U.S. Army Corps
of Engineers

Galveston District
Southwestern Division

Final

Environmental Impact Statement for the Proposed Corpus Christi Ship Channel Deepening Project

March 2024

EXECUTIVE SUMMARY

ES.1 INTRODUCTION AND AUTHORITY

The Port of Corpus Christi Authority (PCCA or Applicant) applied to the U.S. Army Corps of Engineers (USACE), Galveston District (SWG), for a Department of Army (DA) permit. The DA permit application is for deepening of the Corpus Christi Ship Channel (CCSC) at Port Aransas, Nueces County, Texas. The application was originally submitted on January 3, 2019. Based on comments provided by the USACE on May 23, 2019, the application was revised June 4, 2019. The DA determined the permitting constitutes a major Federal Action. The DA permit action is governed under the statutes of the Sections 10 and 14 of the Rivers and Harbors Act of 1899, Section 404 of the Clean Water Act, and Section 103 of the Marine Protection, Research, and Sanctuaries Act. Activities subject to the jurisdiction of the USACE would include dredging of navigable waters to extend the terminus of the authorized channel into the Gulf of Mexico (Gulf); deepening, expanding, and improving the existing CCSC; and beneficial use (BU) and placement of dredged material. The USACE published a Notice of Intent to prepare a Draft Environmental Impact Statement (EIS), which was published in the *Federal Register* on April 7, 2020.

This project was determined to be a covered project under Title 41 of the Fixing America's Surface Transportation Act (FAST-41). As a result, the PCCA Channel Deepening Project (CDP) was added to the Permitting Dashboard for Federal Infrastructure Projects which publicly tracks covered projects. FAST-41 is intended to improve the timeliness, predictability, and transparency of the Federal environmental review and authorization process. The EIS was prepared by a contractor in accordance with Regulatory Guidance Letter 05-08 in conjunction with 40 Code of Federal Regulations (CFR) 1500–1508, Appendix B of 33 of CFR 325, and the Memorandum to Commanders, MSCs and District Commands, Subject: Guidance on Environmental Impact Statement Preparation, USACE Regulatory Program, dated 17 December 1997.

ES.2 PURPOSE AND NEED

The existing 54-foot-deep CCSC limits fully loading very large crude carriers (VLCCs) thereby decreasing transport efficiency. The existing channel depth requires that crude carriers depart partially loaded from the Port of Corpus Christi (Port) or that VLCCs remain offshore while smaller tankers transfer their cargo to fully load the VLCCs, a process referred to as reverse lightering.

The purpose of the preferred project as put forward by the Applicant is to construct a channel with the capability to accommodate transit of fully laden VLCCs from multiple locations on Harbor Island into the Gulf. More efficient transport of crude in greater volumes is the impetus for the Applicant to deepen the channel to accommodate fully loaded VLCCs.

The overall project purpose, as determined by the USACE after concurrence with the Cooperating Agencies is: To safely, efficiently, and economically export current and forecasted crude oil inventories via VLCCs. Crude oil is delivered via pipelines from the Eagle Ford and Permian basins to multiple locations at the

POCC. Crude oil inventories exported at the POCC have increased from 280,000 barrels per day in 2017 to 1,650,000 barrels per day in January 2020 with forecasts increasing to 4,500,000 barrels per day by 2030. Current facilities require reverse lightering to fully load a VLCC, which increases cost and affects safety.

ES.3 DESCRIPTION OF THE PROPOSED ACTION AND ALTERNATIVES

After coordination with the Cooperating Agencies, the USACE determined that the No-Action Alternative and three action alternatives will be carried forward for detailed analysis in this EIS. The following describes those alternatives carried forward for analysis.

No-Action Alternative

Under the No-Action Alternative, the CCSC would not be deepened to a –75 feet mean lower low water (MLLW) and would remain at –54 feet MLLW. VLCCs would continue to be partially loaded and reverse-lightered offshore. The No-Action Alternative does not meet the project purpose and need but is carried forward for detailed analysis in this EIS for comparison purposes.

Alternative 1: Channel Deepening (Applicant's Preferred Alternative)

Alternative 1 consists of deepening the CCSC to –77 feet and –75 feet MLLW from the Gulf to station 110+00 near Harbor Island, including the approximate 10 mile-extension to the Entrance Channel necessary to reach sufficiently deep waters. As a result of one-way transit assumed for VLCCs, the planned widths for the –54-foot currently authorized project are nominally sufficient. Therefore, no widening other than the minor incidental widening to keep these bottom widths and existing channel slopes at the proposed deeper depths would occur. Deepening would take place largely within the footprint of the currently authorized –54-foot channel. Under this alternative, only berths at Axis Midstream and Harbor Island Terminals would be capable of fully loading VLCCs. However, partially loaded outbound VLCCs at Ingleside could top off at Harbor Island and potentially reduce or eliminate reverse lightering.

Dredging 46.3 million cubic yards would be required with inshore and Gulf placement of the material. Placement would occur in a mix of placement areas (PAs), BU sites, and/or the New Work Ocean Dredged Material Disposal Sites (ODMDS). PCCA selected these potential PAs through a process that included agency input and consideration of State and Federal coastal restoration plans.

The Applicant's Preferred Alternative consists of the following elements:

- Deepening from the authorized –54 feet MLLW to approximately –75 feet MLLW, with 2 feet of advanced maintenance and 2 feet of allowable overdredge, from Station 110+00 into the Gulf to Station –72+50 (3.5 miles).
- Deepening from the authorized –56 feet MLLW to approximately –77 feet MLLW, with 2 feet of advanced maintenance and 2 feet of allowable overdredge, from Station –72+50 to Station 620+00 in the Gulf (10.4 miles).

- Placement of new work dredged material at the following BU and PA sites:
  - SS1: Restoring eroded shorelines
  - SS2: Restore eroded shoreline along Port Aransas Nature Preserve/Charlie's Pasture
  - PA4: Reestablish eroded shoreline and land loss in front of PA4 (SS1 Extension), and upland placement within PA4
  - HI-E: Bluff and shoreline restoration with site fill
  - PA6: Raise levee 5-foot and fill with new work material
  - SJI: Beach restoration San José Island
  - B1–B9: Nearshore berms offshore of San José Island and Mustang Island
  - MI: Beach nourishment for Gulf side of Mustang Island
  - ODMDS: Place within New Work ODMDS
- Incremental future maintenance material may be placed at the following PA sites as material suitability allows:
  - Existing Maintenance ODMDS in the vicinity of the CCSC
  - Proposed nearshore berms B1 through B9

Alternative 2: Offshore Single Point Mooring

The CCSC would not be deepened to a –75 foot MLLW and would remain at –54 feet MLLW. The Offshore Single Point Mooring (SPM) Alternative is a multi-buoy, single-point mooring system consisting of multiple sets in an array of SPM buoys (also known as Single Buoy Moorings). It would be in the Gulf approximately 15 miles from the Gulf shoreline. To meet the project purpose, eight individual SPM buoys or four sets in an array would be required. Vessels would be loaded entirely offshore, eliminating the need to traverse the CCSC. This alternative would also eliminate dredging of the channel and the impacts, negative or positive, associated with dredged material placement.

Alternative 3: Inshore/Offshore Combination

The CCSC would not be deepened to a –75 foot MLLW and would remain at –54 foot MLLW. This alternative is an SPM buoy located in the Gulf approximately 15 miles from the Gulf-side shoreline. Each set consists of two SPMs that would be serviced by either one or two pipelines from shore originating in Ingleside or Harbor Island facilities. Vessels are partially loaded inshore then traverse the CCSC offshore to the SPM to fully load. This alternative would also eliminate dredging of the channel and the impacts, negative or positive, associated with dredged material placement.

Alternatives Considered

Two additional alternatives were considered: Houston Alternative that consisted of relocating the project to Port Houston and Brownsville Alternative that consisted of relocating the project to the Port of Brownsville. These alternatives did not meet the USACE's Practicability Factors criteria and were not carried forward for further analysis in this EIS.

ES.4 POTENTIAL ENVIRONMENTAL IMPACTS

This Final EIS addresses the potential impacts of the dredging on human and the environmental resources identified during the public interest review, including placement of dredged material. All factors that may be relevant to the preferred project were considered, including those listed in this section.

Coastal Processes

Many reaches of Texas Gulf and bay shores are undergoing erosion caused by natural processes and anthropogenic impacts. Sediment transport and shoreline change have also been impacted by on-going sea level rise. However, the shorelines along the lower Texas coast are generally more stable than those along the upper Texas coast. Maintenance dredged material placement has been used beneficially to address areas of specific concern. None of the alternatives would alter any of these broad coastal processes.

The No-Action Alternative does not include improvements presented under the Applicant's Preferred Alternative. Therefore, annual maintenance dredging to the CCSC would continue as scheduled. Current impacts include localized sediment redistribution, short-term sediment suspension, and minimal changes in the bathymetry of the area adjacent to dredging. Placement of dredged material would continue as planned. Maintenance material would mostly go into the designated Corpus Christi Maintenance ODMDS in the No-Action Alternative.

Modeling of the Inner Channel indicates that shoaling rates with the Applicant's Preferred Alternative were comparable to that with the No-Action Alternative. However, the model predicted a 5 to 10 percent increase in sedimentation in certain reaches in the Inner Channel under the Applicant's Preferred Alternative because of deeper channel depths. Overall, both 2D and 3D model results indicate that the project impact on sedimentation rates in the Inner Channel is limited to less than 10 percent (W.F. Baird and Associates [Baird], 2022a).

Dredging under the Applicant's Preferred Alternative would result in 46 million cubic yards of new work material. Dredging would be limited mostly to the existing CCSC footprint and would result in localized and temporary turbidity and sedimentation impacts during construction. New work dredged material would be placed in existing upland PAs or used beneficially to restore eroding beach and bay shorelines. There would be no impacts to shorelines from the channel dredging activities under Applicant's Preferred Alternative other than temporary, localized effects resulting from BU placement of sediments on shorelines.

Model simulation results for the Applicant's Preferred Alternative show that little to no sediment from the beach nourishment and nearshore berms settles in the channel. Predicted total settlement is less than 600 cubic yards, suggesting that the beach nourishment and nearshore berms make small contributions to channel sedimentation compared to the overall sedimentation. Modeling also predicted maximum increase in sedimentation due to the New Work ODMDS is approximately 1,200 cubic yards, and therefore was concluded that the contribution from the New Work ODMDS sediment to channel sedimentation is small in comparison with the overall sedimentation.

Physical Oceanography

There would be no impacts to physical oceanography systems by implementing the No-Action Alternative. Minor alterations from maintenance dredging of the existing channel and placement of dredged material at PAs and the Maintenance ODMDS would continue. There may be localized changes to currents and tidal levels within the bays and offshore adjacent to the jetties.

Modeling of the Applicant's Preferred Alternative indicates that channel deepening is unlikely to change mean water levels in the bay. However, the model predicted that high tide would increase by less than 0.79 inches in Corpus Christi Bay and Redfish Bay. A noticeable impact on the tidal range is limited to the Navigation Channel from Point Mustang to the inner basin. Modeling also demonstrates no significant impact on currents in Corpus Christi Bay, Redfish Bay, and Nueces Bay.

Use of the New Work ODMDS would result in a periodic bathymetry change over an area up to 1.36 square nautical miles. However, the site is dispersive, and the change would be temporary and within the permitted boundaries.

Salinity

Gradual salinity change is expected with sea level rise and changes in freshwater inflow. However, the No-Action Alternative would not alter the expected changes. The increased water exchange associated with the Applicant's Preferred Alternative is predicted to result in salinity changes less than 1 part per thousand (ppt) for the bays with up to a 3 ppt change at the outlet of Nueces Bay during high flow periods from the Nueces River and in the vicinity of the deepened channel. Some localized changes in salinity of less than ±3 ppt in the proposed dredge area and connected navigation channels may occur.

Climate Setting

Climate-related impacts are expected along the Texas coast and these changes are expected to occur regardless of the project alternatives. The most significant climate-related impact is expected to be the rise in sea level and, in particular, the elevated impacts of storm surges. The No-Action Alternative would not alter predicted impacts. However, the channel deepening under the Applicant's Preferred Alternative would allow more surge to propagate the channel, intensifying velocity and increasing water levels. The predicted water elevation gain would be up to 3.5 inches with a Category 4 storm, resulting in an increase in inundation area of up to 492 acres. Beach nourishment and nearshore berms proposed under the Applicant's Preferred Alternative would help to offset erosion and attenuate wave energy.

Water Quality and Sediment Quality

Except for impacts associated with dredging, surface water quality trends would not be altered by any of the alternatives. Under the No-Action Alternative, maintenance dredging would continue, resulting in localized and short-term turbidity impacts and potentially nutrient availability. Increased turbidity can also depress dissolved oxygen, but the potential impact would be localized and transient.

Assessments of new work material do not indicate potential for measurable chemical or heavy metals associated with dredging under the Applicant's Preferred Alternative. Short-term suspension of sediments would occur with dredging and placement and the suspension of nutrients can result in increased algal productivity. Similar to maintenance dredging, hypoxic conditions can develop among areas of high turbidity; however, these changes are expected to be localized and temporary.

Sediment quality is not expected to change with the No-Action Alternative. Maintenance dredging would continue as planned for the CCSC, and the maintenance dredged material would be placed in the maintenance ODMDS. Based on the results of sediment testing, no adverse environmental effects would be expected from dredging or placement of the sediment from the project area into the New Work ODMDS. Testing specific to the CDP was conducted by PCCA. Based on the results of the sampling, testing, and evaluation of the sediment, analysis concluded that no adverse environmental effects would be expected from dredging or placement of the sediment form the project area into the New Work ODMDS (U.S. Environmental Protection Agency concurrence, February 2024).

Groundwater and Surface Water Hydrology

There would be no impacts to watershed and river basin hydrology under any of the alternatives. Under the Applicant's Preferred Alternative, there may be localized impacts to surface hydrology associated with BU of dredged material. Containment levees may change patterns of sheet flow from rainfall runoff towards the bay. These impacts are expected to be localized and would continue for several years during the marsh restoration and stabilization process.

Soils

Most of the project area is composed of soils that are classified as "not prime farmland," with a negligible amount classified as "farmland of statewide importance." None of the alternatives would impact prime farmlands or farmlands of statewide importance. For the Applicant's Preferred Alternative, none of the proposed dredged material placement sites are located on prime farmland or farmland of statewide importance.

Energy and Mineral Resources

None of the alternatives would have a discernable direct impact on energy and mineral resources. Under the Applicant's Preferred Alternative, the expansion of the Port facility to accommodate larger-capacity vessels would provide additional capacity for import/export of energy and mineral resources.

Hazardous, Toxic, and Radioactive Waste (HTRW)

As industrial activity continues to increase to accommodate future anticipated demands for petroleum commodities in the U.S., additional indirect HTRW impacts would occur regardless of any of the alternatives. Natural environmental changes including continued sea level rise and hurricane storm surges would continue to place infrastructure at risk, increasing the potential for the release of waste materials into the environment. Under the Applicant's Preferred Alternative, the increased handling of HTRW would increase risks around Harbor Island. However, the risk of spills offshore or nearshore associated with lightering would be reduced.

Air Quality

Except for scheduled maintenance dredging, there would be no emissions associated with construction under the No-Action Alternative. Air emissions associated with light-loading of VLCCs would continue, which consists primarily of volatile organic compounds (VOC), comparable to annual regional VOC emissions.

Under the Applicant's Preferred Alternative, the primary air emissions would be produced from construction equipment, and those from loading of the VLCCs would be reduced. Fugitive emissions, such as volatile and semi-volatile chemicals, from the dredged material are not expected. Air emissions from construction would be a one-time activity occurring over an estimated 5-year period. Construction dredging emissions are not expected to have long-term impacts or pose a risk to attainment standards. Long-term impacts are air emissions reductions associated with reducing at-sea lightering activity, eliminating lightering vessel transit emissions and changing vessel loading from less emissions-controlled loading process to emission-controlled onshore loading. These include particulates, sulfur oxides, nitrogen oxides, carbon monoxide, and VOC, which are expected to decrease by an average of 78 percent since lightering would be eliminated.

Noise

The No-Action Alternative would have no major noise impacts in the immediate future. However, elevated short-term noise may occur during maintenance dredging and noise may increase over the long-term due to increased ship traffic.

Under the Applicant's Preferred Alternative, noise impacts would result from dredging, dredged material placement, and shipping operations. Noise impacts associated with dredging would be comparable to existing maintenance dredging and would last for up to 2 years inside the jetties. Short-term noise impacts would be associated with equipment used for dredged material placement. These impacts would be intermittent and may be lessened due to background noise associated with waves and wind. Vessel loading is not expected to pose noise issues. Noise associated with vessel transit is expected to decrease with the elimination of lightering vessels.

Wetlands and Submerged Aquatic Vegetation

Wetland decline is expected with rising sea levels. None of the alternatives would alter this long-term projection. No direct impacts to wetlands or submerged aquatic vegetation (SAV) would occur under the No-Action Alternative. Without potential BU placement associated with the Applicant's Preferred Alternative to serve as a protective barrier in some areas, SAV may have a higher risk for loss.

Under the Applicant's Preferred Alternative, the dredging would be in the footprint of the existing channel and there would be no impacts to existing wetlands or SAV; placement actions would result in impacts to aquatic resources including wetlands and SAV. Some impacts could be associated with higher turbidity associated with dredging, but those impacts would be localized and temporary. Beneficial use of dredged material would result in direct impacts to wetlands and SAV. Specifically for inshore PA construction, 16.61 acres of tidal wetlands, 122.46 acres of non-tidal wetlands, and 6.88 acres of SAV would be directly impacted.

Aquatic Resources

None of the alternatives would impact freshwater stream since none occur in the project area. Under the No-Action Alternative, there would be no direct impacts to estuarine habitats and fauna. Projected impacts to wetlands and SAV associated with rising sea level would continue. Under the No-Action Alternative, increases in ship traffic and lightering may increase the probability of chemical spills in the estuary.

The Applicant's Preferred Alternative would directly affect the estuarine habitats and fauna in the study area due to dredging and placement activities. Channel dredging (inshore and offshore) would impact 1,182 acres of open water/bottom habitat through excavation. For Gulf side placement actions, nearshore berms (B1–B9) would impact 1,586 acres of open water/bottom habitat (NOAA, 2010), MI and SJI beach nourishment placement would impact 275.19 acres of open water/bottom habitat (Mott MacDonald, 2021, 2022) and the ODMDS would impact 1,180 acres of open water/bottom habitat (NOAA, 2010).

Beneficial use sediment placement would initially directly impact 139.07 acres of wetlands and 6.88 acres of seagrass through the burial of benthic communities and increased turbidity. Impacts would be distributed at four BU sites: palustrine, estuarine, and seagrass habitat at SS1 (25.0 acres), PA4 (46.0 acres), and HI-E (62.5 acres); and 12.5 acres of palustrine and estuarine habitat at SS2. These totals include 16.61 acres of estuarine habitat, 122.46 acres of palustrine habitat, and 6.88 acres of seagrass (Mott MacDonald, 2021, 2022; Triton Environmental Solutions, 2021a, 2022a; Port, 2023).

A variety of plants and the habitat they create would be impacted by placement of sediment for beneficial uses. Palustrine habitat impacted sea ox-eyed daisy (*Borrichia frutescens*), salt meadow cordgrass (*Spartina patens*), and Gulf dune paspalum (*Paspalum monostachyum*) while coastal upland impacts affected little bluestem (*Schizachyrium scoparium*) and prickly pear cactus (*Opuntia engelmannii*) (Port, 2023). Estuarine habitat that was impacted included saltwort (*Batis maritima*), saltgrass (*Distichlis spicata*), shoregrass (*Distichlis littoralis*), smooth cordgrass (*Spartina alterniflora*), dwarf saltwort (*Salicornia bigelovii*), and black mangrove (*Avicennia germinans*). At H1-E. 0.10 acres of oysters would be relocated to avoid impact.

Dredging and placement of sediments for BU would have temporary impacts associated with burial of nearby benthic communities and increase turbidity near those sites. Beneficial use of dredged material is expected to have a long-term positive benefit by improving and protecting habitat and building resistance to rising sea levels. Beneficial use would also create protective barriers along the Gulf shorelines and the eroding shores of Harbor Island and Dagger Island. Without this additional strategically placed material, erosion of these shores combined with rising sea level would threaten substantial zones of valuable estuarine habitat.

Invasive Species in Ballast Water

The No-Action Alternative would not alter the problems with or the protocols for invasive species in ballast water. Vessel traffic is expected to increase within the CCSC and potential issues with invasive species would also increase.

