include permitting, 100% design, engineering costs for advancing the design to the construction phase, pre-construction and as-built surveys, mobilization, materials, and construction of the breakwater. These costs represent the estimated incremental costs; i.e., those costs over and above USACE's least cost and environmentally acceptable dredged material and disposal alternative. Table 5 shows a line-item list of each costing parameter and the total cost estimated for construction.

Table 5
Opinion of Probable Construction Cost to 100% Project Completion

Item	Quantity	Unit	Unit Price	Total
Pre-Construction Survey	1	LS	$ 30,000.00	$ 30,000.00
Geotextile Fabric[1]	15,000	sy	$ 15.00	$ 230,000.00
Stone (bedding and armoring)[2]	35,000	cy	$ 200.00	$ 7,000,000.00
Incremental Dredging Cost (1-mile pipeline)	130,000	cy	$ 5.00	$ 650,000.00
Post-Construction Survey (topography/bathymetry)	1	LS	$ 30,000.00	$ 30,000.00
Post-Construction Survey (aerials)	1	LS	$ 10,000.00	$ 10,000.00
Navigational Aids	10	Each	$ 4,000.00	$ 40,000.00
Subtotal[3]			**Sum**	**$ 8,000,000.00**
Incremental Mobilization	1	5%	$ 400,000.00	$ 400,000.00
Construction Total[3]			**Sum**	**$ 8,400,000.00**
Engineering and Design[3]	1	10%	$ 800,000.00	$ 800,000.00
Permitting	1	Each	$ 100,000.00	$ 100,000.00
Construction Management[3]	1	8%	$ 700,000.00	$ 700,000.00
Post-Construction Management	12	Month	$ 10,000.00	$ 120,000.00
Project Subtotal[3]			**Sum**	**$ 10,100,000.00**
-30% Contingency[3]	1	30%	$ 3,000,000.00	$ 3,000,000.00
+50% Contingency[3]	1	50%	$ 5,100,000.00	$ 5,100,000.00
Low-End Project Estimated Cost[3]			**Total Sum**	**$ 7,100,000.00**
High-End Project Estimated Cost[3]			**Total Sum**	**$ 15,200,000.00**

Notes:
Costs were determined based upon publicly available datasets; no field work was conducted for this phase of the project.
1. Rounded to the nearest $10,000.
2. Future analysis will determine if a lesser quantity of stone can be used because the surrounding oyster reefs offer natural protection.
3. Rounded to the nearest $100,000.

LS: lump sum
sy: square yard

The costs vary from $7.1 million to $15.2 million, depending on the level of contingency allocated to the project cost. Cost savings may be realized by collecting data and evaluating the level of natural protection from erosive forces provided by the surrounding oyster reefs and then reducing the armor stone requirement accordingly.

This 10% design includes the largest bird island desired, based on stakeholder input. Future cost constraints may limit the island size that is ultimately constructed, but at this level of design, it was decided to consider the largest possible site.

The estimates are developed using current and generally accepted engineering cost estimating methods and are based on assumptions concerning future events. Actual costs may be affected by known and unknown risks including, but not limited to, changes in general economic business conditions, Site conditions that were unknown at the time the estimates were performed, future changes in Site conditions, regulatory or enforcement policy changes, and delays in performance. Actual costs may vary from these estimates.

Ecosystem Benefits Expected

Creation of the Site is expected to have positive benefits on the regional ecosystem. Chester Island, a 69-acre rookery island located in the adjacent Matagorda Bay, was used to approximate the ecological benefits for the Site. From 2003 to 2011, Chester Island averaged approximately 12,000 breeding pairs of birds per year across 17 species (5 of which are listed in Table 2; Audubon 2021b[1]). Adjusting for acreage of rookery island, the Site may be expected to create habitat for approximately 1,400 breeding pairs of birds per year.

Due to the location of oyster habitat adjacent to the Site, it is expected that the rock breakwater will be colonized by oysters. This will increase the existing oyster habitat in the regional ecosystem.

Future Work

Of the sites selected for 10% designs in this project, at least eight will be selected for 30% designs, and at least five of those will subsequently be selected for 60% designs and cost estimates. No fatal flaws have been identified in this 10% design effort. Should this Site be selected for additional design efforts, it can be expected that some aspects of the design in this memorandum will be modified and, as appropriate, improved. As previously mentioned, it is possible that in each phase additional designs will be provided toward this project because of the partnership on this project between DU and PCCA.

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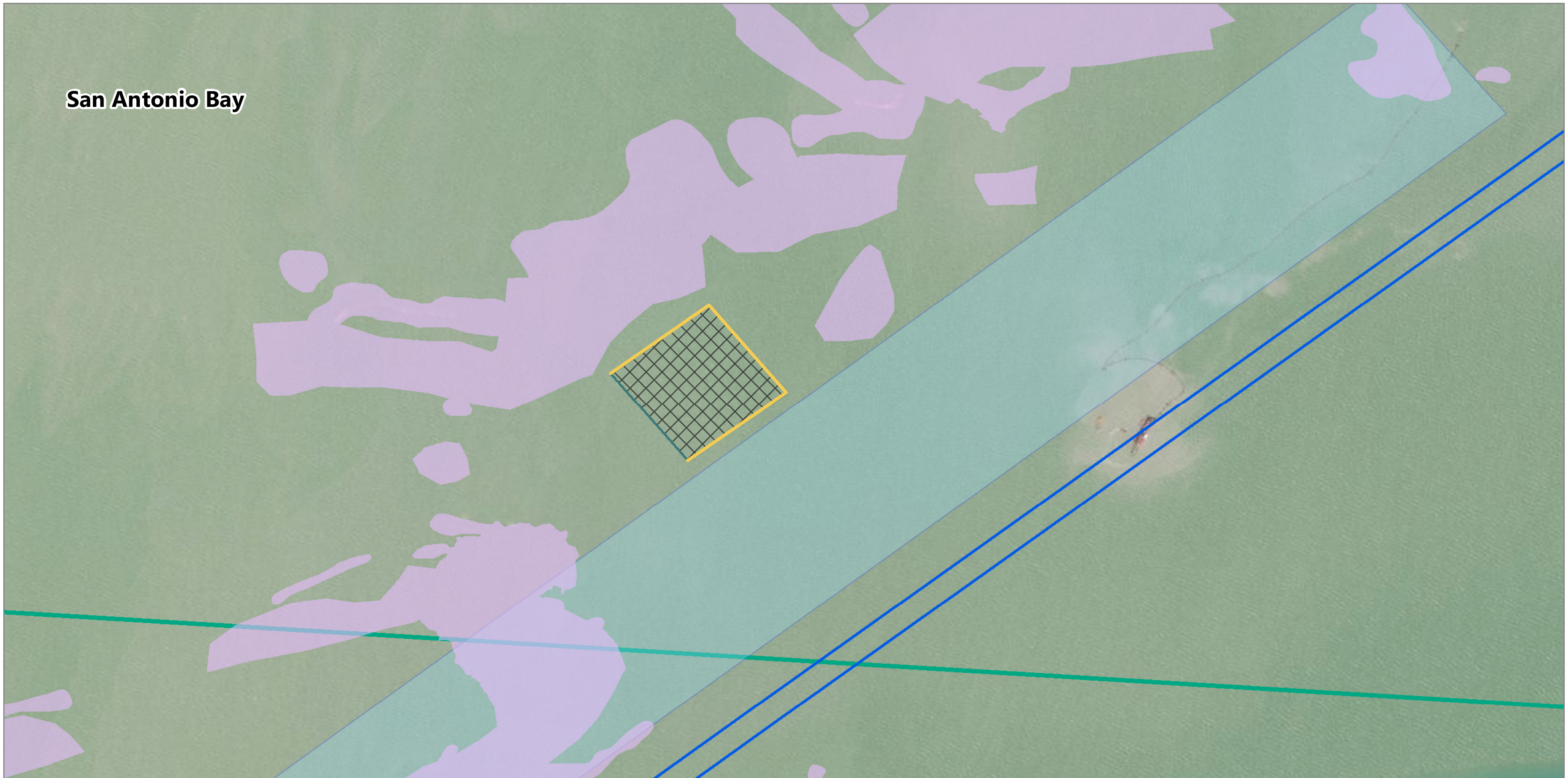
Figures



LEGEND:

- Breakwater
- Pipeline
- Gulf Intracoastal Waterway
- Little Bird Island North Site
- USACE Active Open Water Dredged Material Placement Area
- Oyster Habitat

NOTE:
Aerial imagery is from Esri basemaps

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Feet

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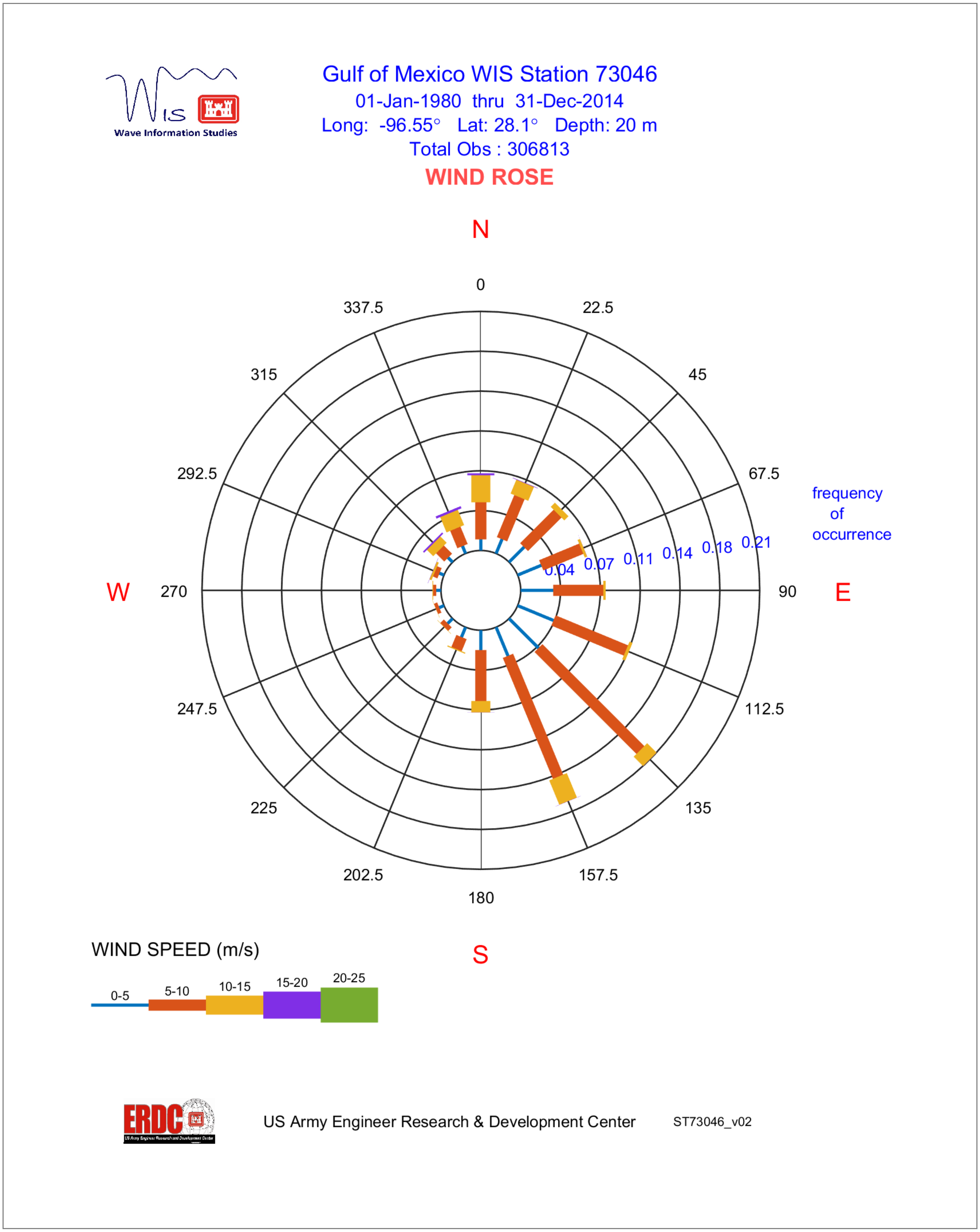
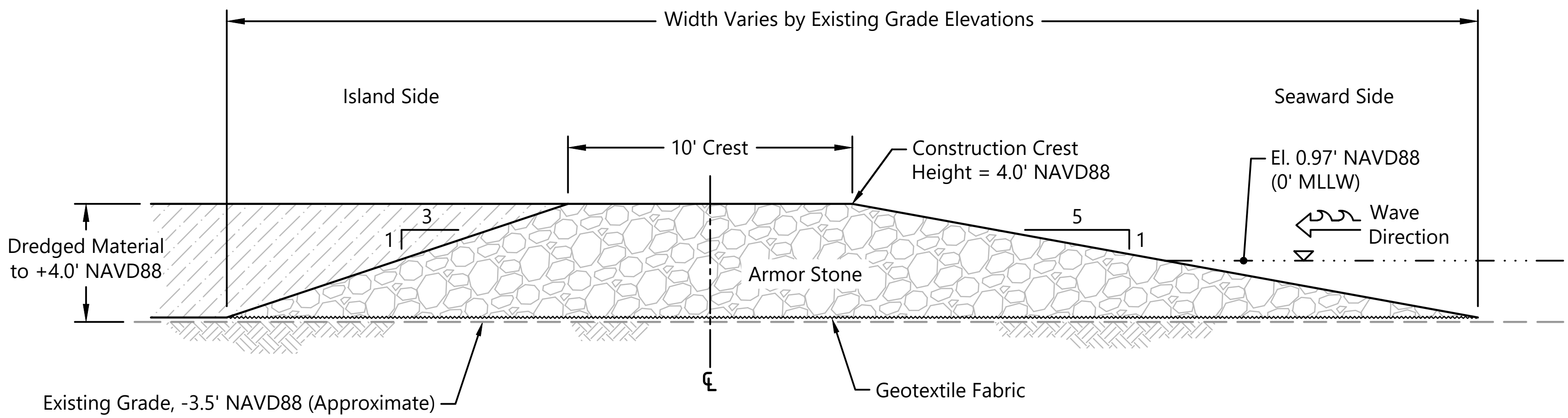
ANCHOR QEA

Figure 1
Little Bird Island North Plan View
Little Bird Island North 10% Design Memorandum
Texas Lower Coast Beneficial Use



ANCHOR QEA

Figure 2
Historical Wind Data for USACE WIS Station 73046
Little Bird Island North 10% Design Memorandum
Texas Lower Coast Beneficial Use



Section A-A' Typical Breakwater
Not to Scale

VERTICAL DATUM: North American Vertical Datum of 1988 (NAVD88)

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Filepath: K:\Projects\1942-Ducks Unlimited\Little Bird Island\Little Bird Island North 10% Design\1942-RP-001a LITTLE BIRD 10%.dwg Figure 3

Figure 3
Section A-A' Typical Breakwater

Little Bird Island North 10% Design Memorandum
Texas Lower Coast Beneficial Use

Memorandum

January 31, 2022

To: Melissa McCutcheon, Texas General Land Office

From: Todd Merendino, Ducks Unlimited, Inc.
Sarah Garza, Harrison McNeil, and Yvonne Dives-Gomez, Port of Corpus Christi Authority
John Laplante, Dan Opdyke, Ray Newby, Adrienne Accardi, Alexander Freddo, and Hayden Smith, Anchor QEA, LLC
Jane Sarosdy, Sarosdy Consulting, Inc.

Re: Nueces Delta 10% Design Memorandum

Introduction

This 10% design memorandum describes design criteria and assessments associated with the proposed Nueces Delta site (Site), located in Texas General Land Office (GLO) Planning Region 3 of the Texas coast in Nueces Bay in San Patricio County, Texas (Figures 1 and 2).

Project Background

GLO awarded a Coastal Management Program Project of Special Merit grant (funded through the Gulf of Mexico Energy Security Act) to Ducks Unlimited, Inc. (DU), to identify priority locations and develop 10% designs and opinions of probable construction costs for at least 16 sites in GLO Planning Regions 3 and 4 of the Texas coast for the beneficial use of dredged material (BU). The project team is led by DU and Port of Corpus Christi Authority (PCCA) and includes Anchor QEA, LLC; Sarosdy Consulting, Inc.; and the Texas Department of Transportation. In addition to the 16 sites identified and prioritized, PCCA will provide additional resources to bring forward more site designs for review if the site prioritization and selection so warrants. The project team coordinated two online stakeholder meetings in each region to receive information about potential BU sites. Based on stakeholder input, GLO feedback, publicly available data, and professional judgment, the project team selected the Site as one of the 16 sites for 10% design development and cost estimation.

The Nueces Delta encompasses more than 10,000 acres of wetlands on the west side of Nueces Bay. Stakeholders have identified the Site as an area with rapidly degrading marsh habitat (Dunton et al. 2019). To provide greater access to dredged material, stakeholders suggested inserting a permanent pipeline directly from the PCCA Viola Turning Basin to the delta (i.e., underneath the Joe Fulton corridor, which is composed of a county road and train tracks, and the Nueces River). This will result in a 0.1- to 0.5-mile permanent pipeline that, when combined with a traditional, temporary pipeline across the marsh, will allow for dredged material to be pumped from the Corpus Christi Ship Channel (CCSC) to the delta. This design addresses one such use of material from the proposed installation of the pipeline that takes advantage of the Nueces Delta Shoreline Protection and Restoration project that has been designed for the Coastal Bend Bays & Estuaries Program (CBBEP). The Shoreline Protection and Restoration project consists of 3,901 linear feet of breakwater along the east side of the delta. The project team is proposing that dredged material accessed via the installation of the pipeline be used to create an area of marsh (the Site) behind that currently designed breakwater to restore marsh lost in the region.

Project Objectives

Frequent dredging is needed to develop and maintain Texas ship channels. The dredged material must be deposited in dredged material placement areas (DMPAs), and many of the existing DMPAs along the Texas coast are nearing capacity. Resource agencies and stakeholders have long advocated using dredged material beneficially to create and restore wetlands and bird islands, nourish beaches, and counteract land loss. Historically, BU projects are difficult to manage because they are multi-year, multi-faceted undertakings in which different organizations manage dredging schedules, funding, project design, permitting, and construction activities. To help address these issues, the objectives of this project include the following:

- Create and restore degrading coastal habitats.
- Establish sites for placement of dredged material to reduce reliance on existing DMPAs.
- Improve coastal resiliency of the natural and built environment.
- Reduce shoaling in the GIWW and other ship channels.

To accomplish these objectives, the project includes the following tasks:

- Stakeholder outreach and coordination
- Identification and selection of BU sites
- 10% designs and cost estimates for at least 16 BU sites
- 30% designs for at least eight BU sites
- 60% designs, cost estimates, and permit application packages for at least five BU sites

This memorandum documents the 10% design and cost estimate for one of the selected sites.

Design Objectives

This Site will be designed to beneficially use dredged material to create marsh habitat in a region with degrading marsh habitat. The design will include installation of a permanent pipeline to beneficially use material dredged from the Viola Turning Basin and CCSC and filling the degraded marsh with dredged material, thus reducing the volume of such material that will need to be placed in existing open-bay or upland DMPAs. This 10% design is based upon publicly available datasets; no field work was conducted for this phase of the project.

Design objectives include the following:

- Develop a preliminary vision based on available data for the Site that includes the following:
  - Habitat to be created or restored
  - Potential sediment source(s)
  - Approaches to minimize long-term maintenance costs
- Delineate conceptual footprints for proposed BU placement.
- Identify key sensitive habitats and construction considerations in the vicinity of the Site.
- Estimate fill volumes for the proposed BU footprints.
- Identify data gaps to be addressed in subsequent design stages.
- Provide preliminary cost estimates.

Existing Data Review

Horizontal and Vertical Datums

The horizontal datum used for the Site is the Texas State Plane Zone 5, North American Datum of 1983 (NAD83), in U.S. survey feet. The primary vertical datum used for the Site is the North American Vertical Datum of 1988 (NAVD88). The National Oceanic and Atmospheric Administration (NOAA) maintains an active tide gauge within the vicinity of the Site. The NOAA Nueces Bay, TX Station 8775244 (Nueces Bay station), which is 3.5 miles to the southeast of the Site, does not provide NAVD88 vertical datums, so the NOAA USS Lexington, Corpus Christi Bay, TX Station 8775296, which is 9 miles southeast of the Site, was used to convert the Nueces Bay station mean lower low water (MLLW) tidal datum to NAVD88. These stations collect and record real time tide information dating back to 2004 and 2010, respectively. The converted vertical datums from the Nueces Bay station that will be used for the Site are shown in Table 1.

Table 1
NOAA Nueces Bay, TX Station 8775244 Tidal Gauge Displaying NAVD88 Tidal Datums

Tidal Datums	Elevation (feet NAVD88)
MHHW	1.09
MHW	1.09
MSL	0.78
MLW	0.45
MLLW	0.42

Notes:
MHHW: mean higher high water
MHW: mean high water
MLW: mean low water
MSL: mean sea level

Meteorological, Ocean, and Wave Data

Wind and Waves

The United States Army Corps of Engineers (USACE) Wave Information Studies (WIS) provides a national resource of long-term wavefield climatologies for U.S. coastal waters that synthesizes observations, multi-decade hindcasts, and storm event archives (USACE 2021). The WIS station closest to the Site is Station 73039, just offshore on the Gulf side of Mustang Island in the Gulf of Mexico. Because the station is located offshore, the wave data are not applicable to this project design. However, the project team considers the wind data to be representative of the winds experienced at the Site. Figure 3 summarizes wind data from January 1, 1980, through December 31, 2014. The data indicate that the predominant wind direction is from the southeast, with significant winds also coming from the north, northeast, east, and south.

There is significant fetch between the Site and the closest land mass in the predominant southeast wind direction. However, the designed breakwater is expected to limit erosion due to wind waves. A wave analysis of the direction and frequency of expected significant wave heights will be conducted in subsequent phases of design.

Wake Erosion

The Site is not directly adjacent to any ship channels that will result in significant ship wake. Due to this, wake erosion is not being considered a driving design factor.

Bathymetry

The NOAA National Centers for Environmental Information continuously updated digital elevation model for the Texas Coast (NOAA 2021) was used to obtain bathymetry data for the Site, as well as a hydrographic survey conducted by Naismith Marine Services, Inc. (Naismith), conducted in October 2020 (Naismith 2020). The survey conducted by Naismith shows that eastern edge of the Site footprint is at approximately -1.5 to -2.5 feet NAVD88; however, the survey does not cover the entirety of the Site footprint. The NOAA digital elevation model shows that the Site has a seabed elevation that averages 0.87 foot NAVD88 and 0.35 foot NAVD88 at the north and south portions of the Site, respectively; however, this dataset shows a uniform maximum depth of approximately -0.33 foot NAVD88 for most of the submerged portion of the Site, which appears to be inaccurate. Hydrographic surveys will need to be conducted during subsequent design phases to verify the accuracy of these sources.

Utilities and Infrastructure

The Railroad Commission of Texas public GIS viewer (RRC 2021) was used to identify utilities and pipelines near the Site. There are many pipelines intercepting the proposed route of the permanent dredged material pipeline, including multiple Flint Hills Resources, LC, crude oil and natural gas pipelines; two Enterprise Products Operating, LLC, natural gas pipelines; and one Nustar Logistics, L.P., refined liquid product pipeline. The methods for constructing the permanent pipeline near these utilities will be evaluated during subsequent design phases. The need for Site-specific utility locations prior to construction will be determined during subsequent design stages.

The permanent dredged material pipeline is also proposed to be constructed underneath the Joe Fulton corridor (composed of County Road 55B, railroad tracks, and the Nueces River) is immediately adjacent to the Site. The Joe Fulton corridor components and their foundations will need to be considered in subsequent phases of design.

Desktop Cultural Resources Survey

A search of cultural resources records in the Texas Historical Commission Atlas Database was completed for the Site between November 29 and December 30, 2021. This search revealed that one archaeological survey has been conducted in part of the proposed disposal site area. No archaeological sites have been identified within the preliminary proposed disposal site boundary (THC 2021).

Sensitive Habitat

Based on GLO oyster habitat GIS data (GLO 2021), a small patch of oyster habitat has been identified approximately 0.1 mile from the center of the south Site. According to Texas Parks and Wildlife Department seagrass data (TPWD 2021), there are no seagrasses mapped within or adjacent to the Site location. Because the sensitive habitat data are not recent, surveys will likely need to be conducted during a subsequent phase of design to evaluate the presence and extents of sensitive habitat to confirm or update the understanding of sensitive habitat in the vicinity of the Site.

Erosion

Google Earth imagery from 2011 to 2020 indicates that the Site is deteriorating from erosional forces. This is consistent with Dunton et al. (2019) and CBBEP (2020), who note that the Nueces Delta marsh is at high risk due to erosional forces such as wave energy, subsidence, and relative sea level rise.

Beneficial Use Source Material

The source of dredged material for this Site is the CCSC Inner Harbor maintenance material. The PCCA has estimated shoaling rates for the Inner Harbor, as shown in Table 2.

Table 2
PCCA Estimated Shoaling Rate for the CCSC Inner Harbor

Inner Harbor West Region Estimated Shoaling (cy/yr)	Inner Harbor Central Region Estimated Shoaling (cy/yr)	Inner Harbor East Region Estimated Shoaling (cy/yr)
35,000	38,000	50,000

Notes:
cy: cubic yard
yr: year

Further information will need to be collected during a subsequent phase of design to evaluate the sediment characteristics inside of the CCSC Inner Harbor. Due to the location of the Site in relation to these sediment sources, there will be a need for a directional drilled pipeline under a County Road and under the Nueces River to access the dredged material. Additionally, CCSC will be expanded during the Channel Improvement project, and it is possible that this new work material could be beneficially used in the Nueces Delta.

Marsh Vegetation Elevation Ranges

Typical habitat ranges for relevant marsh vegetation were determined based on site vegetation surveys conducted by DU at the Lower Neches Wildlife Management Area Old River Unit, Texas Point National Wildlife Refuge (NWR), McFaddin NWR Willow Lake Terraces, Anahuac NWR Roberts Mueller Tract, Schicke Point, Guadalupe River Old Delta, and Goose Island State Park Cells sites located in GLO Planning Regions 1 and 2 of the Texas coast. This is shown in Table 3.

Table 3
Typical Elevations for Target Marsh Vegetation

Species	Elevation (feet MSL)	Elevation (feet NAVD88)
Spartina patens	0.25 to 1	2.04 to 1.78
Spartina alterniflora	0 to 0.75	0.78 to 1.53

10% Design

The main design features that are critical for marsh island success are as follows:

- Site location
- Marsh size and shape
- Containment and erosion protection
- Planting and natural recruitment of vegetation

These design features are evaluated in this memorandum for the preliminary Site design.

Site Location

The proposed location of the Site is approximately 3 miles north of the CCSC Viola Turning Basin. The Site is located between the existing Nueces Delta and the breakwater designed as a part of the Nueces Delta Shoreline Protection and Restoration project for CBBEP (Figures 1 and 2).

The Site has an elevation that averages 0.87 foot NAVD88 and 0.35 foot NAVD88 at the north and south portions of the Site, respectively. Shallow water depths surrounding the Site are assumed to require light draft vessels to be used during construction. Bathymetric surveys will need to be conducted during subsequent design phases to better define Site dimensions and material needs.

Size and Shape

Based on acreage of state-owned submerged land behind the currently designed breakwaters, the project team proposes that the area of the Site be 7 acres. Due to expected mounding of the placed material, the Site will be created with dredged material placed to an elevation of +2.5 feet NAVD88, which will be at the upper end of the suitable habitat range for *Spartina patens* and *Spartina alterniflora*. The elevation of dredged material fill could be adjusted at further stages of design depending on the physical properties of the dredged material or if other target species and their specific requirements are identified. The Site will consist of fill extending from the edge of the existing upland of the delta toward the currently designed breakwater. It is expected that environmental controls such as turbidity curtains will be needed during construction to contain fines placed at the Site.

Fill material will be accessed via the installation of a directionally drilled pipeline from the CCSC Viola Turning Basin to the Nueces Delta. This pipeline will extend underneath the Joe Fulton corridor, which is composed of a county road and train tracks, and the Nueces River. Further analysis and design of this pipeline will need to be conducted during subsequent design phases. Estimated quantities of available material are shown in Table 2. It is predicted that the required consolidated fill volume will be approximately 26,000 cubic yards (cy), with approximately 9,000 cy being settled volume. This value assumes 1 foot of foundation compression for every 3 feet of fill and does not consider bulking. Geotechnical data will likely need to be collected during a subsequent design phase to further evaluate the expected foundation compression and the expected bulking of dredged material.

Containment and Erosion Protection

The currently designed breakwater will serve as protection from wind wave and wake erosion at the Site. It is expected that temporary containment will be necessary to allow the material to consolidate.

Planting and Natural Recruitment of Vegetation

Based on stakeholder input and cost considerations, the project team determined that hydroseeding the edge of the marsh will be the most effective method for vegetating the marsh. Natural vegetation recruitment will then be allowed to proceed from the edge of the marsh inward. If the outcome is unsatisfactory (e.g., if the marsh has a lower-than-expected density of vegetation or if undesirable species of vegetation are present), an adaptive management program can be instituted to modify the vegetation. Table 3 shows some of the targeted vegetation and their preferred habitat elevations.

Site Construction Cost Estimates

Construction costs were estimated for the design outlined in the previous sections. The estimated costs include permitting, 100% design, engineering costs for advancing the design to the construction phase, pre-construction and as-built surveys, mobilization, and materials. These costs represent the estimated incremental costs; i.e., those costs over and above USACE’s least cost and environmentally acceptable dredged material and disposal alternative. Table 4 shows a line-item list of each costing parameter and the total cost estimated for construction.

Table 4
Opinion of Probable Construction Cost to 100% Project Completion

Item	Quantity	Unit	Unit Price	Total
Pre-Construction Survey	1	LS	$ 30,000.00	$ 30,000.00
Incremental Dredging Cost (3-mile pipeline)	26,000	cy	$ 15.00	$ 390,000.00
Post-Construction Survey (topography/ bathymetry)	1	LS	$ 30,000.00	$ 30,000.00
Post-Construction Survey (aerials)	1	LS	$ 10,000.00	$ 10,000.00
Pipeline Construction[1]	1,000	lf	$ 4,000.00	$ 4,000,000.00
Subtotal[2]			**Sum**	**$ 4,500,000.00**
Incremental Mobilization and Demobilization[2]	1	LS	$ 200,000.00	$ 200,000.00
Construction Total[2]			**Sum**	**$ 4,700,000.00**
100% Engineering and Design[2]	1	10%	$ 500,000.00	$ 500,000.00
Permitting	1	Each	$ 100,000.00	$ 100,000.00
Construction Management[2]	1	8%	$ 400,000.00	$ 400,000.00
Post-Construction Management	12	Month	$ 10,000.00	$ 120,000.00
Project Subtotal[2]			**Sum**	**$ 5,800,000.00**
-30% Contingency[2]	1	30%	$ 1,700,000.00	$ 1,700,000.00
+50% Contingency[2]	1	50%	$ 2,900,000.00	$ 2,900,000.00
Low-End Total Project Estimated Cost[2]			**Total Sum**	**$ 4,100,000.00**
High-End Total Project Estimated Cost[2]			**Total Sum**	**$ 8,700,000.00**

Notes:
Costs were determined based upon publicly available datasets; no field work was conducted for this phase of the project.

1. Preliminary cost based on DU Bid: *Siphon Control Structures at Oilcut Ditch and Salt Bayou at the Gulf Intracoastal Waterway for Jefferson County*. Each siphon consisted of four 36-inch HDPE siphons directionally drilled under the GIWW. This is only a preliminary cost, and the ultimate design and associated cost for the pipeline required to be drilled for this project will be refined during subsequent design phases.
2. Rounded to the nearest $100,000.

LS: lump sum
lf: linear foot

The costs vary from $4.1 million to $8.7 million, depending on the level of contingency allocated to the project cost.

This 10% design includes costing for the permanent pipeline that will need to be drilled from the CCSC Viola Turning Basin to the Nueces Delta to provide access to dredged material. This pipeline will be a permanent fixture and could contribute to continuous restoration projects throughout the Nueces Delta to counteract the rapid degradation of the over 10,000 acres of marsh within the delta.

The estimates are developed using current and generally accepted engineering cost estimating methods and are based on assumptions concerning future events. Actual costs may be affected by known and unknown risks including, but not limited to, changes in general economic business conditions, Site conditions that were unknown at the time the estimates were performed, future changes in Site conditions, regulatory or enforcement policy changes, and delays in performance. Actual costs may vary from these estimates.

Ecosystem Benefits Expected

Creation of the Site is expected to have positive benefits on the regional ecosystem. The marsh restoration is expected to add 7 acres of marsh habitat to the regional ecosystem; however, the installed pipeline will provide access to material for many more future restoration projects in the region.

Future Work

Of the sites selected for 10% designs in this project, at least eight will be selected for 30% designs, and at least five of those will subsequently be selected for 60% designs and cost estimates. No fatal flaws have been identified in this 10% design effort. Should this Site be selected for additional design efforts, it can be expected that some aspects of the design in this memorandum will be modified and, as appropriate, improved. As previously mentioned, it is possible that in each phase additional designs will be provided toward this project because of the partnership on this project between DU and PCCA.

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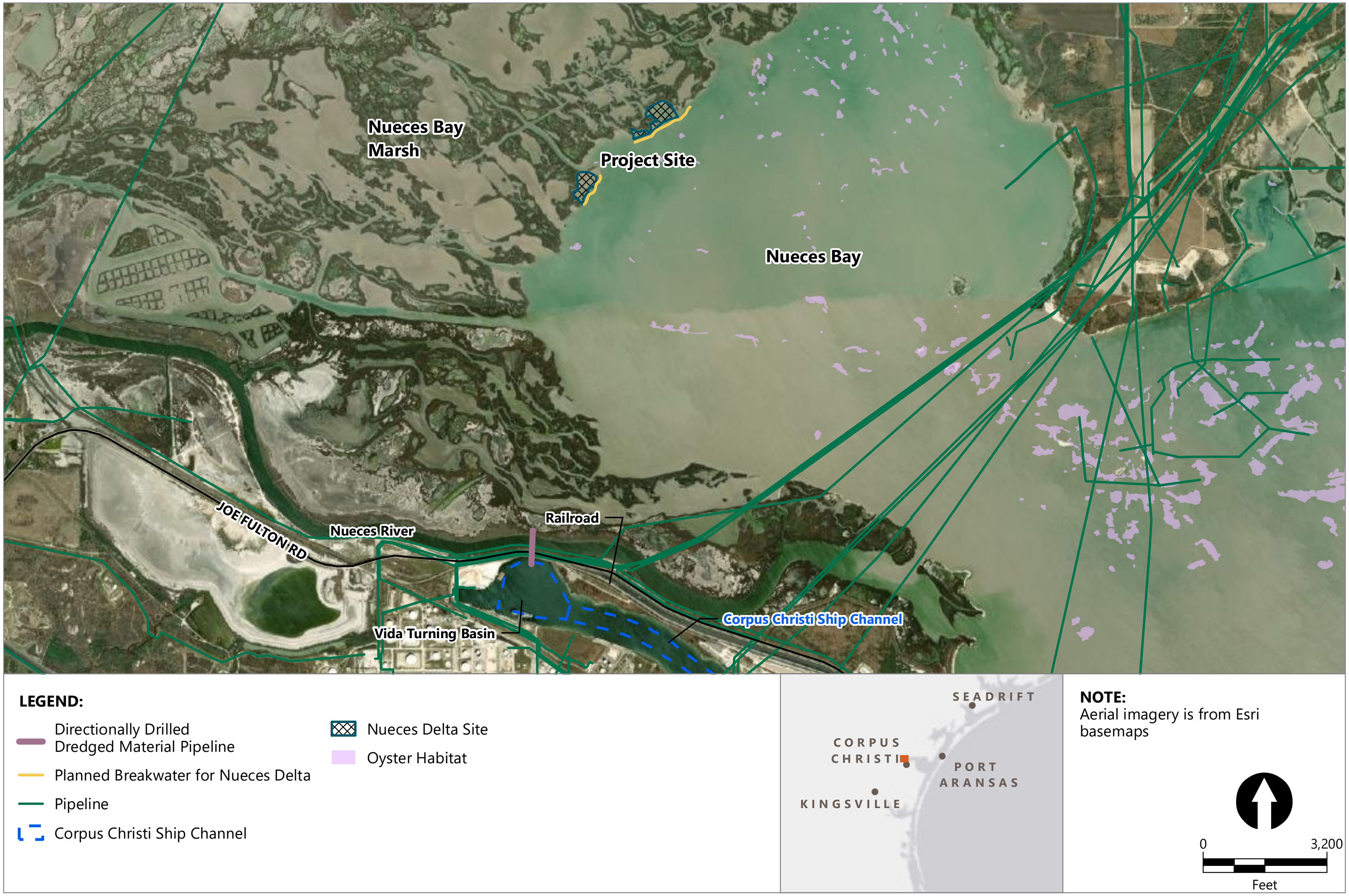
Figures



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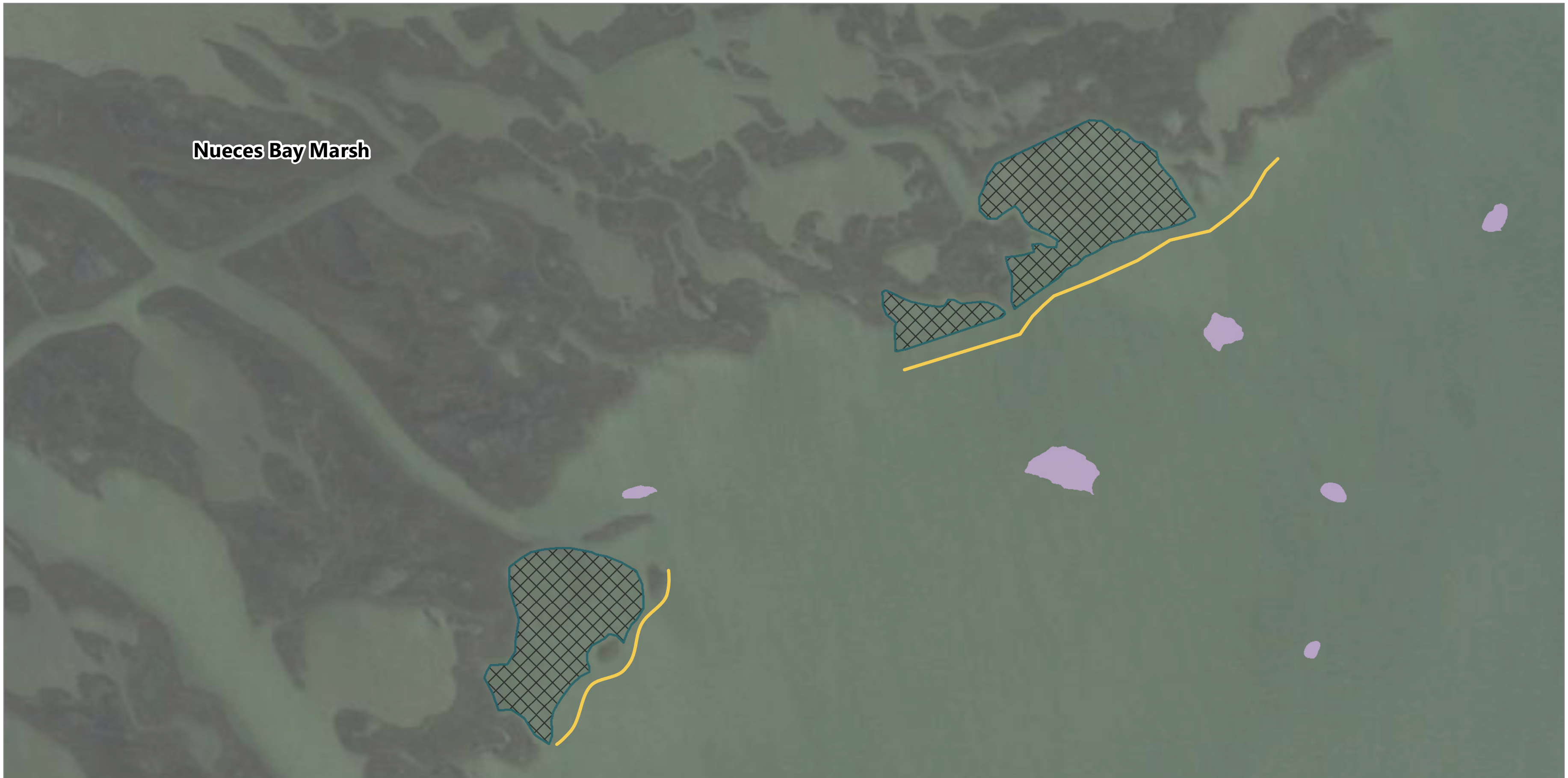
ANCHOR QEA

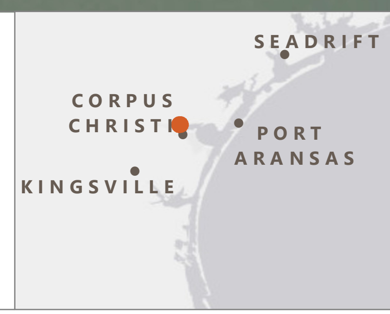
Figure 1
Nueces Delta Site

Nueces Delta 10% Design Memorandum
Texas Lower Coast Beneficial Use



LEGEND:

- Planned Breakwater for Nueces Delta
- Nueces Delta Site
- Oyster Habitat



NOTE:
Aerial imagery is from Esri basemaps

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ANCHOR QEA

Figure 2
Nueces Delta Plan View
Nueces Delta 10% Design Memorandum
Texas Lower Coast Beneficial Use

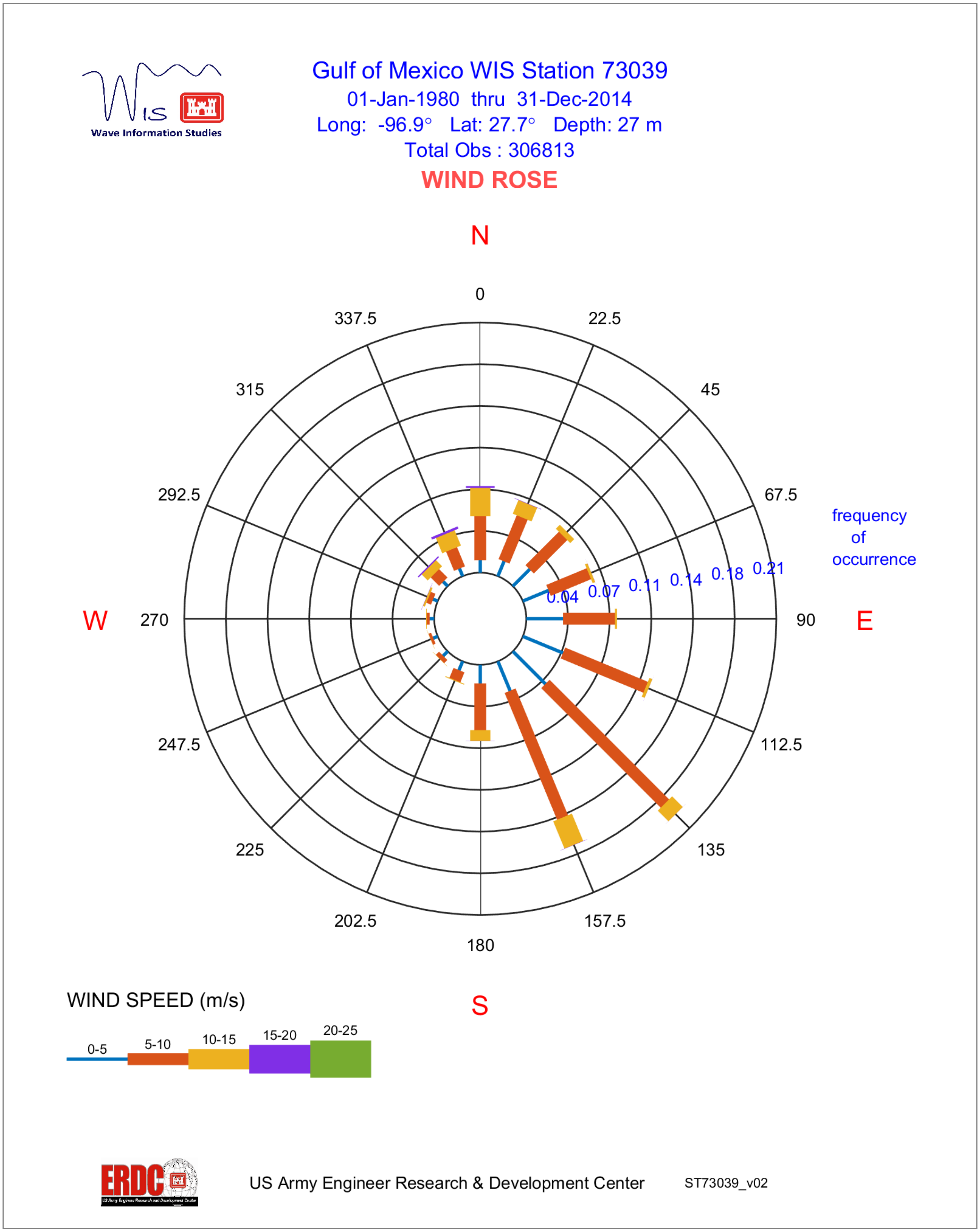

Figure 3
Historical Wind Data for USACE WIS Station 73039

Nueces Delta 10% Design Memorandum
Texas Lower Coast Beneficial Use

Memorandum

January 31, 2022

To: Melissa McCutcheon, Texas General Land Office

From: Todd Merendino, Ducks Unlimited, Inc.
Sarah Garza, Harrison McNeil, and Yvonne Dives-Gomez, Port of Corpus Christi Authority
John Laplante, Dan Opdyke, Ray Newby, Adrienne Accardi, Alexander Freddo, and
Hayden Smith, Anchor QEA, LLC
Jane Sarosdy, Sarosdy Consulting, Inc.

Re: PA9-S Marsh Restoration 10% Design Memorandum

Introduction

This 10% design memorandum describes design criteria and assessments associated with the proposed PA9-S site (Site), located in Texas General Land Office (GLO) Planning Region 3 of the Texas coast in Corpus Christi Bay in Nueces County, Texas (Figure 1).

Project Background

GLO awarded a Coastal Management Program Project of Special Merit grant (funded through the Gulf of Mexico Energy Security Act) to Ducks Unlimited, Inc. (DU), to identify priority locations and develop 10% designs and opinions of probable construction costs for at least 16 sites in GLO Planning Regions 3 and 4 of the Texas coast for the beneficial use of dredged material (BU). The project team is led by DU and Port of Corpus Christi Authority (PCCA) and includes Anchor QEA, LLC; Sarosdy Consulting, Inc.; and the Texas Department of Transportation. In addition to the 16 sites identified and prioritized, PCCA will provide additional resources to bring forward more site designs for review if the site prioritization and selection so warrants. The project team coordinated two online stakeholder meetings in each region to receive information about potential BU sites. Based on stakeholder input, GLO feedback, publicly available data, and professional judgment, the project team selected the Site as one of the 16 sites for 10% design development and cost estimation.

Several sites within Corpus Christi Bay have been identified as important locations for creating and restoring marsh and bird habitat (CBBEP 2020). PA9-S is an island located on state-owned submerged land approximately 0.1 mile east of the Gulf Intracoastal Waterway (GIWW) and 0.2 mile south of the Corpus Christi Ship Channel (CCSC) in Corpus Christi Bay in Nueces County, Texas. The existing PA9-S island is adjacent to patchy seagrass habitat and has limited natural protection from wave energy. The proposed BU Site is immediately south of, and appended to, the existing PA9-S island. This area was selected due to its proximity to potential maintenance dredged material from the CCSC as well as potential dredged material from the CCSC Channel Improvement Project.

Project Objectives

Frequent dredging is needed to develop and maintain Texas ship channels. The dredged material must be deposited in dredged material placement areas (DMPAs), and many of the existing DMPAs along the Texas coast are nearing capacity. Resource agencies and stakeholders have long advocated using dredged material beneficially to create and restore wetlands and bird islands, nourish beaches, and counteract land loss. Historically, BU projects are difficult to manage because they are multi-year, multi-faceted undertakings in which different organizations manage dredging schedules, funding, project design, permitting, and construction activities. To help address these issues, the objectives of this project include the following:

- Create and restore degrading coastal habitats.
- Establish sites for placement of dredged material to reduce reliance on existing DMPAs.
- Improve coastal resiliency of the natural and built environment.
- Reduce shoaling in the GIWW and other ship channels.

To accomplish these objectives, the project includes the following tasks:

- Stakeholder outreach and coordination
- Identification and selection of BU sites
- 10% designs and cost estimates for at least 16 BU sites
- 30% designs for at least eight BU sites
- 60% designs, cost estimates, and permit application packages for at least five BU sites

This memorandum documents the 10% design and cost estimate for one of the selected sites.

Design Objectives

This Site will be designed to beneficially use dredged material to create marsh. The design will use material dredged from navigation channels during routine maintenance and potentially from the CCSC Channel Improvement Project, thus reducing the volume of such material that will need to be placed in existing open-bay or upland DMPAs. This 10% design is based upon publicly available datasets; no field work was conducted for this phase of the project.

Design objectives include the following:

- Develop a preliminary vision based on available data for the Site that includes the following:
  - Habitat to be created or restored
  - Potential sediment source(s)

  - Approaches to minimize long-term maintenance costs
- Delineate conceptual footprints for proposed BU placement.
- Identify key sensitive habitats and construction considerations in the vicinity of the Site.
- Estimate fill volumes for the proposed BU footprints.
- Identify data gaps to be addressed in subsequent design stages.
- Provide preliminary cost estimates.

Existing Data Review

Horizontal and Vertical Datums

The horizontal datum used for the Site is the Texas State Plane Zone 5, North American Datum of 1983 (NAD83), in U.S. survey feet. The primary vertical datum used for the Site is the North American Vertical Datum of 1988 (NAVD88). The National Oceanic and Atmospheric Administration (NOAA) maintains an active tide gauge within the vicinity of the Site. The NOAA Ingleside, MODA Station 8775283 (Ingleside station), which is 3 miles to the west of the Site, does not provide NAVD88 vertical datums, so the NOAA Port Aransas, TX Station 8775237, which is 5 miles east of the Site, was used to convert the Ingleside station mean lower low water (MLLW) tidal datum to NAVD88. These stations collect and record real-time tide information dating back to 2002 and 1989, respectively. The converted vertical datums from the Ingleside station that will be used for the Site are shown in Table 1.

Table 1
NOAA Ingleside, MODA Station 8775283 Tidal Datums

Tidal Datums	Elevation (feet NAVD88)
MHHW	0.55
MHW	0.54
MSL	0.24
MLW	-0.15
MLLW	-0.15

Notes:
Datums converted to NAVD88 using the Port Aransas, Texas, Station 8775237.
MHHW: mean higher high water
MHW: mean high water
MLW: mean low water
MSL: mean sea level

Meteorological, Ocean, and Wave Data

Wind and Waves

The United States Army Corps of Engineers (USACE) Wave Information Studies (WIS) provides a national resource of long-term wavefield climatologies for U.S. coastal waters that synthesizes observations, multi-decade hindcasts, and storm event archives (USACE 2021). The WIS station closest to the Site is Station 73039, just offshore on the Gulf side of Port Aransas in the Gulf of Mexico. Because the station is located offshore, the wave data are not applicable to this project design. However, the project team considers the wind data to be representative of the winds experienced at the Site. Figure 2 summarizes wind data from January 1, 1980, through December 31, 2014. The data indicate that the predominant wind direction is from the southeast, with significant winds also coming from the north, northeast, east, and south.

There is a 4-mile fetch between PA9-S and Mustang Island, the closest land mass in the predominant southeast wind direction. Due to the fetch and surrounding water depths, the Site is anticipated to be in a high wave-energy environment. A wave analysis of the direction and frequency of expected significant wave heights will be conducted in subsequent phases of design.

Wake Erosion

The GIWW is approximately 0.6 mile west of the Site, and the CCSC is approximately 0.4 mile north of the Site. However, ships do not often use this portion of the GIWW; rather, to avoid the “hole,” they transit to the west of M10 Island (Jones 2021; Hamilton et al. 2018). Potential wake erosion from vessels transiting the GIWW and CCSC are expected to be design considerations. The proposed armoring will be designed to resist wind- and vessel-generated erosive forces.

Bathymetry

The NOAA National Centers for Environmental Information continuously updated digital elevation model for the Texas Coast (NOAA 2021) was used to obtain bathymetry data for the Site. The Site footprint begins on the shoreline of the existing upland area and extends out to the -5-foot-NAVD88 contour. The average seabed elevation of the Site footprint is -1.77 feet NAVD88.

Utilities and Infrastructure

The Railroad Commission of Texas public GIS viewer (RRC 2021) was used to identify utilities and pipelines near the Site. There are many pipelines near the Site: an Agua Tranquillo Midstream LLC natural gas pipeline runs north/south directly under the middle of the Site, and many Cinco Natural Resources Corporation natural gas full well stream pipelines ranging between 0.4 and 1 mile from the Site, with most of them being approximately 0.5 mile to the southeast. Impacts of these pipelines on the constructability of the Site will need to be evaluated during subsequent design phases, and offsets that modify the Site footprint and reduce potential storage capacity may be needed. The need for Site-specific utility locations prior to construction will be determined during subsequent design stages. No other infrastructure has been identified in the vicinity of the project Site.

Desktop Cultural Resources Survey

A search of cultural resources records in the THC Atlas Database (THC 2021) was completed on December 16, 2021. It appears that the proposed disposal site has been fully surveyed, and no resources have been identified. The survey will need to be reviewed for applicability to the present project.

Sensitive Habitat

GLO oyster habitat GIS data (GLO 2021) indicate that there is no oyster habitat identified within or adjacent to the Site. According to Texas Parks and Wildlife Department seagrass data (TPWD 2021), patchy seagrass has been mapped surrounding the Site. Because the sensitive habitat data are not recent, surveys will likely need to be conducted during a subsequent phase of design to evaluate the presence and extents of sensitive habitat to confirm or update the understanding of sensitive habitat in the vicinity of the Site.

Beneficial Use Source Material

The main potential source of dredged material is the CCSC, located adjacent to the Site. Continued dredging has recently been confirmed by USACE (Jones 2021). The identified DMPAs used by USACE adjacent to the Site and their associated historical average annual quantity of dredged material, distance from the Site, and channel segments are shown in Table 2. The average grain size and grain type percentages are shown in Table 3. This informs the quantity and characteristics of dredged material that may be available during a dredging cycle.

Table 2
USACE DMPA Areas Adjacent to the Site

DMPA No.	CCSC Channel Segment (station)	Distance from Site (miles)	Average Annual Dredging Quantity (cy)
6	Inner Basin to La Quinta Junction (0+00-270+00)	3.8	0
7	Inner Basin to La Quinta Junction (270+00-320+00)	2.4	35,000
8	Inner Basin to La Quinta Junction (320+00-400+00)	1.3	40,000
9	Inner Basin to La Quinta Junction (400+00-500+00)	0.15	51,000
10	Inner Basin to La Quinta Junction	1.5	0

Notes:
Source: USACE 1999
cy: cubic yard

Table 3
Typical Sediment Characteristics Between the Inner Basin and La Quinta Junction

Sediment Characteristics
D_{50} (mm) = 0.256
87.8% sand
6.6% silt
5.7% clay

Notes:
Channel Segment: (0+00-200+00)
Source: USACE 1999
D_{50}: median grain size
mm: millimeter

Another potential source of sediment is from the CCSC Channel Improvement Project. This project could potentially provide a substantial portion of the material used at the Site; however, analysis of the expected sediment quantities and characteristics from the CCSC Channel Improvement Project will need to be completed during a subsequent design phase. Due to the proximity of the Site to these sediment sources, this Site should allow for lower construction costs compared to more remote potential marsh restoration sites.

Marsh Vegetation Elevation Ranges

Typical habitat ranges for relevant marsh vegetation were determined based on site vegetation surveys conducted by DU at the Lower Neches Wildlife Management Area Old River Unit, Texas Point National Wildlife Refuge (NWR), McFaddin NWR Willow Lake Terraces, Anahuac NWR Roberts Mueller Tract, Schicke Point, Guadalupe River Old Delta, and Goose Island State Park Cells sites located in GLO Planning Regions 1 and 2 of the Texas coast. This is shown in Table 4.

Table 4
Typical Elevations for Target Marsh Vegetation

Species	Elevation (feet MSL)	Elevation (feet NAVD88)
Spartina patens	0.25 to 1	0.49 to 1.24
Spartina alterniflora	0 to 0.75	0.24 to 0.99

10% Design

The main design features that are critical for marsh island success are as follows:

- Site location
- Marsh size and shape
- Containment and erosion protection
- Planting and natural recruitment of vegetation

These design features are evaluated in this memorandum for the preliminary Site design.

Site Location

The proposed location of the Site is on the southern shore of the existing PA9-S, approximately 0.1 mile east of the GIWW and 0.4 mile south of the CCSC. The Site is located near Ingleside in Corpus Christi Bay and between the existing M10 Island and Pelican Island (Figure 1).

The Site footprint begins on the shoreline of the existing upland area and extends out to between the -10 to -11-foot-NAVD88 contour. The average seabed elevation of the Site footprint is -7.2 feet NAVD88 (-7.05 feet MLLW). Seabed elevations of greater than -5 feet NAVD88 surround most of the Site, providing beneficial conditions for construction access. Bathymetric surveys will need to be conducted during subsequent design phases to better define Site dimensions and material needs.

Size and Shape

Based on availability of sediment, a cost analysis, and stakeholder feedback, the project team proposes that the area of the Site be 160 acres. Due to expected mounding of the placed material, the Site will be created with dredged material placed to an elevation of +2.0 feet NAVD88, which will be at the upper end of the suitable habitat range for *Spartina patens* and *Spartina alterniflora*. The elevation of dredged material fill could be adjusted at further stages of design, depending on the physical properties of the dredged material or if other target species and their specific requirements are identified. The Site will consist of fill extending from the edge of the existing island to a newly constructed containment dike that will be built under this project. It is expected that environmental controls such as turbidity curtains will be needed during construction to contain fines placed at the Site.

Fill material would likely be obtained from the CCSC, as described in Table 2. It is predicted that the required fill volume will be approximately 3,600,000 cubic yards (cy), with approximately 960,000 cy being settled volume. This value assumes 1 foot of foundation compression for every 3 feet of fill and does not consider bulking. Geotechnical data will likely need to be collected during a subsequent design phase to further evaluate the expected foundation compression and the expected bulking of dredged material.

Containment and Erosion Protection

Based on the fetch in the predominant southeast wind direction and potential risk of wake erosion, the project team proposes containment and armoring for the Site consisting of a 6,000-foot-long dike with a rock breakwater constructed on its seaward side at the -3.5-foot NAVD88 contour of the dike that will mitigate erosion to the marsh island and contain the dredged material. The dike will be composed of a hydraulic stiff clay dike fill. The dike will reside on a varied grade with an average of approximately -8 feet NAVD88. The dike will contain a 5-horizontal-to-1-vertical (5H:1V) seaward side slope and a 3H:1V landward side slope connected by a 15-foot-wide crest. The construction height of the crest will be +5.5 feet NAVD88. The exact width will be dependent on the existing grade, but assuming -8.0 feet NAVD88, the dike base width will be 123 feet. The breakwater will contain a 5H:1V seaward side slope and a 3H:1V landward side slope connected by a 15-foot-wide crest. The construction height of the crest will be +2.5 feet NAVD88. The exact width will be dependent on the existing grade, but assuming -3.5 feet NAVD88, the dike base width will be 63 feet. Figure 3 depicts a typical cross section of the dike. The size of the rock breakwater and the final slope and cross-sectional dimensions of the dike will need to be determined and refined, respectively, through modeling and analysis of the sediment characteristics of the dredged material and the dike subgrade during a subsequent phase of design.

The dike will be constructed before the dredged material is pumped to the Site. As shown in Figure 3, the fill material will be directly contained by the dike. Confining the dredged slurry within the dike will reduce potential impacts to potential nearby sensitive habitat. The dike is proposed to protect the south shoreline of the Site from wind and wave impacts.

Planting and Natural Recruitment of Vegetation

Based on stakeholder input and cost considerations, the project team determined that that hydroseeding the edges of the marsh will be the most effective method for vegetating the marsh. Natural vegetation recruitment will then be allowed to proceed from the edge of the marsh inward. If the outcome is unsatisfactory (e.g., if the marsh has a lower-than-expected density of vegetation or if undesirable species of vegetation are present), an adaptive management program can be instituted to modify the vegetation. Table 4 shows some of the targeted vegetation and their preferred habitat elevations.

Site Construction Cost Estimates

Construction costs were estimated for the design outlined in the previous sections. The estimated costs include permitting, 100% design, engineering costs for advancing the design to the construction phase, pre-construction and as-built surveys, mobilization, materials, hydroseeding, and construction of the dike. These costs represent the estimated incremental costs; i.e., those costs over and above USACE's least cost and environmentally acceptable dredged material and disposal alternative. Table 5 shows a line-item list of each costing parameter and the total cost estimated for construction.

Table 5
Opinion of Probable Construction Cost to 100% Project Completion

Item	Quantity	Unit	Unit Price	Total
Pre-Construction Survey	1	LS	$ 30,000.00	$ 30,000.00
Rock Breakwater (armor stone)[1]	7,800	lf	$ 625.00	$ 4,900,000.00
Incremental Dredging Cost (2-mile pipeline)	3,600,000	cy	$ 10.00	$ 36,000,000.00
Shaping the Dike[1]	7,800	lf	$ 15.00	$ 100,000.00
Hydroseeding[2]	160,000	sf	$ 0.20	$ 30,000.00
Post-Construction Survey (topography/ bathymetry)	1	LS	$ 30,000.00	$ 30,000.00
Post-Construction Survey (aerials)	1	LS	$ 10,000.00	$ 10,000.00
Navigational Aids	15	Each	$ 4,000.00	$ 60,000.00
Subtotal[1]			**Sum**	**$ 41,200,000.00**
Incremental Mobilization and Demobilization[1]	1	5%	$ 2,100,000.00	$ 2,100,000.00
Construction Total[1]			**Sum**	**$ 43,300,000.00**
100% Engineering and Design[1]	1	10%	$ 4,300,000.00	$ 4,300,000.00
Permitting	1	Each	$ 100,000.00	$ 100,000.00
Construction Management[1]	1	8%	$ 3,500,000.00	$ 3,500,000.00
Post-Construction Management	12	Month	$ 10,000.00	$ 120,000.00
Project Subtotal[1]			**Sum**	**$ 51,300,000.00**
-30% Contingency[1]	1	30%	$ 15,400,000.00	$ 15,400,000.00
+50% Contingency[1]	1	50%	$ 25,700,000.00	$ 25,700,000.00
Low-End Project Estimated Cost[1]			**Total Sum**	**$ 35,900,000.00**
High-End Total Project Estimated Cost[1]			**Total Sum**	**$ 77,000,000.00**

Notes:
Costs were determined based upon publicly available datasets; no field work was conducted for this phase of the project.
1. Rounded to the nearest $100,000.
2. Rounded to the nearest $10,000.

LS: lump sum
sf: square foot
lf: linear foot

The costs vary from $35.9 million to $77 million, depending on the level of contingency allocated to the project cost. Cost savings may be realized by further analysis and modeling of wind and wave conditions during subsequent design phases and refining the level of armoring. The estimates are developed using current and generally accepted engineering cost estimating methods and are based on assumptions concerning future events. Actual costs may be affected by known and unknown risks including, but not limited to, changes in general economic business conditions, Site conditions that were unknown at the time the estimates were performed, future changes in Site conditions, regulatory or enforcement policy changes, and delays in performance. Actual costs may vary from these estimates.

Ecosystem Benefits Expected

Creation of the Site is expected to have positive benefits on the regional ecosystem. The marsh restoration is expected to add 160 acres of mash habitat to the regional ecosystem. The armored island created at the Site will also provide resiliency to the degrading existing shoreline of PA9-S and increase foraging habitat for birds.

Future Work

Of the sites selected for 10% designs in this project, at least eight will be selected for 30% designs, and at least five of those will subsequently be selected for 60% designs and cost estimates. No fatal flaws have been identified in this 10% design effort. Should this Site be selected for additional design efforts, it can be expected that some aspects of the design in this memorandum will be modified and, as appropriate, improved. As previously mentioned, it is possible that in each phase additional designs will be provided toward this project because of the partnership on this project between DU and PCCA.

References

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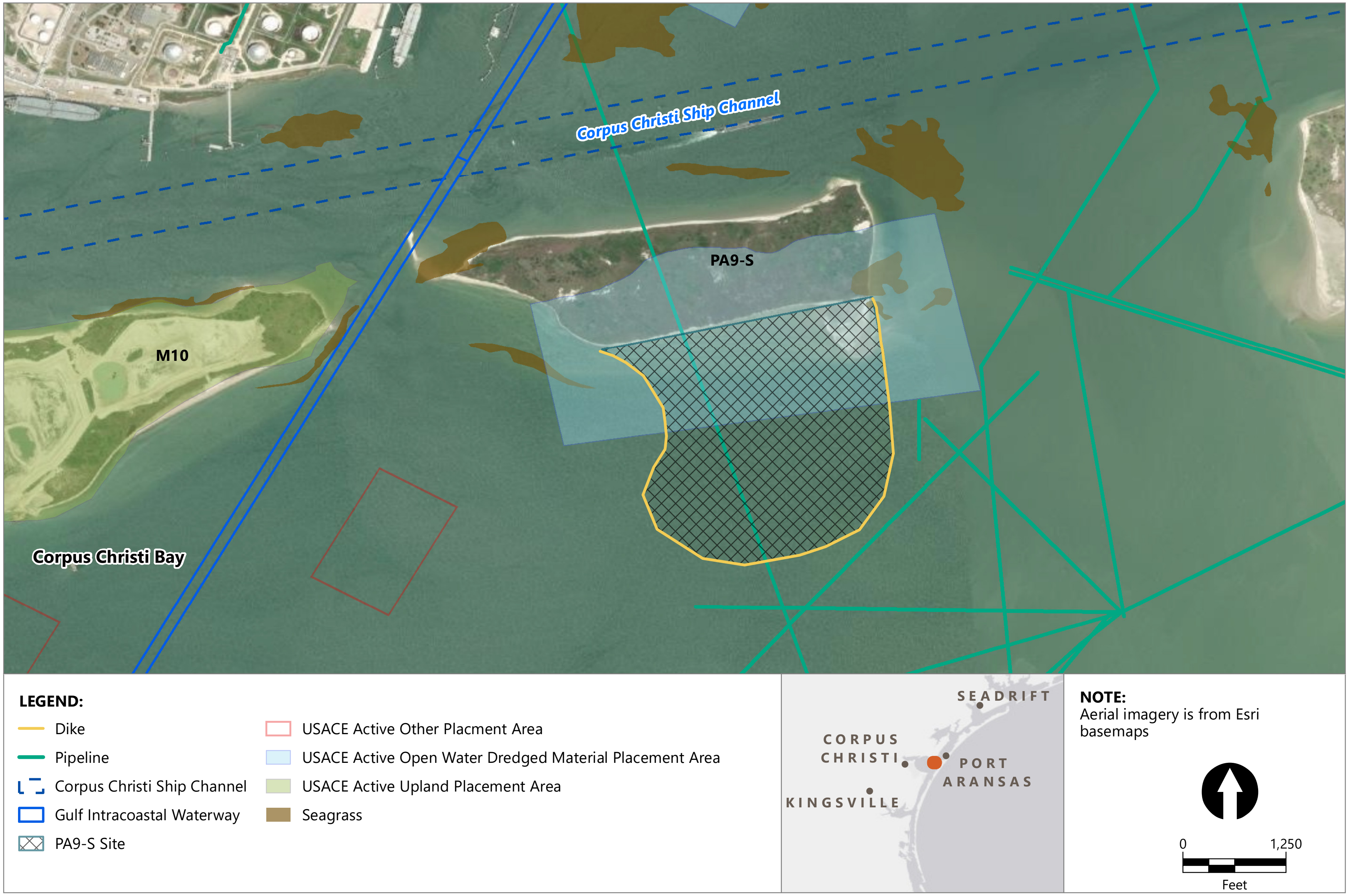
Figures



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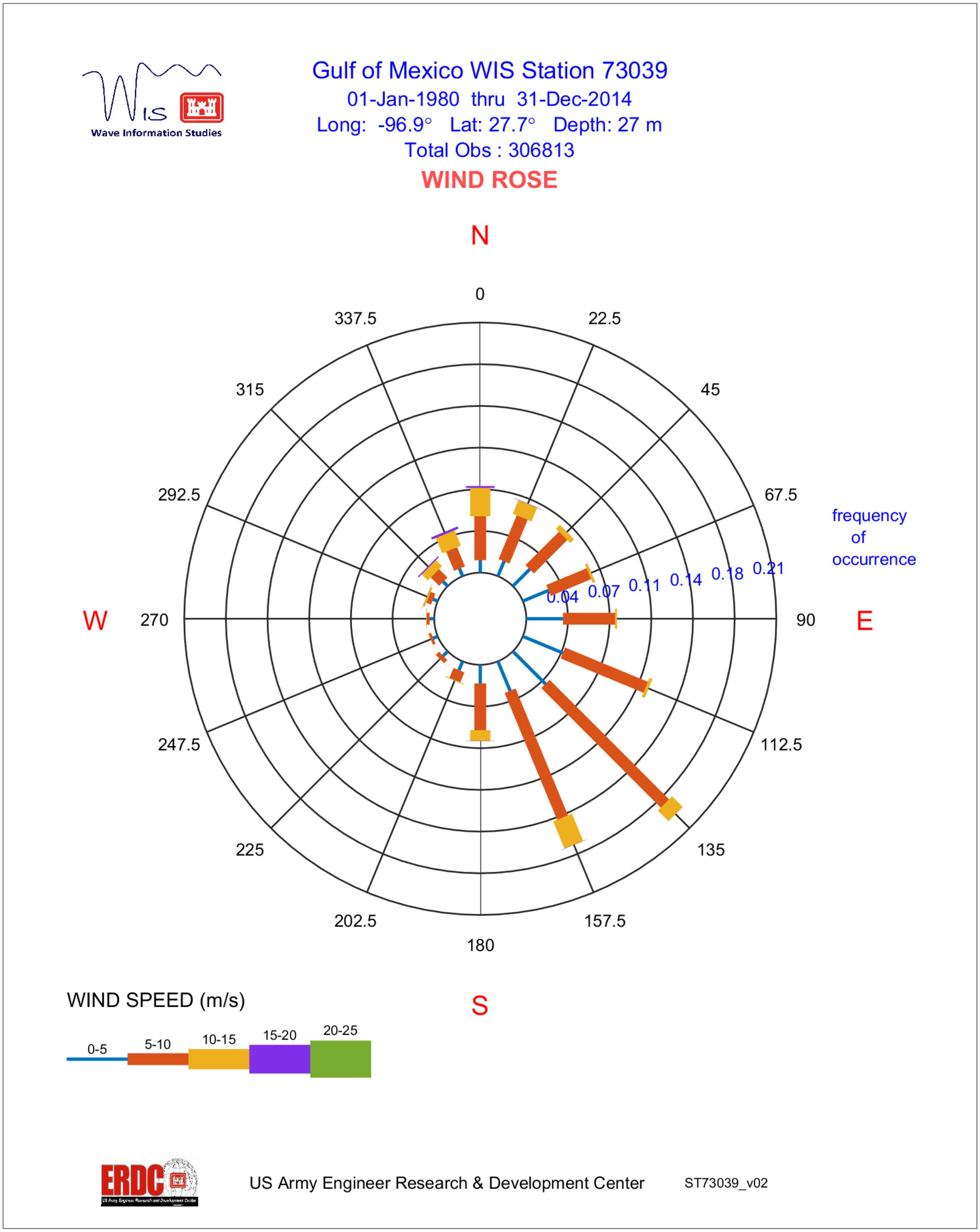
ANCHOR QEA

Figure 1
PA9-S Plan View

PA9-S Marsh Restoration 10% Design Memorandum
Texas Lower Coast Beneficial Use



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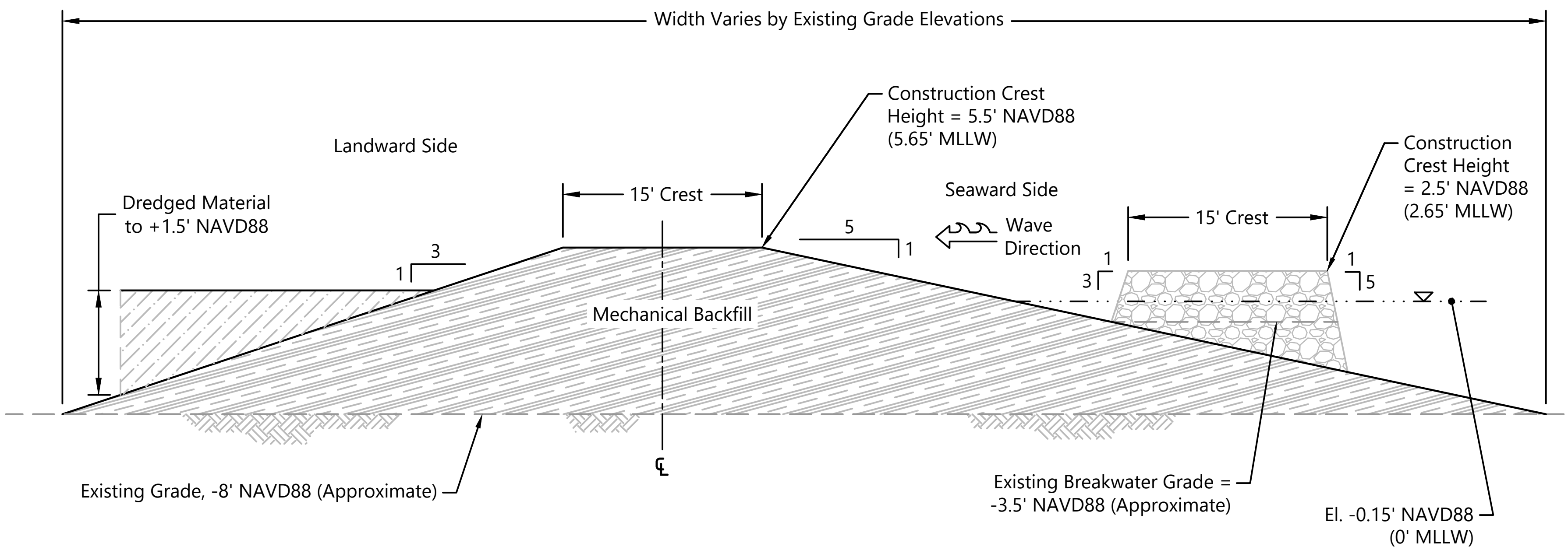
ANCHOR QEA

Figure 2
Historical Wind Data for USACE WIS Station 73039
PA9-S Marsh Restoration 10% Design Memorandum
Texas Lower Coast Beneficial Use



Section A-A' Typical Dike
Not to Scale

VERTICAL DATUM: North American Vertical Datum of 1988 (NAVD88)

Memorandum

January 31, 2022

To: Melissa McCutcheon, Texas General Land Office

From: Todd Merendino, Ducks Unlimited, Inc.
Sarah Garza, Harrison McNeil, and Yvonne Dives-Gomez, Port of Corpus Christi Authority
John Laplante, Dan Opdyke, Ray Newby, Adrienne Accardi, Alexander Freddo, and Hayden Smith, Anchor QEA, LLC
Jane Sarosdy, Sarosdy Consulting, Inc.

Re: Packery Flats 10% Design Memorandum

Introduction

This 10% design memorandum describes design criteria and assessments associated with the proposed Packery Flats site (Site), located in Texas General Land Office (GLO) Planning Region 3 of the Texas coast in Corpus Christi Bay in Nueces County, Texas (Figure 1).

Project Background

GLO awarded a Coastal Management Program Project of Special Merit grant (funded through the Gulf of Mexico Energy Security Act) to Ducks Unlimited, Inc. (DU), to identify priority locations and develop 10% designs and opinions of probable construction costs for at least 16 sites in GLO Planning Regions 3 and 4 of the Texas coast for the beneficial use of dredged material (BU). The project team is led by DU and Port of Corpus Christi Authority (PCCA) and includes Anchor QEA, LLC; Sarosdy Consulting, Inc.; and the Texas Department of Transportation. In addition to the 16 sites identified and prioritized, PCCA will provide additional resources to bring forward more site designs for review if the site prioritization and selection so warrants. The project team coordinated two online stakeholder meetings in each region to receive information about potential BU sites. Based on stakeholder input, GLO feedback, publicly available data, and professional judgment, the project team selected the Site as one of the 16 sites for 10% design development and cost estimation.

Conservationists have identified Corpus Christi Bay as an important location for creating and restoring tidal flats (CBBEP 2020). Since 2005, when Packery Channel was opened, tidal flats have been rapidly eroding on the bayside of Mustang Island near the channel. Due to the lack of successful, targeted tidal flat restoration along the Texas Coast, a pilot tidal flat restoration project has been selected by the project team to be built within an open-water low point in an area of marsh located on state-owned submerged land approximately 0.5 mile north of the of the Packery Channel and directly adjacent to, and southeast of, State Highway 361 in Nueces County, Texas.

Project Objectives

Frequent dredging is needed to develop and maintain Texas ship channels. The dredged material must be deposited in dredged material placement areas (DMPAs), and many of the existing DMPAs along the Texas coast are nearing capacity. Resource agencies and stakeholders have long advocated using dredged material beneficially to create and restore wetlands and bird islands, nourish beaches, and counteract land loss. Historically, BU projects are difficult to manage because they are multi-year, multi-faceted undertakings in which different organizations manage dredging schedules, funding, project design, permitting, and construction activities. To help address these issues, the objectives of this project include the following:

- Create and restore degrading coastal habitats.
- Establish sites for placement of dredged material to reduce reliance on existing DMPAs.
- Improve coastal resiliency of the natural and built environment.
- Reduce shoaling in the GIWW and other ship channels.

To accomplish these objectives, the project includes the following tasks:

- Stakeholder outreach and coordination
- Identification and selection of BU sites
- 10% designs and cost estimates for at least 16 BU sites
- 30% designs for at least eight BU sites
- 60% designs, cost estimates, and permit application packages for at least five BU sites

This memorandum documents the 10% design and cost estimate for one of the selected sites.

Design Objectives

This Site will be designed to beneficially use dredged material to construct a pilot tidal flat restoration. The design will use material dredged from navigation channels during routine maintenance, thus reducing the volume of such material that will need to be placed in existing open-bay or upland DMPAs. This 10% design is based upon publicly available datasets; no field work was conducted for this phase of the project.

Design objectives include the following:

- Develop a preliminary vision based on available data for the Site that includes the following:
  - Habitat to be created or restored
  - Potential sediment source(s)
  - Approaches to minimize long-term maintenance costs

- Delineate conceptual footprints for proposed BU placement.
- Identify key sensitive habitats and construction considerations in the vicinity of the Site.
- Estimate fill volumes for the proposed BU footprints.
- Identify data gaps to be addressed in subsequent design stages.
- Provide preliminary cost estimates.

Existing Data Review

Horizontal and Vertical Datums

The horizontal datum used for the Site is the Texas State Plane Zone 5, North American Datum of 1983 (NAD83), in U.S. survey feet. The primary vertical datum used for the Site is the North American Vertical Datum of 1988 (NAVD88). The National Oceanic and Atmospheric Administration (NOAA) maintains an active tide gauge within the vicinity of the Site. The NOAA Packery Channel, TX Station 8775792 is 2 miles west of the proposed Site. This station collects and records real-time tide information dating back to 1990. The vertical datums from this station that will be used for the Site are shown in Table 1.

Table 1
NOAA Packery Channel, TX Station 8775792 Tidal Gauge Displaying NAVD88 Tidal Datums

Tidal Datums	Elevation (feet NAVD88)
MHHW	0.79
MHW	0.79
MSL	0.59
MLW	0.36
MLLW	0.37

MHHW: mean higher high water
MHW: mean high water
MLLW: mean lower low water
MLW: mean low water
MSL: mean sea level

Meteorological, Ocean, and Wave Data

Wind and Waves

The United States Army Corps of Engineers (USACE) Wave Information Studies (WIS) provides a national resource of long-term wavefield climatologies for U.S. coastal waters that synthesizes observations, multi-decade hindcasts, and storm event archives (USACE 2021). The WIS station closest to the Site is Station 73037, just offshore on the Gulf side of Padre Island in the Gulf of Mexico. Because the station is located offshore, the wave data are not applicable to this project design. However, the project team considers the wind data to be representative of the winds experienced at the Site. Figure 2 summarizes wind data from January 1, 1980, through December 21, 2014. The data indicate that the predominant wind direction is from the southeast, with significant winds also coming from the north, northeast, east, and south.

The Site is located just east of State Highway 361; therefore, the wave energy is expected to be minimal.

Wake Erosion

The Site is located just east of State Highway 361, and wake erosion is not expected within the Site.

Bathymetry

The NOAA National Centers for Environmental Information continuously updated digital elevation model for the Texas Coast (NOAA 2021) was used to obtain bathymetry data for the Site. The Site has a relatively uniform seabed elevation that averages -0.54 foot NAVD88.

Utilities and Infrastructure

The Railroad Commission of Texas public GIS viewer (RRC 2021) was used to identify utilities and pipelines near the Site. No utilities were or pipelines were identified within the footprint of the Site, although there is an Agua Tranquillo Midstream LLC natural gas pipeline on the west side of the highway. It is not expected that this pipeline will have design or construction implications. The need for Site-specific utility locations prior to construction will be determined during subsequent design stages.

State Highway 361 is immediately adjacent to the Site. State Highway 181 is mostly a non-elevated highway with a bridge adjacent to the Site, and protection of the highway foundations and encroachment upon the Texas Department of Transportation (TXDOT) highway right-of-way will need to be considered in subsequent phases of design.

Desktop Cultural Resources Survey

A search of cultural resources records in the Texas Historical Commission Atlas Database was completed for the Site between November 29 and December 30, 2021. This search revealed that no archaeological surveys have been conducted and no archaeological sites have been identified within the preliminary proposed placement site boundary (THC 2021).

Sensitive Habitat

GLO oyster habitat GIS data (GLO 2021) indicate that there is no oyster habitat identified within or adjacent to the Site. According to Texas Parks and Wildlife Department (TPWD) seagrass data (TPWD 2021), there are suspected seagrasses that have been mapped within the Site footprint.

Because the sensitive habitat data are not recent, surveys will likely need to be conducted during a subsequent phase of design to evaluate the presence and extents of sensitive habitat to confirm or update the understanding of sensitive habitat in the vicinity of the Site.

Beneficial Use Source Material

One potential source of dredged material is the GIWW, located near the Site (Packery Channel itself is self-scouring and not regularly dredged). The GIWW near the Site is infrequently dredged (Jones 2021; USACE 1999), although there are mounds of relict new work material (e.g., DMPAs #173, #174, and #175) approximately 2 miles away that could serve as a sediment source for the Site.

Another possible source of sediment is the residential canal communities to the west and southwest, which may require maintenance dredging or could provide new work material if new construction occurs. Further information will need to be collected to determine average annual quantities for dredged material from these sources

10% Design

The main design features that are critical for tidal flat success are as follows:

- Site location
- Tidal flat size and shape
- Containment and erosion protection

These design features are evaluated in this memorandum for the preliminary Site design.

Site Location

The proposed location of the Site is approximately 0.5 mile north of the Packery Channel and directly adjacent to, and southeast of, State Highway 361 (Figure 1). The Site is located within open water within an existing marsh. Site layout may need to be refined to avoid encroachment of the TXDOT right-of-way and to avoid impacts on the highway foundation.

Locating the Site within an existing marsh is advantageous because the marsh acts as natural protection against wind waves and wake erosion.

The Site resides on a relative low point within the marsh that ranges in elevation from -1 to 2.1 feet NAVD88 (-1.37 to 1.73 feet mean lower low water). The Site's location adjacent to the highway could potentially provide favorable conditions for transporting materials and equipment to the Site. Bathymetric surveys will need to be conducted during subsequent design phases to better define Site dimensions and material quantity needs.

Size and Shape

Based on availability low points within the existing marsh, the project team proposes that the area of the Site be 7 acres. Due to expected mounding of the placed material, the Site will be created with dredged material placed to an ideal tidal flat elevation of +1.0 foot NAVD88, which will be 0.4 foot above MSL (GCERC 2020; Watson 1979). The elevation of dredged material fill could be adjusted at further stages of design depending on the physical properties of the dredged material. The Site will consist of fill extending from the edge of the existing marsh to the north toward the shoreline to the south for a natural angle of repose on the south side of the fill.

The seagrass data from TPWD (2021) show that there may be sensitive seagrass habitat within the Site footprint; however, the data are not recent. The location of seagrasses will need to be determined through field surveys during subsequent stages of design. For this design, the seagrass data from TPWD were used to inform the extent of the Site footprint. The footprint may change depending on the results of field surveys. It is expected that environmental controls such as turbidity curtains will be needed during construction to contain fines placed at the Site.

Fill material could be obtained from the GIWW, Packery Channel, or the nearby canal communities. It is predicted that the required fill volume will be approximately 24,000 cubic yards (cy), with approximately 6,500 cy being settled volume. This value assumes 1 foot of foundation compression for every 3 feet of fill and does not consider bulking. Geotechnical data will likely need to be collected during a subsequent design phase to further evaluate the expected foundation compression and the expected bulking of dredged material.

Containment and Erosion Protection

The Site is surrounded by marsh such that there is no anticipated need for armoring. The Site is located in an isolated deep pocket of the marsh, and turbidity curtains are expected to be sufficient to contain fine sediments to within the project boundaries.

Site Construction Cost Estimates

Construction costs were estimated for the design outlined in the previous sections. The estimated costs include permitting, 100% design, engineering costs for advancing the design to the construction phase, pre-construction and as-built surveys, mobilization, and materials. These costs represent the estimated incremental costs; i.e., those costs over and above USACE’s least cost and environmentally acceptable dredged material and disposal alternative. Table 2 shows a line-item list of each costing parameter and the total cost estimated for construction.

Table 2
Opinion of Probable Construction Cost to 100% Project Completion

Item	Quantity	Unit	Unit Price	Total
Pre-Construction Survey	1	LS	$ 30,000.00	$ 30,000.00
Incremental Dredging Cost (2-mile pipeline)	24,000	cy	$ 10.00	$ 240,000.00
Post-Construction Survey (topography/ bathymetry)	1	LS	$ 30,000.00	$ 30,000.00
Post-Construction Survey (aerials)	1	LS	$ 10,000.00	$ 10,000.00
Subtotal[1]			**Sum**	**$ 310,000.00**
Incremental Mobilization and Demobilization[1]	1	5%	$ 20,000.00	$ 20,000.00
Construction Total			**Sum**	**$ 330,000.00**
100% Engineering and Design[1]	1	25%	$ 80,000.00	$ 80,000.00
Permitting	1	Each	$ 100,000.00	$ 100,000.00
Construction Management[1]	1	15%	$ 50,000.00	$ 50,000.00
Post-Construction Management	12	Month	$ 10,000.00	$ 120,000.00
Project Subtotal[2]			**Sum**	**$ 700,000.00**
-30% Contingency[2]	1	30%	$ 200,000.00	$ 200,000.00
+50% Contingency[2]	1	50%	$ 340,000.00	$ 400,000.00
Low-End Total Project Estimated Cost[2]			**Total Sum**	**$ 500,000.00**
High-End Total Project Estimated Cost[2]			**Total Sum**	**$ 1,100,000.00**

Notes:
Costs were determined based upon publicly available datasets; no field work was conducted for this phase of the project.
1. Rounded to the nearest $10,000.
2. Rounded to the nearest $100,000.
LS: lump sum

The costs vary from $500,000 to $1.1 million, depending on the level of contingency allocated to the project cost.

The estimates are developed using current and generally accepted engineering cost estimating methods and are based on assumptions concerning future events. Actual costs may be affected by known and unknown risks including, but not limited to, changes in general economic business conditions, Site conditions that were unknown at the time the estimates were performed, future changes in Site conditions, regulatory or enforcement policy changes, and delays in performance. Actual costs may vary from these estimates.

Ecosystem Benefits Expected

Creation of the Site is expected to have positive benefits on the regional ecosystem. The pilot tidal flat restoration is expected to add 8 acres of tidal flat habitat to the regional ecosystem. This region is experiencing loss of tidal flats, and this pilot project will inform future attempts to restore tidal flats in the region.

Future Work

Of the sites selected for 10% designs in this project, at least eight will be selected for 30% designs, and at least five of those will subsequently be selected for 60% designs and cost estimates. No fatal flaws have been identified in this 10% design effort. Should this Site be selected for additional design efforts, it can be expected that some aspects of the design in this memorandum will be modified and, as appropriate, improved. In particular, if seagrasses are present, it is unlikely that the project will move forward as envisioned. Rather, if a similar, nearby, area without seagrasses is identified, that will become a better candidate for tidal flat restoration. As previously mentioned, it is possible that in each phase additional designs will be provided toward this project because of the partnership on this project between DU and PCCA.

References

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USACE, 2021. Wind Rose. Wave Information Studies. U.S. Army Engineer Research & Development Center. Accessed November 1, 2021. Downloaded from: http://frf.usace.army.mil/wis/data.

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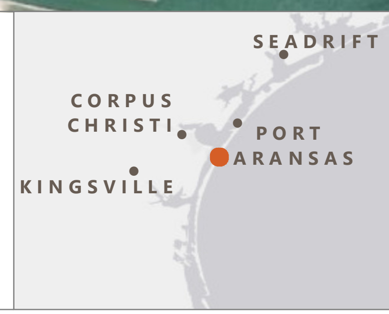
Figures

LEGEND:

- State Highway
- Pipeline
- Packery Flats Site
- Seagrass



NOTE:
Aerial imagery is from Esri basemaps

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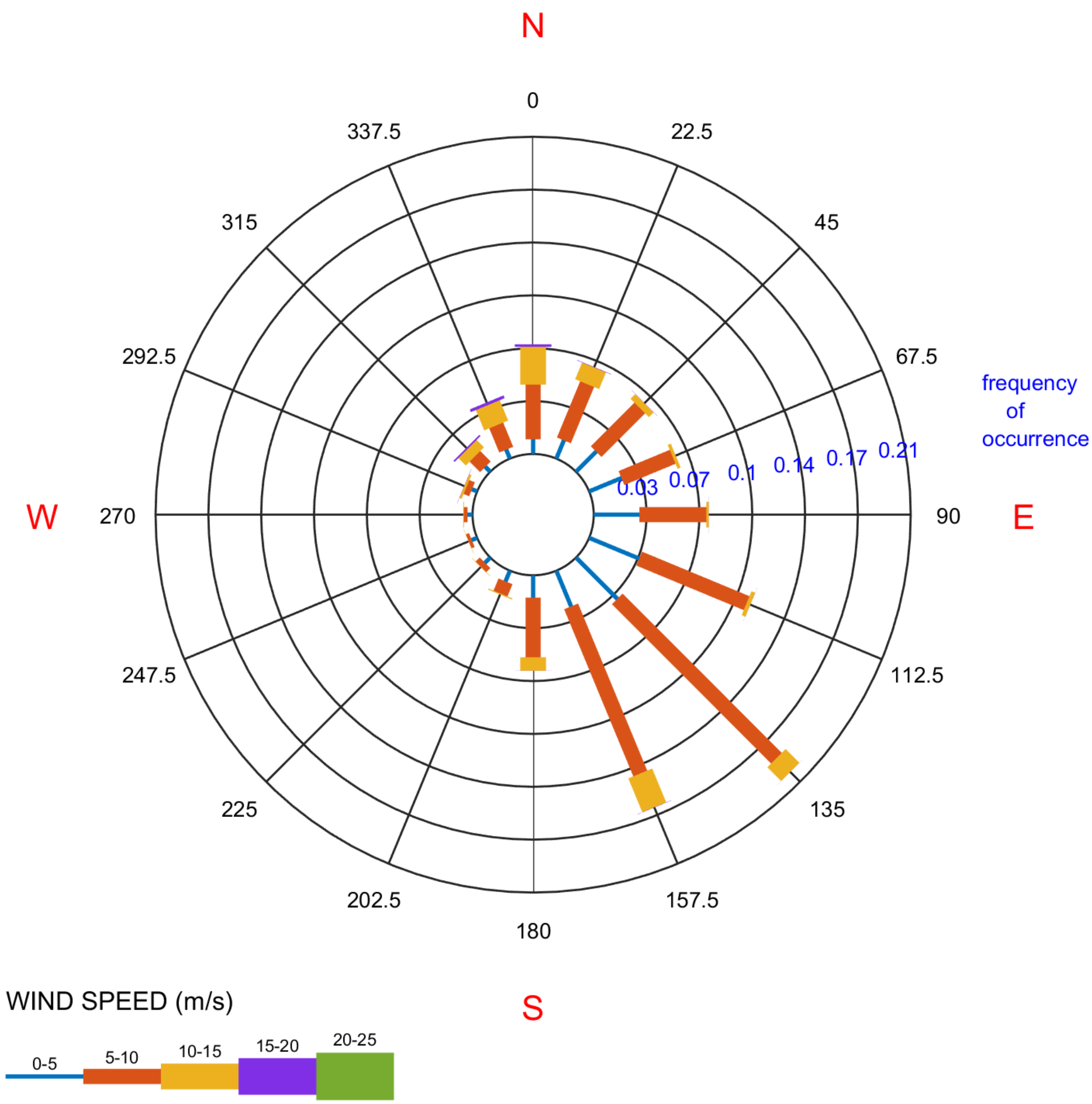
ANCHOR QEA

Figure 1
Packery Flats Plan View

Packery Flats 10% Design Memorandum
Texas Lower Coast Beneficial Use

Wave Information Studies

Gulf of Mexico WIS Station 73037
01-Jan-1980 thru 31-Dec-2014
Long: -97° Lat: 27.5° Depth: 30 m
Total Obs : 306813
WIND ROSE



US Army Engineer Research & Development Center ST73037_v02

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ANCHOR QEA

Figure 2
Historical Wind Data for USACE WIS Station 73037
Packery Flats 10% Design Memorandum
Texas Lower Coast Beneficial Use

Memorandum

January 31, 2022

To: Melissa McCutcheon, Texas General Land Office

From: Todd Merendino, Ducks Unlimited, Inc.
Sarah Garza, Harrison McNeil, and Yvonne Dives-Gomez, Port of Corpus Christi Authority
John Laplante, Dan Opdyke, Ray Newby, Adrienne Accardi, Alexander Freddo, and Hayden Smith, Anchor QEA, LLC
Jane Sarosdy, Sarosdy Consulting, Inc.

Re: Pelican Island (M3) Marsh Restoration 10% Design Memorandum

Introduction

This 10% design memorandum describes design criteria and assessments associated with the proposed Pelican Island (M3) site (Site), located in Texas General Land Office (GLO) Planning Region 3 of the Texas coast in Corpus Christi Bay in Nueces County, Texas (Figure 1).

Project Background

GLO awarded a Coastal Management Program Project of Special Merit grant (funded through the Gulf of Mexico Energy Security Act) to Ducks Unlimited, Inc. (DU), to identify priority locations and develop 10% designs and opinions of probable construction costs for at least 16 sites in GLO Planning Regions 3 and 4 of the Texas coast for the beneficial use of dredged material (BU). The project team is led by DU and Port of Corpus Christi Authority (PCCA) and includes Anchor QEA, LLC; Sarosdy Consulting, Inc.; and the Texas Department of Transportation. In addition to the 16 sites identified and prioritized, PCCA will provide additional resources to bring forward more site designs for review if the site prioritization and selection so warrants. The project team coordinated two online stakeholder meetings in each region to receive information about potential BU sites. Based on stakeholder input, GLO feedback, publicly available data, and professional judgment, the project team selected the Site as one of the 16 sites for 10% design development and cost estimation.

Pelican Island has been identified and used as a site for restoring rookery habitat (CBBEP 2020). This island has also been referred to as M3 in PCCA documents, hence both names are used in this design. The Site is located on state-owned submerged land approximately 2 miles east of the Gulf Intracoastal Waterway (GIWW) and 0.4 mile south of the Corpus Christi Ship Channel (CCSC) in Corpus Christi Bay in Nueces County, Texas. The existing Pelican Island (M3) is adjacent to patchy seagrass habitat that has limited natural protection from wave energy. The Site was damaged during Hurricane Harvey, and the center of the island was washed out. The PCCA has expressed potential plans to extend the northern breakwater and refill the center of the island. The BU design in this memorandum includes extending the South side of the island to create marsh. This design assumes that the northern side of Pelican Island (M3) will be protected; therefore, this design does not include additional protection. The Site was selected to complement the existing rookery use of the upland to increase availability of food for birds, as well as to promote marsh habitat. This area was selected due to its proximity to potential maintenance dredged material from the CCSC, as well as potential dredged material from the CCSC Channel Improvement Project.

Project Objectives

Frequent dredging is needed to develop and maintain Texas ship channels. The dredged material must be deposited in dredged material placement areas (DMPAs), and many of the existing DMPAs along the Texas coast are nearing capacity. Resource agencies and stakeholders have long advocated using dredged material beneficially to create and restore wetlands and bird islands, nourish beaches, and counteract land loss. Historically, BU projects are difficult to manage because they are multi-year, multi-faceted undertakings in which different organizations manage dredging schedules, funding, project design, permitting, and construction activities. To help address these issues, the objectives of this project include the following:

- Create and restore degrading coastal habitats.
- Establish sites for placement of dredged material to reduce reliance on existing DMPAs.
- Improve coastal resiliency of the natural and built environment.
- Reduce shoaling in the GIWW and other ship channels.

To accomplish these objectives, the project includes the following tasks:

- Stakeholder outreach and coordination
- Identification and selection of BU sites
- 10% designs and cost estimates for at least 16 BU sites
- 30% designs for at least eight BU sites
- 60% designs, cost estimates, and permit application packages for at least five BU sites

This memorandum documents the 10% design and cost estimate for one of the selected sites.

Design Objectives

This Site will be designed to beneficially use dredged material to create marsh. The design will use material dredged from navigation channels during routine maintenance and potentially from the CCSC Channel Improvement Project, thus reducing the volume of such material that will need to be placed in existing open-bay or upland DMPAs. This 10% design is based upon publicly available datasets; no field work was conducted for this phase of the project.

Design objectives include the following:

- Develop a preliminary vision based on available data for the Site that includes the following:
  - Habitat to be created or restored
  - Potential sediment source(s)
  - Approaches to minimize long-term maintenance costs
- Delineate conceptual footprints for proposed BU placement.
- Identify key sensitive habitats and construction considerations in the vicinity of the Site.
- Estimate fill volumes for the proposed BU footprints.
- Identify data gaps to be addressed in subsequent design stages.
- Provide preliminary cost estimates.

Existing Data Review

Horizontal and Vertical Datums

The horizontal datum used for the Site is the Texas State Plane Zone 5, North American Datum of 1983 (NAD83), in U.S. survey feet. The primary vertical datum used for the Site is the North American Vertical Datum of 1988 (NAVD88). The National Oceanic and Atmospheric Administration (NOAA) maintains an active tide gauge within the vicinity of the Site. The NOAA Ingleside, MODA Station 8775283 (Ingleside station), which is 3 miles to the west of the Site, does not provide NAVD88 vertical datums, so the NOAA Port Aransas, TX Station 8775237, which is 5 miles east of the Site, was used to convert the Ingleside station mean lower low water (MLLW) tidal datum to NAVD88. These stations collect and record real-time tide information dating back to 2002 and 1989, respectively. The vertical datums from the Ingleside station that will be used for the Site are shown in Table 1.

Table 1
NOAA Ingleside, MODA Station 8775283 Tidal Datums

Tidal Datums	Elevation (feet NAVD88)
MHHW	0.55
MHW	0.54
MSL	0.24
MLW	-0.15
MLLW	-0.15

Notes:
Datums converted to NAVD88 using the Port Aransas, TX Station 8775237.
MHHW: mean higher high water
MHW: mean high water
MLW: mean low water
MSL: mean sea level

Meteorological, Ocean, and Wave Data

Wind and Waves

The United States Army Corps of Engineers (USACE) Wave Information Studies (WIS) provides a national resource of long-term wavefield climatologies for U.S. coastal waters that synthesizes observations, multi-decade hindcasts, and storm event archives (USACE 2021). The WIS station closest to the Site is Station 73039, just offshore on the Gulf side of Port Aransas in the Gulf of Mexico. Because the station is located offshore, the wave data are not applicable to this project design. However, the project team considers the wind data to be representative of the winds experienced at the Site. Figure 2 summarizes wind data from January 1, 1980, through December 31, 2014. The data indicate that the predominant wind direction is from the southeast, with significant winds also coming from the north, northeast, east, and south.

There is a 3-mile fetch between Pelican Island (M3) and Mustang Island, the closest land mass in the predominant southeast wind direction. Due to the fetch and surrounding water depths, the Site is anticipated to be in a high wave-energy environment. A wave analysis of the direction and frequency of expected significant wave heights will be conducted in subsequent phases of design.

Wake Erosion

The GIWW is approximately 2 miles west of the Site, and the CCSC is approximately 0.5 mile north of the Site; however, ships do not often use this portion of the GIWW; rather, to avoid the “hole,” they transit to the west of M10 Island (Jones 2021; Hamilton et al. 2018). Potential wake erosion from vessels transiting the GIWW and CCSC is expected to be a design consideration. However, the project team determined that wake erosion was not the driving erosive wave condition for this design because the Site location will be on the south side of the island, where wind waves will be expected to have a greater erosive impact. The proposed armoring will be designed to resist wind- and vessel-generated erosive forces.

Bathymetry

The NOAA National Centers for Environmental Information continuously updated digital elevation model for the Texas Coast (NOAA 2021) was used to obtain bathymetry data for the Site. The Site footprint begins on the shoreline of the existing upland area and extends out to the -5-foot-NAVD88 contour. The average seabed elevation of the Site footprint is 0.1 foot NAVD88.

Utilities and Infrastructure

The Railroad Commission of Texas public GIS viewer (RRC 2021) was used to identify utilities and pipelines near the Site. There are many pipelines near the Site, including an Enbridge Pipelines (TX Intra) LP natural gas pipeline; a Corpus Christi Leaseholds, Inc., natural gas pipeline; and multiple Cinco Natural Resources Corporation natural gas full well stream (FWS) pipelines that come as close as 100 feet of the Site to the southeast and southwest. Impacts of these pipelines on the constructability of the Site will need to be evaluated during subsequent design phases, and offsets that modify the Site footprint and reduce potential storage capacity may be needed. In addition, there may be a pipeline that crosses the center of the Site; this issue will be evaluated in more detail in subsequent phases of design. The need for Site-specific utility locations prior to construction will be determined during subsequent design stages. No other infrastructure has been identified in the vicinity of the project Site.

Desktop Cultural Resources Survey

A search of cultural resources records in the Texas Historical Commission Atlas Database was completed for the Site between November 29 and December 30, 2021. This search revealed that one archaeological survey has been conducted in part of the proposed placement site area. No archaeological sites have been identified within the preliminary proposed placement site boundary (THC 2021).

Sensitive Habitat

GLO oyster habitat GIS data (GLO 2021) indicate that there is no oyster habitat identified within or adjacent to the Site. According to Texas Parks and Wildlife Department seagrass data (TPWD 2021), patchy seagrass habitat has been mapped to the northwest, northeast, east, southeast, and south. Because the sensitive habitat data are not recent, surveys will likely need to be conducted during a subsequent phase of design to evaluate the presence and extents of sensitive habitat to confirm or update the understanding of sensitive habitat in the vicinity of the Site.

Beneficial Use Source Material

The main potential source of dredged material is the CCSC, located adjacent to the Site. Continued dredging has recently been confirmed by USACE (Jones 2021). The identified DMPAs used by USACE adjacent to the Site and their associated historical average annual quantity of dredged material, distance from the Site, and channel segments are shown in Table 2. The average grain size and grain type percentages are shown in Table 3. This informs the quantity and characteristics of dredged material that may be available during a dredging cycle.

Table 2
USACE DMPA Areas Adjacent to the Site

DMPA No.	CCSC Channel Segment (station)	Distance from Site (miles)	Average Annual Dredging Quantity (cy)
6	Inner Basin to La Quinta Junction (0+00-270+00)	2	0
7	Inner Basin to La Quinta Junction (270+00-320+00)	0.4	35,000
8	Inner Basin to La Quinta Junction (320+00-400+00)	0.7	40,000
9	Inner Basin to La Quinta Junction (400+00-500+00)	1.9	51,000
10	Inner Basin to La Quinta Junction	3.5	0

Notes:
Source: USACE 1999
cy: cubic yard

Table 3
Typical Sediment Characteristics Between the Inner Basin to La Quinta Junction

Sediment Characteristics
D_{50} (mm) = 0.256
87.8% sand
6.6% silt
5.7% clay

Notes:
Channel Segment: (945+000-975+000) and (0+00-200+00)
Source: USACE 1999
mm: millimeter

Another potential source of sediment is from the Lower Bay Reach of the CCSC Channel Improvement Project. This project could potentially provide a substantial portion of the material used at the Site, however, analysis of the expected quantities that may become available during the extent of the CCSC Channel Improvement Project will need to be completed during a subsequent design phase. Further information will need to be collected during a subsequent phase of design to evaluate the precise sediment characteristics. Due to the proximity of the Site to these sediment sources, this Site should allow for lower construction costs compared to more remote potential marsh restoration sites.

Marsh Vegetation Elevation Ranges

Typical habitat ranges for relevant marsh vegetation were determined based on site vegetation surveys conducted by DU at the Lower Neches Wildlife Management Area Old River Unit, Texas Point National Wildlife Refuge (NWR), McFaddin NWR Willow Lake Terraces, Anahuac NWR Roberts Mueller Tract, Schicke Point, Guadalupe River Old Delta, and Goose Island State Park Cells sites located in GLO Planning Regions 1 and 2 of the Texas coast. This is shown in Table 4. Somewhat higher elevations can also support these species. Given the desire to design a long-term, sustainable, marsh, target elevations up to 1 foot above the values shown in Table 4 are considered suitable for design.

Table 4
Typical Elevations for Target Marsh Vegetation

Species	Elevation (feet MSL)	Elevation (feet NAVD88)
Spartina patens	0.25 to 1	0.49 to 1.24
Spartina alterniflora	0 to 0.75	0.24 to 0.99

10% Design

The main design features that are critical for marsh island success are as follows:

- Site location
- Marsh size and shape
- Containment and erosion protection
- Planting and natural recruitment of vegetation

These design features are evaluated in this memorandum for the preliminary Site design.

Site Location

The proposed location of the Site is approximately 2 miles east of the GIWW and 0.4 mile south of the CCSC. The Site is located near Ingleside in Corpus Christi Bay and between the existing PA9-S Island and Mustang Island (Figure 1).

The Site footprint begins on the shoreline of the existing upland area and extends out to the -5-foot-NAVD88 contour. The average elevation of the Site footprint is 0.1 foot NAVD88 (-0.15 foot MLLW). Water depths of greater than 5 feet surround the Site, providing beneficial conditions for construction access. Bathymetric surveys will need to be conducted during subsequent design phases to better define Site dimensions and material needs.

There are Cinco Natural Resources Corporation natural gas pipelines that run within 100 feet of the Site footprint on the southeast and southwest sides of the Site. Potential impacts to these natural gas pipelines will need to be evaluated and the Site footprint refined during subsequent design phases.

Size and Shape

Based on availability of sediment, a cost analysis, and stakeholder feedback, the project team proposes that the area of the Site be 185 acres. Due to expected mounding of the placed material, the Site will be created with dredged material placed to an elevation of +2.0 feet NAVD88, which will be at the upper end of the suitable habitat range for *Spartina patens* and *Spartina alterniflora*. The elevation of dredged material fill could be adjusted at further stages of design, depending on the physical properties of the dredged material or if other target species and their specific requirements are identified. The Site will consist of fill extending from the edge of the existing island to a newly constructed containment dike that will be built under this project. It is expected that environmental controls such as turbidity curtains will be needed during construction to contain fines placed at the Site.

Fill material could be obtained from the CCSC, as described in Table 2. It is predicted that the required fill volume will be approximately 1.2 million cubic yards (cy), with approximately 325,000 cy being settled volume. This value assumes 1 foot of foundation compression for every 3 feet of fill and does not consider bulking. Geotechnical data will likely need to be collected during a subsequent design phase to further evaluate the expected foundation compression and the expected bulking of dredged material.

Containment and Erosion Protection

Based on the fetch in the predominant southeast wind direction and potential risk of wake erosion, the project team proposes containment and armoring for the Site consisting of a 11,000-foot-long dike with a rock breakwater constructed on its seaward side at the -3.5-foot NAVD88 contour of the dike that will mitigate erosion to the marsh island and contain the dredged material. The dike will be composed of a hydraulic stiff clay dike fill with a 4-foot-thick rock revetment on the seaward slope. The dike will reside on an existing -5-foot-NAVD88 grade. The dike will contain a 5-horizontal-to-1-vertical (5H:1V) seaward side slope and a 3H:1V landward side slope connected by a 15-foot-wide crest. The construction height of the crest will be +5.5 feet NAVD88. The exact width will be dependent on the existing grade, but assuming -5.0 feet NAVD88, the breakwater base width will be 99 feet. The breakwater will contain a 5 horizontal to 1 vertical (5H:1V) seaward side slope and a 3H:1V landward side slope connected by a 15-foot-wide crest. The construction height of the crest will be +2.5 feet NAVD88. The exact width will be dependent on the existing grade, but assuming -3.5 feet NAVD88, the dike base width will be 63 feet. Figure 3 depicts a typical cross section of the dike. The size of the rock revetment and the final slope and cross-sectional dimensions of the dike will need to be determined and refined, respectively, through modeling and analysis of the sediment characteristics of the dredged material and the dike subgrade during a subsequent phase of design.

The dike will be constructed before the dredged material is pumped to the Site. As shown in Figure 3, the fill material will be directly contained by the dike. Confining the dredged slurry within the dike will reduce potential impacts to potential nearby sensitive habitat. The dike is proposed to protect the south shoreline of the Site from wind and wave impacts.

Planting and Natural Recruitment of Vegetation

Based on stakeholder input and cost considerations, the project team determined that that hydroseeding the edges of the marsh will be the most effective method for vegetating the marsh. Natural vegetation recruitment will then be allowed to proceed from the edge of the marsh inward. If the outcome is unsatisfactory (e.g., if the marsh has a lower-than-expected density of vegetation or if undesirable species of vegetation are present), an adaptive management program can be instituted to modify the vegetation. Table 4 shows some of the targeted vegetation and their preferred habitat elevations.

Site Construction Cost Estimates

Construction costs were estimated for the design outlined in the previous sections. The estimated costs include permitting, 100% design, engineering costs for advancing the design to the construction phase, pre-construction and as-built surveys, mobilization, materials, hydroseeding, and construction of the dike. These costs represent the estimated incremental costs; i.e., those costs over and above USACE's least cost and environmentally acceptable dredged material and placement alternative. Table 5 shows a line-item list of each costing parameter and the total cost estimated for construction.

Table 5
Opinion of Probable Construction Cost to 100% Project Completion

Item	Quantity	Unit	Unit Price	Total
Pre-Construction Survey	1	LS	$ 30,000.00	$ 30,000.00
Rock Breakwater (armor stone)	10,000	lf	$ 625.00	$ 6,250,000.00
Incremental Dredging Cost (2-mile pipeline)	1,200,000	cy	$ 10.00	$ 12,000,000.00
Shaping the Dike	10,000	lf	$ 15.00	$ 150,000.00
Hydroseeding	200,000	sf	$ 0.20	$ 40,000.00
Post-Construction Survey (topography/ bathymetry)	1	LS	$ 30,000.00	$ 30,000.00
Post-Construction Survey (aerials)	1	LS	$ 10,000.00	$ 10,000.00
Navigational Aids	20	Each	$ 4,000.00	$ 80,000.00
Subtotal[1]			**Sum**	**$ 18,600,000.00**
Incremental Mobilization and Demobilization[1]	1	5%	$ 900,000.00	$ 900,000.00
Construction Total[1]			**Sum**	**$ 19,500,000.00**
100% Engineering and Design[1]	1	10%	$ 2,000,000.00	$ 2,000,000.00
Permitting	1	Each	$ 100,000.00	$ 100,000.00
Construction Management[1]	1	8%	$ 1,600,000.00	$ 1,600,000.00
Post-Construction Management	12	Month	$ 10,000.00	$ 120,000.00
Project Subtotal[1]			**Sum**	**$ 23,300,000.00**
-30% Contingency[1]	1	30%	$ 7,000,000.00	$ 7,000,000.00
+50% Contingency[1]	1	50%	$ 11,700,000.00	$ 11,700,000.00
Low-End Total Project Estimated Cost[1]			**Total Sum**	**$ 16,300,000.00**
High-End Total Project Estimated Cost[1]			**Total Sum**	**$ 35,000,000.00**

Notes:
Costs were determined based upon publicly available data sets; no field work was conducted for this phase of the project.
1. Rounded to the nearest $100,000.
LS: lump sum
sf: square foot
lf: linear foot

The costs vary from $16.3 million to $35 million, depending on the level of contingency allocated to the project cost. Cost savings may be realized by further analysis and modeling of wind and wave conditions during subsequent design phases and refining the level of armoring.

The estimates are developed using current and generally accepted engineering cost estimating methods and are based on assumptions concerning future events. Actual costs may be affected by known and unknown risks including, but not limited to, changes in general economic business conditions, Site conditions that were unknown at the time the estimates were performed, future

changes in Site conditions, regulatory or enforcement policy changes, and delays in performance. Actual costs may vary from these estimates.

Ecosystem Benefits Expected

Creation of the Site is expected to have positive benefits on the regional ecosystem. The marsh restoration is expected to add 185 acres of mash habitat to the regional ecosystem. The armored island created at the Site will also provide resiliency to the degrading existing shoreline of Pelican Island (M3) and increase foraging habitat for birds.

Future Work

Of the sites selected for 10% designs in this project, at least eight will be selected for 30% designs, and at least five of those will subsequently be selected for 60% designs and cost estimates. No fatal flaws have been identified in this 10% design effort. Should this Site be selected for additional design efforts, it can be expected that some aspects of the design in this memorandum will be modified and, as appropriate, improved. As previously mentioned, it is possible that in each phase additional designs will be provided toward this project because of the partnership on this project between DU and PCCA.

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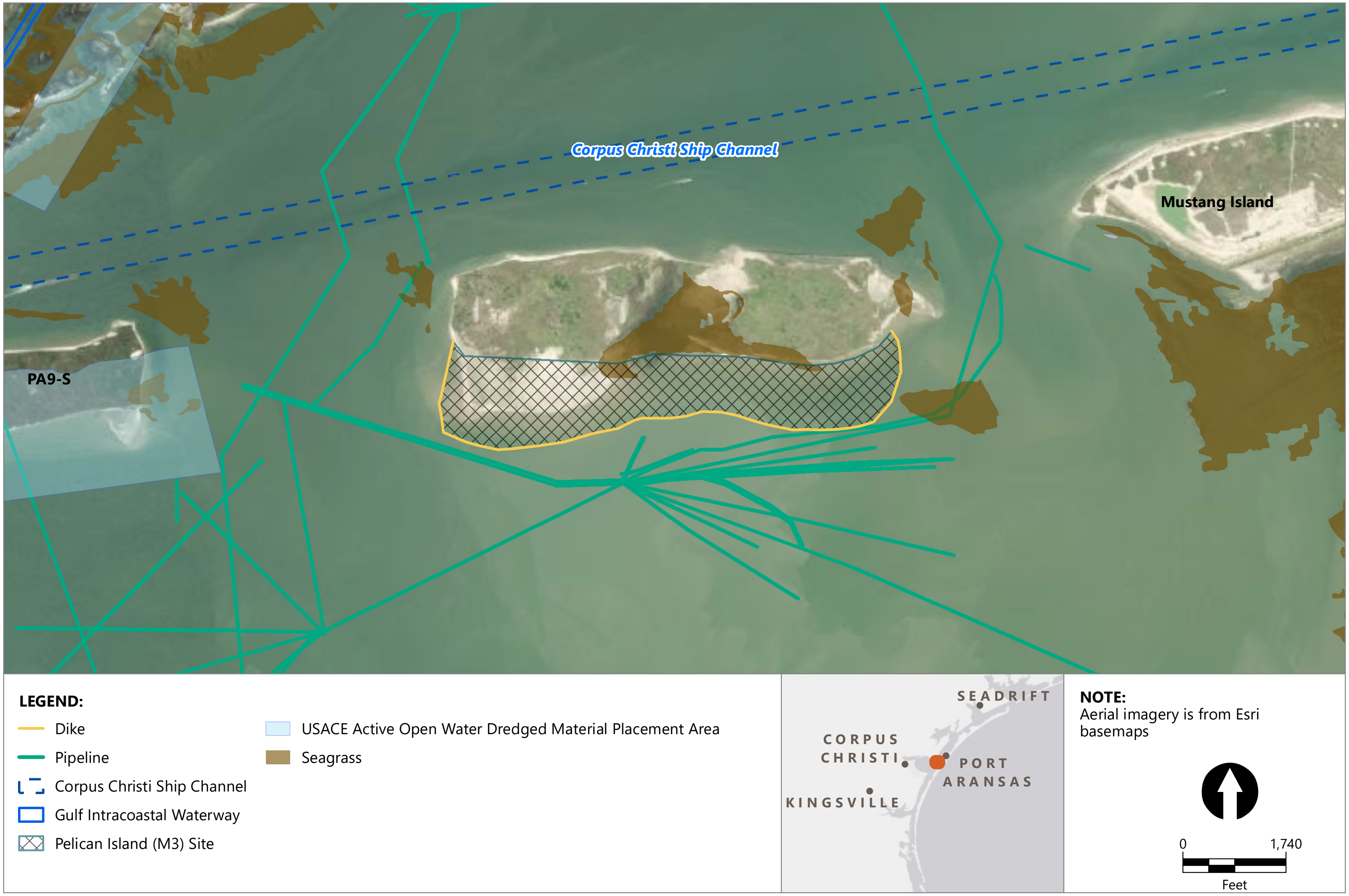
Figures



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ANCHOR QEA

Figure 1
Pelican Island (M3) Plan View
Pelican Island (M3) Marsh Restoration 10% Design Memorandum
Texas Lower Coast Beneficial Use

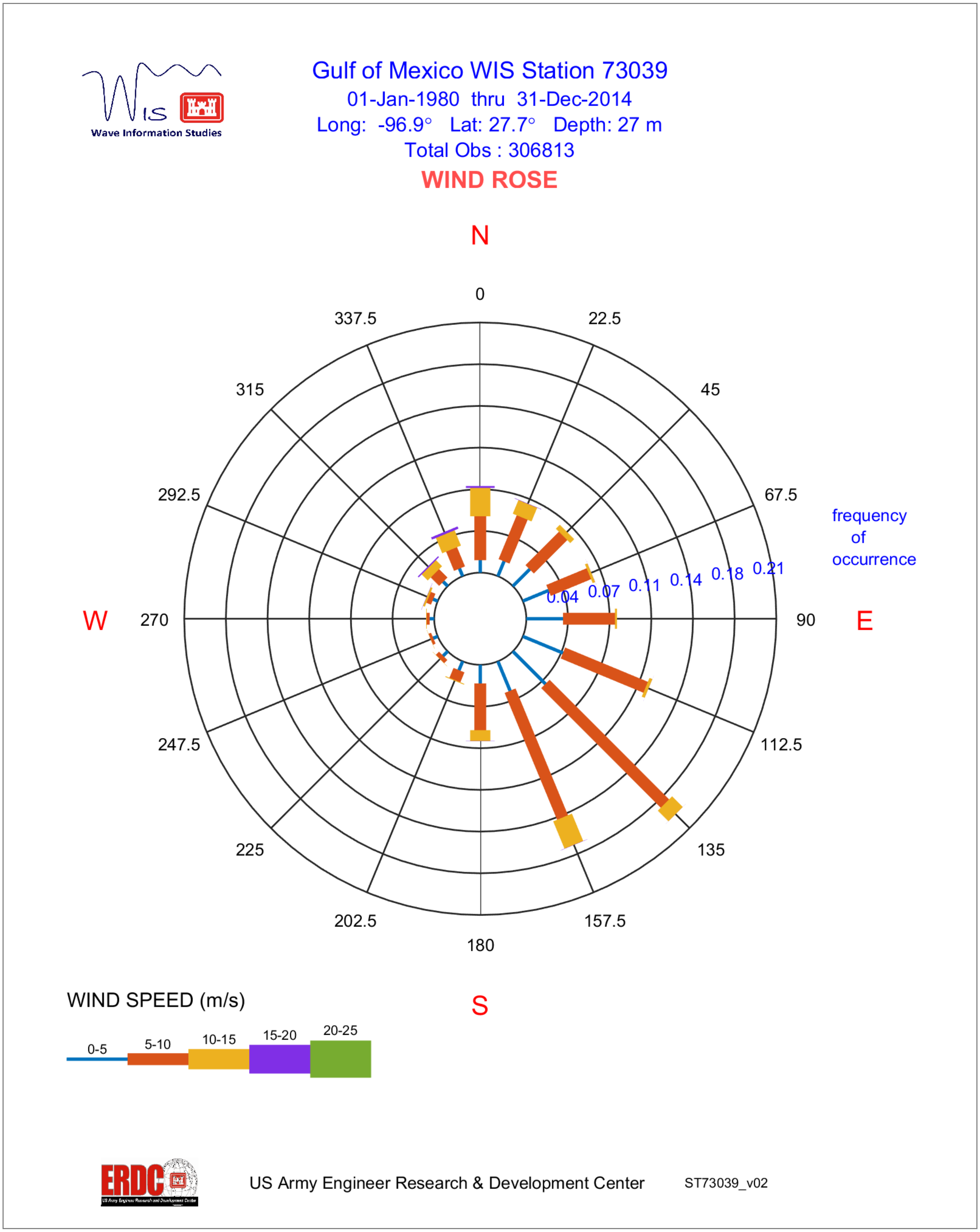

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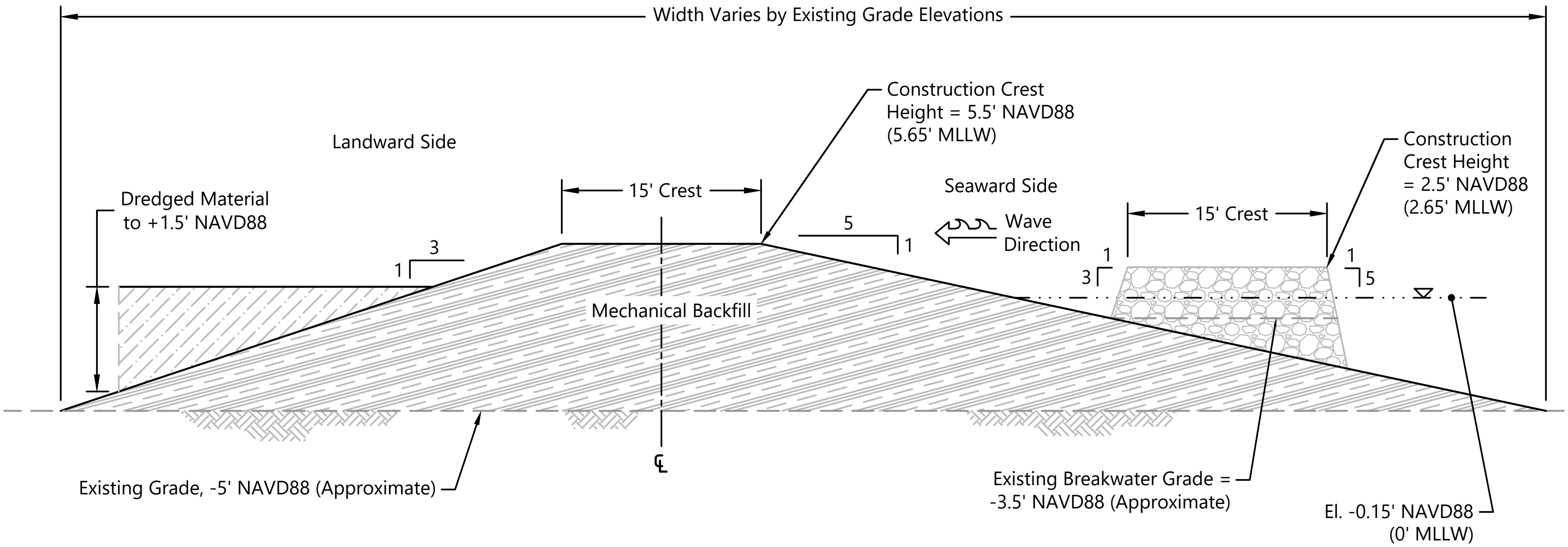
Figure 2
Historical Wind Data for USACE WIS Station 73039
Pelican Island (M3) Marsh Restoration 10% Design Memorandum
Texas Lower Coast Beneficial Use



Section A-A' Typical Dike
Not to Scale

VERTICAL DATUM: North American Vertical Datum of 1988 (NAVD88)

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Filepath: K:\Projects\1942-Ducks Unlimited\Little Bird Island\Little Bird Island North 10% Design\1942-RP-005 PELICAN ISLAND.dwg Figure 3

ANCHOR QEA

Figure 3
Section A-A' Typical Dike

Pelican Island (M3) Marsh Restoration 10% Design Memorandum
Texas Lower Coast Beneficial Use

Memorandum

January 31, 2021

To: Melissa McCutcheon, Texas General Land Office

From: Todd Merendino, Ducks Unlimited
Sarah Garza, Harrison McNeil, and Yvonne Dives-Gomez, Port of Corpus Christi Authority
John Laplante, Dan Opdyke, Ray Newby, Adrienne Accardi, Alexander Freddo, and Hayden Smith, Anchor QEA, LLC
Jane Sarosdy, Sarosdy Consulting, Inc.

Re: Portland Nueces Bay Marsh 10% Design Memorandum

Introduction

This 10% design memorandum describes design criteria and assessments associated with the proposed Portland Nueces Bay Marsh site (Site), located in Texas General Land Office (GLO) Planning Region 3 of the Texas coast in Nueces Bay in Nueces County, Texas (Figure 1).

Project Background

GLO awarded a Coastal Management Program Project of Special Merit grant (funded through the Gulf of Mexico Energy Security Act) to Ducks Unlimited, Inc. (DU), to identify priority locations and develop 10% designs and opinions of probable construction costs for at least 16 sites in GLO Planning Regions 3 and 4 of the Texas coast for the beneficial use of dredged material (BU). To assist in this endeavor, the Port of Corpus Christ Authority (PCCA) has committed to provide in-kind services to advance several additional BU sites in tandem with the aforementioned scope. The project team is led by DU and PCCA and includes Anchor QEA, LLC; Sarosdy Consulting, Inc.; and the Texas Department of Transportation. In addition to the 16 sites identified and prioritized, PCCA will provide additional resources to bring forward more site designs for review if the site prioritization and selection so warrants. The project team coordinated two online stakeholder meetings to receive information about potential BU sites. Ultimately the project team did not select this site as part of the 16 sites for 10% design. However based on stakeholder input, GLO feedback, publicly available data, and professional judgment, PCCA selected the Site to advance to the 10% design development and cost estimation.

Nueces Bay is a shallow bay system with poor hydrologic circulation, averaging 2 to 3 feet, and dominated by mudflats and oyster reefs (CBBEP 2005). Nueces Bay has been the location for multiple successful habitat creation and restoration projects, including Causeway Island and the Nueces Bay Marsh Creation. The Coastal Bend Bays and Estuaries Program (CBBEP) constructed both of the projects. Due to the success of the Nueces Bay Marsh Creation project, CBBEP stakeholders communicated the desire to progress a similar Nueces Bay Marsh design concept at the Site. CBBEP also indicated the desire to create a uniform marsh area in the same footprint as an alternative to the terrace field. Because CBBEP used an excavate-and-sidecast methodology to create the existing terrace field, the project team decided to advance a uniform marsh area. The project team believes that the uniform marsh area is a more practical BU application due to the level of controls and containment that would be required to construct marsh terraces with dredge slurry. The project team selected this Site due to its proximity to a sediment source in the La Quinta Channel and the demonstration of successful implementation of the adjacent Nueces Bay Marsh Creation project.

Project Objectives

Frequent dredging is needed to develop and maintain Texas ship channels. The dredged material must be deposited in dredged material placement areas (DMPAs), and many of the existing DMPAs along the Texas coast are nearing capacity. Resource agencies and stakeholders have long advocated using dredged material beneficially to create and restore wetlands and bird islands, nourish beaches, and counteract land loss. Historically, BU projects are difficult to manage because they are multi-year, multi-faceted undertakings in which different organizations manage dredging schedules, funding, project design, permitting, and construction activities. To help address these issues, the objectives of this project include the following:

- Create and restore degrading coastal habitats.
- Establish sites for disposal of dredged material to reduce reliance on existing DMPAs.
- Improve coastal resiliency of the natural and built environment.
- Reduce shoaling in the GIWW and other ship channels.

To accomplish these objectives, the project includes the following tasks:

- Stakeholder outreach and coordination
- Identification and selection of BU sites
- 10% designs and cost estimates for at least 16 BU sites
- 30% designs for at least eight BU sites
- 60% designs, cost estimates, and permit application packages for at least five BU sites

This memorandum documents the 10% design and cost estimate for one of the selected sites.

Design Objectives

This Site will be designed to beneficially use dredged material to create marsh habitat in a region with degrading tidal marsh. The design will use material dredged from navigation channels during routine maintenance, thus reducing the volume of such material placed in existing open-bay or DMPAs. This 10% design is based upon publicly available datasets; no fieldwork was conducted for this phase of the project.

Design objectives include the following:

- Develop a preliminary vision based on available data for the Site that includes the following:
  - Habitat to be created or restored
  - Potential sediment source(s)
  - Approaches to minimize long-term maintenance costs
- Delineate conceptual footprints for proposed BU placement.
- Identify key sensitive habitats and construction considerations in the vicinity of the Site.
- Estimate fill volumes for the proposed BU footprints.
- Identify data gaps to be addressed in subsequent design stages.
- Provide preliminary cost estimates.

Existing Data Review

Horizontal and Vertical Datums

The horizontal datum used for the Site is the Texas State Plane Zone 5, North American Datum of 1983 (NAD83) in U.S. survey feet. The primary vertical datum used for the Site is the North American Vertical Datum of 1988 (NAVD88). The National Oceanic and Atmospheric Administration (NOAA) maintains an active tide gauge within the vicinity of the Site. The NOAA USS Lexington, Corpus Christi Bay, TX Station 8775296 is 5 miles southwest of the proposed island. This station collects and records real-time tide information dating back to 2004. The vertical datums from this station that will be used for the Site are shown in Table 1.

Table 1
NOAA USS Lexington, Corpus Christi Bay, TX Station 8775296 Tidal Gauge Displaying NAVD88 Tidal Datums

Tidal Datums	Elevation (feet NAVD88)
MHHW	1.02
MHW	1.01
MSL	0.76
MLW	0.43
MLLW	0.42

Notes:
MHHW: mean higher high water
MHW: mean high water
MLLW: mean lower low water
MLW: mean low water
MSL: mean sea level

Meteorological, Ocean, and Wave Data

Wind and Waves

The United States Army Corps of Engineers (USACE) Wave Information Studies (WIS) provides a national resource of long-term wavefield climatologies for U.S. coastal waters that synthesizes observations, multi-decade hindcasts, and storm events archives (USACE 2021). The WIS station closest to the Site is Station 73039, just offshore on the Gulf side of Mustang Island in the Gulf of Mexico. Because the station is located offshore, the wave data were not used. However, the project team considers the wind data to be representative of the winds experienced at the Site. Figure 2 summarizes wind data from January 1, 1980, through December 31, 2014. The data indicate that the predominant wind direction is from the southeast, with significant winds also coming from the north, northeast, east, and south.

Due to its proximity to the Nueces Bay Causeway (U.S. Highway 181) and Portland, the Site is protected from wave action generated by prevailing winds. There is substantial fetch to the west across Nueces Bay at the Site, but winds experienced in this direction are minimal and not considered to be significant.

Wake Erosion

The La Quinta Channel is approximately 3 miles east of the Site. However, the Nueces Bay Causeway and Indian Point serve as hydrologic barriers separating the Site from any commercial navigation channels. Potential wake erosion from vessels transiting the La Quinta Channel is not expected to be a design consideration.

Bathymetry

The NOAA National Centers for Environmental Information continuously updated digital elevation model for the Texas Coast (NOAA 2021) was used to obtain bathymetry data for the Site. The Site has a relatively uniform depth that averages -1 foot NAVD88.

Utilities and Infrastructure

The Railroad Commission of Texas public GIS viewer (RRC 2021) was used to identify utilities and pipelines near the Site. Four pipelines were found landward of the Site: two natural gas gather lines operated by Sulphur River Exploration, Inc.; a crude oil gathering operated by BEPCO, L.P.; and a natural gas gathering line operated by Southcross CCNG Gathering, Ltd. (Figure 1). These lines are located 400 feet from the Site. It is not anticipated that these pipelines will affect the design or constructability of the Site. The need for Site-specific utility locations prior to construction will be determined during subsequent design stages.

U.S. Highway 181, the City of Portland Public Works Department, and a residential complex are immediately adjacent to the Site. Protection of the highway and building foundations will need to be considered in subsequent phases of design.

Desktop Cultural Resources Survey

A search of cultural resources records in the Texas Historical Commission Atlas Database (THC 2021) was completed on December 31, 2021. This search revealed that no cultural resources surveys have been conducted and no cultural resources sites have been identified within the Site. Two cultural resources were identified near the Site (within 1 mile). However, the proposed project will not affect these resources in any way.

Sensitive Habitat

GLO oyster habitat GIS data (GLO 2021) indicate that oyster habitat is located approximately 1,400 feet west of the Site. According to Texas Parks and Wildlife Department seagrass data (TPWD 2021), there are no seagrasses mapped within or adjacent to the Site. Surveys will likely need to be conducted during a subsequent phase of design to evaluate the presence and extent of sensitive habitat.

Beneficial Use Source Material

One potential source of dredged material is the La Quinta Channel Extension located 3 miles east of the Site. PCCA estimates approximately 2,560,000 cubic yards (cy) of maintenance material from the La Quinta Channel Extension as well as 96,600 cy of maintenance material from the berths at the La Quinta Terminal. Additionally, PCCA is authorized to dredge a third berth at the La Quinta Terminal, which would generate approximately 650,500 cy of new work material. Based on Coastal Consistency Determinations from USACE, USACE has historically performed maintenance dredging on the La Quinta Channel near the Site (USACE 1999). The average grain size and grain type percentages are shown in Table 2. This informs the quantity and characteristics of dredged material that may be available during a dredging cycle. For example, the Site will be designed such that the clay, which constitutes a relatively high percentage of nearby sediment, will be sheltered from erosive forces.

Table 2
Typical Sediment Characteristics in the La Quinta Channel

Sediment Characteristics from the LaQuinta Channel
D_{50} (mm) = 0.038
10.78.5% Sand
71.4% Silt
17.9% Clay

Notes:
Source: USACE 1999
D_{50}: median grain size
mm: millimeter

Marsh Vegetation Elevation Ranges

Typical habitat ranges for relevant marsh vegetation were determined based on site vegetation surveys conducted by PCCA at three sites near Harbor Island, Nueces County, Texas, located in GLO Planning Region 3 on the Texas coast. The Site is designed to recruit low and high marsh species, ideally *Spartina patens and Spartina alterniflora.* Table 3 details the recorded elevations for these species near Harbor Island.

Table 3
Typical Elevations for Target Marsh Vegetation

Species	Average Elevation (feet MSL)	Average Elevation (feet NAVD88)
Spartina patens	1.94	2.7
Spartina alterniflora	1.06	1.8

10% Design

The main design features that are critical for marsh island success are as follows:

- Site location
- Marsh size and shape

- Containment and erosion protection
- Planting and natural recruitment of vegetation

These design features are evaluated in this memorandum for the preliminary Site design.

Site Location

The proposed location of the Site is less than 1 mile northeast of the existing Nueces Bay Marsh Creation project. The Site is nested between the city of Portland and U.S. Highway 181 (Nueces Bay Causeway). The Portland water treatment plant outfalls directly north of the Site. Additionally, southwest of the Site, a small overpass allows hydrologic circulation to Sunset Lake and Indian Point Park. Wetlands directly east of the Site also influenced the place and design.

The average water depth surrounding the Site is -1 foot NAVD88 (-0.58 foot mean lower low water). Water depths surrounding the Site will make it difficult to deploy heavy equipment from barges without the dredging of access channels; however, it is assumed that deployment of heavy equipment (e.g., marsh buggies) will be used to stack and shape the marsh. Bathymetric surveys will need to be conducted during subsequent design phases to better define Site dimensions and material needs. Due to the water depth and proximity to other special aquatic sites (e.g., oysters and seagrass), the project team recommends aquatic resource surveys as well.

Size and Shape

Based on the availability of sediment, a cost analysis, and stakeholder feedback, the project team proposes that the area of the Site be 39 acres of marsh. Figure 3 shows a typical cross section of the proposed marsh. The shape of the project was developed to prevent impairment to the existing Portland water treatment and Sunset Lake/Indian Point Park hydrologic exchanges. Further design may either increase or decrease the Site footprint to ensure flow is not impaired.

The Site would be created with dredged material placed to an maximum elevation of +2.7 feet NAVD88. The grade will be design radially with the highest elevation in the center, sloping to meet the existing elevation of the surrounding environment. Because the Site is protected from the prevailing winds, armoring will not be required. The elevation of dredged material fill could be adjusted at further stages of design depending on the physical properties of the dredged material or if target plant species and their specific requirements are identified. It is expected that temporary containment of material will be needed to the west at the open end of Nueces Bay during construction to allow for material dewatering.

Fill material could be obtained from the La Quinta Extension Channel or La Quinta Terminal berths, as described previously in the Beneficial Use Source Material section. It is predicted that the required dried fill volume will be approximately 521,700 cy. This value assumes 1 foot of foundation compression for every 3 feet of fill and does not consider bulking. Geotechnical data will likely need to be collected during a subsequent design phase to further evaluate the expected foundation compression and the expected bulking of dredged material.

Containment and Erosion Protection

It is expected that temporary containment of material and environmental controls such as turbidity curtains will be needed at the open end of Nueces Bay to contain finer sediment placed during construction.

Because the Site is naturally protected from erosive forces, the project team does not propose armoring for the Site.

Planting and Natural Recruitment of Vegetation

Based on stakeholder input and cost considerations, the project team determined that planting will likely be required. The adjacent marsh creation could be a potential source of transplant species for *Spartina alterniflora*. PCCA's beneficial use site 6, located next to the La Quinta Channel extension, could also be another potential source of transplant species.

Site Construction Cost Estimates

Construction costs were estimated for the design outlined in the previous sections. The estimated costs include permitting, 100% design, engineering costs for advancing the design to the construction phase, pre-construction and as-built surveys, mobilization, materials, and construction of the breakwater. These costs represent the estimated incremental costs; i.e., those costs over and above USACE's least cost and environmentally acceptable dredged material and disposal alternative. Table 4 shows a line-item list of each costing parameter and the total cost estimated for construction.

Table 4
Opinion of Probable Construction Cost to 100% Project Completion

Item	Quantity	Unit	Unit Price	Total
Pre-Construction Survey	1	LS	$ 30,000.00	$ 30,000.00
Incremental Dredging Cost (3-mile pipeline)[1]	251,700	cy	$ 15.00	$ 3,780,000.00
Marsh Buggy Fill Maintenance[1]	77	Days	$ 2,500.00	$ 190,000.00
Post-Construction Survey (topography/ bathymetry)	1	LS	$ 30,000.00	$ 30,000.00
Post-Construction Survey (aerials)	1	LS	$ 10,000.00	$ 10,000.00
Subtotal[2]			**Sum**	**$ 4,000,000.00**
Incremental Mobilization	1	5%	$ 200,000.00	$ 200,000.00
Construction Total			**Sum**	**$ 4,200,000.00**
100% Engineering and Design[2]	1	10%	$ 400,000.00	$ 400,000.00
Permitting	1	Each	$ 100,000.00	$ 100,000.00
Construction Management[2]	1	8%	$ 300,000.00	$ 300,000.00
Post-Construction Management	12	Month	$ 10,000.00	$ 120,000.00
Project Subtotal[2]			**Sum**	**$ 5,100,000.00**
-30% Contingency[2]	1	30%	$1,500,000.00	$ 1,500,000.00
+50% Contingency[2]	1	50%	$2,600,000.00	$ 2,600,000.00
Low-End Project Estimated Cost[2]			**Total Sum**	**$ 3,600,000.00**
High-End Project Estimated Cost[2]			**Total Sum**	**$ 7,700,000.00**

Notes:
Costs were determined based upon publicly available datasets; no fieldwork was conducted for this phase of the project.
1. Rounded to the nearest $10,000.
2. Rounded to the nearest $100,000.

LS: lump sum
sy: square yard

The costs vary from $3.6 million to $7.7 million, depending on the level of contingency allocated to the project cost. Future design constraints may alter the size and orientation of individual terraces that are ultimately constructed, but at this level of design, it was decided to consider the largest possible site.

The estimates are developed using current and generally accepted engineering cost estimating methods and are based on assumptions concerning future events. Actual costs may be affected by known and unknown risks including, but not limited to, changes in general economic business conditions, Site conditions that were unknown at the time the estimates were performed, future changes in Site conditions, regulatory or enforcement policy changes, and delays in performance. Actual costs may vary from these estimates.

Ecosystem Benefits Expected

The creation of the Site is expected to have positive benefits on the regional ecosystem. The adjacent Nueces Bay Marsh Creation project created 160 acres of marsh terraces that have successfully established smooth cordgrass (*Spartina alterniflora*). Based on post-construction surveys, this marsh mimics natural marsh sites throughout the Coastal Bend in its vegetation density and faunal abundance (Smee 2016). This proposed Site would construct additional marsh in the same manner in adjacent shallow water and expand the already demonstrated ecological benefit of the CBBEP project.

Future Work

Of the sites selected for 10% designs in this project, at least eight will be selected for 30% designs, and at least five of those will subsequently be selected for 60% designs and cost estimates. No fatal flaws have been identified in this 10% design effort. Should this Site be selected for additional design efforts, it can be expected that some aspects of the design in this memorandum will be modified and, as appropriate, improved. As previously mentioned, it is possible that in each phase additional designs will be provided toward this project because of the partnership on this project between DU and PCCA.

References

CBBEP (Coastal Bend Bays & Estuaries Program), 2005. *Characterization of Potential Health Risks Associated with Consumption of Fish and Shellfish from Nueces Bay, Nueces County, TX*. Publication CBBEP – 48. Project Number – 0403. August 2005. Available at: https://www.cbbep.org/publications/virtuallibrary/2008table/0403.pdf.

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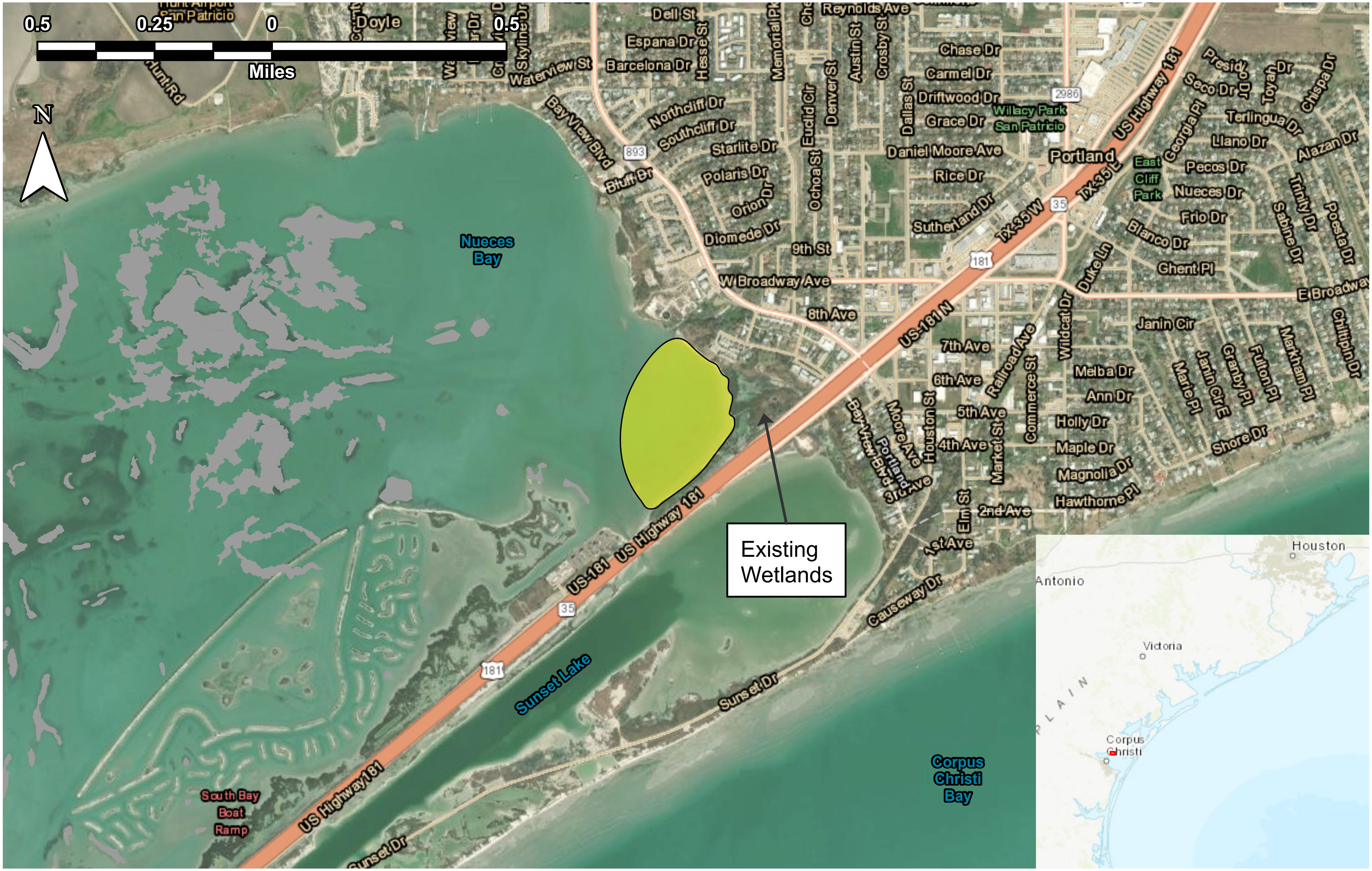
USACE, 2021. Wind Rose. Wave Information Studies. U.S. Army Engineer Research & Development Center. Accessed November 1, 2021. Downloaded from: http://frf.usace.army.mil/wis/data.

Figures



Legend

Nueces Marsh — Oyster Habitat

BU Type

Marsh Terraces

PORTCORPUSCHRISTI

Figure 1
Location Map

Portland Nueces Bay Marsh
10% Design Memorandum
Texas Lower Coast Beneficial Use

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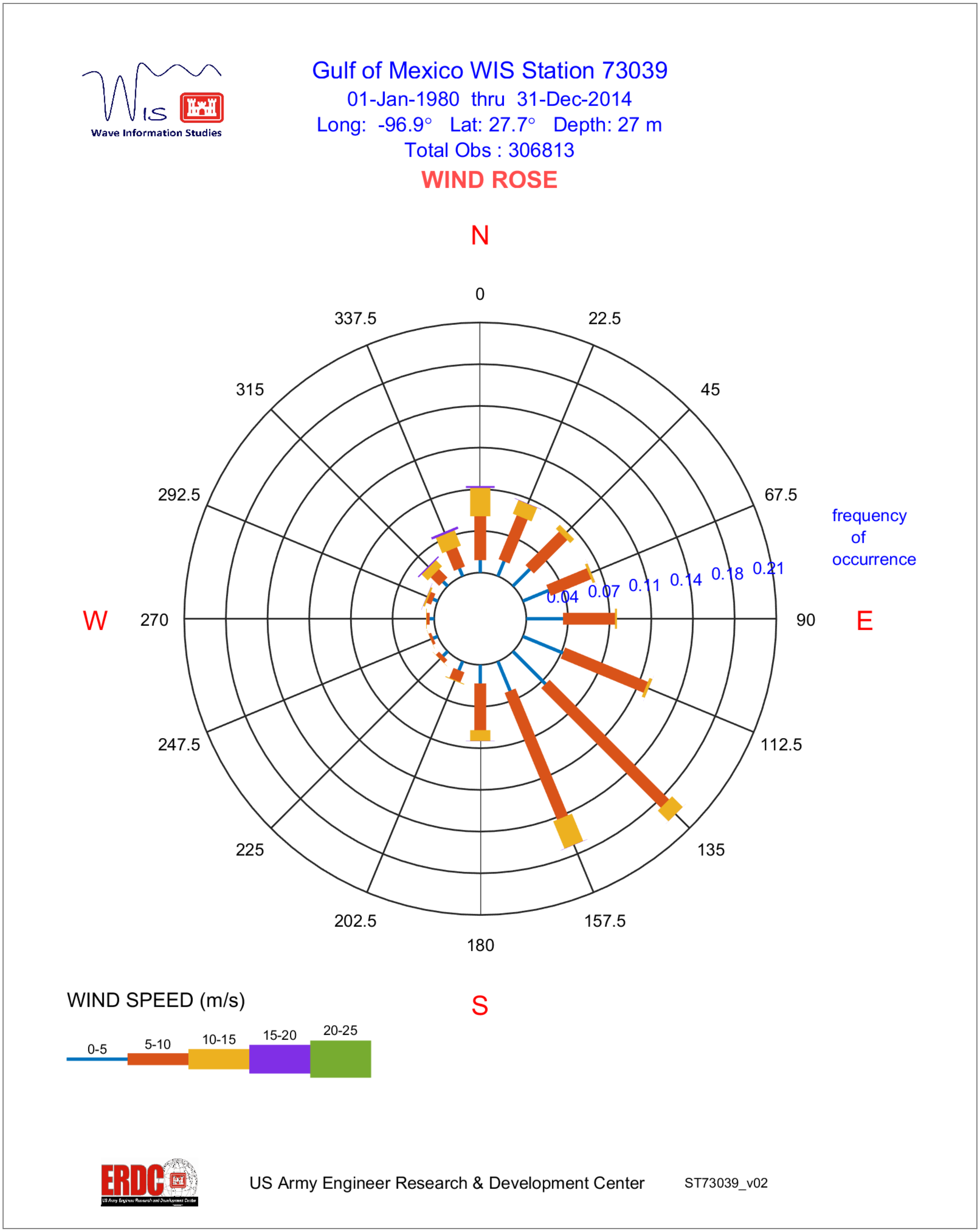

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ANCHOR QEA

Figure 2
Historical Wind Data for USACE WIS Station 73039
Portland Nueces Bay Marsh 10% Design Memorandum
Texas Lower Coast Beneficial Use

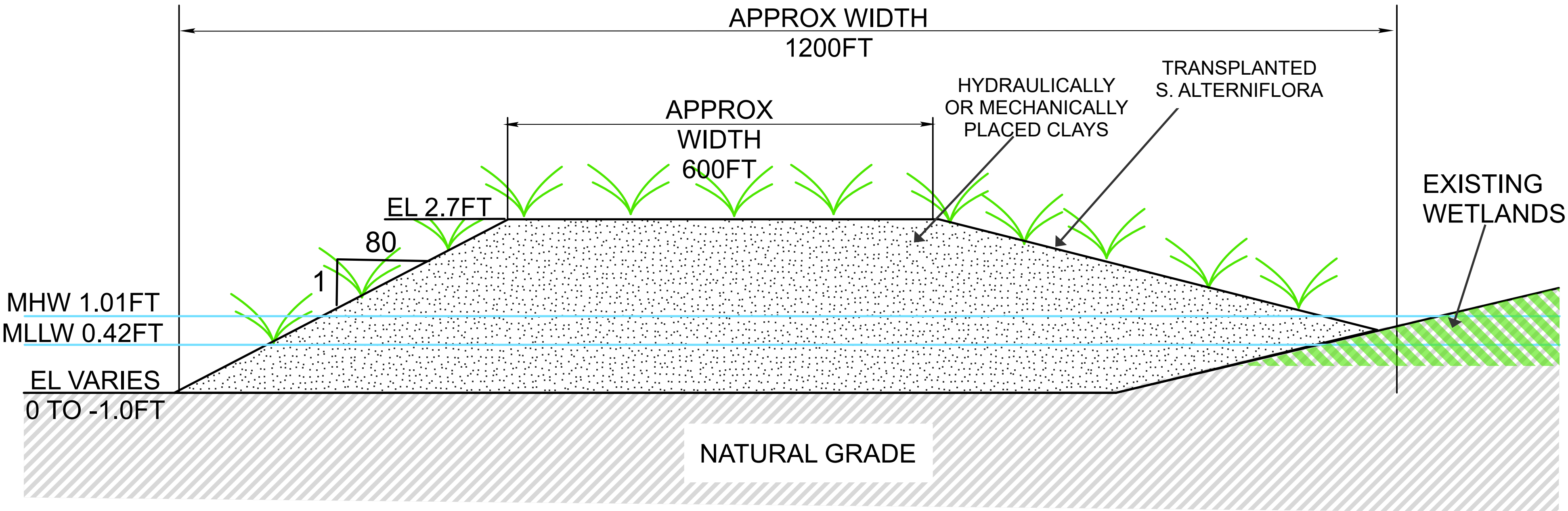

Figure 3
Cross Sections

These drawing are conceptual intended for planning purposes only.
These drawings are not intended to be used for engineer, construction, surveying or bidding documents. These drawings are not to scale.
Vertical datum NAVD88

PORTCORPUSCHRISTI

Portland Nueces Bay Marsh 10% Design Memorandum
Texas Lower Coast Beneficial Use

Memorandum

January 31, 2022

To: Melissa McCutcheon, Texas General Land Office

From: Todd Merendino, Ducks Unlimited
Sarah Garza, Harrison McNeil, and Yvonne Dives-Gomez, Port of Corpus Christi Authority
John Laplante, Dan Opdyke, Ray Newby, Adrienne Accardi, Alexander Freddo, and Hayden Smith, Anchor QEA, LLC
Jane Sarosdy, Sarosdy Consulting, Inc.

Re: Rabbit Island South Bird Island 10% Design Memorandum

Introduction

This 10% design memorandum describes design criteria and assessments associated with the proposed Rabbit Island South site (Site), located in Texas General Land Office (GLO) Planning Region 4 of the Texas coast in the Upper Laguna Madre just outside of Baffin Bay in Kenedy County, Texas (Figure 1).

Project Background

GLO awarded a Coastal Management Program Project of Special Merit grant (funded through the Gulf of Mexico Energy Security Act) to Ducks Unlimited, Inc. (DU), to identify priority locations and develop 10% designs and opinions of probable construction costs for at least 16 sites in GLO Planning Regions 3 and 4 of the Texas coast for the beneficial use of dredged material (BU). The project team is led by DU and Port of Corpus Christi Authority (PCCA) and includes Anchor QEA, LLC; Sarosdy Consulting, Inc.; and the Texas Department of Transportation. In addition to the 16 sites identified and prioritized, PCCA will provide additional resources to bring forward more site designs for review if the site prioritization and selection so warrants. The project team coordinated two online stakeholder meetings in each region to receive information about potential BU sites. Based on stakeholder input, GLO feedback, publicly available data, and professional judgment, the project team selected the Site as one of the 16 sites for 10% design development and cost estimation.

Conservationists have identified the Laguna Madre and Baffin Bay as an important location for creating and restoring bird habitat (CBBEP 2020). Rabbit Island is a small island located on state-owned submerged land approximately 0.2 mile east of the Gulf Intracoastal Waterway (GIWW) in the Upper Laguna Madre just outside Baffin Bay in Kenedy County, Texas. It has been suggested as a site for restoration. However, Texas Parks and Wildlife Department (TPWD) seagrass data show that the existing Rabbit Island is surrounded by seagrass habitat (TPWD 2021), and the existing island also lies within United States Army Corps of Engineers (USACE) dredged material placement area (DMPA) #199, making it an unfavorable location for restoration. Therefore, the project team identified a different area for a new bird island nearby. This area is approximately 1.2 miles south of the existing island, between DMPAs #199 and #200, where data show no suspected seagrasses (Rabbit Island South). This area was selected because of the identified need for a secure and stable rookery island, its proximity to a sediment source in the existing DMPAs and to potential bird foraging areas, and its distance from upland-based predators.

Project Objectives

Frequent dredging is needed to develop and maintain Texas ship channels. The dredged material must be deposited in DMPAs, and many of the existing DMPAs along the Texas coast are nearing capacity. Resource agencies and stakeholders have long advocated using dredged material beneficially to create and restore wetlands and bird islands, nourish beaches, and counteract land loss. Historically, BU projects are difficult to manage because they are multi-year, multi-faceted undertakings in which different organizations manage dredging schedules, funding, project design, permitting, and construction activities. To help address these issues, the objectives of this project include the following:

- Create and restore degrading coastal habitats.
- Establish sites for placement of dredged material to reduce reliance on existing DMPAs.
- Improve coastal resiliency of the natural and built environment.
- Reduce shoaling in the GIWW and other ship channels.

To accomplish these objectives, the project includes the following tasks:

- Stakeholder outreach and coordination
- Identification and selection of BU sites
- 10% designs and cost estimates for at least 16 BU sites
- 30% designs for at least eight BU sites
- 60% designs, cost estimates, and permit application packages for at least five BU sites

This memorandum documents the 10% design and cost estimate for one of the selected sites.

Design Objectives

This Site will be designed to beneficially use dredged material to create a rookery island in a region with degrading coastal bird habitat. During the initial dredging of the GIWW, relict sidecasted new work dredged material was left along the edge of the channel. These relict new work materials that remain from the original construction of the GIWW are considered to have superior structural properties relative to maintenance dredged material (Morton et al. 2001) and hence are the target sediment source for this design. The Site is expected to take advantage of this unique opportunity for mining favorable rookery island material in the area and use material dredged from existing relict new work material inside the surrounding DMPAs and more shallow areas, thus increasing dredged material placement capacity in the DMPAs. Although this project is not proposed to use maintenance dredged material, it can still be considered a BU project because it is expected to take advantage of dredging equipment for which the mobilization and demobilization costs are paid by USACE. This 10% design is based upon publicly available datasets; no field work was conducted for this phase of the project.

Design objectives include the following:

- Develop a preliminary vision based on available data for the Site that includes the following:
  - Habitat to be created or restored
  - Potential sediment source(s)
  - Approaches to minimize long-term maintenance costs
- Delineate conceptual footprints for proposed BU placement.
- Identify key sensitive habitats and construction considerations in the vicinity of the Site.
- Estimate fill volumes for the proposed BU footprints.
- Identify data gaps to be addressed in subsequent design stages.
- Provide preliminary cost estimates.

Existing Data Review

Horizontal and Vertical Datums

The horizontal datum used for the Site is the Texas State Plane Zone 5, North American Datum of 1983 (NAD83), in U.S. survey feet. The primary vertical datum used for the Site is the North American Vertical Datum of 1988 (NAVD88). The National Oceanic and Atmospheric Administration (NOAA) maintains an active tide gauge within the vicinity of the Site. The NOAA Baffin Bay, TX Station 8776604 is 5 miles north of the Site; however, this station only provides NAVD88 and mean sea level (MSL) vertical datums. The next closest station that contains the necessary tidal datums is Packery Channel, TX Station 8775792 (Packery Channel station), 30 miles north of the Site. There is a 0.11-foot difference in the MSL tidal datum between the stations, so the tidal datum from the Packery Channel station was assumed accurate for this level of analysis. The Packery Channel station collects and records real-time tide information dating back to 1990. The vertical datums from this station that will be used for the Site are shown in Table 1.

Table 1
NOAA Packery Channel, TX Station 8775792 Tidal Gauge Displaying NAVD88 Tidal Datums

Tidal Datums	Elevation (feet NAVD88)
MHHW	0.79
MHW	0.79
MSL	0.59
MLW	0.36
MLLW	0.37

MHHW: mean higher high water
MHW: mean high water
MLLW: mean lower low water
MLW: mean low water

Meteorological, Ocean, and Wave Data

Wind and Waves

The USACE Wave Information Studies (WIS) provides a national resource of long-term wavefield climatologies for U.S. coastal waters that synthesizes observations, multi-decade hindcasts, and storm event archives (USACE 2021). The WIS station closest to the Site is Station 73032, just offshore on the Gulf side of North Padre Island in the Gulf of Mexico. Because the station is located offshore, the wave data are not applicable to this project design. However, the project team considers the wind data to be representative of the winds experienced at the Site. Figure 2 summarizes wind data from January 1, 1980, through December 31, 2014. The data indicate that the predominant wind direction is from the southeast, with significant winds also coming from the north, northeast, east, and south.

There is a 3-mile fetch between the Site and North Padre Island, the closest land mass in the predominant southeast wind direction. Due to the fetch, the Site is anticipated to be in a high wave-energy environment. A wave analysis of the direction and frequency of expected significant wave heights will be conducted in subsequent phases of design.

Wake Erosion

The GIWW is approximately 0.2 mile west of the Site. Potential wake erosion from vessels transiting the GIWW is expected to be a design consideration. The proposed armoring will be designed to resist wind- and vessel-generated erosive forces. An analysis of the erosive effects of vessel traffic will be conducted during subsequent stages of design to better understand the extent of vessel-induced erosion on the Site.

Bathymetry

The NOAA National Centers for Environmental Information continuously updated digital elevation model for the Texas Coast (NOAA 2021) was used to obtain bathymetry data for the Site. The Site footprint is open water with an average seabed elevation of -1.24 feet NAVD88 and slopes down to deeper water surrounding the Site at approximately -2.5 feet NAVD88.

Utilities and Infrastructure

The Railroad Commission of Texas public GIS viewer (RRC 2021) was used to identify utilities and pipelines near the Site. No utilities or pipelines were identified near the Site. The need for Site-specific utility locations prior to construction will be determined during subsequent design stages. No other infrastructure has been identified in the vicinity of the project Site.

Desktop Cultural Resources Survey

A search of cultural resources records in the Texas Historical Commission Atlas Database was completed for the Site between November 29 and December 30, 2021. This search revealed that there is a potential cultural resource in the proposed placement site area. No archaeological surveys have been conducted within the preliminary proposed placement site boundary (THC 2021).

Sensitive Habitat

GLO oyster habitat GIS data (GLO 2021) indicate that there is no oyster habitat identified within or adjacent to the Site. According to TPWD seagrass data (TPWD 2021), there are no seagrasses mapped within or adjacent to the Site location. Because the sensitive habitat data are not recent, surveys will likely need to be conducted during a subsequent phase of design to evaluate the presence and extents of sensitive habitat to confirm or update the understanding of sensitive habitat in the vicinity of the Site.

Bird Species

The U.S. Fish and Wildlife Service (USFWS) Information for Planning and Consultation (IPaC) tool was used to identify listed species and migratory birds within a 460-square-mile region around Baffin Bay and a portion of North Padre Island (USFWS 2021). Table 2 includes some of the protected and migratory bird species that are present near the Site and their preferred habitat, as explained in Audubon’s field guide (Audubon 2021a). At this time, no target species, or list of species, has been identified for the Site.

Table 2
USFWS IPaC Species Information

Species	Status	Preferred Habitat[1]
Whooping Crane (*Grus americana*)	Endangered	Prairie pools, marshes, and coastal marshes
Piping Plover (*Charadrius melodus*)	Threatened	Sand beach dunes and expansive sand or mudflats
Red Knot (*Calidris canutus*)	Threatened	Mudflats, tidal zones, and sandy beaches
American Oystercatcher (*Haematopus palliatus*)	Migratory	Strictly coastal; dunes, islands in salt marsh, dredge spoil islands, sandy beaches, and tidal mudflats
Black Skimmer (*Rynchops niger*)	Migratory	Sandy islands, shell beaches, open beaches, lagoons, estuaries, inlets, and sheltered bays
Brown Pelican (*Pelecanus occidentalis*)	Migratory	Bare, rocky, mangrove or tree-covered islands; salt bays, beaches, and oceans
Gull-Billed Tern (*Gelochelidon nilotica*)	Migratory	Beaches, islands, salt marshes, fields, and coastal bays
Marbled Godwit (*Limosa fedoa*)	Migratory	Northern Great Plains, native prairie with marshes or ponds, pools, shores, marshes, and tidal flats
Reddish Egret (*Egretta rufescens*)	Migratory	Red mangrove swamps, arid coastal islands covered with thorny brush, coastal tidal flats, salt marshes, and lagoons
Ring-Billed Gull (*Larus delawarensis*)	Migratory	On ground near water with sparse plant growth, lakes, bays, coasts, piers, dumps, and plowed fields
Royal Tern (*Thalasseus maximus*)	Migratory	Low-lying sandy islands, coasts, lagoons, salt bays, and estuaries
Wilson's Plover (*Charadrius wilsonia*)	Migratory	Dry part of beach, near conspicuous object, coastal regions, open beaches, tidal flats, estuaries, and sandy islands

Notes:
1. Habitat information is from the Audubon field guide (Audubon 2021a) and includes preferred nesting and general habitat.
USFWS IPaC information (USFWS 2021) is provided for a 460-square-mile region around Baffin Bay and a portion of North Padre Island highlighting endangered, threatened, and migratory birds and their preferred habitat.

Erosion

Google Earth imagery from 2011 to 2020 indicates that Rabbit Island South is deteriorating from erosional forces. This is consistent with documentation from the Coastal Bend Bays & Estuaries Program, which notes that the North Padre Island shorelines are at high risk due to erosional forces such as wave energy and relative sea level rise (CBBEP 2020).

Beneficial Use Source Material

The proposed source material for Rabbit Island South will consist of existing relict new work dredged material currently inside of DMPAs #199 and #200, 0.5 and 0.15 mile away, respectively. The material located in the Laguna Madre placement areas came from material dredged from deltaic deposits of Pleistocene Beaumont Formation or the Holocene Rio Grande delta during the original dredging of the GIWW and has been shown to be more stable than recent maintenance dredged material (Morton et al. 2001). Further information will need to be collected to determine more precise composition and available quantities of dredged material from these sources.

10% Design

The main design features that are critical for rookery island success are as follows:

- Site location
- Island size and shape
- Containment and erosion protection
- Planting and natural recruitment of vegetation

These design features are evaluated in this memorandum for the preliminary Site design.

Site Location

The proposed location of the Site is approximately 0.2 mile east of the GIWW and between DMPAs #199 and #200. The Site's location was selected to avoid encroaching on those areas, as well as on potentially dense seagrass habitat at the historic Rabbit Island location (as indicated by TPWD seagrass data).

The proposed Site is approximately 0.7 mile from the nearest shoreline. This distance is above the 0.5-mile distance identified for minimizing predator access to rookery islands (Stanzel 2018).

The Site is located on a mounded area of relict new work material that provides shallow water with a seabed elevation that averages -1.24 feet NAVD88 (-0.87 foot mean lower low water). Because the Site is between two DMPAs, relict new work material existing inside or around the nearby DMPAs can be dredged to construct the rookery island while also increasing the DMPAs' capacity for dredged material. It is anticipated that access channels will need to be constructed for dredgers to access the material inside the DMPAs. There is further shallow relict material with a seabed elevation above -1 foot NAVD88 immediately spanning the east side of the Site that is anticipated to act as a natural wave-energy dissipator and reduce erosive forces. Bathymetric surveys will need to be conducted during subsequent design phases to better define Site dimensions and material needs.

Size and Shape

Based on availability of sediment, a cost analysis, and stakeholder feedback, the project team proposes that the area of the Site be 7 acres. The Site will be created with dredged material placed to an elevation of +3.8 feet NAVD88 and will be approximately rectangular in shape. A high-density relict clay berm on all sides will be constructed to protect the island from wind and vessel-generated waves and can be seen in Figure 1. This shape of fill was selected to promote natural recruitment of vegetation and provide habitat for a range of bird species. The elevation of dredged material fill could be adjusted at further stages of design depending on the physical properties of the dredged material or if target bird species and their specific requirements are identified to be different from these assumptions. It is expected that environmental controls such as turbidity curtains and temporary containment of material will be needed during construction to contain finer sediment placed during construction.

Fill material could be obtained from existing relict material in DMPA #199 and DMPA #200 or from adjacent areas outside of the DMPAs that have relict material. It is predicted that the required fill volume will be approximately 115,000 cubic yards (cy), with approximately 35,000 cy being settled volume. This value assumes 1 foot of foundation compression for every 3 feet of fill and does not consider bulking. Geotechnical data will likely need to be collected during a subsequent design phase to further evaluate the expected foundation compression and the expected bulking of dredged material.

Containment and Erosion Protection

Based on the fetch in the predominant southeast wind direction and potential risk of wake erosion, the project team proposes containment for the Site consisting of an unarmored berm that will mitigate erosion to the rookery island and contain the dredged material. The berm will be composed of higher density clay and constructed on an approximately -2.0 foot-NAVD88 grade. The berm will contain a 4-horizontal-to-1-vertical (4H:1V) seaward side slope and a 3H:1V landward side slope connected by a 12-foot-wide crest. The construction height of the crest will be +3.8 feet NAVD88. The exact width will be dependent on the existing grade, but assuming -2.0 feet NAVD88, the berm base width will be approximately 61 feet. Figure 3 depicts a typical cross section of the berm. The final cross-sectional dimensions and slopes of the berm will need to be determined and refined, respectively, through modeling and analysis of the sediment characteristics of the dredged material and the berm subgrade during a subsequent phase of design.

The berm will be constructed from relict new work material removed from the nearby DMPAs and shallows before the island is constructed. As shown in Figure 3, the fill material will be directly contained by the berm. Confining the dredged fill material within the berm will reduce potential impacts to sensitive habitats. Elevations on the existing mounded area of the Site lie within the -1-foot-NAVD88 contour, and it is assumed that marsh buggies will be used to shape the berm. The berm is proposed with a 4H:1V seaward slope to allow wildlife access into the Site. A 4H:1V slope will also improve slope stability and reduce wave energy compared to steeper berm slopes. With naturally shallow bathymetry surrounding the northeast and east sides of the Site and the predominantly southeast wind direction, it is expected the east side of the island will have additional natural protection from wind and wave impacts.

Planting and Natural Recruitment of Vegetation

Based on stakeholder input and cost considerations, the project team determined that planting may not be needed for the Site. Rather, natural vegetation recruitment will be allowed to proceed. If the outcome is unsatisfactory (e.g., if the island has lower-than-expected use by desired bird species), an adaptive management program can be instituted to modify the vegetation. Table 2 shows some of the listed and migratory birds and their preferred habitats. At further design stages, this list could be used to modify elevations within the Site to promote the preferred habitat of desired bird species.

Site Construction Cost Estimates

Construction costs were estimated for the design outlined in the previous sections. The estimated costs include permitting, 100% design, engineering costs for advancing the design to the construction phase, pre-construction and as-built surveys, mobilization, materials, and construction of the berm. These costs represent the estimated incremental costs; i.e., those costs over and above USACE's least cost and environmentally acceptable dredged material and disposal alternative. Table 3 shows a line-item list of each costing parameter and the total cost estimated for construction.

Table 3
Opinion of Probable Construction Cost to 100% Project Completion

Item	Quantity	Unit	Unit Price	Total
Pre-Construction Survey	1	LS	$ 30,000.00	$ 30,000.00
Bird Island Berm and Internal Fill Excavation[1]	115,000	cy	$ 10.00	$ 1,150,000.00
Marsh Buggy Fill Maintenance[2]	35	days	$ 2,500.00	$ 90,000.00
Post-Construction Survey (topography/ bathymetry)	1	LS	$ 30,000.00	$ 30,000.00
Post-Construction Survey (aerials)	1	LS	$ 10,000.00	$ 10,000.00
Navigational Aids[2]	4	Each	$ 4,000.00	$ 20,000.00
Subtotal[3]			**Sum**	**$ 1,300,000.00**
Incremental Mobilization and Demobilization[3,4]	1	LS	$ 400,000.00	$ 400,000.00
Construction Total[3]			**Sum**	**$ 1,700,000.00**
100% Engineering and Design[3]	1	10%	$ 200,000.00	$ 200,000.00
Permitting	1	Each	$ 100,000.00	$ 100,000.00
Construction Management[3]	1	8%	$ 100,000.00	$ 100,000.00
Post-Construction Management	12	Month	$ 10,000.00	$ 120,000.00
Project Subtotal[3]			**Sum**	**$ 2,200,000.00**
-30% Contingency[3]	1	30%	$ 700,000.00	$ 700,000.00
+50% Contingency[3]	1	50%	$ 1,100,000.00	$ 1,100,000.00
Low-End Total Project Estimated Cost[3]			**Total Sum**	**$ 1,500,000.00**
High-End Total Project Estimated Cost[3]			**Total Sum**	**$ 3,300,000.00**

Notes:
Costs were determined based upon publicly available datasets; no field work was conducted for this phase of the project.
1. Cost is based on incremental cost of diverting dredging equipment from GIWW to excavation areas.
2. Rounded to the nearest $10,000.
3. Rounded to the nearest $100,000.
4. Cost is based on mobilizing equipment above what is required for dredging the GIWW (i.e., marsh buggies).

LS: lump sum
sy: square yard

The costs vary from $1.5 million to $3.3 million, depending on the level of contingency allocated to the project cost.

This 10% design represents a bird island near the upper range of bird island sizes desired, based on stakeholder input. Future cost constraints may limit the island size that is ultimately constructed, but at this level of design, it was decided to consider a site near the upper end of the range identified by stakeholders.

The estimates are developed using current and generally accepted engineering cost estimating methods and are based on assumptions concerning future events. Actual costs may be affected by known and unknown risks including, but not limited to, changes in general economic business conditions, Site conditions that were unknown at the time the estimates were performed, future changes in Site conditions, regulatory or enforcement policy changes, and delays in performance. Actual costs may vary from these estimates.

Ecosystem Benefits Expected

Creation of the Site is expected to have positive benefits on the regional ecosystem. Green Island, an 80-acre rookery island located in the adjacent Laguna Madre, was used to approximate the ecological benefits for the Site. From 2011 to 2015, Green Island averaged approximately 1,000 breeding pairs of birds per year across three species that are listed in Table 2 (Audubon 2021b). Adjusting for acreage of rookery island, the Site may be expected to create habitat for approximately 90 breeding pairs for three species of birds per year.

Due to the location of seagrass habitat adjacent to the Site, dredging of surrounding relict material during construction could result in surrounding water depths that are conducive to further seagrass colonization. This could increase the existing seagrass habitat in the regional ecosystem.

Future Work

Of the sites selected for 10% designs in this project, at least eight will be selected for 30% designs, and at least five of those will subsequently be selected for 60% designs and cost estimates. No fatal flaws have been identified in this 10% design effort. Should this Site be selected for additional design efforts, it can be expected that some aspects of the design in this memorandum will be modified and, as appropriate, improved. As previously mentioned, it is possible that in each phase additional designs will be provided toward this project because of the partnership on this project between DU and PCCA.

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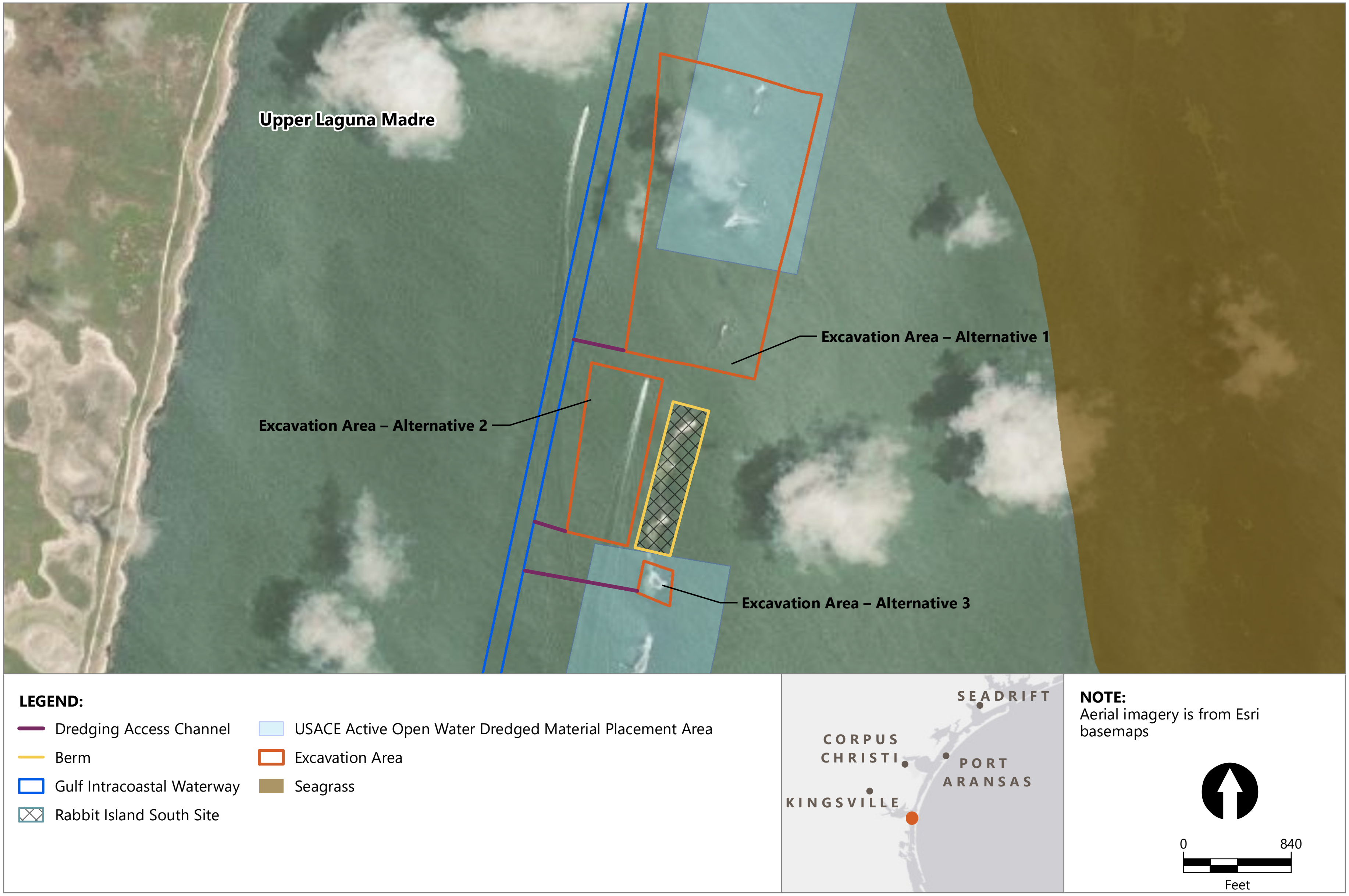
Figures



NOTE:
Aerial imagery is from Esri basemaps

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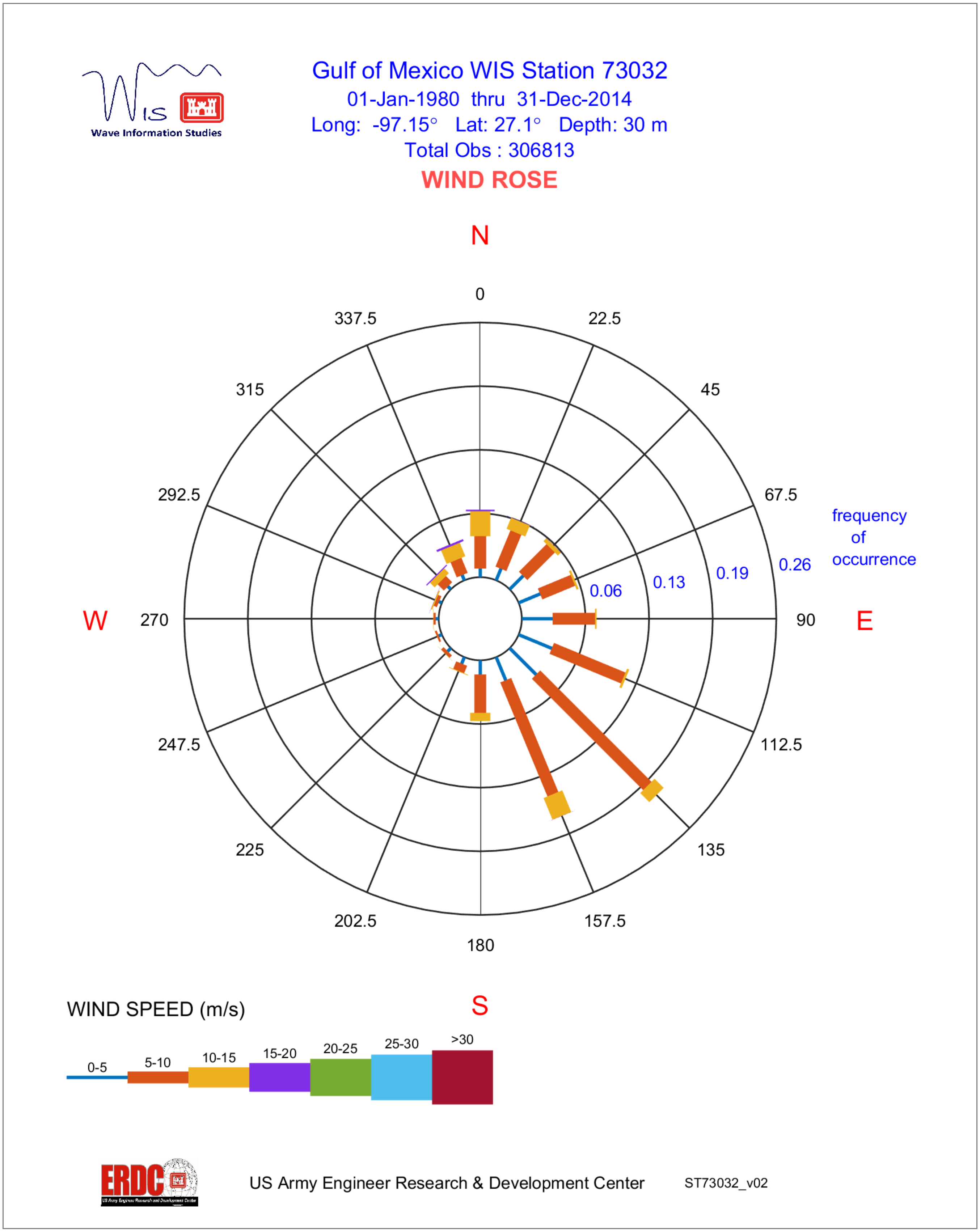
ANCHOR QEA

Figure 1
Rabbit Island South Plan View

Rabbit Island South Bird Island 10% Design Memorandum
Texas Lower Coast Beneficial Use



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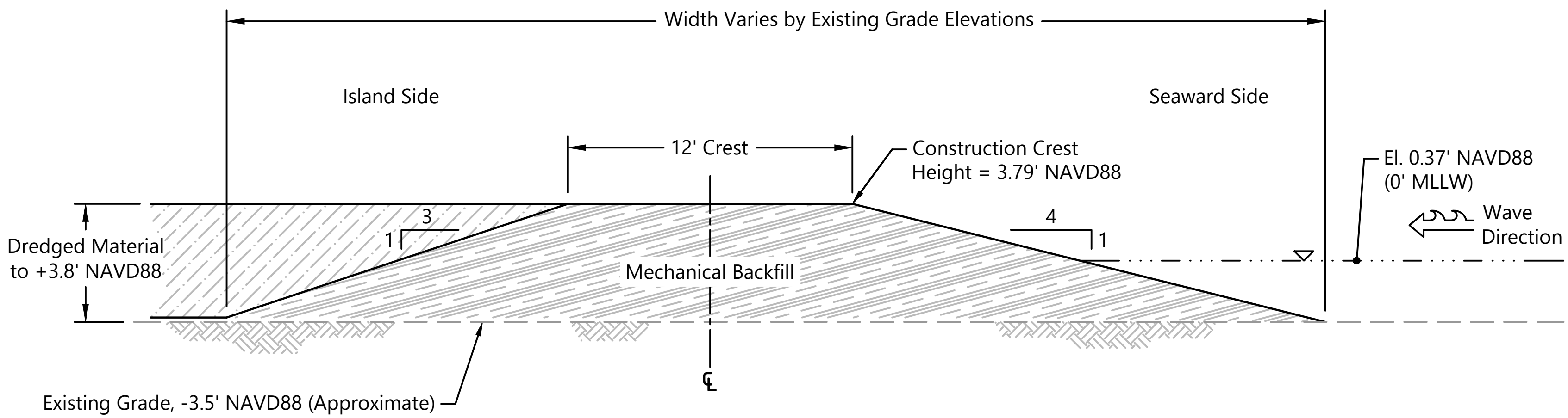
ANCHOR QEA

Figure 2
Historical Wind Data for USACE WIS Station 73032
Rabbit Island South Bird Island 10% Design Memorandum
Texas Lower Coast Beneficial Use



Section A-A' Typical Berm
Not to Scale

VERTICAL DATUM: North American Vertical Datum of 1988 (NAVD88)

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Filepath: K:\Projects\1942-Ducks Unlimited\Little Bird Island\Little Bird Island North 10% Design\1942-RP-003c RABBIT ISLAND.dwg Figure 3

ANCHOR QEA

Figure 3
Section A-A' Typical Berm

Rabbit Island South Bird Island 10% Design Memorandum
Texas Lower Coast Beneficial Use

Memorandum

January 31, 2022

To: Melissa McCutcheon, Texas General Land Office

From: Todd Merendino, Ducks Unlimited
Sarah Garza, Harrison McNeil, and Yvonne Dives-Gomez, Port of Corpus Christi Authority
John Laplante, Dan Opdyke, Ray Newby, Adrienne Accardi, Alexander Freddo, and Hayden Smith, Anchor QEA, LLC
Jane Sarosdy, Sarosdy Consulting, Inc.

Re: Ransom Point 10% Design Memorandum

Introduction

This 10% design memorandum describes design criteria and assessments associated with the proposed Ransom Point site (Site), located in Texas General Land Office (GLO) Planning Region 3 of the Texas coast in Redfish Bay in Nueces County, Texas (Figure 1).

Project Background

GLO awarded a Coastal Management Program Project of Special Merit grant (funded through the Gulf of Mexico Energy Security Act) to Ducks Unlimited, Inc. (DU), to identify priority locations and develop 10% designs and opinions of probable construction costs for at least 16 sites in GLO Planning Regions 3 and 4 of the Texas coast for the beneficial use of dredged material (BU). The project team is led by DU and Port of Corpus Christi Authority (PCCA) and includes Anchor QEA, LLC; Sarosdy Consulting, Inc.; and the Texas Department of Transportation. In addition to the 16 sites identified and prioritized, PCCA will provide additional resources to bring forward more site designs for review if the site prioritization and selection so warrants. The project team coordinated two online stakeholder meetings in each region to receive information about potential BU sites. Based on stakeholder input, GLO feedback, publicly available data, and professional judgment, the project team selected the Site as one of the 16 sites for 10% design development and cost estimation.

Ransom Point is a 70-acre island owned by the City of Aransas Pass approximately 2 miles southeast of the Gulf Intracoastal Waterway (GIWW) and 1.5 miles north of the Corpus Christi Ship Channel (CCSC) in Redfish Bay in Nueces County, Texas. Ransom Point has an existing breakwater to the east and southeast, which protects it from wave energy, making it an advantageous location for restoration. The state-owned submerged land between Ransom Point and the breakwater was selected due to its proximity to possible sediment sources in the GIWW and CCSC, its existing breakwater protection, and its potential to offset the degradation of nearby islands and marsh habitat,

Project Objectives

Frequent dredging is needed to develop and maintain Texas ship channels. The dredged material must be deposited in dredged material placement areas (DMPAs), and many of the existing DMPAs along the Texas coast are nearing capacity. Resource agencies and stakeholders have long advocated using dredged material beneficially to create and restore wetlands and bird islands, nourish beaches, and counteract land loss. Historically, BU projects are difficult to manage because they are multi-year, multi-faceted undertakings in which different organizations manage dredging schedules, funding, project design, permitting, and construction activities. To help address these issues, the objectives of this project include the following:

- Create and restore degrading coastal habitats.
- Establish sites for placement of dredged material to reduce reliance on existing DMPAs.
- Improve coastal resiliency of the natural and built environment.
- Reduce shoaling in the GIWW and other ship channels.

To accomplish these objectives, the project includes the following tasks:

- Stakeholder outreach and coordination
- Identification and selection of BU sites
- 10% designs and cost estimates for at least 16 BU sites
- 30% designs for at least eight BU sites
- 60% designs, cost estimates, and permit application packages for at least five BU sites

This memorandum documents the 10% design and cost estimate for one of the selected sites.

Design Objectives

This Site will be designed to beneficially use dredged material to create marsh habitat in a region with degrading sensitive habitat. The design will use material dredged from navigation channels during routine maintenance and potentially from the CCSC Channel Improvement Project, thus reducing the volume of such material that will need to be placed in existing open-bay or upland DMPAs. This 10% design is based upon publicly available datasets; no field work was conducted for this phase of the project.

Design objectives include the following:

- Develop a preliminary vision based on available data for the Site that includes the following:
  - Habitat to be created or restored
  - Potential sediment source(s)
  - Approaches to minimize long-term maintenance costs
- Delineate conceptual footprints for proposed BU placement.
- Identify key sensitive habitats and construction considerations in the vicinity of the Site.
- Estimate fill volumes for the proposed BU footprints.
- Identify data gaps to be addressed in subsequent design stages.
- Provide preliminary cost estimates.

Existing Data Review

Horizontal and Vertical Datums

The horizontal datum used for the Site is the Texas State Plane Zone 5, North American Datum of 1983 (NAD83), in U.S. survey feet. The primary vertical datum used for the Site is the North American Vertical Datum of 1988 (NAVD88). The National Oceanic and Atmospheric Administration (NOAA) maintains an active tide gauge within the vicinity of the Site. The NOAA Port Aransas Station 8775237 is 4 miles southeast of the proposed marsh restoration. This station collects and records real-time tide information dating back to 2002. The vertical datums from this station that will be used for the Site are shown in Table 1.

Table 1
NOAA Port Aransas Station 8775237 Tidal Gauge Displaying NAVD88 Tidal Datums

Tidal Datums	Elevation (feet NAVD88)
MHHW	0.89
MHW	0.86
MSL	0.50
MLW	-0.03
MLLW	-0.15

MHHW: mean higher high water
MHW: mean high water
MLLW: mean lower low water
MLW: mean low water
MSL: mean sea level

Meteorological, Ocean, and Wave Data

Wind and Waves

The United States Army Corps of Engineers (USACE) Wave Information Studies (WIS) provides a national resource of long-term wavefield climatologies for U.S. coastal waters that synthesizes observations, multi-decade hindcasts, and storm event archives (USACE 2021). The WIS station closest to the Site is Station 73039, just offshore on the Gulf side of Mustang Island in the Gulf of Mexico. Because the station is located offshore, the wave data are not applicable to this project design. However, the project team considers the wind data to be representative of the winds experienced at the Site. Figure 2 summarizes wind data from January 1, 1980, through December 31, 2014. The data indicate that the predominant wind direction is from the southeast, with significant winds also coming from the north, northeast, east, and south.

There is a 0.8-mile fetch between Ransom Point and Harbor Island and a 1.8-mile fetch between Ransom Point and Mustang Island, the closest land masses in the predominant southeast wind direction. The existing breakwater is expected to limit erosion due to wind-generated waves. A wave analysis of the direction and frequency of expected significant wave heights will be conducted in subsequent phases of design.

Wake Erosion

The GIWW is approximately 2 miles northwest of the Site, and the CCSC is approximately 1.5 miles south of the Site. The Site is protected from the GIWW by extensive marsh and seagrass beds. It is also protected from some wakes from the CCSC by the breakwater. However, potential wake erosion from the south or southwest due to vessels transiting the CCSC is expected to be a design consideration.

Bathymetry

The NOAA National Centers for Environmental Information continuously updated digital elevation model for the Texas Coast (NOAA 2021) was used to obtain bathymetry data for the Site. The Site resides on a sloping seabed that ranges in elevation from 0 to -5 foot NAVD88.

Utilities and Infrastructure

The Railroad Commission of Texas public GIS viewer (RRC 2021) was used to identify utilities and pipelines near the Site. No pipelines were found within the footprint of the Site. The need for Site-specific utility locations prior to construction will be determined during subsequent design stages. No other infrastructure has been identified in the vicinity of the project Site.

Desktop Cultural Resources Survey

A search of cultural resources records in the Texas Historical Commission Atlas Database was completed for the Site between November 29 and December 30, 2021. This search revealed that no archaeological surveys have been conducted and no archaeological sites have been identified within the preliminary proposed placement site boundary (THC 2021).

Sensitive Habitat

GLO oyster habitat GIS data (GLO 2021) indicate that there is no oyster habitat identified within or adjacent to the Site. According to Texas Parks and Wildlife Department (TPWD) seagrass data (TPWD 2021), there are seagrasses mapped near the Site footprint (Figure 1). Because the sensitive habitat data are not recent, surveys will likely need to be conducted during a subsequent phase of design to evaluate the presence and extents of sensitive habitat to confirm or update the understanding of sensitive habitat in the vicinity of the Site.

Beneficial Use Source Material

Potential sources of dredged material include the GIWW and CCSC, located near to the Site. The Coastal Consistency Determinations from USACE indicate maintenance dredging on the GIWW and CCSC near the Site (USACE 1999). However, recent communications with USACE indicate that dredging is infrequent within the GIWW (Jones 2021). The identified DMPAs used by USACE near the Site and their associated historical average annual quantity of dredged material, distance from the Site, and channel segments are shown in Table 2. The average grain size and grain type percentages of dredged material are shown in Table 3. This informs the quantity and characteristics of dredged material that may be available during a dredging cycle. For example, the Site will be designed such that the fines, which constitute a relatively high percentage of nearby sediment in the GIWW across Redfish Bay, will be sheltered from erosive forces.