Under the Applicant's Preferred Alternative, most VLCC ballast water exchanges would be located around Axis and Harbor Island, increasing the risk of introducing invasive species to Corpus Christi Bay. However, the overall risk would be less than the No-Action Alternative.

Wildlife Resources

There would be no new direct impacts to wildlife from implementing the No-Action Alternative. Potential impacts associated with maintenance dredging would continue. In addition, predicted increase in vessel traffic and lightering might also increase, increasing potential for shoreline erosion, vessel noise, vessel strikes, and pollution spills.

The Applicant's Preferred Alternative would temporarily cause localized increases in turbidity and lower dissolved oxygen during dredging operations. Dredging for deepening the channel would temporarily increase chances of direct impacts to sea turtles and potentially impair water quality in the short-term in the vicinity of dredging and material placement. The expected reduced vessel traffic might lower the risk of lethal interactions or disturbances caused by vessel traffic. Reduced lightering would potentially reduce the risk of spills. Beneficial use of dredged material is proposed to increase beach and wetland habitat and reduce shoreline erosion.

Protected Lands

There would be no direct impacts to protected lands under the No-Action Alternative. Long-term, sea level rise is expected to inundate low-lying areas with or without any of the project alternatives. Channel deepening associated with the Applicant's Preferred Alternative would not directly impact protected lands within the project area. Wake analysis indicated minimal impact associated with the proposed vessel traffic. However, the decrease in lightering under the Applicant's Preferred Alternative is expected to decrease vessel traffic and possibly associated shoreline erosion. Beneficial use associated with the Applicant's Preferred Alternative would aid in protecting shorelines.

Threatened and Endangered Species

Under the No-Action Alternative, maintenance dredging would continue to have potential impacts to threatened and endangered species such as sea turtles and various birds. Turbidity can temporarily impair visual feeding and placement of dredged material could temporarily alter habitat. Predicted increased vessel traffic could potentially lead to increased collisions with marine mammals and sea turtles. Predicted rising sea level is expected to impact shorelines that serve as foraging, nesting, and wintering habitat used by Northern Aplomado Falcon, Red Knot, Piping Plover, and Whooping Crane.

Similar to maintenance dredging under the No-Action Alternative, dredging under the Applicant's Preferred Alternative would result in temporary and localized turbidity and increase the potential to injure or kill sea turtles. Dredged material placement may temporarily disturb shorebirds such as Piping Plover and Red Knots. Material placed at the potential BU sites could potentially benefit Federally-listed species such as Piping Plovers and Red Knots. The Applicant's Preferred Alternative is expected to reduce vessel traffic, possibly lowering incidences of vessel strikes and noise disturbance to marine mammals and sea turtles. However, transporting larger volumes of crude oil might increase risk of larger spills.

Essential Fish Habitat

Under the No-Action Alternative, trends in wetland loss, declining marshes, relative sea level rise, and increasing salinity and water temperatures would continue. Impacts from maintenance dredging include increased water column turbidity during and for a short time after dredging and placement, and burial of benthic organisms. Turbidity can displace fish and finfish feeding efficiency and potentially displace Federally managed species. However, these impacts are typically localized and temporary.

The Applicant's Preferred Alternative would directly affect the estuarine habitats and fauna in the study area due to dredging and placement activities. Channel dredging (inshore and offshore) would impact 1,182 acres of open water/bottom habitat through excavation. For Gulf side placement actions, nearshore berms (B1–B9) would impact 1,586 acres of open water/bottom habitat (NOAA, 2010), MI and SJI beach nourishment placement would impact 275.19 acres of open water/bottom habitat (Mott MacDonald, 2021, 2022) and the ODMDS would impact 1,180 acres of open water/bottom habitat (NOAA, 2010).

Direct aquatic resource impacts from inshore PA construction include 563.85 acres of open water/bottom habitat, 16.61 acres of tidal wetlands, 122.46 acres of freshwater wetlands, 84.85 acres of unconsolidated shorelines (tidal sand flats/algal flats/beach), 6.88 acres of seagrass, and 0.10 acres of oyster reef (Mott MacDonald, 2021, 2022; Triton Environmental Solutions, 2021a, 2022a; Port, 2023).

As a result, this could impact food available to Federally managed species. The displacement of juvenile and adult finfish and shrimp during project construction and impacts associated with turbidity would likely be temporary. Beneficial use of dredged material is expected to benefit Federally managed species through marsh protection and enhancement.

Migratory Birds and Marine Mammals

The impacts to migratory birds and marine mammals with each of the alternatives would be similar for those described for threatened and endangered species.

Cultural Resources

State and Federal cultural resource regulators reviewed the project's potential to affect significant cultural resources (called, "Historic Properties"). The reviewing agencies commented that the Applicant's Preferred Alternative was not likely to affect non-archaeological historic-age cultural resources, but intensive survey was necessary to assess certain project components impacts to terrestrial and underwater archaeological resources. The data from these surveys indicate that the project would have no adverse effect on significant archaeological resources and, by extension, would have no adverse effect on Historic Properties.

Socioeconomics

Trends in the regional socioeconomic conditions are expected to continue under the No-Action Alternative. Economic growth related to the industrial and petroleum industry is predicted to increase in response to demands for crude oil, refined products, iron, and steel with port-related employment expected to grow. The populations of Aransas Pass, Corpus Christi, and Port Aransas are also expected to increase. Community and recreational resources are expected to adjust to reflect the population changes.

Construction under the Applicant's Preferred Alternative is expected to have minor, short-term benefits to the economy and have little effect on local housing since most dredge crews house on the dredges. Beneficial use of dredged material would help enhance and protect marshes and beaches, providing long-term benefits, such as increased tourism. Over the long-term, Applicant's Preferred Alternative is expected to increase oil exports. A recent study estimated a multiplier of 0.02 port and terminal-related jobs generated per 1,000 tons of crude oil exported. Therefore, project-related employment would support local household income and result in additional economic impacts circulating through the regional economy. Potential impacts of the Applicant's Preferred Alternative to low-income and minority communities are expected to be short-term during construction. Potential benefit for these communities over the long-term may include increased employment, reduction in noise associated with lightering and decreased vessel traffic, and improved environmental conditions associated with beneficial use of dredged material.

Navigation

Under the No-Action Alternative, VLCCs would continue less efficient export shipping of crude oil from Ingleside and Harbor Island. Lightering vessel traffic would continue movements from Ingleside and Harbor Island. One-way traffic restriction delays would continue to be imposed during VLCC transits. Impacts to navigation under the Applicant's Preferred Alternative are not expected to be adverse. There would be no increase in VLCC vessel traffic and no change to the VLCC one-way traffic restrictions. Reductions in reverse lightering would decrease vessel traffic, by reducing the number of Suezmax and/or Aframax class vessels required to carry out reverse lightering operations. Conflicts with the ferry operations at Port Aransas would decrease compared to the No-Action Alternative.

ES.5 CUMULATIVE IMPACTS

Cumulative impact analysis considers the impacts of the preferred project in combination with past, present, and reasonably foreseeable future actions within the study area. For this analysis, the study area is considered the spatial boundary and it includes substantial portions of four counties, four bays, portions of several coastal watersheds, three barrier islands, and offshore extents. For a temporal boundary, projects considered for the cumulative effects analysis included projects that have been completed approximately within the past 5 years (2016 to 2020) or might be constructed approximately within the next 5 years. Forty-two projects were identified and considered which met these criteria, most of which were associated with shipping terminals, dredging, pipelines, and commercial development.

Impacts of past, present, and reasonably foreseeable actions in the study area were described in general and qualitative terms for the cumulative effects analysis. Most effects from projects are assumed to occur primarily during construction, and those impacts are typically localized, temporary, and minor. Some projects are also assumed to have permanent impacts associated with their physical footprint, noise, air emissions, or induced traffic and growth, for example. The preferred action's impacts could contribute to cumulative effects where they overlap with impacts of past, present, and reasonably foreseeable actions. For example, comparing the Applicant's Preferred Alternative with the No-Action Alternative indicates a tidal amplitude increase at the Inner Channel near Port Aransas of up to 15 percent increase. When considering the impacts of tidal amplitude of the No-Action condition (–54 feet MLLW authorized depth) over previous conditions (–48 feet MLLW authorized depth), modeling indicates up to 18 percent at the Inner Channel. These modeling results indicate that the Applicant's Preferred Alternative would result in a direct cumulative increase in tidal range, particularly at the Inner Channel near Port Aransas where it could be as high as 36 percent.

Mitigative efforts or actions that decrease risks of potential cumulative effects of the Applicant's Preferred Alternative include:

- Agency and stakeholder coordination
- Implementation of one-way channel traffic
- Slower speeds requirements
- Appropriate tugboat assistance requirements
- Placement actions targeting BU

ES.6 MITIGATION

Under the Applicant's Preferred Alternative, dredged material would be placed over approximately 1,455.58 acres. Impacts would occur to approximately 139 acres of wetlands. However, beneficial use placement would create approximately 75 acres of marsh and protect other wetlands and marsh habitat from erosion. Beneficial use placement would impact approximately 6.88 acres of seagrass. However, mitigation efforts would re-establish approximately 6.88 acres of seagrass via transplanting live seagrasses from the impacted area. Beneficial use placement would impact approximately 0.10 acres of live oyster. However, mitigation efforts would re-establish approximately 0.10 acres of live oyster by relocating live oysters in the impacted area. Overall, beneficial use PAs were designed to protect approximately 2,400 acres of seagrass in Redfish Bay (Port, 2023).

ES.7 COORDINATION AND PUBLIC INVOLVEMENT

The USACE and PCCA involved the public through public meetings and other outreach throughout the history of the project. A proactive approach was taken to inform and involve the public, resource agencies, industry, local government, and other interested parties about the project and to identify any public concerns. The Applicant conducted an initial agency coordination meeting on September 21, 2018 to obtain the input of Federal, State, and local resource agencies, including the USACE, Galveston District, to help further develop dredged material placement that considered environmental impact and BU opportunities.

The USACE published the Joint Public Notice with TCEQ on August 1, 2019, which initiated the pre-scoping steps for the Lead, Cooperating, and commenting agencies. A FAST-41 Interagency Coordination Meeting was held on July 22, 2019 to discuss the development of the Coordinated Project Plan. The USACE also held two webinars with the agencies on July 31, 2019 and August 1, 2019 to discuss the development of the initial CPP. Throughout the process, the USACE has coordinated updates of the CPP quarterly with the Cooperating Agencies.

Due to COVID-19, a series of virtual public scoping meetings, hosted by the USACE, Galveston District, for the PCCA CDP was held online in June 2020. The first of this series of virtual public scoping meetings was held on Tuesday, June 9, 2020, utilizing PublicInput.com. Due to technical issues associated with the virtual platform, the format was changed and a total of five scoping meetings were hosted. The purpose of the virtual public scoping meetings was to provide the public with information about the preferred project and to solicit comments and information to better enable the USACE to make a reasonable decision on factors affecting the public interest.

An interagency scoping meeting took place prior to the public scoping meeting on May 14, 2020. Agency representatives were given an opportunity to express their concerns and inform the USACE and PCCA of items that will need to be covered in the EIS and points of contact.

In addition to the scoping meetings, a project website was launched in May 2020 (https://pccaeisproject.com/) that contains project information as well as information about the National Environmental Policy Act process. The website provides members of the public the opportunity to sign up for the EIS mailing list and submit comments during comment periods.

This Final EIS is being circulated to all known Federal, State, and local agencies. Interested organizations and individuals are also being sent the Notice of Availability. A list of those who are being sent a copy of this document, along with a request to review and provide comments, is provided in Section 14.0.

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Acronyms and Abbreviations

°F	degrees Fahrenheit
ac-ft	acre-feet
ACS	American Community Survey
APE	Area of Potential Effects
AWOIS	Automated Wreck and Obstruction Information System
Baird	W.F. Baird and Associates
BBEST	Bays Basin and Bay Expert Science Team
BEA	Bureau of Economic Analysis
BP	before present
bpd	barrels per day
BU	beneficial use
CAA	Clean Air Act
CCSC	Corpus Christi Ship Channel
CCSCIP	Corpus Christi Ship Channel Improvement Project
CDP	Channel Deepening Project
CEA	cumulative effect analysis
CEQ	Council on Environmental Quality
CERCLA	Comprehensive Environmental Response, Compensation and Liability Act
CFR	Code of Federal Regulations
CH_4	methane
CO	carbon monoxide
CO_2	carbon dioxide
CO_{2e}	carbon dioxide equivalent
CPP	Coordinated Project Plan
CSD	cutter suction dredge
CWA	Clean Water Act
cy	cubic yards
CZMA	Coastal Zone Management Act
CZMP	Coastal Zone Management Program
DA	Department of Army
dB	decibels
dBA	A-weighted decibels
DEIS	Draft Environmental Impact Statement
DMMP	Dredged Material Management Plan
DMMU	Dredged Material Management Unit

DMPA	dredged material placement area
DO	dissolved oxygen
EFH	Essential Fish Habitat
EIA	U.S. Energy Information Administration
EIS	Environmental Impact Statement
EO	Executive Order
EPA	U.S. Environmental Protection Agency
ERL	effects range-low
ERNS	Emergency Response Notification System
ESA	Endangered Species Act
FAST-41	Fixing America's Surface Transportation, Title 41
FEIS	Final Environmental Impact Statement
FPISC	Federal Permitting Improvement Steering Council
GHG	Greenhouse Gas
GIS	Geographic Information System
GIWW	Gulf Intracoastal Waterway
GLO	Texas General Land Office
GMFMC	Gulf of Mexico Fisheries Management Council
Gulf	Gulf of Mexico
HDD	horizontal directional drill
HRI	Harte Research Institute
HTRW	Hazardous, Toxic, and Radioactive Waste
IC	Institutional Control
IPCC	Intergovernmental Panel on Climate Change
LEDPA	least environmentally damaging practicable alternative
L_{eq}	equivalent sound levels
LNG	liquid natural gas
LPST	Leaking Petroleum Storage Tank
LRL	laboratory reporting limit
LT	long-term
MACT	Maximum Achievable Control Technology
mcy	million cubic yards
MDL	method detection limit
MLLW	mean lower low water
MLT	mean low tide
MMPA	Marine Mammal Protection Act
MPFATE	Multiple Placement Fate
mph	miles per hour

MPRSA	Marine Protection, Research, and Sanctuaries Act
MSFCMA	Magnuson-Stevens Fishery Conservation and Management Act
MTBP	metric ton bollard pull
N_2O	nitrous oxide
NAAQS	National Ambient Air Quality Standards
NAS	naval air station
NEPA	National Environmental Policy Act
NFRAP	No Further Remedial Action Planned
NMFS	National Marine Fisheries Service
NO_2	nitrogen dioxide
NOAA	National Oceanic and Atmospheric Administration
NO_x	nitrogen oxides
NPL	National Priority List
NPS	National Park Service
NRC	National Research Council
NRHP	National Register of Historic Places
NWI	National Wetlands Inventory
NWR	National Wildlife Refuge
O_3	ozone
ODMDS	Ocean Dredged Material Disposal Site
OMB	U.S. Office of Management and Budget
PA	placement area
PAH	polycyclic aromatic hydrocarbon
Pb	lead
PCB	polychlorinated biphenyl
PCCA or Applicant	Port of Corpus Christi Authority
PM	particulate matter
Port	Port of Corpus Christi
ppb	parts per billion
ppm	parts per million
ppt	parts per thousand
PRM	Permittee responsible mitigation
RCRA	Resource Conservation and Recovery Act
ROI	Region of Influence
RRC	Railroad Commission of Texas
RSLC	relative sea level change
RSLR	relative sea level rise
SAL	State Antiquities Landmark

SAV	submerged aquatic vegetation
SEMS	Superfund Enterprise Management System
SH	State Highway
SHPO	State Historic Preservation Officer
SMSFP	Smithsonian Marine Station at Fort Pierce
SO_2	sulfur dioxide
SO_x	sulfur dioxides
SPM	Single Point Mooring
SWG	Galveston District
SWQM	Surface Water Quality Monitoring
TCEQ	Texas Commission on Environmental Quality
TCMP	Texas Coastal Management Program
TCOON	Texas Coastal Ocean Observation Network
TDSHS	Texas Department of State Health Services
TEL	threshold effects level
THC	Texas Historical Commission
TMDL	total maximum daily load
TPWD	Texas Parks and Wildlife Department
TWDB	Texas Water Development Board
TxDOT	Texas Department of Transportation
TxDOT-MRD	Texas Department of Transportation – Maritime Division
ug/m^3	microgram per cubic meter
USACE	U.S. Army Corps of Engineers
USC	United States Code
USCG	United States Coast Guard
USFWS	U.S. Fish and Wildlife Service
USGS	U.S. Geological Survey
VCP	Voluntary Cleanup Program
VLCC	very large crude carriers
VOC	volatile organic compounds
WOTUS	Waters of the United States
WRDA	Water Resources Development Act

1.0 INTRODUCTION, PURPOSE, AND NEED

1.1 INTRODUCTION

The Port of Corpus Christi Authority (PCCA or Applicant) applied to the U.S. Army Corps of Engineers (USACE) , Galveston District (SWG), for a Department of Army (DA) permit. The DA permit application is for deepening of the Corpus Christi Ship Channel (CCSC) . The application was originally submitted on January 3, 2019 (Appendix A1). Based on comments provided by the USACE on May 23, 2019, the application was revised June 4, 2019 (Appendix A2). The DA permit action is governed under the following statutes:

- **Section 10 of the Rivers and Harbors Act of 1899:** Section 10 of the Rivers and Harbors Act prohibits the construction of structures or obstructions in navigable waters without consent of Congress (33 United States Code [USC] 403). Structures include wharves, piers, jetties, breakwaters, bulkheads, etc. The Rivers and Harbors Act also considers any changes to the course, location, condition, or capacity of navigable waters and includes dredge and fill projects in those waters. The USACE oversees implementation of this law. The preferred action would include construction of structures and/or work that may affect navigable waters.
- **Section 14 of the Rivers and Harbors Act of 1899:** Section 14 of the Rivers and Harbors Act authorizes the USACE to approve alterations to public works projects operated and maintained by non-Federal sponsors known as Section 408 (33 USC 408). Any modification to a Federally maintained USACE project requires 408 approval from the USACE Chief of Engineers. The preferred action would constitute a major modification to a Federal navigation channel which will require a more comprehensive review and evaluation.
- **Section 404 of the Clean Water Act (CWA):** Section 404 of the CWA (33 USC 1344) normally requires a USACE permit for the discharge or deposition of dredged or fill material and for the building of structures in all Waters of the United States (WOTUS). The preferred action would include the discharge of dredged or fill material into waters of the United States. Permit applicants must make every effort to avoid and minimize aquatic resource impacts and provide compensatory mitigation to offset any unavoidable impacts. The USACE can only permit the least environmentally damaging practicable alternative (LEDPA) as it pertains to regulated fill discharges. For this preferred project, the LEDPA determination only applies to the inshore components of the Dredged Material Management Plan (DMMP).
- **Section 103 of the Marine Protection, Research, and Sanctuaries Act (MPRSA):** Section 103 of the MPRSA prescribes regulations, procedures, and evaluations applicable to Federal actions transporting dredged material for the purpose of disposal in ocean waters. USACE applies U.S. Environmental Protection Agency's (EPA) ocean dumping criteria to determine whether to authorize ocean disposal of dredged material under MPRSA permits. MPRSA permits are subject to EPA review and concurrence. The preferred action would include disposal of dredged material in an Ocean Dredged Material Disposal Site (ODMDS).

Based on the DA permit application submitted by PCCA, the USACE determined that the permitting action for the preferred project constitutes a major Federal action. The USACE published a Notice of Intent to prepare a Draft Environmental Impact Statement (DEIS), which was published in the *Federal Register* on April 7, 2020 (Appendix B1). The permit application reflecting the Applicant's plans for the preferred project is included in this document as Appendix A2. Table 1-1 provides a summary matrix of the project's proposed actions along with the associated governing regulatory statute(s).

Table 1-1
CDP Preferred Actions and Governing Regulatory Statute

Preferred Action	Governing Regulatory Statute
Deepen existing Federally authorized navigation channel by dredging	Sections 10 and 14 of the Rivers and Harbors Act
Placement of New Work dredged material at a designated ODMDS	MPRSA Section 103
Placement of New Work dredged material to create nearshore berms and to restore coastal beach and dune	Section 10 of the Rivers and Harbors Act, CWA Section 404
Beneficial Use (BU) for shoreline restoration	Section 10 of the Rivers and Harbors Act, CWA Section 404
Upland Placement	Section 10 of the Rivers and Harbors Act

Pursuant to the National Environmental Policy Act (NEPA) of 1969, as amended (42 USC 4323 et seq.), the USACE serves as the Lead Agency for the preparation of the Environmental Impact Statement (EIS). This Final EIS (FEIS) has been prepared to analyze and disclose the potential impacts of the PCCA Channel Deepening Project (CDP) and reasonable alternatives on the natural and human environment. It is intended to be sufficient in scope to address Federal, State, and local requirements with respect to the proposed activities and permit approvals. As part of the NEPA process, the EPA, National Oceanic and Atmospheric Administration (NOAA) , National Marine Fisheries Service (NMFS), the U.S. Fish and Wildlife Service (USFWS), and the U.S. Coast Guard (USCG) are Cooperating Agencies. The Texas Commission on Environmental Quality (TCEQ) and the Texas Parks and Wildlife Department (TPWD) are commenting agencies.

This project was determined to be a covered project under Title 41 of the Fixing America's Surface Transportation Act (FAST-41). As a result, the PCCA CDP was added to the Permitting Dashboard for Federal Infrastructure Projects which tracks covered projects publicly. FAST-41 is intended to improve the timeliness, predictability, and transparency of the Federal environmental review and authorization process.

1.2 PROJECT LOCATION

The PCCA CDP is located in Port Aransas, Nueces County, Texas (Figure 1-1). The CDP channel alignment is within the existing channel bottom of the CCSC starting at Station 110+00 near the southeast side of Harbor Island. The CDP traverses easterly through Aransas Pass and extends beyond the currently authorized terminus at Station –330+00. The CDP extension terminates at an additional 29,000 feet into the Gulf of Mexico (Gulf) at Station –620+00, the channel's proposed new terminus. The approximate distance of the proposed PCCA CDP is 13.8 miles. The Federal navigation channel segments from Stations 110+00 to –72+50 (Jetties Channel's seaward limits) is currently authorized at –54 feet mean lower low water (MLLW). The Federal navigation channel segments from –72+50 to –330+00 (Offshore Channel's seaward limits) is currently authorized at –56 feet MLLW. For these segments, the Federally authorized channel bottom widths vary from 530 feet (inshore segments) to 700 feet (offshore segments).

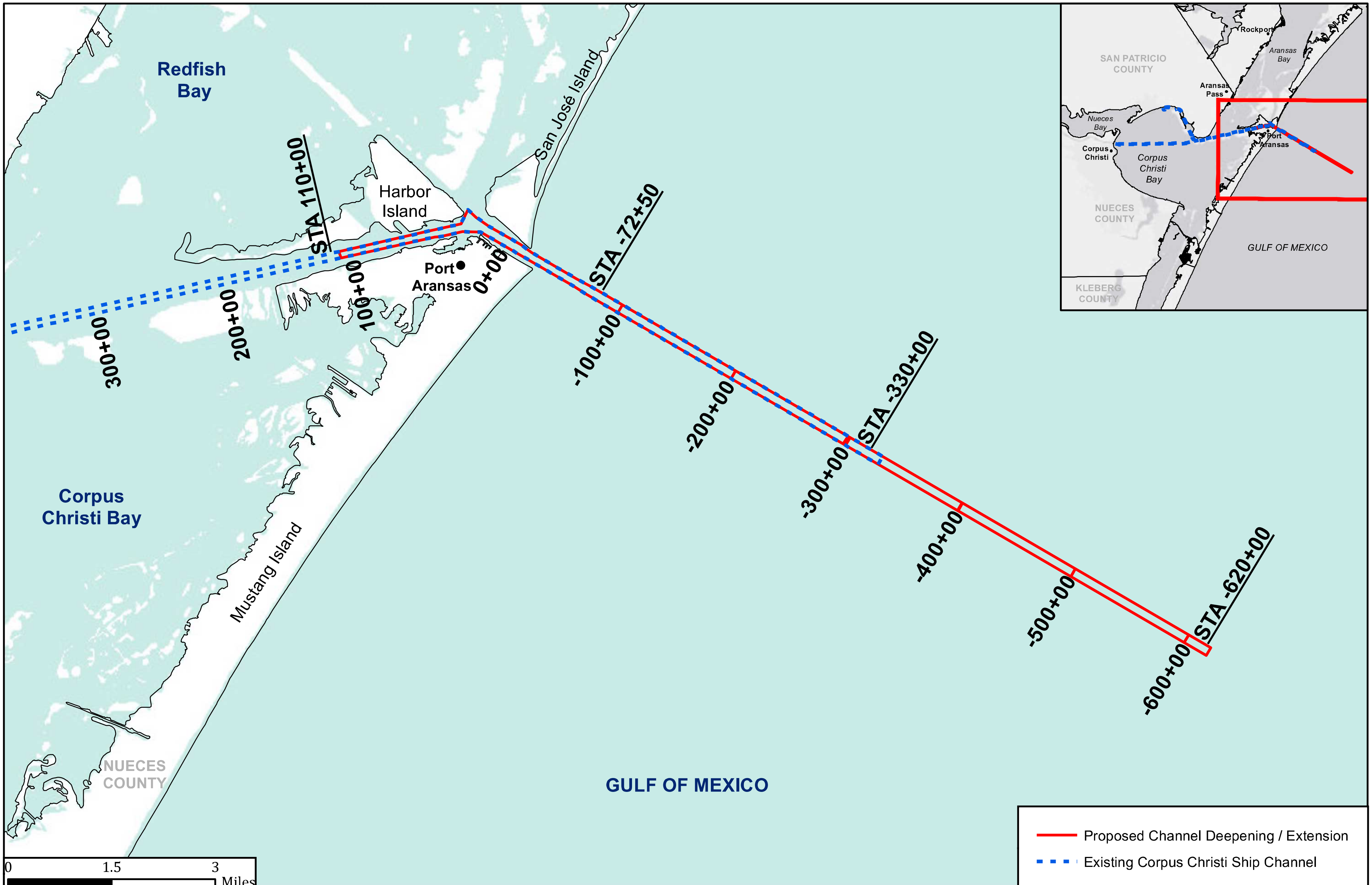
1.3 PROPOSED ACTION

The PCCA CDP would deepen the channel from its current authorized depth of –54 feet MLLW from Station 110+00 to Station –72+50 to –75 feet MLLW. From Station –72+50 to Station –330+00, the channel would be deepened from –54 feet MLLW to –77 feet MLLW. The preferred project includes a 29,000-foot extension of the CCSC from Station–330+00 to Station –620+00 and would be deepened to –77 feet MLLW. Two feet of advanced maintenance and 2 feet of allowable overdredge would be applied to each CDP channel segment. The resulting maximum depth for each CDP channel segment is provided in Table 1-2.

Table 1-2
Maximum Depth for each CDP Channel Segment

Channel Stations	Proposed CDP Channel Depth (feet MLLW)	Advanced Maintenance Plus Allowable Overdredge (feet)	Maximum CDP Channel Depth (feet MLLW)
110+00 to –72+50	75	4	79
–72+50 to –330+00	77	4	81
–330+00 to –620+00	77	4	81

The proposed CDP would span approximately 13.8 miles from a location near the southeast side of Harbor Island to the –80-foot MLLW bathymetric contour in the Gulf. The proposed CDP footprint would cover 1,778 acres, generating 46.3 million cubic yards (mcy) of new work dredged material.



PROJECT NO. PCA20166

DATE CREATED Date: 2/7/2022

DATUM & COORDINATE SYSTEM NAD83 State Plane (feet) Texas South Central

FILE NAME Name: Fig_1-1_Project Location Map

PREPARED BY KLC

Port of Corpus Christi Authority
Corpus Christi Ship Channel Deepening Project

Project Location Map

FIGURE 1-1

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The preferred project consists of the following:

- Deepening a portion of the CCSC from the current authorization of –54 and –56 feet MLLW to final constructed deepened channel ranging from –75 to –77 feet MLLW to accommodate fully-laden Very Large Crude Carriers (VLCC) transiting from Harbor Island to the Gulf from Stations 110+00 to –620+00;
- Extending the existing terminus of the authorized channel an additional 29,000 feet into the Gulf to reach the –80-foot MLLW bathymetric contour to accommodate fully-laden VLCCs transiting from Harbor Island to the Gulf;
- Expanding the existing Inner Basin at Harbor Island, as necessary, to accommodate VLCCs turning;
- Straightening the northeast channel limits of the Harbor Island Transition Flare to accommodate VLCC turning;
- BU placement of new work dredged material at Harbor Island and Port Aransas to restore eroded shorelines adjacent the CCSC;
- Placement of new work dredged material into an existing upland dredged material placement area (DMPA) at Harbor Island;
- BU placement of new work dredged material on the eastern portion of Harbor Island to restore the eroded bluff and shoreline;
- BU placement of dredged material on the Gulf-facing shoreline of San José Island for beach restoration;
- BU placement of dredged material on Gulf-facing shoreline of Mustang Island for beach restoration;
- BU placement of dredged material within nearshore berms offshore San José and Mustang islands; and
- Placement of new work dredged material within the Corpus Christi Expanded New Work ODMDS.

1.4 BACKGROUND

The Port of Corpus Christi (Port) was incorporated as an official navigation district in 1926 (Port, 2016). In 1910, navigation improvements began in Corpus Christi with the Federal authorization of a 12-foot channel through Aransas Pass in 1879, and a 12-foot deep, 100-foot-wide channel through Corpus Christi Bay (USACE, 2003). In 1920, Congress authorized the USACE to conduct a feasibility study for a deepwater port in this area. Congress authorized channel construction in 1922 and from 1925 to 1926 the CCSC was dredged to 25 feet deep and had a bottom width of 200 feet. Since its opening in 1926, the Port has routinely deepened the channel over the years to accommodate the larger ships being used for commodities transport. The major commodity at the Port was initially cotton in the 1920's. In the 1930's oil fields were discovered near the area and refineries began to locate around the Port (Port, 2022a). From

1930 to 1948, various portions of the main and tributary channels were deepened, widened, or modified. These modifications included provision for turning basins up to a 38-foot depth and up to a 400-foot channel width. Following Congressional authorization in 1958, the CCSC was improved to 40 and 42 feet deep along with other widening up to 400 feet. Further modifications to the turning basin were made in 1965. By 1989, following authorization in 1968, the CCSC and La Quinta Channel were deepened to their existing depths of 45 feet. With this authorization, channel widths were widened from 700 feet in the Entrance Channel to 200 feet in the Inner Harbor (USACE, 2003). Finally, the Water Resources Development Act (WRDA) of 2007 authorized the CCSC Channel Improvement Project (CCSCIP). The purpose of the CCSCIP was to improve the efficiency and safety of the deep-draft navigation system and protect the quality of the areas coastal and estuarine resources. It entails improving the CCSC to –54 feet MLLW and –56 feet MLLW. Further modifications associated with the CCSCIP, include the widening of the Lower Bay and Upper Bay channel reaches up to 530 feet (USACE, 2003, 2015a).

The largest vessels accommodated by the currently authorized channel depths are Suezmax vessels that may fully laden but not loaded to their maximum design drafts. Light-loaded VLCCs are additionally accommodated by the currently authorized channel depths. Details of the currently authorized Federal project (CCSCIP) are provided below (USACE, 2003):

1. Deepened CCSC from Viola Turning Basin to the end of the jetties in the Gulf (approximately 34 miles) to –54 feet MLLW. Remainder of the channel into the Gulf (approximately 2 miles) deepened to –56 feet MLLW. The Upper Bay and Lower Bay reaches (approximately 20 miles) widened to 530 feet.
2. Constructed barge shelves (channels) 200 feet wide and 14 feet deep MLLW on both sides of the CCSC. Barge shelves extend from the CCSC junction with the La Quinta Channel to the entrance of the Inner Harbor (approximately Beacon 82 vicinity).
3. Extended La Quinta Channel of approximately 1.4 miles beyond its current limit to a depth of 41 feet MLLW. The channel width of the extension is 400 feet and includes a second turning basin. Turning basin constructed at the end of the channel extension with a diameter of 1,200 feet to a depth of 41 feet MLLW. Creation of 15 acres of seagrass adjacent to the La Quinta Channel extension that mitigates impacts to approximately five acres of seagrass.
4. Constructed ecosystem restoration features. Includes rock breakwaters and geotubes to protect 1,200 acres of an existing high quality, complex wetland ecosystem. Ecosystem elements consists of a mix of subtidal habitat, saltmarsh, blue-green algal flats, sandflats, and associated uplands. Additionally, these ecosystem restoration features protect 40 acres of seagrass. Both components are adjacent to the CCSC in the Lower Bay reach of the channel.

The two ecosystem restoration features were completed in 2012, and extension of the La Quinta Channel was completed in 2013. The Project Partnership Agreement for the deepening, widening, and barge lanes was signed in October 2017, and design and sediment testing for the first contract covering the entrance channel have been completed (Port, 2018). Improvements to the CCSC initiated with a dredging contract awarded in 2020 (USACE, 2022a).

The Port has grown over the years to facilitate crude oil exports from onshore production. In 2021, the Port exported an average of 1.63 million barrels per day (bpd). This is a 9.4 percent increase in crude oil exports from 2020 (Port, 2021a, 2022b). The Port is currently forecasted to become the top crude oil exporter in the U.S. over the next 10 years (Chron, 2019). Other commodities moved through the Port include:

- Dry bulk commodities, including coal, ore, and petroleum coke (Port, 2022c).
- Breakbulk – large goods transported individually; the Port supports cargo ships for these types of goods (Port, 2022d).
- Other liquid bulk, including fuel oil, diesel, gasoline, and others (Port, 2022e).
- Wind energy and project cargo are accommodated by facilities that include near dock laydown yards, accessible highway, and railyards. Three Class-1 railroads directly connected to the Port's interchange yard. In addition, there is connector access to Interstate Highway 37, State Highway (SH) 181, and other major highways (Port, 2022f).

The Port had a record year in 2018. Major port-related events during this time period included (Port, 2019a):

- Became the #1 U.S. crude oil exporter, moving 314 million barrels total.
- Became the 3rd largest seaport in the U.S. by tonnage with greater than 106.2 million tons per year. This tonnage surpasses the Port's previous record of 103.5 million tons.
- Two of the Port's largest customers, Chenier and Moda Midstream (now Enbridge Ingleside Oil Terminal), began production, exports, and acquisitions. Enbridge Ingleside Oil Terminal exports of crude oil include the use of VLCCs, and Chenier exports liquid natural gas (LNG).
- Generated $150 billion of economic activity for the U.S. Of the $150 billion, $17 billion was Texas economic activity, $5.3 billion personal income, and $5.6 billion state and local taxes.
- $50 billion in privately funded industrial projects are underway at and within the vicinity of the CCSC.
- Anticipated crude oil exports boost to 2.8 million bpd in 2021.

1.5 PURPOSE AND NEED

1.5.1 Applicant's Purpose and Need Statement

The following is an Applicant prepared statement submitted with the application as required in 33 Code of Federal Regulations (CFR) 325.1(d).

The purpose of the preferred project is to construct a channel with the capability to accommodate transit of fully-laden VLCCs from multiple locations on Harbor Island into the Gulf. Factors influencing the Applicant's need for the project include:

- The ability for more efficient movement of U.S. produced crude oil to meet current and forecasted demand in support of national energy security and national trade objectives,

- Enhancement of the PCCA's ability to accommodate future growth in energy production, and
- Construction of a channel project that the PCCA can readily implement to accommodate industry needs.

Currently, crude oil is primarily exported using Aframax and Suezmax vessels. VLCCs are now regularly calling on existing crude export facilities further up the channel at Ingleside, including at the Moda terminal. Suezmax and VLCC vessels are light loaded (lightered) due to depth restrictions in the existing CCSC, and would continue to be light loaded when the current Federally-authorized CCSC deepening project is completed. Reverse lightering translates into additional vessel trips, cost, man hours, operational risk, and air emissions. To efficiently and cost effectively move crude oil cargo, oil exporters are increasingly using fully loaded vessels, including VLCCs. To fulfill its mission of leveraging commerce to drive prosperity in support of national priorities, the Port must keep pace with the global marketplace.

The need for the preferred project is driven by the considerations below, which are explained in the following paragraphs:

- Pipelines from Eagle Ford and Permian Basins are being constructed to the Port and to Harbor Island. Crude oil terminals are also being planned at Harbor Island using the Federally-authorized –54-foot deep channel. However, use of the –54-foot deep channel limits the ability to fully load VLCCs, decreasing efficiency and requiring reverse lightering of these vessels.
- Bolstering national energy security through the growth of U.S. crude exports.
- Protecting national economic interests by decreasing the national trade deficit.
- Supporting national commerce by keeping pace with existing and expanded infrastructure being modified or already under development to export crude oil resulting from the large growth in the Permian and Eagle Ford oil field development, which has helped the U.S. recently become the top oil-producing nation in the world.
- Improve safety and efficiency of water-borne freight movements.

The infrastructure and proximity to the major Texas shale plays makes the Port an attractive location for efficiently exporting crude oil by VLCC vessels. The Port has received interest from new and existing customers for developing crude oil export terminals and facilities. Production and export of crude oil and natural gas have greatly increased over the years and are providing an economic boom to the Port and the region.

In 2021 the Port exported an average of 1.63 million bpd of crude oil (Port, 2022b), and projections indicate that exports could increase to 4.5 million bpd by 2030. Investments at the Port that are directly aimed at products from the Eagle Ford Shale and Permian Basin are over $300 million. In the latter part of July 2018, the Port sold more than $216 million in bonds to fund energy export products. A portion of this money will be used for the authorized deepening of the CCSC, and will also help fund other improvements, including a crude oil export terminal under design at Harbor Island. The new oil export terminals being planned at the Port will have loading arms, handling equipment, storage tanks, and other related facilities for larger ships including VLCCs. Similar crude export facilities are planned by multiple other entities at Harbor Island.

More efficient transport of crude in greater volumes is the impetus for the Port to deepen the channel to accommodate fully loaded VLCCs. Presently, the existing channel depth requires that current crude carriers, whether VLCCs or other vessels, depart partially loaded from the Port, or that VLCCs remain offshore while smaller tankers transfer their cargo to the larger VLCCs, a process known as reverse lightering. The inefficiency of this process is compounded by some of these smaller vessels also not being able to be fully loaded while moving through the Port.

Production from the Permian and Eagle Ford basins continues to increase, and several of the major midstream companies are currently undergoing major expansions to facilitate the export of greater volumes of crude. One example of these expansions is the new terminals which are at the center of an emerging pipeline and storage hub near Taft, Texas. The terminals are planned to be connected to the Cactus II Pipeline, the Grey Oak Pipeline, and other crude systems, to store crude oil and supply it to the export markets at Corpus Christi. As these exports increase, the number of lightering vessels and product carriers will also increase, adding to shipping delays and congestion inside and outside of the Port. These delays and congestion will increase the cost of transportation, which in turn will increase the cost of crude oil with the ultimate consequence of making U.S. crude less competitive in the global market.

1.5.2 USACE Scope of Analysis

The determination of the scope of analysis for the USACE Federal action is guided by the USACE Regulatory Program NEPA implementing regulations at 33 CFR 325, Appendix B. The scope of analysis will always include WOTUS where regulated impacts are proposed, as well as uplands where there is sufficient Federal control and responsibility to warrant USACE review. The purpose of establishing the scope of analysis is to identify the geographic area within which the USACE is responsible for evaluating environmental effects, thereby ensuring the impacts of the specific activity requiring a DA permit and those portions of the entire project over which the USACE has sufficient control and responsibility to warrant Federal review are evaluated. Based on the USACEs application of the guidance in Appendix B of 33 CFR 325, it has been determined that the scope of analysis for this review concludes the entire preferred project is within USACE jurisdiction.

1.5.3 USACE Overall Project Purpose

In response to submittal of the Permit Application by the PCCA (see Appendix A2), the USACE must take action to determine whether to issue the requested permit. The purpose of USACE’s preferred action is to fulfill its Congressionally mandated responsibilities related to filling WOTUS under Section 404(b)(1). Additionally, USACE’s preferred action is governed by its MPRSA Section 103 authority for placement of dredged material within an ODMDS, subject to EPA concurrence and use of EPA's dumping criteria. Furthermore, the analyses performed under USACE's preferred action must be at a sufficient level for public interest review. In consideration of the proposed permit, the USACE looks to the purpose and need for the project and considers effects on society based on 21 public interest factors and the preferred action's water dependency. Prior to issuance of a DA permit pursuant to Section 404(b)(1) and MPRSA Section 103 guidelines, the USACE would consider the basic project purpose and overall project purpose. The basic project purpose serves as a basis for determining water dependency. The overall project purpose is used as a basis for assessing the practicable alternatives for the proposal pursuant to regulations. In accordance with 33 CFR 320.4(q), "…when private enterprise makes application for a permit, it will generally be assumed that appropriate economic evaluations have been completed, the proposal is economically viable, and is needed in the market place…" Therefore, for the purpose of the permitting process, the economic need, as stated by the overall project purpose, is considered to be met.