Table 2
USACE DMPA Areas Adjacent to the Site

DMPA No.	GIWW and CCSC Channel Segment (station)	Distance from Site (miles)	Average Annual Dredging Quantity (cy)
156	946+000-950+000	2.5	47,840
157	950+000-960+000	1.9	88,586
158	956+000-960+500	1.75	77,905
159	960+500-963+000	1.7	41,125
160	963+000-967+000	1.9	56,880
161	967+000-971+000	2.3	48,330
162	971+000-978+000	3	78,480
6	Inner Basin to La Quinta Junction (0+00-270+00)	1.9	0
7	Inner Basin to La Quinta Junction (270+00-320+00)	2.2	35,000
8	Inner Basin to La Quinta Junction (320+00-400+00)	2.8	40,000
9	Inner Basin to La Quinta Junction (400+00-500+00)	3.75	51,000

Notes:
Source: USACE 1999
cy: cubic yard

Table 3
Typical Sediment Characteristics Across GIWW in Redfish Bay and from the Inner Basin to La Quinta Junction of the CCSC

Sediment Characteristics Across Redfish Bay	Sediment Characteristics from the Inner Basin to La Quinta Junction
D_{50} (mm) < 0.044	D_{50} (mm) < 0.256
27.6% sand	87.8% sand
33.6% silt	6.6% silt
38.8% clay	5.7% clay

Notes:
Channel Segment: (945+000-975+000) and (0+00-200+00)
Source: USACE 1999
D_{50}: median grain size
mm: millimeter

Further information will need to be collected during a subsequent phase of design to evaluate the precise sediment characteristics. Due to the proximity of the Site to these sediment sources, this Site should allow for lower construction costs compared to more remote potential marsh restoration sites.

Marsh Vegetation Elevation Ranges

Typical habitat ranges for relevant marsh vegetation were determined based on site vegetation surveys conducted by DU at the Lower Neches Wildlife Management Area Old River Unit, Texas Point National Wildlife Refuge (NWR), McFaddin NWR Willow Lake Terraces, Anahuac NWR Roberts Mueller Tract, Schicke Point, Guadalupe River Old Delta, and Goose Island State Park Cells sites located in GLO Planning Regions 1 and 2 of the Texas coast. This is shown in Table 4.

Table 4
Typical Elevations for Target Marsh Vegetation

Species	Elevation (feet MSL)	Elevation (feet NAVD88)
Spartina patens	0.25 to 1	0.75 to 1.50
Spartina alterniflora	0 to 0.75	0.50 to 1.25

10% Design

The main design features that are critical for marsh island success are as follows:

- Site location

- Marsh size and shape
- Containment and erosion protection
- Planting and natural recruitment of vegetation

These design features are evaluated in this memorandum for the preliminary Site design.

Site Location

The proposed location of the Site is approximately 1.5 miles north of the CCSC. The Site is located between the existing Ransom Island and an existing breakwater (Figure 1).

The Site resides on a slope that ranges from 0 to -5 foot NAVD88 (0.03 to -4.97 feet mean lower low water). Water depths of greater than 5 feet surround the Site, providing favorable conditions for construction access. Bathymetric surveys will need to be conducted during subsequent design phases to better define Site dimensions and material quantity needs.

Size and Shape

Based on the potential presence of seagrasses and available space between the breakwater and existing upland, the project team proposes that the area of the Site be 16 acres. Due to expected mounding of the placed material, the Site will be created with dredged material placed to an elevation of +2.0 feet NAVD88, which will be at the upper end of the suitable habitat range for *Spartina patens* and *Spartina alterniflora*. The elevation of dredged material fill could be adjusted at further stages of design, depending on the physical properties of the dredged material or if other target species and their specific requirements are identified. The Site will consist of fill extending from the edge of the existing island toward the existing breakwater, allowing for a natural angle of repose on the breakwater side of the fill.

The seagrass data from TPWD show that there may be sensitive seagrass habitat between the breakwater and the island; however, the data are not recent. The location of seagrasses will need to be determined through field surveys during subsequent stages of design. For this design, the seagrass data from TPWD were used to inform the extent of the Site footprint. The footprint may change depending on the results of field surveys. It is expected that environmental controls such as turbidity curtains and temporary containment of material will be needed during construction to contain fines placed at the Site.

Fill material could be obtained from the GIWW or the CCSC, as described in Table 3. It is predicted that the required fill volume will be approximately 100,000 cubic yards (cy), with approximately 25,000 cy being settled volume. This value assumes 1 foot of foundation compression for every 3 feet of fill and does not consider bulking. Geotechnical data will likely need to be collected during a subsequent design phase to further evaluate the expected foundation compression and the expected bulking of dredged material.

Containment and Erosion Protection

The existing breakwater will serve as protection from wind wave and wake erosion at the Site. Temporary containment will be needed around the fill to allow the material to dewater and consolidate. The footprint of the placed dredged material will need to be refined based on modeling and analysis of the protection from wave erosion afforded by the existing breakwater.

Planting and Natural Recruitment

Based on stakeholder input and cost considerations, the project team determined that hydroseeding the edge of the marsh will be the most effective method for vegetating the marsh. Natural recruitment will then be allowed to proceed from the edge of the marsh inward. If the outcome is unsatisfactory (e.g., if the marsh has a lower-than-expected density of vegetation or if undesirable species of vegetation are present), an adaptive management program can be instituted to modify the vegetation. Table 4 shows some of the targeted vegetation and their preferred habitat elevations.

Site Construction Cost Estimates

Construction costs were estimated for the design outlined in the previous sections. The estimated costs include permitting, 100% design, engineering costs for advancing the design to the construction phase, pre-construction and as-built surveys, mobilization, and materials. These costs represent the estimated incremental costs; i.e., those costs over and above USACE’s least cost and environmentally acceptable dredged material and disposal alternative. Table 5 shows a line-item list of each costing parameter and the total cost estimated for construction.

Table 5
Opinion of Probable Construction Cost to 100% Project Completion

Item	Quantity	Unit	Unit Price	Total
Pre-Construction Survey	1	LS	$ 30,000.00	$ 30,000.00
Incremental Dredging Cost (2 miles pipeline)	100,000	cy	$ 10.00	$ 1,000,000.00
Marsh Buggy Fill Maintenance[1]	31	Days	$ 2,500.00	$ 80,000.00
Hydroseeding[1]	60,000	sf	$ 0.20	$ 10,000.00
Post-Construction Survey (topography/ bathymetry)	1	LS	$ 30,000.00	$ 30,000.00
Post-Construction Survey (aerials)	1	LS	$ 10,000.00	$ 10,000.00
Subtotal[2]			**Sum**	**$ 1,200,000.00**
Incremental Mobilization and Demobilization	1	5%	$ 60,000.00	$ 60,000.00
Construction Total[2]			**Sum**	**$ 1,300,000.00**
100% Engineering and Design[2]	1	10%	$ 100,000.00	$ 100,000.00
Permitting	1	Each	$ 100,000.00	$ 100,000.00
Construction Management[2]	1	8%	$ 100,000.00	$ 100,000.00
Post-Construction Management	12	Month	$ 10,000.00	$ 120,000.00
Project Subtotal[2]			**Sum**	**$ 1,700,000.00**
-30% Contingency[2]	1	30%	$ 500,000.00	$ 500,000.00
50% Contingency[2]	1	50%	$ 900,000.00	$ 900,000.00
Low-End Total Project Estimated Cost[2]			**Total Sum**	**$ 1,200,000.00**
High-End Total Project Estimated Cost[2]			**Total Sum**	**$ 2,600,000.00**

Notes:
Costs were determined based upon publicly available datasets; no field work was conducted for this phase of the project.
1. Rounded to the nearest $10,000.
2. Rounded to the nearest $100,000.

LS: lump sum
sf: square foot

The costs vary from $1.2 million to $2.6 million, depending on the level of contingency allocated to the project cost.

The estimates are developed using current and generally accepted engineering cost estimating methods and are based on assumptions concerning future events. Actual costs may be affected by known and unknown risks including, but not limited to, changes in general economic business conditions, Site conditions that were unknown at the time the estimates were performed, future changes in Site conditions, regulatory or enforcement policy changes, and delays in performance. Actual costs may vary from these estimates.

Ecosystem Benefits Expected

Creation of the Site is expected to have positive benefits on the regional ecosystem. The marsh restoration is expected to add 16 acres of marsh habitat to the regional ecosystem. This region is also experiencing degrading upland and marsh habitats and the restoration will improve the resilience of habitats northwest of the Site as well as Ransom Island.

Future Work

Of the sites selected for 10% designs in this project, at least eight will be selected for 30% designs, and at least five of those will subsequently be selected for 60% designs and cost estimates. No fatal flaws have been identified in this 10% design effort, although there is a risk that more detailed seagrass mapping could significantly reduce the available fill footprint. Should this Site be selected for additional design efforts, it can be expected that some aspects of the design in this memorandum will be modified and, as appropriate, improved. In particular, field monitoring to identify the presence and extent of seagrasses will be important to confirm the viability of this project and the spatial extent of marsh creation. As previously mentioned, it is possible that in each phase additional designs will be provided toward this project because of the partnership on this project between DU and PCCA.

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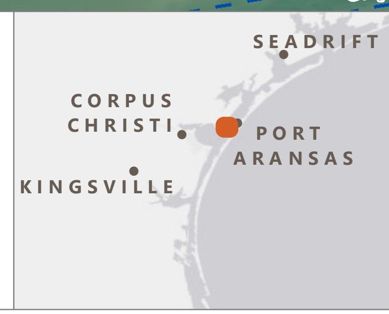
Figures

LEGEND:

- State Highway
- Existing Breakwater
- Pipeline
- Corpus Christi Ship Channel
- Gulf Intracoastal Waterway
- Ransom Point Site
- USACE Active Open Water Dredged Material Placement Area
- Seagrass



NOTE:
Aerial imagery is from Esri basemaps

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Feet

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ANCHOR QEA

Figure 1
Ransom Point Plan View
Ransom Point 10% Design Memorandum
Texas Lower Coast Beneficial Use

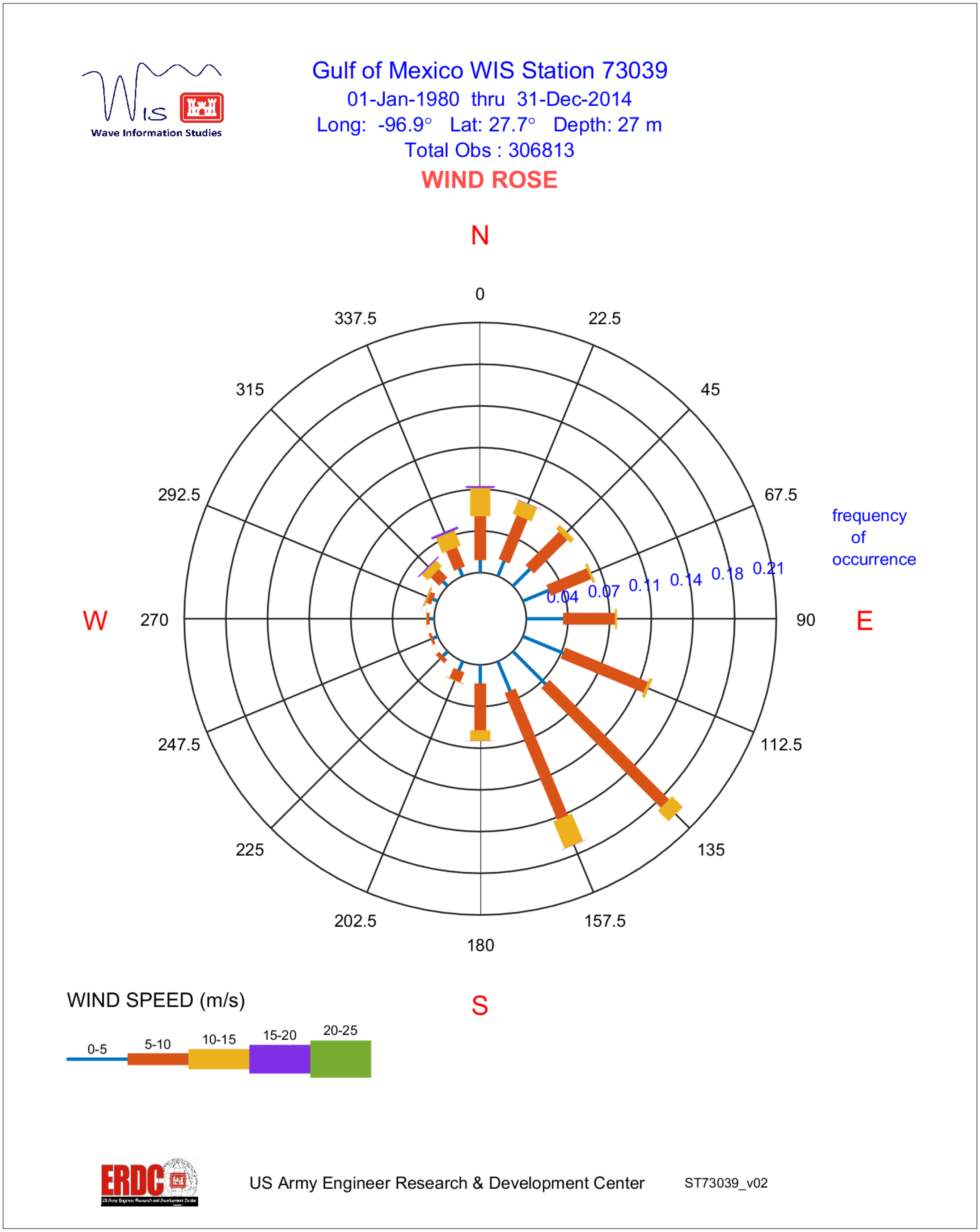

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Figure 2
Historical Wind Data for USACE WIS Station 73039

Memorandum

January 31, 2022

To: Melissa McCutcheon, Texas General Land Office

From: Todd Merendino, Ducks Unlimited, Inc.
Sarah Garza, Harrison McNeil, and Yvonne Dives-Gomez, Port of Corpus Christi Authority
John Laplante, Dan Opdyke, Ray Newby, Adrienne Accardi, Alexander Freddo, and Hayden Smith, Anchor QEA, LLC
Jane Sarosdy, Sarosdy Consulting, Inc.

Re: Rockport Beach 10% Design Memorandum

Introduction

This 10% design memorandum describes design criteria and assessments associated with the proposed Rockport Beach site (Site), located in Texas General Land Office (GLO) Planning Region 3 of the Texas coast in Aransas Bay in Aransas County, Texas (Figure 1).

Project Background

GLO awarded a Coastal Management Program Project of Special Merit grant (funded through the Gulf of Mexico Energy Security Act) to Ducks Unlimited, Inc. (DU), to identify priority locations and develop 10% designs and opinions of probable construction costs for at least 16 sites in GLO Planning Regions 3 and 4 of the Texas coast for the beneficial use of dredged material (BU). The project team is led by DU and Port of Corpus Christi Authority (PCCA) and includes Anchor QEA, LLC; Sarosdy Consulting, Inc.; and the Texas Department of Transportation. In addition to the 16 sites identified and prioritized, PCCA will provide additional resources to bring forward more site designs for review if the site prioritization and selection so warrants. The project team coordinated two online stakeholder meetings in each region to receive information about potential BU sites. Based on stakeholder input, GLO feedback, publicly available data, and professional judgment, the project team selected the Site as one of the 16 sites for 10% design development and cost estimation.

Rockport Beach is a public beach located on Aransas County Navigational District (ACND) land approximately 1.7 miles northwest of the Gulf Intracoastal Waterway (GIWW) in Aransas Bay, Aransas County, Texas. Due to erosion from Hurricane Harvey, the profile of the beach was altered, limiting pedestrian wading access into Aransas Bay. This Site was selected due to a need for beach nourishment to return the underwater beach profile to pre-Harvey conditions and due to the proximity of beach quality sand identified in the GIWW. ACND has a separate effort to design and fund restoration of that portion of the beach profile above the waterline.

Project Objectives

Frequent dredging is needed to develop and maintain Texas ship channels. The dredged material must be deposited in dredged material placement areas (DMPAs), and many of the existing DMPAs along the Texas coast are nearing capacity. Resource agencies and stakeholders have long advocated using dredged material beneficially to create and restore wetlands and bird islands, nourish beaches, and counteract land loss. Historically, BU projects are difficult to manage because they are multiyear, multifaceted undertakings in which different organizations manage dredging schedules, funding, project design, permitting, and construction activities. To help address these issues, the objectives of this project include the following:

- Create and restore degrading coastal habitats.
- Establish sites for placement of dredged material to reduce reliance on existing DMPAs.
- Improve coastal resiliency of the natural and built environment.
- Reduce shoaling in the GIWW and other ship channels.

To accomplish these objectives, the project includes the following tasks:

- Stakeholder outreach and coordination
- Identification and selection of BU sites
- 10% designs and cost estimates for at least 16 BU sites
- 30% designs for at least eight BU sites
- 60% designs, cost estimates, and permit application packages for at least five BU sites

This memorandum documents the 10% design and cost estimate for one of the selected sites.

Design Objectives

This Site will be designed to beneficially use dredged material to nourish a public beach eroded during Hurricane Harvey. The design will use material dredged from navigation channels during routine maintenance, thus reducing the volume of such material that will need to be placed in existing open-bay or upland DMPAs. This 10% design is based upon publicly available datasets; no field work was conducted for this phase of the project.

Design objectives include the following:

- Develop a preliminary vision based on available data for the Site that includes the following:
  - Habitat to be created or restored
  - Potential sediment source(s)
  - Approaches to minimize long-term maintenance costs

- Delineate conceptual footprints for proposed BU placement.
- Identify key sensitive habitats and construction considerations in the vicinity of the Site.
- Estimate fill volumes for the proposed BU footprints.
- Identify data gaps to be addressed in subsequent design stages.
- Provide preliminary cost estimates.

Existing Data Review

Horizontal and Vertical Datums

The horizontal datum used for the Site is the Texas State Plane Zone 4, North American Datum of 1983 (NAD83), in U.S. survey feet. The primary vertical datum used for the Site is the North American Vertical Datum of 1988 (NAVD88). The National Oceanic and Atmospheric Administration (NOAA) maintains an active tide gauge within the vicinity of the Site. The NOAA Rockport, TX Station 8774770 is 0.7 mile southwest of the proposed beach. This station collects and records real-time tide information dating back to 1948. The vertical datums from this station that will be used for the Site are shown in Table 1.

Table 1
NOAA Rockport, TX Station 8774770 Tidal Gauge Displaying NAVD88 Tidal Datums

Tidal Datums	Elevation (feet NAVD88)
MHHW	1.30
MHW	1.29
MSL	1.12
MLW	0.94
MLLW	0.93

Notes:
MHHW: mean higher high water
MHW: mean high water
MLLW: mean lower low water
MLW: mean low water
MSL: mean sea level

Meteorological, Ocean, and Wave Data

Wind and Waves

The United States Army Corps of Engineers (USACE) Wave Information Studies (WIS) provides a national resource of long-term wavefield climatologies for U.S. coastal waters that synthesizes observations, multidecade hindcasts, and storm event archives (USACE 2021). The WIS station closest to the Site is Station 73042, just offshore on the Gulf side of Matagorda Island in the Gulf of Mexico.

Because the station is located offshore, the wave data are not applicable to this project design. However, the project team considers the wind data to be representative of the winds experienced at the Site. Figure 2 summarizes wind data from January 1, 1980, through December 31, 2014. The data indicate that the predominant wind direction is from the southeast, with significant winds also coming from the north, northeast, east, and south.

There is a 5-mile fetch between Rockport Beach and Matagorda Island, the closest land mass in the predominant southeast wind direction. Due to the fetch, the Site is anticipated to be in a high wave-energy environment.

Beach nourishment is intended to add sand to replace material that has been lost due to wind/wave action; ideally this replacement will be done using similarly sized material to the beach sands that are naturally present on the Site. Thus, the post-nourishment condition will be expected to have similar stability under wave attack compared to the beach before the erosion event. Natural beaches are dynamic, with sand that moves seasonally; they are not intended to be static, stable shoreline features. Thus, selecting materials for stability against waves is not a design consideration for this project, and a wind-wave analysis may not be needed during subsequent design phases.

Bathymetry

Surveys of the Rockport Beach profile from pre- and post-Hurricane Harvey were used to determine the bathymetry for the Site (GLO 2018). Surveys indicate an episodic erosion from Hurricane Harvey occurring from the eastern jetty and extending west approximately 800 feet. The surveys indicate that a significant portion of that eroded material may have migrated further offshore into a bar system. The pre-Hurricane Harvey beach profile at the location of the episodic erosion is approximately -2 to -4 feet NAVD88. The depth after Hurricane Harvey extends to as deep as -10 feet NAVD88.

Utilities and Infrastructure

The Railroad Commission of Texas public GIS viewer (RRC 2021) was used to identify utilities and pipelines near the Site. No utilities or pipelines were identified near the Site. The need for Site-specific utility locations prior to construction will be determined during subsequent design stages; however, utilities are not expected to be a major design consideration for a project of this nature.

The beach has groins along its eastern and western sides. These will need to be avoided during construction of the Site.

Desktop Cultural Resources Survey

A search of cultural resources records in the Texas Historical Commission Atlas Database was completed for the Site between November 29 and December 30, 2021. This search revealed that no archaeological surveys have been conducted and no archaeological sites have been identified within the preliminary proposed placement site boundary (THC 2021).

Cultural resources are not expected to be a major design consideration for a project of this nature.

Sensitive Habitat

GLO oyster habitat GIS data (GLO 2021) indicate that there is no oyster habitat identified within or adjacent to the Site. According to Texas Parks and Wildlife Department seagrass data (TPWD 2021), there are no seagrasses mapped within or adjacent to the Site location. Because the sensitive habitat data are not recent, surveys will likely need to be conducted during a subsequent phase of design to evaluate the presence and extents of sensitive habitat to confirm or update the understanding of sensitive habitat in the vicinity of the Site.

Beneficial Use Source Material

One potential source of dredged material is the GIWW and associated DMPAs, located adjacent to the Site. Based on Coastal Consistency Determinations from USACE, USACE has historically performed maintenance dredging on the GIWW near the Site (USACE 1999). Continued dredging has recently been confirmed by USACE (Jones 2021). The identified DMPAs used by USACE adjacent to the Site and their associated historical average annual quantity of dredged material, distance from the Site, and channel segments are shown in Table 2.

Table 2
USACE DMPA Areas Near the Site with Expected Beach Quality Sand

DMPA No.	Channel Segment (station)	Distance from Site (miles)	Average Annual Dredging Quantity (cy)
138	883+000-891+000	1.6	125,624
139	891+000-895+000	1.9	77,088
140	895+000-902+000	2.5	88,051
141	890+000-906+000	2.8	165,185

Notes:
Source: USACE 1999
cy: cubic yard

10% Design

The main design features that are critical for beach restoration success are as follows:

- Site location
- Size and shape

These design features are evaluated in this memorandum for the preliminary Site design.

Site Location

The proposed location of the Site is on the bayward side of the surf zone of Rockport Beach. This Site is approximately 1.5 miles north of the GIWW in Rockport, Texas.

The Site is located in the hole in the surf zone caused by Hurricane Harvey. Before Hurricane Harvey, there was an existing hole at approximately -5 feet NAVD88 at its deepest point that was increased to -10 feet NAVD88 post-Hurricane Harvey (GLO 2018). This hole extends across the shoreline of the beach, gradually becoming more shallow toward the western portion of the beach.

Size and Shape

Based on the pre-Hurricane Harvey conditions of the beach, it is proposed to fill the hole caused by Hurricane Harvey up to approximately -2 to -3 feet NAVD88, depending on the cross-shore location of the hole along the beach. This will bring the hole back up to historic beach elevations.

GLO approximates that 11,000 cubic yards (cy) of material were eroded from the beach, most of which was eroded from the eastern portion of the beach now containing the hole. By reviewing the profiles of the beach taken by GLO (2018), it appears that a high percentage of the eroded material has moved further offshore into a bar system. There is the potential that some of that material may have been pushed back into the hole through current and wave forcing in the years since the GLO data were collected. The profiles also indicate that the eastern portion of the beach has experienced persistent erosion in the deepest locations of the hole, so it is also possible that the hole has continued to erode and may be deeper now than when the survey was conducted in 2018. Surveys will need to be conducted during subsequent design phases to determine the current extent of the hole and how much dredged material will be required to return the beach to pre-Hurricane Harvey conditions.

Site Construction Cost Estimates

Construction costs were estimated for the design outlined in the previous sections. The estimated costs include permitting, 100% design, engineering costs for advancing the design to the construction phase, pre-construction and as-built surveys, mobilization, materials, and construction of the nourishment. These costs represent the estimated incremental costs; i.e., those costs over and above USACE’s least cost and environmentally acceptable dredged material and disposal alternative. Table 3 shows a line-item list of each costing parameter and the total cost estimated for construction.

Table 3
Opinion of Probable Construction Cost to 100% Project Completion

Item	Quantity	Unit	Unit Price	Total
Pre-Construction Survey	1	LS	$ 30,000.00	$ 30,000.00
Incremental Dredging Cost (2-mile pipeline)	11,000	cy	$ 10.00	$ 110,000.00
Marsh Buggy Fill Maintenance[1]	7	days	$ 2,500.00	$ 20,000.00
Post-Construction Survey (topography/ bathymetry)	1	LS	$ 30,000.00	$ 30,000.00
Subtotal			**Sum**	**$ 190,000.00**
Incremental Mobilization	1	LS	$ 20,000.00	$ 20,000.00
Construction Total			**Sum**	**$ 210,000.00**
100% Engineering and Design[1]	1	25%	$ 50,000.00	$ 50,000.00
Permitting	1	Each	$ 60,000.00	$ 60,000.00
Construction Management[1]	1	20%	$ 40,000.00	$ 40,000.00
Post-Construction Management	3	Month	$ 10,000.00	$ 30,000.00
Project Subtotal[2]			**Sum**	**$ 400,000.00**
-30% Contingency	1	30%	$ 120,000.00	$ 120,000.00
+50% Contingency	1	50%	$ 200,000.00	$ 200,000.00
Low-End Total Project Estimated Cost			**Total Sum**	**$ 280,000.00**
High-End Total Project Estimated Cost			**Total Sum**	**$ 600,000.00**

Notes:
Costs were determined based upon publicly available datasets; no field work was conducted for this phase of the project.
1. Rounded to the nearest $10,000.
2. Rounded to the nearest $100,000.

LS: lump sum

The costs vary from $280,000 to $600,000, depending on the level of contingency allocated to the project cost.

The estimates are developed using current and generally accepted engineering cost estimating methods and are based on assumptions concerning future events. Actual costs may be affected by known and unknown risks including, but not limited to, changes in general economic business conditions, Site conditions that were unknown at the time the estimates were performed, future changes in Site conditions, regulatory or enforcement policy changes, and delays in performance. Actual costs may vary from these estimates.

Benefits Expected

Creation of the Site is expected to have positive benefits to public recreation in the region. This nourishment will bring the beach to pre-Hurricane Harvey conditions and will increase public safety by filling a steep hole within the surf zone of the public beach.

Future Work

Of the sites selected for 10% designs in this project, at least eight will be selected for 30% designs, and at least five of those will subsequently be selected for 60% designs and cost estimates. No fatal flaws have been identified in this 10% design effort. Should this Site be selected for additional design efforts, it can be expected that some aspects of the design in this memorandum will be modified and, as appropriate, improved. As previously mentioned, it is possible that in each phase additional designs will be provided toward this project because of the partnership on this project between DU and PCCA.

References

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TPWD (Texas Parks and Wildlife Department), 2021. Layer: Seagrass TPWD (ID: 2). ArcGIS REST Services Directory. Accessed November 23, 2021. Available at: https://tpwd.texas.gov/arcgis/rest/services/GIS/Seagrass/MapServer/2.

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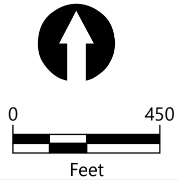
USACE, 2021. Wind Rose. Wave Information Studies. U.S. Army Engineer Research & Development Center. Accessed November 1, 2021. Downloaded from: http://frf.usace.army.mil/wis/data.

Figures

LEGEND:

- Groin
- Rockport Beach Site
- Seagrass

NOTE:
Aerial imagery is from Esri basemaps



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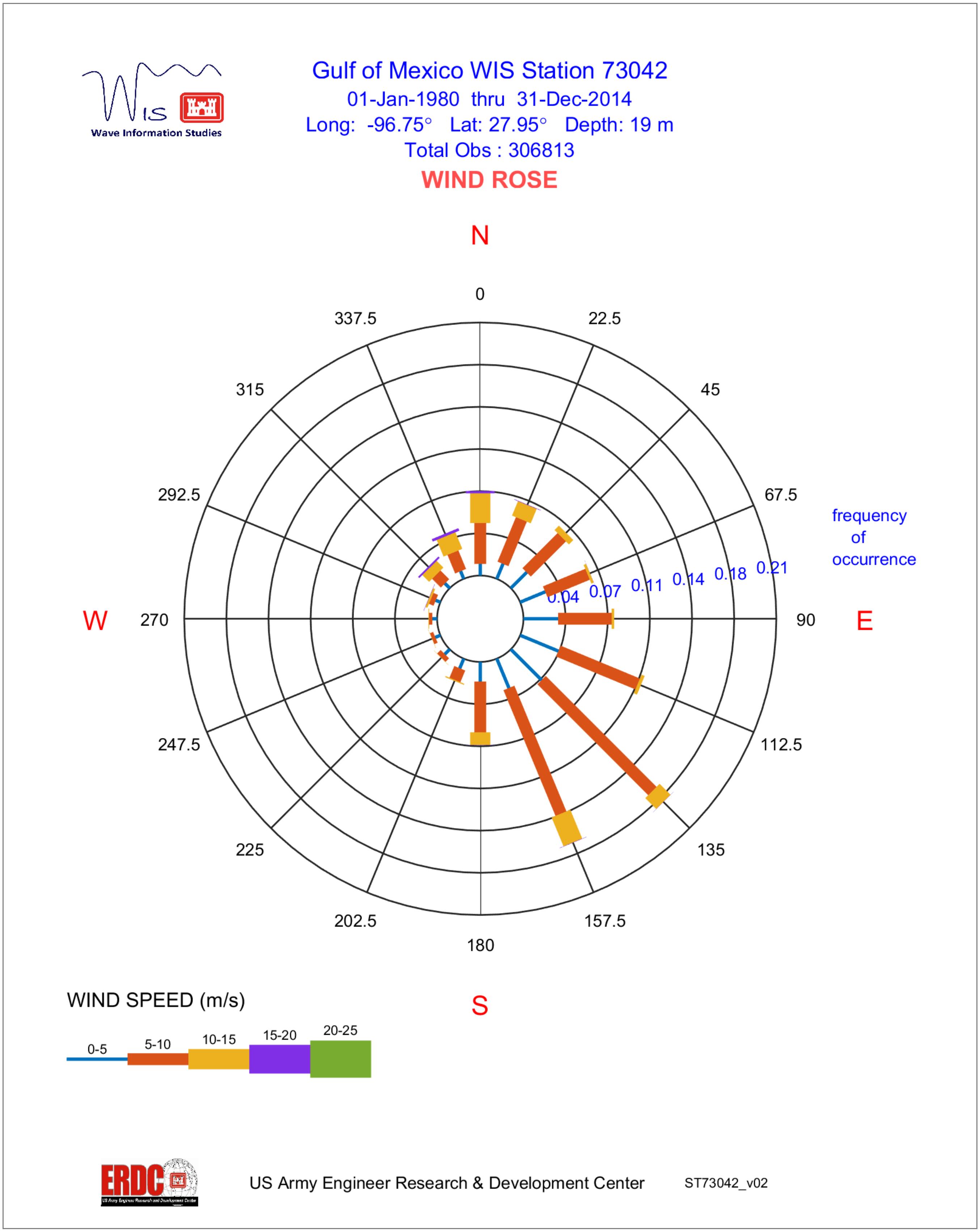
ANCHOR QEA

Figure 1
Rockport Beach Plan View
Rockport Beach 10% Design Memorandum
Texas Lower Coast Beneficial Use



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ANCHOR QEA

Figure 2
Historical Wind Data for USACE WIS Station 73042
Rockport Beach 10% Design Memorandum
Texas Lower Coast Beneficial Use

Memorandum

January 31, 2022

To: Melissa McCutcheon, Texas General Land Office

From: Todd Merendino, Ducks Unlimited
Sarah Garza, Harrison McNeil, and Yvonne Dives-Gomez, Port of Corpus Christi Authority
John Laplante, Dan Opdyke, Ray Newby, Adrienne Accardi, Alexander Freddo, and Hayden Smith, Anchor QEA, LLC
Jane Sarosdy, Sarosdy Consulting, Inc.

Re: Sunset Lake 10% Design Memorandum

Introduction

This 10% design memorandum describes design criteria and assessments associated with the proposed Sunset Lake site (Site), located in Texas General Land Office (GLO) Planning Region 3 of the Texas coast near Corpus Christi Bay in San Patricio County, Texas (Figure 1).

Project Background

GLO awarded a Coastal Management Program Project of Special Merit grant (funded through the Gulf of Mexico Energy Security Act) to Ducks Unlimited, Inc. (DU), to identify priority locations and develop 10% designs and opinions of probable construction costs for at least 16 sites in GLO Planning Regions 3 and 4 of the Texas coast for the beneficial use of dredged material (BU). To assist in this endeavor, the Port of Corpus Christ Authority (PCCA) has committed to provide in-kind services to advance several additional BU sites in tandem with the aforementioned scope. The project team is led by DU and PCCA and includes Anchor QEA, LLC; Sarosdy Consulting, Inc.; and the Texas Department of Transportation. In addition to the 16 sites identified and prioritized, PCCA will provide additional resources to bring forward more site designs for review if the site prioritization and selection so warrants. The project team coordinated two online stakeholder meetings to receive information about potential BU sites. Ultimately, the project team did not select this site as part of the 16 sites for 10% design. However, based on stakeholder input, GLO feedback, publicly available data, and professional judgment, PCCA selected the Site to advance to the 10% design development and cost estimation.

Sunset Lake is a saltwater habitat located 0.5 mile south of the City of Portland, Texas, that provides recreational kayaking and fishing opportunities. It was created as a borrow pit to source fill material related to the construction of the Nueces Bay Causeway. The Site contains deep water with limited circulation to Nueces Bay via a single inlet. This deep water offers marginal habitat value and likely experiences hypoxic conditions. Stakeholder engagements (mainly Coastal Bend Bay & Estuaries Program [CBBEP]) indicate that the Site would provide significantly greater habitat value as seagrass beds.

Project Objectives

Frequent dredging is needed to develop and maintain Texas ship channels. The dredged material must be deposited in dredged material placement areas (DMPAs), and many of the existing DMPAs along the Texas coast are nearing capacity. Resource agencies and stakeholders have long advocated using dredged material beneficially to create and restore wetlands and bird islands, nourish beaches, and counteract land loss. Historically, BU projects are difficult to manage because they are multiyear, multifaceted undertakings in which different organizations manage dredging schedules, funding, project design, permitting, and construction activities. To help address these issues, the objectives of this project include the following:

- Create and restore degrading coastal habitats.
- Establish sites for disposal of dredged material to reduce reliance on existing DMPAs.
- Improve coastal resiliency of the natural and built environment.
- Reduce shoaling in the GIWW and other ship channels.

To accomplish these objectives, the project includes the following tasks:

- Stakeholder outreach and coordination
- Identification and selection of BU sites
- 10% designs and cost estimates for at least 16 BU sites
- 30% designs for at least eight BU sites
- 60% designs, cost estimates, and permit application packages for at least five BU sites

This memorandum documents the 10% design and cost estimate for one of the selected sites.

Design Objectives

This Site design will beneficially use dredged material to create seagrass beds in a region of deepwater tidal habitat with adjacent tidal wetlands. The design will use material dredged from navigation channels and PCCA projects during routine maintenance, thus reducing the volume of such material placed in existing open-bay or upland DMPAs. This 10% design is based upon publicly available datasets; no field work was conducted for this phase of the project.

Design objectives include the following:

- Develop a preliminary vision based on available data for the Site that includes the following:
  - Habitat to be created or restored
  - Potential sediment source(s)
  - Approaches to minimize long-term maintenance costs
- Delineate conceptual footprints for proposed BU placement.
- Identify key sensitive habitats and construction considerations in the vicinity of the Site.
- Estimate fill volumes for the proposed BU footprints.
- Identify data gaps to be addressed in subsequent design stages.
- Provide preliminary cost estimates.

Existing Data Review

Horizontal and Vertical Datums

The horizontal datum used for the Site is the Texas State Plane Zone 5, North American Datum of 1983 (NAD83), in U.S. survey feet. The primary vertical datum used for the Site is the North American Vertical Datum of 1988 (NAVD88). The National Oceanic and Atmospheric Administration (NOAA) maintains an active tide gauge within the vicinity of the Site. The USS Lexington, Corpus Christi Bay, TX Station 8775296 is approximately 5.4 miles southwest of the proposed Site. This station collects and records real time tide information dating back to 2010. The Station 8775296 vertical datums used for the Site are shown in Table 1.

Table 1
USS Lexington, Corpus Christi Bay, TX Station 8775296 Tidal Gauge Displaying NAVD88 Tidal Datums

Tidal Datums	Elevation (feet NAVD88)
MHHW	1.02
MHW	1.01
MSL	0.76
MLW	0.43
MLLW	0.42

Notes:
MHHW: mean higher high water
MHW: mean high water
MLLW: mean lower low water
MLW: mean low water
MSL: mean sea level

Meteorological, Ocean, and Wave Data

Wind and Waves

The United States Army Corps of Engineers (USACE) Wave Information Studies (WIS) provides a national resource of long-term wavefield climatologies for U.S. coastal waters that synthesizes observations, multi-decade hindcasts, and storm event archives (USACE 2021). The WIS station closest to the Site is Station 73039, just offshore on the Gulf side of Port Aransas, Texas, in the Gulf of Mexico. Because the station is located offshore, the wave data were not used. However, the project team considers the wind data to be representative of the winds experienced at the Site. Figure 2 summarizes wind data from January 1, 1990, through December 31, 2014. The data indicate that the predominant wind direction is from the southeast, with significant winds also coming from the north, northeast, east, and south.

The southeast shoreline of Sunset Lake dissipates waves in the predominate southeast wind direction. Due to the Site's proximity to the Nueces Bay Causeway (U.S. Highway 181) and Portland, the Site is protected from wave action from the north, northeast, and east. Wave energy is expected to be minimal.

Wake Erosion

The Site is bounded by a combination of estuarine and marine wetlands and shorelines that dissipate potential wake erosion from vessels transiting La Quinta Channel and recreational vessels in the nearby Nueces and Corpus Christi bays. However, there is recreational vessel traffic inside of Sunset Lake, and an analysis of the erosive effects of vessel traffic will be conducted during subsequent phases of design to better understand the extent of the present and future vessel-induced erosion inside of Sunset Lake.

Bathymetry

Average water depths within the Site are shown to be -0.26 foot NAVD88 (0.16 foot MLLW). These data are assumed to be inaccurate; therefore, bathymetric surveys will likely need to be conducted during a subsequent phase of design to evaluate Site water depth and determine accurate volume of placement material.

Utilities and Infrastructure

The Railroad Commission of Texas public GIS viewer (RRC 2021) was used to identify utilities and pipelines near the Site. Within a 1-mile radius, three plugged gas wells and two plugged oil/gas wells are documented. The nearest plugged gas well is approximately 0.1 mile from the Site; however, it is not anticipated that it will affect the design or constructability of the Site. Four pipelines were found approximately 0.7 mile northeast of the Site boundary: two natural gas gathering lines operated by Sulphur River Exploration, LLC; a crude oil gathering line operated by BEPCO, L.P.; and a natural gas gathering line operated by Southcross CCNG Gathering, Ltd. Pipeline locations are shown in Figure 1. The need for Site-specific utility locations prior to construction will be determined during subsequent design stages.

U.S. Highway 181 and residential properties are immediately adjacent to the Site. Protection of the highway and residential foundations will need to be considered in subsequent phases of design.

Desktop Cultural Resources Survey

A search of cultural resources records in the Texas Historical Commission Atlas Database (THC 2021) was completed on December 21, 2021. This search revealed that no sites have been identified within the Site. Two cultural resources were identified within 1 mile of the Site: a historical marker for Reef Road and a marker for the Bay View College site. The proposed project will not affect these resources.

Sensitive Habitat

Based on GLO oyster habitat GIS data (GLO 2021), oyster habitat is located approximately 1,300 to 2,600 feet southwest, west, northwest, north, and northeast of the Site. All of the oyster habitat is separated from the Site by uplands or the Nueces Bay Causeway. According to Texas Parks and Wildlife Department seagrass data (TPWD 2021), there are seagrasses mapped within the Site and immediately adjacent to the Sunset Lake shoreline in Corpus Christi Bay. Surveys will likely need to be conducted during a subsequent phase of design to evaluate the presence and extents of sensitive habitat.

Erosion

Sunset Lake southeast shorelines are subject to erosion from waves created as a result of the prevailing southeast wind and long fetch of Corpus Christi Bay. Due to its location within Corpus Christi Bay, the Site is believed to be protected from erosive forces.

Beneficial Use Source Material

A potential source of dredge material is La Quinta Channel Extension, located 3 miles northeast of the Site. PCCA estimates approximately 2,560,000 cubic yards (cy) of maintenance material from the La Quinta Channel Extension as well as 96,600 cy of maintenance material from the berths at the La Quinta Terminal. Additionally, PCCA is authorized to dredge a third berth at the La Quinta Terminal, which would generate approximately 650,500 cy of new work material. Based on Coastal Consistency Determinations from USACE, USACE has historically performed maintenance dredging on the La Quinta Channel near the Site (USACE 1999). The average grain size and grain type percentages are shown in Table 2. This informs the quantity and characteristics of dredged material that may be available during a dredging cycle. For example, the Site will be designed such that the clay, which constitutes a relatively high percentage of nearby sediment, will be sheltered from erosive forces.

Table 2
Typical Sediment Characteristics in the La Quinta Channel

Sediment Characteristics from the La Quinta Channel
D_{50} (mm) =0.020
10.78.5% Sand
71.4% Silt
17.9% Clay

Notes:
Source: USACE 1999
D_{50}: median grain size
mm: millimeter

10% Design Features

The main design features that are critical for seagrass beds success are as follows:

- Site location
- Size and shape
- Planting and natural recruitment of vegetation

These design features are evaluated in this memorandum for the preliminary Site design.

10% Design

Site Location

The Site is located between U.S. Highway 181 and Sunset Drive, Portland, Texas, approximately 600 feet east and 1,000 feet southeast of existing seagrass beds. The project proposes to raise the existing borrow pit to seagrass elevations. Because the Site is in the vicinity of seagrasses, it is likely that seagrasses will naturally propagate with the newly constructed design elevations; therefore, planting is not proposed.

The water depths within the Site are expected to be deep water due to previous borrow pit activity; however, according to data in the NOAA Digital Elevation Model (NOAA 2021), average water depths within the Site are shown to be -0.26 foot NAVD88 (0.16 foot MLLW). The average seabed elevations surrounding the Site are +1.39 feet NAVD88 (+1.81 feet MLLW). These depths will make it difficult to deploy heavy equipment from barges without the dredging of access channels. An option could be to designate a work corridor and laydown area along the access road of U.S. Highway 181 or lay a dredged material pipeline across, or under, Sunset Lake Park and Sunset Drive. Bathymetric surveys will need to be conducted during subsequent design phases to better define Site dimensions and material needs.

Size and Shape

Based on availability of sediment, a cost analysis, and stakeholder feedback, the project team proposes that the area of the Site be 63.1 acres. The Site would be created with dredged material placed to an elevation of -1.0 foot NAVD88 to resemble the preference of the surrounding seagrass habitat. The Site perimeter will follow the shape of the shoreline with no proposed armoring. The perimeter is bounded by existing estuarine and marine wetlands. A sole inlet located northwest of the Site and under the Nueces Bay Causeway (U.S. Highway 181), driven by the tidal cycle in Nueces Bay, will allow for water exchange, as well as ingress and egress of organisms.

Fill material could be obtained from the nearby La Quinta Channel, as described in Table 2. It is expected that temporary containment of material on the open end will be needed during construction to allow for material dewatering. Because accurate bathymetry is not available for the Site, an assumed average water depth of 5 feet was used to calculate fill material volume. This volume was approximated to be 398,430 cy. This value assumes 1 foot of foundation compression for every 3 feet of fill and does not consider bulking. Bathymetry surveys will be needed during the subsequent design phase to determine the required dried fill volume and present seagrass colonization depths. Geotechnical data also will likely need to be collected during a subsequent design phase to further evaluate the expected foundation compression and the expected bulking of dredged material.

Planting and Natural Recruitment

Based on stakeholder input and cost considerations, the project team determined that planting will not be needed for the Site. Rather, natural recruitment will be allowed to proceed. If the outcome is unsatisfactory an adaptive management program can be instituted to modify the vegetation.

Site Construction Cost Estimates

Construction costs were estimated for the design outlined in the previous sections. The estimated costs include permitting, 100% design, engineering costs for advancing the design to the construction phase, pre-construction and as-built surveys, mobilization and materials. These costs represent the estimated incremental costs; i.e., those costs over and above USACE’s least cost and environmentally acceptable dredged material and disposal alternative. Table 3 shows a line-item list of each costing parameter and the total cost estimated for construction.

Table 3
Opinion of Probable Construction Cost to 100% Project Completion

Item	Quantity	Unit	Unit Price	Total
Pre-Construction Survey	1	LS	$ 30,000.00	$ 30,000.00
Post Construction Survey (topography/ bathymetry)	1	LS	$ 30,000.00	$ 30,000.00
Incremental Dredging Cost (3-mile pipeline)[1]	398,430	cy	$ 15.00	$ 6,000,000.00
Post Construction Survey (aerials)	1	LS	$ 10,000.00	$ 10,000.00
Subtotal[1]			**Sum**	**$ 6,100,000.00**
Incremental Mobilization[2]	1	5%	$ 310,000.00	$ 310,000.00
Construction Total[1]			**Sum**	**$ 6,400,000.00**
100% Engineering and Design[1]	1	10%	$ 600,000.00	$ 600,000.00
Permitting	1	Each	$ 100,000.00	$ 100,000.00
Construction Management[1]	1	8%	$ 500,000.00	$ 500,000.00
Post-Construction Management	12	Month	$ 10,000.00	$ 120,000.00
Project Subtotal[1]			**Sum**	**$ 7,700,000.00**
-30% Contingency[1]	1	30%	$ 2,000,000.00	$ 2,300,000.00
+50% Contingency[1]	1	50%	$ 3,200,000.00	$ 3,900,000.00
Low-End Total Project Estimated Cost[1]			**Total Sum**	**$ 5,400,000.00**
High-End Total Project Estimated Cost[1]			**Total Sum**	**$ 11,600,000.00**

Notes:
Costs were determined based upon publicly available datasets; no field work was conducted for this phase of the project.
1. Rounded to the nearest $100,000.
2. Rounded to nearest $10,000

LS: lump sum

The costs vary from $5.4 million to $11.6 million, depending on the level of contingency allocated to the project cost. Cost savings may be realized after bathymetric surveys are conducted and fill volume is revisited. The estimates are developed using current and generally accepted engineering cost estimating methods and are based on assumptions concerning future events. Actual costs may be affected by known and unknown risks including, but not limited to, changes in general economic business conditions, Site conditions that were unknown at the time the estimates were performed, future changes in Site conditions, regulatory or enforcement policy changes, and delays in performance. Actual costs may vary from these estimates.

Ecosystem Benefits Expected

Creation of the Site is expected to have positive benefits on the regional ecosystem. The proposed change in elevations will convert a deep-water hypoxic environment to one with better water quality and where seagrass beds can naturally propagate. The seagrasses will contribute to increased habitat acreage and quality, nursery areas for fish and other marine organisms, and food sources for other wildlife. The Site will also improve water quality through nutrient uptake and retention and sediment trapping.

Future Work

Of the sites selected for 10% designs in this project, at least eight will be selected for 30% designs, and at least five of those will subsequently be selected for 60% designs and cost estimates. No fatal flaws have been identified in this 10% design effort. Should this Site be selected for additional design efforts, it can be expected that some aspects of the design in this memorandum will be modified and, as appropriate, improved. As previously mentioned, it is possible that in each phase additional designs will be provided toward this project because of the partnership on this project between DU and PCCA.

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NOAA (National Oceanic and Atmospheric Administration), 2021. Continuously Updated Digital Elevation Model (CUDEM) – Ninth Arc-Second Resolution Bathymetric-Topographic Tiles. Last updated December 1, 2021. Available at: https://coast.noaa.gov/htdata/raster2/elevation/NCEI_ninth_Topobathy_2014_8483/.

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USACE (U.S. Army Corps of Engineers), 1999. Series of Federal Consistency Determinations for Texas Regional Waterways for the Coastal Coordination Council. 39 documents. U.S. Army Corps of Engineers, Galveston District. Galveston, Texas.

USACE, 2021. Wind Rose. Wave Information Studies. U.S. Army Engineer Research & Development Center. Accessed November 1, 2021. Downloaded from: http://frf.usace.army.mil/wis/data.

Figures

Path: H:\Environmental\Duck Unlimited Beneficial Use Project\DU Beneficial Use Sites\DU Beneficial Use Sites.aprx Date Saved: 1/26/2022 10:23 AM User: hmcneil

Legend

Sunset Lake

BU Type

- Seagrass Creation
- TPWD Seagrass
- Oyster Habitat

Railroad Commission Pipelines

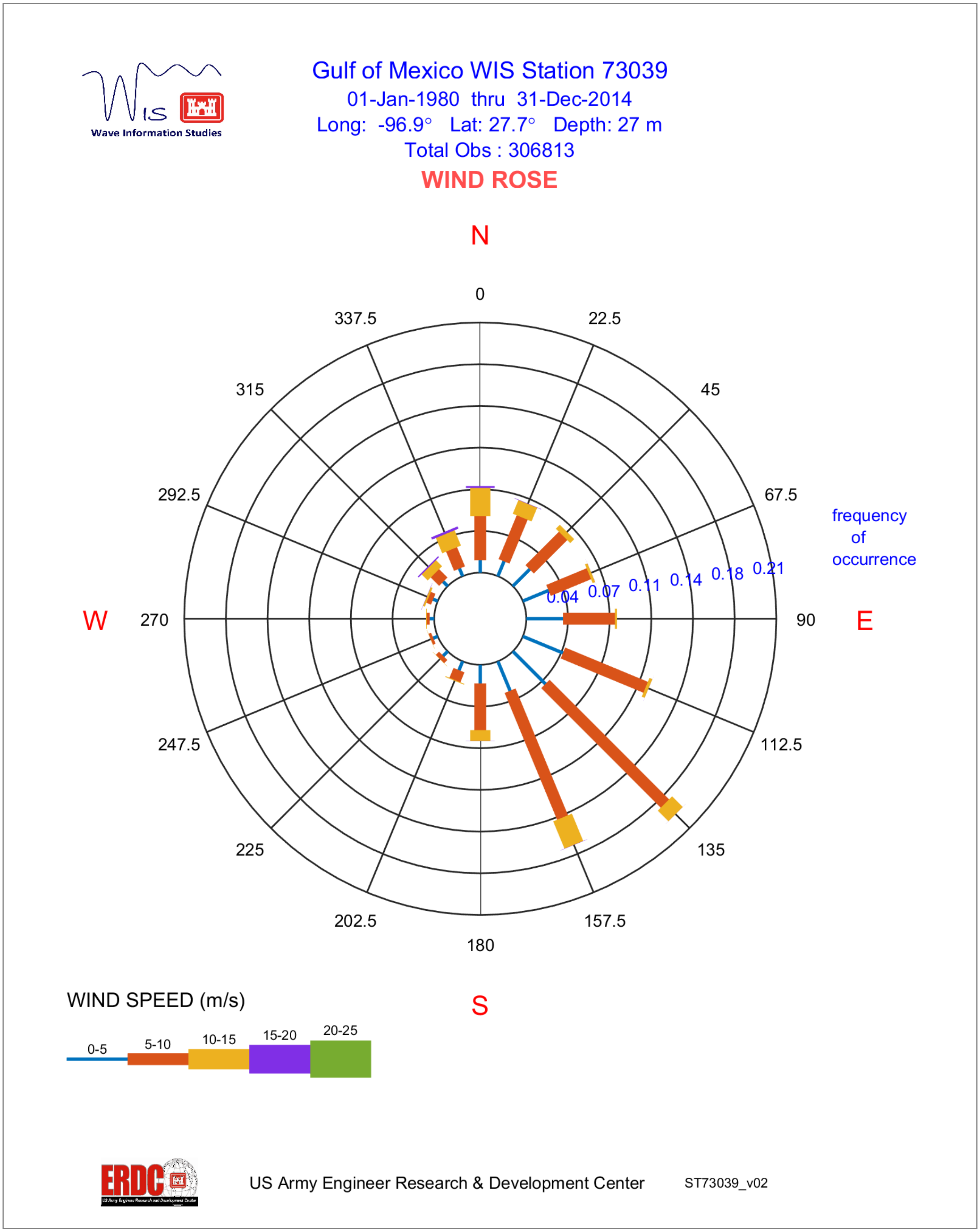
Status

- Abandoned
- In-Service

PORTCORPUSCHRISTI

Figure 1
Location Map

Sunset Lake - Seagrass Creation
10% Design Memorandum
Texas Lower Coast Beneficial Use

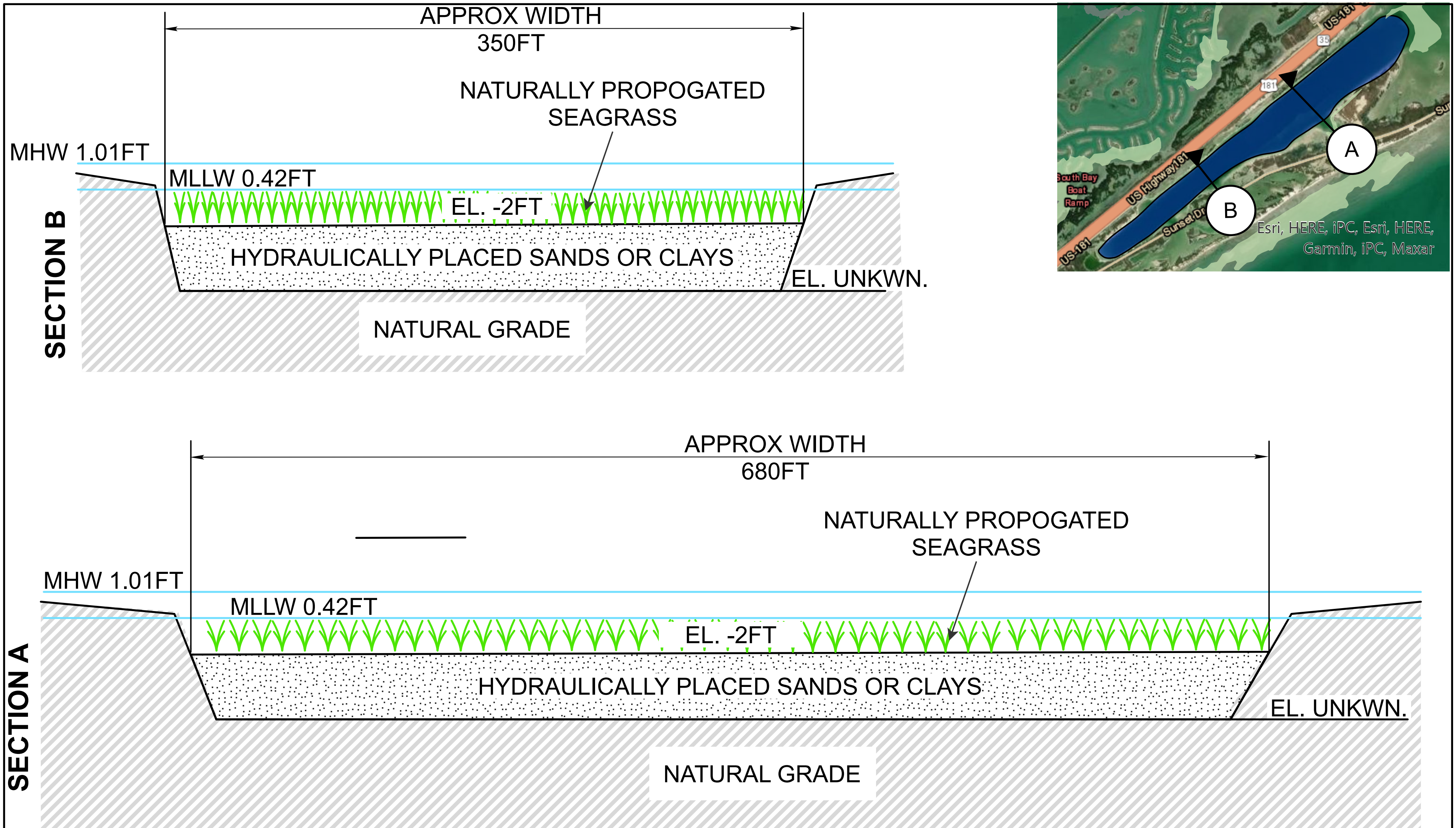


Filepath: \\Fuji\Austin\D_drive\Projects\GLO\BU Lower Coast\Documents_Team\10pct Design Memos\PCCA Memos\Sunset Lake\Figure 2_Sunset Lake.docx

ANCHOR QEA

Figure 2
Historical Wind Data for USACE WIS Station 73039

Sunset Lake 10% Design Memorandum
Texas Lower Coast Beneficial Use



These drawing are conceptual intended for planning purposes only. These drawings are not intended to be used for engineer, construction, surveying or bidding documents. These drawings are not to scale. Vertical datum NAVD88

PORTCORPUSCHRISTI

Figure 3
Cross Sections

Sunset Lake 10% Design Memorandum
Texas Lower Coast Beneficial Use

Appendix B

30% Design Memoranda

Memorandum

June 30, 2022

To: Melissa McCutcheon, Texas General Land Office

From: Todd Merendino, Ducks Unlimited, Inc.
Sarah Garza, Harrison McNeil, and Yvonne Dives-Gomez, Port of Corpus Christi Authority
John Laplante, Dan Opdyke, Renee Robertson, Alexander Freddo, and Hayden Smith, Anchor QEA, LLC
Jane Sarosdy, Sarosdy Consulting, Inc.

Re: Causeway Bird Island 30% Design Memorandum

Introduction

This 30% design memorandum describes design criteria and assessments associated with a beneficial use of dredged material (BU) project at the proposed Causeway Bird Island site (Site), located in Texas General Land Office (GLO) Planning Region 3 of the Texas coast in Nueces Bay in Nueces County, Texas (Figure 1).

Project Background

GLO awarded a Coastal Management Program Project of Special Merit grant (funded through the Gulf of Mexico Energy Security Act) to Ducks Unlimited, Inc. (DU) to coordinate with stakeholders and identify restoration sites for BU. The Port of Corpus Christi Authority (PCCA), a project partner, has also contributed staff and financial resources to expand the project scope. The project team is led by DU and PCCA and includes Anchor QEA, LLC; Sarosdy Consulting, Inc.; and the Texas Department of Transportation. Collectively, the project team coordinated three stakeholder meetings with state and federal resource agencies, nongovernmental organizations, academia, consultants, and local officials in each region to solicit information about potential BU sites. Based on stakeholder input, GLO feedback, publicly available data, and professional judgment, the project team has developed 10% designs for 18 sites in GLO Planning Regions 3 and 4 of the Texas coast and 2 GLO-approved sites in Mesquite Bay and San Antonio Bay in GLO Planning Region 2. After completion of the 10% designs, 11 of the designs were selected to continue to 30% designs, and up to 7 of those designs will be chosen for 60% designs and permit application packages. The project team selected the Site as one of the 20 sites for 10% design development and cost estimation. Based on the Site's restoration potential and construction feasibility, the project team selected the Site to proceed to

30% design and opinion of probable construction costs using funding from the GLO Coastal Management Program Project of Special Merit grant.

Conservationists have identified the Nueces Bay rookery islands as an important location for protecting and restoring bird habitat (CBBEP 2020a; Hackney et al. 2016). Causeway Bird Island is located on state-owned submerged land approximately 0.1 mile northeast of the Rincon Canal and 2.3 miles north of the Corpus Christi Ship Channel (CCSC) in Nueces Bay in Nueces County, Texas (Figure 1). This area was selected because offshore breakwaters constructed in 2022 provide protection to the existing island, and placement of dredged material between the breakwaters and the existing island will increase bird habitat. Placement of material has not yet been designed and is the subject of this design. The Site is ideal for restoration because of its proximity to sediment sources in the Rincon Canal and CCSC and its proximity to nearby potential bird foraging areas.

Project Objectives

Frequent dredging is needed to develop and maintain Texas navigation channels. The dredged material is often deposited in dredged material placement areas (DMPAs), and many of the existing DMPAs along the Texas coast are nearing capacity. Resource agencies and stakeholders have long advocated using dredged material beneficially to create and restore wetlands and bird islands, nourish beaches, and counteract land loss. Historically, BU projects are difficult to manage because they are multiyear, multifaceted undertakings in which different organizations manage dredging schedules, funding, project design, permitting, and construction activities. To help address these issues, the objectives of this project include the following:

- Create and restore degrading coastal habitats.
- Establish sites for placement of dredged material to reduce reliance on existing DMPAs.
- Improve coastal resiliency of the natural and built environment.

To accomplish these objectives, the project includes the following tasks:

- Stakeholder outreach and coordination
- Identification and selection of BU sites
- 10% designs and cost estimates for 20 BU sites
- 30% designs and cost estimates for 11 BU sites
- 60% designs, cost estimates, and permit application packages for up to seven BU sites

This memorandum documents the 30% design and cost estimate for the Site.

Design Objectives

The Site will be designed to beneficially use dredged material to restore a rookery island in a region with degrading coastal bird habitat. The design will potentially use material from the CCSC and

Rincon Canal maintenance dredging, thus reducing the volume of such material that will need to be placed in existing open-bay or upland DMPAs. This 30% design is based upon publicly available datasets, as well as focused field work conducted by DU.

Design objectives include the following:

- Develop a preliminary vision based on available data for the Site that includes the following:
  - Habitat to be created or restored
  - Potential sediment source(s)
  - Approaches to minimize long-term maintenance costs
- Delineate conceptual footprints for proposed BU placement.
- Identify key sensitive habitats and construction considerations in the vicinity of the Site.
- Estimate fill volumes for the proposed BU footprints.
- Identify data gaps to be addressed in subsequent design phases.
- Provide preliminary cost estimates.

Existing Data Review

A review of existing data and the focused data collected by DU was performed to develop the Site. This section describes the data reviewed and collected for the 30% design.

Horizontal and Vertical Datums

The horizontal datum used for the Site is the Texas State Plane South Zone, North American Datum of 1983 in U.S. survey feet. The primary vertical datum used for the Site design is the North American Vertical Datum of 1988 (NAVD88). The National Oceanic and Atmospheric Administration (NOAA) maintains an active tide gauge within the vicinity of the Site. The NOAA USS Lexington, Corpus Christi Bay, TX Station 8775296 (Lexington Station) is 2.0 miles southwest of the proposed project. This station collects and records real-time tide information dating back to 2004. The vertical datums from this station that will be used for the Site are shown in Table 1. The Lexington Station was also used to define a preliminary design water level, as described in the Water Level section.

Table 1
Lexington Station Tidal Gauge Displaying NAVD88 Tidal Datums

Tidal Datums	Elevation (feet NAVD88)	Elevation (feet MLLW)
MHHW	1.02	0.60
MHW	1.01	0.59
MSL	0.76	0.34
MLW	0.43	0.01
MLLW	0.42	0

Notes:
MHHW: mean higher high water

MHW: mean high water
MLLW: mean lower low water
MLW: mean low water
MSL: mean sea level

Meteorological, Ocean, and Wave Data

Water Level

To determine an approximate design water level elevation for the Site, an existing water level analysis using data from the Lexington Station was used (Anchor QEA 2021). Data were compiled for the period from October 2015 to January 2021 and used to calculate a 90th-percentile water level of 2.0 feet NAVD88. Because they represent recent water level conditions measured near the Site, the data at the Lexington Station are considered appropriate to inform the Site design.

Wind and Waves

The U.S. Army Corps of Engineers (USACE) Wave Information Studies database provides a national resource of long-term wavefield climatologies for U.S. coastal waters that synthesizes observations, multidecade hindcasts, and storm event archives (USACE 2021). The Wave Information Studies station closest to the Site is Station 73039, just offshore on the Gulf side of Mustang Island in the Gulf of Mexico. Because the station is located offshore, the wave data are not applicable to this project design. However, the project team considers the wind data to be representative of the winds experienced at the Site. Figure 2 summarizes wind data from January 1, 1980, through December 21, 2014. The data indicate that the predominant wind direction is from the southeast, with significant winds also coming from the north, northeast, east, and south.

The breakwater surrounding the existing island is expected to minimize impacts of wind-generated waves to the Site, causing the Site to experience a low wave-energy environment.

Wake Erosion

The Rincon Canal is approximately 0.1 mile southwest of the Site, and the CCSC is approximately 2.3 miles south of the Site. Vessel wakes from the CCSC are not expected because of the Site's distance from the CCSC sailing line. However, several types of vessels, including recreational and commercial vessels and commercial tugboats and barges, may operate in the Rincon Canal and generate wake waves that propagate to the Site. Like wind-generated waves, vessel-generated wake waves produce the greatest erosive forces in the region where the waves break (i.e., the surf zone).

The Bhowmik et al. (1991) and Weggel and Sorensen (1986) vessel-generated wave prediction methods—based on vessel dimensions, travel speed, and distance between the sailing line and Site—were used to evaluate the range of vessel-generated waves for a conservative selection of representative vessels known to operate in the area. A sport yacht with a draft of 4 feet was selected to evaluate recreation vessel wakes generated by vessels traveling near the proposed Site. A generic tugboat with maximum dimensions recorded in the Automatic Identification System (AIS) database was selected, along with a similar tugboat transiting with twin barges (identified using Google Earth imagery of ports in the region) to evaluate the commercial vessel wakes generated by vessels traveling in the Rincon Canal. Calculation of the sport yacht's maximum vessel wakes, traveling at varying speeds along the Rincon Canal 528 feet from the Site, can be seen in Table 2. Calculation of the maximum vessel wakes of the tugboat and tugboat with twin barges, traveling in 14 feet of water at varying speeds up to 11 miles per hour (mph; considered conservative) along the Rincon Canal 528 feet from the Site, can be seen in Table 3.

These wave heights are generally 1 foot or less, and the existing breakwater should mitigate the impacts of those wakes.

Table 2
Sea Ray Sundancer Sport Yacht Maximum Vessel Wake Calculations at Various Speeds

Vessel	Length (feet)	Draft (feet)	Vessel Speed (mph)	Maximum Wave Height (feet)	Wave Period (seconds)
Sea Ray Sundancer sport yacht	51	4	7.2	1.04	1.28
			15	0.79	1.11
			25	0.66	1.02
			35	0.59	0.96
			45.4	0.54	0.92

Note:
Maximum wave heights were calculated using Bhowmik et al. (1991), in which vessel speeds ranged from 6.7 to 45.4 mph.

Table 3
Tugboat and Tugboat with Twin Barges Maximum Vessel Wake Calculations at Various Speeds

Vessel	Length (feet)	Beam (feet)	Draft (feet)	Vessel Speed (mph)	Maximum Wave Height (feet)	Wave Period (seconds)
Generic tugboat with maximum dimensions recorded in AIS data[1]	87	33	11	3	0.00	8.40
	87	33	11	5	0.00	5.04
	87	33	11	7	0.00	3.60
	87	33	11	9	0.00	2.80
	87	33	11	11	0.72	2.29
Generic tugboat with maximum dimensions recorded in AIS data and twin barges[2]	387	110	11	3	0.00	7.31
	387	110	11	5	0.00	4.38
	387	110	11	7	0.00	3.13
	387	110	11	9	0.00	2.44
	387	110	11	11	0.00	2.29

Notes:
Maximum wave heights were calculated for vessels traveling within Froude number boundaries and at 3, 5, 7, 9, and 11 mph (Weggel and Sorensen 1986).

1. Vessel hull geometric coefficients were input using a tugboat from Hay (1967).
2. Vessel hull geometric coefficients were input using a barge from Hay (1967).

Bathymetry and Topography

DU conducted bathymetric and topographic surveys at the Site within the breakwater on March 16, 2022. DU's survey contained data gaps due to the presence of nesting birds. The DU survey data gaps were supplemented with a modified T. Baker Smith (TBS) transect survey conducted prior to the breakwater construction for HDR, Inc., on December 30, 2020. The modification included shifting all the TBS data vertically by 0.17 foot to match the common point between the two surveys. The Site has an average elevation of 0.42 foot NAVD88 and ranges from -3.84 to +5.68 feet NAVD88.

Utilities and Infrastructure

The Railroad Commission of Texas public GIS viewer (RRC 2021) and GLO pipeline data (GLO 2021a) were used to identify mapped utilities and pipelines near the Site. No pipelines were identified near the Site. An underground utility cable was identified adjacent to the Site in the TBS data, and its approximate location is shown in Attachment 1, C01. The need for Site-specific utility locations prior to construction will be determined during subsequent design phases.

U.S. Highway 181 is immediately adjacent to the Site. U.S. Highway 181 is an elevated causeway, and protection of the highway foundation is not expected to be a design consideration because the proposed fill material would be inside the existing breakwater. However, if information is found that identifies concerns with this project and the foundation, additional evaluation may be performed during subsequent phases of design.

Desktop Cultural Resources Survey

A search of cultural resources records in the Texas Historical Commission Texas Historical Sites Atlas Database was completed for the Site on November 29, 2021. This search revealed that no archaeological surveys have been conducted, and no archaeological sites have been identified within the preliminary proposed placement site boundary (THC 2021). Furthermore, the 2022 construction of the breakwater, and earlier construction of the existing island and a previous breakwater, indicate the potential presence of cultural resources has not prevented previous projects.

Sensitive Habitat

GLO oyster habitat GIS data (GLO 2021b) indicate there is no oyster habitat identified within the Site; however, there is oyster habitat identified approximately 200 feet beyond the extent of the Site, past the existing breakwater to the north and west of the Site footprint (Attachment 1, C01). Visual surveys conducted by DU on March 16, 2022, do not indicate oyster habitat within or immediately adjacent to the Site. Oyster habitat is not expected to be a design consideration.

According to the Texas Parks and Wildlife Department seagrass data (TPWD 2021), there are no seagrasses mapped within or adjacent to the Site location. Visual surveys conducted by DU on March 16, 2022, do not indicate seagrass habitat within or adjacent to the Site.

Because this information is based on visual surveys, more extensive habitat surveys may need to be conducted during a subsequent phase of design.

Bird Species

The U.S. Fish and Wildlife Service (USFWS) Information for Planning and Consultation (IPaC) tool was used to identify listed species and migratory birds within a 480-square-mile region around Nueces and Corpus Christi Bay (USFWS 2021). Table 4 includes some of the protected and migratory bird species present near the Site and their preferred habitat as explained in the *Guide to North American Birds* (Audubon 2021). At this time, no target species or list of species has been identified for the Site.

Table 4
USFWS IPaC Species Information[1]

Species	Status	Preferred Habitat[2]
Whooping crane (*Grus americana*)	Endangered	Prairie pools, marshes, and coastal marshes
Piping plover (*Charadrius melodus*)	Threatened	Sand beach dunes and expansive sand or mudflats
Red knot (*Calidris canutus*)	Threatened	Mudflats, tidal zones, and sandy beaches
American oystercatcher (*Haematopus palliatus*)	Migratory	Strictly coastal; dunes, islands in salt marsh, dredge spoil islands, sandy beaches, and tidal mudflats
Black skimmer (*Rynchops niger*)	Migratory	Sandy islands, shell beaches, open beaches, lagoons, estuaries, inlets, and sheltered bays
Brown pelican (*Pelecanus occidentalis*)	Migratory	Bare, rocky, mangrove or tree-covered islands; salt bays, beaches, and oceans
Gull-billed tern (*Gelochelidon nilotica*)	Migratory	Beaches, islands, salt marshes, fields, and coastal bays
Marbled godwit (*Limosa fedoa*)	Migratory	Northern Great Plains, native prairie with marshes or ponds, pools, shores, marshes, and tidal flats
Reddish egret (*Egretta rufescens*)	Migratory	Red mangrove swamps, arid coastal islands covered with thorny brush, coastal tidal flats, salt marshes, and lagoons
Ring-billed gull (*Larus delawarensis*)	Migratory	On ground near water with sparse plant growth, lakes, bays, coasts, piers, dumps, and plowed fields

Species	Status	Preferred Habitat[2]
Royal tern (*Thalasseus maximus*)	Migratory	Low-lying sandy islands, coasts, lagoons, salt bays, and estuaries
Wilson's plover (*Charadrius wilsonia*)	Migratory	Dry part of beach, near conspicuous object, coastal regions, open beaches, tidal flats, estuaries, and sandy islands

Notes:

1. USFWS IPaC information (USFWS 2021) is provided for a 480-square-mile region around Nueces Bay and Corpus Christi Bay highlighting endangered, threatened, and migratory birds and their preferred habitat.
2. Habitat information is from the *Guide to North American Birds* (Audubon 2021) and includes preferred nesting and general habitat.

Erosion

According to documentation from the Coastal Bend Bays & Estuaries Program, the Site "has suffered from erosion for many years due to its exposure to wind and waves" (CBBEP 2022). The construction of a breakwater surrounding the Site was completed in early 2022, and the Site's risk of erosion is reduced.

Beneficial Use Source Material

Potential sources of dredged material are the Rincon Canal, located adjacent to the Site, and the CCSC, located 2.3 miles away. Based on coastal consistency determinations from USACE, USACE has historically performed maintenance dredging on the CCSC near the Site (USACE 1999). Continued dredging has recently been confirmed by USACE (Jones 2021). The identified DMPAs used by USACE when dredging the CCSC adjacent to the Site from the LaQuinta Junction to Beacon 82, historical average annual quantity of dredged material, distance from the Site to DMPA, and channel segments are shown in Table 5. PCCA has estimated shoaling rates for the Inner Harbor adjacent to the Site (from Beacon 82 to the Viola Turning Basin; Table 6). With the ongoing widening and deepening of the CCSC, it is expected that the average annual dredging quantities will be higher in the future. The average grain size and grain type percentages for from the LaQuinta Junction to Beacon 82 and from Beacon 82 to the Viola Turning Basin are shown in Table 7. This informs the quantity and characteristics of dredged material that may be available during a dredging cycle.

Table 5
USACE DMPA Areas Along the CCSC Near the Site

DMPA No.	Channel Segment (Station)	Distance from Site to DMPA (miles)	Average Annual Dredging Quantity (CY)
16A	LaQuinta Junction to Beacon 82 (800+00-900+00)	4.8	91,000
16B	LaQuinta Junction to Beacon 82 (800+00-900+00)	4.2	92,000
17A	LaQuinta Junction to Beacon 82 (900+00-1050+00)	3.6	107,000
17B	LaQuinta Junction to Beacon 82 (900+00-1050+00)	3.2	296,000

Notes:
Source: USACE 1999.
CY: cubic yard

Table 6
PCCA Estimated Shoaling Rate for the CCSC Inner Harbor

Inner Harbor West Region Estimated Shoaling (CY per year)	Inner Harbor Central Region Estimated Shoaling (CY per year)	Inner Harbor East Region Estimated Shoaling (CY per year)
35,000	38,000	50,000

Table 7
Typical Sediment Characteristics from the LaQuinta Junction to Beacon 82 and from Beacon 82 to the Viola Turning Basin

Sediment Characteristics from the LaQuinta Junction to Beacon 82 (550+00 to 1050+00)	Sediment Characteristics from the Beacon 82 to the Viola Turning Basin (1050+00 to 1550+00)
D_{50} (mm) = 0.020	D_{50} (mm) = 0.047
8.5% sand	24.4% sand
54.5% silt	40.6% silt
37.1% clay	35.1% clay

Notes:
Source: USACE 1999
D_{50}: median grain size
mm: millimeter

Approximately 400,000 cubic yards (CY) of material are dredged from the Rincon Canal every seven years (USEPA and USACE 2018). Due to the relative proximity of the Site to these sediment sources, the Site should allow for lower construction costs compared to those of potential bird island sites that are more remote.

30% Design

The main design elements evaluated for the Site are as follows:

- Site location
- Rookery island size and shape
- Containment and erosion protection
- Constructability
- Planting and natural recruitment of vegetation
- Performance expectations
- Site construction cost estimates
- Expected ecosystem benefits
- Data and information gaps

These design elements are evaluated in this memorandum for the 30% Site design.

Site Location

The proposed location of the Site is the historical Causeway Bird Island, approximately 0.1 mile northeast of Rincon Canal and 2.3 miles north of the CCSC (Figure 1). The island is surrounded by a recently constructed breakwater and exhibits an average elevation of 0.42 foot NAVD88. The advantages of creating additional bird habitat at this location include the following:

- The bird island was larger (historically), and stakeholders have indicated an interest in expanding bird island habitat at this location.
- The existing breakwater is expected to protect placed dredged material from erosion and contain placed dredged material.
- The location is not in the vicinity of sensitive habitat.
- Adjacent channels may provide relatively deeper water construction access on the southwest side of the site.

Although the Site is closer to shore than the desired 0.5-mile distance identified for minimizing predator access to rookery islands (Stanzel 2018), it is an active rookery that currently supports thousands of nesting pairs of colonial waterbirds (CBBEP 2020a).

Rookery Island Size and Shape

Based on the existing size of the island and breakwater, the project team proposes a site area of approximately 16 acres. This represents a bird island larger than the optimum size suggested by stakeholders (4 to 10 acres). However, not all of the Site will be built out to bird island habitat elevations. The Site is an active rookery that supports thousands of nesting pairs of colonial waterbirds (CBBEP 2020a), and habitat restoration at the Site may further increase colonial waterbird presence.

The Site will be created with dredged material placed to varying elevations to promote a variety of habitats. The Site will be filled to 0.0 foot NAVD88 from the landward side of the breakwater to the existing 0.0-foot NAVD88 contour to create a variety of tidal flat, sandy beach, and low marsh habitat. From the existing 0.0-foot NAVD88 contour, the Site will be filled to +3.5 feet NAVD88 to the existing +3.5-foot NAVD88 contour to create a mix of high marsh and upland habitat. Existing upland rookery elevations greater than the approximate +3.5-foot NAVD88 contour will be avoided to minimize disturbance to the rookery. It has been assumed that the breakwater has been designed and located so that loads from the breakwater are not imparted on the existing causeway foundations and, therefore, that any loads from new fill behind the breakwater will also not be imparted on the existing causeway foundations. This assumption will be revisited and re-evaluated during a subsequent phase of design.

This shape of fill was selected to promote natural recruitment of vegetation and provide a variety of habitat for a range of bird species. The elevation of dredged material fill could be adjusted at further phases of design, depending on the physical properties of the dredged material or if target vegetation or bird species are identified. It is expected that environmental controls may be needed to contain finer sediment placed during construction.

It is predicted that the required fill volume for the 30% design will be approximately 70,000 CY. This value assumes 1 foot of foundation compression for every 3 feet of fill and does not consider bulking. Based on the information in Table 5, this quantity of material is expected to be available in the vicinity of the site. Geotechnical data is expected to be needed and would be collected during a subsequent design phase to further evaluate the expected foundation compression and expected bulking of dredged material. The volume of material may be updated during a subsequent phase of design based on the dredged material characteristics, characteristics of the subgrade, and refinement of rookery island design.

The purpose of the project is to restore a range of coastal bird habitat in the near term. For the purposes of Site design, relative sea level rise is not considered. However, relative sea level rise may impact the Site in the future. A strategy to mitigate against relative sea level rise could be to place BU material to higher elevations in preparation for higher relative sea levels and tidal elevations associated with relative sea level rise. The impacts of relative sea level rise may also be mitigated in the future through adaptive management strategies targeting bird preferred vegetation ranges, such as additional placement of maintenance material to upland or marsh habitat.

Containment and Erosion Protection

The existing breakwater will serve as containment and to protect the proposed Site from wake erosion and wind-generated waves. The breakwater construction was completed in early 2022 and is approximately 3,400 linear feet of graded riprap split into nine different-sized segments by two large gaps (approximately 30 feet wide at the top of each gap) and seven small gaps (approximately 20 feet wide at the top of each gap). The breakwater side slopes are approximately 2 horizontal to 1 vertical, the crest elevation is approximately +3.0 feet NAVD88, and the crest width is approximately 5 feet (Hydroterra 2022).

Constructability

This section describes the proposed methods of construction. Actual methods will be dependent on the chosen contractor's equipment and Site conditions at the time of construction. In addition, the contractor may provide alternate construction methods from those described in this section. The channel near the island on the southwest side of the Site may be beneficial for construction access. Bathymetric surveys will need to be conducted during subsequent design phases to better define Site dimensions, material needs, and construction accessibility.

Geotextile fabric or jute will be placed along the landward slope of the breakwater to prevent fines from passing through the armor stone. Environmental controls may be deployed to manage decant water and temporarily block breakwater gaps and other areas to prevent dredged material from leaving the Site during construction. Dredged material will be placed up to the required fill elevations. If needed, marsh excavators may be used to shape the dredged material behind the breakwater.

Planting and Natural Recruitment of Vegetation

Based on stakeholder input and cost considerations, the project team determined that planting may not be needed for the Site. Rather, natural vegetation recruitment will be allowed to proceed. If the outcome is unsatisfactory (e.g., if the island has lower-than-expected use by desired bird species), an adaptive management program can be instituted to modify the vegetation. Table 4 shows some of the listed and migratory birds and their preferred habitats. At further design phases, this list could be used to modify elevations within the Site to promote the preferred habitat of desired bird species.

Performance Expectations

The performance goal for the project is to restore a variety of rookery habitat by placing material to a range of elevations to promote natural recruitment of vegetation. Potential environmental controls and the existing breakwaters are expected to contain placement of dredged material.

Site Construction Cost Estimates

Preliminary construction costs were estimated for the design outlined in the previous sections. The estimated costs include indirect construction costs (i.e., permitting, 100% engineering and design costs, construction management, and post-construction management such as site visits and vegetation monitoring). These costs represent the estimated incremental costs (i.e., costs over and above USACE's least-costly and environmentally acceptable dredged material and placement alternative). Table 8 shows a line-item list of each costing parameter and the total cost estimated for construction.

The estimates are developed using current and generally accepted engineering cost estimating methods and are based on assumptions concerning future events. Actual costs may be affected by known and unknown risks including, but not limited to, changes in general economic business conditions, Site conditions that were unknown at the time the estimates were performed, future changes in Site conditions, regulatory or enforcement policy changes, and delays in performance. Actual costs may vary from these estimates.

The costs range from $1.0 million to $2.1 million, depending on the level of uncertainty allocated to the project cost. The lower bound of uncertainty (-30%) and upper bound of uncertainty (+50%) were selected due to the existing data gaps, high levels of inflation, and rising fuel costs. Of note, future adaptive management measures and labor and equipment to reshape placed dredged material are not included in the estimate, as the future need for such measures is unknown.

Table 8
Opinion of Probable Construction Cost to 100% Project Completion

Item	Quantity	Unit	Unit Price	Total
Direct Construction Costs				
Incremental Mobilization and Demobilization[1,2]	1	%	15	$ 150,000.00
Preconstruction Survey	1	LS	$30,000.00	$ 30,000.00
Geotextile Fabric[2]	4,900	SY	$ 15.00	$ 70,000.00
Incremental Dredging Cost (2-Mile Pipeline)[2]	70,000	CY	$ 12.00	$ 840,000.00
As-Built Survey	1	LS	$60,000.00	$ 60,000.00
Subtotal[3]			**Sum**	$ 1,000,000.00
Direct Construction Subtotal[3]			**Sum**	$ 1,000,000.00
Indirect Construction Costs				
100% Engineering and Design[3]	1	%	10	$ 100,000.00
Permitting	1	Each	$35,000.00	$ 35,000.00
Construction Management[3]	1	%	8	$ 100,000.00
Post-Construction Management[4]	12	Month	$10,000.00	$ 120,000.00
Indirect Construction Subtotal[3]			**Sum**	**$ 400,000.00**

Project Subtotal[3]			**Sum**	**$ 1,400,000.00**
-30% Uncertainty[3]	1	%	30	$ 400,000.00
+50% Uncertainty[3]	1	%	50	$ 700,000.00
Low-End Total Project Estimated Cost[3]			**Total Sum**	**$ 1,000,000.00**
High-End Total Project Estimated Cost[3]			**Total Sum**	**$ 2,100,000.00**

Notes:
Costs were determined based upon a combination of publicly available datasets and sediment surface grabs, and topographic, bathymetric, and visual habitat surveys.

1. Cost is based upon mobilizing equipment beyond what is required for dredging Rincon Canal and CCSC (e.g., marsh buggies).
2. Value is rounded to the nearest $10,000.
3. Value is rounded to the nearest $100,000.
4. Post-construction management may include Site visits to observe the material consolidation, vegetation, and water levels on the Site. Monthly aerials may be performed. Additional post-construction management practices may be considered during subsequent phases of design.

LS: lump sum
SY: square yard

Expected Ecosystem Benefits

Restoration of the Site is expected to have positive benefits on the regional ecosystem and will substantially increase habitat for the herons, egrets, terns, skimmers, and pelicans that currently reside on the island (CBBEP 2020b).

The relative sea level rise trend in Corpus Christi is 5.54 millimeters per year (NOAA 2022). Assuming no changes in the relative sea level rise trend and no erosion, the rookery island at +3.5 feet NAVD88 would be below mean sea level (MSL) by 2215, and the maximum elevation (+5.68 feet NAVD88) would be below MSL by 2293.

Opportunities to create a variety of habitat during construction of this rookery island include the following:

- Designing placement of material to target certain vegetation ranges that promote specific bird populations
  - Sandy beach habitat in the west and south portions of the Site to promote wading bird access and habitat for the endangered piping plover
  - Low marsh habitat for nekton food sources
  - High marsh and upland habitat for birds that prefer nesting at higher elevations
- Vegetation planting in areas to accelerate colonization and promote avian and aquatic habitat

Data and Information Gaps

At this phase of design, the following data and information gaps have been identified:

- Geotechnical characteristics of source material (maintenance and new work material) and subgrade of the placement area to refine evaluations of subgrade and source material settlement and short- and long-term capacity for dredged material placement
- Geotechnical characteristics and settling data for the existing breakwater
- Breakwater design characteristics to evaluate expected breakwater performance against storms
- Oyster habitat surveys on the landward side of the breakwater during preconstruction
- Refined survey information such as utility locations and supplemental bathymetry and topography, where appropriate
- Existing bird populations and preferred elevations and locations specific to target species (needed if target bird species are identified), which could also be used as a baseline to evaluate the post-construction performance of the BU project
- Based on stakeholder feedback, targeting higher upland elevations on areas not currently vegetated (This may be evaluated during subsequent design phases.)

These data gaps may need to be addressed during the progression from 30% design to final design. This current project is taking the analyses as far as practicable, considering the constraints of the project scope, budget, and schedule.

Future Work

Of the sites selected for 30% designs in this project, up to seven will be selected for 60% designs, cost estimates, and permit application packages. No fatal flaw has been identified at this phase of the design. Should the Site be selected for additional design efforts, it can be expected that some aspects of the design in this memorandum will be modified and, as appropriate, enhanced.

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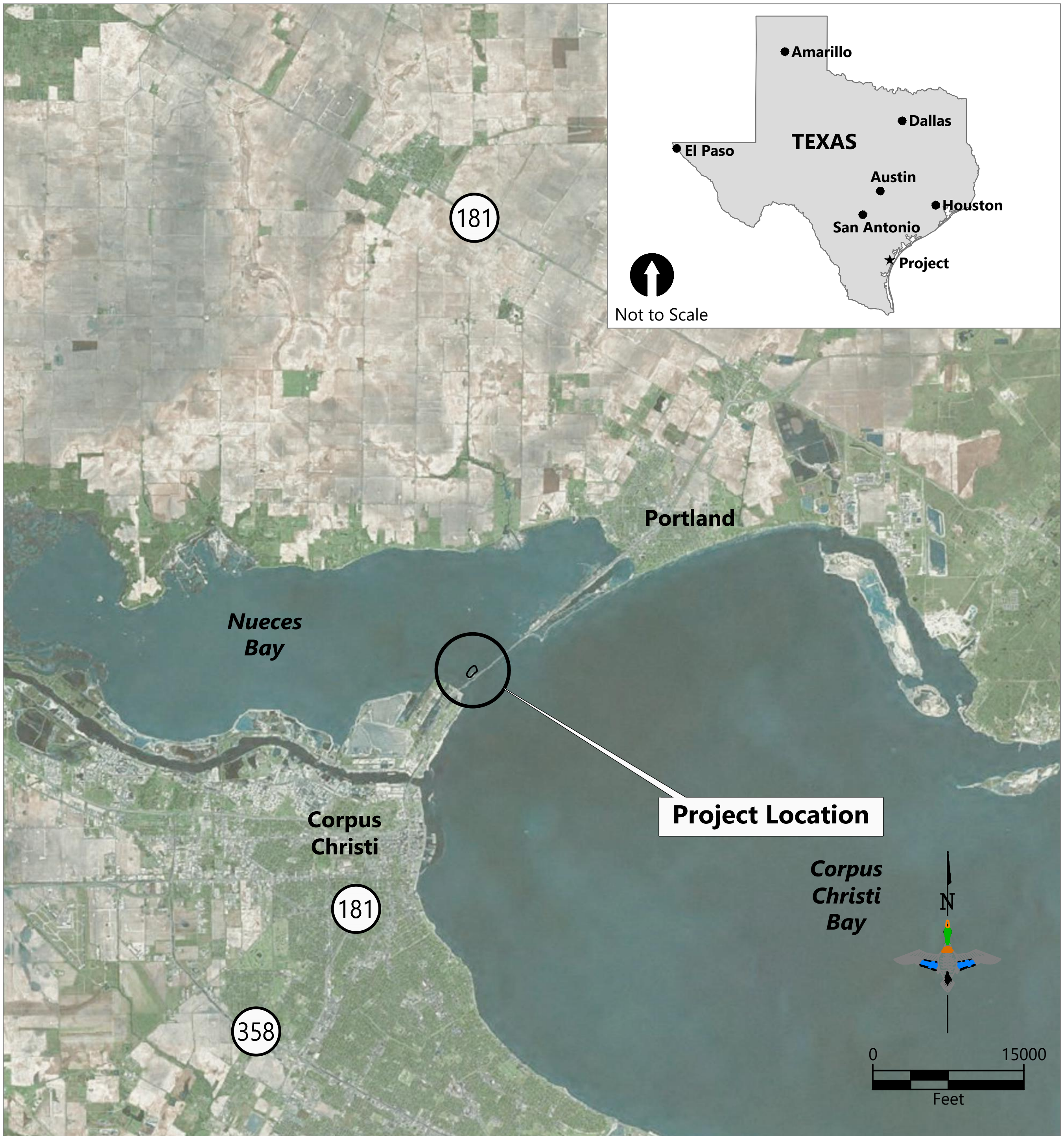
Figures



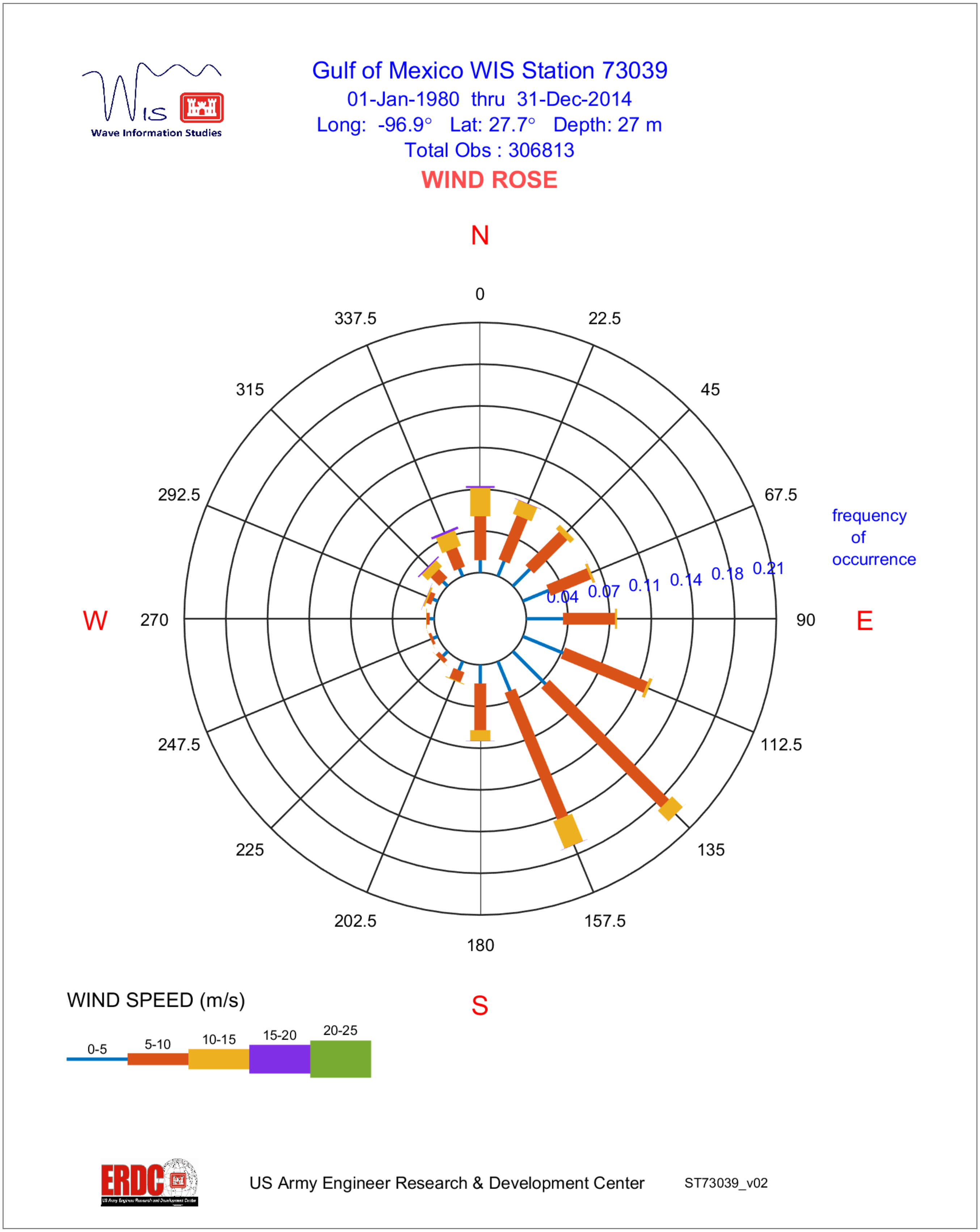
SOURCE: Aerial provided by Bing Maps.
HORIZONTAL DATUM: Texas State Plane South Zone, North American Datum of 1983, U.S. Survey Feet

Publish Date: 2022/06/09 4:07 PM | User: mpratschner
Filepath: K:\Projects\2018-PCCA Beneficial Use\CAUSEWAY BIRD ISLAND\2018 RP-001 VIC MAP.dwg Figure 1

ANCHOR QEA

Figure 1
Vicinity Map

Causeway Bird Island 30% Design Memorandum
Texas Lower Coast Beneficial Use



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ANCHOR QEA

Figure 2

Historical Wind Data for USACE WIS Station 73039

Causeway Bird Island 30% Design Memorandum

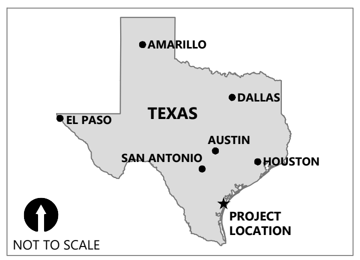
Texas Lower Coast Beneficial Use

Attachment 1
Construction Drawings

30% DESIGN SUBMITTAL

TEXAS LOWER COAST BENEFICIAL USE - CAUSEWAY BIRD ISLAND

TEXAS GENERAL LAND OFFICE



AERIAL BY BING MAPS

DRAWING INDEX		
SHEET	DRAWING	TITLE
1	T01	TITLE SHEET
2	C01	PLAN VIEW
3	C02	TYPICAL FILL SECTION

NOTES:

1. HORIZONTAL DATUM: TEXAS STATE PLANE SOUTH ZONE, NAD83, U.S. SURVEY FEET
2. VERTICAL DATUM: NORTH AMERICAN VERTICAL DATUM OF 1988 (NAVD88)
3. BATHYMETRIC, TOPOGRAPHIC, AND VISUAL HABITAT SURVEYS CONDUCTED BY DUCKS UNLIMITED ON MARCH 16, 2022. A BATHYMETRIC AND TOPOGRAPHIC SURVEY CONDUCTED BY BY T. BAKER SMITH ON DECEMBER 30, 2020, WAS USED TO FILL DATA GAPS DUE TO NESTING BIRDS. BOTH SETS OF BATHYMETRIC SURVEY DATA WERE COMBINED ON APRIL 19, 2022.

PLAN INTENDED TO BE VIEWED IN COLOR. ADJACENT BLOCK IS "BLUE"

ONE INCH

AT FULL SIZE, IF NOT ONE INCH SCALE ACCORDINGLY

DRAFT-NOT FOR CONSTRUCTION

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Jun 28, 2022 2:33pm mpratschner

ANCHOR QEA

TEXAS GENERAL LAND OFFICE ESTABLISHED 1836

DUCKS UNLIMITED

REVISIONS				
REV	DATE	BY	APP'D	DESCRIPTION

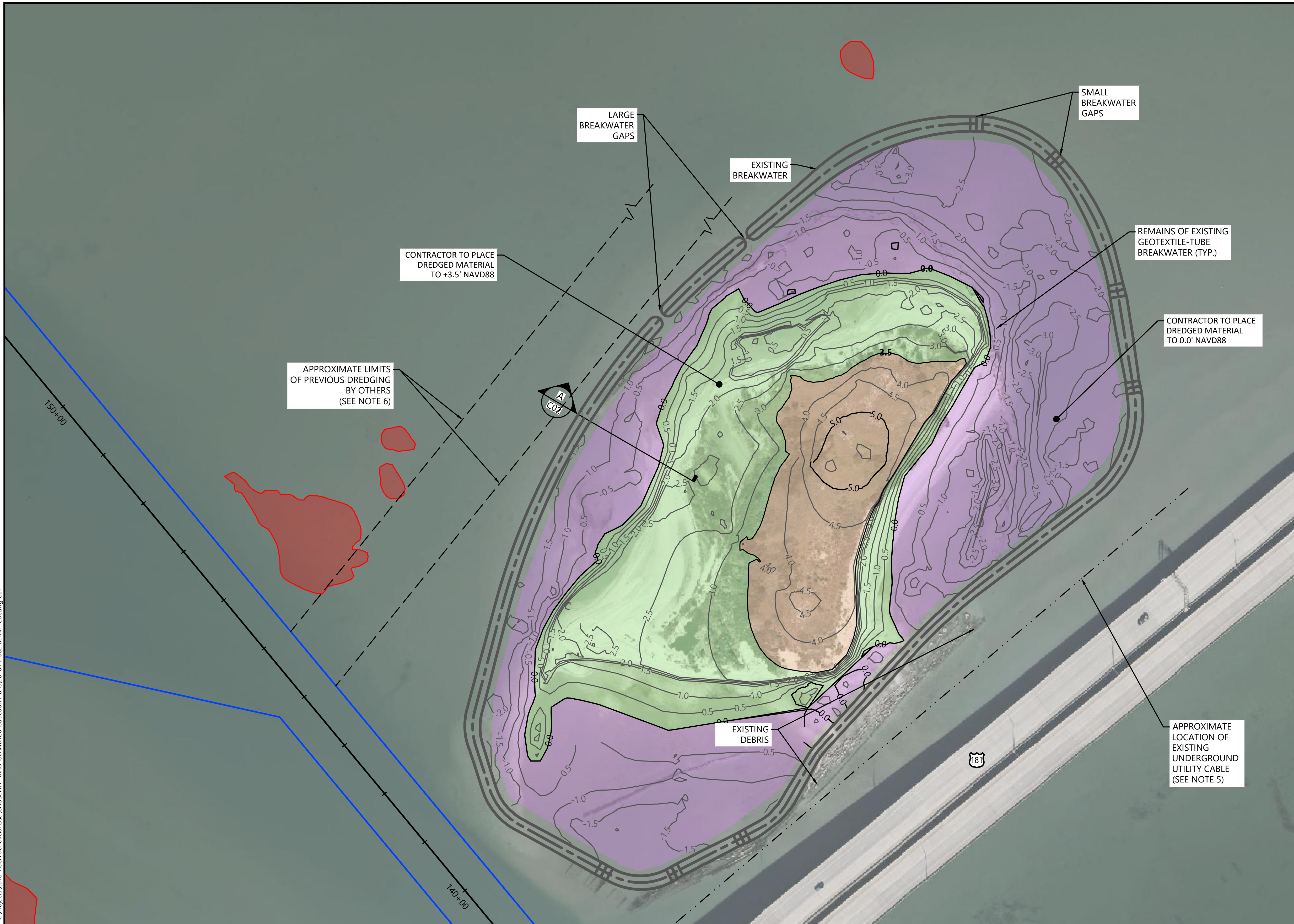
DESIGNED BY: H. SMITH
DRAWN BY: M. PRATSCHNER
CHECKED BY: R. ROBERTSON
APPROVED BY: J. LAPLANTE
SCALE: AS NOTED
DATE: JUNE 2022

TEXAS LOWER COAST BENEFICIAL USE - CAUSEWAY BIRD ISLAND

TITLE SHEET

T01

SHEET # 1 OF 3



LEGEND:

- OYSTER HABITAT
- RINCON CANAL
- —0— EXISTING CONTOUR (5')
- --3-- EXISTING CONTOUR (0.5')
- DREDGED MATERIAL PLACED TO 0.0' NAVD88
- DREDGED MATERIAL PLACED TO +3.5' NAVD88
- EXISTING ROOKERY APPROX. ELEVATION GREATER THAN +3.5' NAVD88

N

0 80 160
SCALE IN FEET

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4. GLO (TEXAS GENERAL LAND OFFICE), 2021B. LAYER: OYSTER HABITAT (ID: 57). ARCGIS REST SERVICES DIRECTORY. ACCESSED NOVEMBER 23, 2021.
5. NOT ALL EXISTING UTILITIES ARE SHOWN. CONTRACTOR IS RESPONSIBLE FOR LOCATING ALL UTILITIES PRIOR TO COMMENCING WORK.
6. ACCESS CHANNEL SHOWN WAS DREDGED DURING A 2002 GEOTEXTILE TUBE PROJECT AS A BORROW AREA FOR MATERIAL TO FILL GEOTEXTILE-TUBES. CHANNEL LIMITS SHOWN ARE APPROXIMATE, AND CHANNEL HAS NOT BEEN MAINTAINED SINCE DREDGING IN 2002.

PLAN INTENDED TO BE VIEWED IN COLOR. ADJACENT BLOCK IS "BLUE"

ONE INCH

AT FULL SIZE, IF NOT ONE INCH SCALE ACCORDINGLY

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Jun 28, 2022 2:33pm mpratschner

REVISIONS

REV	DATE	BY	APP'D	DESCRIPTION

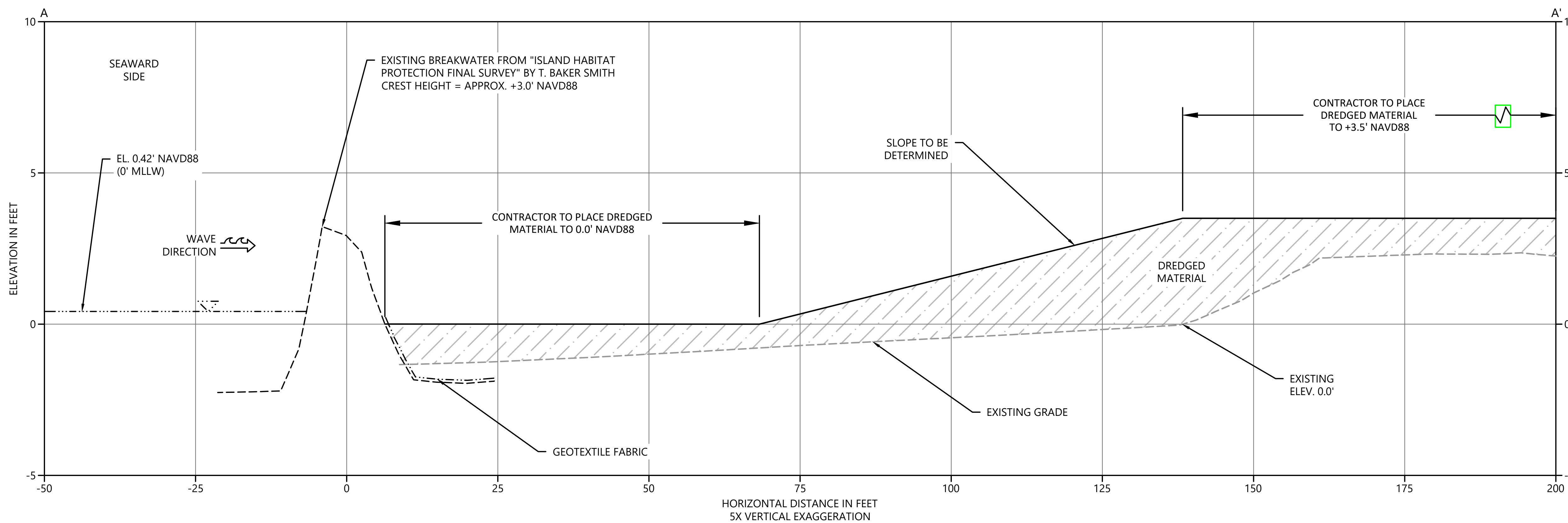
DESIGNED BY: H. SMITH
DRAWN BY: M. PRATSCHNER
CHECKED BY: R. ROBERTSON
APPROVED BY: J. LAPLANTE
SCALE: AS NOTED
DATE: JUNE 2022

TEXAS LOWER COAST BENEFICIAL USE - CAUSEWAY BIRD ISLAND

PLAN VIEW

C01

SHEET # 2 OF 3



A / C01 SECTION
HORIZONTAL SCALE: 1" = 10'
VERTICAL SCALE: 1" = 2'

NOTES:

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ONE INCH

AT FULL SIZE, IF NOT ONE INCH SCALE ACCORDINGLY

DRAFT-NOT FOR CONSTRUCTION

REVISIONS

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DESIGNED BY: H. SMITH
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APPROVED BY: J. LAPLANTE
SCALE: AS NOTED
DATE: JUNE 2022

TEXAS LOWER COAST BENEFICIAL USE - CAUSEWAY BIRD ISLAND

TYPICAL FILL SECTION

C02

SHEET # 3 OF 3

Attachment 2

Technical Specification Outline

TABLE OF CONTENTS

Memorandum

June 30, 2022

To: Sarah Garza, Harrison McNeil, and Yvonne Dives-Gomez, Port of Corpus Christi Authority

From: Todd Merendino, Ducks Unlimited, Inc.
John Laplante, Dan Opdyke, Renee Robertson, Alexander Freddo, and Hayden Smith, Anchor QEA, LLC
Jane Sarosdy, Sarosdy Consulting, Inc.

Re: Dagger Island 30% Design Memorandum

Introduction

This 30% design memorandum describes design criteria and assessments associated with a beneficial use of dredged material (BU) project at the proposed Dagger Island site (Site), located in Texas General Land Office (GLO) Planning Region 3 of the Texas coast in Redfish Bay in Ingleside, Texas (Figure 1).

Project Background

GLO awarded a Coastal Management Program Project of Special Merit grant (funded through the Gulf of Mexico Energy Security Act) to Ducks Unlimited, Inc. (DU) to coordinate with stakeholders and identify restoration sites for BU. . The Port of Corpus Christi Authority (PCCA), a project partner, has also contributed staff and financial resources to expand the project scope. The project team is led by DU and PCCA and includes Anchor QEA, LLC; Sarosdy Consulting, Inc.; and the Texas Department of Transportation. Collectively, the project team coordinated three stakeholder meetings with state and federal resource agencies, nongovernmental organizations, academia, consultants, and local officials in each region to solicit information about potential BU sites. Based on stakeholder input, GLO feedback, publicly available data, and professional judgment, the project team has developed 10% designs for 18 sites in GLO Planning Regions 3 and 4 of the Texas coast and 2 GLO-approved sites in Mesquite Bay and San Antonio Bay in GLO Planning Region 2. After completion of the 10% designs, 11 of the designs were selected to continue to 30% designs, and up to 7 of those designs will be chosen for 60% designs and permit application packages. The project team selected the Site as one of the 20 sites for 10% design development and cost estimation. Based on the Site's restoration potential and construction feasibility, the project team selected the Site to proceed to 30% design and opinion of probable construction costs using funding from PCCA.

The existing Dagger Island is located in Redfish Bay, Aransas Pass, Nueces County, Texas, approximately 0.1 mile east of the Gulf Intracoastal Waterway (GIWW) and 0.4 mile north of the Corpus Christi Ship Channel (CCSC). The island is in GLO State Tract 352 Unit, pooling agreement 3171, which includes private lands, and is currently owned by Buckeye Partners, L.P. However, the BU project described in this memorandum is proposed to be on state-owned submerged land to the southwest of the island (GLO 2022). Creation of upland containment berms and placing dredged material fill adjacent to remnant landmasses to the southwest of Dagger Island will convert open water to marsh and provide protection to seagrass in Redfish Bay. The Site was selected due to the erosion of the historical shoreline from hurricanes, storm surge, and wave energy caused by winds and large vessel traffic on the CCSC.

Project Objectives

Frequent dredging is needed to develop and maintain Texas navigation channels. The dredged material is often deposited in dredged material placement areas (DMPAs), and many of the existing DMPAs along the Texas coast are nearing capacity. Resource agencies and stakeholders have long advocated using dredged material beneficially to create and restore wetlands and bird islands, nourish beaches, and counteract land loss. Historically, BU projects are difficult to manage because they are multiyear, multifaceted undertakings in which different organizations manage dredging schedules, funding, project design, permitting, and construction activities. To help address these issues, the objectives of this project include the following:

- Create and restore degrading coastal habitats.
- Establish sites for disposal of dredged material to reduce reliance on existing DMPAs.
- Improve coastal resiliency of the natural and built environment.

To accomplish these objectives, the project includes the following tasks:

- Stakeholder outreach and coordination
- Identification and selection of BU sites
- 10% designs and cost estimates for 20 BU sites
- 30% designs and cost estimates for 11 BU sites
- 60% designs, cost estimates, and permit application packages for up to seven BU sites

This memorandum documents the 30% design and cost estimate for the Site.

Design Objectives

The Site will be designed to beneficially use dredged material to restore natural washouts and eroded landmasses, thereby protecting sensitive seagrass habitat in the region. The design will use material dredged from the CCSC during future deepening projects and routine maintenance, thus reducing the volume of such material placed in existing open-bay or upland DMPAs. This 30% design is based upon publicly available datasets, as well as focused field work instructed by PCCA and conducted by Triton Environmental Solutions, LLC (Triton).

Design objectives include the following:

- Develop a preliminary vision based on available data for the Site that includes the following:
  - Habitat to be created or restored
  - Potential sediment source(s)
  - Approaches to minimize long-term maintenance costs
- Delineate conceptual footprints for proposed BU placement.
- Identify key sensitive habitats and construction considerations in the vicinity of the Site.
- Estimate fill volumes for the proposed BU footprints.
- Identify data gaps to be addressed in subsequent design phases.
- Provide preliminary cost estimates.

Existing Data Review

A review of existing data and the focused data collected by Triton was performed to develop the Site and containment berm designs. This section describes the data reviewed and collected for the 30% design.

Horizontal and Vertical Datums

The horizontal datum used for the Site is the Texas State Plane Zone 5, North American Datum of 1983, in U.S. survey feet. The primary vertical datum used for the Site design is the North American Vertical Datum of 1988 (NAVD88). The National Oceanic and Atmospheric Administration (NOAA) maintains an active tide gauge within the vicinity of the Site. The NOAA Ingleside, Moda Station 8775283 (Ingleside Station), which is 2.0 miles southwest of the Site, does not provide NAVD88 vertical datums, so the NOAA Port Aransas, TX Station 8775237, which is 6.5 miles east of the Site, was used to convert the Ingleside Station mean lower low water (MLLW) tidal datum to NAVD88. These stations collect and record real-time tide information dating back to 2002 and 1989, respectively. The converted vertical datums from the Ingleside Station that will be used for the Site are shown in Table 1. The NOAA USS Lexington Station 8775283 (Lexington Station) was also used to define a preliminary design water level, as described in the Water Level section.

Table 1
Ingleside Station Tidal Datums

Tidal Datums	Elevation (feet NAVD88)	Elevation (feet MLLW)
MHHW	0.55	0.71
MHW	0.54	0.70
MSL	0.24	0.40
MLW	-0.15	0.00
MLLW	-0.15	0.00

MHHW: mean higher high water
MHW: mean high water
MLW: mean low water
MSL: mean sea level

Meteorological, Ocean, and Wave Data

Water Level

To determine an approximate design water level elevation for the Site, an existing water level analysis using data from the Lexington Station, which is 13 miles west of the Site, was used due to a lack of recent, continuous water level data from the adjacent Ingleside Station (Anchor QEA 2021). Data were compiled for the period from October 2015 to January 2021 and used to calculate a 90th-percentile water level of 2.0 feet NAVD88.

The MHHW from the 1983 to 2001 tidal epoch at the Lexington Station is 1.02 feet NAVD88, which is 0.47 foot higher than at the Ingleside Station. Due to this difference in the MHHW, water levels at the Lexington Station were considered a conservative estimate of the water levels that would be experienced at the Site.

Wind and Waves

The U.S. Army Corps of Engineers (USACE) Wave Information Studies (WIS) provides a national resource of long-term wavefield climatologies for U.S. coastal waters that synthesizes observations, multidecade hindcasts, and storm event archives (USACE 2021). The WIS station closest to the Site is Station 73039, just offshore on the Gulf side of Port Aransas, Texas, in the Gulf of Mexico. Because the station is located offshore, the wave data are not applicable to the Site and were not used. However, the project team considers the wind data to be representative of the winds experienced at the Site. Figure 2 summarizes wind data from January 1, 1980, through December 31, 2014. The data indicate that the predominant wind direction is from the southeast, with significant winds also coming from the north, northeast, east, and south.

Wind and wave conditions for this phase of design were assumed to be the same as identified in the AECOM design report for the M10 site located approximately 2 miles southwest of the Site

(AECOM 2020). The wind speed and direction values used for the analysis were taken from the Packery Channel NOAA Tidal Station No. 8775792 at 3-hour intervals from June 2008 to June 2018. A Coastal Modeling System 2D numerical wave (CMS-Wave) model was used to simulate wind-driven waves from 180° to 270° (south to west) direction winds. Waves were generated with wind speeds varying from 3 to 51 knots (1.5 to 26.2 meters per second). The design wave was chosen based on the maximum wave height produced by the CMS-Wave model (Table 2). The wind speed used to produce the maximum wave height is considered conservative for this analysis because it represents the 99.9th percentile of the wind speed recorded at WIS Station 73039. This design wave and associated design period were extracted from the M10 report and used in this 30% analysis as a conservative approach to understanding the wave climate potentially experienced at the Site (Table 2). However, a visual analysis of the wave field simulation in Figure 3 from AECOM (2020) indicates wave heights experienced at the Site are shorter than those at M10; therefore, the 2.69-foot wave height assumption is assessed to be conservative for 30% design and will be revisited during subsequent design phases.

Table 2
Assumed Wind and Wave Data from M10 Design

Datum	Value
Wind direction (degrees)	210
Wind speed (knots)	39
Wave height (feet)	2.687
Wave period (seconds)	3.63

Note:
Source: AECOM 2020

Wake Erosion

The GIWW is approximately 0.1 mile northwest of the Site, and the CCSC is approximately 0.7 mile south of the Site (Figure 1). Several types of vessels, including recreational and commercial vessels, commercial tugboats and barges, and very large crude carriers (VLCCs) operate in the GIWW and CCSC and generate wake waves that propagate to the Site. Like wind-generated waves, vessel-wake waves produce the greatest erosion in the region where the waves break (i.e., the surf zone). Most of the Site has natural protection from vessel wakes from the GIWW; however, there are a few locations along the southwestern edge of the Site that would be expected to receive direct impacts from vessel wakes generated in the GIWW.

The Bhowmik et al. (1991) and Weggel and Sorensen (1986) vessel-generated wave prediction methods—based on vessel dimensions, travel speed, and distance between the sailing line and Site—were used to evaluate the range of vessel-generated waves for a conservation selection of representative vessels known to operate in the area. A sport yacht with a draft of 4 feet was selected to evaluate recreational vessel wakes generated by vessels traveling near the proposed Site. A generic tugboat with maximum dimensions recorded in the Automatic Identification System (AIS) database was selected, along with a similar tugboat transiting with twin barges (identified using Google Earth imagery of ports in the region) to evaluate the commercial vessel wakes generated by vessels traveling in the GIWW. Calculation of the sport yacht's maximum vessel wakes, traveling at varying speeds along the nearest edge of the GIWW, 530 feet from the southwestern edge of the Site, can be seen in Table 3. Calculation of the tugboat and tugboat with twin barges maximum vessel wakes, traveling in 14 feet of water at varying speeds up to 11 miles per hour (mph; considered conservative) along the nearest edge of the GIWW, 530 feet from the southwestern edge of the Site, are shown in Table 4.

VLCC wake conditions from the CCSC for this phase of design were assumed to be similar to those identified in the AECOM design report for the SS1 site located approximately 3.5 miles east of the Site (AECOM 2020). SS1 is approximately 900 feet closer to the predicted sailing line of vessels transiting the CCSC than the Site is, and VLCC wakes calculated for SS1 did not exceed 1.26 feet. Therefore, vessel wakes experienced at the Site from VLCCs transiting the CCSC are expected to not exceed 1.26 feet.

These wave heights are smaller than the conservative design wave extracted from the M10 report (AECOM 2020), and wind-generated waves will be considered the predominant erosive force and used during design evaluations. The vessel wakes in Tables 3 and 4 are limited to vessels traveling the GIWW, and further analysis should be conducted to understand the frequency and distance additional recreational vessels travel near the Site. Additional analysis surrounding a variety of recreational vessel drafts and speeds may be considered during subsequent design phases.

Table 3
Sea Ray Sundancer Sport Yacht Maximum Vessel-Wake Calculations Transiting the GIWW at Various Speeds

Vessel	Length (feet)	Draft (feet)	Vessel Speed (mph)	Maximum Wave Height (feet)	Wave Period (seconds)
Sea Ray Sundancer sport yacht	51	4	6.7	1.04	1.28
			15	0.79	1.11
			25	0.66	1.02
			35	0.59	0.96
			45.4	0.54	0.92

Note:
Maximum wave heights were calculated using Bhowmik et al. (1991), where vessel speeds ranged from 6.7 to 45.4 mph.

Table 4
Tugboat and Tugboat with Twin Barges Maximum Vessel-Wake Calculations Transiting GIWW at Various Speeds

Vessel	Length (feet)	Beam (feet)	Draft (feet)	Vessel Speed (mph)	Maximum Wave Height (feet)	Wave Period (seconds)
Generic tugboat with maximum dimensions recorded in AIS data[1]	87	33	11	3	0.00	8.40
	87	33	11	5	0.00	5.04
	87	33	11	7	0.00	3.60
	87	33	11	9	0.00	2.80
	87	33	11	11	0.72	2.29
Generic tugboat with maximum dimensions recorded in AIS data and with twin barges[2]	387	110	11	3	0.00	7.31
	387	110	11	5	0.00	4.38
	387	110	11	7	0.00	3.13
	387	110	11	9	0.00	2.44
	387	110	11	11	0.00	2.29

Notes:
Maximum wave heights were calculated for vessels traveling within Froude number boundaries and at 3. 5, 7, 9, and 11 mph (Weggel and Sorensen 1986).
1. Vessel hull geometric coefficients were input using a tugboat from Hay (1967).
2. Vessel hull geometric coefficients were input using a barge from Hay (1967).

Bathymetry and Topography

Triton conducted a bathymetric and topographic survey at the Site in March and April 2022. The Site footprint consists of mostly open-water shallows with sand flats, low marsh, and high marsh upland habitat. The Site footprint has an average seabed elevation of 0 foot NAVD88, and contours range from -2.7 to 1.95 feet NAVD88. During the survey, Triton conducted sediment probing in 22 areas in the vicinity of the Site (Attachment 1, C01). The minimum and maximum probing distance to substrate refusal was 0.75 and 10.17 feet, respectively, with an average distance to refusal of 5.57 feet. Within those areas, it was qualitatively determined that the material is relatively soft.

Utilities and Infrastructure

The Railroad Commission of Texas public GIS viewer (RRC 2021) and GLO pipeline data (GLO 2021a) were used to identify mapped utilities near the Site. Two oil wells and four plugged oil and gas wells were also found in the Site vicinity (Attachment 1, C01). These utilities are submerged. It is anticipated that the plugged wells will not impact design or construction. However, the two active oil wells will be considered in design and construction, during which preliminary concepts are to design the Site armoring to have gaps with the appropriate right-of-way distance limits surrounding the wells. The need for Site-specific utility locations prior to construction will be determined during subsequent design phases. No other infrastructure has been identified in the vicinity of the project.

Desktop Cultural Resources Survey

A search of cultural resources records in the Texas Historical Commission Texas Historical Sites Atlas Database (THC 2021) was completed on December 21, 2021. This search revealed that no cultural sites have been identified within the preliminary proposed Site.

Sensitive Habitat

GLO oyster habitat GIS data (GLO 2021b) indicate there is no oyster habitat identified within or adjacent to the Site. However, Triton habitat surveys indicate approximately 0.05 acre of live oysters in the northeast corner of the Site (Attachment 1, C01). Based on discussions with the Texas Parks and Wildlife Department (TPWD), oysters have been relocated at Dagger Island for other projects. If allowed by TPWD and other regulatory agencies, the oysters could potentially be relocated 0.1 mile north, outside of the Site footprint prior to construction. Alternatively, a buffer between the Site and oyster habitat could be constructed based on regulatory agency feedback.

According to TPWD seagrass data (TPWD 2021), there are approximately 700 acres of seagrass mapped behind the Site west, southwest, and northwest in Redfish Cove and approximately 100 acres of seagrass mapped east and southeast of the Site. Triton habitat surveys indicate approximately 2.3 acres of sparse seagrass presence within the Site footprint. Impacts to seagrass could be mitigated by filling 2 acres of the adjacent, derelict channel up to an elevation conducive for seagrass habitat, while maintaining recreational vessel right-of-passage depths and boundaries. Additionally, seagrass habitat impacts could be mitigated by planting seagrass in areas behind the Site where seagrass colonization is possible, but seagrasses are not currently present.

Similar habitat surveys may need to be conducted during a subsequent phase of design to re-evaluate the presence and extents of sensitive habitat.

Erosion

Since 1956, the Site has lost more than 89 acres of land due to erosion from both natural and human causes (Silva 2021). The natural causes of shoreline erosion include the predominant southeast winds, storm events, and decades of sea level rise accompanied by subsidence. Direct human impacts contributing to the erosion include high-energy ship wakes caused by vessels traveling down the CCSC (Silva 2021). Wind-generated waves are expected to be larger than waves generated by vessels based on the analysis in the Wind and Waves and Wake Erosion sections and, therefore, are used to inform the Site design.

Beneficial Use Source Material

The proposed source material for the Site may consist of suitable material excavated from inside the Site (borrow area) and dredged material from the CCSC and GIWW, located adjacent to the Site. Sediment availability from material excavated from within the borrow area at different depths of excavation is shown in Table 5. Based on coastal consistency determinations from USACE, USACE has historically performed maintenance dredging on the GIWW near the Site (USACE 1999). The continued need for dredging has recently been confirmed by USACE (Jones 2021). The identified USACE DMPAs adjacent to the Site and their average annual quantity of dredged material, distance from the Site to DMPA, and channel segments are shown in Table 6. With the ongoing widening and deepening of the CCSC, it is expected that the average annual dredging quantities will be higher in the future. The average grain size and grain type percentages are shown in Table 7.

Table 5
Borrow Area Sediment Volume Availability at Different Excavation Depths

Excavation Area	Excavation Elevation (feet NAVD88)	Volume (CY)[2]
Borrow area[1]	-1.28	24,700
	-2.28	49,500
	-3.28	74,200
	-4.28	98,900
	-5.28	123,700

Notes:
Volume availability was calculated geometrically using the bathymetric and topographic surveys collected by Triton in March and April 2022.

1. Volume availability was calculated inside the 50-foot buffer region, away from the interior toe of the berm, and depth values were assumed to start at the average seabed elevation of the seaward boundary of the borrow area at -0.28 foot NAVD88.
2. Value is rounded to the nearest 100 CY.

CY: cubic yard

Table 6
USACE DMPA Areas Near the Site That Received Dredged Material

DMPA No.	Channel Segment (Station)	Distance from Site to DMPA (miles)	Average Annual Dredging Quantity (CY)
157	950+000-960+000	3.9	88,586
158	956+000-960+500	2.8	77,905
159	960+500-963+000	2.3	41,125
160	963+000-967+000	1.6	56,880
161	967+000-971+000	0.9	48,330
162	971+000-978+000	0	78,480
7	Inner Basin to La Quinta Junction (270+00-320+00)	2.4	35,000
8	Inner Basin to La Quinta Junction (320+00-400+00)	1.3	40,000
9	Inner Basin to La Quinta Junction (400+00-500+00)	0	51,000

Note:
Source: USACE 1999

Table 7
Typical Sediment characteristics Across Redfish Bay and Between the Inner Basin and LaQuinta Junction

Sediment Characteristics Across Redfish Bay[1]	Sediment Characteristics Between the Inner Basin and LaQuinta Junction[2]
D_{50} (mm) = 0.044	D_{50} (mm) = 0.256
27.6% sand	87.8% sand
33.6% silt	6.6% silt
38.8% clay	5.7% clay

Notes:
Source: USACE 1999
1. Refers to channel segments along the GIWW
2. Refers to channel segments along the CCSC
D_{50}: median grain size

Another potential source of sediment is from the proposed CCSC Channel Deepening Project. This project could potentially provide a substantial portion of the material used at the Site; however, analysis of the expected sediment quantities and characteristics from the CCSC Channel Deepening Project will need to be completed during a subsequent design phase.

Marsh Vegetation Elevation Ranges

Table 8 shows typical habitat ranges for relevant marsh vegetation based on Site vegetation surveys conducted by Triton. The range represents minimum and maximum values found during the survey, while the mode represents the most frequently occurring values during the survey. Mode was used as the most accurate representation of the conditions for the Site.

Table 8
Typical Elevations for Target Marsh Vegetation

Species	Dagger Island: Elevation (feet MSL)	
	Range	Mode
High marsh	1.0 to 4.2	1.6 to 2.3
Low marsh	-1.1 to 3.3	0.6 to 1.1
Seagrass	-5.4 to 0.9	-3.0 to -0.7
Smooth cordgrass	-1.5 to 1.5	-0.4 to 0.3
Sand flats	1.93 to 1.94	1.93 to 1.94
Uplands	2.3 to 5.9	2.3 to 5.9

30% Design

The main design elements evaluated for the Site are as follows:

- Site location
- Marsh size and shape
- Containment and erosion protection
- Constructability
- Planting and natural recruitment of vegetation
- Performance expectations
- Site construction cost estimates
- Expected ecosystem benefits
- Data and information gaps

These design elements are evaluated in this memorandum for the 30% Site design.

Site Location

The Site is 0.4 mile north of the CCSC and 0.1 mile east of the GIWW and located between Redfish Cove and the CCSC. (Figure 1). A derelict oil and gas channel likely only used by recreational vessels is also located in the Site footprint (Attachment 1, C02). The existing DMPA #162 overlaps partially, but not completely, with the Site. This DMPA is permitted for open-bay placement, and dredged material could continue to be discharged outside the footprint of the Site. While it is not expected that construction of the Site would inhibit USACE's ability to place material in DMPA #162, coordination with USACE will be necessary and may require a real estate agreement.

The average elevation of the Site is -0.2 foot NAVD88 (-0.05 foot MLLW). Because of the shallow water depths, lightly loaded barges may be needed to access the Site. The Site design includes constructing containment berms between the existing islands and filling the open water areas with dredged material to create marsh (Attachment 1, C02). There are seagrasses in the southwest portion of the Site and sparse seagrasses in the northeast portion of the Site. The seagrasses present within the Site footprint are patchy and not contiguous. Bathymetric surveys may need to be conducted during subsequent design phases to better define Site dimensions and material needs.

Marsh Size and Shape

Based on availability of sediment, a cost analysis, and stakeholder feedback, the project team proposes that the area of the Site be approximately 28 acres; creating marsh in open water areas of the Site. Sediment will be placed within a range of elevations to create a variety of habitats. The marsh is being designed to suit a range of low and high marsh habitat, at 2.26 feet mean sea level (MSL; 2.5 feet NAVD88; Table 8.) The elevation of dredged material fill will be adjusted at further phases of design, depending on the physical properties of the dredged material and to target a variety of vegetation habitats. The Site will consist of fill extending to the edge of the existing vegetation or to the edge of the constructed containment berm described in the next section. Evaluations on the impact of infrastructure within the footprint identified in the Attachment 1 drawings are ongoing and the size and shape of the Site may need to be refined during subsequent design phases.

With preliminary input from stakeholders, the project team is proposing a seagrass mitigation area within the Site. The potential seagrass mitigation area of the Site would be approximately 2 acres; raising the water bottom elevations to those conducive for creation of seagrass habitat. The mitigation area average elevation is -3.94 feet NAVD88, and the mitigation area will be brought up to -0.5 foot NAVD88, which is in the suitable habitat range for seagrass (Table 8). This will need to be evaluated during subsequent design phases to minimize impacts on water quality and to avoid encroaching on recreational vessel access to Redfish Bay. Any potential seagrass mitigation requirements may need to be evaluated during a subsequent phase of design.

Fill material would likely be obtained from the CCSC and/or GIWW (Table 3). It is predicted that the required fill volume will be approximately 230,000 cubic yards. This value assumes 1 foot of foundation compression for every 3 feet of fill and does not consider bulking. Based on sediment probing data from Triton in areas within the vicinity of the Site, there are significant relatively thick deposits of soft material that may be compressible. This supports consideration of settlement as a key design consideration Based on the information in Table 6, this quantity of material is expected to be available in the vicinity of the site. Additional geotechnical data may be collected during a subsequent design phase to further evaluate the expected foundation compression and bulking of dredged material.

Relative sea level rise may impact the Site in the future. A strategy to mitigate against relative sea level rise could be to place BU material to higher elevations in preparation for higher relative sea levels and tidal elevations associated with sea level rise. However, this would not allow for creation of target habitat in the near term. The impacts of relative sea level rise may be mitigated in the future through adaptive management strategies such as thin-layer placement of additional dredged material.

Containment and Erosion Protection

The design includes a 6,700-linear-foot containment berm to contain the dredged material and protect the future marsh and the existing seagrasses behind the marsh from erosion. As shown in Attachment 1, the containment berm will be constructed predominately on the seaward side of the Site and along open gaps toward Redfish Cove and the banks of the derelict channel. The design is based on the M10 data (Table 2). The proposed centerline of the containment berm is currently designed along the -0.8-foot NAVD88 contour. The containment berm will be composed of a side casted material core from the borrow area with a layer of armor stone over the core. The borrow area's available quantity of material from different excavation elevations are shown in Table 5. Use of the borrow area material for a containment berm core will need to be evaluated during subsequent designs with access to more geotechnical data.

The containment berm crest height and width were evaluated with a wave transmission analysis using the wave parameters from Table 2, an armor stone D_{50} of 1.1 feet based on the armor stone size selected in the M10 design report (AECOM 2020), and a water surface elevation of 2.0 feet NAVD88 based on the 90th-percentile water level. The transmitted wave heights through the containment berm were determined using the van der Meer and d'Angremond method, as outlined in USACE *Coastal Engineering Manual*, Table VI-5-15 (USACE 2006). Table 9 shows the results of the analysis for varied crest widths and crest heights of the containment berm. Based on the results of the analysis, a conservative 10-foot crest width with a +4.0-foot NAVD88 crest height was selected with a 4 horizontal to 1 vertical (4H:1V) seaward side slope and 2H:1V landward side slope that could potentially be reduced during subsequent design phases. The size of the armor stone and the final slope and cross-sectional dimensions of the berm will be further refined through modeling and analysis of the wind-wave hydrodynamics and sediment characteristics of the dredged material, the containment berm subgrade, and an analysis of initial capital construction costs versus maintenance costs during a subsequent phase of design. A summary of the containment berm geometry is in Table 10. The containment berm will provide protection to the Site from erosive forces from the CCSC and Redfish Cove. The locations and geometry of the containment berm will be determined based on discussions with regulatory agencies during final design.

Table 9
Transmitted Wave Analysis

Crest Width(feet)	Crest Height(feet NAVD88)	Transmitted Wave Height(feet)
10	2.50	0.54
10	3.00	0.34
10	3.50	0.20
10	**4.00**	**0.20**
10	4.50	0.20
12	2.50	0.43
12	3.00	0.23
12	3.50	0.20
12	4.00	0.20
12	4.50	0.20
15	2.50	0.24
15	3.00	0.20
15	3.50	0.20
15	4.00	0.20
15	4.50	0.20

Notes:
Data is based on the van der Meer and d'Angremond method (USACE 2006)
The **bold** row shows the configuration selected for this design.
Parameters used for analysis are as follows:

1. D50 = 1.10 feet
2. Water surface elevation = 2.00 feet NAVD88
3. Bed elevation = -0.8 foot NAVD88
4. Wave height = 2.69 feet
5. Wave period = 3.63 seconds

Table 10
Phase 1 Containment Berm and Phase 2 Fill Design Characteristics

Phase 1: Containment Berm	
Containment Berm Design Criteria	**Dagger Island Containment Berm**
Total project length	6,700 feet
Total containment berm acreage	Approximately 6 acres
Crest width	10 feet
Base width	Approximately 39 feet, depending on water depth
Assumed bottom elevation	-0.8 feet NAVD88
Total structure height	4.8 feet
Containment berm materials	Side casted material, geotextile fabric, and rock
Containment berm core material volume	34,000 CY

Phase 1: Containment Berm	
Containment Berm Design Criteria	**Dagger Island Containment Berm**
Containment berm rock volume	31,500 CY
Estimated settlement[1]	1.6 feet
Design side slopes (seaward side)	4H:1V
Design side slopes (landward side)	2H:1V
Maximum design crest elevation	+4 feet NAVD88

Notes:
The final cross-sectional dimensions, slopes of the containment berm, and volume required for interior fill will need to be determined and refined, respectively, through modeling and analysis of the wind-wave hydrodynamics and sediment characteristics of the dredged material and containment berm subgrade during a subsequent phase of design.
1. Based on 1 foot of settlement for every 3 feet of fill

Constructability

This section describes the proposed methods of construction. Actual methods will be dependent on the chosen contractor's equipment and Site conditions at the time of construction. In addition, the contractor may provide alternate construction methods from those described in this section.

The Site could be constructed in two different phases, as follows.

Phase 1

Material from the borrow area will be mechanically excavated and side casted into a berm along the perimeter of the Site. This material will be used to construct the core of the containment berm to the required design elevations and geometry. Prior to installing the 2.5-foot-thick armor layer, a geotextile fabric or jute cloth will be placed over the core material to prevent fines from passing through the armor stone. Phase 1 construction may require light load transport of armor stone access channels and mobilizing equipment beyond what is required for dredging the GIWW (e.g., marsh buggies, a deck barge, and an excavator). Marsh buggies and deck-barged excavators may be used to shape the containment berm.

Phase 2

Phase 2 of construction will consist of placing fill inside the Phase 1 containment berm to design elevations. Confining the dredged slurry within the containment berm will reduce potential impacts to adjacent seagrass habitat outside of the Site footprint. Phase 2 construction may require mobilizing equipment beyond what is required for dredging the GIWW (e.g., marsh buggies and a deck barge). Marsh buggies may be used to shape the fill to the required fill elevations.

Phase 2 of construction will also consist of placing fill inside of the derelict channel to create seagrass habitat and mitigate construction impacts to seagrass habitat. Dredged material can be placed during routine maintenance of the CCSC or GIWW for both the marsh and seagrass habitat construction.

Planting and Natural Recruitment of Vegetation

Based on stakeholder input and cost considerations, the project team determined that natural recruitment of vegetation within the marsh and seagrass mitigation area will be the most effective method for vegetating the marsh. Table 8 shows some of the targeted vegetation and their preferred habitat elevations. If the outcome is unsatisfactory (e.g., if the marsh and/or seagrass mitigation area has a lower-than-desired density of vegetation or if undesirable species of vegetation are present), an adaptive management program can be instituted to directly plant, adjust Site elevations, remove undesirable species, etc.

Performance Expectations

The performance goal for the project is to create approximately 28 acres of sustainable high and low marsh. The designed armoring is expected to contain placement of dredged material, be resilient to typical storm events, and provide protection for the interior habitat.

The project is also expected to close open-water breaches, which are passing wave energy and allowing erosion to occur in the seagrass beds behind the Site. Closing of open-water habitat and restoring the Site will help protect and enhance existing seagrass habitat.

Oysters are expected to colonize areas of the containment berm due to the presence of oysters along the north side of the Site.

Site Construction Cost Estimates

Preliminary construction costs were estimated for the design outlined in the previous sections. The estimated costs also include the indirect construction costs (i.e., permitting, 100% engineering and design costs, construction management, and post-construction management such as site visits and dewatering management). These costs represent the estimated incremental costs (i.e., costs over and above USACE’s least-costly and environmentally acceptable dredged material and disposal alternative). Because the Site is close to sediment sources, it should allow for lower construction costs compared to more remote potential marsh restoration sites. Table 11 shows a line-item list of each costing parameter and the total cost estimated for construction.

The costs range from $5.9 million to $12.8 million, depending on the level of uncertainty allocated to the project cost. The lower bound of uncertainty (-30%) and upper bound of uncertainty (+50%) were selected due to the existing data gaps, high levels of inflation, and rising fuel costs. Cost savings may be realized by further analysis and modeling of wind and wave conditions during subsequent design phases and refining the level of armoring. An evaluation of the initial capital construction versus projected maintenance costs could be conducted to determine an optimum armoring design that allows for satisfactory protection of the interior marsh, while being within the project budget. The estimates are developed using current and generally accepted engineering cost estimating methods and are based on assumptions concerning future events. Actual costs may be affected by known and unknown risks including, but not limited to, changes in general economic business conditions, Site conditions that were unknown at the time the estimates were performed, future changes in Site conditions, regulatory or enforcement policy changes, and delays in performance. Actual costs may vary from these estimates.

Table 11
Opinion of Probable Construction Cost to 100% Project Completion

Item	Quantity	Unit	Unit Price	Total
Direct Construction Costs				
Phase 1: Containment Berm Construction				
Mobilization and Demobilization[1,2]	1	%	10	$ 500,000.00
Preconstruction Survey	1	LS	$ 30,000.00	$ 30,000.00
Side Casted Berm Core[2,3]	6,700	LF	$ 90.00	$ 600,000.00
Armor Stone[4]	50,400	tons	$ 90.00	$ 4,500,000.00
As-Built Survey	1	LS	$ 50,000.00	$ 50,000.00
Navigational Aids[2]	4	Each	$ 4,000.00	$ 20,000.00
Phase 1 Subtotal[4]			**Sum**	**$ 5,700,000.00**
Phase 2: Interior Fill and Seagrass Mitigation Placement				
Incremental Mobilization and Demobilization[1,5]	1	%	10	$ 190,000.00
Preconstruction Survey	1	LS	$ 50,000.00	$ 50,000.00
Incremental Dredging Interior Placement[2]	230,000	CY	$ 6.00	$ 1,380,000.00
Incremental Dredging Seagrass Mitigation Placement[2]	13,000	CY	$ 6.00	$ 80,000.00
As-Built Survey	1	LS	$ 80,000.00	$ 80,000.00
Phase 2 Subtotal[4]			**Sum**	**$ 1,800,000.00**
Direct Construction Total[4]			**Sum**	**$ 7,500,000.00**
Indirect Construction Costs				
100% Engineering and Design	1	LS	$500,000.00	$ 500,000.00
Permitting	1	Each	$150,000.00	$ 150,000.00
Construction Management	1	LS	$200,000.00	$ 200,000.00
Post-Construction Management[6]	12	Month	$ 10,000.00	$ 120,000.00
Indirect Construction Subtotal[4]			**Sum**	**$ 1,000,000.00**
Project Subtotal[4]			**Sum**	**$ 8,500,000.00**
-30% Uncertainty[4]	1	%	30	$ 2,600,000.00
+50% Uncertainty[4]	1	%	50	$ 4,300,000.00

Low-End Total Project Estimated Cost[4]	**Total Sum**	**$ 5,900,000.00**
High-End Total Project Estimated Cost[4]	**Total Sum**	**$12,800,000.00**

Notes:
Costs were determined based upon a combination of publicly available datasets and sediment surface grabs, and topographic, bathymetric, and visual habitat surveys.

1. Cost is based upon mobilizing equipment beyond what is required for dredging the GIWW (e.g., marsh buggies)
2. Value is rounded to the nearest $10,000.
3. Cost includes side casting existing water bottoms and shaping of the containment berm.
4. Value is rounded to the nearest $100,000.
5. Cost is based on incremental cost of diverting dredging equipment from GIWW to excavation areas.
6. Post-construction management may include Site visits to observe the material consolidation, vegetation, and water levels on the Site. Monthly aerials may be performed. Additional post-construction management practices may be considered during subsequent phases of design.

CY: cubic yard
LF: linear foot
LS: lump sum

Expected Ecosystem Benefits

Creation of the Site is expected to have a net positive benefit on the regional ecosystem. The marsh restoration is expected to add approximately 28 acres of mostly marsh habitat to the regional ecosystem. The armored island created at the Site will also provide resiliency to sections of islands near the Site and increase foraging habitat for birds.

Due to the location of the proposed relocated oyster habitat adjacent to the Site, it is expected that the rock containment berm will be colonized by oysters. This will increase the existing oyster habitat in the regional ecosystem.

The following are different opportunities to restore seagrass habitat potentially lost during construction:

- Raising approximately 2 acres of the derelict channel bottom elevations to elevations conducive for seagrass colonization.
- Transplanting seagrass within the footprint or planting new seagrass between Redfish Cove and the Site, where colonization is probable but presently sparse.
- The Site will be a protective barrier to high energy waves and currents experienced at the Site. Therefore, the Site will help protect seagrass habitat in Redfish Bay.

These costs ideas have not been costed at the 30% design stage; however, they may be included during subsequent design phases.

The mean relative sea level rise trend averaged between Rockport and Corpus Christi is 5.74 mm per year (NOAA 2022). Assuming no changes in the mean relative sea level rise trend and no erosion, as well as not considering inorganic and organic accretion, the marsh within the target elevation of the Site (2.5 feet NAVD88 or 2.26 feet MSL) would be below MSL by 2140.

Data and Information Gaps

At this phase of design, the following data and information gaps have been identified:

- Coordination with USACE will be necessary, given that the Site is partially within a DMPA. USACE staff have indicated that for them to support the Site, it should avoid limiting their future placement of material, either by making it more costly to place material in their DMPAs, decreasing the capacity of their DMPAs, or by creating habitat for sensitive species that could inhibit future placement of material.
- Based on stakeholder feedback, an offshore breakwater south of the Site to protect existing seagrasses in Corpus Christi Bay may be evaluated during subsequent design phases.
- Site-specific wind-generated and vessel wake wave heights, which would inform the optimization of site armor design, should be determined.
- Geotechnical characteristics of the source material (maintenance and new work material) and subgrade of the placement area to refine evaluations of containment structure stability, subgrade and source material settlement, and short- and long-term capacity for dredged material placement, should be identified.
- Survey information such as property lines, utility locations, and supplemental bathymetry, where appropriate, should be refined.
- Information should be gathered regarding a potential USACE BU site that may be located between the Site and CCSC and may impact the wave environment at the Site.

These data gaps may need to be addressed during the progression from 30% design to final design. For example, supplemental data collection and modeling would allow optimizing the project design to reduce construction costs. It is expected that the cost of addressing these information gaps would be offset by the cost savings that would be realized by optimizing the project design. Because the 30% design has been prepared without such data, conservative assumptions (e.g., regarding armoring) have been used, increasing the estimated construction cost. This current project is taking the analyses as far as practicable, considering the constraints of the project scope, budget, and schedule.

Future Work

Of the sites selected for 30% designs in this project, up to seven will be selected for 60% designs, cost estimates, and permit packages. No fatal flaw has been identified at this phase of the design.

Discussions with infrastructure owners within the Site footprint are ongoing and may affect the Site footprint and design during subsequent design phases. The presence of seagrass and live oysters inside of the Site footprint and seagrasses immediately adjacent to the Site poses a potential fatal flaw. Potential impacts to seagrasses and oysters should be further evaluated and clearly communicated to resource agencies and stakeholders in the region. Verbal and written approval confirming understanding of likely habitat impacts and proposed mitigation measures should be received before the Site proceeds toward later design phases.

Should the Site be selected for additional design efforts, it can be expected that some aspects of the design in this memorandum will be modified and, as appropriate, enhanced.

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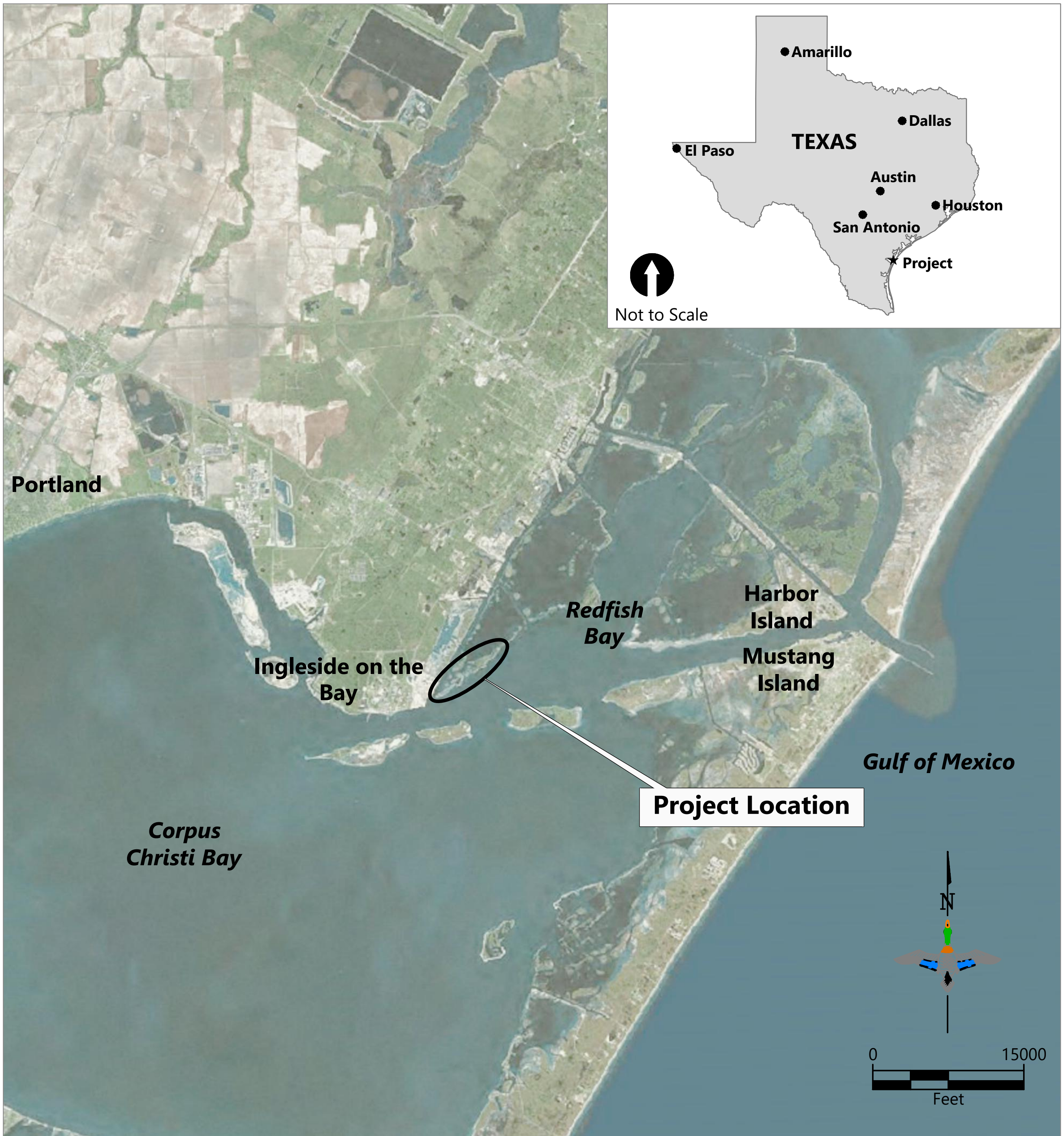
Figures



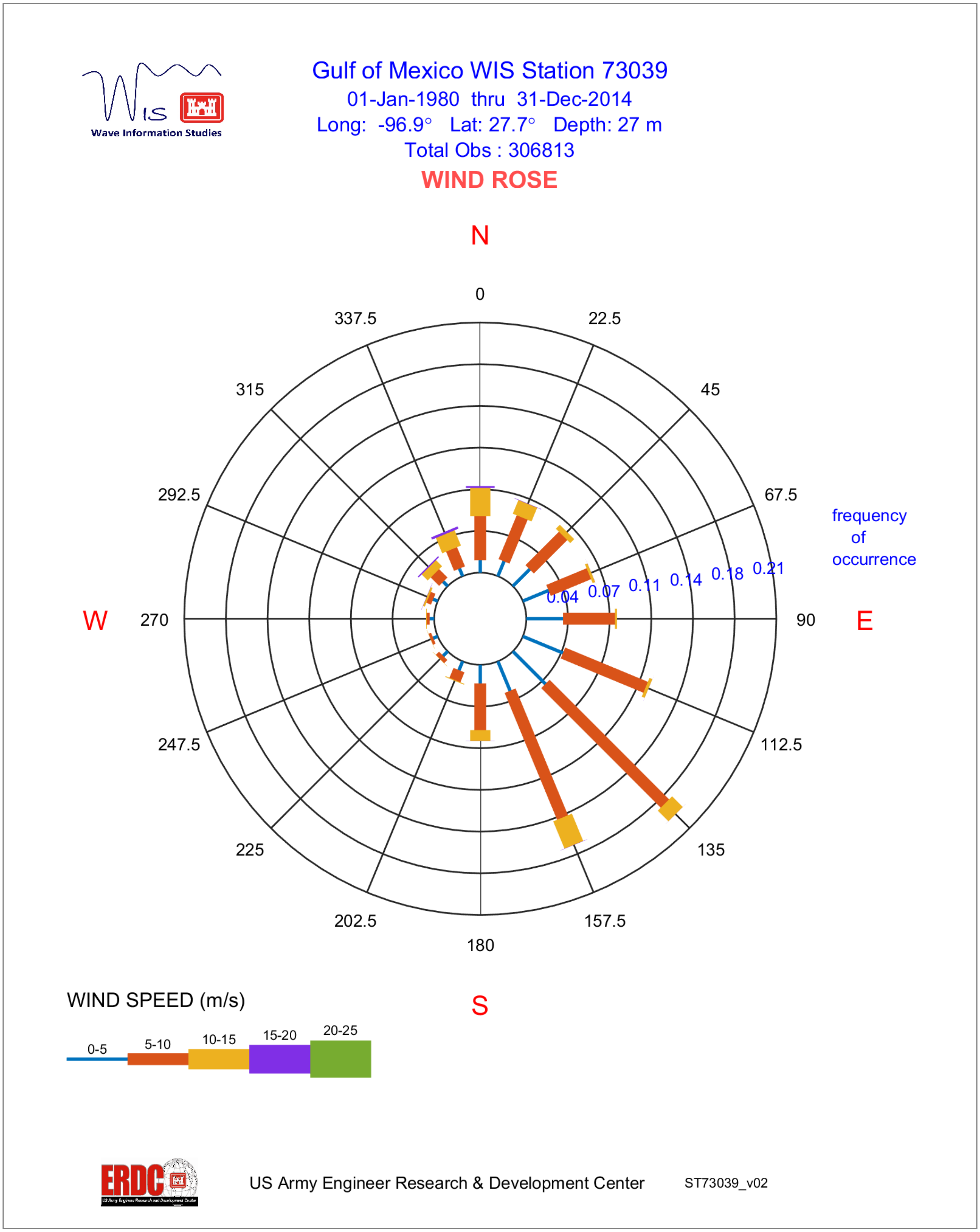
SOURCE: Aerial provided by Bing Maps.
HORIZONTAL DATUM: Texas State Plane South Zone, North American Datum of 1983, U.S. Survey Feet

Publish Date: 2022/06/09 4:13 PM | User: mpratschner
Filepath: K:\Projects\2018-PCCA Beneficial Use\DAGGER ISLAND\2018 RP-001 VIC MAP.dwg Figure 1

ANCHOR QEA

Figure 1
Vicinity Map

Dagger Island 30% Design Memorandum
Texas Lower Coast Beneficial Use



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ANCHOR QEA

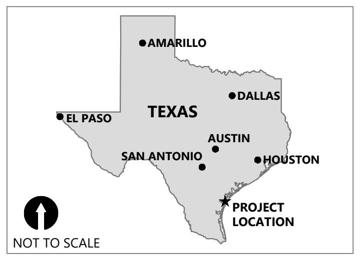
Figure 2
Historical Wind Data for USACE WIS Station 73039
Dagger Island 30% Design Memorandum
Texas Lower Coast Beneficial Use

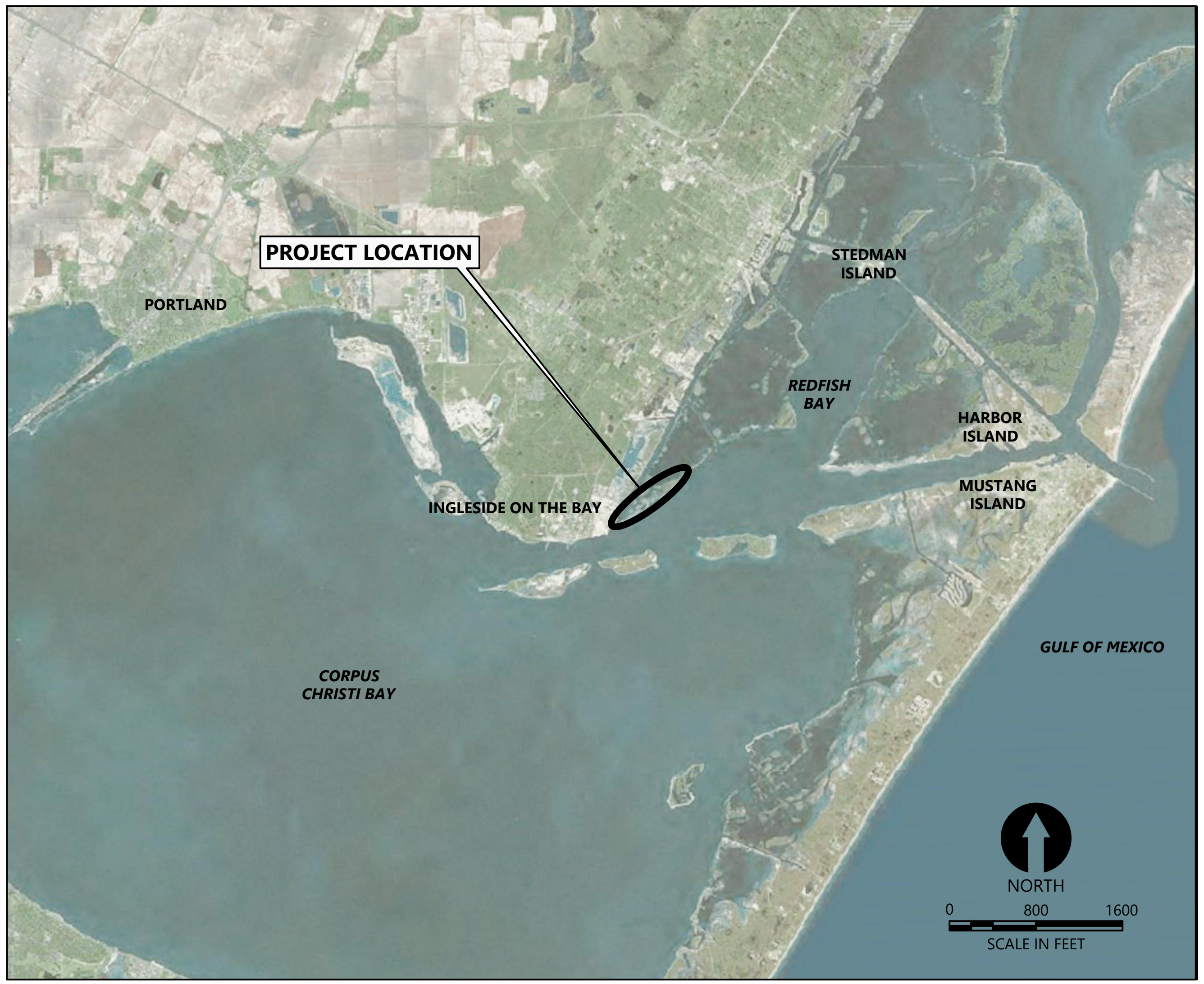
Attachment 1
Construction Drawings

30% DESIGN SUBMITTAL

TEXAS LOWER COAST BENEFICIAL USE - DAGGER ISLAND

PORT OF CORPUS CHRISTI AUTHORITY





AERIAL BY BING MAPS

DRAWING INDEX		
SHEET	DRAWING	TITLE
1	T01	TITLE SHEET
2	C01	SITE OVERVIEW
3	C02	PLAN VIEW
4	C03	TYPICAL CONTAINMENT BERM SECTION

NOTES:

1. HORIZONTAL DATUM: TEXAS STATE PLANE SOUTH CENTRAL ZONE, NAD83, U.S. SURVEY FEET
2. VERTICAL DATUM: NORTH AMERICAN VERTICAL DATUM OF 1988 (NAVD88)
3. BATHYMETRIC AND TOPOGRAPHIC SURVEYS CONDUCTED BY TRITON ENVIRONMENTAL SOLUTIONS, LLC, ON MARCH 18 AND MARCH 21, 2022.
4. HABITAT SURVEY CONDUCTED BY TRITON ENVIRONMENTAL SOLUTIONS, LLC, ON MARCH 18 AND MARCH 21, 2022.

PLAN INTENDED TO BE VIEWED IN COLOR. ADJACENT BLOCK IS "BLUE"

ONE INCH

AT FULL SIZE, IF NOT ONE INCH SCALE ACCORDINGLY

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TEXAS GENERAL LAND OFFICE ESTABLISHED 1836

PORT CORPUS CHRISTI

REVISIONS				
REV	DATE	BY	APP'D	DESCRIPTION

DESIGNED BY: H. SMITH
DRAWN BY: M. PRATSCHNER
CHECKED BY: R. ROBERTSON
APPROVED BY: J. LAPLANTE
SCALE: AS NOTED
DATE: JUNE 2022

TEXAS LOWER COAST BENEFICIAL USE - DAGGER ISLAND

TITLE SHEET

T01

SHEET # 1 OF 4

LEGEND:

- PROPOSED CONTAINMENT BERM
- U.S. ARMY CORPS OF ENGINEERS OPEN WATER DREDGED MATERIAL PLACEMENT AREA
- RAILROAD COMMISSION OF TEXAS MAPPED OIL AND GAS INFRASTRUCTURE LOCATIONS
- GULF INTRACOASTAL WATERWAY
- —0— EXISTING CONTOUR (10')
- —2— EXISTING CONTOUR (2')
- SP# SEDIMENT PROBE LOCATION
- SEAGRASS MAPPED BY TRITON ENVIRONMENTAL SOLUTIONS, LLC
- OYSTER HABITAT MAPPED BY TRITON ENVIRONMENTAL SOLUTIONS, LLC

NOTES:

1. HORIZONTAL DATUM: TEXAS STATE PLANE SOUTH CENTRAL ZONE, NAD83, U.S. SURVEY FEET
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3. BATHYMETRIC AND TOPOGRAPHIC SURVEYS CONDUCTED BY TRITON ENVIRONMENTAL SOLUTIONS, LLC, ON MARCH 18 AND MARCH 21, 2022.
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PLAN INTENDED TO BE VIEWED IN COLOR. ADJACENT BLOCK IS "BLUE"

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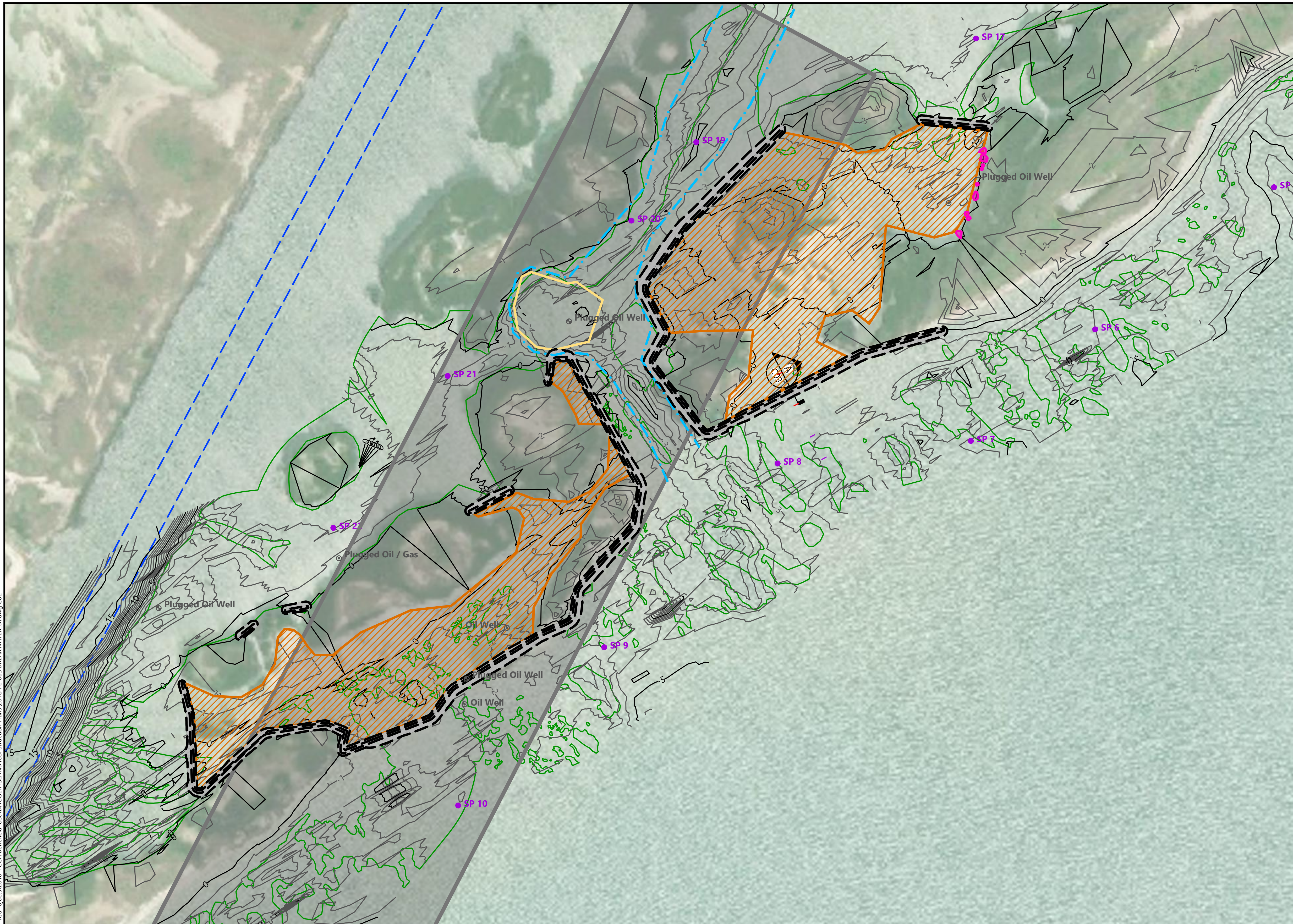
APPROVED BY: J. LAPLANTE
SCALE: AS NOTED
DATE: JUNE 2022

TEXAS LOWER COAST BENEFICIAL USE - DAGGER ISLAND

SITE OVERVIEW

C01

SHEET # 2 OF 4



LEGEND:

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- U.S. ARMY CORPS OF ENGINEERS OPEN WATER DREDGED MATERIAL PLACEMENT AREA
- DREDGED MATERIAL PLACED TO +2.5' NAVD88
- GULF INTRACOASTAL WATERWAY
- SEAGRASS MAPPED BY TRITON ENVIRONMENTAL SOLUTIONS, LLC
- OYSTER HABITAT MAPPED BY TRITON ENVIRONMENTAL SOLUTIONS, LLC
- —0— EXISTING CONTOUR (5')
- —2— EXISTING CONTOUR (1')
- DERELICT CHANNEL
- SEAGRASS MITIGATION AREA
- APPROXIMATE BOUNDARY OF FILL
- SP# SEDIMENT PROBE LOCATION
- RAILROAD COMMISSION OF TEXAS MAPPED OIL AND GAS INFRASTRUCTURE LOCATIONS

NORTH

0 200 400

SCALE IN FEET

NOTES:

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3. BATHYMETRIC AND TOPOGRAPHIC SURVEYS CONDUCTED BY TRITON ENVIRONMENTAL SOLUTIONS, LLC, ON MARCH 18 AND MARCH 21, 2022.
4. HABITAT SURVEY CONDUCTED BY TRITON ENVIRONMENTAL SOLUTIONS, LLC, ON MARCH 18 AND MARCH 21, 2022.

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PLAN INTENDED TO BE VIEWED IN COLOR. ADJACENT BLOCK IS "BLUE"

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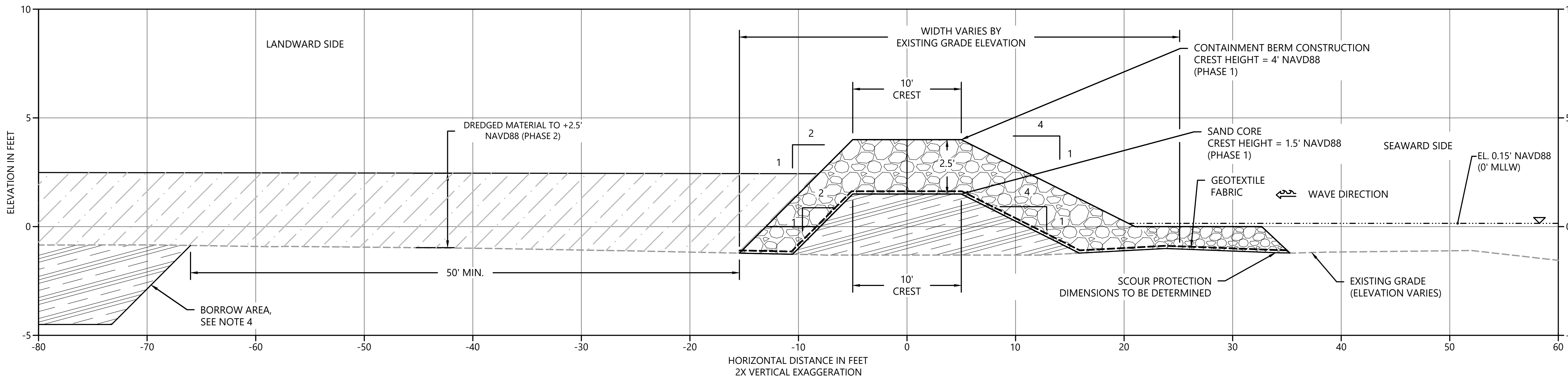
TEXAS LOWER COAST BENEFICIAL USE - DAGGER ISLAND

PLAN VIEW

C02

SHEET # 3 OF 4



A
C02
SECTION
HORIZONTAL SCALE: 1" = 5'
VERTICAL SCALE: 1" = 2.5'

NOTES:

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2. VERTICAL DATUM: NORTH AMERICAN VERTICAL DATUM OF 1988 (NAVD88)
3. BATHYMETRIC AND TOPOGRAPHIC SURVEYS CONDUCTED BY TRITON ENVIRONMENTAL SOLUTIONS, LLC, ON MARCH 18 AND MARCH 21, 2022.
4. BORROW AREA DIMENSIONS SHOWN FOR ILLUSTRATION PURPOSES ONLY. ACTUAL DIMENSIONS TO BE DETERMINED BASED ON FINAL DESIGN AND BY SELECTED CONTRACTOR.

PLAN INTENDED TO BE VIEWED IN COLOR, ADJACENT BLOCK IS "BLUE"

ONE INCH
AT FULL SIZE, IF NOT ONE INCH SCALE ACCORDINGLY

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DATE: JUNE 2022

TEXAS LOWER COAST BENEFICIAL USE - DAGGER ISLAND

TYPICAL CONTAINMENT BERM SECTION

C03

SHEET # 4 OF 4

Attachment 2

Technical Specification Outline

TABLE OF CONTENTS

Memorandum

June 30, 2022

To: Melissa McCutcheon, Texas General Land Office

From: Todd Merendino, Ducks Unlimited, Inc.
Sarah Garza, Harrison McNeil, and Yvonne Dives-Gomez, Port of Corpus Christi Authority
John Laplante, Dan Opdyke, Renee Robertson, Alexander Freddo, and Hayden Smith, Anchor QEA, LLC
Jane Sarosdy, Sarosdy Consulting, Inc.

Re: DMPA #214 Bird Island 30% Design Memorandum

Introduction

This 30% design memorandum describes design criteria and assessments associated with a beneficial use of dredged material (BU) project at the proposed Dredged Material Placement Area (DMPA) #214 Bird Island site (Site), located in Texas General Land Office (GLO) Planning Region 4 of the Texas coast in the Lower Laguna Madre in Kenedy County, Texas (Figure 1).

Project Background

GLO awarded a Coastal Management Program Project of Special Merit grant (funded through the Gulf of Mexico Energy Security Act) to Ducks Unlimited, Inc. (DU) to coordinate with stakeholders and identify restoration sites for BU. The Port of Corpus Christi Authority (PCCA), a project partner, has also contributed staff and financial resources to expand the project scope. The project team is led by DU and PCCA and includes Anchor QEA, LLC; Sarosdy Consulting, Inc.; and the Texas Department of Transportation. Collectively, the project team coordinated three stakeholder meetings with state and federal resource agencies, nongovernmental organizations, academia, consultants, and local officials in each region to solicit information about potential BU sites. Based on stakeholder input, GLO feedback, publicly available data, and professional judgment, the project team has developed 10% designs for 18 sites in GLO Planning Regions 3 and 4 of the Texas coast and 2 GLO-approved sites in Mesquite Bay and San Antonio Bay in GLO Planning Region 2. After completion of the 10% designs, 11 of the designs were selected to continue to 30% designs, and up to 7 of those designs will be chosen for 60% designs and permit application packages. The project team selected the Site as one of the 20 sites for 10% design development and cost estimation. Based on the Site's restoration potential and construction feasibility, the project team selected the Site to proceed to

30% design and opinion of probable construction costs using funding from the GLO Coastal Management Program Project of Special Merit grant.

Conservationists have identified the Laguna Madre as an important location for creating and restoring bird habitat (CBBEP 2020). The Site is a small island located on state-owned submerged land approximately 0.25 mile east of the Gulf Intracoastal Waterway (GIWW) in Laguna Madre in Kenedy County, Texas. It lies between two U.S. Army Corps of Engineers (USACE) DMPAs (#213 and #214) and is in the vicinity of seagrasses. This area was selected because of the identified need for secure and stable rookery island habitat in the region, its proximity to a sediment source in the existing DMPAs, its proximity to potential bird foraging areas, and its sufficient distance from upland-based predators.

Project Objectives

Frequent dredging is needed to develop and maintain Texas navigation channels. The dredged material is often deposited in DMPAs. While many of the existing DMPAs along the Texas coast are nearing capacity, those in the vicinity of the Site are not contained and, effectively, have unlimited capacity. Despite capacity not being a limiting factor, resource agencies and stakeholders have long advocated using dredged material beneficially to create and restore wetlands and bird islands, nourish beaches, and counteract land loss. Historically, BU projects are difficult to manage because they are multiyear, multifaceted undertakings in which different organizations manage dredging schedules, funding, project design, permitting, and construction activities. To help address these issues, the objectives of this project include the following:

- Create and restore degrading coastal habitats.
- Establish sites for placement of dredged material to reduce reliance on existing DMPAs.
- Improve coastal resiliency of the natural and built environment.

To accomplish these objectives, the project includes the following tasks:

- Stakeholder outreach and coordination
- Identification and selection of BU sites
- 10% designs and cost estimates for 20 BU Sites
- 30% designs and cost estimates for 11 BU sites
- 60% designs, cost estimates, and permit application packages for up to seven BU sites

This memorandum documents the 30% design and cost estimate for the Site.

Design Objectives

The Site will be designed to beneficially use dredged material to create a rookery island in a region with scarce or degrading coastal bird habitat. During the initial dredging of the GIWW, new work dredged material was side casted and left along the edge of the channel. The native material and dredged materials that remain from the original construction of the GIWW (termed "relict new work materials" in this memorandum) are considered to have superior structural properties relative to maintenance dredged material (Morton et al. 2001), and hence are the target sediment source for this design. The Site is expected to take advantage of this unique opportunity for mining favorable rookery island material in the area and use material dredged from existing relict new work material inside the surrounding DMPAs and adjacent shallows. Although this project may not use maintenance dredged material, it can still be considered a BU project because it is expected to take advantage of dredging equipment for which the mobilization and demobilization costs are paid by USACE during placement of material in the interior of the rookery island. This 30% design is based upon publicly available datasets, as well as focused field work conducted by DU.

Design objectives include the following:

- Develop a preliminary vision based on available data for the Site that includes the following:
  - Habitat to be created or restored
  - Potential sediment source(s)
  - Approaches to minimize long-term maintenance costs
- Delineate conceptual footprints for proposed BU placement.
- Identify key sensitive habitats and construction considerations in the vicinity of the Site.
- Estimate fill volumes for the proposed BU footprints.
- Identify data gaps to be addressed in subsequent design phases.
- Provide preliminary cost estimates.

Existing Data Review

A review of existing data and the focused data collected by DU was performed to develop the Site and containment berm designs. This section describes the data reviewed and collected for the 30% design.

Horizontal and Vertical Datums

The horizontal datum used for the Site is the Texas State Plane South Zone, North American Datum of 1983 in U.S. survey feet. The primary vertical datum used for the Site design is the North American Vertical Datum of 1988 (NAVD88). The National Oceanic and Atmospheric Administration (NOAA) maintains an active tide gauge within the vicinity of the Site. The NOAA Rincon Del San Jose, Texas, Station 8777812 (Rincon Del San Jose Station) is 5.25 miles north of the Site; however, this station only provides elevations for NAVD88 and mean sea level (MSL) vertical datums. The next-closest station that contains the necessary tidal datums is Packery Channel, TX Station 8775792 (Packery Channel Station) 64 miles north of the Site. There is only a 0.16-foot difference in the MSL tidal datum between the stations, so the tidal datums from the Packery Channel Station were assumed to be accurate for this level of analysis. The Packery Channel Station collects and records real-time tide information dating back to 1990. The vertical datums from this station that will be used for the Site are shown in Table 1. The NOAA USS Lexington Station, Corpus Christi Bay, TX Station 8775296 (Lexington Station) was also used to define a preliminary design water level, as described in the Water Level section.

Table 1
Packery Channel Station Tidal Gauge Displaying NAVD88 Tidal Datums

Tidal Datum	Elevation (feet NAVD88)	Elevation (feet MLLW)
MHHW	0.79	0.42
MHW	0.79	0.42
MSL	0.59	0.22
MLW	0.36	-0.01
MLLW	0.37	0

Notes:
MHHW: mean higher high water
MHW: mean high water
MLLW: mean lower low water
MLW: mean low water

Meteorological, Ocean, and Wave Data

Water Level

To determine an approximate design water level elevation for the Site, an existing water level analysis using data from the Lexington Station, which is 75 miles north of the Site, was used (Anchor QEA 2021). Data were compiled for the period from October 2015 to January 2021 and used to calculate a 90th-percentile water level of 2.0 feet NAVD88, which is 1.24 feet MSL at Lexington Station. To more closely depict water levels represented at the Site, this elevation of 1.24 feet was added to the reported MSL at the Rincon Del San Jose Station MSL (which is 0.43 feet NAVD88) to generate a reasonable design water level of 1.67 feet NAVD88.

This water level was used for a preliminary understanding of the wave growth at the Site, and a more comprehensive analysis based on historical water levels at the Rincon Del San Jose Station may be used during subsequent design phases.

Wind and Waves

The USACE Wave Information Studies (WIS) database provides a national resource of long-term wavefield climatologies for U.S. coastal waters that synthesizes observations, multidecade hindcasts, and storm event archives (USACE 2021). The WIS station closest to the Site is Station 73027, just offshore on the Gulf side of North Padre Island in the Gulf of Mexico. Because the station is located offshore, the wave data are not applicable to this project design. However, the project team considers the wind data to be representative of the winds experienced at the Site. Figure 2 summarizes wind data from January 1, 1980, through December 31, 2014. The data indicate that the predominant wind direction is from the southeast, with significant winds also coming from the north, northeast, east, and south.

The Coastal Engineering Design and Analysis System (CEDAS) Automated Coastal Engineering System (ACES) tool was used to calculate the wave growth over the restricted shallow-water fetch from the south and north (Leenknecht et al. 1992a). These two directions were selected because each exhibit significant winds over long, restricted fetch distances. Inputs for the ACES tool consist of the items described in the following subsections.

North Wind

- The main wind direction was input to be from 0° clockwise from the north.
- The average depth along the fetch in the north direction was input as 4.13 feet (based on a conservative water surface elevation of 1.67 feet NAVD88; NOAA 2021).
- The fetch length for the north wind direction was input as 5.92 miles.
- The observed wind speed was input according to the WIS station extreme value analysis, in which return periods and their wind speeds were predicted inside a ±22.5° bin from 0°. (The 0° bin is represented by all winds measured from the 337.5° to 22.5° wind direction.)

South Wind

- The main wind direction was input to be from 180° clockwise from the north.
- The average depth along the fetch in the southeast direction was input as 6.27 feet (based on a conservative water surface elevation of 1.67 feet NAVD88; NOAA 2021).
- The fetch length for the southeast wind direction was input as 48 miles.
- The observed wind speed was input according to the WIS station extreme value analysis, in which return periods and their wind speeds were predicted inside a ±22.5° bin from 180°. (The 180° bin is represented by all winds measured from the 157.5° to 202.5° wind direction.)

Common Inputs

- The elevation of observed wind was 10 meters (Leenknecht et al. 1992b).
- The temperature difference between the air and sea was input as 0°F.
- The duration of the observed wind and duration of the final wind are from the hindcasted time interval associated with the WIS data recordings and input as 1 hour.
- WIS Station 73032 is at 26.75° latitude observing over water.
- The fetch option most associated with the Site is shallow restricted, meaning the wind-wave generation is impacted by the geometry of the Site and where wind is measured traveling from a point along the shoreline to the point of interest (Leenknecht et al. 1992b).
- The number of angles was input as three, with a radial angle increment as 10°. This results in the direction of the first radial fetch to be 10° less than the predominant wind direction from

both the north and south (350° and 170°, respectively), the second radial fetch to be the predominant wind direction from both the north and south (0° and 180°, respectively), and the third radial fetch to be 10° more than the predominant wind direction from both the north and south (10° and 190°, respectively). This approach forces the ACES tool to correctly calculate the wave growth across the desired main wind direction angle of 0° and 180°.

The predicted wave height growth from the north and southeast wind directions are shown in Tables 2 and 3, respectively.

Table 2
CEDAS ACES Predicted Wave Height Growth in the North (0°) Wind Direction

Wind Direction	Fetch Distance (miles)	Return Period (year)	Wind Speed (mph)	Wave Height (Hmo, feet)[1]	Wave Period (Tp, seconds)[2]
North 0° (337.5°–22.5°)	5.92	1	34.6	1.35	2.53
		2	37.7	1.44	2.63
		10	50.0	1.76	3.01
		20	56.5	1.92	3.18
		50	65.8	2.13	3.42
		100	73.4	2.30	3.59

Notes:
1. Wave heights are determined from spectrally based methods (Hmo; Bretschneider and Reid 1954).
2. Wave periods are determined from spectrally based methods (Tp; Bretschneider and Reid 1954).
mph: miles per hour

Table 3
CEDAS ACES Predicted Wave Height Growth in the South (180°) Wind Direction

Wind Direction	Fetch Distance (miles)	Return Period (year)	Wind Speed (mph)	Wave Height (Hmo, feet)[1]	Wave Period (Tp, seconds)[2]
South 180° (157.5°–202.5°)	48	1	28.0	1.79	3.36
		2	30.8	1.90	3.50
		10	41.8	2.32	3.98
		20	47.6	2.53	4.20
		50	56.0	2.82	4.49
		100	62.8	3.05	4.70

Notes:
1. Wave heights are determined from spectrally based methods (Hmo; Bretschneider and Reid 1954).
2. Wave periods are determined from spectrally based methods (Tp; Bretschneider and Reid 1954).

Wind-generated waves from the predominant north and southeast wind direction were calculated to determine the approximate wave climate at the Site. One-year return period winds generated waves no greater than 1.35 feet. A more detailed hydrodynamic model analyzing the direction and frequency of expected significant wave heights may be developed during subsequent phases of design.

Wake Erosion

The GIWW is approximately 0.16 mile west of the Site. Several types of vessels, including recreational and commercial vessels and commercial tugboats and barges, operate in the GIWW and generate wake waves that propagate to the Site. Like wind-generated waves, vessel wake waves produce the greatest erosive forces in the region where the waves break (i.e., the surf zone).

The Bhowmik et al. (1991) and Weggel and Sorensen (1986) vessel-generated wave prediction methods—based on vessel dimensions, travel speed, and distance between the sailing line and Site—were used to evaluate the range of vessel-generated waves for a conservative selection of representative vessels known to operate in the area. A sport yacht with a draft of 4 feet was selected to evaluate recreation vessel wakes generated by vessels traveling near the proposed Site. A generic tugboat with maximum dimensions recorded in the Automatic Identification System (AIS) database was selected, along with a similar tugboat transiting with twin barges (identified using Google Earth imagery of ports in the region) to evaluate the commercial vessel wakes generated by vessels traveling in the GIWW. Calculation of the sport yacht's maximum vessel wakes, traveling at varying speeds along the nearest edge of the GIWW 820 feet from the Site, can be seen in Table 4. Calculation of the maximum vessel wakes of the tugboat and tugboat with twin barges, traveling in 14 feet of water at varying speeds up to 11 miles per hour (mph; considered conservative) along the nearest edge of the GIWW 820 feet from the Site, can be seen in Table 5.

These wave heights are shorter than the predicted wind-generated wave heights at the Site, and thus, wind-generated waves will be considered the predominant erosive force for design evaluations. The vessel wakes are limited to vessels traveling on the edge of the GIWW. This assumption likely holds for commercial vessels, but further analysis should be conducted to understand the frequency and distance recreational vessels travel near the Site. Additional analysis surrounding a variety of recreational vessel drafts and speeds may be considered in future design phases.

Table 4
Sea Ray Sundancer Sport Yacht Maximum Vessel Wake Calculations at Various Speeds

Vessel	Length (feet)	Draft (feet)	Vessel Speed (mph)	Maximum Wave Height (feet)	Wave Period (seconds)
Sea Ray Sundancer sport yacht	51	4	6.7	0.89	1.19
			15	0.68	1.03
			25	0.57	0.94
			35	0.51	0.89
			45.4	0.46	0.85

Note:
Maximum wave heights were calculated using Bhowmik et al. (1991), in which vessel speeds ranged from 6.7 to 45.4 mph.

Table 5
Tugboat and Tugboat with Twin Barges Maximum Vessel Wake Calculations at Various Speeds

Vessel	Length (feet)	Beam (feet)	Draft (feet)	Vessel Speed (mph)	Maximum Wave Height (feet)	Wave Period (seconds)
Generic tugboat with maximum dimensions recorded in AIS data[1]	87	33	11	3	0.00	8.40
	87	33	11	5	0.00	5.04
	87	33	11	7	0.00	3.60
	87	33	11	9	0.33	2.80
	87	33	11	11	0.84	2.29
Generic tugboat with maximum dimensions recorded in AIS data and twin barges[2]	387	110	11	3	0.00	7.31
	387	110	11	5	0.00	4.38
	387	110	11	7	0.00	3.13
	387	110	11	9	0.00	2.44
	387	110	11	11	0.91	2.29

Notes:
Maximum wave heights were calculated for vessels traveling within Froude number boundaries and at 3, 5, 7, 9, and 11 mph (Weggel and Sorensen 1986).
1. Vessel hull geometric coefficients were input using a tugboat from Hay (1967).
2. Vessel hull geometric coefficients were input using a barge from Hay (1967).

Bathymetry and Topography

DU conducted bathymetric and topographic surveys at the Site on March 25, 2022. The Site footprint consists of mostly open-water shallows with small upland remnants containing shell hash and vegetation. The Site footprint has an average seabed elevation of -1.2 feet NAVD88 and slopes steeply down to deeper water surrounding the Site at approximately -3.6 feet NAVD88. The Site contours range from -3.6 to +1.7 feet NAVD88. During the survey, DU conducted sediment probing in 30 areas of the Site. The minimum and maximum probing distance to substrate refusal was 0.09 and 1.07 feet, respectively, with an average distance to refusal of 0.30 foot. Within those areas, it was qualitatively determined that the material was firm throughout and is not expected to have substantial settling.

Utilities and Infrastructure

The Railroad Commission of Texas public GIS viewer (RRC 2021) and GLO pipeline data (GLO 2021a) were used to identify mapped utilities and pipelines near the Site. Two dry holes were identified within a 1-mile radius and are not expected to impact design and construction. No utilities or pipelines were identified near the Site. The need for Site-specific utility locations prior to construction may be determined during subsequent design phases. No other infrastructure has been identified in the vicinity of the Site.

Desktop Cultural Resources Survey

A search of cultural resources records in the Texas Historical Commission Texas Historical Sites Atlas Database was completed for the Site on December 16, 2021. This search revealed that no archaeological surveys have been conducted, and no archaeological sites have been identified within the preliminary proposed Site (THC 2021).

Sensitive Habitat

GLO oyster habitat GIS data (GLO 2021b) and visual surveys conducted by DU on March 25, 2022, do not indicate oyster habitat within or adjacent to the Site.

The visual survey conducted by DU on March 25, 2022, indicated seagrasses within the excavation areas and within the Site from approximately the shoreline to -4 feet MSL (-3.41 feet NAVD88; Attachment 1, C01). Seagrasses were identified visually in shallow water and assumed to be present in deeper water where water appeared dark. Because this information is based on visual surveys, more extensive seagrass surveys may need to be conducted during a subsequent phase of design.

Bird Species

The U.S. Fish and Wildlife Service (USFWS) Information for Planning and Consultation (IPaC) tool was used to identify listed species and migratory birds within a 525-square-mile region around North Padre Island and the Laguna Madre Region (USFWS 2021). Table 6 includes some of the protected and migratory bird species present near the Site and their preferred habitat as explained in the *Guide to North American Birds* (Audubon 2021a). At this time, no target species or list of species has been identified for the Site.

Table 6
USFWS IPaC Species Information[1]

Species	Status	Preferred Habitat[2]
Whooping crane (*Grus americana*)	Endangered	Prairie pools, marshes, and coastal marshes
Piping plover (*Charadrius melodus*)	Threatened	Sand beach dunes and expansive sand or mudflats
Red knot (*Calidris canutus*)	Threatened	Mudflats, tidal zones, and sandy beaches
American oystercatcher (*Haematopus palliatus*)	Migratory	Strictly coastal; dunes, islands in salt marsh, dredge spoil islands, sandy beaches, and tidal mudflats
Black skimmer (*Rynchops niger*)	Migratory	Sandy islands, shell beaches, open beaches, lagoons, estuaries, inlets, and sheltered bays
Brown pelican (*Pelecanus occidentalis*)	Migratory	Bare, rocky, mangrove- or tree-covered islands; salt bays, beaches, and oceans
Gull-billed tern (*Gelochelidon nilotica*)	Migratory	Beaches, islands, salt marshes, fields, and coastal bays
Marbled godwit (*Limosa fedoa*)	Migratory	Northern Great Plains, native prairie with marshes or ponds, pools, shores, marshes, and tidal flats
Reddish egret (*Egretta rufescens*)	Migratory	Red mangrove swamps, arid coastal islands covered with thorny brush, coastal tidal flats, salt marshes, and lagoons
Ring-billed gull (*Larus delawarensis*)	Migratory	On ground near water with sparse plant growth, lakes, bays, coasts, piers, dumps, and plowed fields
Royal tern (*Thalasseus maximus*)	Migratory	Low-lying sandy islands, coasts, lagoons, salt bays, and estuaries
Wilson's plover (*Charadrius wilsonia*)	Migratory	Dry part of beach, near conspicuous object, coastal regions, open beaches, tidal flats, estuaries, and sandy islands

Notes:
1. USFWS IPaC information (USFWS 2021) is provided for a 525-square-mile region around North Padre Island and the Laguna Madre highlighting endangered, threatened, and migratory birds and their preferred habitat.
2. Habitat information is from the *Guide to North American Birds* (Audubon 2021a) and includes preferred nesting and general habitat.

Erosion

Google Earth imagery indicates DMPA #214 Bird Island is becoming submerged over time and has lost approximately 1.2 acres of upland from 1995 to 2016. This is consistent with documentation from the Coastal Bend Bays & Estuaries Program, which notes that the North Padre Island shorelines are at high risk due to erosional forces (CBBEP 2020).

Beneficial Use Source Material

The proposed source material for DMPA #214 Bird Island may consist of existing relict new work material excavated from inside the Site (borrow area) and DMPAs #213 and #214, approximately 0.25 mile away (Excavation Areas 1 and 2; Attachment 1, C01 and C02). The material located in these proposed areas came from material dredged from deltaic deposits of Pleistocene Beaumont Formation or the Holocene Rio Grande delta during the original dredging of the GIWW and has been shown to be more stable than recent maintenance dredged material (Morton et al. 2001). The containment berm will primarily be constructed with the borrow area material, while exterior excavation area material may be used if the quantity available from the borrow area is insufficient. The exterior excavation areas will be used to provide the material for containment berm enlargement. The exterior excavation areas and, possibly, maintenance dredged material, will be used to provide the interior fill for the Site. The available volume inside each excavation area alternative at different excavation elevations is shown in Table 7.

Table 7
Excavation Area Alternative and Borrow Area Sediment Volume Availability at Different Excavation Elevations

Excavation Area	Excavation Elevation (feet NAVD88)	Volume (CY)[3]
Area 1[1]	-4	20,800
	-5	53,300
	-6	85,700
	-7	118,200
	-8	150,700
	-9	183,200
	-10	215,600
	-11	248,100
	-12	280,600
Area 2[1]	-3	7,800
	-4	16,100
	-5	24,400
	-6	32,700
	-7	41,000
	-8	49,300
	-9	57,600
	-10	65,900
	-11	74,200

Notes:
Volume availability was calculated geometrically using the bathymetric and topographic surveys collected by DU on March 25, 2022.
1. Volume availability may need to be refined during future phases of design using surfaces created in Civil3D.

CY: cubic yards

DU collected six surface sediment grab samples: two inside the Site (borrow area), two in Excavation Area 1, and two in Excavation Area 2 (Attachment 1, C01). The surface samples are not necessarily representative of the material below the surface sediments. A visual inspection of the surface grab material shows varying characteristics. Further sampling and testing would be needed to determine the physical characteristics and suitability of the material for construction. Nevertheless, Table 8 shows qualitative descriptions for each of the six surface grabs.

Table 8
Qualitative Descriptions of Five Surface Sediment Grabs During Basic Inspection

Grab Number	General Location	Latitude (N)	Longitude (W)	Qualitative Descriptions
1	Excavation Area 2	26.727927	97.450425	Mostly fines and clays High organic material
2	Excavation Area 2	26.729564	97.45094	Mostly fines and clays High organic material
3	Borrow area	26.730977	97.451200	Mostly sand with silts High organic material
4	Borrow area	26.731904	97.451846	Mostly sand with silts Low organic material
5	Excavation area 1	26.73671	97.452616	Mostly shells/rock (approximately 0.5–1.0-cm diameter) Moderate organic material
6	Excavation Area 1	26.740273	97.453146	Mostly sands and clays with shell hash No organic material

Note:
Grab samples were collected by DU on March 25, 2022.

Additionally, GIWW maintenance material with grain size characteristics from the USACE Dredged Material Management Program Reach 4 – DMPA 211-222 consisting of 28% sand, 50% silt, and 21% clay (Neill 2022) is being considered for interior placement at the Site.

30% Design

The main design elements evaluated for the Site are as follows:

- Site location
- Rookery island size and shape
- Containment and erosion protection
- Constructability
- Planting and natural recruitment of vegetation

- Performance expectations
- Site construction cost estimates
- Expected ecosystem benefits
- Data and information gaps

These design elements are evaluated in this memorandum for the 30% Site design.

Site Location

The proposed Site location is approximately 0.25 mile east of the GIWW and between DMPAs #213 and #214. The Site's location was selected to avoid encroaching on those areas, as well as on potentially dense seagrass habitat (as indicated by Texas Parks and Wildlife Department data; TPWD 2021). The proposed Site is approximately 1 mile from the nearest shoreline. This distance is greater than the 0.5-mile distance identified for minimizing predator access to rookery islands (Stanzel 2018).