The PCCA's purpose and need statement was used by the USACE to determine the "basic" and "overall" project purposes. The Cooperating Agencies pursuant to NEPA and One Federal Decision have concurred with the following Basic and Overall project purpose:

Basic Project Purpose: To safely, efficiently, and economically export current and forecasted crude oil inventories from the facilities at the Port.

Determination: The preferred project does not require access or proximity to, or siting within, a special aquatic site in order to fulfill its basic purpose. Alternatives that do not involve impacts to special aquatic sites are presumed to be available.

Overall Project Purpose: The overall project purpose, as determined by the USACE after concurrence with the Cooperating Agencies is: To safely, efficiently, and economically export current and forecasted crude oil inventories via VLCC, a common vessel in the world fleet. Crude oil is delivered via pipeline from the Eagle Ford and Permian Basins to multiple locations at the Port. Crude oil inventories exported at the Port have increased from 280,000 bpd in 2017 to 1,650,000 barrels in January 2020 with forecasts increasing to 4,500,000 bpd by 2030. Current facilities require vessel lightering to fully load a VLCC which increases cost and effects safety.

The overall project purpose is used to evaluate less environmentally damaging practicable alternatives. The 404(b)(1) Guidelines state that an alternative is practicable if it is available and capable of being done after taking into consideration cost, existing technology, and logistics in light of overall project purposes. This evaluation applies to all WOTUS, not just special aquatic sites such as wetlands and seagrasses.

2.0 PROPOSED ACTION AND ALTERNATIVES

In its evaluation of permit applications to discharge dredged or fill material into WOTUS, including wetlands, the USACE is required to analyze alternatives to the preferred project that achieve its purpose. The USACE conducts this analysis pursuant to two main requirements – the 404(b)(1) Guidelines found in 40 CFR 230 and NEPA found in 33 CFR Part 325 Appendix B and 40 CFR 1508. The USACE also considers alternatives as part of its Public Interest Review evaluation found in 33 CFR 320.4(a)(2)(ii). Potential project components may include ocean dredged material disposal; therefore, this alternatives analysis also considers compliance with Section 103 of the MPRSA (33 CFR 325.6). Last, since this project involves navigation and has the potential to impact operations of a Federally maintained navigation channel, the alternatives analysis also considers requirements of 33 USC 408.

The project purpose is used to evaluate less environmentally damaging practicable alternatives. The 404(b)(1) guidelines state that an alternative is practicable if it is available and capable of being done after considering cost, existing technology, and logistics relative to overall project purpose. This evaluation applies to all WOTUS, including special aquatic sites such as wetlands and seagrasses.

The overall project purpose, as determined by the USACE after concurrence with Cooperating Agencies is:

> *To safely, efficiently, and economically export current and forecasted crude oil inventories via VLCC, a common vessel in the world fleet. Crude oil is delivered via pipeline from the Eagle Ford and Permian Basins to multiple locations at the Port of Corpus Christi. Crude Oil inventories exported at the Port of Corpus Christi have increased from 280,000 bpd in 2017 to 1,650,000 bpd in January 2020 with forecasts increasing to 4,500,000 barrels per day by 2030. Current facilities require vessel lightering to fully load a VLCC which increases cost and effects safety.*

The USACE evaluated information obtained from public input, meetings with Federal and State agencies, and data collection and analysis of environmental, socioeconomic, and engineering factors. Development of project alternatives prioritized minimization of impacts, both individually and cumulatively, to aquatic resources during both construction and operations. Using these concepts and considering avoidance and minimization to reduce impacts, the following six project alternatives were identified.

- No-Action Alternative – Under the No-Action Alternative, the CCSC would not be deepened to a –75 feet MLLW, but would remain at the current Federal authorized depth of –54 feet MLLW. VLCCs would continue to be partially loaded and reverse-lightered offshore. The No-Action Alternative does not meet the project purpose and need but is carried forward for detailed analysis in this EIS for comparison purposes.
- Channel Deepening Alternative (Applicant's Preferred Alternative) – This alternative consists of deepening the CCSC Outer Channel to –77 feet MLLW (with 2 feet of advanced maintenance and 2 feet of allowable overdredge) in the Gulf from Stations 620+00 to 330+00. Channel

deepening to –75 feet MLLW (with 2 feet of advanced maintenance and 2 feet of allowable overdredge) would continue from the CCSC Approach Channel to inshore at station 110+00 near Harbor Island. Approximately 10 miles of channel extension into the Gulf is necessary to reach sufficiently deep waters. Deepening would take place largely within the footprint of the currently authorized –54-foot MLLW channel. Dredging 46.3 mcy would be required with inshore and offshore placement of the material. During this analysis, alternatives to dredged material placement would be conducted on a case-by case basis. Under this alternative, only berths at Harbor Island would be capable of fully loading VLCCs. Partially loaded outbound VLCCs at Ingleside could top off at Harbor Island thereby reducing or eliminating reverse-lightering.

- Offshore Alternative – The CCSC would not be deepened to a –75 foot MLLW and would remain at –54 feet MLLW. To meet the project purpose, multiple deep water port facilities capable of sustaining all projected oil exportation would be constructed. VLCCs would be fully loaded offshore eliminating the need to traverse the channel and reverse-lighter. This alternative would also eliminate dredging of the channel and the impacts associated with dredged material placement.
- Combined Inshore/Offshore – The CCSC would not be deepened to a –75 foot MLLW and would remain at –54 foot MLLW. To meet the project purpose, VLCC vessels would be partially loaded at inshore facilities in Ingleside and Harbor Island then traverse the channel to the offshore facility to be fully loaded. This alternative would eliminate the need to reverse-lighter and would also eliminate dredging of the channel and the impacts associated with dredged material placement.
- Houston Alternative – This alternative consists of relocating the project to Port Houston. The Houston Ship Channel is currently maintained at –46.5 feet MLLW. This alternative would either require the Houston Ship Channel be dredged to –75 feet MLLW or construct offshore facilities to eliminate reverse-lightering.
- Brownsville Alternative – This alternative consists of relocating the project to the Port of Brownsville. The Brownsville Ship Channel is maintained at –42 feet MLLW. This alternative would require either the Brownsville Ship Channel to be dredged to –75 feet MLLW or construct offshore facilities to eliminate reverse-lightering.

The USACE used a multi-step process to screen the range of alternatives to determine which alternatives are reasonable, practicable, and meet the project purpose. The project alternatives were analyzed using the following screening criteria to identify a range of reasonable alternatives: satisfaction of the overall project purpose; practicable based on CWA Section 404(b)(1) guidelines (technology, logistics, cost); and consideration of potential aquatic resources impacts.

As previously stated, alternatives that are practicable are those that are available and capable of being done by the Applicant considering the project purpose. An alternative needs to fail only one practicability factor to be eliminated during the screening process. Those practicability factors include:

- *Existing Technology* – The alternatives examined should consider the limitations of existing technology yet incorporate the most efficient/least-impacting construction methods currently available. Implementation of state-of-the-art technologies might be available and should be considered if applicable. However, it is recognized that such actions may result in the alternative being determined as impracticable due to costs.

- *Logistics* – The alternatives evaluated may incorporate an examination of various logistics associated with the project. Examples of alternatives that may not be practicable considering logistics could include placement of facilities too far from major thoroughfares, no available existing storage or staging areas, and/or safety concerns that cannot be overcome.
- *Costs* – The overall scope/cost of the project is considered as to whether it is unreasonably expensive. This determination is typically made in relation to comparable costs for similar actions in the region or analogous markets. If costs of an alternative are clearly exorbitant compared to those similar actions, and possibly the Applicant's preferred action, they can be eliminated without the need to establish a cost threshold for practicability determinations. Cost is to be based on an objective, industry-neutral inquiry that does not consider an individual Applicant's financial standing. The data used for any cost must be current with respect to the time of the alternatives analysis. A location far from existing infrastructure might not be practicable based on the costs associated with upgrading/establishing the infrastructure necessary to use that site. However, just because one alternative cost more than another does not mean that the more expensive alternative is impracticable. It is important to note that in the context of this definition, cost does not include economics. Economic considerations, such as job loss or creation, effects to the local tax base, or other effects a project is anticipated to have on the local economy are not part of the cost analysis.

Regarding an alternative's availability, the 404(b)(1) Guidelines state that if it is otherwise a practicable alternative, an area not presently owned by the Applicant that could reasonably be obtained, utilized, expanded, or managed to fulfill the overall purpose of the proposed activity can still be considered a practicable alternative. In other words, the fact that an Applicant does not own an alternative parcel, does not preclude that parcel from consideration as a practicable alternative. This factor is normally a consideration as a logistics and possibly a cost limitation.

Based on this analysis, after coordination with the Cooperating Agencies, the USACE has determined that the No-Action Alternative and three action alternatives will be carried forward for detailed analysis in this EIS (Table 2-1) (Appendix B2). Sites that lie substantially outside the PCCAs geographic jurisdiction identified in the overall project purpose are not practicable, and therefore unreasonable, and can be eliminated with little information. Therefore, alternative locations, such as Houston and Brownsville, which were scoped in by the public, are not carried forward in the analysis. The following sections describe those alternatives carried forward for analysis.

Table 2-1
Comparison of Alternatives and Alternative
Practicability Factors for the PCCA CDP

Alternative	Carried Forward (Yes/No)			
	Purpose and Need	Practicability – Technology	Practicability – Logistics	Practicability – Cost*
No-Action	No	Yes	Yes	Yes
Channel Deepening Corpus Christi	Yes	Yes	Yes	Yes
Offshore Corpus Christi	Yes	Yes	Yes	Yes
Inshore/Offshore Corpus Christi	Yes	Yes	Yes	Yes
Port of Brownsville	No	No	No	No
Port of Houston	No	No	No	No

* It is not a particular Applicant's financial standing that is the primary consideration for determining practicability regarding cost, but rather the characteristics of the project and what constitutes a reasonable expense for these projects that are most relevant to practicability determinations.

2.1 NO-ACTION ALTERNATIVE

Under the No-Action Alternative, the CCSC would not be deepened to –75 feet MLLW and would remain at –54 feet MLLW. VLCCs would continue to be partially loaded and reverse-lightered offshore. The No-Action Alternative does not meet the project purpose and need but is carried forward for detailed analysis in this EIS for comparison purposes.

The No-Action Alternative provides a means to evaluate the environmental impacts that would occur if the USACE were to deny the permit for the proposed channel improvements. The Applicant's objective of safely, efficiently, and economically exporting current and forecasted crude oil inventories via VLCC would not be met. Since the CDP requires dredging in navigable waters subject to Section 10 of the Rivers and Harbors Act, and fill activities subject to Section 404 of the CWA, and Section 103 of MPRSA for ocean dredged material disposal, construction activities involving dredge and fill would not proceed without a permit from the USACE. In the event of permit denial, the potential impacts described for the preferred action would not occur.

While the CDP would not occur under the No-Action Alternative, it is assumed that previously permitted and authorized actions at the Port and in the vicinity of the Port would continue according to previously approved plans. The CDP reaches have been improved to the authorized depth of –54 feet as implemented by the CCSCIP from the Gulf to the Inner Harbor to date. Projects currently under way include building and operating a crude oil export terminal on land owned by the PCCA on Harbor Island and constructing facilities and pipelines for marine transport vessels by Axis Midstream (Port, 2019a; USACE, 2018, 2020). Under this alternative, it is assumed that maintenance dredging would continue at a frequency indicated for the –54 feet MLLW CCSCIP. Maintenance material would mostly go into the designated Corpus Christi Maintenance ODMDS. The CCSCIP has been authorized and is currently underway, the Harbor Island and

Axis Midstream projects are currently in the permit evaluation process. The No-Action Alternative assumes that the Harbor Island and Axis Midstream marine terminal projects have been constructed. The preliminary review of these applications indicated that an EIS is not required and, therefore, no NEPA documentation is available. Best professional judgement will be used to aid in descriptions of future conditions under the No-Action Alternative, as appropriate.

Although the No-Action Alternative does not meet purpose and need of the proposed CDP, it is carried forward in this EIS (per 40 CFR section 1502.14(d)) to provide a means by which to compare potential future conditions for action alternatives. Thus, the potential environmental effects resulting from denial of the permit (not implementing the CDP) will be compared with the effects of permitting the CDP or an alternative action.

2.2 ALTERNATIVE 1: CHANNEL DEEPENING (APPLICANT'S PREFERRED ALTERNATIVE)

2.2.1 Background

Alternative 1 consists of deepening the CCSC to –77 feet and –75 feet MLLW from the Gulf to station 110+00 near Harbor Island, including the approximate 10 mile-extension to the Entrance Channel necessary to reach sufficiently deep waters. As a result of one-way transit assumed for VLCCs, the planned widths for the –54-foot currently authorized project are nominally sufficient. Therefore, no widening other than the minor incidental widening to keep these bottom widths and existing channel slopes at the proposed deeper depths would occur. Deepening would take place largely within the footprint of the currently authorized –54-foot channel. Under this alternative, only berths at Axis Midstream and Harbor Island terminals would be capable of fully loading VLCCs; however, partially loaded outbound VLCCs at Ingleside could top off at Harbor Island and potentially reduce or eliminate reverse lightering.

Dredging 46.3 mcy would be required with inshore and Gulf placement of the material. Placement would occur in a mix of PAs, BU sites, and/or the Corpus Christi New Work ODMDS. The Applicant selected these potential PAs through a process that included agency input and consideration of State and Federal coastal restoration plans. Based on review of existing borings from geotechnical investigation conducted by the PCCA, approximately 29.2 mcy of the new work material would consist of sandy material (about 63 percent), and 17.1 mcy would consist of clays, with the remainder comprised of other material types (Fugro USA Land, Inc., 2019).

2.2.2 Project Site and Components

Deepening the CCSC would consist of the features shown in Table 2-2 and Figure 2-1. This alternative consists of deepening the CCSC to –77 and –75 MLLW from the Gulf to station 110+00 near Harbor Island, including the approximate 10-mile extension to the Entrance Channel. Deepening would take place largely within the footprint of the currently authorized –54-foot MLLW channel and placement would occur at both inland PAs, beachfill, nearshore berms, and/or the New Work ODMDS. The Applicant's DMMP is included in Appendix C1 and Dredge Placement Work Plan is included in Section 4.0 of the Beneficial Use Monitoring Plan, Appendix C2 (PCCA, 2023).

Table 2-2
Description of Channel Deepening Alternative

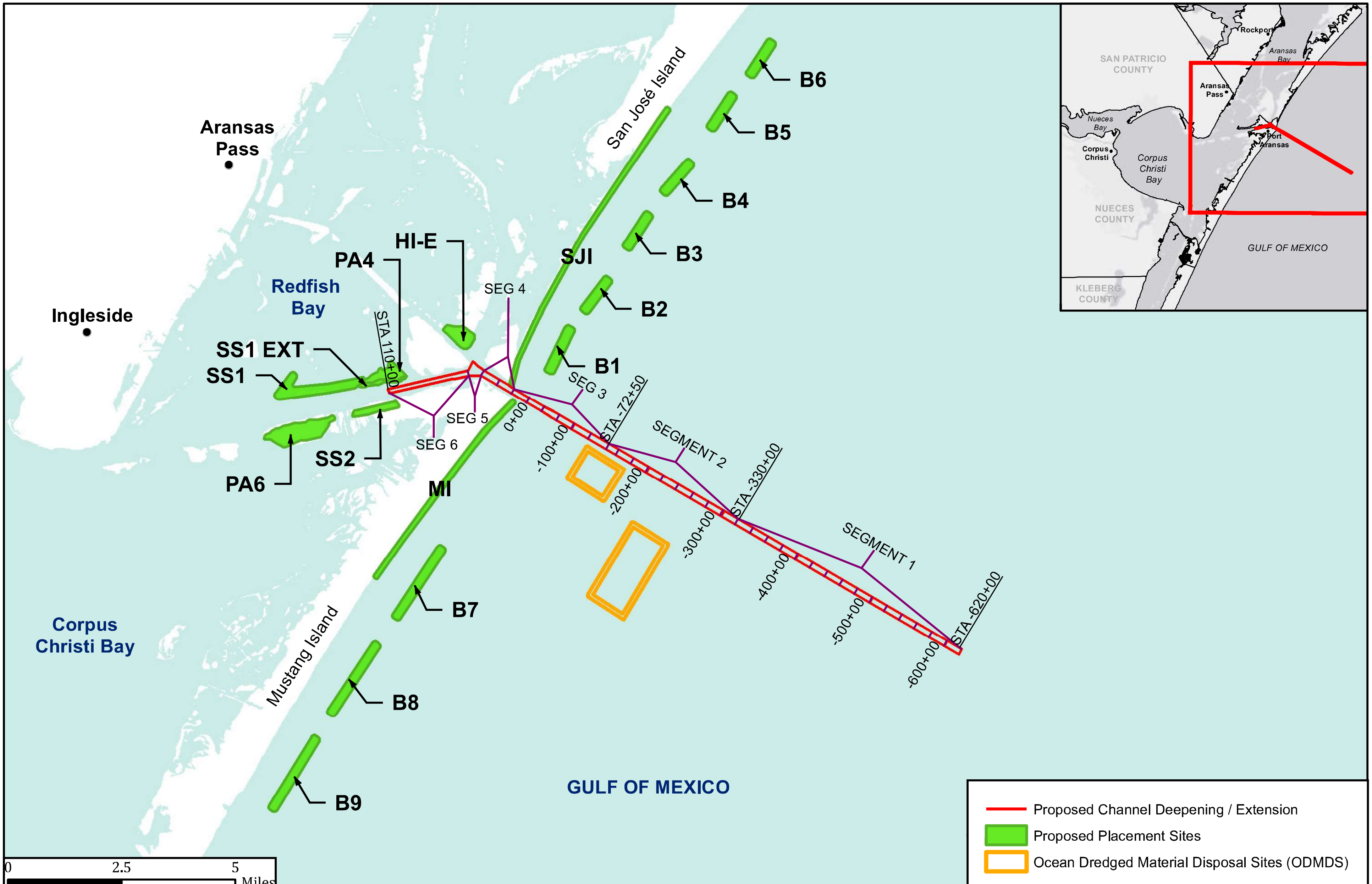
Segment	Stationing		Description	Length (feet)	Width (feet)	Base Depth (feet)	Depth[1] (feet)	Side Slopes (H:V)
	Start	End						
1	–620+00	–330+00	Outer Channel	29,000	640	–77	–81	10:1
2	–330+00	–72+50	Approach Channel	25,750	640	–77	–81	10:1
3	–72+50	–20+00	Jetties to Harbor Island Transition Flare	5,250	540	–75	–79	3:1
4	–20+00	20+82.07	Harbor Island Transition Flare[2]	4,082	Varies	–75	–79	3:1
5	20+82.07	38+16.43	Harbor Island Junction	1,744	Varies	–75	–79	3:1
6	38+16.43	110+00	CCSC	7,184	Varies	–75	–79	3:1

[1] Depth includes 2.0 foot advanced maintenance dredging or 2.0 foot allowable over dredge.

[2] Segment would include slight straightening of the transition flare feature determined necessary for safe vessel transit.

The Applicant's Preferred Alternative consists of the following elements (see Figure 2-1):

- Deepening from the authorized –54 feet MLLW to approximately –75 feet MLLW, with 2 feet of advanced maintenance and 2 feet of allowable overdredge, from Station 110+00 into the Gulf to Station –72+50 (3.5 miles).
- Deepening from the authorized –56 feet MLLW to approximately –77 feet MLLW, with 2 feet of advanced maintenance and 2 feet of allowable overdredge, from Station –72+50 to Station 620+00 in the Gulf (10.4 miles).
- Placement of new work dredged material at the following BU and PA sites (Table 2-3, and see Figure 2-1):
    - SS1: Restoring eroded shorelines
    - SS2: Restore eroded shoreline along Port Aransas Nature Preserve/Charlie's Pasture
    - PA4: Reestablish eroded shoreline and land loss in front of PA4 (SS1 Extension), and upland placement within PA4
    - HI-E: Bluff and shoreline restoration with site fill
    - PA6: Raise levee 5-foot and fill with new work material
    - SJI: Beach nourishment at San José Island
    - B1–B9: Nearshore berms offshore of San José Island and Mustang Island



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PREPARED BY
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Port of Corpus Christi Authority
Corpus Christi Ship Channel Deepening Project

Project Features

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FIGURE 2-1

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Table 2-3
Description of Placement Sites

Placement Site	Description	Total Volume (cubic yards [cy])	Features Being Built		
			Purpose	From Dredged Material	Others (Armoring etc.)
SS1	Restoring eroded shorelines and creating low marsh, high marsh, and marsh-upland fringe habitat	2,793,000	Restore eroded shoreline landmass and provide protection to Harbor Island seagrass area. Mitigation for unavoidable impacts to wetlands and submerged aquatic vegetation (SAV).	Dikes, landmass backfill	Slope armoring/riprap
SS2	Restoring two shoreline breaches and landmass along Port Aransas Nature Preserve resulting from Hurricane Harvey. Would add land mass behind Federal Emergency Management Agency shoreline bulkhead project. Low marsh habitat creation	374,000	Restore shoreline washed out by Hurricane Harvey to protect Piping Plover sand flat Critical Habitat. Mitigation for unavoidable impacts to wetlands.	Interior dikes, landmass backfill	Bulkhead
PA4	Reestablish eroded shoreline and land loss in front of PA4 (SS1 Extension), and upland placement within PA4	4,537,000	Restore eroded shoreline and land loss; provide protection to Harbor Island seagrass by extending SS1 berm in front of PA4. Raise levees for placement of new work material unsuitable for BU.	Exterior containment dike, landmass backfill, raise interior levee, PA interior fill	Slope armoring/riprap
HI-E	Bluff and shoreline land mass restoration with site fill on eastern Harbor Island	1,825,000	Restore eroded bluff and shoreline to historic profiles. Mitigation for unavoidable impacts to oysters.	Containment levees, landmass backfill	Slope armoring/riprap
PA6	Raise PA dike 5 feet and fill with 4 feet of new work material	1,796,400	No environmental benefit, material unsuitable for BU	Raise levee, PA interior fill	
SJI	Beach nourishment at San José Island	2,000,000	Restores several miles of beach profile that was washed away during Hurricane Harvey	Beach	
B1–B9	Nearshore berms offshore of San José Island and Mustang Island	8,660,000	Nearshore berms within transport zone to indirectly nourish barrier islands	Nearshore berms	

Placement Site	Description	Total Volume (cubic yards [cy])	Features Being Built		
			Purpose	From Dredged Material	Others (Armoring etc.)
MI	Beach nourishment for Gulf side of Mustang Island	2,000,000	Mustang Island beach nourishment to enhance shoreline	Beach	
New Work ODMDS	Place material in existing New Work ODMDS	22,531,200	No environmental benefit, material suitable for ocean placement	Placement mound	

  - MI: Beach nourishment for Gulf side of Mustang Island
  - ODMDS: Place within New Work ODMDS
- Incremental future maintenance material may be placed at the following PA sites as material suitability allows:
  - Existing Maintenance ODMDS in the vicinity of the CCSC
  - Proposed nearshore berms B1 through B9

2.2.3 Construction

The channel deepening would be constructed with varying slopes and channel bottom widths along six segments (see Table 2-2). Segments 1 and 2 (Outer and Approach channels, respectively) would be constructed with a 10:1 side slope and channel width of 640 feet. Segment 3 (Jetties to the Harbor Island Transition Flare) would have 3:1 slopes and channel width of 540 feet. Segments 4 to 6 (Harbor Island Transition Flare, Harbor Island Junction, and then the CCSC) would also be constructed with 3:1 side slopes but with varying channel width.

The deepening of the channel would likely be constructed primarily with a cutterhead suction hydraulic dredge but may utilize other dredging methodologies, such as mechanical bucket dredging. Dredged material would be transported to the BU sites via pipeline deployed and mobilized by smaller barges. These barges would deploy once, remaining at the location until work is completed. Other barges would be used to transport material dredged mechanically where stiff clays present in the upper project reaches would be used for BU site construction.

During the construction phase of the project, new work dredging through the Harbor Island junction would require provisions to lessen disruption of ferry use , such as planning dredging for the off-peak or after-hours of ferry operation. These would be similar to the provisions carried out during periodic maintenance of this segment that occurs approximately every 2 years for the existing channel. The BU work plan, including equipment, mobilization, staging, demobilization, dredge sequencing, sediment quality parameters, and geotechnical investigations are detailed in the Beneficial Use Monitoring Plan (Port, 2023; Appendix C2).

The Applicant's DMMP for this alternative would include construction of several PA and BU sites (see Appendix C1). PA4 incorporates an SS1 Extension that would repair an eroded shoreline and land loss in front of PA4, and includes placement of material unsuitable for BU behind the newly created containment levees. SS1 and SS2 would similarly restore eroded shorelines. SS1 would restore elevations to potentially provide protection to seagrass within Redfish Bay. SS2 would restore shorelines along the Port Aransas Nature Preserve and Charlie's Pasture that were damaged during Hurricane Harvey and includes construction or repair of a bulkhead. SS1 Extension, SS1, and SS2 would include the construction of a containment berm with borrowed fill. Behind this containment berm, dredged material would be discharged to increase elevations. PA6 would also include containment levee raising with borrow fill and then it would be filled with dredged materials to increase elevation by 4 feet. PCCA would utilize native plant species for SS1 and SS2. PCCA would likely transplant existing plugs sourced from adjacent PA4 for SS1 and similar wetlands identified within the area from SS2. PCCA would obtain a TPWD permit to transplant vegetation prior to conducting work. PCCA would transplant plugs on 5-foot centers for all habitat types. Following the placement of dredged material at SS1, PCCA would plant the site during the following spring/fall to take advantage of south Texas seasonal rainfall.

SJI would involve the use of sandy new work materials to repair the beach profile on San José Island along approximately 7 miles, which was damaged during Hurricane Harvey. MI would involve beach nourishment of Mustang Island, where sandy new work material would enhance the beach profile from the south CCSC jetty 5 miles along the Gulf side of Mustang Island. B1 through B9 would involve nearshore berms offshore of San José Island and Mustang Island that would be located within the active transport zone in front of the depth of closure, and indirectly nourish these barrier islands.

HI-E would involve restoration of an eroded bluff at the junction of CCSC and Lydia Ann Channel, across from Harbor Island. The new shoreline would be armored. New work material would be used to raise the levee and provide interior fills.

Dredge material would be transported to a designated location by pipeline, scow, or hopper, and support any associated dredging equipment. Dredge and support equipment in service during dredging operations would primarily include dredges, booster pumps and associated barges, dredge tender barges, tugboats, work-related transport and supply boats, survey boats, and crew boats. Onshore construction equipment related to the dredged material PAs would include cranes, trucks, dozers, front-end loaders, backhoes, compactors, graders, and dump trucks.

The proposed construction dredging would occur for 8 to 12 hours per day. It is assumed that work would occur 7 days per week (with some scheduled down time). Supporting equipment would be utilized to transport the crew to and from the dredges for each shift. Light plants would be used in the late afternoon and evening time frames to provide additional lighting for the crew and to serve as safety beacons to surrounding waterborne traffic.

2.2.4 Operations and Maintenance

During operations, impacts to the operation by docking activities at Harbor Island are functions of the Harbor Island terminal projects that are being planned independently and would operate without this CDP. The duration of typical VLCC docking operations at other berths within CCSC are estimated at 30 minutes. This would represent the interruption of two cycles of ferry crossings. It is expected that the terminal projects would coordinate with the Texas Department of Transportation (TxDOT) to account for VLCC berthing operations. However, the proposed channel deepening itself would only affect operations through reduction of vessel calls. Risk of in-channel vessel incident or allision would be reduced by slow vessel speed, multiple tug assist, and one way transit when bringing VLCCs in the Port.

Approximately 400,000 cy of additional (incremental) maintenance material over the current Federal maintenance responsibility for the authorized CCSC would be generated over a period of 20 years after construction of this alternative (AECOM, 2018). It is currently assumed that the maintenance material would be mostly placed in the Corpus Christi New Work ODMDS. PA2 and nearshore berms B1 through B9 may also be applicable for use.

2.3 ALTERNATIVE 2: OFFSHORE SINGLE POINT MOORING

2.3.1 Background

The Offshore Single Point Mooring (SPM) Alternative is a multi-buoy single-point mooring system consisting of multiple sets in an array of SPM buoys (also known as Single Buoy Moorings). It would be located in the Gulf approximately 15 miles from the Gulf-side shoreline. Vessels would be loaded entirely offshore, eliminating the need to traverse the CCSC.

Based on offshore loading rates from various projects in Texas and globally, the loading rate per SPM when operated for multiple vessel loading can be expected to range from 40,000 to 60,000 barrels per hour (Bluewater Texas Terminal, 2019a; Texas Gulf Terminals, 2018; Trans-Balkan Pipeline B.V., 2009). A VLCC can carry approximately 1.9 to 2.2 million barrels. This volume could require approximately between 48 and 60 hours to load to full capacity.

VLCC loading operations are limited to periods of mild to moderate weather conditions and seas. Apart from filling time, the loading process requires time to approach and maneuver towards the SPM buoy, gather, tend, and connect SPM mooring lines (hawsers), floating hoses, and other connections to the vessel, operate valves, and similar disconnection procedures. There is also routine maintenance and inspection. Under this alternative filling, connection, and maintenance times may be more predictable. There are less predictable logistical and scheduling events, such as next vessel arrival (which itself is subject to individual vessel company scheduling), journey delays, shipment customer orders, and contract variability and delays. These factors affect the usage rate of a given offshore loading facility. Therefore, practical throughput is not solely a function of pumping rate, filling time, mooring/connection duration, and scheduled maintenance. Literature from other SPM project planning and offshore permitting documentation indicates that SPM facility planners expect a monthly usage rate of approximately eight VLCCs per month per SPM buoy (Bluewater Texas Terminal, 2019a; Texas Gulf Terminals, 2018; Trans-Balkan Pipeline B.V., 2009).

Factoring in weather, sea state, tendering/loading operations, administration, maintenance, and vessel logistics/scheduling, each SPM has the assumed capacity to load approximately eight VLCCs per month. For each two-SPM array, an average of 16 VLCCs could be loaded per month. This equates to approximately 32.8 million barrels per month, or approximately 1.1 million bpd. To meet a 4.5 million bpd demand, there would have to be eight individual SPM buoys or four sets in an array as described above.

2.3.2 Project Site and Components

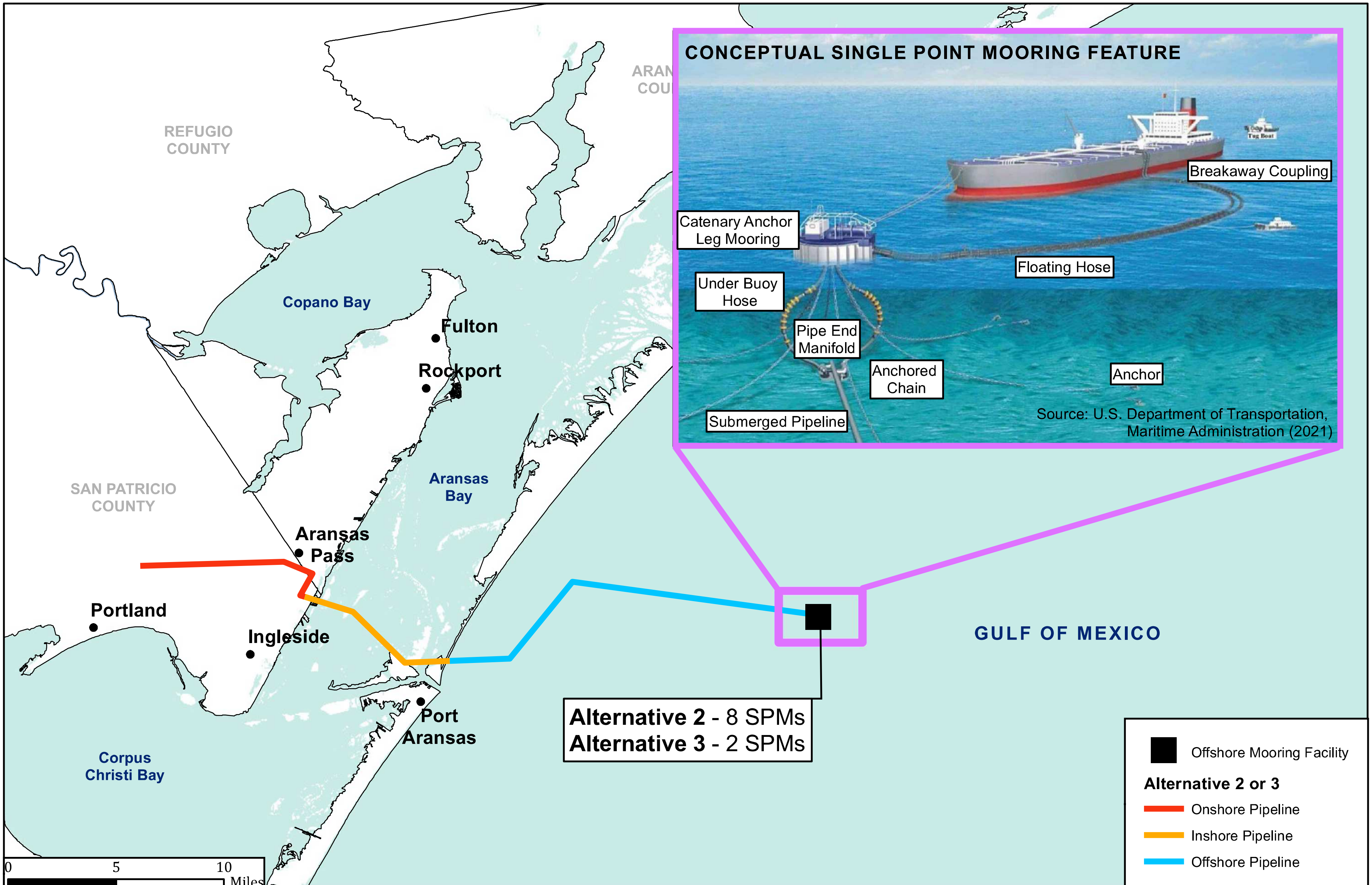
The Offshore SPM Alternative would include an array of SPM buoys located in the Gulf approximately 15 miles from the Gulf-side shoreline (Figure 2-2). Each set consists of two SPMs that would be serviced by either one or two pipelines from shore that would originate in Ingleside or Harbor Island facilities. The pipelines can be single, such as a 48-inch diameter pipe, or dual, such as two 30-inch diameter pipes, consistent with SPM offshore permit applications (Bluewater Texas Terminal, 2019a; Texas Gulf Terminals, 2018). Each SPM buoy would be in a water depth of approximately 90 feet and typically secured by a Catenary Anchor Leg Mooring configuration consisting of approximately six catenary anchor chains (legs). The chains or legs would be attached to seabed anchor points such as gravity-based anchors or piles (SBM Offshore, 2012). The number of SPM sets depends on the total daily throughput needed from the area serviced by the Offshore SPM Alternative. To meet a 4.5 million bpd demand indicated by the Applicant, there would have to be eight individual SPM buoys or four sets.

As aforementioned, the most common number proposed by individual entities for single projects is two SPMs. Locally, the Louisiana Offshore Oil Port, the largest U.S. offshore facility, hosts three SPMs (Louisiana Department of Transportation and Development, 2022). Larger numbers of loading points for single facilities either involve full loading platforms such as the four-berth Iraqi Al Basrah Oil Terminal, or intermediary pumping/metering platforms such as the six-SPM Saudi Arabian Ju'aymah Crude Terminal, both operated under more centralized and nationalized crude oil production (Office of the Special Inspector General for Iraq Reconstruction, 2007; Saudi Aramco, undated).

This alternative does not include any deepening of the CCSC and requires no inshore berthing (i.e., all VLCC vessels would be fully loaded offshore). Alternative 2 eliminates the need to traverse the CCSC and does not require reverse lightering. As is typical of SPMs, the buoy would not be equipped with vapor recovery or other loading emission controls other than what is achievable and practical for offshore loading systems. This typically consists of submerged filling and inert gas management plan to prevent unnecessary venting of volatile organic compound (VOC) vapors. Pipelines would originate inland and lead to the offshore SPM array.

2.3.3 Construction

The primary infrastructure that would need to be constructed includes the pipeline and the SPM facility. The pipeline would likely be constructed in a similar manner that is proposed for the Axis Midstream Harbor Island Terminal (SWG-2018-00789) or Bluewater Terminal (USACE, 2020; U.S. Department of Transportation, 2021), where the pipeline would likely be installed via horizontal directional drill (HDD)



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PREPARED BY
KLC

Port of Corpus Christi Authority
Corpus Christi Ship Channel Deepening Project

Alternatives 2 and 3 Conceptual Features

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FIGURE 2-2

Date Saved: 2/8/2022 2:10:44 PM   Path: H:\ENVIRONMENTAL\Final_Exhibits\EIS Figures\Fig_2_2_Alternatives 2 and 3 Conceptual Features.mxd across Redfish Bay to minimize impacts. Construction of the Offshore SPM would include the SPM buoy(s) secured by a Catenary Anchor Leg Mooring configuration with approximately six catenary anchor chains (legs) attached to gravity-based anchors or piles (SBM Offshore, 2012).

2.3.4 Operations and Maintenance

Like the proposed Bluewater Texas Terminal (Bluewater Texas Terminal, 2019a; U.S. Department of Transportation, 2021), it is assumed that 24/7 monitoring would take place on Harbor Island. Operations would also include an on-site support vessel while loading. For spill preventions, there would be spill and fire response equipment and personnel, and the pipeline route would include shut-off valves and auto shut-off hoses. In addition to maintenance of the Offshore SPM facility itself, it is also assumed that maintenance dredging would be the same as the No-Action Alternative. Alternative 2 would not induce future maintenance dredged material volumes in excess of the No-Action Alternative as maintenance cycles and placement would be associated with the –54-foot MLLW CCSCIP that is currently underway. Most maintenance material would be placed in the ODMDS.

2.4 ALTERNATIVE 3: INSHORE/OFFSHORE COMBINATION

2.4.1 Background

Like the Offshore SMP Alternative, the Inshore/Offshore Combination Alternative is a SPM buoy located in the Gulf approximately 15 miles from the Gulf-side shoreline. The SPM buoy is located at a water depth of approximately 90 feet and is typically secured by a Catenary Anchor Leg Mooring configuration consisting of approximately six catenary anchor chains (legs) secured to seabed with anchor points such as gravity-based anchors or piles (SBM Offshore, 2012). Vessels are partially loaded inshore then traverse the CCSC offshore to the SPM to fully load.

Like the Offshore SPM Alternative, this alternative does not consist of deepening the CCSC and does not require reverse lightering. Some inshore berthing would be required at Harbor Island and Ingleside to partially fill half-laden VLCCs. The half-laden VLCCs would be fully loaded at the SPM.

2.4.2 Project Site and Components

The project site is the same as the Offshore SPM Alternative (see Figure 2-2). It would include an array of SPM buoys located in the Gulf approximately 15 miles from the Gulf-side shoreline. Each set consists of two SPMs that would be serviced by either one or two pipelines from shore that would originate in Ingleside or Harbor Island facilities.

2.4.3 Construction

Construction of this alternative would be like the Offshore SPM Alternative. The primary infrastructure that would need to be constructed includes the pipeline and the SPM facility. The pipeline would likely be constructed in a similar manner that is proposed for the Axis Midstream Harbor Island Terminal (SWG-2018-00789) or Bluewater Terminal (USACE, 2020; U.S. Department of Transportation, 2021), where the pipeline would likely be installed via HDD across Redfish Bay to minimize impacts. Construction of the Offshore SPM would include the SPM buoy(s) secured by a Catenary Anchor Leg Mooring configuration with approximately six catenary anchor chains (legs) attached to gravity-based anchors or piles (SBM Offshore, 2012). This alternative also assumes that facilities would be constructed on Harbor Island through other USACE authorizations.

2.4.4 Operations and Maintenance

During operations of this alternative, inshore berthing of VLCCs would still occur at LaQuinta or Harbor Island for partial filling (i.e., half laden). These VLCCs would then fully fill at the Offshore SPM facility. Like the Offshore SPM alternative, it is assumed that 24/7 monitoring would take place on Harbor Island and that a support vessel would always be on-site while loading. For spill preventions, there would be spill and fire response equipment and personnel, and the pipeline route would include shut-off valves and auto shut-off hoses. Similar to the Offshore SPM Alternative, this alternative would not induce future maintenance dredged material volumes in excess of the No-Action Alternative. Most maintenance material would be placed in the ODMDS.

3.0 AFFECTED ENVIRONMENT

The purpose of the Affected Environment section of this EIS is to provide a description of the existing environment in areas likely to be affected by the proposed CDP alternatives in a manner that allows effects to be completely understood. To reduce the size of this document, descriptions are commensurate with the importance of the anticipated impact. Resources likely to have little or no impact are summarized, and a more-thorough description is provided for resources more likely to be impacted.