The Site is located on mounded upland ridges of relict new work material with an average -0.9-foot NAVD88 (-1.27 feet MLLW) seabed elevation. The existing upland ridges are small with minimal to no vegetation and do not support significant bird populations.

Rookery Island Size and Shape

Based on availability of sediment, a cost analysis, and stakeholder feedback, the project team proposes that the upland area of the Site be approximately 7 acres. This 30% design represents a bird island near the upper range of bird island sizes desired, based on stakeholder input. Seagrass constraints may limit the size of island ultimately constructed, but at this level of design, it was decided to consider a site on the upper end of the range identified by stakeholders.

The Site will be created with dredged material placed to an elevation of +4.0 feet NAVD88. The Site will be shaped to reside on an existing mound, and its perimeter will extend down to the approximate -3.0-foot NAVD88 contour. This shape of fill was selected to promote natural recruitment of vegetation and provide habitat for a range of bird species. The elevation of dredged material fill could be adjusted at future phases of design, depending on the physical properties of the dredged material or if target bird species and their specific requirements different from these characteristics are identified. It is expected that environmental controls may be needed during construction to contain finer sediment placed during construction.

Because the Site is between two DMPAs, relict new work material from the DMPAs may be dredged to construct the rookery island. Fill material could also come from GIWW maintenance material. The Site is located on an existing high point and provides beneficial constructability conditions with typical seabed elevations of approximately -5 feet NAVD88 surrounding the Site for construction access. However, access channels may still need to be dredged for contractors to access the Site and

DMPAs (Attachment 1, C01). Preconstruction bathymetric surveys may need to be conducted during subsequent design phases to better define Site dimensions and material requirements.

Containment and Erosion Protection

A high-density clay containment berm made of the relict new work material will be constructed on all sides to protect the island from wind- and vessel-generated waves, as well as contain placed dredged material (Attachment 1, C02). The proposed design includes constructing the centerline of the containment berm approximately along the -3.0-foot NAVD88 contour in two phases as discussed in the Constructability section. Based on sediment probing, which indicated the substrate is extremely firm throughout, the conceptual design assumes 1 foot of foundation compression for every 6 feet of fill and does not consider bulking. However, sediment cores and geotechnical data may need to be collected during a subsequent design phase to further evaluate the expected foundation compression and expected bulking of both mechanically excavated and hydraulically dredged material. Geotechnical data collection and analysis may also be necessary to determine the availability and suitability of material in the proposed borrow areas and excavation areas.

The proposed centerline of the containment berms is shown in Attachment 1, C01. Attachment 1, C03 depicts a typical cross section of the containment berms. The containment berm will be allowed to dewater and consolidate; then, it will be nourished and enlarged with additional high-quality, relict new work dredged material, described as the overtopping slope in Phase 2. The containment berm design characteristics are shown in Table 9 for Phase 1, and Table 10 is a summary for Phase 2. The estimated total volume for Phases 1 and 2 is 204,000 cubic yards (CY). This assumes the borrow area could be excavated to approximately -9 feet NAVD88 to provide the necessary quantity of material for the Phase 1 containment berm construction, and voids would be filled during Phase 2 interior fill construction. The design includes a 10 horizontal to 1 vertical (10H:1V) gradual seaward side slope that may allow the rookery island to transition into a stable, natural grade, which is expected to reduce wave erosion on the rookery island, help the island stabilize naturally over time, and facilitate wading bird access into the Site. A shallower slope may be considered during subsequent phases to provide more potential seagrass habitat and further decrease wave erosion on the Site.

Table 9
Phase 1 Containment Berm Design Characteristics

Containment Berm Design Criteria	DMPA #214 Bird Island Containment Berm
Total project length	2,552 feet
Total containment berm acreage	Approximately 4.5 acres
Crest width	12 feet
Base width	Approximately 76 feet, depending on water depth
Assumed bottom elevation	-3.0 feet NAVD88
Total structure height	8.0 feet

Containment Berm Design Criteria	DMPA #214 Bird Island Containment Berm
Containment berm materials	Mechanically excavated relict new work material
Containment berm volume	33,000 to 43,000 CY
Estimated settlement	1 foot for every 6 feet of fill
Design side slopes (seaward side)	5H:1V, depending on material
Design side slopes (landward side)	3H:1V, depending on material
Maximum design crest elevation	+5 feet NAVD88

Note:
The final cross-sectional dimensions and slopes of the containment berm may be refined through hydrodynamic modeling and evaluation of sediment characteristics of the dredged material and containment berm subgrade during a subsequent phase of design.

Table 10
Phase 2 Containment Berm and Fill Design Characteristics

Containment Berm Design Criteria	DMPA #214 Bird Island Containment Berm
Total project length	2,552 feet
Total containment berm acreage	Approximately 7.4 acres
Crest width	15 feet
Base width	Approximately 126 feet, depending on water depth
Assumed bottom elevation	-3.0 feet NAVD88
Total structure height	8.5 feet
Containment berm materials	Mechanically excavated relict new work material
Containment berm volume	23,000 to 47,000 CY
Estimated settlement[1]	1 foot for every 6 feet of fill
Design side slopes (seaward side)	10H:1V, depending on material
Design side slopes (landward side)	3H:1V, depending on material
Maximum design crest elevation	+5.5 feet NAVD88
Internal Fill Design Criteria	**DMPA #214 Bird Island Internal Fill**
Fill acreage	6.2 acres
Fill elevation	+4.0 feet NAVD88
Fill volume[2]	114,000 CY

Notes:
The final cross-sectional dimensions, slopes of the containment berm, and volume required for interior fill may be refined through hydrodynamic modeling and evaluation of sediment characteristics of the dredged material and containment berm subgrade during a subsequent phase of design.

1. Estimated settlement only includes subgrade not previously impacted by the Phase 1 containment berm.
2. Estimated fill volume was calculated after excavating the borrow area to at least -8.7 feet NAVD88.

Although the new relict islands are slowly eroding, they have been in existence (albeit in reduced form) for more than 70 years after the construction of the GIWW in the 1940s. This indicates that the relict new work material (also proposed for the Site construction) is fairly resilient to erosion.

Therefore, armoring is not currently proposed at this point for the containment berms created from the relict new work material. The wave analysis described in the Meteorological, Ocean, and Wave Data section also indicates armoring of the Site may not be necessary. The initial investigation of wind-generated waves and vessel wakes does not indicate wave heights greater than 3.05 feet (for the 100-year return interval; Tables 2 and 3). However, further evaluation using a detailed wind-wave model to analyze the direction and frequency of expected significant wave heights may be conducted during subsequent phases of design to determine if armoring of the Site is necessary. During final design phases, the initial capital construction costs and maintenance costs with armoring versus without armoring may be evaluated.

Constructability

This section describes the proposed methods of construction. Actual methods will be dependent on the chosen contractor's equipment and Site conditions at the time of construction. In addition, the contractor may provide alternate construction methods from those described in this section.

Dredging is typically performed along the GIWW Corpus Christi to Port Isabel reach every 1 to 2 years (Neill 2022). The Site is proposed to be constructed in two different phases to beneficially use dredged material from a USACE dredging cycle, which makes the project more feasible. Phase 1 containment berm construction will be completed prior to a USACE dredging event to allow for dewatering and consolidation; then, Phase 2 containment berm and interior fill construction will be completed during a USACE dredging event.

The Site could be constructed in two different phases, as follows.

Phase 1

The initial containment berm will be constructed during Phase 1 to allow for settlement, dewatering, and consolidation of the containment berm before placing fill material into the Site (Phase 2; Attachment 1, C02 and C03). Phase 1 construction may require mobilizing equipment beyond what is required for dredging the GIWW (e.g., marsh buggies, a deck barge, and an excavator). The containment berm may be constructed from mechanically excavated relict new work material from borrow areas currently residing in the Site footprint and/or from immediately adjacent shallow-water areas that have the relict new work material (Excavation Areas 1 and 2) if borrow area material quantity is insufficient. Depending on water depths, marsh buggies or deck-barged excavators may be used to shape the containment berm.

Phase 2

Phase 2 of construction will consist of raising the containment berm crest to +5.5 feet NAVD88 and placing fill inside the Site to create the bird island. (Attachment 1, C02 and C03). Phase 2 construction may require mobilizing equipment beyond what is required for dredging the GIWW (e.g., marsh buggies, a deck barge, and an excavator) and incremental mobilization consisting of diverting typical dredging equipment from the GIWW to the Site. The material for the Phase 2 containment berm and interior fill may be either hydraulically dredged relict new work material from Excavation Areas 1 and 2 or from GIWW maintenance material. The hydraulically dredged relict material is likely to produce clay balls or clumps that will fall near the end of the pipe and congregate. The clay balls or clumps may then be used construct the Phase 2 containment berm geometry.

Planting and Natural Recruitment of Vegetation

Based on stakeholder input and cost considerations, the project team determined that planting on the interior may not be needed. Rather, natural vegetation recruitment will be allowed to proceed. If the outcome is unsatisfactory (e.g., if the island has lower-than-expected use by desired bird species), an adaptive management program can be instituted to modify the vegetation. Table 6 shows some of the listed and migratory birds and their preferred habitats. At further design phases, this list could be used to modify elevations within the Site to promote the preferred habitat of desired bird species.

Stakeholders suggested that existing seagrasses be transplanted to a temporary site prior to construction and then reintroduced following construction and consolidation of placed material. This may accelerate the revegetation of the shallow-water areas surrounding the Site. There is also the possibility of transplanting seagrasses from other locations or allowing seagrasses to recolonize naturally. Stakeholders additionally suggested planting mangroves on the Phase 2 containment berm to further stabilize the shoreline. These strategies would need to be evaluated to determine impact on project costs, as well as the impact they may have on the bird species that would colonize the Site.

Performance Expectations

The existing relict new work upland islands in the Upper Laguna Madre have shown to be erosion resilient over time. Because the Site is to be constructed mostly using the relict new work dredged material, it is expected to experience the same resiliency as the Upper Laguna Madre islands. The relict new work material on the Site is expected to weather and stabilize over time to a natural slope similar to that of other upland islands composed of relict new work material in the Upper Laguna Madre.

Site Construction Cost Estimates

Preliminary construction costs were estimated for the design outlined in the previous sections. The estimated costs include indirect construction costs (i.e., permitting, 100% engineering and design costs, construction management, and post-construction management such as Site visits and dewatering management). These costs represent the estimated incremental costs (i.e., over and above USACE’s least-costly and environmentally acceptable dredged material and placement alternative).

Table 11 shows a line-item list of each costing parameter and the total cost estimated for construction.

The costs range from $2.4 million to $5.1 million, depending on the level of uncertainty allocated to the project cost. The lower bound of uncertainty (-30%) and upper bound of uncertainty (+50%) were selected due to the existing data gaps, high levels of inflation, and rising fuel costs. During subsequent design phases, the effect of armoring versus not armoring on the initial capital construction versus projected maintenance costs may be evaluated. The estimates are developed using current and generally accepted engineering cost estimating methods and are based on assumptions concerning future events. Actual costs may be affected by known and unknown risks including, but not limited to, changes in general economic business conditions, Site conditions that were unknown at the time the estimates were performed, future changes in Site conditions, regulatory or enforcement policy changes, and delays in performance. Actual costs may vary from these estimates.

Table 11
Opinion of Probable Construction Cost to 100% Project Completion

Item	Quantity	Unit	Unit Price	Total
Direct Construction Costs				
Phase 1: Containment Berm Construction				
Mobilization and Demobilization[1]	1	LS	$150,000.00	$ 150,000.00
Preconstruction Survey	1	LS	$ 30,000.00	$ 30,000.00
Containment Berm[2,3]	2,552	LF	$ 104.00	$ 270,000.00
As-Built Survey	1	LS	$ 50,000.00	$ 50,000.00
Navigational Aids[2]	4	Each	$ 4,000.00	$ 20,000.00
Phase 1 Subtotal[4]			**Sum**	**$ 500,000.00**
Phase 2: Interior Fill Placement and Containment Berm Enlargement				
Incremental Mobilization and Demobilization[1,2,5]	1	LS	$250,000.00	$ 250,000.00
Preconstruction Survey	1	LS	$ 50,000.00	$ 50,000.00
Dredged Material Interior Placement[2]	114,000	CY	$ 12.00	$ 1,370,000.00
Containment Berm[2,3]	2,552	LF	$ 90.00	$ 230,000.00
As-Built Survey	1	LS	$ 60,000.00	$ 60,000.00
Phase 2 Subtotal[4]			**Sum**	**$2,000,000.00**
Direct Construction Subtotal[4]			**Sum**	**$2,500,000.00**
Indirect Construction Costs				
100% Engineering and Design	1	LS	$500,000.00	$ 500,000.00
Permitting	1	Each	$100,000.00	$ 100,000.00
Construction Management[4]	1	%	8	$ 200,000.00

Item	Quantity	Unit	Unit Price	Total
Post-Construction Management[6]	12	Month	$10,000.00	$ 120,000.00
Indirect Construction Subtotal[4]			**Sum**	**$ 900,000.00**
Project Subtotal[4]			**Sum**	**$3,400,000.00**
-30% Uncertainty[4]	1	%	30	$ 1,000,000.00
50% Uncertainty[4]	1	%	50	$ 1,700,000.00
Low-End Total Project Estimated Cost[4]			**Total Sum**	**$2,400,000.00**
High-End Total Project Estimated Cost[4]			**Total Sum**	**$5,100,000.00**

Notes:
Costs were determined based upon a combination of publicly available data sets, sediment surface grabs, and topographic, bathymetric, and visual habitat surveys.
Phase 2 containment berm assumes maintenance material from the GIWW is not conducive interior fill and containment berm material and the USACE dredge will mine new work relict material.

1. Cost is based upon mobilizing equipment beyond what is required for dredging the GIWW (e.g., marsh buggies)
2. Value is rounded to the nearest $10,000.
3. Cost includes side casting existing water bottoms (or dredged material) and shaping of the containment berm.
4. Value is rounded to the nearest $100,000.
5. Cost is based on incremental cost of diverting dredging equipment from GIWW to excavation areas.
6. Post-construction management may include Site visits to observe the material consolidation, vegetation, and water levels on the Site. Monthly aerials may be performed. Additional post-construction management practices may be considered during subsequent phases of design.

LF: linear foot
LS: lump sum

Expected Ecosystem Benefits

Creation of the Site is expected to have positive benefits on the regional ecosystem. Green Island, an 80-acre rookery island located in the adjacent Laguna Madre, was used to approximate the ecological benefits for the Site. From 2011 to 2015, Green Island averaged approximately 1,000 breeding pairs of birds per year across three species listed in Table 2 (Audubon 2021b). Adjusting for acreage of rookery island, the Site may be expected to create habitat for approximately 90 breeding pairs for three species of birds per year.

The mean relative sea level rise trend averaged between Corpus Christi and Port Mansfield is 4.61 millimeters per year (NOAA 2022). Assuming no changes in the mean relative sea level rise trend and no erosion, the rookery island within the target elevation of the Site (+4.0 feet NAVD88 or +3.41 feet MSL) would be below MSL by 2248.

The following are different opportunities to restore seagrass habitat potentially lost during construction of this rookery island:

- Dredging of surrounding shallow-water areas during construction may require excavation of some seagrasses (which were observed by DU in shallow-water areas) but could result in more suitable depths for seagrasses, depending on the depth of cut.

- Where excavation areas are cut to a depth beyond that ideal for seagrasses, GIWW maintenance material could be placed to elevations conducive to seagrasses.
- Planting of seagrass could occur in areas of the Upper Laguna Madre, where colonization is probable but presently sparse.

Data and Information Gaps

At this phase of design, the following data and information gaps have been identified:

- Coordination with USACE will be necessary, given that the Site is proposed to harvest material and lies between two DMPAs. USACE staff have indicated that for them to support the Site, it should avoid limiting their future placement of material, either by making it more costly to place material in their DMPAs, decreasing the capacity of their DMPAs, or by creating habitat for sensitive species that could inhibit future placement of material. USACE has also expressed concerns that removal of relict, new work mounds from inside the surrounding DMPAs could allow GIWW maintenance dredged material to more readily transport back into the GIWW and result in more frequent dredging.
- Based on stakeholder feedback, targeting higher interior fill and containment berm elevations to better combat relative sea level rise may be beneficial. This may be evaluated during subsequent design phases.
- Site-specific wind-generated and vessel wake wave modeling would inform the future optimization of Site armor design.
- Geotechnical characteristics of the source material (maintenance and relict new work material) and subgrade of the placement area would refine evaluations of containment structure stability, subgrade and source material settlement, and short- and long-term capacity for dredged material placement.
- Refined survey information, such as property lines, utility locations, and supplemental bathymetry, where appropriate, are needed.
- An extensive seagrass habitat survey would inform the Site design and could be used to shift excavation areas or the Site footprint to reduce impacts to seagrasses. However, given the extensive presence of seagrasses at and surrounding the Site, it is unlikely that the island could be constructed without impacts to seagrasses.

These data gaps may need to be addressed during the progression from 30% design to final design. In the absence of such data, this 30% design assumes an acceptably resilient bird island can be constructed without rock armoring, which has resulted in a lower cost project than if armoring were included. This current project is taking the analyses as far as practicable, considering the constraints of the project scope, budget, and schedule.

Future Work

Of the sites selected for 30% designs in this project, up to seven will subsequently be selected for 60% designs and cost estimates and permit application packages.

The scattered presence of seagrass immediately adjacent to the Site and inside the excavation areas poses a potential fatal flaw. Potential impacts to seagrasses should be further evaluated and clearly communicated to resource agencies and stakeholders in the region. Verbal and written approval confirming understanding of likely habitat impacts and proposed mitigation measures should be received before the Site proceeds toward later design phases.

Should the Site be selected for additional design efforts, it can be expected that some aspects of the design in this memorandum will be modified and, as appropriate, enhanced.

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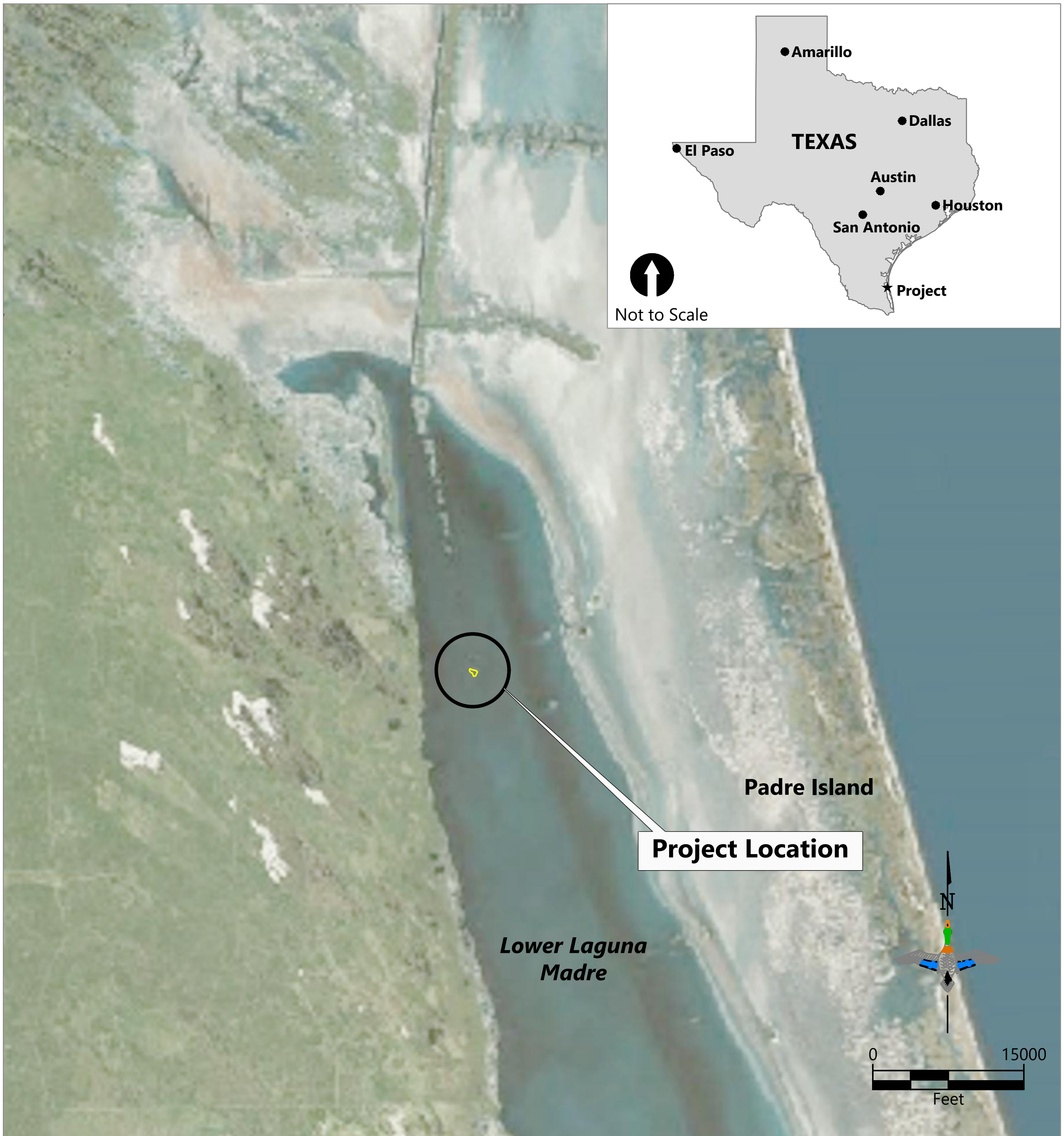
Figures



SOURCE: Aerial provided by Bing Maps.
HORIZONTAL DATUM: Texas State Plane South Zone, North American Datum of 1983, U.S. Survey Feet

Publish Date: 2022/06/09 4:17 PM | User: mpratschner
Filepath: K:\Projects\2018-PCCA Beneficial Use\DMPA 214 BIRD ISLAND\2018 RP-001 VIC DMPA 214 MAP.dwg Figure 1

ANCHOR QEA

Figure 1
Vicinity Map

DMPA #214 Bird Island 30% Design Memorandum
Texas Lower Coast Beneficial Use

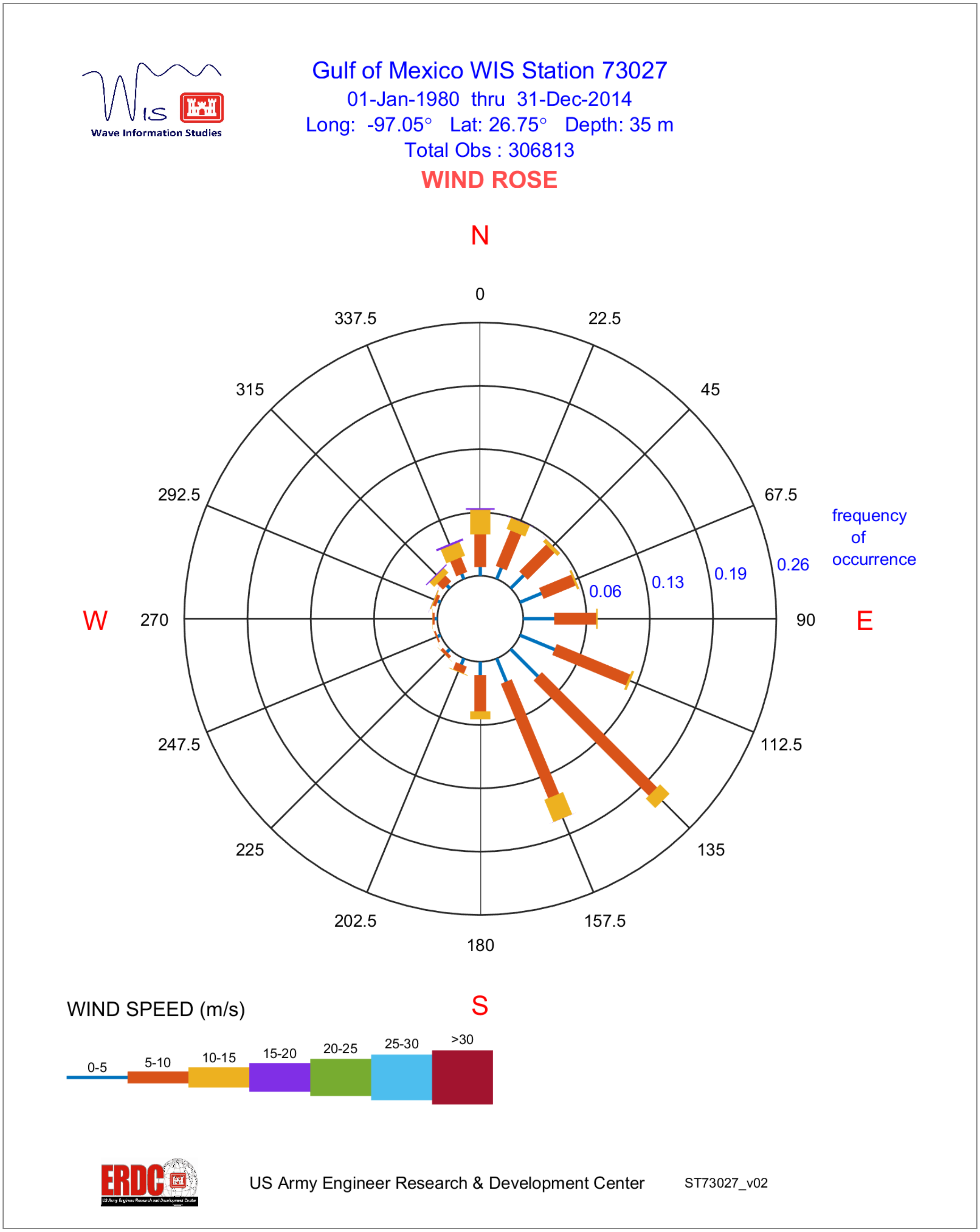


Figure 2
Historical Wind Data for USACE WIS Station 73027

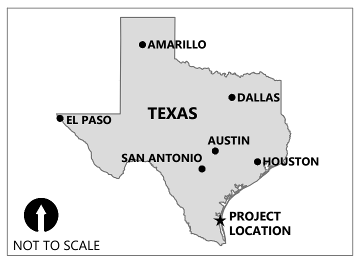
Attachment 1

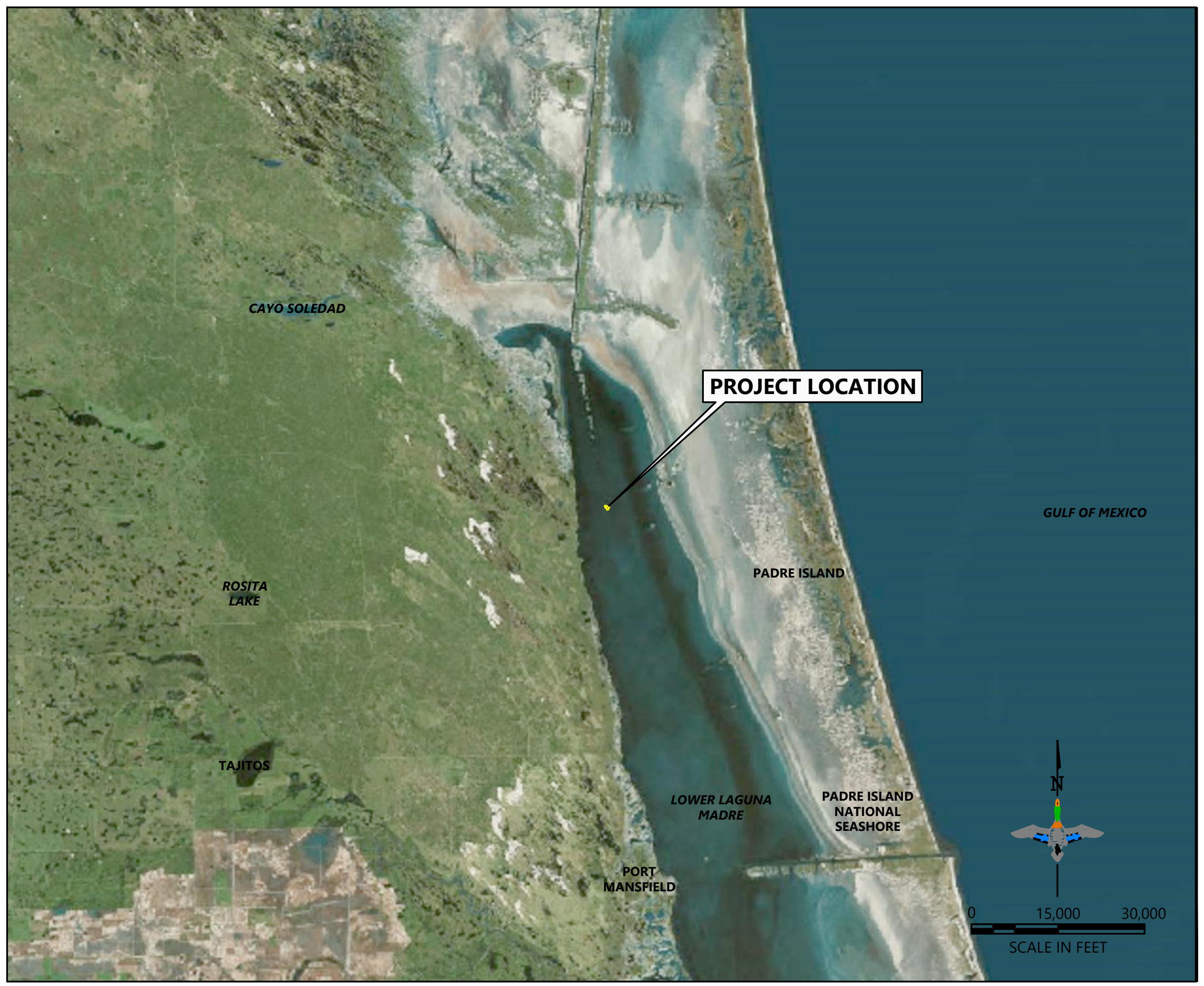
Construction Drawings

30% DESIGN SUBMITTAL

TEXAS LOWER COAST BENEFICIAL USE - DMPA #214 BIRD ISLAND

TEXAS GENERAL LAND OFFICE





AERIAL BY BING MAPS

DRAWING INDEX		
SHEET	DRAWING	TITLE
1	T01	TITLE SHEET
2	C01	SITE OVERVIEW
3	C02	PLAN VIEW
4	C03	TYPICAL CONTAINMENT BERM SECTION

NOTES:

1. HORIZONTAL DATUM: TEXAS STATE PLANE SOUTH ZONE, NAD83, U.S. SURVEY FEET
2. VERTICAL DATUM: NORTH AMERICAN VERTICAL DATUM OF 1988 (NAVD88)
3. BATHYMETRIC, TOPOGRAPHIC, AND VISUAL HABITAT SURVEYS CONDUCTED BY DUCKS UNLIMITED ON MARCH 25, 2022.

PLAN INTENDED TO BE VIEWED IN COLOR. ADJACENT BLOCK IS "BLUE"

ONE INCH

AT FULL SIZE, IF NOT ONE INCH SCALE ACCORDINGLY

DRAFT-NOT FOR CONSTRUCTION

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Jun 28, 2022 4:51pm mpratschner

ANCHOR QEA

TEXAS GENERAL LAND OFFICE ESTABLISHED 1836

DUCKS UNLIMITED

REVISIONS				
REV	DATE	BY	APP'D	DESCRIPTION

DESIGNED BY: H. SMITH
DRAWN BY: M. PRATSCHNER
CHECKED BY: R. ROBERTSON
APPROVED BY: J. LAPLANTE
SCALE: AS NOTED
DATE: JUNE 2022

TEXAS LOWER COAST BENEFICIAL USE - DMPA #214 BIRD ISLAND

TITLE SHEET

T01

SHEET # 1 OF 4

LEGEND:

- PROPOSED CONTAINMENT BERM
- GULF INTRACOASTAL WATERWAY
- U.S. ARMY CORPS OF ENGINEERS OPEN WATER DREDGED MATERIAL PLACEMENT AREA
- APPROXIMATE LOCATION OF VISUALLY SURVEYED SEAGRASS
- —0— EXISTING CONTOUR (5')
- —-3— EXISTING CONTOUR (1')
- EXCAVATION AREA
- PROPOSED CONSTRUCTION ACCESS CHANNEL
- RAILROAD COMMISSION OF TEXAS MAPPED OIL AND GAS INFRASTRUCTURE LOCATIONS
- GRAB SAMPLE LOCATION

N

0 500 1000

SCALE IN FEET

NOTES:

1. HORIZONTAL DATUM: TEXAS STATE PLANE SOUTH ZONE, NAD83, U.S. SURVEY FEET
2. VERTICAL DATUM: NORTH AMERICAN VERTICAL DATUM OF 1988 (NAVD88)
3. BATHYMETRIC, TOPOGRAPHIC, AND VISUAL HABITAT SURVEYS CONDUCTED BY DUCKS UNLIMITED ON MARCH 25, 2022.
4. GRAB SAMPLES PERFORMED BY DUCKS UNLIMITED ON MARCH 25, 2022.

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DATE: JUNE 2022

TEXAS LOWER COAST BENEFICIAL USE - DMPA #214 BIRD ISLAND

SITE OVERVIEW

C01

SHEET # 2 OF 4

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Jun 28, 2022 4:52pm mpratschner

LEGEND:

- PROPOSED CONTAINMENT BERM
- ARMY CORPS OF ENGINEERS OPEN WATER DREDGED MATERIAL PLACEMENT AREA
- APPROXIMATE LOCATION OF VISUALLY SURVEYED SEAGRASS
- —0— EXISTING CONTOUR (5')
- —-3— EXISTING CONTOUR (1')
- EXCAVATION AREA
- GRAB SAMPLE LOCATION

NOTES:

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4. GRAB SAMPLES PERFORMED BY DUCKS UNLIMITED ON MARCH 25, 2022.

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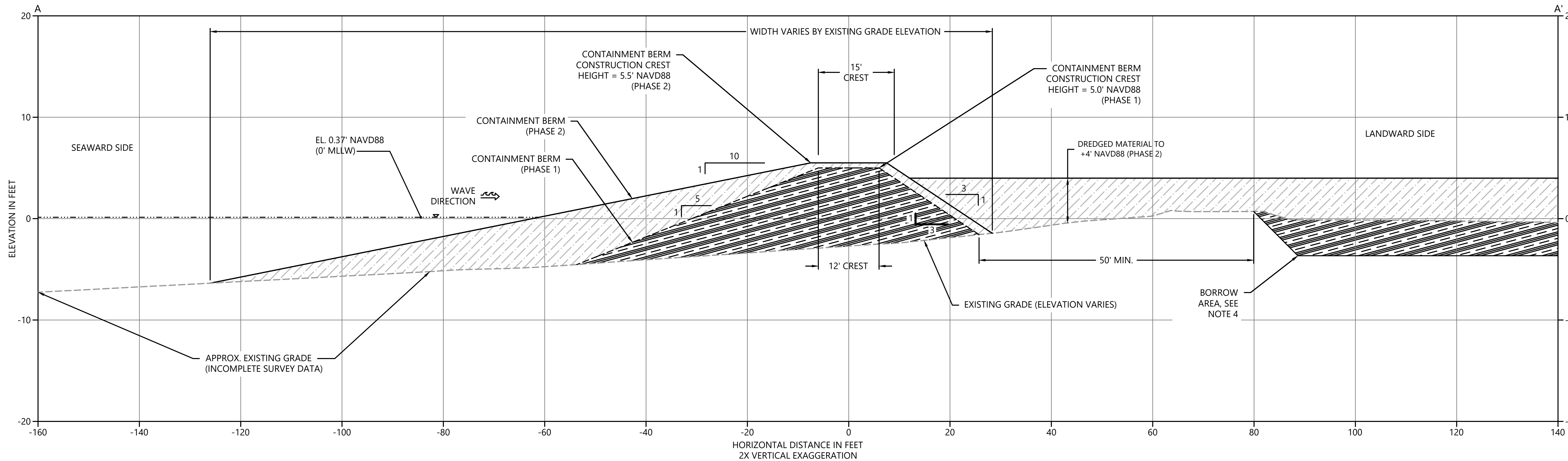
DESIGNED BY: H. SMITH
DRAWN BY: M. PRATSCHNER
CHECKED BY: R. ROBERTSON
APPROVED BY: J. LAPLANTE
SCALE: AS NOTED
DATE: JUNE 2022

TEXAS LOWER COAST BENEFICIAL USE - DMPA #214 BIRD ISLAND

PLAN VIEW

C02

SHEET # 3 OF 4



A | SECTION
C02 | HORIZONTAL SCALE: 1" = 10'
VERTICAL SCALE: 1" = 5'

NOTES:

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2. VERTICAL DATUM: NORTH AMERICAN VERTICAL DATUM OF 1988 (NAVD88)
3. BATHYMETRIC, TOPOGRAPHIC, AND VISUAL HABITAT SURVEYS CONDUCTED BY DUCKS UNLIMITED ON MARCH 25, 2022.
4. BORROW AREA DIMENSIONS SHOWN FOR ILLUSTRATION PURPOSES ONLY. ACTUAL DIMENSIONS TO BE DETERMINED BASED ON FINAL DESIGN AND BY SELECTED CONTRACTOR.

DRAFT-NOT FOR CONSTRUCTION

PLAN INTENDED TO BE VIEWED IN COLOR. ADJACENT BLOCK IS "BLUE"

ONE INCH

AT FULL SIZE, IF NOT ONE INCH SCALE ACCORDINGLY

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DUCKS UNLIMITED

REVISIONS

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TEXAS LOWER COAST BENEFICIAL USE - DMPA #214 BIRD ISLAND

TYPICAL CONTAINMENT BERM SECTION

C03

SHEET # 4 OF 4

Attachment 2

Technical Specification Outline

TABLE OF CONTENTS

Memorandum

June 30, 2022

To: Sarah Garza, Harrison McNeil, and Yvonne Dives-Gomez, Port of Corpus Christi Authority

From: Todd Merendino, Ducks Unlimited, Inc.
John Laplante, Dan Opdyke, Renee Robertson, Alexander Freddo, and Hayden Smith, Anchor QEA, LLC
Jane Sarosdy, Sarosdy Consulting, Inc.

Re: Feeder Berm North of Fish Pass 30% Design Memorandum

Introduction

This 30% design memorandum describes design criteria and assessments associated with a beneficial use of dredged material (BU) project at the proposed Feeder Berm North of Fish Pass site (Site), located in Texas General Land Office (GLO) Planning Region 3 of the Texas coast, in the Gulf of Mexico near Mustang Island, Nueces County, Texas (Figure 1).

Project Background

GLO awarded a Coastal Management Program Project of Special Merit grant (funded through the Gulf of Mexico Energy Security Act) to Ducks Unlimited, Inc. (DU) to coordinate with stakeholders and identify restoration sites for BU. The Port of Corpus Christi Authority (PCCA), a project partner, has also contributed staff and financial resources to expand the project scope. The project team is led by DU and PCCA and includes Anchor QEA, LLC; Sarosdy Consulting, Inc.; and the Texas Department of Transportation. Collectively, the project team coordinated three stakeholder meetings with state and federal resource agencies, nongovernmental organizations, academia, consultants, and local officials in each region to solicit information about potential BU sites. Based on stakeholder input, GLO feedback, publicly available data, and professional judgment, the project team has developed 10% designs for 18 sites in GLO Planning Regions 3 and 4 of the Texas coast and 2 GLO-approved sites in Mesquite Bay and San Antonio Bay in GLO Planning Region 2. After completion of the 10% designs, 11 of the designs were selected to continue to 30% designs, and up to 7 of those designs will be chosen for 60% designs and permit application packages. The project team selected the Site as one of the 20 sites for 10% design development and cost estimation. Based on the Site's restoration potential and construction feasibility, the project team selected the Site to proceed to 30% design and opinion of probable construction costs using funding from PCCA.

Beaches provide economic value to humans, as well as habitat for breeding and foraging wildlife (Marbán 2019). The beaches along the Texas coast, especially Mustang Island, serve as a habitat for threatened and endangered species, including all five species of sea turtles (green sea turtle [*Chelonia mydas*], hawksbill sea turtle [*Eretmochelys imbricata*], Kemp's ridley sea turtle [*Lepidochelys kempii*], leatherback sea turtle [*Dermochelys coriacea*], and loggerhead sea turtle [*Caretta caretta*]), the piping plover (*Charadrius melodus*), and the red knot (*Calidris canutus*) (USFWS 2021; NPS 2022). The stretch of shoreline on Mustang Island from Fish Pass to Port Aransas is in an erosive environment resulting in coastline retreat (BEG 2019). Gulf beach erosion directly reduces available habitat for threatened and endangered sea turtles and avian species.

Fish Pass is a relict channel on Mustang Island located approximately 13 miles south of Port Aransas and approximately 5 miles north of the Packery Channel. Although once a source of hydrologic exchange between the Gulf of Mexico and Corpus Christi Bay, the pass has shoaled over time. Conversations with Deidre Williams of the Conrad Blucher Institute identified an area north of Fish Pass to be an ideal location for a feeder berm (Williams 2021). The proposed berm would nourish eroding beaches over time as a result of natural processes driven by prevailing southeast winds and resulting nearshore currents.

Project Objectives

Frequent dredging is needed to develop and maintain Texas navigation channels. The dredged material is often deposited in dredged material placement areas (DMPAs), and many of the existing DMPAs along the Texas coast are nearing capacity. Resource agencies and stakeholders have long advocated using dredged material beneficially to create and restore wetlands and bird islands, nourish beaches, and counteract land loss. Historically, BU projects are difficult to manage because they are multiyear, multifaceted undertakings in which different organizations manage dredging schedules, funding, project design, permitting, and construction activities. To help address these issues, the objectives of this project include the following:

- Create and restore degrading coastal habitats.
- Establish sites for disposal of dredged material to reduce reliance on existing DMPAs.
- Improve coastal resiliency of the natural and built environment.

To accomplish these objectives, the project includes the following tasks:

- Stakeholder outreach and coordination
- Identification and selection of BU sites
- 10% designs and cost estimates for 20 BU sites
- 30% designs for 11 BU sites
- 60% designs, cost estimates, and permit application packages for up to seven BU sites

This memorandum documents the 30% design and cost estimate for the Site.

Design Objectives

The Site will be designed to beneficially use dredged material of suitable beach quality to create a feeder berm in a region with coastal and beach erosion. Suitable beach-quality material may be available from navigation channels during routine maintenance or new work dredging associated with future PCCA projects, thus reducing the volume of such material placed in existing open-bay or upland DMPAs. This 30% design is based upon publicly available datasets, as well as focused field work conducted by T. Baker Smith.

Design objectives include the following:

- Develop a preliminary vision based on available data for the Site that includes the following:
  - Beach to be nourished
  - Potential sediment source(s)
- Delineate conceptual footprints for proposed BU placement.
- Identify key sensitive habitats and construction considerations in the vicinity of the Site.
- Estimate fill volumes for the proposed BU footprints.
- Identify data gaps to be addressed in subsequent design phases.
- Provide preliminary cost estimates.

Existing Data Review

A review of existing data and the focused data collected by T. Baker Smith and other existing data was performed to develop the Site. This section describes the data reviewed and collected for the 30% design.

Horizontal and Vertical Datums

The horizontal datum used for the Site is the Texas State Plane South Zone, North American Datum of 1983 in U.S. survey feet. The primary vertical datum used for the Site design is the North American Vertical Datum of 1988 (NAVD88). The National Oceanic and Atmospheric Administration (NOAA) maintains an active tide gauge within the vicinity of the Site. The NOAA Bob Hall Pier Station 8775870 (Bob Hall Pier Station) is approximately 8 miles southwest of the proposed feeder berm. This station collects and records real-time tide information dating back to 1983. The vertical datums from this station that will be used for the Site are shown in Table 1.

Table 1
Bob Hall Pier Station Tidal Gauge Displaying NAVD88 Tidal Datums

Tidal Datums	Elevation (feet NAVD88)	Elevation (feet MLLW)
MHHW	1.13	1.63
MHW	1.04	1.54
MSL	0.43	0.93
MLW	-0.28	0.22
MLLW	-0.50	0

Notes:
MHHW: mean higher high water
MHW: mean high water
MLLW: mean lower low water
MLW: mean low water
MSL: mean sea level

Meteorological, Ocean, Wave, Depth of Closure, and Longshore Transport Data

Wind and Waves

The U.S. Army Corps of Engineers (USACE) Wave Information Studies (WIS) provides a national resource of long-term wavefield climatologies for U.S. coastal waters that synthesizes observations, multidecade hindcasts, and storm event archives (USACE 2021). The WIS station closest to the Site is Station 73039, located just offshore on the Gulf side of Mustang Island in the Gulf of Mexico. Data from this station was analyzed to determine different design wave heights.

The project team considers the wind and wave data to be representative of the wind and wave climatologies experienced at the Site for this phase of design. Figures 2 and 3 summarize the wind and wave data, respectively, for January 1, 1980, through December 31, 2014. The data indicate the predominant wind direction is from the southeast, with significant winds also coming from the north, northeast, east, and south. Table 2 displays relevant summary statistics of the WIS Station 73039 wave data.

Table 2
WIS Station 73039 Wave Data from 1980 to 2014

Percent Rank	Wave Height[1] (feet NAVD88)	Wave Period[2] (seconds)
90th	5.64	7.63
75th	4.26	6.93
50th	3.05	5.73

Notes:
Data was extracted from the 45° to 180° direction (degrees clockwise from true north).
1. Significant wave height: average wave height of highest one-third of the waves
2. Peak spectral wave period discrete spectral band

Wake Erosion

There are no existing navigation channels in the proximity of the Site. There may be some erosion due to recreational vessels; however, the project team does not anticipate that wake erosion from passing vessels will negatively affect this project, as the berm is being designed to erode.

Bathymetry

On March 14, 2022, T. Baker Smith conducted a bathymetric survey of the Site (Attachment 1, C01). The water depth at the Site varies from -10 to -15 feet NAVD88, with a slope between 100 horizontal to 1 vertical (100H:1V) to 150H:1V.

Depth of Closure

The depth of closure represents the water depth below which sediment transport due to waves is negligible. Nearshore berms placed at depths greater than the depth of closure would remain stable and would not erode nor provide sediment into the nearshore littoral transport system. Stakeholders provided feedback that a feeder berm placed at elevations below approximately -10 to -15 feet mean sea level (MSL; 10 to 15 feet deep measuring from MSL to the seabed) would likely provide little to no benefit to the beach (Williams 2022). To compare the stakeholder guidance for appropriate elevations for berm placement with an approximated depth of closure, the Hands and Allison (1991) analytical method for predicting active (feeder) berms versus stable berms was used. Table 3 shows the results of this analysis. A frequency distribution analysis of the wave data from WIS Station 73039 was conducted, and results of that analysis informed the wave conditions used in the depth of closure analysis. The Hands and Allison (1991) method identifies critical values for 75th- and 95th-percentile maximum nearbed horizontal wave orbital velocities, above which sand berms would be within the depth of closure and expected to erode into the littoral system. The 75th- and 95th- percentile limits are 40 and 70 centimeters per second (cm/sec), respectively. For all water depths ranging from 10 feet to 20 feet, the 75th- percentile maximum nearbed horizontal wave orbital velocity is well above the 40 cm/sec target identified in Hands and Allison (1991). At 15 feet of water depth, the 90th- percentile maximum nearbed horizontal orbital velocity is equal to the 70-cm/sec limit. If the water depth is measured from the MSL datum, the method indicates the depth of closure would coincide with the -15-foot-MSL contour. This analysis supports the stakeholder feedback that, beyond the -15-foot-MSL contour, it is expected that the nearshore berm would remain stable and not feed adjacent beaches. For this reason, the feeder berm will be placed within the -15-foot-MSL contour to provide benefit to adjacent beaches.

Table 3
Maximum Nearbed Horizontal Wave Orbital Velocities

Water Depth[1] (feet)	Water Depth[1] (meters)	75th-Percentile Velocity[2] (cm/sec)	90th-Percentile Velocity[2] (cm/sec)
10	3.05	**61.7**	77.6
11	3.35	**60.1**	75.9
12	3.66	**58.7**	74.3
13	3.96	**57.4**	72.8
14	4.27	**56.1**	71.3
15	4.57	**54.9**	70.0
16	4.88	**53.7**	68.7
17	5.18	**52.6**	67.4
18	5.49	**51.5**	66.2
19	5.79	**50.4**	65.0
20	6.10	**49.5**	63.9

Notes:
Bold values are above the threshold identified by Hands and Allison (1991) and are expected to erode a sand berm.
1. Water depths were measured from MSL to the seabed.
2. Deepwater waves used for analysis are the 75th- and 95th-percentile wave heights and periods from Table 2.

Longshore Transport

Near the Site, longshore (i.e., parallel to the beach) currents occur in the northward and southward direction variously throughout the year. These currents are driven primarily by the direction of the prevailing winds, and it is suspected that hydrographic features of the inshore shelf waters interact with the winds to determine the longshore current direction (Whilden 2015; McFarland 1961).

A modeling study by HR Wallingford was developed to analyze transport within GLO Region 4 of the Texas coast (HR Wallingford 2021). Although the model was built for GLO Region 4, some of the output is relevant to the location of the Site and was used to develop the preliminary design. The model describes the littoral transport in the longshore direction (and suggests there would be residual sediment transport, mostly occurring northward during the summer months and mostly southward during the winter). The model also predicts that the net annual residual sediment transport would be to the north (HR Wallingford 2021). Because the Site is located in GLO Region 3, the model may not be optimized for our region of interest. A further modeling study by HR Wallingford for GLO Region 3 is planned and may provide information regarding longshore transport at the Site.

Based on existing studies and data, this area of the coast is expected to have longshore currents moving either north or south throughout the year, depending on the prevailing wind direction. This means sediment from the feeder berm could be transported either north or south as the berm erodes. Understanding this transport is critical to understanding the areas of the beach that would be receiving material eroded from the berm. This is especially important to the Site due to the possibility of negative impacts to recreational activities should sediment be transported to the jetties 1 mile southwest of the Site.

Utilities

The Railroad Commission of Texas public GIS viewer (RRC 2021) and GLO pipeline data (GLO 2021a) were used to identify mapped utilities and pipelines near the Site. One pipeline was found: a natural gas offshore gathering pipeline operated by TR Offshore, LLC, located approximately 2.2 miles east of Fish Pass (Attachment 1, C01). It is not anticipated that this pipeline will affect the design or constructability of the Site. The need for Site-specific utility locations prior to construction will be determined during subsequent design phases.

Desktop Cultural Resources Survey

A search of cultural resources records in the Texas Historical Commission Texas Historical Sites Atlas Database (THC 2021) was completed on December 29, 2021. This search revealed that no cultural resources surveys have been conducted, and no cultural resources sites have been identified within the Site.

Sensitive Habitat

GLO oyster habitat GIS data (GLO 2021b) indicates there is no oyster habitat located within or adjacent to the Site. According to Texas Parks and Wildlife Department seagrass data (TPWD 2021), there are no seagrasses mapped within or adjacent to the Site. However, surveys may need to be conducted during a subsequent phase of design to evaluate the presence and extent of sensitive habitat.

Erosion

According to the Bureau of Economic Geology at the University of Texas at Austin, coastal erosion between Fish Pass and the Port Aransas jetties varies from 0 to 3.35 feet per year (BEG 2019). This erosion is believed to be the result of a combination of coastal storms and wind-wave action from the Gulf of Mexico.

Beneficial Use Source Material

One potential source of dredged material is the Corpus Christi Entrance Channel, located 13 miles north of the Site. PCCA has proposed to deepen and extend the Entrance Channel, resulting in the dredging of 29.2 million cubic yards (CY) of sand from new work and maintenance over a 10-year period. PCCA is proposing to place the material at a combination of previously authorized facilities, as well as several proposed BU sites. The BU sites include multiple feeder berms north of the proposed Site.

The Site is also 11 miles from the Corpus Christi Ocean Dredged Material Disposal Sites (ODMDSs). These ODMDSs are approved locations for offshore placement of dredged material. If the ODMDSs currently contain suitable material, they could be used as a secondary source for mining dredged material and transporting it to the Site via scows for placement.

30% Design

Feeder berms are nearshore berms typically placed as an elongate bar or a mound within the depth of closure of a shoreline to nourish adjacent beaches with sediment. They can be the preferred BU method due to less-strict grain size requirements (with a goal for sands to erode into the littoral zone to nourish beaches, while fines are dispersed offshore), as well as generally being less costly to build, easier to construct, and having less environmental impact to beach nesting than direct beach placement (Brutsché et al. 2019). Along with the benefits, dredged material placement within a feeder berm may have potential unintended impacts. Some of the unintended impacts may include the following:

- Uneven distribution of material along the beach
- Uneven eroding of the berm, leading to wave focusing due to refraction
- Transport of dredged material in the longshore direction, which could place sediment in an adjacent area.

For these reasons, it is important to have a detailed understanding of the wind, wave, and hydrodynamic conditions for the Site.

The main design elements evaluated for the Site are as follows:

- Site location
- Size and shape
- Constructability
- Performance expectations
- Site construction cost estimates
- Expected ecosystem benefits
- Data and information gaps

These design elements are evaluated in this memorandum for the 30% Site design.

Site Location

Location, haul distance, and longshore extent of area to be nourished are all critical components to determining the location of a feeder berm (McLellan et al. 1990). The location of the Site is approximately 1.0 mile northeast of Fish Pass and is not expected to interfere with feeder berms proposed for the area north of the Site. The Site is also 13 miles from the Corpus Christi Ship Channel (CCSC) and 11 miles from the ODMDSs potential dredged material borrow sources.

Based on stakeholder feedback and depth of closure analysis (elevation of depth of closure at approximately -15 feet NAVD88), the proposed feeder berm site is in an area with average elevations ranging from -10 to -15 feet NAVD88. Deeper water provides easier access for construction equipment than does shallow water, but it also requires more dredged material to build to the target elevation.

The adjacent longshore area that is in an erosional environment extends from north of Fish Pass to the Port Aransas Jetties (12 miles northeast of the Site; BEG 2019). This entire area could conceivably benefit from sediment being transported to the beaches from the Site. Further analysis of sediment transport of material from the Site will need to be evaluated, and the location of the Site may need to be refined to prevent negatively impacting recreational surfing activity near the eastern jetty of Fish Pass (approximately 1 mile southwest of the Site) or other recreational areas reliant upon consistent wave action.

Size and Shape

Based on the availability of sediment, a cost analysis, and stakeholder feedback, the project team proposes that the area of the Site be 75 acres. This 30% design is a simplified version of the feeder berms proposed by PCCA as part of the CCSC Channel Improvement Project. The design may change due to further engineering analysis by the project team. Upper design crest elevation for the berm will be dependent on the draft of the hopper dredge or barges used to place the dredged material. For this preliminary design, an elevation of -8 feet NAVD88 was selected. The Site would be rectangular in shape and oriented parallel to the shore (Attachment 1, C02). The linear shape of the Site is ideal for promoting even erosion of the berm.

To avoid wave focusing by refraction, the berm length should be at least 2.5 times the average wavelength (McLellan et al. 1990). The average wavelength at the Site is 114 feet at the seaward toe of the Site (based on the 50th-percentile wave from WIS Station 73039), which means the minimum berm length should be 285 feet. The proposed berm length, 5,000 feet, exceeds the minimum identified length for avoiding wave focusing.

A preliminary crest width for the berm of 450 feet was selected. It is generally true that wider berms will cause more wave steepening, and this berm crest width may be refined during subsequent design phases to either increase or decrease the level of wave steepening over the berm. The side slopes are expected to naturally form at slope ranging from 16H:1V to 100H:1V, depending on the grain size and sediment density of the placed material (McLellan et al. 1990). For preliminary volume analysis, a slope of 24H:1V was selected. Table 4 summarizes the key berm design characteristics.

Fill material could be obtained from the CCSC Entrance Channel or either of the ODMDSs. It is predicted that the required fill volume will be approximately 500,000 CY.

Table 4
Berm Design Characteristics

Design Criteria	Berm
Length	5,000 feet
Total acreage	75 acres
Crest width	450 feet
Base width	650 feet
Assumed bottom elevation	-10 to -15 feet NAVD88
Total structure height	3.9 feet
Materials	Mostly sand
Volume	500,000 CY
Side slopes	24H:1V
Maximum design crest elevation	-8.0 feet NAVD88

Constructability

The final construction would be based on the selected means and methods and selected equipment from the contractor; however, construction could potentially be conducted by either mechanically placing the material into barges for transport or hydraulically dredging with a hopper dredge. The material would then be placed at the site from the hopper dredge or barge. In addition, the contractor may provide alternate construction methods from those described in this section.

Performance Expectations

It is expected that dredged material placed within the depth of closure will erode into the nearshore littoral transport system and will not remain a stable feature. The expectation is that this material will be moved in the cross-shore and longshore directions, thus providing material to adjacent shorelines. During the erosion process, the feeder berm will alter wave conditions for the portion of the beach within the vicinity of the feeder berm. This process will also result in fines migrating offshore, while sands will migrate into the nearshore littoral transport system.

Site Construction Cost Estimates

Construction costs were estimated for the design outlined in the previous sections. The estimated costs include permitting, 100% design, engineering costs for advancing the design to the construction phase, pre-construction and as-built surveys, mobilization, materials, and construction of the feeder berm. These costs represent the estimated incremental costs; i.e., those costs over and above USACE's least-costly and environmentally acceptable dredged material and disposal alternative. Table 5 shows a line-item list of each costing parameter and the total cost estimated for construction.

The costs range from $2.7 million to $5.9 million, depending on the level of contingency allocated to the project cost. The lower bound of uncertainty (-30%) and upper bound of uncertainty (+50%) were selected due to the existing data gaps, high levels of inflation, and rising fuel costs. The estimates are developed using current and generally accepted engineering cost estimating methods and are based on assumptions concerning future events. Actual costs may be affected by known and unknown risks including, but not limited to, changes in general economic business conditions, Site conditions that were unknown at the time the estimates were performed, future changes in Site conditions, regulatory or enforcement policy changes, and delays in performance. Actual costs may vary from these estimates.

Table 5
Opinion of Probable Construction Cost to 100% Project Completion

Item	Quantity	Unit	Unit Price	Total
Direct Construction Costs				
Incremental Mobilization and Demobilization[1,2]	1	%	10	$ 280,000.00
Preconstruction Survey	1	LS	$ 30,000.00	$ 30,000.00
Dredged Material Transport[1,3,4]	161	Trips	$ 17,000.00	$ 2,700,000.00
As-Built Survey/Aerials	1	LS	$ 40,000.00	$ 40,000.00
Subtotal[4]			**Sum**	**$3,100,000.00**
Direct Construction Total[4]			**Sum**	**$3,100,000.00**
Indirect Construction Costs				
100% Engineering and Design[4]	1	%	LS	$ 300,000.00
Permitting[4]	1	Each	$100,000.00	$ 100,000.00
Construction Management[4]	1	%	6	$ 200,000.00
Indirect Construction Subtotal			**Sum**	$ 600,000.00
Project Subtotal[2]			**Sum**	$ 3,700,000.00
-30% Uncertainty[4]	1	%	30	$ 1,100,000.00
+50% Uncertainty[4]	1	%	50	$ 1,900,000.00
Low-End Total Project Estimated Cost[4]			**Total Sum**	**$2,600,000.00**
High-End Total Project Estimated Cost[4]			**Total Sum**	**$5,600,000.00**

Notes:
Costs were determined based upon a combination of publicly available datasets and sediment surface grabs, and topographic, bathymetric, and visual habitat surveys.

1. The estimate assumes dredge material will be transported via 3,000 CY capacity scows and placed mechanically.
2. Value is rounded to the nearest $10,000.
3. The estimate assumes one trip a day.
4. Value is rounded to the nearest $100,000.

LS: lump sum

Expected Ecosystem Benefits

The creation of the Site is expected to have positive benefits on the local ecosystem. The beach nourishment combats erosion to the natural beach system along Mustang Island. This beach provides foraging, nesting, and breeding ground to federally protected species like the piping plover, red knot, and all five species of sea turtles.

Data and Information Gaps

Due to the potential unintended impacts of feeder berms (e.g., uneven eroding of berms, causing focused waves, and sediment transporting in the longshore direction, affecting recreation), a better understanding of the important elements that influence the behavior of a feeder berm is necessary prior to final design. To achieve this understanding, the following data and information gaps have been identified:

- Coupled hydrodynamic and wave model analysis
- Evaluation of the feeder berm’s impact to adjacent beach profiles
- Evaluation of beach cross-shore morphology
- Evaluation of longshore sediment transport
- Geotechnical characteristics of the source material (maintenance and new work material)

These data gaps may need to be addressed during the progression from 30% design to final design. This current project is taking the analyses as far as practicable, considering the constraints of the project scope, budget, and schedule.

Future Work

Of the sites selected for 30% designs in this project, up to seven will be selected for 60% designs, cost estimates, and permit packages. No fatal flaw has been identified at this phase of the design; however, there are several important data and information gaps that will need to be filled prior to final design. Should the Site be selected for additional design efforts, it can be expected that some aspects of the design in this memorandum will be modified and, as appropriate, enhanced.

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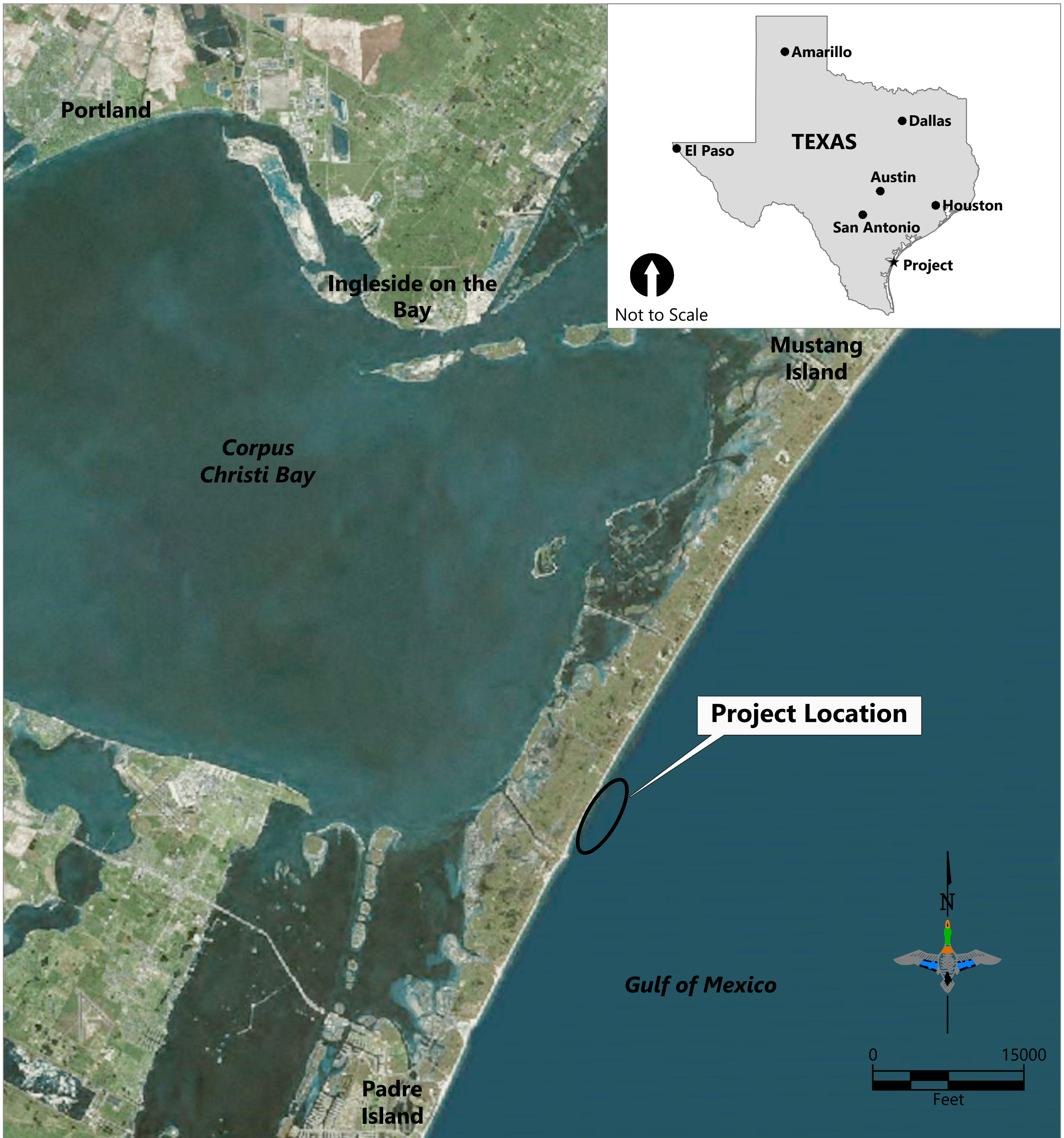
Figures



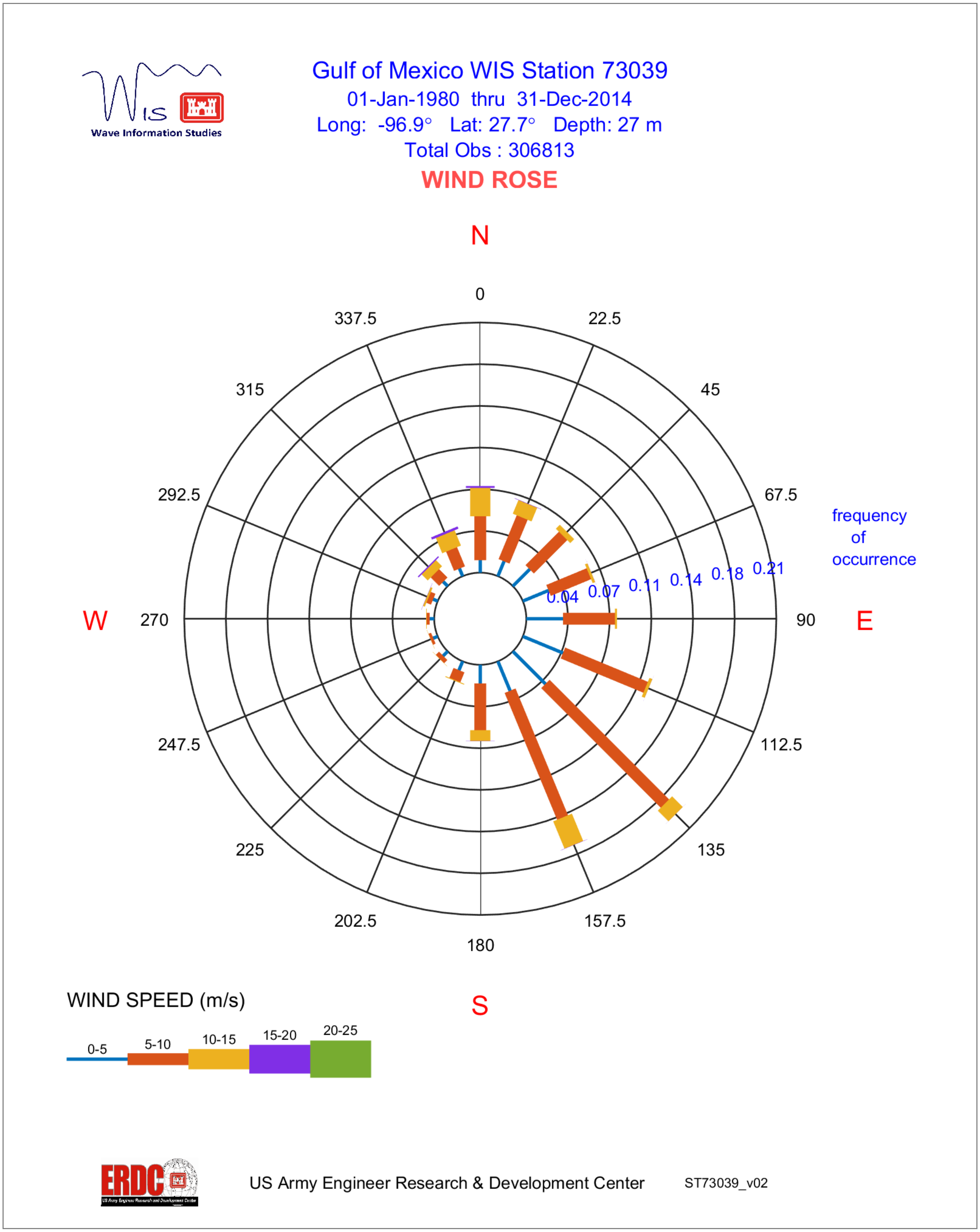
SOURCE: Aerial provided by Bing Maps.
HORIZONTAL DATUM: Texas State Plane South Zone, North American Datum of 1983, U.S. Survey Feet

Publish Date: 2022/06/09 4:44 PM | User: mpratschner
Filepath: K:\Projects\2018-PCCA Beneficial Use\FISH PASS\2018 RP-001 VIC MAP FBNFP.dwg Figure 1

ANCHOR QEA

Figure 1
Vicinity Map

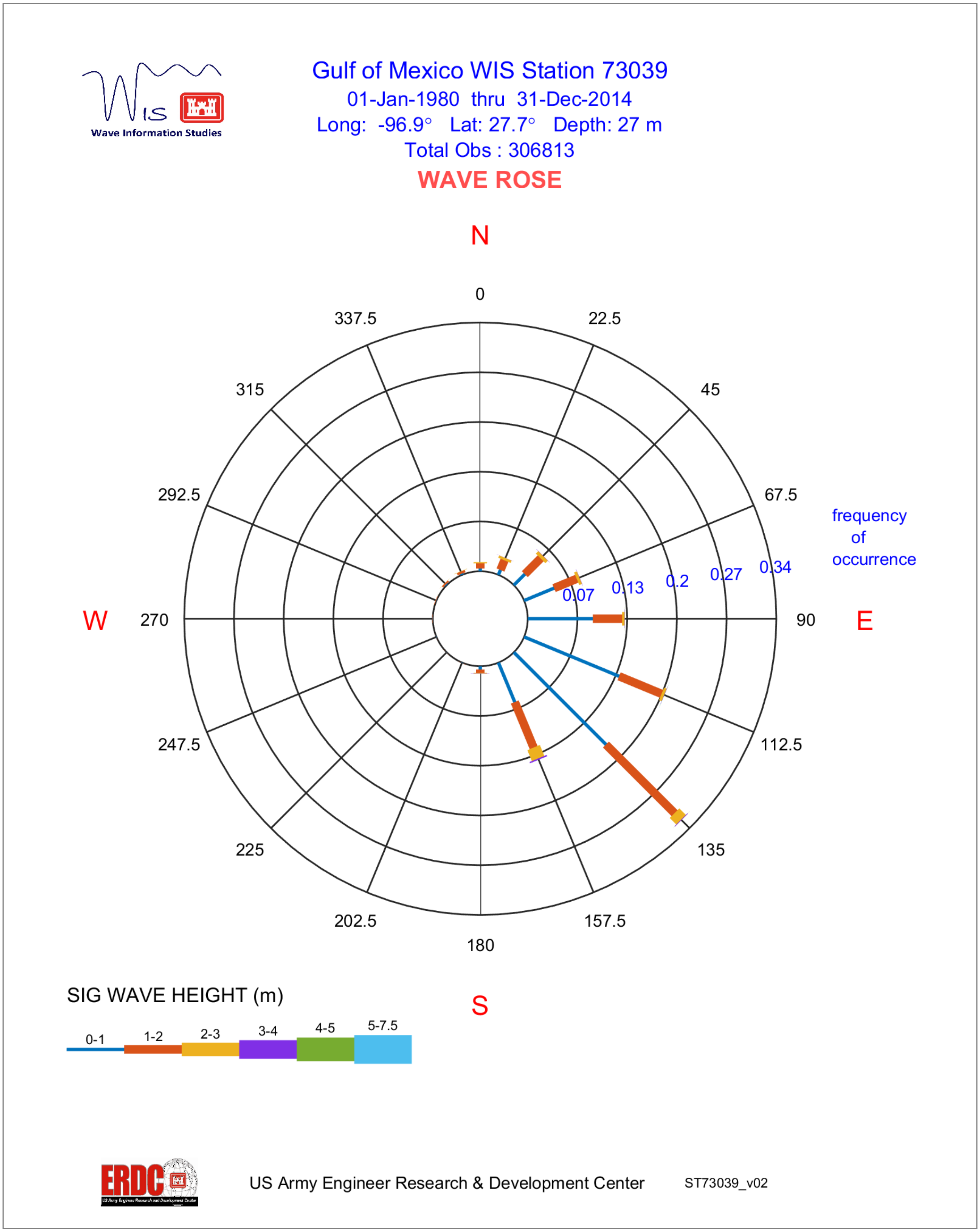
Feeder Berm North of Fish Pass 30% Design Memorandum
Texas Lower Coast Beneficial Use



Filepath: \\Fuji\Austin\D_drive\Projects\GLO\BU Lower Coast\Design\30% Designs\Feeder Berm North of Fish Pass\Figures\Figure 2.docx

ANCHOR QEA

Figure 2
Historical Wind Data for USACE WIS Station 73039
Feeder Berm North of Fish Pass 30% Design Memorandum
Texas Lower Coast Beneficial Use



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ANCHOR QEA

Figure 3
Historical Wave Data for USACE WIS Station 73039
Feeder Berm North of Fish Pass 30% Design Memorandum
Texas Lower Coast Beneficial Use

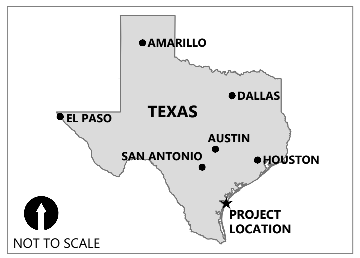
Attachment 1

Construction Drawings

30% DESIGN SUBMITTAL

TEXAS LOWER COAST BENEFICIAL USE - FEEDER BERM NORTH OF FISH PASS

PORT OF CORPUS CHRISTI AUTHORITY



AERIAL BY BING MAPS

DRAWING INDEX		
SHEET	DRAWING	TITLE
1	T01	TITLE SHEET
2	C01	PLAN VIEW
3	C02	TYPICAL BERM CROSS SECTION

NOTES:

1. HORIZONTAL DATUM: TEXAS STATE PLANE SOUTH ZONE, NAD83, U.S. SURVEY FEET
2. VERTICAL DATUM: NORTH AMERICAN VERTICAL DATUM OF 1988 (NAVD88)
3. BATHYMETRIC SURVEY CONDUCTED BY T. BAKER SMITH ON MARCH 14, 2022.

PLAN INTENDED TO BE VIEWED IN COLOR, ADJACENT BLOCK IS "BLUE"

ONE INCH

AT FULL SIZE, IF NOT ONE INCH SCALE ACCORDINGLY

DRAFT-NOT FOR CONSTRUCTION

K:\Projects\2018-PCCA Beneficial Use\FISH PASS\Construction Plans\2018 PL-001 TITLE_FP.dwg T01

Jun 22, 2022 3:17pm mpratschner

ANCHOR QEA

TEXAS GENERAL LAND OFFICE ESTABLISHED 1836

PORT CORPUS CHRISTI

REVISIONS				
REV	DATE	BY	APP'D	DESCRIPTION

DESIGNED BY: A. FREDDO
DRAWN BY: M. PRATSCHNER
CHECKED BY: R. ROBERTSON
APPROVED BY: J. LAPLANTE
SCALE: AS NOTED
DATE: JUNE 2022

TEXAS LOWER COAST BENEFICIAL USE - FEEDER BERM NORTH OF FISH PASS

TITLE SHEET

T01

SHEET # 1 OF 3

LEGEND:

- PROPOSED FEEDER BERM
- —0— EXISTING CONTOUR (5')
- —3— EXISTING CONTOUR (1')
- — · — GLO MAPPED PIPELINES
- ⊙ RAILROAD COMMISSION OF TEXAS MAPPED OIL AND GAS INFRASTRUCTURE LOCATIONS

NORTH

0 600 1200

SCALE IN FEET

NOTES:

1. HORIZONTAL DATUM: TEXAS STATE PLANE SOUTH ZONE, NAD83, U.S. SURVEY FEET
2. VERTICAL DATUM: NORTH AMERICAN VERTICAL DATUM OF 1988 (NAVD88)
3. BATHYMETRIC SURVEY CONDUCTED BY T. BAKER SMITH ON MARCH 14, 2022.

PLAN INTENDED TO BE VIEWED IN COLOR. ADJACENT BLOCK IS "BLUE"

ONE INCH

AT FULL SIZE, IF NOT ONE INCH SCALE ACCORDINGLY

DRAFT-NOT FOR CONSTRUCTION

K:\Projects\2018-PCCA Beneficial Use\FISH PASS\Construction Plans\2018 PL-002 FEEDER BERM_FP.dwg C01

Jun 22, 2022 3:17pm mpratschner

ANCHOR QEA

TEXAS GENERAL LAND OFFICE ESTABLISHED 1836

PORT CORPUS CHRISTI

REVISIONS

REV	DATE	BY	APP'D	DESCRIPTION

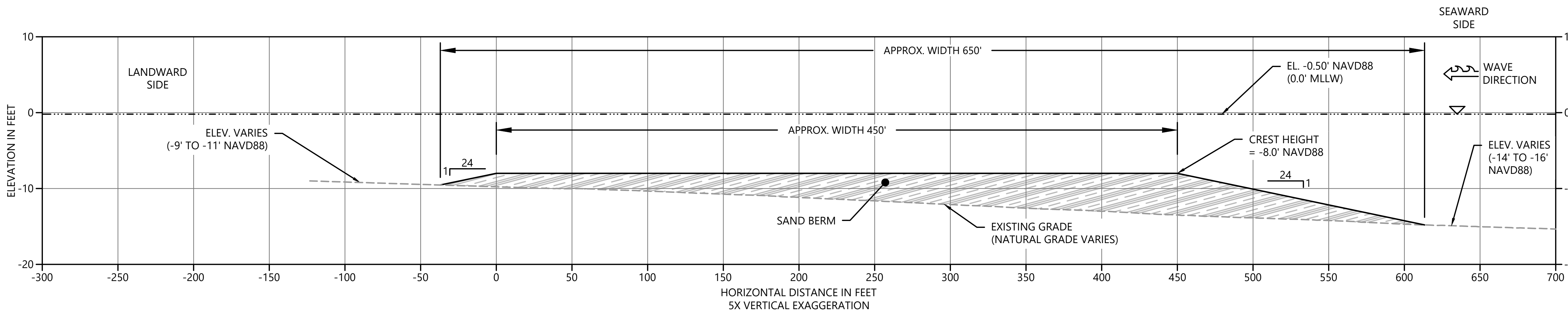
DESIGNED BY: A. FREDDO
DRAWN BY: M. PRATSCHNER
CHECKED BY: R. ROBERTSON
APPROVED BY: J. LAPLANTE
SCALE: AS NOTED
DATE: JUNE 2022

TEXAS LOWER COAST BENEFICIAL USE - FEEDER BERM NORTH OF FISH PASS

PLAN VIEW

C01

SHEET # 2 OF 3



A / C01 SECTION
HORIZONTAL SCALE: 1" = 40'
VERTICAL SCALE: 1" = 8'

NOTES:

1. HORIZONTAL DATUM: TEXAS STATE PLANE SOUTH ZONE, NAD83, U.S. SURVEY FEET
2. VERTICAL DATUM: NORTH AMERICAN VERTICAL DATUM OF 1988 (NAVD88)
3. BATHYMETRIC SURVEY CONDUCTED BY T. BAKER SMITH ON MARCH 10, 2022.

PLAN INTENDED TO BE VIEWED IN COLOR. ADJACENT BLOCK IS "BLUE"

ONE INCH
AT FULL SIZE, IF NOT ONE INCH SCALE ACCORDINGLY

DRAFT-NOT FOR CONSTRUCTION

K:\Projects\2018-PCCA Beneficial Use\FISH PASS\Construction Plans\2018 PL-002 FEEDER BERM_FP.dwg C02
Jun 22, 2022 3:17pm mpratschner

ANCHOR QEA
PORT CORPUS CHRISTI

REVISIONS

REV	DATE	BY	APP'D	DESCRIPTION

DESIGNED BY: A. FREDDO
DRAWN BY: M. PRATSCHNER
CHECKED BY: R. ROBERTSON
APPROVED BY: J. LAPLANTE
SCALE: AS NOTED
DATE: JUNE 2022

TEXAS LOWER COAST BENEFICIAL USE - FEEDER BERM NORTH OF FISH PASS

TYPICAL BERM CROSS SECTION

C02

Attachment 2
Technical Specification Outline

TABLE OF CONTENTS

Memorandum

June 30, 2022

To: Melissa McCutcheon, Texas General Land Office

From: Todd Merendino, Ducks Unlimited, Inc.
Sarah Garza, Harrison McNeil, and Yvonne Dives-Gomez, Port of Corpus Christi Authority
John Laplante, Dan Opdyke, Renee Robertson, Alexander Freddo, and Hayden Smith, Anchor QEA, LLC
Jane Sarosdy, Sarosdy Consulting, Inc.

Re: Little Bird Island North 30% Design Memorandum

Introduction

This 30% design memorandum describes design criteria and assessments associated with a beneficial use of dredged material (BU) project at the proposed Little Bird Island North site (Site), located in Texas General Land Office (GLO) Planning Region 2 of the Texas coast in San Antonio Bay in Calhoun County, Texas (Figure 1).

Project Background

GLO awarded a Coastal Management Program Project of Special Merit grant (funded through the Gulf of Mexico Energy Security Act) to Ducks Unlimited, Inc. (DU) to coordinate with stakeholders and identify restoration sites for BU The Port of Corpus Christi Authority (PCCA), a project partner, has also contributed staff and financial resources to expand the project scope. The project team is led by DU and PCCA and includes Anchor QEA, LLC; Sarosdy Consulting, Inc.; and the Texas Department of Transportation. Collectively, the project team coordinated three stakeholder meetings with state and federal resource agencies, nongovernmental organizations, academia, consultants, and local officials in each region to solicit information about potential BU sites. Based on stakeholder input, GLO feedback, publicly available data, and professional judgment, the project team has developed 10% designs for 18 sites in GLO Planning Regions 3 and 4 of the Texas coast and 2 GLO-approved sites in Mesquite Bay and San Antonio Bay in GLO Planning Region 2. After completion of the 10% designs, 11 of the designs were selected to continue to 30% designs, and up to 7 of those designs will be chosen for 60% designs and permit application packages. The project team selected the Site as one of the 20 sites for 10% design development and cost estimation. Based on the Site's restoration potential and construction feasibility, the project team selected the Site to proceed to

30% design and opinion of probable construction costs using funding from the GLO Coastal Management Program Project of Special Merit grant.

Conservationists have identified San Antonio Bay as an important location for creating and restoring bird habitat (CBBEP 2020; Hardegree 2014). Little Bird Island is a small island located on state-owned submerged land approximately 0.25 mile south of the Gulf Intercoastal Waterway (GIWW) in San Antonio Bay in Calhoun County, Texas. However, the existing Little Bird Island is surrounded by oyster habitat and has limited natural protection from wave energy, making it an unfavorable location for restoration; therefore, the project team identified a different area for a new bird island nearby but to the north of the GIWW (Little Bird Island North). This area was selected because of its proximity to a sediment source in the GIWW and to potential bird foraging areas, as well as its distance from upland-based predators and lack of immediately adjacent oyster habitat.

Project Objectives

Frequent dredging is needed to develop and maintain Texas navigation channels. The dredged material is often deposited in dredged material placement areas (DMPAs). While many of the existing DMPAs along the Texas coast are nearing capacity, those in the vicinity of the Site are not contained and effectively have unlimited capacity. Despite capacity not being a limiting factor, resource agencies and stakeholders have long advocated using dredged material beneficially to create and restore wetlands and bird islands, nourish beaches, and counteract land loss. Historically, BU projects are difficult to manage because they are multiyear, multifaceted undertakings in which different organizations manage dredging schedules, funding, project design, permitting, and construction activities. To help address these issues, the objectives of this project include the following:

- Create and restore degrading coastal habitats.
- Establish sites for disposal of dredged material to reduce reliance on existing DMPAs.
- Improve coastal resiliency of the natural and built environment.

To accomplish these objectives, the project includes the following tasks:

- Stakeholder outreach and coordination
- Identification and selection of BU sites
- 10% designs and cost estimates for 20 BU sites
- 30% designs and cost estimates for 11 BU sites
- 60% designs, cost estimates, and permit application packages for up to seven BU sites

This memorandum documents the 30% design and cost estimate for the Site.

Design Objectives

The Site will be designed to beneficially use dredged material to create a rookery island in a region with degrading coastal bird habitat. The design will use material dredged from navigation channels during routine maintenance, thus reducing the volume of such material placed in existing open-bay or upland DMPAs. This 30% design is based upon publicly available datasets, as well as focused field work conducted by DU.

Design objectives include the following:

- Develop a preliminary vision based on available data for the Site that includes the following:
  - Habitat to be created or restored
  - Potential sediment source(s)
  - Approaches to minimize long-term maintenance costs
- Delineate conceptual footprints for proposed BU placement.
- Identify key sensitive habitats and construction considerations in the vicinity of the Site.
- Estimate fill volumes for the proposed BU footprints.
- Identify data gaps to be addressed in subsequent design phases.
- Provide preliminary cost estimates.

Existing Data Review

A review of existing data and the focused data collected by DU was performed to develop the Site and containment berm designs. This section describes the data reviewed and collected for the 30% design.

Horizontal and Vertical Datums

The horizontal datum used for the Site is the Texas State Plane South Central Zone, North American Datum of 1983 in U.S. survey feet. The primary vertical datum used for the Site design is the North American Vertical Datum of 1988 (NAVD88). The National Oceanic and Atmospheric Administration (NOAA) maintains an active tide gauge within the vicinity of the Site. The NOAA Aransas National Wildlife Refuge (ANWR) Station 8774230 (ANWR Station) is 8 miles southwest of the proposed island and collects and records real-time tide information dating back to 2012. The vertical datums from this station that will be used for the Site are shown in Table 1. The ANWR Station was also used to define a preliminary design water level, as described in the Water Level section.

Table 1
ANWR Station Tidal Gauge Displaying NAVD88 Tidal Datums

Tidal Datum	Elevation (feet NAVD88)	Elevation (feet MLLW)
MHHW	1.28	0.33
MHW	1.28	0.33
MSL	1.12	0.17
MLW	0.95	0
MLLW	0.95	0

Notes:
MHHW: mean higher high water
MHW: mean high water
MLLW: mean lower low water
MLW: mean low water
MSL: mean sea level

Meteorological, Ocean, and Wave Data

Water Level

To determine an approximate design water level elevation for the Site, an existing water level analysis using data from the ANWR Station, which is 8 miles southwest of the Site, was used. Data were compiled for the period from November 2015 to February 2021, and a range of water levels was used to inform the hydrodynamic model (Anchor QEA 2021). As can be seen in Table 2, the 1-year north wind, higher tide scenario resulted in the highest annual wave conditions and one of the highest annual water levels. The associated water level of that scenario was 2.6 feet NAVD88. This water level correlates to approximately the 95% percentile water level at the ANWR Station (i.e., the water level higher than 95% of the recorded water levels; Anchor QEA 2021), and results from that scenario will be used to inform this 30% design.

Table 2
Maximum Predicted Wave Conditions at the Site for the Modeled Storm Scenarios

Model Scenario	Approximate Return Period at the Site	Maximum Significant Wave Height, Hs (feet)	Associated Peak Wave Period, (Tp, seconds)	Associated Water Level (feet NAVD88)
1-year southeast wind, lower tide[1]	1 year	0.9	1.8	1.8
1-year southeast wind, higher tide[2]	1 year	1.1	2.1	2.7
1-year north wind, higher tide[2]	1 year	1.4	2.1	2.6
Hurricane Allen	10 year	1.8	2.4	4.1
Hurricane Harvey	10 year	1.7	1.2	1.9

Notes:
1. The lower tide scenario used a tidal boundary condition that peaked at approximately the 50th-percentile water level at the ANWR Station (i.e., the water level higher than 50% of the recorded water levels).

2. The higher tide scenario used a tidal boundary condition that peaked at approximately the 95th-percentile water level at the ANWR Station (i.e., the water level higher than 95% of the recorded water levels).

Wind and Waves

The U.S. Army Corps of Engineers (USACE) Wave Information Studies (WIS) provides a national resource of long-term wavefield climatologies for U.S. coastal waters that synthesizes observations, multidecade hindcasts, and storm event archives (USACE 2021). The WIS station closest to the Site is Station 73046, just offshore on the Gulf side of Matagorda Island in the Gulf of Mexico. Because the station is located offshore, the wave data were not used. However, the project team considers the wind data to be representative of the winds experienced at the Site. Figure 2 summarizes wind data from January 1, 1980, through December 31, 2014. The data indicate that the predominant wind direction is from the southeast, with significant winds also coming from the north, northeast, east, and south.

There is a 5-mile fetch between Little Bird Island North and Matagorda Island, the closest land mass, in the predominant southeast wind direction. Due to the fetch, the Site is anticipated to be in a high wave-energy environment.

A wave and hydrodynamic model of San Antonio Bay was previously developed by Anchor QEA for the Dagger Point breakwater design along the ANWR shoreline (Anchor QEA 2021). The ANWR project (in Austwell, Texas) is approximately 6.5 miles northwest of the Site. Because the Site location is included within the Dagger Point model domain, the model results were used to develop the Site design.

The Dagger Point model simulations included three annual storm scenarios (i.e., storms with an estimated return period of 1 year) developed from the USACE WIS Station 73046 (Figure 2) using wind speeds out of the north and southeast at 33 and 24 miles per hour (mph), respectively. Two hurricane events, Hurricane Harvey (August 2017) and Hurricane Allen (August 1980), were also included as events with a minimum return period of approximately 10 years, based on maximum storm surge elevations measured near San Antonio Bay with waves coming from the southeast (the primary wave direction). Table 2 provides a summary of the maximum significant wave heights predicted by the model at the Site for the annual storm and hurricane scenarios, along with the associated peak wave periods and water levels. This table also provides the estimated return period for each event at the Site. For the two annual storm scenarios, the estimated return period is 1 year, based on the return periods of the wind conditions used to drive the model. For the two hurricane scenarios, the estimated return period is based on the maximum storm surge elevation predicted by the model at the Site, in comparison with return-period storm surge elevations published by the Federal Emergency Management Agency (FEMA 2018).

Wake Erosion

The GIWW is approximately 0.23 mile south of the Site. Several types of vessels, including recreational and commercial vessels and commercial tugboats and barges, operate in the GIWW and generate wake waves that propagate to the Site. Like wind-generated waves, vessel wake waves produce the greatest erosive forces in the region where the waves break (i.e., the surf zone).

The Bhowmik et al. (1991) and Weggel and Sorensen (1986) vessel-generated wave prediction methods—based on vessel dimensions, travel speed, and distance between the sailing line and Site—were used to evaluate the range of vessel-generated waves for a conservative selection of representative vessels known to operate in the area. A sport yacht with a draft of 4 feet was selected to evaluate recreation vessel wakes generated by vessels traveling near the proposed Site. A generic tugboat with maximum dimensions recorded in the Automatic Identification System (AIS) database was selected, along with a similar tugboat transiting with twin barges (identified using Google Earth imagery of ports in the region) to evaluate the commercial vessel wakes generated by vessels traveling in the GIWW. Calculation of the sport yacht's maximum vessel wakes, traveling at varying speeds along the nearest edge of the GIWW 1,230 feet from the Site, can be seen in Table 3. Calculation of the tugboat and tugboat with twin barges maximum vessel wakes, traveling in 14 feet of water at varying speeds up to 11 miles per hour (considered conservative) along the nearest edge of the GIWW 1,230 feet from the Site, can be seen in Table 4.

These wave heights are shorter than the predicted wind-generated wave heights at the Site, and thus, wind-generated waves will be considered the predominant erosive force for design evaluations. The vessel wakes are limited to vessels traveling on the edge of the GIWW. This assumption likely holds for commercial vessels, but further analysis should be conducted to understand the frequency and distance recreational vessels travel near the Site. Additional analysis surrounding a variety of recreational vessel drafts and speeds may be considered in future design phases.

Table 3
Sea Ray Sundancer Sport Yacht Maximum Vessel-Wake Calculations at Various Speeds

Vessel	Length (feet)	Draft (feet)	Vessel Speed (mph)	Maximum Wave Height (feet)	Wave Period (seconds)
Sea Ray Sundancer sport yacht	51	4	6.7	0.78	1.11
			15	0.59	0.96
			25	0.49	0.88
			35	0.44	0.83
			45.4	0.40	0.79

Note:
Maximum wave heights were calculated using Bhowmik et al. (1991), in which vessel speeds ranged from 6.7 to 45.4 mph.

Table 4
Tugboat and Tugboat with Twin Barges Maximum Vessel-Wake Calculations at Various Speeds

Vessel	Length (feet)	Beam (feet)	Draft (feet)	Vessel Speed (mph)	Maximum Wave Height (feet)	Wave Period (seconds)
Generic tugboat with maximum dimensions recorded in AIS data[1]	87	33	11	3	0.00	8.40
	87	33	11	5	0.00	5.04
	87	33	11	7	0.00	3.60
	87	33	11	9	0.00	2.80
	87	33	11	11	0.26	2.29
Generic tugboat with maximum dimensions recorded in AIS data and with twin barges[2]	387	110	11	3	0.00	7.31
	387	110	11	5	0.00	4.38
	387	110	11	7	0.00	3.13
	387	110	11	9	0.00	2.44
	387	110	11	11	0.00	2.29

Notes:
Maximum wave heights were calculated for vessels traveling within Froude number boundaries and at 3, 5, 7, 9, and 11 mph (Weggel and Sorensen 1986).
1. Vessel hull geometric coefficients were input using a tugboat from Hay (1967).
2. Vessel hull geometric coefficients were input using a barge from Hay (1967).

Bathymetry

DU conducted bathymetric and topographic surveys at the Site on March 31, 2022. The Site footprint consists of open-water shallows and has an average seabed elevation of -3.5 feet NAVD88. The Site contours range from -4.1 to -3.2 feet NAVD88. During the survey, DU conducted sediment probing in three areas of the Site. The three probes from substrate to substrate refusal were from -3.77 to -3.95 feet NAVD88, -3.64 to -4.05 feet NAVD88, and -3.99 to -4.18 feet NAVD88, with an average distance to refusal of 0.26 foot. Within those areas, it was qualitatively determined that the material was firm sand throughout and is not expected to exhibit substantial settling.

Utilities and Infrastructure

The Railroad Commission of Texas public GIS viewer (RRC 2021) and GLO pipeline data (GLO 2021a) were used to identify mapped utilities and pipelines near the Site. One pipeline was identified in the database search: a Houston Oil and Minerals Corporation natural gas pipeline located 1,200 feet southwest of the Site. There are also five dry holes, a plugged oil well, a plugged gas well, and a cancelled/abandoned location within an approximate 1-mile radius of the Site. Utility and pipeline locations are shown in Attachment 1, C01. It is not anticipated that the utilities and pipeline will affect the design or constructability of the Site. The need for Site-specific utility locations prior to construction may be determined during subsequent design phases. No other infrastructure has been identified in the vicinity of the Site.

Desktop Cultural Resources Survey

A search of cultural resources records in the Texas Historical Commission Texas Historical Sites Atlas Database was completed for the Site on November 29, 2021. This search revealed that no archaeological surveys have been conducted, and no archaeological sites have been identified within the preliminary proposed placement site boundary (THC 2021).

Sensitive Habitat

GLO oyster habitat GIS data (GLO 2021b) indicates that oyster habitat is located approximately 100 to 500 feet away from the Site, except in the south and southeast directions. DU confirmed the presence of oyster habitat visually and through sediment probing during the March 31, 2022, low tide Site visit. Oysters were observed north and west of the Site footprint and in water depths of approximately -2.7 to -3.7 feet NAVD88 (Attachment 1, C01). Oysters were not observed in the Site footprint. Because this information is based on sediment probing and visual surveys, more extensive oyster surveys may need to be conducted during a subsequent phase of design.

According to Texas Parks and Wildlife Department seagrass data (TPWD 2021), there are no seagrasses mapped within or adjacent to the Site location. No seagrasses or roots/rhizomes were observed during the DU March 31, 2022, visual survey. Because the sensitive habitat data are not recent, and the seagrass information from DU is based on visual surveys, more extensive surveys may need to be conducted during a subsequent phase of design.

Bird Species

The U.S. Fish and Wildlife Service (USFWS) Information for Planning and Consultation (IPaC) tool was used to identify listed species and migratory birds within a 172-square-mile region around San Antonio Bay (USFWS 2021). Table 5 includes some of the protected and migratory bird species present near the Site and their preferred habitat as explained in the *Guide to North American Birds* field guide (Audubon 2021a). At this time, no target species, or list of species, has been identified for the Site.

Table 5
USFWS IPaC Species Information[1]

Species	Status	Preferred Habitat[2]
Whooping crane (*Grus americana*)	Endangered	Prairie pools, marshes, and coastal marshes
Piping plover (*Charadrius melodus*)	Threatened	Sand beach dunes and expansive sand or mudflats
Red knot (*Calidris canutus*)	Threatened	Mudflats, tidal zones, and sandy beaches

Species	Status	Preferred Habitat[2]
American oystercatcher (*Haematopus palliatus*)	Migratory	Strictly coastal; dunes, islands in salt marsh, dredge spoil islands, sandy beaches, and tidal mudflats
Black skimmer (*Rynchops niger*)	Migratory	Sandy islands, shell beaches, open beaches, lagoons, estuaries, inlets, and sheltered bays
Brown pelican (*Pelecanus occidentalis*)	Migratory	Bare, rocky mangrove- or tree-covered islands; salt bays, beaches, and oceans
Gull-billed tern (*Gelochelidon nilotica*)	Migratory	Beaches, islands, salt marshes, fields, and coastal bays
Marbled godwit (*Limosa fedoa*)	Migratory	Northern Great Plains, native prairie with marshes or ponds, pools, shores, marshes, and tidal flats
Reddish egret (*Egretta rufescens*)	Migratory	Red mangrove swamps, arid coastal islands covered with thorny brush, coastal tidal flats, salt marshes, and lagoons
Ring-billed gull (*Larus delawarensis*)	Migratory	On ground near water with sparse plant growth, lakes, bays, coasts, piers, dumps, and plowed fields
Royal tern (*Thalasseus maximus*)	Migratory	Low-lying sandy islands, coasts, lagoons, salt bays, and estuaries
Wilson's plover (*Charadrius wilsonia*)	Migratory	Dry part of beach, near conspicuous object, coastal regions, open beaches, tidal flats, estuaries, and sandy islands

Notes:

1. USFWS IPaC information (USFWS 2021) is provided for a 172-square-mile region around San Antonio Bay highlighting endangered, threatened, and migratory birds and their preferred habitat.
2. Habitat information is from the *Guide to North American Birds* (Audubon 2021a) and includes preferred nesting and general habitat.

Erosion

Data from 1982 to 2013 (Paine et al. 2016) indicate the San Antonio Bay shoreline near the Site is eroding with some areas experiencing greater than 1 meter (3.3 feet) of erosion per year.

Beneficial Use Source Material

The proposed source material for the Site may consist of existing excavated material from inside the Site (borrow area) and dredged material from the GIWW (0.25 mile southeast of the Site) and Channel to Victoria (1 mile northeast of the Site). Based on coastal consistency determinations from USACE, USACE has historically performed GIWW and Channel to Victoria maintenance dredging near the Site (USACE 1999) and continues to dredge the area (Jones 2021).

The project team proposes the containment berm interior core be primarily constructed with the borrow area material. The borrow area's available quantity of material from different excavation elevations are shown in Table 6. The dredged material from the GIWW and Channel to Victoria will be used to provide the interior fill for the Site. The quantity and characteristics of dredged material that may be available for placement at the Site are shown in Tables 6 and 7. There are eight potential

USACE DMPAs near the Site with a total average annual dredging volume of 1,358,976 cubic yards (CY; Table 6). The majority of the dredged sediment appears to be clay and silts (Table 7).

Table 6
USACE DMPA Areas Along the GIWW and Channel to Victoria Near the Site

DMPA No.	Channel Station	Distance from Site to DMPA (miles)	Average Annual Dredging Quantity (CY)
121A	GIWW: 715+000 to 730+000	1.5	117,587
122	GIWW: 730+000 to 740+000	0.1	178,917
123	GIWW: 740+000 to 750+000	2	171,561
124	GIWW: 750+000 to 760+000	3.5	153,899
125	GIWW: 760+000 to 770+000	5	173,696
1	Channel to Victoria: East and West Wye: 0+00 to 200+00	1.6	156,882
2	Channel to Victoria: 200+00 to 500+00	1.1	310,131
3	Channel to Victoria: 500+00 to 800+00	2	96,303
		Total	**1,358,976**

Note:
Source: USACE 1999

Table 7
Typical Sediment Characteristics Across the GIWW in San Antonio Bay and from the Channel to Victoria (Bay and Landlocked Segments)

Sediment Characteristics Across GIWW in San Antonio Bay	Sediment Characteristics Channel to Victoria (Bay Segment: 0+00 to 400+00)	Sediment Characteristics Channel to Victoria (Landlocked Segment: 400+00 to 1850+00)
D_{50} (mm) <0.016	D_{50} (mm) = 0.025	D_{50} (mm) = 0.037
14.3% sand	13.8% sand	25.0% sand
35.7% silt	49.1% silt	41.2% silt
50.0% clay	37.1% clay	33.8% clay

Notes:
Source: USACE 1999.
D_{50}: median grain size
mm: millimeter

30% Design

The main design elements evaluated for the Site are as follows:

- Site location

- Rookery island size and shape
- Containment and erosion protection
- Constructability
- Planting and natural recruitment of vegetation
- Performance expectations
- Site construction cost estimates
- Expected ecosystem benefits
- Data and information gaps

These design elements are evaluated in this memorandum for the 30% Site design.

Site Location

The proposed Site is 0.7 mile northeast of the existing Little Bird Island, 50 feet from existing oyster habitat to the north and northwest of the Site, 100 feet from existing oyster habitat to the west and southwest of the Site, and 150 feet from the USACE DMPA #122 (Attachment 1, C01 and C02). The shallow depths and surrounding oyster reefs may provide shelter to the Site from erosive forces.

Locating the Site 0.25 mile northwest of the GIWW (Figure 1) is advantageous because the prevailing southeast winds will transport any sediment eroded from the island away from the GIWW. Also, because the Site is located near the USACE DMPA and GIWW, construction costs are expected to be lower compared to more remote potential bird island sites. The proposed Site is approximately 1.75 miles from the nearest shoreline. This distance is well above the 0.5-mile distance identified for minimizing predator access to rookery islands (Stanzel 2018).

Rookery Island Size and Shape

Based on availability of sediment, a cost analysis, and stakeholder feedback, the project team proposes that the area of the Site be approximately 8 acres. This 30% design includes the largest bird island desired, based on stakeholder input. Future cost constraints may limit the size of the island that is ultimately constructed, but at this level of design, it was decided to consider a site near the upper end of the range identified by stakeholders. The Site will be ovular in shape, with armoring on three of the four sides, as shown in Attachment 1, C01 and C02. A 200-foot-wide beach habitat with a natural slope from the average bay bottom depth of -3.5 feet NAVD88 to +4.0 feet NAVD88 will be created on the southwest side to allow ingress and egress of organisms to the Site. The Site will be created with dredged material placed to an elevation of +4.0 feet NAVD88. This shape of fill was selected to promote natural recruitment of vegetation at varied elevations and provide a variety of habitat for a range of bird species. The elevation of dredged material fill could be adjusted at further phases of design, depending on the physical properties of the dredged material or if target vegetation or bird species are identified.

As described in the Beneficial Use of Source Material section, fill material could be obtained from the GIWW or nearby Channel to Victoria (Table 7). It is predicted that the required fill volume for the 30% design will be approximately 191,000 CY. This value assumes 1 foot of foundation compression for every 6 feet of fill and does not consider bulking. Based on the information in Table 6, this quantity of material is expected to be available in the vicinity of the site. Geotechnical data is expected to be needed and would be collected during a subsequent design phase to further evaluate foundation compression and expected bulking of dredged material. During a subsequent phase of design, the volume of material may be updated based on the dredged material characteristics, characteristics of the subgrade, and refinement of the rookery island design.

For the purposes of Site design, relative sea level rise is not considered but may impact the Site in the future. A strategy to mitigate against relative sea level rise could be to place BU material to higher elevations in preparation for higher relative sea levels and tidal elevations associated with relative sea level rise. The impacts of relative sea level rise may also be mitigated in the future through adaptive management strategies targeting bird preferred vegetation ranges, such as additional placement of maintenance material to upland habitat or thin-layer placement of dredged material.

Containment and Erosion Protection

Based on the wave and hydrodynamic model (Wind and Waves section; Anchor QEA 2021), a containment berm is proposed for the Site. The containment berm will serve to contain and protect the Site from erosion. Table 8 summarizes the 30% containment berm design components. The proposed centerline of the containment berm is currently designed along -3.5 feet NAVD88 and is intended to mitigate erosion and contain Site material. The containment berm will be composed of a side casted material core from the borrow area and overlain with armor stone (Attachment 1, C03). The design assumes the borrow source could be excavated to -10 feet NAVD88 to provide the 52,000 CY of material needed for the side casted core construction. However, geotechnical data and analysis, during subsequent design phases, may be necessary to determine the availability and suitability of material in the borrow areas.

The armor stone size of the berm was selected to equal 1.1 feet based on the AECOM Technical Services, Inc. (AECOM) M10 report for a site located approximately 46 miles southwest of the Site (AECOM 2020). AECOM computed the armor stone size for a wave height of 2.69 feet, which is larger than the computed maximum 10-year wave height at the Site of 1.8 feet. Therefore, an armor stone D_{50} of 1.1 feet may be considered conservative.

The selected containment berm geometry (Table 8) was intended to minimize wave energy transmitting through and over the structure under an annual north wind scenario at higher tide with a wave height of 1.4 feet. The transmitted wave energy through the containment berm was determined using the van der Meer and d'Angremond method, as outlined in USACE *Coastal*

Engineering Manual, Table VI-5-15 (USACE 2006). Based on the results of the analysis, the transmitted wave energy behind the proposed containment berm armor stone is expected to be minimal. The containment berm geometry and armor stone size will be further refined through Site-specific modeling and analysis of the wave conditions during a subsequent phase of design.

Table 8
Phase 1: Containment Berm Design Characteristics

Containment Berm Design Criteria	Little Bird Island North Containment Berm
Total project length	2,733 feet
Total containment berm acreage	Approximately 5 acres
Crest width	10 feet
Base width	Approximately 78 feet, depending on water depth
Assumed bottom elevation	-3.5 feet NAVD88
Total structure height	8.5 feet
Containment berm materials	Side casted material, geotextile fabric, and rock
Containment berm core volume	52,000,000 CY
Containment berm armor volume	29,500 CY
Estimated settlement	1 foot for every 6 feet of fill
Design side slopes (seaward side)	5H:1V[1]
Design side slopes (landward side)	3H:1V[1]
Maximum design crest elevation	+5 feet NAVD88

Notes:
The final cross-sectional dimensions and slopes of the containment berm may be refined through hydrodynamic modeling and evaluation of sediment characteristics of the dredged material and berm subgrade during a subsequent phase of design.
1. Horizontal to vertical

Constructability

This section describes the proposed methods of construction. Actual methods will be dependent on the chosen contractor's equipment and Site conditions at the time of construction. In addition, the contractor may provide alternate construction methods from those described in this section.

The average water depth surrounding the Site is -3.5 feet NAVD88 (-4.45 feet mean lower low water), which helps with costs and constructability. Water depth, depending on the tides, should provide sufficient access for construction equipment, but it also requires more dredged material and armor stone to build to the target elevation. Contractor light loading or access channels may need to be dredged for contractors to access the Site.

The Site could be constructed in two different phases, as follows.

Phase 1

Material from the borrow area will likely be mechanically excavated and side casted to the required design elevations and geometry to construct the core of the containment berm. A geotextile fabric or jute cloth will be placed atop the side cast core to prevent fines from passing through before placement of the 3-foot-thick armor layer. Phase 1 construction may require construction of access channels, light-load transport of armor stone, and mobilizing equipment beyond what is required for dredging the GIWW (e.g., marsh buggies, a deck barge, and an excavator). Marsh buggies and/or deck-barged excavators may be used to shape the containment berm. Environmental controls may be needed during Phase 1 construction.

Phase 2

Phase 2 of construction will consist of placing fill inside the Phase 1 containment berm. Confining the dredged slurry within the containment berm will reduce potential impacts to adjacent oyster habitat. Dredged material can be placed during routine maintenance of the GIWW or Channel to Victoria. Phase 2 construction may require mobilizing equipment beyond what is required for dredging the GIWW (e.g., marsh buggies and a deck barge). Marsh buggies may be used to shape the fill to the required fill elevations. Environmental controls may be needed during fill placement to contain finer sediment.

Planting and Natural Recruitment of Vegetation

Based on stakeholder input and cost considerations, the project team determined that planting may not be needed for the Site. Rather, natural vegetation recruitment will be allowed to proceed. If the outcome is unsatisfactory, (e.g., if the island has lower-than-expected use by desired bird species), an adaptive management program can be instituted to modify the vegetation. Table 5 shows some of the listed and migratory birds and their preferred habitats. At further design phases, this list could be used to modify elevations within the Site to promote the preferred habitat of desired bird species.

Performance Expectations

The performance goal for the project is to create approximately 8 acres of sustainable rookery habitat, promote natural recruitment of vegetation at varied elevations, and provide a variety of habitat for a range of bird species. The designed containment berm is expected to contain placement of dredged material, be resilient to typical storm events, and provide protection for the interior habitat.

Site Construction Cost Estimates

Preliminary construction costs were estimated for the design outlined in the previous sections. The estimated costs include indirect construction costs (i.e., permitting, 100% engineering and design costs, construction management, and post-construction management such as Site visits and dewatering management). These costs represent the estimated incremental costs (i.e., costs over and above USACE's least-costly and environmentally acceptable dredged material and placement alternative). Table 9 shows a line-item list of each costing parameter and the total cost estimated for construction.

The costs range from $5.2 million to $1 million, depending on the level of uncertainty allocated to the project cost. The lower bound of uncertainty (-30%) and upper bound of uncertainty (+50%) were selected due to the existing data gaps, high levels of inflation, and rising fuel costs. As the design is further refined, the costs have a potential to decrease if Site-specific modeling shows that the containment berm geometry and quantity of armor stone can be reduced. An evaluation of the initial capital construction versus projected maintenance costs could be conducted to determine an optimum armoring design that allows for satisfactory protection of the interior rookery island, while being within the project budget. The estimates are developed using current and generally accepted engineering cost estimating methods and are based on assumptions concerning future events. Actual costs may be affected by known and unknown risks including, but not limited to, changes in general economic business conditions, Site conditions that were unknown at the time the estimates were performed, future changes in Site conditions, regulatory or enforcement policy changes, and delays in performance. Actual costs may vary from these estimates.

Table 9
Opinion of Probable Construction Cost to 100% Project Completion

Item	Quantity	Unit	Unit Price	Total
Direct Construction Costs				
Phase 1: Containment Berm Construction				
Mobilization and Demobilization[1,2]	1	%	10	$ 460,000.00
Preconstruction Survey	1	LS	$ 30,000.00	$ 30,000.00
Sand Berm Core[2,3]	2,733	LF	$ 110.00	$ 300,000.00
Armor Stone	47,000	tons	$ 90.00	$ 4,200,000.00
As-Built Survey	1	LS	$ 50,000.00	$ 50,000.00
Navigational Aids[2]	4	Each	$ 4,000.00	$ 20,000.00
Phase 1 Subtotal[4]			**Sum**	**$ 5,100,000.00**
Phase 2: Interior Fill Placement				
Incremental Mobilization and Demobilization[1,5]	1	%	10	$ 130,000.00
Preconstruction Survey	1	LS	$ 50,000.00	$ 50,000.00
Incremental Dredging Interior Placement (1-Mile Pipeline)[2]	191,000	cy	$ 6.00	$ 1,150,000.00
As-Built Survey	1	LS	$ 60,000.00	$ 60,000.00
Phase 2 Subtotal4			**Sum**	**$ 1,400,000.00**
Direct Construction Subtotal4			**Sum**	**$ 6,500,000.00**

Indirect Construction Costs				
100% Engineering and Design	1	LS	$500,000.00	$ 500,000.00
Permitting	1	Each	$100,000.00	$ 100,000.00
Construction Management	1	LS	$200,000.00	$ 200,000.00
Post-Construction Management[6]	12	Month	$ 10,000.00	$ 120,000.00
Indirect Construction Subtotal[4]			**Sum**	**$ 900,000.00**
Project Subtotal[4]			**Sum**	**$ 7,400,000.00**
-30% Uncertainty[4,6]	1	%	30	$ 2,200,000.00
+50% Uncertainty[4,6]	1	%	50	$ 3,700,000.00
Low-End Total Project Estimated Cost[4]			**Total Sum**	**$ 5,200,000.00**
High-End Total Project Estimated Cost[4]			**Total Sum**	**$11,100,000.00**

Notes:
Costs were determined based upon a combination of publicly available datasets and sediment surface grabs, and topographic, bathymetric, and visual habitat surveys.

1. Cost is based upon mobilizing equipment beyond what is required for dredging the GIWW (e.g., marsh buggies)
2. Value is rounded to the nearest $10,000.
3. Cost includes side casting existing water bottoms and shaping of the containment berm.
4. Value is rounded to the nearest $100,000.
5. Cost is based on incremental cost of diverting dredging equipment from GIWW to excavation areas.
6. Post-construction management may include Site visits to observe the material consolidation, vegetation, and water levels on the Site. Monthly aerials may be performed. Additional post-construction management practices may be considered during subsequent phases of design.

LF: linear foot
LS: lump sum

Expected Ecosystem Benefits

Creation of the Site is expected to have positive benefits on the regional ecosystem. Chester Island, a 69-acre rookery island located in the adjacent Matagorda Bay, was used to approximate the ecological benefits for the Site. From 2003 to 2011, Chester Island averaged approximately 12,000 breeding pairs of birds per year across 17 species (5 of which are listed in Table 5; Audubon 2021b[1]). Adjusting for rookery island acreage, the Site may be expected to create habitat for approximately 1,450 breeding pairs of birds per year.

The mean relative sea level rise averaged between Freeport and Rockport is 5.1 millimeters per year (NOAA 2022). Assuming no changes in the mean relative sea level rise trend and no erosion, the rookery island within the target elevation of the Site (+4.0 feet NAVD88 or 2.88 feet mean sea level [MSL]) would be below MSL by 2195.

[1] Audubon 2021b refers to Sundown Island, which is now called Chester Island.

Due to the location of oyster habitat adjacent to the Site, it is expected that the containment berm armor will be colonized by oysters. This will increase the existing oyster habitat in the regional ecosystem.

Data and Information Gaps

At this phase of design, the following data and information gaps have been identified:

- Coordination with USACE will be necessary, given that the Site is adjacent to a DMPA. USACE staff have indicated that for them to support the Site, it should avoid limiting their future placement of material, either by making it more costly to place material in their DMPAs, decreasing the capacity of their DMPAs, or by creating habitat for sensitive species that could inhibit future placement of material.
- Based on stakeholder feedback, targeting higher interior fill and containment berm elevations to better combat relative sea level rise may be beneficial. Additionally, adding a rock sill at the southwest containment berm opening may add more erosion protection from wind-generated waves, increase the level of dredged material containment, and provide more oyster habitat. These may be evaluated during subsequent design phases.
- Refine site-specific wind-generated wave heights, which would inform the optimization of site armor design.
- Identify geotechnical characteristics of the source material (maintenance material) and subgrade of the placement area to refine evaluations of containment berm structure stability, subgrade and source material settlement, and short- and long-term capacity for dredged material placement.
- Refine survey information such as property lines, utility locations, and supplemental bathymetry, where appropriate, with an extensive oyster habitat survey that would inform the Site design.

These data gaps may need to be addressed during the progression from 30% design to final design. For example, supplemental data collection and modeling would allow optimizing the project design to reduce construction costs. It is expected that the cost of addressing these information gaps would be offset by the cost savings that would be realized by optimizing the project design. Because the 30% design has been prepared without such data, conservative assumptions (e.g., regarding armoring) have been used, increasing the estimated construction cost. This current project is taking the analyses as far as practicable, considering the constraints of the project scope, budget, and schedule.

Future Work

Of the sites selected for 30% designs in this project, up to seven will be selected for 60% designs, cost estimates, and permit application packages. No fatal flaw has been identified at this phase of the design. The presence of oyster habitat adjacent to the Site may affect the Site footprint and design during subsequent design phases.

Should the Site be selected for additional design efforts, it can be expected that some aspects of the design in this memorandum will be modified and, as appropriate, enhanced.

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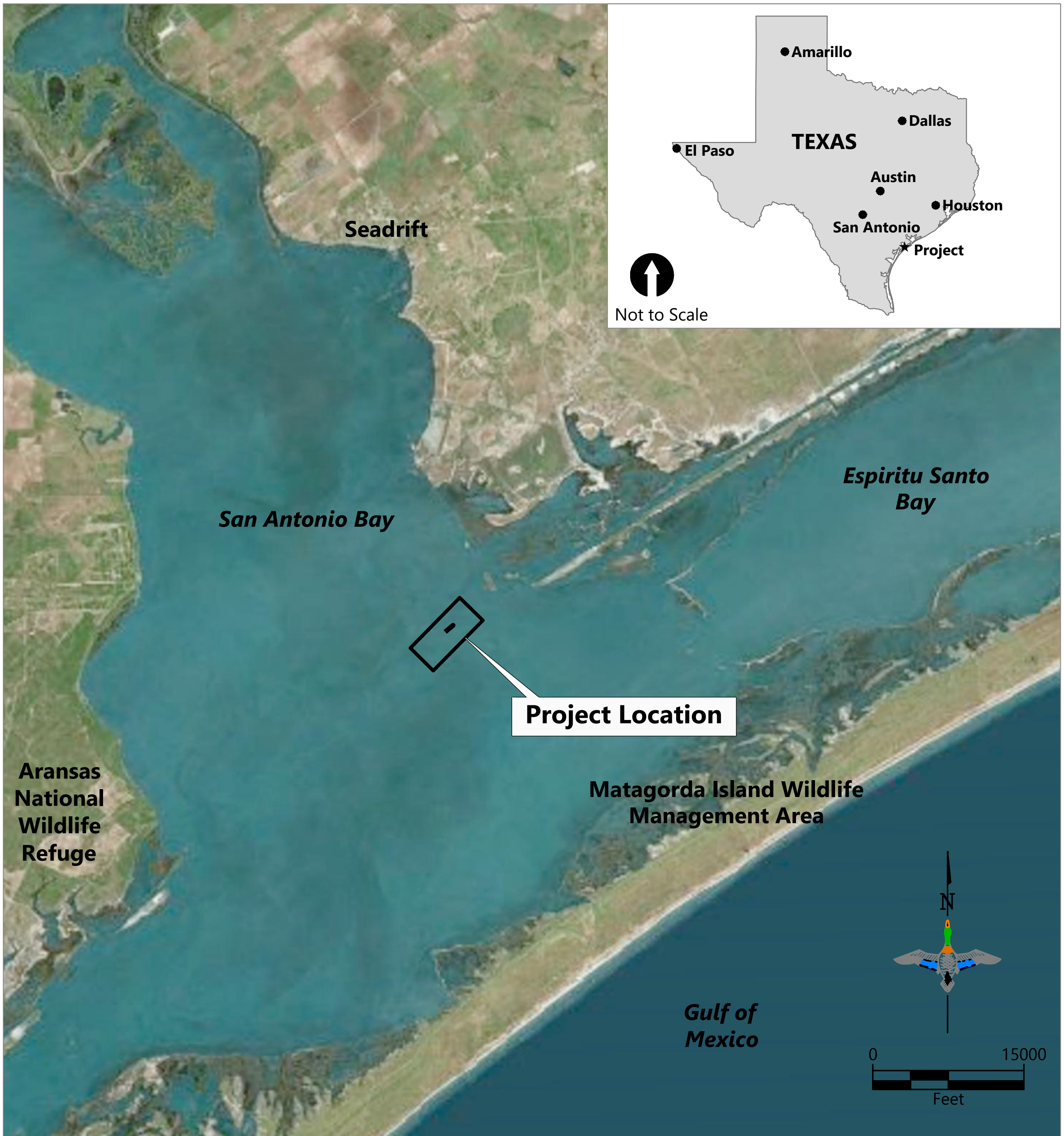
Figures



SOURCE: Aerial provided by Bing Maps.
HORIZONTAL DATUM: Texas State Plane South Zone, North American Datum of 1983, U.S. Survey Feet

Publish Date: 2022/06/21 11:12 AM | User: mpratschner
Filepath: K:\Projects\2018-PCCA Beneficial Use\Little BIrd Island North\2018 RP-001 VIC MAP LBIN.dwg Figure 1

ANCHOR QEA

Figure 1
Vicinity Map

Little Bird Island North 30% Design Memorandum
Texas Lower Coast Beneficial Use

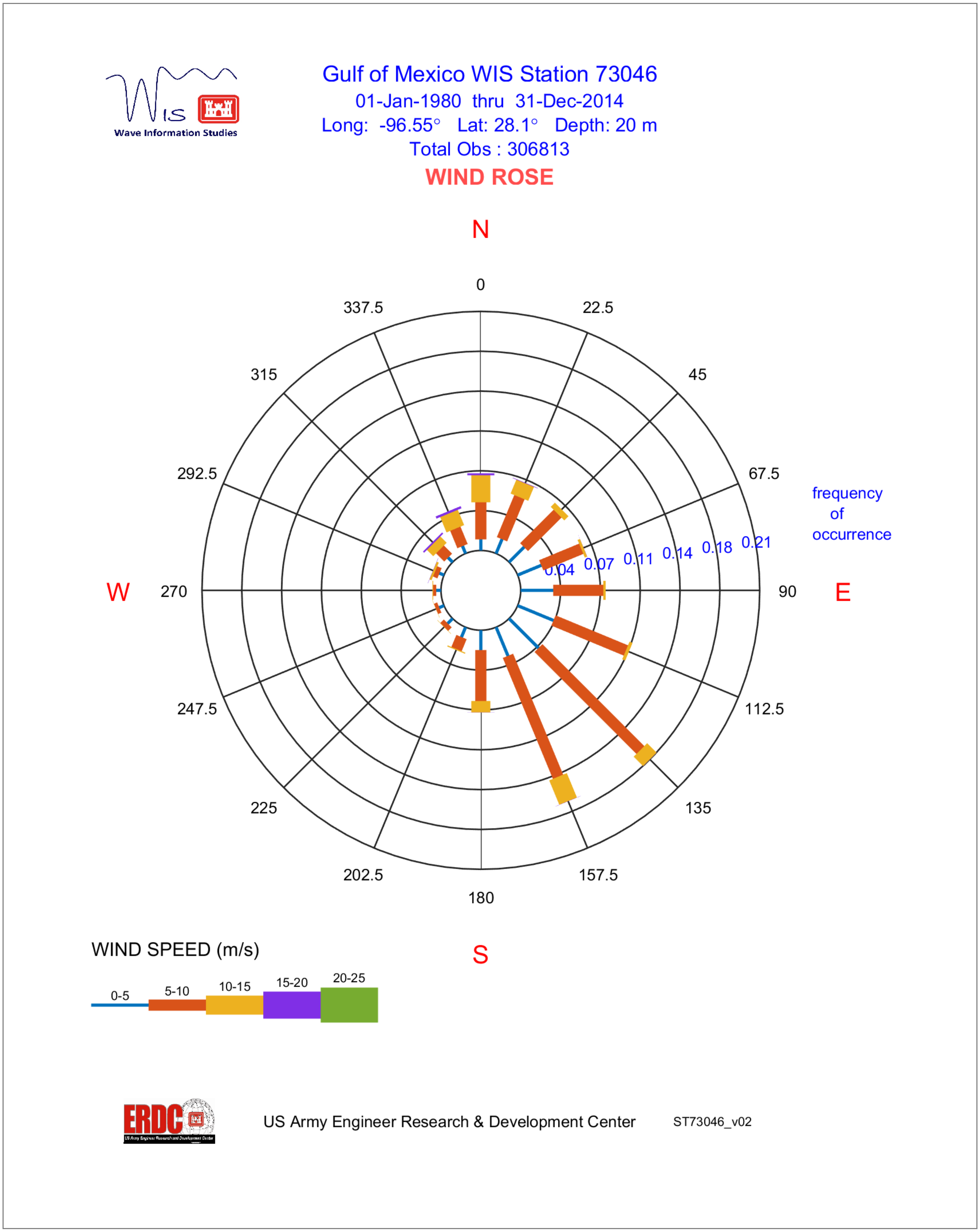


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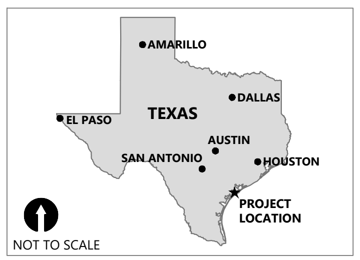
Figure 2
Historical Wind Data for USACE WIS Station 73046
Little Bird Island North 30% Design Memorandum
Texas Lower Coast Beneficial Use

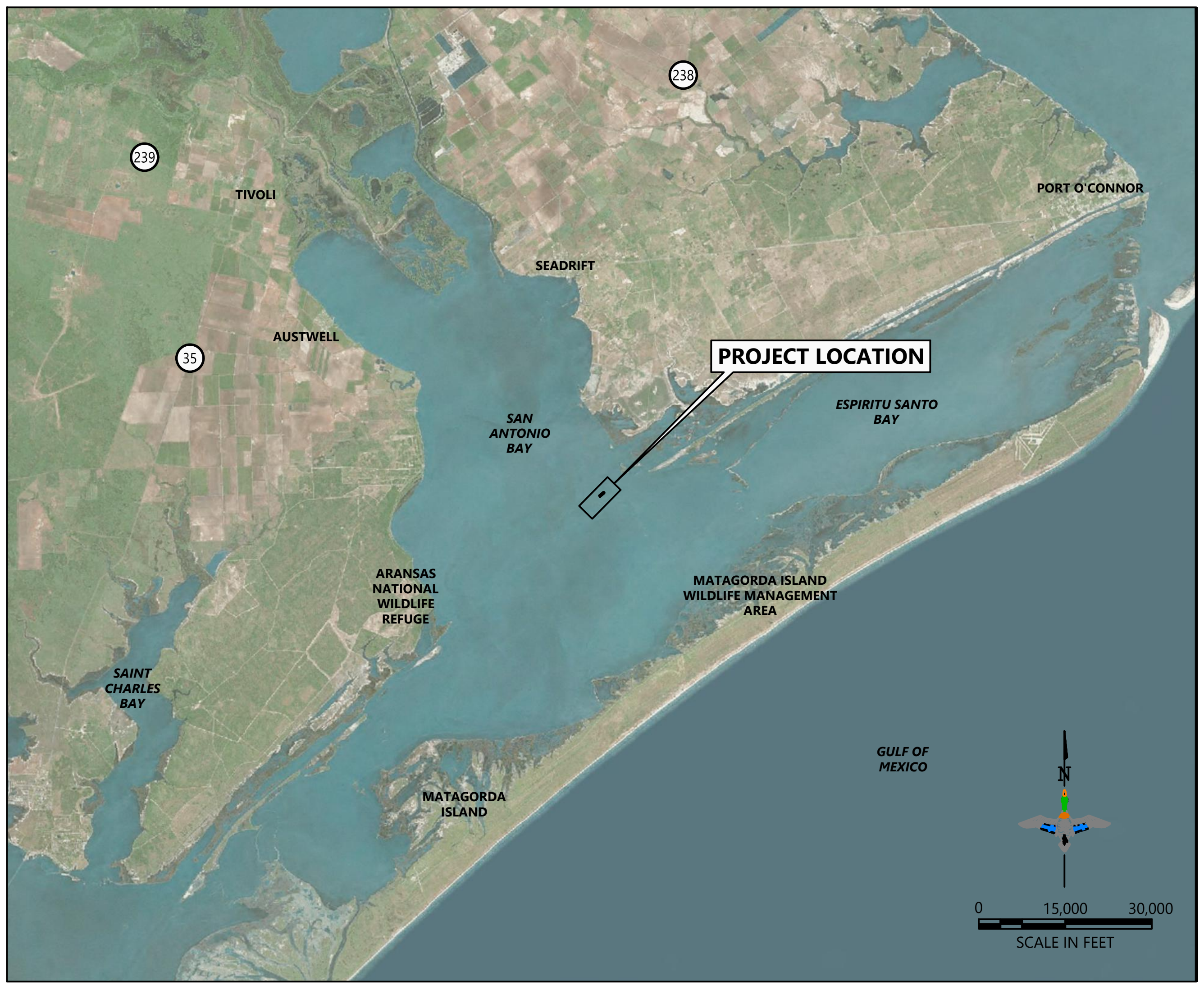
Attachment 1
Construction Drawings

30% DESIGN SUBMITTAL

TEXAS LOWER COAST BENEFICIAL USE - LITTLE BIRD ISLAND NORTH

TEXAS GENERAL LAND OFFICE





AERIAL BY BING MAPS

DRAWING INDEX		
SHEET	DRAWING	TITLE
1	T01	TITLE SHEET
2	C01	SITE OVERVIEW
3	C02	PLAN VIEW
4	C03	TYPICAL CONTAINMENT BERM SECTION

NOTES:

1. HORIZONTAL DATUM: TEXAS STATE PLANE SOUTH CENTRAL ZONE, NAD83, U.S. SURVEY FEET
2. VERTICAL DATUM: NORTH AMERICAN VERTICAL DATUM OF 1988 (NAVD88)
3. BATHYMETRIC SURVEY CONDUCTED BY DUCKS UNLIMITED ON MARCH 31, 2022.

PLAN INTENDED TO BE VIEWED IN COLOR. ADJACENT BLOCK IS "BLUE"

ONE INCH

AT FULL SIZE, IF NOT ONE INCH SCALE ACCORDINGLY

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Jun 29, 2022 3:20pm mpratschner

ANCHOR QEA

TEXAS GENERAL LAND OFFICE ESTABLISHED 1836

DUCKS UNLIMITED

REVISIONS				
REV	DATE	BY	APP'D	DESCRIPTION

DESIGNED BY: H. SMITH
DRAWN BY: M. PRATSCHNER
CHECKED BY: R. ROBERTSON
APPROVED BY: J. LAPLANTE
SCALE: AS NOTED
DATE: JUNE 2022

TEXAS LOWER COAST BENEFICIAL USE - LITTLE BIRD ISLAND NORTH

TITLE SHEET

T01

SHEET # 1 OF 4

LEGEND:

- PROPOSED CONTAINMENT BERM
- GULF INTRACOASTAL WATERWAY
- EXISTING CONTOUR (5')
- EXISTING CONTOUR (0.5')
- RAILROAD COMMISSION OF TEXAS MAPPED OIL AND GAS INFRASTRUCTURE LOCATIONS
- U.S. ARMY CORPS OF ENGINEERS OPEN WATER DREDGED MATERIAL PLACEMENT AREA
- GLO MAPPED OYSTER HABITAT
- EXTENTS OF VISUALLY INSPECTED OYSTER HABITAT
- GLO MAPPED PIPELINE

N

0 500 1000
SCALE IN FEET

NOTES:

1. HORIZONTAL DATUM: TEXAS STATE PLANE SOUTH CENTRAL ZONE, NAD83, U.S. SURVEY FEET
2. VERTICAL DATUM: NORTH AMERICAN VERTICAL DATUM OF 1988 (NAVD88)
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4. GLO, 2021B. "LAYER: OYSTER HABITAT (ID: 57)." ARCGIS REST SERVICES DIRECTORY. ACCESSED NOVEMBER 23, 2021.

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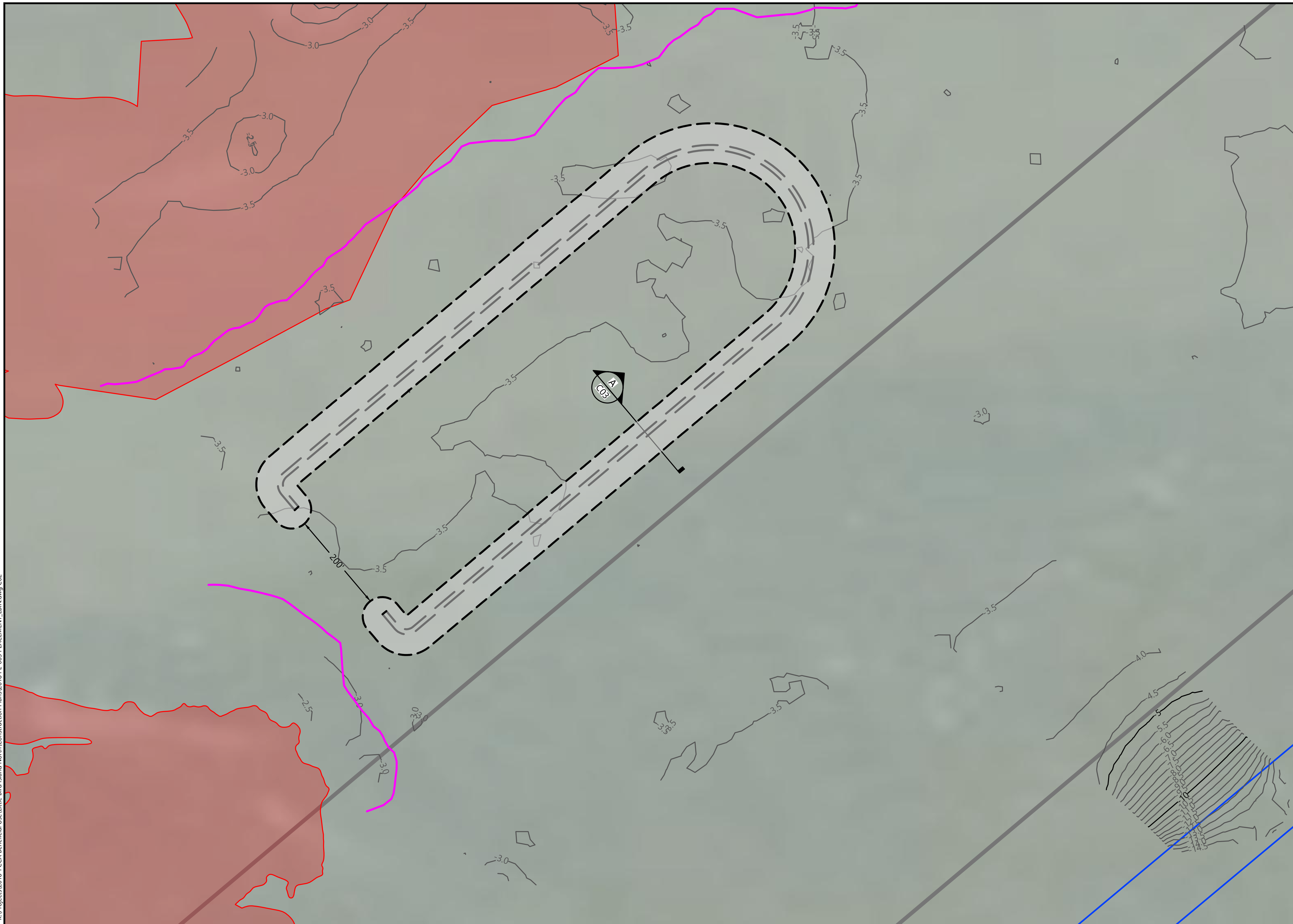
TEXAS LOWER COAST BENEFICIAL USE - LITTLE BIRD ISLAND NORTH

SITE OVERVIEW

C01

SHEET # **2** OF **4**



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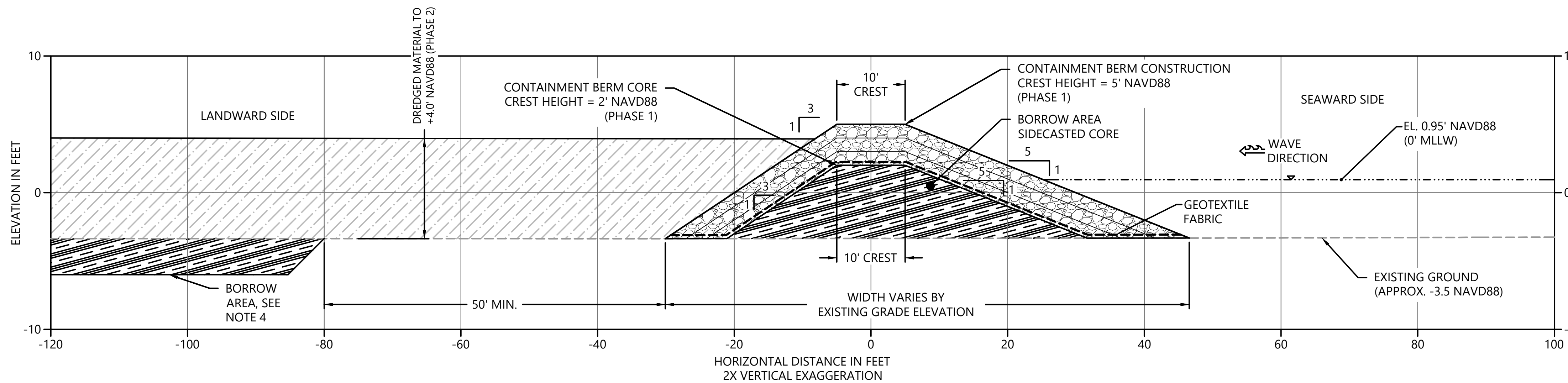
DATE: JUNE 2022

TEXAS LOWER COAST BENEFICIAL USE - LITTLE BIRD ISLAND NORTH

PLAN VIEW

C02

SHEET # 3 OF 4



A SECTION
C02
HORIZONTAL SCALE: 1" = 10'
VERTICAL SCALE: 1" = 5'

NOTES:

1. HORIZONTAL DATUM: TEXAS STATE PLANE SOUTH CENTRAL ZONE, NAD83, U.S. SURVEY FEET
2. VERTICAL DATUM: NORTH AMERICAN VERTICAL DATUM OF 1988 (NAVD88)
3. BATHYMETRIC AND VISUAL HABITAT SURVEYS CONDUCTED BY DUCKS UNLIMITED ON MARCH 31, 2022.
4. BORROW AREA DIMENSIONS SHOWN FOR ILLUSTRATION PURPOSES ONLY. ACTUAL DIMENSIONS TO BE DETERMINED BASED ON FINAL DESIGN AND BY SELECTED CONTRACTOR.

PLAN INTENDED TO BE VIEWED IN COLOR. ADJACENT BLOCK IS "BLUE"

ONE INCH
AT FULL SIZE, IF NOT ONE INCH SCALE ACCORDINGLY

DRAFT-NOT FOR CONSTRUCTION

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TEXAS LOWER COAST BENEFICIAL USE - LITTLE BIRD ISLAND NORTH

TYPICAL CONTAINMENT BERM SECTION

C03

SHEET # 4 OF 4

Attachment 2
Technical Specification Outline

TABLE OF CONTENTS

Memorandum

June 30, 2022

To: Melissa McCutcheon, Texas General Land Office

From: Todd Merendino, Ducks Unlimited, Inc.
Sarah Garza, Harrison McNeil, and Yvonne Dives-Gomez, Port of Corpus Christi Authority
John Laplante, Dan Opdyke, Renee Robertson, Alexander Freddo, and Hayden Smith, Anchor QEA, LLC
Jane Sarosdy, Sarosdy Consulting, Inc.

Re: Nueces Delta 30% Design Memorandum

Introduction

This 30% design memorandum describes design criteria and assessments associated with a beneficial use of dredged material (BU) project at the proposed Nueces Delta site (Site), located in Texas General Land Office (GLO) Planning Region 3 of the Texas coast in Nueces Bay in San Patricio County, Texas (Figure 1).

Project Background

GLO awarded a Coastal Management Program Project of Special Merit grant (funded through the Gulf of Mexico Energy Security Act) to Ducks Unlimited, Inc. (DU) to coordinate with stakeholders and identify restoration sites for BU. The Port of Corpus Christi Authority (PCCA), a project partner, has also contributed staff and financial resources to expand the project scope. The project team is led by DU and PCCA and includes Anchor QEA, LLC; Sarosdy Consulting, Inc.; and the Texas Department of Transportation. Collectively, the project team coordinated three stakeholder meetings with state and federal resource agencies, nongovernmental organizations, academia, consultants, and local officials in each region to solicit information about potential BU sites. Based on stakeholder input, GLO feedback, publicly available data, and professional judgment, the project team has developed 10% designs for 18 sites in GLO Planning Regions 3 and 4 of the Texas coast and 2 GLO-approved sites in Mesquite Bay and San Antonio Bay in GLO Planning Region 2. After completion of the 10% designs, 11 of the designs were selected to continue to 30% designs, and up to 7 of those designs will be chosen for 60% designs and permit application packages. The project team selected the Site as one of the 20 sites for 10% design development and cost estimation. Based on the Site's restoration potential and construction feasibility, the project team selected the Site to proceed to

30% design and opinion of probable construction costs using funding from the GLO Coastal Management Program Project of Special Merit grant.

The Nueces Delta encompasses more than 10,000 acres of wetlands on the west side of Nueces Bay. Stakeholders have identified the Site as an area with rapidly degrading marsh habitat (Dunton et al. 2019). To provide greater access to dredged material, stakeholders suggested inserting a permanent pipeline directly from the PCCA Viola Turning Basin to the delta (i.e., underneath the Joe Fulton corridor, which is composed of a county road, railroad tracks, and the Nueces River). This will result in a 0.1- to 0.5-mile permanent pipeline that, when combined with a traditional, temporary pipeline across the marsh, will allow for dredged material to be pumped from the Corpus Christi Ship Channel (CCSC) to the delta. This design addresses one such use of material from the proposed installation of the pipeline that takes advantage of the Nueces Delta Shoreline Protection and Restoration project that has been designed for the Coastal Bend Bays & Estuaries Program (CBBEP). The Shoreline Protection and Restoration project consists of 4,000 linear feet (lf) of breakwater along the east side of the delta. The project team is proposing that dredged material accessed via the installation of the pipeline be used to create an area of marsh (the Site), consisting of a northern and southern portion of the Site, behind that currently designed breakwater to restore marsh lost in the region (Attachment 1, C01). Accordingly, this design is contingent on the breakwater being constructed prior to construction of the BU Site.

Project Objectives

Frequent dredging is needed to develop and maintain Texas navigation channels. The dredged material is often deposited in dredged material placement areas (DMPAs), and many of the existing DMPAs along the Texas coast are nearing capacity. Resource agencies and stakeholders have long advocated using dredged material beneficially to create and restore wetlands and bird islands, nourish beaches, and counteract land loss. Historically, BU projects are difficult to manage because they are multiyear, multifaceted undertakings in which different organizations manage dredging schedules, funding, project design, permitting, and construction activities. To help address these issues, the objectives of this project include the following:

- Create and restore degrading coastal habitats.
- Establish sites for placement of dredged material to reduce reliance on existing DMPAs.
- Improve coastal resiliency of the natural and built environment.

To accomplish these objectives, the project includes the following tasks:

- Stakeholder outreach and coordination
- Identification and selection of BU sites
- 10% designs and cost estimates for 20 BU sites
- 30% designs and cost estimates for 11 BU sites

- 60% designs, cost estimates, and permit application packages for up to seven BU sites

This memorandum documents the 30% design and cost estimate for the Site.

Design Objectives

The Site will be designed to beneficially use dredged material to create marsh habitat in a region with degrading marsh habitat. The design will include the use of a permanent pipeline conduit (designed through a separate effort) to beneficially use material dredged from the Viola Turning Basin and CCSC and fill the degraded marsh with dredged material, thus reducing the volume of such material that will need to be placed in existing open-bay or upland DMPAs. This 30% design is based upon publicly available datasets, as well as focused field work conducted by DU.

Design objectives include the following:

- Develop a preliminary vision based on available data for the Site that includes the following:
  - Habitat to be created or restored
  - Potential sediment source(s)
- Delineate conceptual footprints for proposed BU placement.
- Identify key sensitive habitats and construction considerations in the vicinity of the Site.
- Estimate fill volumes for the proposed BU footprints.
- Identify data gaps to be addressed in subsequent design phases.
- Provide preliminary cost estimates.

Existing Data Review

A review of existing data and the focused data collected by DU was performed to develop the Site design. This section describes the data reviewed and collected for the 30% design.

Horizontal and Vertical Datums

The horizontal datum used for the Site is the Texas State Plane South Zone, North American Datum of 1983 in U.S. survey feet. The primary vertical datum used for the Site design is the North American Vertical Datum of 1988 (NAVD88). The National Oceanic and Atmospheric Administration (NOAA) maintains an active tide gauge within the vicinity of the Site. The NOAA Nueces Bay, TX Station 8775244 (Nueces Bay Station), which is 3.5 miles southeast of the Site, does not provide NAVD88 vertical datums, so the NOAA USS Lexington, Corpus Christi Bay, TX Station 8775296 (Lexington Station), which is 9 miles southeast of the Site, was used to convert the Nueces Bay Station mean lower low water (MLLW) tidal datum to NAVD88. Due to the proximity of the NOAA stations, it was assumed that the difference between MLLW and NAVD88 at the Lexington Station (0.42 foot) could be used at the Nueces Bay Station to shift the tidal datums from MLLW to NAVD88. Accordingly, the converted vertical datums, as well as the official datums in MLLW for the

Nueces Bay Station, that will be used for the Site are shown in Table 1. The Nueces Bay and Lexington stations collect and record real-time tide information dating back to 2010 and 2004, respectively.

Table 1
Nueces Bay Station Tidal Gauge Displaying NAVD88 Tidal Datums

Tidal Datums	Elevation (feet NAVD88)	Elevation (feet MLLW)
MHHW	1.09	0.67
MHW	1.09	0.67
MSL	0.78	0.36
MLW	0.45	0.03
MLLW	0.42	0.00

Notes:
MHHW: mean higher high water
MHW: mean high water
MLW: mean low water
MSL: mean sea level

Meteorological, Ocean, and Wave Data

Wind and Waves

The U.S. Army Corps of Engineers (USACE) Wave Information Studies (WIS) provides a national resource of long-term wavefield climatologies for U.S. coastal waters that synthesizes observations, multidecade hindcasts, and storm event archives (USACE 2021). The WIS station closest to the Site is Station 73039, just offshore on the Gulf side of Mustang Island in the Gulf of Mexico. Because the station is located offshore, the wave data are not applicable to this project design. However, the project team considers the wind data to be representative of the winds experienced at the Site. Figure 2 summarizes wind data from January 1, 1980, through December 31, 2014. The data indicate the predominant wind direction is from the southeast, with significant winds also coming from the north, northeast, east, and south.

There is significant fetch between the Site and the closest land mass in the predominant southeast wind direction. However, this project assumes the proposed breakwater has been designed to limit erosion due to wind waves, causing the Site to experience a low wave-energy environment.

Wake Erosion

The Site is not directly adjacent to any ship channels that will result in significant ship wake, so wake erosion would be limited to shallow-draft recreational vessels. Accordingly, waves generated via recreational vessels is expected to create waves smaller than wind-generated waves; therefore, wake erosion is not considered to be a driving design factor.

Bathymetry and Topography

Surveys for the site include bathymetric and topographic surveys performed by DU on April 19, 2022, and a bathymetric survey conducted by Naismith Marine Services, Inc., in October 2020 (Attachment 1, C02 and C03). Summary information for the northern and southern portions of the Site are shown in Table 2.

Table 2
Summary of Bathymetric and Topographic Surveys

Elevation Type	Northern Portion of Site	Southern Portion of Site
Average elevation	-1.51	-0.84
Lowest elevation	-3.11	-2.71
Highest elevation	+1.88	+2.27
Average elevation along breakwater	-2.25	-2.10

Notes:
Elevations are in feet NAVD88.
Data collected during DU April 19, 2022, survey and T. Baker Smith October 2020 survey.

Utilities and Infrastructure

The Railroad Commission of Texas public GIS viewer (RRC 2021) and GLO pipeline data (GLO 2021a) were used to identify mapped utilities and pipelines near the Site. There were no pipelines identified within the vicinity of the Site. The need for Site-specific utility locations prior to construction will be determined during subsequent design phases.

Desktop Cultural Resources Survey

A search of cultural resources records in the Texas Historical Commission Texas Historical Sites Atlas Database was completed for the Site on December 30, 2021. This search revealed that one archaeological survey has been conducted in part of the proposed Site. No archaeological sites have been identified within the preliminary proposed disposal site boundary (THC 2021).

Sensitive Habitat

Based on GLO oyster habitat GIS data (GLO 2021b), a small patch of oyster habitat has been identified approximately 0.1 mile from the center of the south Site. According to Texas Parks and Wildlife Department seagrass data (TPWD 2021), there are no seagrasses mapped within or adjacent to the Site location. No seagrasses or oysters were observed during the visual survey conducted by DU on April 19, 2022. Although it is unlikely that seagrass or oysters are present due to the ongoing erosion, turbidity, and wave action along the Nueces Delta shoreline, detailed surveys may need to be conducted during a subsequent phase of design.

Erosion

Aerial images show the shoreline has eroded from 400 to 800 feet across the project area from 1950 to 2020. This is consistent with a 2019 Texas Water Development Board report that shows the shoreline in the vicinity of the Site has eroded as much as 15 feet per year between 2005 and 2016 (Dunton et al. 2019).

Beneficial Use Source Material

The source of dredged material for the Site is the CCSC Inner Harbor maintenance material. PCCA has estimated shoaling rates for the Inner Harbor (Table 3). With the ongoing widening and deepening of the CCSC under the Channel Improvement Project, it is expected that the average annual dredging quantities will be higher in the future. The average grain size and grain type percentages from Beacon 82 to the Viola Turning Basin (containing the inner harbor) are shown in Table 4.

Table 3
PCCA Estimated Shoaling Rate for the CCSC Inner Harbor

Inner Harbor West Region Estimated Shoaling (CY per year)	Inner Harbor Central Region Estimated Shoaling (CY per year)	Inner Harbor East Region Estimated Shoaling (CY per year)
35,000	38,000	50,000

Note:
CY: cubic yard

Table 4
Typical Sediment Characteristics from Beacon 82 to the Viola Turning Basin

Sediment Characteristics from Beacon 82 to the Viola Turning Basin (1050+00 to 1550+00)
D_{50} (mm) = 0.047
24.4% sand
40.6% silt
35.1% clay

Notes:
Source: USACE 1999
D_{50}: median grain size
mm: millimeter

Marsh Vegetation Elevation Ranges

Table 5 shows typical habitat ranges for relevant marsh vegetation based on site vegetation surveys conducted by PCCA at the Dagger Island and Nueces Bay Portland marsh in Redfish Bay and Nueces Bay, respectively. The range represents minimum and maximum values found during the survey, while the mode represents the most frequently occurring values during the survey. The mode was judged to best represent suitable elevations for each habitat. The design elevation (1.5 feet mean sea level [MSL]) was selected to target the upper end of low marsh. The 1.5 feet MSL represents an average elevation for the Site, with the expectation that varying elevations conducive to low and high marsh, smooth cordgrass, tidal flat, and open water habitats will be constructed.

Table 5
Typical Elevations for Target Marsh Vegetation

Habitat	Dagger Island: Elevation (feet MSL)		Nueces Bay Portland Marsh: Elevation (feet MSL)	
	Range	Mode	Range	Mode
High marsh	1.0 to 4.2	1.6 to 2.3	N/A	N/A
Low marsh	-1.1 to 3.3	0.6 to 1.1	0.4 to 1.8	0.7 to 0.9
Seagrass	-5.4 to 0.9	-3.0 to -0.7	N/A	N/A
Smooth cordgrass	-1.5 to 1.5	-0.4 to 0.3	0.2 to 0.5	-0.2 to 0.0
Sand flats	1.93 to 1.94	1.93 to 1.94	N/A	N/A
Uplands	2.3 to 5.9	2.3 to 5.9	N/A	N/A

Note:
N/A: not applicable

30% Design

The main design elements evaluated for the Site are as follows:

- Site location
- Marsh size and shape
- Containment and erosion protection
- Constructability
- Planting and natural recruitment of vegetation
- Performance expectations
- Site construction cost estimates
- Expected ecosystem benefits
- Data and information gaps

These design elements are evaluated in this memorandum for the 30% Site design.

Site Location

The proposed Site is approximately 3 miles north of the CCSC Viola Turning Basin. The Site is located between the existing Nueces Delta and the breakwater designed as a part of the Nueces Delta Shoreline Protection and Restoration project for CBBEP (Attachment 1, C01). Average Site elevations are -1.51 feet NAVD88 and -0.84 foot NAVD88 at the northern and southern portions of the Site, respectively. The advantages of creating marsh habitat at the Site include the following:

- The Site would restore a portion of the historical marsh that has been lost in recent decades.
- The existing breakwater may protect placed dredged material from erosion.
- The Site is not in the vicinity of sensitive habitat.
- There is marsh adjacent to the Site that would promote natural recruitment of vegetation.

Marsh Size and Shape

Based on acreage of state-owned submerged land behind the currently designed breakwaters, the project team proposes that the area of the Site be 18 acres. Sediment will be placed within a range of elevations, typically between 1.0 to 3.0 feet NAVD88, to create a variety of habitats. The site average elevation will be +2.5 feet NAVD88 (1.7 feet MSL[1]), which is at the upper end of the suitable habitat range for low marsh and smooth cordgrass, i.e., *Spartina alterniflora* (Table 5). The elevation of dredged material fill will be adjusted at further phases of design, depending on the physical properties of the dredged material, and to target varying habitats of low and high marsh, smooth cordgrass, tidal flat, and open water.

Fill will be placed from the edge of the existing marsh to the landward toe of the breakwater. To protect the structural integrity of the breakwater, the dredged material will be placed up to no higher than 0 foot NAVD88 immediately adjacent to the breakwater. The dredged material will slope at a natural angle of repose up to the design elevation. Fill material will be placed at the Site via the use of a directionally drilled pipeline conduit from the CCSC Viola Turning Basin to Nueces Delta that will be designed and constructed through a separate effort prior to Site construction. Estimated quantities of available material are shown in Table 3.

To help determine the potential volume of material needed for the Site, DU collected four surface sediment grabs—two in the northern portion and two in the southern portion—at the Site. The samples showed that the surface material was soft sediments consisting of mostly fines, clays, and some sands. Therefore, it was assumed there will be 1 foot of foundation compression for every 3 feet of fill, and the estimated consolidated fill volume will be approximately 180,000 cubic yards (CY). The total volume does not consider bulking. Based on the information in Table 3, this quantity of material is expected to be available via use of the directionally drilled pipeline conduit. Geotechnical data will likely need to be collected during a subsequent design phase to further evaluate the expected foundation compression and expected bulking of dredged material.

Relative sea level rise may impact the Site in the future. A strategy to mitigate against relative sea level rise could be to place BU material to higher elevations in preparation for higher relative sea levels and

[1] For this design, the primary vertical datum is NAVD88, and the target constructed elevation is specified to the nearest 0.5 foot. Hence, the desired habitat elevation of 1.5 feet MSL becomes 2.5 feet NAVD88 (which is equivalent to 1.7 feet MSL).

tidal elevations associated with sea level rise. However, placement of BU material above approximately 2.5 feet NAVD88 (1.7 feet MSL) would not allow for near-term low marsh habitat development and, hence, would not meet Site objectives. Therefore, for the purposes of Site design, relative sea level rise is not considered. The impacts of relative sea level rise may be mitigated in the future through adaptive management strategies such as thin-layer placement of additional dredged material.

Containment and Erosion Protection

Once constructed, the breakwater, temporary containment, and existing marsh edge will serve as containment and to protect the proposed Site from wind waves and wake erosion. The breakwater was designed for a 10-year return storm, similar to Hurricane Hannah. Temporary containment (e.g., hay bales, earthen mounds, temporary sheet piles) will need to be placed around areas of the Site open to the bay and surrounding channels as shown in Attachment 1.

Constructability

The final construction would be based on the selected means and methods and selected equipment from the contractor; however, construction could potentially be conducted in two main phases. In addition, the contractor may provide alternate construction methods from those described in this section.

The Site could be constructed in two different phases, as follows.

Phase I

A pipeline conduit would be directionally drilled from the Viola Turning Basin in the CCSC to Nueces Delta, running below the Joe Fulton Corridor. The methods for constructing the permanent pipeline near the utilities, identified in "Utilities and Infrastructure," will be evaluated during subsequent design phases.

Phase II

Shallow water depths surrounding the Site are assumed to require shallow-draft vessels to be used during this phase of construction. Temporary containment would be built at the Site to contain dredged slurry. A pipeline would be run from within the CCSC, through the pipeline conduit and to the marsh Site. Dredged material would be placed at the northern cell up to the design elevations; then, the pipeline would be moved to the southern Site, and dredged material would be placed to the design elevations. Once the dredged material has reached 90% consolidation, temporary containment would be removed to allow tidal flushing into the marsh.

Planting and Natural Recruitment of Vegetation

Based on stakeholder input and cost considerations, the project team determined that natural recruitment of vegetation within the marsh will be the most effective method for vegetating the marsh. Table 5 shows some of the targeted vegetation and their preferred habitat elevations. Natural vegetation recruitment will be allowed to proceed within the Site. If the outcome is unsatisfactory (e.g., if the marsh has a lower-than-expected density of vegetation or if undesirable species of vegetation are present), an adaptive management program can be instituted to modify the vegetation.

Performance Expectations

The performance goal for the project is to create 18 acres of sustainable high and low marsh, smooth cordgrass, tidal flat, and open water habitats behind an existing breakwater. This project will also create a pipeline conduit below the Joe Fulton Corridor that will provide a conduit for pipelines carrying dredged material to discharge that material into Nueces Delta, both for this project and other future projects. The existing armoring is expected to contain placement of dredged material, be resilient to typical storm events, and provide protection for the interior habitat.

Site Construction Cost Estimates

Construction costs were estimated for the design outlined in the previous sections. The lower bound of uncertainty (-30%) and upper bound of uncertainty (+50%) were selected due to the existing data gaps, high levels of inflation, and rising fuel costs. The estimated costs include permitting, 100% design, engineering costs for advancing the design to the construction phase, preconstruction and as-built surveys, mobilization, and materials. These costs represent the estimated incremental costs; i.e., those costs over and above USACE's least-costly and environmentally acceptable dredged material and disposal alternative. Table 6 shows a line-item list of each costing parameter and the total cost estimated for construction.

The estimates are developed using current and generally accepted engineering cost estimating methods and are based on assumptions concerning future events. Actual costs may be affected by known and unknown risks including, but not limited to, changes in general economic business conditions, Site conditions that were unknown at the time the estimates were performed, future changes in Site conditions, regulatory or enforcement policy changes, and delays in performance. Actual costs may vary from these estimates.

The 30% design includes costing for the permanent pipeline conduit that will need to be drilled from the CCSC Viola Turning Basin to Nueces Delta to provide access to dredged material. This pipeline conduit will be a permanent fixture and could contribute to continuous restoration projects throughout the Nueces Delta to counteract the ongoing degradation of the more than 10,000 acres of marsh within the delta. Considering only the marsh fill, the project would cost \$2.9 million to \$6.2 million. The total project costs, including the permanent pipeline, range from \$5.9 million to \$12.6 million, depending on the level of contingency allocated to the project cost.

Table 6
Opinion of Probable Construction Cost to 100% Project Completion

Item	Quantity	Unit	Unit Price	Total
Pipeline Conduit: Direct and Indirect Construction Cost				
Pipeline Conduit Construction[1]	1,000	lf	$ 4,000.00	$ 4,000,000.00
Subtotal[2]			**Sum**	**$ 4,000,000.00**
Total Project Estimate Cost			**Total Sum**	**$ 4,000,000.00**
Marsh Restoration: Direct Construction Costs				
Incremental Mobilization and Demobilization[2]	1	%	10	$ 300,000.00
Preconstruction Survey	1	LS	$ 30,000.00	$ 30,000.00
Incremental Dredging Cost[2] (3-Mile Pipeline)	180,000	CY	$ 18.00	$ 3,200,000.00
As-Built Survey/Aerials	1	LS	$ 40,000.00	$ 40,000.00
Subtotal[2]			**Sum**	**$ 3,600,000.00**
Direct Construction Total[2]			**Sum**	**$ 3,600,000.00**
Marsh Restoration: Indirect Construction Costs				
100% Engineering and Design[2]	1	LS	$ 150,000	$ 150,000.00
Permitting	1	Each	$50,000.00	$ 50,000.00
Construction Management[2]	1	%	6	$ 200,000.00
Post-Construction Management[3]	12	Month	$10,000.00	$ 120,000.00
Indirect Construction Subtotal[2]			**Sum**	**$ 500,000.00**
Project Subtotal			**Sum**	**$ 4,100,000.00**
-30% Uncertainty[2]	1	%	30	$ 1,200,000.00
+50% Uncertainty[2]	1	%	50	$ 2,100,000.00
Low-End Marsh Project Estimated Cost[2]			**Total Sum**	**$ 2,900,000.00**
High-End Marsh Project Estimated Cost[2]			**Total Sum**	**$ 6,200,000.00**
Low-End Total Project Estimated Cost[2,3]			**Total Sum**	**$ 5,700,000.00**
High-End Total Project Estimated Cost[2,3]			**Total Sum**	**$12,200,000.00**

Notes:
Costs were determined based upon a combination of publicly available datasets and sediment surface grabs, and topographic, bathymetric, and visual habitat surveys.

1. Preliminary cost based on DU Bid: *Siphon Control Structures at Oilcut Ditch and Salt Bayou at the Gulf Intracoastal Waterway for Jefferson County*. Each siphon consisted of four 36-inch high-density polyethylene high-density polyethylene (HDPE) siphons directionally drilled under the Gulf Intracoastal Waterway. This is only a preliminary cost, and the ultimate design and associated cost for the pipeline required to be drilled for this project will be refined during subsequent design phases. This cost includes all direct and indirect construction costs associated with construction of the pipeline conduit.
2. Value is rounded to the nearest $100,000.
3. Cost includes separate Pipeline Conduit Project cost with Marsh Restoration cost
4. Post-construction management may include Site visits to observe the material consolidation, vegetation, and water levels on the Site. Monthly aerials may be performed. Additional post-construction management practices may be considered during subsequent phases of design.

LS: lump sum

Expected Ecosystem Benefits

Creation of the Site is expected to have positive benefits on the regional ecosystem. The marsh restoration is expected to add 18 acres of marsh habitat to the regional ecosystem; however, the installed pipeline will provide access to material for many more future restoration projects in the region.

The mean relative sea level rise trend at Corpus Christi is 5.54 millimeters per year (NOAA 2022). Assuming no changes in the mean relative sea level rise trend and no erosion, as well as not considering inorganic and organic accretion, the marsh within the target elevation of the Site (+2.5 feet NAVD88 or +1.72 feet MSL) would be below MSL by 2117.

Data and Information Gaps

At this phase of design, the following data and information gaps have been identified:

- Geotechnical characteristics of the source material (maintenance and new work material) and subgrade of the placement area to refine evaluations of temporary containment structure stability, subgrade, and source material settlement, and short- and long-term capacity for dredged material placement
- Geotechnical characteristics of the subgrade along the directional drilling alignment
- Refined survey information, such as property lines, utility locations, and supplemental bathymetry, where appropriate
- Analysis of existing channels in the delta to determine fish access routes in and out of the delta, as well as hydrodynamic erosion of the Site due to existing channels
- Technological and access challenges associated with drilling and installing the permanent pipeline under the Joe Fulton Corridor and Nueces River
- Coordination with USACE (At the time of this writing, USACE is exploring options for placement of dredged material associated with the ongoing Channel Improvement Project. USACE may be considering a similar permanent pipeline to convey dredged material from the Inner Harbor to Nueces Delta. Coordination with USACE will be necessary to reduce duplication of effort.)

These data gaps may need to be addressed during the progression from 30% design to final design. This current project is taking the analyses as far as practicable, considering the constraints of the project scope, budget, and schedule.

Future Work

Of the sites selected for 30% designs in this project, up to seven will be selected for 60% designs, cost estimates, and permit packages. No fatal flaw has been identified at this phase of the design; however, at the time of this writing, USACE is exploring options for placement of dredged material associated with the ongoing Channel Improvement Project. USACE is considering a similar but larger project to convey dredged material from the Inner Harbor to the Nueces Delta and has reached out to CBBEP to coordinate. The project team has provided information to CBBEP to assist with its evaluations. If USACE moves forward with its project, it may obviate the need for this design. Should USACE's project not move forward and the Site be selected for additional design efforts under other funding, it can be expected that some aspects of the design in this memorandum will be modified and, as appropriate, enhanced.

References

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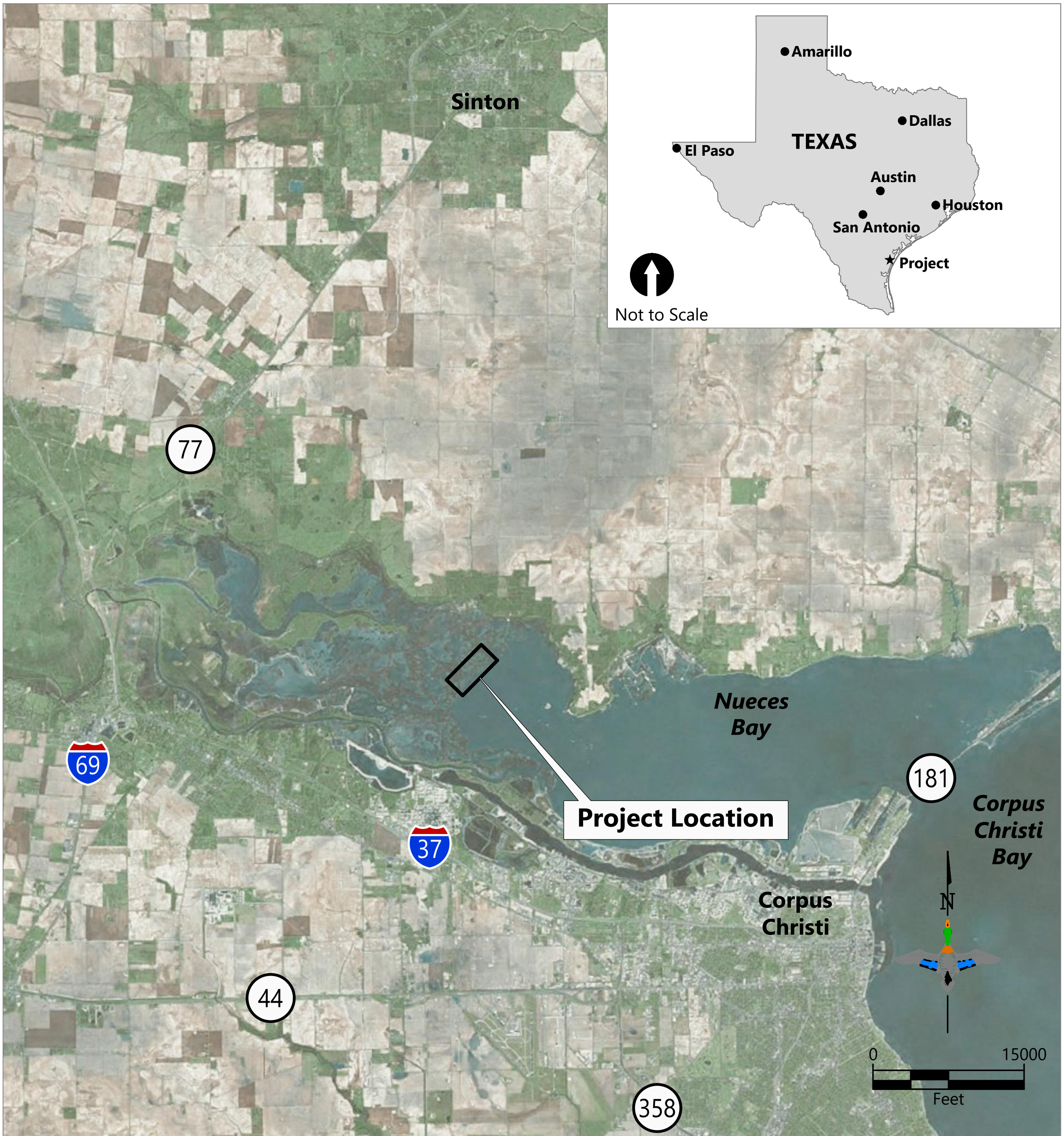
Figures



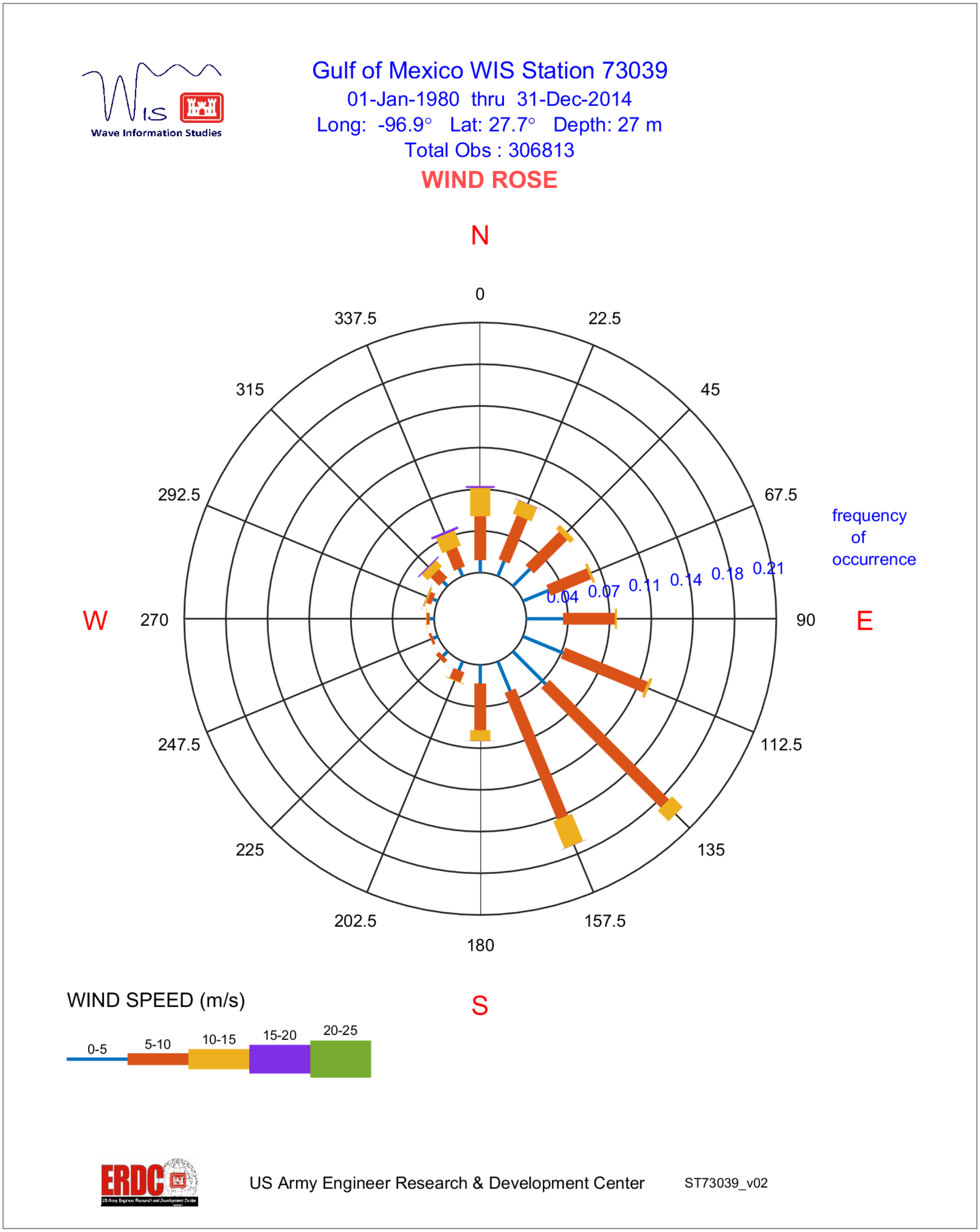
SOURCE: Aerial provided by Bing Maps.
HORIZONTAL DATUM: Texas State Plane South Zone, North American Datum of 1983, U.S. Survey Feet

Publish Date: 2022/06/29 4:04 PM | User: mpratschner
Filepath: K:\Projects\2018-PCCA Beneficial Use\Nueces Delta\2018 RP-001 VIC MAP ND.dwg Figure 1

ANCHOR QEA

Figure 1
Vicinity Map

Nueces Delta 30% Design Memorandum
Texas Lower Coast Beneficial Use



Filepath: \\Fuji\Austin\D_drive\Projects\GLO\BU Lower Coast\Design\30% Designs\Nueces Delta\Figures\Figure 2.docx

ANCHOR QEA

Figure 2
Historical Wind Data for USACE WIS Station 73039

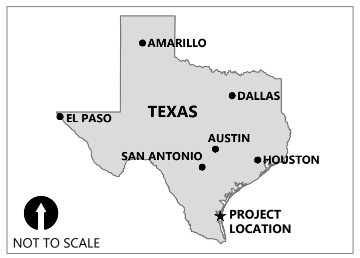
Nueces Delta 30% Design Memorandum
Texas Lower Coast Beneficial Use

Attachment 1
Construction Drawings

30% DESIGN SUBMITTAL

TEXAS LOWER COAST BENEFICIAL USE - NUECES DELTA

TEXAS GENERAL LAND OFFICE



AERIAL BY BING MAPS

DRAWING INDEX		
SHEET	DRAWING	TITLE
1	T01	TITLE SHEET
2	C01	SITE OVERVIEW
3	C02	NORTHERN MARSH PLAN VIEW
4	C03	SOUTHERN MARSH PLAN VIEW
5	C04	TYPICAL MARSH CROSS SECTION

NOTES:

1. HORIZONTAL DATUM: TEXAS STATE PLANE SOUTH ZONE, NAD83, U.S. SURVEY FEET
2. VERTICAL DATUM: NORTH AMERICAN VERTICAL DATUM OF 1988 (NAVD88)
3. BATHYMETRIC, TOPOGRAPHIC, AND VISUAL HABITAT SURVEYS CONDUCTED BY DUCKS UNLIMITED ON APRIL 19, 2022.

PLAN INTENDED TO BE VIEWED IN COLOR. ADJACENT BLOCK IS "BLUE"

ONE INCH

AT FULL SIZE, IF NOT ONE INCH SCALE ACCORDINGLY

DRAFT-NOT FOR CONSTRUCTION

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Jun 30, 2022 4:26pm mpratschner

ANCHOR QEA

TEXAS GENERAL LAND OFFICE ESTABLISHED 1836

DUCKS UNLIMITED

REVISIONS				
REV	DATE	BY	APP'D	DESCRIPTION

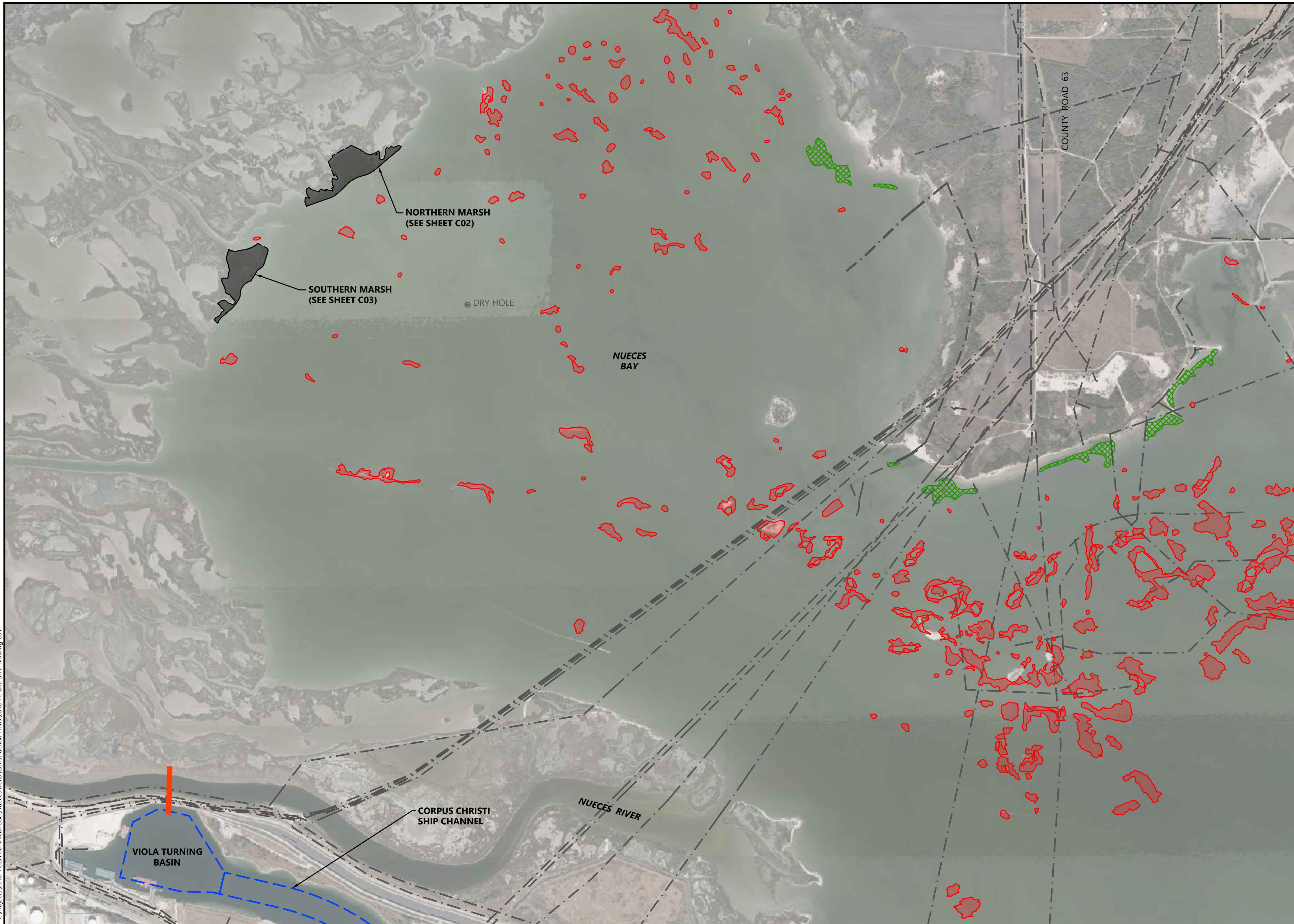
DESIGNED BY: H. SMITH
DRAWN BY: M. PRATSCHNER
CHECKED BY: R. ROBERTSON
APPROVED BY: J. LAPLANTE
SCALE: AS NOTED
DATE: JUNE 2022

TEXAS LOWER COAST BENEFICIAL USE - NUECES DELTA

TITLE SHEET

T01

SHEET # 1 OF 5



LEGEND:

- GLO MAPPED PIPELINES
- RAILROAD COMMISSION OF TEXAS MAPPED OIL AND GAS INFRASTRUCTURE LOCATIONS
- TPWD MAPPED SEAGRASS
- MARSH
- GLO MAPPED OYSTER HABITAT
- POTENTIAL LOCATION OF DREDGED MATERIAL PIPELINE CONDUIT
- CORPUS CHRISTI SHIP CHANNEL

N

0 80 160

SCALE IN FEET

NOTES:

1. HORIZONTAL DATUM: TEXAS STATE PLANE SOUTH ZONE, NAD83, U.S. SURVEY FEET
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3. BATHYMETRIC, TOPOGRAPHIC, AND VISUAL HABITAT SURVEYS CONDUCTED BY DUCKS UNLIMITED ON APRIL 19, 2022.
4. TEXAS PARKS AND WILDLIFE DEPARTMENT (TPWD), 2021. LAYER: SEAGRASS TWPD (ID: 2). ARCGIS REST SERVICES DIRECTORY. ACCESSED NOVEMBER 23, 2021.
5. GLO (TEXAS GENERAL LAND OFFICE), 2021B. LAYER: OYSTER HABITAT (ID:57). ARCGIS REST SERVICES DIRECTORY. ACCESSED NOVEMBER 23, 2021.

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ONE INCH

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REVISIONS

REV	DATE	BY	APP'D	DESCRIPTION

DESIGNED BY: A. FREDDO
DRAWN BY: M. PRATSCHNER
CHECKED BY: R. ROBERTSON
APPROVED BY: J. LAPLANTE
SCALE: AS NOTED
DATE: JUNE 2022

TEXAS LOWER COAST BENEFICIAL USE - NUECES DELTA

SITE OVERVIEW

C01

SHEET # 2 OF 5

LEGEND:

- GLO MAPPED OYSTER HABITAT
- —0— EXISTING CONTOUR (5')
- —2— EXISTING CONTOUR (1')
- DREDGED MATERIAL FILL: APPROX. ELEVATION +2.5' NAVD88
- TEMPORARY CONTAINMENT
- PROPOSED BREAKWATER
- • # GRAB SAMPLE LOCATION

N

0 80 160
SCALE IN FEET

NOTES:

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4. GLO (TEXAS GENERAL LAND OFFICE), 2021B. LAYER: OYSTER HABITAT (ID:57). ARCGIS REST SERVICES DIRECTORY. ACCESSED NOVEMBER 23, 2021.

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ONE INCH
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REV	DATE	BY	APP'D	DESCRIPTION

DESIGNED BY: A. FREDDO
DRAWN BY: M. PRATSCHNER
CHECKED BY: R. ROBERTSON
APPROVED BY: J. LAPLANTE
SCALE: AS NOTED
DATE: JUNE 2022

TEXAS LOWER COAST BENEFICIAL USE - NUECES DELTA

NORTHERN MARSH PLAN VIEW

C02

SHEET # 3 OF 5

LEGEND:

- GLO MAPPED OYSTER HABITAT
- —0— EXISTING CONTOUR (5')
- —2— EXISTING CONTOUR (1')
- DREDGED MATERIAL FILL: APPROX. ELEVATION +2.5' NAVD88
- TEMPORARY CONTAINMENT
- PROPOSED BREAKWATER
- ● # GRAB SAMPLE LOCATION

N

0 80 160

SCALE IN FEET

NOTES:

1. HORIZONTAL DATUM: TEXAS STATE PLANE SOUTH ZONE, NAD83, U.S. SURVEY FEET
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PLAN INTENDED TO BE VIEWED IN COLOR. ADJACENT BLOCK IS "BLUE"

ONE INCH

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DUCKS UNLIMITED

REVISIONS

REV	DATE	BY	APP'D	DESCRIPTION

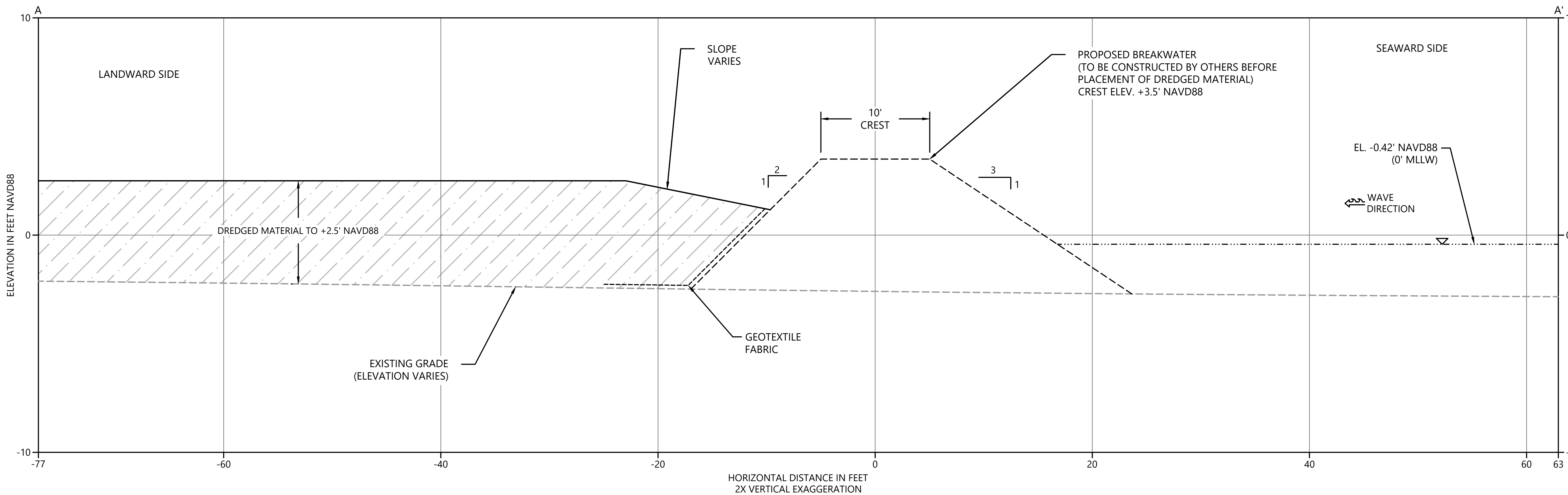
DESIGNED BY: A. FREDDO
DRAWN BY: M. PRATSCHNER
CHECKED BY: R. ROBERTSON
APPROVED BY: J. LAPLANTE
SCALE: AS NOTED
DATE: JUNE 2022

TEXAS LOWER COAST BENEFICIAL USE - NUECES DELTA

SOUTHERN MARSH PLAN VIEW

C03

SHEET # 4 OF 5



A / C02 SECTION
HORIZONTAL SCALE: 1" = 5'
VERTICAL SCALE: 1" = 2.5'

NOTES:

1. HORIZONTAL DATUM: TEXAS STATE PLANE SOUTH ZONE, NAD83, U.S. SURVEY FEET
2. VERTICAL DATUM: NORTH AMERICAN VERTICAL DATUM OF 1988 (NAVD88)
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REVISIONS

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DESIGNED BY: A. FREDDO
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CHECKED BY: R. ROBERTSON
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DATE: JUNE 2022

TEXAS LOWER COAST BENEFICIAL USE - NUECES DELTA

TYPICAL MARSH CROSS SECTION

C04

SHEET # 5 OF 5

Attachment 2

Technical Specification Outline

TABLE OF CONTENTS

Memorandum

June 30, 2022

To: Melissa McCutcheon, Texas General Land Office

From: Todd Merendino, Ducks Unlimited, Inc.
Sarah Garza, Harrison McNeil, and Yvonne Dives-Gomez, Port of Corpus Christi Authority
John Laplante, Dan Opdyke, Renee Robertson, Alexander Freddo, and Hayden Smith, Anchor QEA, LLC
Jane Sarosdy, Sarosdy Consulting, Inc.

Re: PA9-S Marsh Restoration 30% Design Memorandum

Introduction

This 30% design memorandum describes design criteria and assessments associated with a beneficial use of dredged material (BU) project at the proposed PA9-S site (Site), located in Texas General Land Office (GLO) Planning Region 3 of the Texas coast in Corpus Christi Bay in Nueces County, Texas (Figure 1).

Project Background

GLO awarded a Coastal Management Program Project of Special Merit grant (funded through the Gulf of Mexico Energy Security Act) to Ducks Unlimited, Inc. (DU) to coordinate with stakeholders and identify restoration sites for BU. The Port of Corpus Christi Authority (PCCA), a project partner, has also contributed staff and financial resources to expand the project scope. The project team is led by DU and PCCA and includes Anchor QEA, LLC; Sarosdy Consulting, Inc.; and the Texas Department of Transportation. Collectively, the project team coordinated two virtual stakeholder meetings with state and federal resource agencies, nongovernmental organizations, academia, consultants, and local officials in each region to solicit information about potential BU sites. Based on stakeholder input, GLO feedback, publicly available data, and professional judgment, the project team has developed 10% designs for 18 sites in GLO Planning Regions 3 and 4 of the Texas coast and 2 GLO-approved sites in Mesquite Bay and San Antonio Bay in GLO Planning Region 2. After completion of the 10% designs, 11 of the designs were selected to continue to 30% designs, and up to 7 of those designs will be chosen for 60% designs and permit application packages. The project team selected the Site as one of the 20 sites for 10% design development and cost estimation. Based on the Site's restoration potential and construction feasibility, the project team selected the Site to proceed to 30% design and opinion of probable construction costs using funding from the GLO Coastal Management Program Project of Special Merit grant.

Several sites within Corpus Christi Bay have been identified as important locations for creating and restoring marsh and bird habitat (CBBEP 2020). PA9-S is an open-bay placement area with an emergent island located on state-owned submerged land approximately 0.5 mile east of the Gulf Intracoastal Waterway (GIWW) and 0.2 mile south of the Corpus Christi Ship Channel (CCSC) in Corpus Christi Bay in Nueces County, Texas. The existing PA9-S island is adjacent to patchy seagrass habitat and has limited natural protection from wave energy. The proposed site is immediately south of, and appended to, the existing PA9-S island. This area was selected due to its proximity to potential maintenance dredged material from the CCSC and potential new work dredged material from the proposed CCSC channel deepening project, as well as its capacity to accept a large volume of dredged material.

Project Objectives

Frequent dredging is needed to develop and maintain Texas navigation channels. The dredged material is often deposited in dredged material placement areas (DMPAs), and many of the existing DMPAs along the Texas coast are nearing capacity. Resource agencies and stakeholders have long advocated using dredged material beneficially to create and restore wetlands and bird islands, nourish beaches, and counteract land loss. Historically, BU projects are difficult to manage because they are multiyear, multifaceted undertakings in which different organizations manage dredging schedules, funding, project design, permitting, and construction activities. To help address these issues, the objectives of this project include the following:

- Create and restore degrading coastal habitats.
- Establish sites for placement of dredged material to reduce reliance on existing DMPAs.
- Improve coastal resiliency of the natural and built environment.

To accomplish these objectives, the project includes the following tasks:

- Stakeholder outreach and coordination
- Identification and selection of BU sites
- 10% designs and cost estimates for 20 BU sites
- 30% designs and cost estimates for 11 BU sites
- 60% designs, cost estimates, and permit application packages for up to 7 BU sites

This memorandum documents the 30% design and cost estimate for the Site.

Design Objectives

The PA9-S design objective is to provide BU capacity for dredged material generated from nearby navigation channels during routine maintenance and, potentially, new work material from the proposed CCSC Channel Deepening Project, thus reducing the volume of such material that will need to be placed in existing open-bay or upland DMPAs. This 30% design is based upon publicly available datasets, as well as focused field work conducted by DU and PCCA.

Design objectives include the following:

- Develop a preliminary vision based on available data for the Site that includes the following:
  - Habitat to be created or restored
  - Potential sediment source(s)
  - Approaches to minimize long-term maintenance costs
- Delineate conceptual footprints for proposed BU placement.
- Identify key sensitive habitats and construction considerations in the vicinity of the Site.
- Estimate fill volumes for the proposed BU footprints.
- Identify data gaps to be addressed in subsequent design phases.
- Provide preliminary cost estimates.

Existing Data Review

A review of existing data and the focused data collected by DU was performed to develop the Site and containment berm designs. This section describes the data reviewed and collected for the 30% design.

Horizontal and Vertical Datums

The horizontal datum used for the Site is the Texas State Plane South Zone, North American Datum of 1983 (NAD83), in U.S. survey feet. The primary vertical datum used for the Site design is the North American Vertical Datum of 1988 (NAVD88). The National Oceanic and Atmospheric Administration (NOAA) maintains two active tide gauges within the vicinity of the Site. The NOAA Ingleside, Moda Station 8775283 (Ingleside Station), is 2 miles to the west of the Site and has water level data back to 2021. The NOAA Port Aransas, TX Station 8775237, is 7 miles east of the Site and has water level data back to 2015. The Ingleside Station does not provide an NAVD88 vertical datum, but the Port Aransas Station does. Due to the proximity of the NOAA stations, it was assumed that the difference between mean lower low water (MLLW) and NAVD88 at Port Aransas (-0.15 foot) could be used, without adjustment at Ingleside to shift the tidal datums from MLLW to NAVD88. Accordingly, the converted vertical datums, as well as the official datums in MLLW for the Ingleside Station that will be used for the Site are shown in Table 1. The NOAA USS Lexington Station 8775283 (Lexington Station) was also used to define a preliminary design water level, as described in the Water Level section.

Table 1
Ingleside Station Tidal Datums

Tidal Datums	Elevation (feet NAVD88)	Elevation (feet MLLW)
MHHW	0.56	0.71
MHW	0.55	0.70
MSL	0.25	0.40
MLW	-0.15	0.00
MLLW	-0.15	0.00

Notes:
Datums converted to NAVD88 using the Port Aransas, Texas, Station 8775237.
MHHW: mean higher high water
MHW: mean high water
MLW: mean low water
MSL: mean sea level

Meteorological, Ocean, and Wave Data

Water Level

To determine an approximate design water level elevation for the Site, an existing water level analysis using data from the Lexington Station, which is 12 miles west of the Site, was used due to a lack of recent, continuous water level data from the adjacent Ingleside Station (Anchor QEA 2021). Data were compiled for the period from Oct 2015 to Jan 2021 and used to calculate a 90th-percentile water level of 2.0 feet NAVD88.

The MHHW from the 1983 to 2001 tidal epoch at the Lexington Station is 1.02 feet NAVD88, which is 0.47 feet higher than at the Ingleside Station. Due to this difference in the MHHW, water levels at the Lexington Station were considered a conservative estimate of the water levels that would be experienced at the Site.

Wind and Waves

The U.S. Army Corps of Engineers (USACE) Wave Information Studies provides a national resource of long-term wavefield climatologies for U.S. coastal waters that synthesizes observations, multidecade hindcasts, and storm event archives (USACE 2021). The Wave Information Studies station closest to the Site is Station 73039, just offshore on the Gulf side of Port Aransas in the Gulf of Mexico. Because the station is located offshore, the wave data are not applicable to this project design. However, the project team considers the wind data to be representative of the winds experienced at the Site. Figure 2 summarizes wind data from January 1, 1980, through December 31, 2014. The data indicate that the predominant wind direction is from the southeast, with significant winds also coming from the north, northeast, east, and south.