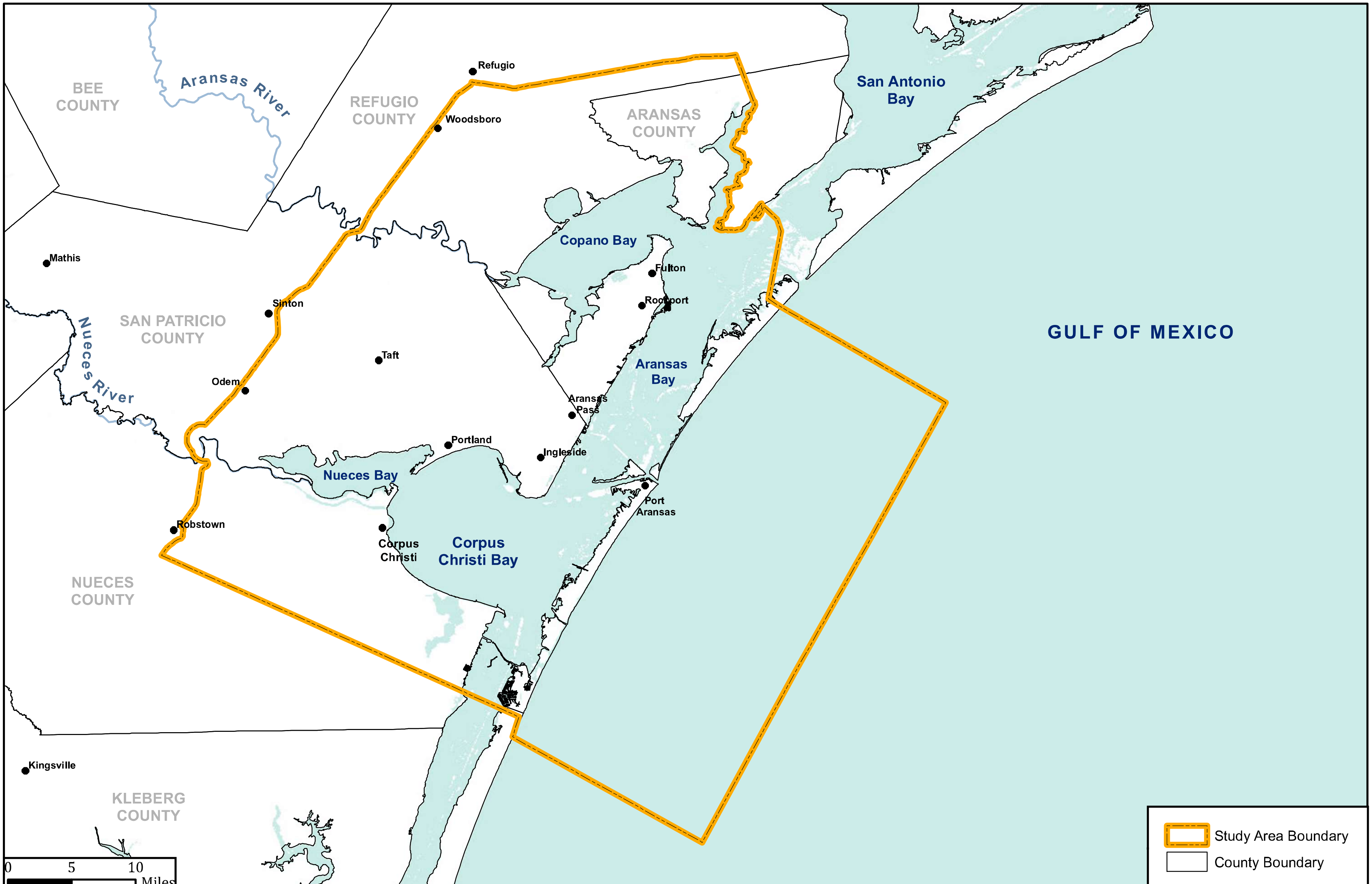
A study area and project area have been refined to more-accurately describe existing resources and potential impacts associated with the proposed CDP. The study area encompasses an area that provides spatial boundaries for resources that could be indirectly impacted by the proposed CDP (Figure 3-1). The study area is defined to facilitate discussion of existing conditions in a general context as well as discussion of indirect and cumulative impacts. For some resources (e.g., air quality, noise, socioeconomics) the study and project areas may be defined differently.

The project area provides spatial boundaries for evaluation of resources that may be more-directly impacted by the construction and operation of the preferred project, and is therefore a smaller area, more immediate to the preferred project features. Specifically, for purposes of analysis in this EIS, the project is defined as the footprint of the construction area within the channel plus a 1-mile buffer area and the beneficial use sites (Figure 3-2). Detailed descriptions of the study and project areas along with the natural systems and human components are discussed below.

Based on scoping, it was determined that further development of baseline conditions for specific resources from a desktop review was needed to properly analyze the impacts. Existing conditions were modeled for those resources and are summarized in the appropriate resource sections below.

3.1 GENERAL SETTING

The preferred project is located mainly in the Corpus Christi Bay system and extends 11 miles into the Gulf. The study area includes portions of four coastal counties, Nueces, San Patricio, Refugio, and Aransas (Figure 3-1). The study area is on the south-central portion of the Texas coast, 200 miles southwest of Galveston and 150 miles north of the mouth of the Rio Grande. Most of the CCSC is in Nueces County, with a small portion of the channel entrance running through Aransas County at the pass between San José and Mustang islands, and the channel passes existing terminals located in Ingleside in San Patricio County. The study area extends approximately 17 miles offshore from San José, Mustang, and North Padre islands beyond the proposed CCSC extension. The CCSC provides deep water access from the Gulf to the Port, via the Port Aransas Channel, through Redfish Bay and Corpus Christi Bay. The waterway extends from the jettied Port Aransas entrance 20.75 miles to the Inner Harbor. Access points to the CCSC include the La Quinta Channel, the Gulf Intracoastal Waterway (GIWW), and the Rincon Canal. The La Quinta



PROJECT NO.
PCA20166

DATE CREATED
Date: 2/27/2024

DATUM & COORDINATE SYSTEM
NAD83 State Plane (feet) Texas South Central

FILE NAME
Name: Fig_3-1_Study Area Boundary

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KLC

Port of Corpus Christi Authority
Corpus Christi Ship Channel Deepening Project

Study Area Boundary

FIGURE 3-1

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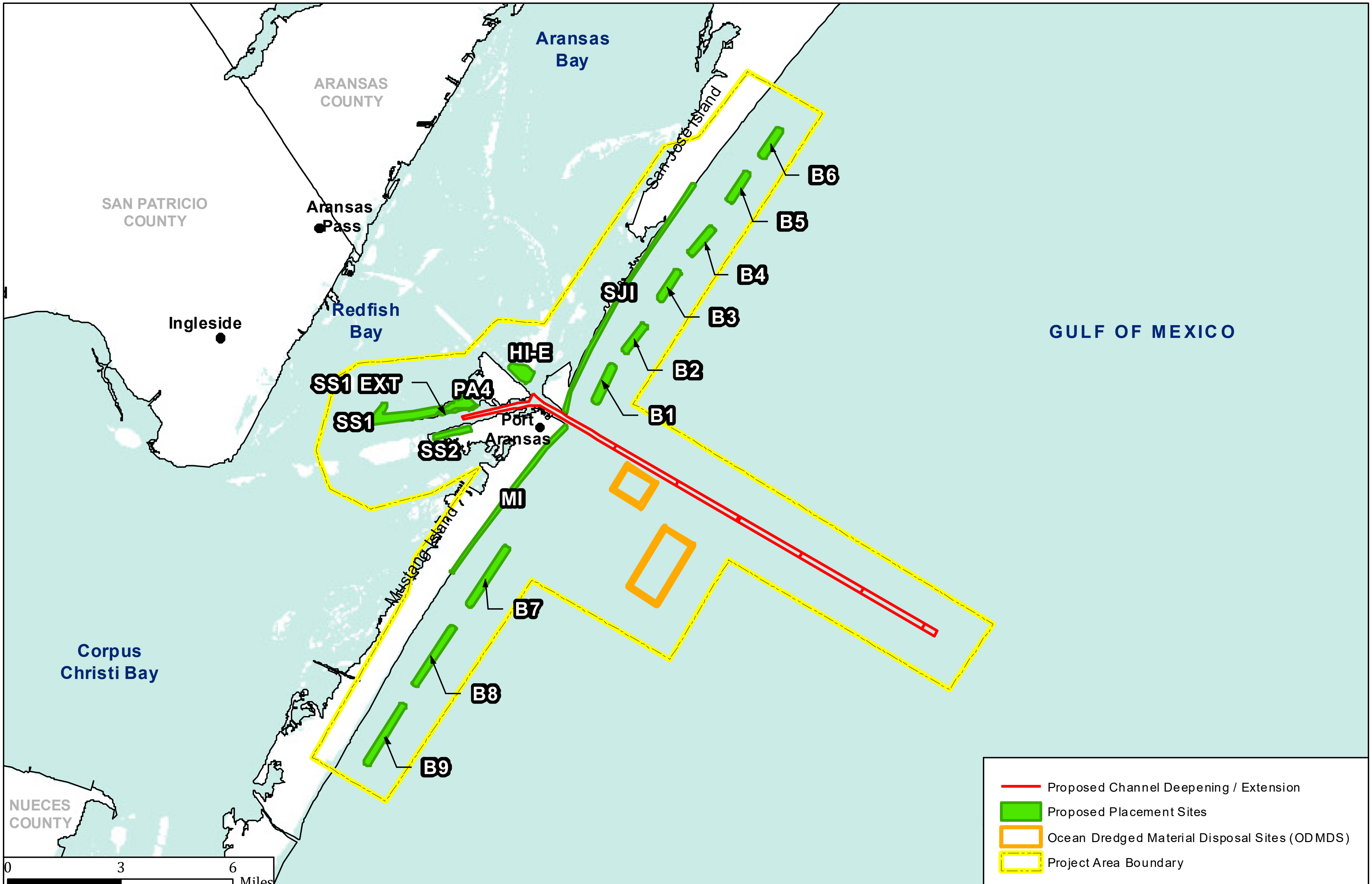

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DATE CREATED Date: 12/11/2023

DATUM & COORDINATE SYSTEM NAD83 State Plane (feet) Texas South Central

FILE NAME Name: Fig_3-2_Project Area Boundary

PREPARED BY KLC

Port of Corpus Christi Authority
Corpus Christi Ship Channel Deepening Project

Project Area Boundary

N W E S

FIGURE 3-2

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Channel extends from the CCSC near Ingleside, Texas, and runs parallel to the eastern shoreline of Corpus Christi Bay for 5.9 miles to the La Quinta Turning Basin.

The study area is characterized by interconnected natural waterways, restricted bays, lagoons, estuaries, narrow barrier islands, and dredged intracoastal canals and channels (USACE, 2003). With a central position on Texas' coast, the region is known as the Coastal Bend and includes three of the seven major estuary systems in Texas. The Nueces Estuary forms the middle and largest portion of the estuarine study area. It includes Nueces Bay, Corpus Christi Bay, and Oso Bay, with a collective surface area of approximately 167 square miles. The Nueces Estuary receives most of its freshwater inflow via the Nueces River, although smaller watersheds like Oso Creek and other short low-gradient streams drain directly into the estuary (Texas Water Development Board [TWDB], 2021a). Corpus Christi Bay is the deepest bay system within the study area, with depths ranging up to 15 feet. The CCSC is currently maintained at a navigation channel depth of –45 feet in Corpus Christi Bay and the Inner Harbor. The CCSCIP is underway that would deepen the inshore sections to the authorized depth of –54 feet. The Mission-Aransas Estuary is part of the upper estuarine portion of the study area. It consists of the larger waterbodies of Aransas Bay and Copano Bay as well as several smaller bays, including Saint Charles Bay, Mission Bay, and Redfish Bay. The combined surface area of the estuary is approximately 175 square miles, and it receives freshwater inflow via the Aransas and Mission rivers and smaller coastal watersheds (TWDB, 2021b). The average depth in the estuary is 5.5 feet, and seagrasses such as turtle grass (*Thalassia testudinum*) and shoal grass (*Halodule wrightii*) cover large areas of the shallow bays. The Mission-Aransas Estuary is protected by a barrier island known as San José Island; however, the estuary has a Gulf connection via the CCSC at the Port Aransas Channel. The last major estuary within the study area includes a small portion of the Upper Laguna Madre Estuary. It has a direct hydrologic connection to Corpus Christi Bay and the Gulf through Packery Channel. One of the world's few hypersaline lagoons, the Laguna Madre spans approximately 439 square miles and has an average depth of 4.5 feet (TWDB, 2021c). Within the study area, the Upper Laguna Madre is bounded by north Padre Island.

The surface topography of the study area is mainly flat to gently rolling and slopes to the southeast, with coastal prairies dominated by farmlands, chaparral pastures, and brushy rangeland (U.S. Geological Survey [USGS], 1984, 1985). Urban development within the study area is minor, with Corpus Christi being the only city in the study area with a population above 20,000 inhabitants. However, significant resort, tourist, and retirement developments occur in Rockport, Port Aransas, and on Mustang and North Padre islands (Pulich, 2007). On the Gulf side of the barrier islands (Mustang, Padre, San José) and for a short distance inland, sand dunes break the flat terrain.

The study area is a subtropical, semiarid region with average rainfall of 30 to 35 inches and evaporation usually exceeding 70 inches per year (Pulich, 2007). Average monthly temperature ranges from 47 degrees Fahrenheit (°F) in January to 94°F in August. Prevailing winds are from the southeast, and the region frequently experiences high wind conditions with gusts often reaching more than 40 miles per hour (mph). Total yearly rainfall along the central Texas coast, including Corpus Christi varies from year to year.

Ranging from a low of 5.4 inches in 1917 to a high of 48.2 inches in 1888, with an average of 31.8 inches. In 2011, the area had the lowest total annual precipitation of 12 inches during one of Texas' worst drought years. The total rainfall for 2017 was 30.9 inches. Between June 18 and 21, 2018, some storms produced rainfall rates as high as 5 to 6 inches per hour. Storm total rainfall amounts were as high as 15 to 18 inches across some locations in Nueces County and central San Patricio County. Most locations in the Coastal Bend area received between 5 and 15 inches of rainfall during this period (NOAA, 2021a).

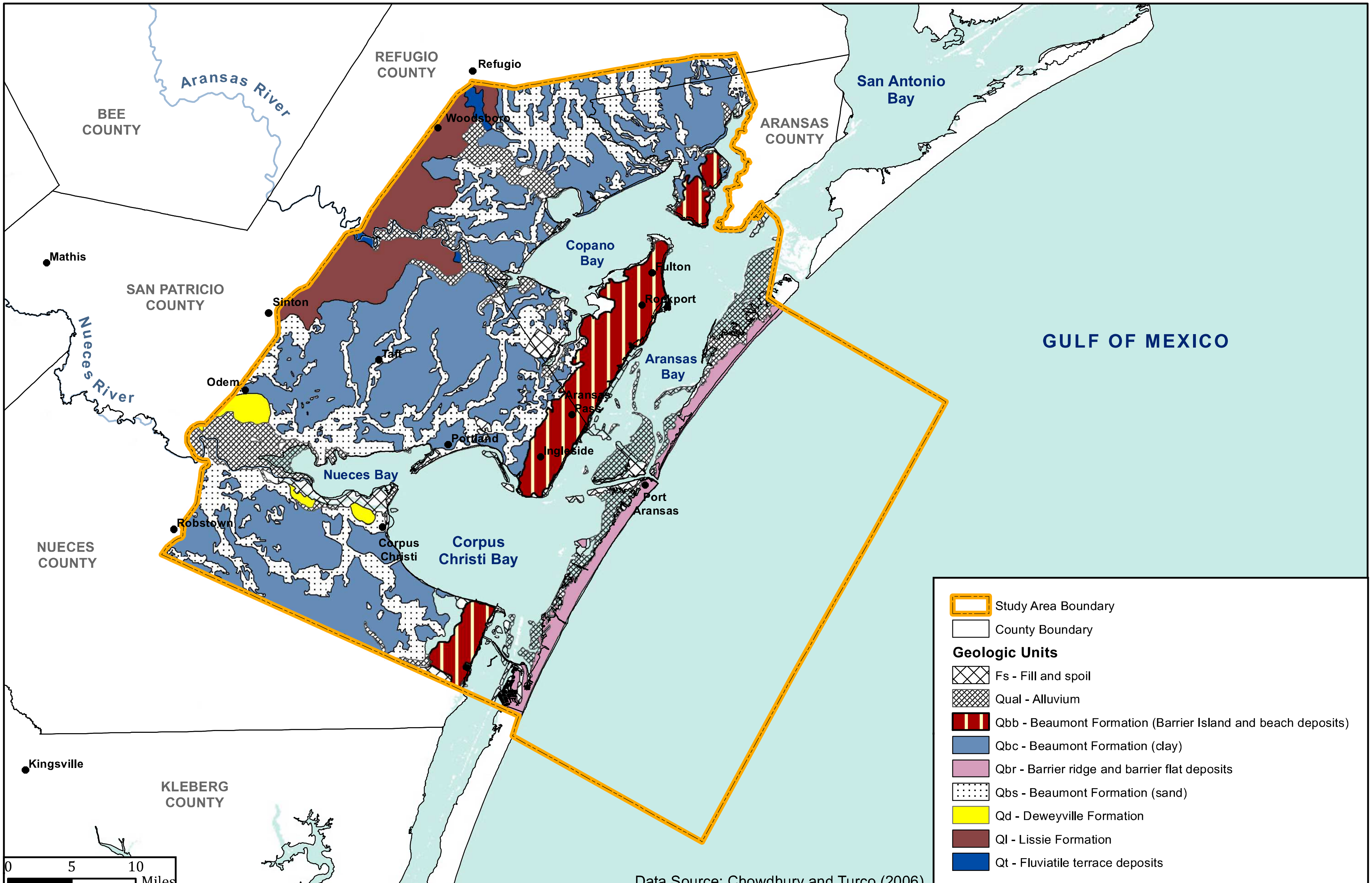
Another notable severe weather event occurred on August 25, 2017, when Hurricane Harvey made landfall near Rockport, Texas, approximately 30 miles northeast of Corpus Christi. It hit as a Category 4 hurricane with maximum sustained winds of 130 mph. Hurricane Harvey was the first Category 4 hurricane to make landfall in Texas since Hurricane Carla in 1961. Port Aransas reported sustained winds of 110 mph with gusts to 132 mph (Murphy, 2018).

3.2 PHYSICAL RESOURCES

3.2.1 Geology

The geological setting of the Texas coastline and the major geomorphological features have been developed through a combination of fluvial, coastal, and marine processes occurring over the last 125,000 years (Anderson et al., 2016). Anderson et al. (2016) used sedimentary rock analysis to determine the geological record and reconstruct the evolution of the Texas coast. Analysis included detailed lithological descriptions, identification of sedimentary structures, grain size analysis, seismic stratigraphic analysis, macro- and micro-faunal analyses, magnetic susceptibility and clay mineralogy, hundreds of radiocarbon dates, oxygen isotope profiles, and micro-paleontological data. A geological record interpretation was developed for the depositional environments created during the sea level changes within the last 125,000 years. It was determined by evaluating relative age assignments of sea level transgressions and regressions. This analysis helped to develop the history of the geology and geomorphology of the Texas coast.

The Beaumont Formation, or Beaumont clays, is a Pleistocene formation present across the Texas coast composed of the oldest coastal deposits. Bernard et al. (1970) and Fisher et al. (1972) originally defined the Beaumont Formation as a fluvial delta with shallow marine deposits and barrier-strand plain-Chenier units that formed 35,000 to 400,000 years ago. The Beaumont Formation is present in large areas of the former coastal plains and continental shelf (Figure 3-3). This figure shows the surficial geology of the coastal Texas aquifers illustrating the extension of the Beaumont clay throughout the Texas coast (Chowdhury and Turco, 2006). Blum and Price (1998) dated the age of the Beaumont Formation using the nearby Colorado River system. It showed that the representative period of the deltaic and fluvial deposition spanned from 85,000 to 400,000 years ago. These deposits consisted of multiple fluvial and deltaic cycles of river valley incision and filling as responses to sea level changes (Blum and Price, 1998). The Beaumont Formation also includes



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FILE NAME	Name: Fig_3-3_Geology
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Corpus Christi Ship Channel Deepening Project

Geology of Gulf Coast Aquifer

FIGURE 3-3

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Path: H:\ENVIRONMENTAL\Final_Exhibits\EIS Figures\Fig_3-3_Geology.mxd ancient barrier islands and beach deposits created over 35,000 years ago. These can be observed in Rockport, Port O'Connor, Ingleside, and on the north shorelines of West and East Galveston bays (Fisher et al., 1972). In the last 2,000 to 9,000 years sea level change (the rise of the water level regardless of where the water is touching the land) slowed down. The current coastline became a mix of sandy barrier island environments, marsh-swamps, bay-estuary-lagoons, inlets and offshore shorefaces, and fluvial-deltaic systems that covered the Beaumont Formation. These new depositional environments consist of a wide range of sands, silts, and clays in different geomorphological environments. The post-Beaumont Formation coastal deposits correspond to reworked deposits from these alluvial, fluviatile, and aeolian processes being placed in the newly created coastal environments. Following the slowdown of sea level change, the coastal environment has been characterized by sandy lowlands that are subject to severe shoreline retreat and limited sediment supply (Anderson et al., 2016).