Wind and wave conditions for this phase of design were assumed to be the same as were identified in a design report by AECOM for the M10 site located 1.5 miles west of the Site (AECOM 2020). The wind speed and direction values used for the analysis were taken from the Packery Channel NOAA Tidal Station No. 8775792 at 3-hour intervals from June 2008 to June 2018. A Coastal Modeling System 2D numerical wave model was used to simulate wind-driven waves from 180° to 270° (south to west) direction winds. Waves were generated with wind speeds varying from 3 to 51 knots (1.5 to 26.2 meters per second). The design wave was chosen based on the maximum wave height produced by the CMS-Wave model. This design wave and associated design period were extracted from the M10 report and used in this 30% analysis (Table 2).

Table 2
Assumed Wind and Wave Data from M10 Design

Datum	Value
Wind direction (degrees)	210
Wind speed (knots)	39
Wave height (feet)	2.687
Wave period (seconds)	3.63

Notes:
Source: (AECOM 2020)

Wake Erosion

The GIWW is approximately 0.5 mile west of the Site, and the CCSC is approximately 0.4 mile north of the Site. However, ships do not often use this portion of the GIWW (Hamilton et al. 2018). Potential wake erosion from vessels transiting the CCSC, from smaller vessels transiting the GIWW, and recreational vessels traveling near the Site are expected to be design considerations. The proposed armoring will be designed to resist wind- and vessel-generated erosive forces. Wake erosion from recreational vessels and the ship channels is not expected to drive armor sizing; however, it may inform the transition of the armored containment berm to the existing island. These impacts will be evaluated during subsequent design phases.

Bathymetry

In March 2022, DU conducted a bathymetric and topographic survey of the Site. As shown in Attachment 1, the Site contours range from +2 feet NAVD88 to -10 feet NAVD88. During the survey, DU conducted sediment probing in areas of the Site shallower than -3 feet NAVD88 and, within those areas, qualitatively determined that the material was firm and is not expected to have substantial settling. To determine expected settling of the fill material and containment berm, geotechnical analysis of the substrate within the containment berm footprint and fill area will need to be conducted during subsequent design phases.

Utilities and Infrastructure

The Railroad Commission of Texas (RRC) public GIS viewer (RRC 2021) and GLO pipeline data (GLO 2021a) were used to identify mapped utilities and pipelines near the Site. There are many pipelines near the Site: an Agua Tranquillo Midstream, LLC, natural gas pipeline runs north/south directly under the middle of the Site, as do many Cinco Natural Resources Corporation natural gas full well stream pipelines ranging between 0.4 and 1 mile from the Site, with most of them being approximately 0.5 mile to the southeast. There were also several plugged wells identified within the Site, as shown in the Attachment 1 drawings. The footprint of the Site was refined to avoid containment structures being placed directly on top of plugged wells. Impacts of the pipelines on the constructability of the Site will need to be evaluated during subsequent design phases, and offsets that modify the Site footprint and reduce potential storage capacity may be needed. The need for Site-specific utility locations prior to construction will be determined during subsequent design phases.

An oil and gas platform, as well as two other unidentified structures not displayed in the GLO data or the RRC public GIS viewer were identified within the footprint of the Site in Google Earth imagery and are shown in Attachment 1, C01. Communications regarding these facilities are ongoing and may impact the Site design. For this analysis, impacts of these structures on the design are not evaluated; however, it is expected that the design will be refined during subsequent design phases to account for these structures.

Desktop Cultural Resources Survey

A search of cultural resources records in the Texas Historical Commission Texas Historical Sites Atlas Database (THC 2021) was completed on December 2, 2021. It appears that the proposed placement site has been fully surveyed for cultural resources, and no resources have been identified.

Sensitive Habitat

GLO oyster habitat GIS data (GLO 2021b) indicate there is no oyster habitat identified within or adjacent to the Site. According to Texas Parks and Wildlife Department seagrass data (TPWD 2021), patchy seagrass has been mapped surrounding the Site.

No seagrasses were observed during the visual survey conducted by DU on March 11, 2022. Because the sensitive habitat data from TPWD are not recent, and the seagrass information from DU is based on visual surveys, more extensive seagrass surveys may need to be conducted during a subsequent phase of design.

Beneficial Use Source Material

The main potential source of dredged material is the CCSC, located adjacent to the Site. Continued dredging has recently been confirmed by USACE (Jones 2021). The identified DMPAs used by USACE adjacent to the Site and their associated historical average annual quantity of dredged material, distance from the Site, and channel segments are shown in Table 3. With the ongoing widening and deepening of the CCSC, it is expected that the average annual dredging quantities will be higher in the future. The average grain size and grain type percentages are shown in Table 4. This informs the quantity and characteristics of dredged material that may be available during a dredging cycle.

Table 3
USACE DMPA Areas Near the Site That Received Dredged Material

DMPA No.	CCSC Channel Segment (Station)	Distance from Site to DMPA (miles)	Average Annual Dredging Quantity (CY)
7	Inner Basin to La Quinta Junction (270+00-320+00)	2.4	35,000
8	Inner Basin to La Quinta Junction (320+00-400+00)	1.3	40,000
9 (also referred to as PA9-S)	Inner Basin to La Quinta Junction (400+00-500+00)	0 (adjoining site)	51,000

Notes:
Source: USACE 1999
CY: cubic yard

Table 4
Typical Sediment Characteristics Between the Inner Basin and La Quinta Junction

Sediment Characteristics
D_{50} (mm) = 0.256
87.8% sand
6.6% silt
5.7% clay

Notes:
CCSC Channel Segment Station (0+00-200+00)
Source: USACE 1999
D_{50}: median grain size
mm: millimeter

Another potential source of sediment is from the proposed CCSC Channel Deepening Project. This project could potentially provide a substantial portion of the material used at the Site; however, analysis of the expected sediment quantities and characteristics from the CCSC Channel Deepening Project will need to be completed during a subsequent design phase. Due to the proximity of the Site to these sediment sources, the Site should allow for lower construction costs compared to more remote potential marsh restoration sites.

Marsh Vegetation Elevation Ranges

Table 5 shows typical habitat ranges for relevant marsh vegetation determined based on site vegetation surveys conducted by PCCA at the Dagger Island and Nueces Bay Portland marsh in Redfish Bay and Nueces Bay, respectively. The range represents minimum and maximum values found during the survey, while the mode represents the most frequently occurring values during the survey. Mode was used as the most accurate representation of the conditions for the Site.

Table 5
Typical Elevations for Target Marsh Vegetation

Species	Dagger Island: Elevation (feet MSL)		Portland Nueces Bay Marsh: Elevation (feet MSL)	
	Range	Mode	Range	Mode
High marsh	1.0 to 4.2	1.6 to 2.3	N/A	N/A
Low marsh	-1.1 to 3.3	0.6 to 1.1	0.4 to 1.8	0.7 to 0.9
Seagrass	-5.4 to 0.9	-3.0 to -0.7	N/A	N/A
Smooth cordgrass	-1.5 to 1.5	-0.4 to 0.3	0.2 to 0.5	-0.2 to 0.0
Sand flats	1.93 to 1.94	1.93 to 1.94	N/A	N/A
Uplands	2.3 to 5.9	2.3 to 5.9	N/A	N/A

Note:
N/A: not applicable

30% Design

The main design elements evaluated for the Site are as follows:

- Site location
- Marsh size and shape
- Containment and erosion protection
- Constructability
- Planting and natural recruitment of vegetation
- Performance expectations
- Site construction cost estimate
- Expected ecosystem benefits
- Data and information gaps

These design elements are evaluated in this memorandum for the 30% Site design.

Site Location

PA 9-S is a DMPA located approximately 0.5 mile east of the GIWW and 0.4 mile south of the CCSC and between the existing M10 Island and Pelican Island (Figure 1). The proposed Site will expand the southern footprint of the existing PA9-S island, The existing DMPA PA9-S is permitted for open-bay disposal and dredged material could continue to be discharged outside the footprint of the Site. The design of the Site overlaps partially, but not completely, with the existing DMPA footprint.

The Site footprint begins on the shoreline of the existing upland area and extends out to between the -10 to -11-foot-NAVD88 contour. The average seabed elevation of the Site footprint is -7 feet NAVD88 (-6.85 feet MLLW). Seabed elevations of deeper than -5 feet NAVD88 surround most of the Site, providing beneficial conditions for construction access. Bathymetric surveys will need to be conducted during subsequent design phases to better define Site dimensions and material needs.

Size and Shape

Based on availability of sediment, a cost analysis, and stakeholder feedback, the project team proposes that the area of the Site be 220 acres, with approximately 40 acres being the footprint of the proposed armoring and containment. Sediment will be placed within a range of elevations, typically between 0 to 2.0 feet NAVD88, to create a variety of habitats, with the highest elevations existing as mounds. The site average elevation will be +2.0 feet NAVD88 (1.75 feet MSL), which is at the upper end of the suitable habitat range for smooth cordgrass, i.e., *Spartina alterniflora* (Table 5). The elevation of dredged material fill will be adjusted at further phases of design, depending on the physical properties of the dredged material and to target varying habitats of low to high marsh, tidal flat, and open water. The Site will consist of fill extending from the edge of the existing island to a newly constructed containment berm that will be built under this project. The containment berm will have sills to allow tidal flow into the contained marsh via open water channels extending into the marsh. The locations and geometry of the sills will be determined based on discussions with regulatory agencies during final design. Tidal flat habitat is proposed to line these channels. Evaluations on the impact of the infrastructure within the footprint identified in Attachment 1 drawings are ongoing and the size and shape of the Site may need to be refined during subsequent design phases.

Fill material would likely be obtained from the CCSC (Table 2). It is predicted that the required fill and containment berm volume will be approximately 3,800,000 cubic yards. This value assumes 1 foot of foundation compression for every 6 feet of fill and does not consider bulking. Based on sediment probing data from DU in areas of the site at elevations greater than -3 feet NAVD88, this is a conservative estimate and would need to be refined with further geotechnical data collected during a subsequent design phase to further evaluate the expected foundation compression and bulking of dredged material.

The purpose of the work at the Site is to create a range of low to high marsh, tidal flat, and open water habitat in the near term. Relative sea level rise may impact the Site in the future. A strategy to mitigate against relative sea level rise could be to place BU material to higher elevations in preparation for higher relative sea levels and tidal elevations associated with sea level rise. However, placement of BU material above approximately 2.00 feet NAVD88 would not allow for near-term marsh habitat development and, hence, would not meet the Site objectives. Therefore, for the purposes of Site design, relative sea level rise is not considered. The impacts of relative sea level rise may be mitigated in the future through adaptive management strategies such as thin-layer placement of additional dredged material.

Containment and Erosion Protection

A containment berm will be used to create capacity of the Site, as well as to protect the intertidal habitats developed using dredged materials from erosion. The containment berm serves two purposes: containment and protection of the dredged materials and future marsh from edge erosion. Based on the extracted data from the AECOM M10 report shown in Table 2, the project team proposes containment and armoring for the Site consisting of an 8,000-foot-long containment berm with a rock breakwater constructed on its seaward side. Attachment 1 contains the 30% drawings. The proposed centerline of breakwater is currently designed along the -3.5-foot NAVD88 contour and is intended to mitigate erosion to the earthen containment berm. The containment berm will be composed of stiff clay fill. The containment berm will reside on a varied grade ranging from +2 feet NAVD88 to -11 feet NAVD88. The containment berm will contain a 5-horizontal-to-1-vertical (5H:1V) seaward side slope and a 3H:1V landward side slope connected by a 15-foot-wide crest. The construction height of the crest will be +5.5 feet NAVD88. The exact width will be dependent on the existing grade, but assuming -8.0 feet NAVD88, the containment berm base width will be 123 feet. The breakwater crest height and width were evaluated with a wave transmission analysis using the wave parameters from Table 2, an armor stone D_{50} of 1.1 feet based on the armor stone size selected in the M10 design report (AECOM 2020), and a water surface elevation of 2.0 feet NAVD88 based on the 90th percentile water level. The transmitted wave heights through the rock breakwater were determined by using the van der Meer and d'Angremond method, as outlined in USACE *Coastal Engineering Manual*, Table VI-5-15 (USACE 2006). Table 7 shows the results of the analysis for varied crest widths and crest heights of the breakwater. Based on the results of the analysis, a conservative 15-foot crest width with a +2.5 feet NAVD88 crest height was selected with a 5H:1V seaward side slope and 3H:1V landward side slope that could potentially be reduced during subsequent design phases. The exact width will be dependent on the existing grade, but assuming -8.5 feet NAVD88 to the mudline, the breakwater base width will be approximately 85 feet. The size of the rock armor stone and the final slope and cross-sectional dimensions of the containment berm and breakwater will be further refined through modeling and analysis of the sediment characteristics of the dredged material, the containment berm subgrade, and an analysis of initial capital construction costs versus maintenance costs during a subsequent phase of design. A summary of the containment berm and breakwater geometry is in Table 6.

Table 6
Containment Berm and Breakwater Design Characteristics

Design Criteria	Containment Berm	Breakwater
Length	8,000 feet	8,100 feet
Total acreage	40 acres	16 acres
Crest width	15 feet	15 feet
Base width	Variable	85 feet
Assumed bottom elevation	Variable	-3.5 ft NAVD88 (measured at centerline)
Total structure height	Variable	6 feet (measured at centerline)
Materials	New work stiff clay	Rock
Volume	700,000 CY	200,000 CY
Design side slopes (seaward side)	5H:1V	5H:1V
Design side slopes (landward side)	3H:1V	3H:1V
Maximum design crest elevation	5.5 feet NAVD88	2.5 feet NAVD88

Table 7
Transmitted Wave Analysis

Crest Width (feet)	Crest Height (feet NAVD88)	Transmitted Wave Height (feet)
10	0.5	1.34
10	1.0	1.14
10	1.5	0.94
10	2.0	0.74
10	2.5	0.54
12	0.5	1.23
12	1.0	1.03
12	1.5	0.83
12	2.0	0.63
12	2.5	0.43
15	0.5	1.05
15	1.0	0.84
15	1.5	0.64
15	2.0	0.44
15	**2.5**	**0.24**

Notes:
The **bold** row shows the configuration selected for this design.
Data is based on the van der Meer and d'Angremond method (USACE 2006)
Parameters used for analysis:
D50 = 1.10 feet
Water surface elevation = 2.00 feet NAVD88
Bed elevation = -10.00 feet NAVD88
Wave height = 2.69 feet
Wave period = 3.63 seconds

Constructability

The final construction would be based on the selected means and methods and selected equipment from the contractor; however, construction could potentially be conducted in three main phases:

Phase I

Stiff clay new work material from the CCSC will be hydraulically discharged along the perimeter of the Site. This material will be used to construct the containment berm to the required design elevations and geometry. As the dredged material dries, the containment berm will be shaped above the MLLW to the identified design slopes.

Phase II

After a consolidation period to be determined during final design, the centerline of the rock breakwater will be constructed on the -3.5-foot NAVD88 seaward contour of the containment berm on top of a layer of geotextile fabric.

Phase III

Once the containment berm and rock breakwater are in place, dredged material can be placed either hydraulically or mechanically within the Site during routine maintenance or new work dredging events within the CCSC. This material will be placed up to the required fill elevations.

Planting and Natural Recruitment of Vegetation

Based on stakeholder input and cost considerations, the project team determined that that natural recruitment of vegetation within the marsh will be the most effective method for vegetating the marsh. Table 5 shows some of the targeted vegetation and their preferred habitat elevations; however, it is also recognized that tidal flats are important habitats, and stakeholders may wish some or all high-functioning tidal flats to remain. If the outcome is unsatisfactory (e.g., if the marsh has a lower-than-desired density of vegetation or if undesirable species of vegetation are present), an adaptive management program can be instituted to directly plant, adjust Site elevations, remove undesirable species, etc.

Performance Expectations

The performance goal for the project is to create 175 acres of sustainable high and low marsh, tidal flat, and open water habitat. The designed containment and armoring are expected to contain placement of dredged material, be resilient to typical storm events, and provide protection for the interior habitat.

Site Construction Cost Estimates

Preliminary construction costs were estimated for the design outlined in the previous sections. The estimated costs also include the indirect construction costs (i.e., permitting, 100% engineering and design costs, construction management, and post-construction management such as site visits and dewatering management). These costs represent the estimated incremental costs (i.e., costs over and above USACE's least costly and environmentally acceptable dredged material and disposal alternative). Table 8 shows a line-item list of each costing parameter and the total cost estimated for construction.

The costs range from $61 million to $130.7 million, depending on the level of uncertainty allocated to the project cost. The lower bound of uncertainty (-30%) and upper bound of uncertainty (+50%) were selected due to the existing data gaps, high levels of inflation, and rising fuel costs. Cost savings may be realized by further analysis and modeling of wind and wave conditions during subsequent design phases and refining the level of armoring. Table 7 shows several options for reducing breakwater crest width and crest elevation that also reduce breakwater cost but result in larger waves being transmitted through the breakwater. For example, reducing the breakwater elevation and crest width to 2.0 feet NAVD88 and 10 feet, respectively, would reduce the breakwater cost from $29.7 million to $22.5 million. An evaluation of the initial capital construction versus projected maintenance costs could be conducted to determine an optimum armoring design that allows for satisfactory protection of the interior marsh, while being within the project budget. The estimates are developed using current and generally accepted engineering cost estimating methods and are based on assumptions concerning future events. Actual costs may be affected by known and unknown risks including, but not limited to, changes in general economic business conditions, Site conditions that were unknown at the time the estimates were performed, future changes in Site conditions, regulatory or enforcement policy changes, and delays in performance. Actual costs may vary from these estimates.

Table 8
Opinion of Probable Construction Cost to 100% Project Completion

Item	Quantity	Unit	Unit Price	Total
Direct Construction Costs				
Phase 1: Containment Berm Construction				
Incremental Mobilization and Demobilization[1,2]	1	%	10	$ 2,500,000.00
Preconstruction Survey	1	LS	$ 30,000.00	$ 30,000.00
Incremental Dredging Cost (6-Mile Pipeline)[2]	700,000	CY	$ 36.00	$ 25,200,000.00
Shaping the Containment Berm[2]	8,000	LF	$ 15.00	$ 100,000.00
As-Built Survey/Aerials	1	LS	$ 40,000.00	$ 40,000.00
Navigational Aids[3]	16	Each	$ 4,000.00	$ 60,000.00
Phase 1 Subtotal[2]			**Sum**	**$ 27,900,000.00**
Phase 2: Breakwater Construction				
Mobilization and Demobilization[2,4]	1	%	10	$ 3,000,000.00
Preconstruction Survey	1	LS	$ 30,000.00	$ 30,000.00
Rock Breakwater[2]	330,000	tons	$ 90.00	$ 29,700,000.00
As-Builts/aerials	1	LS	$ 40,000.00	$ 40,000.00
Phase 2 Subtotal[2]			**Sum**	**$ 32,800,000.00**
Phase 3: Internal Fill Placement				
Incremental Mobilization and Demobilization[1,2]	1	%	10	$ 1,900,000.00
Preconstruction Survey	1	LS	$ 30,000.00	$ 30,000.00
Incremental Dredging Cost (1-Mile Pipeline)[2]	3,100,000	CY	$ 6.00	$ 18,600,000.00
As-Built Survey/Aerials	1	LS	$ 70,000.00	$ 70,000.00

Item	Quantity	Unit	Unit Price	Total
Direct Construction Costs				
Phase 3 Subtotal[2]			**Sum**	**$ 20,600,000.00**
Direct Construction Total[2]			**Sum**	**$ 81,300,000.00**
Indirect Construction Costs				
100% Engineering and Design[2]	1	LS	$ 700,000	$ 700,000.00
Permitting	1	Each	$100,000.00	$ 100,000.00
Construction Management[2]	1	%	6	$ 4,900,000.00
Post-Construction Management[5]	12	Month	$ 10,000.00	$ 120,000.00
Indirect Construction Subtotal			**Sum**	$ 5,800,000.00
Project Subtotal[2]			**Sum**	$ 87,100,000.00
-30% Uncertainty[2]	1	%	30	$ 26,100,000.00
+50% Uncertainty[2]	1	%	50	$ 43,600,000.00
Low-End Total Project Estimated Cost[2]			**Total Sum**	**$ 61,000,000.00**
High-End Total Project Estimated Cost[2]			**Total Sum**	**$130,700,000.00**

Notes:
Costs were determined based upon a combination of publicly available datasets and sediment surface grabs, and topographic, bathymetric, and visual habitat surveys.
Mobilization and demobilization costs are based on line items within their respective phases.

1. Cost is based upon mobilizing equipment above what is required for dredging the CCSC (i.e., marsh buggies)
2. Value is rounded to the nearest $100,000.
3. Value is rounded to the nearest $10,000.
4. Cost is based upon mobilizing equipment for construction of the rock breakwater.
5. Post-construction management may include Site visits to observe the material consolidation, vegetation, and water levels on the Site. Monthly aerials may be performed. Additional post-construction management practices may be considered during subsequent phases of design.

LF: linear foot
LS: lump sum
sf: square foot

Expected Ecosystem Benefits

Creation of the Site is expected to have a net positive benefit on the regional ecosystem. The marsh restoration is expected to add 175 acres of marsh and tidal flat habitat to the regional ecosystem. The armored island created at the Site will also provide resiliency to the degrading existing shoreline of PA9-S and increase foraging habitat for birds.

The mean relative sea level rise trend at Corpus Christi is 5.54 millimeters per year (NOAA 2022). Assuming no changes in the mean relative sea level rise trend and no erosion, as well as not considering inorganic and organic accretion, the marsh within the target elevation of the Site (1.5 feet NAVD88 or 1.26 feet MSL) would be below mean sea level by 2092.

Data and Information Gaps

At this phase of design, the following data and information gaps have been identified:

- Coordination with USACE will be necessary, given that the Site is partially within a DMPA. USACE staff have indicated that for them to support the Site, it should avoid limiting their future placement of material, either by making it more costly to place material in the DMPA, decreasing the capacity of the DMPA, or by creating habitat for sensitive species that could inhibit future placement of material.
- Site-specific wind-generated and vessel wake wave heights would inform the optimization of site armor design.
- Geotechnical characteristics of the source material (maintenance and new work material) and subgrade of the placement area would refine evaluations of containment structure stability, subgrade and source material settlement, and short- and long-term capacity for dredged material placement.
- Refined survey information such as property lines, utility locations, and supplemental bathymetry, where appropriate, is needed.
- Location of suitable material is needed for containment berm construction.
- An evaluation of containment berm footprint reduction and using sediment dredged from within the shallows of the Site to construct a sand containment berm would greatly reduce costs at the Site but reduce capacity for BU.

These data gaps may need to be addressed during the progression from 30% design to final design. For example, supplemental data collection and modeling would allow optimizing the project design to reduce construction costs. It is expected that the cost of addressing these information gaps would be offset by the cost savings that would be realized by optimizing the project design. Because the 30% design has been prepared without such data, conservative assumptions (e.g., regarding armoring) have been used, increasing the estimated construction cost. This current project is taking the analyses as far as practicable considering the constraints of the project scope, budget, and schedule.

Future Work

Of the sites selected for 30% designs in this project, up to seven will be selected for 60% designs, cost estimates, and permit packages. No fatal flaw has been identified at this phase of the design.

Discussions with infrastructure owners within the Site footprint are ongoing and may affect the Site footprint and design during subsequent design phases. Should the Site be selected for additional design efforts, it can be expected that some aspects of the design in this memorandum will be modified and, as appropriate, enhanced.

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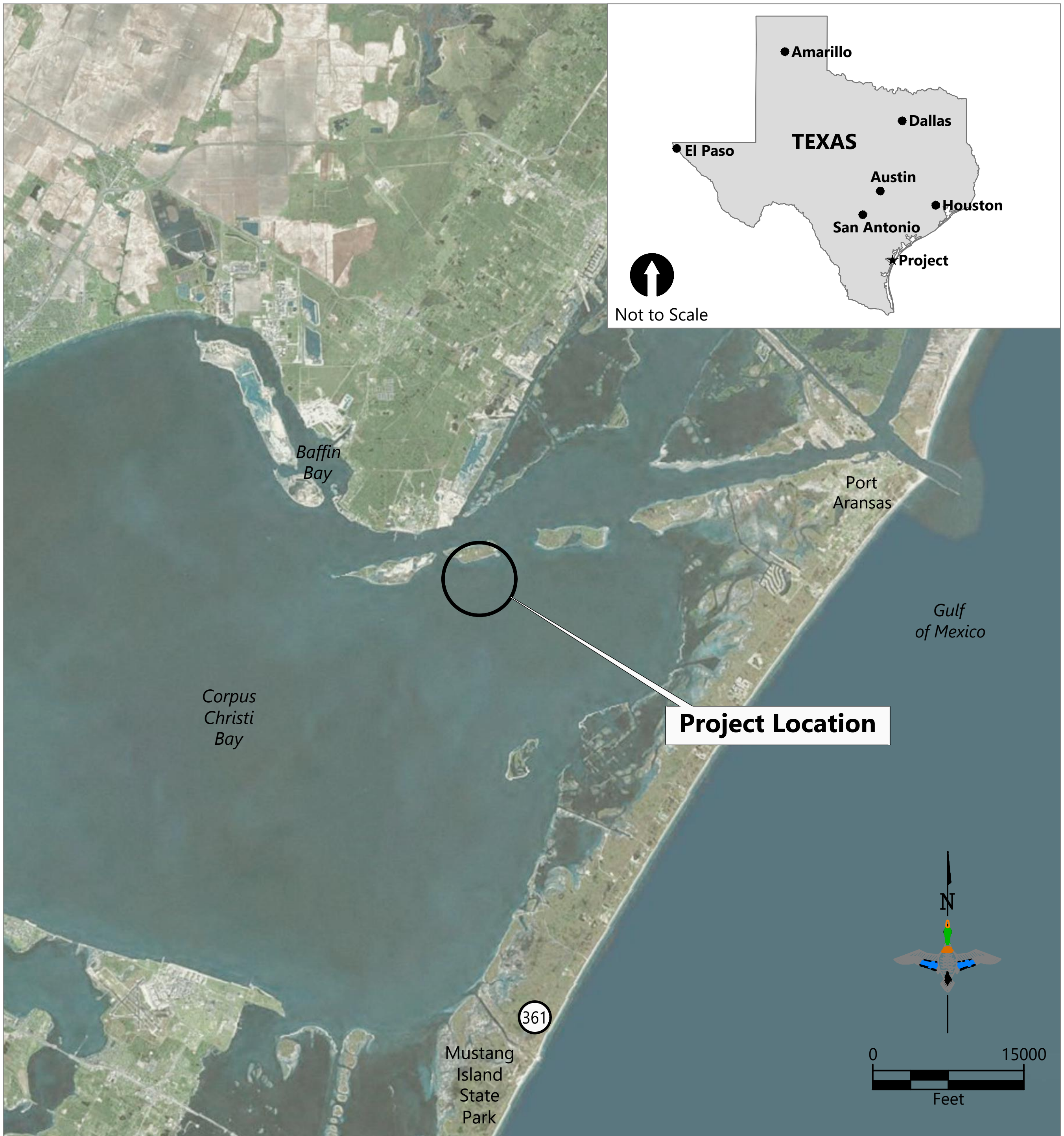
Figures



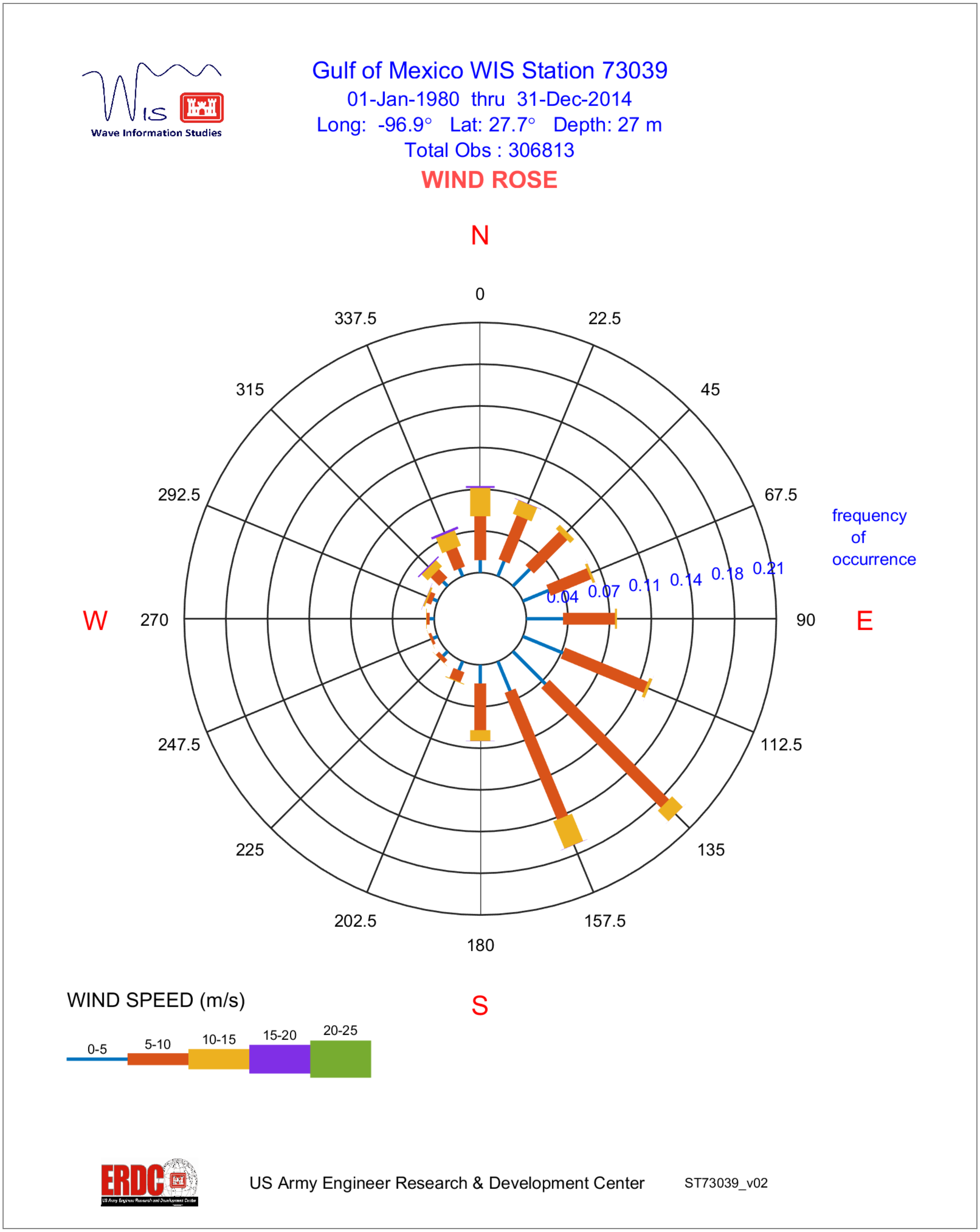
SOURCE: Aerial provided by Bing Maps.
HORIZONTAL DATUM: Texas State Plane South Zone, North American Datum of 1983, U.S. Survey Feet

Publish Date: 2022/04/21 1:49 PM | User: mpratschner
Filepath: K:\Projects\2018-PCCA Beneficial Use\PA9-S\2018 RP-001 VIC MAP.dwg Figure 1

ANCHOR QEA

Figure 1
Vicinity Map

PA9-S 30% Design Memorandum
Texas Lower Coast Beneficial Use



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ANCHOR QEA

Figure 2
Historical Wind Data for USACE WIS Station 73039

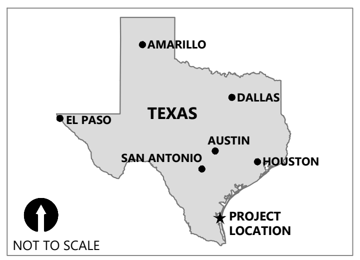
PA9-S 30% Design Memorandum
Texas Lower Coast Beneficial Use

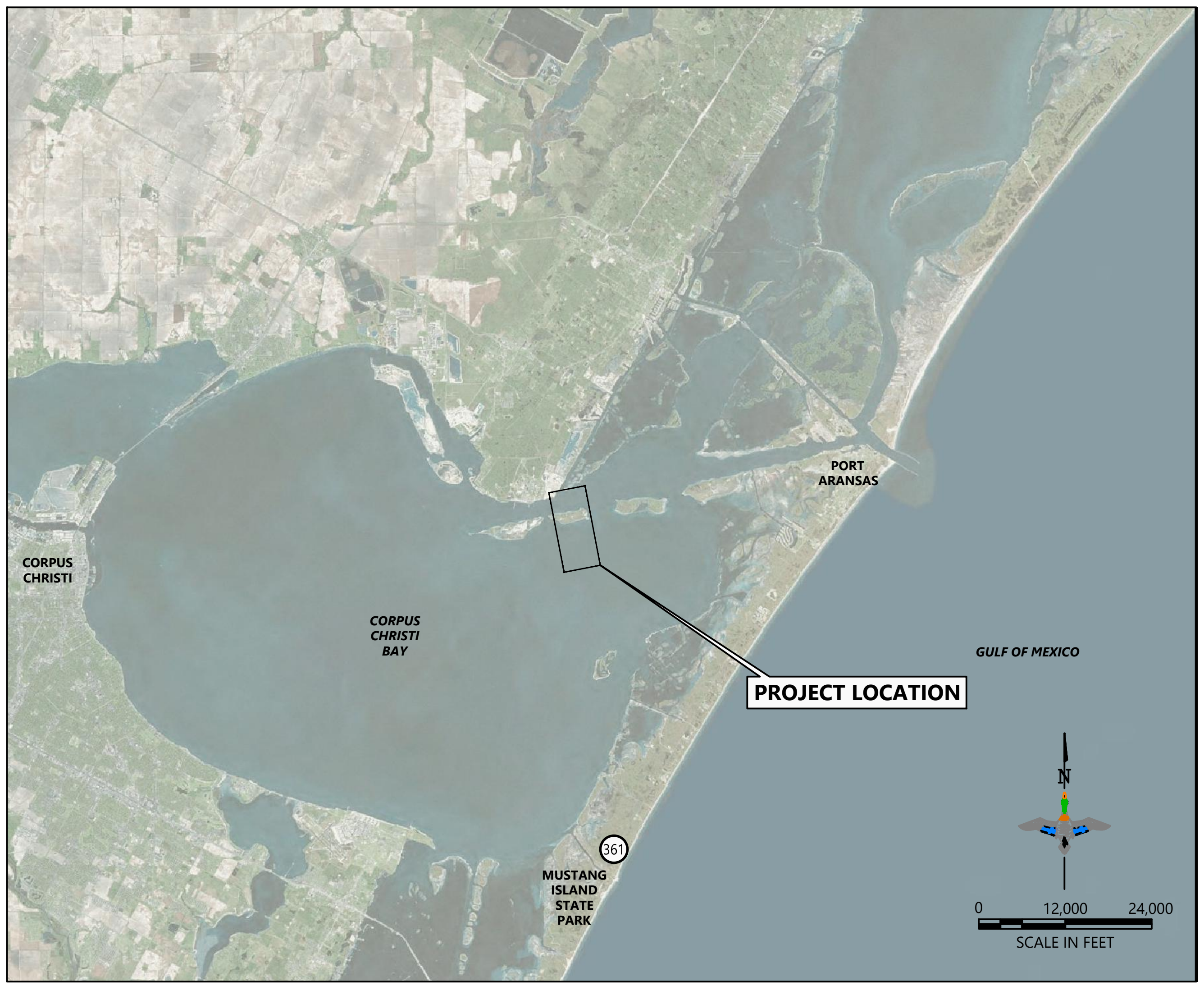
Attachment 1
Construction Drawings

30% DESIGN SUBMITTAL

TEXAS LOWER COAST BENEFICIAL USE - PA9-S

TEXAS GENERAL LAND OFFICE





AERIAL BY BING MAPS

DRAWING INDEX		
SHEET	DRAWING	TITLE
1	T01	TITLE SHEET
2	C01	PLAN VIEW
3	C02	TYPICAL DIKE SECTION

NOTES:

1. HORIZONTAL DATUM: TEXAS STATE PLANE SOUTH ZONE, NAD83, U.S. SURVEY FEET
2. VERTICAL DATUM: NORTH AMERICAN VERTICAL DATUM OF 1988 (NAVD88)
3. BATHYMETRIC, TOPOGRAPHIC, AND VISUAL HABITAT SURVEYS CONDUCTED BY DUCKS UNLIMITED ON MARCH 01, 2022.

PLAN INTENDED TO BE VIEWED IN COLOR. ADJACENT BLOCK IS "BLUE"

ONE INCH

AT FULL SIZE, IF NOT ONE INCH SCALE ACCORDINGLY

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Jun 29, 2022 3:06pm mpratschner

ANCHOR QEA

DUCKS UNLIMITED

REVISIONS				
REV	DATE	BY	APP'D	DESCRIPTION

DESIGNED BY: A. FREDDO
DRAWN BY: M. PRATSCHNER
CHECKED BY: R. ROBERTSON
APPROVED BY: J. LAPLANTE
SCALE: AS NOTED
DATE: JUNE 2022

TEXAS LOWER COAST BENEFICIAL USE - PA9-S

TITLE SHEET

T01

SHEET # 1 OF 3

LEGEND:

- PROPOSED DIKE
- U.S. ARMY CORPS OF ENGINEERS PLACEMENT AREA
- U.S. ARMY CORPS OF ENGINEERS OPEN WATER DREDGED MATERIAL PLACEMENT AREA
- GLO MAPPED PIPELINES
- RAILROAD COMMISSION OF TEXAS MAPPED OIL AND GAS INFRASTRUCTURE LOCATIONS
- DIRECTIONAL SURFACE LOCATION
- CORPUS CHRISTI SHIP CHANNEL
- TPWD MAPPED SEAGRASS
- -10- EXISTING CONTOUR (5')
- -3- EXISTING CONTOUR (1')
- OIL & GAS INFRASTRUCTURE

N

0 400 800

SCALE IN FEET

NOTES:

1. HORIZONTAL DATUM: TEXAS STATE PLANE SOUTH ZONE, NAD83, U.S. SURVEY FEET
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4. TEXAS PARKS AND WILDLIFE DEPARTMENT (TPWD), 2021. LAYER: SEAGRASS TWPD (ID: 2). ARCGIS REST SERVICES DIRECTORY. ACCESSED NOVEMBER 23, 2021.

PLAN INTENDED TO BE VIEWED IN COLOR. ADJACENT BLOCK IS "BLUE"

ONE INCH

AT FULL SIZE, IF NOT ONE INCH SCALE ACCORDINGLY

DRAFT-NOT FOR CONSTRUCTION

ANCHOR QEA

DUCKS UNLIMITED

REVISIONS

REV	DATE	BY	APP'D	DESCRIPTION

DESIGNED BY: A. FREDDO
DRAWN BY: M. PRATSCHNER
CHECKED BY: R. ROBERTSON
APPROVED BY: J. LAPLANTE
SCALE: AS NOTED
DATE: JUNE 2022

TEXAS LOWER COAST BENEFICIAL USE - PA9-S

PLAN VIEW

C01

SHEET # 2 OF 3

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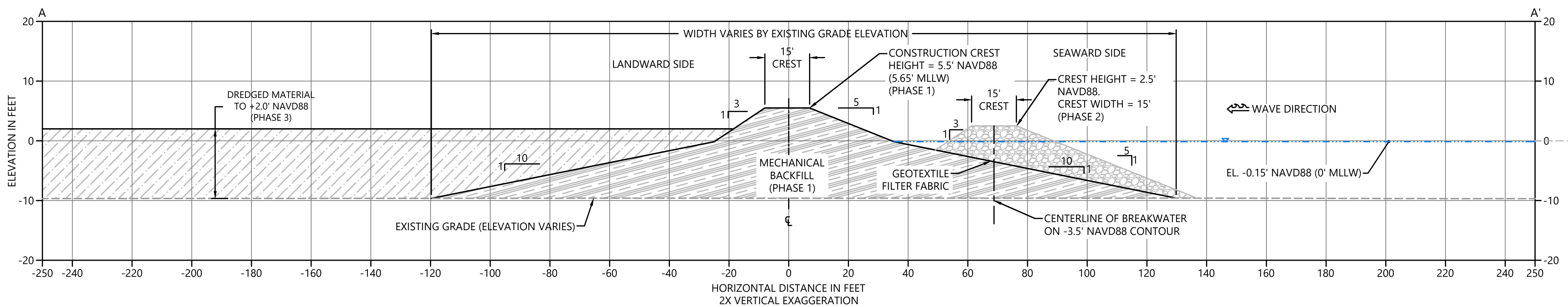
Jun 29, 2022 3:06pm mpratschner



A SECTION
C01
HORIZONTAL SCALE: 1" = 20'
VERTICAL SCALE: 1" = 10'

NOTES:

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PLAN INTENDED TO BE VIEWED IN COLOR. ADJACENT BLOCK IS "BLUE"

ONE INCH AT FULL SIZE, IF NOT ONE INCH SCALE ACCORDINGLY

DRAFT-NOT FOR CONSTRUCTION

ANCHOR QEA

TEXAS GENERAL LAND OFFICE ESTABLISHED 1836

DUCKS UNLIMITED

REVISIONS

REV	DATE	BY	APP'D	DESCRIPTION

DESIGNED BY: A. FREDDO
DRAWN BY: M. PRATSCHNER
CHECKED BY: R. ROBERTSON
APPROVED BY: J. LAPLANTE
SCALE: AS NOTED
DATE: JUNE 2022

TEXAS LOWER COAST BENEFICIAL USE - PA9-S

TYPICAL DIKE SECTION

C02

SHEET # 3 OF 3

Attachment 2

Technical Specification Outline

TABLE OF CONTENTS

Memorandum

June 30, 2022

To: Melissa McCutcheon, Texas General Land Office

From: Todd Merendino, Ducks Unlimited, Inc.
Sarah Garza, Harrison McNeil, and Yvonne Dives-Gomez, Port of Corpus Christi Authority
John Laplante, Dan Opdyke, Renee Robertson, Alexander Freddo, and Hayden Smith, Anchor QEA, LLC
Jane Sarosdy, Sarosdy Consulting, Inc.

Re: Pelican Island (M3) Marsh Restoration 30% Design Memorandum

Introduction

This 30% design memorandum describes design criteria and assessments associated with a beneficial use of dredged material (BU) project at the proposed Pelican Island (M3) site (Site), located in Texas General Land Office (GLO) Planning Region 3 of the Texas coast in Corpus Christi Bay in Nueces County, Texas (Figure 1).

Project Background

GLO awarded a Coastal Management Program Project of Special Merit grant (funded through the Gulf of Mexico Energy Security Act) to Ducks Unlimited, Inc. (DU) to coordinate with stakeholders and identify restoration sites for BU. The Port of Corpus Christi Authority (PCCA), a project partner, has also contributed staff and financial resources to expand the project scope. The project team is led by DU and PCCA and includes Anchor QEA, LLC; Sarosdy Consulting, Inc.; and the Texas Department of Transportation. Collectively, the project team coordinated three stakeholder meetings with state and federal resource agencies, nongovernmental organizations, academia, consultants, and local officials in each region to solicit information about potential BU sites. Based on stakeholder input, GLO feedback, publicly available data, and professional judgment, the project team has developed 10% designs for 18 sites in GLO Planning Regions 3 and 4 of the Texas coast and 2 GLO-approved sites in Mesquite Bay and San Antonio Bay in GLO Planning Region 2. After completion of the 10% designs, 11 of the designs were selected to continue to 30% designs, and up to 7 of those designs will be chosen for 60% designs and permit application packages. The project team selected the Site as one of the 20 sites for 10% design development and cost estimation. Based on the Site's restoration potential and construction feasibility, the project team selected the Site to proceed to

30% design and opinion of probable construction costs using funding from the GLO Coastal Management Program Project of Special Merit grant.

Pelican Island has been identified and used as a site for restoring rookery habitat (CBBEP 2020). This island has also been referred to as M3 in PCCA documents; hence, both names are used in this design. The Site is located on state-owned submerged land approximately 2 miles east of the Gulf Intracoastal Waterway (GIWW) and 0.4 mile south of the Corpus Christi Ship Channel (CCSC) in Corpus Christi Bay in Nueces County, Texas. The existing Pelican Island (M3) is composed of dredged material and partially contained within two dredged material placement areas (DMPAs; #7 and #8). Adjacent to the island is patchy seagrass habitat that has limited natural protection from wave energy. The existing Pelican Island was damaged during Hurricane Harvey, and the center of the island was washed out. Stakeholders also identified existing tidal flats with stable benthic communities that currently provide a high-value food source for shorebirds on Pelican Island. PCCA has expressed potential plans to extend the northern breakwater to the west and refill the center of the island. The BU design in this memorandum includes extending the eastern lobe on the south side of the island to create marsh, as well as bringing up the sea bottom on the western lobe of the south side of the island to tidal flat elevations to extend the existing tidal flat habitat. This design assumes the northern side of Pelican Island (M3) will be protected; therefore, this design does not include protection from that direction. The Site was selected to complement the existing rookery use of the upland to increase availability of food for birds, as well as to promote marsh and tidal flat habitat. This area was selected due to its proximity to potential maintenance dredged material from the CCSC, as well as potential dredged material from the proposed CCSC Channel Deepening Project.

Project Objectives

Frequent dredging is needed to develop and maintain Texas ship channels. The dredged material is often deposited in DMPAs, and many of the existing DMPAs along the Texas coast are nearing capacity. Resource agencies and stakeholders have long advocated using dredged material beneficially to create and restore wetlands and bird islands, nourish beaches, and counteract land loss. Historically, BU projects are difficult to manage because they are multiyear, multifaceted undertakings in which different organizations manage dredging schedules, funding, project design, permitting, and construction activities. To help address these issues, the objectives of this project include the following:

- Create and restore degrading coastal habitats.
- Establish sites for placement of dredged material to reduce reliance on existing DMPAs.
- Improve coastal resiliency of the natural and built environment.

To accomplish these objectives, the project includes the following tasks:

- Stakeholder outreach and coordination

- Identification and selection of BU sites
- 10% designs and cost estimates for 20 BU sites
- 30% designs for 11 BU sites
- 60% designs, cost estimates, and permit application packages for up to seven BU sites

This memorandum documents the 30% design and cost estimate for the Site.

Design Objectives

The Site is designed to beneficially use dredged material to create marsh and tidal flat habitats. The design will use material dredged from navigation channels during routine maintenance and, potentially, new work material from the proposed CCSC Channel Deepening Project, thus reducing the volume of such material that will need to be placed in existing open-bay or upland DMPAs. This 30% design is based upon publicly available datasets, as well as focused field work conducted by DU and PCCA.

Design objectives include the following:

- Develop a preliminary vision based on available data for the Site that includes the following:
  - Habitat to be created or restored
  - Potential sediment source(s)
  - Approaches to minimize long-term maintenance costs
- Delineate conceptual footprints for proposed BU placement.
- Identify key sensitive habitats and construction considerations in the vicinity of the Site.
- Estimate fill volumes for the proposed BU footprints.
- Identify data gaps to be addressed in subsequent design phases.
- Provide preliminary cost estimates.

Existing Data Review

A review of existing data and the focused data collected by DU and PCCA was performed to develop the Site and containment berm designs. This section describes the data reviewed and collected for the 30% design.

Horizontal and Vertical Datums

The horizontal datum used for the Site is the Texas State Plane South Zone, North American Datum of 1983 in U.S. survey feet. The primary vertical datum used for the Site design is the North American Vertical Datum of 1988 (NAVD88). The National Oceanic and Atmospheric Administration (NOAA) maintains two active tide gauges within the vicinity of the Site. The NOAA Ingleside, Moda Station 8775283 (Ingleside Station), is 2.5 miles to the west of the Site and has water level data back to 2021. The NOAA Port Aransas, TX Station 8775237, is 5 miles east of the Site and has water level data back to 2015. The Ingleside Station does not provide a NAVD88 vertical datum, but the Port Aransas station does. Due to the proximity of the NOAA stations, it was assumed that the difference between mean lower low water (MLLW) and NAVD88 at Port Aransas (-0.15 foot) could be used at Ingleside Station to shift the tidal datums from MLLW to NAVD88. Accordingly, the converted vertical datums, as well as the official datums in MLLW for the Ingleside Station that will be used for the Site are shown in Table 1. The NOAA USS Lexington Station 8775283 (Lexington Station) was also used to define a preliminary design water level, as described in the Water Level section.

Table 1
Ingleside Station Tidal Datums

Tidal Datums	Elevation (feet NAVD88)	Elevation (feet MLLW)
MHHW	0.56	0.71
MHW	0.55	0.70
MSL	0.25	0.40
MLW	-0.15	0.00
MLLW	-0.15	0.00

Notes:
Datums converted to NAVD88 using the Port Aransas, TX Station 8775237.
MHHW: mean higher high water
MHW: mean high water
MLW: mean low water
MSL: mean sea level

Meteorological, Ocean, and Wave Data

Water Level

To determine an approximate design water level elevation for the Site, an existing water level analysis using data from the Lexington Station, which is 14 miles west of the Site, was used due to a lack of recent, continuous water level data from the adjacent Ingleside Station (Anchor QEA 2021). Data were compiled for the period from October 2015 to January 2021 and used to calculate a 90th-percentile water level of 2.0 feet NAVD88.

The MHHW from the 1983 to 2001 tidal epoch at the Lexington Station is 1.02 feet NAVD88, which is 0.47 foot higher than at the Ingleside Station. Due to this difference in the MHHW, water levels at the Lexington Station were considered a conservative estimate of the water levels that would be experienced at the Site.

Wind and Waves

The U.S. Army Corps of Engineers (USACE) Wave Information Studies (WIS) provides a national resource of long-term wavefield climatologies for U.S. coastal waters that synthesizes observations, multi-decade hindcasts, and storm event archives (USACE 2021). The WIS station closest to the Site is Station 73039, just offshore on the Gulf side of Port Aransas in the Gulf of Mexico. Because the station is located offshore, the wave data are not applicable to this project design. However, the project team considers the wind data to be representative of the winds experienced at the Site. Figure 2 summarizes wind data from January 1, 1980, through December 31, 2014. The data indicate that the predominant wind direction is from the southeast, with significant winds also coming from the north, northeast, east, and south.

Wind and wave conditions for this phase of design were assumed to be the same as identified in the AECOM design report for the M10 site located 3.0 miles west of the Site (AECOM 2020). The wind speed and direction values used for the analysis were taken from the Packery Channel NOAA Tidal Station No. 8775792 at 3-hour intervals from June 2008 to June 2018. A Coastal Modeling System 2D numerical wave (CMS-Wave) model was used to simulate wind-driven waves from 180° to 270° (south to west) direction winds. Waves were generated with wind speeds varying from 3 to 51 knots (1.5 to 26.2 meters per second). The design wave was chosen based on the maximum wave height produced by the CMS-Wave model. This design wave and associated design period were extracted from the M10 report and used in this 30% analysis (Table 2). The wind speed used for the M10 design is considered conservative for this analysis because it represents the 99.9th percentile of the wind speeds recorded at WIS station 73039 from 1980 to 2014.

Table 2
Assumed Wind and Wave Data from M10 Design

Datum	Value
Wind direction (degrees)	210
Wind speed (knots)	39
Wave height (feet)	2.687
Wave period (seconds)	3.63

Note:
Source: (AECOM 2020)

Wake Erosion

The GIWW is approximately 0.5 mile west of the Site, and the CCSC is approximately 0.4 mile north of the Site. However, ships do not often use this portion of the GIWW (Hamilton et al. 2018). Potential wake erosion from vessels transiting the CCSC, from smaller vessels transiting the GIWW, and recreational vessels traveling near the Site are expected to be design considerations during subsequent design phases. Wake erosion from recreational vessels and the ship channels is not expected to drive the containment berm design; however, it may inform the transition of the containment berm to the existing island to prevent wake-driven scour around the edge of the containment berm. These impacts will be evaluated during subsequent design phases.

Bathymetry and Topography

In March 2022, DU conducted a bathymetric and topographic survey of the Site. As shown in Attachment 1, C02, the Site contours range from -10 feet NAVD88 to +2 feet NAVD88. During the survey, DU conducted sediment probing in areas of the Site shallower than -2 feet NAVD88 and, within those areas, qualitatively determined that the material was firm.

Utilities and Infrastructure

The Railroad Commission of Texas public GIS viewer (RRC 2021) and GLO pipeline data (GLO 2021a) were used to identify mapped utilities and pipelines near the Site. There are several pipelines near the Site, including an Enbridge Pipelines (TX Intra) LP natural gas pipeline; a Corpus Christi Leaseholds, Inc., natural gas pipeline; and multiple Cinco Natural Resources Corporation natural gas full well stream pipelines that come as close as 100 feet of the Site to the southeast and southwest. In addition, there may be a pipeline that crosses the center of the Site; this issue will be evaluated in more detail in subsequent phases of design. There were also several plugged wells identified within the Site, as shown in Attachment 1, C01. The footprint of the Site was refined to avoid containment structures being placed directly on top of plugged wells. Several oil and gas platforms and an active well have been identified near the Site and are also shown in Attachment 1, C01. Communications with the owners regarding these structures are ongoing.

Impacts of pipelines, wells, and platforms on the constructability of the Site will need to be evaluated during subsequent design phases, and offsets that modify the Site footprint and reduce potential storage capacity may be needed. The need for Site-specific utility locations prior to construction will be determined during subsequent design phases.

Desktop Cultural Resources Survey

A search of cultural resources records in the Texas Historical Commission Texas Historical Sites Atlas Database was completed for the Site on December 2, 2021. This search revealed that one archaeological survey has been conducted in part of the western portion of the proposed placement site area. No archaeological sites have been identified within the preliminary proposed placement site boundary (THC 2021).

Sensitive Habitat

GLO oyster habitat GIS data (GLO 2021b) indicate there is no oyster habitat identified within or adjacent to the Site. According to Texas Parks and Wildlife Department seagrass data (TPWD 2021), patchy seagrass habitat has been mapped near the Site (Attachment 1, C01).

Seagrasses were observed between the existing DMPAs just north of the Site footprint during the visual survey conducted by DU in March 2022. Conversations with David Newstead of the Coastal Bend Bays & Estuaries Program identified an area of existing tidal flat habitat on the western lobe of the Site (Newstead 2022).

Beneficial Use Source Material

The main potential sources of dredged material are the CCSC, located adjacent to the Site, as well as side casted material within the footprint of the Site. Continued maintenance dredging has recently been confirmed by USACE (Jones 2021). The quantity and characteristics of dredged material that may be available for placement at the Site are shown in Tables 3 and 6. There are three potential USACE DMPAs used by USACE adjacent to the Site with a total average annual dredging volume of 126,000 cubic yards (CY). It is expected that the quantity of dredged material will likely increase with completion of the ongoing CCSC channel deepening under the Channel Improvement Project. The majority of the dredged sediment appears to be sand (Table 4).

Table 3
USACE DMPA Areas Near the Site that Received Dredged Material

DMPA No.	CCSC Channel Segment (Station)	Distance from Site to DMPA (miles)	Average Annual Dredging Quantity (CY)
7 (also referred to as Pelican Island or M3)	Inner Basin to La Quinta Junction (270+00-320+00)	0.4	35,000
8 (also referred to as Pelican Island or M3)	Inner Basin to La Quinta Junction (320+00-400+00)	0.7	40,000
9	Inner Basin to La Quinta Junction (400+00-500+00)	1.9	51,000

Note:
Source: USACE 1999

Table 4
Typical Sediment Characteristics Between the Inner Basin to La Quinta Junction

Sediment Characteristics
D_{50} (mm) = 0.256
87.8% sand
6.6% silt
5.7% clay

Notes:
Channel segment: (0+00-200+00)
Source: USACE 1999
mm: millimeter

Other potential sediment sources include the proposed CCSC Channel Deepening Project and material from within the Site footprint. The CCSC Channel Deepening Project could potentially provide a substantial portion of the material used at the Site. Based on the DU sediment probes, Google Earth aerial imagery, as well as the sediment characteristics of maintenance material that has been sampled for a portion of the CCSC from the Inner Basin to La Quinta Junction, the material in the Site footprint may contain a high percentage of sand. Further information will need to be collected during a subsequent phase of design to evaluate the precise sediment characteristics of the potential new work and Site footprint sediments.

Marsh Vegetation Elevation Ranges

Table 5 shows typical habitat ranges for relevant marsh vegetation based on site vegetation surveys conducted by PCCA at the Dagger Island and Nueces Bay Portland marsh in Redfish Bay and Nueces Bay, respectively. The range represents minimum and maximum values found during the survey, while the mode represents the most frequently occurring values during the survey. Mode was used as the most accurate representation of the conditions for the Site.

Table 5
Typical Elevations for Target Marsh Vegetation

	Dagger Island: Elevation (feet MSL)		Portland Nueces Bay Marsh: Elevation (feet MSL)	
Species	**Range**	**Mode**	**Range**	**Mode**
High marsh	1.0 to 4.2	1.6 to 2.3	N/A	N/A
Low marsh	-1.1 to 3.3	0.6 to 1.1	0.4 to 1.8	0.7 to 0.9
Seagrass	-5.4 to 0.9	-3.0 to -0.7	N/A	N/A
Smooth cordgrass	-1.5 to 1.5	-0.4 to 0.3	0.2 to 0.5	-0.2 to 0.0
Sand flats	1.93 to 1.94	1.93 to 1.94	N/A	N/A
Uplands	2.3 to 5.9	2.3 to 5.9	N/A	N/A

Note:
N/A: not applicable

30% Design

The main design elements evaluated for the Site are as follows:

- Site location
- Marsh and tidal flat size and shape
- Containment and erosion protection
- Constructability
- Planting and natural recruitment of vegetation
- Performance expectations

- Site construction cost estimates
- Expected ecosystem benefits
- Data and information gaps

These design elements are evaluated in this memorandum for the 30% Site design.

Site Location

The Site is approximately 2 miles east of the GIWW and 0.4 mile south of the CCSC near Ingleside in Corpus Christi Bay and between the existing PA9-S Island and Mustang Island (Figure 1). The Site is on the southern end of the existing Pelican Island, which contains portions of DMPAs #7 and #8.

Marsh and Tidal Flat Size and Shape

Based on availability of sediment, a cost analysis, and stakeholder feedback, the project team proposes that the area of the Site be 260 acres as follows (Attachment 1, C02):

- 160 acres on the eastern portion of the Site (marsh)
  - 105 acres of marsh
  - 55 acres of containment berm
- 100 acres on the western portion of the Site (tidal flats)
  - Aquatic habitat with at least 20 acres of tidal flats

As discussed in the Utilities and Infrastructure section, the size and shape of the Site may need to be refined during subsequent design phases due to the pipelines, wells, and platforms in and near the site footprint. The average seabed elevation of the Site is -3.94 feet NAVD88 (-3.79 feet MLLW) and -2.6 feet NAVD88 (-2.45 feet MLLW) on the eastern and western portions of the Site, respectively.

The marsh will extend from the shoreline of the existing upland area out to the existing -8-foot NAVD88 contour. Sediment will be placed within a range of elevations, typically between 0 to 3.0 feet NAVD88, to create a variety of habitats. The marsh is being designed for the upper end of the suitable habitat range for smooth cordgrass (*Spartina alterniflora*), 1.5 feet MSL (1.75 feet NAVD88; Table 5). For constructability, the target elevation for the dredged material is +2.0 feet NAVD88. The elevation of dredged material fill will be adjusted at further phases of design, depending on the physical properties of the dredged material and to target varying habitats of low and high marsh, smooth cordgrass, tidal flat, and open water.

In the footprint of the proposed tidal flats, existing elevations between 0 to -1 foot NAVD88 will be brought up to 0 foot NAVD88 (-0.25 foot MSL). This is a preliminary target elevation for tidal flat habitat and may be refined during subsequent design phases. The tidal flat will slope down from the outer edge of the fill to the seabed at a 100 horizontal to 1 vertical (100H:1V). This design aims to extend the existing tidal flat habitat by at least 20 acres. This will also increase the resilience of the existing tidal flat by causing wave breaking to occur farther from the existing tidal flat habitat.

Fill material could be obtained from the CCSC, as described in the Beneficial Use of Source Material section. Table 6 shows the estimated fill and settlement volumes needed for the marsh and tidal flat construction. DU conducted sediment probing in areas of the Site shallower than -2 feet NAVD88 and, within those areas, qualitatively determined that the material was firm and is not expected to have substantial settling. Based on the information in Table 3, the Site is expected to be filled over several dredging cycles. To determine expected settling of the fill material and containment berm, geotechnical analysis of the substrate within the containment berm footprint and fill area will need to be conducted during subsequent design phases.

Table 6
Site Volume Summary

Fill	Total Volume (CY)
Marsh	2,000,000[1]
Tidal flats	100,000

Notes:
"Total Volume" is the sum of settled and non-settled volume. Values assume 1 foot of foundation compression for every 6 feet of fill.
1. Assumes containment berm is built completely with side casted material from within the marsh footprint

Relative sea level rise may impact the Site in the future. A strategy to mitigate against relative sea level rise could be to place BU material to higher elevations in preparation for higher relative sea levels and tidal elevations associated with sea level rise. However, placement of BU material above approximately 2.0 feet NAVD88 in the marsh portion and 0.0 feet NAVD88 in the tidal flat portion of the Site would not allow for near-term low marsh and tidal flat habitat development and, hence, would not meet the Site objectives. Therefore, for the purposes of Site design, relative sea level rise is not considered. The impacts of relative sea level rise may be mitigated in the future through adaptive management strategies such as thin-layer placement of additional dredged material.

Containment and Erosion Protection

For the marsh, a 6,000-foot-long sand containment berm will be constructed to create capacity and protect the placed dredged material and created intertidal habitats from erosion. Sand from within the footprint of the Site or sandy maintenance material from the channel could be used to construct the containment berm. Material for the sand containment berm would be side casted from sandy material within the identified borrow area shown in Attachment 1, C03.

Table 7 summarizes the proposed constructed containment berm design, as well as the projected final containment berm configuration after a period of natural reconfiguration under wind and wave forces. The containment berm will reside on a varied grade ranging from +3 feet NAVD88 to -8 feet NAVD88 along the length of the containment berm. The constructed containment berm is expected to be transformed and take on a more natural appearance (final containment berm) through wind-wave action to its final design characteristics in the span of weeks to months. Final containment berm geometries were also estimated for the 30% design (Table 7). The required volume to construct the containment berm is 800,000 CY. Dredging the entire footprint of the borrow site down 7 feet below the existing mudline would provide almost 900,000 CY of dredged material, which is more than sufficient to construct the containment berm. Depending on stakeholder and regulatory agency feedback, the containment berm may have sills to allow tidal flow into the contained marsh via open water channels extending into the marsh. The locations and geometry of the sills will be determined based on discussions with regulatory agencies during final design. The constructed and final slope and cross-sectional dimensions of the containment berm will be further refined through modeling and analysis of the sediment characteristics of the dredged material, the containment berm subgrade, the hydrodynamic and wind-wave conditions. and an analysis of initial capital construction costs versus maintenance costs during a subsequent phase of design.

Table 7
Containment Berm Design Characteristics

Design Criteria	Constructed Containment Berm	Final Containment Berm
Length	6,000 feet	6,000 feet
Total acreage	33 acres	53 acres
Crest width	130 feet	10 feet
Base width[1]	240 feet	390 feet
Assumed bottom elevation[1]	-5.60 feet NAVD88	-5.60 feet NAVD88
Total structure height[1]	12 feet	11 feet
Materials	Sand	Sand
Volume	800,000 CY	800,000 CY
Design side slopes (seaward side)	5H:1V	30H:1V
Design side slopes (landward side)	4H:1V	4H:1V
Maximum design crest elevation	7.0 feet NAVD88	6.0 feet NAVD88

Note:
1. Based on average elevation along the containment berm

Temporary containment may need to be placed between the marsh and tidal flat portions of the Site and the seagrasses identified north of the Site (Attachment 1).

Constructability

Final construction would be based on the selected means and methods and selected equipment from the contractor; however, construction could potentially be conducted in three main phases. In addition, the contractor may provide alternate construction methods from those described in this section.

The Site could be constructed in two different phases, as follows.

Phase I

Sandy material from within the borrow area would be placed using a combination of hydraulic and mechanical dredging to build up the containment berm. After the containment berm is placed, wind-wave and hydrodynamic forcing would erode the front of the containment berm down to the final design slope, crest width, and crest height.

Phase II

Fill material from either maintenance or new work dredging would be hydraulically placed into the marsh and tidal flat portions of the Site. Thin-layer placement could be used to construct the design slopes identified on the tidal flat portion of the Site.

Planting and Natural Recruitment of Vegetation

Based on stakeholder input and cost considerations, the project team determined that hydroseeding the edges of the marsh will be the most effective method for vegetating the marsh portion of the Site. Natural vegetation recruitment will then be allowed to proceed from the edge of the marsh inward. If the outcome is unsatisfactory (e.g., if the marsh has a lower-than-expected density of vegetation or if undesirable species of vegetation are present), an adaptive management program can be instituted to modify the vegetation. Table 5 shows some of the targeted vegetation and their preferred habitat elevations. There is no planned planting for the tidal flat portion of the Site.

Performance Expectations

The performance goal for the project is to create 105 acres of sustainable high and low marsh, smooth cordgrass, and open water habitat and more than 20 acres of tidal flat habitat. The designed containment berm is expected to contain placement of dredged material, be resilient to typical storm events, and provide protection for the interior habitat. The gradual slope constructed on the seaward side of the tidal flat habitat is expected to provide erosion protection to the tidal flat habitat.

Site Construction Cost Estimates

Construction costs were estimated for the design outlined in the previous sections. The estimated costs include permitting, 100% design, engineering costs for advancing the design to the construction phase, preconstruction and as-built surveys, mobilization, and materials. These costs represent the estimated incremental costs (i.e., those costs over and above USACE's least-costly and environmentally acceptable dredged material and disposal alternative). Because the Site is close to sediment sources, the Site should allow for lower construction costs compared to more remote potential marsh restoration sites. Table 8 shows a line-item list of each costing parameter and the total cost estimated for construction.

The estimates are developed using current and generally accepted engineering cost estimating methods and are based on assumptions concerning future events. Actual costs may be affected by known and unknown risks including, but not limited to, changes in general economic business conditions, Site conditions that were unknown at the time the estimates were performed, future changes in Site conditions, regulatory or enforcement policy changes, and delays in performance. Actual costs may vary from these estimates.

The costs range from $18.4 million to $39.5 million, depending on the level of contingency allocated to the project cost. The lower bound of uncertainty (-30%) and upper bound of uncertainty (+50%) were selected due to the existing data gaps, high levels of inflation, and rising fuel costs. Cost savings may be realized by further analysis and modeling of wind and wave conditions during subsequent design phases and refining the size and dimensions of the containment berm.

Table 8
Opinion of Probable Construction Cost to 100% Project Completion

Item	Quantity	Unit	Unit Price	Total
Direct Construction Costs				
Phase 1: Containment Berm Construction				
Incremental Mobilization and Demobilization[1,2]	1	%	10	$ 1,000,000.00
Preconstruction Survey	1	LS	$ 30,000.00	$ 30,000.00
Containment Berm[2]	800,000	CY	$ 12.00	$ 9,600,000.00
As-Built Survey/Aerials	1	LS	$ 40,000.00	$ 40,000.00
Navigational Aids[3]	12	Each	$ 4,000.00	$ 50,000.00
Phase 1 Subtotal[2]			**Sum**	**$10,700,000.00**
Phase 2: Marsh and Tidal Flat Fill Placement				
Incremental Mobilization and Demobilization[1,2]	1	%	10	$ 1,200,000.00
Preconstruction Survey	1	LS	$ 30,000.00	$ 30,000.00
Incremental Dredging Cost (1-Mile Pipeline)[2]	2,000,000	CY	$ 6.00	$ 12,000,000.00
Hydroseeding[3]	120,000	sf	$ 0.20	$ 20,000.00
As-Builts/Aerials	1	LS	$ 40,000.00	$ 40,000.00
Phase 2 Subtotal[2]			**Sum**	**$13,300,000.00**
Direct Construction Total[2]			**Sum**	**$24,000,000.00**

Item	Quantity	Unit	Unit Price	Total
Indirect Construction Costs				
100% Engineering and Design[2]	1	LS	$700,000.00	$ 700,000.00
Permitting	1	Each	$100,000.00	$ 100,000.00
Construction Management[2]	1	%	6	$ 1,400,000.00
Post-Construction Management[4]	12	Month	$ 10,000.00	$ 120,000.00
Indirect Construction Subtotal[2]			**Sum**	**$ 2,300,000.00**
Project Subtotal[2]			**Sum**	**$26,300,000.00**
-30% Uncertainty[2]	1	%	30	$ 7,900,000.00
+50% Uncertainty[2]	1	%	50	$ 13,200,000.00
Low-End Total Project Estimated Cost[2]			**Total Sum**	**$18,400,000.00**
High-End Total Project Estimated Cost[2]			**Total Sum**	**$39,500,000.00**

Notes:
Costs were determined based upon a combination of publicly available datasets and sediment surface grabs, and topographic, bathymetric, and visual habitat surveys.
Mobilization and demobilization costs are based on line items within their respective phases.

1. Cost is based upon mobilizing equipment beyond what is required for dredging the CCSC (i.e., excavators)
2. Value is rounded to the nearest $100,000.
3. Value is rounded to the nearest $10,000.
4. Post-construction management may include Site visits to observe the material consolidation, vegetation, and water levels on the Site. Monthly aerials may be performed. Additional post-construction management practices may be considered during subsequent phases of design.

LF: linear foot
LS: lump sum
sf: square foot

Expected Ecosystem Benefits

Creation of the Site is expected to have positive benefits on the regional ecosystem. The marsh and tidal flat restorations are expected to add 105 acres of mash habitat and more than 20 acres of tidal flat habitat to the regional ecosystem. The sand containment berm and extended, shallow tidal flat slope created at the Site will also provide resiliency to the degrading existing shoreline of Pelican Island (M3) and increase foraging habitat for birds.

The mean relative sea level rise at Corpus Christi is 5.54 millimeters per year (NOAA 2022). Assuming no changes in the mean relative sea level rise and no erosion, as well as not considering inorganic and organic accretion, the marsh within the target elevation of the Site (2.0 feet NAVD88 or 1.75 feet MSL) would be below MSL by 2120.

Data and Information Gaps

At this phase of design, the following data and information gaps have been identified:

- Coordination with USACE will be necessary, given that the Site is partially within two DMPAs. USACE staff have indicated that for them to support the Site, it should avoid limiting its future placement of material, either by making it more costly to place material in its DMPAs, decreasing the capacity of its DMPAs, or by creating habitat for sensitive species that could inhibit future placement of material.

- Site-specific wind-generated and vessel wake wave heights, which would inform the optimization of the containment berm design, should be identified.
- Geotechnical characteristics of the source material (maintenance and new work material) and subgrade of the placement area would refine evaluations of containment structure stability, subgrade and source material settlement, and short- and long-term capacity for dredged material placement.
- Refined survey information such as property lines, utility locations, and supplemental bathymetry, where appropriate, is needed.
- A detailed survey of the benthic community present in the tidal flats would refine the tidal flat restoration and preservation goals, including target elevation(s).

These data gaps may need to be addressed during the progression from 30% design to final design. This current project is taking the analyses as far as practicable, considering the constraints of the project scope, budget, and schedule.

Future Work

Of the sites selected for 30% designs in this project, up to seven will be selected for 60% designs, cost estimates, and permit packages. No fatal flaw has been identified at this phase of the design. Discussions with infrastructure owners near the Site footprint are ongoing and may affect the Site footprint and design during subsequent design phases. Should the Site be selected for additional design efforts, it can be expected that some aspects of the design in this memorandum will be modified and, as appropriate, enhanced.

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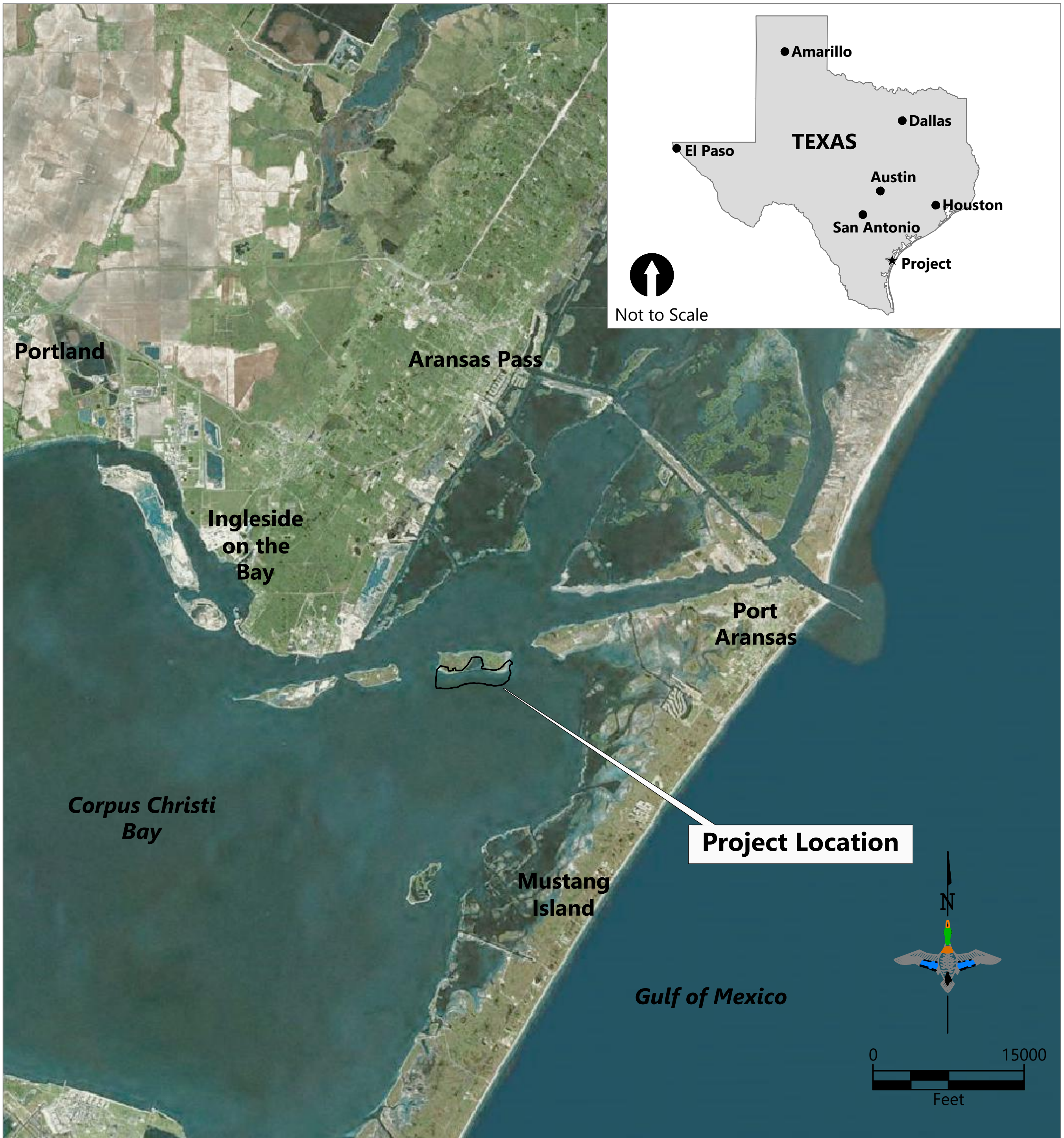
USACE, 2021. "Wind Rose." *Wave Information Studies*. Accessed November 1, 2021. Available at: http://frf.usace.army.mil/wis/data.

Figures



SOURCE: Aerial provided by Bing Maps.
HORIZONTAL DATUM: Texas State Plane South Zone, North American Datum of 1983, U.S. Survey Feet

ANCHOR QEA

Figure 1
Vicinity Map

Pelican Island (M3) 30% Design Memorandum
Texas Lower Coast Beneficial Use

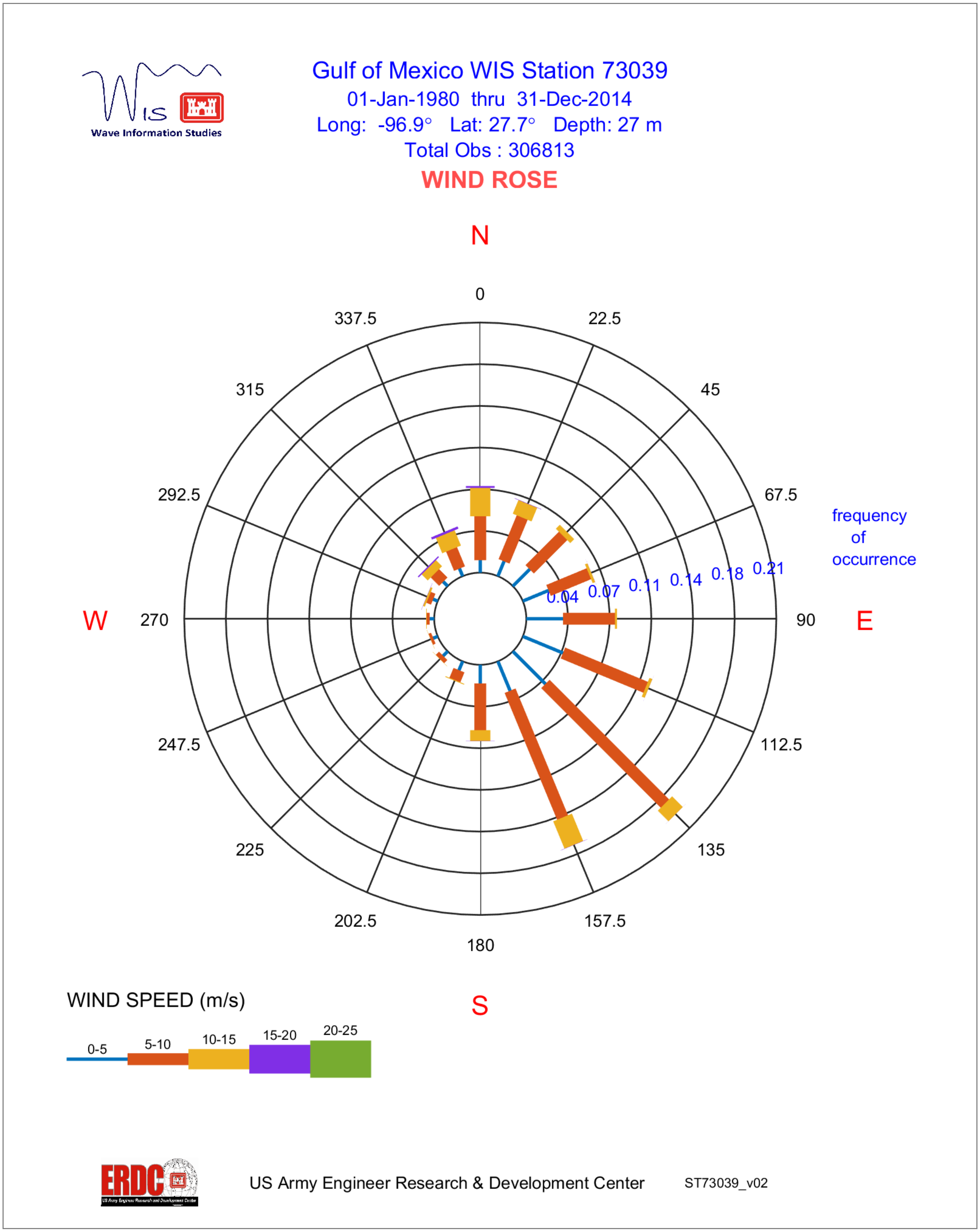


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Figure 2
Historical Wind Data for USACE WIS Station 73039
Pelican Island (M3) 30% Design Memorandum
Texas Lower Coast Beneficial Use

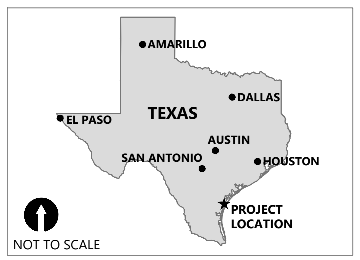
Attachment 1

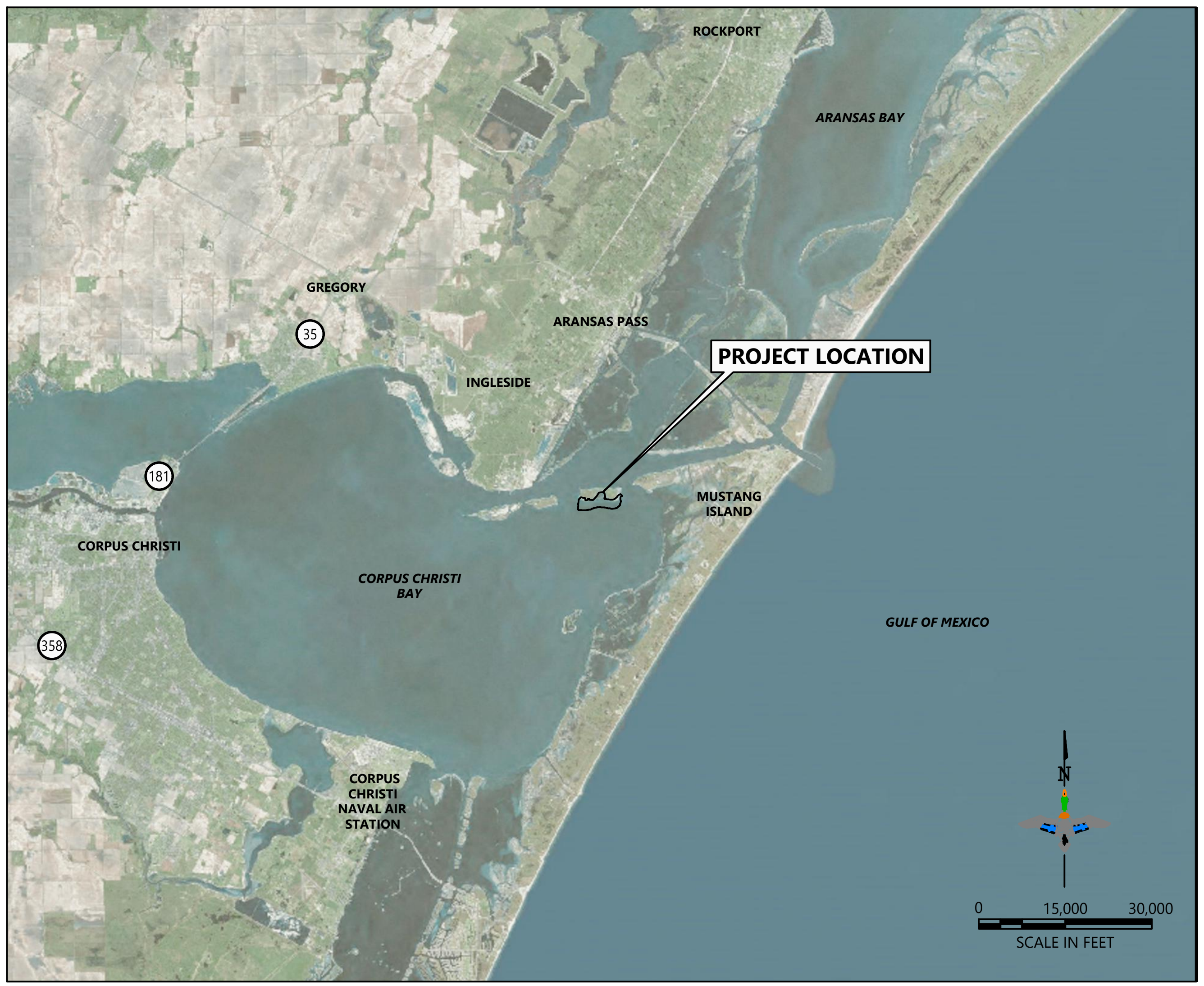
Construction Drawings

30% DESIGN SUBMITTAL

TEXAS LOWER COAST BENEFICIAL USE - PELICAN ISLAND (M3)

TEXAS GENERAL LAND OFFICE





AERIAL BY BING MAPS

DRAWING INDEX		
SHEET	DRAWING	TITLE
1	T01	TITLE SHEET
2	C01	EXISTING CONDITIONS
3	C02	PLAN VIEW
4	C03	TYPICAL MARSH FILL SECTION
5	C04	TYPICAL TIDAL FLAT FILL SECTION

NOTES:

1. HORIZONTAL DATUM: TEXAS STATE PLANE SOUTH ZONE, NAD83, U.S. SURVEY FEET
2. VERTICAL DATUM: NORTH AMERICAN VERTICAL DATUM OF 1988 (NAVD88)
3. BATHYMETRIC, TOPOGRAPHIC, AND VISUAL HABITAT SURVEYS CONDUCTED BY DUCKS UNLIMITED ON MARCH 15, 2022.

PLAN INTENDED TO BE VIEWED IN COLOR. ADJACENT BLOCK IS "BLUE"

ONE INCH

AT FULL SIZE, IF NOT ONE INCH SCALE ACCORDINGLY

DRAFT-NOT FOR CONSTRUCTION

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Jun 29, 2022 2:30pm mpratschner

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TEXAS GENERAL LAND OFFICE ESTABLISHED 1836

DUCKS UNLIMITED

REVISIONS				
REV	DATE	BY	APP'D	DESCRIPTION

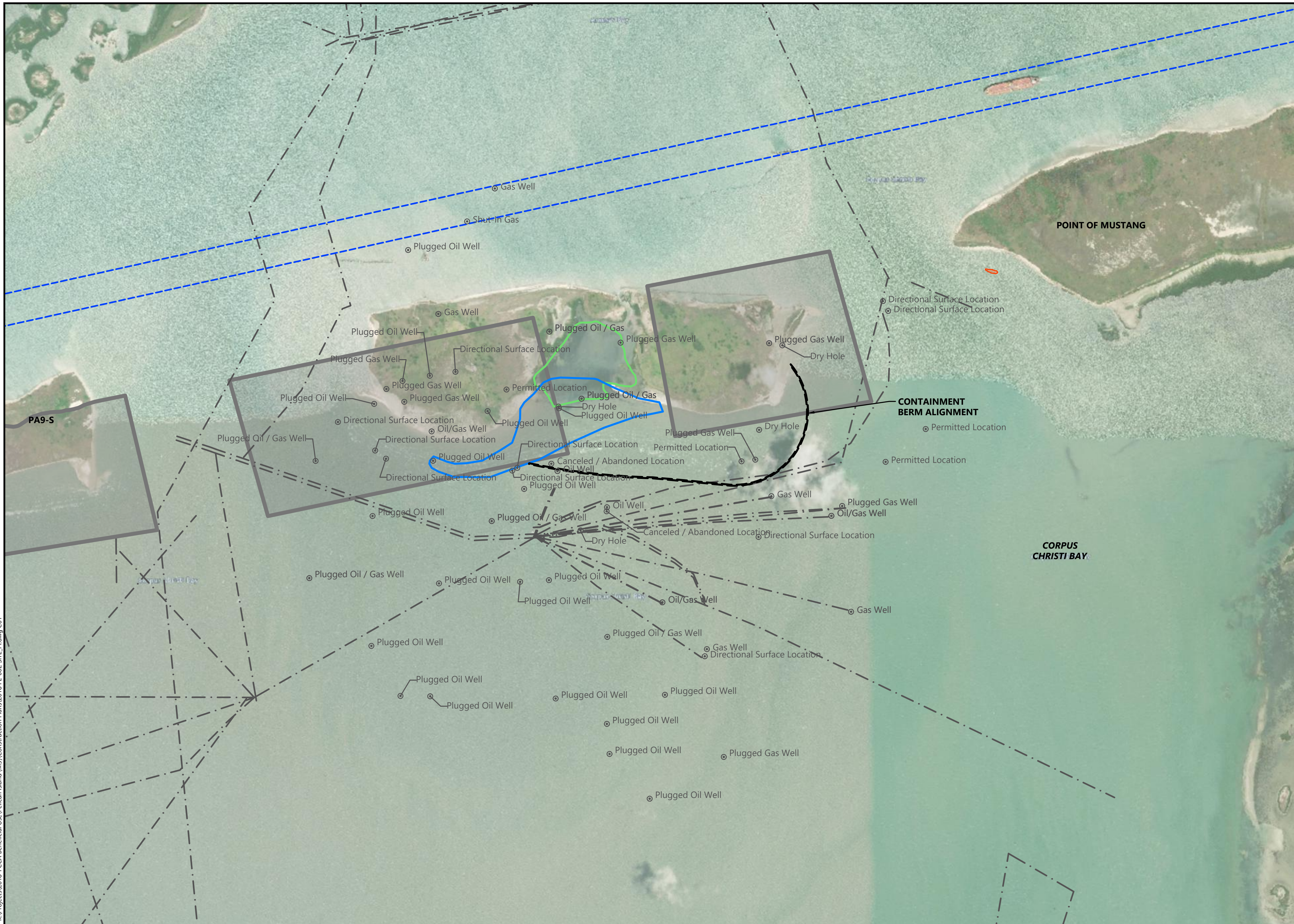
DESIGNED BY: A. FREDDO
DRAWN BY: M. PRATSCHNER
CHECKED BY: R. ROBERTSON
APPROVED BY: J. LAPLANTE
SCALE: AS NOTED
DATE: JUNE 2022

TEXAS LOWER COAST BENEFICIAL USE - PELICAN ISLAND (M3)

TITLE SHEET

T01

SHEET # 1 OF 5



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- PROPOSED CONTAINMENT BERM
- CORPUS CHRISTI SHIP CHANNEL
- EXISTING CONTOUR (5')
- EXISTING CONTOUR (1')
- U.S. ARMY CORPS OF ENGINEERS OPEN WATER DREDGED MATERIAL PLACEMENT AREA
- GLO MAPPED PIPELINES
- RAILROAD COMMISSION OF TEXAS MAPPED OIL AND GAS INFRASTRUCTURE LOCATIONS
- GLO MAPPED OYSTER HABITAT
- APPROXIMATE EXISTING TIDAL FLATS
- DUCKS UNLIMITED OBSERVED SEAGRASS

N

0 800 1600

SCALE IN FEET

NOTES:

1. HORIZONTAL DATUM: TEXAS STATE PLANE SOUTH ZONE, NAD83, U.S. SURVEY FEET
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PLAN INTENDED TO BE VIEWED IN COLOR. ADJACENT BLOCK IS "BLUE"

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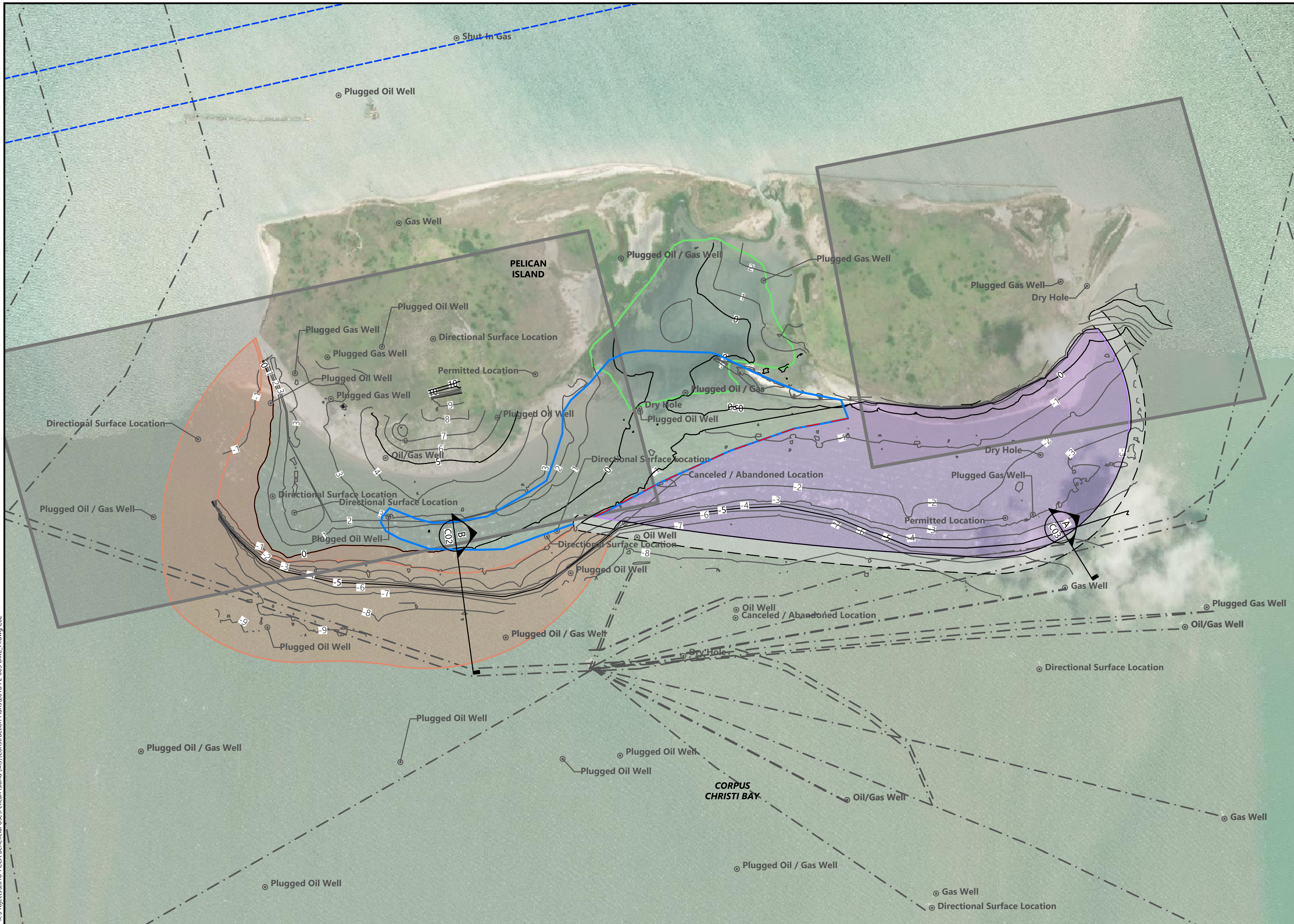
DRAWN BY: M. PRATSCHNER
CHECKED BY: R. ROBERTSON
APPROVED BY: J. LAPLANTE
SCALE: AS NOTED
DATE: JUNE 2022

TEXAS LOWER COAST BENEFICIAL USE - PELICAN ISLAND (M3)

EXISTING CONDITIONS

C01

SHEET # 2 OF 5



LEGEND:

PROPOSED CONTAINMENT BERM

EXISTING CONTOUR (5')

EXISTING CONTOUR (1')

GLO MAPPED PIPELINES

RAILROAD COMMISSION OF TEXAS MAPPED OIL AND GAS INFRASTRUCTURE LOCATIONS

U.S. ARMY CORPS OF ENGINEERS OPEN WATER DREDGED MATERIAL PLACEMENT AREA

MARSH FILL: APPROX. ELEVATION +1.5' NAVD88

TIDAL FLAT FILL: APPROX. ELEVATION 0' NAVD88

APPROXIMATE EXISTING TIDAL FLATS

DUCKS UNLIMITED OBSERVED SEAGRASS

CORPUS CHRISTI SHIP CHANNEL

TEMPORARY CONTAINMENT

N

0 800 1600

SCALE IN FEET

NOTES:

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PLAN INTENDED TO BE VIEWED IN COLOR. ADJACENT BLOCK IS "BLUE"

ONE INCH

AT FULL SIZE, IF NOT ONE INCH SCALE ACCORDINGLY

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TEXAS GENERAL LAND OFFICE ESTABLISHED 1836

DUCKS UNLIMITED

REVISIONS

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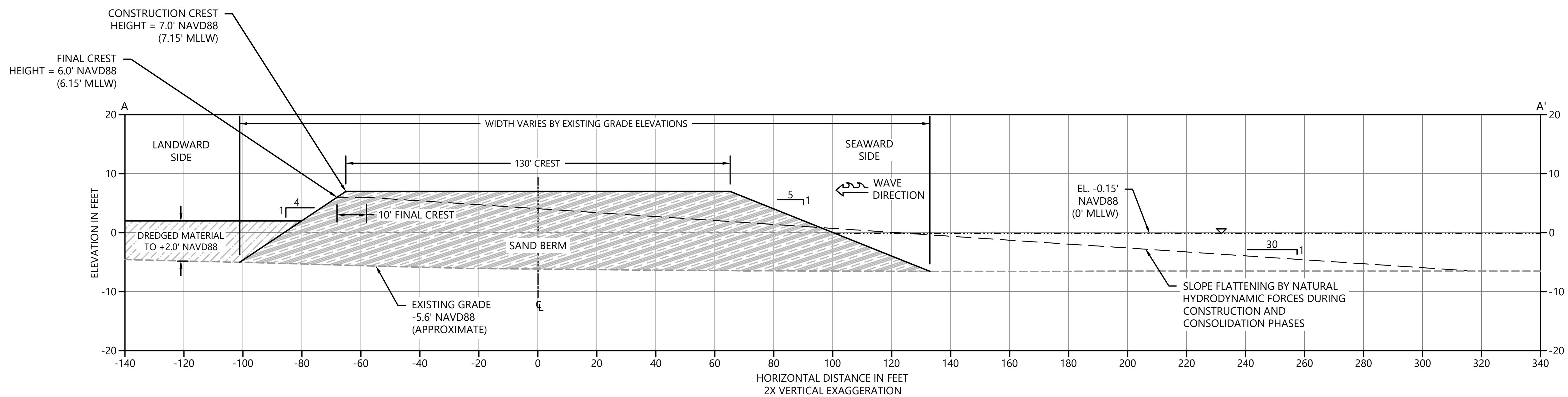
DRAWN BY: M. PRATSCHNER
CHECKED BY: R. ROBERTSON
APPROVED BY: J. LAPLANTE
SCALE: AS NOTED
DATE: JUNE 2022

TEXAS LOWER COAST BENEFICIAL USE - PELICAN ISLAND (M3)

PLAN VIEW

C02

SHEET # 3 OF 5



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SECTION
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VERTICAL SCALE: 1" = 10'

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2. VERTICAL DATUM: NORTH AMERICAN VERTICAL DATUM OF 1988 (NAVD88)
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PLAN INTENDED TO BE VIEWED IN COLOR. ADJACENT BLOCK IS "BLUE"

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AT FULL SIZE, IF NOT ONE INCH SCALE ACCORDINGLY

DRAFT-NOT FOR CONSTRUCTION

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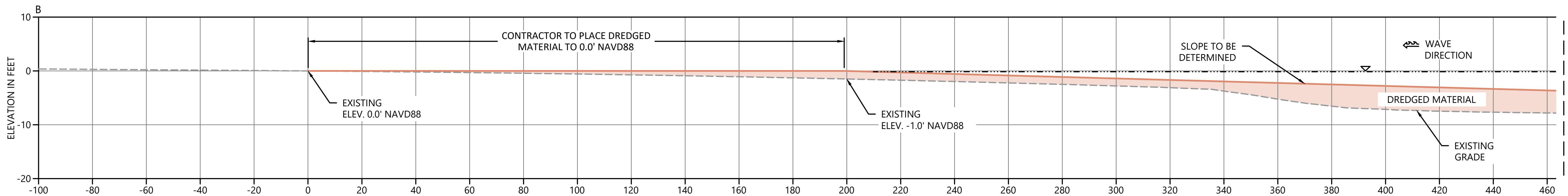
CHECKED BY: R. ROBERTSON
APPROVED BY: J. LAPLANTE
SCALE: AS NOTED
DATE: JUNE 2022

TEXAS LOWER COAST BENEFICIAL USE - PELICAN ISLAND (M3)

TYPICAL MARSH FILL SECTION

C03

SHEET # 4 OF 5



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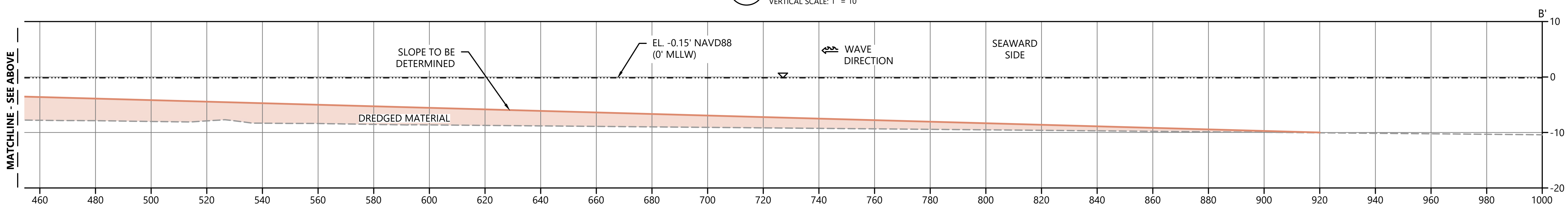

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C02
SECTION
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VERTICAL SCALE: 1" = 10'

NOTES:

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ONE INCH
AT FULL SIZE, IF NOT ONE INCH SCALE ACCORDINGLY

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Jun 29, 2022 2:31pm mpratschner

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TEXAS GENERAL LAND OFFICE ESTABLISHED 1836
DUCKS UNLIMITED

REVISIONS

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DRAWN BY: M. PRATSCHNER
CHECKED BY: R. ROBERTSON
APPROVED BY: J. LAPLANTE
SCALE: AS NOTED
DATE: JUNE 2022

TEXAS LOWER COAST BENEFICIAL USE - PELICAN ISLAND (M3)

TYPICAL TIDAL FLAT FILL SECTION

C04

SHEET # 5 OF 5

Attachment 2

Technical Specification Outline

TABLE OF CONTENTS

Memorandum

June 30, 2021

To: Sarah Garza, Harrison McNeil, and Yvonne Dives-Gomez, Port of Corpus Christi Authority

From: Todd Merendino, Ducks Unlimited, Inc.
John Laplante, Dan Opdyke, Renee Robertson, Alexander Freddo, and Hayden Smith, Anchor QEA, LLC
Jane Sarosdy, Sarosdy Consulting, Inc.

Re: Portland Nueces Bay Marsh 30% Design Memorandum

Introduction

This 30% design memorandum describes design criteria and assessments associated with a beneficial use of dredged material (BU) project at the proposed Portland Nueces Bay Marsh site (Site), located in Texas General Land Office (GLO) Planning Region 3 of the Texas coast in Nueces Bay in Nueces County, Texas (Figure 1).

Project Background

GLO awarded a Coastal Management Program Project of Special Merit grant (funded through the Gulf of Mexico Energy Security Act) to Ducks Unlimited, Inc. (DU) to coordinate with stakeholders and identify restoration sites for BU. The Port of Corpus Christi Authority (PCCA), a project partner, has also contributed staff and financial resources to expand the project scope. The project team is led by DU and PCCA and includes Anchor QEA, LLC; Sarosdy Consulting, Inc.; and the Texas Department of Transportation. Collectively, the project team coordinated three stakeholder meetings with state and federal resource agencies, nongovernmental organizations, academia, consultants, and local officials in each region to solicit information about potential BU sites. Based on stakeholder input, GLO feedback, publicly available data, and professional judgment, the project team has developed 10% designs for 18 sites in GLO Planning Regions 3 and 4 of the Texas coast and 2 GLO-approved sites in Mesquite Bay and San Antonio Bay in GLO Planning Region 2. After completion of the 10% designs, 11 of the designs were selected to continue to 30% designs, and up to 7 of those designs will be chosen for 60% designs and permit application packages. The project team selected the Site as one of the 20 sites for 10% design development and cost estimation. Based on the Site's restoration potential and construction feasibility, the project team selected the Site to proceed to 30% design and opinion of probable construction costs using funding from PCCA.

Nueces Bay is a shallow bay system with poor hydrologic circulation, averaging 2 to 3 feet, and dominated by mudflats and oyster reefs (CBBEP 2005). The Site is in the far northeast corner of Nueces Bay, adjacent to a constructed marsh restoration site composed of terrace fields built from on-site sediment called the Nueces Bay Marsh Restoration project. Due to the success of the Nueces Bay Marsh Restoration project, Coastal Bend Bays & Estuaries Program, Inc. (CBBEP) stakeholders communicated the desire for an additional restoration site nearby, with a focus on beneficially using dredged material to construct a more uniform marsh The project team believes that a relatively uniform marsh area is a more practical BU application due to the level of controls and containment that would be required to construct marsh terraces with dredge slurry, as well as allowing more acres of marsh habitat to be created. The project team selected the Site due to its proximity to the La Quinta Channel, a likely sediment source, and the successful implementation of the adjacent Nueces Bay Marsh Restoration project.

Project Objectives

Frequent dredging is needed to develop and maintain Texas navigation channels. The dredged material is often deposited in dredged material placement areas (DMPAs), and many of the existing DMPAs along the Texas coast are nearing capacity. Resource agencies and stakeholders have long advocated using dredged material beneficially to create and restore wetlands and bird islands, nourish beaches, and counteract land loss. Historically, BU projects are difficult to manage because they are multiyear, multifaceted undertakings in which different organizations manage dredging schedules, funding, project design, permitting, and construction activities. To help address these issues, the objectives of this project include the following:

- Create and restore degrading coastal habitats.
- Establish sites for disposal of dredged material to reduce reliance on existing DMPAs.
- Improve coastal resiliency of the natural and built environment.

To accomplish these objectives, the project includes the following tasks:

- Stakeholder outreach and coordination
- Identification and selection of BU sites
- 10% designs and cost estimates for 20 BU sites
- 30% designs for 11 BU sites
- 60% designs, cost estimates, and permit application packages for up to seven BU sites

This memorandum documents the 30% design and cost estimate for the Site.

Design Objectives

The Site will be designed to beneficially use dredged material to create marsh habitat in a region with degrading tidal marsh. The design will use material dredged from navigation channels during routine maintenance or the proposed widening and deepening of the La Quinta Channel, thus reducing the volume of such material placed in existing open-bay or upland DMPAs. This 30% design is based upon publicly available datasets, as well as focused field work conducted by PCCA.

Design objectives include the following:

- Develop a preliminary vision based on available data for the Site that includes the following:
  - Habitat to be created or restored
  - Potential sediment source(s)
  - Approaches to minimize long-term maintenance costs
- Delineate conceptual footprints for proposed BU placement.
- Identify key sensitive habitats and construction considerations in the vicinity of the Site.
- Estimate fill volumes for the proposed BU footprints.
- Identify data gaps to be addressed in subsequent design phases.
- Provide preliminary cost estimates.

Existing Data Review

A review of existing data and the focused data collected by PCCA was performed to develop the Site and containment berm designs. This section describes the data reviewed and collected for the 30% design.

Horizontal and Vertical Datums

The horizontal datum used for the Site is the Texas State Plane South Zone, North American Datum of 1983 in U.S. survey feet. The primary vertical datum used for the Site design is the North American Vertical Datum of 1988 (NAVD88). The National Oceanic and Atmospheric Administration (NOAA) maintains an active tide gauge within the vicinity of the Site. The NOAA USS Lexington, Corpus Christi Bay, TX Station 8775296 (Lexington Station) is 2 miles southwest of the Site. This station collects and records real-time tide information dating back to 2004. The vertical datums from this station that will be used for the Site are shown in Table 1. The Lexington Station was also used to define a preliminary design water level, as described in the Water Level section.

Table 1
Lexington Station Tidal Gauge Displaying NAVD88 Tidal Datums

Tidal Datums	Elevation (feet NAVD88)	Elevation (feet MLLW)
MHHW	1.02	0.60
MHW	1.01	0.59
MSL	0.76	0.34
MLW	0.43	0.01
MLLW	0.42	0

Notes:
MHHW: mean higher high water
MHW: mean high water
MLLW: mean lower low water
MLW: mean low water
MSL: mean sea level

Meteorological, Ocean, and Wave Data

Water Level

To determine an approximate design water level elevation for the Site, an existing water level analysis using data from the Lexington Station was used (Anchor QEA 2021). Data were compiled for the period from October 2015 to January 2021 and used to calculate a 90th-percentile water level of 2.0 feet NAVD88.

Wind and Waves

The U.S. Army Corps of Engineers (USACE) Wave Information Studies (WIS) provides a national resource of long-term wavefield climatologies for U.S. coastal waters that synthesizes observations, multidecade hindcasts, and storm event archives (USACE 2021). The WIS station closest to the Site is Station 73039, just offshore on the Gulf side of Mustang Island in the Gulf of Mexico. Because the station is located offshore, the wave data are not applicable to this project design. However, the project team considers the wind data to be representative of the winds experienced at the Site. Figure 2 summarizes wind data from January 1, 1980, through December 21, 2014. The data indicate the predominant wind direction is from the southeast, with significant winds also coming from the north, northeast, east, and south.

Due to its proximity to the Nueces Bay Causeway (U.S. Highway 181) and Portland, the Site is protected from wave action generated by prevailing winds from the southeast. However, there is substantial fetch to the west and northwest across Nueces Bay at the Site.

The Coastal Engineering Design and Analysis System (CEDAS) Automated Coastal Engineering System (ACES) tool was used to calculate the wave growth over the restricted shallow-water fetch from the west and northwest (Leenknecht et al. 1992a). Inputs for the ACES tool consist of the following.

West Wind

- The main wind direction was input to be from 270° clockwise from the north.
- The average depth along the fetch in the west direction was input as 6.01 feet (based on a water surface elevation of 2.0 feet NAVD88. The elevations used to determine the water depth were based on the following sources:
  - Texas Commission on Environmental Quality water depth measurements (TCEQ 2021) near the Site used in combination with water level measurements collected during the same times at the Lexington Station
  - NOAA Continuously Updated Digital Elevation Model (NOAA 2021) near the Site
- The fetch length for the west wind direction was input as 11.13 miles.
- The observed wind speed was input according to the WIS station extreme value analysis, in which return periods and their wind speeds were predicted inside a ±22.5° bin from 270°. (The 270° bin is represented by all winds measured from the 247.5° to 292.5° wind direction.)

Northwest Wind

- The main wind direction was input to be from 315° clockwise from the north.
- The average depth along the fetch in the southeast direction was input as 5.12 feet (based on a water surface elevation of 2.0 feet NAVD88. The elevations used to determine the water depth were based on the following sources:
  - Texas Commission on Environmental Quality water depth measurements (TCEQ 2021) near the Site, used in combination with water level measurements collected during the same times at the Lexington Station
  - NOAA Continuously Updated Digital Elevation Model (NOAA 2021) near the Site
- The fetch length for the northwest wind direction was input as 1.16 miles.
- The observed wind speed was input according to the WIS station extreme value analysis where return periods and their wind speeds were predicted inside a ±22.5° bin from 315°. (The 315° bin is represented by all winds measured from the 292.5° to 337.5° wind direction.)

Common Inputs

- The elevation of observed wind was 10 meters (Leenknecht et al. 1992b)
- The temperature difference between the air and sea was input as 0°F.
- The duration of the observed wind and the duration of the final wind are from the hindcasted time interval associated with the WIS data recordings and input as 1 hour.
- WIS Station 73039 is at 27.7° latitude observing over water.

- The fetch option most associated with the Site is shallow restricted, meaning that the wind-wave generation is impacted by the geometry of the Site and where wind is measured traveling from a point along the shoreline to the point of interest (Leenknecht et al. 1992b)
- The number of angles was input as 3, with a radial angle increment as 10°. This results in the direction of the first radial fetch to be 10° less than the predominant wind direction from both the west and northwest (260° and 305°, respectively), the second radial fetch to be the predominant wind direction from both the west and northwest (270° and 315°, respectively), and the third radial fetch to be 10° more than the predominant wind direction from both the west and northwest (280° and 325°, respectively). This approach forces the ACES tool to correctly calculate the wave growth across the desired main wind direction angle of 270° and 315°.

The predicted wave height growth from both the west and northwest wind directions are shown in Tables 2 and 3, respectively.

Table 2
CEDAS ACES Predicted Wave Height Growth in the West (270°) Wind Direction

Wind Direction	Fetch Distance (miles)	Return Period (years)	Wind Speed (mph)	Wave Height (Hmo[1], feet)	Wave Period (Tp[2], seconds)
West 270° (247.5° to 292.5°)	11.13	1	17.96	1.17	2.27
		2	27.74	1.65	2.80
		10	35.78	1.99	3.16
		20	38.29	2.09	3.26
		50	41.19	2.20	3.37
		100	43.17	2.27	3.45

Notes:
1. Wave heights are determined from spectrally based methods (Hmo; Bretschneider and Reid 1954).
2. Wave periods are determined from spectrally based methods (Tp; Bretschneider and Reid 1954).
mph: miles per hour

Table 3
CEDAS ACES Predicted Wave Height Growth in the Northwest (315°) Wind Direction

Wind Direction	Fetch Distance (miles)	Return Period (years)	Wind Speed (mph)	Wave Height (Hmo[1], feet)	Wave Period (Tp[2], seconds)
Northwest 315° (292.5° to 337.5°)	1.16	1	22.94	0.66	1.53
		2	36.61	1.11	1.95
		10	43.2	1.32	2.13
		20	45.72	1.40	2.19
		50	48.98	1.51	2.27
		100	51.42	1.59	2.33

Notes:

1. Wave heights are determined from spectrally based methods (Hmo; Bretschneider and Reid 1954).
2. Wave periods are determined from spectrally based methods (Tp; Bretschneider and Reid 1954).

Wind-generated waves from the west and northwest wind directions were calculated to determine the wave climate at the Site. One-year return period winds generated waves no greater than 1.17 feet. A more detailed hydrodynamic model analyzing the direction and frequency of expected significant wave heights may be developed during subsequent design phases.

Wake Erosion

The La Quinta Channel is approximately 3 miles east of the Site. However, the Nueces Bay Causeway and Indian Point serve as hydrologic barriers separating the Site from any commercial navigation channels. Potential wake erosion from vessels transiting the La Quinta Channel is not expected to be a design consideration. Recreational vessels may cause wake at the Site, however, due to water depths requiring shallow-draft boats in the area, wake erosion is expected to be less significant than wind-waves at the Site.

Bathymetry and Topography

On March 15, 2022, Triton Environmental Solutions, LLC (Triton) conducted a bathymetric and topographic survey of the Site for PCCA (Attachment 1, C01). Contours at the Site range from -2.6 feet to +2.5 feet NAVD88 with an average of -1.4 feet NAVD88. Qualitative sediment probing conducted during the survey showed the depth to refusal within the Site ranged from 0.8 to 17.4 feet, with an average of 8.1 feet.

Utilities and Infrastructure

The Railroad Commission of Texas public GIS viewer (RRC 2021) and GLO pipeline data (GLO 2021a) were used to identify mapped utilities and pipelines near the Site. Four pipelines were found landward of the Site: two natural gas gather lines operated by Sulphur River Exploration, Inc.; a crude oil gathering line operated by BEPCO, L.P.; and a natural gas gathering line operated by Southcross CCNG Gathering, Ltd. (Figure 1). These lines are located 400 feet from the Site. It is not anticipated that these pipelines will affect the design or constructability of the Site. The need for Site-specific utility locations prior to construction will be determined during subsequent design phases.

U.S. Highway 181, the City of Portland Public Works Department and wastewater treatment plant, and a residential complex are immediately adjacent to the Site. Protection of the highway and building foundations will need to be considered in subsequent phases of design.

Desktop Cultural Resources Survey

A search of cultural resources records in the Texas Historical Commission Texas Historical Sites Atlas Database (THC 2021) was completed on December 31, 2021. This search revealed that no cultural resources surveys have been conducted, and no cultural resources sites have been identified within the Site. Two cultural resources were identified near the Site (within 1 mile). However, the proposed project will not affect these resources.

Sensitive Habitat

GLO oyster habitat GIS data (GLO 2021b) indicate oyster habitat is located approximately 600 feet west of the Site. Habitat surveys conducted by Triton (2022) for PCCA within the footprint of the Site showed several areas of shell (gaping halves, fragments, etc.); however, no live oysters were found. Stakeholder feedback indicated scattered live oysters have historically been found in this area but only during extended wet periods that provide suitable salinity conditions. Based on the survey and stakeholder input, impacts to oysters are expected to be negligible.

The habitat surveys conducted by Triton also showed no live seagrasses within the survey area (Triton 2022).

Beneficial Use Source Material

A potential source of dredged material is the La Quinta Channel Extension located 3 miles east of the Site. PCCA estimates approximately 2,560,000 cubic yards (CY) of maintenance material from the La Quinta Channel Extension, as well as 96,600 CY of maintenance material from the berths at the La Quinta Terminal. Additionally, PCCA is authorized to dredge a third berth at the La Quinta Terminal, which would generate approximately 650,500 CY of new work material, and PCCA has proposed a widening and deepening project for the La Quinta Channel, which would result in additional new work dredged material. Average grain size and grain type percentages are shown in Table 4. This informs the quantity and characteristics of dredged material that may be available during a dredging cycle. For example, the Site will be designed such that the silt, which constitutes a relatively high percentage of nearby sediment, will be sheltered from erosive forces.

Table 4
Typical Sediment Characteristics in the La Quinta Channel

Sediment Characteristics from the LaQuinta Channel
D50 (mm) = 0.038
10.7% sand
71.4% silt
17.9% clay

Notes:
Source: USACE 1999
D_{50}: median grain size
mm: millimeter

Marsh Vegetation Elevation Ranges

Table 5 shows typical habitat ranges for relevant marsh vegetation based on site vegetation surveys conducted by PCCA at the Dagger Island and Portland Nueces Bay Marsh in Redfish Bay and Nueces Bay, respectively. The range represents minimum and maximum values found during the survey, while the mode represents the most frequently occurring values during the survey. The mode was used as the most accurate representation of the conditions for the Site.

Table 5
Typical Elevations for Target Marsh Vegetation

	Dagger Island: Elevation (feet MSL)		Portland Nueces Bay Marsh: Elevation (feet MSL)	
Species	Range	Mode	Range	Mode
High marsh	1.0 to 4.2	1.6 to 2.3	N/A	N/A
Low marsh	-1.1 to 3.3	0.6 to 1.1	0.4 to 1.8	0.7 to 0.9
Seagrass	-5.4 to 0.9	-3.0 to -0.7	N/A	N/A
Smooth cordgrass	-1.5 to 1.5	-0.4 to 0.3	0.2 to 0.5	-0.2 to 0.0
Sand flats	1.93 to 1.94	1.93 to 1.94	N/A	N/A
Uplands	2.3 to 5.9	2.3 to 5.9	N/A	N/A

Note:
N/A: not applicable

30% Design

The main design elements evaluated for the Site are as follows:

- Site location
- Marsh size and shape
- Containment and erosion protection
- Potential design alternatives avoiding live oysters

- Constructability
- Planting and natural recruitment of vegetation
- Performance expectations
- Site construction cost estimates
- Expected ecosystem benefits
- Data and information gaps

These design elements are evaluated in this memorandum for the 30% Site design.

Site Location

The proposed location of the Site is less than 1 mile northeast of the existing Nueces Bay Marsh Restoration project, between the city of Portland and U.S. Highway 181 (Nueces Bay Causeway). The Portland wastewater treatment plant outfalls directly north of the Site. Additionally, southwest of the Site, a small overpass allows hydrologic circulation to Sunset Lake and Indian Point Park.

The average elevation within the Site is -1.4 feet NAVD88 (-1.8 feet MLLW).

No live oysters or seagrasses were found within the boundary of the Site habitat survey (Triton 2022); however, oyster shell was found. It is not expected that this shell will recruit live oysters. However, if conditions within this region of the bay shift, such that the locations with shell within the footprint become viable oyster habitat, the design may need to be refined as discussed in the Potential Design Alternatives Avoiding Live Oysters section.

Marsh Size and Shape

Based on availability of sediment, a cost analysis, and stakeholder feedback, the project team proposes that the area of the Site be 40 acres, with approximately 2 acres being the footprint of the proposed armoring and containment. The shape of the project was developed to avoid potential impacts to the existing Portland wastewater treatment plant, Sunset Lake/Indian Point Park hydrologic exchanges, and the wetlands directly east of the Site. Possible impacts to the surrounding area may be further evaluated in subsequent design phases.

Sediment will be placed within a range of elevations, typically between 1.5 to 3.5 feet NAVD88, to create a variety of habitats. The marsh is being designed for the upper end of the suitable habitat range for smooth cordgrass (*Spartina alterniflora*), at 1.5 feet mean sea level (MSL; 2.26 feet NAVD88; Table 5). For constructability, the target elevation for the dredged material is +2.5 feet NAVD88. The elevation of dredged material fill will be adjusted at further phases of design, depending on the physical properties of the dredged material and to target varying habitats of low to high marsh, smooth cordgrass, tidal flat, and open water. The Site will consist of fill extending from the edge of the existing upland to the containment berm described in the Containment and Erosion Protection section.

Fill material could be obtained from the La Quinta Extension Channel or La Quinta Terminal berths, as described previously in the Beneficial Use Source Material section. It is predicted that the required consolidated fill volume will be approximately 410,000 CY. Based on the estimated dredged material quantities from the La Quinta Channel, also discussed in the Beneficial Use Source Material section, this quantity of material is expected to be available in the vicinity of the Site. The total volume assumes 1 foot of foundation compression for every 3 feet of fill and does not consider bulking. Qualitative sediment probing conducted during the Site habitat survey showed that the depth to refusal was an average of 8.1 feet, so it is assumed the material at the Site consists of soft sediments. Geotechnical data will likely need to be collected during a subsequent design phase to further evaluate the expected foundation compression and expected bulking of dredged material.

Relative sea level rise may impact the Site in the future. A strategy to mitigate against relative sea level rise could be to place BU material to higher elevations in preparation for higher relative sea levels and tidal elevations associated with sea level rise. However, targeting a placement of BU material above the upper range of smooth cordgrass and low marsh (the target elevation) would not allow for the near-term desired low to high marsh habitat distribution and, hence, would not meet the Site objectives. Therefore, for the purposes of Site design, relative sea level rise is not considered. The impacts of relative sea level rise may be mitigated in the future through adaptive management strategies such as thin-layer placement of additional dredged material.

Containment and Erosion Protection

Based on feedback from stakeholders and the use of armoring at the adjacent Nueces Bay Marsh Restoration project, a containment berm will be used to contain the placed dredged material, as well as to protect the intertidal habitats from wind-wave erosion. The preliminary wind-wave analysis, Table 2, shows that the 1-year return wave height from the west is more than 1 foot. This indicates typical conditions would be erosive to the marsh edge without armoring. The armoring would consist of a 2,400-foot-long rock containment berm, with the containment berm centerline along the -2.5- to +1.1-foot-NAVD88 contours as shown in Attachment 1. A summary of the containment berm geometry is in Table 6. For this preliminary design, the containment berm slopes and crest width are based on the dimensions of the rock containment berm constructed for the Causeway Bird Island project (Hydroterra 2022). The containment berm will have sills to allow tidal exchange into the contained marsh. The locations and geometry of the sills will be determined based on discussions with regulatory agencies during final design.

The containment berm crest height was selected to be +3.5 feet NAVD88 to allow 1 foot of freeboard between the height of the containment berm crest and target height of the marsh. This crest height was evaluated with a wave transmission analysis using the wave parameters from Table 2, an armor stone D50 of 1.4 feet based on the 50th-percentile armor stone size selected for the Causeway Bird Island berm (HDR 2021) and a water surface elevation of 2.0 feet NAVD88 based on the 90th-percentile water level. The transmitted wave heights through the rock containment berm were determined by using the van der Meer and d'Angremond method (USACE 2006, Table VI-5-15). Table 7 shows the results of the analysis for varied crest heights of the containment berm. Waves resulting from 10-year winds were used, due to 1-year return waves not being high enough to be in the valid range for the method. This analysis shows that 10-year return waves would be reduced below 1 foot, and, since these waves are higher than the 1-year return waves, 1-year return transmitted waves are expected to be lower than the previously identified 1-foot wave height threshold, above which significant marsh edge erosion may be expected to occur. The constructed base width will be dependent on the existing grade, but assuming a mudline elevation of -1.6 feet NAVD88 within the footprint of the breakwater, the containment berm base width will be approximately 37 feet. The size of the armor stone and final slope and cross-sectional dimensions of the containment berm will be further refined through modeling and analysis of the sediment characteristics of the dredged material, the dike subgrade, and an analysis of initial capital construction costs versus maintenance costs during a subsequent phase of design.

Table 6
Containment Berm Design Characteristics

Design Criteria	Containment Berm
Length	2,400 feet
Total acreage	2 acres
Crest width	6 feet
Base width	37 feet
Assumed bottom elevation	-1.6 feet NAVD88
Total structure height	5.1 feet
Materials	Rock
Volume	20,000 CY
Design side slopes (seaward side)	4H:1V[1]
Design side slopes (landward side)	2H:1V[1]
Maximum design crest elevation	3.5 feet NAVD88

Note:
1. Horizontal to vertical

Table 7
Transmitted Wave Analysis

Crest Width (feet)	Crest Height (feet NAVD88)	Transmitted Wave Height (feet)
6	3.5	0.93

Notes:
Data is based on the van der Meer and d'Angremond method (USACE 2006)
Parameters used for analysis:
D50 = 1.4 feet
Water surface elevation = 2.00 feet NAVD88
Bed elevation = -2.50 feet NAVD88
Wave height = 1.99 feet
Wave period = 3.16 seconds

Potential Design Alternatives Avoiding Live Oysters

No live oysters were found within the footprint of the Site during the Site habitat survey; however, even though it is unlikely, changing Site conditions could promote recruitment of live oysters onto the existing shell beds (e.g., gaping halves, fragments; Attachment 1, CO1). Several alternatives that may be considered in the event of live oysters being found within the Site footprint are discussed in Table 8.

Table 8
Live Oyster Design Alternatives

Alternative	Pros	Cons
Move oysters to the containment berm or other nearby oyster habitat.	• Allows the largest acreage of marsh to be constructed	• Environmental analysis needed to determine suitability of new oyster location and feasibility of moving the oysters • Additional construction cost to move the oysters
Construct a smaller marsh footprint to avoid oysters.	• Does not disturb oysters	• Additional berms will need to be constructed to prevent dredged material from covering the oyster beds. • Reduction in marsh creation acreage • Less use of dredged material
Construct a terrace field.	• Does not disturb oysters • Successful terrace field directly adjacent to the site (Nueces Bay Marsh Creation project) indicates the design could be successful. • May promote aquatic habitat	• Reduction in marsh creation acreage • Little to no use of dredged material

Constructability

Water depths surrounding the Site may make it difficult to access the Site via barge and in-water equipment. However, the Site is adjacent to Highway 35 and could potentially be accessed from land. The final construction would be based on the selected means and methods and selected equipment from the contractor; however, construction could potentially be conducted in two main phases. In addition, the contractor may provide alternate construction methods from those described in this section.

The Site could be constructed in two different phases, as follows.

Phase I

The rock containment berm is constructed along the proposed containment berm footprint.

Phase II

Temporary containment is placed in the containment berm sills to prevent placed dredged material from leaving the Site through the gaps in the containment berm. Dredged material will then be placed within the site up to the design elevations. Once dredged material has consolidated, temporary containment would be removed to allow tidal exchange into the marsh.

Planting and Natural Recruitment of Vegetation

Based on stakeholder input and cost considerations, the project team determined that natural recruitment of vegetation within the marsh will be the most effective method for vegetating the marsh. Table 5 shows some of the targeted vegetation and their preferred habitat elevations. If the outcome is unsatisfactory (e.g., if the marsh has a lower-than-desired density of vegetation or if undesirable species of vegetation are present), an adaptive management program can be instituted to directly plant, adjust Site elevations, remove undesirable species, etc.

Performance Expectations

The performance goal for the project is to create 38 acres of sustainable high and low marsh, smooth cordgrass, and open water habitat. The designed containment and armoring are expected to contain placement of dredged material, be resilient to typical storm events, and provide protection for the interior habitat.

Site Construction Cost Estimates

Preliminary construction costs were estimated for the design outlined in the previous sections. The estimated costs also include the indirect construction costs (i.e., permitting, 100% engineering and design costs, construction management, and post-construction management such as site visits and dewatering management). These costs represent the estimated incremental costs (i.e., costs over and above USACE’s least-costly and environmentally acceptable dredged material and disposal alternative). Table 9 shows a line-item list of each costing parameter and the total cost estimated for construction.

The costs range from $9.1 million to $19.5 million, depending on the level of uncertainty allocated to the project cost. The lower bound of uncertainty (-30%) and upper bound of uncertainty (+50%) were selected due to the existing data gaps, high levels of inflation, and rising fuel costs. Cost savings may be realized by further analysis and modeling of wind and wave conditions during subsequent design phases and refining the level of armoring. An evaluation of the initial capital construction versus projected maintenance costs could be conducted to determine an optimum armoring design that allows for satisfactory protection of the interior marsh, while being within the project budget. The estimates are developed using current and generally accepted engineering cost estimating methods and are based on assumptions concerning future events. Actual costs may be affected by known and unknown risks including, but not limited to, changes in general economic business conditions, Site conditions that were unknown at the time the estimates were performed, future changes in Site conditions, regulatory or enforcement policy changes, and delays in performance. Actual costs may vary from these estimates.

Table 9
Opinion of Probable Construction Cost to 100% Project Completion

Item	Quantity	Unit	Unit Price	Total
Direct Construction Costs Phase 1: Containment Berm Construction				
Mobilization and Demobilization[1,2]	1	%	10	$ 290,000.00
Preconstruction Survey	1	LS	$ 30,000.00	$ 30,000.00
Rock Containment Berm[1]	31,000	tons	$ 90.00	$ 2,790,000.00
As-Built Survey/Aerials	1	LS	$ 40,000.00	$ 40,000.00
Navigational Aids[1]	5	Each	$ 4,000.00	$ 20,000.00
Phase 1 Subtotal[3]			**Sum**	**$ 3,200,000.00**
Direct Construction Costs Phase 2: Internal Fill Construction				
Incremental Mobilization and Demobilization[1,4]	1	%	10	$ 750,000.00
Preconstruction Survey	1	LS	$ 30,000.00	$ 30,000.00
Incremental Dredging Cost (3-Mile Pipeline)[1,4]	410,000	CY	$ 18.00	$ 7,380,000.00
As-Builts/aerials	1	LS	$ 40,000.00	$ 40,000.00
Phase 2 Subtotal[3]			**Sum**	**$ 8,200,000.00**
Direct Construction Total[3]			**Sum**	**$11,400,000.00**
Indirect Construction Costs				
100% Engineering and Design[3]	1	%	6	$ 700,000.00
Permitting	1	Each	$100,000.00	$ 100,000.00

Item	Quantity	Unit	Unit Price	Total
Construction Management[3]	1	%	6	$ 700,000.00
Post-Construction Management[5]	12	Month	$ 10,000.00	$ 120,000.00
Indirect Construction Subtotal			**Sum**	$ 1,620,000.00
Project Subtotal[3]			**Sum**	$ 13,020,000.00
-30% Uncertainty[3]	1	%	30	$ 3,900,000.00
+50% Uncertainty[3]	1	%	50	$ 6,500,000.00
Low-End Total Project Estimated Cost[3]			**Total Sum**	**$ 9,100,000.00**
High-End Total Project Estimated Cost[3]			**Total Sum**	**$19,500,000.00**

Notes:
Costs were determined based upon a combination of publicly available datasets and sediment surface grabs, and topographic, bathymetric, and visual habitat surveys.
Mobilization and demobilization costs are based on line items within their respective phases.

1. Value is rounded to the nearest $10,000.
2. Cost is based upon mobilizing equipment for construction of the rock containment berm.
3. Value is rounded to the nearest $100,000.
4. Cost is based upon mobilizing equipment beyond what is required for dredging the La Quinta Channel (e.g., marsh buggies)
5. Post-construction management may include Site visits to observe the material consolidation, vegetation, and water levels on the Site. Monthly aerials may be performed. Additional post-construction management practices may be considered during subsequent phases of design.

LS: lump sum

Expected Ecosystem Benefits

The creation of the Site is expected to have positive benefits on the regional ecosystem. The adjacent Nueces Bay Marsh Restoration project created a 160-acre terrace field that has successfully established smooth cordgrass (*Spartina alterniflora*). Based on post-construction surveys, the terraces in the terrace field mimic natural marsh sites throughout the Coastal Bend in their vegetation density and faunal abundance (Smee 2016). Up to 38 acres of marsh habitat at the Site would be constructed in the same region of the bay, expanding the already demonstrated ecological benefit of the CBBEP project.

The mean relative sea level rise trend at Corpus Christi is 5.54 millimeters per year (NOAA 2022). Assuming no changes in the mean relative sea level rise trend and no erosion, as well as not considering inorganic and organic accretion, the marsh within the target elevation of the Site (2.5 feet NAVD88 or 1.74 feet MSL) would be below MSL by 2120.

Data and Information Gaps

At this phase of design, the following data and information gaps have been identified:

- Site-specific wind-generated waves, which would inform the optimization of site armor design
- Geotechnical characteristics of the source material (maintenance and new work material) and subgrade of the placement area to refine evaluations of containment structure stability,

subgrade and source material settlement, and short- and long-term capacity for dredged material placement

- Refined survey information, such as property lines, oyster, and utility locations
- Additional coordination with the City of Portland and adjacent landowners to evaluate and select preferred design options
  - This may include exploring the possibility of expanding the constructed marsh to the north and routing the discharge from the Portland wastewater treatment plant through the marsh, although this would take significant coordination, planning, and support from the City of Portland and Texas Commission on Environmental Quality.

These data gaps may need to be addressed during the progression from 30% design to final design. For example, supplemental data collection and modeling would allow optimizing the project design to reduce construction costs. It is expected that the cost of addressing these information gaps would be offset by the cost savings that would be realized by optimizing the project design. Because the 30% design has been prepared without such data, conservative assumptions (e.g., regarding armoring) have been used, increasing the estimated construction cost. Information on the design and performance of the adjacent Nueces Bay Marsh Restoration site may also help facilitate future phases of design of the Site. This current project is taking the analyses as far as practicable, considering the constraints of the project scope, budget, and schedule.

Future Work

Of the sites selected for 30% designs in this project, up to seven will be selected for 60% designs, cost estimates, and permit packages. No fatal flaw has been identified at this phase of the design. Should the Site be selected for additional design efforts, it can be expected that some aspects of the design in this memorandum will be modified and, as appropriate, enhanced.

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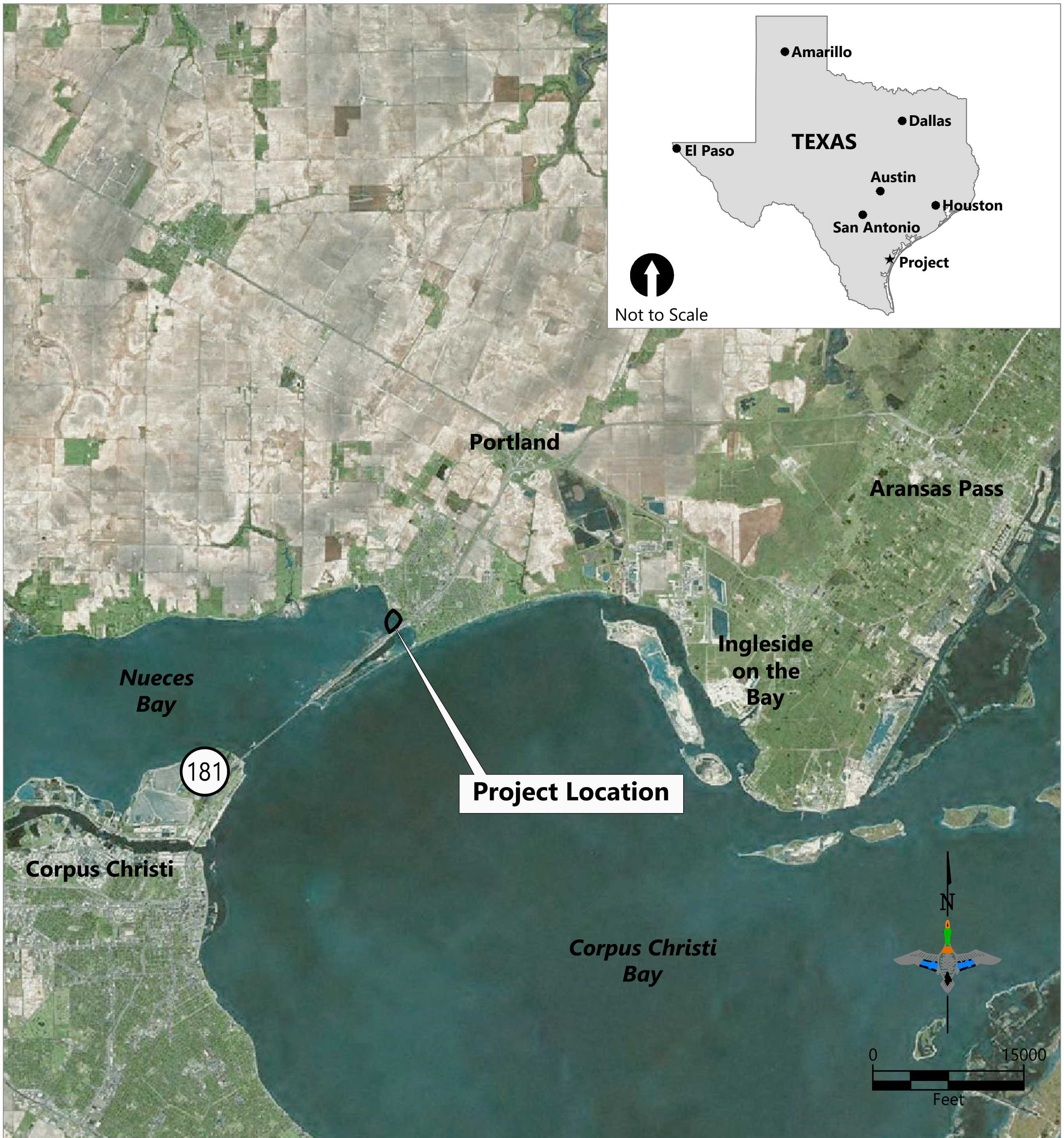
Figures



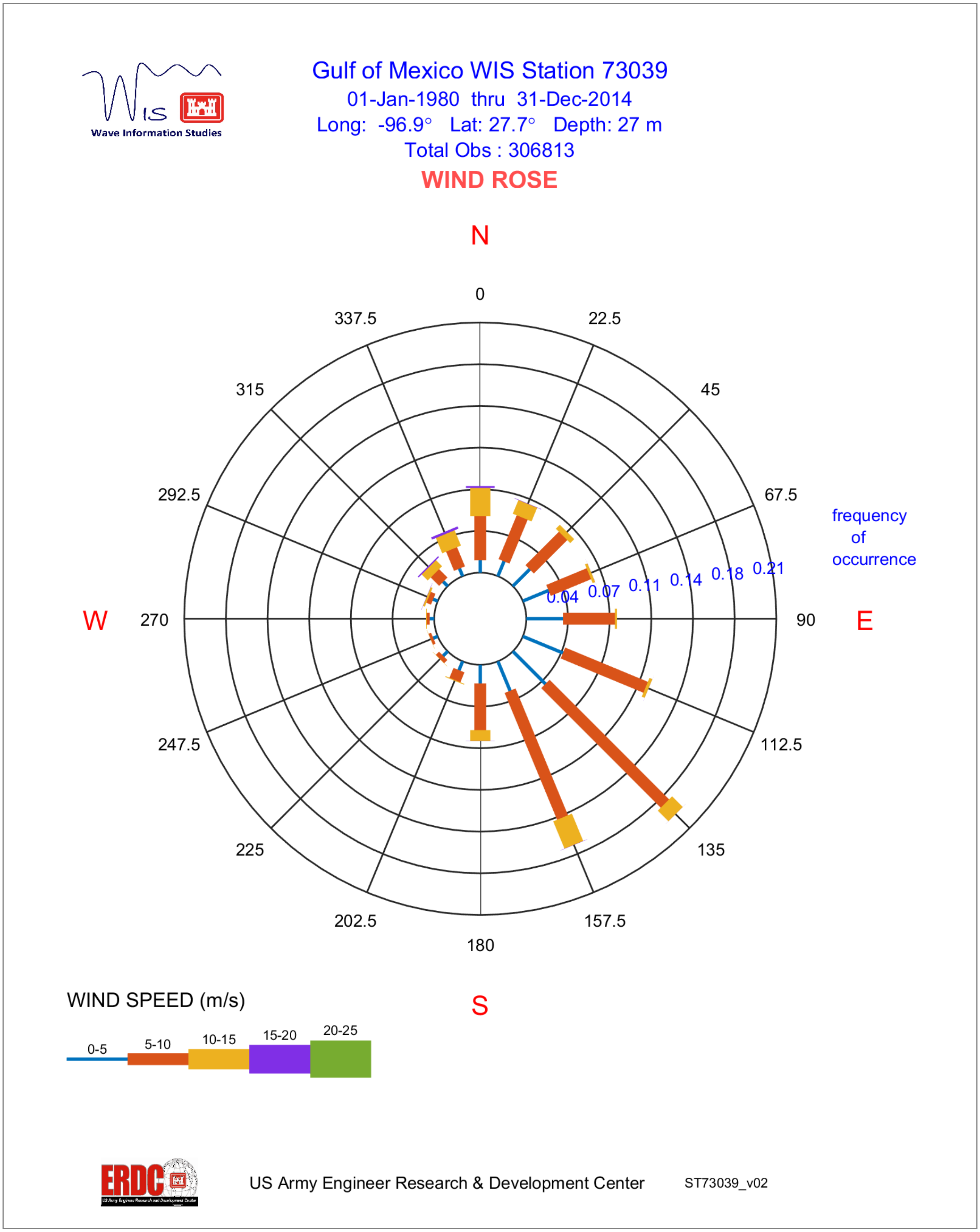
SOURCE: Aerial provided by Bing Maps.
HORIZONTAL DATUM: Texas State Plane South Zone, North American Datum of 1983, U.S. Survey Feet

Publish Date: 2022/06/09 4:34 PM | User: mpratschner
Filepath: K:\Projects\2018-PCCA Beneficial Use\PORTLAND NUECES BAY MARSH\2018 RP-001 VIC MAP PNBM.dwg Figure 1

ANCHOR QEA

Figure 1
Vicinity Map

Portland Nueces Bay Marsh 30% Design Memorandum
Texas Lower Coast Beneficial Use



Filepath: \\Fuji\Austin\D_drive\Projects\GLO\BU Lower Coast\Design\30% Designs\Portland Nueces Bay Marsh\Figures\Figure 2.docx

ANCHOR QEA

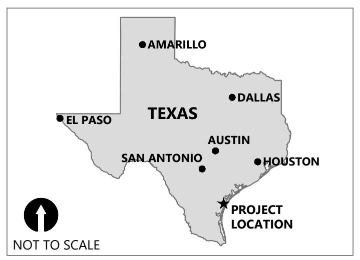
Figure 2
Historical Wind Data for USACE WIS Station 73039
Portland Nueces Bay Marsh 30% Design Memorandum
Texas Lower Coast Beneficial Use

Attachment 1
Construction Drawings

30% DESIGN SUBMITTAL

TEXAS LOWER COAST BENEFICIAL USE - PORTLAND NUECES BAY MARSH

PORT OF CORPUS CHRISTI AUTHORITY



AERIAL BY BING MAPS

DRAWING INDEX		
SHEET	DRAWING	TITLE
1	T01	TITLE SHEET
2	C01	SITE OVERVIEW
3	C02	PLAN VIEW
4	C03	TYPICAL CONTAINMENT BERM SECTION

NOTES:

1. HORIZONTAL DATUM: TEXAS STATE PLANE SOUTH ZONE, NAD83, U.S. SURVEY FEET
2. VERTICAL DATUM: NORTH AMERICAN VERTICAL DATUM OF 1988 (NAVD88)
3. BATHYMETRIC AND TOPOGRAPHIC SURVEY CONDUCTED BY TRITON ENVIRONMENTAL SOLUTIONS, LLC, ON MARCH 15, 2022.

PLAN INTENDED TO BE VIEWED IN COLOR, ADJACENT BLOCK IS "BLUE"

ONE INCH

AT FULL SIZE, IF NOT ONE INCH SCALE ACCORDINGLY

DRAFT-NOT FOR CONSTRUCTION

ANCHOR QEA

TEXAS GENERAL LAND OFFICE ESTABLISHED 1836

PORT CORPUS CHRISTI

REVISIONS				
REV	DATE	BY	APP'D	DESCRIPTION

DESIGNED BY: A. FREDDO
DRAWN BY: M. PRATSCHNER
CHECKED BY: R. ROBERTSON
APPROVED BY: J. LAPLANTE
SCALE: AS NOTED
DATE: JUNE 2022

TEXAS LOWER COAST BENEFICIAL USE - PORTLAND NUECES BAY MARSH

TITLE SHEET

T01

SHEET # 1 OF 4

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Jun 30, 2022 12:56pm mpratschner

LEGEND:

- CONTAINMENT BERM
- GLO MAPPED PIPELINES
- RAILROAD COMMISSION OF TEXAS MAPPED OIL AND GAS INFRASTRUCTURE LOCATIONS
- SMOOTH CORDGRASS MAPPED BY TRITON ENVIRONMENTAL SOLUTIONS, LLC
- —10— EXISTING CONTOUR (5')
- —3— EXISTING CONTOUR (1')
- GLO MAPPED OYSTER HABITAT
- SHELL FRAGMENTS MAPPED BY TRITON ENVIRONMENTAL SOLUTIONS, LLC

NORTH

0 300 600

SCALE IN FEET

NOTES:

1. HORIZONTAL DATUM: TEXAS STATE PLANE SOUTH ZONE, NAD83, U.S. SURVEY FEET
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3. BATHYMETRIC AND TOPOGRAPHIC SURVEY CONDUCTED BY TRITON ENVIRONMENTAL SOLUTIONS, LLC, ON MARCH 15, 2022.
4. GLO (TEXAS GENERAL LAND OFFICE), 2021B. LAYER: OYSTER HABITAT (ID: 57). ARCGIS REST SERVICES DIRECTORY. ACCESSED NOVEMBER 23, 2021.

PLAN INTENDED TO BE VIEWED IN COLOR. ADJACENT BLOCK IS "BLUE"

ONE INCH

AT FULL SIZE, IF NOT ONE INCH SCALE ACCORDINGLY

DRAFT-NOT FOR CONSTRUCTION

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Jun 30, 2022 12:56pm mpratschner

ANCHOR QEA

PORT CORPUS CHRISTI

REVISIONS

REV	DATE	BY	APP'D	DESCRIPTION

DESIGNED BY: A. FREDDO
DRAWN BY: M. PRATSCHNER
CHECKED BY: R. ROBERTSON
APPROVED BY: J. LAPLANTE
SCALE: AS NOTED
DATE: JUNE 2022

TEXAS LOWER COAST BENEFICIAL USE - PORTLAND NUECES BAY MARSH

SITE OVERVIEW

C01

SHEET # 2 OF 4

LEGEND:

- CONTAINMENT BERM
- GLO MAPPED PIPELINES
- RAILROAD COMMISSION OF TEXAS MAPPED OIL AND GAS INFRASTRUCTURE LOCATIONS
- SMOOTH CORDGRASS MAPPED BY TRITON ENVIRONMENTAL SOLUTIONS, LLC
- -10- EXISTING CONTOUR (5')
- -3- EXISTING CONTOUR (1')
- GLO MAPPED OYSTER HABITAT
- DREDGED MATERIAL PLACED TO +2.5' NAVD88
- SHELL FRAGMENTS MAPPED BY TRITON ENVIRONMENTAL SOLUTIONS, LLC

NORTH

0 150 300

SCALE IN FEET

NOTES:

1. HORIZONTAL DATUM: TEXAS STATE PLANE SOUTH ZONE, NAD83, U.S. SURVEY FEET
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ONE INCH

AT FULL SIZE, IF NOT ONE INCH SCALE ACCORDINGLY

DRAFT-NOT FOR CONSTRUCTION

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Jun 30, 2022 12:56pm mpratschner

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PORT CORPUS CHRISTI

REVISIONS

REV	DATE	BY	APP'D	DESCRIPTION

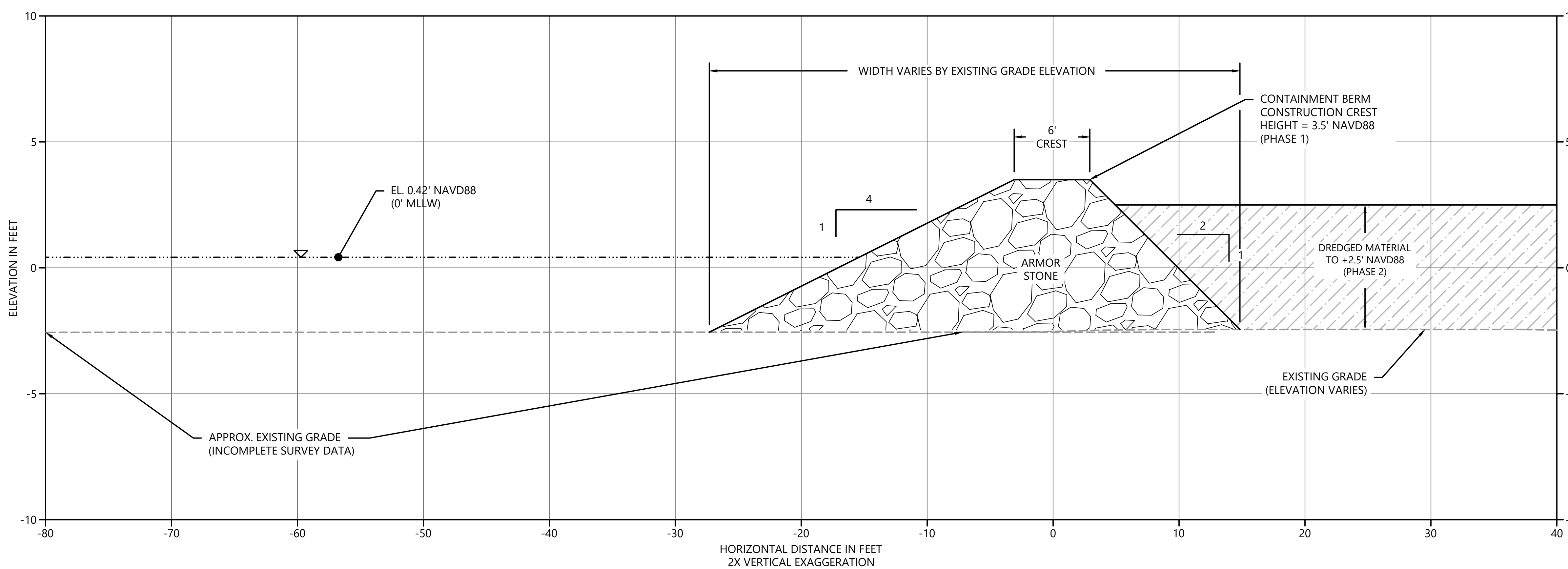
DESIGNED BY: A. FREDDO
DRAWN BY: M. PRATSCHNER
CHECKED BY: R. ROBERTSON
APPROVED BY: J. LAPLANTE
SCALE: AS NOTED
DATE: JUNE 2022

TEXAS LOWER COAST BENEFICIAL USE - PORTLAND NUECES BAY MARSH

PLAN VIEW

C02

SHEET # 3 OF 4



A SECTION C02
HORIZONTAL SCALE: 1" = 5'
VERTICAL SCALE: 1" = 2.5'

NOTES:

1. HORIZONTAL DATUM: TEXAS STATE PLANE SOUTH ZONE, NAD83, U.S. SURVEY FEET
2. VERTICAL DATUM: NORTH AMERICAN VERTICAL DATUM OF 1988 (NAVD88)
3. BATHYMETRIC AND TOPOGRAPHIC SURVEY CONDUCTED BY TRITON ENVIRONMENTAL SOLUTIONS, LLC, ON MARCH 15, 2022.

PLAN INTENDED TO BE VIEWED IN COLOR. ADJACENT BLOCK IS "BLUE"

ONE INCH
AT FULL SIZE, IF NOT ONE INCH SCALE ACCORDINGLY

DRAFT-NOT FOR CONSTRUCTION

K:\Projects\2018-PCCA Beneficial Use\PORTLAND NUECES BAY MARSH\Construction Plans\2018 PL-003 BERM_PNBM.dwg C03
Jun 30, 2022 12:56pm mpratschner

ANCHOR QEA

PORT CORPUS CHRISTI

REVISIONS

REV	DATE	BY	APP'D	DESCRIPTION

DESIGNED BY: A. FREDDO
DRAWN BY: M. PRATSCHNER
CHECKED BY: R. ROBERTSON
APPROVED BY: J. LAPLANTE
SCALE: AS NOTED
DATE: JUNE 2022

TEXAS LOWER COAST BENEFICIAL USE - PORTLAND NUECES BAY MARSH

TYPICAL CONTAINMENT BERM SECTION

C03

Attachment 2

Technical Specification Outline

TABLE OF CONTENTS

Memorandum

June 30, 2022

To: Melissa McCutcheon, Texas General Land Office

From: Todd Merendino, Ducks Unlimited, Inc.
Sarah Garza, Harrison McNeil, and Yvonne Dives-Gomez, Port of Corpus Christi Authority
John Laplante, Dan Opdyke, Renee Robertson, Alexander Freddo, and Hayden Smith, Anchor QEA, LLC
Jane Sarosdy, Sarosdy Consulting, Inc.

Re: Rabbit Island South Bird Island 30% Design Memorandum

Introduction

This 30% design memorandum describes design criteria and assessments associated with a beneficial use of dredged material (BU) project at the proposed Rabbit Island South site (Site), located in Texas General Land Office (GLO) Planning Region 4 of the Texas coast in the Upper Laguna Madre just outside of Baffin Bay in Kenedy County, Texas (Figure 1).

Project Background

GLO awarded a Coastal Management Program Project of Special Merit grant (funded through the Gulf of Mexico Energy Security Act) to Ducks Unlimited, Inc. (DU) to coordinate with stakeholders and identify restoration sites for BU. The Port of Corpus Christi Authority (PCCA), a project partner, has also contributed staff and financial resources to expand the project scope. The project team is led by DU and PCCA and includes Anchor QEA, LLC; Sarosdy Consulting, Inc.; and the Texas Department of Transportation. Collectively, the project team coordinated three stakeholder meetings with state and federal resource agencies, nongovernmental organizations, academia, consultants, and local officials in each region to solicit information about potential BU sites. Based on stakeholder input, GLO feedback, publicly available data, and professional judgment, the project team has developed 10% designs for 18 sites in GLO Planning Regions 3 and 4 of the Texas coast and 2 GLO-approved sites in Mesquite Bay and San Antonio Bay in GLO Planning Region 2. After completion of the 10% designs, 11 of the designs were selected to continue to 30% designs, and up to 7 of those designs will be chosen for 60% designs and permit application packages. The project team selected the Site as one of the 20 sites for 10% design development and cost estimation. Based on the Site's restoration potential and construction feasibility, the project team selected the Site to proceed to

30% design and opinion of probable construction costs using funding from the GLO Coastal Management Program Project of Special Merit grant.

Conservationists have identified the Laguna Madre and Baffin Bay as important locations for creating and restoring bird habitat (CBBEP 2020). Rabbit Island is a small island located on state-owned submerged land approximately 0.2 mile east of the Gulf Intracoastal Waterway (GIWW) in the Upper Laguna Madre just outside Baffin Bay in Kenedy County, Texas, and David Newstead with the Coastal Bend Bays and Estuaries Program has suggested it as a site for restoration. However, the Texas Parks and Wildlife Department (TPWD) seagrass data show that the existing Rabbit Island is surrounded by seagrass habitat (TPWD 2021), and the existing island also lies within U.S. Army Corps of Engineers (USACE) dredged material placement area (DMPA) #199, making it an unfavorable location for restoration. Therefore, the project team identified a different area for a new bird island nearby. This area, Rabbit Island South, is approximately 1.2 miles south of the existing island, between DMPAs #199 and #200, where TPWD data do not indicate seagrasses. This area was selected because of the identified need for a secure and stable rookery island, its proximity to a sediment source in the existing DMPAs and adjacent shallows, its proximity to potential bird foraging areas, and its distance from upland-based predators.

Project Objectives

Frequent dredging is needed to develop and maintain Texas navigation channels. The dredged material is often deposited in DMPAs. While many of the existing DMPAs along the Texas coast are nearing capacity, those in the vicinity of the Site are not contained and effectively have unlimited capacity. Despite capacity not being a limiting factor, resource agencies and stakeholders have long advocated using dredged material beneficially to create and restore wetlands and bird islands, nourish beaches, and counteract land loss. Historically, BU projects are difficult to manage because they are multiyear, multifaceted undertakings in which different organizations manage dredging schedules, funding, project design, permitting, and construction activities. To help address these issues, the objectives of this project include the following:

- Create and restore degrading coastal habitats.
- Establish sites for placement of dredged material to reduce reliance on existing DMPAs.
- Improve coastal resiliency of the natural and built environment.

To accomplish these objectives, the project includes the following tasks:

- Stakeholder outreach and coordination
- Identification and selection of BU sites
- 10% designs and cost estimates for 20 BU sites
- 30% designs and cost estimates for 11 BU sites
- 60% designs, cost estimates, and permit application packages for up to seven BU sites

This memorandum documents the 30% design and cost estimate for the Site.

Design Objectives

The Site will be designed to beneficially use dredged material to create a rookery island in a region with scarce or degrading coastal bird habitat. During the initial dredging of the GIWW, side casted new work dredged material was left along the edge of the channel. The native material and dredged material that remain from the original construction of the GIWW (termed "relict new work materials" in this memorandum) are considered to have superior structural properties relative to maintenance dredged material (Morton et al. 2001) and, hence, are the target sediment source for this design. The Site is expected to take advantage of this unique opportunity for mining favorable rookery island material in the area and use material dredged from existing relict new work material inside the surrounding DMPAs and adjacent shallows. Although this project may not use maintenance dredged material, it can still be considered a BU project because it is expected to take advantage of dredging equipment for which the mobilization and demobilization costs are paid by USACE during placement of material in the interior of the rookery island. This 30% design is based upon publicly available datasets, as well as focused field work conducted by DU.

Design objectives include the following:

- Develop a preliminary vision based on available data for the Site that includes the following:
  - Habitat to be created or restored
  - Potential sediment source(s)
  - Approaches to minimize long-term maintenance costs
- Delineate conceptual footprints for proposed BU placement.
- Identify key sensitive habitats and construction considerations in the vicinity of the Site.
- Estimate fill volumes for the proposed BU footprints.
- Identify data gaps to be addressed in subsequent design phases.
- Provide preliminary cost estimates.

Existing Data Review

A review of existing data and the focused data collected by DU was performed to develop the Site and containment berm designs. This section describes the data reviewed and collected for the 30% design.

Horizontal and Vertical Datums

The horizontal datum used for the Site is the Texas State Plane South Zone, North American Datum of 1983 in U.S. survey feet. The primary vertical datum used for the Site design is the North American Vertical Datum of 1988 (NAVD88). The National Oceanic and Atmospheric Administration (NOAA) maintains an active tide gauge within the vicinity of the Site. The NOAA Baffin Bay, TX Station

8776604 (Baffin Bay Station) is 5 miles north of the Site; however, this station only provides elevations for NAVD88 and mean sea level (MSL) vertical datums. The next-closest station that contains the necessary tidal datums is Packery Channel, TX Station 8775792 (Packery Channel Station) 30 miles north of the Site. There is a 0.11-foot difference in the MSL tidal datum between the stations, so the tidal datum from the Packery Channel Station was assumed accurate for this level of analysis. The Packery Channel Station collects and records real-time tide information dating back to 1990. The vertical datums from this station that will be used for the Site are shown in Table 1. The NOAA USS Lexington Station, Corpus Christi Bay, TX Station 8775296 was also used to define a preliminary design water level, as described in the Water Level section.

Table 1
Packery Channel Station Tidal Gauge Displaying NAVD88 Tidal Datums

Tidal Datum	Elevation (feet NAVD88)	Elevation (feet MLLW)
MHHW	0.79	0.42
MHW	0.79	0.42
MSL	0.59	0.22
MLW	0.36	-0.01
MLLW	0.37	0

Notes:
MHHW: mean higher high water
MHW: mean high water
MLLW: mean lower low water
MLW: mean low water

Meteorological, Ocean, and Wave Data

Water Level

To determine an approximate design water level elevation for the Site, an existing water level analysis using data from the Lexington Station, which is 40 miles north of the Site, was used (Anchor QEA 2021). Data were compiled for the period from October 2015 to January 2021 and used to calculate a 90th-percentile water level of 2.0 feet NAVD88, which is 1.24 feet MSL at Lexington Station. To more closely depict water levels represented at the Site, this elevation of 1.24 feet was added to the reported MSL at the Baffin Bay Station MSL (which is 0.48 feet NAVD88) to generate a reasonable design water level of 1.72 feet NAVD88.

This water level was used for a preliminary understanding of the wave growth at the Site, and a more comprehensive analysis based on historical water levels at the Baffin Bay Station may be used during subsequent design phases.

Wind and Waves

The USACE Wave Information Studies (WIS) provides a national resource of long-term wavefield climatologies for U.S. coastal waters that synthesizes observations, multidecade hindcasts, and storm event archives (USACE 2021). The WIS station closest to the Site is Station 73032, just offshore on the Gulf side of North Padre Island in the Gulf of Mexico. Because the station is located offshore, the wave data are not applicable to this project design. However, the project team considers the wind data to be representative of the winds experienced at the Site. Figure 2 summarizes wind data from January 1, 1980, through December 31, 2014. The data indicate that the predominant wind direction is from the southeast, with significant winds also coming from the north, northeast, east, and south.

The Coastal Engineering Design and Analysis System (CEDAS) Automated Coastal Engineering System (ACES) tool was used to calculate the wave growth over the restricted shallow-water fetch from the southeast and north (Leenknecht et al. 1992a). These two directions were selected because each exhibits significant winds over long, restricted fetch distances. Inputs for the ACES tool consist of the items described in the following subsections.

North Wind

- The main wind direction was input to be from 0° clockwise from the north.
- The average depth along the fetch in the north direction was input as 5.1 feet (based on a conservative water surface elevation of 1.72 feet NAVD88 (NOAA 2021).
- The fetch length for the north wind direction was input as 6.25 miles.
- The observed wind speed was input according to the WIS station extreme value analysis in which return periods and their wind speeds were predicted inside a ±22.5° bin from 0°. (The 0° bin is represented by all winds measured from the 337.5 to 22.5° wind direction.)

Southeast Wind

- The main wind direction was input to be from 135° clockwise from the north.
- The average depth along the fetch in the southeast direction was input as 4.0 feet (based on a conservative water surface elevation of 1.72 feet NAVD88 (NOAA 2021).
- The fetch length for the southeast wind direction was input as 3.37 miles.
- The observed wind speed was input according to the WIS station extreme value analysis in which return periods and their wind speeds were predicted inside a ±22.5° bin from 135°. (The 135° bin is represented by all winds measured from the 112.5° to 157.5° wind direction.)

Common Inputs

- The elevation of observed wind was 10 meters (Leenknecht et al. 1992b)
- The temperature difference between the air and sea was input as 0°F.
- The duration of the observed wind and duration of the final wind are from the hindcasted time interval associated with the WIS data recordings and input as 1 hour.

- WIS Station 73032 is at 27.1° latitude observing over water.
- The fetch option most associated with the Site is shallow restricted, meaning that the wind-wave generation is impacted by the geometry of the Site and where wind is measured traveling from a point along the shoreline to the point of interest (Leenknecht et al. 1992b)
- The number of angles was input as three, with a radial angle increment as 10°. This results in the direction of the first radial fetch to be 10° less than the predominant wind direction from both the north and southeast (350° and 125°, respectively), the second radial fetch to be the predominant wind direction from both the north and southeast (0° and 135°, respectively), and the third radial fetch to be 10° more than the predominant wind direction from both the north and southeast (10° and 145°, respectively). This approach forces the ACES tool to correctly calculate the wave growth across the desired main wind direction angle of 0° and 135°.

The predicted wave height growth from the north and southeast wind directions is shown in Tables 2 and 3, respectively.

Table 2
CEDAS ACES Predicted Wave Height Growth in the North (0°) Wind Direction

Wind Direction	Fetch Distance (miles)	Return Period (years)	Wind Speed (mph)	Wave Height (Hmo, feet)[1]	Wave Period (Tp, s)[2]
North 0° (337.5°–22.5°)	6.25	1	33.0	1.49	2.58
		2	38.6	1.69	2.78
		10	43.2	1.84	2.94
		20	44.6	1.88	2.98
		50	46.3	1.93	3.03
		100	47.4	1.97	3.07

Notes:
1. Wave heights are determined from spectrally based methods (Hmo; Bretschneider and Reid 1954).
2. Wave periods are determined from spectrally based methods (Tp; Bretschneider and Reid 1954).

mph: miles per hour
s: seconds

Table 3
CEDAS ACES Predicted Wave Height Growth in the Southeast (135°) Wind Direction

Wind Direction	Fetch Distance (miles)	Return Period (years)	Wind Speed (mph)	Wave Height (Hmo, feet)[1]	Wave Period (Tp, s)[2]
Southeast 135° (112.5°–157.5°)	3.37	1	27.5	1.03	2.05
		2	30.9	1.13	2.17
		10	44.1	1.52	2.58
		20	51.0	1.70	2.77
		50	61.1	1.95	3.03
		100	69.3	2.14	3.22

Notes:
1. Wave heights are determined from spectrally based methods (Hmo; Bretschneider and Reid 1954).
2. Wave periods are determined from spectrally based methods (Tp; Bretschneider and Reid 1954).

Wind-generated waves from the predominant north and southeast wind direction were calculated to inform the approximate wave climate at the Site. One-year return period winds generated waves no greater than 1.16 feet. A more detailed hydrodynamic model analyzing the direction and frequency of expected significant wave heights may be developed during subsequent phases of design.

Wake Erosion

The GIWW is approximately 0.14 mile west of the Site. Several types of vessels, including recreational and commercial vessels and commercial tugboats and barges, operate in the GIWW and generate wake waves that propagate to the Site. Like wind-generated waves, vessel wake waves produce the greatest erosive forces in the region where the waves break (i.e., the surf zone).

The Bhowmik et al. (1991) and Weggel and Sorensen (1986) vessel-generated wave prediction methods—based on vessel dimensions, travel speed, and distance between the sailing line and Site—were used to evaluate the range of vessel-generated waves for a conservative selection of representative vessels known to operate in the area. A sport yacht with a draft of 4 feet was selected to evaluate recreation vessel wakes generated by vessels traveling near the proposed Site. A generic tugboat with maximum dimensions recorded in the Automatic Identification System (AIS) database was selected, along with a similar tugboat transiting with twin barges (identified using Google Earth imagery of ports in the region) to evaluate the commercial vessel wakes generated by vessels traveling in the GIWW. Calculation of the sport yacht's maximum vessel wakes, traveling at varying speeds along the nearest edge of the GIWW 750 feet from the Site, can be seen in Table 4. Calculation of the tugboat and tugboat with twin barges maximum vessel wakes, traveling in 14 feet of water at varying speeds up to 11 miles per hour (mph; considered conservative) along the nearest edge of the GIWW 750 feet from the Site, can be seen in Table 5.

These wave heights are smaller than the predicted wind-generated wave heights at the Site; thus, wind-generated waves will be considered the predominant erosive force for design evaluations. The vessel wakes are limited to vessels traveling on the edge of the GIWW. This assumption likely holds for commercial vessels, but further analysis should be conducted to understand the frequency and distance recreational vessels travel near the Site. Additional analysis surrounding a variety of recreational vessel drafts and speeds may be considered in future design phases.

Table 4
Sea Ray Sundancer Sport Yacht Maximum Vessel-Wake Calculations at Various Speeds

Vessel	Length (feet)	Draft (feet)	Vessel Speed (mph)	Maximum Wave Height (feet)	Wave Period (s)
Sport yacht Sea Ray Sundancer	51	4	6.7	0.92	1.21
			15	0.70	1.05
			25	0.59	0.96
			35	0.52	0.91
			45.4	0.48	0.87

Note:
Maximum wave heights were calculated using Bhowmik et al. (1991), in which vessel speeds ranged from 6.7 to 45.4 mph.

Table 5
Tugboat and Tugboat with Twin Barges Maximum Vessel-Wake Calculations at Various Speeds

Vessel	Length (feet)	Beam (feet)	Draft (feet)	Vessel Speed (mph)	Maximum Wave Height (feet)	Wave Period (s)
Generic tugboat with maximum dimensions recorded in AIS data[1]	87	33	11	3	0.00	8.40
	87	33	11	5	0.00	5.04
	87	33	11	7	0.00	3.60
	87	33	11	9	0.09	2.80
	87	33	11	11	0.69	2.29
Generic tugboat with maximum dimensions recorded in AIS data and twin barges[2]	387	110	11	3	0.00	7.31
	387	110	11	5	0.00	4.38
	387	110	11	7	0.00	3.13
	387	110	11	9	0.00	2.44
	387	110	11	11	0.96	2.29

Notes:
Maximum wave heights were calculated for vessels traveling within Froude number boundaries and at 3. 5, 7, 9, and 11 mph (Weggel and Sorensen 1986).

1. Vessel hull geometric coefficients were input using a tugboat from Hay (1967).
2. Vessel hull geometric coefficients were input using a barge from Hay (1967).

Bathymetry and Topography

DU conducted bathymetric and topographic surveys at the Site on March 23, 2022. The Site footprint consists of mostly open-water shallows with small upland remnants containing shell hash and vegetation. The Site footprint has an average seabed elevation of -1.80 feet NAVD88 and slopes steeply down to deeper water surrounding the Site at approximately -4.0 feet NAVD88. The Site contours range from -4.6 to +2.9 feet NAVD88. During the survey, DU conducted sediment probing in 35 areas of the Site. The minimum and maximum probing distance to substrate refusal was 0.03 and 1.02 feet, respectively, with an average distance to refusal of 0.31 feet. Within those areas, it was qualitatively determined that the material was firm throughout and is not expected to have substantial settling.

Utilities and Infrastructure

The Railroad Commission of Texas public GIS viewer (RRC 2021) and GLO pipeline data (GLO 2021a) were used to identify mapped utilities and pipelines near the Site. Three dry holes were identified within a 1-mile radius and are not expected to impact design and construction (Attachment 1, C01). No utilities or pipelines were identified near the Site. The need for Site-specific utility locations prior to construction may be determined during subsequent design phases. No other infrastructure has been identified in the vicinity of the Site.

Desktop Cultural Resources Survey

A search of cultural resources records in the Texas Historical Commission Texas Historical Sites Atlas Database was completed for the Site on December 16, 2021. This search revealed there may be a cultural resource close enough to the Site to warrant further investigation. No archaeological surveys have been conducted within the preliminary proposed placement Site boundary (THC 2021). It is anticipated that the Site will not disturb the cultural resource, however, additional locations, investigations, and coordination are recommended during subsequent design phases and prior to construction if this excavation area is used.

Sensitive Habitat

GLO oyster habitat GIS data (GLO 2021b) and visual surveys conducted by DU on March 23, 2022, do not indicate oyster habitat within or adjacent to the Site.

The visual survey conducted by DU on March 23, 2022, indicated scattered seagrasses surrounding the excavation areas and along the Site from approximately the shoreline to -4 feet MSL (-3.41 feet NAVD88; Attachment 1, C01). Seagrasses were identified visually in shallow water and assumed to be present in deeper water where water appeared dark. Because this information is based on visual surveys, more extensive seagrass surveys may need to be conducted during a subsequent phase of design.

Bird Species

The U.S. Fish and Wildlife Service (USFWS) Information for Planning and Consultation (IPaC) tool was used to identify listed species and migratory birds within a 460-square-mile region around Baffin Bay and a portion of North Padre Island (USFWS 2021). Table 6 includes some of the protected and migratory bird species present near the Site and their preferred habitat, as explained in *Guide to North American Birds* (Audubon 2021a). At this time, no target species or list of species, has been identified for the Site. Brown pelicans, reddish egrets, and great blue herons (*Ardea herodias*) were observed on the upland of Excavation Area – Alternative 3 and the shell hash ridge of the Site during the DU Site survey on March 23, 2022.

Table 6
USFWS IPaC Species Information[1]

Species	Status	Preferred Habitat[2]
Whooping crane (*Grus americana*)	Endangered	Prairie pools, marshes, and coastal marshes
Piping plover (*Charadrius melodus*)	Threatened	Sand beach dunes and expansive sand or mudflats
Red knot (*Calidris canutus*)	Threatened	Mudflats, tidal zones, and sandy beaches
American oystercatcher (*Haematopus palliatus*)	Migratory	Strictly coastal; dunes, islands in salt marsh, dredge spoil islands, sandy beaches, and tidal mudflats
Black skimmer (*Rynchops niger*)	Migratory	Sandy islands, shell beaches, open beaches, lagoons, estuaries, inlets, and sheltered bays
Brown pelican (*Pelecanus occidentalis*)	Migratory	Bare, rocky, mangrove- or tree-covered islands; salt bays, beaches, and oceans
Gull-billed tern (*Gelochelidon nilotica*)	Migratory	Beaches, islands, salt marshes, fields, and coastal bays
Marbled godwit (*Limosa fedoa*)	Migratory	Northern Great Plains, native prairie with marshes or ponds, pools, shores, marshes, and tidal flats
Reddish egret (*Egretta rufescens*)	Migratory	Red mangrove swamps, arid coastal islands covered with thorny brush, coastal tidal flats, salt marshes, and lagoons
Ring-billed gull (*Larus delawarensis*)	Migratory	On ground near water with sparse plant growth, lakes, bays, coasts, piers, dumps, and plowed fields
Royal tern (*Thalasseus maximus*)	Migratory	Low-lying sandy islands, coasts, lagoons, salt bays, and estuaries
Wilson's plover (*Charadrius wilsonia*)	Migratory	Dry part of beach, near conspicuous object, coastal regions, open beaches, tidal flats, estuaries, and sandy islands

Notes:

1. USFWS IPaC information (USFWS 2021) is provided for a 460-square-mile region around Baffin Bay and a portion of North Padre Island highlighting endangered, threatened, and migratory birds and their preferred habitat.
2. Habitat information is from the Audubon Guide to North American Birds (Audubon 2021a) and includes preferred nesting and general habitat.

Erosion

Google Earth imagery indicates Rabbit Island South is becoming submerged over time and has lost approximately 1 acre of upland from 1995 to 2016. This is consistent with documentation from the Coastal Bend Bays & Estuaries Program, which notes that the North Padre Island shorelines are at high risk due to erosional forces (CBBEP 2020).

Beneficial Use Source Material

The proposed source material for Rabbit Island South may consist of existing relict new work material excavated from inside the Site (borrow area); DMPAs #199 and #200, 0.5 and 0.15 mile away, respectively (Excavation Areas 1 and 3); and adjacent shallows west of the Site (Excavation Area 2; Attachment 1, C01 and C02). The material located in these proposed areas came from material dredged from deltaic deposits of Pleistocene Beaumont Formation or the Holocene Rio Grande delta during the original dredging of the GIWW and has been shown to be more stable than recent maintenance dredged material (Morton et al. 2001). The containment berm will primarily be constructed with the borrow area material while exterior excavation area material may be used if the quantity available from the borrow area is insufficient. The exterior excavation areas will be used to provide the material for containment berm enlargement. The exterior excavation areas and, possibly, maintenance dredged material, will be used to provide the interior fill for the Site. The available volume inside of each excavation area alternative at different excavation elevations was calculated and is shown in Table 7.

Table 7
Excavation Area Alternative and Borrow Area Sediment Volume Availability at Different Excavation Elevations

Excavation Area	Excavation Elevation (feet NAVD88)	Volume (CY)[3]
Area 1[1]	-1	2,200
	-2	6,400
	-3	14,800
	-4	30,700
	-5	64,300
	-6	128,900
	-7	214,900
	-8	300,900
Area 2[1]	-1	0
	-2	0
	-3	0
	-4	0

Excavation Area	Excavation Elevation (feet NAVD88)	Volume (CY)[3]
	-5	100
	-6	6,700
	-7	29,400
	-8	52,300
Area 3[1]	-1	1,500
	-2	3,300
	-3	5,400
	-4	7,600
	-5	9,800
	-6	11,900
	-7	14,100
	-8	16,300

Notes:
Volume availability was calculated using Civil3D from surfaces creating using the bathymetric and topographic surveys collected by DU on March 23, 2022.

1. Bathymetric surveys do not cover the full excavation area limits, and some bathymetric data were assumed. Volume availability may need to be refined during future phases of design.
2. Volume availability was calculated inside the 50-foot buffer region, away from the interior toe of the containment berm, and elevation values were assumed to start at the average seabed elevation of -1.8 feet NAVD88
3. Value is rounded to the nearest 100 CY.

CY: cubic yards

DU collected five surface sediment grab samples: one at the north end of the Site, three in Excavation Area 1, and one in Excavation Area 3 (Attachment 1, C01). During this sampling event, organics, inorganics, conventional geotechnical parameters, and gradations were not analyzed in a laboratory. The surface samples are not necessarily representative of the material below the surface sediments. A visual inspection of the surface grab material shows varying characteristics. Further sampling and testing would be needed to more precisely describe this material and gauge its utility for construction. Nevertheless, Table 8 shows qualitative descriptions for each of the five surface grabs.

Table 8
Qualitative Descriptions of Five Surface Sediment Grabs During Basic Inspection

Grab Number	Latitude (N)	Longitude (W)	Qualitative Descriptions
1	27.232618	97.416819	Mostly coarse grained with shell Approximately 5–10% fines
2	27.230739	97.417912	Mostly fines with organics Silty, non-cohesive material

Grab Number	Latitude (N)	Longitude (W)	Qualitative Descriptions
3	27.235984	97.416642	Mostly sand with clay and silts Relatively low cohesiveness
4	27.237638	97.416163	Mostly sands and with clays and silts Moderate cohesiveness
5	27.227435	97.418598	Mostly sands and clays with some shell Relatively high cohesiveness

Note:
Grab samples were collected by DU on March 23, 2022.

Additionally, GIWW maintenance material with grain size characteristics from the USACE Dredged Material Management Program Reach 2 – DMPA 192-202 consisting of 23% sand, 46% silt, and 31% clay (Neill 2022) is being considered for interior placement at the Site.

30% Design

The main design elements evaluated for the Site are as follows:

- Site location
- Rookery island size and shape
- Containment and erosion protection
- Constructability
- Planting and natural recruitment of vegetation
- Performance expectations
- Site construction cost estimate
- Expected ecosystem benefits
- Data and information gaps

These design elements are evaluated in this memorandum for the 30% Site design.

Site Location

The proposed location of the Site is approximately 0.2 mile east of the GIWW and between DMPAs #199 and #200. The Site's location was selected to avoid encroaching on those areas, as well as on potentially dense seagrass habitat at the existing Rabbit Island location (as indicated by TPWD seagrass data).

The proposed Site is approximately 0.7 mile from the nearest shoreline. This distance is above the 0.5-mile distance identified for minimizing predator access to rookery islands (Stanzel 2018).

The Site is currently located on mounded, upland ridges of relict new work material that provides shallow water with a seabed elevation that averages -1.8 feet NAVD88 (-2.17 foot mean lower low water [MLLW]). The existing upland ridges are small with minimal to no vegetation and do not support significant bird populations.

Rookery Island Size and Shape

Based on availability of sediment, a cost analysis, and stakeholder feedback, the project team proposes that the upland area of the Site be approximately 10 acres. This 30% design represents a bird island near the upper range of bird island sizes desired, based on stakeholder input. Seagrass constraints may limit the size of island ultimately constructed, but at this level of design, it was decided to consider a site near the upper end of the range identified by stakeholders.

The Site will be created with dredged material placed to an elevation of +4.0 feet NAVD88 and will be approximately elliptical in shape. A high-density clay containment berm made of the relict new work material will be constructed on all sides to protect the island from wind and vessel-generated waves, as well as contain placed dredged material (Attachment 1, C02). This shape of fill and elevation was selected to promote natural recruitment of vegetation and provide habitat for a range of bird species. The elevation of dredged material fill could be adjusted at future phases of design, depending on the physical properties of the dredged material or if target bird species and their specific requirements are different from these characteristics are identified. It is expected that environmental controls may be needed during construction to contain finer sediment placed during construction.

Because the Site is between two DMPAs, relict new work material existing inside or around the nearby DMPAs may be dredged to construct the rookery island. Fill material could also come from GIWW maintenance material. Because of the shallow water depths, access channels may need to be dredged for contractors to access the project sites (Attachment 1, C01). There is additional shallow relict new work material with a seabed elevation above -1.0 foot NAVD88 immediately adjacent to the east side of the Site that is anticipated to act as a natural wave-energy dissipator and reduce erosive forces. Preconstruction bathymetric surveys may need to be conducted during subsequent design phases to better define Site dimensions and material requirements.

Containment and Erosion Protection

Based on the fetch in the predominant north and southeast wind directions and potential risk of vessel-wake erosion, the project team currently proposes no armoring for the Site. The initial investigation of wind-generated waves and vessel wakes does not show wave heights >2.14 feet. Furthermore, the continued existence of these islands (albeit in reduced form) more than 70 years after construction indicates that the material is fairly resilient to erosion. Accordingly, the perimeter of the Site is designed to be constructed using the relict new work material. Further evaluation using a detailed wind-wave model to analyze the direction and frequency of expected significant wave heights may be conducted during subsequent phases of design. Such information would inform the possible benefits of armoring, including the tradeoffs between initial capital construction costs and maintenance costs with armoring versus without armoring.

A containment berm will be constructed around the Site to contain the dredged material. The proposed design includes constructing the centerline of the north, south, and west containment berms approximately along the -3.5-foot NAVD88 contour, and the east containment berm along the approximate -4.0-foot NAVD88 contour. Based on the sediment probing, which indicated that the substrate is extremely firm throughout, the conceptual design assumes 1 foot of foundation compression for every 6 feet of fill and does not consider bulking. However, sediment cores and geotechnical data may need to be collected during a subsequent design phase to further evaluate the expected foundation compression and expected bulking of both mechanically excavated and hydraulically dredged material. Sediment cores and geotechnical data may also be necessary to determine the availability and suitability of material in the proposed borrow areas and excavation areas. Table 9 summarizes the Phase 1 containment berm design characteristics.

Table 9
Phase 1 Containment Berm Design Characteristics

Containment Berm Design Criteria	Rabbit Island South Containment Berm
Total project length	2,600 feet
Total containment berm acreage	Approximately 4.8 to 5.0 acres
Crest width	12 feet
Base width	80 to 84 feet, depending on water depth
Assumed bottom elevation	-3.5 to -4.0 feet NAVD88
Total structure height	8.5 to 9.0 feet
Containment berm materials	Mechanically excavated relict new work dredged material
Containment berm volume	38,000 to 50,000 CY
Estimated settlement	1 foot for every 6 feet of fill
Design side slopes (seaward side)	5H:1V[1], depending on material
Design side slopes (landward side)	3H:1V[1], depending on material
Maximum design crest elevation	+5 feet NAVD88

Notes:
The final cross-sectional dimensions and slopes of the containment berm will need to be determined and refined, respectively, through modeling and analysis of the wind-wave hydrodynamics and sediment characteristics of the dredged material and containment berm subgrade during a subsequent phase of design.
1. Horizontal to vertical

The proposed centerline of the containment berm is shown in Attachment 1, C01. Attachment 1, C03 depicts a typical cross section of the containment berm. The containment berm will be allowed to dewater and consolidate; then, it will be nourished and enlarged with additional high-quality, relict new work dredged material, described as the overtopping slope in Phase 2. Table 10 summarizes the Phase 2 containment berm and fill design characteristics.

Table 10
Phase 2 Containment Berm and Fill Design Characteristics

Containment Berm Design Criteria	Rabbit Island South Containment Berm
Total project length	2,600 feet
Total containment berm acreage	7.9 to 8.3 acres
Crest width	15 feet
Base width	132 to 139 feet, depending on water depth
Assumed bottom elevation	-3.5 to -4.0 feet NAVD88
Total structure height	9.0 to 9.5 feet
Containment berm materials	Mechanically excavated relict new work dredged material
Containment berm volume	36,000 to 47,000 CY
Estimated settlement[1]	1 foot for every 6 feet of fill
Design side slopes (seaward side)	10H:1V or vertical, depending on material
Design side slopes (landward side)	3H:1V or vertical, depending on material
Maximum design crest elevation	+5.5 feet NAVD88
Internal Fill Design Criteria	**Rabbit Island South Internal Fill**
Fill acreage	5 acres
Fill elevation	+4.0 feet NAVD88
Fill volume[2]	95,000 CY

Notes:
The final cross-sectional dimensions, slopes of the containment berm, and volume required for interior fill will need to be determined and refined, respectively, through modeling and analysis of the wind-wave hydrodynamics and sediment characteristics of the dredged material and containment berm subgrade during a subsequent phase of design.
1. Estimated settlement only includes subgrade not previously impacted by the Phase 1 containment berm.
2. Estimated fill volume was calculated after excavating the borrow area to at least -6.8 feet NAVD88.

Attachment 1, C03 depicts a typical cross section of the interior fill and gradual slope placement overtopping the containment berm. It is predicted that the required total volume for Phase 1 and Phase 2 will be approximately 231,000 cubic yards (CY). This value assumes 1 foot t of foundation compression for every 6 feet of fill and does not consider bulking.

The team expects that a 10 horizontal to 1 vertical (10H:1V) gradual seaward side slope will allow the rookery island to transition into a stable, natural grade, which is expected to reduce wave erosion on the rookery island, help the island be naturally stable over time, and facilitate wading bird access into the Site. A shallower slope may be considered during subsequent phases to provide more potential seagrass habitat and further decrease wave erosion on the Site.

A typical minimum wave height where armoring should be considered is 1 foot, which is approximately equal to the 10-year return wind condition from the southeast and the 1-year return wind condition from the north. Armoring is not proposed at this phase based on this wave analysis; the resilience of similar relict new work islands in the vicinity of the Site; and to reduce construction costs. However, further wind-wave analysis, as well as an evaluation of initial capital construction cost versus projected maintenance costs, may need to be conducted during subsequent design phases to determine if armoring may be cost effective.

Constructability

This section describes the proposed methods of construction. Actual methods will be dependent on the chosen contractor's equipment and Site conditions at the time of construction. In addition, the contractor may provide alternate construction methods from those described in this section.

Dredging is typically performed along the GIWW Corpus Christi to Port Isabel reach every 1 to 2 years (Neill 2022). The Site is proposed to be constructed in two different phases to beneficially use dredged material from a USACE dredging cycle, which makes the project more feasible. Phase 1 containment berm construction will be completed prior to a USACE dredging event to allow for dewatering and consolidation; then, Phase 2 containment berm and interior fill construction will be completed during a USACE dredging event.

The Site could be constructed in two different phases, as follows.

Phase 1

The initial containment berm will be constructed during Phase 1 to allow for settlement, dewatering, and consolidation of the containment berm before placing fill material into the Site (Phase 2; Attachment 1, C02 and C03). Phase 1 construction may require mobilizing equipment beyond what is required for dredging the GIWW (e.g., marsh buggies, a deck barge, and an excavator). The containment berm may be constructed from mechanically excavated relict new work material from borrow areas currently residing in the Site footprint and/or from immediately adjacent shallow areas that have the relict new work material (Excavation Areas 1 and 2) if borrow area material quantity is insufficient. Depending on water depths, marsh buggies or deck-barged excavators may be used to shape the containment berm.

Phase 2

Phase 2 of construction will consist of raising the containment berm crest to +5.5 feet NAVD88 and placing fill inside the Site to create the bird island (Attachment 1, C02 and C03). Phase 2 construction may require mobilizing equipment beyond what is required for dredging the GIWW (e.g., marsh buggies, a deck barge, and an excavator) and incremental mobilization consisting of diverting typical dredging equipment from the GIWW to the Site. The material for the Phase 2 containment berm and interior fill may be either hydraulically dredged relict new work material from Excavation Areas 1 and 2 or from GIWW maintenance material. The hydraulically dredged relict material is likely to produce clay balls or clumps that will fall near the end of the pipe and congregate. The clay balls or clumps may then be used construct the Phase 2 containment berm geometry.

Planting and Natural Recruitment of Vegetation

Based on stakeholder input and cost considerations, the project team determined that planting on the interior may not be needed. Rather, natural vegetation recruitment will be allowed to proceed. If the outcome is unsatisfactory (e.g., if the island has lower-than-expected use by desired bird species), an adaptive management program can be instituted to modify the vegetation. Table 6 shows some of the listed and migratory birds and their preferred habitats. At further design phases, this list could be used to modify elevations within the Site to promote the preferred habitat of desired bird species.

Stakeholders suggested existing seagrasses be transplanted to a temporary site prior to construction and then reintroduced following construction and consolidation of placed material. This may accelerate the revegetation of the shallow water areas surrounding the Site. There is also the possibility of transplanting seagrasses from other locations or allowing seagrasses to recolonize naturally. Stakeholders additionally suggested planting mangroves on the Phase 2 containment berm to further stabilize the shoreline. These strategies would need to be evaluated to determine impact on project costs, as well as the impact they may have on the bird species that would colonize the Site.

Performance Expectations

The existing relict new work upland islands in the Upper Laguna Madre have shown to be erosion resilient over time. Because the Site is to be constructed mostly using the relict new work dredged material, it is expected to experience the same resiliency as the Upper Laguna Madre islands. The relict new work material on the Site is expected to weather and stabilize over time to a natural slope similar to that of other upland islands composed of relict new work material in the Upper Laguna Madre.

Site Construction Cost Estimates

Preliminary construction costs were estimated for the design outlined in the previous sections. The estimated costs include indirect construction costs (i.e., permitting, 100% engineering and design costs, construction management, and post-construction management such as Site visits, dewatering management). These costs represent the estimated incremental costs (i.e., costs over and above USACE's least costly and environmentally acceptable dredged material and placement alternative). Table 11 shows a line-item list of each costing parameter and the total cost estimated for construction.

The costs range from $2.2 million to $4.7 million, depending on the level of uncertainty allocated to the project cost. The lower bound of uncertainty (-30%) and upper bound of uncertainty (+50%) were selected due to the existing data gaps, high levels of inflation, and rising fuel costs. During subsequent design phases, the effect of armoring versus not armoring on the initial capital construction versus projected maintenance costs may be evaluated. The estimates are developed using current and generally accepted engineering cost estimating methods and are based on assumptions concerning future events. Actual costs may be affected by known and unknown risks including, but not limited to, changes in general economic business conditions, Site conditions that were unknown at the time the estimates were performed, future changes in Site conditions, regulatory or enforcement policy changes, and delays in performance. Actual costs may vary from these estimates.

Table 11
Opinion of Probable Construction Cost to 100% Project Completion

Item	Quantity	Unit	Unit Price	Total
Direct Construction Costs				
Phase 1: Containment Berm Construction				
Mobilization and Demobilization[1,2]	1	LS	$ 150,000.00	$ 150,000.00
Preconstruction Survey	1	LS	$ 30,000.00	$ 30,000.00
Containment Berm[2,3]	2,606	LF	$ 104.00	$ 270,000.00
As-Built Survey	1	LS	$ 50,000.00	$ 50,000.00
Navigational Aids[2]	4	Each	$ 4,000.00	$ 20,000.00
Phase 1 Subtotal[4]			**Sum**	**$ 500,000.00**
Phase 2: Interior Fill Placement and Containment Berm Enlargement				
Incremental Mobilization and Demobilization[1,2,5]	1	LS	$ 250,000.00	$ 250,000.00
Preconstruction Survey	1	LS	$ 50,000.00	$ 50,000.00
Dredged Material Interior Placement[2]	95,000	CY	$ 12.00	$ 1,140,000.00
Containment Berm[2,3]	2,606	LF	$ 90.00	$ 230,000.00
As-Built Survey	1	LS	$ 60,000.00	$ 60,000.00
Phase 2 Subtotal[4]			**Sum**	**$1,700,000.00**
Direct Construction Subtotal[4]			**Sum**	**$2,200,000.00**
Indirect Construction Costs				
100% Engineering and Design[4]	1	LS	$ 500,000.00	$ 500,000.00
Permitting	1	Each	$ 100,000.00	$ 100,000.00
Construction Management[4]	1	%	8	$ 200,000.00
Post-Construction Management[6]	12	Month	$ 10,000.00	$ 120,000.00
Indirect Construction Subtotal[4]			**Sum**	**$ 900,000.00**
Project Subtotal[4]			**Sum**	**$3,100,000.00**
-30% Uncertainty[4]	1	%	30	$ 900,000.00
+50% Uncertainty[4]	1	%	50	$ 1,600,000.00
Low-End Total Project Estimated Cost[4]			**Total Sum**	**$2,200,000.00**
High-End Total Project Estimated Cost[4]			**Total Sum**	**$4,700,000.00**

Notes:
Costs were determined based upon a combination of publicly available datasets and sediment surface grabs, and topographic, bathymetric, and visual habitat surveys.
The Phase 2 containment berm assumes maintenance material from the GIWW is not conducive to be interior fill or containment berm material and that the USACE dredge will mine relict new work material.

1. Cost is based upon mobilizing equipment above what is required for dredging the GIWW (e.g., marsh buggies).
2. Value is rounded to the nearest $10,000.
3. Cost includes side casting existing relict new work material (or dredged material) and shaping of the containment berm.
4. Value is rounded to the nearest $100,000.
5. Cost is based on the incremental cost of diverting dredging equipment from GIWW to excavation areas.

6. Post-construction management may include Site visits to observe the material consolidation, vegetation, and water levels on the Site. Monthly aerials may be performed. Additional post-construction management practices may be considered during subsequent phases of design.

LF: linear foot
LS: lump sum

Expected Ecosystem Benefits

Creation of the Site is expected to have positive benefits on the regional ecosystem. Green Island, an 80-acre rookery island located in the adjacent Laguna Madre, was used to approximate the ecological benefits for the Site. From 2011 to 2015, Green Island averaged approximately 1,000 breeding pairs of birds per year across three species listed in Table 6 (Audubon 2021b). Adjusting for the acreage of the rookery island, the Site may be expected to create habitat for approximately 90 breeding pairs for three species of birds per year.