The general geologic setting of the study area, as described by Morton and Peterson (2005, 2006a, 2006b), is characterized by wide, long, sandy barrier islands (Mustang, Padre, and San José islands) that are mostly undeveloped. Wide beaches and densely vegetated high continuous dunes characterize the area except for north of Mansfield Channel. Two natural inlets (Aransas Pass and Packery Channel) occur in this area due to the low tidal range and high sand supply in the littoral system. Following the deepening of Aransas Pass for navigation in 1930, Packery Channel closed but was reopened in 2004 to allow small boats shorter access to the Gulf. Along this portion of the Texas coast, beaches change orientation from northeast to southwest to north-south. They are composed of fine sand with some broken shell except in the area known as Big Shell Beach. Shells are concentrated here because the area falls in the zone of convergence of longshore currents. These flow from the northeast and south at different times, and the winds blow sand from the beach leaving the shell deposits (Morton and Peterson, 2006a).

Several factors indirectly impact the regional and local geologic settings as natural conditions occur along the coastline. These include shoreline retreat or accretion, land loss due to relative sea level change (RSLC, the rise of water level relative to the surface of the land), and subsidence. Relative sea level rise (RSLR) effects may be translated into higher water elevations, increased sediment transport, and exposure of new geologic stratigraphy to erosion altering the composition of the sedimentary environment. These geomorphic processes are described in detail in sections 3.2.2, 3.2.3, and 3.2.4.

3.2.2 Coastal Processes

3.2.2.1 Sediment Transport

Several processes act upon coastal sediment transport along Gulf shorelines to form and erode beaches, barrier islands, and peninsulas. These include local and regional natural geomorphic and hydrodynamic processes (including river processes, tides, storm surges, circulation eddies, and longshore drift transporting sand from river deltas to other locations along the coast), catastrophic or episodic storm events, and anthropogenic developments (navigation infrastructure or the presence of engineered structures or shorelines) (Freese and Nichols, Inc., 2016). Gulf and bay shorelines are exhibiting moderate to high rates of shoreline erosion. This is due to these natural processes and anthropogenic modifications of the State's shorelines, rivers, and estuaries.

Typically, sediments that are deposited into bay systems tend to migrate toward the Gulf. They are then carried in a southwesterly direction along the coast from Port Arthur to south of Corpus Christi via longshore drift (Dunn and Raines, 2001). An opposing northward current creates a zone of convergence and transports material in a northerly direction from the Mexico coastline toward Corpus Christi (Freese and Nichols, Inc., 2016). However, this fluvial sediment supply that nourishes the Gulf has been highly altered due to extensive reservoir construction, changes in land use, and instream sand and gravel mining (Dunn and Raines, 2001). These activities as well as manmade coastal infrastructure can alter the sediment budget, possibly resulting in regional sediment sinks.

This impoundment of sediment may result in or cause the disintegration of marsh systems, deltas, inlets, bird island habitat, oyster reefs, and other eco-geomorphologic systems (Moya et al., 2012). Texas has relatively few large rivers. Some are sediment deficient (Trinity and Sabine) and do not contribute sediment directly to the Gulf shoreline and others carry a heavier sediment load (Colorado and Brazos). On a geologic time-scale the dominant source of sediments entering the northern Gulf come from the Mississippi River. Due to channelization of its banks preventing the river from changing course over time, most sediment flows offshore rather than becoming part of the nearshore sediment budget that would make its way along the Texas coast (Ellis and Dean, 2012).

Both natural and jetty stabilized passes impact sediment budgets and transport. Hard structures such as groins, jetties, and breakwaters, interfere with longshore drift and impound sediments. This induces either shoreline erosion or accretion adjacent to these artificial structures (Freese and Nichols, Inc., 2016; Morang et al., 2012; Morton et al., 2004). Typically, the beach on the downdrift side of longshore transport direction suffers erosion due to the lack of a sediment supply. The upstream side experiences accretion due to deposition at or near the hard structures.

The jetties at Aransas Pass extend 3,600 to 3,950 feet gulfward from the shoreline, interrupting the longshore sediment exchange between Mustang Island and San José Island (Paine and Caudle, 2020). The authors also point out several smaller structures with possible local effects on sediment transport in the area. These include the short jetties (about 500 feet) at the closed Fish Pass on Mustang Island and jetties (about 1,000 feet) at Packery Channel, delineating Mustang Island and Padre Island.

Maintenance dredging of navigation channels has historically resulted in sediments that were typically stored in DMPAs or dumped into the Gulf via open placement (USACE, 1975). Since the Texas coast is now considered a sediment-starved system, more opportunities to use dredged material beneficially are under consideration for the construction of coastal protection and ecosystem restoration projects (Freese and Nichols, Inc., 2016). Overall, the Texas coast is less developed than many other coastal states.

Therefore, less is understood regarding sediment pathways, beach volume changes, and sediment budgets (Morang et al., 2012).

3.2.2.2 Shoreline Change

The Texas coastal shoreline consists of a dynamic environment involving eustatic (global) sea level change, subsidence, diminished sediment supply, littoral drift, and frequent and intense storms. Sediment supplies have been altered within most watersheds and coastal systems (Paine et al., 2014). Reservoir construction and operations along major rivers has reduced the sediment supply that enters bays and nourishes coastlines thereby resulting in widespread shoreline erosion (Paine et al., 2012). However, the rate of sediment accretion from reservoirs does not match sediment starvation along the coast. Sediment is often deposited in the floodplains, primarily a result of reservoir operations affecting downstream transport.

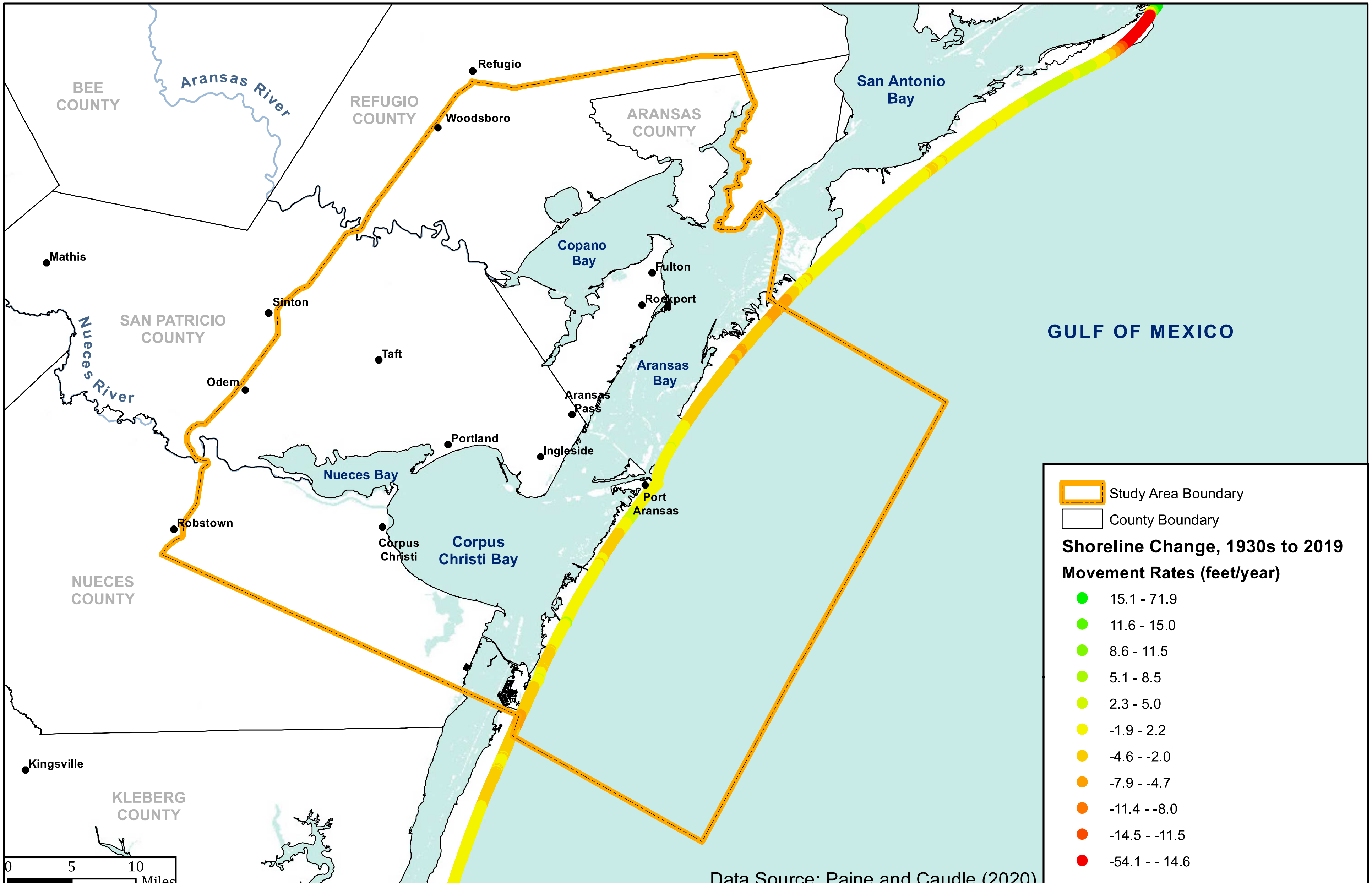
Shoreline erosion threatens coastal habitats, recreation opportunities, and residential, transportation, and industrial infrastructure. According to Paine and Caudle (2020), Gulf shoreline erosion rates along the entire Texas coast between the 1930s and 2019 averaged 4.17 feet per year of retreat. Rates of Gulf shoreline change are generally greater on the upper Texas coast (from the mouth of the Colorado River to Sabine Pass) than those in the mid to lower Gulf Coast. The upper Texas coast retreat was calculated at 5.6 feet per year, and the mid to lower coast retreated an average of 3.2 feet per year. Table 3-1 and Figure 3-4 show the net shoreline and land area change from the 1930s to 2019 for geomorphic areas along the Texas Gulf shoreline within the study area.

Table 3-1
Net Gulf Shoreline Change for the Texas Gulf Shoreline, 1930’s to 2019*

Geomorphic Area	Number of Sample Sites	Net Rate of Retreat (feet/year)	Standard Deviation (feet/year)	Range of Retreat (feet/year)	Are Change Rate (acres/year)	Area Change (acres)
San José Island	622	–2.75	2.19	–6.23 to +2.62	–6.42	–570
Mustang Island	574	–0.95	1.70	–4.59 to +5.57	–2.05	–17
North Padre Island	2,403	–2.52	3.05	–14.43 to +3.28	–22.73	–202

Source: Paine and Caudle (2020).

* Data calculated using coastwide LiDAR data collected from April to June 2019. Rates represent conditions 20 to 22 months after Hurricane Harvey, which made landfall on the middle Texas coast in late August 2017.



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DATUM & COORDINATE SYSTEM NAD83 State Plane (feet) Texas South Central

FILE NAME Name: Fig_3-4_Shoreline Change

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Shoreline Change 1930s to 2019

FIGURE 3-4

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Recent short-term trends for San José Island show decreased rates of erosion between 2000 to 2019 of –0.2 feet/year. Compare that to the average rate of retreat between the 1930s and 2019 which was –2.8 feet/year. For Mustang Island, the rate of retreat between 1930s and 2019 (–1.0 feet/year) showed a shift to net gain from 2000 to 2019 (0.5 feet/year). Annual land loss estimated from these rates (1930s–2019) are 6.4 acres/year on San José Island and 2.1 acres/year on Mustang Island (Paine and Caudle, 2020). Significant net shoreline advance has also occurred adjacent to the jetties that protect the dredged channel at Aransas Pass (Paine et al., 2014).

The Mustang Island gulf shoreline, managed by Nueces county and the City of Port Aransas, in the vicinity of the CCSC, does not have any history of previous beach nourishment activities. San José Island also has no public history of beach nourishment projects taking place, as it is a privately-owned island.

Beach nourishments on the north end of North Padre Island have occurred due to dredging at Packery Channel, which lies approximately 18 miles south of the CCSC entrance. During the construction of the channel in 2005–2006, roughly 136,000 cy of material was dredged and placed on North Padre Island. Shortly thereafter, in early 2006 approximately 679,000 cy of material was dredged and used again to nourish North Padre Island beaches (Williams et al., 2007). Packery Channel was dredged between 2013 and 2014, and 238,000 cy of material was placed along and in front of the seawall on North Padre Island (Davis et al., 2018).

3.2.3 Physical Oceanography

3.2.3.1 Bathymetry

The bathymetry of the study area has been partially modified by channel dredging and subsequent formation of dredged material PAs. Area tidal channels, passes, and dredged channels are greater than the average depth of the bay systems and nearshore Gulf waters. Water depths in the bay segment of the CCSC are currently maintained by the USACE to depths of –47 MLLW. The offshore section outside of the jetties has been deepened to –56 feet MLLW as part of the CCSCIP. The northernmost region of the study area is comprised of the Mission-Aransas Estuary and includes Aransas and Copano bays and the adjacent systems of Saint Charles, Mission, Redfish, and Port bays. The average depth in the estuary is 5.5 feet, with Aransas Bay the deepest on average at approximately 8 feet (Ward, 1997). Copano Bay is a northwesterly extension of Aransas Bay and is known as a prominent oyster harvest area with many oyster reefs that extend across the bay (Mott and Lehman, 2005). Within the Nueces Estuary, Corpus Christi Bay is one of the deeper bays on the Texas coast, averaging over 11 feet deep with a mostly flat and uniform bottom. In contrast, Nueces Bay is shallow and averages 2.5 feet deep (Ward, 1997). At the upper end of Nueces Bay lies the Nueces River delta with extensive areas of tidal marsh. The northern tip of the Upper Laguna Madre Estuary is included within the study area. It is an extremely shallow bay system that averages 1 foot deep with expansive seagrass beds. The Upper Laguna Madre has no direct inlet to the Gulf. The upper end is hydrologically connected with Corpus Christi Bay near Packery Channel that divides Mustang and North Padre islands.

3.2.3.2 Tides

Three factors influence tidal exchange in this region: astronomical (true tides), meteorological (i.e., mostly influenced by winds and barometric pressure), and density stratification. Meteorological tides have the most profound effect on water levels, raising or lowering water levels on Gulf beaches as much as 3 feet (not including tropical cyclone storm surge) (Armstrong et al., 1987). During winter, passage of strong fronts can dramatically change water levels in estuaries as water is “forced” out of the system by the northerly winds (Morton et al., 1994).

The astronomical tidal range (the difference in height between the highs and the lows) within the study area is less than 1.5 feet on average. The Texas coast experiences a mixed tidal regime with week-long periods of diurnal tides (once-per-day high and low) followed by a week of semidiurnal tides (twice-per-day high and low). In Texas, diurnal tides have a much greater range than semidiurnal (Amos, 2014).

Density currents develop due to differences in salinity between water layers and the salinity gradient between freshwater inflows and saline Gulf waters. In stratified systems, less dense freshwater sits on top of dense saltwater that is more rapidly replaced by tidal forces. Mixing and diffusion at the interface between higher and lower salinity water results in gradual development of a more uniform vertical density profile. The intensity of the density current increases with greater stratification in estuarine systems and with increasing water depths (Armstrong et al., 1987).

Texas coast tide data are provided by NOAA and Texas Coastal Ocean Observation Network (TCOON) tide stations (NOAA, 2021b). These stations are established along the Texas coast and provide the most comprehensive assessment of tides, water levels, and general meteorological and physical oceanography data available. Table 3-2 shows the mean tide range (difference in height between mean high water and mean low water) for the pass and bay stations starting from north moving to south within the study area. The lower tidal range observed within the bays is indicative of the lag time and buffering that occurs as distance from Gulf access increases.

3.2.3.3 Currents and Circulation

The ocean current system of the North Atlantic Gyre consists of four interconnecting ocean currents: Gulf Stream Current, North Atlantic Current, Canary Current, and North Equatorial Current (Stott, 2021). It consists of convection currents driven by temperature and salinity differentials and the Coriolis Effect (NOAA, 2011). The Gulf Loop Current is a warm-water system that flows through the Yucatan Strait, flowing clockwise through the Gulf and out the Florida Strait into the Atlantic Ocean (NOAA, 2021c). The position of the Gulf Loop Current is variable based on ocean trends such as surface temperature, wind, and salinity concentration. Occasionally portions of the loop can be pinched off. The resulting eddies of warm water can propagate westward toward the shorelines of Texas or Mexico (Gyory et al., 2021). Warm core eddies and the Gulf Loop Current provide a deep layer of warm water, which can provide energy and strengthen hurricanes (Jaimes and Shay, 2009).

Table 3-2
Tide Ranges Within the Study Area

Station	Station ID	Mean Range of Tide (feet)
Rockport, Texas	8774770	0.36
Port Aransas, Texas (TCOON)	8775237	0.89
Aransas Pass, Texas (TCOON)	8775241	1.10
Nueces Bay, Texas (TCOON)	8775244	0.64*
USS Lexington, Corpus Christi, Texas (TCOON)	8775296	0.58
Packery Channel, Texas (TCOON)	8775792	0.43
Bob Hall Pier, Corpus Christi, Texas	8775870	1.31

Source: NOAA (2021b).

* Mean range of tide not available, value reported mean high water minus mean low water.

Local winds often play an active role in shaping shorelines and influencing tides and surface currents. This is due to the gently sloping and shallow nature of the Gulf continental shelf and relatively low wave action (King et al., 2018). Waves, which propagate across an ocean or bay expanse, obtain energy from the wind, delivering and transferring wave energy to nearshore coastal environments. These wind-generated waves induce longshore and cross-shore currents, which transport sediments along Gulf and bay shores. Longshore currents run parallel to the coastline and are produced by waves striking the shoreline at an angle. Longshore currents carry sediments along the coastline. Cross-shore currents are shore-perpendicular currents and are generally weaker than longshore currents (with the exception of localized rip currents). Cumulatively these two current components affect physical changes to coastal and bay shorelines by transporting sediments. Where differences in transport rates into and out of an area of shoreline occur then the shoreline experiences either accretion or erosion. Accretion is more sediment moving into the area than moving out of it and erosion is more sediment moving out of an area than moving into it. Wind direction, angle of wave approach, and the geographic orientation of the shoreline can influence the current direction and amount of sediment transportation from the beachhead (NOAA, 2021d).

The major estuarine systems within the study area are generally low-energy environments protected on the seaward side by barrier islands. These ecosystems can be influenced by several factors. These include increased exchange with Gulf waters through channelization, geomorphic changes to barrier islands, water diversions and dams, and RSLR. Increased exchange and exposure to the Gulf may change the tidal prism and salinity regime, impacting bay marsh vegetation and erosion. Increased water exchange due to lower hydraulic resistance may also place existing infrastructure at greater risk to storm-induced damages. The Gulf facing barrier islands within the study area including San José, Mustang, and North Padre islands form the first line of defense, followed by inshore living shorelines and bay and estuarine marshes. The major estuarine systems within the study area are briefly described below.

Mission-Aransas Estuary System. The Mission-Aransas Estuary System spans a total of 111,780 acres. The estuary consists of Aransas and Copano bays and several smaller bays, including Saint Charles, Mission, and Redfish bays. The estuary receives an average 490,000 acre-feet (ac-ft) of fresh water primarily from the Aransas and Mission rivers, in addition to smaller coastal watersheds (TWDB, 2021b). Average salinity in the Mission-Aransas system is approximately 20 parts per thousand (ppt) (TPWD, 2010).

Nueces Estuary System. The Nueces Estuary System consists of Nueces Bay, Corpus Christi Bay, and Oso Bay and spans 106,990 acres. The estuary receives an average of 587,000 ac-ft of fresh water from the Nueces River annually (TWDB, 2021a). Corpus Christi Bay does not receive as much freshwater inflow as bay systems along the upper Texas coast. This is due to the semi-arid region and water diversions and supply projects (Lake Corpus Christi and Choke Canyon Reservoir). The estuary is connected to the Gulf by Aransas Pass and indirectly by the GIWW and Packery Channel (Ward, 1997). Salinities in Nueces Bay range from less than 2 ppt during floods to over 45 ppt during dry conditions (USACE, 2012a). The average annual salinity for the system is 25 ppt. During dry periods, with little to no freshwater inflow, high evapotranspiration can increase salinities in the delta region over 80 ppt, exceeding bay salinities (Hill et al., 2015). Salinity levels greater than 35 ppt are considered hypersaline as they exceed typical seawater salinity level.