The mean relative sea level rise trend averaged between Corpus Christi and Port Mansfield is 4.61 millimeters per year (NOAA 2022). Assuming no changes in the mean relative sea level rise trend and no erosion, the rookery island within the target elevation of the Site (+4 feet NAVD88 or +3.41 feet MSL) would be below mean sea level by 2248.

The following are different opportunities to restore seagrass habitat potentially lost during construction of this rookery island:

- Dredging of surrounding shallow areas during construction may require excavation of some seagrasses (which were observed by DU in shallow areas) but could result in more suitable depths for seagrasses, depending on the depth of cut.
- Where excavation areas are cut to a depth beyond that ideal for seagrasses, GIWW maintenance material could be placed to elevations conducive to seagrasses.
- Planting of seagrass could occur in areas of the Upper Laguna Madre, where colonization is probable but presently sparse.

Data and Information Gaps

At this phase of design, the following data and information gaps have been identified:

- The Site was selected in lieu of the existing Rabbit Island located 1.2 miles north of the Site due to seagrasses not being shown on existing maps within the vicinity of the Site (TPWD 2021). Because seagrasses were observed during DU's survey of the site, there is seemingly no advantage, with respect to seagrasses, to creating an island at the Site versus restoring the existing Rabbit Island.
- Coordination with the Texas Historical Commission surrounding the cultural resource is needed.

- Coordination with USACE will be necessary, given that the Site is proposed to harvest material and lies between two DMPAs. USACE staff have indicated that for them to support the Site, it should avoid limiting its future placement of material, either by making it more costly to place material in its DMPAs, decreasing their capacity, or by creating habitat for sensitive species that could inhibit future placement of material. USACE has also expressed concerns that removal of relict, new work mounds from inside the surrounding DMPAs could allow GIWW maintenance dredged material to more readily transport back into the GIWW and result in more frequent dredging.
- Based on stakeholder feedback, targeting higher interior fill and containment berm elevations to better combat relative sea level rise may be beneficial. This may be evaluated during subsequent design phases.
- Site-specific wind-generated and vessel wake wave modeling would inform the future optimization of Site armor design.
- Geotechnical characteristics of the source material (maintenance and relict new work material) and subgrade of the placement area would refine evaluations of containment structure stability, subgrade and source material settlement, and short- and long-term capacity for dredged material placement.
- Refined survey information, such as property lines, utility locations, and supplemental bathymetry, where appropriate, are needed.
- An extensive seagrass habitat survey would inform the Site design and could be used to shift excavation areas or the Site footprint to reduce impacts to seagrasses. However, given the extensive presence of seagrasses at and surrounding the Site, it is unlikely that the island could be constructed without impacts to seagrasses.

These data gaps may need to be addressed during the progression from 30% design to final design. In the absence of such data, this 30% design assumes an acceptably resilient bird island can be constructed without rock armoring, which has resulted in a lower cost project than if armoring were included. This current project is taking the analyses as far as practicable considering the constraints of the project scope, budget, and schedule.

Future Work

Of the sites selected for 30% designs in this project, up to seven will subsequently be selected for 60% designs, cost estimates, and permit application packages.

The scattered presence of seagrass immediately adjacent to the Site and inside of the excavation areas poses a potential fatal flaw. Potential impacts to seagrasses should be further evaluated and clearly communicated to resource agencies and stakeholders in the region. Verbal and written approval confirming understanding of likely habitat impacts and proposed mitigation measures should be received before the Site proceeds toward later design phases.

Should the Site be selected for additional design efforts, it can be expected that some aspects of the design in this memorandum will be modified and, as appropriate, enhanced.

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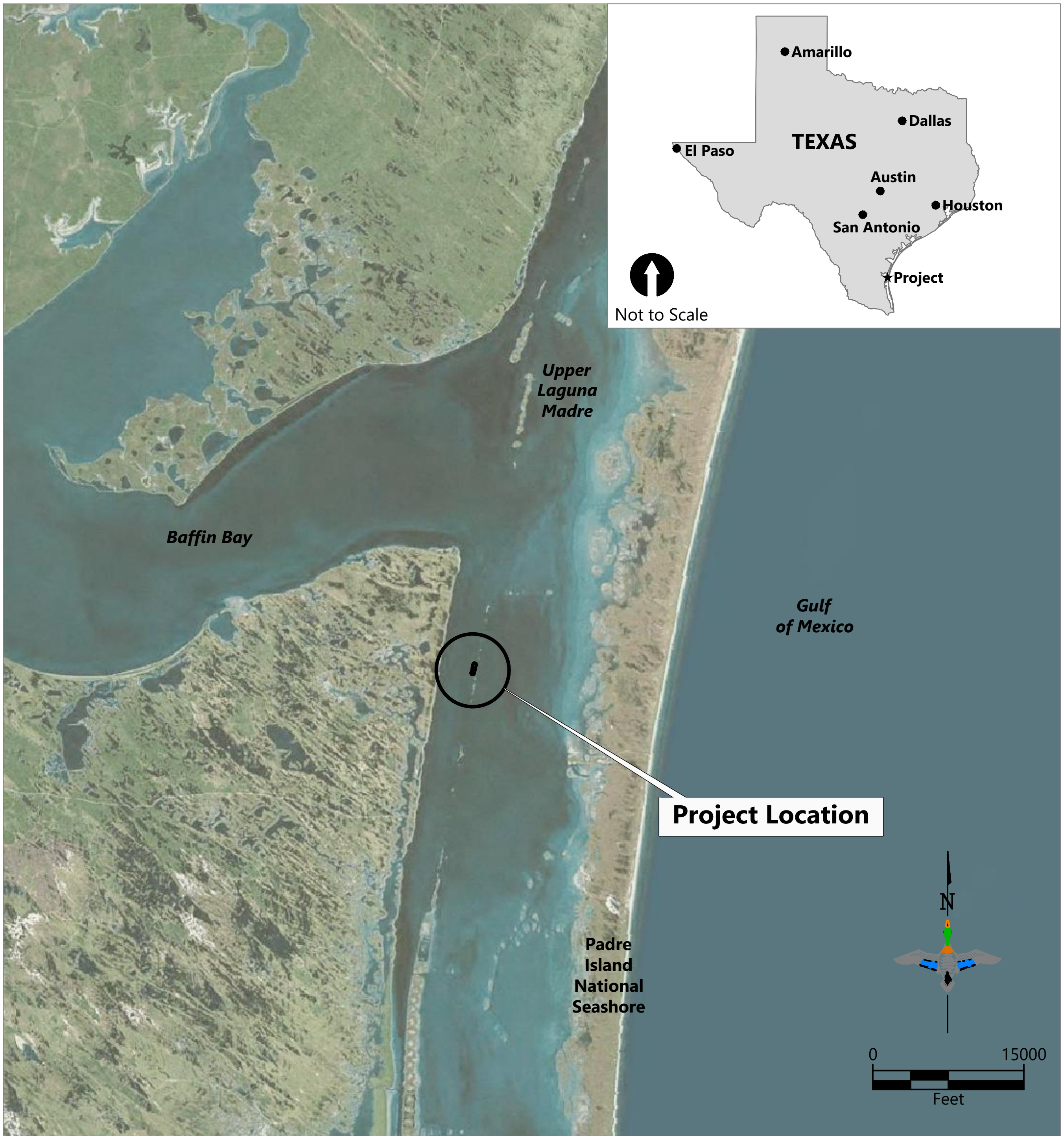
Figures



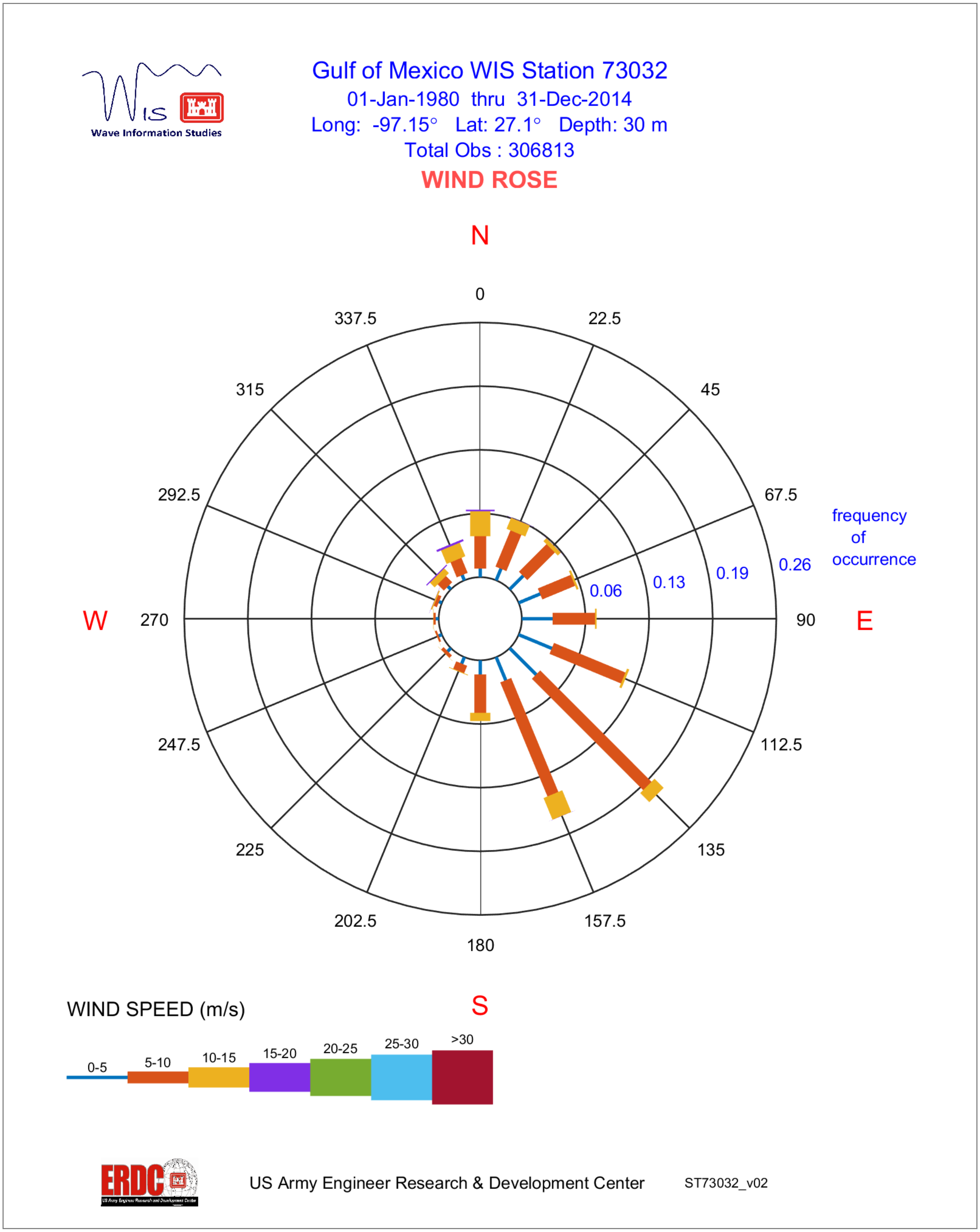
SOURCE: Aerial provided by Bing Maps.
HORIZONTAL DATUM: Texas State Plane South Zone,
North American Datum of 1983, U.S. Survey Feet

Publish Date: 2022/06/21 11:54 AM | User: mpratschner
Filepath: K:\Projects\2018-PCCA Beneficial Use\RABBIT ISLAND SOUTH\2018 RP-001 VIC MAP RI.dwg Figure 1

ANCHOR QEA

Figure 1
Vicinity Map

Rabbit Island South 30% Design Memorandum
Texas Lower Coast Beneficial Use



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ANCHOR QEA

Figure 2
Historical Wind Data for USACE WIS Station 73032
Rabbit Island South 30% Design Memorandum
Texas Lower Coast Beneficial Use

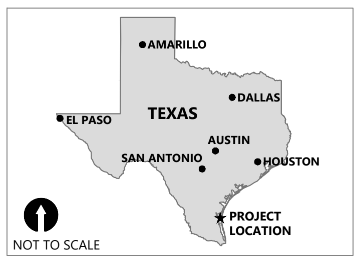
Attachment 1

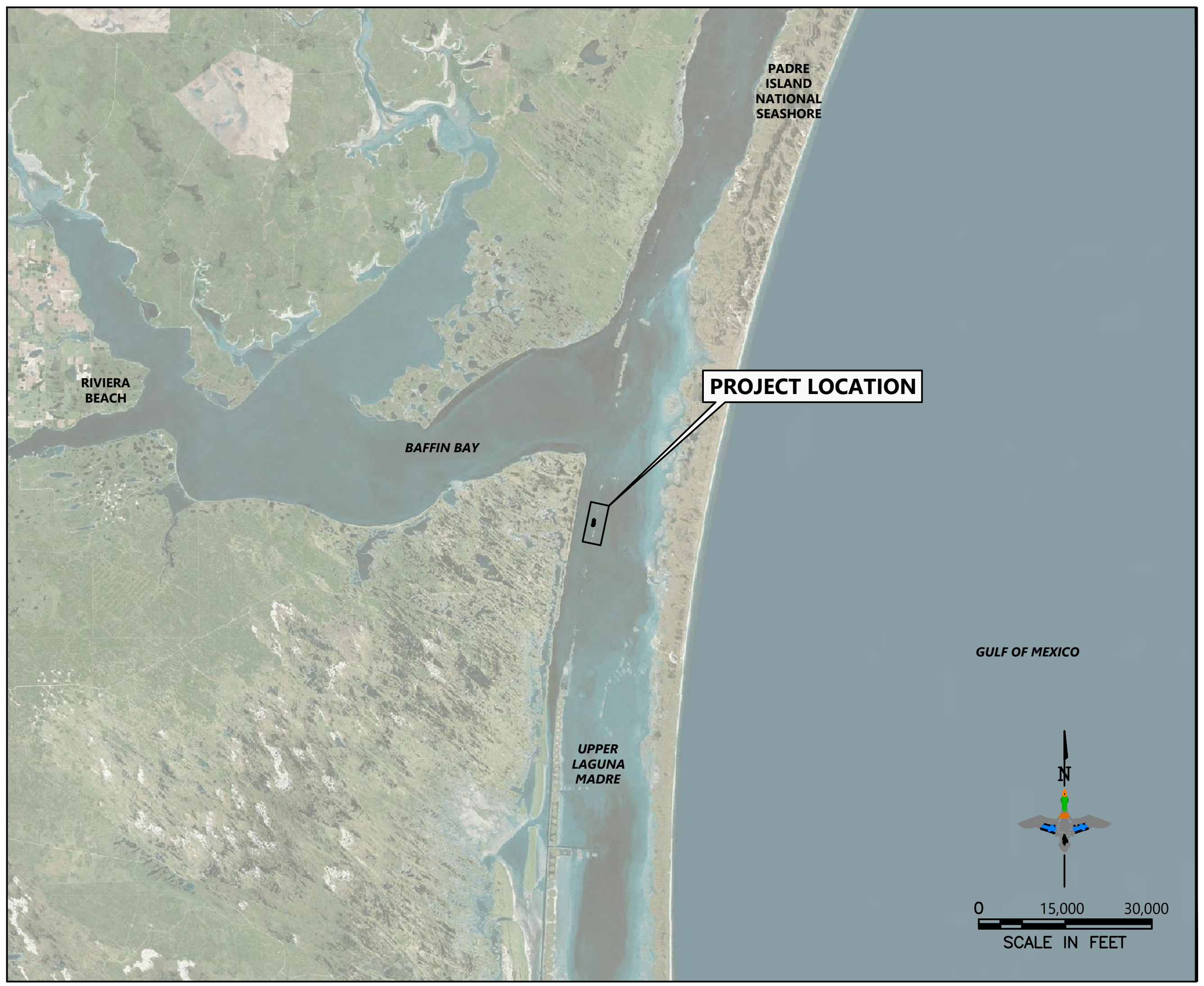
Construction Drawings

30% DESIGN SUBMITTAL

TEXAS LOWER COAST BENEFICIAL USE - RABBIT ISLAND SOUTH

TEXAS GENERAL LAND OFFICE





AERIAL BY BING MAPS

DRAWING INDEX		
SHEET	DRAWING	TITLE
1	T01	TITLE SHEET
2	C01	SITE OVERVIEW
3	C02	PLAN VIEW
4	C03	TYPICAL CONTAINMENT BERM SECTION

NOTES:

1. HORIZONTAL DATUM: TEXAS STATE PLANE SOUTH ZONE, NAD83, U.S. SURVEY FEET
2. VERTICAL DATUM: NORTH AMERICAN VERTICAL DATUM OF 1988 (NAVD88)
3. BATHYMETRIC, TOPOGRAPHIC, AND VISUAL HABITAT SURVEYS CONDUCTED BY DUCKS UNLIMITED ON MARCH 23, 2022.

PLAN INTENDED TO BE VIEWED IN COLOR. ADJACENT BLOCK IS "BLUE"

ONE INCH

AT FULL SIZE, IF NOT ONE INCH SCALE ACCORDINGLY

DRAFT-NOT FOR CONSTRUCTION

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Jun 29, 2022 12:50pm mpratschner

ANCHOR QEA

TEXAS GENERAL LAND OFFICE ESTABLISHED 1836

DUCKS UNLIMITED

REVISIONS				
REV	DATE	BY	APP'D	DESCRIPTION

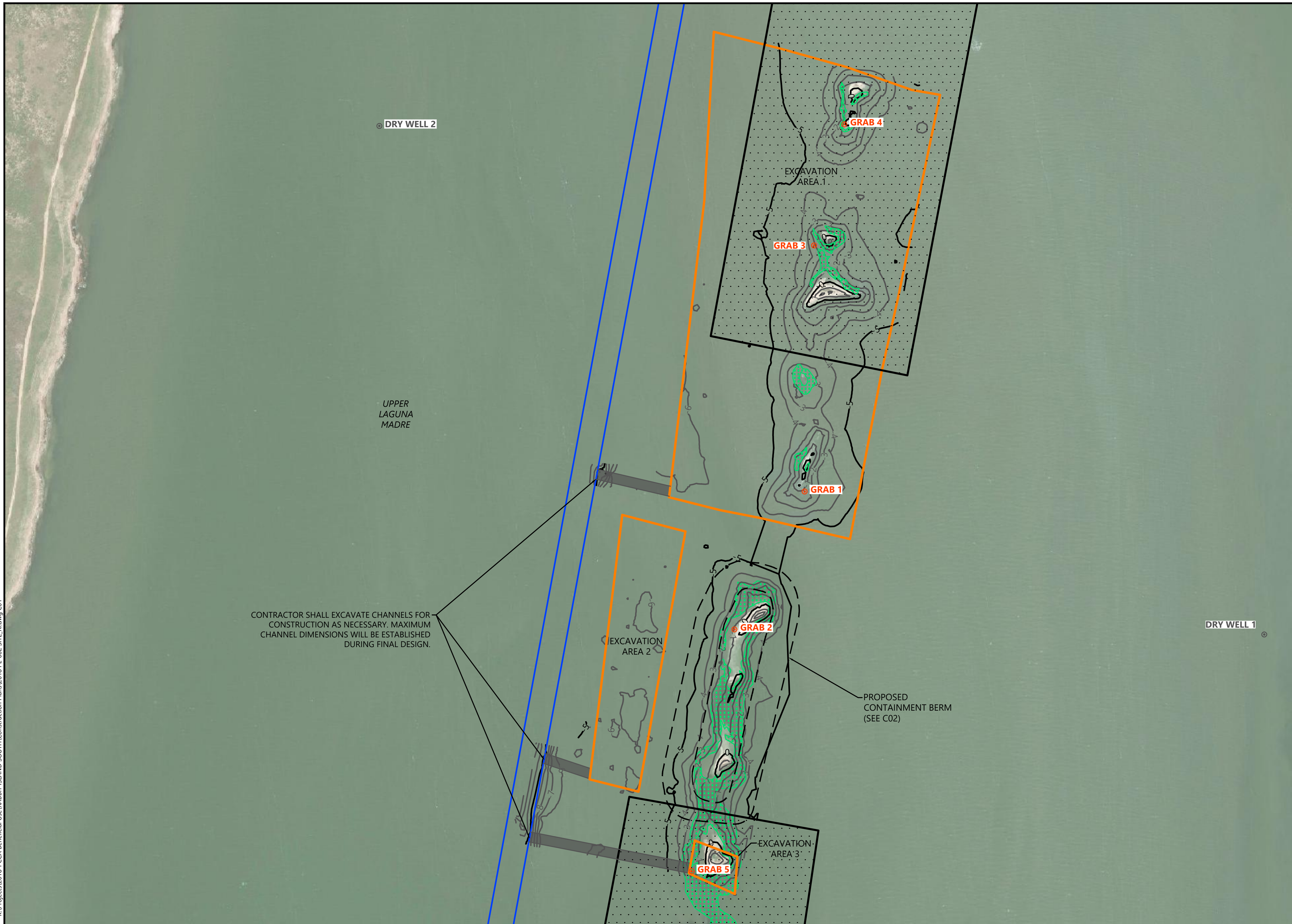
DESIGNED BY: H. SMITH
DRAWN BY: M. PRATSCHNER
CHECKED BY: R. ROBERTSON
APPROVED BY: J. LAPLANTE
SCALE: AS NOTED
DATE: JUNE 2022

TEXAS LOWER COAST BENEFICIAL USE - RABBIT ISLAND SOUTH

TITLE SHEET

T01

SHEET # 1 OF 4



LEGEND:

- PROPOSED CONTAINMENT BERM
- GULF INTRACOASTAL WATERWAY
- APPROXIMATE LOCATION OF VISUALLY SURVEYED SEAGRASS
- EXISTING CONTOUR (5')
- EXISTING CONTOUR (1')
- EXCAVATION AREA
- U.S. ARMY CORPS OF ENGINEERS OPEN WATER DREDGED MATERIAL PLACEMENT AREA
- PROPOSED CONSTRUCTION ACCESS CHANNEL
- RAILROAD COMMISSION OF TEXAS MAPPED OIL AND GAS INFRASTRUCTURE LOCATIONS
- GRAB SAMPLE LOCATION

N

0 250 500
SCALE IN FEET

NOTES:

1. HORIZONTAL DATUM: TEXAS STATE PLANE SOUTH ZONE, NAD83, U.S. SURVEY FEET
2. VERTICAL DATUM: NORTH AMERICAN VERTICAL DATUM OF 1988 (NAVD88)
3. BATHYMETRIC, TOPOGRAPHIC, AND VISUAL HABITAT SURVEYS CONDUCTED BY DUCKS UNLIMITED ON MARCH 23, 2022.
4. GRAB SAMPLES PERFORMED BY DUCKS UNLIMITED ON MARCH 23, 2022.

PLAN INTENDED TO BE VIEWED IN COLOR. ADJACENT BLOCK IS "BLUE"

ONE INCH
AT FULL SIZE, IF NOT ONE INCH SCALE ACCORDINGLY

DRAFT-NOT FOR CONSTRUCTION

REVISIONS

REV	DATE	BY	APP'D	DESCRIPTION

DESIGNED BY: H. SMITH
DRAWN BY: M. PRATSCHNER
CHECKED BY: R. ROBERTSON
APPROVED BY: J. LAPLANTE
SCALE: AS NOTED
DATE: JUNE 2022

TEXAS LOWER COAST BENEFICIAL USE - RABBIT ISLAND SOUTH

SITE OVERVIEW

C01

SHEET # 2 OF 4

LEGEND:

- PROPOSED CONTAINMENT BERM
- GULF INTRACOASTAL WATERWAY
- APPROXIMATE LOCATION OF VISUALLY SURVEYED SEAGRASS
- —0— EXISTING CONTOUR (5')
- --3-- EXISTING CONTOUR (1')
- EXCAVATION AREA
- GRAB SAMPLES
- U.S. ARMY CORPS OF ENGINEERS OPEN WATER DREDGED MATERIAL PLACEMENT AREA
- DREDGING ACCESS CHANNEL

N

0 80 160
SCALE IN FEET

NOTES:

1. HORIZONTAL DATUM: TEXAS STATE PLANE SOUTH ZONE, NAD83, U.S. SURVEY FEET
2. VERTICAL DATUM: NORTH AMERICAN VERTICAL DATUM OF 1988 (NAVD88)
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PLAN INTENDED TO BE VIEWED IN COLOR. ADJACENT BLOCK IS "BLUE"

ONE INCH
AT FULL SIZE, IF NOT ONE INCH SCALE ACCORDINGLY

DRAFT-NOT FOR CONSTRUCTION

K:\Projects\2018-PCCA Beneficial Use\RABBIT ISLAND SOUTH\Construction Plans\2018 PL-003 PLACEMENT_RI.dwg C02

Jun 29, 2022 12:50pm mpratschner

ANCHOR QEA | TEXAS GENERAL LAND OFFICE ESTABLISHED 1836 | DUCKS UNLIMITED

REVISIONS

REV	DATE	BY	APP'D	DESCRIPTION

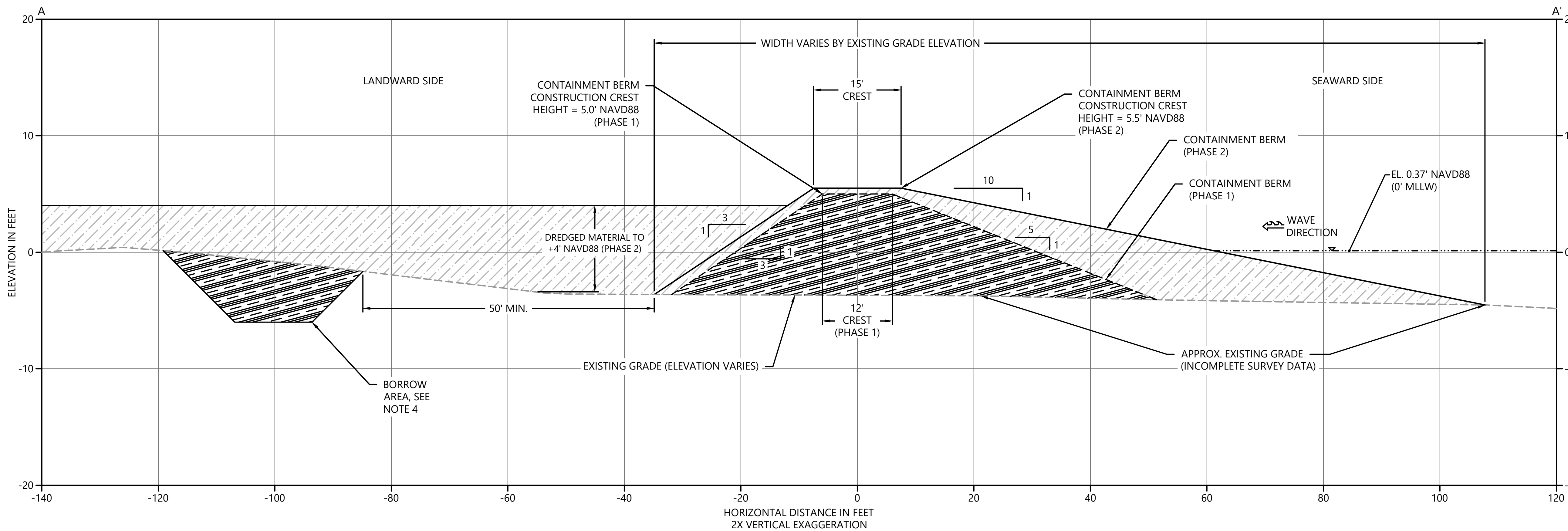
DESIGNED BY: H. SMITH
DRAWN BY: M. PRATSCHNER
CHECKED BY: R. ROBERTSON
APPROVED BY: J. LAPLANTE
SCALE: AS NOTED
DATE: JUNE 2022

TEXAS LOWER COAST BENEFICIAL USE - RABBIT ISLAND SOUTH

PLAN VIEW

C02

SHEET # 3 OF 4



A
C02
SECTION
HORIZONTAL SCALE: 1" = 10'
VERTICAL SCALE: 1" = 5'

NOTES:

1. HORIZONTAL DATUM: TEXAS STATE PLANE SOUTH ZONE, NAD83, U.S. SURVEY FEET
2. VERTICAL DATUM: NORTH AMERICAN VERTICAL DATUM OF 1988 (NAVD88)
3. BATHYMETRIC, TOPOGRAPHIC, AND VISUAL HABITAT SURVEYS CONDUCTED BY DUCKS UNLIMITED ON MARCH 23, 2022.
4. BORROW AREA DIMENSIONS SHOWN FOR ILLUSTRATION PURPOSES ONLY. ACTUAL DIMENSIONS TO BE DETERMINED BASED ON FINAL DESIGN AND BY SELECTED CONTRACTOR.

PLAN INTENDED TO BE VIEWED IN COLOR, ADJACENT BLOCK IS "BLUE"

ONE INCH

AT FULL SIZE, IF NOT ONE INCH SCALE ACCORDINGLY

DRAFT-NOT FOR CONSTRUCTION

REVISIONS

REV	DATE	BY	APP'D	DESCRIPTION

DESIGNED BY: H. SMITH
DRAWN BY: M. PRATSCHNER
CHECKED BY: R. ROBERTSON
APPROVED BY: J. LAPLANTE
SCALE: AS NOTED
DATE: JUNE 2022

TEXAS LOWER COAST BENEFICIAL USE - RABBIT ISLAND SOUTH

TYPICAL CONTAINMENT BERM SECTION

C03

SHEET # **4** OF **4**

Attachment 2
Technical Specification Outline

TABLE OF CONTENTS

Memorandum

June 30, 2022

To: Melissa McCutcheon, Texas General Land Office

From: Todd Merendino, Ducks Unlimited, Inc.
Sarah Garza, Harrison McNeil, and Yvonne Dives-Gomez, Port of Corpus Christi Authority
John Laplante, Dan Opdyke, Renee Robertson, Alexander Freddo, and Hayden Smith, Anchor QEA, LLC
Jane Sarosdy, Sarosdy Consulting, Inc.

Re: Rockport Beach Informational Memorandum

Introduction

Building on a 10% memorandum, this informational memorandum describes the assessments associated with a potential beneficial use of dredged material (BU) project at the proposed Rockport Beach site (Site). The Site is located in Texas General Land Office (GLO) Planning Region 3 of the Texas coast in Aransas Bay in Aransas County, Texas (Figures 1 and 2). From the information we have gathered, it is determined that the primary objective of the project has self-mitigated; therefore, no further design work is warranted at this time.

Project Background

GLO awarded a Coastal Management Program Project of Special Merit grant (funded through the Gulf of Mexico Energy Security Act) to Ducks Unlimited, Inc. (DU) to coordinate with stakeholders and identify restoration sites for BU. The Port of Corpus Christi Authority (PCCA), a project partner, has also contributed staff and financial resources to expand the project scope. The project team is led by DU and PCCA and includes Anchor QEA, LLC; Sarosdy Consulting, Inc.; and the Texas Department of Transportation. Collectively, the project team coordinated three stakeholder meetings with state and federal resource agencies, nongovernmental organizations, academia, consultants, and local officials in each region to solicit information about potential BU sites. Based on stakeholder input, GLO feedback, publicly available data, and professional judgment, the project team has developed 10% designs for 18 sites in GLO Planning Regions 3 and 4 of the Texas coast and 2 GLO-approved sites in Mesquite Bay and San Antonio Bay in GLO Planning Region 2. After completion of the 10% designs, 11 of the designs were selected to continue to 30% designs, and up to 7 of those designs will be chosen for 60% designs and permit application packages.

Rockport Beach is a public beach located on Aransas County Navigational District (ACND) land approximately 1.7 miles northwest of the Gulf Intracoastal Waterway (GIWW) in Aransas Bay, Aransas County, Texas. Due to Hurricane Harvey, the profile of the beach was eroded, creating a large hole that limited pedestrian wading near the eastern jetty into Aransas Bay. The project team selected the Site as one of the 20 sites for 10% design development and cost estimation. Due to a perceived need for beach nourishment to return the underwater beach profile to pre-Hurricane Harvey conditions and due to the potential proximity of beach-quality sand identified in the GIWW, the project team selected the Site to proceed to 30% design and opinion of probable construction costs using funding from the GLO Coastal Management Program Project of Special Merit grant. However, the primary objective of the proposed project – filling a beach void created by Hurricane Harvey – has self-mitigated, and no further design work is warranted at this time Accordingly, while no further design work is needed, this memorandum documents the data collection and analyses that were performed in the event that such information is helpful for future possible projects. The ACND has a separate effort to design and fund restoration of the beach profile above the waterline, which remains damaged from Hurricane Harvey.

Project Objectives

Frequent dredging is needed to develop and maintain Texas navigation channels. The dredged material is often deposited in dredged material placement areas (DMPAs), and many of the existing DMPAs along the Texas coast are nearing capacity. Resource agencies and stakeholders have long advocated using dredged material beneficially to create and restore wetlands and bird islands, nourish beaches, and counteract land loss. Historically, BU projects are difficult to manage because they are multiyear, multifaceted undertakings in which different organizations manage dredging schedules, funding, project design, permitting, and construction activities. To help address these issues, the objectives of this project include the following:

- Create and restore degrading coastal habitats.
- Establish sites for placement of dredged material to reduce reliance on existing DMPAs.
- Improve coastal resiliency of the natural and built environment.

To accomplish these objectives, the project includes the following tasks:

- Stakeholder outreach and coordination
- Identification and selection of BU sites
- 10% designs and cost estimates for 20 BU sites
- 30% designs and cost estimates for 11 BU sites
- 60% designs, cost estimates, and permit application packages for up to seven BU sites

This memorandum documents the 30% design and cost estimate for the Site.

Design Objectives

The intent of the design was to beneficially use dredged material to fill a hole and nourish a public beach eroded during Hurricane Harvey. Using material dredged from navigation channels during routine maintenance would reduce the volume of material placed in existing open-bay or upland DMPAs. Because the hole has self-mitigated, the design work will not go forward at this time. The 30% design analysis would have been based upon publicly available datasets, as well as focused field work conducted by DU.

Design objectives would have included the following:

- Develop a preliminary vision based on available data for the Site that includes the following:
  - Area to be created or restored
  - Potential sediment source(s)
  - Approaches to minimize long-term maintenance costs
- Delineate conceptual footprints for proposed BU placement.
- Identify key sensitive habitats and construction considerations in the vicinity of the Site.
- Estimate fill volumes for the proposed BU footprints.
- Identify data gaps to be addressed in subsequent design phases.
- Provide preliminary cost estimates.

Existing Data Review

A review of existing data and the focused data collected by DU was performed for the Site design analysis. The data described in this section was collected and reviewed prior to receiving recent bathymetry surveys, which indicate that the hole has naturally filled in and is no longer a concern. This section serves to document the data reviewed and collected for the analysis.

Horizontal and Vertical Datums

The Site horizontal datum is the Texas State Plane South Central Zone, North American Datum of 1983 in U.S. survey feet. Site vertical datum includes the North American Vertical Datum of 1988 (NAVD88) from the National Oceanic and Atmospheric Administration Rockport, TX Station 8774770 (Rockport Station), which is 0.7 mile southwest of the Site. This station collects and records real-time tide information dating back to 1948. The vertical datums are shown in Table 1.

Table 1
Rockport Station Tidal Gauge Displaying NAVD88 Tidal Datums

Tidal Datum	Elevation (feet NAVD88)	Elevation (feet MLLW)
MHHW	1.30	0.37
MHW	1.29	0.36
MSL	1.12	0.19

Tidal Datum	Elevation (feet NAVD88)	Elevation (feet MLLW)
MLW	0.94	0.01
MLLW	0.93	0

Notes:
MHHW: mean higher high water
MHW: mean high water
MLLW: mean lower low water
MLW: mean low water
MSL: mean sea level

Meteorological, Ocean, and Wave Data

Wind and Waves

The U.S. Army Corps of Engineers (USACE) Wave Information Studies (WIS) provides a national resource of long-term wavefield climatologies for U.S. coastal waters that synthesizes observations, multidecade hindcasts, and storm event archives (USACE 2021). The WIS station closest to the Site is Station 73042, just offshore on the Gulf side of Matagorda Island in the Gulf of Mexico. Because the station is located offshore, the wave data are not applicable to this project design. However, the project team considers the wind data to be representative of the winds experienced at the Site. Figure 3 summarizes wind data from January 1, 1980, through December 31, 2014. The data indicate that the predominant wind direction is from the southeast, with significant winds also coming from the north, northeast, east, and south.

There is a 5-mile fetch between Rockport Beach and Matagorda Island, the closest land mass in the predominant southeast wind direction. Due to the fetch, the Site is anticipated to be in a high wave-energy environment.

Beach nourishment is intended to add sand to replace material that has been lost due to wind/wave action; ideally, this replacement will be done using similarly sized material to the beach sands that are naturally present on the Site. Thus, the post-nourishment condition will be expected to have similar stability under wave attack compared to that of the beach before an erosion event. Natural beaches are dynamic, with sand that moves seasonally; they are not static, stable shoreline elements. Thus, selecting materials for stability against waves is not a design consideration for this project, and a wind-wave analysis may not be needed during subsequent design phases.

Bathymetry

Surveys of the Rockport Beach profile from pre- and post-Hurricane Harvey were used to determine the bathymetry for the Site (Figure 2; GLO 2018; Texas A&M 2020). Surveys from 2015 to 2019 indicate Hurricane Harvey eroded the water bottoms from the eastern jetty to approximately 800 feet west, and a significant portion of that eroded material may have migrated farther offshore into a bar system. The pre-Hurricane Harvey beach profile at the location of the erosion is approximately -2 to -6 feet NAVD88. The post-Hurricane Harvey depth extends to as deep as -10 feet NAVD88 (Figure 3; Texas A&M 2020).

However, the later surveys from September 2019 (Texas A&M 2020) and August 24, 2020, indicate that the erosion location has self-mitigated back to a profile similar to the pre-Hurricane Harvey condition, with elevations approximately between -2 to -6 feet NAVD88.

Utilities and Infrastructure

The Railroad Commission of Texas public GIS viewer (RRC 2021) and GLO pipeline data (GLO 2021a) were used to identify mapped utilities and pipelines near the Site. No utilities or pipelines were identified near the Site. The need for Site-specific utility locations prior to construction will be determined during subsequent design stages; however, utilities are not expected to be a major design consideration for a project of this nature.

The beach has groins along its eastern and western sides that would need to be avoided if construction were to occur at the Site.

Desktop Cultural Resources Survey

A search of cultural resources records in the Texas Historical Commission Texas Historical Sites Atlas Database was completed for the Site between November 29 and December 30, 2021. This search revealed that no archaeological surveys have been conducted, and no archaeological sites have been identified within the preliminary proposed placement site boundary (THC 2021).

Cultural resources are not expected to be a major design consideration for a project of this nature.

Sensitive Habitat

GLO oyster habitat GIS data (GLO 2021b) and Texas Parks and Wildlife Department seagrass data (TPWD 2021) indicate there is no oyster habitat or seagrasses mapped within or adjacent to the Site.

DU conducted visual habitat surveys on May 6, 2022, and did not observe oyster or seagrass habitat within or adjacent to the Site and potential borrow areas.

Beneficial Use Source Material

Potential sources of dredged material are the GIWW and associated DMPAs, located near the Site. Based on coastal consistency determinations from USACE, USACE has historically performed maintenance dredging on the GIWW near the Site (USACE 1999). Continued dredging has recently been confirmed by USACE (Jones 2021). Based on a grab sample (data point TBEG AB27) from the Texas Sediment Geodatabase (GLO 2022) that shows 95% sand, 4% silt, and 1% gravel near the Site, it was anticipated that GIWW channel segments adjacent to the Site and their associated DMPAs may have high quantities of sand to be used at the Site if the sand is beach quality. The identified

DMPAs used by USACE adjacent to the Site and their associated historical average annual quantity of dredged material, distance from the Site, and channel segments are shown in Table 2. The average grain size and grain type percentages are shown in Table 3. This informs on the quantity and characteristics of dredged material that may be available during a dredging cycle.

Table 2
USACE DMPA Areas Along the GIWW Near the Site with Potential Sand

DMPA No.	Channel Segment (station)	Distance from Site to DMPA (miles)	Average Annual Dredging Quantity (CY)
138[1]	883+000-891+000	1.6	125,624
139[1]	891+000-895+000	1.9	77,088
140[1]	895+000-902+000	2.5	88,051
141[2]	890+000-906+000	2.8	165,185

Notes:
Source: USACE 1999
1. DMPAs are along the GIWW and used for GIWW placement.
2. DMPAs are along the GIWW and used for placement on the Lydia Ann Channel.
CY: cubic yard

Table 3
Typical Sediment Characteristics Across Aransas Bay: Western Job and Lydia Ann Channel

Western Job (860+000 to 900+000)	Lydia Ann Channel
D_{50} (mm) = 0.028	D_{50} (mm) = 0.131
15.7% sand	53.8% sand
56.8% silt	33.0% silt
27.5% clay	13.2% clay

Notes:
Source: USACE 1999
D_{50}: median grain size
mm: millimeter

DU collected 15 surface sediment grab samples to compare beach sand with potential borrow area candidates: 3 within and adjacent to the USACE DMPA #139 (grab samples 5, 6, and 8), 8 within and adjacent to the USACE DMPA #140 (grab samples 1, 2, 9, 10, 11, 12, 13, 15), and 4 along the current Rockport Beach (grab samples 3, 4, 7 14; Figures 2 and 4). The surface samples are not necessarily representative of the material below the surface sediments. A visual inspection of the surface grab material shows varying characteristics. Further sampling and testing would be needed to determine if the source material's sediment color and gradation is suitable for beach placement. Nevertheless,

Table 4 shows qualitative descriptions for each of the 15 surface grab samples. Based on these observations, locations corresponding to grab samples 1, 2, 5, 9, 10, and 15 could be possible candidates for further investigation as borrow areas for beach nourishment. These possible candidates have varying levels of shell, and that shell content may need to be evaluated if it becomes a concern for beach placement.

Table 4
Qualitative Descriptions of 15 Surface Sediment Grab Samples During Basic Inspection

Grab Sample Number	Latitude (N)	Longitude (W)	Qualitative Descriptions	Sample Location	Main Sediment Type
1	27.992890	97.053900	Mostly sands with some silts Non-cohesive	DMPA #140	Sand
2	27.990023	97.050060	Sands, clays, and silts Cohesive	DMPA #140	Sand
3	28.028578	97.037916	Mostly sand with some silt	Rockport Beach	Sand
4	28.026646	97.043733	High percentage of sand Non-cohesive	Rockport Beach	Sand
5	28.000986	97.042992	Mostly silts with sand and lots of shell Non-cohesive	DMPA #139	Sand
6	28.003007	97.033013	High shell with some sand and silt	DMPA #139	Shell/sand
7	28.029594	97.034545	High percentage of sand Non-cohesive	Rockport Beach	Sand
8	28.000980	97.041034	Silt, clay, and sand with some shell Slightly-cohesive	DMPA #139	Fines
9	27.991973	97.050973	Mostly sand with some fines Slightly cohesive	DMPA #140	Sand
10	27.993024	97.049007	High percentage of sand with small fragments	DMPA #140	Sand
11	27.993005	97.054030	Mostly silts with sand Non-cohesive	DMPA #140	Fines
12	27.997103	97.040067	High percentage of silt Non-cohesive	DMPA #140	Fines
13	27.995988	97.042980	High percentage of silt with some clay Slightly cohesive	DMPA #140	Fines
14	28.027700	97.041256	High percentage of sand Non-cohesive	Rockport Beach	Sand
15	27.993969	97.0547951	Silts and sand with slight shell fragments Non-cohesive	DMPA #140	Sand

Note:
Grab samples were collected by DU on May 6, 2022.

30% Design Analysis

The Site is on the bayward side of Rockport Beach, approximately 1.5 miles north of the GIWW in Rockport, Texas. The location of the Site is approximately 75 feet southwest from the tip of the eastern jetty. Before Hurricane Harvey, the Site consisted of elevations ranging from approximately -2 to -6 feet NAVD88 (Figure 5; GLO 2018). The survey post-Hurricane Harvey in September 2017 showed that Hurricane Harvey eroded a hole in the water bottom from approximately -6 to -10 feet NAVD88 at the deepest point.

However, recent data from GLO and information from the ACND suggest that the previously eroded area has largely filled in (naturally), and that elevations are at approximately -5.5 feet NAVD88 at its deepest point (Figure 5; GLO 2018; Belaire 2022). As a result, the Site is currently no longer a target for BU (Belaire 2022). However, if similar erosion that requires beneficial use of dredged material happens in the future, then it is possible that suitable material is present in the potential borrow source locations (see the Beneficial Use Source Material section) if the material is determined to be compatible with existing Rockport Beach sediment.

Future Work

Of the sites selected for 30% designs in this project, up to seven will be selected for 60% designs, cost estimates, and permit application packages.

Recent personal communication with local stakeholders have indicated that the Site is self-mitigating and that BU is no longer necessary (Belaire 2022). It is recommended that the Site not be selected for additional design efforts at this time, although a future erosive event could revive the need for a BU project at the Site. Should the Site be selected for additional design efforts in the future, it can be expected that some aspects of the evaluations in this memorandum will be modified and, as appropriate, enhanced.

References

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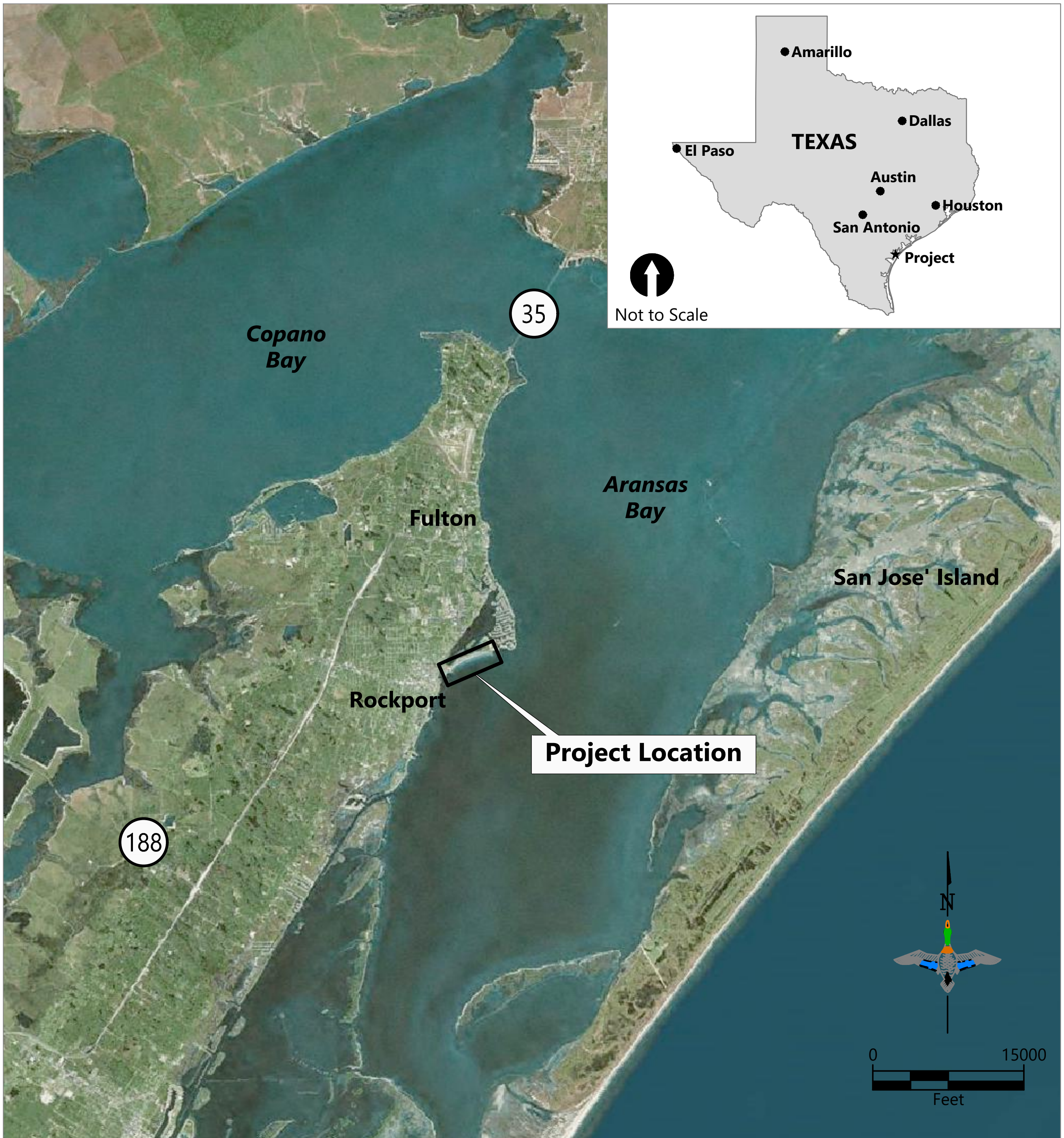
Figures



SOURCE: Aerial provided by Bing Maps.
HORIZONTAL DATUM: Texas State Plane South Central Zone, North American Datum of 1983, U.S. Survey Feet

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Filepath: K:\Projects\2018-PCCA Beneficial Use\Rockport Beach\2018 RP-001 VIC MAP RB.dwg Figure 1

ANCHOR QEA

Figure 1
Vicinity Map

Rockport Beach Informational Memorandum
Texas Lower Coast Beneficial Use

LEGEND:

—0— EXISTING CONTOUR (5')

—-3— EXISTING CONTOUR (1')

GRAB SAMPLE LOCATION

NOTES:

1. HORIZONTAL DATUM: TEXAS STATE PLANE SOUTH CENTRAL ZONE, NAD83, U.S. SURVEY FEET
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3. BATHYMETRIC SURVEY CONDUCTED BY T. BAKER SMITH ON SUGUST 24, 2020.
4. GRAB SAMPLES PERFORMED BY DUCKS UNLIMITED ON MAY 6, 2022.

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Feet

Publish Date: 2022/06/30 4:14 PM | User: mpratschner
Filepath: K:\Projects\2018-PCCA Beneficial Use\Rockport Beach\Construction Plans\2018 RP-001 Plan View_RB.dwg Figure 3

ANCHOR QEA

Figure 2
Plan View

Rockport Beach Informational Memorandum
Texas Lower Coast Beneficial Use

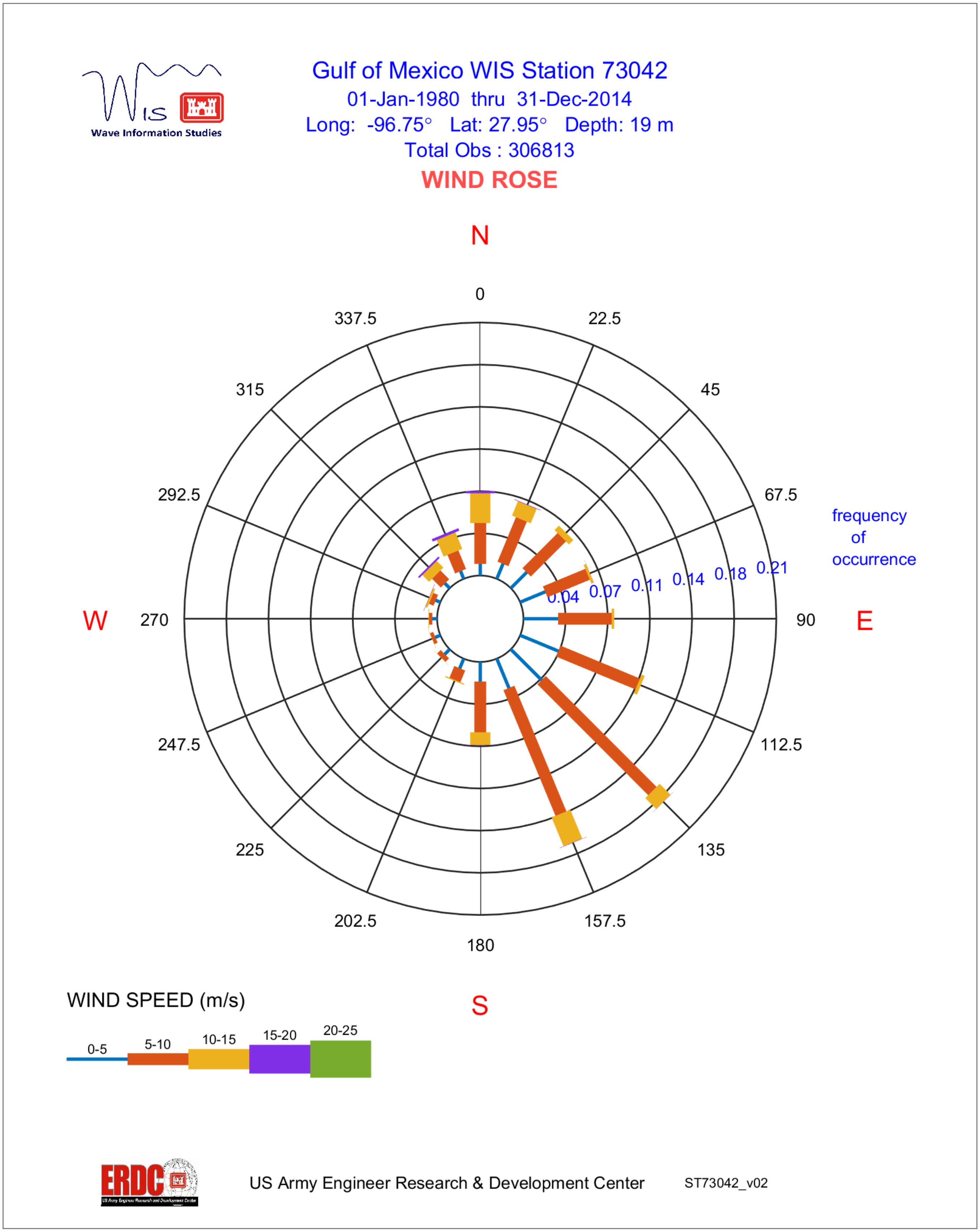

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Figure 3
Historical Wind Data for USACE WIS Station 73042

LEGEND:

GRAB SAMPLE LOCATION

U.S. ARMY CORPS OF ENGINEERS OPEN WATER DREDGED MATERIAL PLACEMENT AREA

GULF INTRACOASTAL WATERWAY

NOTES:

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4. GRAB SAMPLES PERFORMED BY DUCKS UNLIMITED ON MAY 6, 2022.

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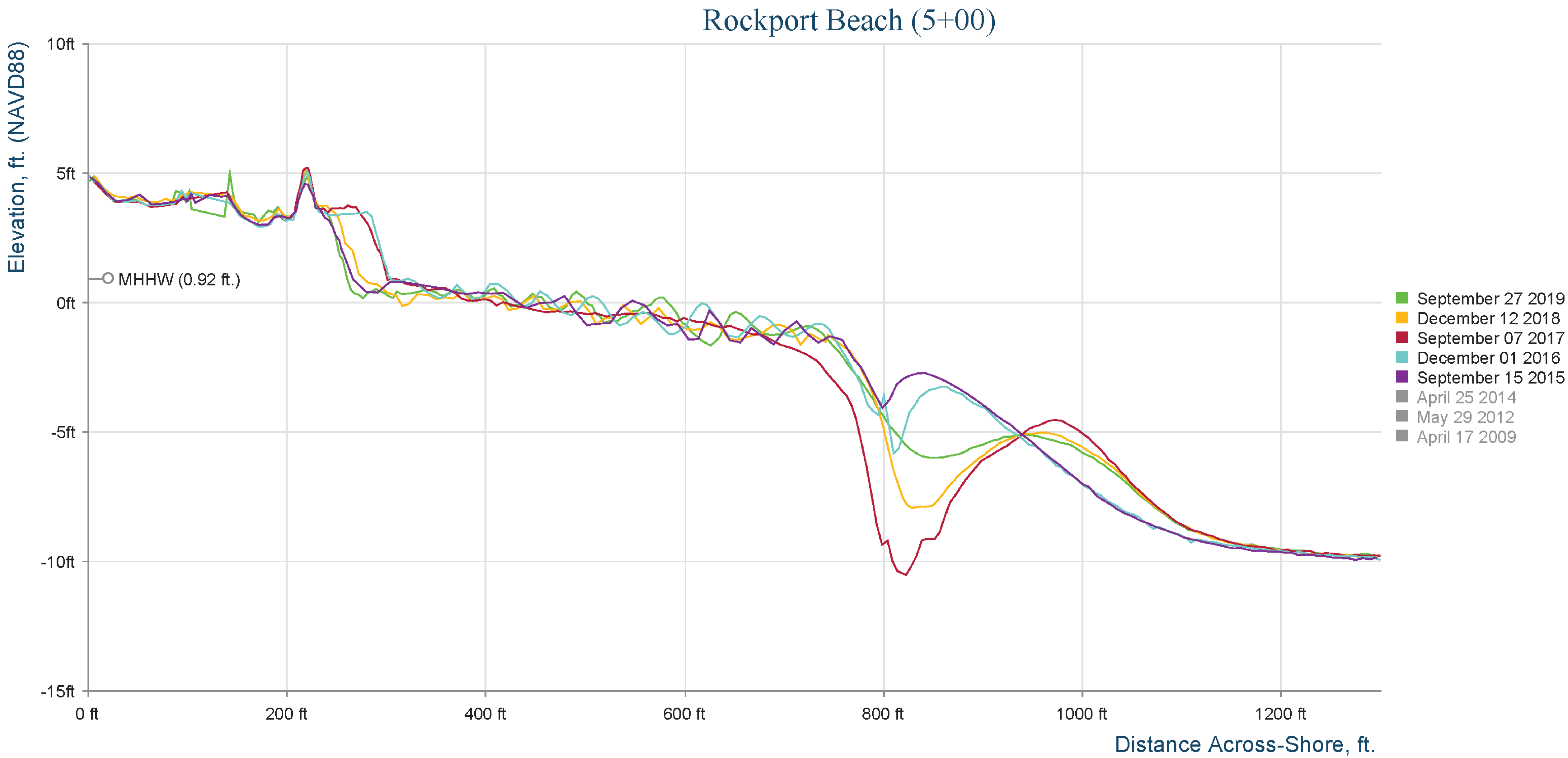
Feet

Publish Date: 2022/06/30 4:14 PM | User: mpratschner
Filepath: K:\Projects\2018-PCCA Beneficial Use\Rockport Beach\Construction Plans\2018 RP-002 Grab Sample Locations_RB.dwg Figure 4

ANCHOR QEA

Figure 4
Grab Sample Locations

Rockport Beach Informational Memorandum
Texas Lower Coast Beneficial Use



Notes:
SOURCE: This figure is reproduced from Texas A&M (Texas A&M University Conrad Blucher Institute for Surveying and Science), 2020. *Corpus Christi CHRGIS Beach Profile Analysis*. Last modified August 17, 2020. Available at: https://sandy.tamucc.edu/chrgis/profiles/.
ft/ft.: foot
NAVD88: North American Vertical Datum of 1988

Appendix C
Basis of Design Reports
(60% Design Memoranda)

Memorandum

September 30, 2022

To: Melissa McCutcheon, Texas General Land Office

From: Todd Merendino, Ducks Unlimited, Inc.
Sarah Garza, Harrison McNeil, and Yvonne Dives-Gomez, Port of Corpus Christi Authority
John Laplante, Dan Opdyke, Renee Robertson, Alexander Freddo, and Hayden Smith, Anchor QEA, LLC
Jane Sarosdy, Sarosdy Consulting, Inc.
Ray Newby, Texas Department of Transportation

Re: Causeway Bird Island 60% Design Memorandum

Introduction

This 60% design memorandum describes design criteria and assessments associated with a beneficial use of dredged material (BU) project at the proposed Causeway Bird Island site (Site), located in Texas General Land Office (GLO) Planning Region 3 of the Texas coast in Nueces Bay in Nueces County, Texas (Figure 1). Photographs of the Site are in Attachment 1.

Project Background

GLO awarded a Coastal Management Program Project of Special Merit grant (funded through the Gulf of Mexico Energy Security Act) to Ducks Unlimited, Inc. (DU) to coordinate with stakeholders and identify restoration sites for BU. The Port of Corpus Christi Authority (PCCA), a project partner, has also contributed staff and financial resources to expand the project scope. The project team is led by DU and PCCA and includes Anchor QEA, LLC; Sarosdy Consulting, Inc.; and the Texas Department of Transportation. Collectively, the project team coordinated three stakeholder meetings with state and federal resource agencies, nongovernmental organizations, academia, consultants, and local officials in each region to solicit information about potential BU sites. Based on stakeholder input, GLO feedback, publicly available data, and professional judgment, the project team has developed 10% designs for 18 sites in GLO Planning Regions 3 and 4 of the Texas coast and 2 GLO-approved sites in Mesquite Bay and San Antonio Bay in GLO Planning Region 2. After completion of the 10% designs, 11 of the designs were selected to continue to 30% designs, and seven of those designs were chosen for 60% designs and permit application packages. Based on the Site's restoration potential and construction feasibility, the project team selected the Site to proceed to

60% design, opinion of probable construction costs, and permit application packages using funding from the GLO Coastal Management Program Project of Special Merit grant.

Conservationists have identified the Nueces Bay rookery islands as an important location for protecting and restoring bird habitat (CBBEP 2020a; Hackney et al. 2016). The Site is located on state-owned submerged land approximately 0.1 mile northeast of the Rincon Canal and 2.3 miles north of the Corpus Christi Ship Channel (CCSC) in Nueces Bay in Nueces County, Texas (Figure 1). This area was selected because offshore breakwaters constructed in 2022 provide protection to the existing island, and placement of dredged material between the breakwaters and the existing island will increase bird habitat. Placement of material has not yet been designed and is the subject of this design. The Site is ideal for restoration because of its proximity to sediment sources in the Rincon Canal and CCSC and its proximity to nearby potential bird foraging areas.

Project Objectives

Frequent dredging is needed to develop and maintain Texas navigation channels. The dredged material is often deposited in dredged material placement areas (DMPAs), and many of the existing DMPAs along the Texas coast are nearing capacity. Resource agencies and stakeholders have long advocated using dredged material beneficially to create and restore wetlands and bird islands, nourish beaches, and counteract land loss. Historically, BU projects are difficult to manage because they are multiyear, multifaceted undertakings in which different organizations manage dredging schedules, funding, project design, permitting, and construction activities. To help address these issues, the objectives of this project include the following:

- Create and restore degrading coastal habitats.
- Establish sites for placement of dredged material to reduce reliance on existing DMPAs.
- Improve coastal resiliency of the natural and built environment.

To accomplish these objectives, the project includes the following tasks:

- Stakeholder outreach and coordination
- Identification and selection of BU sites
- 10% designs and cost estimates for 20 BU sites
- 30% designs and cost estimates for 11 BU sites
- 60% designs, cost estimates, and permit application packages for seven BU sites

This memorandum documents the 60% design and cost estimate for the Site.

Design Objectives

The Site will be designed to beneficially use dredged material to restore a rookery island in a region with degrading coastal bird habitat. The design will potentially use material from the CCSC and

Rincon Canal maintenance dredging, thus reducing the volume of such material that will need to be placed in existing open-bay or upland DMPAs. This 60% design is based upon publicly available datasets, stakeholder recommendations, and focused field work conducted by DU.

Design objectives include the following:

- Develop a preliminary vision based on available data for the Site that includes the following:
  - Habitat to be created or restored
  - Potential sediment source(s)
  - Approaches to minimize long-term maintenance costs
- Delineate conceptual footprints for proposed BU placement.
- Identify key sensitive habitats and construction considerations in the vicinity of the Site.
- Estimate fill volumes for the proposed BU footprints.
- Evaluate key rookery species in the region.
- Identify data gaps to be addressed in subsequent design phases.
- Provide preliminary cost estimates.

Stakeholder Feedback

The 30% design for the Site was presented at the Lower Coast Beneficial Use Planning Region 3 Stakeholder meeting on June 14, 2022. Attendees included staff from GLO, the U.S. Army Corps of Engineers (USACE), the Texas Parks and Wildlife Department (TPWD), the Coastal Bend Bays & Estuaries Program (CBBEP), the U.S. Fish and Wildlife Service (USFWS), local officials, and other professionals.

Some comments from this meeting, as well as written comments on the 30% designs, follow:

- USFWS recommended determining the different types of oyster habitat included in the GLO data.
  - The design team agrees with this recommendation and that any oyster habitat surveys conducted prior to construction should explicitly define the type of oyster habitat.
- USFWS suggested that, if there were more than one dredging cycle, then it would be prudent to construct the Site into two or three different cells to maximize completion of targeted elevations in each cell so as to reach bird nesting for one cell sooner than the others.
  - It is anticipated that the project would be able to be constructed with dredged material from the Rincon Canal in a single dredging cycle; however, if the Site is not able to be constructed in a single dredging cycle, the design team agrees with this recommendation, and it will be considered during final design once a dredged material source has been identified.
- TPWD recommended increasing the elevations in some locations to +6.0 feet NAVD88.

  - The design team increased the range of target elevations for the Site to 0.0 to 6.0 feet NAVD88. Specific locations with 6.0-foot NAVD88 elevations will be determined in future phases of design by the project proponent and will be dependent on the suitability of dredged material placed.
- CBBEP liked the concept of increasing the elevation and added that it may be acceptable to cover some existing vegetation on the north side of the island to build the island to higher elevations.
  - The design team has increased the upper range of elevations to 6.0 feet NAVD88, and specific locations for material placement that covers vegetation will be decided in future phases of design.

The comments above represent the key issues brought forward to the project team. Other comments, generally more minor and easily addressed, are not included in this list. When feasible, comments have been incorporated into the 60% design, as noted in the below sections, and others may be addressed in the final design.

Existing Data Review

A review of existing data and the focused data collected by DU was performed to develop the Site. This section describes the data reviewed and collected to support the 60% design.

Horizontal and Vertical Datums

The horizontal datum used for the Site is the Texas State Plane South Zone, North American Datum of 1983 in U.S. survey feet. The primary vertical datum used for the Site design is the North American Vertical Datum of 1988 (NAVD88). The National Oceanic and Atmospheric Administration (NOAA) maintains an active tide gage within the vicinity of the Site. The NOAA USS Lexington, Corpus Christi Bay, TX Station 8775296 (Lexington Station) is 2.0 miles southwest of the proposed project. This station collects and records real-time tide information dating back to 2004. The vertical datums from this station that will be used for the Site are shown in Table 1. The Lexington Station was also used to define a preliminary design water level, as described in the Water Level section.

Table 1
Lexington Station Tidal Datums

Tidal Datums	Elevation (feet NAVD88)	Elevation (feet MLLW)
MHHW	1.02	0.60
MHW	1.01	0.59
MSL	0.76	0.34
MLW	0.43	0.01
MLLW	0.42	0

Notes:

MHHW: mean higher high water
MHW: mean high water
MLLW: mean lower low water
MLW: mean low water
MSL: mean sea level

Meteorological, Ocean, and Wave Data

Water Level

To determine an approximate design water level elevation for the Site, an existing water level analysis using data from the Lexington Station was used (Anchor QEA 2021). Data were compiled for the period from October 2015 to January 2021 and used to calculate a 90th-percentile water level of 2.0 feet NAVD88. Because they represent recent water level conditions measured near the Site, the data at the Lexington Station are considered appropriate to inform the Site design.

In future phases of design, to determine the water level during island overtopping events, the water level data from the Lexington Station could be separated into months, and the water levels during months critical to target rookery nesting could be further evaluated to refine the rookery island elevation during subsequent design phases. The existing water level analysis for the Lexington Station shows that the 99.9th-percentile water level, including storm events, is approximately 4.0 feet NAVD88. Wind and Waves

USACE Wave Information Studies provides a national resource of long-term wavefield climatologies for U.S. coastal waters that synthesizes observations, multidecade hindcasts, and storm event archives (USACE 2021). The Wave Information Studies station closest to the Site is Station 73039, just offshore on the Gulf side of Mustang Island in the Gulf of Mexico. Because the station is located offshore, the wave data are not applicable to this project design. However, the project team considers the wind data to be representative of the winds experienced at the Site. Figure 2 summarizes wind data from January 1, 1980, through December 21, 2014. The data indicate that the predominant wind direction is from the southeast, with significant winds also coming from the north, northeast, east, and south.

The breakwater surrounding the existing island is expected to minimize impacts of wind-generated waves to the Site, causing the Site to experience a low wave-energy environment.

Wake Erosion

Several types of vessels, including recreational and commercial vessels and commercial tugboats and barges, may operate in the Rincon Canal (0.1 mile southwest of the Site) and generate wake waves that propagate to the Site. Like wind-generated waves, vessel-generated wake waves produce the greatest erosive forces in the region where the waves break (i.e., the surf zone).

The Bhowmik et al. (1991) and Weggel and Sorensen (1986) vessel-generated wave prediction methods—based on vessel dimensions, travel speed, and distance between the sailing line and Site—were used to evaluate the range of vessel-generated waves for a conservative selection of representative vessels known to operate in the area. A sport yacht with a draft of 4 feet was selected to evaluate recreation vessel wakes generated by vessels traveling near the proposed Site. A generic tugboat with maximum dimensions recorded in the Automatic Identification System (AIS) database was selected, along with a similar tugboat transiting with twin barges (identified using Google Earth imagery of ports in the region) to evaluate the commercial vessel wakes generated by vessels traveling in the Rincon Canal. Calculation of the sport yacht's maximum vessel wakes, traveling at varying speeds along the Rincon Canal 528 feet from the Site, can be seen in Table 2. Calculation of the maximum vessel wakes of the tugboat and tugboat with twin barges, traveling in 14 feet of water at varying speeds up to 11 miles per hour (mph; considered conservative) along the Rincon Canal 528 feet from the Site, can be seen in Table 3. These wave heights are generally 1 foot or less, and the existing breakwater should mitigate the impacts of those wakes.

Vessel wakes from the CCSC (approximately 2.3 miles south of the Site) were modeled (HDR 2018) at the southern, eastern, and northern shorelines of the Site, and vessel wakes behind the breakwater are not expected to exceed 0.3 foot NAVD88.

Table 2
Sea Ray Sundancer Sport Yacht Maximum Vessel Wake Calculations at Various Speeds

Vessel	Length (feet)	Draft (feet)	Vessel Speed (mph)	Maximum Wave Height (feet)	Wave Period (seconds)
Sea Ray Sundancer sport yacht	51	4	7.2	1.04	1.28
			15	0.79	1.11
			25	0.66	1.02
			35	0.59	0.96
			45.4	0.54	0.92

Note:
Maximum wave heights were calculated using Bhowmik et al. (1991), in which vessel speeds ranged from 6.7 to 45.4 mph.

Table 3
Tugboat and Tugboat with Twin Barges Maximum Vessel Wake Calculations at Various Speeds

Vessel	Length (feet)	Beam (feet)	Draft (feet)	Vessel Speed (mph)	Maximum Wave Height (feet)	Wave Period (seconds)
Generic tugboat with maximum dimensions recorded in AIS data[1]	87	33	11	3	0.00	8.40
	87	33	11	5	0.00	5.04
	87	33	11	7	0.00	3.60
	87	33	11	9	0.00	2.80
	87	33	11	11	0.72	2.29
Generic tugboat with maximum dimensions recorded in AIS data and twin barges[2]	387	110	11	3	0.00	7.31
	387	110	11	5	0.00	4.38
	387	110	11	7	0.00	3.13
	387	110	11	9	0.00	2.44
	387	110	11	11	0.00	2.29

Notes:
Maximum wave heights were calculated for vessels traveling within Froude number boundaries and at 3, 5, 7, 9, and 11 mph (Weggel and Sorensen 1986).

1. Vessel hull geometric coefficients were input using a tugboat from Hay (1967).
2. Vessel hull geometric coefficients were input using a barge from Hay (1967).

Bathymetry and Topography

DU conducted bathymetric and topographic surveys at the Site within the breakwater on March 16, 2022. DU's survey contained data gaps due to the presence of nesting birds. The DU survey data gaps were supplemented with a modified T. Baker Smith (TBS) transect survey conducted prior to the breakwater construction for HDR, Inc., on December 30, 2020. The modification included shifting all the TBS data vertically by 0.17 foot to match the common point between the two surveys. The Site has an average elevation of 0.42 foot NAVD88 and ranges from -3.84 to +5.68 feet NAVD88.

Utilities and Infrastructure

The Railroad Commission of Texas public GIS viewer (RRC 2021) and GLO pipeline data (GLO 2021a) were used to identify mapped utilities and pipelines near the Site. No pipelines were identified near the Site. An underground utility cable was identified adjacent to the Site in the TBS data, and its approximate location is shown in Attachment 2, Figure 2. The need for Site-specific utility locations prior to construction will be determined during subsequent design phases.

U.S. Highway 181 is immediately adjacent to the Site. U.S. Highway 181 is an elevated causeway, and protection of the highway foundation is not expected to be a design consideration because the proposed fill material would be inside the existing breakwater.

Desktop Cultural Resources Survey

A search of cultural resources records in the Texas Historical Commission Texas Historical Sites Atlas Database was completed for the Site on November 29, 2021. This search revealed that no archaeological surveys have been conducted, and no archaeological sites have been identified within the preliminary proposed placement site boundary (THC 2021). Furthermore, the 2022 construction of the breakwater, and earlier construction of the existing island and a previous breakwater, indicate the potential presence of cultural resources has not prevented previous projects.

Sensitive Habitat

GLO oyster habitat GIS data (GLO 2021b) indicate there is no oyster habitat identified within the Site, but there is oyster habitat approximately 200 feet north and west of the Site footprint (Attachment 2, Figure 2). The GLO oyster habitat data do not provide details on the viability of the oyster habitats. For instance, the areas shown on the GLO site may contain live oysters, other bivalve species, or shell/hard substrate remnants. Based on Venable et al. 2011 and communications with CBBEP, Nueces Bay and the Site are not always conducive for oyster growth due to the low influx of freshwater into the bay and resulting high salinity. Therefore, the GLO oyster habitat in Attachment 2, Figure 2 likely represents remnants of historical reefs (Venable et al. 2011) and is noted as potential shell substrate on the figures. Also, live oysters were not found within or immediately adjacent to the Site during the visual surveys conducted by DU on March 16, 2022.

According to the Texas Parks and Wildlife Department seagrass data (TPWD 2021), there are no seagrasses mapped within or adjacent to the Site location. Visual surveys conducted by DU on March 16, 2022, confirmed the absence of seagrasses within and adjacent to the Site.

Although oysters and submerged aquatic vegetation are not likely to inhabit the site, habitat surveys may be performed if required by regulatory agencies. The seagrass survey would be performed during peak growing season in late summer to early fall.

Bird Species

The USFWS Information for Planning and Consultation (IPaC) tool was used to identify listed species and migratory birds within a 480-square-mile region around Nueces and Corpus Christi Bay (USFWS 2021). Table 4 includes some of the protected bird species present near the Site and their preferred habitat as explained in the *Guide to North American Birds* (Audubon 2021). At this time, no target species or list of species has been identified for the Site.

Table 4
USFWS IPaC Species Information[1]

Species	Status	Preferred Habitat[2]
Whooping crane (*Grus americana*)	Endangered	Prairie pools, marshes, and coastal marshes
Piping plover (*Charadrius melodus*)	Threatened	Sand beach dunes and expansive sand or mudflats
Red knot (*Calidris canutus*)	Threatened	Mudflats, tidal zones, and sandy beaches
American oystercatcher (*Haematopus palliatus*)	Migratory	Strictly coastal; dunes, islands in salt marsh, dredge spoil islands, sandy beaches, and tidal mudflats
Black skimmer (*Rynchops niger*)	Migratory	Sandy islands, shell beaches, open beaches, lagoons, estuaries, inlets, and sheltered bays
Brown pelican (*Pelecanus occidentalis*)	Migratory	Bare, rocky, mangrove or tree-covered islands; salt bays, beaches, and oceans
Gull-billed tern (*Gelochelidon nilotica*)	Migratory	Beaches, islands, salt marshes, fields, and coastal bays
Marbled godwit (*Limosa fedoa*)	Migratory	Northern Great Plains, native prairie with marshes or ponds, pools, shores, marshes, and tidal flats
Reddish egret (*Egretta rufescens*)	Migratory	Red mangrove swamps, arid coastal islands covered with thorny brush, coastal tidal flats, salt marshes, and lagoons
Ring-billed gull (*Larus delawarensis*)	Migratory	On ground near water with sparse plant growth, lakes, bays, coasts, piers, dumps, and plowed fields
Royal tern (*Thalasseus maximus*)	Migratory	Low-lying sandy islands, coasts, lagoons, salt bays, and estuaries
Wilson's plover (*Charadrius wilsonia*)	Migratory	Dry part of beach, near conspicuous object, coastal regions, open beaches, tidal flats, estuaries, and sandy islands

Notes:

1. USFWS IPaC information (USFWS 2021) is provided for a 480-square-mile region around Nueces Bay and Corpus Christi Bay highlighting endangered and threatened birds and their preferred habitat.
2. Habitat information is from the *Guide to North American Birds* (Audubon 2021) and includes preferred nesting and general habitat.

Erosion

According to documentation from the Coastal Bend Bays & Estuaries Program, the Site "has suffered from erosion for many years due to its exposure to wind and waves" (CBBEP 2022). The construction of a breakwater surrounding the Site was completed in early 2022, and the Site's risk of erosion is reduced.

Beneficial Use Source Material

Potential sources of dredged material are the Rincon Canal, located adjacent to the Site, and the CCSC, located 2.3 miles away. Based on coastal consistency determinations from USACE, USACE has historically performed maintenance dredging on the CCSC near the Site (USACE 1999). Continued dredging has recently been confirmed by USACE (Jones 2021). The identified DMPAs used by USACE when dredging the CCSC adjacent to the Site from the La Quinta Junction to Beacon 82, historical average annual quantity of dredged material, distance from the Site to DMPA, and channel segments are shown in Table 5. PCCA has estimated shoaling rates for the Inner Harbor adjacent to the Site (from Beacon 82 to the Viola Turning Basin; Table 6). With the ongoing widening and deepening of the CCSC, it is expected that the average annual dredging quantities will be higher in the future. The average grain size and grain type percentages for from the La Quinta Junction to Beacon 82 and from Beacon 82 to the Viola Turning Basin are shown in Table 7. This informs the quantity and characteristics of dredged material that may be available during a dredging cycle. PCCA has identified the Site as one of the DMPAs for the planned dredging of Rincon Canal in 2024.

Table 5
USACE DMPA Areas Along the CCSC Near the Site

DMPA No.	Channel Segment (Station)	Distance from Site to DMPA (miles)	Average Annual Dredging Quantity (CY)
16A	La Quinta Junction to Beacon 82 (800+00-900+00)	4.8	91,000
16B	La Quinta Junction to Beacon 82 (800+00-900+00)	4.2	92,000
17A	La Quinta Junction to Beacon 82 (900+00-1050+00)	3.6	107,000
17B	La Quinta Junction to Beacon 82 (900+00-1050+00)	3.2	296,000

Notes:
Source: USACE 1999.
CY: cubic yard

Table 6
PCCA Estimated Shoaling Rate for the CCSC Inner Harbor

Inner Harbor West Region Estimated Shoaling (CY per year)	Inner Harbor Central Region Estimated Shoaling (CY per year)	Inner Harbor East Region Estimated Shoaling (CY per year)
35,000	38,000	50,000

Table 7
Typical Sediment Characteristics from the La Quinta Junction to Beacon 82 and from Beacon 82 to the Viola Turning Basin

Sediment Characteristics from the La Quinta Junction to Beacon 82 (550+00 to 1050+00)	Sediment Characteristics from the Beacon 82 to the Viola Turning Basin (1050+00 to 1550+00)
D_{50} (mm) = 0.020	D_{50} (mm) = 0.047
8.5% sand	24.4% sand
54.5% silt	40.6% silt
37.1% clay	35.1% clay

Notes:
Source: USACE 1999
D_{50}: median grain size
mm: millimeter

In addition to the above information, USEPA and USACE (2018) state that approximately 400,000 cubic yards (CY) of material are dredged from the Rincon Canal every 7 years. Due to the relative proximity of the Site to these sediment sources, the Site should allow for lower construction costs compared to those of potential bird island sites that are more remote.

60% Design

The main design elements evaluated for the Site are as follows:

- Site location
- Rookery island size and shape
- Containment and erosion protection
- Constructability
- Planting and natural recruitment of vegetation
- Performance expectations
- Site construction cost estimates
- Expected ecosystem benefits
- Data and information gaps

These design elements are evaluated in this memorandum for the 60% Site design.

The placement of dredged material is expected to be paid for by the project owner but contracted by the entity funding the dredging itself (e.g., USACE). Because the dredging will be performed under a USACE (or another entity) contract, this entity will provide the drawings and technical specifications for BU placement of the dredged material. As a result, it is not useful to prepare 60% construction drawings and technical specifications for dredged material placement at this time. Rather, a Dredged Material Management Plan (DMMP) that provides design details on the placement of dredged material for the interior of the site was developed (Attachment 2). It is expected that USACE (or another entity) will incorporate the DMMP into the construction drawings and technical specifications it has with the dredger. This will ensure the BU design grades and project objectives are achieved.

Site Location

The proposed Site is the historical Causeway Bird Island, approximately 0.1 mile northeast of Rincon Canal and 2.3 miles north of the CCSC (Figure 1). The island is surrounded by a recently constructed breakwater and exhibits an average elevation of 0.42 foot NAVD88. The advantages of creating additional bird habitat at this location include the following:

- The bird island was larger (historically), and stakeholders have indicated an interest in expanding bird island habitat at this location.
- The existing breakwater is expected to protect placed dredged material from erosion and contain placed dredged material.
- The location is not in the vicinity of sensitive habitat.
- Adjacent channels may provide relatively deeper water construction access on the southwest side of the site.

Although the Site is closer to shore than the desired 0.5-mile distance identified for minimizing predator access to rookery islands (Stanzel 2018), it is an active rookery that currently supports thousands of nesting pairs of colonial waterbirds (CBBEP 2020a). According to Jarrett "Woody" Woodrow, fish and wildlife biologist for USFWS, several existing and successful rookery islands are also located closer than 0.5 mile to a mainland shoreline that may harbor predators.

Rookery Island Size and Shape

Based on the existing size of the island and breakwater, the project team proposes a site area of approximately 16 acres. This represents a bird island larger than the optimum size suggested by stakeholders (4 to 10 acres). However, not all of the Site will be built out to bird island habitat elevations. The Site is an active rookery that supports thousands of nesting pairs of colonial waterbirds (CBBEP 2020a), and habitat restoration at the Site may further increase colonial waterbird presence.

The Site will be created with dredged material placed to varying elevations to promote a variety of habitats. The Site will be filled to elevations ranging from 0.0 to +6 feet NAVD88 from the landward side of the breakwater to the existing 3.0-foot NAVD88 contour to create a variety of tidal flat, sandy beach, marsh habitat, and upland habitat. Existing upland rookery elevations greater than the approximate +3.0-foot NAVD88 contour will be avoided to minimize disturbance to the existing vegetation and rookery. It has been assumed that the breakwater has been designed and located so that loads from the breakwater are not imparted on the existing causeway foundations and, therefore, that any loads from new fill behind the breakwater will also not be imparted on the existing causeway foundations.

Fill elevations were selected to promote natural recruitment of vegetation and provide a variety of habitat for a range of bird species. The fill elevations were also designed to provide some protection from overtopping during higher tide and storm events The elevation of dredged material fill could be adjusted at further phases of design, depending on the physical properties of the dredged material or if target vegetation or bird species are identified in a specific location.

It is predicted that the required fill volume for the 60% design will be approximately 106,000 CY. This value assumes 1 foot of foundation compression for every 6 feet of fill (based on the relative incompressibility of the underlying sand reported by HDR [2018]) and does not consider bulking. It is anticipated that if dredged material from the planned Rincon Canal dredging in 2024 is placed at the Site, the project could be completed within a single dredging cycle. Additional geotechnical data is expected to be needed and would be collected during a subsequent design phase to further evaluate the expected foundation compression and expected bulking of dredged material. The volume of material may be updated during a subsequent phase of design based on the dredged material characteristics, characteristics of the subgrade, and refinement of rookery island design.

The purpose of the project is to restore a range of coastal bird habitat in the near term. However, relative sea level rise may impact the Site in the future. A strategy to accommodate relative sea level rise could be to place BU material to higher elevations in preparation for higher relative sea levels and tidal elevations associated with relative sea level rise; however, this would incur higher costs. The impacts of relative sea level rise may also be managed in the future through adaptive management strategies targeting bird preferred vegetation ranges, such as additional placement of maintenance material to upland or marsh habitat or thin-layer placement of dredged material.

Containment and Erosion Protection

The existing breakwater will serve as containment and to protect the proposed Site from wake erosion and wind-generated waves. The breakwater construction was completed in early 2022 and is approximately 3,400 linear feet of graded riprap split into nine different-sized segments by two large gaps (approximately 30 feet wide at the top of each gap) and seven small gaps (approximately 20 feet wide at the top of each gap). The breakwater side slopes are approximately 2 horizontal to 1 vertical, the crest elevation is approximately +3.0 feet NAVD88, and the crest width is approximately 5 feet (Hydroterra 2022).

Constructability

This section describes the proposed methods of construction. Actual methods will be dependent on the chosen contractor’s equipment and Site conditions at the time of construction. In addition, the contractor may provide alternate construction methods from those described in this section. The channel near the island on the southwest side of the Site may be beneficial for construction access. Bathymetric surveys will need to be conducted during subsequent design phases to better define Site dimensions, material needs, and construction accessibility.

Geotextile fabric or jute will be placed along the landward slope of the breakwater to prevent fines from passing through the armor stone. Environmental controls may be deployed to manage decant water and temporarily block breakwater gaps and other areas to prevent dredged material from leaving the Site during construction. Dredged material will be placed up to the required fill elevations. If needed, marsh excavators may be used to shape the dredged material behind the breakwater.

If construction occurs during bird nesting season, BMPs may be needed to minimize disturbance of bird habitats. BMPs would be coordinated with regulatory agencies during permitting.

Planting and Natural Recruitment of Vegetation

Based on stakeholder input and cost considerations, the project team determined that planting may not be needed for the Site. Rather, natural vegetation recruitment will be allowed to proceed. If the outcome is unsatisfactory (e.g., if the island has lower-than-expected use by desired bird species), an adaptive management program can be instituted to modify the vegetation. Table 4 shows some of the listed and migratory birds and their preferred habitats. At further design phases, this list could be used to modify elevations within the Site to promote the preferred habitat of desired bird species.

Performance Expectations

The performance goal for the project is to restore a variety of rookery habitat by placing material to a range of elevations to promote natural recruitment of vegetation. Potential environmental controls and the existing breakwaters are expected to contain placement of dredged material.

Site Construction Cost Estimates

Preliminary construction costs were estimated for the design outlined in the previous sections. The estimated costs include indirect construction costs (i.e., permitting, 100% engineering and design costs, construction management, and postconstruction management such as site visits and vegetation monitoring). These costs represent the estimated incremental costs (i.e., costs over and above USACE's least-costly and environmentally acceptable dredged material and placement alternative). Table 8 shows a line-item list of each costing parameter and the total cost estimated for construction.

The estimates are developed using current and generally accepted engineering cost estimating methods and are based on assumptions concerning future events. Actual costs may be affected by known and unknown risks including, but not limited to, changes in general economic business conditions, Site conditions that were unknown at the time the estimates were performed, future

changes in Site conditions, regulatory or enforcement policy changes, and delays in performance. Actual costs may vary from these estimates.

The costs range from $900,000 to $2.0 million, depending on the level of uncertainty allocated to the project cost. The lower bound of uncertainty (-30%) and upper bound of uncertainty (+50%) were selected due to the existing data gaps, high levels of inflation, and rising fuel costs. Of note, future adaptive management measures and labor and equipment to reshape placed dredged material are not included in the estimate, as the future need for such measures is unknown.

Table 8
Opinion of Probable Construction Cost to 100% Project Completion

Item	Quantity	Unit	Unit Price	Total
Direct Construction Costs				
Incremental Mobilization and Demobilization[1,2]	1	%	15	$ 120,000.00
Preconstruction Survey	1	LS	$30,000.00	$ 30,000.00
Geotextile Fabric[2]	4,900	SY	$ 15.00	$ 70,000.00
Incremental Dredging Cost (1-Mile Pipeline)[2]	106,000	CY	$ 6.00	$ 640,000.00
As-Built Survey	1	LS	$60,000.00	$ 60,000.00
Subtotal[3]			**Sum**	$ 900,000.00
Direct Construction Subtotal[3]			**Sum**	$ 900,000.00
Indirect Construction Costs				
100% Engineering and Design[3]	1	%	10	$ 100,000.00
Permitting	1	Each	$35,000.00	$ 35,000.00
Construction Management[3]	1	%	8	$ 100,000.00
Postconstruction Management[4]	12	Month	$10,000.00	$ 120,000.00
Indirect Construction Subtotal[3]			**Sum**	**$ 400,000.00**
Project Subtotal[3]			**Sum**	**$ 1,300,000.00**
-30% Uncertainty[3]	1	%	30	$ 400,000.00
+50% Uncertainty[3]	1	%	50	$ 700,000.00
Low-End Total Project Estimated Cost[3]			**Total Sum**	**$ 900,000.00**
High-End Total Project Estimated Cost[3]			**Total Sum**	**$ 2,000,000.00**

Notes:
Costs were determined based upon a combination of publicly available datasets and sediment surface grabs, and topographic, bathymetric, and visual habitat surveys.

1. Cost is based upon mobilizing equipment beyond what is required for dredging Rincon Canal and CCSC (e.g., marsh buggies).
2. Value is rounded to the nearest $10,000.
3. Value is rounded to the nearest $100,000.
4. Postconstruction management may include Site visits to observe the material consolidation, vegetation, and water levels on the Site. Monthly aerials may be performed. Additional postconstruction management practices may be considered during subsequent phases of design.

LS: lump sum
SY: square yard

Expected Ecosystem Benefits

Restoration of the Site is expected to have positive benefits on the regional ecosystem and will substantially increase habitat for the herons, egrets, terns, skimmers, and pelicans that currently reside on the island (CBBEP 2020b).

The relative sea level rise trend in Corpus Christi is 5.54 millimeters per year (NOAA 2022). Assuming no changes in the relative sea level rise trend and no erosion, the rookery island at +3.0 feet NAVD88 would remain above the 90th-percentile water level until 2078, and the maximum elevation (+6.0 feet NAVD88) would remain above the 90th-percentile water level until 2243.

Opportunities to create a variety of habitat during construction of this rookery island include the following:

- Designing placement of material to target certain vegetation ranges that promote specific bird populations
  - Sandy beach habitat to promote wading bird access and habitat for the endangered piping plover
  - Low marsh habitat for nekton food sources
  - High marsh and upland habitat for birds that prefer nesting at higher elevations
- Vegetation planting in areas to accelerate colonization and promote avian and aquatic habitat

Data and Information Gaps

At this phase of design, the following data and information gaps have been identified:

- Geotechnical characteristics of source material (maintenance and new work material) and subgrade of the placement area to refine evaluations of subgrade and source material settlement and short- and long-term capacity for dredged material placement
- Geotechnical characteristics and settling data for the existing breakwater
- Oyster and seagrass habitat surveys, if required by the regulatory agencies
- Refined survey information such as utility locations and supplemental bathymetry and topography, where appropriate
- Based on stakeholder feedback, targeting higher upland elevations mostly on areas not currently vegetated, except for some vegetation toward the north side of the Site that would be acceptable to cover to build to higher elevations (This may be evaluated during subsequent design phases.)

These data gaps may need to be addressed during the progression from 60% design to final design. This current project is taking the analyses as far as practicable, considering the constraints of the project scope, budget, and schedule.

Future Work

No fatal flaw has been identified at this phase of the design. Should the Site be selected for additional design efforts, it can be expected that some aspects of the design in this memorandum will be modified and, as appropriate, enhanced.

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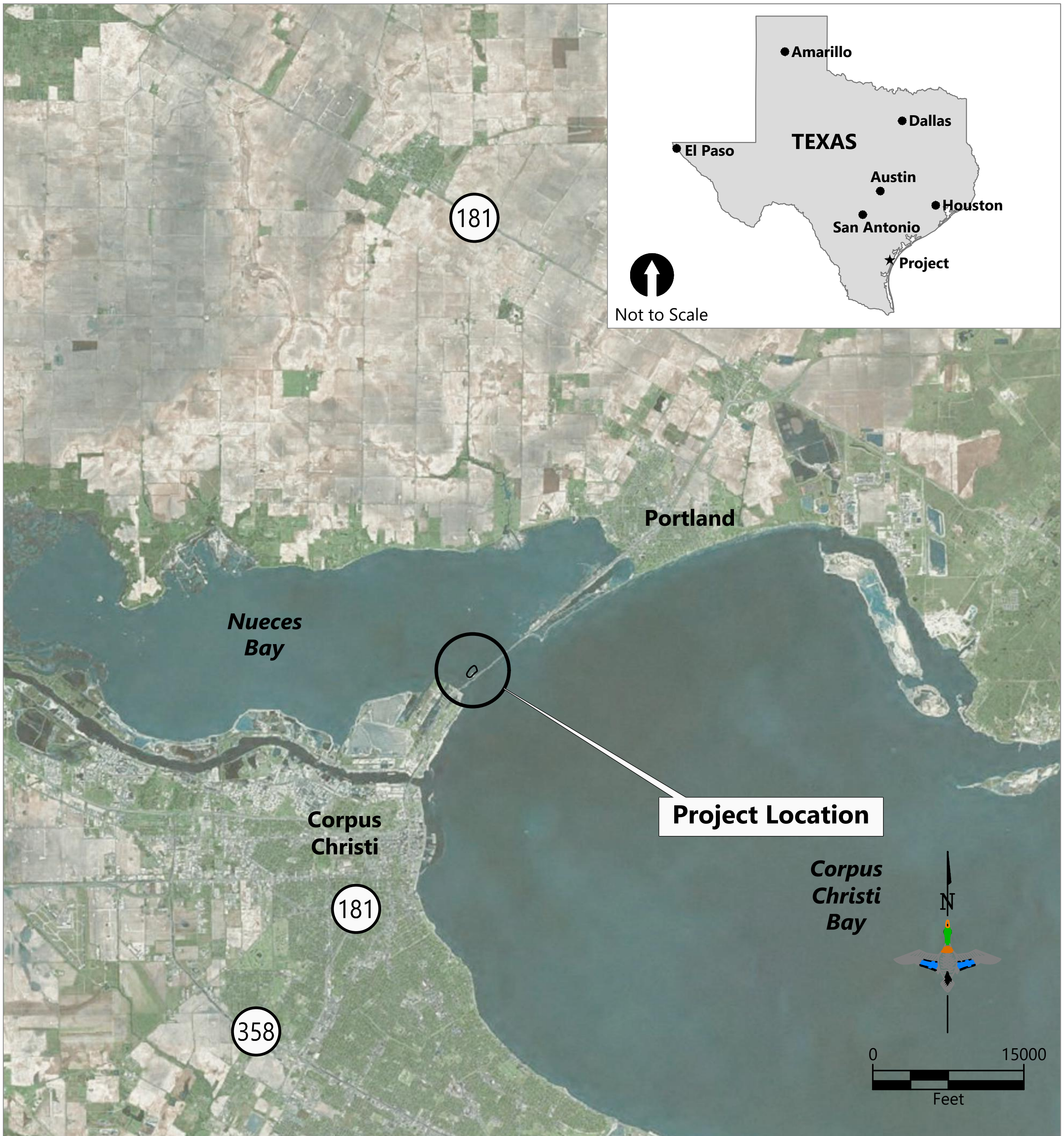
Figures



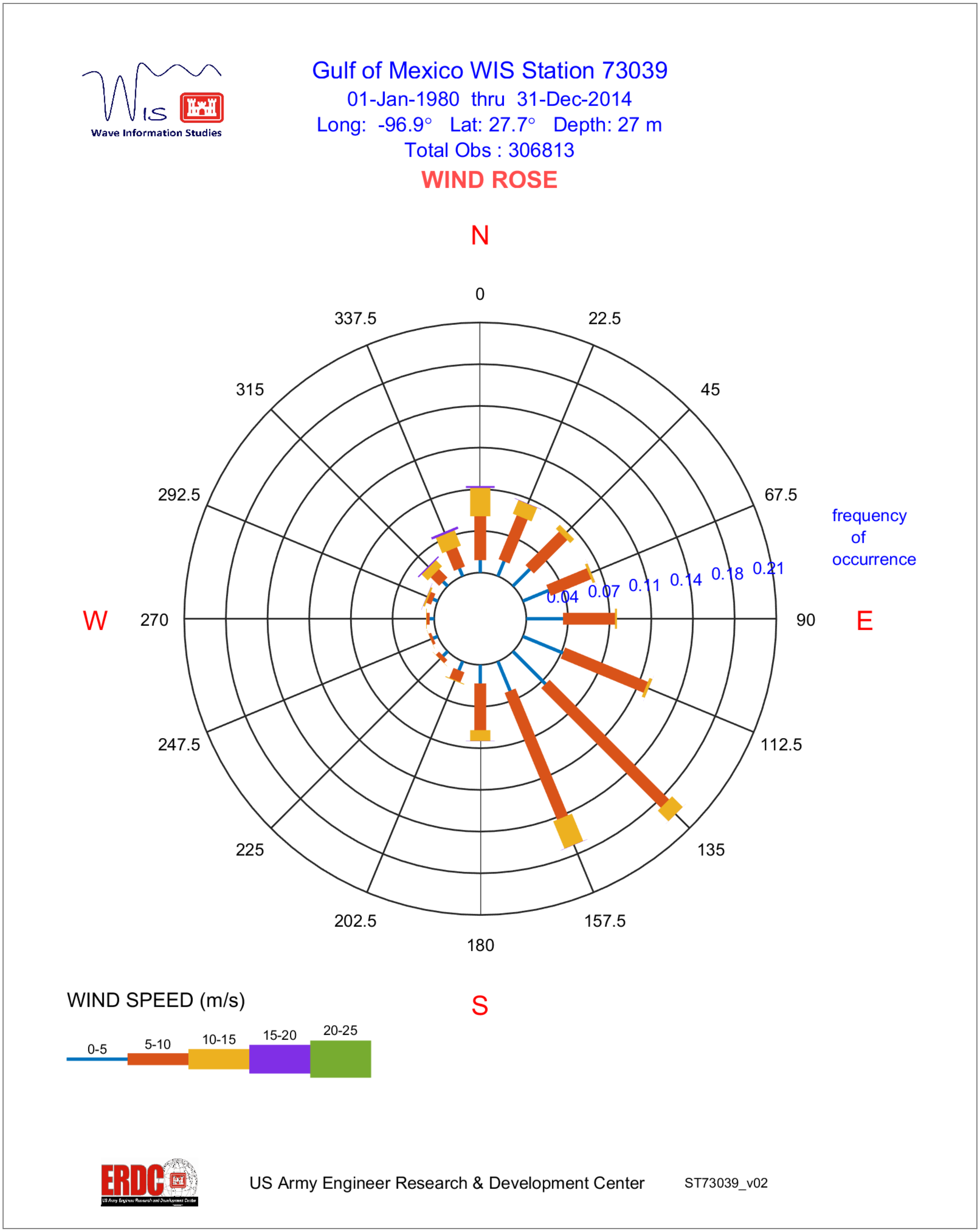
SOURCE: Aerial provided by Bing Maps.
HORIZONTAL DATUM: Texas State Plane South Zone, North American Datum of 1983, U.S. Survey Feet

Publish Date: 2022/09/29 4:33 PM | User: mpratschner
Filepath: K:\Projects\2018-PCCA Beneficial Use\CAUSEWAY BIRD ISLAND\2018 RP-001 VIC MAP.dwg Figure 1

ANCHOR QEA

Figure 1
Vicinity Map

Causeway Bird Island 60% Design Memorandum
Texas Lower Coast Beneficial Use



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ANCHOR QEA

Figure 2
Historical Wind Data for USACE WIS Station 73039

Causeway Bird Island 60% Design Memorandum
Texas Lower Coast Beneficial Use

Attachment 1
Site Photographs

Existing rubble mound breakwater (photo credit: Ducks Unlimited)

View of island from southwest (photo credit: Ducks Unlimited)

Eastern side of island looking north (photo credit: Ducks Unlimited)

Eastern side of island looking southwest (photo credit: Ducks Unlimited)

Existing upland vegetation on island (photo credit: Ducks Unlimited)

Northern end of island (photo credit: Ducks Unlimited)

Western side of island (photo credit: Ducks Unlimited)

Attachment 2

Dredged Material Management Plan

Dredged Material Management Plan – Causeway Bird Island

The Dredged Material Management Plan for Causeway Bird Island provides guidance on placement of dredged material and postconstruction rookery island monitoring. Figures 1 through 3 are provided for informational purposes. The intent is to place fill at varying ranges to create a range of upland and tidal habitats.

Dredged Material Placement

The following details the recommended dredged material placement plan:

- Prior to placing dredged material, the Contractor shall submit a plan for Engineer approval that addresses the means and methods for controlling the release of dredged material, decant water, and turbidity from the existing breakwater voids and gaps. One method of turbidity control could include installation of geotextile along the inside face of the existing breakwater. Attached to this Dredged Material Management Plan is reference specification 31 05 19 that could be used for the geotextile.
- The Contractor shall place dredged material in the rookery island creation area as directed by the Engineer. The proposed method of placement shall be approved by the Engineer prior to commencement of work. The Contractor shall avoid placing material during bird nesting seasons and will follow approved bird abatement plans.
- Dredged material placement elevations during rookery island creation will be determined by the Engineer. Based on surveys and site visits, the Engineer will direct the Contractor on placement areas and elevations. The intent of the placement is to create varying elevations of upland, tidal flat, sandy beach, and marsh habitat within the rookery island footprint and for final rookery elevations, after consolidation, to be =0.0 and +6.0 feet North American Vertical Datum of 1988 (NAVD88). Unless approved by the Engineer, dredged material will not be placed on areas with vegetation and active rookery areas (i.e., elevation +3.0 feet NAVD88 or greater).
- The Contractor shall begin placing dredged material in accordance with the specifications and Contractor's approved work plan. Deviations will be reviewed and approved, if acceptable, on a weekly basis by the Engineer, based on the adaptive placement approach, using survey and aerial images, if required, to guide the decision-making process.
- The Contractor shall use a placement method and employ best management environmental control practices that can be adapted for placing dredged material in varying locations and elevations and that will minimize turbidity in the water discharged from the rookery island placement area.
- If hydraulically placing dredged material, the Contractor shall limit its discharge rate as necessary for the proposed equipment, water depth, surface area, weirs (if applicable), and borrow material properties to prevent turbidity exceedances and weir and berm overtopping. Depending on the proposed discharge rate into the area by the Contractor, intermittent discharge may be required to prevent overtopping. Once established, the Contractor shall not overtop the breakwater with dredged material.
- At the completion of rookery island creation and as directed by the Engineer, the Contractor shall complete the as-built survey of the constructed rookery island.
- Deviations in rookery island elevation will be dependent on the characteristics of the dredged material and determined by the Engineer. If no direction is given, the elevation deviations shall not be greater than +/-0.5 foot.

Postconstruction Monitoring

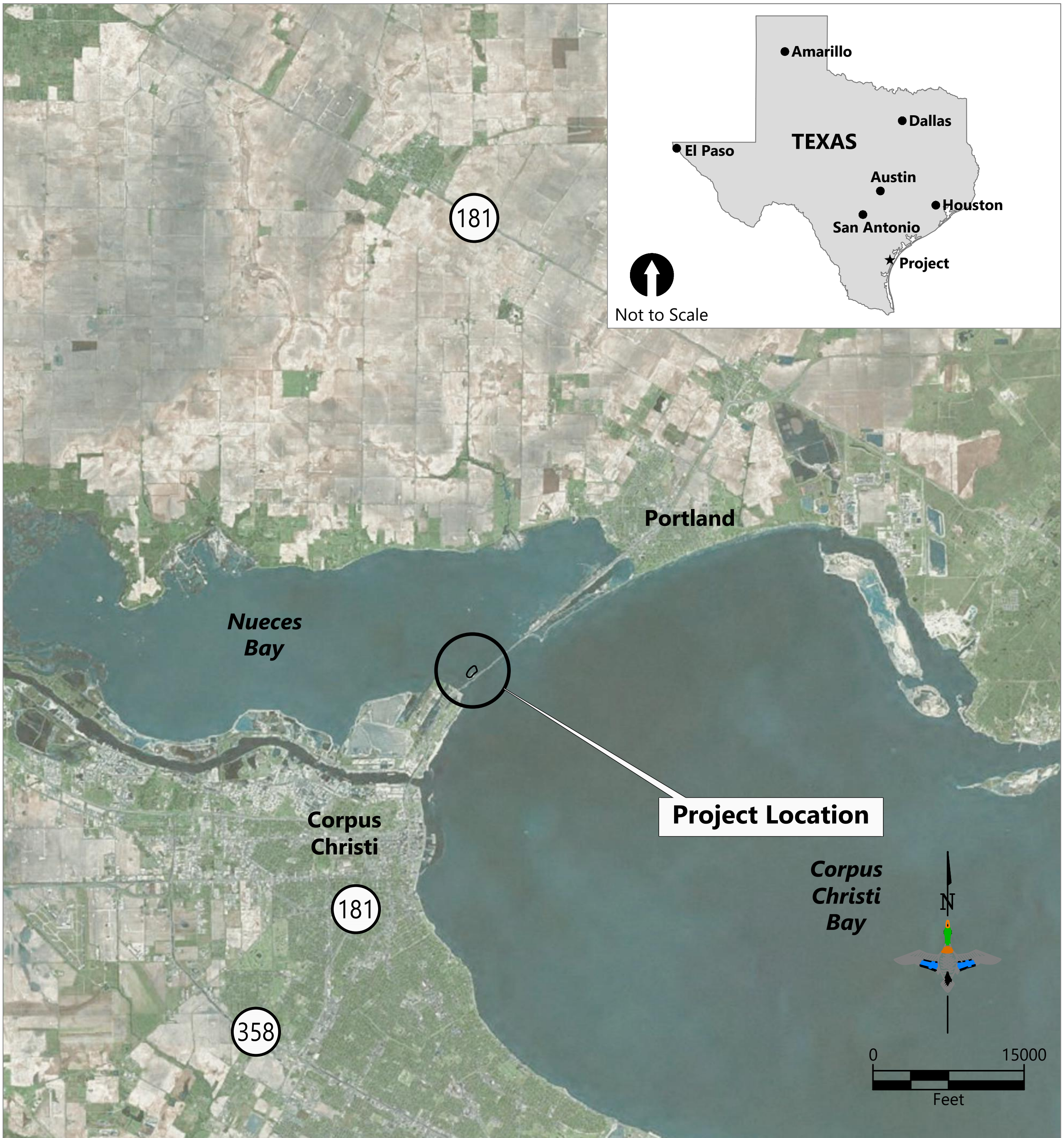
Once the Engineer determines rookery island placement operations are complete, the Contractor shall begin the postconstruction monitoring phase of the project as directed by the Engineer. It is the intent that all irregularities will be resolved on site with the Engineer and Contractor as the rookery island fill is placed. Work during the monitoring phase may be restricted to avoid bird nesting seasons.

The Contractor shall monitor, maintain, and adjust the decant system or weirs as needed to decant water from the site to allow the dredged material to settle and consolidate. The Engineer will determine when postconstruction monitoring is complete.

At the completion of postconstruction monitoring and as directed by the Engineer, the Contractor shall remove any decant system or weirs if directed by Engineer. Degrading and breaching locations and elevations, if required, will be determined by the Engineer based on the last postconstruction monitoring visit.

At the completion of this work item, and as directed by the Engineer, the Contractor shall complete the as-built survey of the constructed rookery island.

Figures



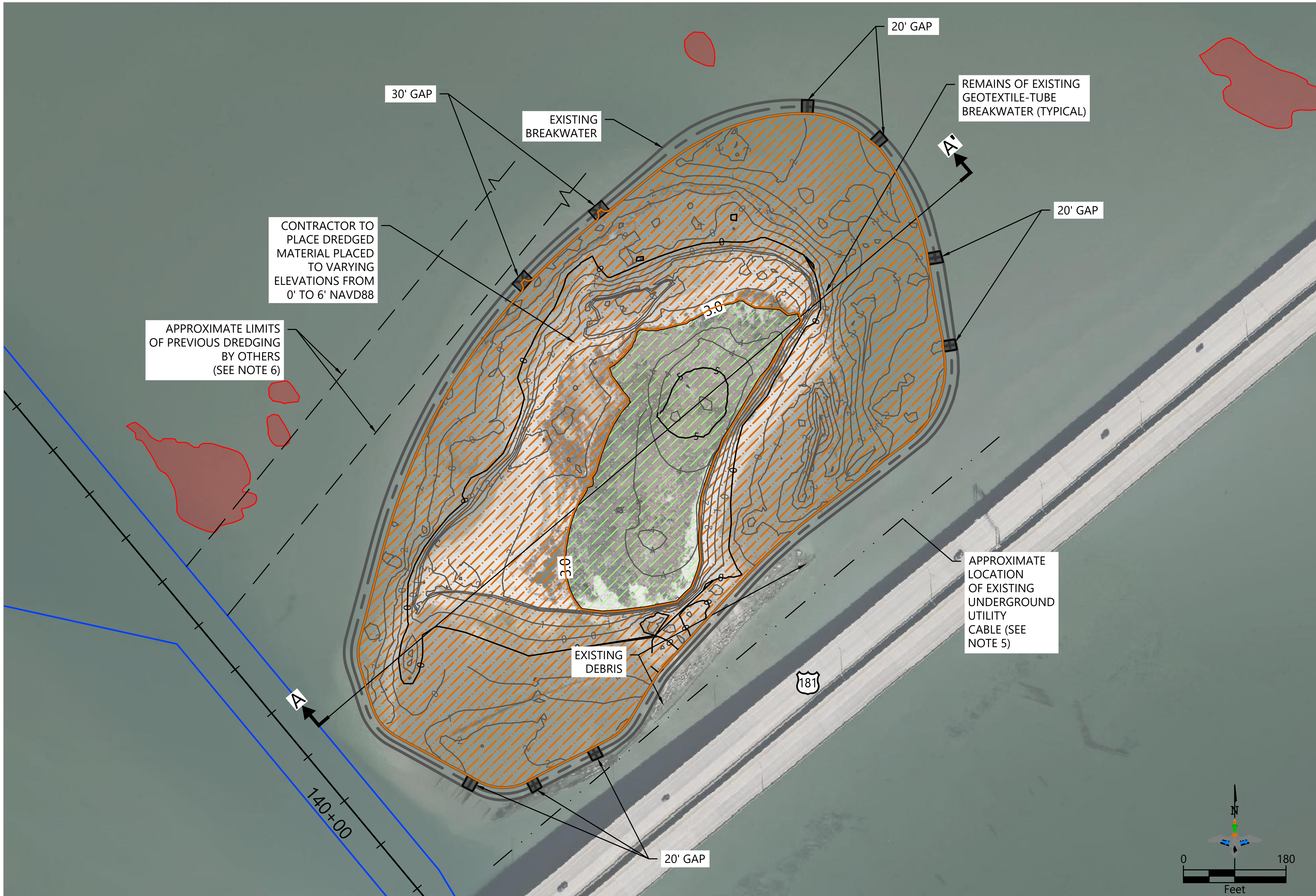
SOURCE: Aerial provided by Bing Maps.
HORIZONTAL DATUM: Texas State Plane South Zone, North American Datum of 1983, U.S. Survey Feet

Publish Date: 2022/09/29 4:38 PM | User: mpratschner
Filepath: K:\Projects\2018-PCCA Beneficial Use\CAUSEWAY BIRD ISLAND\2018 RP-001 VIC MAP.dwg Figure 1_DMMP

ANCHOR QEA

Figure 1
Vicinity Map

Causeway Bird Island Attachment 2
Texas Lower Coast Beneficial Use



LEGEND:

- POTENTIAL SHELL SUBSTRATE
- RINCON CANAL
- —0— EXISTING CONTOUR (5')
- –-3–- EXISTING CONTOUR (0.5')
- EXISTING VEGETATION APPROX. ELEVATION GREATER THAN +3.0' NAVD88 (SEE NOTE 8)
- DREDGED MATERIAL PLACED TO VARYING ELEVATIONS FROM 0.0' TO 6.0' NAVD88 (SEE NOTE 7)
- TURBIDITY CONTROLS

NOTES:

1. HORIZONTAL DATUM: TEXAS STATE PLANE SOUTH ZONE, NAD83, U.S. SURVEY FEET
2. VERTICAL DATUM: NORTH AMERICAN VERTICAL DATUM OF 1988 (NAVD88)
3. BATHYMETRIC, TOPOGRAPHIC, AND VISUAL HABITAT SURVEYS CONDUCTED BY DUCKS UNLIMITED ON MARCH 16, 2022. A BATHYMETRIC AND TOPOGRAPHIC SURVEY CONDUCTED BY BY T. BAKER SMITH ON DECEMBER 30, 2020, WAS USED TO FILL DATA GAPS DUE TO NESTING BIRDS. BOTH SETS OF BATHYMETRIC SURVEY DATA WERE COMBINED ON APRIL 19, 2022.
4. GLO (TEXAS GENERAL LAND OFFICE), 2021B. LAYER: OYSTER HABITAT (ID: 57). ARCGIS REST SERVICES DIRECTORY. ACCESSED NOVEMBER 23, 2021.
5. NOT ALL EXISTING UTILITIES ARE SHOWN. CONTRACTOR IS RESPONSIBLE FOR LOCATING ALL UTILITIES PRIOR TO COMMENCING WORK.
6. ACCESS CHANNEL SHOWN WAS DREDGED DURING A 2002 GEOTEXTILE TUBE PROJECT AS A BORROW AREA FOR MATERIAL TO FILL GEOTEXTILE-TUBES. CHANNEL LIMITS SHOWN ARE APPROXIMATE, AND CHANNEL HAS NOT BEEN MAINTAINED SINCE DREDGING IN 2002.
7. ELEVATIONS ARE DEPENDANT ON THE MATERIAL PLACED.
8. THE INTENT IS TO NOT COVER THE EXISTING VEGETATION WITH DREDGED MATERIAL.

Publish Date: 2022/09/29 4:38 PM | User: mpratschner
Filepath: K:\Projects\2018-PCCA Beneficial Use\CAUSEWAY BIRD ISLAND\Construction Plans\Construction Plans_60%\2018 RP-002 BERM _CBI.dwg Figure 2

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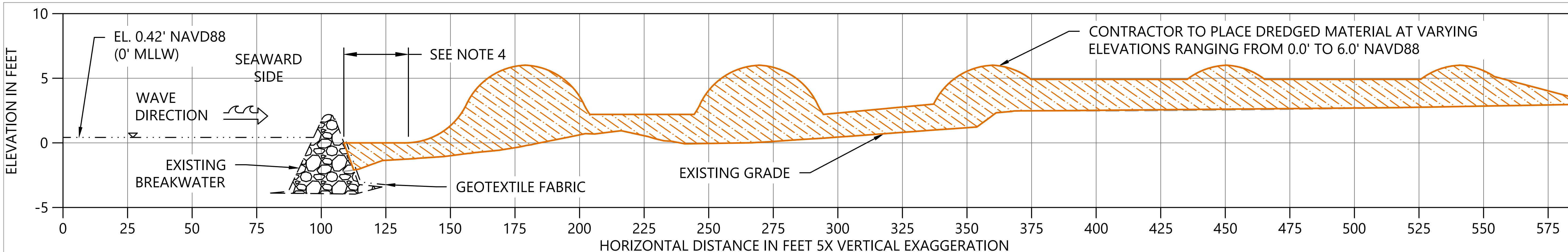
Figure 2
Plan View

Causeway Bird Island Attachment 2
Texas Lower Coast Beneficial Use



A
Fig2
TYPICAL CAUSEWAY BIRD ISLAND FILL SECTION
HORIZONTAL SCALE: 1" = 40'
VERTICAL SCALE: 1" = 8'

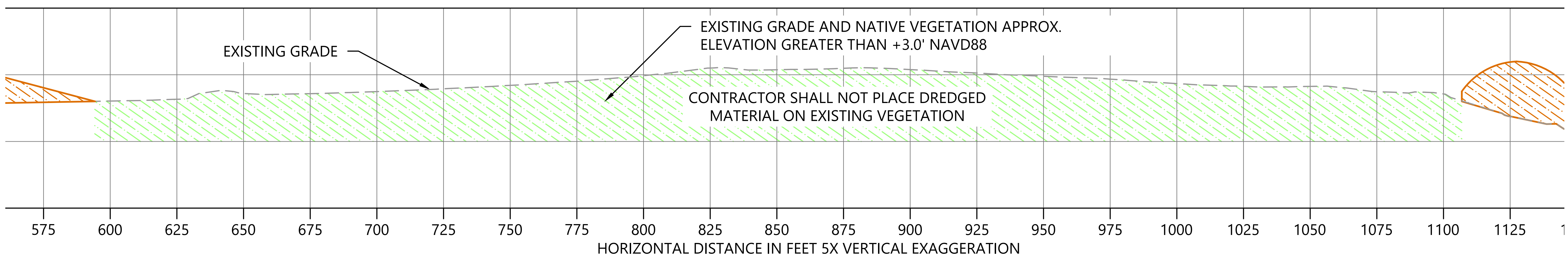


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Fig2
TYPICAL CAUSEWAY BIRD ISLAND FILL SECTION
HORIZONTAL SCALE: 1" = 40'
VERTICAL SCALE: 1" = 8'

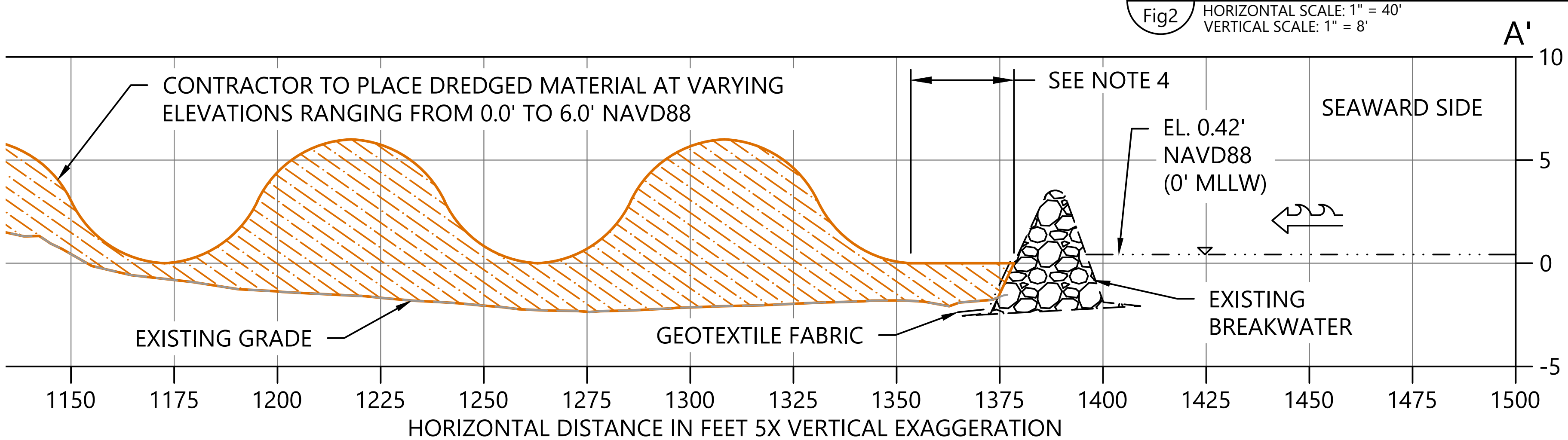

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Fig2
TYPICAL CAUSEWAY BIRD ISLAND FILL SECTION
HORIZONTAL SCALE: 1" = 40'
VERTICAL SCALE: 1" = 8'

NOTES:

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4. CONTRACTOR SHALL NOT PLACE DREDGED MATERIAL GREATER THAN 0' NAVD88 WITHIN 25' OF THE BREAKWATER.

SECTION 31 05 19

GEOGRID AND GEOTEXTILES

PART 1 - GENERAL

1.01 SUMMARY

A. The Contractor shall furnish all labor, equipment, materials, and incidentals necessary to install the geocomposite underlayment (a nonwoven geotextile mechanically connected to a geogrid to form a two-layer geosynthetic reinforcement) for the containment berm as shown on the Construction Drawings as "Geocomposite."

B. Related Sections

1. Section 01 20 00 – Measurement and Payment Procedures
2. Section 01 33 00 – Submittal Procedures
3. Section 01 35 43 – Environmental Protection
4. Section 35 33 00 – Containment Berm

1.02 REFERENCES

A. American Association of State Highway and Transportation Officials (AASHTO): Standard Specification for Highway Bridges (2002)

B. ASTM International (ASTM):

1. D1388 – Standard Test Method for Stiffness of Fabrics
2. D3786 – Standard Test Method for Bursting Strength of Textile Fabrics – Diaphragm Bursting Strength Tester Method
3. C4354 – Practice Method for Sampling of Geosynthetics for Testing
4. C4355 – Standard Test Method for Deterioration of Geotextiles by Exposure to Light, Moisture and Heat in a Xenon Arc Type Apparatus
5. D4491 – Standard Test Methods for Water Permeability of Geotextiles by Permittivity
6. D4533 – Standard Test Method for Trapezoid Tearing Strength of Geotextiles
7. D4632 – Standard Test Method for Grab Breaking Load and Elongation of Geotextiles
8. D4751 – Standard Test Method for Determining Apparent Opening Size of a Geotextile
9. D4759 – Standard Practice for Determining the Specification Conformance of Geosynthetics
10. D4833 – Standard Test Method for Index Puncture Resistance of Geomembranes and Related Products
11. D4873 – Standard Guide for Identification, Storage, and Handling of Geosynthetic Rolls and Samples
12. D4884 – Standard Test Method for Strength Sewn or Bonded Seams of Geotextiles

13. D5199 – Standard Test Method for Measuring the Nominal Thickness of Geosynthetics

14. D5261 – Standard Test Method for Measuring Mass Per Unit Area of Geotextiles

15. D5321 – Standard Test Method for Determining the Shear Strength of Soil-Geosynthetic and Geosynthetic-Geosynthetic Interfaces by Direct Shear

16. D6241 – Standard Test Method for Static Puncture Strength of Geotextiles and Geotextile-Related Products Using a 50-mm Probe

17. D6637 – Standard Test Method for Determining Tensile Properties of Geogrids by the Single or Multi-Rib Tensile Method

18. D7737 – Standard Test Method for Individual Geogrid Junction Strength

19. D7748 – Standard Test Method for Flexural Rigidity of Geogrids, Geotextiles and Related Products

C. U.S. Army Corps of Engineers (USACE): USACE Methodology for Measurement of Torsional Rigidity

D. Geosynthetic Research Institute (GRI) – GG9 Torsional Behavior of Bidirectional Geogrids when Subjected to In-Plane Rotation

E.

1.03 SUBMITTALS

A. The following shall be submitted a minimum of 7 calendar days prior to installation in accordance with SECTION 01 33 00 − SUBMITTAL PROCEDURES: Requirements for Submittals. The failure of the Contractor to obtain approval prior to installation shall be grounds for nonpayment.

1. Geocomposite Sample: The Contractor shall submit a 6-inch by 6-inch or larger sample of the geocomposite to the Engineer for approval.

2. Manufacturer's Certificate: The Contractor shall submit the manufacturer's certificate of compliance with the name of the manufacturer, product name, style number, and other relevant information to fully describe the geocomposite. The certificate should state that the composite meets the requirements of this section and shall be attested to by a person having legal authority to bind the composite manufacturer.

3. Manufacturer's Instructions: The Contractor shall submit installation instructions to the Engineer for review.

4. Shop Drawings: The Contractor shall submit typical details of the typical sections and connections.

1.04 QUALITY ASSURANCE

A. A minimum of 7 days prior to installation of the geocomposite, the Contractor shall provide, to the Engineer for approval, the samples, manufacturer's certificate and instructions, and shop drawings.

B. The Contractor will provide a description of the methods and procedures proposed for installation of the geocomposite as part of the Construction Work Plan in accordance with SECTION 01 33 00 − SUBMITTAL PROCEDURES and 35 33 00 − CONTAINMENT BERM.

1.05 DELIVERY, STORAGE, AND HANDLING

A. Delivery

1. The Contractor shall notify the Engineer a minimum of 24 hours prior to delivery and unloading of the geocomposite packaged in an opaque, waterproof, protective plastic wrapping.

2. The manufacturer's plastic wrapping shall not be removed until deployment. If quality-assurance samples are collected, immediately rewrap rolls with the plastic wrapping or equivalent as approved by the Engineer. Geotextile or plastic wrapping damaged during storage or handling shall be repaired or replaced, as directed, at no additional cost to the Agency.

3. The Contractor shall label each roll with the manufacturer's name, geotextile type, roll number, roll dimensions (length, width, and gross weight), and date manufactured.

B. Storage

4. The Contractor shall protect rolls of geocomposite from, but not limited to, construction equipment, chemicals, sparks, and flames; temperatures below minus 20°F or in excess of 160°F; or any environmental condition that may damage the physical properties of the geotextile.

5. Geocomposite should not be exposed to direct sunlight for time frames beyond those recommended by the manufacturer. Geocomposite exposed beyond such time frames shall be disposed of and replaced at no additional cost to the Agency and shall not allow the construction schedule to be extended.

6. The Contractor shall protect geocomposite from becoming saturated by elevating rolls off the ground or placing them on a sacrificial sheet of plastic in an area where water will not accumulate. If the geocomposite becomes saturated prior to installation, the Contractor shall remove the geotextile from the site and replace at no additional costs to the Agency.

C. Handling: Handle and unload geotextile rolls with load-carrying straps, a forklift with a stinger bar, or an axial bar assembly. Rolls shall not be dragged along the ground, lifted by one end, or dropped to the ground.

PART 2 - PRODUCTS

2.01 MATERIALS

A. The geocomposite system shall meet the following requirements:

1. Positive mechanical interlock with underlayer; contiguous sections of itself when overlapped and embedded in bedding stone or similar.

2. Sufficient cross-sectional profile to present a substantial abutment interface to particulate construction fill materials, such as bedding stone, and to resist movement relative to such materials.

3. Sufficient flexural rigidity to help maintain intimate contact of the geotextile with the underlying material when bedding stone, riprap, or armor stone is placed on top.

4. Sufficient true initial modulus to cause applied force to be transferred to the geogrid at low strain levels without material deformation of the reinforced structure.

5. Complete continuity of all properties throughout its structure and shall be suitable for use with bedding stone, riprap, and armor stone materials in coastal and waterway environments to improve the long-term stability of the coastal structure such as rubble mound breakwaters, jetties, and groins.

B. The geogrid part of the geocomposite shall meet the properties as outlined in Table 1. Where applicable, values represent minimum average roll values (MARVs) in accordance with ASTM D4759.

TABLE 1: GEOGRID PROPERTIES

Property	**Test Method**	**Unit**	**Value**
Aperture Size (nominal dimensions)	ASTM D4759	in	1.0 to 2.0
Minimum Rib Thickness (nominal dimensions)	ASTM D4759	in	0.06
Tensile Strength @ 2% Strain	ASTM D6637	lb/ft	450
True Initial Modulus in Use	ASTM D6637	lb/ft	1,575
Junction Efficiency	ASTM D7737	%	90
Flexural Stiffness	ASTM D7748	mg-cm	750,000
Ultraviolet Stability (Retained Strength @ 500 hours)	ASTM D4355	%	90

C. Geotextiles shall meet the requirements specified in Table 2. Where applicable, Table 2 property values represent MARVs in the weakest principal direction. Values for Apparent Opening Size represent maximum average roll values.

TABLE 2: GEOTEXTILE PROPERTIES

Property	Test Method	Unit	Minimum Test Value
Apparent Opening Size	ASTM D4751	US Sieve	100 (Maximum)
Permittivity	ASTM D4491	sec^{-1}	0.57
Puncture	ASTM D4833	lbs	75
Grab Tensile Strength	ASTM D4632	lbs	180
Trapezoidal Tear	ASTM D4533	lbs	50
Ultraviolet Degradation	ASTM D4355	% strength @ 500 hrs.	70
Weight	ASTM D5261	oz/sq. yd.	8
Burst Strength	ASTM D3787	lbs	290

PART 3 - EXECUTION

3.01 SUBGRADE PREPARATION

A. The Contractor shall ensure that the surface underlying the geocomposite is smooth and free of debris, ruts, or protrusions, which could damage the geotextile.

3.02 INSTALLATION

A. The Contractor shall notify the Engineer a minimum of 24 hours prior to installation of the geocomposite.

B. Geocomposite rolls that are damaged or contain imperfections shall be repaired or replaced as directed by the Engineer at no additional cost to the Agency.

C. The Contractor shall install the geocomposite as shown in the Construction Drawings. The width of the installed geocomposite will vary as the containment berm width varies due to changes in water bottom elevations.

D. The geocomposite shall be laid flat and smooth so that it is in direct contact with the subgrade. Correct orientation (roll direction) of the geocomposite shall be verified by the Contractor. The geocomposite may be temporarily secured with sandbags. The geotextile component of the geocomposite shall extend a minimum of 1 foot beyond the limits of the toe of the containment berm, as shown in the Construction Drawings.

E. Armor stone shall be placed atop the geocomposite as described in SECTION 35 33 00 − CONTAINMENT BERM in a manner that minimizes the wrinkles and/or movement of the composite and uniformly loads the structure and minimizes displacing the underlying foundation. The Contractor shall place rock in a manner that prevents material from entering the composite overlaps and prevents tensile stress from being mobilized in the composite and prevents wrinkles from folding over onto themselves.

3.03 SEAMS

A. The Contractor shall continuously overlap the geocomposite panels a minimum of 2 feet at all longitudinal and transverse joints.

3.04 PROTECTION AND REPAIRS

B. The Contractor shall protect the geocomposite during installation from tears and other damage. Damaged composite shall be repaired or replaced as directed by the Engineer at no additional cost to the Agency.

C. The Contractor shall repair torn or damaged geocomposite. The Contractor shall perform repairs by placing a patch of the same type of geocomposite over the damaged area. The patch shall extend a minimum of 2 feet beyond the edge of the damaged area. Patches shall be continuously fastened using the manufacturer's approved methods. The machine direction of the patch shall be aligned with the machine direction of the geocomposite being repaired. The Contractor shall remove and replace geocomposite which cannot be repaired. Repairs shall be performed at no additional expense to the Agency and shall not allow the construction schedule to be extended.

END OF SECTION 31 05 19

Memorandum

September 30, 2022

To: Sarah Garza, Harrison McNeil, and Yvonne Dives-Gomez, Port of Corpus Christi Authority

From: Todd Merendino, Ducks Unlimited, Inc.
John Laplante, Dan Opdyke, Renee Robertson, Alexander Freddo, and Hayden Smith, Anchor QEA, LLC
Jane Sarosdy, Sarosdy Consulting, Inc.
Ray Newby, Texas Department of Transportation

Re: Dagger Island 60% Design Memorandum

Introduction

This 60% design memorandum describes design criteria and assessments associated with a beneficial use of dredged material (BU) project at the proposed Dagger Island site (Site), located in Texas General Land Office (GLO) Planning Region 3 of the Texas coast in Redfish Bay in Ingleside, Texas (Figure 1). Photographs of the Site are in Attachment 1.

Project Background

GLO awarded a Coastal Management Program Project of Special Merit grant (funded through the Gulf of Mexico Energy Security Act) to Ducks Unlimited, Inc. (DU) to coordinate with stakeholders and identify restoration sites for BU. The Port of Corpus Christi Authority (PCCA), a project partner, has also contributed staff and financial resources to expand the project scope. The project team is led by DU and PCCA and includes Anchor QEA, LLC; Sarosdy Consulting, Inc.; and the Texas Department of Transportation. Collectively, the project team coordinated three stakeholder meetings with state and federal resource agencies, nongovernmental organizations, academia, consultants, and local officials in each region to solicit information about potential BU sites. Based on stakeholder input, GLO feedback, publicly available data, and professional judgment, the project team has developed 10% designs for 18 sites in GLO Planning Regions 3 and 4 of the Texas coast and 2 GLO-approved sites in Mesquite Bay and San Antonio Bay in GLO Planning Region 2. After completion of the 10% designs, 11 of the designs were selected to continue to 30% designs, and 7 of those designs were chosen for 60% designs and permit application packages. The project team selected the Site as one of the 7 sites for 60% design development, cost estimation, and permit application package development using funding from PCCA.

The existing Site is located in Redfish Bay, Aransas Pass, Nueces County, Texas, approximately 0.1 mile east of the Gulf Intracoastal Waterway (GIWW) and 0.4 mile north of the Corpus Christi Ship Channel (CCSC). The island is in GLO State Tract 352 Unit, pooling agreement 3171, which includes private lands, and is currently owned by Buckeye Partners, L.P. However, the BU project described in this memorandum is proposed to be on state-owned submerged land to the southwest of the island (GLO 2022). Creation of upland containment berms and placing dredged material fill adjacent to remnant landmasses to the southwest of the Site will convert open water to marsh and seagrass habitat and provide protection to seagrass in Redfish Bay. The Site was selected due to the erosion of the historical shoreline from hurricanes, storm surge, and wave energy caused by winds and large vessel traffic on the CCSC.

Project Objectives

Frequent dredging is needed to develop and maintain Texas navigation channels. The dredged material is often deposited in dredged material placement areas (DMPAs), and many of the existing DMPAs along the Texas coast are nearing capacity. Resource agencies and stakeholders have long advocated using dredged material beneficially to create and restore wetlands and bird islands, nourish beaches, and counteract land loss. Historically, BU projects are difficult to manage because they are multiyear, multifaceted undertakings in which different organizations manage dredging schedules, funding, project design, permitting, and construction activities. To help address these issues, the objectives of this project include the following:

- Create and restore degrading coastal habitats.
- Establish sites for disposal of dredged material to reduce reliance on existing DMPAs.
- Improve coastal resiliency of the natural and built environment.

To accomplish these objectives, the project includes the following tasks:

- Stakeholder outreach and coordination
- Identification and selection of BU sites
- 10% designs and cost estimates for 20 BU sites
- 30% designs and cost estimates for 11 BU sites
- 60% designs, cost estimates, and permit application packages for 7 BU sites

This memorandum documents the 60% design and cost estimate for the Site.

Design Objectives

The Site will be designed to beneficially use dredged material to restore natural washouts and eroded landmasses, thereby restoring marsh and seagrass habitat and protecting existing seagrass habitat in the region. The design will use material dredged from the CCSC during future deepening projects and routine maintenance, thus reducing the volume of such material placed in existing open-bay or upland DMPAs. This 60% design is based upon publicly available datasets, stakeholder recommendations, and focused field work instructed by PCCA and conducted by Triton Environmental Solutions, LLC (Triton).

Design objectives include the following:

- Develop a preliminary vision based on available data for the Site that includes the following:
  - Habitat to be created or restored
  - Potential sediment source(s)
  - Approaches to minimize long-term maintenance costs, while providing adequate erosion protection and containment
- Delineate conceptual footprints for proposed BU placement.
- Identify key sensitive habitats and construction considerations in the vicinity of the Site.
- Estimate fill volumes for the proposed BU footprints.
- Evaluate existing marsh conditions to inform marsh target elevations
- Restore habitat and protect existing island chain while maintaining recreational access to Redfish Cove
- Identify data gaps to be addressed in subsequent design phases.
- Provide preliminary cost estimates.

Stakeholder Feedback

The 30% design for the Site was presented at the Lower Coast Beneficial Use Planning Region 3 Stakeholder meeting on June 14, 2022. Attendees included staff from GLO, the U.S. Army Corps of Engineers (USACE), the Texas Parks and Wildlife Department (TPWD), the Coastal Bend Bays & Estuaries Program, the U.S. Fish and Wildlife Service (USFWS), local officials, and other professionals.

Some comments from this meeting, as well as written comments on the 30% designs, follow:

- USFWS suggested placing a breakwater southeast of the Site and seagrasses southeast of the islands to protect the islands from ship wake and wind-wave erosion.
  - The design team assesses that the addition of a breakwater may reduce erosion southeast of the Site; however, it would have effects on the local hydrodynamics of the Site and may cause accretion of sediment northwest of the breakwater. The possible addition of a breakwater will be determined during subsequent design phases under the direction of the Site proponent (yet to be determined).
- USFWS suggested targeting elevations of high marsh to adapt to relative sea level rise (RSLR).
  - The design team increased the target elevation of the Site to +3.0 feet North American Vertical Datum of 1988 (NAVD88; the upper end of high marsh) to address RSLR.

- National Marine Fisheries Services stated that an adaptive management plan should be created during final design to ensure there is no net loss of essential fish habitat due to the project.
  - The design team will consider development of an adaptive management plan during final design.
- The National Marine Fisheries Services recommended performing a submerged aquatic vegetation (SAV) survey during late summer (peak SAV season).
  - The design team agrees with this recommendation and concurs that any SAV surveys conducted prior to construction should target these survey windows.
- TPWD suggested evaluating the potential impacts of the new BU site located between the CCSC and project site that is being constructed as a part of the CCSC Channel Improvement Project.
  - During final design, potential impacts from the new BU site constructed as part of the CCSC Channel Improvement Project will be evaluated.
- TPWD recommended planting target marsh species with a minimum of 3-foot-centers to enhance recruitment. TPWD also suggested that planting with 1-foot centers would help discourage the establishment of nontarget species.
  - Evaluation of the density and types of vegetation will need to be coordinated during final design phases in coordination with the project proponent.

The comments above represent the key issues brought forward to the project team. Other comments, generally more minor and easily addressed, are not included in this list. When feasible, comments have been incorporated into the 60% design, as noted in the below sections, and others may be addressed in the final design.

Existing Data Review

A review of existing data and the focused data collected by Triton was performed to develop the Site and containment berm designs. This section describes the data reviewed and collected to support the 60% design.

Horizontal and Vertical Datums

The horizontal datum used for the Site is the Texas State Plane Zone 5, North American Datum of 1983, in U.S. survey feet. The primary vertical datum used for the Site design is NAVD88. The National Oceanic and Atmospheric Administration (NOAA) maintains an active tide gage, Enbridge, Ingleside Station 8775283 (Ingleside Station), 2.0 miles southwest of the Site. This station collects and records real-time tide information dating back to 2002. The Ingleside Station does not provide NAVD88 vertical datums, so the NOAA Online Vertical Datum Transformation tool was used to convert the mean lower low water (MLLW) vertical datums to NAVD88 (NOAA 2022a). The converted vertical datums from the Ingleside Station that will be used for the Site are shown in Table 1. The NOAA USS Lexington Station 8775283 (Lexington Station) was also used to define a preliminary design water level, as described in the Water Level section.

Table 1
Ingleside Station Tidal Datums

Tidal Datums	Elevation (feet MLLW)	Elevation (feet NAVD88)
MHHW	0.71	0.85
MHW	0.70	0.84
MSL	0.40	0.54
MLW	0.00	0.14
MLLW	0.00	0.14

MHHW: mean higher high water
MHW: mean high water
MLW: mean low water
Vertical uncertainty in NAVD88 estimates using NOAA (2022a): +/- 0.484 foot

Meteorological, Ocean, and Wave Data

Water Level

To determine an approximate design water level elevation for the Site, an existing water level analysis using data from the Lexington Station, which is 13 miles west of the Site, was used due to a lack of recent, continuous water level data from the adjacent Ingleside Station (Anchor QEA 2021). Data were compiled for the period from October 2015 to January 2021 and used to calculate a 90th-percentile water level of 2.0 feet NAVD88.

The MHHW from the 1983 to 2001 tidal epoch at the Lexington Station is 1.02 feet NAVD88, which is 0.17 foot higher than at the Ingleside Station. Due to this difference in the MHHW, water levels at the Lexington Station were considered a conservative estimate of the water levels that would be experienced at the Site.

Wind and Waves

USACE Wave Information Studies (WIS) provides a national resource of long-term wavefield climatologies for U.S. coastal waters that synthesizes observations, multidecade hindcasts, and storm event archives (USACE 2021). The WIS station closest to the Site is Station 73039, just offshore on the Gulf side of Port Aransas, Texas, in the Gulf of Mexico. Because the station is located offshore, the wave data are not applicable to the Site and were not used. However, the project team considers the wind data to be representative of the winds experienced at the Site. Figure 2 summarizes wind data from January 1, 1980, through December 31, 2014. The data indicate that the predominant wind direction is from the southeast, with significant winds also coming from the north, northeast, east, and south.

Wind and wave conditions for this phase of design were assumed to be the same as identified in the AECOM design report for the M10 site located approximately 2 miles southwest of the Site (AECOM 2020). The wind speed and direction values used for the analysis were taken from the Packery Channel NOAA Tidal Station No. 8775792 at 3-hour intervals from June 2008 to June 2018. A Coastal Modeling System 2D numerical wave (CMS-Wave) model was used to simulate wind-driven waves from 180° to 270° (south to west) direction winds. Waves were generated with wind speeds varying from 3 to 51 knots (1.5 to 26.2 meters per second). The design wave was chosen based on the maximum wave height produced by the CMS-Wave model (Table 2). The wind speed used to produce the maximum wave height is considered conservative for this analysis because it represents the 99.9th percentile of the wind speed recorded at WIS Station 73039. This design wave and associated design period were extracted from the M10 report and used in this 60% analysis as a conservative approach to understanding the wave climate potentially experienced at the Site (Table 2). However, a visual analysis of the wave field simulation in Figure 3 from AECOM (2020) indicates wave heights experienced at the Site are shorter than those at M10; therefore, the 2.69-foot wave height assumption is assessed to be conservative for 60% design and will be revisited during subsequent design phases.

Table 2
Assumed Wind and Wave Data from M10 Design

Datum	Value
Wind direction (degrees)	210
Wind speed (knots)	39
Wave height (feet)	2.687
Wave period (seconds)	3.63

Note:
Source: AECOM 2020

Wake Erosion

The GIWW is approximately 0.1 mile northwest of the Site, and the CCSC is approximately 0.7 mile south of the Site (Figure 1). Several types of vessels, including recreational and commercial vessels, commercial tugboats and barges, and very large crude carriers (VLCCs) operate in the GIWW and CCSC and generate wake waves that propagate to the Site. Like wind-generated waves, vessel-wake waves produce the greatest erosion in the region where the waves break (i.e., the surf zone). Most of the Site has natural protection from vessel wakes from the GIWW; however, there are a few locations along the southwestern edge of the Site that would be expected to receive direct impacts from vessel wakes generated in the GIWW.

The Bhowmik et al. (1991) and Weggel and Sorensen (1986) vessel-generated wave prediction methods—based on vessel dimensions, travel speed, and distance between the sailing line and Site—were used to evaluate the range of vessel-generated waves for a conservation selection of representative vessels known to operate in the area. A sport yacht with a draft of 4 feet was selected to evaluate recreational vessel wakes generated by vessels traveling near the proposed Site. A generic tugboat with maximum dimensions recorded in the Automatic Identification System (AIS) database was selected, along with a similar tugboat transiting with twin barges (identified using Google Earth imagery of ports in the region) to evaluate the commercial vessel wakes generated by vessels traveling in the GIWW. Calculation of the sport yacht's maximum vessel wakes, traveling at varying speeds along the nearest edge of the GIWW, 530 feet from the southwestern edge of the Site, can be seen in Table 3. Calculation of the tugboat and tugboat with twin barges maximum vessel wakes, traveling in 14 feet of water at varying speeds up to 11 miles per hour (mph; considered conservative) along the nearest edge of the GIWW, 530 feet from the southwestern edge of the Site, are shown in Table 4.

VLCC wake conditions from the CCSC for this phase of design were assumed to be similar to those identified in the AECOM design report for the SS1 site located approximately 3.5 miles east of the Site (AECOM 2020). SS1 is approximately 900 feet closer to the predicted sailing line of vessels transiting the CCSC than the Site is, and VLCC wakes calculated for SS1 did not exceed 1.26 feet. Therefore, vessel wakes experienced at the Site from VLCCs transiting the CCSC are expected to not exceed 1.26 feet.

These wave heights are smaller than the conservative design wave extracted from the M10 report (AECOM 2020), and wind-generated waves will be considered the predominant erosive force and used during design evaluations. The vessel wakes in Tables 3 and 4 are limited to vessels traveling the GIWW, and further analysis should be conducted to understand the frequency and distance additional recreational vessels travel near the Site. Additional analysis surrounding a variety of recreational vessel drafts and speeds may be considered during subsequent design phases.

Table 3
Sea Ray Sundancer Sport Yacht Maximum Vessel-Wake Calculations Transiting the GIWW at Various Speeds

Vessel	Length (feet)	Draft (feet)	Vessel Speed (mph)	Maximum Wave Height (feet)	Wave Period (seconds)
Sea Ray Sundancer sport yacht	51	4	6.7	1.04	1.28
			15	0.79	1.11
			25	0.66	1.02

			35	0.59	0.96
			45.4	0.54	0.92

Note:
Maximum wave heights were calculated using Bhowmik et al. (1991), where vessel speeds ranged from 6.7 to 45.4 mph.

Table 4
Tugboat and Tugboat with Twin Barges Maximum Vessel-Wake Calculations Transiting GIWW at Various Speeds

Vessel	Length (feet)	Beam (feet)	Draft (feet)	Vessel Speed (mph)	Maximum Wave Height (feet)	Wave Period (seconds)
Generic tugboat with maximum dimensions recorded in AIS data[1]	87	33	11	3	0.00	8.40
	87	33	11	5	0.00	5.04
	87	33	11	7	0.00	3.60
	87	33	11	9	0.00	2.80
	87	33	11	11	0.72	2.29
Generic tugboat with maximum dimensions recorded in AIS data and with twin barges[2]	387	110	11	3	0.00	7.31
	387	110	11	5	0.00	4.38
	387	110	11	7	0.00	3.13
	387	110	11	9	0.00	2.44
	387	110	11	11	0.00	2.29

Notes:
Maximum wave heights were calculated for vessels traveling within Froude number boundaries and at 3. 5, 7, 9, and 11 mph (Weggel and Sorensen 1986).

1. Vessel hull geometric coefficients were input using a tugboat from Hay (1967).
2. Vessel hull geometric coefficients were input using a barge from Hay (1967).

Bathymetry and Topography

Triton conducted a bathymetric and topographic survey at the Site in March and April 2022 (Triton 2022). The Site footprint consists of mostly open-water shallows with sand flats, low marsh, and high marsh upland habitat. The Site footprint has an average seabed elevation of 0.0 foot NAVD88, and contours range from -2.7 to +2.0 feet NAVD88. During the survey, Triton conducted sediment probing in 22 areas in the vicinity of the Site (Attachment 2, C01). Depths of refusal ranged from 0.75 to 10.17 feet, with an average depth of refusal of 5.57 feet. These probes were outside the footprint of the Site; however, they indicate there is a significant quantity of relative soft sediment within the vicinity of the Site.

Utilities and Infrastructure

The Railroad Commission of Texas public GIS viewer (RRC 2021) and GLO pipeline data (GLO 2021a) were used to identify mapped utilities near the Site. Two oil wells and four plugged oil and gas wells were also found in the Site vicinity (Attachment 2, C01). These utilities are submerged. It is anticipated that the plugged wells will not impact design or construction. However, the two active oil wells will be considered in design and construction, during which preliminary concepts are to design the Site armoring to have gaps with the appropriate right-of-way distance limits surrounding the wells. The need for Site-specific utility locations prior to construction will be determined during subsequent design phases.

A preliminary investigation was conducted for utilities identified within the Texas 811 database by submitting a ticket (No. 2270177728) for the proposed work. The following responses were received:

- AEP Texas: Electric
  - Response on July 20, 2022: clear
- Kinder Morgan, Inc.: gas and petroleum products
  - Response on July 22, 2022: clear
- Southcross Energy GP LLC: gas
  - Response on July 20, 2022: clear

Another two organizations with potential utilities in the area were identified, but no response to the ticket was received:

- Buckeye Partners, L.P.: petroleum products
- Agua Tranquillo: gas

This preliminary investigation is not sufficient to clear the Site for construction and excavation. Further investigation into underground and aboveground utilities must be conducted prior to construction of this project.

Desktop Cultural Resources Survey

A search of cultural resources records in the Texas Historical Commission Texas Historical Sites Atlas Database (THC 2021) was completed on December 21, 2021. This search revealed that no cultural sites have been identified within the preliminary proposed Site.

Sensitive Habitat

Triton habitat surveys indicate approximately 0.05 acre of live oysters in the northeast corner of the Site (Attachment 2, C01). Based on discussions with TPWD, oysters have been relocated at the Site for other projects. If allowed by TPWD and other regulatory agencies, the oysters could potentially be relocated 0.1 mile north, outside of the Site footprint prior to construction. Alternatively, a buffer between the Site and oyster habitat could be constructed based on regulatory agency feedback.

According to TPWD seagrass data (TPWD 2021), there are approximately 700 acres of seagrass mapped behind the Site west, southwest, and northwest in Redfish Cove and approximately

100 acres of seagrass mapped east and southeast of the Site. Triton habitat surveys indicate approximately 1.8 acres of sparse seagrass presence within the Site footprint.

Similar habitat surveys may need to be conducted during a subsequent phase of design to re-evaluate the presence and extents of sensitive habitat.

Erosion

Since 1956, the Site has lost more than 89 acres of land due to erosion from both natural and human causes (Silva 2021). The natural causes of shoreline erosion include the predominant southeast winds, storm events, and decades of sea level rise accompanied by subsidence. Direct human impacts contributing to the erosion include high-energy ship wakes caused by vessels traveling down the CCSC (Silva 2021). Wind-generated waves are expected to be larger than waves generated by vessels based on the analysis in the Wind and Waves and Wake Erosion sections and, therefore, are used to inform the Site design.

Beneficial Use Source Material

The proposed source material for the Site may consist of suitable material excavated from inside the Site (borrow area) and dredged material from the CCSC and GIWW, located adjacent to the Site. Sediment availability from material excavated from within the borrow area at different depths of excavation is shown in Table 5. The values shown in Table 5 assume all the material excavated within the borrow area is suitable for berm construction. If it is determined that the borrow area does not contain suitable fill or the necessary construction volume, suitable off-site material may be used to complete the containment berm construction. Based on coastal consistency determinations from USACE, USACE has historically performed maintenance dredging on the CCSC near the Site (USACE 1999). The identified USACE DMPAs adjacent to the Site and their average annual quantity of dredged material, distance from the Site to DMPA, and channel segments are shown in Table 6. With the ongoing widening and deepening of the CCSC, it is expected that the average annual dredging quantities will be higher in the future. The average grain size and grain type percentages are shown in Table 7.

Table 5
Borrow Area Sediment Volume Availability at Different Excavation Depths

Excavation Area	Excavation Elevation (feet NAVD88)	Volume (CY)[2]
Borrow area[1]	-1.28	25,000
	-2.28	50,000
	-3.28	76,000
	-4.28	101,000
	-5.28	126,000

Notes:

Volume availability was calculated geometrically using the bathymetric and topographic surveys collected by Triton in March and April 2022.

1. Volume availability was calculated inside the 50-foot buffer region, away from the interior toe of the berm, and depth values were assumed to start at the average seabed elevation of the seaward boundary of the borrow area at -0.28 foot NAVD88.
2. Value is rounded to the nearest 1,000 CY.

Table 6
USACE DMPA Areas Near the Site That Received Dredged Material

DMPA No.	Channel Segment (Station)	Distance from Site to DMPA (miles)	Average Annual Dredging Quantity (CY)
7	Inner Basin to La Quinta Junction (270+00-320+00)	2.4	35,000
8	Inner Basin to La Quinta Junction (320+00-400+00)	1.3	40,000
9	Inner Basin to La Quinta Junction (400+00-500+00)	0	51,000

Note:
Source: USACE 1999

Table 7
Typical Sediment Characteristics Between the Inner Basin and LaQuinta Junction

Sediment Characteristics Between the Inner Basin and La Quinta Junction[1]
D_{50} (mm) = 0.256
87.8% sand
6.6% silt
5.7% clay

Notes:
Source: USACE 1999
1. Refers to channel segments along the CCSC
D_{50}: median grain size

Another potential source of sediment is from the proposed CCSC Channel Deepening Project and the proposed La Quinta Channel Deepening. These projects could potentially provide a substantial portion of the material used at the Site; however, analysis of the expected sediment quantities and characteristics from the CCSC Channel Deepening Project and La Quinta Channel Deepening will need to be completed during a subsequent design phase.

Marsh Vegetation Elevation Ranges

Table 8 shows typical habitat ranges for relevant marsh vegetation based on Site vegetation surveys conducted by Triton. The range represents minimum and maximum values found during the survey, while the mode represents the most frequently occurring values during the survey. Mode was used as the most accurate representation of the conditions for the Site.

Table 8
Typical Elevations for Target Marsh Vegetation at the Site

Species	Elevation (feet MSL)		Elevation (feet NAVD88)	
	Range	Mode	Range	Mode
High marsh	0.66 to 3.86	1.26 to 1.96	1.2 to 4.4	1.8 to 2.5
Low marsh	-1.44 to 2.96	0.26 to 0.76	-0.9 to 3.5	0.8 to 1.3
Seagrass	-5.74 to 0.56	-3.34 to -1.04	-5.2 -to 1.1	-2.8 to -0.5
Smooth cordgrass	-1.84 to 1.16	-0.74 to -0.04	-1.3 to 1.7	-0.2 to 0.5
Sand flats	1.63 to 1.64	1.63 to 1.64	2.17 to 2.18	2.17 to 2.18
Uplands	1.96 to 5.56	1.96 to 5.56	2.5 to 6.1	2.5 to 6.1

60% Design

The main design elements evaluated for the Site are as follows:

- Site location
- Marsh size and shape
- Containment and erosion protection
- Constructability
- Planting and natural recruitment of vegetation
- Performance expectations
- Site construction cost estimates
- Expected ecosystem benefits
- Data and information gaps

These design elements are evaluated in this memorandum for the 60% Site design.

This project is planned to be constructed in two phases. Phase 1 will include the containment berm, while Phase 2 will be the placement of dredged material within the berm. The first phase is expected to be paid for and contracted by the project owner (e.g., a conservation organization with funding). Accordingly, for Phase 1, this memorandum includes 60% construction drawings (Attachment 2), which provide details for the containment berm construction, and technical specifications (Attachment 3). The second phase is expected to be paid for by the project owner but contracted by the entity funding the dredging itself (e.g., USACE). Because USACE (or another entity) will be directing the dredger, the entity will provide the dredger with its technical specifications and will work the beneficial use aspect of the dredging project into its drawings. As a result, it is not useful to prepare 60% construction drawings and technical specifications for Phase 2. Rather, a Dredged Material Management Plan (DMMP) that provides design details on the placement of dredged material for the interior of the Site was developed (Attachment 4). It is expected that USACE (or another entity) will incorporate the DMMP into the construction drawings and technical specifications it has with the dredger. This will ensure the BU design grades and project objectives are achieved.

Site Location

The Site is 0.4 mile north of the CCSC and 0.1 mile east of the GIWW and located between Redfish Cove and the CCSC. (Figure 1). A derelict oil and gas channel likely only used by recreational vessels is also located in the Site footprint (Attachment 2, C02). The existing DMPA #162 overlaps partially, but not completely, with the Site. This DMPA is permitted for open-bay placement, and dredged material could continue to be discharged outside the footprint of the Site. Initial communications with USACE staff have indicated they are not concerned about the Site inhibiting their future ability to discharge dredged material in the DMPA (Kinman 2022; Jones 2022). However, additional coordination with USACE will be necessary, and construction may require a real estate agreement.

The average elevation of the Site is -0.2 foot NAVD88 (-0.34 foot MLLW). Because of the shallow water depths, lightly loaded barges may be needed to access the Site. The Site design includes constructing containment berms between the existing islands and filling the open water areas with dredged material to create marsh (Attachment 2, C02). There are seagrasses in the southwest portion of the Site and sparse seagrasses in the northeast portion of the Site. The seagrasses present within the Site footprint are patchy and not contiguous. Bathymetric surveys may need to be conducted during subsequent design phases to better define Site dimensions and material needs.

Marsh Size and Shape

Based on availability of sediment, a cost analysis, and stakeholder feedback, the project team proposes that the area of the Site be approximately 33 acres and restore marsh and seagrass in open water areas of the Site. The Site will consist of fill extending to the edge of the existing vegetation or to the edge of the constructed containment berm described in Containment and Erosion Protection. Sediment will be placed within a range of elevations to create a variety of habitats. The fill elevations described in this section may be adjusted in further phases of design, depending on the physical properties of the dredged material and to target a variety of vegetation habitats.

The marsh restoration area is expected to be 28 acres and is being designed to support a range of low and high marsh habitat, from 1.5 feet NAVD88 to 3.5 feet NAVD88, with a target elevation of 3 feet NAVD88 (2.46 feet mean sea level [MSL]; Table 8)..

With preliminary input from stakeholders, the project team is also proposing a seagrass restoration area of approximately 5.3 acres. The seagrass restoration area average elevation is -4.0 feet NAVD88 in the western portion, and the average elevation is -3.0 feet NAVD88 in the eastern portion. The seagrass restoration area will be brought up to -0.5 foot NAVD88, which is in the suitable habitat range for seagrass (Table 8). This will need to be evaluated during subsequent design phases to minimize impacts on water quality and to avoid encroaching on recreational vessel access to Redfish Bay.

Evaluations on the impact of infrastructure within the footprint identified in Attachment 2 are ongoing, and the size and shape of the Site may need to be refined during subsequent design phases.

Fill material would likely be obtained from the CCSC (Table 6). It is predicted that the required fill volume for both the marsh and seagrass areas will be approximately 260,000 cubic yards (CY). This value assumes 1 foot of foundation compression for every 3 feet of fill and does not consider bulking. Based on sediment probing data from Triton in areas within the vicinity of the Site, there are relatively thick deposits of soft material that are compressible. This supports consideration of settlement as a key design consideration that will need to be further evaluated during final design. Based on the volumes in Table 6, multiple maintenance dredging events may be needed to fill the site to the proposed design elevations. However, if new work material becomes available, either through the CCSC Channel Deepening Project, the La Quinta Channel Deepening, or other new work projects, the site could possibly be filled during a single dredging event. Additional geotechnical data may be collected during a subsequent design phase to further evaluate the expected foundation compression and bulking of dredged material.

RSLR may impact the Site in the future. A strategy to address RSLR could be to place BU material to higher elevations in preparation for higher relative sea levels and tidal elevations associated with RSLR. The upper ranges of high marsh were included in the design to accommodate for RSLR impacts, while also creating valuable marsh habitat in the short term. The impacts of RSLR may be adapted to in the future through adaptive management strategies such as thin-layer placement of additional dredged material.

Containment and Erosion Protection

A 4,000-linear-foot berm will be designed to contain and protect the dredged materials and future marsh from edge erosion. Based on AECOM’s M10 wind and wave data in Table 2, the containment berm will likely require armoring or vegetation to protect the berm from erosion. As shown in

Attachment 2, the containment berm will be constructed predominately on the seaward side of the Site and along open gaps toward Redfish Cove and the banks of the derelict channel. Because the west side of the site appears to be sheltered from wind-waves and vessel wakes, a vegetated earthen containment berm is proposed along the eastern bank of the derelict channel. The armored containment berm will be constructed with a core composed of side casted material from the borrow area overlain with armor stone. The vegetated containment berm will be composed of side casted material from the borrow area, and will either be covered in a vegetated mat or will be planted during construction. The borrow area's available quantity of material from different excavation elevations are shown in Table 5. Use of the borrow area material for a containment berm core will need to be evaluated during subsequent design phases following collection of more geotechnical data.

The armored containment berm crest height and width were evaluated with a wave transmission analysis using the wave parameters from Table 2, an armor stone D_{50} of 1.1 feet based on the armor stone size selected in the M10 design report (AECOM 2020), and a water surface elevation of 2.0 feet NAVD88 based on the 90th-percentile water level. The transmitted wave heights through the armored containment berm were determined using the van der Meer and d'Angremond method, as outlined in USACE *Coastal Engineering Manual*, Table VI-5-15 (USACE 2006). Table 9 shows the results of the analysis for varied crest widths and crest heights of the armored containment berm. Based on the results of the analysis, a conservative 6-foot crest width with a +4.0-foot NAVD88 crest height was selected with a 3 horizontal to 1 vertical (3H:1V) seaward side slope and 2H:1V landward side slope that could potentially be reduced during subsequent design phases. The size of the armor stone and the final slope and cross-sectional dimensions of the armored berm will be further refined through modeling and analysis of the wind-wave hydrodynamics and sediment characteristics of the dredged material, the armored containment berm subgrade, and an analysis of initial capital construction costs versus maintenance costs during a subsequent phase of design. A summary of the armored containment berm geometry is in Table 10. The armored containment berm will provide protection to the Site from erosive forces from the CCSC and Redfish Cove. The locations and geometry of the armored containment berm will be confirmed based on discussions with regulatory agencies during final design.

The vegetated containment berm will have the same dimensions as the armored berm, except the landward slope will be 3H:1V to allow the side casted material to stack up to the +4.0 foot NAVD88 crest height. The final slope and cross-sectional dimensions of the vegetated containment berm will be further refined through modeling and analysis of the wind-wave hydrodynamics, derelict channel hydraulics, sediment characteristics of the dredged material, vegetated containment berm subgrade, and an analysis of initial capital construction costs versus maintenance costs during a subsequent phase of design. A summary of the vegetated containment berm geometry is in Table 10.

Table 9
Transmitted Wave Analysis

Crest Width(feet)	Crest Height (feet NAVD88)	Transmitted Wave Height (feet)
10	2.50	0.54
10	3.00	0.34
10	3.50	0.20
10	**4.00**	**0.20**
10	4.50	0.20
12	2.50	0.43
12	3.00	0.23
12	3.50	0.20
12	4.00	0.20
12	4.50	0.20
15	2.50	0.24
15	3.00	0.20
15	3.50	0.20
15	4.00	0.20
15	4.50	0.20

Notes:
Data is based on the van der Meer and d'Angremond method (USACE 2006)
The **bold** row shows the configuration selected for this design.
Parameters used for analysis are as follows:

1. D50 = 1.10 feet
2. Water surface elevation = 2.00 feet NAVD88
3. Bed elevation = -0.8 foot NAVD88
4. Wave height = 2.69 feet
5. Wave period = 3.63 seconds

Table 10
Phase 1 Containment Berm and Phase 2 Fill Design Characteristics

Phase 1: Containment Berm		
Containment Berm Design Criteria	**Armored Containment Berm**	**Vegetated Containment Berm**
Total project length	2,800 feet	1,200 feet
Total containment berm acreage	Approximately 2 acres	Approximately 1 acre
Crest width	6 feet	6 feet
Base width	Approximately 30 feet, depending on water depth	Approximately 30 feet, depending on water depth
Assumed bottom elevation	-0.7 feet NAVD88	0.0 feet NAVD88
Total structure height	4.7 feet	3.9 feet
Containment berm materials	Side casted material, geotextile fabric, and rock	Side casted material

Phase 1: Containment Berm		
Containment Berm Design Criteria	**Armored Containment Berm**	**Vegetated Containment Berm**
Containment berm side casted material volume	13,500CY	6,000 CY
Containment berm rock volume	10,500 CY	N/A
Estimated settlement[1]	1.6 feet	1.3 feet
Design side slopes (seaward side)	3H:1V	3H:1V
Design side slopes (landward side)	2H:1V	3H:1V
Maximum design crest elevation	+4 feet NAVD88	+4 feet NAVD88

Notes:
The final cross-sectional dimensions, slopes of the containment berm, and volume required for interior fill will need to be determined and refined, respectively, through modeling and analysis of the wind-wave hydrodynamics and sediment characteristics of the dredged material and containment berm subgrade during a subsequent phase of design.

1. Based on 1 foot of settlement for every 3 feet of fill

N/A: not applicable

Constructability

This section describes the proposed methods of construction. Actual methods will be dependent on the chosen contractor's equipment and Site conditions at the time of construction. In addition, the contractor may provide alternate construction methods from those described in this section.

The Site could be constructed in two different phases. Phase 1 would be constructed through a separate contract from Phase 2, which would likely be an addition to an existing dredging contract for new work or maintenance dredging of an adjacent navigation channel. Descriptions of the two phases follow.

Phase 1

Material from the borrow area will be mechanically excavated and side casted to construct the containment berms along the perimeter of the Site to the required design elevations and geometry. Prior to installing the 2.5-foot-thick armor layer on the armored berm, a geotextile fabric or jute cloth will be placed over the core material to prevent fines from passing through the armor stone. Once the vegetated berm is constructed, it will be either planted or have a vegetated mat laid over the vegetated berm to the desired vegetation density. Phase 1 construction may require light load transport of armor stone access channels and mobilizing equipment beyond what is required for dredging the CCSC (e.g., marsh buggies, a deck barge, and an excavator). Marsh buggies and deck-barged excavators may be used to shape the containment berm.

Phase 2

Phase 2 of construction will consist of placing fill inside the Phase 1 containment berm to design elevations. Phase 2 construction may require mobilizing equipment beyond what is required for dredging the CCSC (e.g., marsh buggies and a deck barge). Marsh buggies may be used to shape the fill to the required fill elevations.

Phase 2 of construction will also consist of placing fill inside of the derelict channel to create seagrass habitat. Dredged material can be placed during routine maintenance of the CCSC or GIWW for both the marsh and seagrass habitat construction.

Planting and Natural Recruitment of Vegetation

The decision to plant the marsh or to allow natural recruitment will be determined during subsequent design phases through collaboration with the project proponent (yet to be determined). For the vegetated berm, planting or placement of a vegetated mat over the berm will be conducted once the vegetated berm is constructed to improve berm resilience. Table 8 shows some of the targeted vegetation and their preferred habitat elevations. If the outcome is unsatisfactory (e.g., if the marsh and/or seagrass restoration area has a lower-than-desired density of vegetation or if undesirable species of vegetation are present), an adaptive management program can be instituted to directly plant, adjust Site elevations, remove undesirable species, etc. Performance metrics for satisfactory vegetation outcomes will be set by working with agencies during a subsequent phase of design. The decision to plant for a desired level of biodiversity or for a target species will ultimately come from collaboration between the project proponent, design team, and permitting agencies during subsequent design phases.

Performance Expectations

The performance goal for the project is to create approximately 28 acres of sustainable high and low marsh, as well as 5.3 acres of seagrass habitat. The designed berms are expected to contain placement of dredged material, be resilient to typical storm events, and provide protection for the interior habitat.

The project is also expected to close or restrict open-water breaches, which are passing wave energy and allowing erosion to occur in the seagrass beds behind the Site. Reducing open-water habitat and restoring the Site will help protect and enhance existing seagrass habitat.

Oysters are expected to colonize armored portions of the containment berm due to the presence of oysters along the north side of the Site.

Site Construction Cost Estimates

Preliminary construction costs were estimated for the design outlined in the previous sections. The estimated costs also include the indirect construction costs (i.e., permitting, 100% engineering and design costs, construction management, and postconstruction management such as site visits and dewatering management). These costs represent the estimated incremental costs (i.e., costs over and above USACE's least-costly and environmentally acceptable dredged material and disposal alternative). Because the Site is close to sediment sources, it should allow for lower construction costs compared to more remote potential marsh restoration sites. Table 11 shows a line-item list of each costing parameter and the total cost estimated for construction.

The costs range from $3.8 million to $8.3 million, depending on the level of uncertainty allocated to the project cost. The lower bound of uncertainty (-30%) and upper bound of uncertainty (+50%) were selected due to the existing data gaps, high levels of inflation, and rising fuel costs. Cost savings may be realized by further analysis and modeling of wind and wave conditions during subsequent design phases and refining the level of armoring. An evaluation of the initial capital construction versus projected maintenance costs could be conducted to determine an optimum armoring design that allows for satisfactory protection of the interior marsh, while being within the project budget. The estimates are developed using current and generally accepted engineering cost estimating methods and are based on assumptions concerning future events. Actual costs may be affected by known and unknown risks including, but not limited to, changes in general economic business conditions, Site conditions that were unknown at the time the estimates were performed, future changes in Site conditions, regulatory or enforcement policy changes, and delays in performance. Actual costs may vary from these estimates.

Table 11
Opinion of Probable Construction Cost to 100% Project Completion

Item	Quantity	Unit	Unit Price	Total
Direct Construction Costs				
Phase 1: Containment Berm Construction				
Mobilization and Demobilization[1,2]	1	%	10	$ 200,000.00
Preconstruction Survey	1	LS	$ 30,000.00	$ 30,000.00
Side Casted Armored Berm Core[2,3]	2,800	LF	$ 90.00	$ 250,000.00
Armor Stone[4]	20,000	tons	$ 90.00	$ 1,800,000.00
Side Casted Vegetated Berm	1,200	LF	$ 90.00	$ 110,000.00
Planting Vegetated Berm[5]	1	Acres	$100,000.00	$ 100,000.00
As-Built Survey	1	LS	$ 50,000.00	$ 50,000.00
Navigational Aids[2]	4	Each	$ 4,000.00	$ 20,000.00
Phase 1 Subtotal[4]			**Sum**	**$ 2,600,000.00**
Phase 2: Interior Fill and Seagrass Mitigation Placement				
Incremental Mobilization and Demobilization[1,6]	1	%	10	$ 170,000.00
Preconstruction Survey	1	LS	$ 50,000.00	$ 50,000.00
Incremental Dredging Interior Placement[4]	260,000	CY	$ 6.00	$ 1,600,000.00
As-Built Survey	1	LS	$ 80,000.00	$ 80,000.00
Phase 2 Subtotal[4]			**Sum**	**$ 1,900,000.00**

Item	Quantity	Unit	Unit Price	Total
Direct Construction Total[4]			**Sum**	**$ 4,500,000.00**
Indirect Construction Costs				
100% Engineering and Design	1	LS	$500,000.00	$ 500,000.00
Permitting	1	Each	$150,000.00	$ 150,000.00
Construction Management	1	LS	$200,000.00	$ 200,000.00
Postconstruction Management[7]	12	Month	$ 10,000.00	$ 120,000.00
Indirect Construction Subtotal[4]			**Sum**	**$ 1,000,000.00**
Project Subtotal[4]			**Sum**	**$ 5,500,000.00**
-30% Uncertainty[4]	1	%	30	$ 1,700,000.00
+50% Uncertainty[4]	1	%	50	$ 2,800,000.00
Low-End Total Project Estimated Cost[4]			**Total Sum**	**$3,800,000.00**
High-End Total Project Estimated Cost[4]			**Total Sum**	**$8,300,000.00**

Notes:
Costs were determined based upon a combination of publicly available datasets and sediment surface grabs, and topographic, bathymetric, and visual habitat surveys.

1. Cost is based upon mobilizing equipment beyond what is required for dredging the GIWW (e.g., marsh buggies)
2. Value is rounded to the nearest $10,000.
3. Cost includes side casting existing water bottoms and shaping of the containment berm.
4. Value is rounded to the nearest $100,000.
5. Cost is based on planting *Spartina patens* and *Spartina alterniflora* at 1.5-foot centers and $5 per plant unit.
6. Cost is based on incremental cost of diverting dredging equipment from GIWW to excavation areas.
7. Postconstruction management may include Site visits to observe the material consolidation, vegetation, and water levels on the Site. Monthly aerials may be performed. Additional postconstruction management practices may be considered during subsequent phases of design.

LF: linear foot
LS: lump sum

Expected Ecosystem Benefits

Creation of the Site is expected to have a net positive benefit on the regional ecosystem. The marsh restoration is expected to add approximately 28 acres of mostly marsh habitat to the regional ecosystem. The containment berm created at the Site will also provide resiliency to sections of islands near the Site and increase foraging habitat for birds.

Due to the location of the proposed relocated oyster habitat adjacent to the Site, it is expected that the rock containment berm will be colonized by oysters. This will increase the existing oyster habitat in the regional ecosystem.

The Site is planned to create 5.3 acres of seagrass habitat by bringing sections of the derelict channel running through the Site up to elevations conducive to seagrass colonization. The marsh and containment berm will also serve as a protective barrier to high-energy waves and currents for the seagrass habitat currently within Redfish Bay.

The mean RSLR trend averaged between Rockport and Corpus Christi is 5.74 mm per year (NOAA 2022b). Assuming no changes in the mean RSLR trend and no erosion, as well as not considering inorganic and organic accretion, the marsh within the target elevation of the Site (3.0 feet NAVD88) would remain above the 90th-percentile water level until 2076.

Data and Information Gaps

At this phase of design, the following data and information gaps have been identified:

- Coordination with USACE will be necessary, given that the Site is partially within a DMPA. For USACE staff to support the Site, it should avoid limiting their future placement of material, either by making it more costly to place material in their DMPAs, decreasing the capacity of their DMPAs, or by creating habitat for sensitive species that could inhibit future placement of material. Initial communications with USACE staff have indicated they are not concerned about the Site inhibiting their future ability to discharge dredged material in the DMPA (Kinman 2022; Jones 2022). However, additional coordination with USACE will be necessary, and construction may require a real estate agreement.
- Based on stakeholder feedback, an offshore breakwater south of the Site to protect existing seagrasses in Corpus Christi Bay may be evaluated during subsequent design phases. Such a breakwater may lessen wave energy at the Site and reduce the need for armoring. However, this breakwater could also promote accretion over the seagrasses.
- Site-specific wind-generated and vessel wake wave heights, which would inform the optimization of site armor design, should be determined.
- Geotechnical characteristics of the source material (maintenance and new work material) and subgrade of the placement area to refine evaluations of containment structure stability, subgrade and source material settlement, and short- and long-term capacity for dredged material placement, should be identified.
- Survey information such as property lines, utility locations, and supplemental bathymetry, where appropriate, should be refined.
- Information should be gathered regarding the USACE BU site currently being constructed between the Site and the CCSC and may impact the wave environment at the Site.

These data gaps may need to be addressed during the progression from 60% design to final design. For example, supplemental data collection and modeling would allow for optimizing the project design to reduce construction costs. It is expected that the cost of addressing these information gaps would be offset by the cost savings that would be realized by optimizing the project design. Because the 60% design has been prepared without such data, conservative assumptions (e.g., regarding armoring) have been used, increasing the estimated construction cost. This current project is taking the analyses as far as practicable, considering the constraints of the project scope, budget, and schedule.

Future Work

No fatal flaw has been identified at this phase of the design.

Discussions with infrastructure owners within the Site footprint are ongoing and may affect the Site footprint and design during subsequent design phases. The presence of seagrass and live oysters inside of the Site footprint and seagrasses immediately adjacent to the Site pose potential fatal flaws. Potential impacts to seagrasses and oysters should be further evaluated and clearly communicated to resource agencies and stakeholders in the region. Verbal and written approval confirming understanding of likely habitat impacts and proposed offsets should be received before the Site proceeds toward later design phases.

Should the Site be selected for additional design efforts, it can be expected that some aspects of the design in this memorandum will be modified and, as appropriate, enhanced.

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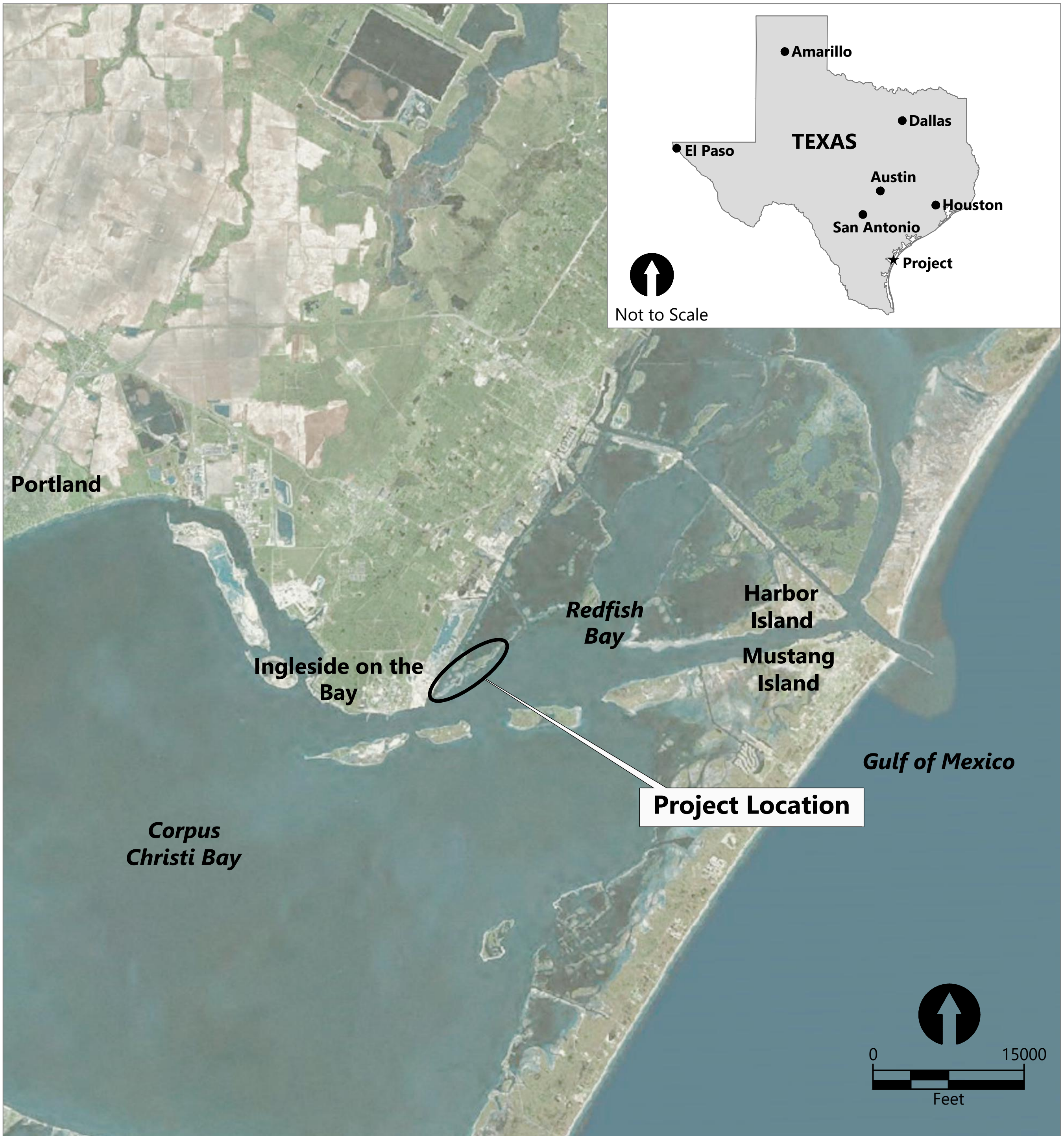
Figures



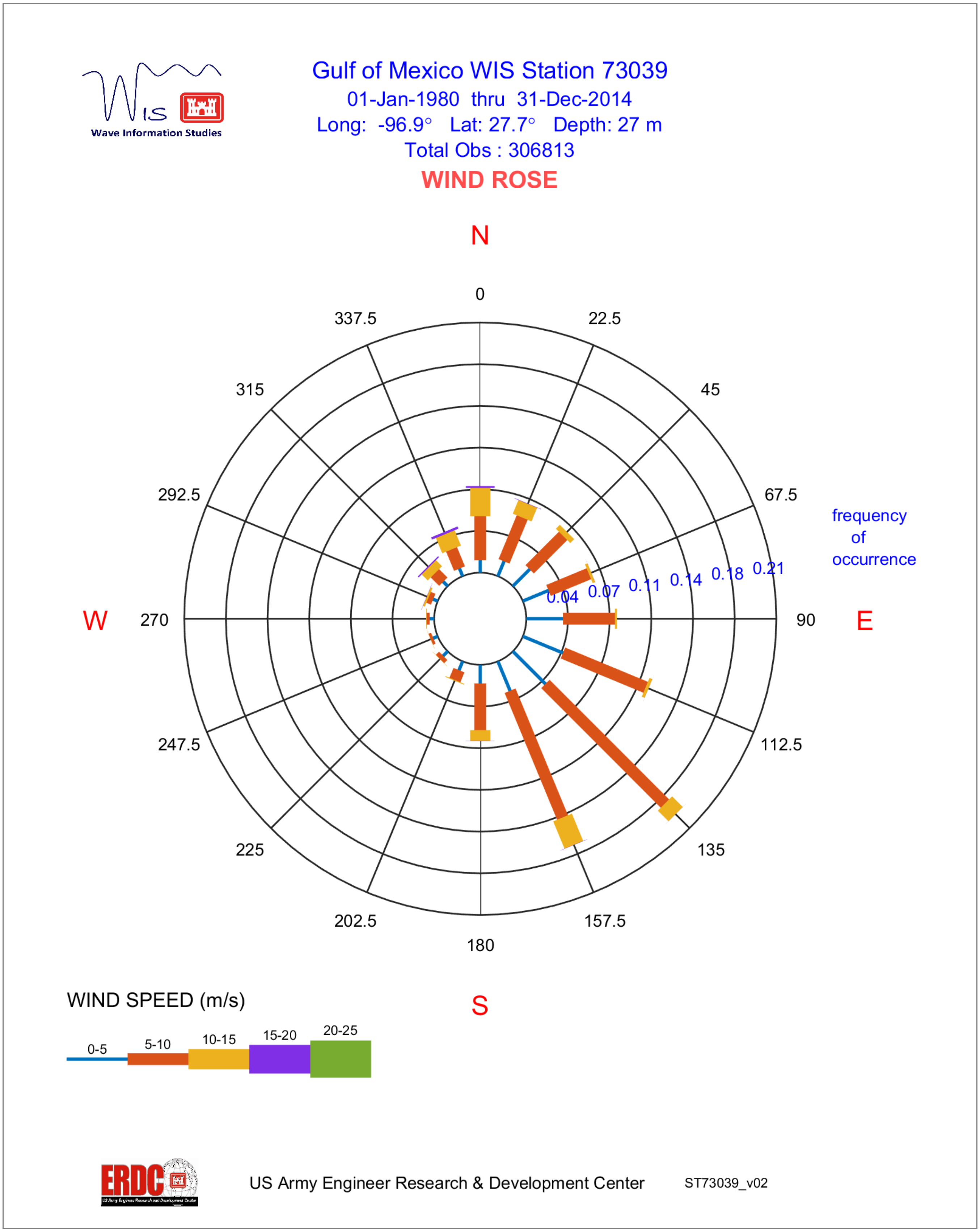
SOURCE: Aerial provided by Bing Maps.
HORIZONTAL DATUM: Texas State Plane South Zone, North American Datum of 1983, U.S. Survey Feet

Publish Date: 2022/09/14 3:42 PM | User: mpratschner
Filepath: K:\Projects\2018-PCCA Beneficial Use\DAGGER ISLAND\2018 RP-001 VIC MAP.dwg Figure 1 DMMP

ANCHOR QEA

Figure 1
Vicinity Map

Dagger Island 60% Design Memorandum
Texas Lower Coast Beneficial Use



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ANCHOR QEA

Figure 2
Historical Wind Data for USACE WIS Station 73039
Dagger Island 60% Design Memorandum
Texas Lower Coast Beneficial Use

Attachment 1
Site Photographs

Representative photographs of live oysters within the aquatic survey area (Source: Triton, 2022)

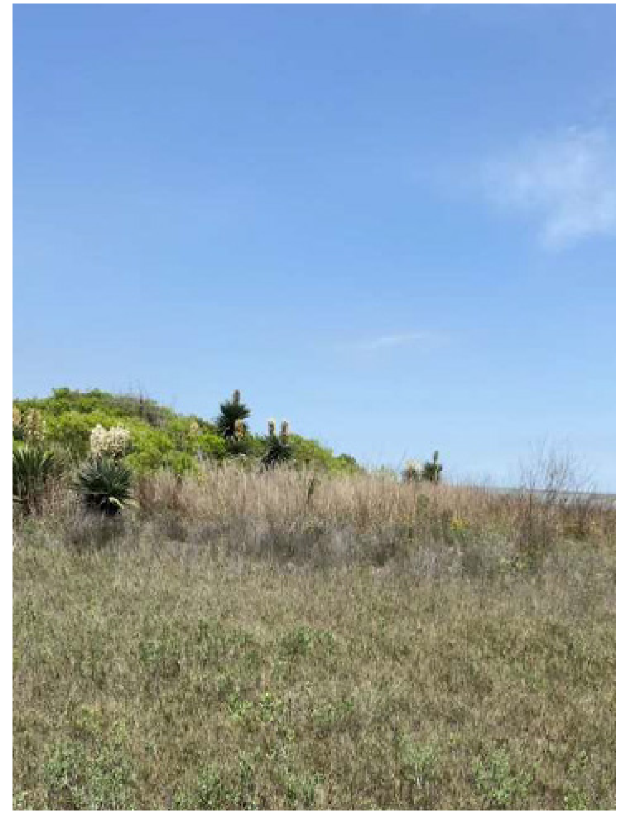

Representative photographs of survey area (Source: Triton, 2022)

Representative photograph of mangrove and smooth cordgrass within survey area (Source: Triton, 2022)

Representative photograph of mangrove marsh within survey area (Source: Triton, 2022)

Representative photograph of sand flat within survey area (Source: Triton, 2022)

Representative photographs of estuarine marsh within survey area (Source: Triton, 2022)



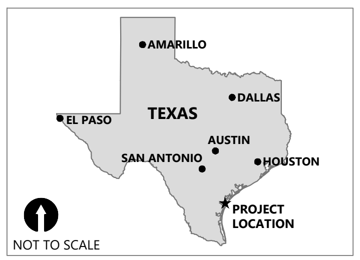
Representative photograph of uplands within survey area (Source: Triton, 2022)

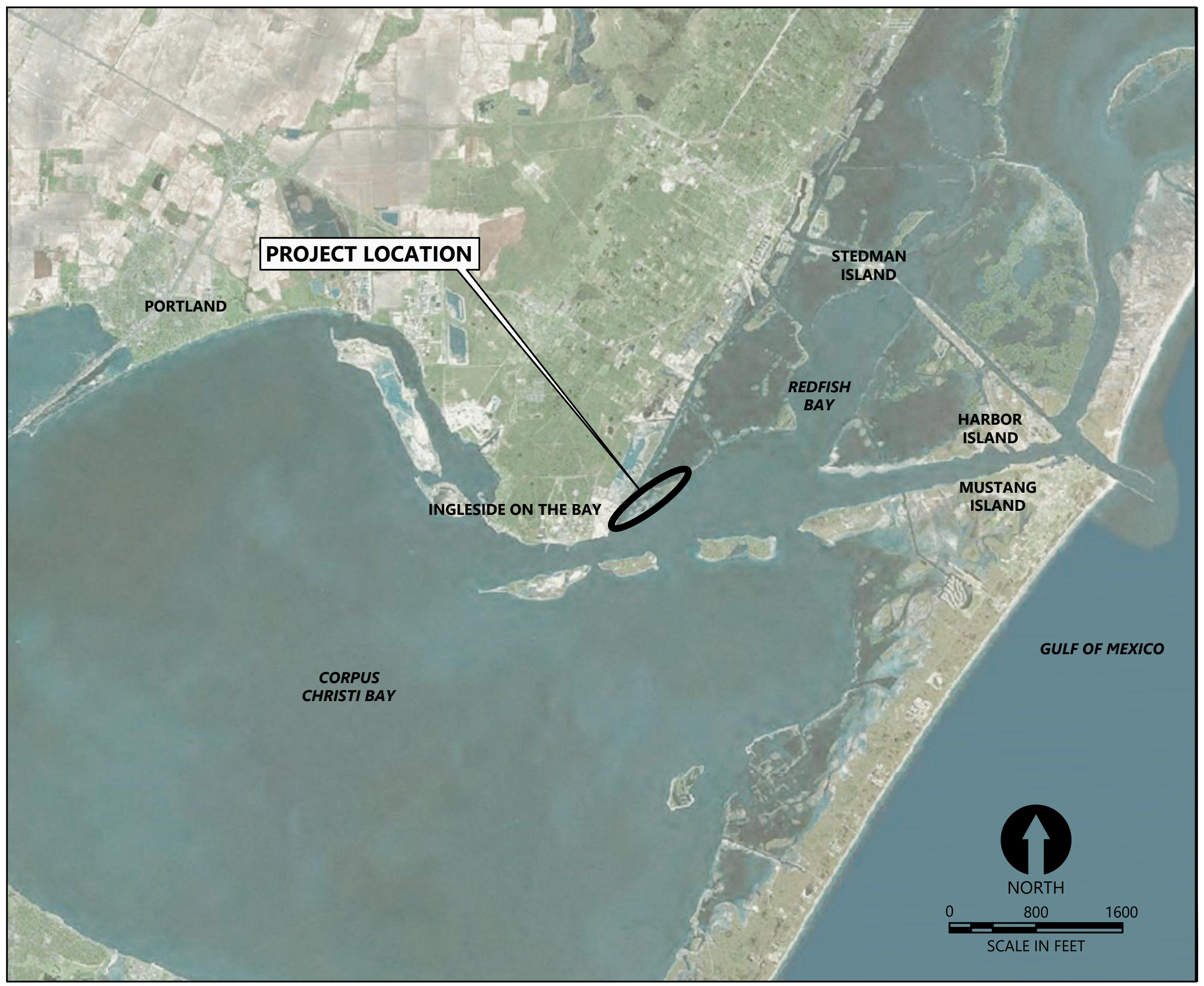
Attachment 2
Construction Drawings

60% DESIGN SUBMITTAL

TEXAS LOWER COAST BENEFICIAL USE - DAGGER ISLAND

PORT OF CORPUS CHRISTI AUTHORITY





AERIAL BY BING MAPS

DRAWING INDEX		
SHEET	DRAWING	TITLE
1	T01	TITLE SHEET
2	G01	GENERAL NOTES AND ABBREVIATIONS
3	C01	SITE OVERVIEW
4	C02	PLAN VIEW
5	C03	BORROW AREAS
6	C04	TYPICAL ARMORED CONTAINMENT BERM SECTION
7	C05	TYPICAL VEGETATED CONTAINMENT BERM SECTION

NOTES:

1. HORIZONTAL DATUM: TEXAS STATE PLANE SOUTH CENTRAL ZONE, NAD83, U.S. SURVEY FEET
2. VERTICAL DATUM: NORTH AMERICAN VERTICAL DATUM OF 1988 (NAVD88)
3. BATHYMETRIC AND TOPOGRAPHIC SURVEYS CONDUCTED BY TRITON ENVIRONMENTAL SOLUTIONS, LLC, ON MARCH 18 AND MARCH 21, 2022.
4. HABITAT SURVEY CONDUCTED BY TRITON ENVIRONMENTAL SOLUTIONS, LLC, ON MARCH 18 AND MARCH 21, 2022.

PLAN INTENDED TO BE VIEWED IN COLOR. ADJACENT BLOCK IS "BLUE"

ONE INCH

AT FULL SIZE, IF NOT ONE INCH SCALE ACCORDINGLY

DRAFT-NOT FOR CONSTRUCTION

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Sep 15, 2022 11:06am mpratschner

ANCHOR QEA

TEXAS GENERAL LAND OFFICE ESTABLISHED 1836

PORT CORPUS CHRISTI

REVISIONS				
REV	DATE	BY	APP'D	DESCRIPTION

DESIGNED BY: A. FREDDO
DRAWN BY: M. PRATSCHNER
CHECKED BY: R. ROBERTSON
APPROVED BY: J. LAPLANTE
SCALE: AS NOTED
DATE: SEPTEMBER 2022

TEXAS LOWER COAST BENEFICIAL USE - DAGGER ISLAND

TITLE SHEET

T01

SHEET # 1 OF 7

GENERAL NOTES

1. THE CONTRACTOR SHALL COMPLY WITH ALL REQUIREMENTS OF THE DRAWINGS, SPECIFICATIONS, PERMITS, AND ALL APPLICABLE REGULATIONS AND ORDINANCES.
2. IN THE EVENT OF A CONFLICT BETWEEN THE SPECIFICATIONS AND THE DRAWINGS, THE DRAWINGS SHALL GOVERN.
3. BATHYMETRIC AND TOPOGRAPHIC SURVEYS CONDUCTED BY TRITON ENVIRONMENTAL SOLUTIONS, LLC, ON MARCH 18 AND MARCH 21, 2022.
4. HABITAT SURVEY CONDUCTED BY TRITON ENVIRONMENTAL SOLUTIONS, LLC, ON MARCH 18 AND MARCH 21, 2022.
5. AERIAL IMAGE ©2022 MICROSOFT BING, MICROSOFT CORPORATION EARTHSTAR GEOGRAPHICS.
6. GEOTECHNICAL AND ENGINEERING DATA PROVIDED ARE FOR REPRESENTATIVE PURPOSES. THE CONTRACTOR SHALL FIELD VERIFY CONDITIONS AND/OR COLLECT ANY ADDITIONAL DATA, AS IT DEEMS NECESSARY.
7. THE CONTRACTOR SHALL FIELD VERIFY ALL FIELD BASELINE CONDITIONS, AS WELL AS ALL LOCATIONS AND DIMENSIONS.
8. THE CONTRACTOR SHALL LOCATE AND FIELD VERIFY ALL ABOVEGROUND AND BELOWGROUND UTILITIES BEFORE BEGINNING WORK.
9. THE CONTRACTOR SHALL BE RESPONSIBLE FOR DAMAGE TO BOTH ON- AND OFF-SITE FACILITIES CAUSED BY ITS ACTIVITIES DURING PERFORMANCE OF THE WORK. THE CONTRACTOR SHALL RESTORE ALL SUCH DAMAGES TO THEIR PRECONSTRUCTION CONDITION AT NO COST TO THE OWNER.
10. THE CONTRACTOR SHALL AT ALL TIMES KEEP ITS CONSTRUCTION AREAS FREE FROM ACCUMULATIONS OF WASTE MATERIALS OR RUBBISH AND, PRIOR TO COMPLETION OF THE WORK, REMOVE ANY RUBBISH FROM THE PREMISES, AS WELL AS ALL TOOLS, EQUIPMENT, AND MATERIALS THAT ARE NOT THE PROPERTY OF THE OWNER.

PERMITS AND PERMIT CONDITIONS

1. THE CONTRACTOR SHALL COMPLY WITH ALL PERMIT CONDITIONS.
2. THE CONTRACTOR SHALL BE RESPONSIBLE FOR OBTAINING ANY ADDITIONAL PERMITS THAT MAY BE REQUIRED FOR THE CONDUCT OF THIS WORK. COSTS OF OBTAINING PERMITS NOT SUPPLIED BY THE OWNER SHALL BE BORNE BY THE CONTRACTOR.

HORIZONTAL DATUM

TEXAS STATE PLANE SOUTH CENTRAL ZONE, NAD83, U.S. SURVEY FEET

VERTICAL DATUM

NORTH AMERICAN VERTICAL DATUM OF 1988 (NAVD88)

ABBREVIATIONS

CP	CONTROL POINT
E	EASTING
EL.	ELEVATION
MIN.	MINIMUM
MLLW	MEAN LOWER LOW WATER
N	NORTHING

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ONE INCH

AT FULL SIZE, IF NOT ONE INCH SCALE ACCORDINGLY

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PORT CORPUS CHRISTI

REVISIONS

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DRAWN BY: M. PRATSCHNER
CHECKED BY: R. ROBERTSON
APPROVED BY: J. LAPLANTE
SCALE: AS NOTED
DATE: SEPTEMBER 2022

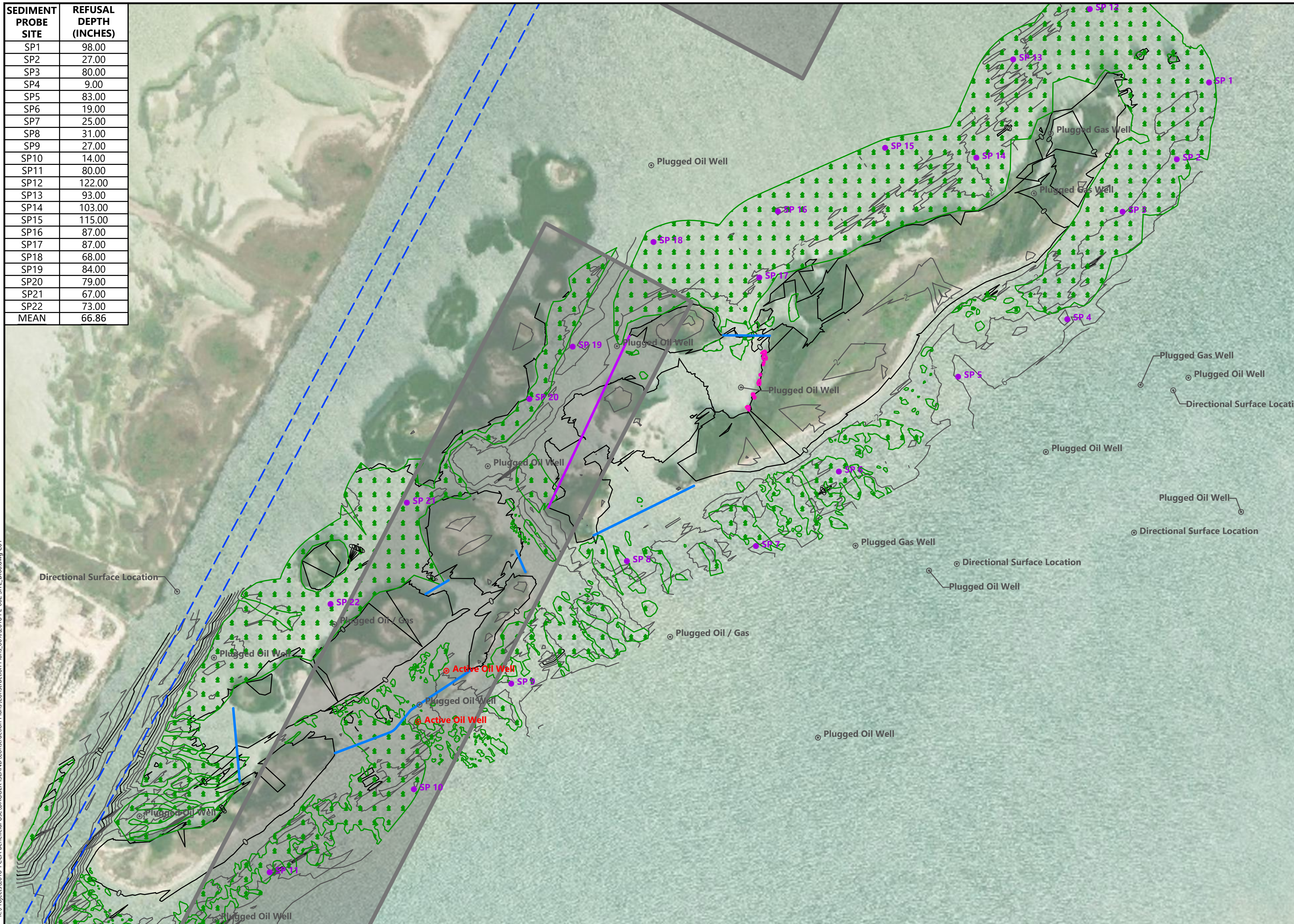
TEXAS LOWER COAST BENEFICIAL USE - DAGGER ISLAND

GENERAL NOTES AND ABBREVIATIONS

G01

SHEET # 2 OF 7

SEDIMENT PROBE SITE	REFUSAL DEPTH (INCHES)
SP1	98.00
SP2	27.00
SP3	80.00
SP4	9.00
SP5	83.00
SP6	19.00
SP7	25.00
SP8	31.00
SP9	27.00
SP10	14.00
SP11	80.00
SP12	122.00
SP13	93.00
SP14	103.00
SP15	115.00
SP16	87.00
SP17	87.00
SP18	68.00
SP19	84.00
SP20	79.00
SP21	67.00
SP22	73.00
MEAN	66.86



LEGEND:

- PROPOSED ARMORED CONTAINMENT BERM
- PROPOSED VEGETATED CONTAINMENT BERM
- U.S. ARMY CORPS OF ENGINEERS OPEN WATER DREDGED MATERIAL PLACEMENT AREA
- RAILROAD COMMISSION OF TEXAS MAPPED OIL AND GAS INFRASTRUCTURE LOCATIONS
- ACTIVE OIL WELL
- GULF INTRACOASTAL WATERWAY
- —0— EXISTING CONTOUR (10')
- —2— EXISTING CONTOUR (2')
- SP# SEDIMENT PROBE LOCATION
- SEAGRASS MAPPED BY TRITON ENVIRONMENTAL SOLUTIONS, LLC
- OYSTER HABITAT MAPPED BY TRITON ENVIRONMENTAL SOLUTIONS, LLC

NORTH

0 300 600

SCALE IN FEET

NOTES:

1. HORIZONTAL DATUM: TEXAS STATE PLANE SOUTH CENTRAL ZONE, NAD83, U.S. SURVEY FEET
2. VERTICAL DATUM: NORTH AMERICAN VERTICAL DATUM OF 1988 (NAVD88)
3. BATHYMETRIC AND TOPOGRAPHIC SURVEYS CONDUCTED BY TRITON ENVIRONMENTAL SOLUTIONS, LLC, ON MARCH 18 AND MARCH 21, 2022.
4. HABITAT SURVEY CONDUCTED BY TRITON ENVIRONMENTAL SOLUTIONS, LLC, ON MARCH 18 AND MARCH 21, 2022.

PLAN INTENDED TO BE VIEWED IN COLOR. ADJACENT BLOCK IS "BLUE"

ONE INCH

AT FULL SIZE, IF NOT ONE INCH SCALE ACCORDINGLY

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DATE: SEPTEMBER 2022

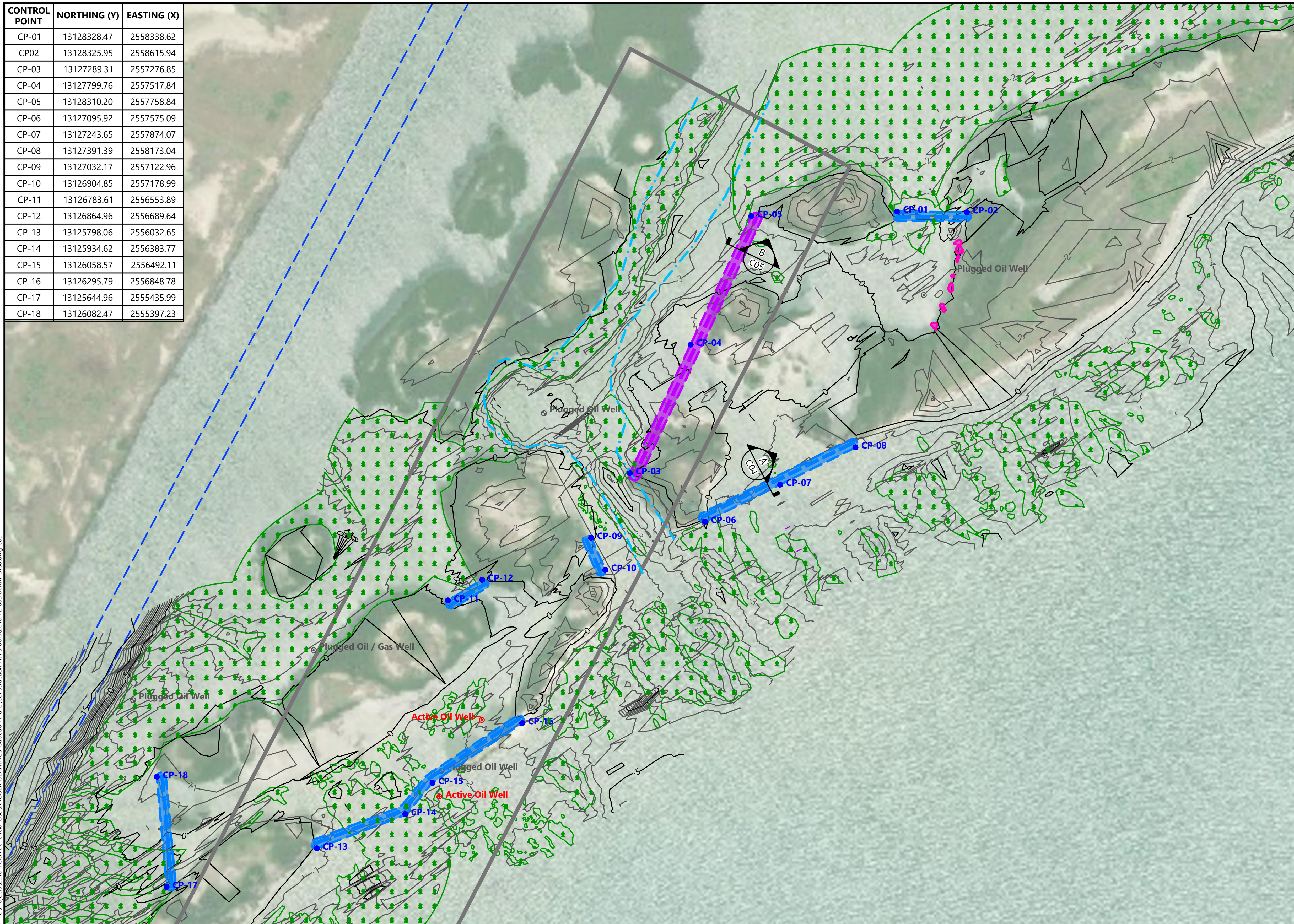
TEXAS LOWER COAST BENEFICIAL USE - DAGGER ISLAND

SITE OVERVIEW

C01

SHEET # 3 OF 7

CONTROL POINT	NORTHING (Y)	EASTING (X)
CP-01	13128328.47	2558338.62
CP02	13128325.95	2558615.94
CP-03	13127289.31	2557276.85
CP-04	13127799.76	2557517.84
CP-05	13128310.20	2557758.84
CP-06	13127095.92	2557575.09
CP-07	13127243.65	2557874.07
CP-08	13127391.39	2558173.04
CP-09	13127032.17	2557122.96
CP-10	13126904.85	2557178.99
CP-11	13126783.61	2556553.89
CP-12	13126864.96	2556689.64
CP-13	13125798.06	2556032.65
CP-14	13125934.62	2556383.77
CP-15	13126058.57	2556492.11
CP-16	13126295.79	2556848.78
CP-17	13125644.96	2555435.99
CP-18	13126082.47	2555397.23



LEGEND:

- PROPOSED ARMORED CONTAINMENT BERM
- PROPOSED VEGETATED CONTAINMENT BERM
- CP-## CONTROL POINT
- U.S. ARMY CORPS OF ENGINEERS OPEN WATER DREDGED MATERIAL PLACEMENT AREA
- GULF INTRACOASTAL WATERWAY
- SEAGRASS MAPPED BY TRITON ENVIRONMENTAL SOLUTIONS, LLC
- OYSTER HABITAT MAPPED BY TRITON ENVIRONMENTAL SOLUTIONS, LLC
- 0 EXISTING CONTOUR (5')
- 2 EXISTING CONTOUR (1')
- DERELICT CHANNEL
- RAILROAD COMMISSION OF TEXAS MAPPED OIL AND GAS INFRASTRUCTURE LOCATIONS
- ACTIVE OIL WELL

NORTH

0 200 400

SCALE IN FEET

NOTES:

1. HORIZONTAL DATUM: TEXAS STATE PLANE SOUTH CENTRAL ZONE, NAD83, U.S. SURVEY FEET
2. VERTICAL DATUM: NORTH AMERICAN VERTICAL DATUM OF 1988 (NAVD88)
3. BATHYMETRIC AND TOPOGRAPHIC SURVEYS CONDUCTED BY TRITON ENVIRONMENTAL SOLUTIONS, LLC, ON MARCH 18 AND MARCH 21, 2022.
4. HABITAT SURVEY CONDUCTED BY TRITON ENVIRONMENTAL SOLUTIONS, LLC, ON MARCH 18 AND MARCH 21, 2022.
5. NAVIGATION AIDS MUST BE PLACED ALONG THE CONTAINMENT BERM IN ACCORDANCE WITH TECHNICAL SPECIFICATIONS SECTION 35 12 10

PLAN INTENDED TO BE VIEWED IN COLOR. ADJACENT BLOCK IS "BLUE"

ONE INCH AT FULL SIZE, IF NOT ONE INCH SCALE ACCORDINGLY

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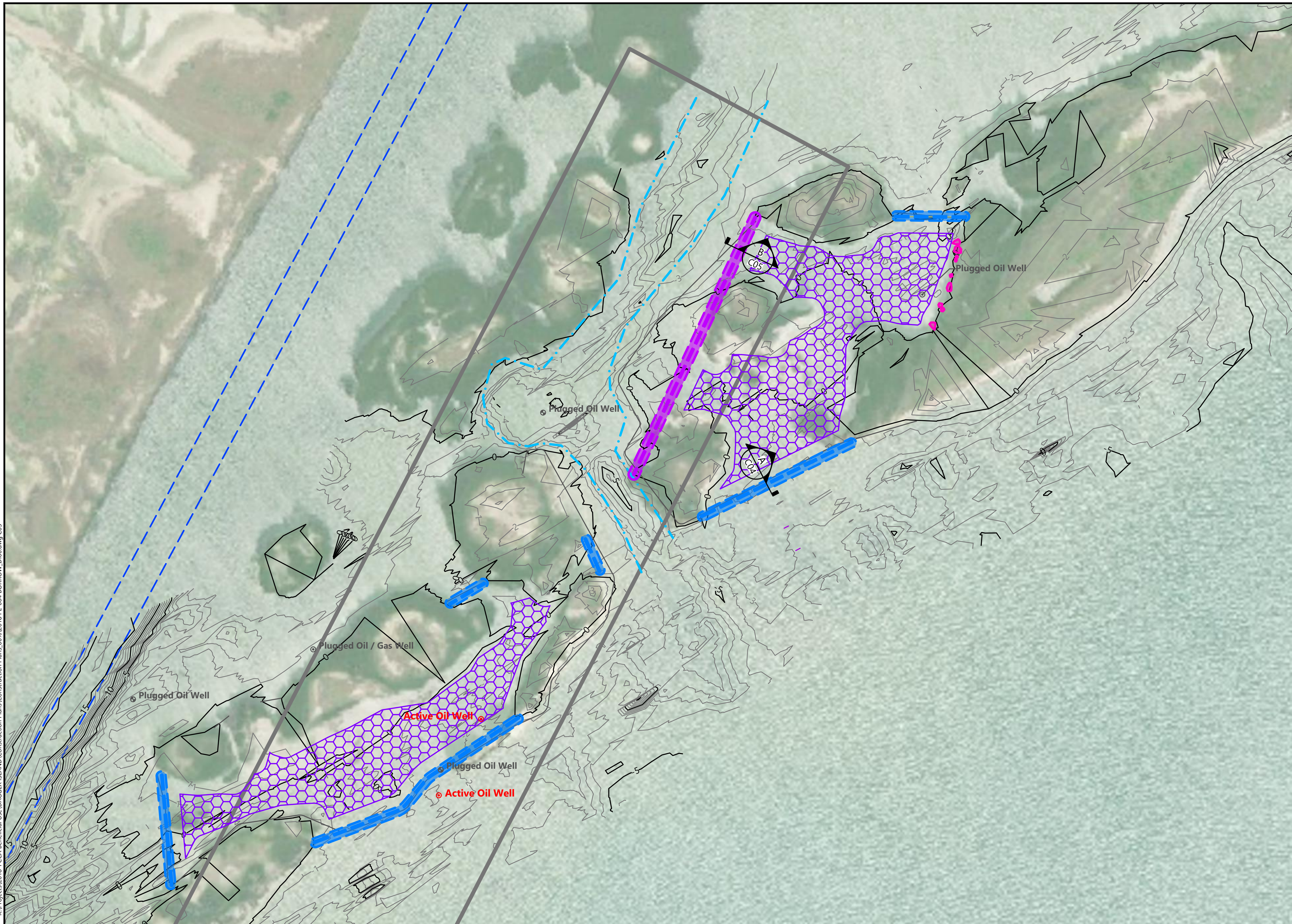
TEXAS LOWER COAST BENEFICIAL USE - DAGGER ISLAND

PLAN VIEW

C02

SHEET # 4 OF 7



LEGEND:

- PROPOSED ARMORED CONTAINMENT BERM
- PROPOSED VEGETATED CONTAINMENT BERM
- BORROW AREA
- U.S. ARMY CORPS OF ENGINEERS OPEN WATER DREDGED MATERIAL PLACEMENT AREA
- GULF INTRACOASTAL WATERWAY
- OYSTER HABITAT MAPPED BY TRITON ENVIRONMENTAL SOLUTIONS, LLC
- —0— EXISTING CONTOUR (5')
- --2-- EXISTING CONTOUR (1')
- DERELICT CHANNEL
- RAILROAD COMMISSION OF TEXAS MAPPED OIL AND GAS INFRASTRUCTURE LOCATIONS
- ACTIVE OIL WELL

NORTH

0 200 400

SCALE IN FEET

NOTES:

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4. HABITAT SURVEY CONDUCTED BY TRITON ENVIRONMENTAL SOLUTIONS, LLC, ON MARCH 18 AND MARCH 21, 2022.
5. NAVIGATION AIDS MUST BE PLACED ALONG THE CONTAINMENT BERM IN ACCORDANCE WITH TECHNICAL SPECIFICATIONS SECTION 35 12 10.

PLAN INTENDED TO BE VIEWED IN COLOR. ADJACENT BLOCK IS "BLUE"

ONE INCH

AT FULL SIZE, IF NOT ONE INCH SCALE ACCORDINGLY

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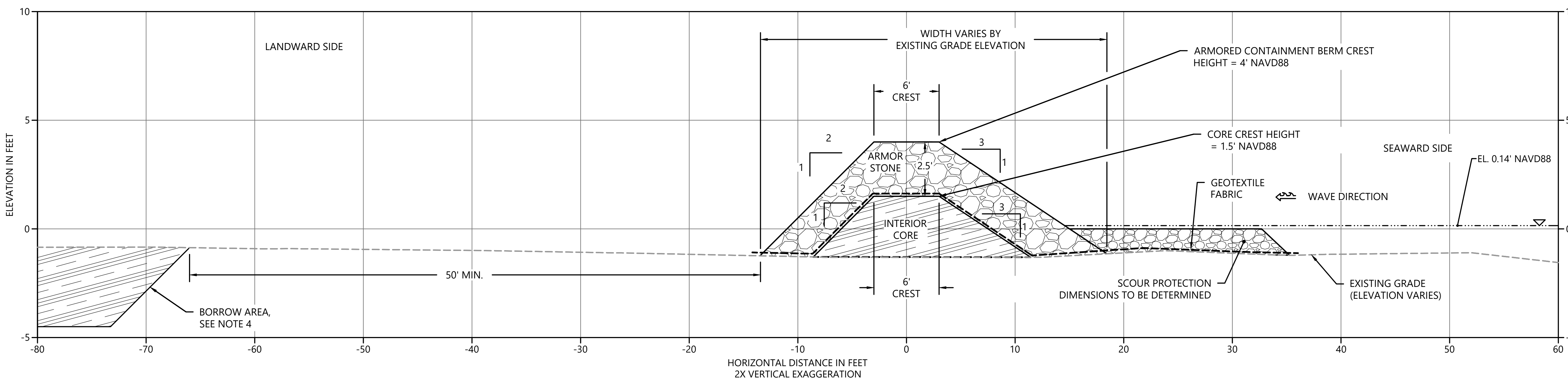
TEXAS LOWER COAST BENEFICIAL USE - DAGGER ISLAND

BORROW AREAS

C03

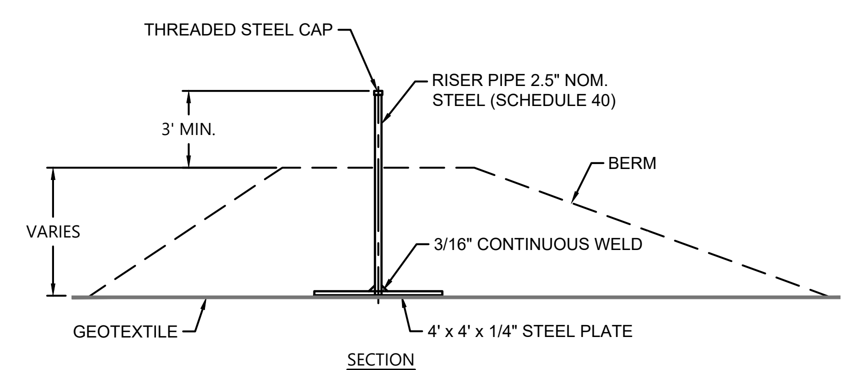
SHEET # 5 OF 7



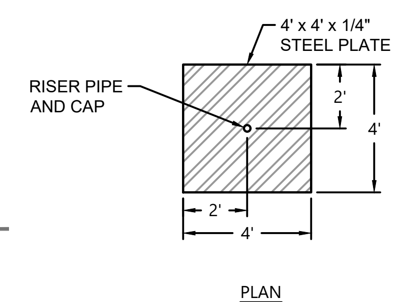
A
C02

TYPICAL ARMORED CONTAINMENT BERM SECTION

HORIZONTAL SCALE: 1" = 5'
VERTICAL SCALE: 1" = 2.5'



SECTION



PLAN

PLAN AND SECTION VIEWS OF TYPICAL SETTLEMENT PLATE

NOT TO SCALE

NOTES:

1. HORIZONTAL DATUM: TEXAS STATE PLANE SOUTH CENTRAL ZONE, NAD83, U.S. SURVEY FEET
2. VERTICAL DATUM: NORTH AMERICAN VERTICAL DATUM OF 1988 (NAVD88)
3. BATHYMETRIC AND TOPOGRAPHIC SURVEYS CONDUCTED BY TRITON ENVIRONMENTAL SOLUTIONS, LLC, ON MARCH 18 AND MARCH 21, 2022.
4. BORROW AREA DIMENSIONS SHOWN FOR ILLUSTRATION PURPOSES ONLY. ACTUAL DIMENSIONS TO BE DETERMINED BASED ON FINAL DESIGN AND BY SELECTED CONTRACTOR.
5. NAVIGATION AIDS MUST BE PLACED ALONG THE CONTAINMENT BERM IN ACCORDANCE WITH TECHNICAL SPECIFICATIONS SECTION 35 12 10.

PLAN INTENDED TO BE VIEWED IN COLOR. ADJACENT BLOCK IS "BLUE"

ONE INCH

AT FULL SIZE, IF NOT ONE INCH SCALE ACCORDINGLY

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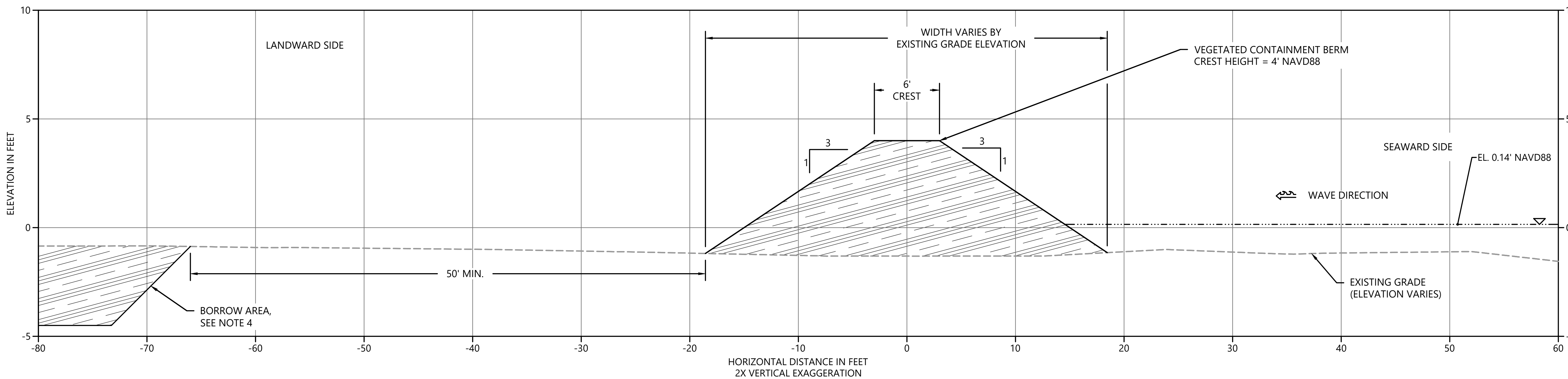
TEXAS LOWER COAST BENEFICIAL USE - DAGGER ISLAND

TYPICAL ARMORED CONTAINMENT BERM SECTION

C04

SHEET # 6 OF 7



B / C02 TYPICAL VEGETATED CONTAINMENT BERM SECTION
HORIZONTAL SCALE: 1" = 5'
VERTICAL SCALE: 1" = 2.5'

NOTES:

1. HORIZONTAL DATUM: TEXAS STATE PLANE SOUTH CENTRAL ZONE, NAD83, U.S. SURVEY FEET
2. VERTICAL DATUM: NORTH AMERICAN VERTICAL DATUM OF 1988 (NAVD88)
3. BATHYMETRIC AND TOPOGRAPHIC SURVEYS CONDUCTED BY TRITON ENVIRONMENTAL SOLUTIONS, LLC, ON MARCH 18 AND MARCH 21, 2022.
4. BORROW AREA DIMENSIONS SHOWN FOR ILLUSTRATION PURPOSES ONLY. ACTUAL DIMENSIONS TO BE DETERMINED BASED ON FINAL DESIGN AND BY SELECTED CONTRACTOR.
5. CONTRACTOR SHALL INSTALL VEGETATION ON CONTAINMENT BERM PER SPECIFICATIONS.
6. NAVIGATION AIDS MUST BE PLACED ALONG THE CONTAINMENT BERM IN ACCORDANCE WITH TECHNICAL SPECIFICATIONS SECTION 35 12 10.

PLAN INTENDED TO BE VIEWED IN COLOR. ADJACENT BLOCK IS "BLUE"

ONE INCH
AT FULL SIZE, IF NOT ONE INCH SCALE ACCORDINGLY

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TEXAS LOWER COAST BENEFICIAL USE - DAGGER ISLAND

TYPICAL VEGETATED CONTAINMENT BERM SECTION

C05

SHEET # 7 OF 7

Attachment 3

Technical Specifications

SECTION 31 05 19

GEOGRID AND GEOTEXTILES

PART 1 - GENERAL

1.01 SUMMARY

A. The Contractor shall furnish all labor, equipment, materials, and incidentals necessary to install the geocomposite underlayment for the containment berm as shown on the Construction Drawings as "Geocomposite."

B. Related Sections

1. Section 01 20 00 – Measurement and Payment Procedures
2. Section 01 33 00 – Submittal Procedures
3. Section 01 35 43 – Environmental Protection
4. Section 35 33 00 – Containment Berm

1.02 REFERENCES

A. American Association of State Highway and Transportation Officials (AASHTO): Standard Specification for Highway Bridges (2002)

B. ASTM International (ASTM):

1. D1388 – Standard Test Method for Stiffness of Fabrics
2. D3786 – Standard Test Method for Bursting Strength of Textile Fabrics – Diaphragm Bursting Strength Tester Method
3. C4354 – Practice Method for Sampling of Geosynthetics for Testing
4. C4355 – Standard Test Method for Deterioration of Geotextiles by Exposure to Light, Moisture and Heat in a Xenon Arc Type Apparatus
5. D4491 – Standard Test Methods for Water Permeability of Geotextiles by Permittivity
6. D4533 – Standard Test Method for Trapezoid Tearing Strength of Geotextiles
7. D4632 – Standard Test Method for Grab Breaking Load and Elongation of Geotextiles
8. D4751 – Standard Test Method for Determining Apparent Opening Size of a Geotextile
9. D4759 – Standard Practice for Determining the Specification Conformance of Geosynthetics
10. D4833 – Standard Test Method for Index Puncture Resistance of Geomembranes and Related Products
11. D4873 – Standard Guide for Identification, Storage, and Handling of Geosynthetic Rolls and Samples
12. D4884 – Standard Test Method for Strength Sewn or Bonded Seams of Geotextiles
13. D5199 – Standard Test Method for Measuring the Nominal Thickness of Geosynthetics

14. D5261 – Standard Test Method for Measuring Mass Per Unit Area of Geotextiles

15. D5321 – Standard Test Method for Determining the Shear Strength of Soil-Geosynthetic and Geosynthetic-Geosynthetic Interfaces by Direct Shear

16. D6241 – Standard Test Method for Static Puncture Strength of Geotextiles and Geotextile-Related Products Using a 50-mm Probe

17. D6637 – Standard Test Method for Determining Tensile Properties of Geogrids by the Single or Multi-Rib Tensile Method

18. D7737 – Standard Test Method for Individual Geogrid Junction Strength

19. D7748 – Standard Test Method for Flexural Rigidity of Geogrids, Geotextiles and Related Products

C. U.S. Army Corps of Engineers (USACE): USACE Methodology for Measurement of Torsional Rigidity

D. Geosynthetic Research Institute (GRI) – GG9 Torsional Behavior of Bidirectional Geogrids when Subjected to In-Plane Rotation

1.03 SUBMITTALS

A. The following shall be submitted a minimum of 7 calendar days prior to installation in accordance with SECTION 01 33 00 − SUBMITTAL PROCEDURES: Requirements for Submittals. The failure of the Contractor to obtain approval prior to installation shall be grounds for nonpayment.

1. Geocomposite Sample: The Contractor shall submit a 6-inch by 6-inch or larger sample of the geocomposite to the Engineer for approval.

2. Manufacturer's Certificate: The Contractor shall submit the manufacturer's certificate of compliance with the name of the manufacturer, product name, style number, and other relevant information to fully describe the geocomposite. The certificate should state that the composite meets the requirements of this section and shall be attested to by a person having legal authority to bind the composite manufacturer.

3. Manufacturer's Instructions: The Contractor shall submit installation instructions to the Engineer for review.

4. Shop Drawings: The Contractor shall submit typical details of the typical sections and connections.

1.04 QUALITY ASSURANCE

A. A minimum of 7 days prior to installation of the geocomposite, the Contractor shall provide, to the Engineer for approval, the samples, manufacturer's certificate and instructions, and shop drawings.

B. The Contractor will provide a description of the methods and procedures proposed for installation of the geocomposite as part of the Construction Work Plan in accordance with SECTION 01 33 00 − SUBMITTAL PROCEDURES and 35 33 00 − CONTAINMENT BERM.

1.05 DELIVERY, STORAGE, AND HANDLING

A. Delivery

1. The Contractor shall notify the Engineer a minimum of 24 hours prior to delivery and unloading of the geocomposite packaged in an opaque, waterproof, protective plastic wrapping.

2. The manufacturer's plastic wrapping shall not be removed until deployment. If quality-assurance samples are collected, immediately rewrap rolls with the plastic wrapping or equivalent as approved by the Engineer. Geotextile or plastic wrapping damaged during storage or handling shall be repaired or replaced, as directed, at no additional cost to the Agency.

3. The Contractor shall label each roll with the manufacturer's name, geotextile type, roll number, roll dimensions (length, width, and gross weight), and date manufactured.

B. Storage

1. The Contractor shall protect rolls of geocomposite from, but not limited to, construction equipment, chemicals, sparks, and flames; temperatures below minus 20°F or in excess of 160°F; or any environmental condition that may damage the physical properties of the geotextile.

2. Geocomposite should not be exposed to direct sunlight for time frames beyond those recommended by the manufacturer. Geocomposite exposed beyond such time frames shall be disposed of and replaced at no additional cost to the Agency and shall not allow the construction schedule to be extended.

3. The Contractor shall protect geocomposite from becoming saturated by elevating rolls off the ground or placing them on a sacrificial sheet of plastic in an area where water will not accumulate. If the geocomposite becomes saturated prior to installation, the Contractor shall remove the geotextile from the site and replace at no additional costs to the Agency.

C. Handling: Handle and unload geotextile rolls with load-carrying straps, a forklift with a stinger bar, or an axial bar assembly. Rolls shall not be dragged along the ground, lifted by one end, or dropped to the ground.

PART 2 - PRODUCTS

2.01 MATERIALS

A. The geocomposite system shall meet the following requirements:

1. Positive mechanical interlock with underlayer; contiguous sections of itself when overlapped and embedded in bedding stone or similar.

2. Sufficient cross-sectional profile to present a substantial abutment interface to particulate construction fill materials, such as bedding stone, and to resist movement relative to such materials.

3. Sufficient flexural rigidity to help maintain intimate contact of the geotextile with the underlying material when bedding stone, riprap, or armor stone is placed on top.

4. Sufficient true initial modulus to cause applied force to be transferred to the geogrid at low strain levels without material deformation of the reinforced structure.

5. Complete continuity of all properties throughout its structure and shall be suitable for use with bedding stone, riprap, and armor stone materials in coastal and waterway environments to improve the long-term stability of the coastal structure such as rubble mound breakwaters, jetties, and groins.

B. The geogrid part of the geocomposite shall meet the properties as outlined in Table 1. Where applicable, values represent minimum average roll values (MARVs) in accordance to ASTM D4759.

TABLE 1: GEOGRID PROPERTIES

Property	Test Method	Unit	Value
Aperture Size (nominal dimensions)	ASTM D4759	in	1.0 to 2.0
Minimum Rib Thickness (nominal dimensions)	ASTM D4759	in	0.06
Tensile Strength @ 2% Strain	ASTM D6637	lb/ft	450
True Initial Modulus in Use	ASTM D6637	lb/ft	1,575
Junction Efficiency	ASTM D7737	%	90
Flexural Stiffness	ASTM D7748	mg-cm	750,000
Ultraviolet Stability (Retained Strength @ 500 hours)	ASTM D4355	%	90

Note:
1. Resistance to in-plane rotational movement is measured by applying a 20-kg-cm (2 N-m) moment to the central junction of a 9-inch by 9-inch specimen restrained at its perimeter in accordance with GRI GG9.

C. Geotextiles shall meet the requirements specified in Table 2. Where applicable, Table 2 property values represent MARVs in the weakest principal direction. Values for Apparent Opening Size represent maximum average roll values.

TABLE 2: GEOTEXTILE PROPERTIES

Property	Test Method	Unit	Minimum Test Value
Apparent Opening Size	ASTM D4751	US Sieve	100 (Maximum)
Permittivity	ASTM D4491	sec^{-1}	0.57
Puncture	ASTM D4833	lbs	75
Grab Tensile Strength	ASTM D4632	lbs	180
Trapezoidal Tear	ASTM D4533	lbs	50
Ultraviolet Degradation	ASTM D4355	% strength @ 500 hrs.	70
Weight	ASTM D5261	oz/sq. yd.	8
Burst Strength	ASTM D3787	lbs	290

PART 3 - EXECUTION

3.01 SUBGRADE PREPARATION

3.02 INSTALLATION

A. The Contractor shall notify the Engineer a minimum of 24 hours prior to installation of the geocomposite.

B. Geocomposite rolls that are damaged or contain imperfections shall be repaired or replaced as directed by the Engineer at no additional cost to the Agency.

C. The Contractor shall install the geocomposite as shown in the Construction Drawings. The width of the installed geocomposite will vary as the containment berm width varies due to changes in water bottom elevations.

D. The geocomposite shall be laid flat and smooth so that it is in direct contact with the subgrade. Correct orientation (roll direction) of the geocomposite shall be verified by the Contractor. The geocomposite may be temporarily secured with sandbags. The geotextile component of the geocomposite shall extend a minimum of 1 foot beyond the limits of the toe of the containment berm, as shown in the Construction Drawings.

E. Armor stone shall be placed atop the geocomposite as described in SECTION 35 33 00 − CONTAINMENT BERM in a manner that minimizes the wrinkles and/or movement of the composite and uniformly loads the structure and minimizes displacing the underlying foundation. The Contractor shall place rock in a manner that prevents material from entering the composite overlaps and prevents tensile stress from being mobilized in the composite and prevents wrinkles from folding over onto themselves.

3.03 SEAMS

A. The Contractor shall continuously overlap the geocomposite panels a minimum of 2 feet at all longitudinal and transverse joints.

3.04 PROTECTION AND REPAIRS

A. The Contractor shall protect the geocomposite during installation from tears and other damage. Damaged composite shall be repaired or replaced as directed by the Engineer at no additional cost to the Agency.

B. The Contractor shall repair torn or damaged geocomposite. The Contractor shall perform repairs by placing a patch of the same type of geocomposite over the damaged area. The patch shall extend a minimum of 2 feet beyond the edge of the damaged area. Patches shall be continuously fastened using the manufacturer's approved methods. The machine direction of the patch shall be aligned with the machine direction of the geocomposite being repaired. The Contractor shall remove and replace geocomposite which cannot be repaired. Repairs shall be performed at no additional expense to the Agency and shall not allow the construction schedule to be extended.

END OF SECTION 31 05 19

F. If any damage occurs to permanent ATON placed during construction, the Contractor shall replace or repair the ATON at no cost to the Owner and at the direction of the Owner or its authorized representative.

END OF SECTION 35 12 10

SECTION 35 12 10

AIDS TO NAVIGATION

PART 1 - GENERAL

1.01 SUMMARY

A. The Contractor shall furnish all labor, equipment, materials, and incidentals necessary to install permanent navigational markers as shown on the Construction Drawings as "Aids to Navigation" (ATON) and in accordance with the U.S. Coast Guard (USCG) marking determination (Appendix TBD). The Contractor shall also be responsible for installing and maintaining temporary navigational markers or lighted beacons during construction of the containment berm structures in accordance with applicable federal, state, and local laws, ordinances, and relevant permit requirements. Contractor shall install at (at least X) (or as necessary to identify maritime risks) temporary navigational markers. Contractor shall remove the temporary navigational markers upon completing installation of the required permanent navigational markers.

B. The Contractor shall display signal lights and conduct operations in accordance with the General Regulations of the Department of the Army and of USCG as set forth in Navigation Rules and Regulations Handbook 2014 and 33 Code of Federal Regulations (CFR) 84 through 33 CFR 89 (Inland) as applicable.

1.02 RELATED DOCUMENTS

A. Appendix TBD – USCG Marking Determination Package (point to appropriate appendix)

B. Section 01 20 00 – Measurement and Payment Procedures

C. Section 01 33 00 – Submittal Procedures

D. Section 01 35 43 – Environmental Protection

E. Section 35 33 00 – Containment Dike

1.03 REFERENCES

A. American Wood Preservers Association (AWPA): AWPA P5 – Standard for Waterborne Preservatives

B. USCG: USCG CFR, Title 33, Chapter 1, Parts 62, 64, and 66

C. 2022 AWPA Book of Standards

1.04 SUBMITTALS

A. Before the Contractor orders ATON materials, the following shall be submitted in accordance with SECTION 01 33 00 − SUBMITTAL PROCEDURES:

1. Manufacturer's Data Sheets: The Contractor shall submit the manufacturer's data sheets for all permanent ATON, including buoys, lights, signs, reflective material, pilings, and any other material used for the ATON. The data sheets shall include the name of the manufacturer, product name, style number, and other relevant information to fully describe the ATON material.

B. The failure of the Contractor to obtain approval prior to ordering material shall be grounds for nonpayment.

PART 2 - PRODUCTS

2.01 MATERIALS

A. Temporary ATON

1. Warning Buoys – 1 nautical mile USCG-approved marine lanterns (TBD LED Rating), buoys with solar powered, flashing white light with a flash period of 2.5 seconds (0.3 seconds on / 2.2 seconds off)

B. Permanent ATON

1. Pilings: The contractor shall install X-foot-long, class X timber pilings, pressure treated with Chromated Copper Arsenate at 2.5 pounds per cubic foot per AWPA U1.

2. Signs: The contractor shall install the signs indicated in the USCG Determination Package with the lettering “DANGER” in black text on white dayboard film background with 2-inch orange retroreflective border. All hardware connecting the sign shall be hot-dipped galvanized or approved equal. Examples of USCG-approved signage is included in Appendix X.

3. Lights: The contractor shall install lights meeting the requirements described in Appendix X.

PART 3 - EXECUTION

3.01 INSTALLATION

A. Prior to installation, the Contractor shall determine if underground utilities exist in the proposed locations of the permanent ATON. The Contractor shall also verify water depths and bottom types at the locations.

B. As the work progresses, the Contractor shall install temporary or permanent ATON at the locations specified in Attachment M and Construction Drawings. Discrepancies between the coordinates designated on the USCG permit or Construction Drawings shall be reported to the Owner or its designated representative prior to installation.

C. The Contractor will place temporary ATON prior to construction and shall maintain the temporary ATON during construction until installation of the permanent ATON is complete. The contractor shall relocate temporary ATON by request of the Owner, Engineer, USCG, or USACE during construction without incurring additional cost to the Owner. The Contractor shall remove temporary ATON and install permanent ATON prior to final acceptance of the project. All temporary ATON will be considered property of the Contractor, and theContractor shall take full responsibility for removal, transportation, storage, or proper disposal of the temporary ATON.

D. Timber piles shall be carefully handled with no sudden dropping, breaking of outer fibers, bruising, or penetration of the surface with tools. Piles damaged or not located in the proper location shall be withdrawn and replaced by new piles or shall be cut off at the mudline and additional piles installed as directed, without additional cost to the Owner.

E. Signs shall be installed so that the bottom of the signage is a minimum of 7 feet above the mean high water level and does not exceed 9 feet above the mean high water level. The Contractor shall shorten the pilings dictated by the normal mean high watermark in the project area, as necessary. Each sign shall be fastened with at least three 3/4-inch-diameter by 12-inch-long hot-dipped galvanized bolts and connected with a hot-dipped galvanized ogee washer, lockwasher, and nut. Bolt holes shall be bored 1/8 inch larger than the diameter of the bolt.

F. If any damage occurs to permanent ATON placed during construction, the Contractor shall replace or repair the ATON at no cost to the Owner and at the direction of the Owner or its authorized representative.

END OF SECTION 35 12 10

SECTION 35 33 00

CONTAINMENT BERM

PART 1 - GENERAL

1.01 SUMMARY

A. The Contractor shall furnish all labor, equipment, materials, and incidentals necessary to install the containment berm as described herein and in the Construction Drawings. The work shall include, but is not necessarily limited to, excavation of sediment within the footprint of the Site, construction of containment berm core, and purchase, delivery, and installation of the armor stone to construct the Dagger Island containment berm as shown in the Construction Drawings.

1.02 RELATED SECTIONS:

A. Section 01 20 00 – Measurement and Payment Procedures

B. Section 01 32 00 – Construction Progress Documentation

C. Section 01 32 23 – Surveys and Layout Data

D. Section 01 33 00 – Submittal Procedures

E. Section 01 35 43 – Environmental Protection

F. Section 31 05 19 – Geogrid and Geotextiles

G. Section 35 12 10 – Aids to Navigation

H. Appendix X – USACE Permit

1.03 REFERENCES

A. ASTM International (ASTM):

1. ASTM C97 – Standard Test Methods for Absorption and Bulk Specific Gravity Dimension Stone
2. ASTM C127 – Standard Test Method for Density, Relative Density (Specific Gravity), and Absorption of Coarse Aggregate
3. ASTM C131 – Standard Test Method for Resistance to Degradation of Small-Size Coarse Aggregate by Abrasion and Impact in the Los Angeles Machine
4. ASTM C295 – Standard Guide for Petrographic Examination of Aggregates for Concrete
5. ASTM D535-12 – Standard Test Method for Resistance to Degradation of Large-Size Coarse Aggregate by Abrasion and Impact in the Los Angeles Machine
6. ASTM D75/D75M-14 – Standard Practice for Sampling Aggregates
7. ASTM D1141-98(2013) – Standard Practice for the Preparation of Substitute Ocean Water
8. ASTM D4791 – Standard Test Method for Flat Particles, Elongated Particles, or Flat and Elongated Particles in Coarse Aggregate

1.04 SUBMITTALS

A. The following submittals shall be submitted in accordance with SECTION 01 33 00 – SUBMITTAL PROCEDURES: Requirements for Submittals

B. Construction Work Plan: Prior to the start of construction, the Contractor shall provide a Construction Work Plan containing, at a minimum, the following:

1. Work Sequencing and Equipment:
    a. Order and sequence in which work shall be performed
    b. Number, type, and capacity of equipment to be used
    c. Hours of operation
    d. Estimated schedule
    e. Procedures for placing materials and confirming thicknesses and grades are met
2. Methods, Procedures, and Equipment addressing the following:
    f. Protection of the geocomposite layers during material placement
    g. Installation method of interior core and armor stone
    h. Methods for confirming elevation of placed dredged material containment berm
    i. Placement to distribute the load across the compressible foundation
    j. Survey and photography methods to monitor and control the work and progress surveys
    k. Verification of minimum design template
    l. Settlement monitoring and output format
    m. Toe construction underwater

C. Source Material
1. Armor Stone aggregate:
    a. Prior to the preconstruction meeting, the Contractor shall submit quarry records including, but not limited to, the history of the quarry and the capability to produce the material to the required specifications.
    b. Submit compliance test results as specified in Part 2 of this Specification.

D. Quality Control Surveys: During construction, the Contractor shall provide interim surface elevation surveys per SECTION 01 32 23 − SURVEYS AND LAYOUT DATA.

E. Daily Construction Report: The Contractor shall prepare and maintain a daily report of operations and furnish copies by noon the following day or as requested by the Owner as described in SECTION 01 32 00 − CONSTRUCTION PROGRESS DOCUMENTATION.

F. Stop Work: The Owner and/or Engineer may elect to stop work activities at the Site if the required submittals have not been submitted or are not of acceptable quality (as determined by the Owner or Engineer) and per the schedules specified herein in accordance with SECTION 01 33 00 − SUBMITTAL PROCEDURES. Any delays related to submittal approvals shall not allow the construction schedule to be extended and shall not be reason to increase the Contract price.

1.05 QUALITY CONTROL

A. Contractor will perform control surveys as specified in SECTION 01 32 23 – SURVEYS AND LAYOUT DATA.

PART 2 - PRODUCTS

2.01 CONTAINMENT BERM MATERIALS

A. The Contractor may use the material from within the designated borrow area to construct the armored containment berm interior core as well as for the vegetated containment berm, as shown in the construction drawings. The Contractor is responsible for determining which material within the designated borrow area is sufficient for use as armored containment berm core or vegetated containment berm material during containment berm creation and is also suitable for its placement operations. If the Contractor deems that no material within the designated borrow area is sufficient for use as armored containment berm core material or vegetated containment berm material, suitable offsite material may be used to completework. The Contractor shall provide details in the Construction Work Plan as outlined in Section 1.04 A.

2.02 ROCK

A. The Contractor shall make arrangements, pay royalties, and secure the permits for procurement, furnishing, and transporting stone. The Contractor shall vary the quarrying, processing, loading, and placing operations to produce the sizes and quality of stone specified. If the stone being furnished by the Contractor does not meet the requirements as specified herein, the Contractor shall furnish, at no additional cost to the Owner, other stone meeting these requirements.

B. Before stone is produced from a source for completion of the work under this contract, the source of stone shall be approved by the Engineer/Owner. Approval of a stone source shall not be construed as a waiver of the right of the Owner to require the Contractor to furnish stone that complies as specified herein. Materials produced from localized areas, zones, or strata will be rejected when these materials do not comply as specified herein.

C. If requested, stone samples shall be provided to the Owner for testing. Stone from a proposed source or sources shall be tested by the Contractor for quality compliance as described below. Copies of the compliance testing for each gradation shall be provided to the Engineer before installation.

D. Testing and Analysis of Materials shall be performed in accordance with applicable ASTM standards. When tests indicate materials do not meet specified requirements, the Contractor shall remove and legally dispose of the unsuitable material off site and replace with suitable material at no cost to the Agency. Rock shall meet the following minimum test requirements:

TEST REQUIREMENTS		
TEST	TEST METHOD	REQUIREMENTS
Specific Gravity (Bulk SSD)	ASTM C127	(2.60) minimum (2.75) maximum
Absorption	ASTM C127	(3.0%) maximum
Abrasion loss	ASTM D535-12	(40%) max. loss[1]
Note: 1. Weakening and loss of individual surface particles is permissible unless bonding of the surface grains softens and causes general disintegration of the surface material.		

E. In addition to the above tests, the stone shall be subjected to a Petrographic and X-Ray Diffraction analysis in accordance with ASTM C295. The stone shall not contain expansive clays. The test procedure for Petrographic and X-Ray Diffraction is performed according to ASTM C295, except for the following:

1. A colored microscope photograph shall be made of each stone type, including igneous, sedimentary, or metamorphic, and the individual minerals within the stone type shall be identified by labels and arrows upon the photograph.
2. Detailed macroscopic and microscopic descriptions shall be made of the stone to include the entire mineral constituents, individual sizes, their approximate percentages, and mineralogical histories. A description of stone hardness, texture, weathering, and durability factors shall be discussed. Pictures of the source wall within the quarry to show any layering and lithology shall be included.
3. A written summary of the suitability of stone for use as armor stone based on the Petrographic and X-ray tests and the abrasion loss (L.A. Rattler) shall be presented in the final laboratory report on stone quality.

F. The required gradations for stone to be used are as follows:

4. Armor Stone:

Weight of Stone (Pounds)	**Percent Lighter by Weight (%)**
2200–900	100
900–440	50
440–130	15
130–75	5

2.03 SOURCE QUALITY CONTROL

A. Testing and Analysis of Materials shall be performed in accordance with applicable ASTM standards.

B. When tests indicate materials do not meet specified requirements, the Contractor shall remove and legally dispose of the unsuitable material off site and replace with suitable material at no cost to the Agency.

PART 3 - EXECUTION

3.01 GENERAL

A. The Contractor shall perform a preconstruction survey via a third-party independent surveyor licensed in the State of Texas. Prior to the start of construction, the Contractor shall verify all existing elevations and grades and provide templates and stone volumes per SECTION 01 32 23 – SURVEYS AND LAYOUT DATA. The Contractor shall establish the baseline depicted and provide a layout for review before starting placement operations.

B. The Contractor will not be allowed to dredge access channels to construct the containment berm. In emergency situations (as determined by the Engineer and Owner), the Contractor, after approval from the Engineer and Owner, may dredge to remove equipment from the site but must backfill the area immediately following emergency response activities.

C. The Contractor shall install the geocomposite as described in SECTION 31 05 19 – GEOGRID AND GEOTEXTILES and shall take care to avoid damaging the geocomposite layers during placement of overlying material. Placement shall be done in such a manner so as not to rip, puncture, disturb, or damage the geocomposite layer as specified herein.

D. The Contractor shall construct the containment berm to the elevations and alignments shown on the Construction Drawings within the construction tolerances stated in these specifications. The stone materials shall be placed and the surfaces shall be measured at adequate intervals to accurately delineate the surfaces of the layers. Unless the Engineer approves alternate construction methods in writing, all stone on slopes shall be placed in horizontal layers from the toe of the slope up toward the crest.

E. Stone shall be placed so that a well-graded mass is produced with minimum interstitial voids. Stone shall be placed evenly to compress the existing foundation using a method that shall avoid damage to the geocomposite or underlying structure, when present.

F. The height of the stone installation drop shall not be greater than that which may cause damage to the geocomposite or the stone itself. When allowable drop heights are developed on-site, between the Engineer and Contractor, these heights shall be based on actual performance. The Contractor shall maintain the stone layer until accepted, and if material is displaced or the surface damaged, replacement shall be made to the indicated lines and grades at the Contractor's expense. Final surfaces of the finished stone shall be uniform and shall follow with the indicated lines and grades without continuous under or overbuilding.

G. Material that escapes or is lost while loading, transporting, or placing stone, or which is deposited in areas other than shown on the Construction Drawings or approved in writing by the Owner and Engineer, shall be removed and redeposited at the Contractor's expense and at no additional cost to the Owner or, if not removed and redeposited, shall be deducted from the final quantities for payment.

3.02 ARMORED CONTAINMENT BERM INSTALLATION

A. The Contractor shall install settlement plates prior to interior core placement as shown on the Construction Drawings and described in Part 3.03 of this Section.

B. The subsurface sediments along the containment berm contain compressible sediments that will consolidate during and after construction. Due to the sediment consolidation, the contractor may be required to halt placement operations at certain locations and elevations and wait for the underlying sediments to consolidate before placing additional interior core or armor stone in the specified area. If applicable, the Engineer shall determine when the sediments have reached consolidation (based on Contractor field surveys) and when the Contractor can resume placement activities in the specified area. The Contractor shall place the interior core and armor stone in the following sequence:

1. Install interior core to the full template and perform quality control surveys and weekly settlement monitoring surveys in accordance with SECTION 01 32 23 – SURVEYS AND LAYOUT DATA.
2. Install additional interior core (based on surveys and as directed by the Engineer) as needed to meet minimum lines and grades.
3. Install armor stone to full template and perform quality control surveys and weekly settlement monitoring surveys of the containment berm in accordance with SECTION 01 32 23 – SURVEYS AND LAYOUT DATA.
4. Install additional armor stone (based on settlement monitoring surveys and as directed by the Engineer) as needed to meet minimum lines and grades and perform a quality control survey in accordance with SECTION 01 32 23 – SURVEYS AND LAYOUT DATA.

C. During hurricane season or in the event of forecast extreme weather, at the Engineer’s discretion, the Contractor may be limited to the amount of interior core placed at one time and may be required to install the armor stone layer before moving to the next containment berm section. The Contractor is responsible for replacing any interior core (prior to cover by armor stone) or berm material that is lost from the project work due to storms at any time during the construction at no additional cost to the Agency.

3.03 VEGETATED CONTAINMENT BERM INSTALLATION

D. The Contractor shall install settlement plates prior to berm placement as shown on the Construction Drawings and described in Part 3.03 of this Section.

E. The subsurface sediments along the containment berm contain compressible sediments that will consolidate during and after construction. Due to the sediment consolidation, the contractor may be required to halt placement operations at certain locations and elevations and wait for the underlying sediments to consolidate before placing additional berm material in the specified area. If applicable, the Engineer shall determine when the sediments have reached consolidation (based on Contractor field surveys) and when the Contractor can resume placement activities in the specified area. For the armored portion of the containment berm, the Contractor shall place the interior core and armor stone in the following sequence:

1. Install berm material to the full template and perform quality control surveys in accordance with SECTION 01 32 23 – SURVEYS AND LAYOUT DATA.
2. Install additional berm material (based on surveys and as directed by the Engineer) as needed to meet minimum lines and grades.

3.04 SETTLEMENT PLATES

A. Settlement plates shall be constructed with a 4-foot by 4-foot, 1/4-inch-thick steel plate with a 3-inch-diameter steel riser pipe attached to the center of the plate. The settlement plates shall be hot-dipped galvanized after fabrication. The riser pipe shall extend a minimum of 3 feet above the design elevation of the armor stone.

B. Settlement plates shall be placed after installation of the geocomposite and prior to interior core installation or other berm material placement at the locations detailed in the construction drawings. Plates shall be placed so that the riser pipe conforms to a vertical plumb standard of no more than 10.5° from true vertical. The riser pipe shall be marked with reflective tape or flagging.

C. During installation of the containment berm, the Contractor shall carefully place materials near the settlement plate and maintain the plates until completion of the project. After acceptance of the containment berm, the Contractor shall cut the riser pipe so that it is no more than 6 inches above the top of the constructed containment berm elevation.

D. Settlement plates shall be surveyed per SECTION 01 32 23 – SURVEYS AND LAYOUT DATA as follows:

1. Prior to interior core or other berm material placement
2. After placement of interior core or other berm materials
3. After placement of armor stone
4. Bi-weekly during containment berm materialplacement
5. After cutting the riser pipe (as described in 3.03 C. of this Section)
6. Bi-weekly after completing the containment berm material placement, for a minimum of 3 post-construction survey data pointsw

3.05 SURVEYS

A. All surveys shall be conducted in accordance with SECTION 01 32 23 – SURVEYS AND LAYOUT DATA.

3.06 TOLERANCES

A. Deviations in crest elevation from the design value shall not be greater than +0.5 foot for the interior core and berm material and +0.5 foot for the armor stone. Deviations below crest elevations shown on Construction Drawings will be filled in accordance with this Section until either crest elevation or allowable deviation is achieved.

B. Transitions in alignments shall be smooth and shall be no more than a 1-foot horizontal change in a 20-foot length unless otherwise approved by the Owner and Engineer.

C. Deviations in seaward slope lengths should not be greater than +0.5 feet. Deviations in the landward slope lengths should not be greater than +/-1.5 feet.

3.07 ACCEPTANCE

A. Acceptance will be based on the approved stone source, compliance tests, barge displacement surveys, and surveys performed by the Contractor per SECTION 01 20 00 – MEASUREMENT AND PAYMENT PROCEDURES and SECTION 01 32 23 – SURVEYS AND LAYOUT DATA. The Owner may perform field check tests and/or surveys to verify the Contractor's barge displacement and/or surveys. The Agency survey checks will govern any discrepancies.

END OF SECTION 35 33 00

Attachment 4

Dredged Material Management Plan

Dredged Material Management Plan – Dagger Island

The Dredged Material Management Plan for Dagger Island provides guidance on placement of dredged material and postconstruction marsh management. Figures 1 through 3 are provided for informational purposes. The intent is to place fill at varying ranges to create a range of tidal marsh habitats.

Dredged Material Placement

The following details the recommended dredged material placement plan:

- The Contractor shall place dredged material in the marsh creation area as directed by the Engineer. The proposed method of placement shall be approved by the Engineer prior to commencement of work.
- Dredged material placement elevations during marsh creation will be determined by the Engineer. Based on surveys and site visits, the Engineer will direct the Contractor on placement areas and elevations. The intent of the placement is to create varying elevations of marsh within the marsh footprint and for final marsh elevations, after consolidation, to be between 1.5 to 3.5 feet North American Vertical Datum of 1988 (NAVD88).
- The Contractor shall begin placing dredged material in accordance with the specifications and Contractor's approved work plan. Deviations will be approved on a weekly basis by the Engineer, based on the adaptive placement approach, using the survey and aerial images to guide the decision process.
- The Contractor shall use a placement method and employ best management environmental control practices that can be adapted for placing dredged material in varying locations and elevations and that will minimize turbidity in the water discharged from the marsh placement area.
- If hydraulically placing dredged material, the Contractor shall limit its discharge rate as necessary for the proposed equipment, water depth, surface area, weirs (if applicable), and borrow material properties to prevent turbidity exceedances and weir and berm overtopping. Depending on the proposed discharge rate into the area by the Contractor, intermittent discharge may be required to prevent overtopping. Once established, the Contractor shall not overtop the containment berm with dredged material.
- At the completion of marsh creation and as directed by the Engineer, the Contractor shall complete the as-built survey of the constructed marsh.
- Deviations in marsh elevation will be dependent on the characteristics of the dredged material and determined by the Engineer. If no direction is given, the elevation deviations shall not be greater than +/-0.5 foot.

Postconstruction Management

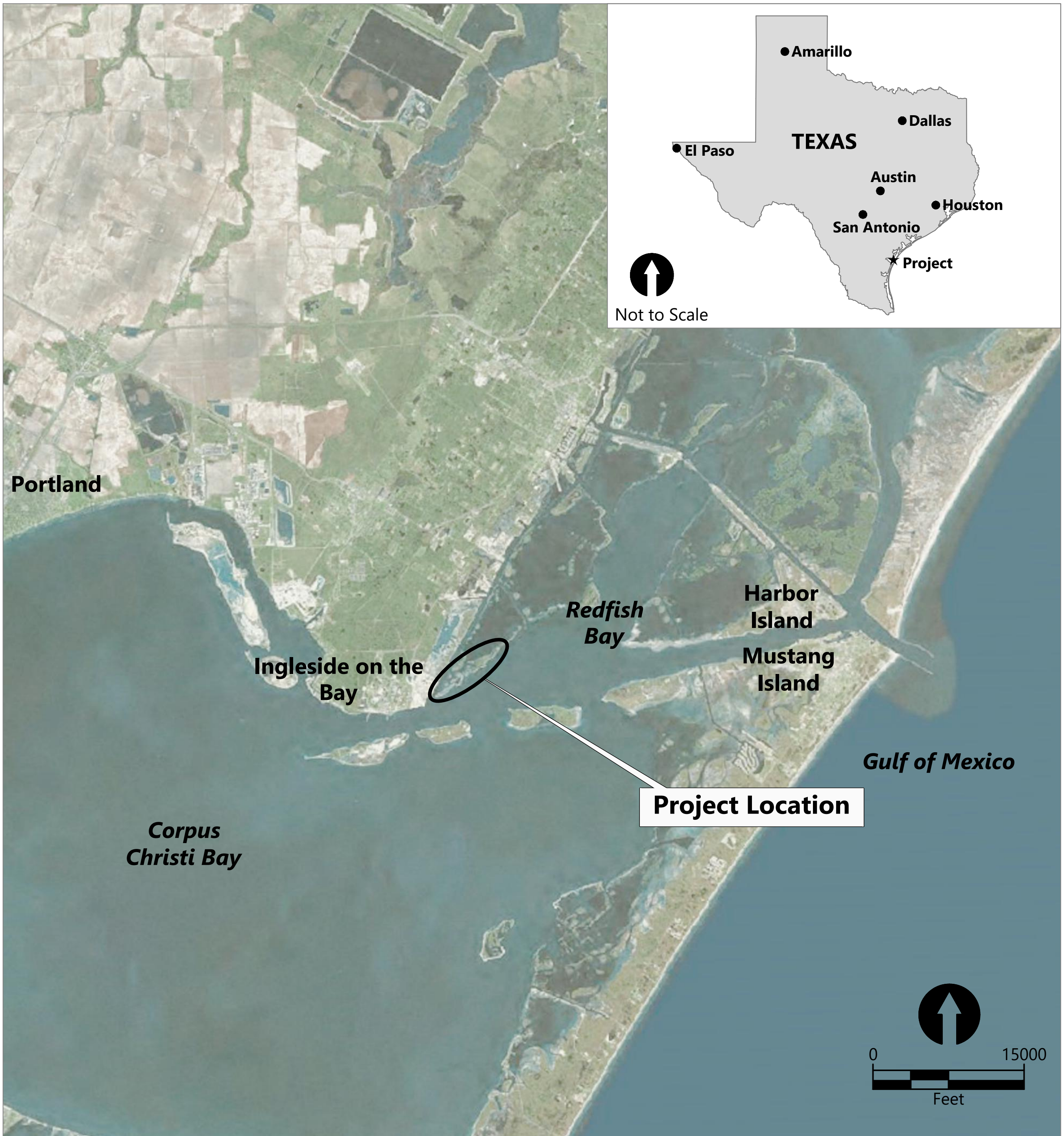
Once the Engineer determines marsh placement operations are complete, the Contractor shall begin the postconstruction management phase of the project as directed by the Engineer. It is the intent that all irregularities will be resolved on site with the Engineer and Contractor as the marsh fill is placed. Once the marsh management component of the work begins, no further work will be done inside the fill area.

The Contractor shall monitor, maintain, and adjust the decant system or weirs as needed to decant water from the site to allow the dredged material to settle and consolidate. The Engineer will determine when postconstruction management is complete.

At the completion of postconstruction management and as directed by the Engineer, the Contractor shall remove any decant system or weirs if directed by Engineer. Degrading and breaching locations and elevations, if required, will be determined by the Engineer based on the last postconstruction management visit.

At the completion of this work item, and as directed by the Engineer, the Contractor shall complete the as-built survey of the constructed marsh.

Figures



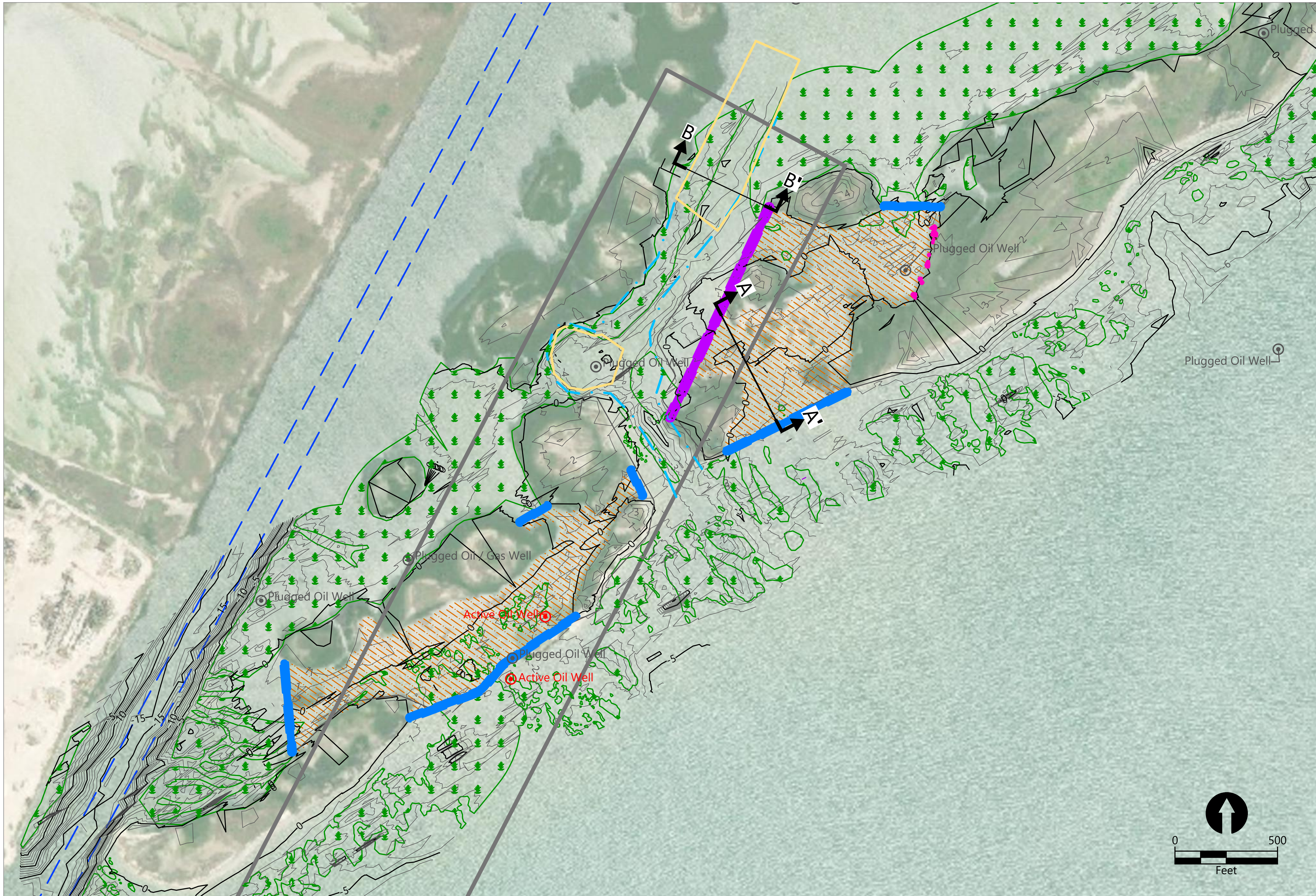
SOURCE: Aerial provided by Bing Maps.
HORIZONTAL DATUM: Texas State Plane South Zone,
North American Datum of 1983, U.S. Survey Feet

Publish Date: 2022/09/14 3:42 PM | User: mpratschner
Filepath: K:\Projects\2018-PCCA Beneficial Use\DAGGER ISLAND\2018 RP-001 VIC MAP.dwg Figure 1 DMMP

ANCHOR QEA

Figure 1
Vicinity Map

Dagger Island Attachment 4
Texas Lower Coast Beneficial Use



LEGEND:

- PROPOSED ARMORED CONTAINMENT BERM
- PROPOSED VEGETATED CONTAINMENT BERM
- U.S. ARMY CORPS OF ENGINEERS OPEN WATER DREDGED MATERIAL PLACEMENT AREA
- DREDGED MATERIAL PLACED TO VARYING ELEVATIONS FROM 1.5' TO 3.5' NAVD88, SEE NOTE 5
- GULF INTRACOASTAL WATERWAY
- SEAGRASS MAPPED BY TRITON ENVIRONMENTAL SOLUTIONS, LLC
- OYSTER HABITAT MAPPED BY TRITON ENVIRONMENTAL SOLUTIONS, LLC
- —0— EXISTING CONTOUR (5')
- —-2— EXISTING CONTOUR (1')
- DERELICT CHANNEL
- RAILROAD COMMISSION OF TEXAS MAPPED OIL AND GAS INFRASTRUCTURE LOCATIONS
- ACTIVE OIL WELL
- SEAGRASS RESTORATION AREAS (5.3 ACRES)

NOTES:

1. HORIZONTAL DATUM: TEXAS STATE PLANE SOUTH CENTRAL ZONE, NAD83, U.S. SURVEY FEET
2. VERTICAL DATUM: NORTH AMERICAN VERTICAL DATUM OF 1988 (NAVD88)
3. BATHYMETRIC AND TOPOGRAPHIC SURVEYS CONDUCTED BY TRITON ENVIRONMENTAL SOLUTIONS, LLC, ON MARCH 18 AND MARCH 21, 2022.
4. HABITAT SURVEY CONDUCTED BY TRITON ENVIRONMENTAL SOLUTIONS, LLC, ON MARCH 18 AND MARCH 21, 2022.
5. ELEVATIONS ARE DEPENDENT ON THE MATERIAL PLACED.

Publish Date: 2022/09/14 3:42 PM | User: mpratschner
Filepath: K:\Projects\2018-PCCA Beneficial Use\DAGGER ISLAND\2018 RP-002 BERM_DI DMMP.dwg Figure 2

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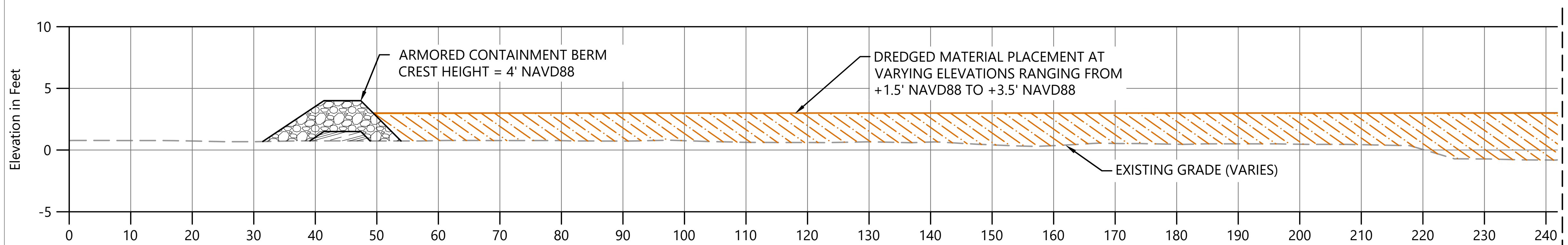
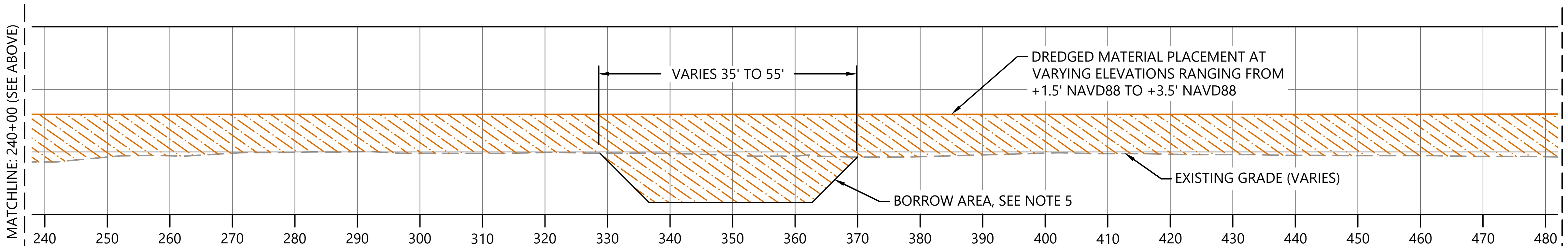
Figure 2
Plan View

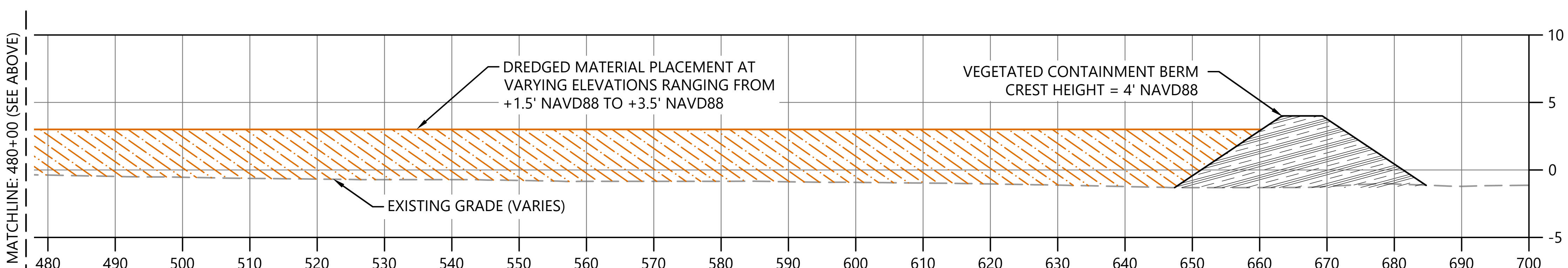
Dagger Island Attachment 4
Texas Lower Coast Beneficial Use



A
Fig 2
TYPICAL MARSH FILL SECTION
HORIZONTAL SCALE: 1" = 20'
VERTICAL SCALE: 1" = 10'



A
Fig 2
TYPICAL MARSH FILL SECTION
HORIZONTAL SCALE: 1" = 20'
VERTICAL SCALE: 1" = 10'



A
Fig 2
TYPICAL MARSH FILL SECTION
HORIZONTAL SCALE: 1" = 20'
VERTICAL SCALE: 1" = 10'

NOTES:

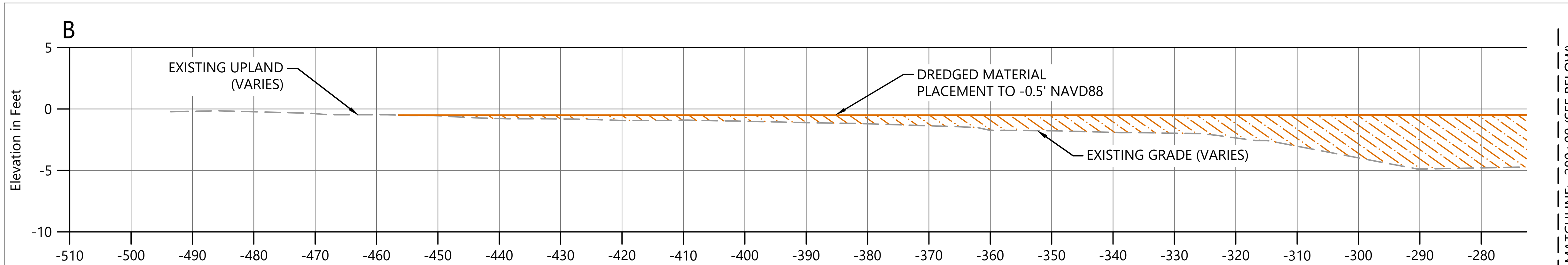
1. HORIZONTAL DATUM: TEXAS STATE PLANE SOUTH CENTRAL ZONE, NAD83, U.S. SURVEY FEET
2. VERTICAL DATUM: NORTH AMERICAN VERTICAL DATUM OF 1988 (NAVD88)
3. BATHYMETRIC AND TOPOGRAPHIC SURVEYS CONDUCTED BY TRITON ENVIRONMENTAL SOLUTIONS, LLC, ON MARCH 18 AND MARCH 21, 2022.
4. HABITAT SURVEY CONDUCTED BY TRITON ENVIRONMENTAL SOLUTIONS, LLC, ON MARCH 18 AND MARCH 21, 2022.
5. BORROW AREA DIMENSIONS SHOWN FOR ILLUSTRATION PURPOSES ONLY. ACTUAL DIMENSIONS TO BE DETERMINED BASED ON FINAL DESIGN AND BY SELECTED CONTRACTOR.

Publish Date: 2022/09/14 3:42 PM | User: mpratschner
Filepath: K:\Projects\2018-PCCA Beneficial Use\DAGGER ISLAND\2018 RP-002 BERM_DI DMMP.dwg Figure 3

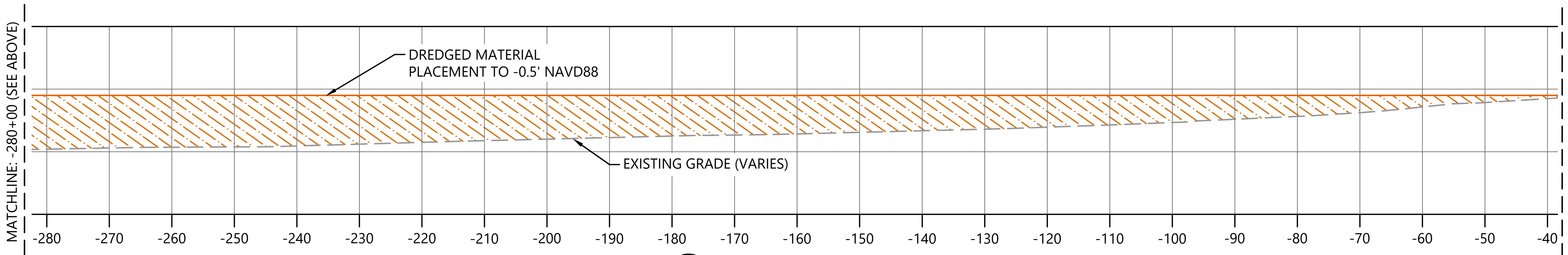
ANCHOR QEA

Figure 3
Typical Marsh Fill Section

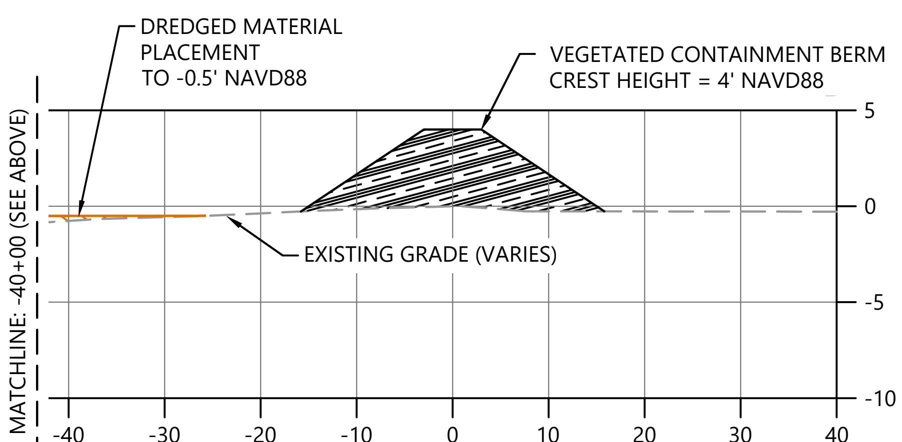
Dagger Island Attachment 4
Texas Lower Coast Beneficial Use



B
Fig 2
TYPICAL SEAGRASS FILL SECTION
HORIZONTAL SCALE: 1" = 20'
VERTICAL SCALE: 1" = 10'



B
Fig 2
TYPICAL SEAGRASS FILL SECTION
HORIZONTAL SCALE: 1" = 20'
VERTICAL SCALE: 1" = 10'



B
Fig 2
TYPICAL SEAGRASS FILL SECTION
HORIZONTAL SCALE: 1" = 20'
VERTICAL SCALE: 1" = 10'

NOTES:

1. HORIZONTAL DATUM: TEXAS STATE PLANE SOUTH CENTRAL ZONE, NAD83, U.S. SURVEY FEET
2. VERTICAL DATUM: NORTH AMERICAN VERTICAL DATUM OF 1988 (NAVD88)
3. BATHYMETRIC AND TOPOGRAPHIC SURVEYS CONDUCTED BY TRITON ENVIRONMENTAL SOLUTIONS, LLC, ON MARCH 18 AND MARCH 21, 2022.
4. HABITAT SURVEY CONDUCTED BY TRITON ENVIRONMENTAL SOLUTIONS, LLC, ON MARCH 18 AND MARCH 21, 2022.

Figure 4
Typical Seagrass Fill Section

Memorandum

September 30, 2022

To: Sarah Garza, Harrison McNeil, and Yvonne Dives-Gomez, Port of Corpus Christi Authority

From: Todd Merendino, Ducks Unlimited, Inc.
John Laplante, Dan Opdyke, Renee Robertson, Alexander Freddo, and Hayden Smith, Anchor QEA, LLC
Jane Sarosdy, Sarosdy Consulting, Inc.
Ray Newby, Texas Department of Transportation

Re: Feeder Berm North of Fish Pass 60% Design Memorandum

Introduction

This 60% design memorandum describes design criteria and assessments associated with a beneficial use of dredged material (BU) project at the proposed Feeder Berm North of Fish Pass site (Site), located in Texas General Land Office (GLO) Planning Region 3 of the Texas coast, in the Gulf of Mexico near Mustang Island, Nueces County, Texas (Figure 1). Photographs of the Site are in Attachment 1.

Project Background

GLO awarded a Coastal Management Program Project of Special Merit grant (funded through the Gulf of Mexico Energy Security Act) to Ducks Unlimited, Inc. (DU) to coordinate with stakeholders and identify restoration sites for BU. The Port of Corpus Christi Authority (PCCA), a project partner, has also contributed staff and financial resources to expand the project scope. The project team is led by DU and PCCA and includes Anchor QEA, LLC; Sarosdy Consulting, Inc.; and the Texas Department of Transportation. Collectively, the project team coordinated three stakeholder meetings with state and federal resource agencies, nongovernmental organizations, academia, consultants, and local officials in each region to solicit information about potential BU sites. Based on stakeholder input, GLO feedback, publicly available data, and professional judgment, the project team has developed 10% designs for 18 sites in GLO Planning Regions 3 and 4 of the Texas coast and 2 GLO-approved sites in Mesquite Bay and San Antonio Bay in GLO Planning Region 2. After completion of the 10% designs, 11 of the designs were selected to continue to 30% designs, and 7 of those designs were chosen for 60% designs and permit application packages. The project team selected the Site as one of the seven sites for 60% design development and cost estimation, and permit application package development using funding from PCCA.

Beaches provide economic value to humans, as well as habitat for breeding and foraging wildlife (Marbán 2019). The beaches along the Texas coast, especially Mustang Island, serve as a habitat for threatened and endangered species, including all five species of sea turtles (green sea turtle [*Chelonia mydas*], hawksbill sea turtle [*Eretmochelys imbricata*], Kemp's ridley sea turtle [*Lepidochelys kempii*], leatherback sea turtle [*Dermochelys coriacea*], and loggerhead sea turtle [*Caretta caretta*]), the piping plover (*Charadrius melodus*), and the red knot (*Calidris canutus*) (USFWS 2021; NPS 2022). The stretch of shoreline on Mustang Island from Fish Pass to Port Aransas is in an erosive environment resulting in coastline retreat (BEG 2019). Gulf beach erosion directly reduces available habitat for threatened and endangered sea turtles and avian species.

Fish Pass is a relict channel on Mustang Island located approximately 13 miles south of Port Aransas and approximately 5 miles north of the Packery Channel. Although once a source of hydrologic exchange between the Gulf of Mexico and Corpus Christi Bay, the pass has shoaled over time. Conversations with Deidre Williams of the Texas A&M Corpus Christi Conrad Blucher Institute (CBI) identified an area north of Fish Pass to be an appropriate location for a prototype feeder berm (Attachment 2, Figure 1; Williams 2021). The proposed berm would nourish eroding beaches over time as a result of natural processes driven by prevailing southeast winds and resulting nearshore currents.

Project Objectives

Frequent dredging is needed to develop and maintain Texas navigation channels. The dredged material is often deposited in dredged material placement areas (DMPAs), and many of the existing DMPAs along the Texas coast are nearing capacity. Resource agencies and stakeholders have long advocated using dredged material beneficially to create and restore wetlands and bird islands, nourish beaches, and counteract land loss. Historically, BU projects are difficult to manage because they are multiyear, multifaceted undertakings in which different organizations manage dredging schedules, funding, project design, permitting, and construction activities. To help address these issues, the objectives of this project include the following:

- Create and restore degrading coastal habitats.
- Establish sites for disposal of dredged material to reduce reliance on existing DMPAs.
- Improve coastal resiliency of the natural and built environment.

To accomplish these objectives, the project includes the following tasks:

- Stakeholder outreach and coordination
- Identification and selection of BU sites
- 10% designs and cost estimates for 20 BU sites
- 30% designs for 11 BU sites
- 60% designs, cost estimates, and permit application packages for seven BU sites

This memorandum documents the 60% design and cost estimate for the Site.

Design Objectives

The Site will be designed to beneficially use dredged material of suitable beach quality to create a feeder berm in a region with coastal and beach erosion. Suitable beach-quality material may be available from navigation channels during routine maintenance or new work dredging associated with future PCCA projects, thus reducing the volume of such material placed in existing open-bay or upland DMPAs. This 60% design is based upon publicly available datasets, stakeholder recommendations, and focused field work conducted by T. Baker Smith.

Design objectives include the following:

- Develop a preliminary vision based on available data for the Site that includes the following:
  - Beach to be nourished
  - Potential sediment source(s)
- Delineate conceptual footprints for proposed BU placement.
- Identify key sensitive habitats and construction considerations in the vicinity of the Site.
- Estimate fill volumes for the proposed BU footprints.
- Evaluating depth of closure near the Site
- Selecting berm shape and location to avoid increasing wave erosion on existing beaches
- Identify data gaps to be addressed in subsequent design phases.
- Provide preliminary cost estimates.

Stakeholder Feedback

The 30% design for the Site was presented at the Lower Coast Beneficial Use Planning Region 3 Stakeholder meeting on June 14, 2022. Attendees included staff from GLO, the U.S. Army Corps of Engineers (USACE), the Texas Parks and Wildlife Department (TPWD), the Coastal Bend Bays & Estuaries Program, the U.S. Fish and Wildlife Service, local officials, and other professionals.

Some comments from this meeting, as well as written comments on the 30% designs, follow:

- A coastal scientist at CBI recommended early dialog with Beach Ops, Surfrider, and Corpus Christi's Watershore and Beach Advisory Committee.
  - The design team has initiated communication with Surfrider and agrees that a dialog with Beach Ops, Surfrider, and Watershore and Beach Advisory Committee should be set up during the subsequent design phases.
- TPWD staff explained that beach-quality material is necessary to avoid adverse effects on biological and recreational uses of the Gulf beach.
  - The design team agrees that potential sources of material, once identified, should be tested to ensure beach-quality material is nourishing the beaches.

- Nueces County staff suggested the project team partner with researchers at CBI to improve modeling of predicted sediment transport and accretion.
  - The design team has started communications with researchers at CBI. Further communications during subsequent design phases would be beneficial to improve the efficacy of the Site.
- A coastal scientist at CBI recommended considering shifting the project to the northeast to increase benefit to the eroding beaches closer to Access Road 2 on Mustang Island.
  - There are currently nearshore berms planned northeast of the site as a part of the Corpus Christi Ship Channel (CCSC) Deepening Project. The design team has elected to keep the location of the project in its current position due to uncertainty in the influence of this project on the planned nearshore berms for the CCSC Deepening Project. The location may be refined in subsequent design phases through communication with the proponents of the CCSC Deepening Project planned nearshore berms.

The comments above represent the key issues brought forward to the project team. Other comments, generally more minor and easily addressed, are not included in this list. When feasible, comments have been incorporated into the 60% design, as noted in the below sections, and others may be addressed in the final design.

Existing Data Review

A review of existing data and the focused data collected by T. Baker Smith and other existing data was performed to develop the Site. This section describes the data reviewed and collected to support the 60% design.

Horizontal and Vertical Datums

The horizontal datum used for the Site is the Texas State Plane South Zone, North American Datum of 1983 in U.S. survey feet. The primary vertical datum used for the Site design is the North American Vertical Datum of 1988 (NAVD88). The National Oceanic and Atmospheric Administration (NOAA) maintains an active tide gage within the vicinity of the Site. The NOAA Bob Hall Pier Station 8775870 (Bob Hall Pier Station) is approximately 8 miles southwest of the proposed feeder berm. This station collects and records real-time tide information dating back to 1983. The vertical datums from this station that will be used for the Site are shown in Table 1.

Table 1
Bob Hall Pier Station Tidal Datums

Tidal Datums	Elevation (feet NAVD88)	Elevation (feet MLLW)
MHHW	1.13	1.63
MHW	1.04	1.54
MSL	0.43	0.93
MLW	-0.28	0.22
MLLW	-0.50	0

Notes:
MHHW: mean higher high water
MHW: mean high water
MLLW: mean lower low water
MLW: mean low water
MSL: mean sea level

Meteorological, Ocean, Wave, Depth of Closure, and Longshore Transport Data

Wind and Waves

USACE Wave Information Studies (WIS) provides a national resource of long-term wavefield climatologies for U.S. coastal waters that synthesizes observations, multidecade hindcasts, and storm event archives (USACE 2021). The WIS station closest to the Site is Station 73039, located just offshore on the Gulf side of Mustang Island in the Gulf of Mexico. Data from this station was analyzed to determine different design wave heights.

The project team considers the wind and wave data to be representative of the wind and wave climatologies experienced at the Site for this phase of design. Figures 2 and 3 summarize the wind and wave data, respectively, for January 1, 1980, through December 31, 2014. The data indicate the predominant wind direction is from the southeast, with significant winds also coming from the north, northeast, east, and south. Table 2 displays relevant summary statistics of the WIS Station 73039 wave data.

Table 2
WIS Station 73039 Wave Data from 1980 to 2014

Percent Rank	Wave Height[1] (feet)	Wave Period[2] (seconds)
95th	6.7	5.8
75th	4.3	5.0
50th	3.1	4.8

Notes:
Data was extracted from the 45° to 180° direction (degrees clockwise from true north).
1. Significant wave height: average wave height of highest one-third of the waves
2. Peak spectral wave period discrete spectral band

Wake Erosion

There are no existing navigation channels in the proximity of the Site. There may be some erosion due to recreational and commercial fishing vessels; however, the project team does not anticipate that wake erosion from passing vessels will negatively affect this project, as the berm is being designed to erode.

Bathymetry

On March 14, 2022, T. Baker Smith conducted a bathymetric survey of the Site (Attachment 2, Figure 2). The water depth at the Site varies from -10 to -15 feet NAVD88, with a slope between 100 horizontal to 1 vertical (100H:1V) to 150H:1V.

Depth of Closure

The depth of closure (DOC) is the most offshore point beyond which sediment would not feasibly erode and transport to the subaerial beach. Placement beyond the depth of closure would likely result in no benefit to the beach. As defined by Kraus et al. (1998), the "depth of closure for a given or characteristic time interval is the most landward depth seaward of which there is no significant change in bottom elevation and no significant net sediment transport between the nearshore and the offshore." Generally, the DOC can be defined as the depth at which time-series profiles converge (i.e., there is no elevation change). As described in Brutsché et al. (2019), the inner DOC marks the seaward extent of the littoral zone, which extends to the seaward limit of intense bed activity caused by extreme near-breaking waves and breaker-related currents. The outer DOC marks the seaward extent of the shoal zone, where expected surface waves are likely to cause little sand transport, and the waves have no effect on the bed.

For the 60% design, the Hands and Allison (1991) analytical method for predicting active (feeder) berms versus stable berms was used to determine a preliminary depth of closure for the area. A frequency analysis of the wave data from WIS Station 73039 was performed to determine bottom wave orbital velocities. Table 3 shows the results of this analysis. The Hands and Allison (1991) method identifies critical values for 75th- and 95th-percentile maximum nearbed horizontal wave orbital velocities, above which sand berms would be within the depth of closure and expected to erode into the littoral system. The 75th- and 95th- percentile limits are 40 and 70 centimeters per second (cm/sec), respectively. For water depths ranging from 10 feet to 20 feet, the 75th- percentile maximum nearbed horizontal wave orbital velocity is well above the 40 cm/sec target identified in Hands and Allison (1991). Beyond 25 feet of water depth, the 90th-percentile maximum nearbed horizontal orbital velocity drops below the 70-cm/sec limit. If the water depth is measured from the MSL datum, the method indicates the depth of closure would coincide with approximately the -

20-foot-NAVD88 contour. This analysis suggests that within the -20-foot-NAVD88 contour, it is expected the nearshore berm would be active and potentially nourish adjacent beaches.

Table 3
Maximum Nearbed Horizontal Wave Orbital Velocities

Water Depth[1] (feet)	Water Depth[1] (meters)	75th-Percentile Velocity[2] (cm/sec)	95th-Percentile Velocity[2] (cm/sec)
10	3.05	**94.7**	**161**
15	4.57	**67.1**	**116**
20	6.10	**51.3**	**90.7**
25	7.62	40.7	**73.9**
30	9.14	32.7	61.7

Notes:
Bold values are above the threshold identified by Hands and Allison (1991) and are expected to erode a sand berm.
1. Water depths were measured from MSL to the seabed.
2. Deepwater waves used for analysis are the 75th- and 95th-percentile wave heights and periods from Table 2.

As a comparison with the analysis using the Hands and Allison (1991) analysis, beach profile data collected by CBI from 2,200 feet north of the Fish Pass Jetty were reviewed (Williams 2021; Figure 4). The profile comparisons show that there is little bed elevation change deeper than the -15- to -18-foot NAVD88 contour.

Based on these two analyses, the feeder berm is proposed to be placed within the -15-foot NAVD88 contour for the 60% design. It should be noted that a recent study performed for PCCA for proposed nearshore feeder berms near Mustang Island, the outer DOC was identified as being as deep as -28 feet NAVD88 (Vitale 2021). As part of final design, a more detailed analysis of the DOC will be performed.

Longshore Transport

Near the Site, longshore (i.e., parallel to the beach) currents occur in the northward and southward direction variously throughout the year. These currents are driven primarily by the direction of the prevailing winds, and it is suspected that hydrographic features of the inshore shelf waters interact with the winds to determine the longshore current direction (Whilden 2015; McFarland 1961).

A modeling study by HR Wallingford was developed to analyze transport within GLO Region 4 of the Texas coast (HR Wallingford 2021). Although the modeling was focused on GLO Region 4, some of the output is relevant to the location of the Site and was used to develop the preliminary design. The model describes the littoral transport in the longshore direction (and suggests there would be residual sediment transport, mostly occurring northward during the summer months and mostly southward during the winter). The model also predicts that the net annual residual sediment transport would be to the north (HR Wallingford 2021). Because the Site is located in GLO Region 3, the model results may not be representative of the Site. A further modeling study by HR Wallingford for GLO Region 3 is planned and may provide better information regarding longshore transport at the Site.

Based on existing studies and data, this area of the coast is expected to have longshore currents moving either north or south throughout the year, depending on the prevailing wind direction. This means sediment from the feeder berm could be transported either north or south as the berm erodes. Understanding this transport is critical to understanding the areas of the beach that would be receiving material eroded from the berm. This is especially important due to the possibility of negative impacts to recreational activities should sediment be transported to the jetties 1 mile southwest of the Site. Discussions with CBI indicated that sands transported south may be transported around the Fish Pass jetties and not accumulate on the northern edge of the jetties. However, it is important to understand the transport of the fine portion of the sediment to the south to ensure no negative impacts to the recreational area (Williams 2022). Modeling of the sediment transport from the feeder berm will need to be conducted during a subsequent design phase to refine the feeder berm design.

Utilities

The Railroad Commission of Texas public GIS viewer (RRC 2021) and GLO pipeline data (GLO 2021a) were used to identify mapped utilities and pipelines near the Site. One pipeline was found: a natural gas offshore gathering pipeline operated by TR Offshore, LLC, located approximately 2.2 miles east of Fish Pass (Attachment 2, Figure 2). It is not anticipated that this pipeline will affect the design or constructability of the Site. The need for Site-specific utility locations prior to construction will be determined during subsequent design phases.

Desktop Cultural Resources Survey

A search of cultural resources records in the Texas Historical Commission Texas Historical Sites Atlas Database (THC 2021) was completed on December 29, 2021. This search revealed that no cultural resources surveys have been conducted, and no cultural resources sites have been identified within the Site.

Sensitive Habitat

GLO oyster habitat GIS data (GLO 2021b) indicates there is no oyster habitat located within or adjacent to the Site. According to TPWD seagrass data (TPWD 2021), there are no seagrasses mapped within or adjacent to the Site. The Site is meant to be placed between -10 and -15 feet NAVD88, and seagrasses are not expected at this depth. Moreover, the constructed feeder is meant to nourish the adjacent beaches, which are not seagrass habitat. There are not expected to be seagrass impact concerns with this project.

Endangered sea turtles and birds are known to occur in this area. However, the placement of sediment offshore, followed by slow erosion and accretion on the beach, are designed to benefit these species. Consultation with natural resource agency staff will continue to ensure no negative impacts to these species.

Erosion

According to the Bureau of Economic Geology at the University of Texas at Austin, coastal erosion between Fish Pass and the Port Aransas jetties varies from 0 to 3.35 feet per year (BEG 2019). This erosion is believed to be the result of a combination of coastal storms and wind-wave action from the Gulf of Mexico.

Beneficial Use Source Material

One potential source of dredged material is the Corpus Christi Entrance Channel, located 13 miles north of the Site. PCCA has proposed to deepen and extend the Entrance Channel, resulting in the dredging of 29.2 million cubic yards (CY) of sand from new work and maintenance over a 10-year period. PCCA is proposing to place the material at a combination of previously authorized facilities, as well as several proposed BU sites. The BU sites include multiple feeder berms north of the proposed Site.

The Site is also 11 miles from the Corpus Christi Ocean Dredged Material Disposal Sites (ODMDSs). These ODMDSs are approved locations for offshore placement of dredged material. If the ODMDSs currently contain suitable material, they could be used as a secondary source for mining dredged material and transporting it to the Site via scows for placement.

60% Design

Feeder berms are nearshore berms typically placed as elongate bars or mounds between the depth of closure and shoreline. They can be the preferred BU method due to less-strict grain size requirements (with a goal for sands to erode into the littoral zone to nourish beaches, while fines are dispersed offshore), as well as generally being less costly to build, easier to construct, and having less environmental impact to beach nesting than direct beach placement (Brutsché et al. 2019). Along with the benefits, dredged material placement within a feeder berm may have potential unintended impacts. Some of the unintended impacts may include the following:

- Uneven distribution of material along the beach
- Uneven eroding of the berm, leading to wave focusing due to refraction
- Transport of dredged material in the longshore direction, which could place sediment in an adjacent area.

For these reasons, it is important to have a detailed understanding of the wind, wave, and hydrodynamic conditions for the Site.

The main design elements evaluated for the Site are as follows:

- Site location
- Size and shape
- Constructability
- Performance expectations
- Site construction cost estimates
- Expected ecosystem benefits
- Data and information gaps

These design elements are evaluated in this memorandum for the 60% Site design.

The placement of dredged material is expected to be paid for by the project owner but contracted by the entity funding the dredging itself (e.g., USACE). Because the dredging will be performed under a USACE (or another entity) contract, they will provide the drawings and technical specifications for BU placement of the dredged material. As a result, it is not useful to prepare 60% construction drawings and technical specifications for dredged material placement at this time. Rather, a Dredged Material Management Plan (DMMP) that provides guidance on the placement of dredged material for the Site was developed (Attachment 2). It is expected that USACE (or another entity) will incorporate the DMMP into the construction drawings and technical specifications it has with the dredger. This will ensure that the BU design grades and project objectives are achieved.

Site Location

Location, haul distance, and longshore extent of area to be nourished are all critical components to determining the location of a feeder berm (McLellan et al. 1990). The location of the Site is approximately 1.0 mile northeast of Fish Pass and is not expected to interfere with feeder berms proposed for the area north of the Site. The Site is also 13 miles from the CCSC and 11 miles from the ODMDSs potential dredged material borrow sources.

Based on stakeholder feedback and depth of closure analysis (elevation of depth of closure at approximately -15 feet NAVD88), the proposed feeder berm site is in an area with average elevations ranging from -10 to -15 feet NAVD88. Deeper water provides easier access for construction equipment than shallower water, but it reduces the likelihood that eroded sand will accrete on the beach.

The adjacent longshore area that is in an erosional environment extends from north of Fish Pass to the Port Aransas Jetties (12 miles northeast of the Site; BEG 2019). This entire area could conceivably benefit from sediment being transported to the beaches from the Site. Further analysis of sediment transport of material from the Site will need to be evaluated, and the location of the Site may need to be refined to prevent negatively impacting recreational surfing near the eastern jetty of Fish Pass (approximately 1 mile southwest of the Site) or other recreational areas reliant upon consistent wave action.

Size and Shape

Based on the availability of sediment, a cost analysis, and stakeholder feedback, the project team proposes that the area of the Site be 75 acres. Upper design crest elevation for the berm will be dependent on the draft of the hopper dredge or barges used to place the dredged material. If hydraulically placed, the crest elevation could be increased. For this preliminary design, a crest elevation of -8 feet NAVD88 was selected. The Site would be rectangular and oriented parallel to the shore (Attachment 2, Figure 2). The linear shape of the Site is ideal for promoting even erosion of the berm.

To avoid wave focusing by refraction, the berm length should be at least 2.5 times the average wavelength (McLellan et al. 1990). The average wavelength at the Site is 114 feet at the seaward toe of the Site (based on the 50th-percentile wave from WIS Station 73039), which means the minimum berm length should be 285 feet. The proposed berm length, 5,000 feet, exceeds the minimum identified length for avoiding wave focusing.

A 450-foot preliminary crest width for the berm was selected. It is generally true that wider berms provide more opportunity to cause wave breaking, and this berm crest width may be refined during subsequent design phases to either increase or decrease the level of wave breaking over the berm or to increase the total volume contained within the berm. The side slopes are expected to naturally form at a slope ranging from 16H:1V to 100H:1V, depending on the grain size and sediment density of the placed material (McLellan et al. 1990). For preliminary volume analysis, a slope of 24H:1V was selected. Table 4 summarizes the key berm design characteristics.

Fill material could be obtained from the CCSC Entrance Channel or either of the ODMDSs. It is predicted that the required fill volume will be approximately 500,000 CY.

Table 4
Berm Design Characteristics

Design Criteria	Berm
Length	5,000 feet
Total acreage	75 acres
Crest width	450 feet
Base width	650 feet
Assumed bottom elevation	-10 to -15 feet NAVD88
Total structure height	3.9 feet
Materials	Mostly sand

Design Criteria	Berm
Volume	500,000 CY
Side slopes	24H:1V
Maximum design crest elevation	-8.0 feet NAVD88

A feeder berm is placed in sufficiently shallow water and with relatively high relief and induces wave breaking, especially during storm conditions, therefore significantly reducing the wave energy arriving at the shoreline. A feeder berm also tends to migrate onshore under accretionary wave conditions. As such, hydrodynamic modeling, especially predictions of wave propagation, wave-induced currents, and wave dissipation, plays a crucial role in the evaluation of the design and anticipated performance of nearshore berms (Brutsché et al. 2019).

Initial wave modeling of the proposed feeder berm was performed as part of the 60% design. The purpose of the modeling was to evaluate the potential for wave breaking and energy dissipation over the berm for representative waves from predominant directions. Wave data from WIS Station 73039 were examined to evaluate prevailing wind and wave conditions that could approach and impact the site. The coastal modeling analysis was performed using a 2D wave model to simulate nearshore wave conditions. Delft3D Flexible was the numerical model selected for these simulations. The model was developed and supported by Deltares and validated for use in riverine, estuarine, and open-coast hydrodynamic systems. Wave growth and transformation modeling was performed with the 2D Delft3D-WAVE (WAVE) model. The WAVE model is based on the Simulating Waves Nearshore (SWAN) model. The SWAN model was developed by the University of Delft and includes all relevant wave processes, such as refraction, shoaling, diffraction approximated by directional spreading of the phase-averaged waves, and wave breaking.

Based on a review of the WIS data (Figure 3), model simulations were performed for waves approaching from the southeast, south-southeast, and east. Table 5 shows the wave conditions simulated.

Table 5
Model Simulation Scenarios

Wave Direction	Significant Wave Height (feet)	Peak Wave Period (seconds)
Southeast	8.2	4.0
South-southeast	8.2	4.0
East	8.2	4.0

Figures 5 through 10 show a comparison of wave model results for existing and proposed conditions, and the wave height differences for the three directions modeled. The model results show how the feeder berm induces wave breaking over the feeder berm. The difference plots show that there is a significant decrease of up to 2 feet in wave height directly over the berm due to waves breaking over it. This creates a lower-energy zone directly between the berm and shoreline. These results suggest the feeder berms in these locations would be active berms. As part of subsequent design phases, additional modeling, including coupling the wave model with a hydrodynamic model to evaluate inner and outer DOC limits, nearshore bed orbital velocities and bed shear stresses, longshore currents, and sediment transport potential, will be performed. These results will be compared with and used in conjunction with USACE design guidance to confirm the optimal location of the feeder berm, as well as to understand the effect the feeder berm would have on wave and current conditions along the shoreline and adjacent areas.

Constructability

The final construction would be based on the selected means and methods and selected equipment from the contractor; however, construction could potentially be conducted by either mechanically placing the material into barges for transport or hydraulically dredging with a hopper dredge. The material would then be placed at the site from the hopper dredge or barge, either by mechanical or hydraulic placement. In addition, the contractor may provide alternate construction methods from those described in this section.

Performance Expectations

It is expected that dredged material placed within the depth of closure will erode into the nearshore littoral transport system and will not remain a stable feature. The expectation is that this material will be moved in the cross-shore and longshore directions, thus providing material to adjacent shorelines. During the erosion process, the feeder berm will alter wave conditions for the portion of the beach within the vicinity of the feeder berm. This process will also result in fines migrating offshore, while sands will migrate into the nearshore littoral transport system.

Site Construction Cost Estimates

Construction costs were estimated for the design outlined in the previous sections. The estimated costs include permitting, 100% design, engineering costs for advancing the design to the construction phase, preconstruction and as-built surveys, mobilization, materials, and construction of the feeder berm. These costs represent the estimated incremental costs; i.e., those costs over and above USACE's least-costly and environmentally acceptable dredged material and disposal alternative. Table 6 shows a line-item list of each costing parameter and the total cost estimated for construction.

The costs range from $2.6 million to $5.6 million, depending on the level of contingency allocated to the project cost. The lower bound of uncertainty (-30%) and upper bound of uncertainty (+50%) were selected due to the existing data gaps, high levels of inflation, and rising fuel costs. The estimates are developed using current and generally accepted engineering cost estimating methods and are based on assumptions concerning future events. Actual costs may be affected by known and unknown risks including, but not limited to, changes in general economic business conditions, Site conditions that were unknown at the time the estimates were performed, future changes in Site conditions, regulatory or enforcement policy changes, and delays in performance. Actual costs may vary from these estimates.

Table 6
Opinion of Probable Construction Cost to 100% Project Completion

Item	Quantity	Unit	Unit Price	Total
Direct Construction Costs				
Incremental Mobilization and Demobilization[1,2]	1	%	10	$ 280,000.00
Preconstruction Survey	1	LS	$ 30,000.00	$ 30,000.00
Dredged Material Transport[1,3,4]	161	Trips	$ 17,000.00	$ 2,700,000.00
As-Built Survey	1	LS	$ 40,000.00	$ 40,000.00
Subtotal[4]			**Sum**	**$3,100,000.00**
Direct Construction Total[4]			**Sum**	**$3,100,000.00**
Indirect Construction Costs				
100% Engineering and Design[4]	1	%	LS	$ 300,000.00
Permitting[4]	1	Each	$100,000.00	$ 100,000.00
Construction Management[4]	1	%	6	$ 200,000.00
Indirect Construction Subtotal			**Sum**	$ 600,000.00
Project Subtotal[2]			**Sum**	$ 3,700,000.00
-30% Uncertainty[4]	1	%	30	$ 1,100,000.00
+50% Uncertainty[4]	1	%	50	$ 1,900,000.00
Low-End Total Project Estimated Cost[4]			**Total Sum**	**$2,600,000.00**
High-End Total Project Estimated Cost[4]			**Total Sum**	**$5,600,000.00**

Notes:
Costs were determined based upon a combination of publicly available datasets and sediment surface grabs, and topographic, bathymetric, and visual habitat surveys.

1. The estimate assumes dredged material will be transported via 3,000 CY capacity scows and placed mechanically.
2. Value is rounded to the nearest $10,000.
3. The estimate assumes one trip a day.
4. Value is rounded to the nearest $100,000.

LS: lump sum

Expected Ecosystem Benefits

The creation of the Site is expected to have positive benefits on the local ecosystem. The beach nourishment combats erosion to the natural beach system along Mustang Island. This beach provides foraging, nesting, and breeding grounds to federally protected species like the piping plover, red knot, and all five species of sea turtles.

Data and Information Gaps

Due to the potential unintended impacts of feeder berms (e.g., uneven eroding of berms [causing focused waves] and sediment transporting in the longshore direction [affecting recreation]), a better understanding of the important elements that influence the behavior of a feeder berm is necessary prior to final design. To achieve this understanding, the following data and information gaps have been identified:

- Coupled hydrodynamic, sediment transport, and wave model analysis
- Evaluation of the feeder berm's impact to adjacent beach profiles
- Evaluation of beach cross-shore morphology
- Evaluation of longshore sediment transport
- Geotechnical characteristics of the source material (maintenance and new work material)

These data gaps may need to be addressed during the progression from 60% design to final design. This current project is taking the analyses as far as practicable, considering the constraints of the project scope, budget, and schedule.

Future Work

No fatal flaw has been identified at this phase of the design; however, there are several important data and information gaps that will need to be filled prior to final design. Should the Site be selected for additional design efforts, it can be expected that some aspects of the design in this memorandum will be modified and, as appropriate, enhanced.

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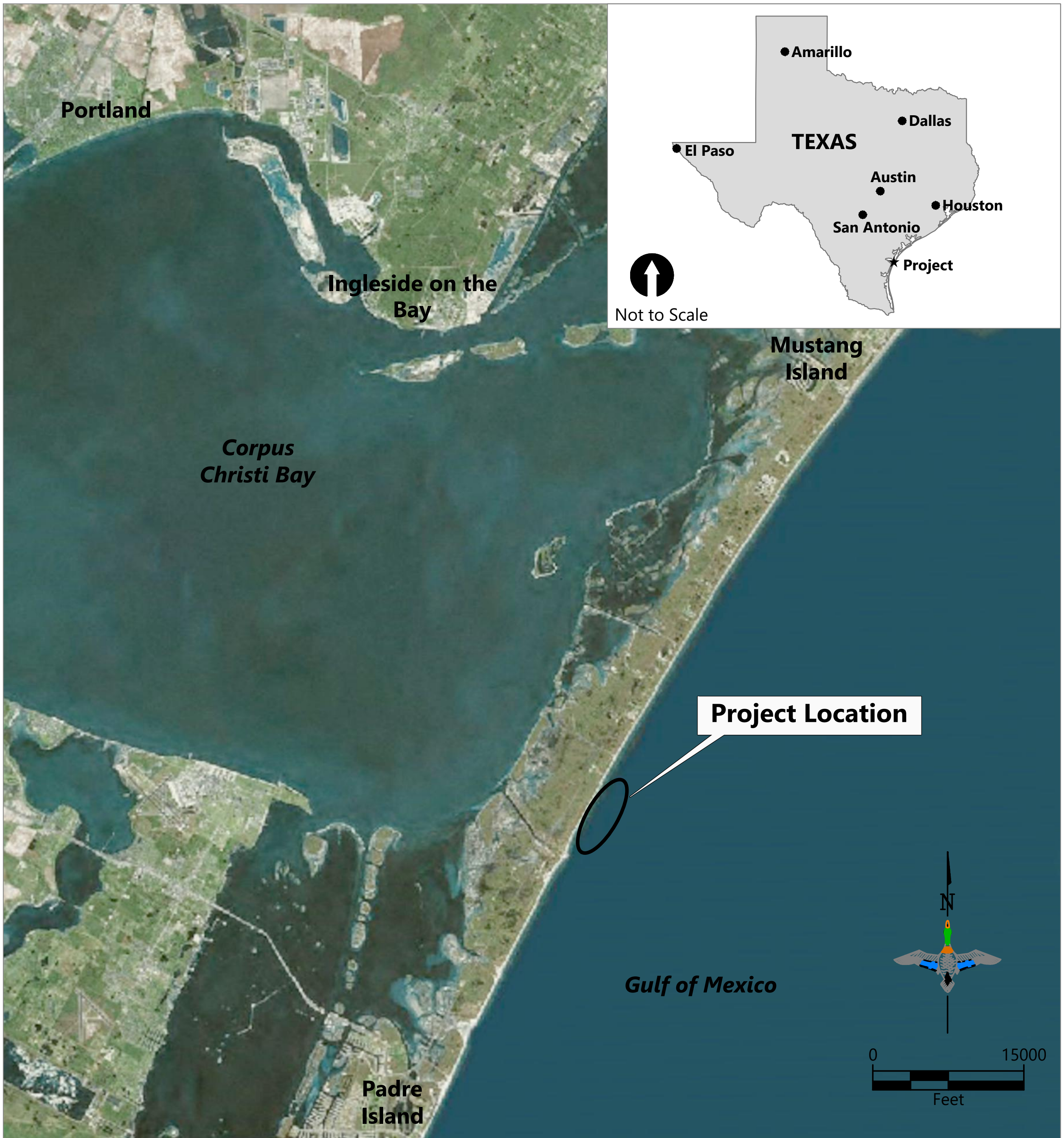
Figures

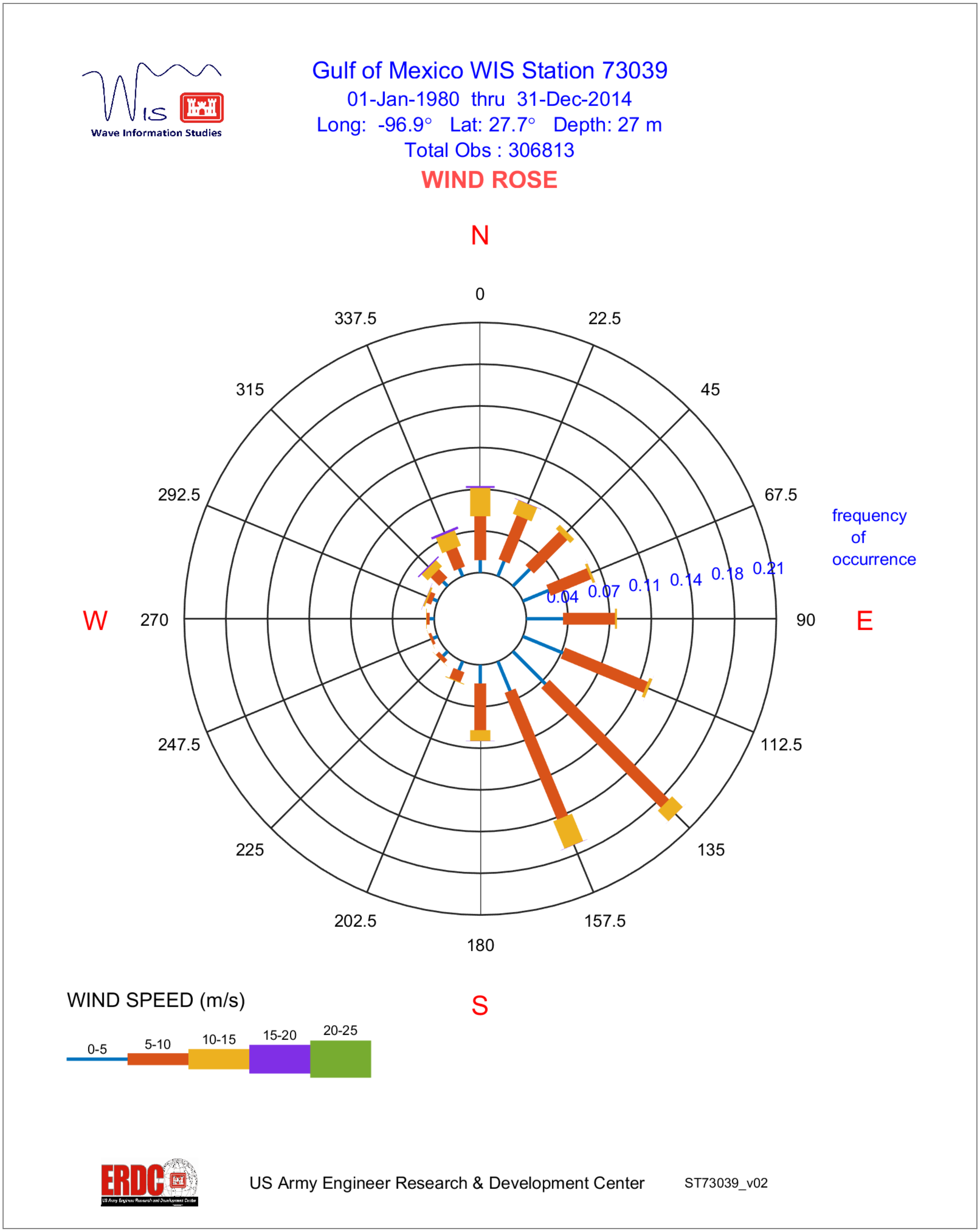


SOURCE: Aerial provided by Bing Maps.
HORIZONTAL DATUM: Texas State Plane South Zone, North American Datum of 1983, U.S. Survey Feet

Publish Date: 2022/06/09 4:44 PM | User: mpratschner
Filepath: K:\Projects\2018-PCCA Beneficial Use\FISH PASS\2018 RP-001 VIC MAP FBNFP.dwg Figure 1

Figure 1
Vicinity Map

Feeder Berm North of Fish Pass 60% Design Memorandum
Texas Lower Coast Beneficial Use



ANCHOR QEA

Figure 2
Historical Wind Data for USACE WIS Station 73039
Feeder Berm North of Fish Pass 60% Design Memorandum
Texas Lower Coast Beneficial Use

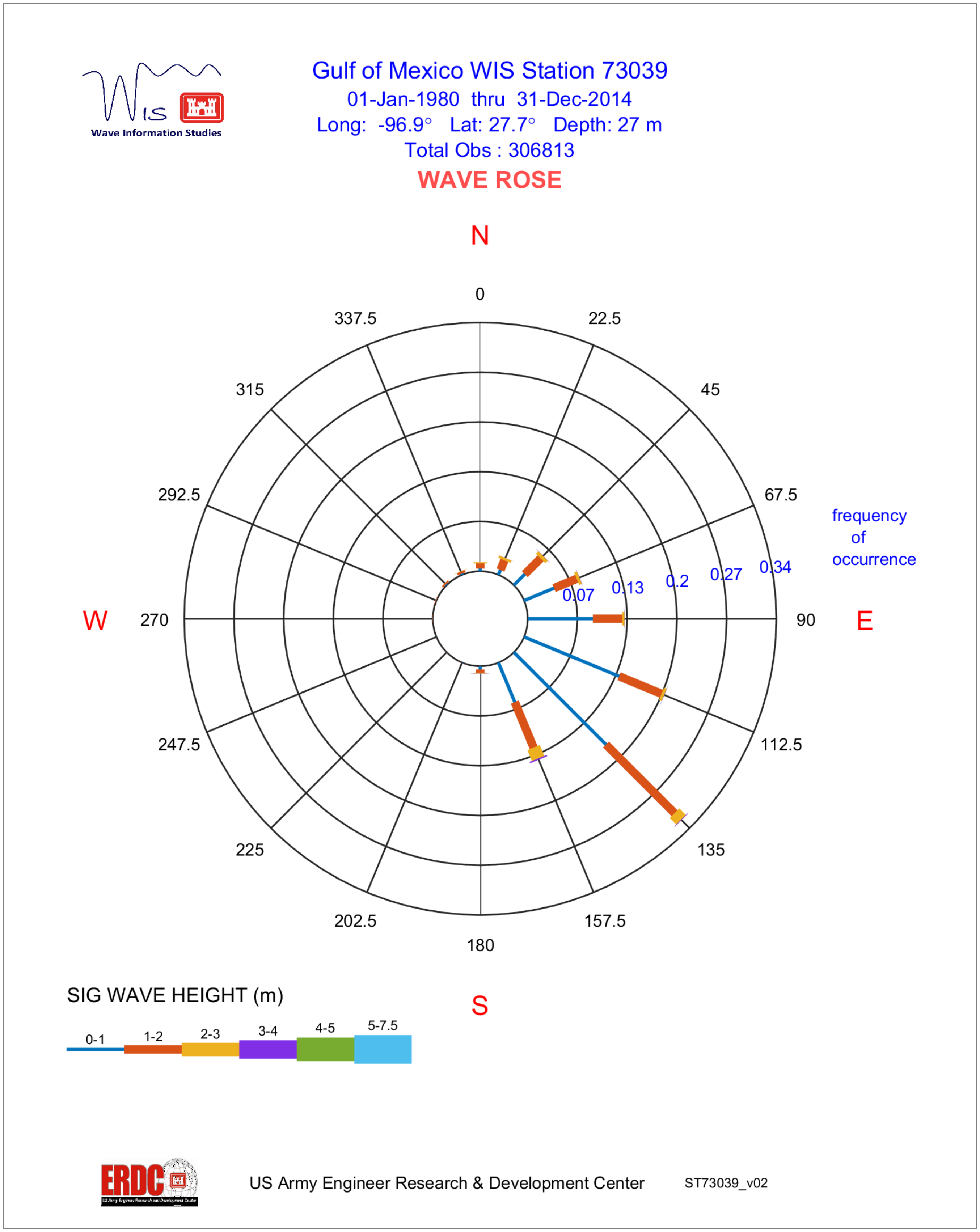
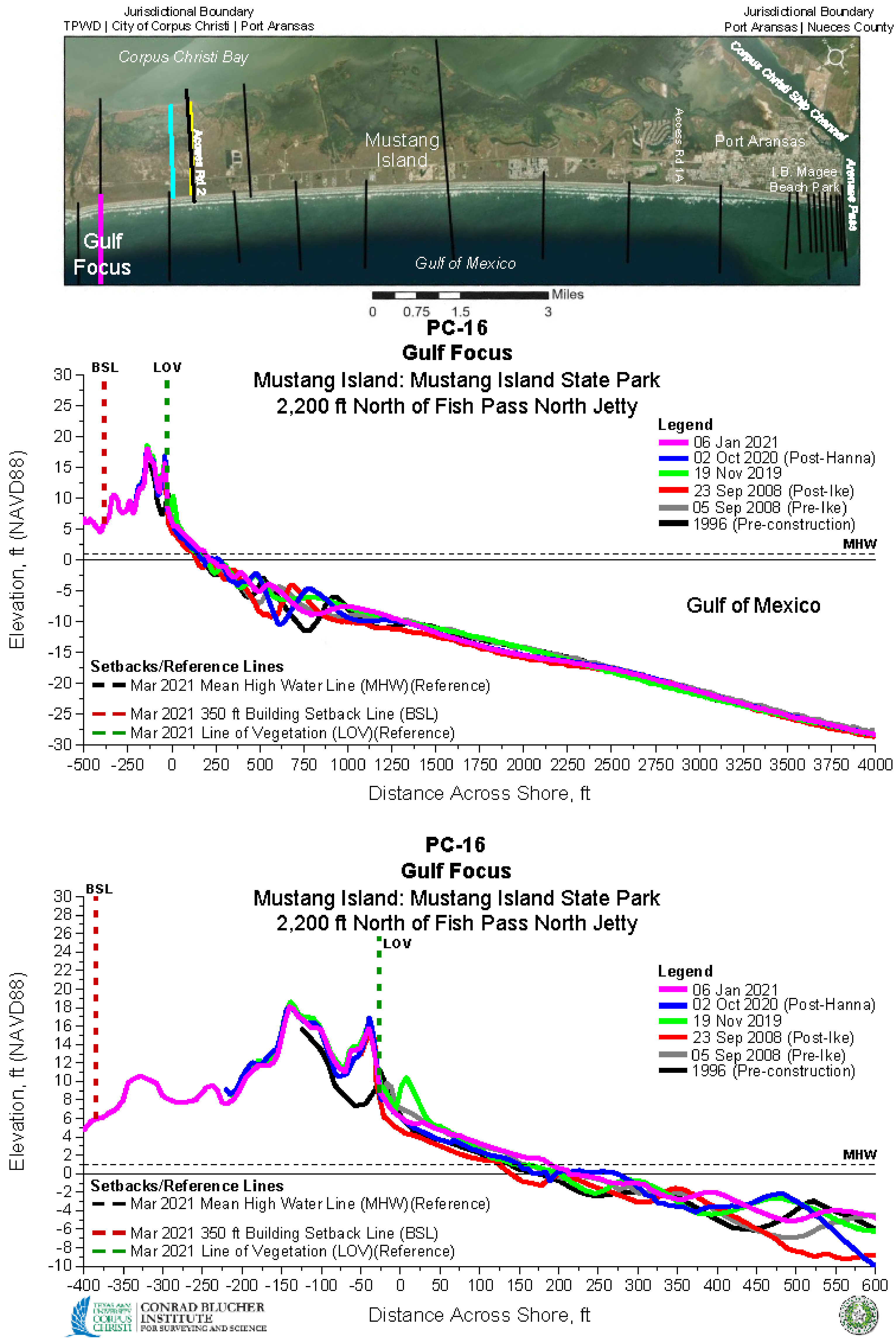


Figure 3
Historical Wave Data for USACE WIS Station 73039
Feeder Berm North of Fish Pass 60% Design Memorandum
Texas Lower Coast Beneficial Use



Notes:
Source: Texas A&M Corpus Christi Conrad Blucher Institute for Surveying Science Nueces County Beach and Coastal Resource Monitoring Program
ft: feet
NAVD88: North American Vertical Datum of 1988
TPWD: Texas Parks and Wildlife Department

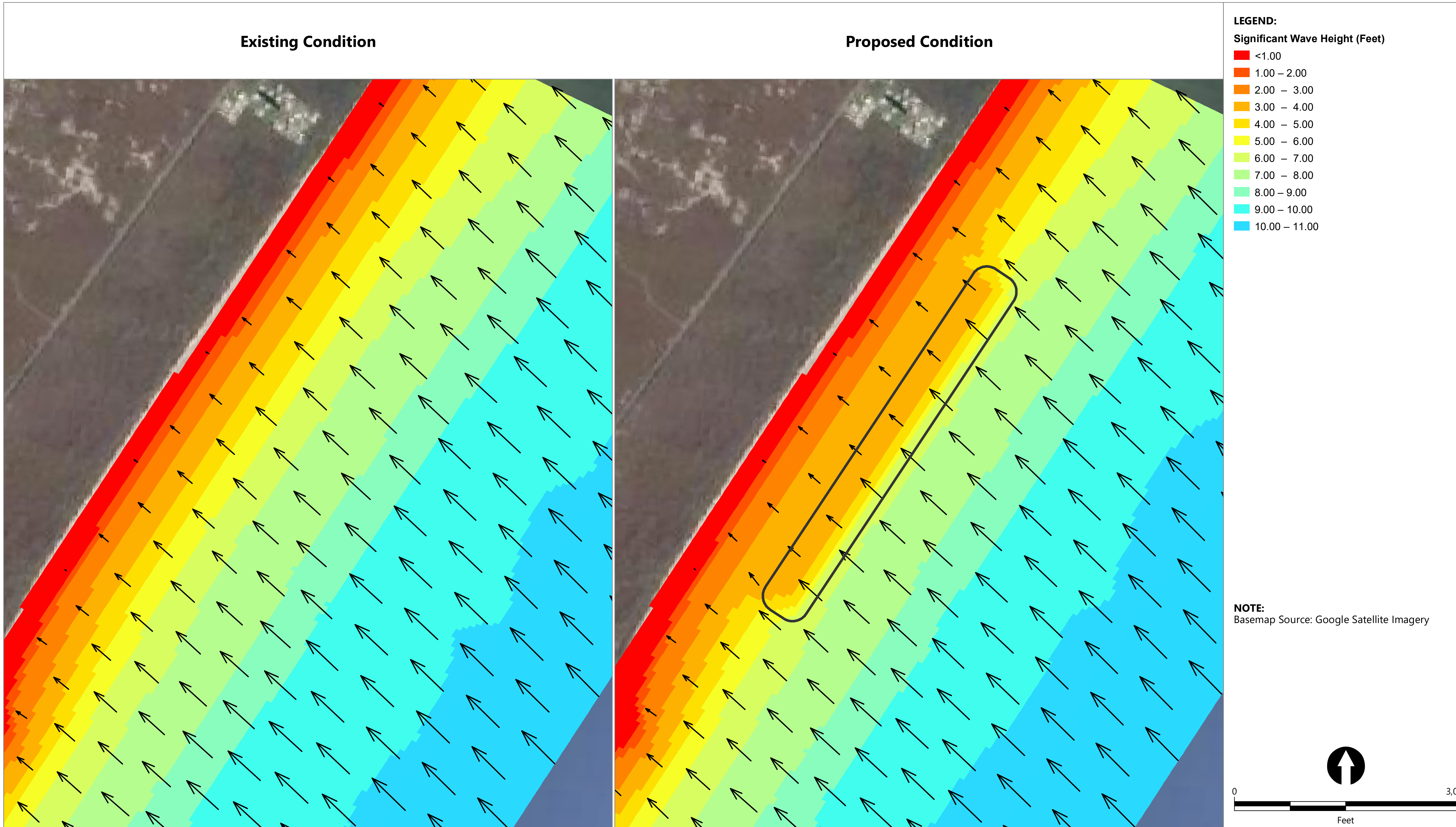


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Figure 5
Wave Height Results: Southeasterly Wind and Wave, Wave Results
Feeder Berm North of Fish Pass 60% Design Memorandum
Texas Lower Coast Beneficial Use

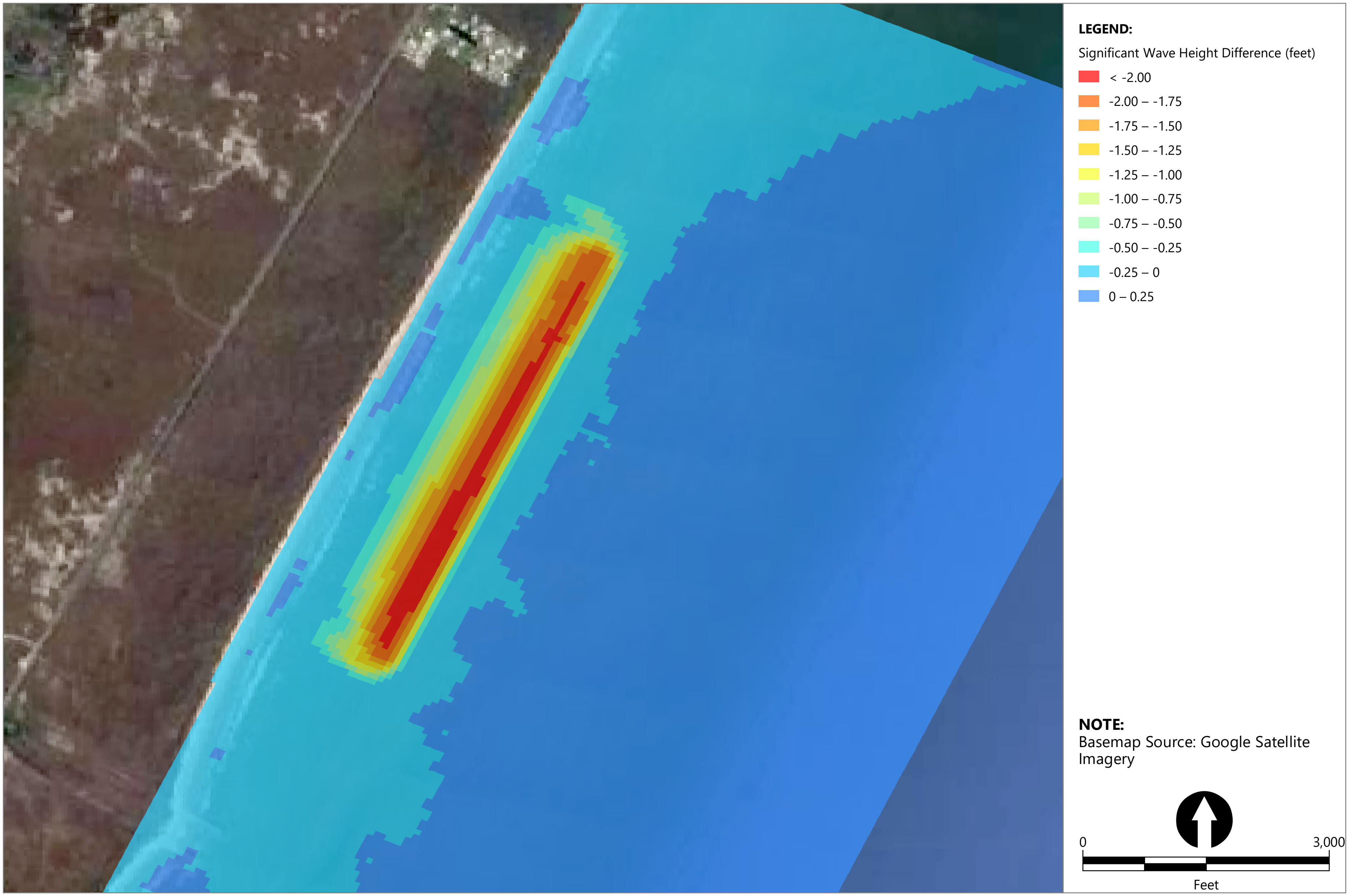

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Figure 6
Wave Height Difference Results: Southerly Wind and Wave
Feeder Berm North of Fish Pass 60% Design Memorandum
Texas Lower Coast Beneficial Use

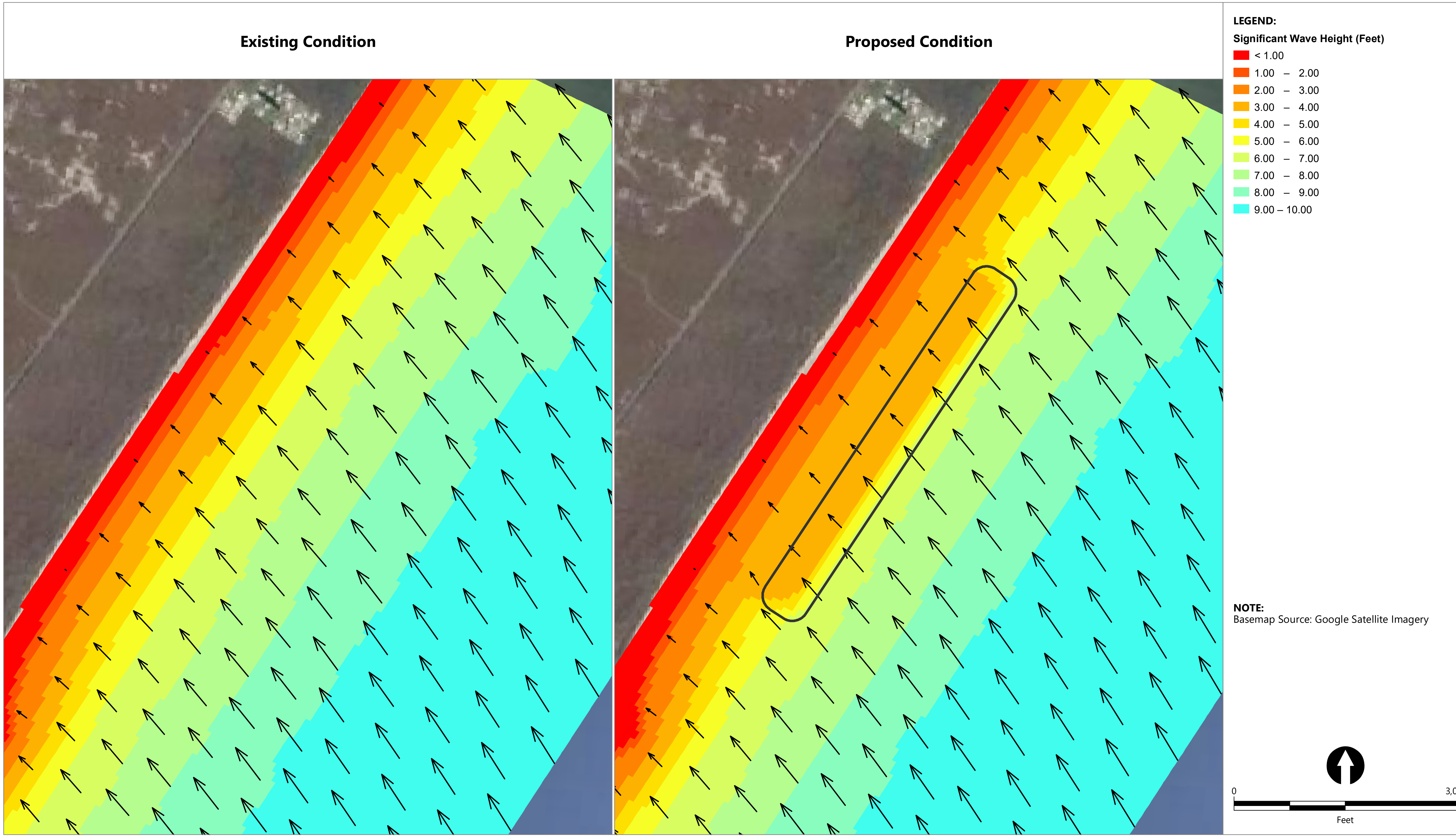

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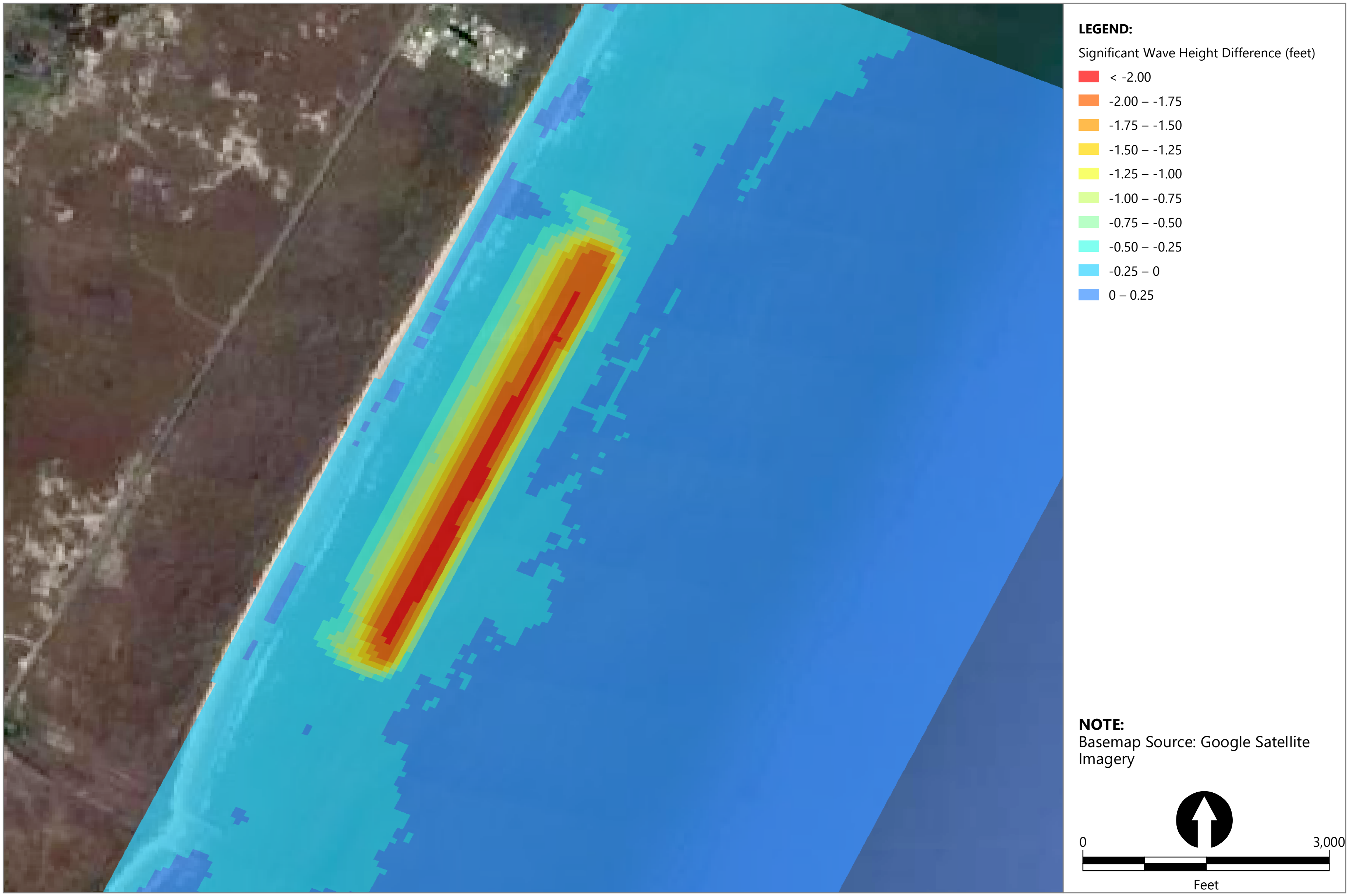
Figure 7
Wave Height Results: South-Southeasterly Wind and Wave, Wave Results
Feeder Berm North of Fish Pass 60% Design Memorandum
Texas Lower Coast Beneficial Use



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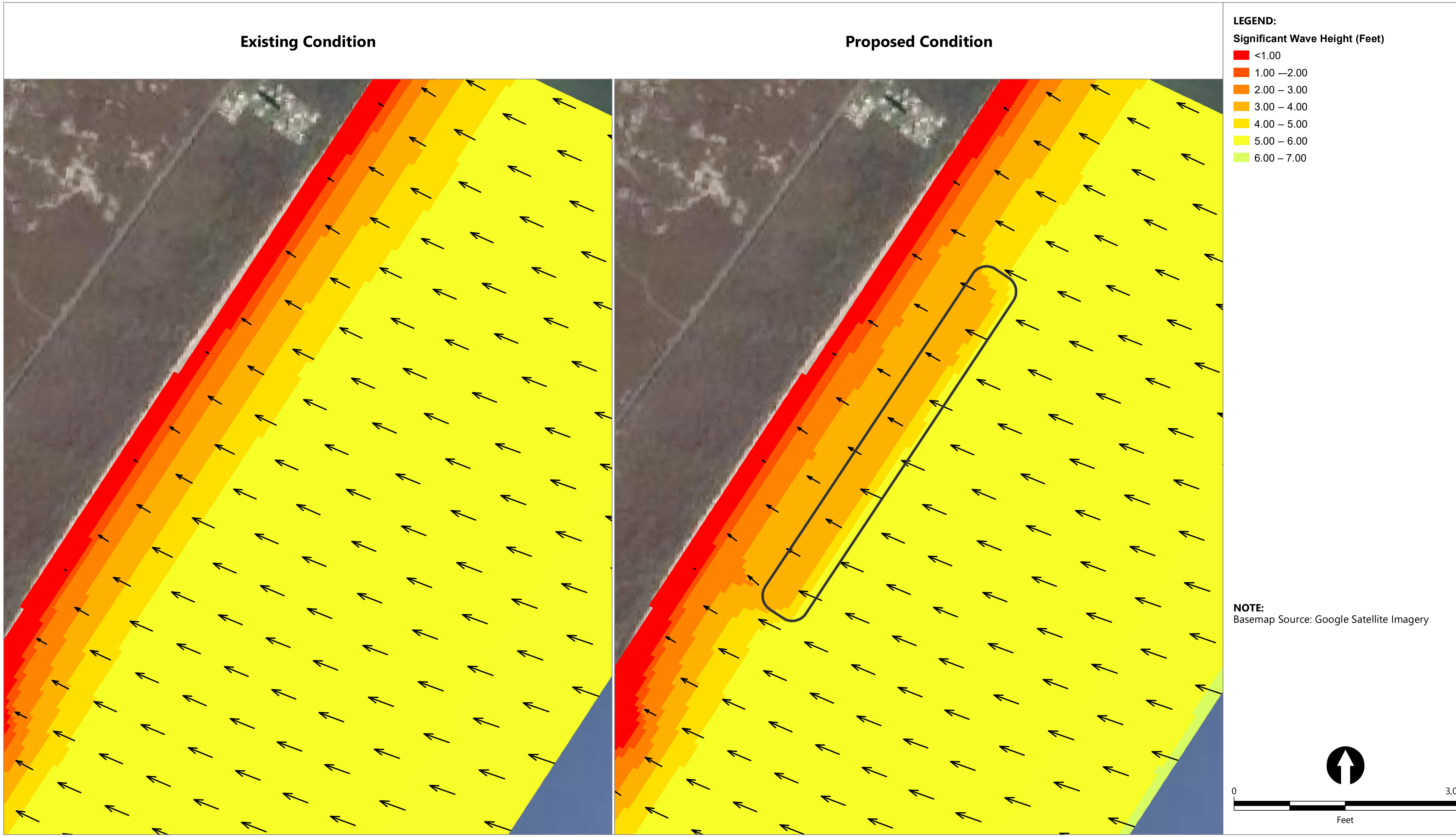
ANCHOR QEA

Figure 8
Wave Height Difference Results: South-Southeasterly Wind and Wave

Feeder Berm North of Fish Pass 60% Design Memorandum
Texas Lower Coast Beneficial Use



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ANCHOR QEA

Figure 9
Wave Height Results: Easterly Wind and Wave, Wave Results
Feeder Berm North of Fish Pass 60% Design Memorandum
Texas Lower Coast Beneficial Use

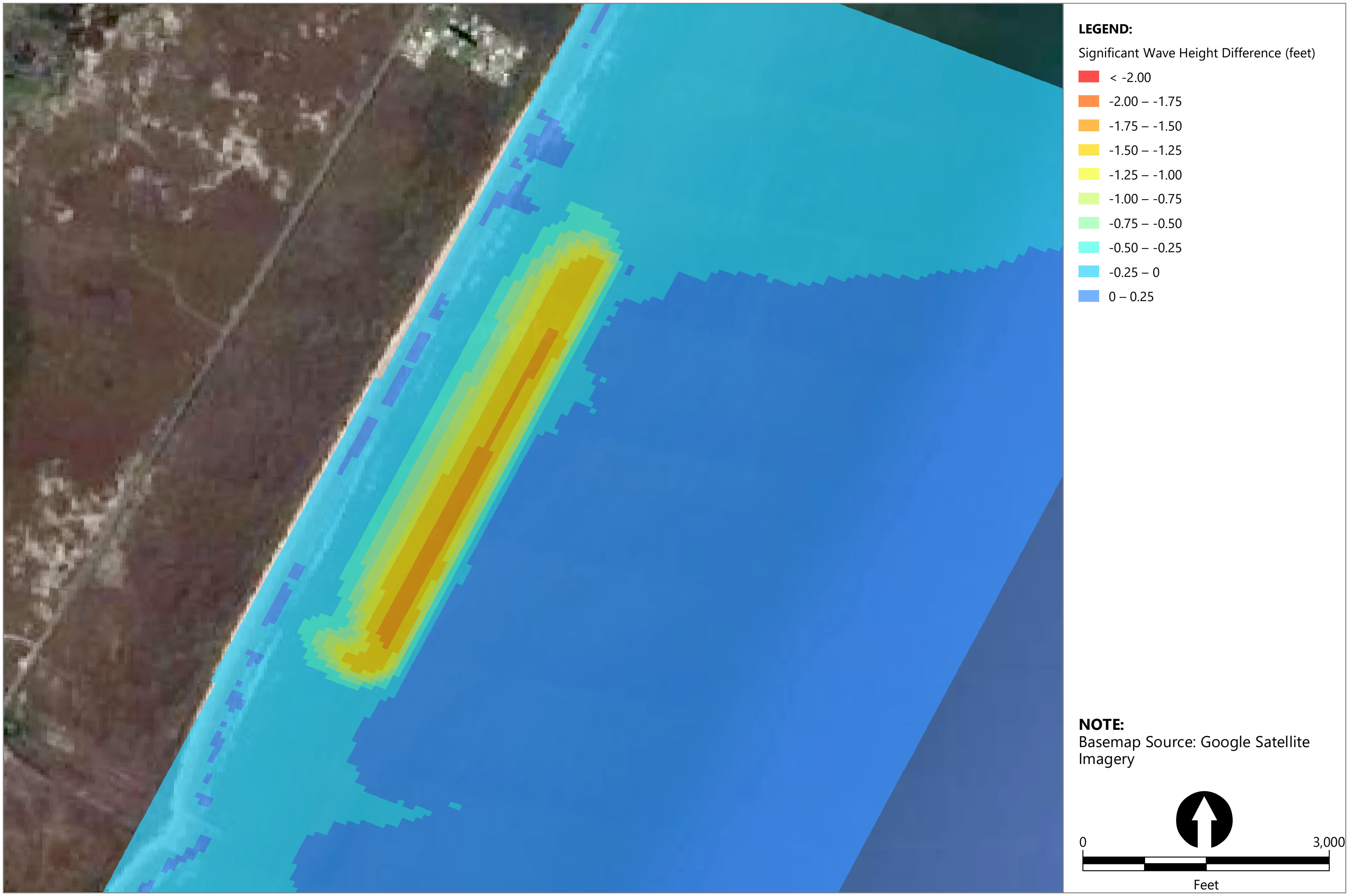

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Figure 10
Wave Height Difference Results: Easterly Wind and Wave
Feeder Berm North of Fish Pass 60% Design Memorandum
Texas Lower Coast Beneficial Use

Attachment 1
Site Photographs

View of beach from Fish Pass Jetty looking north

View of waves breaking near Fish Pass Jetty looking north

View of beach near Fish Pass Jetty looking north

View of waves breaking on beach north of Fish Pass Jetty

Attachment 2
Dredged Material Management Plan

Dredged Material Management Plan – Feeder Berm North of Fish Pass

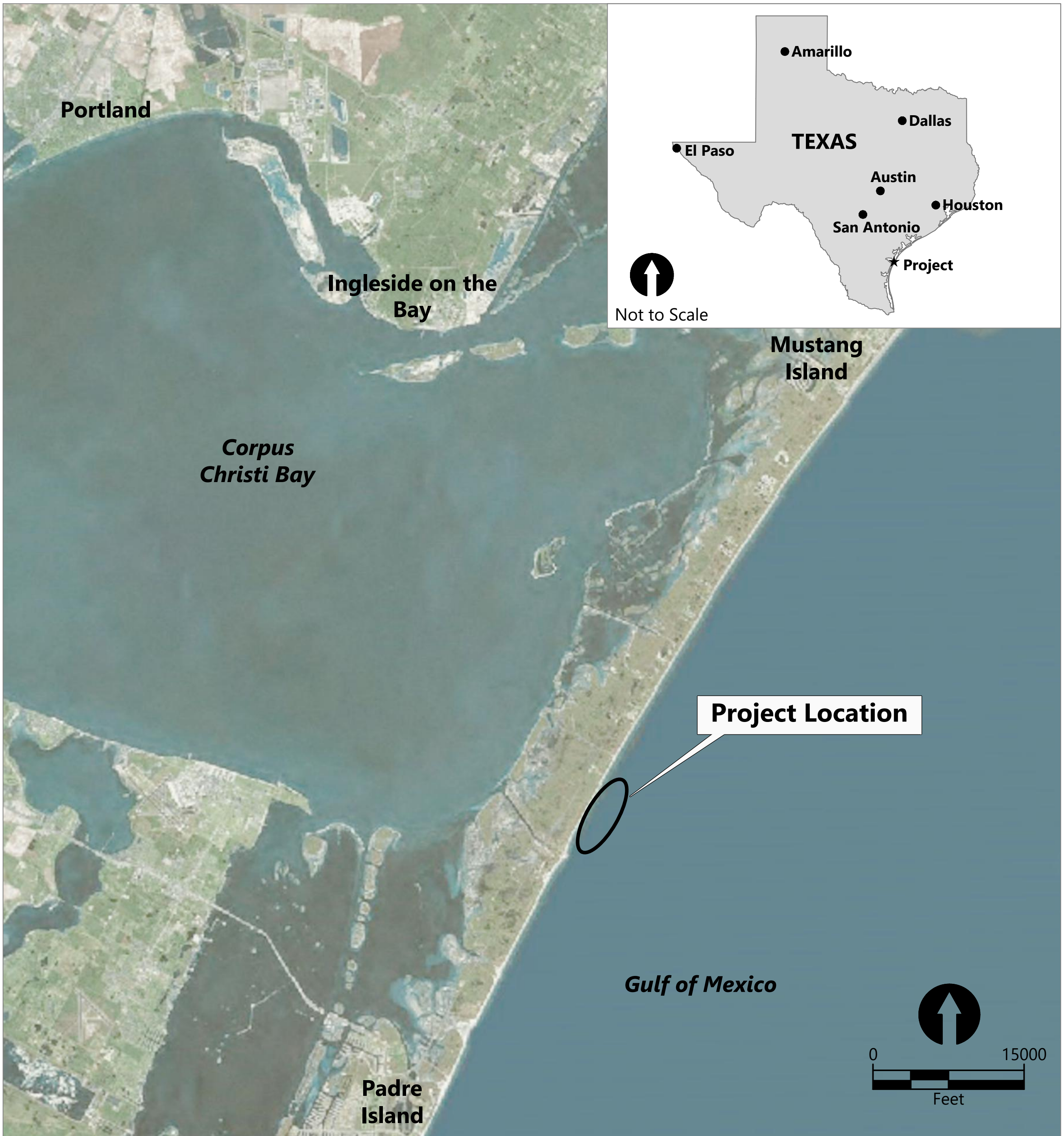
The Dredged Material Management Plan for Feeder Berm North of Fish Pass provides guidance on placement of dredged material. Figures 1 through 3 are provided for informational purposes. The intent is to place dredged material to create a nearshore berm.

Dredged Material Placement

The following details the recommended placement plan:

- The Contractor shall place dredged material in the berm area as directed by the Engineer. The proposed method of placement shall be approved by the Engineer prior to commencement of work.
- Dredged material placement elevations during berm creation will be determined by the Engineer. Based on surveys and site visits, the Engineer will direct the Contractor on placement areas and elevations. The intent of the placement is to create a 450-foot-wide, 5,000-foot-long berm with a crest elevation of -8.0 feet North American Vertical Datum of 1988.
- The Contractor shall begin placing the dredged material in accordance with the specifications and Contractor's approved work plan. Deviations will be approved on a weekly basis by the Engineer, based on the adaptive placement approach, using surveys to guide the decision process.
- The Contractor shall use a placement method and employ best management environmental control practices that can be adapted for placing dredged material in varying locations and elevations and that will minimize turbidity in the water discharged from the berm placement area.
- If hydraulically placing dredged material, the Contractor shall limit its discharge rate as necessary for the proposed equipment, water depth, surface area, and borrow material properties to prevent turbidity exceedances.
- At the completion of berm creation and as directed by the Engineer, the Contractor shall complete the as-built survey of the constructed berm.
- Deviations in berm elevation shall not be greater than +/-1.0 foot.

Figures



SOURCE: Aerial provided by Bing Maps.
HORIZONTAL DATUM: Texas State Plane South Zone, North American Datum of 1983, U.S. Survey Feet

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Filepath: K:\Projects\2018-PCCA Beneficial Use\FISH PASS\2018 RP-001 VIC MAP FBNFP.dwg Figure 1 DMMP

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Figure 1
Vicinity Map

Feeder Berm North of Fish Pass Attachment 2
Texas Lower Coast Beneficial Use

CONTROL POINT	NORTHING (Y)	EASTING (X)
CP-01	17143636.49	1420454.41
CP-02	17143390.32	1420913.73
CP-03	17141019.28	1419716.09
CP-04	17138709.12	1418404.86
CP-05	17138955.29	1417945.54
CP-06	17141326.33	1419143.18

LEGEND:

- PROPOSED FEEDER BERM
- CP-# CONTROL POINT
- —0— EXISTING CONTOUR (5')
- —-3— EXISTING CONTOUR (1')
- — · — GLO MAPPED PIPELINES
- RAILROAD COMMISSION OF TEXAS MAPPED OIL AND GAS INFRASTRUCTURE LOCATIONS

NOTES:

1. HORIZONTAL DATUM: TEXAS STATE PLANE SOUTH ZONE, NAD83, U.S. SURVEY FEET
2. VERTICAL DATUM: NORTH AMERICAN VERTICAL DATUM OF 1988 (NAVD88)
3. BATHYMETRIC SURVEY CONDUCTED BY T. BAKER SMITH ON MARCH 14, 2022.

0 1200
Feet

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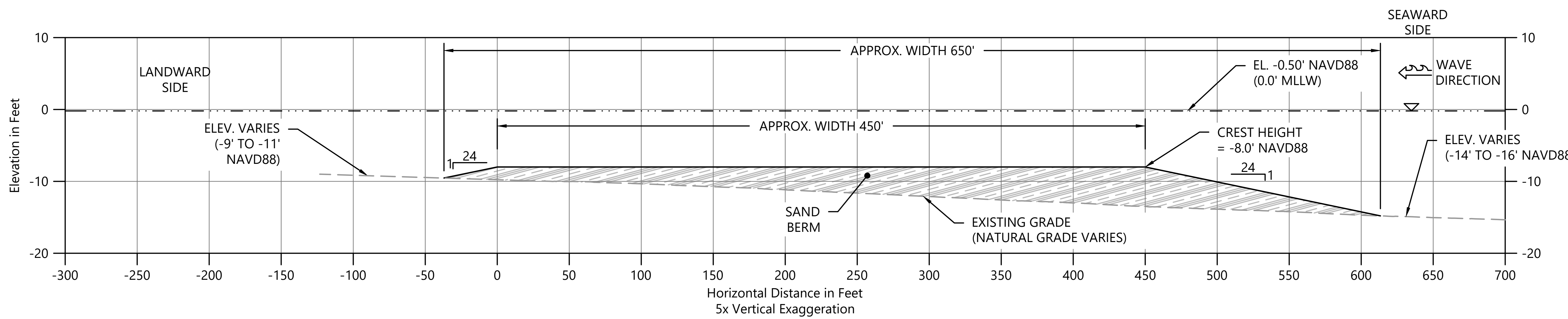
Figure 2
Plan View

Feeder Berm North of Fish Pass Attachment 2
Texas Lower Coast Beneficial Use



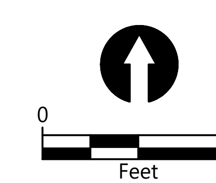
A
Fig-2
SECTION
HORIZONTAL SCALE: 1" = 80'
VERTICAL SCALE: 1" = 16'

NOTES:

1. HORIZONTAL DATUM: TEXAS STATE PLANE SOUTH ZONE, NAD83, U.S. SURVEY FEET

2. VERTICAL DATUM: NORTH AMERICAN VERTICAL DATUM OF 1988 (NAVD88)

3. BATHYMETRIC SURVEY CONDUCTED BY T. BAKER SMITH ON MARCH 14, 2022.



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Filepath: K:\Projects\2018-PCCA Beneficial Use\FISH PASS\2018 RP-002 FEEDER BERM_FP DMMP.dwg Figure 3

ANCHOR QEA

Figure 3
Typical Section

Feeder Berm North of Fish Pass Attachment 2
Texas Lower Coast Beneficial Use

Memorandum

September 30, 2022

To: Melissa McCutcheon, Texas General Land Office

From: Todd Merendino, Ducks Unlimited, Inc.
Sarah Garza, Harrison McNeil, and Yvonne Dives-Gomez, Port of Corpus Christi Authority
John Laplante, Dan Opdyke, Renee Robertson, Alexander Freddo, and Hayden Smith, Anchor QEA, LLC
Jane Sarosdy, Sarosdy Consulting, Inc.
Ray Newby, Texas Department of Transportation

Re: Little Bird Island North 60% Design Memorandum

Introduction

This 60% design memorandum describes design criteria and assessments associated with a beneficial use of dredged material (BU) project at the proposed Little Bird Island North site (Site), located in Texas General Land Office (GLO) Planning Region 2 of the Texas coast in San Antonio Bay in Calhoun County, Texas (Figure 1). Photographs of the Site are in Attachment 1.

Project Background

GLO awarded a Coastal Management Program Project of Special Merit grant (funded through the Gulf of Mexico Energy Security Act) to Ducks Unlimited, Inc. (DU) to coordinate with stakeholders and identify restoration sites for BU The Port of Corpus Christi Authority (PCCA), a project partner, has also contributed staff and financial resources to expand the project scope. The project team is led by DU and PCCA and includes Anchor QEA, LLC; Sarosdy Consulting, Inc.; and the Texas Department of Transportation. Collectively, the project team coordinated three stakeholder meetings with state and federal resource agencies, nongovernmental organizations, academia, consultants, and local officials in each region to solicit information about potential BU sites. Based on stakeholder input, GLO feedback, publicly available data, and professional judgment, the project team has developed 10% designs for 18 sites in GLO Planning Regions 3 and 4 of the Texas coast and 2 GLO-approved sites in Mesquite Bay and San Antonio Bay in GLO Planning Region 2. After completion of the 10% designs, 11 of the designs were selected to continue to 30% designs, and 7 of those designs were chosen for 60% designs and permit application packages. Based on the Site's restoration potential and construction feasibility, the project team selected the Site to proceed to 60% design, opinion of probable construction costs, and permit application packages using funding from the GLO Coastal Management Program Project of Special Merit grant.

Conservationists have identified San Antonio Bay as an important location for creating and restoring bird habitat (CBBEP 2020; Hardegree 2014). Little Bird Island is a small island located on state-owned submerged land approximately 0.25 mile south of the Gulf Intercoastal Waterway (GIWW) in San Antonio Bay in Calhoun County, Texas. However, the existing Little Bird Island is surrounded by oyster habitat and has limited natural protection from wave energy, making it an unfavorable location for restoration; therefore, the project team identified a different area for a new bird island nearby but to the north of the GIWW This area was selected because of its proximity to a sediment source in the GIWW and to potential bird foraging areas, as well as its distance from upland-based predators and lack of immediately adjacent oyster habitat.

Project Objectives

Frequent dredging is needed to develop and maintain Texas navigation channels. The dredged material is often deposited in dredged material placement areas (DMPAs). While many of the existing DMPAs along the Texas coast are nearing capacity, those in the vicinity of the Site are not contained and effectively have unlimited capacity. Despite capacity not being a limiting factor, resource agencies and stakeholders have long advocated using dredged material beneficially to create and restore wetlands and bird islands, nourish beaches, and counteract land loss. Historically, BU projects are difficult to manage because they are multiyear, multifaceted undertakings in which different organizations manage dredging schedules, funding, project design, permitting, and construction activities. To help address these issues, the objectives of this project include the following:

- Create and restore degrading coastal habitats.
- Establish sites for disposal of dredged material to reduce reliance on existing DMPAs.
- Improve coastal resiliency of the natural and built environment.

To accomplish these objectives, the project includes the following tasks:

- Stakeholder outreach and coordination
- Identification and selection of BU sites
- 10% designs and cost estimates for 20 BU sites
- 30% designs and cost estimates for 11 BU sites
- 60% designs, cost estimates, and permit application packages for 7 BU sites

This memorandum documents the 60% design and cost estimate for the Site.

Design Objectives

The Site will be designed to beneficially use dredged material to create a rookery island in a region with degrading coastal bird habitat. The design will use material dredged from navigation channels during routine maintenance, thus reducing the volume of such material placed in existing open-bay or upland DMPAs. This 60% design is based upon publicly available datasets, stakeholder recommendations, and focused field work conducted by DU.

Design objectives include the following:

- Develop a preliminary vision based on available data for the Site that includes the following:
  - Habitat to be created or restored
  - Potential sediment source(s)
  - Approaches to minimize long-term maintenance costs, while providing adequate erosion protection and containment
- Delineate conceptual footprints for proposed BU placement.
- Identify key sensitive habitats and construction considerations in the vicinity of the Site.
- Estimate fill volumes for the proposed BU footprints.
- Avoid impacts to sensitive habitats and adjacent DMPA during dredged material placement.
- Identify data gaps to be addressed in subsequent design phases.
- Provide preliminary cost estimates.

Stakeholder Feedback

The 30% design for the Site was presented at the Lower Coast Beneficial Use Planning Region 3 Stakeholder meeting on June 14, 2022. Attendees included staff from GLO, the U.S. Army Corps of Engineers (USACE), the Texas Parks and Wildlife Department (TPWD), the Coastal Bend Bays & Estuaries Program, the U.S. Fish and Wildlife Service (USFWS), local officials, and other professionals.

Some comments from this meeting, as well as written comments on the 30% designs, follow:

- USFWS recommended filling the Site to +5 feet North American Vertical Datum of 1988 (NAVD88), rather than the +4 feet NAVD88 proposed in the 30% design, to provide additional protection to the rookery during nesting season from overtopping during storm events.
  - The design team increased the target elevation in the center of the Site to +5 feet NAVD88 to provide additional protection to the rookery from overtopping during storm events during nesting season.
- The National Marine Fisheries Service recommended performing a more detailed oyster survey and submerged aquatic vegetation (SAV) survey during peak SAV growing season.
  - The design team agrees with this recommendation and concurs that any SAV surveys conducted prior to construction should target these survey windows.

- TPWD suggested inclusion of a rock sill at the opening of the armored containment berm to help contain dredged material and create additional surface area for oyster colonization.
  - The design team included a 200-foot-long rock sill at the opening of the armored containment berm to help contain dredged material and create additional oyster habitat surface area.

The comments above represent the key issues brought forward to the project team. Other comments, generally more minor and easily addressed, are not included in this list. When feasible, comments have been incorporated into the 60% design, as noted in the below sections, and others may be addressed in the final design.

Existing Data Review

A review of existing data and the focused data collected by DU was performed to develop the Site and containment berm designs. This section describes the data reviewed and collected to support the 60% design.

Horizontal and Vertical Datums

The horizontal datum used for the Site is the Texas State Plane South Central Zone, North American Datum of 1983 in U.S. survey feet. The primary vertical datum used for the Site design is NAVD88. The National Oceanic and Atmospheric Administration (NOAA) maintains multiple active tide gages within the vicinity of the Site. The NOAA Aransas National Wildlife Refuge (ANWR) Station 8774230 (ANWR Station) is 8 miles southwest of the proposed island and collects and records real-time tide information dating back to 2012, and the NOAA Seadrift Station 8773037 is 7.2 miles north of the proposed island and collects and records real-time tide information dating back to 2004. The vertical datums from these stations are shown in Table 1. The difference between vertical datums (feet NAVD88) for the ANWR Station and the Seadrift Station are within 0.1 foot. It is anticipated that tidal elevations at the Site will be between both of those stations, and since the difference between the two is less than 0.1 foot, the project team determined that the ANWR station vertical datums were sufficient for this level of design and will be used for the Site. The ANWR Station was also used to define a preliminary design water level, as described in the Water Level section.

Table 1
ANWR and Seadrift Station Tidal Datums

Tidal Datum	ANWR Elevation (feet NAVD88)	ANWR Elevation (feet MLLW)	Seadrift Elevation (feet NAVD88)
MHHW	1.28	0.33	1.34
MHW	1.28	0.33	1.34
MSL	1.12	0.17	1.18
MLW	0.95	0	1.01
MLLW	0.95	0	0.99

Notes:
MHHW: mean higher high water
MHW: mean high water
MLLW: mean lower low water
MLW: mean low water
MSL: mean sea level

Meteorological, Ocean, and Wave Data

Water Level

A wave and hydrodynamic model of San Antonio Bay was previously developed by Anchor QEA for the Dagger Point breakwater design along the ANWR shoreline (Anchor QEA 2021). The ANWR Dagger Point project (in Austwell, Texas) is approximately 6.5 miles northwest of the Site. Because the Site location is included within the Dagger Point model domain, the model results were used to develop the Site design.

The Dagger Point model simulations included three annual storm scenarios (i.e., storms with an estimated return period of 1 year) developed from USACE Wave Information Studies (WIS) Station 73046 (Figure 2) using wind speeds out of the north and southeast at 33 and 24 miles per hour (mph), respectively. Two hurricane events, Hurricane Harvey (August 2017) and Hurricane Allen (August 1980), were also included as events with a minimum return period of approximately 10 years, based on maximum storm surge elevations measured near San Antonio Bay with waves coming from the southeast (the primary wave direction). Table 2 provides a summary of the maximum significant wave heights predicted by the model at the Site for the annual storm and hurricane scenarios, along with the associated peak wave periods and water levels. This table also provides the estimated return period for each event at the Site. For the two annual storm scenarios, the estimated return period is 1 year, based on the return periods of the wind conditions used to drive the model. For the two hurricane scenarios, the estimated return period is based on the maximum storm surge elevation predicted by the model at the Site, in comparison with return-period storm surge elevations published by the Federal Emergency Management Agency (FEMA 2018). As can be seen in Table 2, the "1-year north wind, higher tide" scenario resulted in the highest annual wave conditions and one of the highest annual water levels. The associated water level of that scenario was 2.6 feet NAVD88. This water level correlates to approximately the 95th-percentile water level at the ANWR Station (i.e., the water level higher than 95% of the recorded water levels; Anchor QEA 2021), and results from that scenario will be used to inform this 60% design.

To determine the water level during island overtopping events, the water level data from the ANWR Station could be separated into months, and the water levels during months critical to target rookery nesting could be further evaluated to refine the rookery island elevation during subsequent design phases. The existing water level analysis for the ANWR Station shows that the 99.9th-percentile water level, including storm events, is approximately 5.1 feet NAVD88.

Table 2
Maximum Predicted Wave Conditions at the Site for the Modeled Storm Scenarios

Model Scenario	Approximate Return Period at the Site	Maximum Significant Wave Height, Hs (feet)	Associated Peak Wave Period, (Tp, seconds)	Associated Water Level (feet NAVD88)
1-year southeast wind, lower tide[1]	1 year	0.9	1.8	1.8
1-year southeast wind, higher tide[2]	1 year	1.1	2.1	2.7
1-year north wind, higher tide[2]	1 year	1.4	2.1	2.6
Hurricane Allen	10 year	1.8	2.4	4.1
Hurricane Harvey	10 year	1.7	1.2	1.9

Notes:
1. The lower tide scenario used a tidal boundary condition that peaked at approximately the 50th-percentile water level at the ANWR Station (i.e., the water level higher than 50% of the recorded water levels).
2. The higher tide scenario used a tidal boundary condition that peaked at approximately the 95th-percentile water level at the ANWR Station (i.e., the water level higher than 95% of the recorded water levels).

Wind and Waves

USACE WIS provides a national resource of long-term wavefield climatologies for U.S. coastal waters that synthesizes observations, multidecade hindcasts, and storm event archives (USACE 2021). The WIS station closest to the Site is Station 73046, just offshore on the Gulf side of Matagorda Island in the Gulf of Mexico. Because the station is located offshore, the wave data were not used. However, the project team considers the wind data to be representative of the winds experienced at the Site. Figure 2 summarizes wind data from January 1, 1980, through December 31, 2014. The data indicate that the predominant wind direction is from the southeast, with significant winds also coming from the north, northeast, east, and south.

There is a 5-mile fetch between the Site and Matagorda Island, the closest land mass, in the predominant southeast wind direction. Due to the fetch, the Site is anticipated to be in a high wave-energy environment.

Table 2 shows the highest wave conditions experienced at the Site for three different annual storm scenarios and two different hurricane scenarios.

Wake Erosion

The GIWW is approximately 0.23 mile south of the Site. Several types of vessels, including recreational and commercial vessels and commercial tugboats and barges, operate in the GIWW and generate wake waves that propagate to the Site. Like wind-generated waves, vessel wake waves produce the greatest erosive forces in the region where the waves break (i.e., the surf zone).

The Bhowmik et al. (1991) and Weggel and Sorensen (1986) vessel-generated wave prediction methods—based on vessel dimensions, travel speed, and distance between the sailing line and Site—were used to evaluate the range of vessel-generated waves for a conservative selection of representative vessels known to operate in the area. A sport yacht with a draft of 4 feet was selected to evaluate recreation vessel wakes generated by vessels traveling near the proposed Site. A generic tugboat with maximum dimensions recorded in the Automatic Identification System (AIS) database was selected, along with a similar tugboat transiting with twin barges (identified using Google Earth imagery of ports in the region) to evaluate the commercial vessel wakes generated by vessels traveling in the GIWW. Calculation of the sport yacht's maximum vessel wakes, traveling at varying speeds along the nearest edge of the GIWW 1,230 feet from the Site, can be seen in Table 3. Calculation of the tugboat and tugboat with twin barges maximum vessel wakes, traveling in 14 feet of water at varying speeds up to 11 miles per hour (considered conservative) along the nearest edge of the GIWW 1,230 feet from the Site, can be seen in Table 4.

These wave heights are shorter than the predicted wind-generated wave heights at the Site, and thus, wind-generated waves will be considered the predominant erosive force for design evaluations. The vessel wakes are limited to vessels traveling on the edge of the GIWW. This assumption likely holds for commercial vessels, but further analysis should be conducted to understand the frequency and distance recreational vessels travel near the Site. Additional analysis surrounding a variety of recreational vessel drafts and speeds may be considered in future design phases.

Table 3
Sea Ray Sundancer Sport Yacht Maximum Vessel-Wake Calculations at Various Speeds

Vessel	Length (feet)	Draft (feet)	Vessel Speed (mph)	Maximum Wave Height (feet)	Wave Period (seconds)
Sea Ray Sundancer sport yacht	51	4	6.7	0.78	1.11
			15	0.59	0.96
			25	0.49	0.88
			35	0.44	0.83
			45.4	0.40	0.79

Note:
Maximum wave heights were calculated using Bhowmik et al. (1991), in which vessel speeds ranged from 6.7 to 45.4 mph.

Table 4
Tugboat and Tugboat with Twin Barges Maximum Vessel-Wake Calculations at Various Speeds

Vessel	Length (feet)	Beam (feet)	Draft (feet)	Vessel Speed (mph)	Maximum Wave Height (feet)	Wave Period (seconds)
Generic tugboat with maximum dimensions recorded in AIS data[1]	87	33	11	3	0.00	8.40
	87	33	11	5	0.00	5.04
	87	33	11	7	0.00	3.60
	87	33	11	9	0.00	2.80
	87	33	11	11	0.26	2.29
Generic tugboat with maximum dimensions recorded in AIS data and with twin barges[2]	387	110	11	3	0.00	7.31
	387	110	11	5	0.00	4.38
	387	110	11	7	0.00	3.13
	387	110	11	9	0.00	2.44
	387	110	11	11	0.00	2.29

Notes:
Maximum wave heights were calculated for vessels traveling within Froude number boundaries and at 3, 5, 7, 9, and 11 mph (Weggel and Sorensen 1986).
1. Vessel hull geometric coefficients were input using a tugboat from Hay (1967).
2. Vessel hull geometric coefficients were input using a barge from Hay (1967).

Bathymetry

DU conducted bathymetric and topographic surveys at the Site on March 31, 2022. The Site footprint consists of open-water shallows and has an average seabed elevation of -3.5 feet NAVD88. The Site contours range from -4.1 to -3.2 feet NAVD88. During the survey, DU conducted three sediment probes. Depths of refusal ranged from 0.2 to 0.4 feet below mudline. Within those areas, it was qualitatively determined that the material was firm sand throughout and is not expected to exhibit substantial settling.

Utilities and Infrastructure

The Railroad Commission of Texas public GIS viewer (RRC 2021) and GLO pipeline data (GLO 2021a) were used to identify mapped utilities and pipelines near the Site. One pipeline was identified in the database search: a Houston Oil and Minerals Corporation natural gas pipeline located 1,200 feet southwest of the Site. There are also five dry holes, a plugged oil well, a plugged gas well, and a cancelled/abandoned location within an approximate 1-mile radius of the Site. Utility and pipeline locations are shown in Attachment 2, C01. It is not anticipated that the utilities and pipeline will affect the design or constructability of the Site. The need for Site-specific utility locations prior to construction will be determined during subsequent design phases. No other infrastructure has been identified in the vicinity of the Site.

A preliminary investigation was conducted for utilities identified within the Texas 811 database by submitting a ticket (No. 2276935059) for the proposed work. The following responses were received:

- Lamar Oil and Gas: Gas, Petroleum Products
  - Response on September 26, 2022: Lamar Oil & Gas is clear and will not be marking location.

This preliminary investigation is not sufficient to clear the Site for construction and excavation. Further investigation into underground and aboveground utilities must be conducted prior to construction of this project.

Desktop Cultural Resources Survey

A search of cultural resources records in the Texas Historical Commission Texas Historical Sites Atlas Database was completed for the Site on November 29, 2021. This search revealed that no archaeological surveys have been conducted, and no archaeological sites have been identified within the preliminary proposed placement site boundary (THC 2021).

Sensitive Habitat

GLO oyster habitat GIS data (GLO 2021b) indicates that oyster habitat is located approximately 100 to 500 feet away from the Site, except in the south and southeast directions. DU confirmed the presence of oyster habitat visually and through sediment probing during the March 31, 2022, low tide Site visit. Oysters were observed north and west of the Site footprint and in water depths of approximately -2.7 to -3.7 feet NAVD88 (Attachment 2, C01). Oysters were not observed in the Site footprint. Because this information is based on GLO oyster habitat data, sediment probing, and visual surveys, more extensive oyster surveys may need to be conducted during a subsequent phase of design to determine the extent of live oysters or presence of other bivalve species, or delineate shell/hard substrate remnants.

According to TPWD seagrass data (TPWD 2021), there are no seagrasses mapped within or adjacent to the Site location. No seagrasses or roots/rhizomes were observed during the DU March 31, 2022, visual survey. Because the sensitive habitat data are not recent, and the seagrass information from DU is based on visual surveys, more extensive surveys may need to be conducted during the late summer peak seagrass growing season and during a subsequent phase of design.

Bird Species

The USFWS Information for Planning and Consultation (IPaC) tool was used to identify listed species and migratory birds within a 172-square-mile region around San Antonio Bay (USFWS 2021). Table 5 includes some of the protected and migratory bird species present near the Site and their preferred habitat as explained in the *Guide to North American Birds* field guide (Audubon 2021a). At this time, no target species, or list of species, has been identified for the Site.

Table 5
USFWS IPaC Species Information[1]

Species	Status	Preferred Habitat[2]
Whooping crane (*Grus americana*)	Endangered	Prairie pools, marshes, and coastal marshes
Piping plover (*Charadrius melodus*)	Threatened	Sand beach dunes and expansive sand or mudflats
Red knot (*Calidris canutus*)	Threatened	Mudflats, tidal zones, and sandy beaches
American oystercatcher (*Haematopus palliatus*)	Migratory	Strictly coastal; dunes, islands in salt marsh, dredge spoil islands, sandy beaches, and tidal mudflats
Black skimmer (*Rynchops niger*)	Migratory	Sandy islands, shell beaches, open beaches, lagoons, estuaries, inlets, and sheltered bays
Brown pelican (*Pelecanus occidentalis*)	Migratory	Bare, rocky mangrove- or tree-covered islands; salt bays, beaches, and oceans
Gull-billed tern (*Gelochelidon nilotica*)	Migratory	Beaches, islands, salt marshes, fields, and coastal bays
Marbled godwit (*Limosa fedoa*)	Migratory	Northern Great Plains, native prairie with marshes or ponds, pools, shores, marshes, and tidal flats
Reddish egret (*Egretta rufescens*)	Migratory	Red mangrove swamps, arid coastal islands covered with thorny brush, coastal tidal flats, salt marshes, and lagoons
Ring-billed gull (*Larus delawarensis*)	Migratory	On ground near water with sparse plant growth, lakes, bays, coasts, piers, dumps, and plowed fields
Royal tern (*Thalasseus maximus*)	Migratory	Low-lying sandy islands, coasts, lagoons, salt bays, and estuaries
Wilson's plover (*Charadrius wilsonia*)	Migratory	Dry part of beach, near conspicuous object, coastal regions, open beaches, tidal flats, estuaries, and sandy islands

Notes:

1. USFWS IPaC information (USFWS 2021) is provided for a 172-square-mile region around San Antonio Bay highlighting endangered, threatened, and migratory birds and their preferred habitat.
2. Habitat information is from the *Guide to North American Birds* (Audubon 2021a) and includes preferred nesting and general habitat.

Erosion

Data from 1982 to 2013 (Paine et al. 2016) indicate the San Antonio Bay shoreline near the Site is eroding with some areas experiencing greater than 1 meter (3.3 feet) of erosion per year.

Beneficial Use Source Material

The proposed source material for the Site may consist of existing excavated material from inside the Site (borrow area) and dredged material from the GIWW (0.25 mile southeast of the Site) and Channel to Victoria (1 mile northeast of the Site). Based on coastal consistency determinations from USACE, USACE has historically performed GIWW and Channel to Victoria maintenance dredging near the Site (USACE 1999) and continues to dredge the area (Jones 2021).

The project team proposes the containment berm interior core be primarily constructed with the borrow area material. If it is determined that the borrow area does not contain suitable fill or the necessary construction volume, suitable off-site material may be used to complete the containment berm construction The dredged material from the GIWW and Channel to Victoria will be used to provide the interior fill for the Site. The quantity and characteristics of dredged material that may be available for placement at the Site are shown in Tables 6 and 7. There are eight potential USACE DMPAs near the Site with a total average annual dredging volume of 1,358,976 cubic yards (CY; Table 6). The majority of the dredged sediment appears to be clay and silts (Table 7).

Table 6
USACE DMPA Areas Along the GIWW and Channel to Victoria Near the Site

DMPA No.	Channel Station	Distance from Site to DMPA (miles)	Average Annual Dredging Quantity (CY)
121A	GIWW: 715+000 to 730+000	1.5	117,587
122	GIWW: 730+000 to 740+000	0.1	178,917
123	GIWW: 740+000 to 750+000	2	171,561
124	GIWW: 750+000 to 760+000	3.5	153,899
125	GIWW: 760+000 to 770+000	5	173,696
1	Channel to Victoria: East and West Wye: 0+00 to 200+00	1.6	156,882
2	Channel to Victoria: 200+00 to 500+00	1.1	310,131
3	Channel to Victoria: 500+00 to 800+00	2	96,303
		Total	**1,358,976**

Note:
Source: USACE 1999

Table 7
Typical Sediment Characteristics Across the GIWW in San Antonio Bay and from the Channel to Victoria (Bay and Landlocked Segments)

Sediment Characteristics Across GIWW in San Antonio Bay	Sediment Characteristics Channel to Victoria (Bay Segment: 0+00 to 400+00)	Sediment Characteristics Channel to Victoria (Landlocked Segment: 400+00 to 1850+00)
D_{50} (mm) <0.016	D_{50} (mm) = 0.025	D_{50} (mm) = 0.037
14.3% sand	13.8% sand	25.0% sand
35.7% silt	49.1% silt	41.2% silt
50.0% clay	37.1% clay	33.8% clay

Notes:
Source: USACE 1999.
D_{50}: median grain size
mm: millimeter

60% Design

The main design elements evaluated for the Site are as follows:

- Site location
- Rookery island size and shape
- Containment and erosion protection
- Constructability
- Planting and natural recruitment of vegetation
- Performance expectations
- Site construction cost estimates
- Expected ecosystem benefits
- Data and information gaps

These design elements are evaluated in this memorandum for the 60% Site design.

This project is planned to be constructed in two phases. Phase 1 will include a containment berm and rock sill (sill), while Phase 2 will be the placement of dredged material within the berm. The first phase is expected to be paid for and contracted by the project owner. Accordingly, for Phase 1, this memorandum includes 60% construction drawings (Attachment 2), which provide details for the containment berm and sill construction, and technical specifications (Attachment 3). The second phase is expected to be paid for by the project owner but contracted by the entity funding the dredging itself (e.g., USACE). Because USACE (or another entity) will be directing the dredger, the entity will provide the dredger with its technical specifications and will work the beneficial use aspect of the dredging project into its drawings. As a result, it is not useful to prepare 60% construction drawings and technical specifications for Phase 2. Rather, a Dredged Material Management Plan

(DMMP) that provides design details on the placement of dredged material for the interior of the Site was developed (Attachment 4). It is expected that USACE (or another entity) will incorporate the DMMP into the construction drawings and technical specifications it has with the dredger. This will ensure the BU design grades and project objectives are achieved.

Site Location

The proposed Site is 0.7 mile northeast of the existing Little Bird Island, 50 feet from existing oyster habitat to the north and northwest of the Site, 100 feet from existing oyster habitat to the west and southwest of the Site, and 150 feet from the USACE DMPA #122 (Attachment 2, C01 and C02). The shallow depths and surrounding oyster reefs may provide shelter to the Site from erosive forces.

Locating the Site 0.25 mile northwest of the GIWW (Figure 1) is advantageous because the prevailing southeast winds will transport any sediment eroded from the island away from the GIWW. Also, because the Site is located near the USACE DMPA and GIWW, construction costs are expected to be lower compared to more remote potential bird island sites. The proposed Site is approximately 1.75 miles from the nearest shoreline. This distance is well above the 0.5-mile distance identified for minimizing predator access to rookery islands (Stanzel 2018).

Rookery Island Size and Shape

Based on availability of sediment, a cost analysis, and stakeholder feedback, the project team proposes that the area of the Site be approximately 8 acres. Future cost constraints may limit the size of the island that is ultimately constructed, but at this level of design, it was decided to consider a site near the upper end of the range identified by stakeholders. The Site will be ovular in shape, with an armored containment berm (Attachment 2, C01 and C02). A 200-foot-long sill will be constructed along the southwest edge of the Site to help contain dredged material and increase the hard substrate surface area for oyster colonization. Dredged material will be placed to a natural slope from 0 feet NAVD88 along the sill up to +5.0 feet NAVD88 toward the center of the Site on the southwest side to create intertidal beach habitat and allow ingress and egress of organisms to the Site.

Following construction of the containment berm and sill, the Site will be filled with dredged material (under a separate construction phase or phases) placed to varying elevations to promote a variety of habitats. The center of the Site will be filled to +5.0 feet NAVD88 and will slope down to +4.0 feet NAVD88 at the landward edge of the armored containment berm. The Site will also slope down to a future elevation range that supports beach habitat near the constructed sill from the elevation of +5.0 to 0.0 feet NAVD88. Fill elevations were selected to promote natural recruitment of vegetation at varied elevations, provide a variety of habitat for a range of bird species. The fill elevations were also designed to provide some protection from overtopping during higher tide and storm events and relative sea level rise (RSLR). The elevation of dredged material fill could be adjusted at further phases of design, depending on the physical properties of the dredged material or if target vegetation or bird species is identified.

It is predicted that the required fill volume for the 60% design will be approximately 202,200 CY. This value assumes 1 foot of foundation compression for every 6 feet of fill and does not consider bulking. Based on the information in Table 6, 202,000 CY of dredged material is expected to be available in the vicinity of the site.

Geotechnical data are expected to be needed and would be collected during a subsequent design phase to further evaluate foundation compression and, if source material can be characterized, the expected bulking of dredged material. The volume of material may be updated during a subsequent phase of design based on the dredged material characteristics, characteristics of the subgrade, and refinement of the rookery island design.

The purpose of the project is to create a range of coastal bird habitat in the near term. However, RSLR may impact the Site in the future. A strategy to accommodate RSLR could be to place BU material to higher elevations in preparation for higher relative sea levels and tidal elevations associated with RSLR; however, this would incur higher costs. The impacts of RSLR may also be managed in the future through adaptive management strategies targeting bird preferred vegetation ranges.

Containment and Erosion Protection

Based on the wave and hydrodynamic model (Wind and Waves section; Anchor QEA 2021), a containment berm and sill are proposed for the Site. Table 8 and 9 summarize the 60% containment berm and sill design components, respectively. The proposed centerline of the containment berm is currently designed along -3.5 feet NAVD88. The containment berm is intended to mitigate erosion, and the crest elevation was selected to contain Site material up to the desired rookery elevations. The proposed centerline of the sill is currently designed along -3.5 feet NAVD88. The sill is intended to provide additional oyster habitat, and the crest elevation was selected to contain Site material along the naturally sloping, intertidal beach habitat. Both the containment berm and sill will be composed of a side casted material core from the borrow area and overlain with armor stone (Attachment 2, C03 and C04). The design assumes the borrow area could be excavated to -10.5 feet NAVD88 to provide the 52,300 CY of material needed for the side casted core construction. However, geotechnical data and analysis, during subsequent design phases, may be necessary to determine the availability and suitability of material in the borrow areas.

For the M10 BU site located 46 miles southwest of the Site, AECOM Technical Services, Inc. (AECOM) chose a 1.1-foot D_{50} armor stone for a wave height of 2.69 feet. (AECOM 2020). The preliminary armor stone sizing chosen for the Site based on AECOM's calculations is a 1.1-foot D_{50}. However, this armor stone size may be considered conservative because the 2.69 feet wave height used in the analysis is larger than the computed maximum 10-year wave height at the Site of 1.8 feet (Table 2). Further modeling and direction on the desired level of armoring from the project proponent will be used to refine the armor stone D_{50} selection.

The selected containment berm geometry (Table 8) was intended to minimize wave energy transmitting through and over the structure under an annual north wind scenario at higher tide with a wave height of 1.4 feet. The transmitted wave energy through the containment berm was determined using the van der Meer and d'Angremond method, as outlined in USACE Coastal Engineering Manual, Table VI-5-15 (USACE 2006). Based on the results of the analysis, the transmitted wave energy behind the proposed containment berm armor stone is expected to be minimal. The containment berm geometry and armor stone size will be further refined through Site-specific modeling and analysis of the wave conditions during a subsequent phase of design.

Table 8
Containment Berm Design Characteristics

Containment Berm Design Criteria	Site Containment Berm
Total project length	2,700 feet
Total containment berm acreage	Approximately 5 acres
Crest width	10 feet
Base width	Approximately 78 feet, depending on water depth
Assumed bottom elevation	-3.5 feet NAVD88
Total structure height	8.5 feet
Containment berm materials	Side casted material, geotextile fabric, and rock
Containment berm core volume	52,300 CY
Containment berm armor volume	29,700 CY
Estimated settlement	1 foot for every 6 feet of fill
Design side slopes (seaward side)	5H:1V[1]
Design side slopes (landward side)	3H:1V[1]
Maximum design crest elevation	+5 feet NAVD88

Notes:
The final cross-sectional dimensions and slopes of the containment berm may be refined through hydrodynamic modeling and evaluation of sediment characteristics of the dredged material and berm subgrade during a subsequent phase of design.
1. Horizontal to vertical

Table 9
Sill Design Characteristics

Sill Design Criteria	Site Sill
Total project length	200 feet
Total sill acreage	Approximately 0.15 acre
Crest width	5 feet

Sill Design Criteria	Site Sill
Base width	Approximately 32 feet, depending on water depth
Assumed bottom elevation	-3.5 feet NAVD88
Total structure height	4.5 feet
Sill materials	Side casted material, geotextile fabric, and rock
Sill core volume	700 CY
Sill armor volume	600 CY
Estimated settlement	1 foot for every 6 feet of fill
Design side slopes (seaward side)	3H:1V[1]
Design side slopes (landward side)	3H:1V[1]
Maximum design crest elevation	+1 foot NAVD88

Notes:
The final cross-sectional dimensions and slopes of the sill may be refined through hydrodynamic modeling and evaluation of sediment characteristics of the dredged material and sill subgrade during a subsequent phase of design.
2. Horizontal to vertical

Constructability

This section describes the proposed methods of construction. Actual methods will be dependent on the chosen contractor's equipment and Site conditions at the time of construction. In addition, the contractor may provide alternate construction methods from those described in this section.

The average water depth surrounding the Site is -3.5 feet NAVD88 (-4.45 feet mean lower low water), which helps with costs and constructability. Water depth, depending on the tides, should provide sufficient access for construction equipment, but it also requires more dredged material and armor stone to build to the target elevation. Contractor light loading or access channels may need to be dredged for contractors to access the Site.

The Site could be constructed in two different phases, as follows.

Phase 1

Material from the borrow area will likely be mechanically excavated and side casted to the required design elevations and geometry to construct the core of the containment berm and sill. A geotextile fabric or jute cloth will be placed atop the side cast core to prevent fines from passing through before placement of the approximately 3-foot-thick armor layer on the containment berm and approximately 2-foot-thick armor layer on the sill. Phase 1 construction of the containment berm and sill may require construction of access channels, light-load transport of armor stone, and mobilizing equipment beyond what is required for dredging the GIWW (e.g., marsh buggies, a deck barge, and an excavator). Marsh buggies or deck-barged excavators may be used to shape the containment berm and sill. Best management practices for turbidity controls will be adhered to.

Phase 2

Phase 2 of construction will consist of placing dredged material inside the containment berm and sill during USACE maintenance dredging (Attachment 4). Confining the dredged slurry within the containment berm and sill will reduce potential impacts to adjacent oyster habitat. Dredged material can be placed during routine maintenance of the GIWW or Channel to Victoria. Phase 2 construction may require mobilizing equipment beyond what is required for dredging the GIWW (e.g., marsh buggies and a deck barge). Marsh buggies may be used to shape the fill to the required fill elevations. Best management practices for turbidity controls will be adhered to.

Planting and Natural Recruitment of Vegetation

Based on stakeholder input and cost considerations, the project team determined that planting may not be needed for the Site. Rather, natural vegetation recruitment will be allowed to proceed. If the outcome is unsatisfactory, (e.g., if the island has lower-than-expected use by desired bird species), an adaptive management program can be instituted to modify the vegetation). Table 5 shows some of the listed and migratory birds and their preferred habitats. At further design phases, this list could be used to modify elevations within the Site to promote the preferred habitat of desired bird species.

Performance Expectations

The performance goal for the project is to create approximately 8 acres of sustainable rookery habitat, promote natural recruitment of vegetation at varied elevations, and provide a variety of habitat for a range of bird species. The designed containment berm is expected to contain placement of dredged material, be resilient to typical storm events, and provide protection for the interior habitat.

Site Construction Cost Estimates

Preliminary construction costs were estimated for the design outlined in the previous sections. The estimated costs include indirect construction costs (i.e., permitting, 100% engineering and design costs, construction management, and postconstruction management such as Site visits and dewatering management). These costs represent the estimated incremental costs (i.e., costs over and above USACE's least-costly and environmentally acceptable dredged material and placement alternative). Table 9 shows a line-item list of each costing parameter and the total cost estimated for construction.

The costs range from $5.4 million to $11.6 million, depending on the level of uncertainty allocated to the project cost. The lower bound of uncertainty (-30%) and upper bound of uncertainty (+50%) were selected due to the existing data gaps, high levels of inflation, and rising fuel costs. As the design is further refined, the costs have a potential to decrease if Site-specific modeling shows that the containment berm geometry and quantity of armor stone can be reduced. An evaluation of the initial capital construction versus projected maintenance costs could be conducted to determine an optimum armoring design that allows for satisfactory protection of the interior rookery island, while being within the project budget. The estimates are developed using current and generally accepted engineering cost estimating methods and are based on assumptions concerning future events. Actual costs may be affected by known and unknown risks including, but not limited to, changes in general economic business conditions, Site conditions that were unknown at the time the estimates were performed, future changes in Site conditions, regulatory or enforcement policy changes, and delays in performance. Actual costs may vary from these estimates.

Table 10
Opinion of Probable Construction Cost to 100% Project Completion

Item	Quantity	Unit	Unit Price	Total
Direct Construction Costs				
Phase 1: Containment Berm and Sill Construction				
Mobilization and Demobilization[1,2]	1	%	10	$ 480,000.00
Preconstruction Survey	1	LS	$ 30,000.00	$ 30,000.00
Berm Core[2,3]	2,700	LF	$ 110.00	$ 300,000.00
Armor Stone	48,000	tons	$ 90.00	$ 4,400,000.00
As-Built Survey	1	LS	$ 50,000.00	$ 50,000.00
Navigational Aids[2]	4	Each	$ 4,000.00	$ 20,000.00
Phase 1 Subtotal[4]			**Sum**	**$ 5,300,000.00**
Phase 2: Interior Fill Placement				
Incremental Mobilization and Demobilization[1,5]	1	%	10	$ 130,000.00
Preconstruction Survey	1	LS	$ 50,000.00	$ 50,000.00
Incremental Dredging Interior Placement (1-Mile Pipeline)[2]	202,200	cy	$ 6.00	$ 1,210,000.00
As-Built Survey	1	LS	$ 60,000.00	$ 60,000.00
Phase 2 Subtotal4			**Sum**	**$ 1,500,000.00**
Direct Construction Subtotal4			**Sum**	**$ 6,800,000.00**
Indirect Construction Costs				
100% Engineering and Design	1	LS	$500,000.00	$ 500,000.00
Permitting	1	Each	$100,000.00	$ 100,000.00
Construction Management	1	LS	$200,000.00	$ 200,000.00
Postconstruction Management[6]	12	Month	$ 10,000.00	$ 120,000.00
Indirect Construction Subtotal[4]			**Sum**	**$ 900,000.00**
Project Subtotal[4]			**Sum**	**$ 7,700,000.00**
-30% Uncertainty[4,6]	1	%	30	$ 2,300,000.00
+50% Uncertainty[4,6]	1	%	50	$ 3,900,000.00
Low-End Total Project Estimated Cost[4]			**Total Sum**	**$ 5,400,000.00**
High-End Total Project Estimated Cost[4]			**Total Sum**	**$11,600,000.00**

Notes:
Costs were determined based upon a combination of publicly available datasets and sediment surface grabs, and topographic, bathymetric, and visual habitat surveys.

1. Cost is based upon mobilizing equipment beyond what is required for dredging the GIWW (e.g., marsh buggies)
2. Value is rounded to the nearest $10,000.
3. Cost includes side casting existing water bottoms and shaping of the containment berm.
4. Value is rounded to the nearest $100,000.
5. Cost is based on incremental cost of diverting dredging equipment from GIWW to excavation areas.
6. Postconstruction management may include Site visits to observe the material consolidation, vegetation, and water levels on the Site. Monthly aerials may be performed. Additional postconstruction management practices may be considered during subsequent phases of design.

LF: linear foot
LS: lump sum

Expected Ecosystem Benefits

Creation of the Site is expected to have positive benefits on the regional ecosystem. Chester Island, a 69-acre rookery island located in the adjacent Matagorda Bay, was used to approximate the ecological benefits for the Site. From 2003 to 2011, Chester Island averaged approximately 12,000 breeding pairs of birds per year across 17 species (5 of which are listed in Table 5; Audubon 2021b[1]). Adjusting for rookery island acreage, the Site may be expected to create habitat for approximately 1,450 breeding pairs of birds per year.

The mean RSLR averaged between Freeport and Rockport is 5.1 millimeters per year (NOAA 2022). Assuming no changes in the mean RSLR trend and no erosion, the rookery island within the target elevation of the Site (+5.0 feet NAVD88) would remain above the 95th-percentile water level until 2166.

Due to the location of oyster habitat adjacent to the Site, it is expected that the containment berm armor and the sill will be colonized by oysters. This will increase the existing oyster habitat in the regional ecosystem.

Data and Information Gaps

At this phase of design, the following data and information gaps have been identified:

- Refine site-specific wind-generated wave heights, which would inform the optimization of site armor design.
- Identify geotechnical characteristics of the source material (maintenance material) and subgrade of the placement area to refine evaluations of containment berm structure stability, subgrade and source material settlement, and short- and long-term capacity for dredged material placement.
- Oyster and seagrass surveys during seagrass growing season and during preconstruction

[1] Audubon 2021b refers to Sundown Island, which is now called Chester Island.

- Refine survey information such as property lines, utility locations, and supplemental bathymetry, where appropriate

These data gaps may need to be addressed during the progression from 60% design to final design. For example, supplemental data collection and modeling would allow optimizing the project design to reduce construction costs. It is expected that the cost of addressing these information gaps would be offset by the cost savings that would be realized by optimizing the project design. Because the 60% design has been prepared without such data, conservative assumptions (e.g., regarding armoring) have been used, increasing the estimated construction cost. This current project is taking the analyses as far as practicable, considering the constraints of the project scope, budget, and schedule.

Future Work

No fatal flaw has been identified at this phase of the design. The presence of oyster habitat adjacent to the Site may affect the Site footprint and design during subsequent design phases.

Should the Site be selected for additional design efforts, it can be expected that some aspects of the design in this memorandum will be modified and, as appropriate, enhanced.

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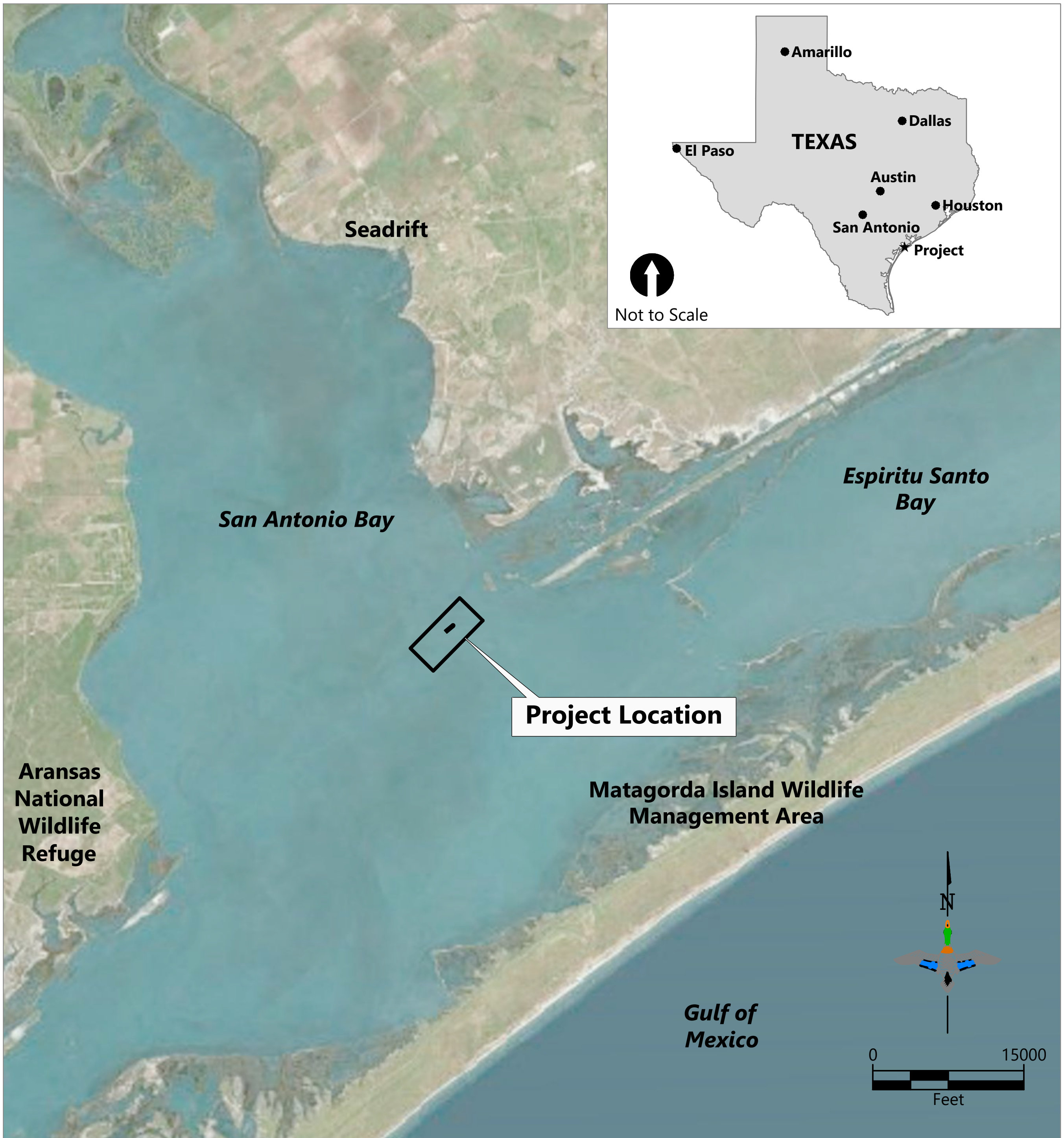
Figures



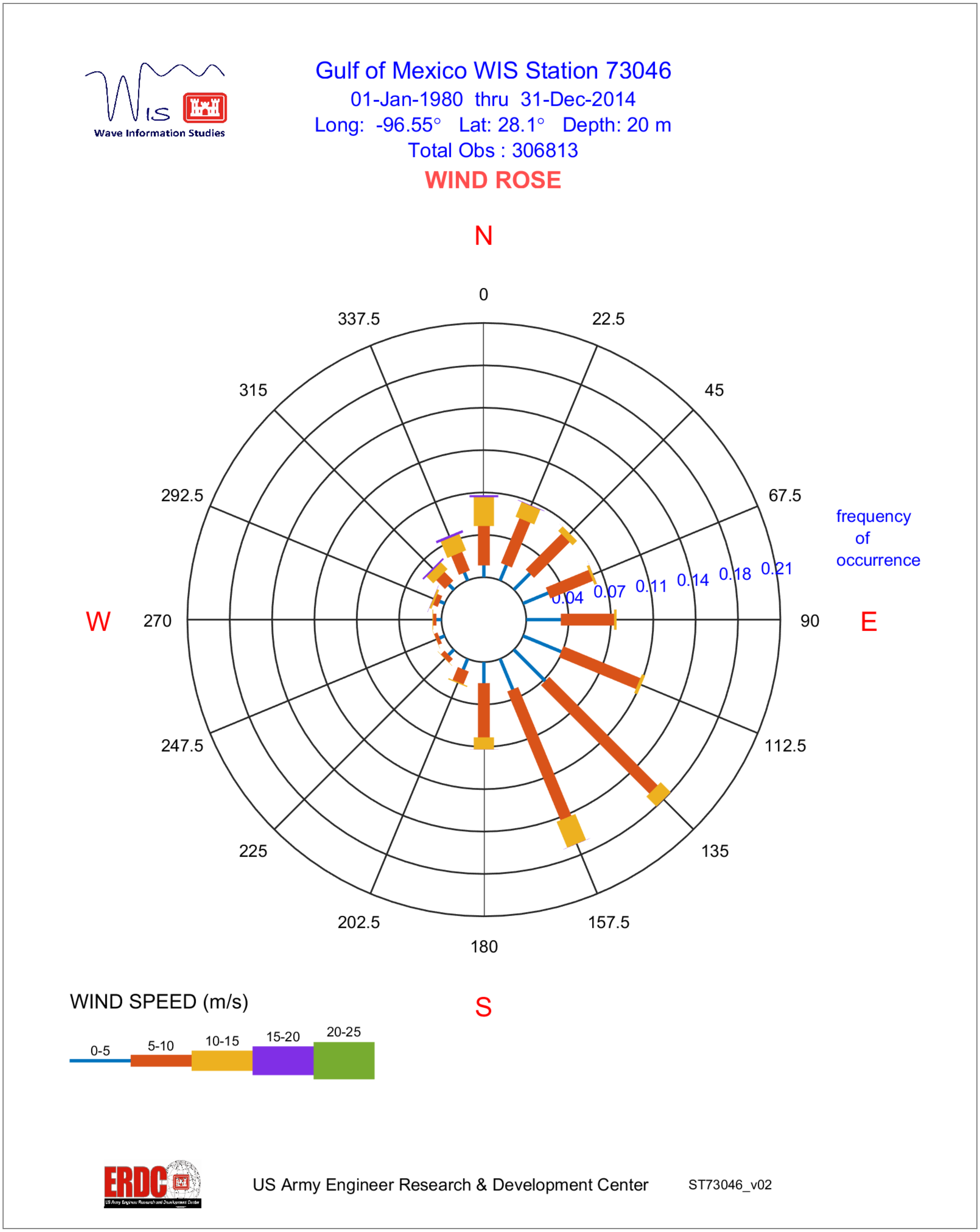
SOURCE: AERIAL IMAGE ©2022 MICROSOFT BING, MICROSOFT CORPORATION EARTHSTAR GEOGRAPHICS.
HORIZONTAL DATUM: TEXAS STATE PLANE SOUTH ZONE, NORTH AMERICAN DATUM OF 1983, U.S. SURVEY FEET

Publish Date: 2022/09/14 9:21 AM | User: psciaba
Filepath: K:\Projects\2018-PCCA Beneficial Use\Little BIrd Island North\2018 RP-002 DMMP Attach - Vicinity Map.dwg Figure 1

ANCHOR QEA

Figure 1
Vicinity Map

Little Bird Island North 60% Design Memorandum
Texas Lower Coast Beneficial Use



Filepath: \\Fuji\Austin\D_drive\Projects\GLO\BU Lower Coast\Design\60% Designs\Little Bird Island North\Figures\Figure 2.docx

ANCHOR QEA

Figure 2
Historical Wind Data for USACE WIS Station 73046
Little Bird Island North 60% Design Memorandum
Texas Lower Coast Beneficial Use

Attachment 1
Site Photographs

Photograph of exposed reef shoal north of Little Bird Island North (photo credit: Ducks Unlimited)

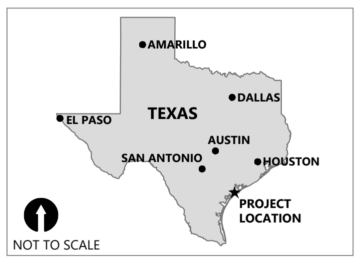
Attachment 2

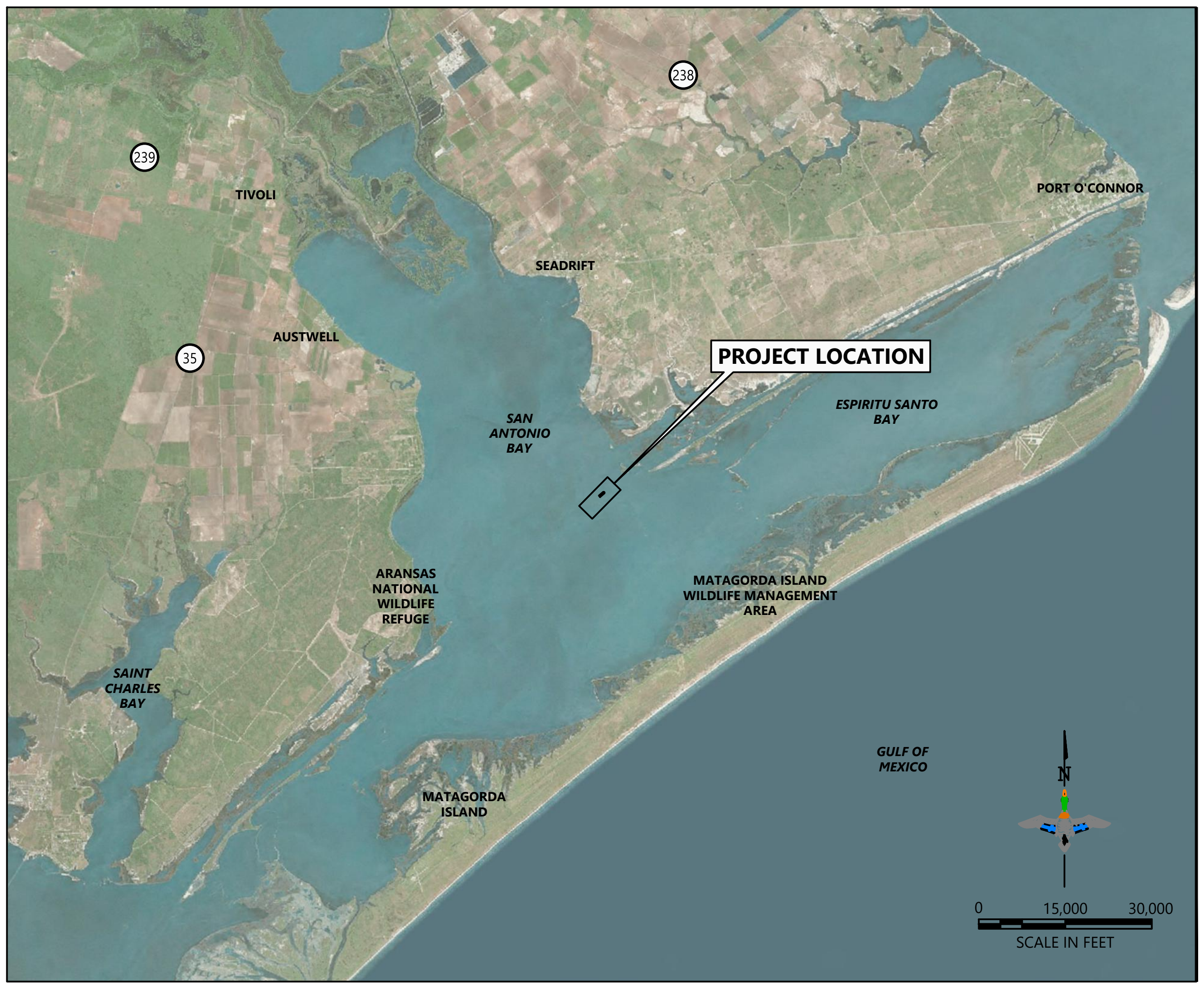
Construction Drawings

60% DESIGN SUBMITTAL

TEXAS LOWER COAST BENEFICIAL USE - LITTLE BIRD ISLAND NORTH

TEXAS GENERAL LAND OFFICE





AERIAL BY BING MAPS

DRAWING INDEX		
SHEET	DRAWING	TITLE
1	T01	TITLE SHEET
2	G01	GENERAL NOTES AND ABBREVIATIONS
3	C01	SITE OVERVIEW
4	C02	PLAN VIEW
5	C03	BORROW AREA
6	C04	TYPICAL CONTAINMENT BERM AND SILL SECTIONS

NOTES:

1. HORIZONTAL DATUM: TEXAS STATE PLANE SOUTH CENTRAL ZONE, NAD83, U.S. SURVEY FEET
2. VERTICAL DATUM: NORTH AMERICAN VERTICAL DATUM OF 1988 (NAVD88)
3. BATHYMETRIC SURVEY CONDUCTED BY DUCKS UNLIMITED ON MARCH 31, 2022.

PLAN INTENDED TO BE VIEWED IN COLOR. ADJACENT BLOCK IS "BLUE"

ONE INCH

AT FULL SIZE, IF NOT ONE INCH SCALE ACCORDINGLY

09-15-2022

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TEXAS GENERAL LAND OFFICE ESTABLISHED 1836

DUCKS UNLIMITED

REVISIONS				
REV	DATE	BY	APP'D	DESCRIPTION

DESIGNED BY: H. SMITH
DRAWN BY: P. SCIABA
CHECKED BY: R. ROBERTSON
APPROVED BY: J. LAPLANTE
SCALE: AS NOTED
DATE: SEPTEMBER 2022

TEXAS LOWER COAST BENEFICIAL USE - LITTLE BIRD ISLAND NORTH

TITLE SHEET

T01

SHEET # **1** OF **6**

GENERAL NOTES

1. THE CONTRACTOR SHALL COMPLY WITH ALL REQUIREMENTS OF THE DRAWINGS, SPECIFICATIONS, PERMITS, AND ALL APPLICABLE REGULATIONS AND ORDINANCES.

2. IN THE EVENT OF A CONFLICT BETWEEN THE SPECIFICATIONS AND THE DRAWINGS, THE DRAWINGS SHALL GOVERN.

3. BATHYMETRIC AND VISUAL HABITAT SURVEYS CONDUCTED BY DUCKS UNLIMITED ON MARCH 31, 2022.

4. AERIAL IMAGE ©2022 MICROSOFT BING, MICROSOFT CORPORATION EARTHSTAR GEOGRAPHICS.

5. GEOTECHNICAL AND ENGINEERING DATA PROVIDED ARE FOR REPRESENTATIVE PURPOSES. THE CONTRACTOR SHALL FIELD VERIFY CONDITIONS AND/OR COLLECT ANY ADDITIONAL DATA IT DEEMS NECESSARY.

6. THE CONTRACTOR SHALL FIELD VERIFY ALL FIELD BASELINE CONDITIONS, AS WELL AS ALL LOCATIONS AND DIMENSIONS.

7. THE CONTRACTOR SHALL LOCATE AND FIELD VERIFY ALL ABOVEGROUND AND BELOWGROUND UTILITIES BEFORE BEGINNING WORK.

8. THE CONTRACTOR SHALL BE RESPONSIBLE FOR DAMAGE TO BOTH ON- AND OFF-SITE FACILITIES CAUSED BY ITS ACTIVITIES DURING PERFORMANCE OF THE WORK. THE CONTRACTOR SHALL RESTORE ALL SUCH DAMAGES TO THEIR PRECONSTRUCTION CONDITION AT NO COST TO THE OWNER.

9. THE CONTRACTOR SHALL AT ALL TIMES KEEP ITS CONSTRUCTION AREAS FREE FROM ACCUMULATIONS OF WASTE MATERIALS OR RUBBISH AND, PRIOR TO COMPLETION OF THE WORK, REMOVE ANY RUBBISH FROM THE PREMISES, AS WELL AS ALL TOOLS, EQUIPMENT, AND MATERIALS THAT ARE NOT THE PROPERTY OF THE OWNER.

PERMITS AND PERMIT CONDITIONS

1. THE CONTRACTOR SHALL COMPLY WITH ALL PERMIT CONDITIONS.

2. THE CONTRACTOR SHALL BE RESPONSIBLE FOR OBTAINING ANY ADDITIONAL PERMITS THAT MAY BE REQUIRED FOR THE CONDUCT OF THIS WORK. COSTS OF OBTAINING PERMITS NOT SUPPLIED BY THE OWNER SHALL BE BORNE BY THE CONTRACTOR.

HORIZONTAL DATUM

TEXAS STATE PLANE SOUTH CENTRAL ZONE, NAD83, U.S. SURVEY FEET

VERTICAL DATUM

NORTH AMERICAN VERTICAL DATUM OF 1988 (NAVD88)

ABBREVIATIONS

CP	CONTROL POINT
E	EASTING
EL.	ELEVATION
MIN.	MINIMUM
MLLW	MEAN LOWER LOW WATER
N	NORTHING

PLAN INTENDED TO BE VIEWED IN COLOR. ADJACENT BLOCK IS "BLUE"

ONE INCH

AT FULL SIZE, IF NOT ONE INCH SCALE ACCORDINGLY

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REVISIONS

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DATE: SEPTEMBER 2022

TEXAS LOWER COAST BENEFICIAL USE - LITTLE BIRD ISLAND NORTH

GENERAL NOTES AND ABBREVIATIONS

G01

SHEET # 2 OF 6

LEGEND:

- PROPOSED CONTAINMENT BERM
- PROPOSED SILL
- GULF INTRACOASTAL WATERWAY
- EXISTING CONTOUR (5')
- EXISTING CONTOUR (0.5')
- RAILROAD COMMISSION OF TEXAS MAPPED OIL AND GAS INFRASTRUCTURE LOCATIONS
- U.S. ARMY CORPS OF ENGINEERS OPEN WATER DREDGED MATERIAL PLACEMENT AREA
- GLO MAPPED OYSTER HABITAT
- EXTENTS OF VISUALLY INSPECTED OYSTER HABITAT
- GLO MAPPED PIPELINE

N

0 500 1000

SCALE IN FEET

NOTES:

1. HORIZONTAL DATUM: TEXAS STATE PLANE SOUTH CENTRAL ZONE, NAD83, U.S. SURVEY FEET
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4. GLO, 2021B. "LAYER: OYSTER HABITAT (ID: 57)." ARCGIS REST SERVICES DIRECTORY. ACCESSED NOVEMBER 23, 2021.
5. NAVIGATION AIDS MUST BE PLACED ALONG THE CONTAINMENT BERM IN ACCORDANCE WITH TECHNICAL SPECIFICATION SECTION 35 12 10.

PLAN INTENDED TO BE VIEWED IN COLOR. ADJACENT BLOCK IS "BLUE"

ONE INCH

AT FULL SIZE, IF NOT ONE INCH SCALE ACCORDINGLY

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APPROVED BY: J. LAPLANTE
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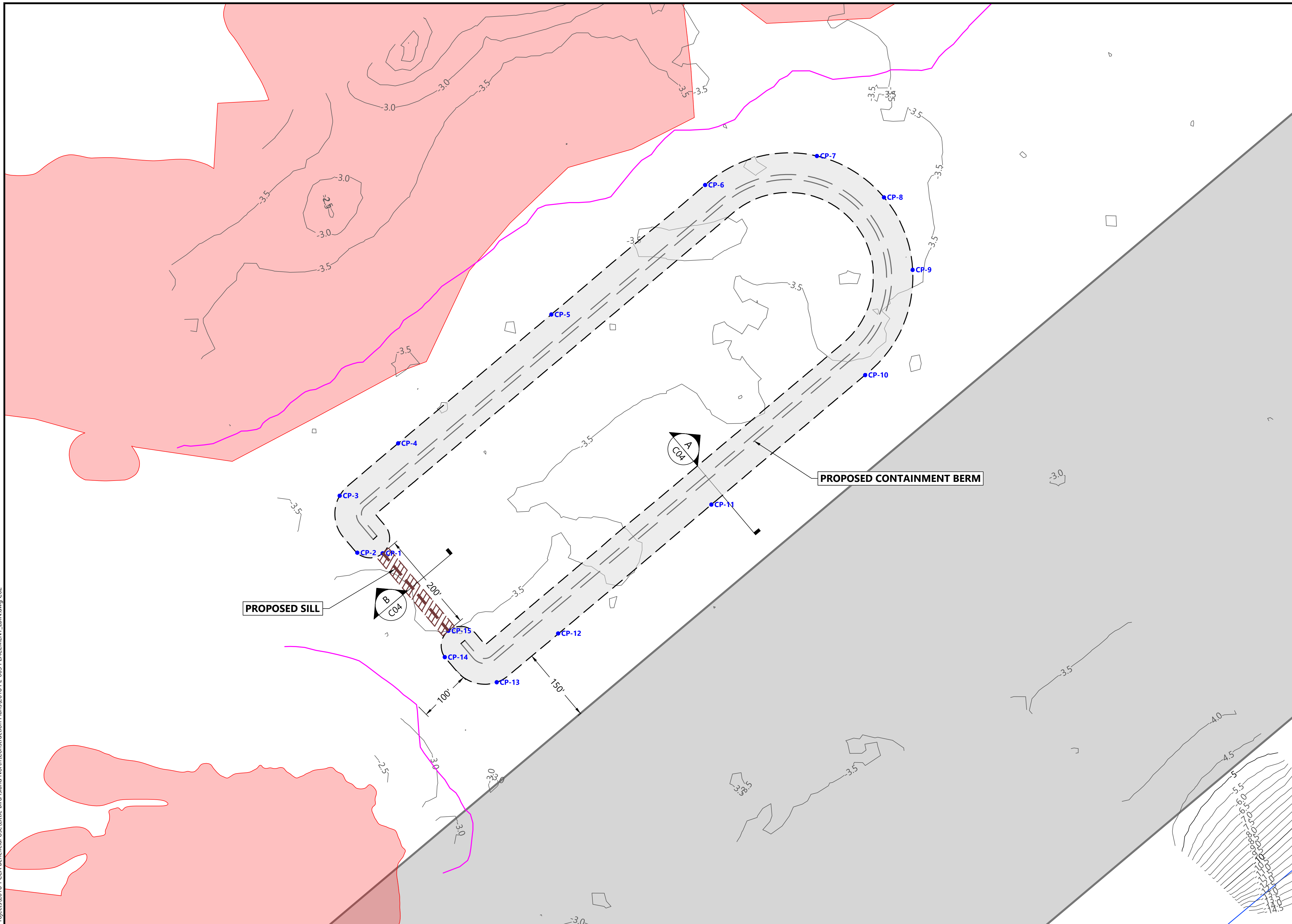
DATE: SEPTEMBER 2022

TEXAS LOWER COAST BENEFICIAL USE - LITTLE BIRD ISLAND NORTH

SITE OVERVIEW

C01

SHEET # 3 OF 6



CONTROL POINT	NORTHING (Y)	EASTING (X)
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CP-2	13301703.2894	2709600.2026
CP-3	13301816.6917	2709565.1865
CP-4	13301920.8797	2709681.4654
CP-5	13302177.3389	2709986.3040
CP-6	13302434.9304	2710292.3214
CP-7	13302492.6326	2710514.7585
CP-8	13302410.2949	2710648.2358
CP-9	13302265.9941	2710705.2118
CP-10	13302056.6682	2710610.7252
CP-11	13301799.0767	2710304.7078
CP-12	13301542.6176	2709999.8691
CP-13	13301445.5467	2709877.5993
CP-14	13301495.5289	2709774.2531
CP-15	13301547.9983	2709781.3080

LEGEND:

- PROPOSED CONTAINMENT BERM
- PROPOSED SILL
- CP-10 CONTROL POINT
- GULF INTRACOASTAL WATERWAY
- 0 EXISTING CONTOUR (5')
- -3 EXISTING CONTOUR (0.5')
- U.S. ARMY CORPS OF ENGINEERS OPEN WATER DREDGED MATERIAL PLACEMENT AREA
- GLO MAPPED OYSTER HABITAT
- EXTENTS OF VISUALLY INSPECTED OYSTER HABITAT

N

0 100 200

SCALE IN FEET

NOTES:

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PLAN INTENDED TO BE VIEWED IN COLOR. ADJACENT BLOCK IS "BLUE"

ONE INCH

AT FULL SIZE, IF NOT ONE INCH SCALE ACCORDINGLY

09-15-2022

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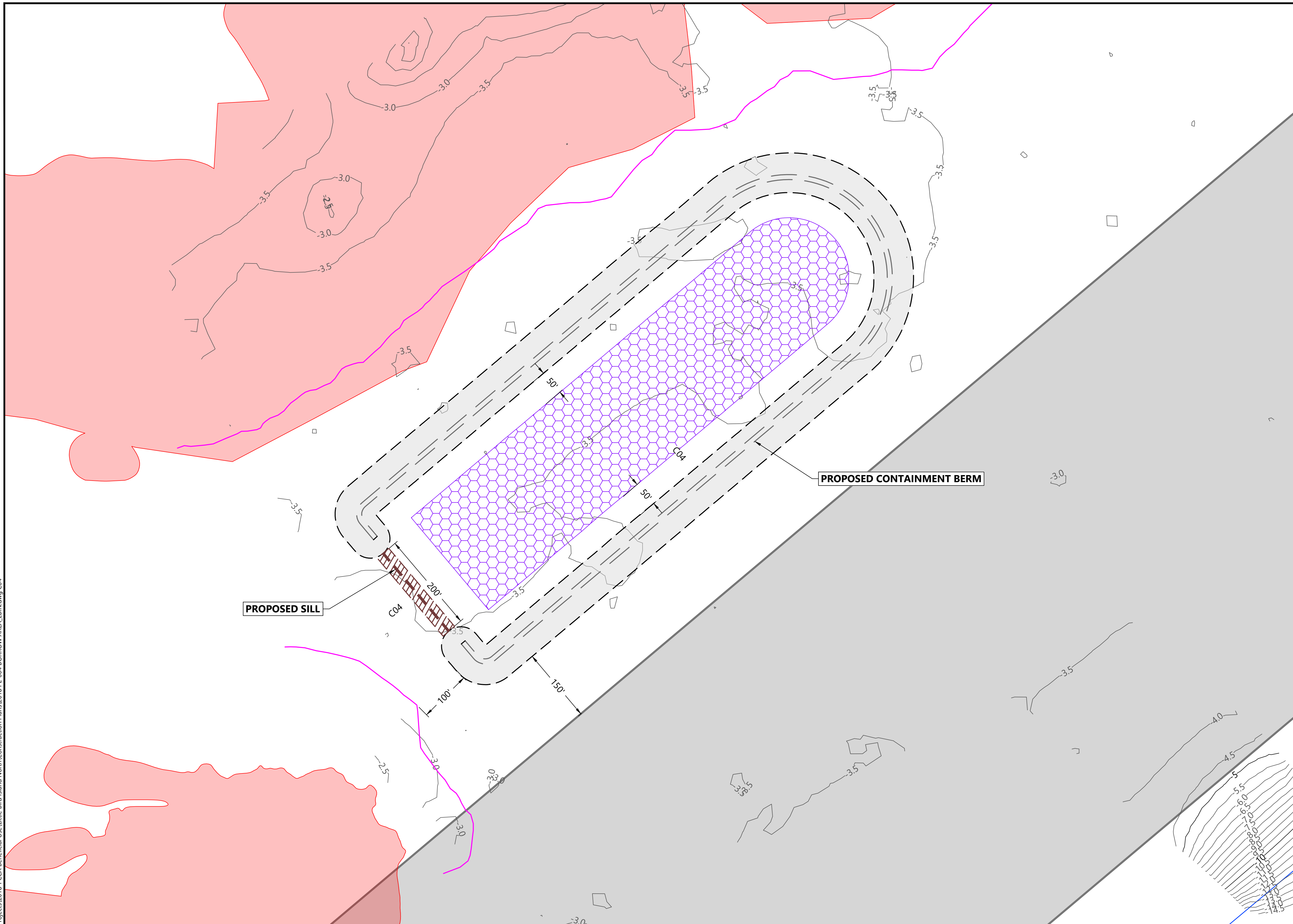
TEXAS LOWER COAST BENEFICIAL USE - LITTLE BIRD ISLAND NORTH

PLAN VIEW

C02

SHEET # 4 OF 6



LEGEND:

- PROPOSED CONTAINMENT BERM
- PROPOSED SILL
- BORROW AREA
- GULF INTRACOASTAL WATERWAY
- EXISTING CONTOUR (5')
- EXISTING CONTOUR (0.5')
- U.S. ARMY CORPS OF ENGINEERS OPEN WATER DREDGED MATERIAL PLACEMENT AREA
- GLO MAPPED OYSTER HABITAT
- EXTENTS OF VISUALLY INSPECTED OYSTER HABITAT

N

0 100 200

SCALE IN FEET

NOTES:

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ONE INCH

AT FULL SIZE, IF NOT ONE INCH SCALE ACCORDINGLY

09-15-2022

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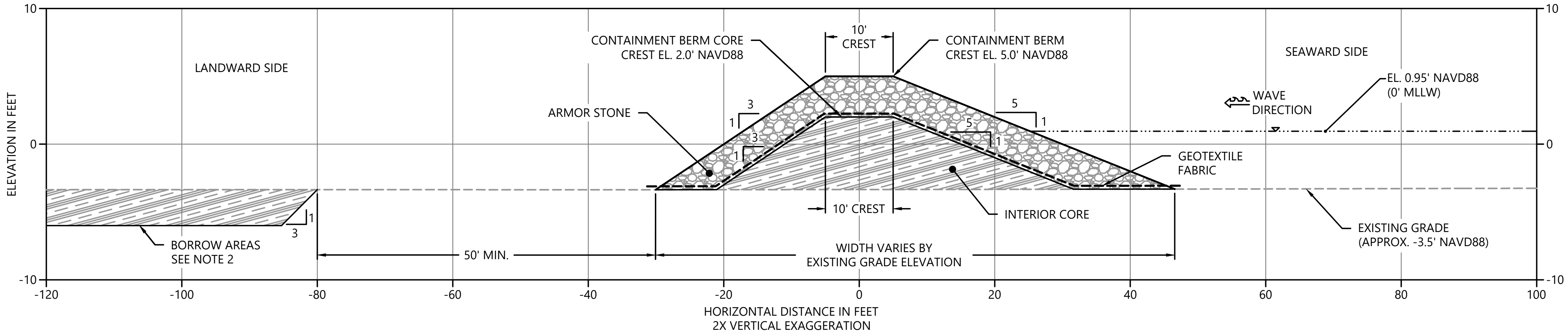
TEXAS LOWER COAST BENEFICIAL USE - LITTLE BIRD ISLAND NORTH

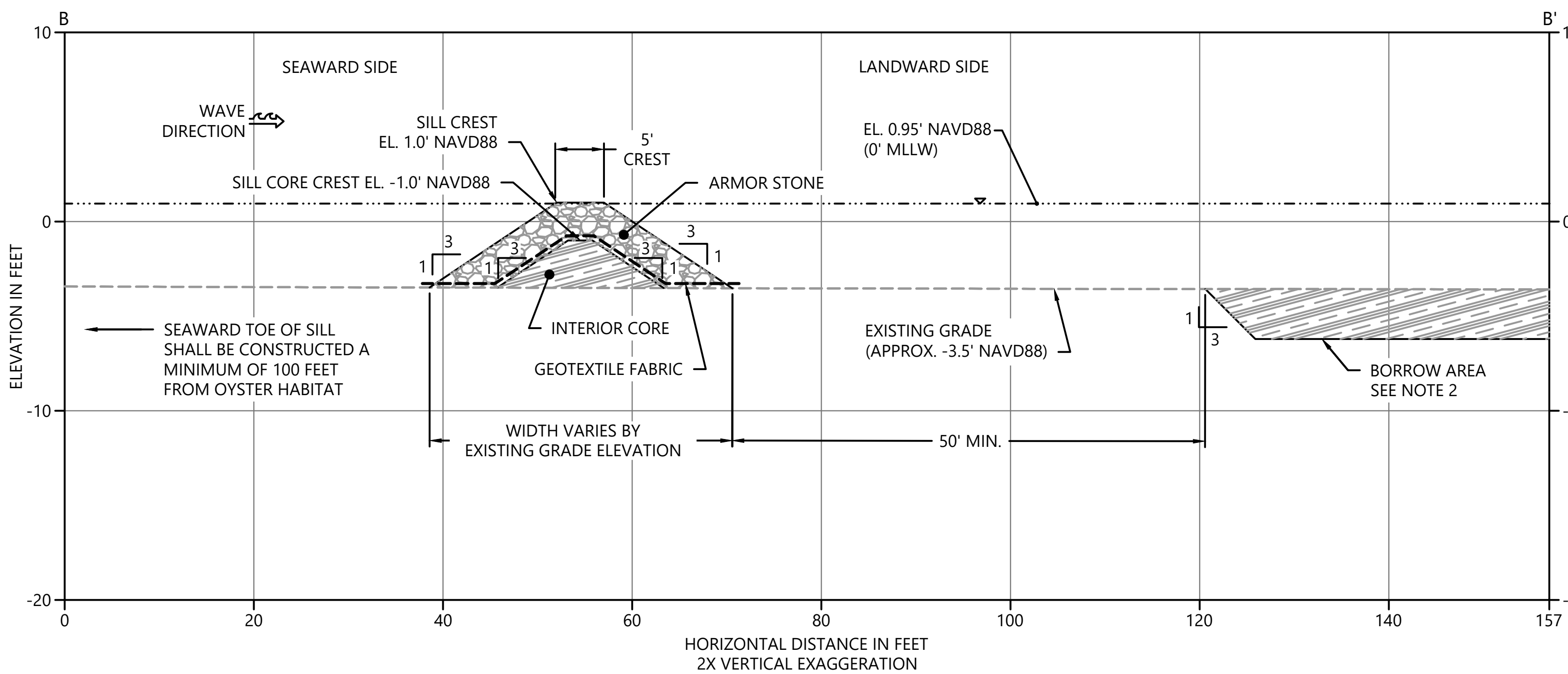
BORROW AREA

C03

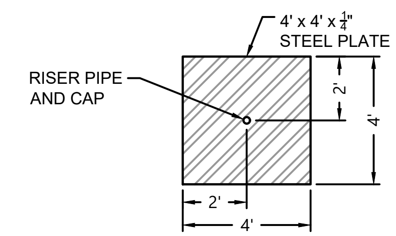
SHEET # 5 OF 6



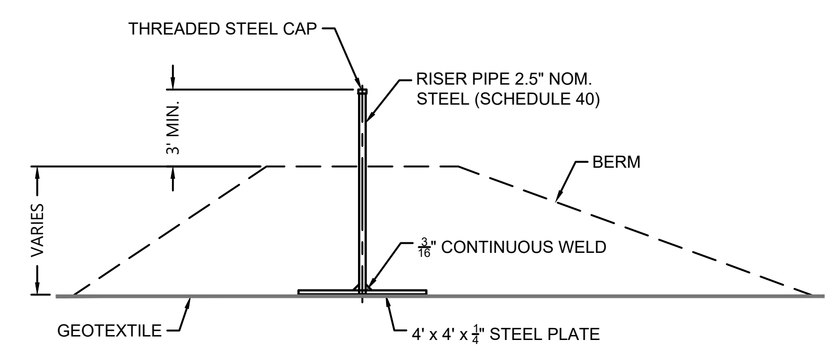
A/C02 TYPICAL CONTAINMENT BERM SECTION
HORIZONTAL SCALE: 1" = 10'
VERTICAL SCALE: 1" = 2'



B/C02 TYPICAL SILL SECTION
HORIZONTAL SCALE: 1" = 10'
VERTICAL SCALE: 1" = 2'



PLAN



SECTION

PLAN AND SECTION VIEWS OF TYPICAL SETTLEMENT PLATE
NOT TO SCALE

NOTES:

1. VERTICAL DATUM: NORTH AMERICAN VERTICAL DATUM OF 1988 (NAVD88).
2. BORROW AREA DIMENSIONS SHOWN FOR ILLUSTRATION PURPOSES ONLY. ACTUAL DIMENSIONS TO BE DETERMINED BASED ON FINAL DESIGN AND BY SELECTED CONTRACTOR.
3. NAVIGATION AIDS MUST BE PLACED ALONG THE CONTAINMENT BERM IN ACCORDANCE WITH TECHNICAL SPECIFICATION SECTION 35 12 10.

PLAN INTENDED TO BE VIEWED IN COLOR. ADJACENT BLOCK IS "BLUE"

ONE INCH AT FULL SIZE, IF NOT ONE INCH SCALE ACCORDINGLY

09-15-2022
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DATE: SEPTEMBER 2022

TEXAS LOWER COAST BENEFICIAL USE - LITTLE BIRD ISLAND NORTH

TYPICAL CONTAINMENT BERM AND SILL SECTIONS

C04

SHEET # 6 OF 6

Attachment 3
Technical Specifications

SECTION 31 05 19

GEOGRID AND GEOTEXTILES

PART 1 - GENERAL

1.01 SUMMARY

A. The Contractor shall furnish all labor, equipment, materials, and incidentals necessary to install the geocomposite underlayment (a nonwoven geotextile mechanically connected to a geogrid to form a two-layer geosynthetic reinforcement) for the containment berm as shown on the Construction Drawings as "Geocomposite."

B. Related Sections

1. Section 01 20 00 – Measurement and Payment Procedures
2. Section 01 33 00 – Submittal Procedures
3. Section 01 35 43 – Environmental Protection
4. Section 35 33 00 – Containment Berm

1.02 REFERENCES

A. American Association of State Highway and Transportation Officials (AASHTO): Standard Specification for Highway Bridges (2002)

B. ASTM International (ASTM):

1. D1388 – Standard Test Method for Stiffness of Fabrics
2. D3786 – Standard Test Method for Bursting Strength of Textile Fabrics – Diaphragm Bursting Strength Tester Method
3. C4354 – Practice Method for Sampling of Geosynthetics for Testing
4. C4355 – Standard Test Method for Deterioration of Geotextiles by Exposure to Light, Moisture and Heat in a Xenon Arc Type Apparatus
5. D4491 – Standard Test Methods for Water Permeability of Geotextiles by Permittivity
6. D4533 – Standard Test Method for Trapezoid Tearing Strength of Geotextiles
7. D4632 – Standard Test Method for Grab Breaking Load and Elongation of Geotextiles
8. D4751 – Standard Test Method for Determining Apparent Opening Size of a Geotextile
9. D4759 – Standard Practice for Determining the Specification Conformance of Geosynthetics
10. D4833 – Standard Test Method for Index Puncture Resistance of Geomembranes and Related Products
11. D4873 – Standard Guide for Identification, Storage, and Handling of Geosynthetic Rolls and Samples
12. D4884 – Standard Test Method for Strength Sewn or Bonded Seams of Geotextiles

13. D5199 – Standard Test Method for Measuring the Nominal Thickness of Geosynthetics
14. D5261 – Standard Test Method for Measuring Mass Per Unit Area of Geotextiles
15. D5321 – Standard Test Method for Determining the Shear Strength of Soil-Geosynthetic and Geosynthetic-Geosynthetic Interfaces by Direct Shear
16. D6241 – Standard Test Method for Static Puncture Strength of Geotextiles and Geotextile-Related Products Using a 50-mm Probe
17. D6637 – Standard Test Method for Determining Tensile Properties of Geogrids by the Single or Multi-Rib Tensile Method
18. D7737 – Standard Test Method for Individual Geogrid Junction Strength
19. D7748 – Standard Test Method for Flexural Rigidity of Geogrids, Geotextiles and Related Products

C. U.S. Army Corps of Engineers (USACE): USACE Methodology for Measurement of Torsional Rigidity

D. Geosynthetic Research Institute (GRI) – GG9 Torsional Behavior of Bidirectional Geogrids when Subjected to In-Plane Rotation

E.

1.03 SUBMITTALS

A. The following shall be submitted a minimum of 7 calendar days prior to installation in accordance with SECTION 01 33 00 − SUBMITTAL PROCEDURES: Requirements for Submittals. The failure of the Contractor to obtain approval prior to installation shall be grounds for nonpayment.

1. Geocomposite Sample: The Contractor shall submit a 6-inch by 6-inch or larger sample of the geocomposite to the Engineer for approval.
2. Manufacturer's Certificate: The Contractor shall submit the manufacturer's certificate of compliance with the name of the manufacturer, product name, style number, and other relevant information to fully describe the geocomposite. The certificate should state that the composite meets the requirements of this section and shall be attested to by a person having legal authority to bind the composite manufacturer.
3. Manufacturer's Instructions: The Contractor shall submit installation instructions to the Engineer for review.
4. Shop Drawings: The Contractor shall submit typical details of the typical sections and connections.

1.04 QUALITY ASSURANCE

A. A minimum of 7 days prior to installation of the geocomposite, the Contractor shall provide, to the Engineer for approval, the samples, manufacturer's certificate and instructions, and shop drawings.

B. The Contractor will provide a description of the methods and procedures proposed for installation of the geocomposite as part of the Construction Work Plan in accordance with SECTION 01 33 00 − SUBMITTAL PROCEDURES and 35 33 00 − CONTAINMENT BERM.

1.05 DELIVERY, STORAGE, AND HANDLING

A. Delivery

1. The Contractor shall notify the Engineer a minimum of 24 hours prior to delivery and unloading of the geocomposite packaged in an opaque, waterproof, protective plastic wrapping.

2. The manufacturer's plastic wrapping shall not be removed until deployment. If quality-assurance samples are collected, immediately rewrap rolls with the plastic wrapping or equivalent as approved by the Engineer. Geotextile or plastic wrapping damaged during storage or handling shall be repaired or replaced, as directed, at no additional cost to the Agency.

3. The Contractor shall label each roll with the manufacturer's name, geotextile type, roll number, roll dimensions (length, width, and gross weight), and date manufactured.

B. Storage

1. The Contractor shall protect rolls of geocomposite from, but not limited to, construction equipment, chemicals, sparks, and flames; temperatures below minus 20°F or in excess of 160°F; or any environmental condition that may damage the physical properties of the geotextile.

2. Geocomposite should not be exposed to direct sunlight for time frames beyond those recommended by the manufacturer. Geocomposite exposed beyond such time frames shall be disposed of and replaced at no additional cost to the Agency and shall not allow the construction schedule to be extended.

3. The Contractor shall protect geocomposite from becoming saturated by elevating rolls off the ground or placing them on a sacrificial sheet of plastic in an area where water will not accumulate. If the geocomposite becomes saturated prior to installation, the Contractor shall remove the geotextile from the site and replace at no additional costs to the Agency.

C. Handling: Handle and unload geotextile rolls with load-carrying straps, a forklift with a stinger bar, or an axial bar assembly. Rolls shall not be dragged along the ground, lifted by one end, or dropped to the ground.

PART 2 - PRODUCTS

2.01 MATERIALS

A. The geocomposite system shall meet the following requirements:

1. Positive mechanical interlock with underlayer; contiguous sections of itself when overlapped and embedded in bedding stone or similar.

2. Sufficient cross-sectional profile to present a substantial abutment interface to particulate construction fill materials, such as bedding stone, and to resist movement relative to such materials.

3. Sufficient flexural rigidity to help maintain intimate contact of the geotextile with the underlying material when bedding stone, riprap, or armor stone is placed on top.

4. Sufficient true initial modulus to cause applied force to be transferred to the geogrid at low strain levels without material deformation of the reinforced structure.

5. Complete continuity of all properties throughout its structure and shall be suitable for use with bedding stone, riprap, and armor stone materials in coastal and waterway environments to improve the long-term stability of the coastal structure such as rubble mound breakwaters, jetties, and groins.

B. The geogrid part of the geocomposite shall meet the properties as outlined in Table 1. Where applicable, values represent minimum average roll values (MARVs) in accordance with ASTM D4759.

TABLE 1: GEOGRID PROPERTIES

Property	Test Method	Unit	Value
Aperture Size (nominal dimensions)	ASTM D4759	in	1.0 to 2.0
Minimum Rib Thickness (nominal dimensions)	ASTM D4759	in	0.06
Tensile Strength @ 2% Strain	ASTM D6637	lb/ft	450
True Initial Modulus in Use	ASTM D6637	lb/ft	1,575
Junction Efficiency	ASTM D7737	%	90
Flexural Stiffness	ASTM D7748	mg-cm	750,000
Ultraviolet Stability (Retained Strength @ 500 hours)	ASTM D4355	%	90

C. Geotextiles shall meet the requirements specified in Table 2. Where applicable, Table 2 property values represent MARVs in the weakest principal direction. Values for Apparent Opening Size represent maximum average roll values.

TABLE 2: GEOTEXTILE PROPERTIES

Property	Test Method	Unit	Minimum Test Value
Apparent Opening Size	ASTM D4751	US Sieve	100 (Maximum)
Permittivity	ASTM D4491	sec-1	0.57
Puncture	ASTM D4833	lbs	75
Grab Tensile Strength	ASTM D4632	lbs	180
Trapezoidal Tear	ASTM D4533	lbs	50
Ultraviolet Degradation	ASTM D4355	% strength @ 500 hrs.	70
Weight	ASTM D5261	oz/sq. yd.	8
Burst Strength	ASTM D3787	lbs	290

PART 3 - EXECUTION

3.01 SUBGRADE PREPARATION

A. The Contractor shall ensure that the surface underlying the geocomposite is smooth and free of debris, ruts, or protrusions, which could damage the geotextile.

3.02 INSTALLATION

A. The Contractor shall notify the Engineer a minimum of 24 hours prior to installation of the geocomposite.

B. Geocomposite rolls that are damaged or contain imperfections shall be repaired or replaced as directed by the Engineer at no additional cost to the Agency.

C. The Contractor shall install the geocomposite as shown in the Construction Drawings. The width of the installed geocomposite will vary as the containment berm width varies due to changes in water bottom elevations.

D. The geocomposite shall be laid flat and smooth so that it is in direct contact with the subgrade. Correct orientation (roll direction) of the geocomposite shall be verified by the Contractor. The geocomposite may be temporarily secured with sandbags. The geotextile component of the geocomposite shall extend a minimum of 1 foot beyond the limits of the toe of the containment berm, as shown in the Construction Drawings.

E. Armor stone shall be placed atop the geocomposite as described in SECTION 35 33 00 − CONTAINMENT BERM in a manner that minimizes the wrinkles and/or movement of the composite and uniformly loads the structure and minimizes displacing the underlying foundation. The Contractor shall place rock in a manner that prevents material from entering the composite overlaps and prevents tensile stress from being mobilized in the composite and prevents wrinkles from folding over onto themselves.

3.03 SEAMS

A. The Contractor shall continuously overlap the geocomposite panels a minimum of 2 feet at all longitudinal and transverse joints.

3.04 PROTECTION AND REPAIRS

A. The Contractor shall protect the geocomposite during installation from tears and other damage. Damaged composite shall be repaired or replaced as directed by the Engineer at no additional cost to the Agency.

B. The Contractor shall repair torn or damaged geocomposite. The Contractor shall perform repairs by placing a patch of the same type of geocomposite over the damaged area. The patch shall extend a minimum of 2 feet beyond the edge of the damaged area. Patches shall be continuously fastened using the manufacturer's approved methods. The machine direction of the patch shall be aligned with the machine direction of the geocomposite being repaired. The Contractor shall remove and replace geocomposite which cannot be repaired. Repairs shall be performed at no additional expense to the Agency and shall not allow the construction schedule to be extended.

END OF SECTION 31 05 19

SECTION 35 12 10

AIDS TO NAVIGATION

PART 1 - GENERAL

1.01 SUMMARY

A. The Contractor shall furnish all labor, equipment, materials, and incidentals necessary to install permanent navigational markers as shown on the Construction Drawings as "Aids to Navigation" (ATON) and in accordance with the U.S. Coast Guard (USCG) marking determination (Appendix TBD). The Contractor shall also be responsible for installing and maintaining temporary navigational markers or lighted beacons during construction of the breakwater structures in accordance with applicable federal, state, and local laws, ordinances, and relevant permit requirements. Contractor shall install at (at least X) (or as necessary to identify maritime risks) temporary navigational markers. Contractor shall remove the temporary navigational markers upon completing installation of the required permanent navigational markers.

B. The Contractor shall display signal lights and conduct operations in accordance with the General Regulations of the Department of the Army and of USCG as set forth in Navigation Rules and Regulations Handbook 2014 and 33 Code of Federal Regulations (CFR) 84 through 33 CFR 89 (Inland) as applicable.

1.02 RELATED DOCUMENTS

A. Appendix TBD – USCG Marking Determination Package (point to appropriate appendix)

B. Section 01 20 00 – Measurement and Payment Procedures

C. Section 01 33 00 – Submittal Procedures

D. Section 01 35 43 – Environmental Protection

E. Section 35 33 00 – Containment Dike

1.03 REFERENCES

A. American Wood Preservers Association (AWPA): AWPA P5 – Standard for Waterborne Preservatives

B. USCG: USCG CFR, Title 33, Chapter 1, Parts 62, 64, and 66

C. 2022 AWPA Book of Standards

1.04 SUBMITTALS

A. Before the Contractor orders ATON materials, the following shall be submitted in accordance with SECTION 01 33 00 − SUBMITTAL PROCEDURES:

1. Manufacturer's Data Sheets: The Contractor shall submit the manufacturer's data sheets for all permanent ATON, including buoys, lights, signs, reflective material, pilings, and any other material used for the ATON. The data sheets shall include the name of the manufacturer, product name, style number, and other relevant information to fully describe the ATON material.

B. The failure of the Contractor to obtain approval prior to ordering material shall be grounds for nonpayment.

PART 2 - PRODUCTS

2.01 MATERIALS

A. Temporary ATON

1. Warning Buoys – 1 nautical mile USCG-approved marine lanterns (TBD LED Rating), buoys with solar powered, flashing white light with a flash period of 2.5 seconds (0.3 seconds on / 2.2 seconds off)

B. Permanent ATON

1. Pilings: The contractor shall install X-foot-long, class X timber pilings, pressure treated with Chromated Copper Arsenate at 2.5 pounds per cubic foot per AWPA U1.

2. Signs: The contractor shall install the signs indicated in the USCG Determination Package with the lettering "DANGER" in black text on white dayboard film background with 2-inch orange retroreflective border. All hardware connecting the sign shall be hot-dipped galvanized or approved equal. Examples of USCG-approved signage is included in Appendix X.

3. Lights: The contractor shall install lights meeting the requirements described in Appendix X.

PART 3 - EXECUTION

3.01 INSTALLATION

A. Prior to installation, the Contractor shall determine if underground utilities exist in the proposed locations of the permanent ATON. The Contractor shall also verify water depths and bottom types at the locations.

B. As the work progresses, the Contractor shall install temporary or permanent ATON at the locations specified in Attachment X and Construction Drawings. Discrepancies between the coordinates designated on the USCG permit or Construction Drawings shall be reported to the Owner or its designated representative prior to installation.

C. The Contractor will place temporary ATON prior to construction and shall maintain the temporary ATON during construction until installation of the permanent ATON is complete. The contractor shall relocate temporary ATON by request of the Owner, Engineer, USCG, or USACE during construction without incurring additional cost to the Owner. The Contractor shall remove temporary ATON and install permanent ATON prior to final acceptance of the project. All temporary ATON will be considered property of the Contractor, and the Contractor shall take full responsibility for removal, transportation, storage, or proper disposal of the temporary ATON.

D. Timber piles shall be carefully handled with no sudden dropping, breaking of outer fibers, bruising, or penetration of the surface with tools. Piles damaged or not located in the proper location shall be withdrawn and replaced by new piles or shall be cut off at the mudline and additional piles installed as directed, without additional cost to the Owner.

E. Signs shall be installed so that the bottom of the signage is a minimum of 7 feet above the mean high water level and does not exceed 9 feet above the mean high water level. The Contractor shall shorten the pilings dictated by the normal mean high watermark in the project area, as necessary. Each sign shall be fastened with at least three 3/4-inch-diameter by 12-inch-long hot-dipped galvanized bolts and connected with a hot-dipped galvanized ogee washer, lockwasher, and nut. Bolt holes shall be bored 1/8 inch larger than the diameter of the bolt.

F. If any damage occurs to permanent ATON placed during construction, the Contractor shall replace or repair the ATON at no cost to the Owner and at the direction of the Owner or its authorized representative.

END OF SECTION 35 12 10

SECTION 35 33 00

CONTAINMENT BERM

PART 1 - GENERAL

1.01 SUMMARY

A. The Contractor shall furnish all labor, equipment, materials, and incidentals necessary to install the containment berm as described herein and in the Construction Drawings. The work shall include, but is not necessarily limited to, excavation of sediment within the footprint of the Site, construction of containment berm and sill core, and purchase, delivery, and installation of the armor stone to construct the Little Bird Island North containment berm as shown in the Construction Drawings.

1.02 RELATED SECTIONS:

A. Section 01 20 00 – Measurement and Payment Procedures

B. Section 01 32 00 – Construction Progress Documentation

C. Section 01 32 23 – Surveys and Layout Data

D. Section 01 33 00 – Submittal Procedures

E. Section 01 35 43 – Environmental Protection

F. Section 31 05 19 – Geogrid and Geotextiles

G. Section 35 12 10 – Aids to Navigation

H. Appendix X – USACE Permit

1.03 REFERENCES

A. ASTM International (ASTM):

1. ASTM C97 – Standard Test Methods for Absorption and Bulk Specific Gravity Dimension Stone
2. ASTM C127 – Standard Test Method for Density, Relative Density (Specific Gravity), and Absorption of Coarse Aggregate
3. ASTM C131 – Standard Test Method for Resistance to Degradation of Small-Size Coarse Aggregate by Abrasion and Impact in the Los Angeles Machine
4. ASTM C295 – Standard Guide for Petrographic Examination of Aggregates for Concrete
5. ASTM D535-12 – Standard Test Method for Resistance to Degradation of Large-Size Coarse Aggregate by Abrasion and Impact in the Los Angeles Machine
6. ASTM D75/D75M-14 – Standard Practice for Sampling Aggregates
7. ASTM D1141-98(2013) – Standard Practice for the Preparation of Substitute Ocean Water
8. ASTM D4791 – Standard Test Method for Flat Particles, Elongated Particles, or Flat and Elongated Particles in Coarse Aggregate

1.04 SUBMITTALS

B. The following submittals shall be submitted in accordance with SECTION 01 33 00 – SUBMITTAL PROCEDURES: Requirements for Submittals

C. Construction Work Plan: Prior to the start of construction, the Contractor shall provide a Construction Work Plan containing, at a minimum, the following:

1. Work Sequencing and Equipment:

   a. Order and sequence in which work shall be performed

   b. Number, type, and capacity of equipment to be used

   c. Hours of operation

   d. Estimated schedule

   e. Procedures for placing materials and confirming thicknesses and grades are met

2. Methods, Procedures, and Equipment addressing the following:

   a. Protection of the geocomposite layers during material placement

   b. Installation method of interior core and armor stone layer

   c.

   d. Methods for confirming elevation of placed dredged material containment berm

   e. Placement to distribute the load across the compressible foundation

   f. Survey and photography methods to monitor and control the work and progress surveys

   g. Verification of minimum design template

   h. Settlement monitoring and output format

   i. Toe construction underwater

D. Source Material

1. Armor Stone aggregate:

   a. Prior to the preconstruction meeting, the Contractor shall submit quarry records including, but not limited to, the history of the quarry and the capability to produce the material to the required specifications.

   b. Submit compliance test results as specified in Part 2 of this Specification.

E. Quality Control Surveys: During construction, the Contractor shall provide interim surface elevation surveys per SECTION 01 32 23 − SURVEYS AND LAYOUT DATA.

F. Daily Construction Report: The Contractor shall prepare and maintain a daily report of operations and furnish copies by noon the following day or as requested by the Owner as described in SECTION 01 32 00 − CONSTRUCTION PROGRESS DOCUMENTATION.

G. Stop Work: The Owner and/or Engineer may elect to stop work activities at the Site if the required submittals have not been submitted or are not of acceptable quality (as determined by the Owner or Engineer) and per the schedules specified herein in accordance with SECTION 01 33 00 − SUBMITTAL PROCEDURES. Any delays related to submittal approvals shall not allow the construction schedule to be extended and shall not be reason to increase the Contract price.

1.05 QUALITY CONTROL

A. Contractor will perform control surveys as specified in SECTION 01 32 23 – SURVEYS AND LAYOUT DATA.

PART 2 - PRODUCTS

2.01 CONTAINMENT BERM MATERIALS

A. General

1. Fill material may be acquired from the designated borrow area as shown on the Project Drawings. The intention is to use the most suitable material obtainable from these sources.

2. If the Contractor and Engineer determines the borrow material is unsuitable for containment berm Construction, the Engineer may modify the berm design or determine if suitable offsite materials should be used to complete containment berm construction.

B. Material

1. Suitable fill material shall consist of an inorganic, granular soil containing between 0% and 12% material passing the No. 200 mesh sieve (sand having a Unified Soil Classification of SP or SP-SM).

2. Materials unsuitable for use as berm fill are defined as follows:

a. Material containing more than 2% organic matter (by dry weight)

b. Materials classified by the Unified Soil Classification System as PT, OH, OL, CH, MH, GM, GC, GW and GP

c. Materials containing roots greater than 1 inch in diameter, logs, scrap lumber, metal objects, plastic and fiberglass objects, concrete construction refuse, and other objectionable debris

d. Materials containing brush, sod, organic, and other perishable materials

2.02 ROCK

A. The Contractor shall make arrangements, pay royalties, and secure the permits for procurement, furnishing, and transporting stone. The Contractor shall vary the quarrying, processing, loading, and placing operations to produce the sizes and quality of stone specified. If the stone being furnished by the Contractor does not meet the requirements as specified herein, the Contractor shall furnish, at no additional cost to the Owner, other stone meeting these requirements.

B. Before stone is produced from a source for completion of the work under this contract, the source of stone shall be approved by the Engineer/Owner. Approval of a stone source shall not be construed as a waiver of the right of the Owner to require the Contractor to furnish stone that complies as specified herein. Materials produced from localized areas, zones, or strata will be rejected when these materials do not comply as specified herein.

C. If requested, stone samples shall be provided to the Owner for testing. Stone from a proposed source or sources shall be tested by the Contractor for quality compliance as described below. Copies of the compliance testing for each gradation shall be provided to the Engineer before installation.

D. Testing and Analysis of Materials shall be performed in accordance with applicable ASTM standards. When tests indicate materials do not meet specified requirements, the Contractor shall remove and legally dispose of the unsuitable material off site and replace with suitable material at no cost to the Agency. Rock shall meet the following minimum test requirements:

TEST REQUIREMENTS		
TEST	TEST METHOD	REQUIREMENTS
Specific Gravity (Bulk SSD)	ASTM C127	(2.60) minimum (2.75) maximum
Absorption	ASTM C127	(3.0%) maximum
Abrasion loss	ASTM D535-12	(40%) max. loss(1)
Note: 1. Weakening and loss of individual surface particles is permissible unless bonding of the surface grains softens and causes general disintegration of the surface material.		

E. In addition to the above tests, the stone shall be subjected to a Petrographic and X-Ray Diffraction analysis in accordance with ASTM C295. The stone shall not contain expansive clays. The test procedure for Petrographic and X-Ray Diffraction is performed according to ASTM C295, except for the following:

1. A colored microscope photograph shall be made of each stone type, including igneous, sedimentary, or metamorphic, and the individual minerals within the stone type shall be identified by labels and arrows upon the photograph.
2. Detailed macroscopic and microscopic descriptions shall be made of the stone to include the entire mineral constituents, individual sizes, their approximate percentages, and mineralogical histories. A description of stone hardness, texture, weathering, and durability factors shall be discussed. Pictures of the source wall within the quarry to show any layering and lithology shall be included.
3. A written summary of the suitability of stone for use as armor stone based on the Petrographic and X-ray tests and the abrasion loss (L.A. Rattler) shall be presented in the final laboratory report on stone quality.

F. The required gradations for stone to be used are as follows:

4. Armor Stone:

Weight of Stone (Pounds)	Percent Lighter by Weight (%)
2200–900	100
900–440	50
440–130	15
130–75	5

2.03 SOURCE QUALITY CONTROL

A. Testing and Analysis of Materials shall be performed in accordance with applicable ASTM standards.

B. When tests indicate materials do not meet specified requirements, the Contractor shall remove and legally dispose of the unsuitable material off site and replace with suitable material at no cost to the Agency.

PART 3 - EXECUTION

3.01 GENERAL

A. The Contractor shall perform a preconstruction survey via a third-party independent surveyor licensed in the State of Texas. Prior to the start of construction, the Contractor shall verify all existing elevations and grades and provide templates and stone volumes per SECTION 01 32 23 – SURVEYS AND LAYOUT DATA. The Contractor shall establish the baseline depicted and provide a layout for review before starting placement operations.

B. The Contractor will not be allowed to dredge access channels to construct the containment berm. In emergency situations (as determined by the Engineer and Owner), the Contractor, after approval from the Engineer and Owner, may dredge to remove equipment from the site but must backfill the area immediately following emergency response activities.

C. The Contractor shall install the geocomposite as described in SECTION 31 05 19 – GEOGRID AND GEOTEXTILES and shall take care to avoid damaging the geocomposite layers during placement of overlying material. Placement shall be done in such a manner so as not to rip, puncture, disturb, or damage the geocomposite layer as specified herein.

D. The Contractor shall construct the containment berm to the elevations and alignments shown on the Construction Drawings within the construction tolerances stated in these specifications. The stone materials shall be placed and the surfaces shall be measured at adequate intervals to accurately delineate the surfaces of the layers. Unless the Engineer approves alternate construction methods in writing, all stone on slopes shall be placed in horizontal layers from the toe of the slope up toward the crest.

E. Stone shall be placed so that a well-graded mass is produced with minimum interstitial voids. Stone shall be placed evenly to compress the existing foundation using a method that shall avoid damage to the geocomposite or underlying structure, when present.

F. The height of the stone installation drop shall not be greater than that which may cause damage to the geocomposite or the stone itself. When allowable drop heights are developed on-site, between the Engineer and Contractor, these heights shall be based on actual performance. The Contractor shall maintain the stone layer until accepted, and if material is displaced or the surface damaged, replacement shall be made to the indicated lines and grades at the Contractor's expense. Final surfaces of the finished stone shall be uniform and shall follow with the indicated lines and grades without continuous under or overbuilding.

G. Material that escapes or is lost while loading, transporting, or placing stone, or which is deposited in areas other than shown on the Construction Drawings or approved in writing by the Owner and Engineer, shall be removed and redeposited at the Contractor's expense and at no additional cost to the Owner or, if not removed and redeposited, shall be deducted from the final quantities for payment.

3.02 CONTAINMENT BERM INSTALLATION

A. The Contractor shall install settlement plates prior to interior core placement as shown on the Construction Drawings and described in Part 3.03 of this Section.

B. The subsurface sediments along the containment berm contain compressible sediments that will consolidate during and after construction. Due to the sediment consolidation, the contractor may be required to halt placement operations at certain locations and elevations and wait for the underlying sediments to consolidate before placing additional interior core or armor stone in the specified area. If applicable, the Engineer shall determine when the sediments have reached consolidation (based on Contractor field surveys) and when the Contractor can resume placement activities in the specified area. The Contractor shall place the interior core and armor stone in the following sequence:

1. Install interior core to the full template and perform quality control surveys and weekly settlement monitoring surveys in accordance with SECTION 01 32 23 – SURVEYS AND LAYOUT DATA.
2. Install additional interior core (based on surveys and as directed by the Engineer) as needed to meet minimum lines and grades.
3. Install armor stone to full template and perform quality control surveys and weekly settlement monitoring surveys of the containment berm in accordance with SECTION 01 32 23 – SURVEYS AND LAYOUT DATA.
4. Install additional armor stone (based on settlement monitoring surveys and as directed by the Engineer) as needed to meet minimum lines and grades and perform a quality control survey in accordance with SECTION 01 32 23 – SURVEYS AND LAYOUT DATA.

3.03 During hurricane season or in the event of forecast extreme weather, at the Engineer's discretion, the Contractor may be limited to the amount of interior core placed at one time and may be required to install the armor stone layer before moving to the next containment berm section. The Contractor is responsible for replacing any interior core (prior to cover by armor stone) that is lost from the project work due to storms at any time during the construction at no additional cost to the Agency.

3.04 Settlement Plates

A. Settlement plates shall be constructed with a 4-foot by 4-foot, 1/4-inch-thick steel plate with a 3-inch-diameter steel riser pipe attached to the center of the plate. The settlement plates shall be hot-dipped galvanized after fabrication. The riser pipe shall extend a minimum of 3 feet above the design elevation of the armor stone.

B. Settlement plates shall be placed after installation of the geocomposite and prior to interior core installation at the locations detailed in the construction drawings. Plates shall be placed so that the riser pipe conforms to a vertical plumb standard of no more than 10.5° from true vertical. The riser pipe shall be marked with reflective tape or flagging.

C. During installation of the containment berm, the Contractor shall carefully place materials near the settlement plate and maintain the plates until completion of the project. After acceptance of the containment berm, the Contractor shall cut the riser pipe so that it is 6 inches above the top of the constructed containment berm elevation.

D. Settlement plates shall be surveyed per SECTION 01 32 23 – SURVEYS AND LAYOUT DATA as follows:

1. Prior to interior core placement
2. After placement of interior core
3. After placement of armor stone
4. Every two weeksy during containment berm material placement
5. After cutting the riser pipe (as described in 3.03 C. of this Section)
6. Bi-weekly after completing the containment berm material placement, for a minimum of 3 post-construction survey data points

3.05 SURVEYS

A. All surveys shall be conducted in accordance with SECTION 01 32 23 – SURVEYS AND LAYOUT DATA.

3.06 TOLERANCES

A. Deviations in crest elevation from the design value shall not be greater than +0.5 foot for the interior core and +0.5 foot for the armor stone. Deviations below crest elevations shown on

Construction Drawings will be filled in accordance with this Section until either crest elevation or allowable deviation is achieved.

B. Transitions in alignments shall be smooth and shall be no more than a 1-foot horizontal change in a 20-foot length unless otherwise approved by the Owner and Engineer.

C. Deviations in seaward slope lengths should not be greater than +0.5 feet. Deviations in the landward slope lengths should not be greater than +/-1.5 feet.

3.07 ACCEPTANCE

A. Acceptance will be based on the approved stone source, compliance tests, barge displacement surveys, and surveys performed by the Contractor per SECTION 01 20 00 – MEASUREMENT AND PAYMENT PROCEDURES and SECTION 01 32 23 – SURVEYS AND LAYOUT DATA. The Owner may perform field check tests and/or surveys to verify the Contractor's barge displacement and/or surveys. The Agency survey checks will govern any discrepancies.

END OF SECTION 35 33 00

Attachment 4

Dredged Material Management Plan

Dredged Material Management Plan – Little Bird Island North

The Dredged Material Management Plan for Little Bird Island North provides guidance on placement of dredged material and postconstruction rookery island monitoring. Figures 1 through 3 are provided for informational purposes. The intent is to place fill at varying ranges to create upland bird and beach habitat.

Dredged Material Placement

The following details the recommended dredged material placement plan:

- The Contractor shall place dredged material in the rookery island creation area as directed by the Engineer. The proposed method of placement shall be approved by the Engineer prior to commencement of work.
- Dredged material placement elevations during rookery island creation will be determined by the Engineer. Based on surveys and site visits, the Engineer will direct the Contractor on placement areas and elevations. The intent of the placement is to create varying elevations of upland and beach within the rookery island footprint and for final rookery elevations, after consolidation, to be +5.0 feet North American Vertical Datum of 1988 (NAVD88) at the center of the rookery island, slope down to +4.0 feet NAVD88 at the landward edge of the armored containment berm, and slope down to 0.0 foot NAVD88 at the landward edge of the sill.
- The Contractor shall begin placing dredged material in accordance with the specifications and Contractor's approved work plan. Deviations will be reviewed and approved, if acceptable, on a weekly basis by the Engineer, based on the adaptive placement approach, using survey and aerial images, if required, to guide the decision-making process.
- The Contractor shall use a placement method and employ best management environmental control practices that can be adapted for placing dredged material in varying locations and elevations and that will minimize turbidity in the water discharged from the rookery island placement area.
- If hydraulically placing dredged material, the Contractor shall limit its discharge rate as necessary for the proposed equipment, water depth, surface area, weirs (if applicable), and borrow material properties to prevent turbidity exceedances and weir and berm overtopping. Depending on the proposed discharge rate into the area by the Contractor, intermittent discharge may be required to prevent overtopping. Once established, the Contractor shall not overtop the containment berm or sill with dredged material.
- At the completion of rookery island creation and as directed by the Engineer, the Contractor shall complete the as-built survey of the constructed rookery island.
- Deviations in rookery island elevation will be dependent on the characteristics of the dredged material and determined by the Engineer. If no direction is given, the elevation deviations shall not be greater than +/-0.5 foot.

Postconstruction Monitoring

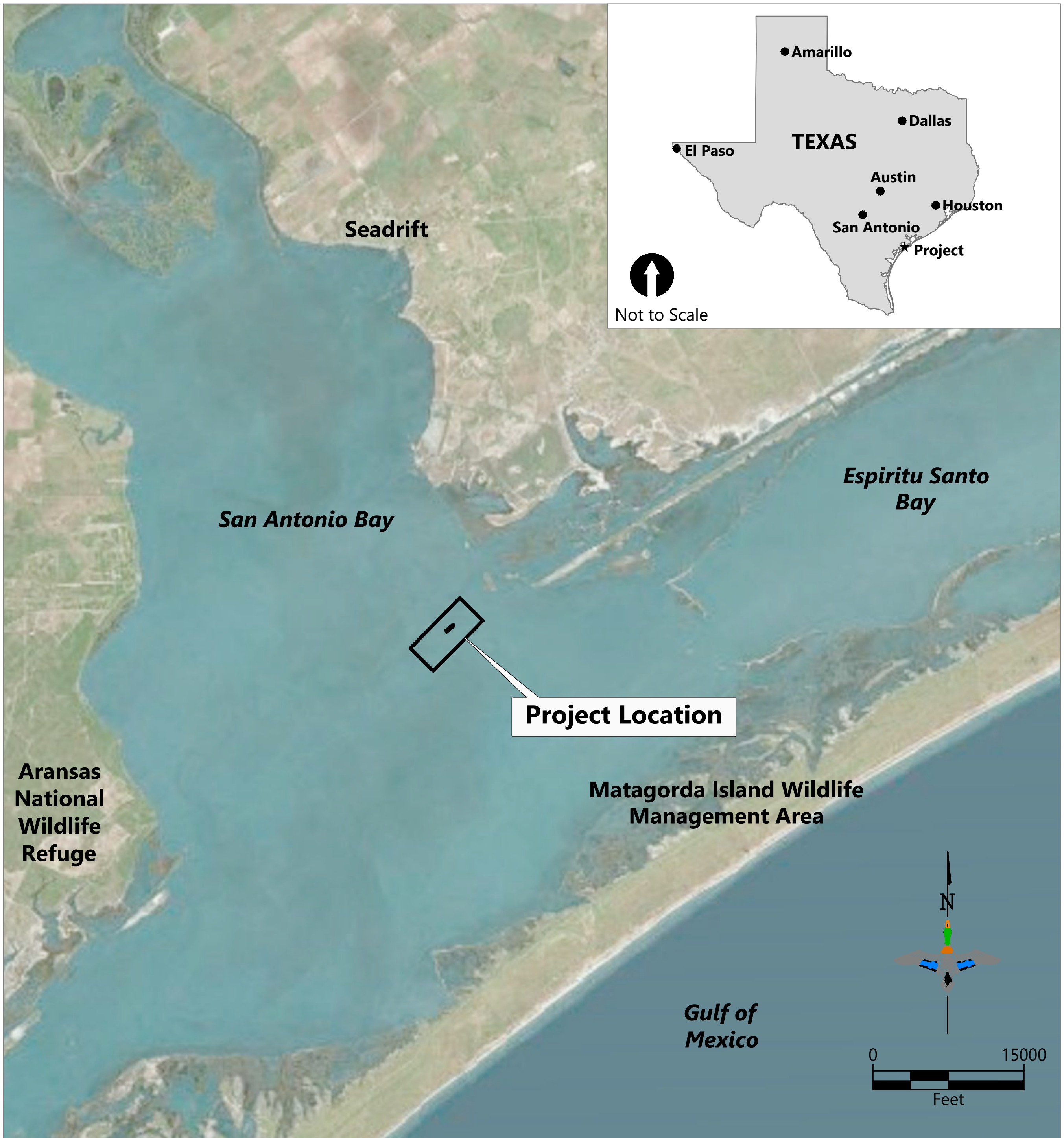
Once the Engineer determines rookery island placement operations are complete, the Contractor shall begin the postconstruction monitoring phase of the project as directed by the Engineer. It is the intent that all irregularities will be resolved on site with the Engineer and Contractor as the rookery island fill is placed. Work during the monitoring phase may be restricted to avoid bird nesting seasons.

The Contractor shall monitor, maintain, and adjust the decant system or weirs as needed to decant water from the site to allow the dredged material to settle and consolidate. The Engineer will determine when post-construction monitoring is complete.

At the completion of postconstruction monitoring and as directed by the Engineer, the Contractor shall remove any decant system or weirs if directed by the Engineer. Degrading and breaching locations and elevations, if required, will be determined by the Engineer based on the last post-construction monitoring visit.

At the completion of this work item, and as directed by the Engineer, the Contractor shall complete the as-built survey of the constructed rookery island.

Figures



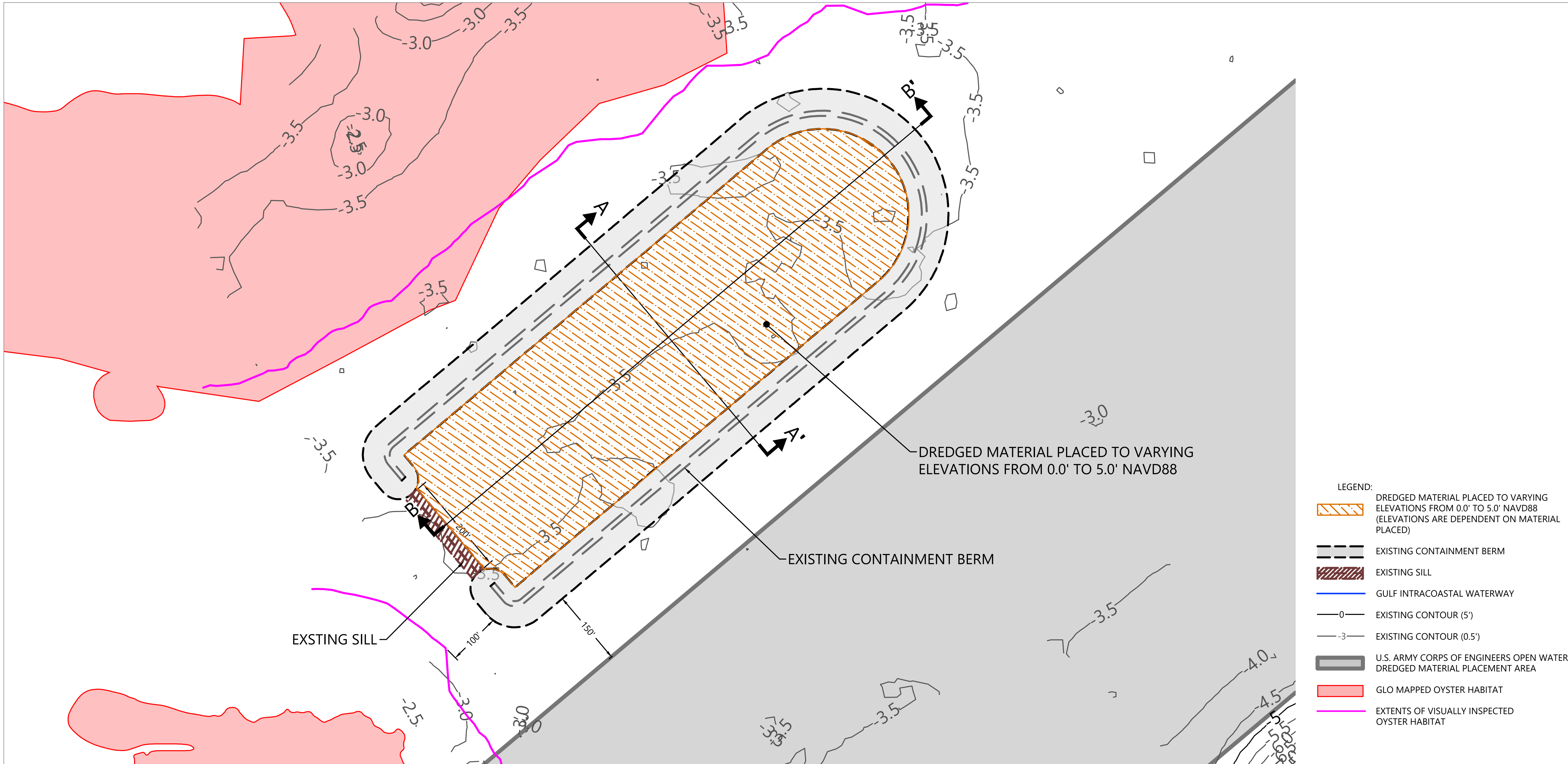
SOURCE: AERIAL IMAGE ©2022 MICROSOFT BING, MICROSOFT CORPORATION EARTHSTAR GEOGRAPHICS.
HORIZONTAL DATUM: TEXAS STATE PLANE SOUTH ZONE, NORTH AMERICAN DATUM OF 1983, U.S. SURVEY FEET

Publish Date: 2022/09/14 9:21 AM | User: psciaba
Filepath: K:\Projects\2018-PCCA Beneficial Use\Little BIrd Island North\2018 RP-002 DMMP Attach - Vicinity Map.dwg Figure 1

ANCHOR QEA

Figure 1
Vicinity Map

Little Bird Island North Attachment 4
Texas Lower Coast Beneficial Use



NOTES:

1. HORIZONTAL DATUM: TEXAS STATE PLANE SOUTH CENTRAL ZONE, NAD83, U.S. SURVEY FEET
2. VERTICAL DATUM: NORTH AMERICAN VERTICAL DATUM OF 1988 (NAVD88)
3. BATHYMETRIC AND VISUAL HABITAT SURVEYS CONDUCTED BY DUCKS UNLIMITED ON MARCH 31, 2022.
4. GLO, 2021B. "LAYER: OYSTER HABITAT (ID: 57)." ARCGIS REST SERVICES DIRECTORY. ACCESSED NOVEMBER 23, 2021.

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Feet

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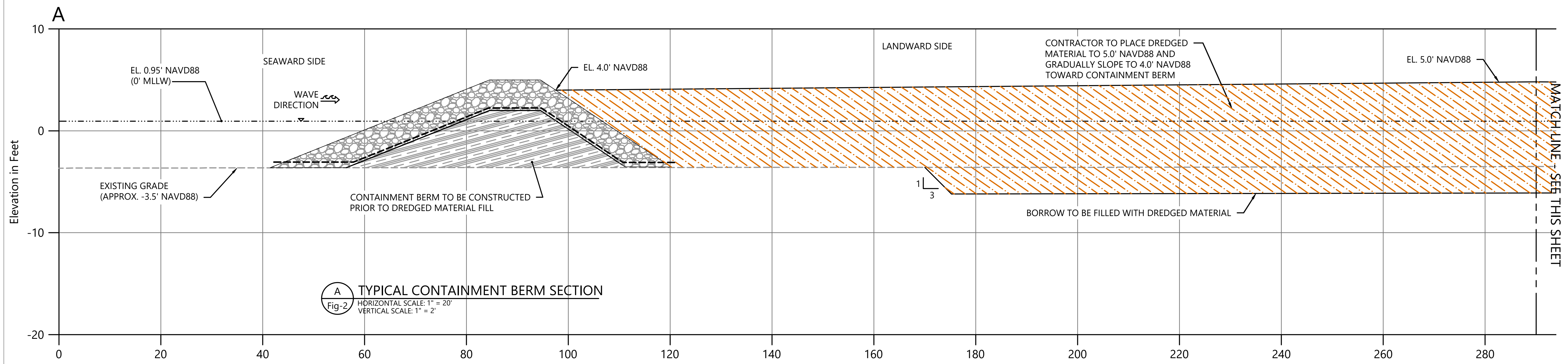
Filepath: K:\Projects\2018-PCCA Beneficial Use\Little Bird Island North\2018 RP-003 DMMP Attach - Plan View and Section.dwg Figure 2

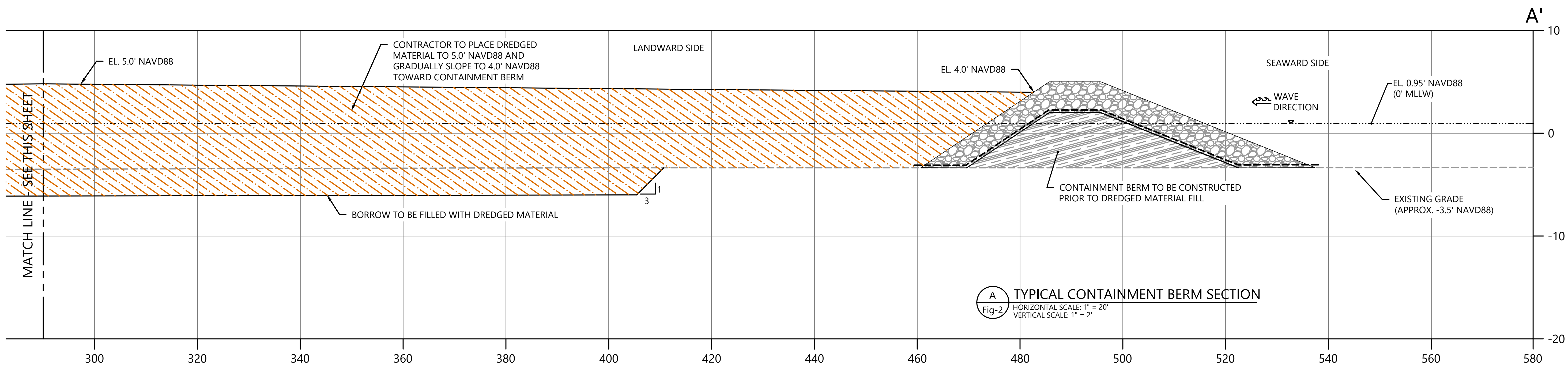
ANCHOR QEA

DUCKS UNLIMITED

Figure 2
Plan View

Little Bird Island North Attachment 4
Texas Lower Coast Beneficial Use





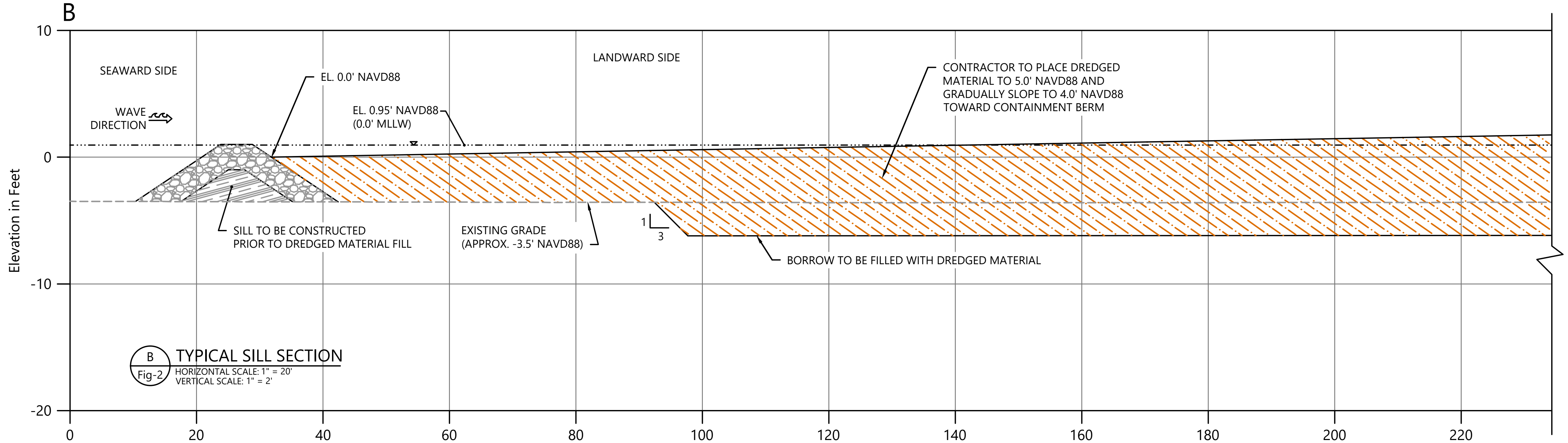
NOTES:

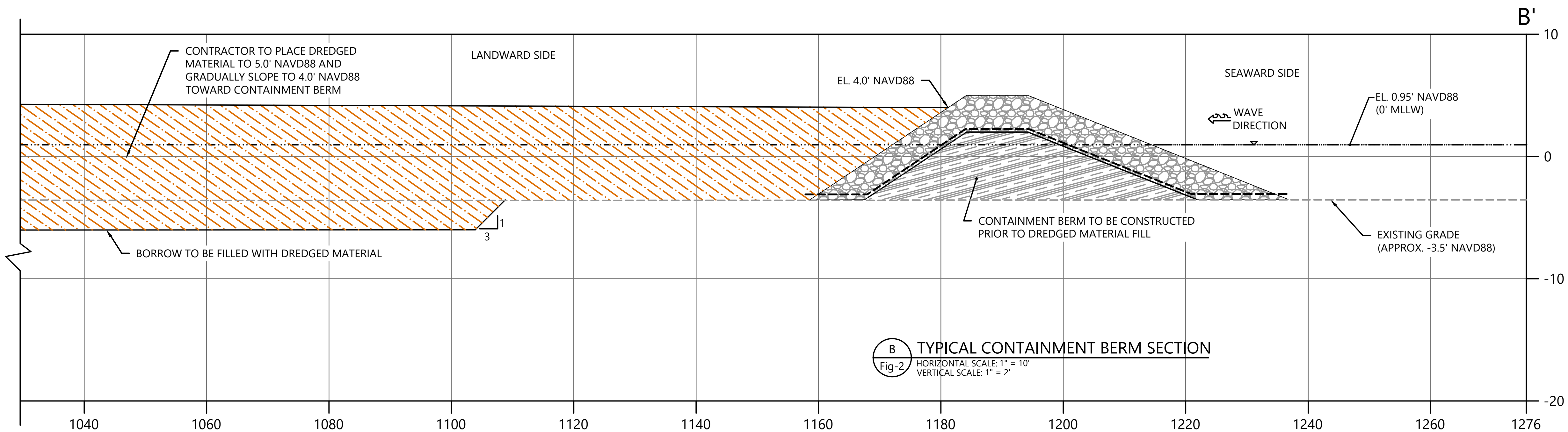
1. VERTICAL DATUM: NORTH AMERICAN VERTICAL DATUM OF 1988 (NAVD88)
2. THE INTENT IS TO PLACE DREDGED MATERIAL TO 5' NAVD88 AT THE CENTER OF THE ROOKERY ISLAND AND GRADUALLY SLOPE DOWN TO 4' NAVD88 AT THE CONTAINMENT BERM. THE GRADUAL SLOPES SHALL BE SET BY THE DREDGED MATERIAL PLACED AND DETERMINED BY THE CONTRACTOR.

Publish Date: 2022/09/14 9:20 AM | User: psciaba
Filepath: K:\Projects\2018-PCCA Beneficial Use\Little Bird Island North\2018 RP-003 DMMP Attach - Plan View and Section.dwg Figure 3

Figure 3
Typical Bird Island Fill Section A-A'

Little Bird Island North Attachment 4
Texas Lower Coast Beneficial Use





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Publish Date: 2022/09/14 9:20 AM | User: psciaba
Filepath: K:\Projects\2018-PCCA Beneficial Use\Little Bird Island North\2018 RP-003 DMMP Attach - Plan View and Section.dwg Figure 4

ANCHOR QEA

DUCKS UNLIMITED

Figure 4
Typical Bird Island Fill Section B-B'

Little Bird Island North Attachment 4
Texas Lower Coast Beneficial Use

Memorandum

January 6, 2023

To: Melissa McCutcheon, Texas General Land Office

From: Todd Merendino, Ducks Unlimited, Inc.
Sarah Garza, Harrison McNeil, and Yvonne Dives-Gomez, Port of Corpus Christi Authority
John Laplante, Dan Opdyke, Renee Robertson, Alexander Freddo, and Hayden Smith, Anchor QEA, LLC
Jane Sarosdy, Sarosdy Consulting, Inc.
Ray Newby, Texas Department of Transportation

Re: M10 60% Design Memorandum

Introduction

This 60% design memorandum describes design criteria and assessments associated with a beneficial use of dredged material (BU) project at the proposed M10 site (Site), located in Texas General Land Office (GLO) Planning Region 3 of the Texas coast in Corpus Christi Bay in Nueces County, Texas (Figure 1).

Project Background

GLO awarded a Coastal Management Program Project of Special Merit grant (funded through the Gulf of Mexico Energy Security Act) to Ducks Unlimited, Inc. (DU) to coordinate with stakeholders and identify restoration sites for BU. The Port of Corpus Christi Authority (PCCA), a project partner, has also contributed staff and financial resources to expand the project scope. The project team is led by DU and PCCA and includes Anchor QEA, LLC; Sarosdy Consulting, Inc.; and the Texas Department of Transportation. Collectively, the project team coordinated three stakeholder meetings with state and federal resource agencies, nongovernmental organizations, academia, consultants, and local officials in each region to solicit information about potential BU sites. Based on stakeholder input, GLO feedback, publicly available data, and professional judgment, the project team has developed 10% designs for 18 sites in GLO Planning Regions 3 and 4 of the Texas coast and 2 GLO-approved sites in Mesquite Bay and San Antonio Bay in GLO Planning Region 2. After completion of the 10% designs, 11 of the designs were selected to continue to 30% designs, and 6 of those designs were chosen for 60% designs and permit application packages. This M10 Site was not included in either the 10% or 30% design phases but was added at the 60% level, bringing the total to seven 60% designs and permit application packages. The project team selected this Site as one of the 7 sites for 60% design development, cost estimation, and permit application package development using funding from the GLO Coastal Management Program Project of Special Merit grant.

Several sites within Corpus Christi Bay have been identified as important locations for creating and restoring marsh and bird habitat (CBBEP 2020). The existing M10 island is an upland placement area located in GLO State Tracts 416, 417, 419, 421, and 421 approximately 0.25 mile south of the Corpus Christi Ship Channel (CCSC) and less than 500 feet west of the Gulf Intracoastal Waterway (GIWW). The BU project (Site) described in this memorandum is proposed to be partially on state-owned submerged land and partially on PCCA-owned submerged land south and southwest of the M10 island. By taking advantage of the existing protection from wakes generated by ships transiting the CCSC afforded by the existing M10 island, containment dikes filled with BU dredged material will be placed south of the island to convert open water to marsh habitat. This Site was selected due to its proximity to source material, existing protection from vessel wakes generated in the CCSC, and the need for marsh habitat in Corpus Christi Bay.

A portion of this Site was designed previously by AECOM (2020a) to the 100% design level and was put out for bid in 2020. A bidder was never selected, the project was never permitted, and the project was never constructed. The project team selected this site due to the existing effort that had gone into the design, the close proximity to expected large sources of dredged material, and because this project has not had permitting completed. By incorporating and refining elements of the existing design from AECOM, the project team is progressing the project by preparing a permit application package, as well as this 60% design memorandum for a Site footprint larger than that of the original AECOM design. Where possible and where appropriate, the DU project team has made modifications to the AECOM design based on our analysis; however, many aspects of the AECOM design will need to be further reviewed and potentially modified during final design of the entire Site.

Project Objectives

Frequent dredging is needed to develop and maintain Texas navigation channels. The dredged material is often deposited in dredged material placement areas (DMPAs), and many of the existing DMPAs along the Texas coast are nearing capacity. Resource agencies and stakeholders have long advocated using dredged material beneficially to create and restore wetlands and bird islands, nourish beaches, and counteract land loss. Historically, BU projects are difficult to manage because they are multiyear, multifaceted undertakings in which different organizations manage dredging schedules, funding, project design, permitting, and construction activities. To help address these issues, the objectives of this project include the following:

- Create and restore degrading coastal habitats.
- Establish sites for disposal of dredged material to reduce reliance on existing DMPAs.
- Improve coastal resiliency of the natural and built environment.

To accomplish these objectives, the project includes the following tasks:

- Stakeholder outreach and coordination
- Identification and selection of BU sites
- 10% designs and cost estimates for 20 BU sites
- 30% designs and cost estimates for 11 BU sites
- 60% designs, cost estimates, and permit application packages for 7 BU sites

This memorandum documents the 60% design and cost estimate for the Site.

Design Objectives

The Site is designed to BU dredged material to convert open-water habitat to a range of marsh habitat. The design will use material dredged from the potential Harbor Island Terminal dredging, the potential CCSC deepening project, or other future deepening projects and routine maintenance, thus reducing the volume of such material placed in existing open-bay or upland DMPAs. This 60% design is based upon publicly available datasets, stakeholder recommendations, and focused field work directed by PCCA and conducted by Triton Environmental Solutions, LLC (Triton); Naismith Marine Services, Inc. (Naismith); Rock Engineering; and AECOM.

Design objectives include the following:

- Develop a preliminary vision based on available data for the Site that includes the following:
  - Habitat to be created or restored
  - Potential sediment source(s)
  - Approaches to minimize long-term maintenance costs, while providing adequate erosion protection and containment
- Delineate conceptual footprints for proposed BU placement.
- Identify key sensitive habitats and construction considerations in the vicinity of the Site.
- Estimate fill volumes for the proposed BU footprints.
- Evaluate existing marsh conditions to inform marsh target elevations.
- Identify data gaps to be addressed in subsequent design phases.
- Provide preliminary cost estimates.

Existing Data Review

A review of published data and the data collected by Triton, Naismith, Rock Engineering, and AECOM was performed to develop the Site and the designs of its containment dikes. This section describes the data reviewed to support the 60% design.

Horizontal and Vertical Datums

The horizontal datum used for the Site is the Texas State Plane South Zone, North American Datum of 1983, in U.S. survey feet. The primary vertical datum used for the Site design is North American Vertical Datum of 1988 (NAVD88). The National Oceanic and Atmospheric Administration (NOAA) maintains an active tide gage, Enbridge, Ingleside Station 8775283 (Ingleside Station), 1.0 mile north of the Site. This station collects and records real-time tide information dating back to 2002. The Ingleside Station does not provide NAVD88 vertical datums, so the NOAA Online Vertical Datum Transformation tool was used to convert the mean lower low water (MLLW) vertical datums to NAVD88 (NOAA 2022a). The converted vertical datums from the Ingleside Station that will be used for the Site are shown in Table 1.

Table 1
Ingleside Station Tidal Datums

Tidal Datum	Elevation (feet MLLW)	Elevation (feet NAVD88)
MHHW	0.71	0.85
MHW	0.70	0.84
MSL	0.40	0.54
MLW	0.00	0.14
MLLW	0.00	0.14

MHHW: mean higher high water
MHW: mean high water
MLW: mean low water
Vertical uncertainty in NAVD88 estimates using NOAA (2022a): ±0.484 foot

Meteorological, Ocean, and Wave Data

Wind and Waves

Wind and wave conditions for this phase of design were assumed to be the same as identified in the AECOM design report for the Site (AECOM 2020a). To summarize from AECOM (2020a), the wind speed and direction values used for the analysis were taken from the Packery Channel NOAA Tidal Station No. 8775792 at 3-hour intervals from June 2008 to June 2018. A Coastal Modeling System 2D numerical wave (CMS-Wave) model was used to simulate wind-driven waves from 180° to 270° (south to west) winds. Waves were generated with wind speeds varying 3 to 51 knots (1.5 to 26.2 meters per second). The design wave was chosen based on the maximum wave height produced by the CMS-Wave model (Table 2). The wind speed used to produce the maximum wave height was considered conservative for this analysis because it represents the 99.9th percentile of the wind speed recorded at the U.S. Army Corps of Engineers (USACE) Wave Information Study Station 73039 (USACE 2021). This design wave and associated design period were extracted from the AECOM M10 report and used in this 60% design as a conservative approach to understanding the wave climate potentially experienced at the Site (Table 2).

Table 2
Assumed Wind and Wave Data from M10 Design

Datum	Value
Wind direction (degrees)	210
Wind speed (knots)	39
Wave height (feet)	2.687
Wave period (seconds)	3.63

Note:
Source: AECOM 2020a

Wake Erosion

The GIWW is approximately 500 feet east of the Site, and the CCSC is approximately 0.25 mile north of the Site. However, ships do not often use this portion of the GIWW (Hamilton et al. 2018). Potential wake erosion from vessels transiting the CCSC is minimized due to the Site being located on the southern side of the existing M10 island. The proposed containment dikes will be designed to resist wind- and vessel-generated erosive forces. Wake erosion from recreational vessels and the ship channels is not expected to drive the design of the dikes; however, it may inform the transition of the containment dikes to the existing island to prevent wake-driven scour around the edge of the containment dikes. These impacts will be evaluated during final design.

Bathymetry

Naismith conducted a bathymetric survey at the Site in October 2019. The Site footprint consists of mostly open-water habitat. The Site footprint has an average seabed elevation of approximately -10.0 feet NAVD88 (-10.14 feet MLLW).

Geotechnical Investigations

Terracon Consultants, Inc. (Terracon) completed a material exploration to partially characterize the borrow source material at Harbor Island. The data provide a partial characterization of the BU source material at this location; however, the exploration program was not meant to provide full characterization (Terracon 2019).

Under the guidance of AECOM, Rock Engineering investigated the M10 site, including boring collection and soil testing, with the purpose of evaluating the substrate’s ability to serve as a foundation for the proposed dikes. Of the seven borings conducted at the Site, clay was the constituent with the highest percentage of cores (AECOM 2020a).

Utilities and Infrastructure

The Railroad Commission of Texas public GIS viewer (RRC 2021) and GLO pipeline data (GLO 2021) were used to identify mapped utilities near the Site. One active gas well was also found in the Site vicinity (Attachment 1, C01). These utilities are submerged. It is anticipated the plugged wells will not impact design or construction. However, the one active gas well will be considered in design and construction, during which preliminary concepts are to design the Site armoring to have sills with the appropriate right-of-way distance limits surrounding the wells.

A magnetometer survey of the Site was conducted by Naismith on October 4 to 18, 2019. This survey showed several probable well bores within the Site footprint (AECOM 2020a). The need for Site-specific utility locations prior to construction will be determined during subsequent design phases.

This investigation is not sufficient to clear the Site for construction. Further investigation into underground and aboveground utilities must be conducted prior to construction of this project.

Desktop Cultural Resources Survey

A search of cultural resources records in the Texas Historical Commission Texas Historical Sites Atlas Database (THC 2021) was completed on December 15, 2022. This search revealed that no cultural sites have been identified within the preliminary proposed Site.

Sensitive Habitat

AECOM identified some wetland habitat near the site but not within the project footprint during its wetland analysis conducted as a part of its original design (AECOM 2020a). AECOM's *Waters of the United States Delineation Report* stated AECOM did not observe the presence of seagrass or oysters within or adjacent to the footprint of the Site (AECOM 2020b). Based on the average elevation of -10 feet NAVD88 (-10.14 feet MLLW) within the footprint of the Site, we do not anticipate seagrass within most of the Site. Based on visual seagrass surveys conducted by DU at the adjacent Pelican Island and PA9-S that showed no seagrass on the south-facing shores of the island, we do not anticipate seagrasses on the shorelines within the footprint of the Site. The visual surveys conducted by DU at Pelican Island and PA9-S also showed no presence of oysters, and it is anticipated that, due to the similar conditions at M10, no oysters will be present.

Similar habitat surveys may need to be conducted during a subsequent phase of design to re-evaluate the presence and extents of sensitive habitat.

Beneficial Use Source Material

A significant portion of the proposed source material for the Site could come from dredged material from the borrow area at Harbor Island (Attachment A, C01) or other suitable borrow sources. A summary of the available material at Harbor Island based on the geotechnical investigation conducted by Terracon is shown in Tables 3 through 5. These tables assume material at elevations greater than 5 feet MLLW will be used at Harbor Island and not M10.

A hazardous, toxic, and radioactive waste analysis of the data collected by Terracon consisting of sediment samples, elutriate tests, and site water samples was conducted by AECOM. AECOM concluded the sediments from Harbor Island should not present water quality issues for diked placement (AECOM 2020a). For this 60% design, AECOM's analysis was considered sufficient; however, further analysis of borrow sediments from Harbor Island may need to be performed prior to final design.

Table 3
Estimated Material Volume In Situ at Harbor Island Dock 1

Soil Description	Elevation (feet MLLW)		Thickness of Soil Unit (feet)	Total Thickness (%)	Estimated Volume (CY)
SP	5	2	3	0.05	126,923
CL	2	-2	4	0.06	169,231
SP	-2	-5	3	0.05	126,923
CH and CL	-5	-10	5	0.08	211,538
SM and SC	-10	-21	11	0.17	465,385
CH and CL	-21	-36	15	0.23	634,615
SM and SC	-36	-53	17	0.26	719,231
CH and CL	-53	-60	7	0.11	296,154
			Total	**1.00**	**2,750,000**

Notes:
Source: AECOM (2020a)
CH: fat clay
CL: lean clay
SC: clayey sand
SM: silty sand
SP: poorly graded sand

Table 4
Estimated Material Volume In Situ at Harbor Island Dock 2

Soil Description	Elevation (feet MLLW)		Thickness of Soil Unit (feet)	Total Thickness (%)	Estimated Volume (CY)
SP	5	2	3	0.05	126,923
CL	2	-2	4	0.06	169,231
SP	-2	-5	3	0.05	126,923
CH and CL	-5	-10	5	0.08	211,538
SM and SC	-10	-23	13	0.20	550,000
CH and CL	-23	-33	10	0.15	423,077

Soil Description	Elevation (feet MLLW)		Thickness of Soil Unit (feet)	Total Thickness (%)	Estimated Volume (CY)
SM, SC and SP-SM	-33	-51	18	0.28	761,538
CH, and CL	-51	-58	7	0.11	296,154
CH, and CL	-58	-60	2	0.03	84,615
			Total	**1.00**	**2,750,00**

Note:
Source: AECOM (2020a)
SP-SM: Poorly Graded Sand

Table 5
Total Estimated Material Volume In Situ at Harbor Island

Sediment Types	Dock 1 Summary	Dock 2 Summary	Total Estimated Quantities
SP, SM, SC, and SP-SM	1,438,462	1,565,385	3,003,846
CH, CL	1,311,538	1,184,615	2,496,154
Total	2,750,000	2,750,000	**5,500,000**

Notes:
Source: AECOM (2020a)
All quantities are in CY.

Additional source material for the Site may come from the CCSC. Based on coastal consistency determinations from USACE, USACE has historically performed maintenance dredging on the CCSC near the Site (USACE 1999). The identified USACE DMPAs adjacent to the Site and their average annual quantity of dredged material, distance from the Site to DMPA, and channel segments are shown in Table 6. With the ongoing widening and deepening of the CCSC, it is expected that the average annual dredging quantities will be higher in the future. The average grain size and grain type percentages are shown in Table 7.

Table 6
USACE DMPA Areas Near the Site That Received Dredged Material

DMPA No.	Channel Segment (Station)	Distance from Site to DMPA (miles)	Average Annual Dredging Quantity (CY)
8	Inner Basin to La Quinta Junction (320+00-400+00)	3.0	40,000
9	Inner Basin to La Quinta Junction (400+00-500+00)	1.5	51,000
10 (M10)	Inner Basin to LaQuinta Junction	0	0
14A	LaQuinta Junction to Beacon 82 (700+00 to 800+00)	2	211,000
14B	LaQuinta Junction to Beacon 82 (700+00 to 800+00)	3	86,000

Note:
Source: USACE 1999

Table 7
Typical Sediment Characteristics Between Inner Basin and LaQuinta Junction

Sediment Characteristics
D_{50} (mm) = 0.256
87.8% sand
6.6% silt
5.7% clay

Notes:
Data are from CCSC Channel Segment Station 0+00 to 200+00
Source: USACE 1999
D_{50}: median grain size

Another potential source of sediment is from the proposed CCSC Channel Deepening Project and La Quinta Channel Deepening. These projects could provide a substantial portion of the material to be placed at the Site. Analysis of the expected sediment quantities and characteristics from the CCSC Channel Deepening Project and La Quinta Channel Deepening will be completed, if needed, during the final design phase.

Marsh Vegetation Elevation Ranges

Table 8 shows typical elevation ranges for relevant marsh vegetation based on vegetation surveys conducted by Triton at the Dagger Island marsh in Redfish Bay approximately 2.5 miles northeast of the Site. The range represents minimum and maximum values found during the survey, while the mode represents the most frequently occurring values found during the survey.

Table 8
Typical Elevations for Target Marsh Vegetation at the Site

Species	Elevation (feet MSL)		Elevation (feet NAVD88)	
	Range	Mode	Range	Mode
High marsh	0.66 to 3.86	1.26 to 1.96	1.2 to 4.4	1.8 to 2.5
Low marsh	-1.44 to 2.96	0.26 to 0.76	-0.9 to 3.5	0.8 to 1.3
Seagrass	-5.74 to 0.56	-3.34 to -1.04	-5.2 -to 1.1	-2.8 to -0.5
Smooth cordgrass	-1.84 to 1.16	-0.74 to -0.04	-1.3 to 1.7	-0.2 to 0.5
Sand flats	1.63 to 1.64	1.63 to 1.64	2.17 to 2.18	2.17 to 2.18
Uplands	1.96 to 5.56	1.96 to 5.56	2.5 to 6.1	2.5 to 6.1

Note:
Source: Triton (2022)

60% Design

The main design elements evaluated for the Site are as follows:

- Site location
- Marsh size and shape
- Containment and erosion protection
- Constructability
- Planting and natural recruitment of vegetation
- Performance expectations
- Site construction cost estimates
- Expected ecosystem benefits
- Data and information gaps

These design elements are evaluated in this memorandum for the 60% Site design.

This project is planned to be constructed in two phases. Phase 1 will include containment dikes A and B and the marsh fill within the diked area contained by those dikes, while Phase 2 will include containment dike C, as well as the marsh fill within the diked area contained by that dike. Phase 1 and 2 are both included in the 60% construction drawings (Attachment 2), which provide details for the construction for the containment dikes, and technical specifications (Attachment 3).

Phase 2 would be constructed later than Phase 1 once a source of dredged material becomes available.

Site Location

The Site is 0.25 mile south of the CCSC and 500 feet west of the GIWW near Ingleside in Corpus Christi Bay. (Figure 1). The existing DMPA No. 10 is directly adjacent to the Site. This DMPA is an upland placement area, and it is not anticipated that the Site would interfere with ongoing USACE operations. However, additional coordination with USACE will be necessary.

The average elevation of the Site is approximately -10.0 feet NAVD88 (-10.14 feet MLLW). The Site design includes constructing containment dikes to the south of the existing M10 island and filling the diked area with dredged material to create marsh (Attachment 2, C02). Additional bathymetric surveys may need to be conducted prior to final design to update any shoaling or erosion that may have occurred since the previous bathymetric survey conducted in October 2019.

Marsh Size and Shape

Based on availability of sediment and a cost analysis, the project team proposes the total site area be 840 acres, with 760 acres as a marsh fill area and 80 acres as containment dikes. The Site will consist of fill extending to the edge of the existing M10 island and to the edge of the constructed containment dikes described in the Containment and Erosion Protection section. Sediment will be placed within a range of elevations to create a variety of habitats. The fill elevations described in this section may be adjusted in further phases of design, depending on the physical properties of the dredged material and to target a variety of vegetation habitats.

The marsh restoration area is expected to be 760 acres and is being designed to support a range of low and high marsh habitat. Elevations will range from 1.5 feet NAVD88 to 3.5 feet NAVD88, with an average target elevation of 3 feet NAVD88 (2.46 feet mean sea level [MSL]; Table 8).

Fill material for Phase 1 would likely be obtained from Harbor Island (Table 5); however, a source for Phase 2 has not yet been identified. It is predicted that the required fill volume for the marsh fill for Phase 1 will be approximately 8 million cubic yards (CY), while the required fill volume for Phase 2 will be approximately 12 million CY. These values assume 1 foot of foundation compression for every 6 feet of fill and do not consider bulking. Additional geotechnical evaluations will be performed (and data collected, if appropriate) during the final design phase to further evaluate the expected foundation compression and bulking of dredged material.

Based on the volumes in Table 5, the material expected to be available from Harbor Island (5.5 million CY) is not sufficient to complete Phase 1. Hence, multiple maintenance dredging events may be needed to fill the remainder of Phase 1 to the proposed design elevations. However, if new work material becomes available, either through the CCSC Channel Deepening Project, the La Quinta Channel Deepening, or other new work projects, the remaining capacity of Phase 1 could be filled during a single dredging event. For Phase 2, multiple new work dredging events or maintenance dredging events may be needed to construct the containment dikes and fill the Site.

The marsh at the Site is designed to be a mix of low and high marsh. Openings (i.e., sills) in the containment dikes will be created to provide connectivity to Corpus Christi Bay. Design features to increase tidal exchange will be evaluated in final design.

Relative sea level rise (RSLR) may impact the Site in the future. A strategy to address RSLR could be to place BU material to higher elevations in preparation for higher relative sea levels and tidal elevations associated with RSLR. The upper ranges of high marsh were included in the design to accommodate for RSLR impacts, while also creating valuable marsh habitat in the short term. The impacts of RSLR may be adapted to in the future through adaptive management strategies such as thin-layer placement of additional dredged material.

Containment and Erosion Protection

Dikes A, B, and C are designed to contain and protect the dredged materials and future marsh from edge erosion. As shown in Attachment 2, the containment dikes will be constructed on the southern end of M10, and dikes A and C will face the open bay, while dike B will be an internal dike splitting the marsh areas of Phases 1 and 2. Based on AECOM's M10 wind and wave data in Table 2, dikes A and C will require armoring. AECOM's design indicated the armored containment dikes will be constructed of hydraulic stiff clay with an armored revetment on their face consisting of a sheet of geotextile fabric overlain with bedding stone, then topped with armor stone. This approach to armoring has been carried forward for this 60% design but may be modified as part of the final design phase. During final design, evaluation of sills placed in the dikes will be evaluated as a means of tidal exchange between the Site and Corpus Christi Bay. If, during final design, coastal analysis shows armoring is needed on dike B to protect the site from erosion during the interim between Phases 1 and 2, then armoring will be added to dike B.

Stability Analysis

To evaluate the slope stability of the dikes, AECOM used the SLOPE/W computer program using the Bishop method. AECOM assumed the placement area was over a sand bay bottom, although the boring logs generally indicate a clay bay bottom (AECOM 2020a). For this 60% design, AECOM's analysis was referenced for design, and the resulting dimensions for the dikes are shown in Table 10. Re-evaluation of dike stability analysis will need to be conducted during final design.

Table 9
Armor Stone Gradation

% Lighter	Minimum (pounds)	Maximum (pounds)
100	440	1,100
50	220	330
15	70	165

Note:
Source: AECOM (2020a)

Wave Runup Analysis

To evaluate the necessary height of the dikes, a wave runup analysis was conducted by AECOM and is described at length in their AECOM 2020 design report. The de Waal and Ven Der Meer (1992) runup equations from the Coastal Engineering Manual Part VI, Chapter 6 were used (USACE 2006). The runup anticipated by the equations for a 50-year event storm for several different slopes were evaluated. Ultimately, a 1 vertical to 4 horizontal slope was selected. For this 60% design, AECOM's analysis was referenced for the design, and the resulting dimensions for the dikes are shown in Table 10. Re-evaluation of this analysis will need to be conducted prior to final design.

Armor Stone Sizing

To determine the size of armor stone needed for dikes A and C, AECOM conducted an armor stone evaluation (AECOM 2020a). To determine the armor stone size, Hudson's equation was used. AECOM assumed limestone would be used as the stone type. To determine the thickness of the armor stone, AECOM used formula VI-5-117 from the *Coastal Engineering Manual* (USACE 2006). The final armor thickness is a minimum of 2.2 feet, and the armor stone gradation is shown in Table 9. For this 60% design, AECOM's analysis was referenced for design. Re-evaluation of this analysis may need to be conducted prior to final design.

Dike Dimensions

For the marsh fills of Phases 1 and 2, a total containment dike length of 22,000 feet will be constructed to create capacity for and protect the placed dredged material from erosion. Table 10 summarizes the proposed design for the construction of the containment dikes.

The containment dikes will have sills to allow tidal flow into the contained marsh via open-water channels extending into the marsh. The locations and geometry of the sills will be determined based on discussions with regulatory agencies during final design and are not depicted on the 60% drawings.

The constructed and final slopes and cross-sectional dimensions of the containment dikes will be further refined through modeling and analysis of the sediment characteristics of the dredged material, the containment dike subgrade, the hydrodynamic and wind-wave conditions, and an analysis of initial capital construction costs versus maintenance costs during a subsequent phase of design.

Table 10
Dike A, B, and C Design Characteristics

Containment Dike Design Criteria	Containment Dike A	Containment Dike B	Containment Dike C
Total project length	7,000 feet	4,900 feet	10,000 feet
Total containment dike acreage	24 acres	16 acres	38 acres
Crest width	20 feet	20 feet	20 feet
Base width	70–180 feet, depending on water depth	70–180 feet, depending on water depth	70–180 feet, depending on water depth
Assumed bottom elevation	-11 feet NAVD88	-11 feet NAVD88	-13 feet NAVD88
Total structure height	16 feet	16 feet	18 feet
Containment dike materials	Hydraulically placed stiff clay, geotextile fabric, and rock	Hydraulically placed stiff clay	Hydraulically placed stiff clay, geotextile fabric, and rock
Containment dike hydraulic fill volume	600,000 CY	400,000 CY	900,000 CY
Containment dike rock volume	30,000 CY	N/A	45,000 CY
Estimated settlement[1]	3 feet	3 feet	3 feet
Design side slopes (seaward side)	4H:1V	4H:1V	4H:1V
Design side slopes (landward side)	4H:1V	4H:1V	4H:1V
Maximum design crest elevation	+5 feet NAVD88	+5 feet NAVD88	+5 feet NAVD88

Notes:
The final cross-sectional dimensions, slopes of the containment dike, and volume required for interior fill will need to be determined and refined, respectively, through modeling and analysis of the wind-wave hydrodynamics and sediment characteristics of the dredged material and containment dike subgrade during a subsequent phase of design.
1. Based on AECOM evaluations (AECOM 2020a)
H:V: horizontal to vertical
N/A: not applicable

Constructability

This section describes the proposed methods of construction. Actual methods will be dependent on the chosen contractor's equipment and Site conditions at the time of construction. In addition, the contractor may propose alternate construction methods, subject to review and approval, from those described in this section.

The Site is expected to be constructed in two different phases. Descriptions of the two phases follow.

Phase 1

Stiff clay new work material from Harbor Island will be mechanically or hydraulically discharged along the perimeter of the Site. This material will be used to construct containment dikes A and B to the required design elevations and geometry. As the dredged material dries, the containment dike will be shaped above the MLLW elevation to the design template. Geotextile fabric and rock will then be placed on the shelf of dike A (Attachment 2, C03). Following completion of the dike, material will be discharged within the site to design elevations to create marsh.

Phase 2

Stiff clay new work material will be mechanically or hydraulically discharged along the perimeter of the Site. This material will be used to construct containment dike C to the required design elevations and geometry. As the dredged material dries, the containment dike will be shaped above the MLLW elevation to the design template. Geotextile fabric and rock will then be placed on the shelf of dike C (Attachment 2, C02). Following completion of the dike, material will also be discharged within the site to design elevations to create marsh.

Planting and Natural Recruitment of Vegetation

The decision to plant the marsh or to allow natural recruitment will be determined during final design through collaboration with the project proponent (yet to be determined). Table 8 shows some of the targeted vegetation types and their preferred habitat elevations. If the outcome is unsatisfactory (e.g., if the marsh area has a lower-than-desired density of vegetation or if undesirable species of vegetation are present), an adaptive management program can be instituted to directly plant, adjust Site elevations, remove undesirable species, etc. Performance metrics for satisfactory vegetation outcomes will be set by working with agencies during final design. The decision to plant for a desired level of biodiversity or for a target species will ultimately come from collaboration between the project proponent, design team, and permitting agencies during final design.

Performance Expectations

The performance goal for the project is to create 760 acres of new habitat, primarily high and low marsh. The designed dikes are expected to contain placement of dredged material, be resilient to typical storm events, and provide protection for the interior habitat.

Site Construction Cost Estimates

Preliminary construction costs were estimated for the design outlined in the previous sections. The estimated costs also include the indirect construction costs (i.e., permitting, 100% engineering and design costs, construction management, and postconstruction management such as site visits and dewatering management). These costs represent the estimated incremental costs (i.e., costs over and above USACE's least costly and environmentally acceptable dredged material placement alternative). Table 11 shows a list of each line item and the total cost estimated for construction.

The costs range from $87.3 million to $187.1 million, depending on the level of uncertainty allocated to the project cost. The lower bound of uncertainty (-30%) and upper bound of uncertainty (+50%) were selected due to the existing data gaps, high levels of inflation, and rising fuel costs.

This cost estimate assumes the BU proponent would not pay for the dredging component of the project. It is possible that the entity paying for the M10 beneficial use site would also pay for the dredging component of the cost.

To understand the dredging component costs of this Site, bids from 2020 for the AECOM design of this project (only Phase 1) were evaluated. Based on the bids, it is anticipated that the direct construction costs of Phases 1 and 2 of this project could increase by approximately $100 million and $200 million, respectively, if the dredging component is included.

Cost savings may be realized by further analysis and modeling of wind and wave conditions during final design and refining the level of armoring. An evaluation of the initial capital construction versus projected maintenance costs could be conducted to determine an optimum armoring design that allows for satisfactory protection of the interior marsh, while being within the project budget.

The estimates are developed using current and generally accepted engineering cost estimating methods and are based on assumptions concerning future events. Actual costs may be affected by known and unknown risks including, but not limited to, changes in general economic business conditions, Site conditions that were unknown at the time the estimates were performed, future changes in Site conditions, regulatory or enforcement policy changes, and delays in performance. Actual costs may vary from these estimates.

Table 11
Opinion of Probable Construction Cost to 100% Project Completion

Item	Quantity	Unit	Unit Price	Total
Direct Construction Costs				
Phase 1				
Incremental Mobilization and Demobilization[1]	1	LS	$12,000,000.00	$ 12,000,000.00
Preconstruction Survey	1	LS	$ 30,000.00	$ 30,000.00
Incremental Dredging Cost (Harbor Island)[1,2]	5,500,000.00	cy	$ 5.00	$ 27,500,000.00
Incremental Dredging Cost (1 Mile)[1,3]	2,500,000.00	cy	$ 3.00	$ 7,500,000.00
Dike Construction[1]	12,000.00	LF	$ 50.00	$ 600,000.00
Bedding and Armor Stone[1]	44,000.00	ton	$ 115.00	$ 5,100,000.00
As-Built Survey/Aerials	1	LS	$ 70,000.00	$ 70,000.00
Navigational Aids[4]	24	Each	$ 10,000.00	$ 240,000.00
Phase 1 Subtotal[1]			**Sum**	$ 53,000,000.00
Phase 2				
Incremental Mobilization and Demobilization[1]	1	LS	$16,000,000.00	$ 16,000,000.00
Preconstruction Survey	1	LS	$ 30,000.00	$ 30,000.00
Incremental Dredging Cost (1 Mile)[1,5]	13,000,000.00	cy	$ 3.00	$ 39,000,000.00
Dike Construction[1]	10,000.00	LF	$ 50.00	$ 500,000.00
Bedding and Armor Stone[1]	71,000.00	ton	$ 115.00	$ 8,200,000.00
As-Built Survey/Aerials	1	LS	$ 70,000.00	$ 70,000.00
Navigational Aids[4]	20	Each	$ 10,000.00	$ 200,000.00
Phase 2 Subtotal[1]			**Sum**	$ 64,000,000.00
Direct Construction Total[1]			**Sum**	$ 117,000,000.00
Indirect Construction Costs				
100% Engineering and Design	1	LS	$4,000,000.00	$ 4,000,000.00
Permitting	1	Each	$ 100,000.00	$ 100,000.00
Construction Management[1]	1	LS	3%	$ 3,500,000.00
Postconstruction Management[6]	12	Month	$ 10,000.00	$ 120,000.00
Indirect Construction Subtotal[1]			**Sum**	**$ 7,700,000.00**
Project Subtotal[1]			**Sum**	**$124,700,000.00**
-30% Uncertainty[1]	1	%	30	$ 37,400,000.00
+50% Uncertainty[1]	1	%	50	$ 62,400,000.00
Low-End Total Project Estimated Cost			**Total Sum**	$ 87,300,000.00
High-End Total Project Estimated Cost			**Total Sum**	$ 187,100,000.00

Notes:
Costs were determined based upon a combination of publicly available datasets and sediment surface grabs, and topographic, bathymetric, and habitat surveys.

1. Value is rounded to the nearest $100,000.

2. Cost is based on the incremental cost of diverting dredged material from the Harbor Island terminal to the Site.
3. Cost is based on the incremental cost of diverting dredged material from maintenance dredging operations to the Site.
4. Value is rounded to the nearest $10,000.
5. Cost is based on the incremental cost of diverting dredged material from new work or maintenance dredging operations to the Site.
6. Postconstruction management may include Site visits to observe the material consolidation, vegetation, and water levels on the Site. Monthly aerials may be performed. Additional postconstruction management practices may be considered during subsequent phases of design.

LF: linear foot
LS: lump sum

Expected Ecosystem Benefits

Creation of the Site is expected to have a net positive benefit on the regional ecosystem. The marsh restoration is expected to add 760 acres of mostly marsh habitat to the regional ecosystem. The Site will also provide resiliency to the existing M10 island and increase foraging habitat for birds.

The mean RSLR trend averaged between Rockport and Corpus Christi is 5.74 millimeters (mm) per year (NOAA 2022b). Assuming no changes in the mean RSLR trend and no erosion, as well as not considering inorganic and organic accretion, the marsh within the target elevation of the Site (3.0 feet NAVD88) would remain above the 90th-percentile water level until 2076.

Data and Information Gaps

At this phase of design, the following data and information gaps have been identified:

- Coordination with USACE will be necessary, given that the Site is directly adjacent to a DMPA. For USACE staff to support the development of this Site, it should avoid limiting future USACE placement of material, either by making it more costly to place material in its DMPAs, decreasing the capacity of its DMPAs, or by creating habitat for sensitive species that could inhibit future placement of material. It is anticipated that the BU Site will not interfere with USACE's operations at the existing M10 DMPA, because the existing M10 DPMA is diked, and material is not released south of the island, nor would dredging pipelines be expected to access the existing site from the south.
- Analyses conducted by AECOM will need to be evaluated to determine whether certain aspects of the design need to be modified or refined.
- Geotechnical characteristics of the source material (maintenance and new work material) and subgrade of the placement area may need to be supplemented, depending on a data gaps assessment to refine evaluations of containment structure stability, subgrade and source material settlement, and short- and long-term capacity for dredged material placement.
- Surveys will need to be conducted to obtain information such as property lines, utility locations, and supplemental bathymetry, where appropriate.

These data gaps may need to be addressed during the progression from 60% design to final design. For example, supplemental data collection and modeling could allow for optimizing the project design to reduce construction costs. It is expected that the cost of addressing these information gaps would be offset by the cost savings that would be realized by optimizing the project design. Because the final design may require supplemental data, the 60% design uses conservative assumptions (e.g., regarding armoring), potentially increasing the estimated construction cost. This current project is taking the analyses as far as practicable, considering the constraints of the project scope, budget, and schedule.

Future Work

No fatal flaw has been identified at this phase of the design. Should the Site be selected for additional design efforts, it can be expected that some aspects of the design in this memorandum will be modified and, as appropriate, enhanced.

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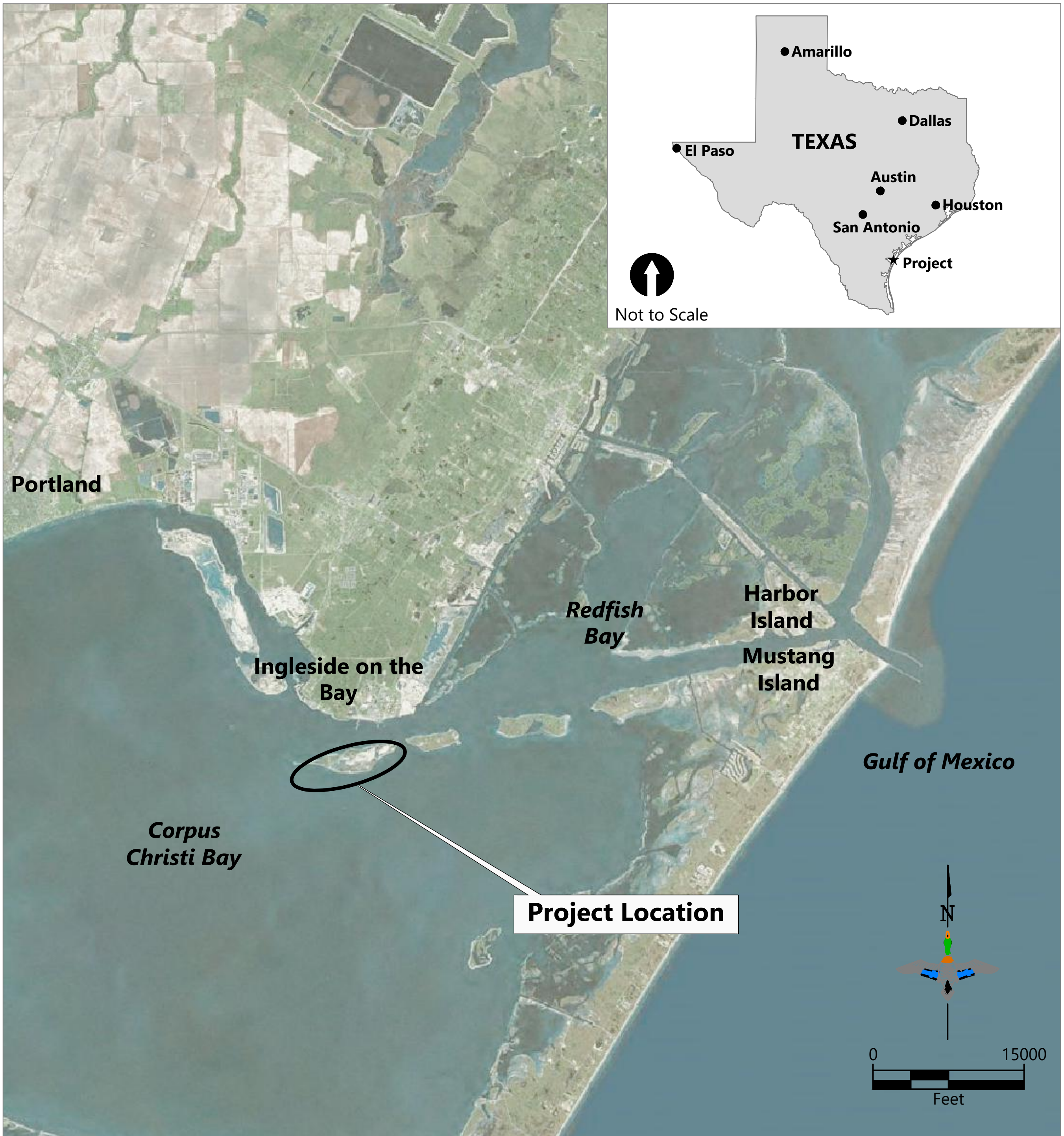
Figure



SOURCE: Aerial provided by Bing Maps.
HORIZONTAL DATUM: Texas State Plane South Zone, North American Datum of 1983, U.S. Survey Feet

Publish Date: 2022/12/15 8:52 AM | User: mpratschner
Filepath: K:\Projects\2018-PCCA Beneficial Use\M10\2018 RP-001 VIC MAP_M10.dwg Figure 1_M10

Figure 1
Vicinity Map

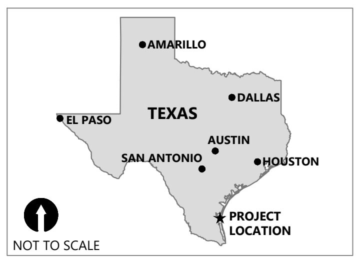
M10 60% Design Memorandum
Texas Lower Coast Beneficial Use

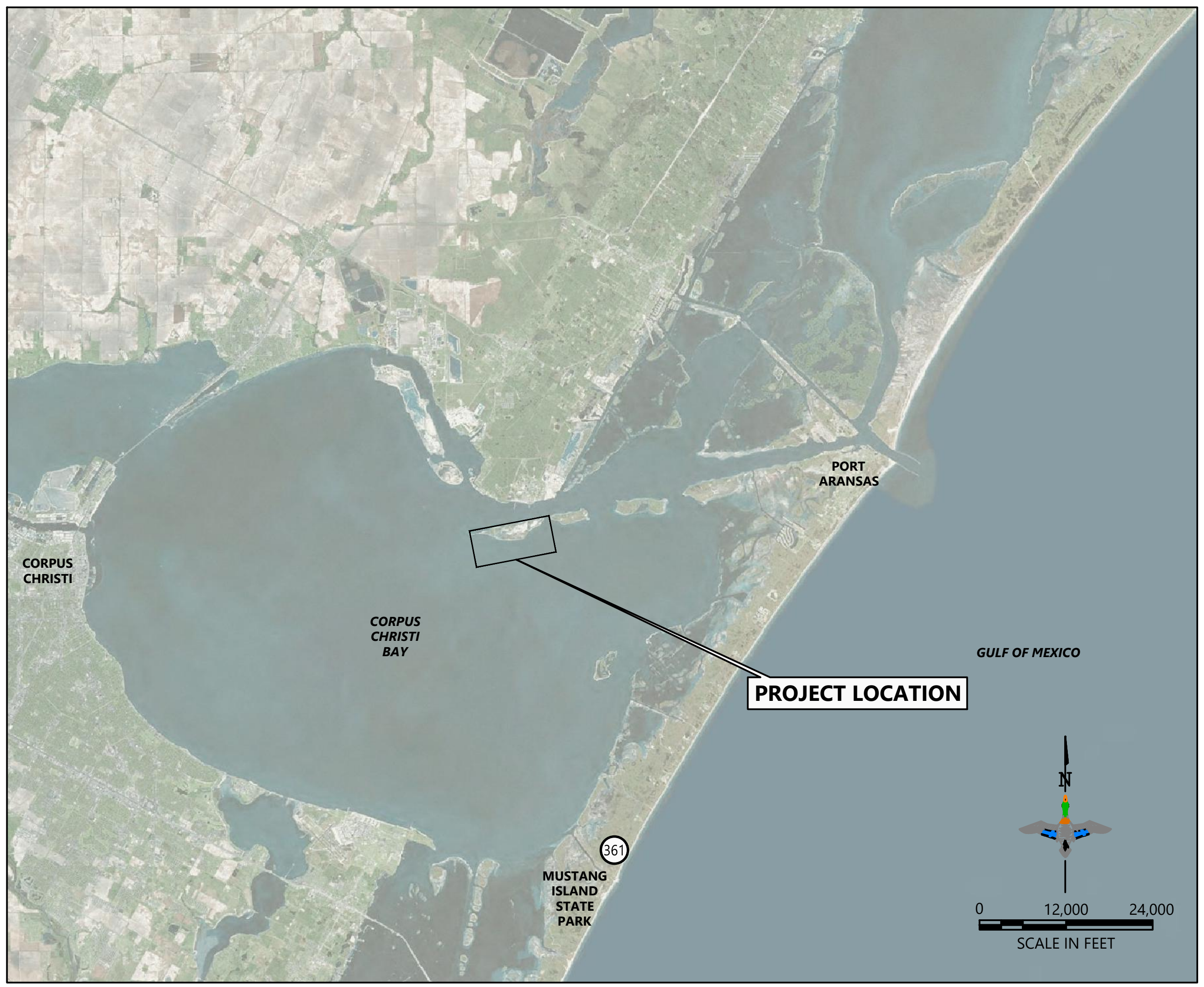
Attachment 1
Construction Drawings

60% DESIGN SUBMITTAL

TEXAS LOWER COAST BENEFICIAL USE - M10

TEXAS GENERAL LAND OFFICE





AERIAL BY BING MAPS

DRAWING INDEX		
SHEET	DRAWING	TITLE
1	T01	TITLE SHEET
2	G01	GENERAL NOTES AND ABBREVIATIONS
3	C01	SITE OVERVIEW
4	C02	PLAN VIEW
5	C03	TYPICAL DIKE SECTIONS

NOTES:

1. HORIZONTAL DATUM: TEXAS STATE PLANE SOUTH ZONE, NAD83, U.S. SURVEY FEET
2. VERTICAL DATUM: NORTH AMERICAN VERTICAL DATUM OF 1988 (NAVD88)
3. BATHYMETRIC, TOPOGRAPHIC AND VISUAL HABITAT SURVEYS CONDUCTED BY DUCKS UNLIMITED ON MARCH 01, 2022.

ONE INCH
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Jan 06, 2023 4:21pm mpratschner

ANCHOR QEA

DUCKS UNLIMITED

REVISIONS				
REV	DATE	BY	APP'D	DESCRIPTION

DESIGNED BY: A. FREDDO
DRAWN BY: M. PRATSCHNER
CHECKED BY: R. ROBERTSON
APPROVED BY: J. LAPLANTE
SCALE: AS NOTED
DATE: DECEMBER 2022

TEXAS LOWER COAST BENEFICIAL USE - M10

TITLE SHEET

T01

SHEET # 1 OF 5

GENERAL NOTES

1. THE CONTRACTOR SHALL COMPLY WITH ALL REQUIREMENTS OF THE DRAWINGS, SPECIFICATIONS, PERMITS, AND ALL APPLICABLE REGULATIONS AND ORDINANCES.
2. IN THE EVENT OF A CONFLICT BETWEEN THE SPECIFICATIONS AND THE DRAWINGS, THE DRAWINGS SHALL GOVERN.
3. CAD FILE PROVIDED BY AECOM ON NOVEMBER 2022.
4. AERIAL IMAGE ©2022 MICROSOFT BING, MICROSOFT CORPORATION EARTHSTAR GEOGRAPHICS.
5. GEOTECHNICAL AND ENGINEERING DATA PROVIDED ARE FOR REPRESENTATIVE PURPOSES. THE CONTRACTOR SHALL FIELD VERIFY CONDITIONS AND/OR COLLECT ANY ADDITIONAL DATA AS IT DEEMS NECESSARY.
6. THE CONTRACTOR SHALL FIELD VERIFY ALL FIELD BASELINE CONDITIONS, AS WELL AS ALL LOCATIONS AND DIMENSIONS.
7. THE CONTRACTOR SHALL LOCATE AND FIELD VERIFY ALL ABOVEGROUND AND BELOWGROUND UTILITIES BEFORE BEGINNING WORK.
8. THE CONTRACTOR SHALL BE RESPONSIBLE FOR DAMAGE TO BOTH ON- AND OFF-SITE FACILITIES CAUSED BY ITS ACTIVITIES DURING PERFORMANCE OF THE WORK. THE CONTRACTOR SHALL RESTORE ALL SUCH DAMAGES TO THEIR PRECONSTRUCTION CONDITION AT NO COST TO THE OWNER.
9. THE CONTRACTOR SHALL AT ALL TIMES KEEP ITS CONSTRUCTION AREAS FREE FROM ACCUMULATIONS OF WASTE MATERIALS OR RUBBISH AND, PRIOR TO COMPLETION OF THE WORK, REMOVE ANY RUBBISH FROM THE PREMISES, AS WELL AS ALL TOOLS, EQUIPMENT, AND MATERIALS THAT ARE NOT THE PROPERTY OF THE OWNER.

PERMITS AND PERMIT CONDITIONS

1. THE CONTRACTOR SHALL COMPLY WITH ALL PERMIT CONDITIONS.
2. THE CONTRACTOR SHALL BE RESPONSIBLE FOR OBTAINING ANY ADDITIONAL PERMITS THAT MAY BE REQUIRED FOR THE CONDUCT OF THIS WORK. COSTS OF OBTAINING PERMITS NOT SUPPLIED BY THE OWNER SHALL BE BORNE BY THE CONTRACTOR.

HORIZONTAL DATUM

TEXAS STATE PLANE SOUTH ZONE, NAD83, U.S. SURVEY FEET

VERTICAL DATUM

NORTH AMERICAN VERTICAL DATUM OF 1988 (NAVD88)

ABBREVIATIONS

CP	CONTROL POINT
E	EASTING
EL.	ELEVATION
MIN.	MINIMUM
MLLW	MEAN LOWER LOW WATER
N	NORTHING

ONE INCH
AT FULL SIZE, IF NOT ONE INCH SCALE ACCORDINGLY

REVISIONS

REV	DATE	BY	APP'D	DESCRIPTION

DESIGNED BY: A. FREDDO
DRAWN BY: M. PRATSCHNER
CHECKED BY: R. ROBERTSON
APPROVED BY: J. LAPLANTE
SCALE: AS NOTED
DATE: DECEMBER 2022

TEXAS LOWER COAST BENEFICIAL USE - M10

GENERAL NOTES AND ABBREVIATIONS

G01

SHEET # 2 OF 5

NOTES:

1. HORIZONTAL DATUM: TEXAS STATE PLANE SOUTH ZONE, NAD83, U.S. SURVEY FEET
2. VERTICAL DATUM: NORTH AMERICAN VERTICAL DATUM OF 1988 (NAVD88)
3. CAD FILE PROVIDED BY AECOM ON NOVEMBER 2022.
4. DMPA: DREDGED MATERIAL PLACEMENT AREA

ONE INCH

AT FULL SIZE, IF NOT ONE INCH SCALE ACCORDINGLY

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ANCHOR QEA

TEXAS GENERAL LAND OFFICE ESTABLISHED 1836

DUCKS UNLIMITED

REVISIONS

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DESIGNED BY: A. FREDDO
DRAWN BY: M. PRATSCHNER
CHECKED BY: R. ROBERTSON
APPROVED BY: J. LAPLANTE
SCALE: AS NOTED
DATE: DECEMBER 2022

TEXAS LOWER COAST BENEFICIAL USE - M10

SITE OVERVIEW

C01

SHEET # 3 OF 5

LEGEND

- PHASE 1 MARSH FILL (SEE NOTE 4)
- PHASE 2 MARSH FILL (SEE NOTE 4)
- EXISTING TOPOGRAPHIC/BATHYMETRIC CONTOURS (5' INTERVALS)
- PORT OF CORPUS CHRISTI AUTHORITY PROPERTY BOUNDARY
- DIKE A
- DIKE B
- DIKE C
- RAILROAD COMMISSION OF TEXAS MAPPED OIL AND GAS INFRASTRUCTURE LOCATIONS
- ACTIVE WELL
- CORPUS CHRISTI SHIP CHANNEL

N

0 500 1000
SCALE IN FEET

NOTES:

1. HORIZONTAL DATUM: TEXAS STATE PLANE SOUTH ZONE, NAD83, U.S. SURVEY FEET
2. VERTICAL DATUM: NORTH AMERICAN VERTICAL DATUM OF 1988 (NAVD88)
3. CAD FILE PROVIDED BY AECOM IN NOVEMBER 2022.
4. DREDGED MATERIAL PLACED TO VARYING ELEVATIONS FROM 1.5' TO 3.5' NAVD88. ELEVATIONS ARE DEPENDENT ON THE MATERIAL PLACED.

ONE INCH
AT FULL SIZE, IF NOT ONE INCH SCALE ACCORDINGLY

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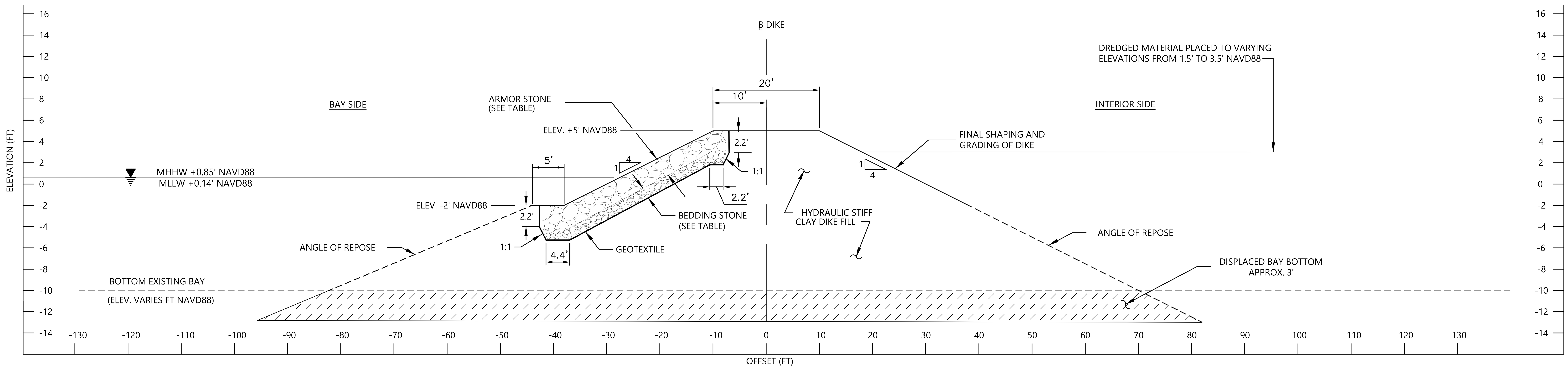
DRAWN BY: M. PRATSCHNER
CHECKED BY: R. ROBERTSON
APPROVED BY: J. LAPLANTE
SCALE: AS NOTED
DATE: DECEMBER 2022

TEXAS LOWER COAST BENEFICIAL USE - M10

PLAN VIEW

C02

SHEET # 4 OF 5



TYPICAL SECTION - M10 DIKE A AND C

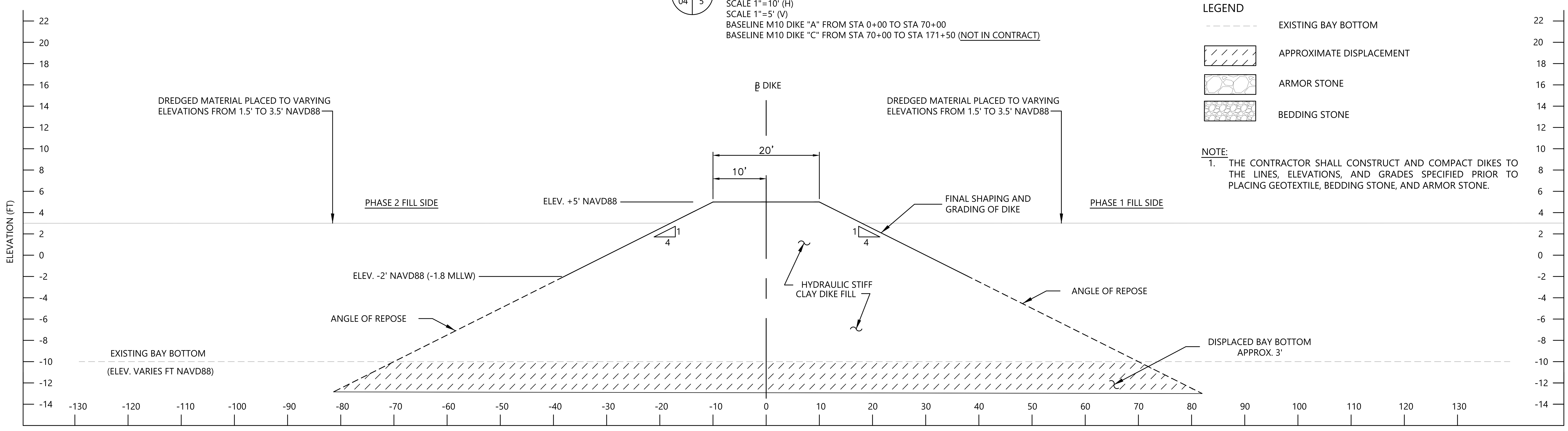
A / 04 / 5

SCALE 1"=10' (H)
SCALE 1"=5' (V)
BASELINE M10 DIKE "A" FROM STA 0+00 TO STA 70+00
BASELINE M10 DIKE "C" FROM STA 70+00 TO STA 171+50 (NOT IN CONTRACT)

LEGEND

- EXISTING BAY BOTTOM
- APPROXIMATE DISPLACEMENT
- ARMOR STONE
- BEDDING STONE

NOTE:
1. THE CONTRACTOR SHALL CONSTRUCT AND COMPACT DIKES TO THE LINES, ELEVATIONS, AND GRADES SPECIFIED PRIOR TO PLACING GEOTEXTILE, BEDDING STONE, AND ARMOR STONE.



TYPICAL SECTION - M10 DIKE B

B / 04 / 5

SCALE 1"=10' (H)
SCALE 1"=5' (V)
BASELINE M10 DIKE "B" FROM STA 0+00 TO STA 50+00

ONE INCH
AT FULL SIZE, IF NOT ONE INCH SCALE ACCORDINGLY

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DRAWN BY: M. PRATSCHNER
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APPROVED BY: J. LAPLANTE
SCALE: AS NOTED
DATE: DECEMBER 2022

TEXAS LOWER COAST BENEFICIAL USE - M10

TYPICAL DIKE SECTIONS

C03

SHEET # 5 OF 5

Attachment 2
Technical Specifications

SECTION 31 05 19

GEOGRID AND GEOTEXTILES

PART 1 - GENERAL

1.01 SUMMARY

The Contractor shall furnish all labor, equipment, materials, and incidentals necessary to install the geocomposite underlayment (a nonwoven geotextile mechanically connected to a geogrid to form a two-layer geosynthetic reinforcement) for the containment dike as shown on the Construction Drawings as "Geocomposite."

Related Sections

1. Section 01 20 00 – Measurement and Payment Procedures
2. Section 01 33 00 – Submittal Procedures
3. Section 01 35 43 – Environmental Protection
4. Section 35 33 00 – Containment Dike

1.02 REFERENCES

American Association of State Highway and Transportation Officials (AASHTO): Standard Specification for Highway Bridges (2002)

ASTM International (ASTM):

1. D1388 – Standard Test Method for Stiffness of Fabrics
2. D3786 – Standard Test Method for Bursting Strength of Textile Fabrics – Diaphragm Bursting Strength Tester Method
3. C4354 – Practice Method for Sampling of Geosynthetics for Testing
4. C4355 – Standard Test Method for Deterioration of Geotextiles by Exposure to Light, Moisture and Heat in a Xenon Arc Type Apparatus
5. D4491 – Standard Test Methods for Water Permeability of Geotextiles by Permittivity
6. D4533 – Standard Test Method for Trapezoid Tearing Strength of Geotextiles
7. D4632 – Standard Test Method for Grab Breaking Load and Elongation of Geotextiles
8. D4751 – Standard Test Method for Determining Apparent Opening Size of a Geotextile
9. D4759 – Standard Practice for Determining the Specification Conformance of Geosynthetics
10. D4833 – Standard Test Method for Index Puncture Resistance of Geomembranes and Related Products
11. D4873 – Standard Guide for Identification, Storage, and Handling of Geosynthetic Rolls and Samples
12. D4884 – Standard Test Method for Strength Sewn or Bonded Seams of Geotextiles

13. D5199 – Standard Test Method for Measuring the Nominal Thickness of Geosynthetics
14. D5261 – Standard Test Method for Measuring Mass Per Unit Area of Geotextiles
15. D5321 – Standard Test Method for Determining the Shear Strength of Soil-Geosynthetic and Geosynthetic-Geosynthetic Interfaces by Direct Shear
16. D6241 – Standard Test Method for Static Puncture Strength of Geotextiles and Geotextile-Related Products Using a 50-mm Probe
17. D6637 – Standard Test Method for Determining Tensile Properties of Geogrids by the Single or Multi-Rib Tensile Method
18. D7737 – Standard Test Method for Individual Geogrid Junction Strength
19. D7748 – Standard Test Method for Flexural Rigidity of Geogrids, Geotextiles and Related Products

U.S. Army Corps of Engineers (USACE): USACE Methodology for Measurement of Torsional Rigidity

Geosynthetic Research Institute – GG9 Torsional Behavior of Bidirectional Geogrids when Subjected to In-Plane Rotation

1.03 SUBMITTALS

The following shall be submitted a minimum of 7 calendar days prior to installation in accordance with SECTION 01 33 00 − SUBMITTAL PROCEDURES: Requirements for Submittals. The failure of the Contractor to obtain approval prior to installation shall be grounds for nonpayment.

1. Geocomposite Sample
   a. The Contractor shall submit a 6-inch by 6-inch or larger sample of the geocomposite to the Engineer for approval.
2. Manufacturer's Certificate
   a. The Contractor shall submit the manufacturer's certificate of compliance with the name of the manufacturer, product name, style number, and other relevant information to fully describe the geocomposite. The certificate should state that the composite meets the requirements of this section and shall be attested to by a person having legal authority to bind the composite manufacturer.
3. Manufacturer's Instructions
   a. The Contractor shall submit installation instructions to the Engineer for review.
4. Shop Drawings
   a. The Contractor shall submit typical details of the typical sections and connections to the Engineer for review.

1.04 QUALITY ASSURANCE

A minimum of 7 days prior to installation of the geocomposite, the Contractor shall provide the samples, manufacturer's certificate and instructions, and shop drawings to the Engineer for approval.

The Contractor will provide a description of the methods and procedures proposed for installation of the geocomposite as part of the Construction Work Plan in accordance with SECTION 01 33 00 − SUBMITTAL PROCEDURES and 35 33 00 − CONTAINMENT DIKE.

1.05 DELIVERY, STORAGE, AND HANDLING

Delivery

1. The Contractor shall notify the Engineer a minimum of 24 hours prior to delivery and unloading of the geocomposite packaged in an opaque, waterproof, protective plastic wrapping.

2. The manufacturer's plastic wrapping shall not be removed until deployment. If quality-assurance samples are collected, immediately rewrap rolls with the plastic wrapping or equivalent as approved by the Engineer. Geotextile or plastic wrapping damaged during storage or handling shall be repaired or replaced, as directed, at no additional cost to the Agency.

3. The Contractor shall label each roll with the manufacturer's name, geotextile type, roll number, roll dimensions (length, width, and gross weight), and date manufactured.

Storage

1. The Contractor shall protect rolls of geocomposite from, but not limited to, construction equipment, chemicals, sparks, and flames; temperatures below minus 20°F or more than 160°F; or any environmental condition that may damage the physical properties of the geotextile.

2. Geocomposite should not be exposed to direct sunlight for time frames beyond those recommended by the manufacturer. Geocomposite exposed beyond such time frames shall be disposed of and replaced at no additional cost to the Agency and shall not allow the construction schedule to be extended.

3. The Contractor shall protect geocomposite from becoming saturated prior to installation by elevating rolls off the ground or placing them on a sacrificial sheet of plastic in an area where water will not accumulate. If the geocomposite becomes saturated prior to installation, the Contractor shall remove the geotextile from the site and replace at no additional costs to the Agency.

Handling: Handle and unload geotextile rolls with load-carrying straps, a forklift with a stinger bar, or an axial bar assembly. Rolls shall not be dragged along the ground, lifted by one end, or dropped to the ground.

PART 2 - PRODUCTS

2.01 MATERIALS

The geocomposite system shall meet the following requirements:

1. Positive mechanical interlock with underlayer and contiguous sections of itself when overlapped and embedded in bedding stone or similar

2. Sufficient cross-sectional profile to resist movement relative to the bedding stone

3. Sufficient flexural rigidity to help maintain intimate contact of the geotextile with the underlying material when bedding stone, riprap, or armor stone is placed on top

4. Sufficient true initial modulus to cause applied force to be transferred to the geogrid at low strain levels without material deformation of the reinforced structure

5. Complete continuity of all properties throughout its structure and suitability for use with bedding stone, riprap, and armor stone materials in coastal and waterway environments to improve the long-term stability of the coastal structure such as rubble mound breakwaters, jetties, and groins.

The geogrid part of the geocomposite shall meet the properties as outlined in Table 1. Where applicable, values represent minimum average roll values (MARVs) in accordance with ASTM D4759.

TABLE 1: GEOGRID PROPERTIES

Property	Test Method	Unit	Value
Aperture Size (Nominal Dimensions)	ASTM D4759	in	1.0 to 2.0
Minimum Rib Thickness (Nominal Dimensions)	ASTM D4759	in	0.06
Tensile Strength @ 2% Strain	ASTM D6637	lb/ft	450
True Initial Modulus in Use	ASTM D6637	lb/ft	1,575
Junction Efficiency	ASTM D7737	%	90
Flexural Stiffness	ASTM D7748	mg-cm	750,000
Ultraviolet Stability (Retained Strength @ 500 hours)	ASTM D4355	%	90

Geotextiles shall meet the requirements specified in Table 2. Where applicable, Table 2 property values represent MARVs in the weakest principal direction. Values for apparent opening size represent maximum average roll values.

TABLE 2: GEOTEXTILE PROPERTIES

Property	Test Method	Unit	Minimum Test Value
Apparent Opening Size	ASTM D4751	US Sieve	100 (Maximum)
Permittivity	ASTM D4491	sec-1	0.57
Puncture	ASTM D4833	lbs	75
Grab Tensile Strength	ASTM D4632	lbs	180
Trapezoidal Tear	ASTM D4533	lbs	50
Ultraviolet Degradation	ASTM D4355	% strength @ 500 hrs.	70
Weight	ASTM D5261	oz/sq. yd.	8
Burst Strength	ASTM D3787	lbs	290

PART 3 - EXECUTION

3.01 SUBGRADE PREPARATION

The Contractor shall ensure the surface underlying the geocomposite is smooth and free of debris, ruts, or protrusions, which could damage the geotextile.

3.02 INSTALLATION

The Contractor shall notify the Engineer a minimum of 24 hours prior to installation of the geocomposite.

Geocomposite rolls that are damaged or contain imperfections shall be repaired or replaced as directed by the Engineer at no additional cost to the Agency.

The Contractor shall install the geocomposite as shown in the Construction Drawings. The width of the installed geocomposite will vary as the containment dike width varies due to changes in water bottom elevations.

The geocomposite shall be laid flat and smooth so that it is in direct contact with the subgrade. Correct orientation (roll direction) of the geocomposite shall be verified by the Contractor. The geocomposite may be temporarily secured with sandbags.

Armor stone shall be placed atop the geocomposite as described in SECTION 35 33 00 − CONTAINMENT DIKE in a manner that minimizes the wrinkles and movement of the composite and uniformly loads the structure and minimizes displacing the underlying foundation. The Contractor shall place rock in a manner that prevents material from entering the composite overlaps and prevents tensile stress from being mobilized in the composite and prevents wrinkles from folding over onto themselves.

3.03 SEAMS

The Contractor shall continuously overlap the geocomposite panels a minimum of 2 feet at all longitudinal and transverse joints.

3.04 PROTECTION AND REPAIRS

The Contractor shall protect the geocomposite during installation from tears and other damage. Damaged composite shall be repaired or replaced as directed by the Engineer at no additional cost to the Agency.

The Contractor shall repair torn or damaged geocomposite. The Contractor shall perform repairs by placing a patch of the same type of geocomposite over the damaged area. The patch shall extend a minimum of 2 feet beyond the edge of the damaged area. Patches shall be continuously fastened using the manufacturer's approved methods. The machine direction of the patch shall be aligned with the machine direction of the geocomposite being repaired. The Contractor shall remove and replace geocomposite that cannot be repaired. Repairs shall be performed at no additional expense to the Agency and shall not allow the construction schedule to be extended.

END OF SECTION 31 05 19

SECTION 35 12 10

AIDS TO NAVIGATION

PART 1 - GENERAL

1.01 SUMMARY

A. The Contractor shall furnish all labor, equipment, materials, and incidentals necessary to install permanent navigational markers as shown on the Construction Drawings as "Aids to Navigation" (ATON) and in accordance with the U.S. Coast Guard (USCG) marking determination (Appendix TBD). The Contractor shall also be responsible for installing and maintaining temporary navigational markers or lighted beacons during construction of the containment dike structures in accordance with applicable federal, state, and local laws, ordinances, and relevant permit requirements. The Contractor shall install at (at least X, or as necessary to identify maritime risks) temporary navigational markers. The Contractor shall remove the temporary navigational markers upon completing installation of the required permanent navigational markers.

B. The Contractor shall display signal lights and conduct operations in accordance with the General Regulations of the Department of the Army and of USCG as set forth in *Navigation Rules and Regulations Handbook 2014* and 33 Code of Federal Regulations (CFR) 84 through 33 CFR 89 (Inland) as applicable.

1.02 RELATED DOCUMENTS

A. Appendix TBD – USCG Marking Determination Package (point to appropriate appendix)

B. Section 01 20 00 – Measurement and Payment Procedures

C. Section 01 33 00 – Submittal Procedures

D. Section 01 35 43 – Environmental Protection

E. Section 35 33 00 – Containment Dike

1.03 REFERENCES

A. American Wood Preservers Association (AWPA): AWPA P5 – Standard for Waterborne Preservatives

B. USCG: USCG CFR, Title 33, Chapter 1, Parts 62, 64, and 66

C. *2022 AWPA Book of Standards*

1.04 SUBMITTALS

A. Before the Contractor orders ATON materials, the following shall be submitted in accordance with SECTION 01 33 00 − SUBMITTAL PROCEDURES:

1. Manufacturer's Data Sheets: The Contractor shall submit the manufacturer's data sheets for all permanent ATON, including buoys, lights, signs, reflective material, pilings, and any other material used for the ATON. The data sheets shall include the name of the manufacturer, product name, style number, and other relevant information to fully describe the ATON material.

B. The failure of the Contractor to obtain approval prior to ordering material shall be grounds for nonpayment.

PART 2 - PRODUCTS

2.01 MATERIALS

A. Temporary ATON

1. Warning Buoys – 1 nautical mile USCG-approved marine lanterns (TBD LED Rating), buoys with solar-powered, flashing white light with a flash period of 2.5 seconds (0.3 seconds on/2.2 seconds off)

B. Permanent ATON

1. Pilings: The contractor shall install X-foot-long, class X timber pilings, pressure treated with chromated copper arsenate at 2.5 pounds per cubic foot per AWPA U1.

2. Signs: The contractor shall install the signs indicated in the USCG Determination Package with the lettering “DANGER” in black text on white dayboard film background with a 2-inch orange retroreflective border. All hardware connecting the sign shall be hot-dipped galvanized or approved equal. Examples of USCG-approved signage is included in Appendix X.

3. Lights: The contractor shall install lights meeting the requirements described in Appendix X.

PART 3 - EXECUTION

3.01 INSTALLATION

A. Prior to installation, the Contractor shall determine if underground utilities exist in the proposed locations of the permanent ATON. The Contractor shall also verify water depths and bottom types at the locations.

B. As the work progresses, the Contractor shall install temporary or permanent ATON at the locations specified in Attachment M and Construction Drawings. Discrepancies between the coordinates designated on the USCG permit or Construction Drawings shall be reported to the Owner or its designated representative prior to installation.

C. The Contractor will place temporary ATON prior to construction and shall maintain the temporary ATON during construction until installation of the permanent ATON is complete. The contractor shall relocate temporary ATON by request of the Owner, Engineer, USCG, or USACE during construction without incurring additional cost to the Owner. The Contractor shall remove temporary ATON and install permanent ATON prior to final acceptance of the project. All temporary ATON will be considered property of the Contractor, and the Contractor shall take full responsibility for removal, transportation, storage, or proper disposal of the temporary ATON.

D. Timber piles shall be carefully handled with no sudden dropping, breaking of outer fibers, bruising, or penetration of the surface with tools. Piles damaged or not located in the proper location shall be withdrawn and replaced by new piles or shall be cut off at the mudline and additional piles installed as directed, without additional cost to the Owner.

E. Signs shall be installed so that the bottom of the signage is a minimum of 7 feet above the mean high water level and does not exceed 9 feet above the mean high water level. The Contractor shall shorten the pilings dictated by the normal mean high water mark in the project area, as necessary. Each sign shall be fastened with at least three 3/4-inch-diameter by 12-inch-long hot-dipped galvanized bolts and connected with a hot-dipped galvanized ogee washer, lock washer, and nut. Bolt holes shall be bored 1/8 inch larger than the diameter of the bolt.

F. If any damage occurs to permanent ATON placed during construction, the Contractor shall replace or repair the ATON at no cost to the Owner and at the direction of the Owner or its authorized representative.

END OF SECTION 35 12 10

SECTION 35 33 00

CONTAINMENT DIKE

PART 1 - GENERAL

1.01 SUMMARY

A. The Contractor shall furnish all labor, equipment, materials, and incidentals necessary to install the containment dike as described herein and in the Construction Drawings. The work shall include, but is not necessarily limited to, construction of containment dike, and purchase, delivery, and installation of the armor stone to construct the M10 containment dike as shown in the Construction Drawings.

1.02 RELATED SECTIONS

A. Section 01 20 00 – Measurement and Payment Procedures

B. Section 01 32 00 – Construction Progress Documentation

C. Section 01 32 23 – Surveys and Layout Data

D. Section 01 33 00 – Submittal Procedures

E. Section 01 35 43 – Environmental Protection

F. Section 31 05 19 – Geogrid and Geotextiles

G. Section 35 12 10 – Aids to Navigation

H. Appendix X – USACE Permit

1.03 REFERENCES

A. ASTM International (ASTM):

1. ASTM C97 – Standard Test Methods for Absorption and Bulk Specific Gravity Dimension Stone

2. ASTM C127 – Standard Test Method for Density, Relative Density (Specific Gravity), and Absorption of Coarse Aggregate

3. ASTM C131 – Standard Test Method for Resistance to Degradation of Small-Size Coarse Aggregate by Abrasion and Impact in the Los Angeles Machine

4. ASTM C295 – Standard Guide for Petrographic Examination of Aggregates for Concrete

5. ASTM D535-12 – Standard Test Method for Resistance to Degradation of Large-Size Coarse Aggregate by Abrasion and Impact in the Los Angeles Machine

6. ASTM D75/D75M-14 – Standard Practice for Sampling Aggregates

7. ASTM D1141-98(2013) – Standard Practice for the Preparation of Substitute Ocean Water

8. ASTM D4791 – Standard Test Method for Flat Particles, Elongated Particles, or Flat and Elongated Particles in Coarse Aggregate

1.04 SUBMITTALS

B. The following submittals shall be submitted in accordance with SECTION 01 33 00 – SUBMITTAL PROCEDURES: Requirements for Submittals

C. Construction Work Plan: Prior to the start of construction, the Contractor shall provide a Construction Work Plan containing, at a minimum, the following:

1. Work Sequencing and Equipment

Order and sequence in which work shall be performed

Number, type, and capacity of equipment to be used

Hours of operation

Estimated schedule

Procedures for placing materials and confirming thicknesses and grades are met

2. Methods, Procedures, and Equipment addressing the following:

Protection of the geocomposite layers during material placement

Installation method of dike fill and armor stone slope protection

Methods for confirming elevation of placed dredged material containment dike

Placement to distribute the load across the compressible foundation

Survey and photography methods to monitor and control the work and progress surveys

Verification of minimum design template

Settlement monitoring and output format

Toe construction underwater

D. Source Material

1. Armor stone aggregate

Prior to the preconstruction meeting, the Contractor shall submit quarry records including, but not limited to, the history of the quarry and the capability to produce the material to the required specifications.

The Contractor shall submit compliance test results as specified in Part 2 of this Specification.

E. Quality Control Surveys

a. During construction, the Contractor shall provide interim surface elevation surveys per SECTION 01 32 23 − SURVEYS AND LAYOUT DATA.

F. Daily Construction Report

a. The Contractor shall prepare and maintain a daily report of operations and furnish copies by noon the following day or as requested by the Owner as described in SECTION 01 32 00 − CONSTRUCTION PROGRESS DOCUMENTATION.

G. Stop Work

a. The Owner or Engineer may elect to stop work activities at the Site if the required submittals have not been submitted or are not of acceptable quality (as determined by the Owner or Engineer) and per the schedules specified herein in accordance with SECTION 01 33 00 − SUBMITTAL PROCEDURES. Any delays related to submittal approvals shall not allow the construction schedule to be extended and shall not be reason to increase the Contract price.

1.05 QUALITY CONTROL

A. The Contractor will perform control surveys as specified in SECTION 01 32 23 – SURVEYS AND LAYOUT DATA.

PART 2 - PRODUCTS

2.01 CONTAINMENT DIKE MATERIALS

A. General

1. Fill material may be acquired from the designated off-site borrow area(s) as shown on the Project Drawings. The intention is to use the most suitable material obtainable from these sources.

2. If the Contractor and Engineer determine the borrow material is unsuitable for containment dike construction, the Engineer may modify the dike design or determine if other suitable off-site materials should be used to complete containment dike construction.

B. Material

3. Suitable fill material shall consist of materials classified in accordance with ASTM D 2487 as CL, CH, and CL-ML free from roots and other organic matter; contamination from hazardous, toxic or radiological substances; trash and debris; and frozen materials. Not all satisfactory materials may be used in the dike construction. Only the satisfactory materials stated above, meaning the additional or modified requirements specified herein, can be used for dike construction.

4. Materials unsuitable for use as dike fill include all other materials not defined above as satisfactory materials. Materials that do not comply with the requirements for satisfactory materials are unsatisfactory. Unsatisfactory materials also include manufactured fills; trash, refuse, and backfills from previous construction.

2.02 ROCK

A. The Contractor shall make arrangements, pay royalties, and secure the permits for procurement, furnishing, and transporting stone. The Contractor shall vary the quarrying, processing, loading, and placing operations to produce the sizes and quality of stone specified. If the stone being furnished by the Contractor does not meet the requirements as specified herein, the Contractor shall furnish, at no additional cost to the Owner, other stone meeting these requirements.

B. Before stone is produced from a source for completion of the work under this contract, the source of stone shall be approved by the Engineer/Owner. Approval of a stone source shall not be construed as a waiver of the right of the Owner to require the Contractor to furnish stone that complies as specified herein. Materials produced from localized areas, zones, or strata will be rejected when these materials do not comply as specified herein.

C. If requested, stone samples shall be provided to the Owner for testing. Stone from a proposed source or sources shall be tested by the Contractor for quality compliance as described below. Copies of the compliance testing for each gradation shall be provided to the Engineer before installation.

D. Testing and Analysis of Materials shall be performed in accordance with applicable ASTM standards. When tests indicate materials do not meet specified requirements, the Contractor shall remove and legally dispose of the unsuitable material off site and replace it with suitable material at no cost to the Agency. Rock shall meet the following minimum test requirements (Will be updated during final design):

Test	Test Method	Requirements
Specific Gravity (Bulk SSD)	ASTM C127	(2.60) minimum (2.75) maximum
Absorption	ASTM C127	(3.0%) maximum
Abrasion loss	ASTM D535-12	(40%) max. loss(1)
Note: 1. Weakening and loss of individual surface particles is permissible unless bonding of the surface grains softens and causes general disintegration of the surface material.		

E. In addition to the above tests, the stone shall be subjected to a petrographic and X-ray diffraction analysis in accordance with ASTM C295. The stone shall not contain expansive clays. The test procedure for petrographic and X-ray diffraction is performed according to ASTM C295, except for the following:

1. A colored microscope photograph shall be made of each stone type, including igneous, sedimentary, or metamorphic, and the individual minerals within the stone type shall be identified by labels and arrows upon the photograph.

2. Detailed macroscopic and microscopic descriptions shall be made of the stone to include the entire mineral constituents, individual sizes, their approximate percentages, and mineralogical histories. A description of stone hardness, texture, weathering, and durability factors shall be discussed. Pictures of the source wall within the quarry to show any layering and lithology shall be included.

3. A written summary of the suitability of stone for use as armor stone based on the petrographic and X-ray tests and the abrasion loss (L.A. Rattler) shall be presented in the final laboratory report on stone quality.

F. The required gradations for stone to be used are as follows (Will be updated during Final Design):

1. Armor Stone:

Weight of Stone (Pounds)	Percentage Lighter by Weight (%)
1100–440	100
330–220	50
165–70	15

2. Bedding Stone:

U.S. Standard Sieve Size (ASTM E11 Opening Size, in Inches)	Percentage Lighter by Weight (%)
4	100-90
3	60-25
2	15-5
1	5-0

2.03 SOURCE QUALITY CONTROL

A. Testing and Analysis of Materials shall be performed in accordance with applicable ASTM standards.

B. When tests indicate materials do not meet specified requirements, the Contractor shall remove and legally dispose of the unsuitable material off site and replace with suitable material at no cost to the Agency.

PART 3 - EXECUTION

3.01 GENERAL

A. The Contractor shall perform a preconstruction survey via a third-party independent surveyor licensed in the State of Texas. Prior to the start of construction, the Contractor shall verify all existing elevations and grades and provide templates and stone volumes per SECTION 01 32 23 – SURVEYS AND LAYOUT DATA. The Contractor shall establish the baseline depicted and provide a layout for review before starting placement operations.

B. The Contractor will not be allowed to dredge access channels to construct the containment dike. In emergency situations (as determined by the Engineer and Owner), the Contractor, after approval from the Engineer and Owner, may dredge to remove equipment from the site but must backfill the area immediately following emergency response activities.

C. The Contractor shall install the geocomposite as described in SECTION 31 05 19 – GEOGRID AND GEOTEXTILES and shall take care to avoid damaging the geocomposite layers during placement of overlying material. Placement shall be done in such a manner so as not to rip, puncture, disturb, or damage the geocomposite layer as specified herein.

D. The Contractor shall construct the containment dike to the elevations and alignments shown on the Construction Drawings within the construction tolerances stated in these specifications. The stone materials shall be placed and the surfaces shall be measured at adequate intervals to accurately delineate the surfaces of the layers. Unless the Engineer approves alternate construction methods in writing, all stone on slopes shall be placed in horizontal layers from the toe of the slope up toward the crest.

E. Stone shall be placed so a well-graded mass is produced with minimum interstitial voids. Stone shall be placed evenly to compress the existing foundation using a method that shall avoid damage to the geocomposite or underlying structure, where present.

F. The height of the stone installation drop shall not be greater than that which may cause damage to the geocomposite or the stone itself. When allowable drop heights are developed on site, between the Engineer and Contractor, these heights shall be based on actual performance. The Contractor shall maintain the stone layer until accepted, and if material is displaced or the surface is damaged, replacement shall be made to the indicated lines and grades at the Contractor's expense. Final surfaces of the finished stone shall be uniform and shall follow with the indicated lines and grades without continuous under or overbuilding.

G. Material that escapes or is lost while loading, transporting, or placing stone or which is deposited in areas other than shown on the Construction Drawings or approved in writing by the Owner and Engineer, shall be removed and redeposited at the Contractor's expense and at no additional cost to the Owner or, if not removed and redeposited, shall be deducted from the final quantities for payment.

3.02 CONTAINMENT DIKE INSTALLATION

A. The Contractor shall install settlement plates prior to dike fill placement as shown on the Construction Drawings and described in Part 3.03 of this Section.

B. The subsurface sediments along the containment dike contain compressible sediments that will consolidate during and after construction. Due to the sediment consolidation, the contractor may be required to halt placement operations at certain locations and elevations and wait for the underlying sediments to consolidate before placing additional dike fill or armor stone in the specified area. If applicable, the Engineer shall determine when the sediments have reached consolidation (based on Contractor field surveys) and when the Contractor can resume placement activities in the specified area. The Contractor shall place the dike fill and armor stone in the following sequence:

1. Install dike fill to the full template and perform quality control surveys and weekly settlement monitoring surveys in accordance with SECTION 01 32 23 – SURVEYS AND LAYOUT DATA.
2. Install additional dike fill (based on surveys and as directed by the Engineer) as needed to meet minimum lines and grades.
3. Install armor stone to full template and perform quality control surveys and weekly settlement monitoring surveys of the containment dike in accordance with SECTION 01 32 23 – SURVEYS AND LAYOUT DATA.
4. Install additional armor stone (based on settlement monitoring surveys and as directed by the Engineer) as needed to meet minimum lines and grades and perform a quality control survey in accordance with SECTION 01 32 23 – SURVEYS AND LAYOUT DATA.

3.03 HYDRAULIC FILL

1. Control of Materials in Hydraulic Construction

In general, distribute the materials in the fill in a way to produce a section of relatively uniform permeability. To maintain uniform permeability of the fill, do not place strata and large pockets of gravel not containing sufficient fines. Whenever they occur, promptly blend with finer materials. Take necessary precautions to prevent damage from discharge water or other causes.

2. Rehandling of Hydraulic Material

Rehandling of hydraulic material to bring the fill area to required grade and cross section must conform to the relevant paragraph in this Section. If, in the opinion of the Owner/Engineer, the rehandled material is too dry to permit its placement by compacted fill method, then the dike material shall be moisture conditioned to a range that allows compaction, or replaced and failed soil must either be replaced and disposed of or reworked, as directed by the Owner/Engineer.

3. Underwater Placement Dike

Dike material shall be placed in underwater areas within the dike footprint. This material shall be placed until reaching 1 foot above the water surface at mean higher high water (MHHW; feet NAVD 88). This placed dike material will be known as the “submerged lift” and will not require compaction or strength testing, unless directed by the Owner/Engineer. Although testing may not be required on the submerged lift, the Contractor shall still ensure the material placed in the submerged lift meets the characterization(s) discussed herein.

4. Above Water Placement

After dike material has reached an elevation of 1 foot above the water surface (at MHHW [feet NAVD 88]) and meets the extent of the dike footprint at that elevation, the dike will then begin to be measured for lift placement. This 1-foot line above the water surface (at MHHW [feet NAVD 88]) will be the base of the first lift. Lifts shall be 14 inches thick when loose, to be compacted to 12 inches.

3.04 COMPACTION

1. Equipment

The Contractor may choose the compaction equipment. The chosen equipment must be able to work the hydraulic fill to comply with the specification requirements herein.

2. Compaction of Fill

No compaction other than that obtained by the controlled movement of the hauling equipment over the area of the fill is required. Route equipment to prevent excessive rutting of the fill surface.

3. Compaction of Hydraulic Fill

Hydraulic fill that is not rehandled will be compacted. The material that must be rehandled to meet project design lines and dimensions is to be compacted by not more than 18 inch lifts by two passes of a D-6 (or equivalent) bulldozer.

3.05 During hurricane season or in the event of forecast extreme weather, at the Engineer's discretion, the Contractor may be limited to the amount of dike fill placed at one time and may be required to install the armor stone slope protection before moving to the next containment dike section. The Contractor is responsible for replacing any dike fill (prior to cover by armor stone) that is lost from the project work due to storms at any time during the construction at no additional cost to the Agency.

3.06 Settlement Plates

A. Settlement plates shall be constructed with a 4-foot by 4-foot, 1/4-inch-thick steel plate with a 3-inch-diameter steel riser pipe attached to the center of the plate. The settlement plates shall be hot-dipped galvanized after fabrication. The riser pipe shall extend a minimum of 3 feet above the design elevation of the armor stone.

B. Settlement plates shall be placed after installation of the geocomposite and prior to dike fill installation at the locations detailed in the construction drawings. Plates shall be placed so that the riser pipe conforms to a vertical plumb standard of no more than 10.5° from true vertical. The riser pipe shall be marked with reflective tape or flagging.

C. During installation of the containment dike, the Contractor shall carefully place materials near the settlement plate and maintain the plates until completion of the project. After acceptance of the containment dike, the Contractor shall cut the riser pipe so it is 6 inches above the top of the constructed containment dike elevation.

D. Settlement plates shall be surveyed per SECTION 01 32 23 – SURVEYS AND LAYOUT DATA as follows:

1. Prior to dike fill placement
2. After placement of dike fill
3. After placement of armor stone
4. Every two weeks during containment dike material placement
5. After cutting the riser pipe (as described in 3.03 C. of this Section)
6. Biweekly after completing the containment dike material placement, for a minimum of three postconstruction survey data points

3.07 SURVEYS

A. All surveys shall be conducted in accordance with SECTION 01 32 23 – SURVEYS AND LAYOUT DATA.

3.08 TOLERANCES

A. Deviations in crest elevation from the design value shall not be greater than +0.5 foot for the dike fill and +0.5 foot for the armor stone. Deviations below crest elevations shown on Construction Drawings will be filled in accordance with this Section until either crest elevation or allowable deviation is achieved.

B. Transitions in alignments shall be smooth and shall be no more than a 1-foot horizontal change in a 20-foot length unless otherwise approved by the Owner and Engineer.

C. Deviations in seaward slope lengths should not be greater than +0.5 feet. Deviations in the landward slope lengths should not be greater than +/-1.5 feet.

3.09 ACCEPTANCE

A. Acceptance will be based on the approved stone source, compliance tests, barge displacement surveys, and surveys performed by the Contractor per SECTION 01 20 00 – MEASUREMENT AND PAYMENT PROCEDURES and SECTION 01 32 23 – SURVEYS AND LAYOUT DATA. The Owner may perform field check tests and/or surveys to verify the Contractor’s barge displacement and/or surveys. The Agency survey checks will govern any discrepancies.

END OF SECTION 35 33 00

Memorandum

January 6, 2023

To: Melissa McCutcheon, Texas General Land Office

From: Todd Merendino, Ducks Unlimited, Inc.
Sarah Garza, Harrison McNeil, and Yvonne Dives-Gomez, Port of Corpus Christi Authority
John Laplante, Dan Opdyke, Renee Robertson, Alexander Freddo, and Hayden Smith, Anchor QEA, LLC
Jane Sarosdy, Sarosdy Consulting, Inc.

Re: PA9-S Marsh Restoration 60% Design Memorandum

Introduction

This 60% design memorandum describes design criteria and assessments associated with a beneficial use of dredged material (BU) project at the proposed PA9-S site (Site), located in Texas General Land Office (GLO) Planning Region 3 of the Texas coast in Corpus Christi Bay in Nueces County, Texas (Figure 1). Photographs of the Site are in Attachment 1.

Project Background

GLO awarded a Coastal Management Program Project of Special Merit grant (funded through the Gulf of Mexico Energy Security Act) to Ducks Unlimited, Inc. (DU) to coordinate with stakeholders and identify restoration sites for BU. The Port of Corpus Christi Authority (PCCA), a project partner, has also contributed staff and financial resources to expand the project scope. The project team is led by DU and PCCA and includes Anchor QEA, LLC; Sarosdy Consulting, Inc.; and the Texas Department of Transportation. Collectively, the project team coordinated three stakeholder meetings with state and federal resource agencies, nongovernmental organizations, academia, consultants, and local officials in each region to solicit information about potential BU sites. Based on stakeholder input, GLO feedback, publicly available data, and professional judgment, the project team has developed 10% designs for 18 sites in GLO Planning Regions 3 and 4 of the Texas coast and 2 GLO-approved sites in Mesquite Bay and San Antonio Bay in GLO Planning Region 2. After completion of the 10% designs, 11 of the designs were selected to continue to 30% designs, and 7 of those designs were chosen for 60% designs and permit application packages. Based on the Site's restoration potential and construction feasibility, the project team selected the Site to proceed to 60% design, opinion of probable construction costs, and permit application packages using funding from the GLO Coastal Management Program Project of Special Merit grant.

An estimated 59,600 acres of estuarine wetlands were lost from the Texas coast from the mid-1950s to the early 1990s (Moulton et al. 1997). PA9-S is an upland placement area with an emergent island located on state-owned submerged land. The island is approximately 0.5 mile east of the Gulf Intracoastal Waterway (GIWW) and 0.2 mile south of the Corpus Christi Ship Channel (CCSC) in Corpus Christi Bay in Nueces County, Texas. The existing PA9-S island has limited natural protection from wave energy. The proposed Site is immediately south of, and appended to, the existing PA9-S island. This area was selected due to its proximity to potential maintenance dredged material from the CCSC and potential new work dredged material from the proposed CCSC channel deepening project, as well as its capacity to accept a large volume of dredged material from other new work or maintenance dredging projects.

Project Objectives

Frequent dredging is needed to develop and maintain Texas navigation channels. The dredged material is often deposited in dredged material placement areas (DMPAs), and many of the existing DMPAs along the Texas coast are nearing capacity. Resource agencies and stakeholders have long advocated using dredged material beneficially to create and restore wetlands and bird islands, nourish beaches, and counteract land loss. Historically, BU projects are difficult to manage because they are multiyear, multifaceted undertakings in which different organizations manage dredging schedules, funding, project design, permitting, and construction activities. To help address these issues, the objectives of this project include the following:

- Create and restore degrading coastal habitats.
- Establish sites for placement of dredged material to reduce reliance on existing DMPAs.
- Improve coastal resiliency of the natural and built environment.

To accomplish these objectives, the project includes the following tasks:

- Stakeholder outreach and coordination
- Identification and selection of BU sites
- 10% designs and cost estimates for 20 BU sites
- 30% designs and cost estimates for 11 BU sites
- 60% designs, cost estimates, and permit application packages for 7 BU sites

This memorandum documents the 60% design and cost estimate for the Site.

Design Objectives

The Site is designed to provide BU capacity for dredged material generated from nearby navigation channels during routine maintenance and, potentially, new work material from the proposed CCSC Channel Deepening Project or other new work projects, thus reducing the volume of such material that will need to be placed in existing open-bay or upland DMPAs. This 60% design is based upon publicly available datasets, stakeholder recommendations, and focused field work directed by PCCA and conducted by Triton Environmental Solutions, LLC (Triton) as well as field work conducted by DU.

Design objectives include the following:

- Develop a preliminary vision based on available data for the Site that includes the following:
  - Habitat to be created or restored
  - Potential sediment source(s)
  - Approaches to minimize long-term maintenance costs, while providing adequate erosion protection and containment
- Delineate footprints for proposed BU placement.
- Identify key sensitive habitats and construction considerations in the vicinity of the Site.
- Estimate fill volumes for the proposed BU footprints.
- Identify data gaps to be addressed in subsequent design phases.
- Provide preliminary cost estimates.

Stakeholder Feedback

The 30% design for the Site was presented at the Lower Coast Beneficial Use Planning Region 3 Stakeholder meeting on June 14, 2022. Attendees included staff from GLO, the U.S. Army Corps of Engineers (USACE), the Texas Parks and Wildlife Department (TPWD), the Coastal Bend Bays & Estuaries Program, the U.S. Fish and Wildlife Service (USFWS), local officials, and other professionals.

Some comments from this meeting, as well as written comments on the 30% design, follow:

- USFWS suggested targeting elevations of high marsh to adapt to relative sea level rise (RSLR).
  - The design team increased the target elevation of the Site to +3.0 feet North American Vertical Datum of 1988 (NAVD88; the upper end of high marsh) to address RSLR
- TPWD recommended planting target marsh species with a minimum of 3-foot-centers to enhance recruitment. TPWD also suggested that planting with 1-foot centers would help discourage the establishment of nontarget species.
  - Evaluation of the density and types of vegetation will need to be coordinated during final design phases in coordination with the project proponent.

The comments above represent the key issues brought forward to the project team. Other comments, generally more minor and easily addressed, are not included in this list. When feasible, comments have been incorporated into the 60% design, as noted in the below sections, and others may be addressed in the final design.

Existing Data Review

A review of existing data and the focused data collected by DU and Triton was performed to develop the Site and containment berm designs. This section describes the data reviewed and collected for the 60% design.

Horizontal and Vertical Datums

The horizontal datum used for the Site is the Texas State Plane South Zone, North American Datum of 1983, in U.S. survey feet. The primary vertical datum used for the Site design is NAVD88. The National Oceanic and Atmospheric Administration (NOAA) maintains an active tide gage, Enbridge, Ingleside Station 8775283 (Ingleside Station), 2.0 miles southwest of the Site. This station collects and records real-time tide information dating back to 2002. The Ingleside Station does not provide NAVD88 vertical datums, so the NOAA Online Vertical Datum Transformation tool was used to convert the mean lower low water (MLLW) vertical datums to NAVD88 (NOAA 2022a). The converted vertical datums from the Ingleside Station that will be used for the Site are shown in Table 1. The NOAA USS Lexington Station 8775283 (Lexington Station) was also used to define a preliminary design water level, as described in the Water Level section.

Table 1
Ingleside Station Tidal Datums

Tidal Datums	Elevation (feet MLLW)	Elevation (feet NAVD88)
MHHW	0.71	0.85
MHW	0.70	0.84
MSL	0.40	0.54
MLW	0.00	0.14
MLLW	0.00	0.14

MHHW: mean higher high water
MHW: mean high water
MLW: mean low water
Vertical uncertainty in NAVD88 estimates using NOAA (2022a): +/- 0.484 foot

Meteorological, Ocean, and Wave Data

Water Level

To determine an approximate design water level elevation for the Site, an existing water level analysis using data from the Lexington Station, which is 12 miles west of the Site, was used due to a lack of recent, continuous water level data from the adjacent Ingleside Station (Anchor QEA 2021).

Data were compiled for the period from October 2015 to January 2021 and used to calculate a 90th-percentile water level of 2.0 feet NAVD88.

The MHHW from the 1983 to 2001 tidal epoch at the Lexington Station is 1.02 feet NAVD88, which is 0.17 foot higher than at the Ingleside Station. Due to this difference in the MHHW, water levels at the Lexington Station were considered a conservative estimate of the water levels that would be experienced at the Site.

Wind and Waves

USACE Wave Information Studies (WIS) provides a national resource of long-term wavefield climatologies for U.S. coastal waters that synthesizes observations, multidecade hindcasts, and storm event archives (USACE 2021). The Wave Information Studies station closest to the Site is Station 73039, just offshore on the Gulf side of Port Aransas in the Gulf of Mexico. Because the station is located offshore, the wave data are not applicable to this project design. However, the project team considers the wind data to be representative of the winds experienced at the Site. Figure 2 summarizes wind data from January 1, 1980, through December 31, 2014. The data indicate that the predominant wind direction is from the southeast, with significant winds also coming from the north, northeast, east, and south.

Wind and wave conditions for this phase of design were assumed to be the same as identified in the AECOM design report for the M10 site located approximately 1 mile west of the Site (AECOM 2020). The wind speed and direction values used in the AECOM analysis were taken from the Packery Channel NOAA Tidal Station No. 8775792 at 3-hour intervals from June 2008 to June 2018. AECOM then applied a Coastal Modeling System 2D numerical wave (CMS-Wave) model to simulate wind-driven waves from 180° to 270° (south to west) direction winds. Waves were generated with wind speeds varying from 3 to 51 knots (1.5 to 26.2 meters per second). AECOM chose the design wave based on the maximum wave height produced by the CMS-Wave model (Table 2). The wind speed used to produce the maximum wave height is considered conservative for this analysis because it represents the 99.9th percentile of the wind speed recorded at WIS Station 73039.

The design wave and associated design period were extracted from the AECOM M10 report and used in this 60% analysis as a conservative approach to understanding the wave climate potentially experienced at the Site (Table 2). Due to the similar fetch and water depth conditions between the M10 and PA9-S sites, the 2.69-foot wave height estimated by AECOM is considered appropriate to use in this 60% design but may be revisited during subsequent design phases.

Table 2
Wind and Wave Design Values from the AECOM M10 Report

Datum	Value
Wind direction (degrees)	210
Wind speed (knots)	39
Wave height (feet)	2.687
Wave period (seconds)	3.63

Notes:
Source: (AECOM 2020)

Wake Erosion

The GIWW is approximately 0.5 mile west of the Site, and the CCSC is approximately 0.4 mile north of the Site. However, ships do not often use this portion of the GIWW (Hamilton et al. 2018). Potential wake erosion from vessels transiting the CCSC is minimized due to the Site being located on the southern side of the existing PA9-S island. Recreational vessels may also travel near the Site. Although wake erosion from recreational vessels and the ship channels is not expected to drive the berm design, both wind- and vessel-generated erosive forces will be evaluated in the final design.

Bathymetry and Near Surface Sediment Density

In March 2022, DU conducted a bathymetric and topographic survey of the Site. As shown in Attachment 2, the Site contours range from +2 feet NAVD88 to -10 feet NAVD88. During the survey, DU conducted sediment probing in areas of the Site shallower than -3 feet NAVD88 and, within those areas, qualitatively determined the near-surface material was firm and is not expected to exhibit substantial settling following placement of material. To determine expected foundation settling following placement of the fill material and containment berm, geotechnical analysis of the near-surface and deeper substrate within the containment berm footprint and fill area will be conducted during the final design phase.

Utilities and Infrastructure

The Railroad Commission of Texas public GIS viewer (RRC 2021) and GLO pipeline data (GLO 2021a) were used to identify mapped utilities near the Site. There are many pipelines near the Site: an Agua Tranquillo Midstream, LLC, natural gas pipeline runs north/south directly under the middle of the Site, while many Cinco Natural Resources Corporation natural gas full well stream pipelines range between 0.4 and 1 mile from the Site, with most of them being approximately 0.5 mile to the southeast. There were also several plugged wells identified within the Site, as shown in the Attachment 1 drawings. The footprint of the Site was refined to avoid building the containment berm directly on top of plugged wells. Impacts of the pipelines on the constructability of the Site will need to be evaluated during subsequent design phases, and offsets that modify the Site footprint and reduce potential storage capacity may be needed. The need for Site-specific utility locations prior to construction will be determined during subsequent design phases.

An oil and gas platform, as well as two other unidentified structures not displayed in the GLO data or the RRC public GIS viewer, were identified within the footprint of the Site using Google Earth imagery and are shown in Attachment 1, C01. Communications regarding the Cinco Natural Resources Corporation facilities are ongoing and may impact the Site design. For this analysis, impacts of these structures on the design are not evaluated; however, it is expected that the final design will be refined to account for these structures.

A magnetometer survey of the Site was conducted by Naismith in October 2018 as a part of the Lower Reach of the Channel Improvement Project. Refinements to the footprint of the Site based on the magnetometer survey may be incorporated during final design.

This preliminary utility investigation is not sufficient to clear the Site for construction and excavation. Further investigation into underground and aboveground utilities must be conducted prior to construction of this project.

Desktop Cultural Resources Survey

A search of cultural resources records in the Texas Historical Commission Texas Historical Sites Atlas Database (THC 2021) was completed on December 2, 2021. It appears that the proposed placement site has been fully surveyed for cultural resources, and no resources have been identified.

Sensitive Habitat

GLO oyster habitat GIS data (GLO 2021b) indicate there is no oyster habitat identified within or adjacent to the Site. According to Texas Parks and Wildlife Department seagrass data (TPWD 2021), patchy seagrass has been mapped surrounding the Site.

No seagrasses were observed during the visual survey conducted by DU on March 11, 2022. Because the sensitive habitat data from TPWD are not recent, and the seagrass information from DU is based on visual surveys, more extensive seagrass surveys may need to be conducted during final design.

Other habitat surveys may need to be conducted during the final design phase to re-evaluate the presence and extents of sensitive habitat.

Beneficial Use Source Material

The proposed source material for the Site may consist of suitable material excavated from inside the Site (borrow area) and dredged material from the CCSC, located adjacent to the Site. Potential borrow area sediment volumes were calculated at various excavation depths and are shown in Table 3. The values shown in Table 3 assume all the material excavated within the borrow area is suitable for berm construction. If it is determined that the borrow area does not contain suitable fill or the necessary construction volume, suitable off-site material may be used to complete the containment berm construction. Based on coastal consistency determinations from USACE, USACE has historically performed maintenance dredging on the CCSC near the Site (USACE 1999). The identified USACE DMPAs adjacent to the Site and their average annual quantity of dredged material, distance from the Site to DMPA, and channel segments are shown in Table 4. With the ongoing widening and deepening of the CCSC, it is expected that the average annual dredging quantities will be higher in the future. The average grain size and grain type percentages of dredged material are shown in Table 5.

Table 3
Borrow Area Sediment Volume Availability at Different Excavation Depths

Excavation Area	Excavation Depth (feet)	Volume (CY)[2]
Borrow area[1]	1	260,000
	2	530,000
	3	790,000
	4	1,050,000
	5	1,310,000

Notes:
Volume availability was calculated geometrically using the March 2022 DU bathymetric surveys.
1. Volume availability was calculated inside the 50-foot buffer region, away from the interior toe of the berm, and depth values were assumed to start at the depth of the mudline. Actual available volume will likely be lower once pipeline offsets are considered during final design.
2. Value is rounded to the nearest 10,000 CY.

Table 4
USACE DMPA Areas Near the Site That Received Dredged Material

DMPA No.	CCSC Channel Segment (Station)	Distance from Site to DMPA (miles)	Average Annual Dredging Quantity (CY)
7	Inner Basin to La Quinta Junction (270+00-320+00)	2.4	35,000
8	Inner Basin to La Quinta Junction (320+00-400+00)	1.3	40,000
9 (also referred to as PA9-S)	Inner Basin to La Quinta Junction (400+00-500+00)	0 (adjoining site)	51,000

Notes:
Source: USACE 1999
CY: cubic yard

Table 5
Typical Sediment Characteristics Between the Inner Basin and La Quinta Junction

Sediment Characteristics
D_{50} (mm) = 0.256
87.8% sand
6.6% silt
5.7% clay

Notes:
CCSC Channel Segment Station (0+00-200+00)
Source: USACE 1999
D_{50}: median grain size
mm: millimeter

Another potential source of sediment is from the proposed CCSC Channel Deepening Project and the proposed La Quinta Channel Deepening. These projects could potentially provide a substantial portion of the material used at the Site; however, analysis of the expected sediment quantities and geotechnical characteristics of the material that would be generated from these projects will need to be completed during the final design phase.

Marsh Vegetation Elevation Ranges

Table 6 shows typical elevation ranges for relevant marsh vegetation based on vegetation surveys conducted by PCCA at the Dagger Island marsh in Redfish Bay approximately 1.3 miles from the Site. The range represents minimum and maximum values found during the survey, while the mode represents the most frequently occurring values during the survey.

Table 6
Typical Elevations for Target Marsh Vegetation

	Dagger Island: Elevation (feet MSL)		Dagger Island: Elevation (feet NAVD88)	
Species	Range	Mode	Range	Mode
High marsh	0.66 to 3.86	1.26 to 1.96	1.2 to 4.4	1.8 to 2.5
Low marsh	-1.44 to 2.96	0.26 to 0.76	-0.9 to 3.5	0.8 to 1.3
Seagrass	-5.74 to 0.56	-3.34 to -1.04	-5.2 -to 1.1	-2.8 to -0.5
Smooth cordgrass	-1.84 to 1.16	-0.74 to -0.04	-1.3 to 1.7	-0.2 to 0.5
Sand flats	1.63 to 1.64	1.63 to 1.64	2.17 to 2.18	2.17 to 2.18
Uplands	1.96 to 5.56	1.96 to 5.56	2.5 to 6.1	2.5 to 6.1

60% Design

The main design elements evaluated for the 60% Site design are as follows:

- Site location
- Marsh size and shape
- Containment and erosion protection
- Constructability
- Planting and natural recruitment of vegetation
- Performance expectations
- Site construction cost estimate
- Expected ecosystem benefits
- Data and information gaps

This project is planned to be constructed in two phases. Phase 1 will include the containment berm, while Phase 2 will be the placement of dredged material within the berm. The first phase is expected to be paid for and contracted by the project owner (e.g., a conservation organization with funding). Accordingly, for Phase 1, this memorandum includes 60% construction drawings (Attachment 3), which provide details for the containment berm construction, and technical specifications (Attachment 4). The second phase is expected to be paid for by the project owner but contracted by the entity funding the dredging itself (e.g., USACE). Because USACE (or another entity) will be directing the dredger, the entity will provide the dredger with its technical specifications and will work the beneficial use aspect of the dredging project into its drawings. As a result, it is not useful to prepare 60% construction drawings and technical specifications for Phase 2. Rather, a Dredged Material Management Plan (DMMP) that provides design details on the placement of dredged material for the interior of the Site was developed (Attachment 5). It is expected that USACE (or another entity) will incorporate the DMMP into the construction drawings and technical specifications into the construction contract it has with the dredger. This will ensure the BU design grades and project objectives are achieved.

Site Location

The existing PA 9-S island is a DMPA located approximately 0.5 mile east of the GIWW and 0.4 mile south of the CCSC and between the existing M10 Island and Pelican Island (Figure 1). The proposed Site will expand the southern footprint of the existing PA9-S island, and, based on discussions with USACE staff, will not interfere with ongoing USACE dredging operations (Knoll 2022).

The Site footprint begins on the shoreline of the existing upland area and extends out to between the -10 to -11-foot-NAVD88 contour. The average seabed elevation of the Site footprint is -7 feet NAVD88 (-6.85 feet MLLW). Seabed elevations deeper than -5 feet NAVD88 surround most of the

Site, providing beneficial conditions for construction access. Bathymetric surveys will need to be conducted during final design to better define Site dimensions and material needs.

Marsh Size and Shape

Based on availability of sediment, a cost analysis, and stakeholder feedback, the project team proposes that the area of the Site be approximately 220 acres and restore marsh in open water areas of the Site. The Site will consist of fill extending to the edge of the existing PA9-S island or to the edge of the constructed containment berm described in Containment and Erosion Protection. Sediment will be placed within a range of elevations to create a variety of habitats. The fill elevations described in this section may be adjusted in further phases of design, depending on the physical properties of the dredged material and to target a variety of vegetation habitats.

The marsh restoration area is expected to be 172 acres and is being designed to support a range of low and high marsh habitat, from 1.5 feet NAVD88 to 3.5 feet NAVD88, with a target elevation averaging 3 feet NAVD88 (2.46 feet mean sea level [MSL]; Table 6).

Evaluations on the impact of infrastructure within the footprint identified in Attachment 2 are ongoing, and the size and shape of the Site may need to be refined during subsequent design phases.

Fill material would likely be obtained from the CCSC (Table 4). It is predicted that the required fill volume will be approximately 4 million CY. This value assumes 1 foot of foundation compression for every 6 feet of fill and does not consider bulking. Based on sediment probing data from DU in shallow regions of the Site, there are areas of sand near the PA9-S island. However, there was no probing conducted in the deep portions of the Site, so to remain conservative for this level of design, 1 foot of compression for every 6 feet of fill was considered an appropriate assumption. Based on the volumes in Table 4, multiple maintenance dredging events may be needed to fill the site to the proposed design elevations. However, if new work material becomes available, either through the CCSC Channel Deepening Project, the La Quinta Channel Deepening, or other new work projects, the site could possibly be filled during a single dredging event. Additional geotechnical data will need to be collected during the final design phase to further evaluate the expected foundation compression and bulking of dredged material.

RSLR may impact the Site in the future. A strategy to address RSLR could be to place BU material to higher elevations in preparation for higher relative sea levels and tidal elevations associated with RSLR. The upper ranges of high marsh were included in the design to accommodate for RSLR impacts, while also creating valuable marsh habitat in the short term. The impacts of RSLR may be adapted to in the future through adaptive management strategies such as thin-layer placement of additional dredged material.

Containment and Erosion Protection

A 6,000-foot-long sand containment berm will be constructed to create capacity and protect the placed dredged material and created intertidal habitats from erosion. Sand from within the footprint of the Site or sandy maintenance material from the channel could be used to construct the containment berm. If the sand is obtained from the footprint of the site, it would be side casted from the identified borrow area shown in Attachment 1, C03.

Table 7 summarizes the proposed constructed containment berm design, as well as the projected final containment berm configuration after a period of natural reconfiguration under wind and wave forces. Based on the bathymetric survey conducted by DU, the water-bottom elevations of the proposed containment berm centerline vary from +3 feet NAVD88 to -8 feet NAVD88. The constructed containment berm is expected to transform over a span of weeks to months to a more natural appearance through wind wave action.

The required volume to construct the containment berm is 700,000 CY. Dredging the entire footprint of the borrow site down 3 feet below the existing mudline would provide almost 800,000 CY of dredged material, which may be sufficient to construct the containment berm if all the material is suitable for berm construction and if pipeline offsets do not significantly reduce the available volume of material.

It is expected that natural openings in the berm allowing tidal exchange into the marsh will be developed as the berm morphs into its final shape under wave action. Depending on stakeholder and regulatory agency feedback, the containment berm may have openings excavated to increase tidal flow into the contained marsh via open water channels extending into the marsh. The locations and geometry of these openings would be determined based on discussions with regulatory agencies during final design.

The constructed and final slope and cross-sectional dimensions of the containment berm will be further refined through modeling and analysis of the sediment characteristics of the dredged material, the containment berm subgrade, the hydrodynamic and wind-wave conditions. And an analysis of initial capital construction costs versus maintenance costs during a subsequent phase of design.

Table 7
Containment Berm Design Characteristics

Design Criteria	Containment Berm
Length	8,000 linear feet
Total acreage	40 acres
Crest width	50 feet
Base width	185 feet

Design Criteria	Containment Berm
Assumed bottom elevation[1]	-8.00 feet NAVD88
Total structure height[1]	15 feet
Materials	Sand
Volume	700,000 CY
Estimated Settlement[2]	2.5 feet
Design side slopes (seaward side)	5H:1V
Design side slopes (landward side)	4H:1V
Maximum design crest elevation	7.0 feet NAVD88

Notes:
The final cross-sectional dimensions, slopes of the containment berm, and volume required for interior fill will need to be determined and refined, respectively, through modeling and analysis of the wind-wave hydrodynamics and sediment characteristics of the dredged material and containment berm subgrade during a subsequent phase of design.

1. Based on average elevation along the containment berm
2. Based on 1 foot of settlement for every 6 feet of fill

Constructability

This section describes the proposed methods of construction. Actual methods will be dependent on the chosen contractor's equipment and Site conditions at the time of construction. In addition, the contractor may provide alternate construction methods from those described in this section.

The Site could be constructed in two different phases. Phase 1 would be constructed through a separate contract from Phase 2. Phase 2 is assumed to likely be an addition to an existing dredging contract for new work or maintenance dredging of an adjacent navigation channel. Phase 1 would be executed after a source of dredged material for Phase 2 is identified. Phase 1 would be constructed to be finished within 12 months of the availability of dredged material for Phase 2. Descriptions of the two phases follow.

Phase 1

Sandy material from within the borrow area would be placed using a combination of hydraulic and mechanical dredging to build up the containment berm. After the containment berm is placed, wind wave, and hydrodynamic forcing would shape the front of the containment berm down to a more natural slope, crest width, and crest height.

Phase 2

Phase 2 of construction will consist of placing fill inside the Phase 1 containment berm to design elevations. Phase 2 construction may require mobilizing equipment beyond what is required for dredging the CCSC (e.g., marsh buggies and a deck barge). Marsh buggies may be used to shape the fill to the required fill elevations.

Planting and Natural Recruitment of Vegetation

Based on stakeholder input and cost considerations, the project team believes that natural recruitment of vegetation within the marsh will be the most cost efficient method for vegetating the marsh. Table 6 shows some of the targeted vegetation and their preferred habitat elevations. If the outcome is unsatisfactory (e.g., if the marsh has a lower-than-desired density of vegetation or if undesirable species of vegetation are present), an adaptive management program can be instituted to directly plant, adjust Site elevations, remove undesirable species, etc.

The final decision to plant the marsh or to allow natural recruitment will be determined during the final design phase through collaboration with the project proponent (yet to be determined). Performance metrics for satisfactory vegetation outcomes will be set by working with agencies during a subsequent phase of design. The decision to plant for a desired level of biodiversity or for a target species will ultimately come from collaboration between the project proponent, design team, and permitting agencies during the final design phase.

Performance Expectations

The performance goal for the project is to create 172 acres of sustainable high and low marsh, tidal flat, and open water habitat. The designed containment is expected to contain placement of dredged material, be resilient to typical storm events, and provide protection for the interior habitat.

Site Construction Cost Estimates

Preliminary construction costs were estimated for the design outlined in the previous sections. The estimated costs also include the indirect construction costs (i.e., permitting, 100% engineering and design costs, construction management, and postconstruction management such as site visits and dewatering management). These costs represent the estimated incremental costs (i.e., costs over and above USACE's least costly and environmentally acceptable dredged material placement alternative). Because the Site is close to sediment sources, it should allow for lower construction costs compared to more remote potential marsh restoration sites. Table 8 shows a line-item list of each costing parameter and the total cost estimated for construction.

The costs range from $18.3 million to $39.2 million, depending on the level of uncertainty allocated to the project cost. The lower bound of uncertainty (-30%) and upper bound of uncertainty (+50%) were selected due to the existing data gaps, ongoing high levels of inflation, and rising fuel costs.

Cost savings may be realized by further analysis and modeling of wind and wave conditions during subsequent design phases. An evaluation of the initial capital construction versus projected maintenance costs could be conducted to determine an optimum containment berm design that allows for satisfactory protection of the interior marsh, while being within the project budget.

The estimates are developed using current and generally accepted engineering cost estimating methods and are based on assumptions concerning future events. Actual costs may be affected by known and unknown risks including, but not limited to, changes in general economic business conditions, Site conditions that were unknown at the time the estimates were performed, future changes in Site conditions, regulatory or enforcement policy changes, and delays in performance. Actual costs may vary from these estimates.

Table 8
Opinion of Probable Construction Cost to 100% Project Completion

Item	Quantity	Unit	Unit Price	Total
Direct Construction Costs				
Phase 1: Containment Berm Construction				
Mobilization and Demobilization[1,2]	1	%	10	$ 900,000.00
Preconstruction Survey	1	LS	$ 30,000.00	$ 30,000.00
Side Casted Berm[2]	700,000	CY	$ 12.00	$ 8,400,000.00
As-Built Survey/Aerials	1	LS	$ 40,000.00	$ 40,000.00
Navigational Aids	16	Each	$ 10,000.00	$ 160,000.00
Phase 1 Subtotal[2]			**Sum**	**$ 9,500,000.00**
Phase 2: Marsh Construction				
Incremental Mobilization and Demobilization[2,4]	1	%	10	$ 1,300,000.00
Preconstruction Survey	1	LS	$ 30,000.00	$ 30,000.00
Incremental Dredging Cost (1 mile pipeline)[2]	4,300,000	CY	$ 3.00	$ 12,900,000.00
As-Builts/Aerials	1	LS	$ 70,000.00	$ 70,000.00
Phase 2 Subtotal[2]			**Sum**	**$ 14,300,000.00**
Direct Construction Total[2]			**Sum**	**$ 23,800,000.00**
Indirect Construction Costs				
100% Engineering and Design[2]	1	LS	$ 700,000	$ 700,000.00
Permitting	1	Each	$100,000.00	$ 100,000.00
Construction Management[2]	1	%	6	$ 1,400,000.00
Postconstruction Management[5]	12	Month	$ 10,000.00	$ 120,000.00
Indirect Construction Subtotal			**Sum**	$ 2,320,000.00
Project Subtotal[2]			**Sum**	$ 26,120,000.00
-30% Uncertainty[2]	1	%	30	$ 7,800,000.00
+50% Uncertainty[2]	1	%	50	$ 13,100,000.00
Low-End Total Project Estimated Cost[2]			**Total Sum**	**$ 18,300,000.00**
High-End Total Project Estimated Cost[2]			**Total Sum**	**$ 39,200,000.00**

Notes:
Costs were determined based upon a combination of publicly available datasets and sediment surface grabs, and topographic, bathymetric, and visual habitat surveys.
Mobilization and demobilization costs are based on line items within their respective phases.

1. Cost is based upon mobilizing equipment for construction of the containment berm
2. Value is rounded to the nearest $100,000.
3. Value is rounded to the nearest $10,000.
4. Cost is based upon mobilizing equipment above what is required for maintenance dredging operations.
5. Postconstruction management may include Site visits to observe the material consolidation, vegetation, and water levels on the Site. Monthly aerials may be performed. Additional postconstruction management practices may be considered during subsequent phases of design.

LF: linear foot
LS: lump sum
sf: square foot

Expected Ecosystem Benefits

Creation of the Site is expected to have a net positive benefit on the regional ecosystem. The marsh restoration is expected to add 172 acres of marsh and tidal flat habitat to the regional ecosystem. The Site will also provide resiliency to the degrading existing shoreline of PA9-S and increase foraging habitat for birds.

The mean relative sea level rise trend at Corpus Christi is 5.54 millimeters per year (NOAA 2022). Assuming no changes in the mean relative sea level rise trend and no erosion, as well as not considering inorganic and organic accretion, the marsh within the target elevation of the Site (3 feet NAVD88 or 2.46 feet MSL) would remain above the 95th-percentile water level until 2078.

Data and Information Gaps

At this phase of design, the following data and information gaps have been identified:

- Further coordination with USACE may be necessary, given that the Site is partially within a DMPA. Communications to date have indicated that the Site won't interfere with USACE's ongoing use of the existing PA9-S DMPA (Knoll 2022). However, additional communication may be necessary to ensure the final design does not conflict with USACE's operations and to obtain a real estate agreement.
- Site-specific wind-generated and vessel wake wave heights for optimization of the containment berm design.
- Geotechnical characteristics of the source material (berm source material and maintenance and new work dredged material) and subgrade of the placement area to refine evaluations of containment structure stability, subgrade and source material settlement, and short- and long-term capacity for dredged material placement.
- Survey information such as property lines, utility locations, and supplemental bathymetry, where appropriate.

- Location of suitable material is needed for containment berm construction. If there is not sufficient sand within the borrow area to construct the desired containment berm, the footprint of the Site could be reduced, or an alternate source of suitable material could be identified.

These data gaps need to be addressed during the progression from 60% design to final design. For example, supplemental data collection and modeling would allow for optimizing the project design to reduce construction costs. It is expected that the cost of addressing these information gaps would be offset by the cost savings that would be realized by optimizing the project design. Because the 60% design has been prepared without such data, conservative assumptions have been used, increasing the estimated construction cost. This current project is taking the analyses as far as practicable, considering the constraints of the project scope, budget, and schedule.

Future Work

No fatal flaw has been identified at this phase of the design.

Discussions with infrastructure owners within the Site footprint are ongoing and may affect the Site footprint and design during subsequent design phases.

Should the Site be selected for additional design efforts, it can be expected that some aspects of the design in this memorandum will be modified and, as appropriate, enhanced.

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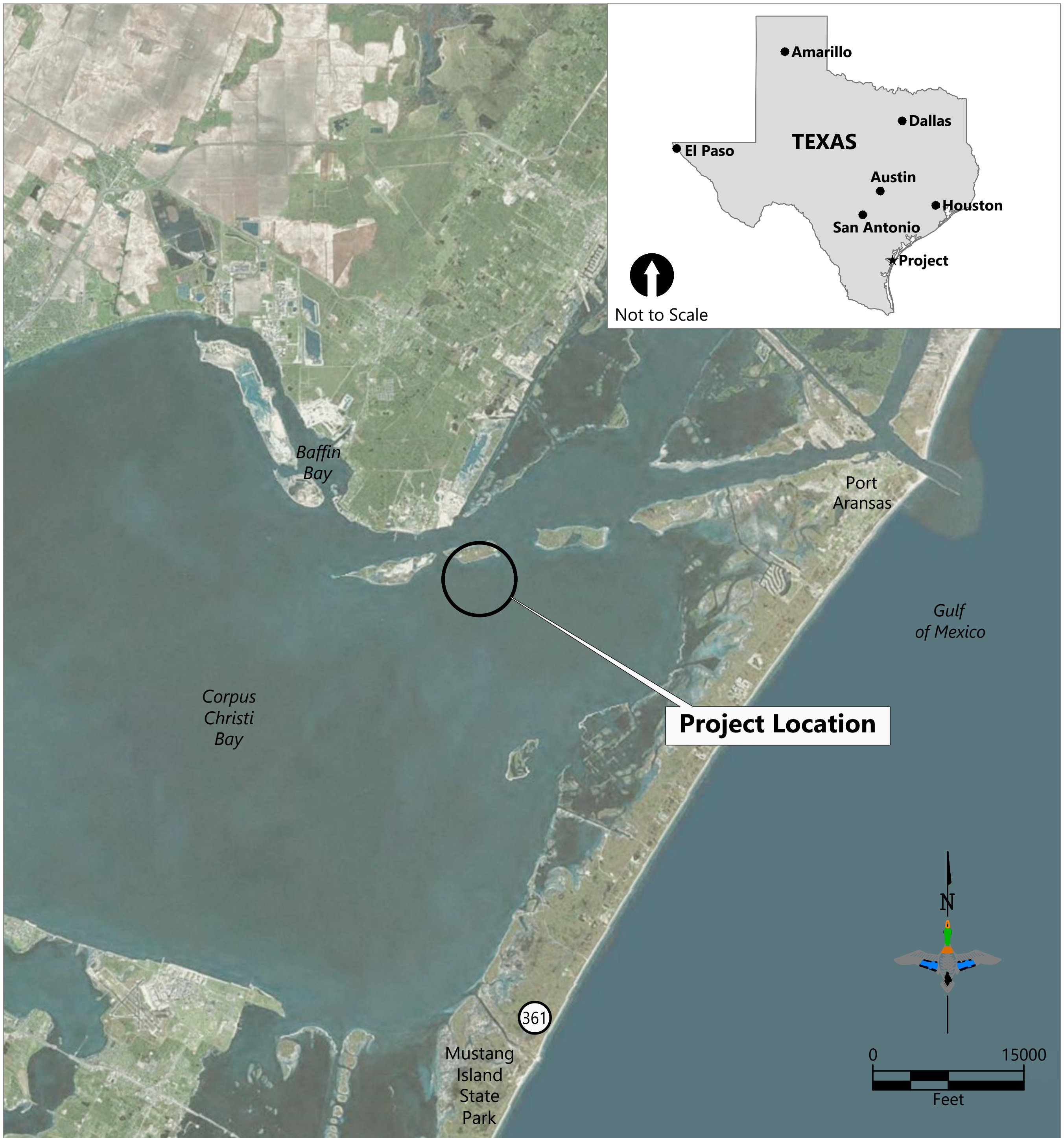
Figures



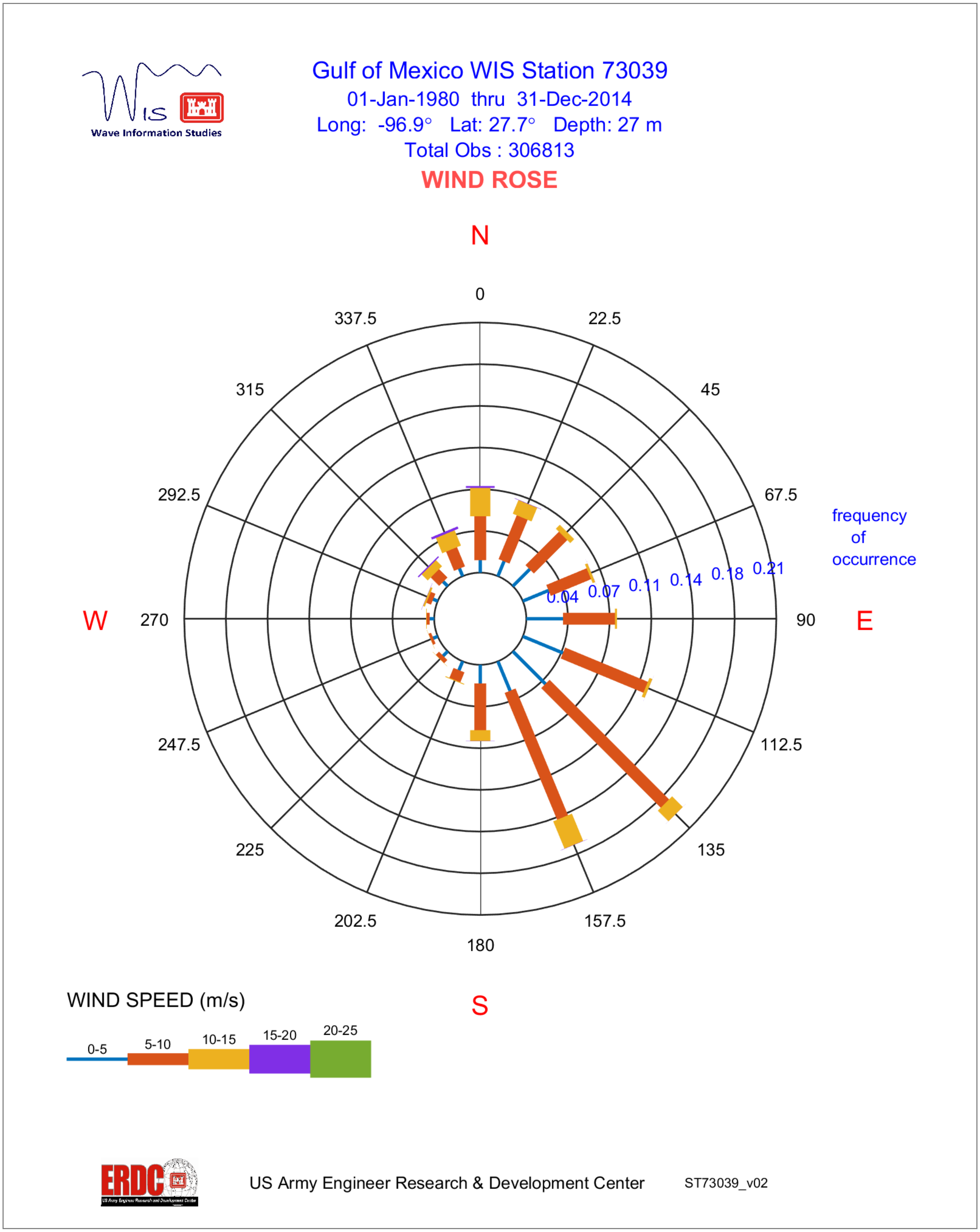
SOURCE: Aerial provided by Bing Maps.
HORIZONTAL DATUM: Texas State Plane South Zone, North American Datum of 1983, U.S. Survey Feet

Publish Date: 2022/04/21 1:49 PM | User: mpratschner
Filepath: K:\Projects\2018-PCCA Beneficial Use\PA9-S\2018 RP-001 VIC MAP.dwg Figure 1

ANCHOR QEA

Figure 1
Vicinity Map

PA9-S 60% Design Memorandum
Texas Lower Coast Beneficial Use



Filepath: \\Fuji\Austin\D_drive\Projects\GLO\BU Lower Coast\Design\30% Designs\PA9-S\Figures\Figure 2_PA9-S.docx

Figure 2
Historical Wind Data for USACE WIS Station 73039

Attachment 1
Site Photographs


Photograph of shoreline, facing north (source: Ducks Unlimited)

Cinco Natural Resources oil and gas platform in project footprint, facing north (source: Ducks Unlimited)

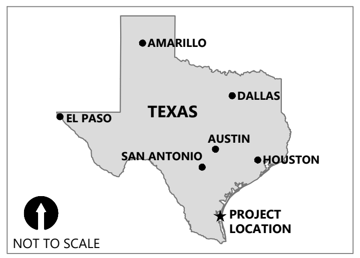
Cinco Natural Resources large platform in project footprint, facing north (source: Ducks Unlimited)

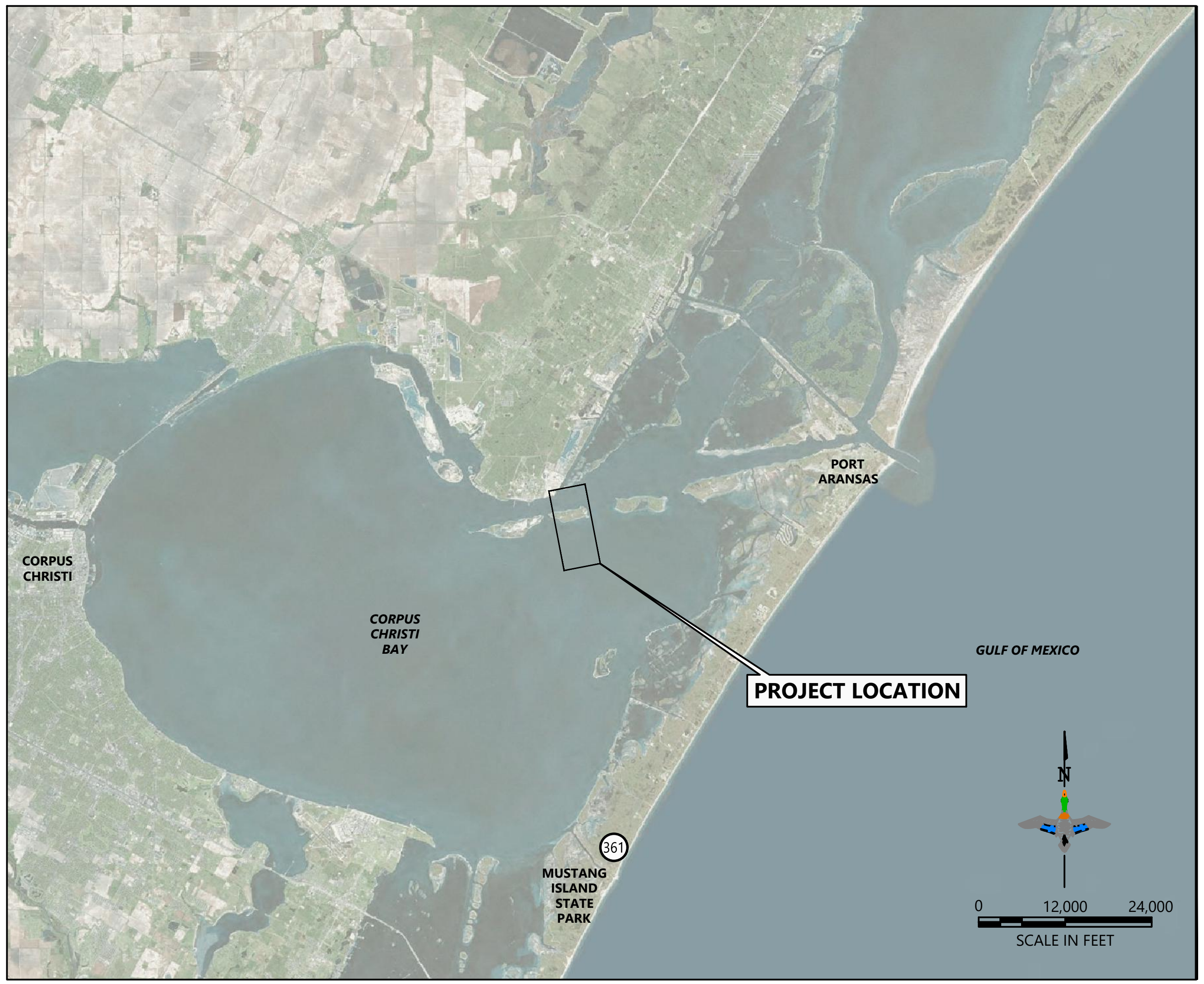
Attachment 2
Construction Drawings

60% DESIGN SUBMITTAL

TEXAS LOWER COAST BENEFICIAL USE - PA9-S

TEXAS GENERAL LAND OFFICE





AERIAL BY BING MAPS

DRAWING INDEX		
SHEET	DRAWING	TITLE
1	T01	TITLE SHEET
2	G01	GENERAL NOTES AND ABBREVIATIONS
3	C01	SITE OVERVIEW
4	C02	PLAN VIEW
5	C03	BORROW AREA
6	C04	TYPICAL CONTAINMENT BERM SECTION

NOTES:

1. HORIZONTAL DATUM: TEXAS STATE PLANE SOUTH ZONE, NAD83, U.S. SURVEY FEET
2. VERTICAL DATUM: NORTH AMERICAN VERTICAL DATUM OF 1988 (NAVD88)
3. BATHYMETRIC, TOPOGRAPHIC AND VISUAL HABITAT SURVEYS CONDUCTED BY DUCKS UNLIMITED ON MARCH 01, 2022.

PLAN INTENDED TO BE VIEWED IN COLOR. ADJACENT BLOCK IS "BLUE"

ONE INCH

AT FULL SIZE, IF NOT ONE INCH SCALE ACCORDINGLY

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Jan 06, 2023 4:33pm mpratschner

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REVISIONS				
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DESIGNED BY: A. FREDDO
DRAWN BY: M. PRATSCHNER
CHECKED BY: R. ROBERTSON
APPROVED BY: J. LAPLANTE
SCALE: AS NOTED
DATE: DECEMBER 2022

TEXAS LOWER COAST BENEFICIAL USE - PA9-S

TITLE SHEET

T01

SHEET # 1 OF 6

GENERAL NOTES

1. THE CONTRACTOR SHALL COMPLY WITH ALL REQUIREMENTS OF THE DRAWINGS, SPECIFICATIONS, PERMITS, AND ALL APPLICABLE REGULATIONS AND ORDINANCES.
2. IN THE EVENT OF A CONFLICT BETWEEN THE SPECIFICATIONS AND THE DRAWINGS, THE DRAWINGS SHALL GOVERN.
3. BATHYMETRIC, TOPOGRAPHIC AND VISUAL HABITAT SURVEYS CONDUCTED BY DUCKS UNLIMITED ON MARCH 01, 2022.
4. AERIAL IMAGE ©2022 MICROSOFT BING, MICROSOFT CORPORATION EARTHSTAR GEOGRAPHICS.
5. GEOTECHNICAL AND ENGINEERING DATA PROVIDED ARE FOR REPRESENTATIVE PURPOSES. THE CONTRACTOR SHALL FIELD VERIFY CONDITIONS AND/OR COLLECT ANY ADDITIONAL DATA IT DEEMS NECESSARY.
6. THE CONTRACTOR SHALL FIELD VERIFY ALL FIELD BASELINE CONDITIONS, AS WELL AS ALL LOCATIONS AND DIMENSIONS.
7. THE CONTRACTOR SHALL LOCATE AND FIELD VERIFY ALL ABOVEGROUND AND BELOWGROUND UTILITIES BEFORE BEGINNING WORK.
8. THE CONTRACTOR SHALL BE RESPONSIBLE FOR DAMAGE TO BOTH ON- AND OFF-SITE FACILITIES CAUSED BY ITS ACTIVITIES DURING PERFORMANCE OF THE WORK. THE CONTRACTOR SHALL RESTORE ALL SUCH DAMAGES TO THEIR PRECONSTRUCTION CONDITION AT NO COST TO THE OWNER.
9. THE CONTRACTOR SHALL AT ALL TIMES KEEP ITS CONSTRUCTION AREAS FREE FROM ACCUMULATIONS OF WASTE MATERIALS OR RUBBISH AND, PRIOR TO COMPLETION OF THE WORK, REMOVE ANY RUBBISH FROM THE PREMISES, AS WELL AS ALL TOOLS, EQUIPMENT, AND MATERIALS THAT ARE NOT THE PROPERTY OF THE OWNER.

PERMITS AND PERMIT CONDITIONS

1. THE CONTRACTOR SHALL COMPLY WITH ALL PERMIT CONDITIONS.
2. THE CONTRACTOR SHALL BE RESPONSIBLE FOR OBTAINING ANY ADDITIONAL PERMITS THAT MAY BE REQUIRED FOR THE CONDUCT OF THIS WORK. COSTS OF OBTAINING PERMITS NOT SUPPLIED BY THE OWNER SHALL BE BORNE BY THE CONTRACTOR.

HORIZONTAL DATUM

TEXAS STATE PLANE SOUTH ZONE, NAD83, U.S. SURVEY FEET

VERTICAL DATUM

NORTH AMERICAN VERTICAL DATUM OF 1988 (NAVD88)

ABBREVIATIONS

CP	CONTROL POINT
E	EASTING
EL.	ELEVATION
MIN.	MINIMUM
MLLW	MEAN LOWER LOW WATER
N	NORTHING

PLAN INTENDED TO BE VIEWED IN COLOR. ADJACENT BLOCK IS "BLUE"

ONE INCH

AT FULL SIZE, IF NOT ONE INCH SCALE ACCORDINGLY

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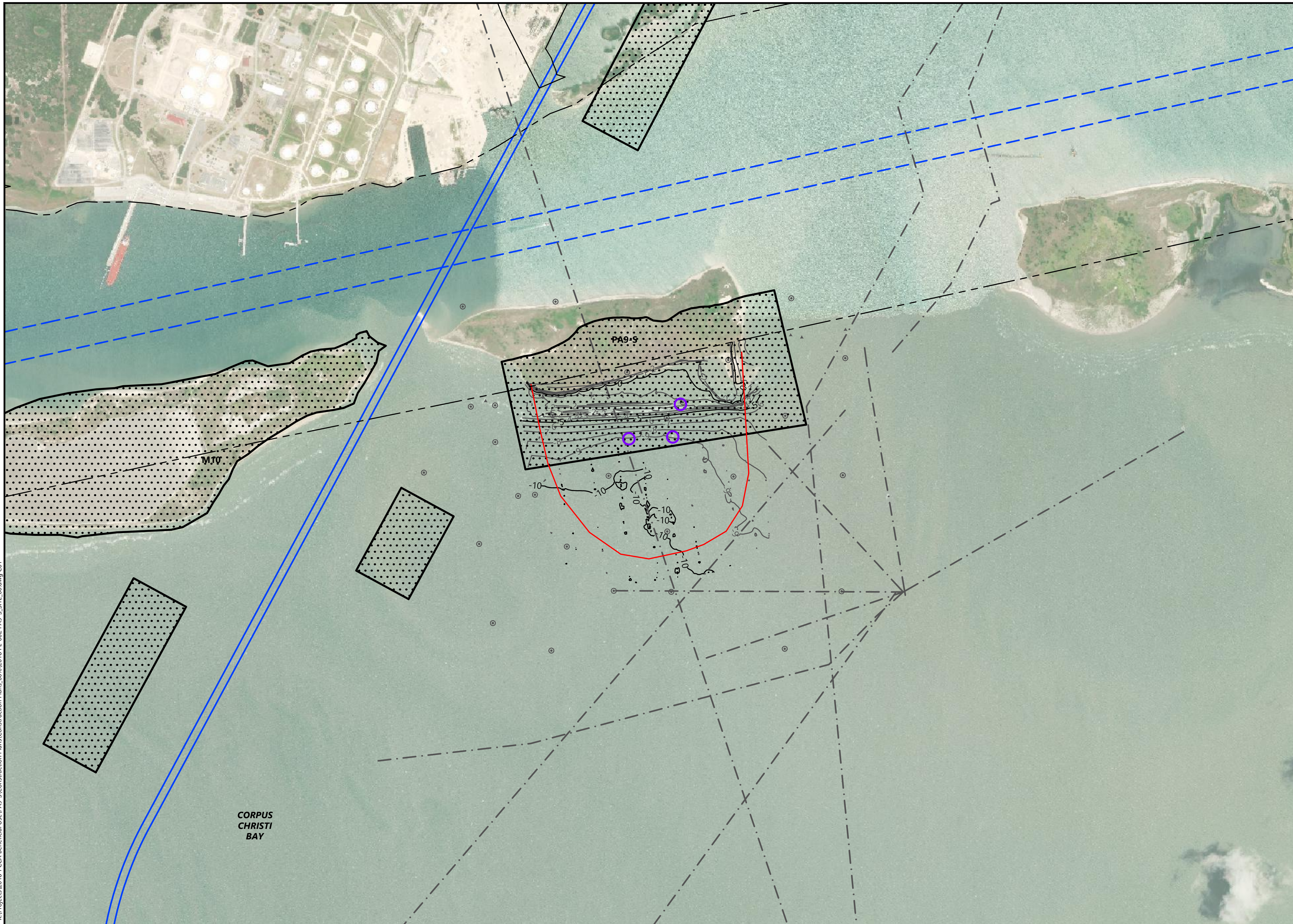
DATE: DECEMBER 2022

TEXAS LOWER COAST BENEFICIAL USE - PA9-S

GENERAL NOTES AND ABBREVIATIONS

G01

SHEET # 2 OF 6



LEGEND:

- PROPOSED CONTAINMENT BERM
- U.S. ARMY CORPS OF ENGINEERS PLACEMENT AREA
- GLO MAPPED PIPELINES
- RAILROAD COMMISSION OF TEXAS MAPPED OIL AND GAS INFRASTRUCTURE LOCATIONS
- CORPUS CHRISTI SHIP CHANNEL
- GULF INTRACOASTAL WATERWAY
- -10 EXISTING CONTOUR (5')
- -3 EXISTING CONTOUR (1')
- VISUALLY IDENTIFIED OIL & GAS INFRASTRUCTURE
- PORT OF CORPUS CHRISTI AUTHORITY (PORT CORPUS CHRISTI) PROPERTY BOUNDARY

N

0 800 1600

SCALE IN FEET

NOTES:

1. HORIZONTAL DATUM: TEXAS STATE PLANE SOUTH ZONE, NAD83, U.S. SURVEY FEET
2. VERTICAL DATUM: NORTH AMERICAN VERTICAL DATUM OF 1988 (NAVD88)
3. BATHYMETRIC, TOPOGRAPHIC, AND VISUAL HABITAT SURVEYS CONDUCTED BY DUCKS UNLIMITED ON MARCH 01, 2022.

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ONE INCH

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TEXAS LOWER COAST BENEFICIAL USE - PA9-S

SITE OVERVIEW

C01

SHEET # 3 OF 6

CONTROL POINT	NORTHING (Y)	EASTING (X)
CP-01	1411728.04	17187201.63
CP-02	1411732.70	17186656.97
CP-03	1411765.74	17186479.38
CP-04	1411891.60	17185261.42
CP-05	1411789.39	17184696.90
CP-06	1411507.46	17184251.83
CP-07	1411115.60	17184009.89
CP-08	1410816.51	17183898.61
CP-09	1410189.12	17183762.01
CP-10	1409688.46	17183847.71
CP-11	1409148.49	17184222.34
CP-12	1408666.84	17184833.53
CP-13	1408459.13	17185383.95
CP-14	1408349.73	17186174.31
CP-15	1408272.66	17186684.25

LEGEND:

- PROPOSED CONTAINMENT BERM
- GLO MAPPED PIPELINES
- RAILROAD COMMISSION OF TEXAS MAPPED OIL AND GAS INFRASTRUCTURE LOCATIONS
- DIRECTIONAL SURFACE LOCATION
- CORPUS CHRISTI SHIP CHANNEL
- GULF INTRACOASTAL WATERWAY
- –10– EXISTING CONTOUR (5')
- –3– EXISTING CONTOUR (1')
- VISUALLY IDENTIFIED OIL & GAS INFRASTRUCTURE

N

0 400 800

SCALE IN FEET

NOTES:

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PLAN INTENDED TO BE VIEWED IN COLOR. ADJACENT BLOCK IS "BLUE"

ONE INCH

AT FULL SIZE, IF NOT ONE INCH SCALE ACCORDINGLY

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TEXAS GENERAL LAND OFFICE ESTABLISHED 1836

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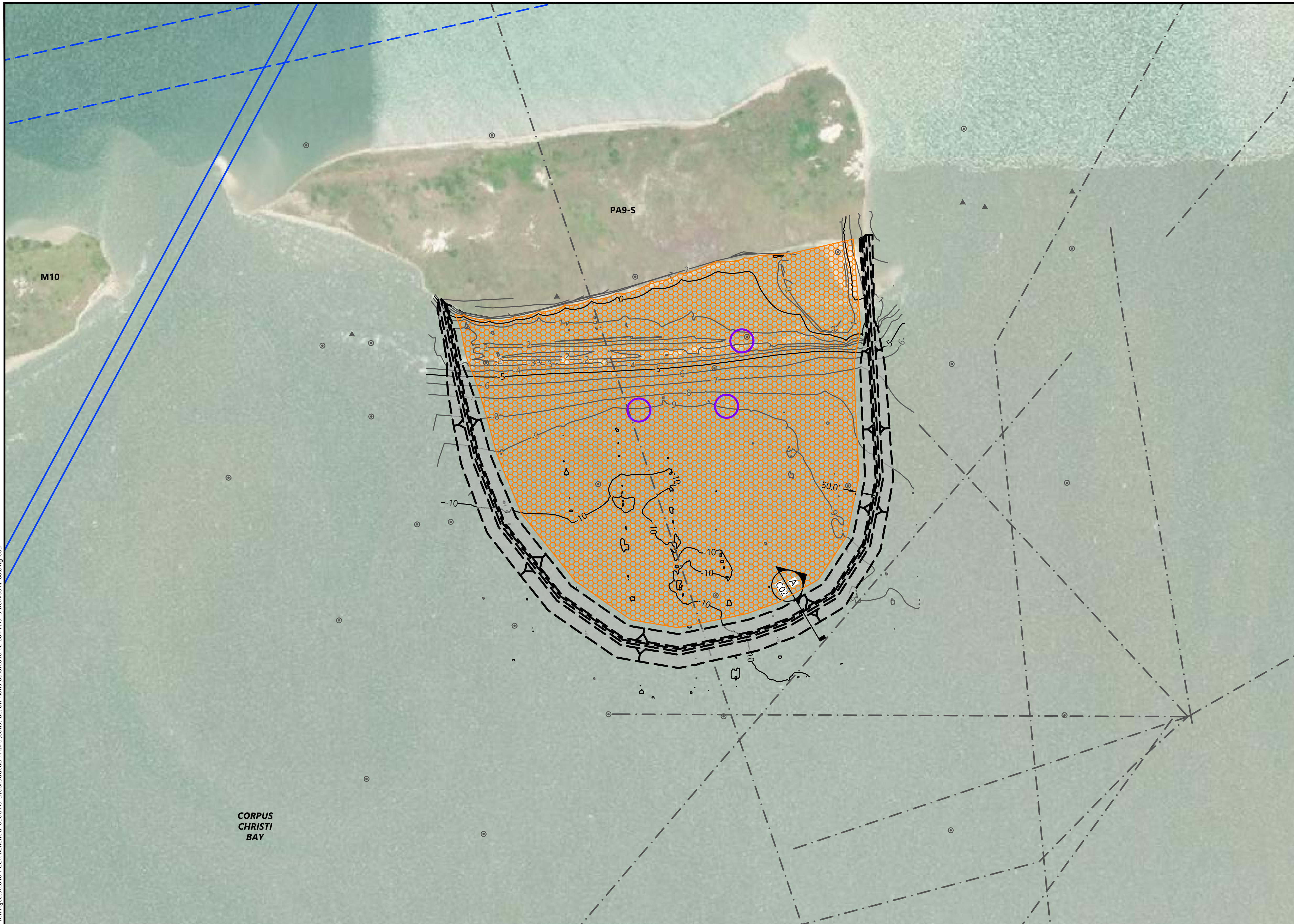
TEXAS LOWER COAST BENEFICIAL USE - PA9-S

PLAN VIEW

C02

SHEET # 4 OF 6



LEGEND:

- PROPOSED CONTAINMENT BERM
- GLO MAPPED PIPELINES
- RAILROAD COMMISSION OF TEXAS MAPPED OIL AND GAS INFRASTRUCTURE LOCATIONS
- DIRECTIONAL SURFACE LOCATION
- CORPUS CHRISTI SHIP CHANNEL
- GULF INTRACOASTAL WATERWAY
- -10- EXISTING CONTOUR (5')
- -3- EXISTING CONTOUR (1')
- VISUALLY IDENTIFIED OIL & GAS INFRASTRUCTURE
- BORROW AREA

N

0 400 800

SCALE IN FEET

NOTES:

1. HORIZONTAL DATUM: TEXAS STATE PLANE SOUTH ZONE, NAD83, U.S. SURVEY FEET
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3. BATHYMETRIC, TOPOGRAPHIC, AND VISUAL HABITAT SURVEYS CONDUCTED BY DUCKS UNLIMITED ON MARCH 01, 2022.
4. THE BORROW AREA WILL BE REFINED TO OFFSET FROM INFRASTRUCTURE

PLAN INTENDED TO BE VIEWED IN COLOR. ADJACENT BLOCK IS "BLUE"

ONE INCH AT FULL SIZE, IF NOT ONE INCH SCALE ACCORDINGLY

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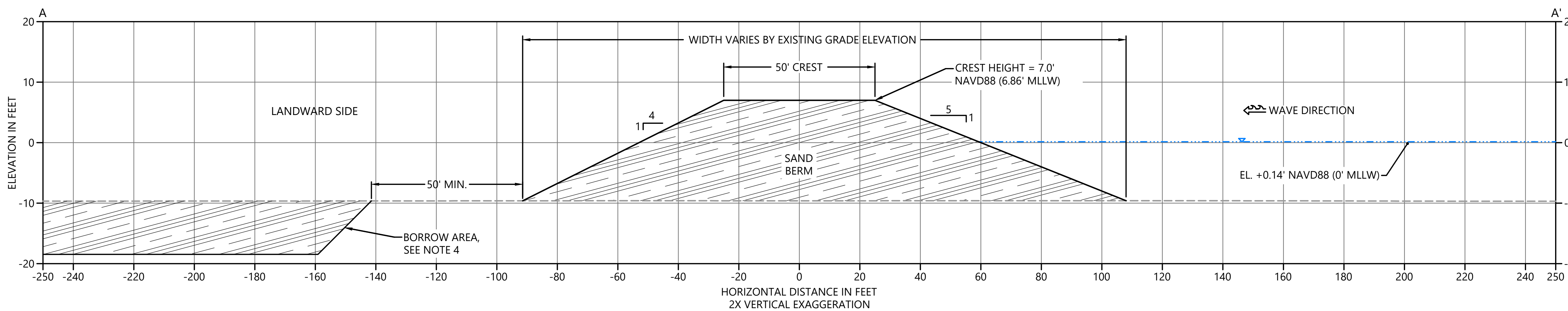
TEXAS LOWER COAST BENEFICIAL USE - PA9-S

BORROW AREA

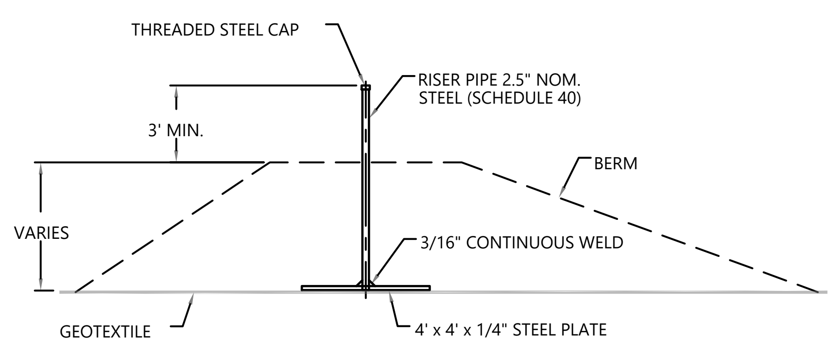
C03

SHEET # 5 OF 6



A C01 TYPICAL CONTAINMENT BERM SECTION

HORIZONTAL SCALE: 1" = 20'
VERTICAL SCALE: 1" = 10'



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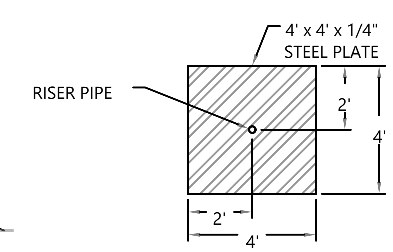

PLAN

PLAN AND SECTION VIEWS OF TYPICAL SETTLEMENT PLATE

NOT TO SCALE

NOTES:

1. HORIZONTAL DATUM: TEXAS STATE PLANE SOUTH ZONE, NAD83, U.S. SURVEY FEET
2. VERTICAL DATUM: NORTH AMERICAN VERTICAL DATUM OF 1988 (NAVD88)
3. BATHYMETRIC, TOPOGRAPHIC, AND VISUAL HABITAT SURVEYS CONDUCTED BY DUCKS UNLIMITED ON MARCH 01, 2022.
4. BORROW AREA DIMESIONS SHOWN FOR ILLUSTRATION PURPOSES ONLY. ACTUAL DIMENSIONS TO BE DETERMINED BASED ON FINAL DESIGN AND BY SELECTED CONTRACTOR.
5. NAVIGATION AIDS MUST BE PLACED ALONG THE CONTAINMENT BERM IN ACCORDANCE WITH TECHNICAL SPECIFICATIONS SECTION 35 12 00

PLAN INTENDED TO BE VIEWED IN COLOR. ADJACENT BLOCK IS "BLUE"

ONE INCH

AT FULL SIZE, IF NOT ONE INCH SCALE ACCORDINGLY

K:\Projects\2018-PCCA Beneficial Use\PA9-S\Construction Plans\Construction Plans_60%\2018 PL-003 PA9-S_BERM_60.dwg C04

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DATE: DECEMBER 2022

TEXAS LOWER COAST BENEFICIAL USE - PA9-S

TYPICAL CONTAINMENT BERM SECTION

C04

SHEET # 6 OF 6

Attachment 3
Technical Specifications

SECTION 35 12 10

AIDS TO NAVIGATION

PART 1 - GENERAL

1.01 SUMMARY

A. The Contractor shall furnish all labor, equipment, materials, and incidentals necessary to install permanent navigational markers as shown on the Construction Drawings as "Aids to Navigation" (ATON) and in accordance with the U.S. Coast Guard (USCG) marking determination (Appendix TBD). The Contractor shall also be responsible for installing and maintaining temporary navigational markers or lighted beacons during construction of the containment berm structures in accordance with applicable federal, state, and local laws, ordinances, and relevant permit requirements. The Contractor shall install at (at least X) (or, as necessary to identify maritime risks) temporary navigational markers. The Contractor shall remove the temporary navigational markers upon completing installation of the required permanent navigational markers.

B. The Contractor shall display signal lights and conduct operations in accordance with the General Regulations of the Department of the Army and of USCG as set forth in *Navigation Rules and Regulations Handbook 2014* and 33 Code of Federal Regulations (CFR) 84 through 33 CFR 89 (Inland), as applicable.

1.02 RELATED DOCUMENTS

A. Appendix TBD – USCG Marking Determination Package (point to appropriate appendix)

B. Section 01 20 00 – Measurement and Payment Procedures

C. Section 01 33 00 – Submittal Procedures

D. Section 01 35 43 – Environmental Protection

E. Section 35 33 00 – Containment Berm

1.03 REFERENCES

A. American Wood Preservers Association (AWPA): AWPA P5 – Standard for Waterborne Preservatives

B. USCG: USCG CFR, Title 33, Chapter 1, Parts 62, 64, and 66

C. *2022 AWPA* Book of Standards

1.04 SUBMITTALS

A. Before the Contractor orders ATON materials, the following shall be submitted in accordance with SECTION 01 33 00 − SUBMITTAL PROCEDURES:

1. Manufacturer's Data Sheets: The Contractor shall submit the manufacturer's data sheets for all permanent ATON, including buoys, lights, signs, reflective material, pilings, and any other material used for the ATON. The data sheets shall include the name of the manufacturer, product name, style number, and other relevant information to fully describe the ATON material.

B. The failure of the Contractor to obtain approval prior to ordering material shall be grounds for nonpayment.

PART 2 - PRODUCTS

2.01 MATERIALS

A. Temporary ATON

1. Warning Buoys – 1 nautical mile USCG-approved marine lanterns (TBD LED Rating), buoys with solar-powered, flashing white light with a flash period of 2.5 seconds (0.3 seconds on/2.2 seconds off)

B. Permanent ATON

1. Pilings: The contractor shall install X-foot-long, class X timber pilings, pressure treated with chromated copper arsenate at 2.5 pounds per cubic foot per AWPA U1.

2. Signs: The contractor shall install the signs indicated in the USCG Determination Package with the lettering "DANGER" in black text on white dayboard film background with a 2-inch orange retroreflective border. All hardware connecting the sign shall be hot-dipped galvanized or approved equal. Examples of USCG-approved signage are included in Appendix X.

3. Lights: The contractor shall install lights meeting the requirements described in Appendix X.

PART 3 - EXECUTION

3.01 INSTALLATION

A. Prior to installation, the Contractor shall determine if underground utilities exist in the proposed locations of the permanent ATON. The Contractor shall also verify water depths and bottom types at the locations.

B. As the work progresses, the Contractor shall install temporary or permanent ATON at the locations specified in Attachment M (Will point to appropriate Attachment) and Construction Drawings. Discrepancies between the coordinates designated on the USCG permit or Construction Drawings shall be reported to the Owner or its designated representative prior to installation.

C. The Contractor will place temporary ATON prior to construction and shall maintain the temporary ATON during construction until installation of the permanent ATON is complete. The contractor shall relocate temporary ATON by request of the Owner, Engineer, USCG, or USACE during construction without incurring additional cost to the Owner. The Contractor shall remove temporary ATON and install permanent ATON prior to final acceptance of the project. All temporary ATON will be considered property of the Contractor, and the Contractor shall take full responsibility for removal, transportation, storage, or proper disposal of the temporary ATON.

D. Timber piles shall be carefully handled with no sudden dropping, breaking of outer fibers, bruising, or penetration of the surface with tools. Piles damaged or not located in the proper location shall be withdrawn and replaced by new piles or shall be cut off at the mudline and additional piles installed as directed, without additional cost to the Owner.

E. Signs shall be installed so that the bottom of the signage is a minimum of 7 feet above the mean high water level and does not exceed 9 feet above the mean high water level. The Contractor shall shorten the pilings dictated by the normal mean high water mark in the project area, as necessary. Each sign shall be fastened with at least three 3/4-inch-diameter by 12-inch-long hot-dipped galvanized bolts and connected with a hot-dipped galvanized ogee washer, lock washer, and nut. Bolt holes shall be bored 1/8 inch larger than the diameter of the bolt.

F. If any damage occurs to permanent ATON placed during construction, the Contractor shall replace or repair the ATON at no cost to the Owner and at the direction of the Owner or its authorized representative.

END OF SECTION 35 12 10

SECTION 35 33 00

CONTAINMENT BERM

PART 1 - GENERAL

1.01 SUMMARY

A. The Contractor shall furnish all labor, equipment, materials, and incidentals necessary to install the containment berm as described herein and in the Construction Drawings. The work shall include, but is not necessarily limited to, excavation of sediment within the footprint of the Site to construct the PA9-S containment berm as shown in the Construction Drawings.

1.02 RELATED SECTIONS:

A. Section 01 20 00 – Measurement and Payment Procedures

B. Section 01 32 00 – Construction Progress Documentation

C. Section 01 32 23 – Surveys and Layout Data

D. Section 01 33 00 – Submittal Procedures

E. Section 01 35 43 – Environmental Protection

F. Section 35 12 10 – Aids to Navigation

G. Appendix X – USACE Permit

1.03 REFERENCES

1.04 SUBMITTALS

H. The following submittals shall be submitted in accordance with SECTION 01 33 00 – SUBMITTAL PROCEDURES: Requirements for Submittals

I. Construction Work Plan: Prior to the start of construction, the Contractor shall provide a Construction Work Plan containing, at a minimum, the following:

1. Work Sequencing and Equipment

   a. Order and sequence in which work shall be performed

   b. Number, type, and capacity of equipment to be used

   c. Hours of operation

   d. Estimated schedule

   e. Procedures for placing materials and confirming thicknesses and grades are met

2. Methods, Procedures, and Equipment addressing the following:

   a. Procedures for placing containment berm and confirming slopes and grades are met

   b. Placement and transportation of berm dredged material (including anticipated trip time and frequencies if barged

   c. Placement to distribute the load across the compressible foundation

   d. Survey and photography methods to monitor and control the work and progress surveys

e. Verification of minimum design template

f. Settlement monitoring and output format

J. Quality Control Surveys

a. During construction, the Contractor shall provide interim surface elevation surveys per SECTION 01 32 23 − SURVEYS AND LAYOUT DATA.

K. Daily Construction Report

a. The Contractor shall prepare and maintain a daily report of operations and furnish copies by noon the following day or as requested by the Owner as described in SECTION 01 32 00 − CONSTRUCTION PROGRESS DOCUMENTATION.

L. Stop Work

a. The Owner and/or Engineer may elect to stop work activities at the Site if the required submittals have not been submitted or are not of acceptable quality (as determined by the Owner or Engineer) and per the schedules specified herein in accordance with SECTION 01 33 00 − SUBMITTAL PROCEDURES. Any delays related to submittal approvals shall not allow the construction schedule to be extended and shall not be reason to increase the Contract price.

1.01 QUALITY CONTROL

A. Contractor will perform control surveys as specified in SECTION 01 32 23 – SURVEYS AND LAYOUT DATA.

PART 2 - PRODUCTS

2.01 CONTAINMENT BERM MATERIALS

A. General

1. Fill material may be acquired from the designated borrow area from within the Site as shown on the Project Drawings. The intention is to use the most suitable material obtainable from this source.

2. If the Contractor demonstrates and the Engineer concurs the borrow material is unsuitable for containment berm construction, the Engineer may modify the containment berm design or determine if suitable off-site materials should be used to complete berm construction. Changes in costs related to Engineer modifications to the berm template or the use of off-site material will be negotiated between the Owner and Contractor.

B. Material

1. Suitable fill material shall consist of an inorganic, granular soil containing between 0% and 12% material passing the No. 200 mesh sieve (sand having a Unified Soil Classification of SP or SP-SM).

2. Materials unsuitable for use as berm fill are defined as follows:

a. Material containing more than 2% organic matter (by dry weight)

b. Materials classified by the Unified Soil Classification System as PT, OH, OL, CH, MH, GM, GC, GW, and GP

c. Materials containing roots greater than 1 inch in diameter, logs, scrap lumber, metal objects, plastic and fiberglass objects, concrete construction refuse, and other anthropogenic debris

d. Materials containing brush, sod, organic, and other perishable materials

2.02 SOURCE QUALITY CONTROL

A. Testing and analysis of materials shall be performed in accordance with applicable ASTM standards.

PART 3 - EXECUTION

3.01 GENERAL

A. The Contractor shall perform a preconstruction survey via a third-party independent surveyor licensed in the State of Texas. Prior to the start of construction, the Contractor shall verify all existing elevations and grades and provide templates per SECTION 01 32 23 – SURVEYS AND LAYOUT DATA. The Contractor shall establish the baseline depicted and provide a layout for review before starting placement operations.

B. The Contractor shall construct the containment berm to the elevations and alignments shown on the Construction Drawings within the construction tolerances stated in these specifications.

C. Material that escapes or is lost while loading, transporting, or placing, or which is deposited in areas other than shown on the Construction Drawings or approved in writing by the Owner, shall be removed and redeposited at the Contractor's expense and at no additional cost to the Owner. If not removed and redeposited, misplaced material quantities shall be deducted from the final quantities for payment, and any penalties incurred by the Owner for misplaced material will be deducted from payment due to the Contractor.

3.02 CONTAINMENT BERM INSTALLATION

A. The Contractor shall install settlement plates prior to containment berm placement as shown on the Construction Drawings and described in Part 3.03 of this Section.

B. The subsurface sediments along the containment berm contain compressible sediments that will consolidate during and after construction. Due to the sediment consolidation, the contractor may be required to halt placement operations at certain locations and elevations and wait for the underlying sediments to consolidate before placing additional dredged material in the specified area. If applicable, the Engineer shall determine when the sediments have reached consolidation (based on Contractor field surveys) and when the Contractor can resume placement activities in the specified area. If the minimum lines and grades are not met (based on surveys and as directed by the Engineer), additional dredged material shall be placed by the Contractor.

3.03 Settlement Plates

A. Settlement plates shall be constructed with a 4-foot by 4-foot, 1/4-inch-thick steel plate with a 3-inch-diameter steel riser pipe attached to the center of the plate. The settlement plates shall be hot-dipped galvanized after fabrication. The riser pipe shall extend a minimum of 3 feet above the design elevation of the berm fill crest.

B. Settlement plates shall be placed prior to placing material for the containment berm at the locations detailed in the construction drawings. Plates shall be placed so that the riser pipe conforms to a vertical plumb standard of no more than 10.5° from true vertical. The riser pipe shall be marked with reflective tape or flagging.

C. During installation of the containment berm, the Contractor shall carefully place materials near the settlement plate and maintain the plates until completion of the project. After acceptance of the containment berm, the Contractor shall cut the riser pipe so it is 6 inches above the top of the constructed containment berm elevation.

D. Settlement plates shall be surveyed per SECTION 01 32 23 – SURVEYS AND LAYOUT DATA as follows:

1. Prior to dredged material placement for containment berm

2. After placement of dredged material placement for containment berm
3. Weekly during containment berm material placement
4. After cutting the riser pipe (as described in 3.03 C. of this Section)
5. Every two weeks after completing the containment berm material placement, for a minimum of 3 postconstruction survey data points

3.04 SURVEYS

A. All surveys shall be conducted in accordance with SECTION 01 32 23 – SURVEYS AND LAYOUT DATA.

3.05 TOLERANCES

A. Deviations in crest elevation from the design value shall not be greater than +0.5 foot. Deviations below crest elevations shown on Construction Drawings will be filled in accordance with this Section until either crest elevation or allowable deviation is achieved.

B. Transitions in alignments shall be smooth and shall be no more than a 1-foot horizontal change in a 20-foot length unless otherwise approved by the Owner and Engineer.

3.06 ACCEPTANCE

A. Acceptance will be based on the approved stone source, compliance tests, barge displacement surveys, and surveys performed by the Contractor per SECTION 01 20 00 – MEASUREMENT AND PAYMENT PROCEDURES and SECTION 01 32 23 – SURVEYS AND LAYOUT DATA. The Owner may perform field check tests and/or surveys to verify the Contractor's barge displacement and/or surveys. The Agency's survey checks will govern any discrepancies.

END OF SECTION 35 33 00

Attachment 4

Dredged Material Management Plan

Dredged Material Management Plan – PA9-S

The Dredged Material Management Plan for PA9-S provides guidance on placement of dredged material and postconstruction marsh management. Figures 1 through 3 are provided for informational purposes. The intent is to place fill at varying ranges to create a range of tidal marsh habitats.

Dredged Material Placement

The following details the recommended dredged material placement plan:

- The Contractor shall place dredged material in the marsh creation area as directed by the Engineer. The proposed method of placement shall be approved by the Engineer prior to commencement of work.
- Dredged material placement elevations during marsh creation will be determined by the Engineer. Based on surveys and site visits, the Engineer will direct the Contractor on placement areas and elevations. The intent of the placement is to create varying elevations of marsh within the marsh footprint and for final marsh elevations, after consolidation, to be between 1.5 to 3.5 feet North American Vertical Datum of 1988.
- The Contractor shall begin placing dredged material in accordance with the specifications and Contractor's approved work plan. Deviations will be approved on a weekly basis by the Engineer, based on the adaptive placement approach (finalized during final design) using the survey and aerial images to guide the decision process.
- The Contractor shall use a placement method and employ best management environmental control practices (finalized during final design) that can be adapted for placing dredged material in varying locations and elevations and that will minimize turbidity in the water discharged from the marsh placement area.
- If hydraulically placing dredged material, the Contractor shall limit its discharge rate as necessary for the proposed equipment, water depth, surface area, weirs (if applicable), and borrow material properties to prevent turbidity exceedances and weir and berm overtopping. Depending on the proposed discharge rate into the area by the Contractor, intermittent discharge may be required to prevent overtopping. Once established, the Contractor shall not overtop the containment berm with dredged material.
- At the completion of marsh creation and as directed by the Engineer, the Contractor shall complete the as-built survey of the constructed marsh.
- Allowable deviations in constructed marsh elevation will be dependent on the characteristics of the dredged material and determined by the Engineer. If no direction is given, the elevation deviations shall not be greater than +/-0.5 foot.

Postconstruction Management

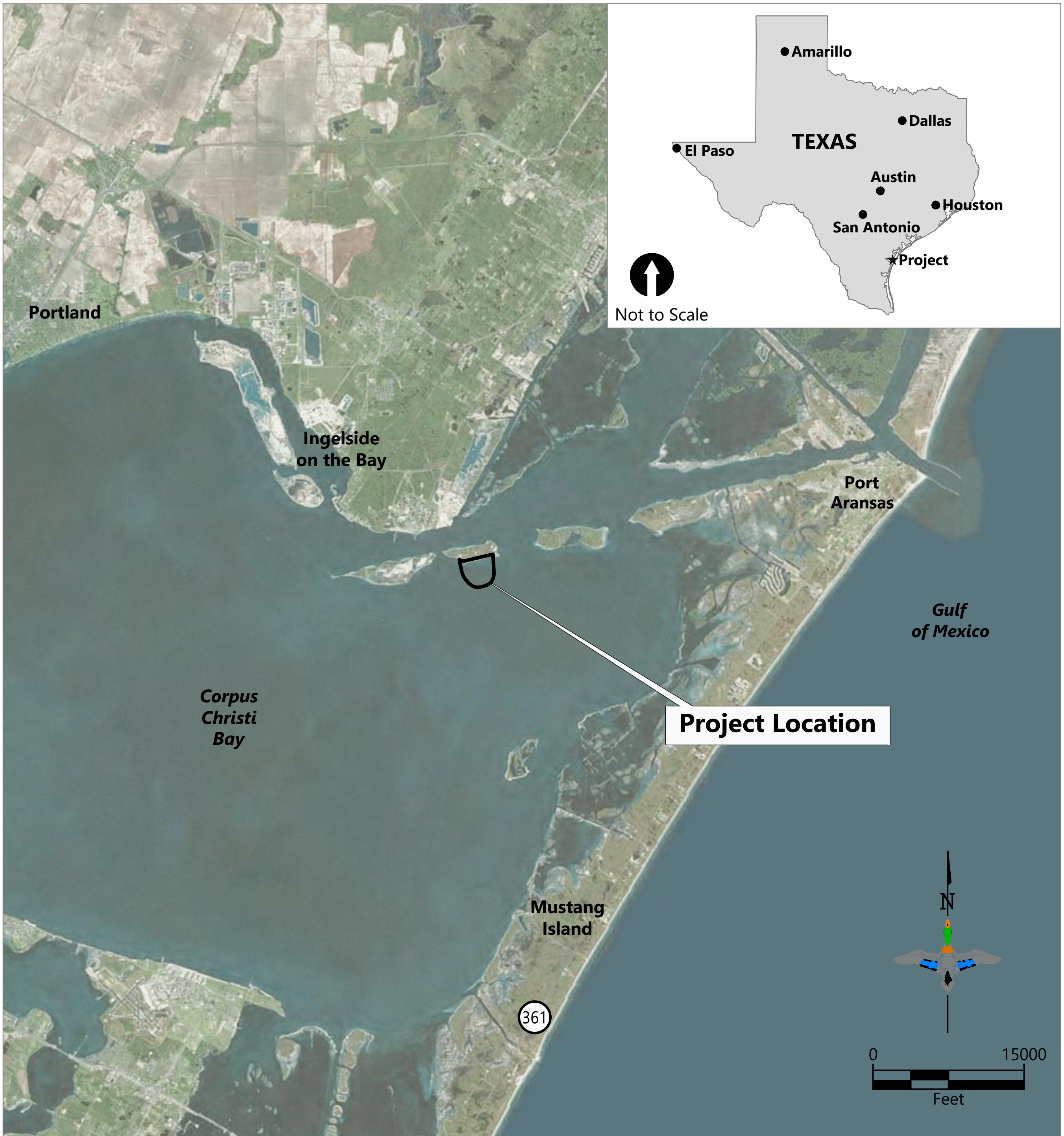
Once the Engineer determines marsh placement operations are complete, the Contractor shall begin the postconstruction management phase of the project as directed by the Engineer. It is the intent that all irregularities will be resolved on site with the Engineer and Contractor as the marsh fill is placed. Once the marsh postconstruction management component of the work begins, no further work will be done inside the fill area.

The Contractor shall monitor, maintain, and adjust the decant system or weirs as needed to decant water from the site to allow the dredged material to settle and consolidate. The Engineer will determine when postconstruction management is complete.

At the completion of postconstruction management and as directed by the Engineer, the Contractor shall remove any decant system or weirs if directed by Engineer. Degrading and breaching locations and elevations, if required, will be determined by the Engineer based on the last postconstruction management visit.

At the completion of this work item, and as directed by the Engineer, the Contractor shall complete the as-built survey of the constructed marsh.

Figures



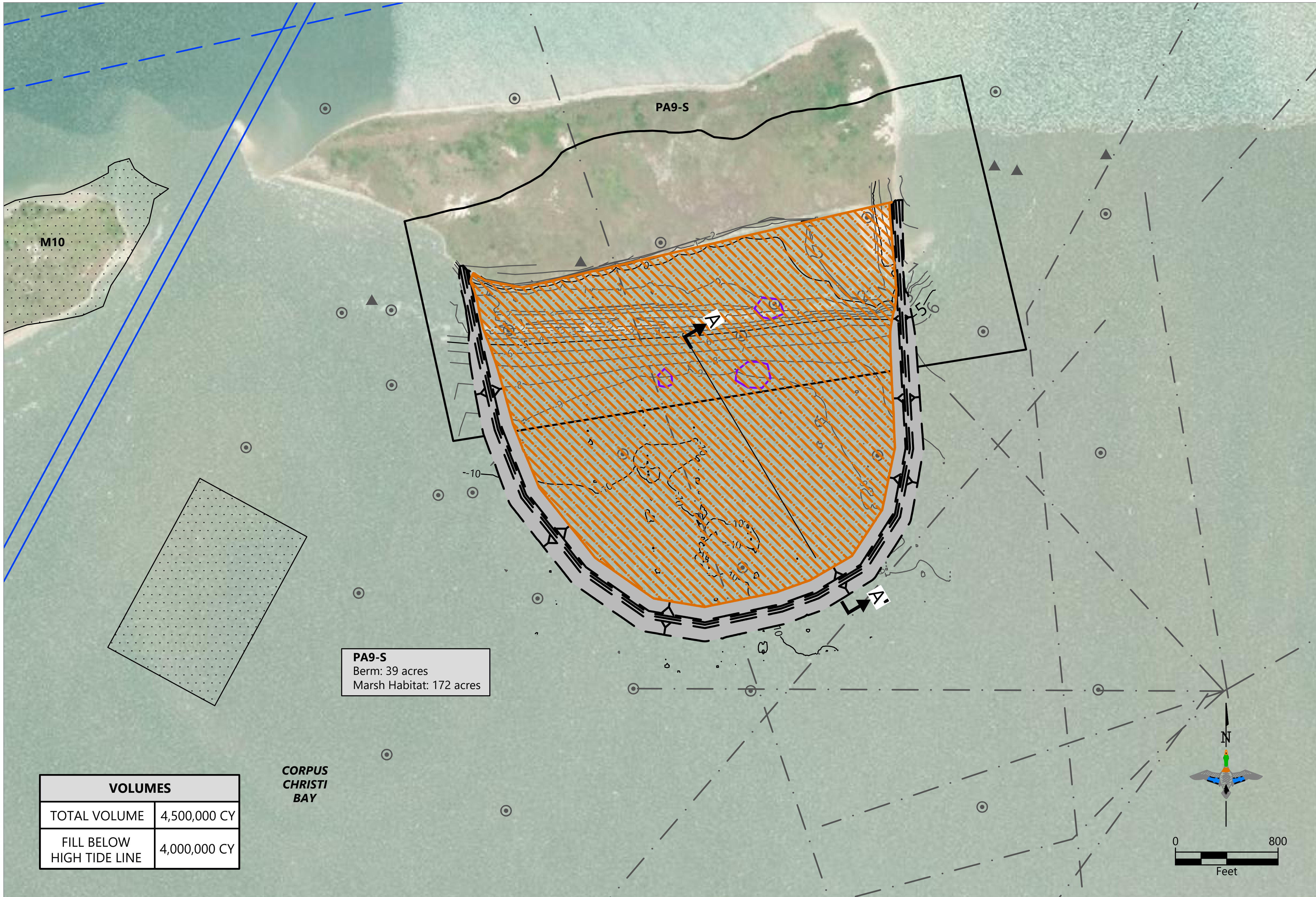
SOURCE: Aerial provided by Bing Maps.
HORIZONTAL DATUM: Texas State Plane South Zone,
North American Datum of 1983, U.S. Survey Feet

Publish Date: 2023/01/06 4:55 PM | User: mpratschner
Filepath: K:\Projects\2018-PCCA Beneficial Use\PA9-S\2018 RP-001 VIC MAP PA9_Attachment 3.dwg Figure 1

ANCHOR QEA

Figure 1
Vicinity Map

PA9-S Attachment 3
Texas Lower Coast Beneficial Use



VOLUMES	
TOTAL VOLUME	4,500,000 CY
FILL BELOW HIGH TIDE LINE	4,000,000 CY

LEGEND:

- PROPOSED CONTAINMENT BERM
- U.S. ARMY CORPS OF ENGINEERS PLACEMENT AREA
- GLO MAPPED PIPELINES
- RAILROAD COMMISSION OF TEXAS MAPPED OIL AND GAS INFRASTRUCTURE LOCATIONS
- DIRECTIONAL SURFACE LOCATION
- CORPUS CHRISTI SHIP CHANNEL
- GULF INTRACOASTAL WATERWAY
- -10- EXISTING CONTOUR (5')
- -3- EXISTING CONTOUR (1')
- VISUALLY IDENTIFIED OIL & GAS INFRASTRUCTURE
- DREDGED MATERIAL PLACED TO VARYING ELEVATIONS FROM 1.5' TO 3.5' NAVD88. SEE NOTE 4.

NOTES:

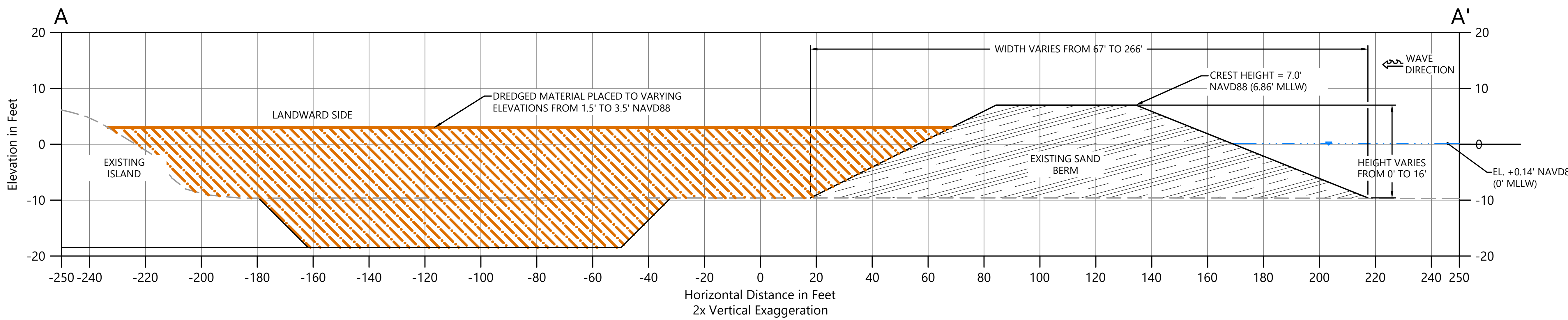
1. HORIZONTAL DATUM: TEXAS STATE PLANE SOUTH ZONE, NAD83, U.S. SURVEY FEET
2. VERTICAL DATUM: NORTH AMERICAN VERTICAL DATUM OF 1988 (NAVD88)
3. BATHYMETRIC, TOPOGRAPHIC, AND VISUAL HABITAT SURVEYS CONDUCTED BY DUCKS UNLIMITED ON MARCH 01, 2022.
4. ELEVATIONS ARE DEPENDENT ON THE MATERIAL PLACED.

Publish Date: 2023/01/06 4:55 PM | User: mpratschner
Filepath: K:\Projects\2018-PCCA Beneficial Use\PA9-S\2018 RP-002 PLAN VIEW PA9 _Attachment 3.dwg Figure 2

ANCHOR QEA

Figure 2
Plan View

PA9-S Attachment 3
Texas Lower Coast Beneficial Use



A Fig-2 TYPICAL MARSH FILL SECTION
HORIZONTAL SCALE: 1" = 40'
VERTICAL SCALE: 1" = 20'

NOTES:

1. HORIZONTAL DATUM: TEXAS STATE PLANE SOUTH ZONE, NAD83, U.S. SURVEY FEET
2. VERTICAL DATUM: NORTH AMERICAN VERTICAL DATUM OF 1988 (NAVD88)
3. BATHYMETRIC, TOPOGRAPHIC, AND VISUAL HABITAT SURVEYS CONDUCTED BY DUCKS UNLIMITED ON MARCH 01, 2022.

ANCHOR QEA

Figure 3
Typical Marsh Fill Section

PA9-S Attachment 3
Texas Lower Coast Beneficial Use

Memorandum

September 30, 2022

To: Melissa McCutcheon, Texas General Land Office

From: Todd Merendino, Ducks Unlimited, Inc.
Sarah Garza, Harrison McNeil, and Yvonne Dives-Gomez, Port of Corpus Christi Authority
John Laplante, Dan Opdyke, Renee Robertson, Alexander Freddo, and Hayden Smith, Anchor QEA, LLC
Jane Sarosdy, Sarosdy Consulting, Inc.
Ray Newby, Texas Department of Transportation

Re: Rabbit Island South Bird Island 60% Design Memorandum

Introduction

This 60% design memorandum describes design criteria and assessments associated with a beneficial use of dredged material (BU) project at the proposed Rabbit Island South site (Site), located in Texas General Land Office (GLO) Planning Region 4 of the Texas coast in the Upper Laguna Madre just outside Baffin Bay in Kenedy County, Texas (Figure 1). Photographs of the Site are in Attachment 1.

Project Background

GLO awarded a Coastal Management Program Project of Special Merit grant (funded through the Gulf of Mexico Energy Security Act) to Ducks Unlimited, Inc. (DU) to coordinate with stakeholders and identify restoration sites for BU. The Port of Corpus Christi Authority (PCCA), a project partner, has also contributed staff and financial resources to expand the project scope. The project team is led by DU and PCCA and includes Anchor QEA, LLC; Sarosdy Consulting, Inc.; and the Texas Department of Transportation. Collectively, the project team coordinated three stakeholder meetings with state and federal resource agencies, nongovernmental organizations, academia, consultants, and local officials in each region to solicit information about potential BU sites. Based on stakeholder input, GLO feedback, publicly available data, and professional judgment, the project team has developed 10% designs for 18 sites in GLO Planning Regions 3 and 4 of the Texas coast and 2 GLO-approved sites in Mesquite Bay and San Antonio Bay in GLO Planning Region 2. After completion of the 10% designs, 11 of the designs were selected to continue to 60% designs, and 7 of those designs were chosen for 60% designs and permit application packages. Based on the Site's restoration potential and construction feasibility, the project team selected the Site to proceed to 60% design, opinion of probable construction costs, and permit application packages using funding from the GLO Coastal Management Program Project of Special Merit grant.

Conservationists have identified the Laguna Madre and Baffin Bay as important locations for creating and restoring bird habitat (CBBEP 2020). Rabbit Island is a small island located on state-owned submerged land approximately 0.2 mile east of the Gulf Intracoastal Waterway (GIWW) in the Upper Laguna Madre just outside Baffin Bay in Kenedy County, Texas, and David Newstead with the Coastal Bend Bays and Estuaries Program has suggested it as a site for restoration. However, the Texas Parks and Wildlife Department (TPWD) seagrass data show that the existing Rabbit Island is surrounded by seagrass habitat (TPWD 2021), and the existing island also lies within U.S. Army Corps of Engineers (USACE) dredged material placement area (DMPA) #199, making it an unfavorable location for restoration. Therefore, the project team identified a different area for a new bird island nearby. The Site is approximately 1.2 miles south of the existing island, between DMPAs #199 and #200, where TPWD data do not indicate seagrasses. This area was selected because of the identified need for a secure and stable rookery island, its proximity to a sediment source in the existing DMPAs and adjacent shallows, its proximity to potential bird foraging areas, and its distance from upland-based predators.

Project Objectives

Frequent dredging is needed to develop and maintain Texas navigation channels. The dredged material is often deposited in DMPAs. While many of the existing DMPAs along the Texas coast are nearing capacity, those in the vicinity of the Site are not contained and effectively have unlimited capacity. Despite capacity not being a limiting factor, resource agencies and stakeholders have long advocated using dredged material beneficially to create and restore wetlands and bird islands, nourish beaches, and counteract land loss. Historically, BU projects are difficult to manage because they are multiyear, multifaceted undertakings in which different organizations manage dredging schedules, funding, project design, permitting, and construction activities. To help address these issues, the objectives of this project include the following:

- Create and restore degrading coastal habitats.
- Establish sites for placement of dredged material to reduce reliance on existing DMPAs.
- Improve coastal resiliency of the natural and built environment.

To accomplish these objectives, the project includes the following tasks:

- Stakeholder outreach and coordination
- Identification and selection of BU sites
- 10% designs and cost estimates for 20 BU sites
- 30% designs and cost estimates for 11 BU sites
- 60% designs, cost estimates, and permit application packages for 7 BU sites

This memorandum documents the 60% design and cost estimate for the Site.

Design Objectives

The Site will be designed to beneficially use dredged material to create a rookery island in a region with scarce or degrading coastal bird habitat. During the initial dredging of the GIWW, side casted new work dredged material was left along the edge of the channel. The native material and dredged material that remain from the original construction of the GIWW (termed "relict new work materials" in this memorandum) are considered to have superior structural properties relative to maintenance dredged material (Morton et al. 2001) and, hence, are the target sediment source for this design. The Site is expected to take advantage of this unique opportunity for mining favorable rookery island material in the area and use material dredged from existing relict new work material inside the adjacent shallows. Although it is possible this project may not use maintenance dredged material, it can still be considered a BU project because it is expected to take advantage of dredging equipment for which the mobilization and demobilization costs are paid by USACE during placement of material in the interior of the rookery island. This 60% design is based upon publicly available datasets, stakeholder recommendations, and focused field work conducted by DU.

Design objectives include the following:

- Develop a preliminary vision based on available data for the Site that includes the following:
  - Habitat to be created or restored
  - Potential sediment source(s)
  - Approaches to minimize long-term maintenance costs, while providing adequate erosion protection and containment
- Delineate conceptual footprints for proposed BU placement.
- Identify key sensitive habitats and construction considerations in the vicinity of the Site.
- Create rookery habitat, while generating net positive impact to seagrass habitat
- Estimate fill volumes for the proposed BU footprints.
- Identify data gaps to be addressed in subsequent design phases.
- Provide preliminary cost estimates.

Stakeholder Feedback

The 30% design for the Site was presented at the Lower Coast Beneficial Use Planning Region 3 Stakeholder meeting on June 14, 2022. Attendees included staff from GLO, USACE, TPWD, the

Coastal Bend Bays & Estuaries Program (CBBEP), the U.S. Fish and Wildlife Service (USFWS), local officials, and other professionals.

Some comments from this meeting, as well as written comments on the 30% designs, follow:

- USFWS recommended filling the Site to +5 feet North American Vertical Datum of 1988 (NAVD88), rather than the +4 feet NAVD88 proposed in the 30% design, to provide additional protection to the rookery during nesting season from overtopping during storm events.
  - The design team increased the target elevation in the center of the Site to +5 feet NAVD88 to provide additional protection to the rookery from overtopping during storm events during nesting season.
- USFWS and CBBEP recommended planting preferred plant species on the edge of the island to help stabilize the shoreline.
  - The design team has considered this as an option. The planting would need to be evaluated in future phases of design and coordinated with the project proponent to determine project cost impacts, as well as the impact they may have on the bird species that would colonize the Site.
- The National Marine Fisheries Service recommended performing a submerged aquatic vegetation (SAV) survey during peak SAV growing season.
  - The design team agrees any additional SAV surveys should be performed during peak growing season.
- Conversations with USACE indicated that material and placement within DMPAs along the GIWW would have implications to their ongoing operations and maintenance.
  - The design team has removed any design features that were inside or impacted the USACE permitted DMPAs adjacent to the Site.

The comments above represent the key issues brought forward to the project team. Other comments, generally more minor and easily addressed, are not included in this list. When feasible, comments have been incorporated into the 60% design, as noted above and in the below sections, and others may be addressed in the final design.

Existing Data Review

A review of existing data and the focused data collected by DU was performed to develop the Site and containment berm designs. This section describes the data reviewed and collected to support the 60% design.

Horizontal and Vertical Datums

The horizontal datum used for the Site is the Texas State Plane South Zone, North American Datum of 1983 in U.S. survey feet. The primary vertical datum used for the Site design is the NAVD88. The National Oceanic and Atmospheric Administration (NOAA) maintains an active tide gage within the vicinity of the Site. The NOAA Baffin Bay, TX Station 8776604 (Baffin Bay Station) is 5 miles north of the Site. The Baffin Bay Station only lists the Mean Sea Level (MSL) tidal datum due to the minimal tidal variation in this region of the Laguna Madre. The vertical datum from this station that will be used for the Site is shown in Table 1. The NOAA USS Lexington Station, Corpus Christi Bay, TX Station 8775296 was also used to define a preliminary design water level, as described in the Water Level section.

Table 1
Baffin Bay Station Tidal Datum

Tidal Datum	Elevation (feet NAVD88)
MSL	0.48

Meteorological, Ocean, and Wave Data

Water Level

To determine an approximate design water level elevation for the Site, water level data from the Baffin Bay Station were analyzed for the period from January 2010 to November 2021 to calculate the highest yearly tides. For the purposes of this analysis, tides resulting from tropical storm events were excluded. As a result, the high tide line was determined to be 2.15 feet NAVD88.

To determine the water level during island overtopping events, the water level data from the Baffin Bay Station could be separated into months, and the water levels during months critical to target rookery nesting could be further evaluated to refine the rookery island elevation during subsequent design phases.

This water level was used for a preliminary understanding of the wave growth at the Site, and a more comprehensive analysis based on historical water levels at the Baffin Bay Station may be used during subsequent design phases.

Wind and Waves

USACE Wave Information Studies (WIS) provides a national resource of long-term wavefield climatologies for U.S. coastal waters that synthesizes observations, multidecade hindcasts, and storm event archives (USACE 2021). The WIS station closest to the Site is Station 73032, just offshore on the Gulf side of North Padre Island in the Gulf of Mexico. Because the station is located offshore, the wave data are not applicable to this project design. However, the project team considers the wind data to be representative of the winds experienced at the Site. Figure 2 summarizes wind data from January 1, 1980, through December 31, 2014. The data indicate that the predominant wind direction is from the southeast, with significant winds also coming from the north, northeast, east, and south.

The Coastal Engineering Design and Analysis System (CEDAS) Automated Coastal Engineering System (ACES) tool was used to calculate the wave growth over the restricted shallow-water fetch from the southeast and north (Leenknecht et al. 1992a). These two directions were selected because each exhibits significant winds over long, restricted fetch distances. Inputs for the ACES tool consist of the items described in the following subsections.

North Wind

- The main wind direction was input to be from 0° clockwise from the north.
- The average depth along the fetch in the north direction was input as 5.6 feet (based on a conservative water surface elevation of 2.18 feet NAVD88 (NOAA 2021).
- The fetch length for the north wind direction was input as 6.25 miles.
- The observed wind speed was input according to the WIS station extreme value analysis in which return periods and their wind speeds were predicted inside a ±22.5° bin from 0°. (The 0° bin is represented by all winds measured from the 337.5 to 22.5° wind direction.)

Southeast Wind

- The main wind direction was input to be from 135° clockwise from the north.
- The average depth along the fetch in the southeast direction was input as 4.5 feet (based on a conservative water surface elevation of 2.18 feet NAVD88 (NOAA 2021).
- The fetch length for the southeast wind direction was input as 3.37 miles.
- The observed wind speed was input according to the WIS station extreme value analysis in which return periods and their wind speeds were predicted inside a ±22.5° bin from 135°. (The 135° bin is represented by all winds measured from the 112.5° to 157.5° wind direction.)

Common Inputs

- The elevation of observed wind was 10 meters (Leenknecht et al. 1992b)
- The temperature difference between the air and sea was input as 0°F.
- The duration of the observed wind and duration of the final wind are from the hindcasted time interval associated with the WIS data recordings and input as 1 hour.
- WIS Station 73032 is at 27.1° latitude observing over water.
- The fetch option most associated with the Site is shallow restricted, meaning that the wind-wave generation is impacted by the geometry of the Site and where wind is measured traveling from a point along the shoreline to the point of interest (Leenknecht et al. 1992b)
- The number of angles was input as three, with a radial angle increment as 10°. This results in the direction of the first radial fetch to be 10° less than the predominant wind direction from both the north and southeast (350° and 125°, respectively), the second radial fetch to be the predominant wind direction from both the north and southeast (0° and 135°, respectively), and the third radial fetch to be 10° more than the predominant wind direction from both the north and southeast (10° and 145°, respectively). This approach forces the ACES tool to

correctly calculate the wave growth across the desired main wind direction angle of 0° and 135°.

The predicted wave height growth from the north and southeast wind directions is shown in Tables 2 and 3, respectively.

Table 2
CEDAS ACES Predicted Wave Height Growth in the North (0°) Wind Direction

Wind Direction	Fetch Distance (miles)	Return Period (years)	Wind Speed (mph)	Wave Height (Hmo, feet)[1]	Wave Period (Tp, s)[2]
North 0° (337.5°–22.5°)	6.25	1	33.0	1.57	2.61
		2	38.6	1.77	2.82
		10	43.2	1.94	2.98
		20	44.6	1.99	3.02
		50	46.3	2.04	3.08
		100	47.4	2.08	3.11

Notes:
1. Wave heights are determined from spectrally based methods (Hmo; Bretschneider and Reid 1954).
2. Wave periods are determined from spectrally based methods (Tp; Bretschneider and Reid 1954).

mph: miles per hour
s: seconds

Table 3
CEDAS ACES Predicted Wave Height Growth in the Southeast (135°) Wind Direction

Wind Direction	Fetch Distance (miles)	Return Period (years)	Wind Speed (mph)	Wave Height (Hmo, feet)[1]	Wave Period (Tp, s)[2]
Southeast 135° (112.5°–157.5°)	3.37	1	27.5	1.08	2.08
		2	30.9	1.19	2.20
		10	44.1	1.62	2.62
		20	51.0	1.82	2.82
		50	61.1	2.09	3.08
		100	69.3	2.30	3.27

Notes:
1. Wave heights are determined from spectrally based methods (Hmo; Bretschneider and Reid 1954).
2. Wave periods are determined from spectrally based methods (Tp; Bretschneider and Reid 1954).

Wind-generated waves from the predominant north and southeast wind direction were calculated to inform the approximate wave climate at the Site. One-year return period winds generated waves no greater than 1.16 feet. A more detailed hydrodynamic model analyzing the direction and frequency of expected significant wave heights may be developed during subsequent phases of design.

Wake Erosion

The GIWW is approximately 0.14 mile west of the Site. Several types of vessels, including recreational and commercial vessels and commercial tugboats and barges, operate in the GIWW and generate wake waves that propagate to the Site. Like wind-generated waves, vessel wake waves produce the greatest erosive forces in the region where the waves break (i.e., the surf zone).

The Bhowmik et al. (1991) and Weggel and Sorensen (1986) vessel-generated wave prediction methods—based on vessel dimensions, travel speed, and distance between the sailing line and Site—were used to evaluate the range of vessel-generated waves for a conservative selection of representative vessels known to operate in the area. A sport yacht with a draft of 4 feet was selected to evaluate recreation vessel wakes generated by vessels traveling near the proposed Site. A generic tugboat with maximum dimensions recorded in the Automatic Identification System (AIS) database was selected, along with a similar tugboat transiting with twin barges (identified using Google Earth imagery of ports in the region) to evaluate the commercial vessel wakes generated by vessels traveling in the GIWW. Calculation of the sport yacht's maximum vessel wakes, traveling at varying speeds along the nearest edge of the GIWW 750 feet from the Site, can be seen in Table 4. Calculation of the tugboat and tugboat with twin barges maximum vessel wakes, traveling in 14 feet of water at varying speeds up to 11 miles per hour (mph; considered conservative) along the nearest edge of the GIWW 750 feet from the Site, can be seen in Table 5.

These wave heights are smaller than the predicted wind-generated wave heights at the Site; thus, wind-generated waves will be considered the predominant erosive force for design evaluations. The vessel wakes are limited to vessels traveling on the edge of the GIWW. This assumption likely holds for commercial vessels, but further analysis should be conducted to understand the frequency and distance recreational vessels travel near the Site. Additional analysis surrounding a variety of recreational vessel drafts and speeds may be considered in future design phases.

Table 4
Sea Ray Sundancer Sport Yacht Maximum Vessel-Wake Calculations at Various Speeds

Vessel	Length (feet)	Draft (feet)	Vessel Speed (mph)	Maximum Wave Height (feet)	Wave Period (s)
Sport yacht Sea Ray Sundancer	51	4	6.7	0.92	1.21
			15	0.70	1.05
			25	0.59	0.96
			35	0.52	0.91
			45.4	0.48	0.87

Note:
Maximum wave heights were calculated using Bhowmik et al. (1991), in which vessel speeds ranged from 6.7 to 45.4 mph.

Table 5
Tugboat and Tugboat with Twin Barges Maximum Vessel-Wake Calculations at Various Speeds

Vessel	Length (feet)	Beam (feet)	Draft (feet)	Vessel Speed (mph)	Maximum Wave Height (feet)	Wave Period (s)
Generic tugboat with maximum dimensions recorded in AIS data[1]	87	33	11	3	0.00	8.40
	87	33	11	5	0.00	5.04
	87	33	11	7	0.00	3.60
	87	33	11	9	0.09	2.80
	87	33	11	11	0.69	2.29
Generic tugboat with maximum dimensions recorded in AIS data and twin barges[2]	387	110	11	3	0.00	7.31
	387	110	11	5	0.00	4.38
	387	110	11	7	0.00	3.13
	387	110	11	9	0.00	2.44
	387	110	11	11	0.96	2.29

Notes:
Maximum wave heights were calculated for vessels traveling within Froude number boundaries and at 3. 5, 7, 9, and 11 mph (Weggel and Sorensen 1986).

1. Vessel hull geometric coefficients were input using a tugboat from Hay (1967).
2. Vessel hull geometric coefficients were input using a barge from Hay (1967).

Bathymetry and Topography

DU conducted bathymetric and topographic surveys at the Site on March 23, 2022. The Site footprint consists of mostly open-water shallows with small upland remnants containing shell hash and vegetation. The Site footprint has an average seabed elevation of -1.4 feet NAVD88 and slopes steeply down to deeper water surrounding the Site at approximately -4.0 feet NAVD88. The Site contours range from -4.6 to +2.9 feet NAVD88. During the survey, DU conducted sediment probing in 35 areas of the Site. The minimum and maximum probing distance to substrate refusal was 0.03 and 1.02 feet, respectively, with an average distance to refusal of 0.31 feet. Within those areas, it was qualitatively determined that the material was firm throughout and is not expected to have substantial settling.

Utilities and Infrastructure

The Railroad Commission of Texas public GIS viewer (RRC 2021) and GLO pipeline data (GLO 2021a) were used to identify mapped utilities and pipelines near the Site. Three dry holes were identified within a 1-mile radius and are not expected to impact design and construction (Attachment 2, C01). No utilities or pipelines were identified near the Site. The need for Site-specific utility locations prior to construction will be determined during subsequent design phases. No other infrastructure has been identified in the vicinity of the Site.

A preliminary investigation was conducted for utilities identified within the Texas 811 database by submitting a ticket (No. 2275118006) for the proposed work. The following response was received:

- Williams Gas Pipeline: Transco
  - Response on September 9, 2022: clear

This preliminary investigation is not sufficient to clear the Site for construction and excavation. Further investigation into underground and aboveground utilities must be conducted prior to construction of this project.

Desktop Cultural Resources Survey

A search of cultural resources records in the Texas Historical Commission Texas Historical Sites Atlas Database was completed for the Site on December 16, 2021. This search revealed there may be a cultural resource close enough to the Site to warrant further investigation. No archaeological surveys have been conducted within the preliminary proposed placement Site boundary (THC 2021). It is anticipated that the Site will not disturb the cultural resource, however, additional locations, investigations, and coordination are recommended during subsequent design phases and prior to construction if this excavation area is used.

Sensitive Habitat

GLO oyster habitat GIS data (GLO 2021b) and visual surveys conducted by DU on March 23, 2022, do not indicate oyster habitat within or adjacent to the Site. Due to high salinity levels, oyster habitat is not expected to be located near the Site; however, a more extensive oyster survey may need to be conducted during a future phase of design based on agency requirements.

The visual survey conducted by DU on March 23, 2022, indicated scattered seagrasses surrounding the excavation areas and along the Site from approximately the shoreline to -4 feet MSL (-3.41 feet NAVD88; Attachment 2, C01). Seagrasses were identified visually in shallow water and assumed to be present in deeper water where water appeared dark. Based on the visual survey, approximately 2.1 acres of seagrass habitat is in the Site footprint. Per the National Marine Fisheries Service's recommendation, a more extensive seagrass survey may need to be conducted during the late summer peak seagrass growing season to support a subsequent phase of design.

Bird Species

The USFWS Information for Planning and Consultation (IPaC) tool was used to identify listed species and migratory birds within a 460-square-mile region around Baffin Bay and a portion of North Padre Island (USFWS 2021). Table 6 includes some of the protected and migratory bird species present near the Site and their preferred habitat, as explained in *Guide to North American Birds* (Audubon 2021a). At this time, no target species or list of species, has been identified for the Site. Brown pelicans, reddish egrets, and great blue herons (*Ardea herodias*) were observed on the upland of Excavation Area – Alternative 3 and the shell hash ridge of the Site during the DU Site survey on March 23, 2022.

Table 6
USFWS IPaC Species Information[1]

Species	Status	Preferred Habitat[2]
Whooping crane (*Grus americana*)	Endangered	Prairie pools, marshes, and coastal marshes
Piping plover (*Charadrius melodus*)	Threatened	Sand beach dunes and expansive sand or mudflats
Red knot (*Calidris canutus*)	Threatened	Mudflats, tidal zones, and sandy beaches
American oystercatcher (*Haematopus palliatus*)	Migratory	Strictly coastal; dunes, islands in salt marsh, dredge spoil islands, sandy beaches, and tidal mudflats
Black skimmer (*Rynchops niger*)	Migratory	Sandy islands, shell beaches, open beaches, lagoons, estuaries, inlets, and sheltered bays
Brown pelican (*Pelecanus occidentalis*)	Migratory	Bare, rocky, mangrove- or tree-covered islands; salt bays, beaches, and oceans
Gull-billed tern (*Gelochelidon nilotica*)	Migratory	Beaches, islands, salt marshes, fields, and coastal bays
Marbled godwit (*Limosa fedoa*)	Migratory	Northern Great Plains, native prairie with marshes or ponds, pools, shores, marshes, and tidal flats
Reddish egret (*Egretta rufescens*)	Migratory	Red mangrove swamps, arid coastal islands covered with thorny brush, coastal tidal flats, salt marshes, and lagoons
Ring-billed gull (*Larus delawarensis*)	Migratory	On ground near water with sparse plant growth, lakes, bays, coasts, piers, dumps, and plowed fields
Royal tern (*Thalasseus maximus*)	Migratory	Low-lying sandy islands, coasts, lagoons, salt bays, and estuaries
Wilson's plover (*Charadrius wilsonia*)	Migratory	Dry part of beach, near conspicuous object, coastal regions, open beaches, tidal flats, estuaries, and sandy islands

Notes:

1. USFWS IPaC information (USFWS 2021) is provided for a 460-square-mile region around Baffin Bay and a portion of North Padre Island highlighting endangered, threatened, and migratory birds and their preferred habitat.
2. Habitat information is from the Audubon Guide to North American Birds (Audubon 2021a) and includes preferred nesting and general habitat.

Erosion

Google Earth imagery indicates the Site is becoming submerged over time and has lost approximately 1 acre of upland from 1995 to 2016. This is consistent with documentation from

CBBEP, which notes the North Padre Island shorelines are at high risk due to erosional forces (CBBEP 2020).

Beneficial Use Source Material

The proposed source material for the Site may consist of existing relict new work material excavated from inside the Site (borrow area), material from adjacent shallows west of the Site (excavation area), and material from dredging the GIWW (0.2 mile west of the Site). USACE has historically performed GIWW maintenance dredging near the Site (USACE and ICT 2002) and continues to dredge the area (Jones 2021).

The proposed design includes constructing the containment berm primarily using material from the onsite borrow area by dredging down to -15 feet NAVD88, and the remaining material needed for construction can be excavated from the adjacent excavation area shown in Attachment 2, C02. These areas are composed of deltaic deposits of the Pleistocene Beaumont Formation or the Holocene Rio Grande delta that were dredged and placed during the original construction of the GIWW. This material has been shown to be more stable than recent maintenance dredged material (Morton et al. 2001).

The GIWW maintenance dredged material will be used to provide the interior fill and seagrass habitat creation shelf (seagrass shelf) for the Site. The quantity and characteristics of GIWW dredged material that may be available for placement at the Site are shown in Tables 7 and 8. There are four potential USACE DMPAs in the USACE Laguna Madre Dredged Material Management Program Reach 2 (DMPAs 192 through 202; USACE and ICT 2002) that are within 3 miles of the Site. The nearby DMPAs have historically been used approximately every 3 years with a total per-cycle dredging of 607,291 cubic yards (CY; Table 7, USACE and ICT 2002). Most of the dredged sediment appears to be clay and silt (Table 8). Based on more recent communications with USACE, the Gulf Intracoastal Waterway: Corpus Christi to Port Isabel dredging contract occurs every 1-2 years, which could be a source of dredged material for the Site (Neil, 2022).

Table 7
USACE DMPA Areas Along the GIWW Near the Site

DMPA No.	Channel Reach	Distance from Site to DMPA (miles)	Per Cycle Dredging (CY)
198	2	2.1	132,755
199	2	0.7	140,854
200	2	0.9	156,537
201	2	3.0	177,145
		Total	**607,261**

Note:
Source: USACE and ICT (2002)

Table 8
Typical Sediment Characteristics Across the GIWW in USACE DMMP Reach 2

Sediment Characteristics Across Laguna Madre Reach 2 (DMPAs 192–202)
23.5% sand
45.5% silt
31.1% clay

Note:
Source: Neill (2022)

DU collected five surface sediment grab samples: one near the middle of the Site, two north of the Site inside of DMPA #199, one north of the Site on an upland ridge, and one south of the Site inside DMPA #200. Only two grab samples are shown in Attachment 2, C01 (Grab 2) because communications with USACE have indicated harvesting material from inside a DMPA is unlikely to be authorized (because removing material from DMPAs could promote future migration of dredged material back into the GIWW, thereby increasing USACE's dredging costs). During this sampling event, organics, inorganics, conventional geotechnical parameters, and gradations were not analyzed in a laboratory. The surface samples are not necessarily representative of the material below the surface sediments. A visual inspection of the surface grab material shows varying characteristics (Table 9). Further sampling and testing would be needed to more precisely describe this material and gauge its utility for construction. Nevertheless, Table 9 shows a qualitative description for two of the surface grabs that could be representative of material that could be used for the project.

Table 9
Qualitative Description of Surface Sediment Grab Collected During Site Inspection

Grab Number	Latitude (N)	Longitude (W)	Qualitative Descriptions
1	27.232618	97.416819	Mostly coarse grained with shell Approximately 5%–10% fines
2	27.230739	97.417912	Mostly fines with organics Silty, non-cohesive material

Note:
Grab sample was collected by DU on March 23, 2022.

60% Design

The main design elements evaluated for the Site are as follows:

- Site location
- Rookery island size and shape

- Containment and erosion protection
- Constructability
- Planting and natural recruitment of vegetation
- Performance expectations
- Site construction cost estimate
- Expected ecosystem benefits
- Data and information gaps

These design elements are evaluated in this memorandum for the 60% Site design.

This project is planned to be constructed in two phases. Phase 1 will include the construction of the containment berm, while Phase 2 will be the placement of dredged material within the berm and construction of the seagrass shelf outside the containment berm on the east side of the Site. The first phase is expected to be paid for and contracted by the project owner. Accordingly, for Phase 1, this memorandum includes 60% construction drawings (Attachment 2), which provide details for the containment berm construction, and technical specifications (Attachment 3). The second phase is expected to be paid for by the project owner but contracted by the entity funding the dredging itself (e.g., USACE). Because USACE (or another entity) will be directing the dredger, the entity will provide the dredger with its technical specifications and will work the beneficial use aspect of the dredging project into its drawings. As a result, it is not useful to prepare 60% construction drawings and technical specifications for Phase 2. Rather, a Dredged Material Management Plan (DMMP) that provides design details on the placement of dredged material for the interior of the Site was developed (Attachment 4). It is expected that USACE (or another entity) will incorporate the DMMP into the construction drawings and technical specifications it has with the dredger. This will ensure the BU design grades and project objectives are achieved.

Site Location

The proposed location of the Site is approximately 0.2 mile east of the GIWW and between DMPAs #199 and #200. The original Site location was selected to avoid encroaching on those areas, as well as on potentially dense seagrass habitat at the existing Rabbit Island location (as indicated by TPWD seagrass data). However, based on visual DU surveys, there is seagrass surrounding the Site from approximately the shoreline to -4 feet MSL (-3.41 feet NAVD88; Attachment 2, C01).

The proposed Site is approximately 0.7 mile from the nearest shoreline. This distance is above the 0.5-mile distance identified for minimizing predator access to rookery islands (Stanzel 2018).

The Site is currently located on mounded, upland ridges of relict new work material that provides shallow water with a seabed elevation that averages -1.4 feet NAVD88 (-1.77 feet mean lower low water [MLLW]). The existing upland ridges are small with minimal to no vegetation and do not support significant bird populations. There are areas with average seabed elevations above -1.0 foot

NAVD88 immediately adjacent to the east side of the proposed seagrass shelf that are anticipated to act as a natural wave-energy dissipator and reduce erosive forces.

Rookery Island Size and Shape

Based on availability of sediment, a cost analysis, and stakeholder feedback, the project team proposes the rookery be approximately 10 acres. This 60% design represents a bird island at the upper range of bird island sizes desired, based on stakeholder input. Seagrass constraints may limit the size of island ultimately constructed, but at this level of design, it was decided to consider a site at the upper end of the range identified by stakeholders.

The purpose of the project is to create a range of coastal bird habitat in the near term. Therefore, the Site will be filled with GIWW maintenance dredged material placed to an elevation of +5.0 feet NAVD88 and will be approximately elliptical in shape (Attachment 4, Figures 2 and 3). Fill elevations were selected to promote natural recruitment of vegetation and provide habitat for a range of bird species. The fill elevation could be adjusted at further phases of design, depending on the physical properties of the dredged material or if target vegetation or bird species are identified. The fill elevations were also designed to provide some protection from overtopping during higher tide and storm events. A strategy to accommodate relative sea level rise (RSLR) could be to place BU material to higher elevations in preparation for higher tidal elevations associated with RSLR; however, this would incur higher costs. The impacts of RSLR may also be managed in the future through adaptive management strategies targeting bird preferred vegetation ranges.

A seagrass shelf will be constructed with GIWW maintenance material along the east side of the Site (Attachment 4, Figures 2 and 3). Based on NOAA charts and existing survey data, the seagrass shelf is estimated to be constructed on the -5.0-foot NAVD88 contour (NOAA 2022a). At this depth, it is expected seagrasses will be sparse, if present at all, and their future viability will be limited due to RSLR. The 370-foot-wide, 690-foot-long proposed seagrass shelf will be constructed to -1.5 feet NAVD88 to create 5.4 acres of high-quality SAV habitat (Attachment 4, Figures 2 and 3). The bathymetric survey data collected by DU in the vicinity of the seagrass shelf is incomplete, and additional bathymetric data should be collected to refine design dimensions and material requirements.

It is predicted that the required dredged material volume needed for the Site's interior fill and seagrass shelf will be approximately 135,000 CY. This value assumes 1 foot of foundation compression for every 6 feet of fill and does not consider bulking. Based on the information in Table 7, 135,000 CY of dredged material is expected to be available in the vicinity of the site every 3 years. However, during the initial placement, if the volume of available dredged material is less than the required fill volume, the rookery may be constructed in phases. For example. portions of the rookery would be constructed to design elevations, and the remaining areas and seagrass shelf would be constructed as dredged material becomes available.

Geotechnical data are needed and may be collected during a subsequent design phase to further evaluate foundation compression, and evaluate expected bulking of dredged material. The volume of material may be updated during a subsequent phase of design based on preconstruction bathymetric surveys, dredged material characteristics, characteristics of the subgrade, and refinement of the rookery island design.

Containment and Erosion Protection

Based on the results of the wave calculations described in the Wind and Waves and Wake Erosion sections, the project team currently proposes no armoring for the Site. The continued existence of these islands (albeit in reduced form) more than 70 years after construction indicates that the material is fairly resilient to erosion. Accordingly, the perimeter of the Site is designed to be constructed using the relict new work material. Further evaluation using a detailed wind-wave model to analyze the direction and frequency of expected significant wave heights may be conducted during subsequent phases of design. Such information would inform the possible benefits of armoring, including the tradeoffs between initial capital construction costs and maintenance costs with armoring versus without armoring.

A containment berm will be constructed around the Site to confine the dredged material, lessen the potential impacts to adjacent seagrass habitat, and reduce erosion. The proposed design includes constructing the centerline of the containment berm approximately along the -4.0-foot NAVD88 contour (Attachment 2, C01). The containment berm will have a gradual seaward facing slope that transitions to a stable, natural grade. The slope may provide wading bird access to the Site and an additional 1.6 acres of seagrass habitat recruitment and subsequent shoreline stabilization. The design assumes the borrow area could be excavated to -15 feet NAVD88 to provide approximately 34,500 CY of side casted material needed for containment berm construction, and the excavation area can be excavated approximately 4.5 feet to the -10.5 feet NAVD88 contour to provide the additional 58,500 CY of material needed to complete the containment berm construction (Attachment 2, C01 and C02). However, geotechnical data and analysis, during subsequent design phases, will be necessary to determine the availability and suitability of material in the borrow area and excavation area. Table 10 summarizes the Phase 1 containment berm design characteristics.

Table 10
Phase 1 Containment Berm Design Characteristics

Containment Berm Design Criteria	Site Containment Berm
Total project length	1,850 feet
Total containment berm acreage	Approximately 5.9 acres
Crest width	10 feet
Base width	140 feet, depending on water depth
Assumed bottom elevation	-4.0 feet NAVD88

Containment Berm Design Criteria	Site Containment Berm
Total structure height	10 feet
Containment berm materials	Mechanically excavated relict new work dredged material
Containment berm volume	93,000 CY
Estimated settlement	1 foot for every 6 feet of fill
Design side slopes (seaward side)	10H:1V[1], depending on material
Design side slopes (landward side)	3H:1V[1], depending on material
Maximum design crest elevation	+6 feet NAVD88

Notes:
The final cross-sectional dimensions and slopes of the containment berm will need to be determined and refined, respectively, through modeling and analysis of the wind-wave hydrodynamics and sediment characteristics of the dredged material and containment berm subgrade during a subsequent phase of design.
1. Horizontal to vertical

Constructability

This section describes the proposed methods of construction. Actual methods will be dependent on the chosen contractor's equipment and Site conditions at the time of construction. In addition, the contractor may provide alternate construction methods from those described in this section.

The Site is proposed to be constructed in two different phases to beneficially use dredged material from a USACE dredging cycle, which makes the project more feasible. Phase 1 containment berm construction will be completed prior to a USACE dredging event to allow for dewatering and consolidation; then, Phase 2 interior fill and seagrass shelf construction will be completed during a USACE dredging event.

The Site would be constructed in two different phases, as follows.

Phase 1

The initial containment berm will be constructed during Phase 1 to allow for settlement, dewatering, and consolidation of the containment berm before placing fill material into the Site (Phase 2; Attachment 2, C01 and C02). Phase 1 construction may require mobilizing equipment beyond what is required for dredging the GIWW (e.g., marsh buggies, a deck barge, and an excavator). The containment berm may be constructed from mechanically excavated relict new work material from the borrow area currently residing in the Site footprint and from immediately adjacent shallow areas that have the relict new work material (Excavation Area). Depending on water depths, access channels may need to be dredged for contractors to access the Site, and marsh buggies or deck-barged excavators may be used to shape the containment berm. Best management practices for turbidity controls will be adhered to.

Phase 2

Phase 2 of construction will consist of placing fill inside the Site to create the bird island and seagrass shelf during routine USACE maintenance dredging (Attachment 4, Figures 2 and 3). Phase 2 construction may require mobilizing equipment beyond what is required for dredging the GIWW (e.g., marsh buggies, a deck barge, and an excavator). The larger grain sized maintenance material is likely to settle and consolidate near the placement pipe, where marsh buggies may be used to shape the material to the required fill elevations and to form the seagrass shelf. Best management practices for turbidity controls will be adhered to.

Planting and Natural Recruitment of Vegetation

The decision to plant the marsh or to allow natural recruitment will be determined during subsequent design phases through collaboration with the project proponent (yet to be determined). Table 6 shows the threatened and endangered birds and their preferred habitats. At further design phases, this list could be used to modify elevations within the Site to promote the preferred habitat of desired bird species.

Some stakeholders suggested planting preferred vegetation (conceivably, *Spartina alterniflora* or mangroves) on the seaward-facing Phase 1 containment berm gradual slope to further stabilize the shoreline. These strategies would need to be evaluated in future phases of design to determine their impact on project costs, as well as the impact they may have on the bird species that would colonize the Site.

Performance Expectations

The existing relict new work upland islands in the Upper Laguna Madre have shown to be erosion resilient over time. Because the containment berm of the Site is to be constructed using the relict new work dredged material, it is expected to experience the same resiliency as the Upper Laguna Madre islands. The relict new work material on the Site is expected to weather and stabilize over time to a natural slope similar to that of other upland islands composed of relict new work material in the Upper Laguna Madre.

Site Construction Cost Estimates

Preliminary construction costs were estimated for the design outlined in the previous sections. The estimated costs include indirect construction costs (i.e., permitting, 100% engineering and design costs, construction management, and postconstruction management such as Site visits, dewatering management). These costs represent the estimated incremental costs (i.e., costs over and above USACE's least costly and environmentally acceptable dredged material and placement alternative). Table 11 shows a line-item list of each costing parameter and the total cost estimated for construction.

The costs range from $2 million to $4.2 million, depending on the level of uncertainty allocated to the project cost. The lower bound of uncertainty (-30%) and upper bound of uncertainty (+50%) were selected due to the existing data gaps, high levels of inflation, and rising fuel costs. During subsequent design phases, the effect of armoring versus not armoring on the initial capital construction versus projected maintenance costs may be evaluated. The estimates are developed using current and generally accepted engineering cost estimating methods and are based on assumptions concerning future events. Actual costs may be affected by known and unknown risks including, but not limited to, changes in general economic business conditions, Site conditions that were unknown at the time the estimates were performed, future changes in Site conditions, regulatory or enforcement policy changes, and delays in performance. Actual costs may vary from these estimates.

Table 11
Opinion of Probable Construction Cost to 100% Project Completion

Item	Quantity	Unit	Unit Price	Total
Direct Construction Costs				
Phase 1: Containment Berm Construction				
Mobilization and Demobilization[1]	1	LS	$ 150,000.00	$ 150,000.00
Preconstruction Survey	1	LS	$ 30,000.00	$ 30,000.00
Containment Berm[2,3]	1,850	LF	$ 140.00	$ 260,000.00
As-Built Survey	1	LS	$ 50,000.00	$ 50,000.00
Navigational Aids[2]	4	Each	$ 4,000.00	$ 20,000.00
Phase 1 Subtotal[4]			**Sum**	**$ 500,000.00**
Phase 2: Interior Fill Placement and Seagrass Shelf Construction				
Incremental Mobilization and Demobilization[1]	1	LS	$ 250,000.00	$ 250,000.00
Preconstruction Survey	1	LS	$ 50,000.00	$ 50,000.00
Incremental Dredging Interior Placement (1-Mile Pipeline)[2]	135,000	CY	$ 6.00	$ 810,000.00
Seagrass Shelf Construction[5]	51,000	CY	$ 4.00	$ 204,000.00
As-Built Survey	1	LS	$ 60,000.00	$ 60,000.00
Phase 2 Subtotal[4]			**Sum**	**$1,400,000.00**
Direct Construction Subtotal[4]			**Sum**	**$1,900,000.00**
Indirect Construction Costs				
100% Engineering and Design[4]	1	LS	$ 500,000.00	$ 500,000.00
Permitting	1	Each	$ 100,000.00	$ 100,000.00
Construction Management[4]	1	%	8	$ 200,000.00
Postconstruction Management[6]	12	Month	$ 10,000.00	$ 120,000.00
Indirect Construction Subtotal[4]			**Sum**	**$ 900,000.00**
Project Subtotal[4]			**Sum**	**$2,800,000.00**
-30% Uncertainty[4]	1	%	30	$ 800,000.00
+50% Uncertainty[4]	1	%	50	$ 1,400,000.00
Low-End Total Project Estimated Cost[4]			**Total Sum**	**$2,000,000.00**
High-End Total Project Estimated Cost[4]			**Total Sum**	**$4,200,000.00**

Notes:
Costs were determined based upon a combination of publicly available datasets and sediment surface grabs, and topographic, bathymetric, and visual habitat surveys.
The Phase 2 containment berm assumes maintenance material from the GIWW is not conducive to be interior fill or containment berm material and that the USACE dredge will mine relict new work material.

2. Cost is based upon mobilizing equipment above what is required for dredging the GIWW (e.g., marsh buggies).
3. Value is rounded to the nearest $10,000.
4. Cost includes side casting existing relict new work material from the borrow area, excavating and transporting relict new work material from the excavation area, and shaping the containment berm.

5. Value is rounded to the nearest $100,000.
6. Cost is based on using dredged material placed inside the Site during Phase 2 interior fill to construct the seagrass shelf. Postconstruction management may include Site visits to observe Site material consolidation, vegetation, and water levels. Monthly aerials may be performed. Additional postconstruction management practices may be considered during subsequent phases of design.

LF: linear foot
LS: lump sum

Expected Ecosystem Benefits

Creation of the Site is expected to have positive benefits on the regional ecosystem. Green Island, a 25-acre rookery island located in the adjacent Laguna Madre, was used to approximate the ecological benefits for the Site. From 2011 to 2015, Green Island averaged approximately 1,000 breeding pairs of birds per year across three species listed in Table 6 (Audubon 2021b). Therefore, it is expected that the Site may create habitat for >500 breeding pairs for multiple species of birds per year (Newstead 2022).

The mean RSLR trend averaged between Corpus Christi and Port Mansfield is 4.61 millimeters per year (NOAA 2022b). Assuming no changes in the mean RSLR trend and no erosion, the rookery island within the target elevation of the Site (+5.0 feet NAVD88) would remain above the high tide line until 2211, and the containment berm (+6.0 feet NAVD88) would remain above the high tide line until 2277.

Data and Information Gaps

At this phase of design, the following data and information gaps have been identified:

- The Site was selected in lieu of the existing Rabbit Island located 1.2 miles north of the Site due to seagrasses not being shown on existing maps within the vicinity of the Site (TPWD 2021). Because seagrasses were observed during DU's survey of the site, there is seemingly no advantage, with respect to seagrasses, to creating an island at the Site versus restoring the existing Rabbit Island.
- Coordination with the Texas Historical Commission surrounding the cultural resource is needed.
- Site-specific wind-generated and vessel wake wave modeling would inform the future optimization of both the containment berm and seagrass shelf.
- Geotechnical characteristics of the source material (maintenance and relict new work material) and subgrade of the placement area would refine evaluations of containment structure stability, subgrade and source material settlement, and short- and long-term capacity for dredged material placement.
- Depending on the Site-specific wind and vessel wake modeling results, the geotechnical characteristics of the relict new work material, or the project proponent's desire for a more resilient bird island, hard armoring could be considered at a subsequent phase of design.

- Refined survey information, such as property lines, utility locations, and supplemental bathymetry, where appropriate, are needed.
- An extensive seagrass habitat survey would inform the Site design and could be used to shift the excavation area or the Site footprint to reduce impacts to seagrasses. However, given the extensive presence of seagrasses at and surrounding the Site, it is unlikely that the island could be constructed without impacts to seagrasses.

These data gaps may need to be addressed during the progression from 60% design to final design. In the absence of such data, this 60% design assumes an acceptably resilient bird island can be constructed without rock armoring, which has resulted in a lower cost project than if armoring were included. This current project is taking the analyses as far as practicable considering the constraints of the project scope, budget, and schedule.

Future Work

The scattered presence of seagrass immediately adjacent to the Site poses a potential fatal flaw. Potential impacts to seagrasses should be further evaluated and clearly communicated to resource agencies and stakeholders in the region. Verbal and written approval confirming understanding of likely habitat impacts and proposed measures to offset those impacts should be received before the Site proceeds toward later design phases.

Should the Site be selected for additional design efforts, it can be expected that some aspects of the design in this memorandum will be modified and, as appropriate, enhanced.

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Attachment 1
Site Photographs

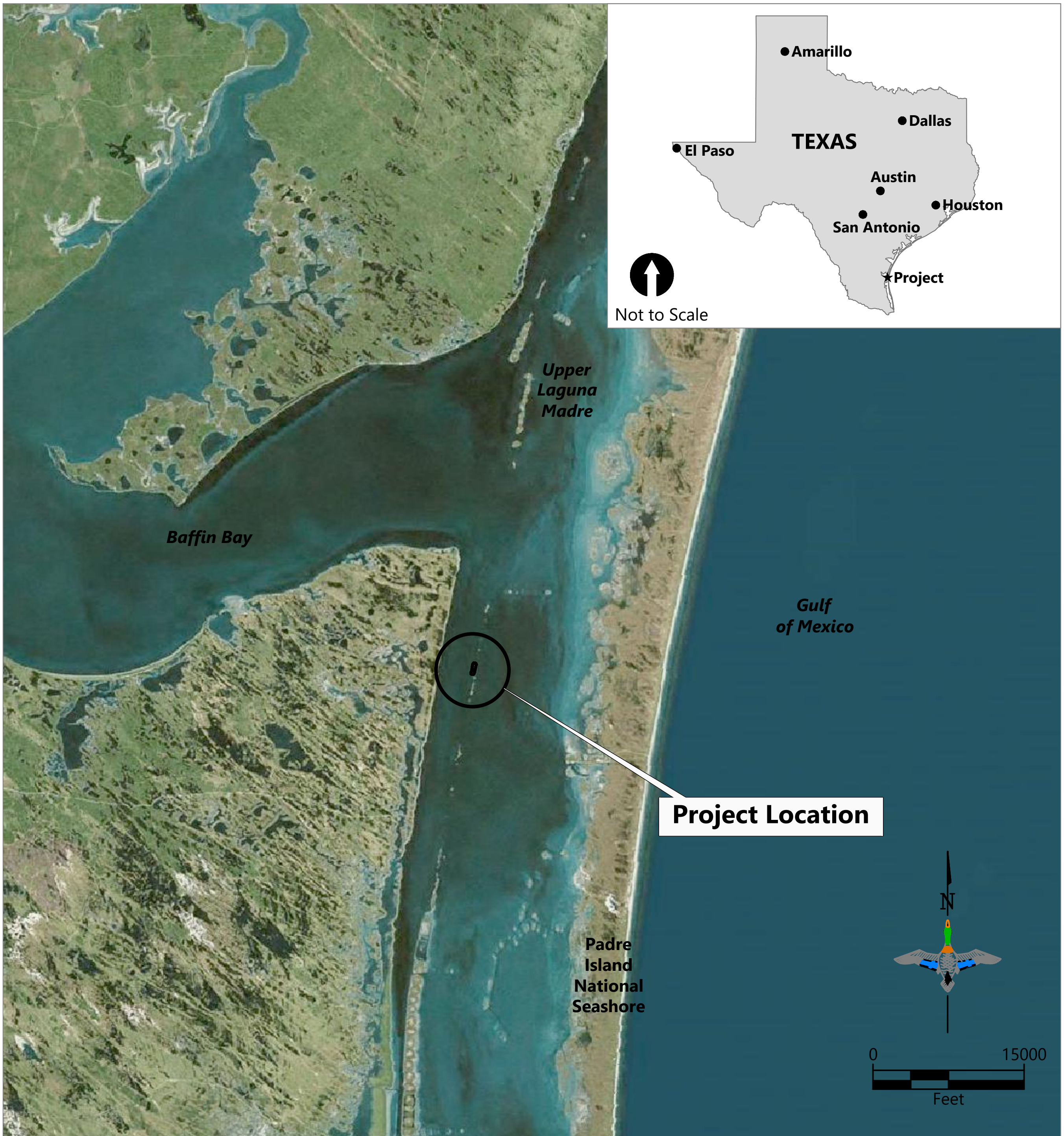
Remnant island on the southern side of Rabbit Island South (photo credit: Ducks Unlimited)

Looking south along the relict new work mounds (photo credit: Ducks Unlimited)

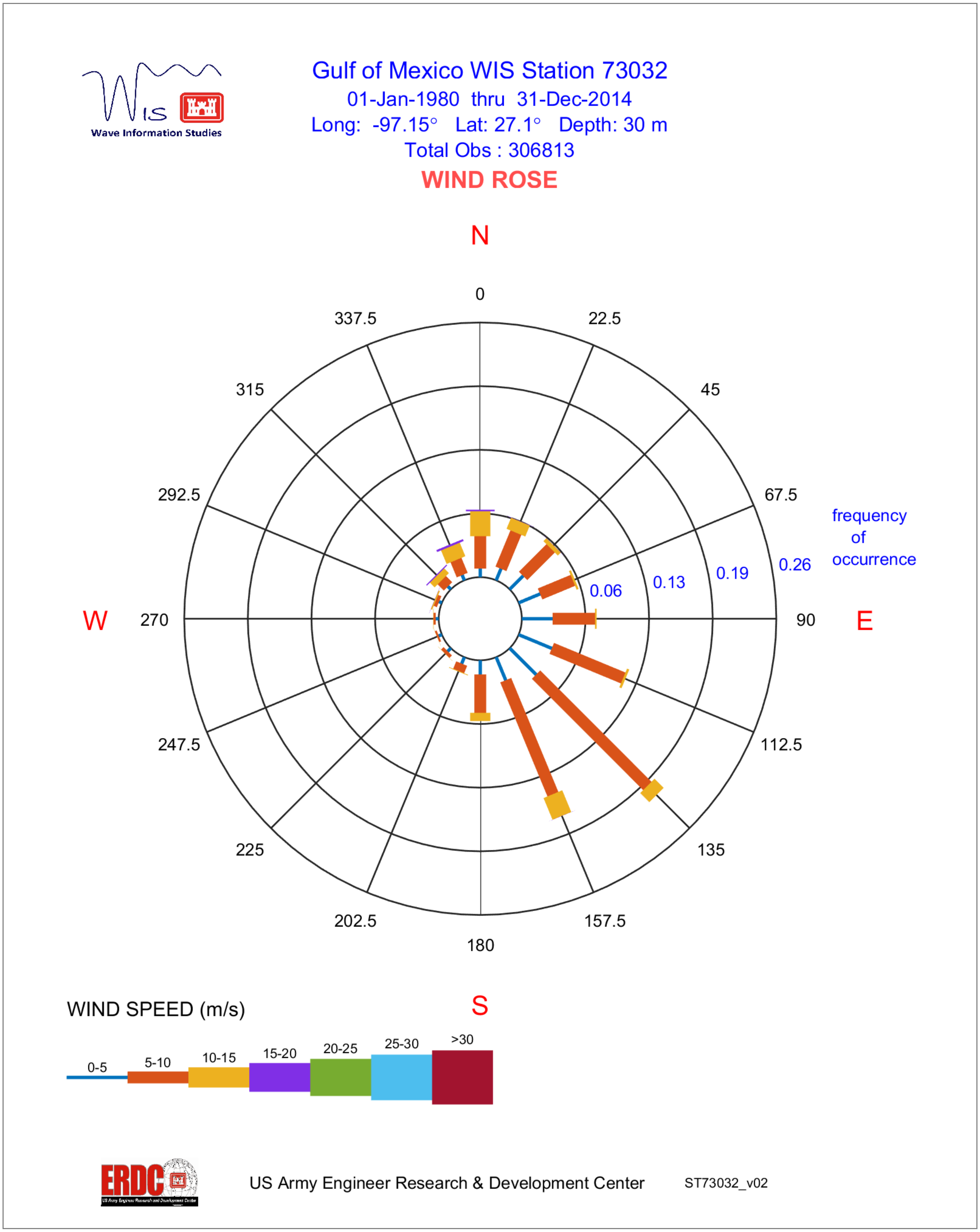
Remnant island on the northern side of Rabbit Island South (photo credit: Ducks Unlimited)

Looking north from Rabbit Island South, with dark areas in the water indicating seagrasses (photo credit: Ducks Unlimited)

Figures



SOURCE: Aerial provided by Bing Maps.
HORIZONTAL DATUM: Texas State Plane South Zone, North American Datum of 1983, U.S. Survey Feet



Wave Information Studies
Gulf of Mexico WIS Station 73032
01-Jan-1980 thru 31-Dec-2014
Long: -97.15° Lat: 27.1° Depth: 30 m
Total Obs : 306813
WIND ROSE
N
0
22.5
45
67.5
90
112.5
135
157.5
180
202.5
225
247.5
270
292.5
315
337.5
E
S
W
0.06
0.13
0.19
0.26
frequency of occurrence
WIND SPEED (m/s)
0-5
5-10
10-15
15-20
20-25
25-30
>30
ERDC
US Army Engineer Research & Development Center
ST73032_v02

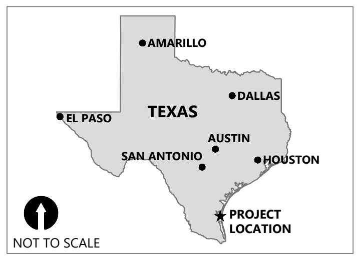
Attachment 2

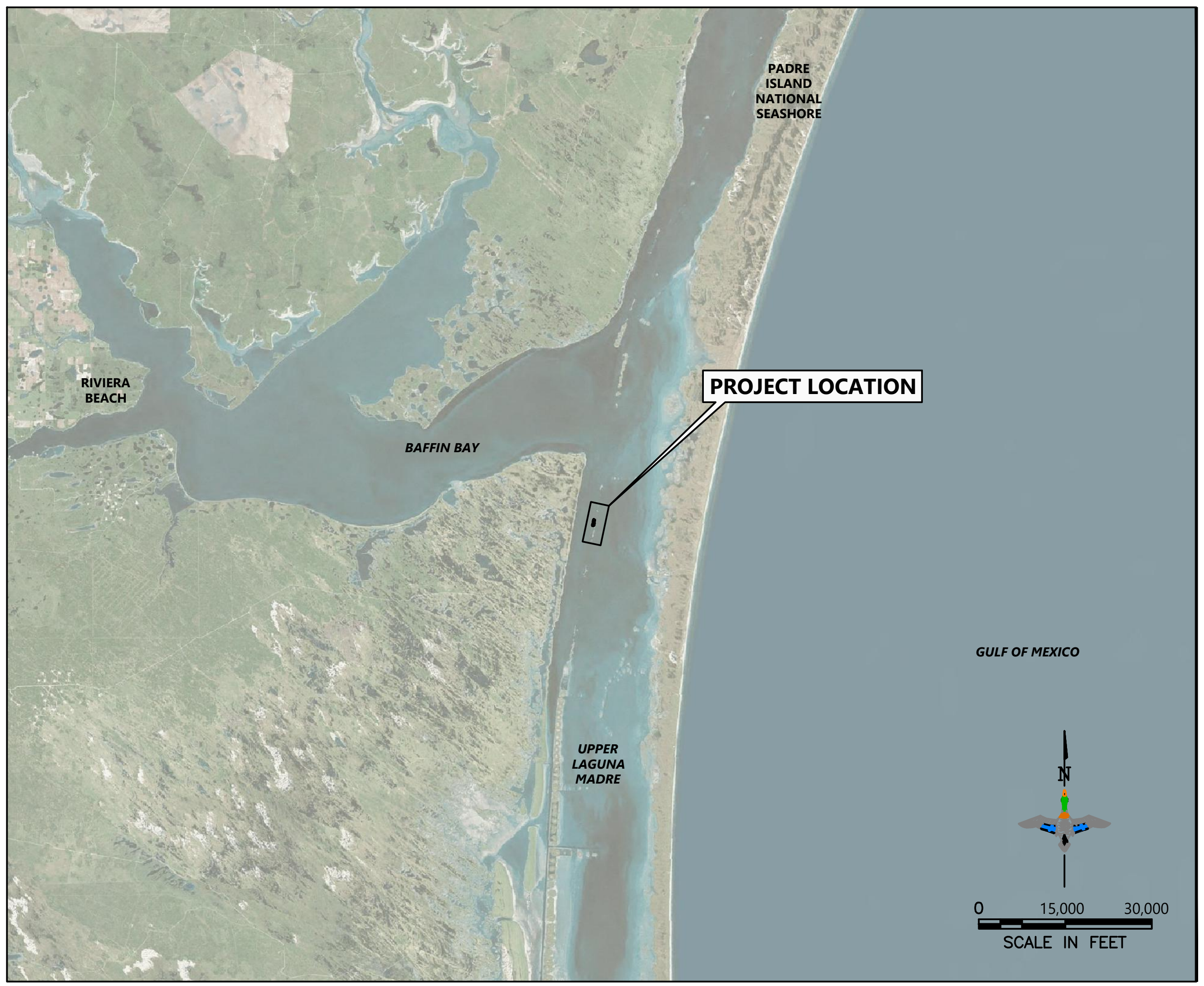
Construction Drawings

60% DESIGN SUBMITTAL

TEXAS LOWER COAST BENEFICIAL USE - RABBIT ISLAND SOUTH

TEXAS GENERAL LAND OFFICE





AERIAL BY BING MAPS

DRAWING INDEX		
SHEET	DRAWING	TITLE
1	T01	TITLE SHEET
2	G01	GENERAL NOTES AND ABBREVIATIONS
3	C01	PLAN VIEW
4	C02	BORROW AND EXCAVATION AREAS
5	C03	TYPICAL CONTAINMENT BERM SECTION

NOTES:

1. HORIZONTAL DATUM: TEXAS STATE PLANE SOUTH ZONE, NAD83, U.S. SURVEY FEET
2. VERTICAL DATUM: NORTH AMERICAN VERTICAL DATUM OF 1988 (NAVD88)
3. BATHYMETRIC, TOPOGRAPHIC, AND VISUAL HABITAT SURVEYS CONDUCTED BY DUCKS UNLIMITED ON MARCH 23, 2022.

PLAN INTENDED TO BE VIEWED IN COLOR. ADJACENT BLOCK IS "BLUE"

ONE INCH

AT FULL SIZE, IF NOT ONE INCH SCALE ACCORDINGLY

DRAFT-NOT FOR CONSTRUCTION

K:\Projects\2018-PCCA Beneficial Use\RABBIT ISLAND SOUTH\Construction Plans\2018 PL-001 SITE_RI.dwg T01

Sep 15, 2022 11:55am mpratschner

ANCHOR QEA

TEXAS GENERAL LAND OFFICE ESTABLISHED 1836

DUCKS UNLIMITED

REVISIONS				
REV	DATE	BY	APP'D	DESCRIPTION

DESIGNED BY: H. SMITH
DRAWN BY: M. PRATSCHNER
CHECKED BY: R. ROBERTSON
APPROVED BY: J. LAPLANTE
SCALE: AS NOTED
DATE: SEPTEMBER 2022

TEXAS LOWER COAST BENEFICIAL USE - RABBIT ISLAND SOUTH

TITLE SHEET

T01

SHEET # 1 OF 5

GENERAL NOTES

1. THE CONTRACTOR SHALL COMPLY WITH ALL REQUIREMENTS OF THE DRAWINGS, SPECIFICATIONS, PERMITS, AND ALL APPLICABLE REGULATIONS AND ORDINANCES.

2. IN THE EVENT OF A CONFLICT BETWEEN THE SPECIFICATIONS AND THE DRAWINGS, THE DRAWINGS SHALL GOVERN.

3. BATHYMETRIC, TOPOGRAPHIC, AND VISUAL HABITAT SURVEY PERFORMED BY DUCKS UNLIMITED ON MARCH 23, 2022.

4. AERIAL IMAGE ©2022 MICROSOFT CORP. MICROSOFT BING

5. GEOTECHNICAL AND ENGINEERING DATA PROVIDED ARE FOR REPRESENTATIVE PURPOSES. THE CONTRACTOR SHALL FIELD VERIFY CONDITIONS AND/OR COLLECT ANY ADDITIONAL DATA, AS IT DEEMS NECESSARY.

6. THE CONTRACTOR SHALL FIELD VERIFY ALL FIELD BASELINE CONDITIONS, AS WELL AS ALL LOCATIONS AND DIMENSIONS.

7. THE CONTRACTOR SHALL LOCATE AND FIELD VERIFY ALL ABOVEGROUND AND BELOWGROUND UTILITIES BEFORE BEGINNING WORK.

8. THE CONTRACTOR SHALL BE RESPONSIBLE FOR DAMAGE TO BOTH ON- AND OFF-SITE FACILITIES CAUSED BY ITS ACTIVITIES DURING PERFORMANCE OF THE WORK. THE CONTRACTOR SHALL RESTORE ALL SUCH DAMAGES TO THEIR PRECONSTRUCTION CONDITION AT NO COST TO THE OWNER.

9. THE CONTRACTOR SHALL AT ALL TIMES KEEP ITS CONSTRUCTION AREAS FREE FROM ACCUMULATIONS OF WASTE MATERIALS OR RUBBISH AND, PRIOR TO COMPLETION OF THE WORK, REMOVE ANY RUBBISH FROM THE PREMISES, AS WELL AS ALL TOOLS, EQUIPMENT, AND MATERIALS THAT ARE NOT THE PROPERTY OF THE OWNER.

PERMITS AND PERMIT CONDITIONS

1. THE CONTRACTOR SHALL COMPLY WITH ALL PERMIT CONDITIONS.

2. THE CONTRACTOR SHALL BE RESPONSIBLE FOR OBTAINING ANY ADDITIONAL PERMITS THAT MAY BE REQUIRED FOR THE CONDUCT OF THIS WORK. COSTS OF OBTAINING PERMITS NOT SUPPLIED BY THE OWNER SHALL BE BORNE BY THE CONTRACTOR.

HORIZONTAL DATUM

TEXAS STATE PLANE SOUTH ZONE, NORTH AMERICAN DATUM OF 1983 (NAD83), US SURVEY FEET.

VERTICAL DATUM

NORTH AMERICAN VERTICAL DATUM OF 1988 (NAVD88)

ABBREVIATIONS

E	EASTING
EL.	ELEVATION
MIN.	MINIMUM
MLLW	MEAN LOWER LOW WATER
N	NORTHING

NOTES:

1. HORIZONTAL DATUM: TEXAS STATE PLANE SOUTH ZONE, NAD83, U.S. SURVEY FEET

2. VERTICAL DATUM: NORTH AMERICAN VERTICAL DATUM OF 1988 (NAVD88)

3. BATHYMETRIC, TOPOGRAPHIC, AND VISUAL HABITAT SURVEYS CONDUCTED BY DUCKS UNLIMITED ON MARCH 23, 2022.

PLAN INTENDED TO BE VIEWED IN COLOR, ADJACENT BLOCK IS "BLUE"

ONE INCH

AT FULL SIZE, IF NOT ONE INCH SCALE ACCORDINGLY

DRAFT-NOT FOR CONSTRUCTION

ANCHOR QEA

TEXAS GENERAL LAND OFFICE ESTABLISHED 1836

DUCKS UNLIMITED

REVISIONS

REV	DATE	BY	APP'D	DESCRIPTION

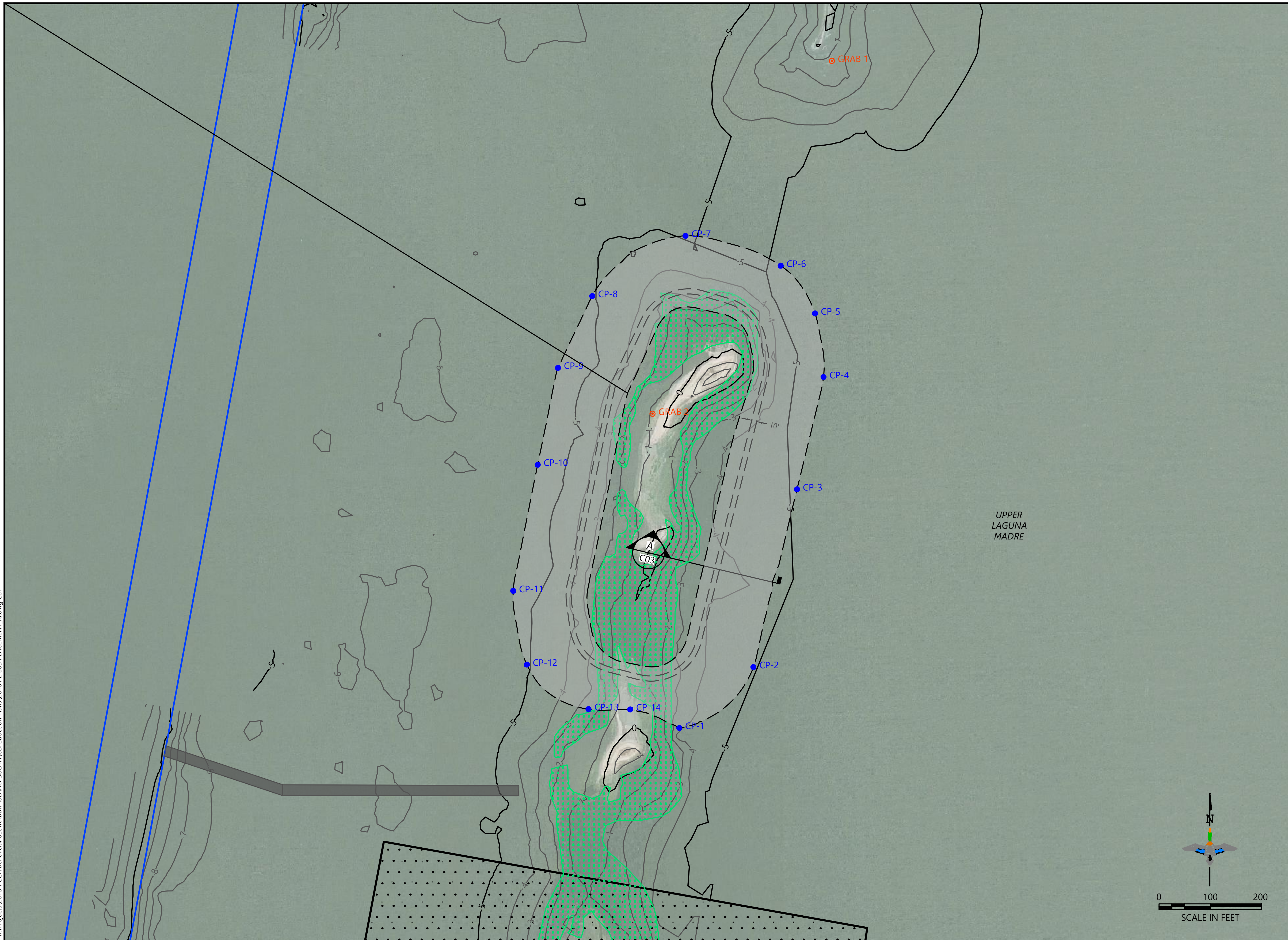
DESIGNED BY: H. SMITH
DRAWN BY: M. PRATSCHNER
CHECKED BY: R. ROBERTSON
APPROVED BY: J. LAPLANTE
SCALE: AS NOTED
DATE: SEPTEMBER 2022

TEXAS LOWER COAST BENEFICIAL USE - RABBIT ISLAND SOUTH

GENERAL NOTES AND ABBREVIATIONS

G01

SHEET # **2** OF **5**



CONTROL POINTS		
CONTROL POINT	NORTHING (Y)	EASTING (X)
CP-1	16973586.55	1335911.46
CP-2	16973704.76	1336055.76
CP-3	16974050.88	1336140.59
CP-4	16974269.00	1336192.26
CP-5	16974392.96	1336175.58
CP-6	16974485.83	1336108.72
CP-7	16974543.92	1335923.59
CP-8	16974426.57	1335741.93
CP-9	16974286.95	1335675.44
CP-10	16974098.64	1335635.81
CP-11	16973853.12	1335588.17
CP-12	16973709.68	1335614.78
CP-13	16973623.01	1335734.78
CP-14	16973622.62	1335816.09

LEGEND:

- PROPOSED CONTAINMENT BERM
- GULF INTRACOASTAL WATERWAY
- CP-# CONTROL POINT
- APPROXIMATE LOCATION OF VISUALLY SURVEYED SEAGRASS
- 0 EXISTING CONTOUR (5')
- 3 EXISTING CONTOUR (1')
- GRAB SAMPLES
- U.S. ARMY CORPS OF ENGINEERS OPEN WATER DREDGED MATERIAL PLACEMENT AREA
- POTENTIAL DREDGING ACCESS CHANNEL

NOTES:

1. HORIZONTAL DATUM: TEXAS STATE PLANE SOUTH ZONE, NAD83, U.S. SURVEY FEET
2. VERTICAL DATUM: NORTH AMERICAN VERTICAL DATUM OF 1988 (NAVD88)
3. BATHYMETRIC, TOPOGRAPHIC, AND VISUAL HABITAT SURVEYS CONDUCTED BY DUCKS UNLIMITED ON MARCH 23, 2022.
4. GRAB SAMPLES PERFORMED BY DUCKS UNLIMITED ON MARCH 23, 2022.
5. NAVIGATION AIDS MUST BE PLACED ALONG THE CONTAINMENT BERM IN ACCORDANCE WITH TECHNICAL SPECIFICATIONS SECTION 35 12 10.

PLAN INTENDED TO BE VIEWED IN COLOR. ADJACENT BLOCK IS "BLUE"

ONE INCH

AT FULL SIZE, IF NOT ONE INCH SCALE ACCORDINGLY

DRAFT-NOT FOR CONSTRUCTION

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TEXAS GENERAL LAND OFFICE ESTABLISHED 1836

DUCKS UNLIMITED

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CHECKED BY: R. ROBERTSON
APPROVED BY: J. LAPLANTE
SCALE: AS NOTED
DATE: SEPTEMBER 2022

TEXAS LOWER COAST BENEFICIAL USE - RABBIT ISLAND SOUTH

PLAN VIEW

C01

SHEET # 3 OF 5

LEGEND:

- PROPOSED CONTAINMENT BERM
- GULF INTRACOASTAL WATERWAY
- BORROW AREA
- EXISTING CONTOUR (5')
- EXISTING CONTOUR (1')
- U.S. ARMY CORPS OF ENGINEERS OPEN WATERDREDGED MATERIAL PLACEMENT AREA
- POTENTIAL DREDGING ACCESS CHANNEL
- EXCAVATION AREA

NOTES:

1. HORIZONTAL DATUM: TEXAS STATE PLANE SOUTH ZONE, NAD83, U.S. SURVEY FEET
2. VERTICAL DATUM: NORTH AMERICAN VERTICAL DATUM OF 1988 (NAVD88)
3. BATHYMETRIC, TOPOGRAPHIC, AND VISUAL HABITAT SURVEYS CONDUCTED BY DUCKS UNLIMITED ON MARCH 23, 2022.
4. NAVIGATION AIDS MUST BE PLACED ALONG THE CONTAINMENT BERM IN ACCORDANCE WITH TECHNICAL SPECIFICATIONS SECTION 35 12 10.

PLAN INTENDED TO BE VIEWED IN COLOR. ADJACENT BLOCK IS "BLUE"

ONE INCH

AT FULL SIZE, IF NOT ONE INCH SCALE ACCORDINGLY

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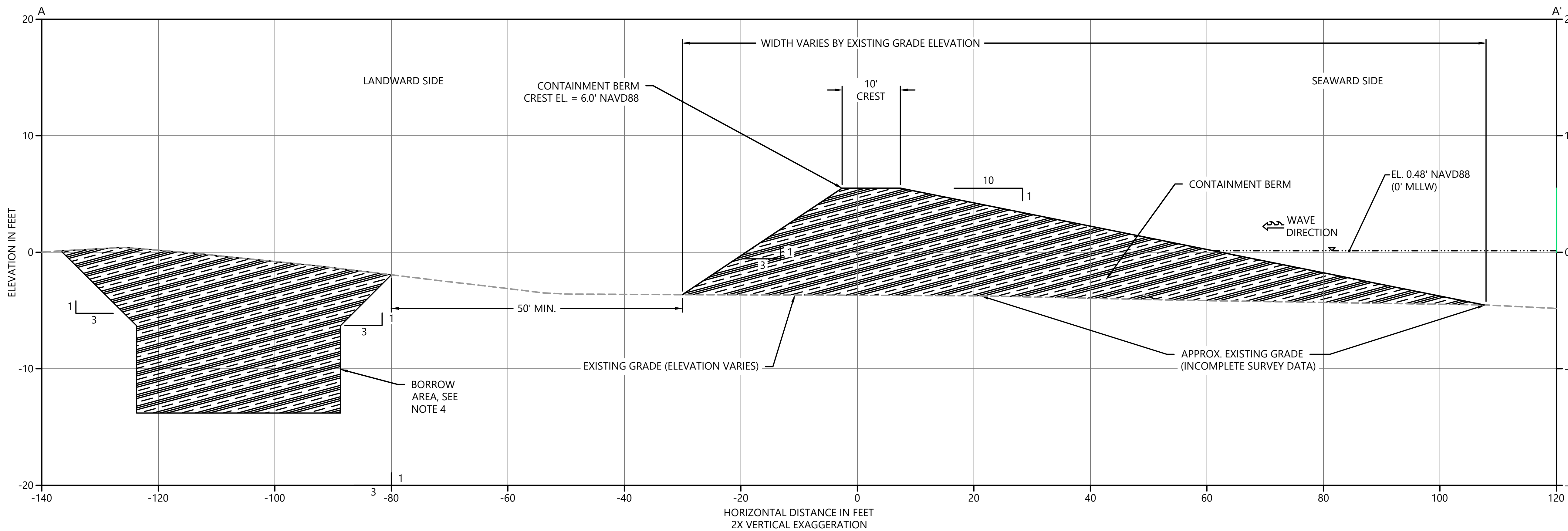
DATE: SEPTEMBER 2022

TEXAS LOWER COAST BENEFICIAL USE - RABBIT ISLAND SOUTH

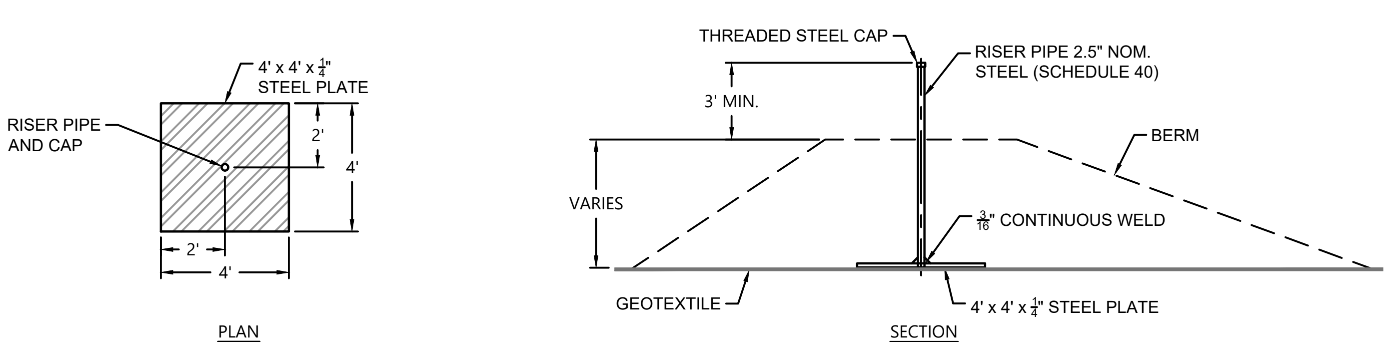
BORROW AND EXCAVATION AREA

C02

SHEET # 4 OF 5



SECTION A / C02
HORIZONTAL SCALE: 1" = 10'
VERTICAL SCALE: 1" = 5'



PLAN AND SECTION VIEWS OF TYPICAL SETTLEMENT PLATE
NOT TO SCALE

NOTES:

1. HORIZONTAL DATUM: TEXAS STATE PLANE SOUTH ZONE, NAD83, U.S. SURVEY FEET
2. VERTICAL DATUM: NORTH AMERICAN VERTICAL DATUM OF 1988 (NAVD88)
3. BATHYMETRIC, TOPOGRAPHIC, AND VISUAL HABITAT SURVEYS CONDUCTED BY DUCKS UNLIMITED ON MARCH 23, 2022.
4. BORROW AREA DIMENSIONS SHOWN FOR ILLUSTRATION PURPOSES ONLY. ACTUAL DIMENSIONS TO BE DETERMINED BASED ON FINAL DESIGN AND BY SELECTED CONTRACTOR.
5. NAVIGATION AIDS MUST BE PLACED ALONG THE CONTAINMENT BERM IN ACCORDANCE WITH TECHNICAL SPECIFICATION SECTION 35 12 10.

PLAN INTENDED TO BE VIEWED IN COLOR. ADJACENT BLOCK IS "BLUE"

ONE INCH
AT FULL SIZE. IF NOT ONE INCH SCALE ACCORDINGLY

DRAFT-NOT FOR CONSTRUCTION

REVISIONS

REV	DATE	BY	APP'D	DESCRIPTION

DESIGNED BY: H. SMITH
DRAWN BY: M. PRATSCHNER
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APPROVED BY: J. LAPLANTE
SCALE: AS NOTED
DATE: SEPTEMBER 2022

TEXAS LOWER COAST BENEFICIAL USE - RABBIT ISLAND SOUTH

TYPICAL CONTAINMENT BERM SECTION

C03

SHEET # 5 OF 5

Attachment 3
Technical Specifications

SECTION 35 12 10

AIDS TO NAVIGATION

PART 1 - GENERAL

1.01 SUMMARY

A. The Contractor shall furnish all labor, equipment, materials, and incidentals necessary to install permanent navigational markers as shown on the Construction Drawings as "Aids to Navigation" (ATON) and in accordance with the U.S. Coast Guard (USCG) marking determination (Appendix TBD). The Contractor shall also be responsible for installing and maintaining temporary navigational markers or lighted beacons during construction of the breakwater structures in accordance with applicable federal, state, and local laws, ordinances, and relevant permit requirements. Contractor shall install at (at least X) (or as necessary to identify maritime risks) temporary navigational markers. Contractor shall remove the temporary navigational markers upon completing installation of the required permanent navigational markers.

B. The Contractor shall display signal lights and conduct operations in accordance with the General Regulations of the Department of the Army and of USCG as set forth in Navigation Rules and Regulations Handbook 2014 and 33 Code of Federal Regulations (CFR) 84 through 33 CFR 89 (Inland) as applicable.

1.02 RELATED DOCUMENTS

A. Appendix TBD – USCG Marking Determination Package (point to appropriate appendix)

B. Section 01 20 00 – Measurement and Payment Procedures

C. Section 01 33 00 – Submittal Procedures

D. Section 01 35 43 – Environmental Protection

E. Section 35 33 00 – Containment Dike

1.03 REFERENCES

A. American Wood Preservers Association (AWPA): AWPA P5 – Standard for Waterborne Preservatives

B. USCG: USCG CFR, Title 33, Chapter 1, Parts 62, 64, and 66

C. 2022 AWPA Book of Standards

1.04 SUBMITTALS

A. Before the Contractor orders ATON materials, the following shall be submitted in accordance with SECTION 01 33 00 − SUBMITTAL PROCEDURES:

1. Manufacturer's Data Sheets: The Contractor shall submit the manufacturer's data sheets for all permanent ATON, including buoys, lights, signs, reflective material, pilings, and any other material used for the ATON. The data sheets shall include the name of the manufacturer, product name, style number, and other relevant information to fully describe the ATON material.

B. The failure of the Contractor to obtain approval prior to ordering material shall be grounds for nonpayment.

PART 2 - PRODUCTS

2.01 MATERIALS

A. Temporary ATON

1. Warning Buoys – 1 nautical mile USCG-approved marine lanterns (TBD LED Rating), buoys with solar powered, flashing white light with a flash period of 2.5 seconds (0.3 seconds on / 2.2 seconds off)

B. Permanent ATON

1. Pilings: The contractor shall install X-foot-long, class X timber pilings, pressure treated with Chromated Copper Arsenate at 2.5 pounds per cubic foot per AWPA U1.

2. Signs: The contractor shall install the signs indicated in the USCG Determination Package with the lettering “DANGER” in black text on white dayboard film background with 2-inch orange retroreflective border. All hardware connecting the sign shall be hot-dipped galvanized or approved equal. Examples of USCG-approved signage is included in Appendix X.

3. Lights: The contractor shall install lights meeting the requirements described in Appendix X.

PART 3 - EXECUTION

3.01 INSTALLATION

A. Prior to installation, the Contractor shall determine if underground utilities exist in the proposed locations of the permanent ATON. The Contractor shall also verify water depths and bottom types at the locations.

B. As the work progresses, the Contractor shall install temporary or permanent ATON at the locations specified in Attachment X and Construction Drawings. Discrepancies between the coordinates designated on the USCG permit or Construction Drawings shall be reported to the Owner or its designated representative prior to installation.

C. The Contractor will place temporary ATON prior to construction and shall maintain the temporary ATON during construction until installation of the permanent ATON is complete. The contractor shall relocate temporary ATON by request of the Owner, Engineer, USCG, or USACE during construction without incurring additional cost to the Owner. The Contractor shall remove temporary ATON and install permanent ATON prior to final acceptance of the project. All temporary ATON will be considered property of the Contractor, and the Contractor shall take full responsibility for removal, transportation, storage, or proper disposal of the temporary ATON.

D. Timber piles shall be carefully handled with no sudden dropping, breaking of outer fibers, bruising, or penetration of the surface with tools. Piles damaged or not located in the proper location shall be withdrawn and replaced by new piles or shall be cut off at the mudline and additional piles installed as directed, without additional cost to the Owner.

E. Signs shall be installed so that the bottom of the signage is a minimum of 7 feet above the mean high water level and does not exceed 9 feet above the mean high water level. The Contractor shall shorten the pilings dictated by the normal mean high watermark in the project area, as necessary. Each sign shall be fastened with at least three 3/4-inch-diameter by 12-inch-long hot-dipped galvanized bolts and connected with a hot-dipped galvanized ogee washer, lockwasher, and nut. Bolt holes shall be bored 1/8 inch larger than the diameter of the bolt.

F. If any damage occurs to permanent ATON placed during construction, the Contractor shall replace or repair the ATON at no cost to the Owner and at the direction of the Owner or its authorized representative.

END OF SECTION 35 12 10

SECTION 35 33 00

CONTAINMENT BERM

PART 1 - GENERAL

1.01 SUMMARY

A. The Contractor shall furnish all labor, equipment, materials, and incidentals necessary to install the containment berm as described herein and in the Construction Drawings. The work shall include, but is not necessarily limited to, excavation of sediment within the footprint of the Site to construct the Rabbit Island South containment berm as shown in the Construction Drawings.

1.02 RELATED SECTIONS:

A. Section 01 20 00 – Measurement and Payment Procedures

B. Section 01 32 00 – Construction Progress Documentation

C. Section 01 32 23 – Surveys and Layout Data

D. Section 01 33 00 – Submittal Procedures

E. Section 01 35 43 – Environmental Protection

F.

G. Section 35 12 10 – Aids to Navigation

H. Appendix X – USACE Permit

1.03 REFERENCES

1.04 SUBMITTALS

I. The following submittals shall be submitted in accordance with SECTION 01 33 00 – SUBMITTAL PROCEDURES: Requirements for Submittals

J. Construction Work Plan: Prior to the start of construction, the Contractor shall provide a Construction Work Plan containing, at a minimum, the following:

1. Work Sequencing and Equipment:

    a. Order and sequence in which work shall be performed

    b. Number, type, and capacity of equipment to be used

    c. Hours of operation

    d. Estimated schedule

    e. Procedures for placing materials and confirming thicknesses and grades are met

2. Methods, Procedures, and Equipment addressing the following:

    a. Procedures for placing containment berm and confirming slopes and grades are met

    b. Placement and transportation of berm dredged material (including anticipated trip time and frequencies if barged

    c. Placement to distribute the load across the compressible foundation

d. Survey and photography methods to monitor and control the work and progress surveys

e. Verification of minimum design template

f. Settlement monitoring and output format

K. Quality Control Surveys: During construction, the Contractor shall provide interim surface elevation surveys per SECTION 01 32 23 − SURVEYS AND LAYOUT DATA.

L. Daily Construction Report: The Contractor shall prepare and maintain a daily report of operations and furnish copies by noon the following day or as requested by the Owner as described in SECTION 01 32 00 − CONSTRUCTION PROGRESS DOCUMENTATION.

M. Stop Work: The Owner and/or Engineer may elect to stop work activities at the Site if the required submittals have not been submitted or are not of acceptable quality (as determined by the Owner or Engineer) and per the schedules specified herein in accordance with SECTION 01 33 00 − SUBMITTAL PROCEDURES. Any delays related to submittal approvals shall not allow the construction schedule to be extended and shall not be reason to increase the Contract price.

1.01 QUALITY CONTROL

A. Contractor will perform control surveys as specified in SECTION 01 32 23 – SURVEYS AND LAYOUT DATA.

PART 2 - PRODUCTS

2.01 CONTAINMENT BERM MATERIALS

A. General

1. Fill material may be acquired from the designated borrow area from within the Site or from the adjacent excavation area as shown on the Project Drawings. The intention is to use the most suitable material obtainable from these sources.

2. If the Contractor and Engineer determines the borrow material is unsuitable for containment berm Construction, the Engineer may modify the containment berm design or determine if suitable offsite materials should be used to complete berm construction.

B. Material

1. Suitable fill material shall consist of an inorganic, granular soil containing between 0% and 12% material passing the No. 200 mesh sieve (sand having a Unified Soil Classification of SP or SP-SM).

2. Materials unsuitable for use as berm fill are defined as follows:

a. Material containing more than 2% organic matter (by dry weight)

b. Materials classified by the Unified Soil Classification System as PT, OH, OL, CH, MH, GM, GC, GW and GP

c. Materials containing roots greater than 1 inch in diameter, logs, scrap lumber, metal objects, plastic and fiberglass objects, concrete construction refuse, and other objectionable debris

d. Materials containing brush, sod, organic, and other perishable materials

2.02 SOURCE QUALITY CONTROL

A. Testing and Analysis of Materials shall be performed in accordance with applicable ASTM standards.

B. When tests indicate materials do not meet specified requirements, the Contractor shall remove and legally dispose of the unsuitable material off site and replace with suitable material at no cost to the Agency.

PART 3 - EXECUTION

3.01 GENERAL

A. The Contractor shall perform a preconstruction survey via a third-party independent surveyor licensed in the State of Texas. Prior to the start of construction, the Contractor shall verify all existing elevations and grades and provide templates per SECTION 01 32 23 – SURVEYS AND LAYOUT DATA. The Contractor shall establish the baseline depicted and provide a layout for review before starting placement operations.

B. The Contractor shall construct the containment berm to the elevations and alignments shown on the Construction Drawings within the construction tolerances stated in these specifications.

C. Material that escapes or is lost while loading, transporting, or placing, or which is deposited in areas other than shown on the Construction Drawings or approved in writing by the Owner and Engineer, shall be removed and redeposited at the Contractor's expense and at no additional cost to the Owner or, if not removed and redeposited, shall be deducted from the final quantities for payment.

3.02 CONTAINMENT BERM INSTALLATION

A. The Contractor shall install settlement plates prior to containment berm placement as shown on the Construction Drawings and described in Part 3.03 of this Section.

B. The subsurface sediments along the containment berm contain compressible sediments that will consolidate during and after construction. Due to the sediment consolidation, the contractor may be required to halt placement operations at certain locations and elevations and wait for the underlying sediments to consolidate before placing additional dredged material in the specified area. If applicable, the Engineer shall determine when the sediments have reached consolidation (based on Contractor field surveys) and when the Contractor can resume placement activities in the specified area. The Contractor shall place the dredged material for the containment berm in the following sequence:

1. Place dredged material to the full template and perform quality control surveys and weekly settlement monitoring surveys in accordance with SECTION 01 32 23 – SURVEYS AND LAYOUT DATA.

2. Place additional dredged material (based on surveys and as directed by the Engineer) as needed to meet minimum lines and grades.

3.03 Settlement Plates

A. Settlement plates shall be constructed with a 4-foot by 4-foot, 1/4-inch-thick steel plate with a 3-inch-diameter steel riser pipe attached to the center of the plate. The settlement plates shall be hot-dipped galvanized after fabrication. The riser pipe shall extend a minimum of 3 feet above the design elevation of the armor stone.

B. Settlement plates shall be placed prior to placing dredged material for the containment berm at the locations detailed in the construction drawings. Plates shall be placed so that the riser pipe conforms to a vertical plumb standard of no more than 10.5° from true vertical. The riser pipe shall be marked with reflective tape or flagging.

C. During installation of the containment berm, the Contractor shall carefully place materials near the settlement plate and maintain the plates until completion of the project. After acceptance of the containment berm, the Contractor shall cut the riser pipe so that it is 6 inches above the top of the constructed containment berm elevation.

D. Settlement plates shall be surveyed per SECTION 01 32 23 – SURVEYS AND LAYOUT DATA as follows:

1. Prior to dredged material placement for containment berm
2. After placement of dredged material placement for containment berm
3.
4. Every two weeks during containment berm material placement
5. After cutting the riser pipe (as described in 3.03 C. of this Section)
6. Every two weeks after completing the containment berm material placement, for a minimum of 3 post-construction survey data points

3.04 SURVEYS

A. All surveys shall be conducted in accordance with SECTION 01 32 23 – SURVEYS AND LAYOUT DATA.

3.05 TOLERANCES

A. Deviations in crest elevation from the design value shall not be greater than +0.5 foot for the interior core and +0.5 foot for the armor stone. Deviations below crest elevations shown on Construction Drawings will be filled in accordance with this Section until either crest elevation or allowable deviation is achieved.

B. Transitions in alignments shall be smooth and shall be no more than a 1-foot horizontal change in a 20-foot length unless otherwise approved by the Owner and Engineer.

C. Deviations in seaward slope lengths should not be greater than +0.5 feet. Deviations in the landward slope lengths should not be greater than +/-1.5 feet.

3.06 ACCEPTANCE

A. Acceptance will be based on the approved stone source, compliance tests, barge displacement surveys, and surveys performed by the Contractor per SECTION 01 20 00 – MEASUREMENT AND PAYMENT PROCEDURES and SECTION 01 32 23 – SURVEYS AND LAYOUT DATA. The Owner may perform field check tests and/or surveys to verify the Contractor's barge displacement and/or surveys. The Agency survey checks will govern any discrepancies.

END OF SECTION 35 33 00

Attachment 4

Dredged Material Management Plan

Dredged Material Management Plan – Rabbit Island South

The Dredged Material Management Plan for Rabbit Island South provides guidance on placement of dredged material and postconstruction rookery island and seagrass shelf monitoring. Figures 1 through 3 are provided for informational purposes. The intent is to place fill to create upland bird and seagrass habitat.

Dredged Material Placement

The following details the recommended dredged material placement plan:

- The Contractor shall place dredged material in the rookery island and seagrass shelf creation area as directed by the Engineer. The proposed method of placement shall be approved by the Engineer prior to commencement of work.
- Dredged material placement elevations during rookery island and seagrass shelf creation will be determined by the Engineer. Based on surveys and site visits, the Engineer will direct the Contractor on placement areas and elevations. The intent of the placement is to create upland within the rookery island footprint and seagrass habitat within the seagrass shelf footprint and for final rookery elevations, after consolidation, to be +5.0 feet North American Vertical Datum of 1988 (NAVD88) within the containment berm throughout the island, for final seagrass shelf elevations, after consolidation, to be -1.5 feet NAVD88 on the exterior shelf of the east side of the island.
- The Contractor shall begin placing dredged material in accordance with the specifications and Contractor's approved work plan. Deviations will be approved on a weekly basis by the Engineer, based on the adaptive placement approach, using survey and aerial images to guide the decision process.
- The Contractor shall use a placement method and employ best management environmental control practices that can be adapted for placing and shaping dredged material in varying locations and elevations and that will minimize turbidity in the water discharged from the rookery island placement area and seagrass shelf construction area.
- If hydraulically placing dredged material, the Contractor shall limit its discharge rate as necessary for the proposed equipment, water depth, surface area, weirs (if applicable), and borrow material properties to prevent turbidity exceedances and weir and berm overtopping. Depending on the proposed discharge rate into the area by the Contractor, intermittent discharge may be required to prevent overtopping. Once established, the Contractor shall not overtop the containment berm with dredged material until it has consolidated and can be reshaped into the seagrass shelf.
- At the completion of rookery island and seagrass shelf creation and as directed by the Engineer, the Contractor shall complete the as-built survey of the constructed rookery island and seagrass shelf.
- Deviations in rookery island and seagrass shelf elevation will be dependent on the characteristics of the dredged material and determined by the Engineer. If no direction is given, the elevation deviations shall not be greater than +/-0.5 foot.

Post Construction Monitoring

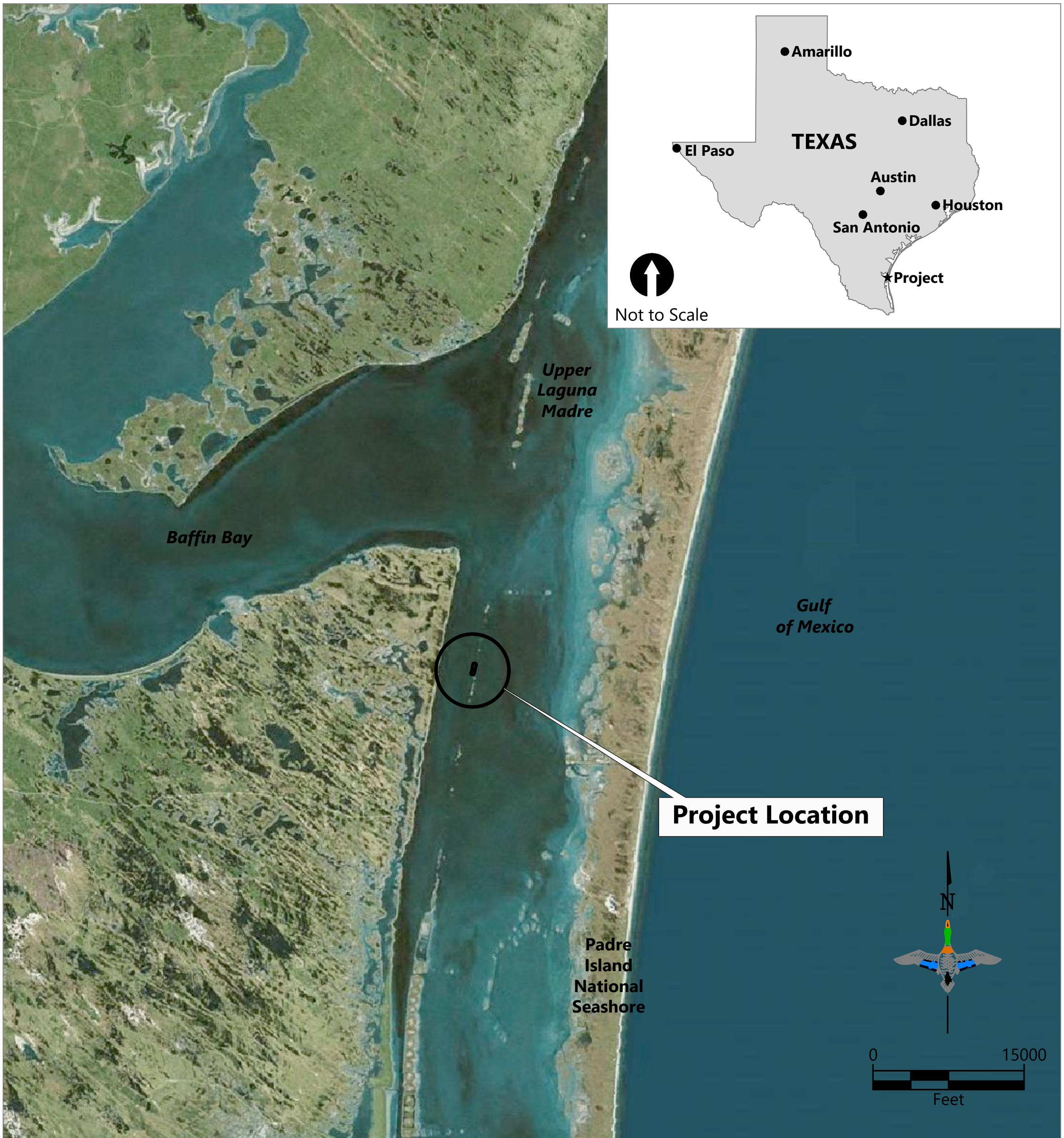
Once the Engineer determines rookery island and seagrass shelf placement operations are complete, the Contractor shall begin the post construction monitoring phase of the project as directed by the Engineer. It is the intent that all irregularities will be resolved on site with the Engineer and Contractor as the rookery island and seagrass shelf fill is placed.

The Contractor shall monitor, maintain, and adjust the decant system or weirs as needed to decant water from the site to allow the dredged material to settle and consolidate. The Engineer will determine when rookery island and seagrass shelf monitoring is complete.

At the completion of postconstruction monitoring and as directed by the Engineer, the Contractor shall remove any decant system or weirs if directed by the Engineer. Degrading and breaching locations and elevations, if required, will be determined by the Engineer based on the last rookery island and seagrass shelf monitoring visit.

At the completion of this work item, and as directed by the Engineer, the Contractor shall complete the as-built survey of the constructed rookery island and seagrass shelf.

Figures



SOURCE: Aerial provided by Bing Maps.
HORIZONTAL DATUM: Texas State Plane South Zone, North American Datum of 1983, U.S. Survey Feet

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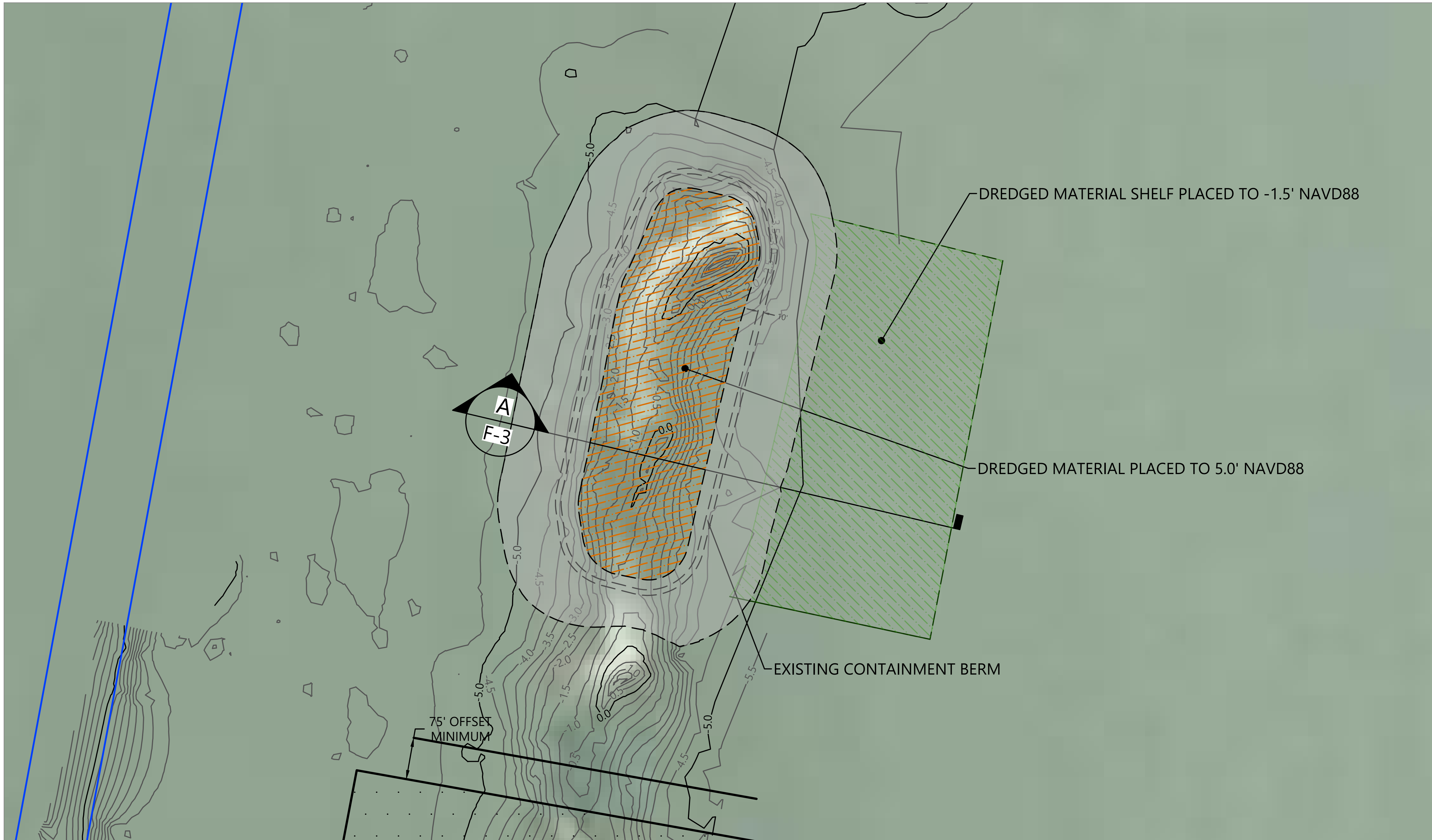
Filepath: K:\Projects\2018-PCCA Beneficial Use\RABBIT ISLAND SOUTH\2018 RP-002 DMMP Attach - Vicinity Map.dwg Figure 1

ANCHOR QEA

Figure 1
Vicinity Map

Rabbit Island South Attachment 4
Texas Lower Coast Beneficial Use

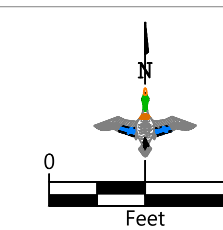


LEGEND:

- DREDGED MATERIAL PLACED TO 5.0' NAVD88 (ELEVATIONS ARE DEPENDENT ON MATERIAL PLACED)
- EXISTING CONTAINMENT BERM
- GULF INTRACOASTAL WATERWAY
- 0 EXISTING CONTOUR (5')
- -3 EXISTING CONTOUR (0.5')
- U.S. ARMY CORPS OF ENGINEERS OPEN WATER DREDGED MATERIAL PLACEMENT AREA
- PROPOSED SEAGRASS SHELF AREA

NOTES:

1. HORIZONTAL DATUM: TEXAS STATE PLANE SOUTH ZONE, NAD83, U.S. SURVEY FEET
2. VERTICAL DATUM: NORTH AMERICAN VERTICAL DATUM OF 1988 (NAVD88)
3. BATHYMETRIC, TOPOGRAPHIC, AND VISUAL HABITAT SURVEYS CONDUCTED BY DUCKS UNLIMITED ON MARCH 23, 2022.



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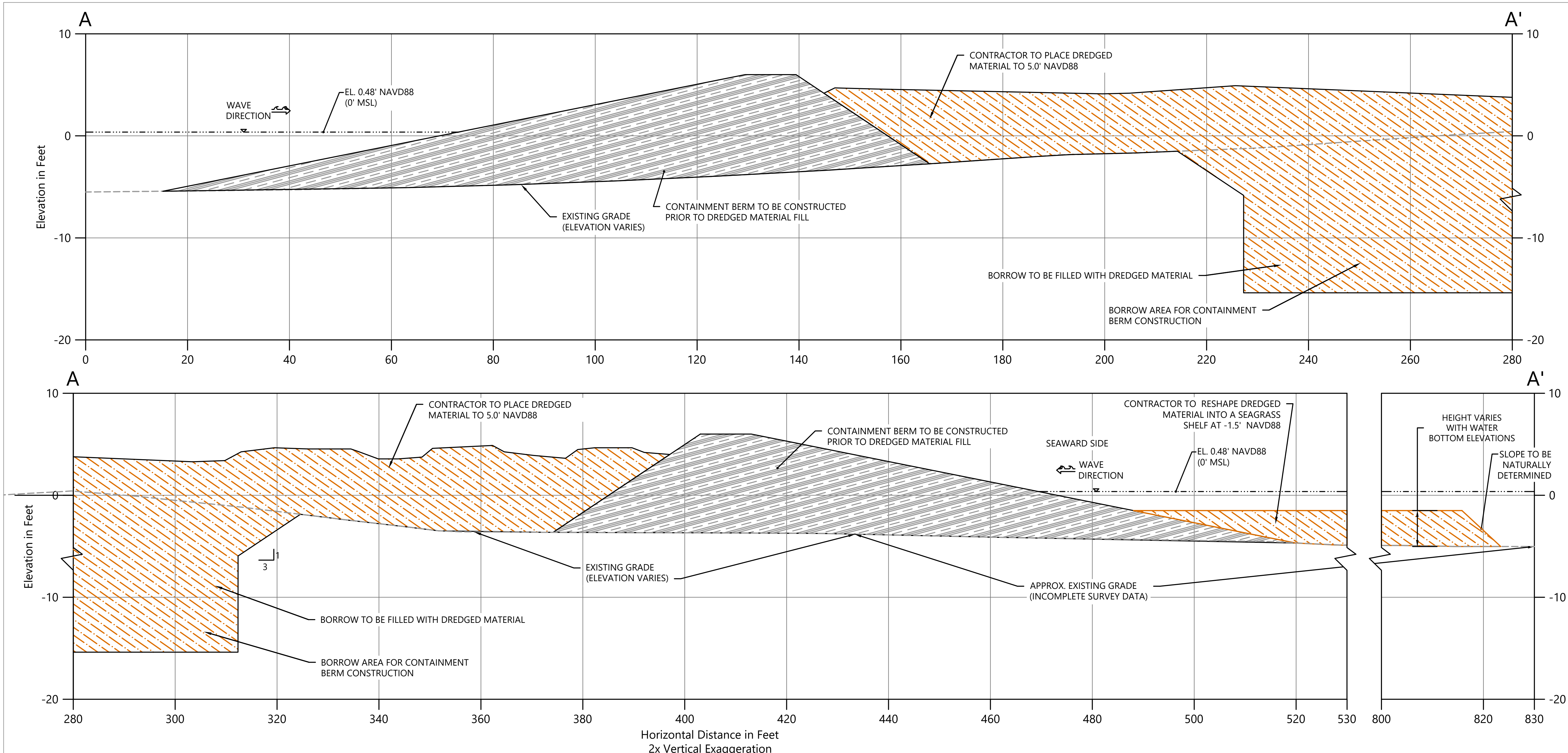
Filepath: K:\Projects\2018-PCCA Beneficial Use\RABBIT ISLAND SOUTH\2018 RP-003 DMMP Attach - Plan View and Section-REVISED.dwg Figure 2

ANCHOR QEA

DUCKS UNLIMITED

Figure 2
Plan View

Rabbit Island South Attachment 4
Texas Lower Coast Beneficial Use



NOTES:

1. HORIZONTAL DATUM: TEXAS STATE PLANE SOUTH ZONE, NAD83, U.S. SURVEY FEET
2. VERTICAL DATUM: NORTH AMERICAN VERTICAL DATUM OF 1988 (NAVD88)
3. BATHYMETRIC, TOPOGRAPHIC, AND VISUAL HABITAT SURVEYS CONDUCTED BY DUCKS UNLIMITED ON MARCH 23, 2022.

A FIG-3 TYPICAL BIRD ISLAND FILL SECTION
HORIZONTAL SCALE: 1" = 10'
VERTICAL SCALE: 1" = 2'

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Filepath: K:\Projects\2018-PCCA Beneficial Use\RABBIT ISLAND SOUTH\2018 RP-003 DMMP Attach - Plan View and Section-REVISED.dwg Figure 3

Figure 3
Typical Bird Island Fill Section

Rabbit Island South Attachment 4
Texas Lower Coast Beneficial Use