Laguna Madre Estuary System. The Laguna Madre Estuary stretches for 280,910 acres. The estuary receives most of its 743,000 ac-ft of freshwater inflows from streams like San Fernando Creek and the Arroyo Colorado (TWDB, 2021c). The Laguna Madre's high evaporation rate and absence of perennial freshwater inflow create a hypersaline environment in the lagoon with an average salinity of 36 ppt (Montagna et al., 2013). Within the study area, the Upper Laguna Madre is connected hydrologically to Corpus Christi Bay and to the Gulf via Packery Channel.

3.2.3.4 Salinity

Estuaries are mixing zones where freshwater from rivers and streams meet saline oceanic waters. These highly dynamic estuarine habitats are characterized by salinities intermediate between fresh water and standard oceanic salinities. Salinity in estuaries varies relative to the amount of freshwater entering the estuary from river basins, the amount of oceanic water entering through passes, the net evaporation from the estuary, and mixing between higher and lower salinity water. The range of salinities in coastal estuaries supports a mosaic of important habitats for commercially, recreationally, and ecologically important fish and shellfish species, as well as other wildlife such as water birds. Wildlife rely on habitats supported by intermediate salinities for successful spawning, development, and growth.

Hypersaline conditions can occur in Texas estuaries during droughts, when salinities can substantially exceed Gulf salinities of 34 ppt. Inversely, prolonged wet periods or storms with exceptionally high rainfall can flush saltwater from bays, dropping salinities to near 0 ppt. Vertical salinity gradients may also be observed in estuaries, where a freshwater layer on the surface is accompanied by saltier water below. These typically occur in upstream areas during periods of drought, as well as in ship channels and inlets where large volumes of tidal exchange occur (Britton and Morton, 1989). Shallower areas of Texas estuaries are typically vertically well mixed and generally do not exhibit strong vertical salinity gradients. Table 3-3 and Table 3-4 present salinity tolerances and maximums for common fish, shellfish, wetlands, and SAV within the study area.

Table 3-3
Salinity Tolerances of Common Fish and Shellfish Within the Study Area

Common Name	Scientific Name	Optimum Salinity Range (Salinity Maximum) (ppt)			Source(s)
		Larvae	Juveniles	Adults	
Brown shrimp	*Farfantepenaeus aztecus*	24–36 (40–69)	10–20 (45)	24–39 (45)	Saoud and Davis (2003), Doerr et al. (2015)
White shrimp	*Litopenaeus setiferus*	0.4–37 (N/A)	2–15 (41)	>27 (40)	Patillo et al. (1997), Doerr et al. (2015)
Blue crab	*Callinectes sapidus*	12–36 (43)	2–21 (N/A)	<10–33 (67)	Patillo et al. (1997), Guillory et al. (2001)
Eastern oyster	*Crassostrea virginica*	10–35 (39)	10–30 (44)	10–30 (44)	Cake (1983), Gulf Marine States Fisheries Commission (2012), Baggett et al. (2014), Hijuelos et al. (2016)
Gulf Menhaden	*Brevoortia patronus*	>29 (N/A)	5–30 (N/A)	>29 (67)	Patillo et al. (1997)
Sheepshead	*Archosargus probatocephalus*	5–25 (45)	0.3–44 (45)	0.3–44 (45)	Patillo et al. (1997)
Spotted Seatrout	*Cynoscion nebulosus*	20–35 (50)	8–25 (48)	20–25 (45)	Patillo et al. (1997), Odell et al. (2017)
Spot	*Leiostomus xanthurus*	6–36 (36)	0–30 (36)	15–30 (60)	Patillo et al. (1997), Odell et al. (2017)
Atlantic Croaker	*Micropogonias undulatus*	15–36 (N/A)	0.5–20 (40)	6–20 (70)	Patillo et al. (1997), Odell et al. (2017)
Black Drum	*Pogonias cromis*	9–34 (36)	9–26 (80)	9–26 (80)	Patillo et al. (1997), Odell et al. (2017)
Red Drum	*Sciaenops ocellatus*	8–36 (50)	20–40 (50)	20–40 (50)	Patillo et al. (1997), Odell et al. (2017)
Southern Flounder	*Paralichthys lethostigma*	10–30 (N/A)	2–37 (60)	20–30 (60)	Patillo et al. (1997), Munroe (2015)

Table 3-4
Salinity Tolerances of Common Wetlands/SAV Within the Study Area

Common Name	Scientific Name	Optimum Salinity Range (Salinity Maximum) (ppt)		
		California Coastal Conservancy (2022), Stachlek and Dunton (2013)	Koch et al. (2007)*	SMSFP (2022a–e), Irlandi (2006), Alleman and Hester (2010)
Smooth cordgrass	*Spartina alterniflora*	10–30 (50–60)	–	–
Black mangrove	*Avicennia germinans*	–	–	24–48 (96)
Shoal grass*	*Halodule wrightii*	–	5–45 (45)	5–39 (60)
Turtle grass*	*Thalassia testudinum*	–	14–62 (45)	>20–48 (60)
Manatee grass*	*Syringodium filiforme*	–	5–45 (45)	20–35 (45)
Clover grass	*Halophila engelmannii*	–	–	5–35 (74)

* Used the pulsed ranges.

SMSFP = Smithsonian Marine Station at Fort Pierce

Mission-Aransas Estuary System. In the Mission-Aransas system, average nearshore salinity from 1982 to 2004 was 19 ppt while over the same time, average salinity in the open water was 21 ppt (TPWD, 2010). Basic salinity objectives were recommended for the Mission-Aransas estuary. These objectives were for spring salinities ranging from 2 to 10 ppt and summer salinities from 10 to 20 ppt to support important estuarine species (Guadalupe, San Antonio, Mission, and Aransas Rivers and Mission, Copano, Aransas, and San Antonio bays) (Guadalupe Bays Basin and Bay Expert Science Team [BBEST], 2011).

Nueces Estuary System. Salinities in Nueces Bay range from <2 ppt during floods to over 45 ppt during dry conditions (USACE, 2012a). Average annual salinity is 25 ppt. The system is frequently a reverse estuary where salinities in the delta are higher than bay salinities and can reach concentrations exceeding 80 ppt (Hill et al., 2015). Nueces bay has seen significant alterations in its freshwater inflows over the past century, due in part to dams and modifications of the Nueces River delta (Blackburn, 2004). Ward and Armstrong (1997) note that there is a long-term increase in salinity in Corpus Christi Bay of about 0.1 ppt per year. They favor the hypothesis that long-term decreases and changes in the timing of freshwater inflow are the cause for this increase in salinity.

The Nueces BBEST (2011) evaluated a variety of different organisms (plants, invertebrates, and fish) that could be used as indicator organisms. These were used to develop an ecologically sound salinity regime for Nueces Bay and would be protective of the bay's biological community. Mean annual salinity for Nueces Bay is 25 ppt. When porewater salinities in the Nueces Delta exceed 25 ppt, the delta experiences substantial declines in cordgrass (*Spartina* spp.) marsh. The biomass of filter-feeding benthic macroinvertebrates is at its highest levels when bay salinities are about 20 ppt. Blue crab abundance declines when salinities exceed 20 ppt, while Atlantic Croaker occurs from 8 to 22 ppt. Based on evaluation of the indicator organisms, an appropriate salinity in the bay during normal flows was suggested to be 18 ppt to maintain ecological health (Nueces BBEST, 2011).

Ward and Armstrong (1997) note that there is little vertical gradient to the salinity profile and no apparent correlation between salinity and the presence of the ship channels. Salinity gradients for both Corpus Christi and Nueces bays are from north to south as a result of freshwater inflow and evaporation. Neither bay shows a gradient from east to west (Ward and Armstrong, 1997).

Laguna Madre Estuary System. The Laguna Madre is one of only three large hypersaline lagoons in the world, including both the Upper Laguna Madre and Lower Laguna Madre bay systems (Ward and Armstrong, 1997). The annual mean salinity of the Upper Laguna Madre (which includes the Baffin Bay complex) is 38 ppt (Schoenbaechler, 2016). Hypersaline conditions are common in the Upper Laguna Madre and Baffin Bay. Salinities in the Upper Laguna Madre commonly reach 45 ppt and 53 ppt in upper Baffin Bay. The principal habitat in the Laguna Madre is seagrass used by a wide variety of estuarine and marine organisms (Tolan et al., 2004). Seagrasses tolerate salinities above 35 ppt but can be harmed when salinities are in the range of 6 to 13 ppt. Sustained, optimal growth of seagrass occurs when salinities are above 20 to 24 ppt ranging up to 37 to 40 ppt (Rio Grande BBEST, 2012).

3.2.4 Climate Setting

3.2.4.1 Climate

The climate of the Corpus Christi Bay area is humid subtropical. Humid, warm to hot conditions occur in the summer months with average daily temperatures ranging from 75°F to 82°F (Table 3-5). Winters are mild with considerable day-to-day variations. Average temperatures in the winter months range from 49°F to 68°F. Data for Corpus Christi from 1981 to 2010 documents an average annual temperature of 72.1°F with a total annual average rainfall of 32.5 inches (National Centers for Environmental Information, 2021a).

Table 3-5
Average Monthly Rainfall and Temperature from
1981 to 2010 at the Corpus Christi Naval Air Station

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Year
Average Temperature (°F)	57.5	60.7	66.1	72.4	78.5	93.1	84.4	85.1	81.7	75.9	67.4	59.3	72.7
Average Total Rainfall (inches)	2.01	2.22	2.25	2.09	3.19	2.64	3.80	2.25	5.20	4.79	2.29	1.54	34.27

Source: National Centers for Environmental Information (2021a).

Rainfall is the main form of precipitation along the coast and tends to occur most frequently and in greatest amounts in the spring and late summer/early fall (Table 3-5). Rainfall rates decrease, and temperatures increase moving south along the coast. Coastal relative humidity averages slightly more than 60 percent over the course of the year (Nielsen-Gammon, Banner et al., 2020). Annual average humidity is 89 percent in the morning and 61 percent in the afternoon (National Centers for Environmental Information, 2021b).

Direction and intensity of wind directly affects climate conditions along the coast. The average hourly wind speed in Corpus Christi varies significantly among seasons over the course of the year. Winds are primarily from the southeast from March to September and from the northeast from October to February. The windier periods last for more than 8 months, from October to July, with average wind speeds of more than 10.8 mph (National Centers for Environmental Information, 2021c). The Gulf hurricane season spans June through November with the greatest number of tropical cyclones occurring in August and September.

During El Niño periods, when Pacific waters are warmer than normal, the Texas coast is typically wetter and cooler than normal in the winter. Freshwater inflows to estuaries may increase and bay salinities may decrease. When Pacific waters are cooler than normal, the La Niña pattern is in place. The winters are warmer and dryer than normal resulting in droughts, reduced freshwater inflows, and increased bay salinities (Tolan, 2007).

Rapid temperature drops in the winter, sometimes to below freezing, have caused fish and sea turtle mortality events along the coast (Martin and McEachron, 1996). High velocity winds associated with these events can cause bay water levels to drop more than a foot below normal low tide. Low pressure systems can form in the Gulf during the winter causing long periods of steady rains along the coast. In rare cases these systems can strengthen, generating high winds and water levels substantially above high tide (Contreras, 2003).

The average annual temperature across the southeast region has risen approximately 2°F since 1970, with the winter exhibiting the highest increase. Increased winter temperatures can by recognized by a decrease in the number of days below freezing, reduced from 11 days on average to 7 days on average each winter. Both the number of days when the temperature has exceeded 95°F, as well as the number of nights exceeding 75°F, have increased (National Climate Assessment and Advisory Development Committee, 2013; U.S. Global Change Research Program, 2017).

Rainfall during fall months has increased 30 percent in the southeast region since 1901. Since the mid-1970s, however, drought areas have increased in size by 12 percent during the spring and by 14 percent during the summer (National Climate Assessment and Advisory Development Committee, 2013). Overall, there has been a long-term upward trend in precipitation in Texas in all seasons, averaging about 8.5 percent per century (Nielsen-Gammon, Escobedo et al., 2020). There has also been an upward trend in extreme precipitation events (U.S. Global Change Research Program, 2017). Impacts from recent climate-related extremes, such as heat waves, droughts, floods, cyclones, and wildfires reveal significant vulnerability of ecological and human systems to climate variability (Intergovernmental Panel on Climate Change [IPCC], 2021).

Observed annual average temperature for the southeast U.S. show a change of 0.46°F between present day (1986 to 2016) and the first half of the last century (1901 to 1960) (U.S. Global Change Research Program, 2017). Climate models project temperature increases in the southeast region of the U.S. during all seasons, with greatest increases occurring during summers. By 2080, average temperatures in the region are expected to increase between 4.5 and 9.0°F (U.S. Global Change Research Program, 2009) and the number of days exceeding 95°F is expected to increase (National Climate Assessment and Advisory Development Committee, 2013). Climate changes are predicted to increase hurricane peak wind speeds, rainfall intensity, and storm surge height and strength (National Climate Assessment and Advisory Development Committee, 2013; U.S. Global Change Research Program, 2009).

3.2.4.2 Relative Sea Level Change

Sea level serves as the base measurement for elevation and depth on Earth. Sea level change is any variation in sea level that occurs compared to a reference point on land (Rovere et al., 2016). The USACE policy in Engineering Regulation 1100-2-8162 and Engineering Technical Letter 1100-2-1, *Sea Level Change Considerations for Civil Works Programs*, requires all studies to consider impacts from sea level change (USACE, 2013, 2014a).

RSLR can result in declining marshes and other estuarine habitats, such as tidal flats, and is often accompanied by shoreline retreat and erosion (White et al., 2002). Trends in sea level change are important because they impact coastal mapping, marine boundary delineation, coastal zone management, coastal engineering, and sustainable habitat restoration design (NOAA, 2021e). Rising sea level also likely contributes to increased storm surges, tides, and associated impacts (IPCC, 2021).

Sea level along the Texas coast is somewhat variable. It depends on the time of day and the season and is primarily impacted by winds and seasonal variation in tides. Sea level along the mid-Texas coast tends to be higher in the late spring and fall when the moon is closer to the earth and lower in the summer and winter when the moon is farther from the earth (NOAA, 2021f). El Niño events can also influence sea level changes over periods of months to a year or more (Johnson and Parsons, 2016).

Sea level changes have occurred over hundreds and thousands of years. For at least the last 18,000 years, sea level rose more than 400 feet along the Texas coast. The rate of sea level change has slowed over the last 3,500 years (Davis, 2011). The average absolute sea level (eustatic sea level change) around the world has risen over 9 inches since 1880 (EPA, 2016).

Sea level continues to rise along the Texas coast, and the rate of change has increased in recent years due to two key factors (EPA, 2016):

1. Eustatic sea level change caused by increased volume of water in the oceans, caused by the addition of water from melting glaciers and ice sheets, and the expansion of ocean water as it warms with increasing temperatures, and

2. RSLR caused by subsidence, caused by the sinking of land due to soil compaction and/or withdrawal of subsurface liquids.

Sea level rise along the mid-Texas coast has increased more than 0.2 inch per year from 1937 to 2020. The relative sea level trend for Rockport, Texas is 0.23 inches per year with a 95 percent confidence interval of ±0.02 inches per year based on monthly mean sea level data from 1937 to 2020 (Gauge #8774770). This is equivalent to a change of 1.92 feet over the course of 100 years. Similarly, the relative sea level trend for Corpus Christi, Texas is 0.21 inches per year with a 95 percent confidence interval of ±0.04 inches per year based on mean sea level data from 1983 to 2020 (Gauge #8775870). This is equivalent to a change of 1.78 feet over the course of 100 years (NOAA, 2021f).

3.2.4.3 History of Severe Storms and Hurricanes

Severe storms and hurricanes in Texas originate in tropical seas (usually starting as a tropical wave off the African coast), and their landfall can alter coastal areas for years. These storms occur seasonally from June through November with a peak mid-August to late October. They influence the geologic history of the Gulf coastline, especially barrier islands (Britton and Morton, 1989). Extreme winds and waves can cause shoreline erosion, transport sediments and sands, and affect water circulation patterns. Wind intensity and direction control the orientation and size of associated wave sequences along the shorelines, eroding or depositing sediment and sand along the banks (Birchler et al., 2014).

Intense storms (tropical storms and depressions) can result in flooding due to heavy rains, high winds, tornadoes, and extensive loss of life. Hurricanes are categorized and measured by the Saffir-Simpson Hurricane Wind Scale, which characterizes storm intensity relative to the sustained wind speed and estimates potential property damage. Wind speeds must reach a maximum sustained intensity of 74 mph to be classified as a hurricane, and categories range from Category 1 (lowest) to Category 5 (highest). Because of their potential for significant loss of life and damage to property, Category 3 and higher storms are considered major hurricanes. Category 1 and 2 storms are still considered dangerous with damaging winds and require preventative measures (NOAA, 2013a).

The greatest threat to life and property occurs from storm surge and tides during a hurricane landfall. Storm tides are a combination of astronomical tide and storm surge raising the water level during a storm. The combination of storm tide, high winds, and waves can cause severe damage to the coast. This results in loss of life, beach and dune erosion, destruction of infrastructure, and saltwater intrusion into bays and estuaries, capable of traveling several miles inland. In addition, hurricanes and tropical storms can also produce tornadoes, high winds, heavy rainfall, and rip currents, all capable of causing severe damage (NOAA, 2013a).

The probability of hurricane landfall on the Texas coast is about one every 6 years along any 50-mile stretch. Annual probabilities of a landfall range from 31 percent at Sabine Pass to 41 percent at Matagorda Bay. The annual average occurrence of a tropical storm or hurricane is about 0.8 per year or three every 4 years.

Hurricane frequency is inconsistent; a 10-year hurricane-free period occurred from 1989 to 1999, the longest since 1829 (Roth, 2010).

Texas has been affected by several hurricanes and severe storms during the last century. The top five costliest for Texas have all occurred since 2000, two of which only reached tropical storm status (Table 3-6) (Blake et al., 2011; NOAA, 2021g). As of the end of the 2020 Hurricane season, Hurricane Harvey was the costliest storm in Texas history and the Nation's second costliest storm on record. Hurricane Katrina was the costliest at $172.2 billion (NOAA, 2021g). The storm stalled over southeast Texas for four days, dropping historic amounts of rainfall of more than 60 inches (Blake and Zelinsky, 2017). In 2019 Tropical Storm Imelda became the second most expensive tropical storm in Texas at $5.1 billion, producing historic rainfall totals and devastating flooding in southeast Texas (Latto and Berg, 2019; NOAA, 2021g).

Table 3-6
Top 5 Costliest Texas Storms, 1900 to 2020

Name	Year	Category	Landfall	Unadjusted Costs	Adjusted Costs*
Harvey	2017	3	Rockport	$125.0 billion	$133.8 billion
Ike	2008	2	Galveston	$30.0 billion	$37.5 billion
Rita	2005	3	Sabine Pass	$18.5 billion	$25.5 billion
Allison	2001	TS	Freeport	$8.5 billion	$12.8 billion
Imelda	2019	TS	Freeport	$5.0 billion	$5.1 billion

Source: NOAA (2021g); Blake et al. (2011).

* Cost values are based on the 2021 Consumer Price Index adjusted cost.

TS = Tropical Storm

3.2.4.4 Storm Surge Effects

Storm surge is an abnormal rise of water level over and above the predicted astronomical tides resulting from winds of tropical storms and hurricanes. Some of the costliest natural disaster damages to life and property in the United States are caused by storm surge. Many of the more extreme and damaging hurricane events have occurred along the U.S. Gulf coast (Needham and Keim, 2012). The hurricane that struck Galveston Island, Texas, in 1900 and Hurricane Harvey that struck Rockport, Texas, in 2017 are examples of the costly extreme hurricane events as described above (NOAA, 2018; Rappaport and Fernandez-Partagas, 1995). Extreme high-water levels associated with storm surges at coastal locations are an important public concern. They are also a factor in coastal hazard assessment, navigational safety, and ecosystem management.

The coastal environment can be dramatically affected by surges from extreme hurricane events. The affects may result in significant morphological changes to barrier islands, destruction of forests, agricultural lands, critical infrastructure, inundation of coastal shorelines with salt water, and severe damages to essential wildlife habitat (Needham and Keim, 2012). For example, Hurricane Beulah (1967) made landfall with an 18-foot storm surge. It inundated South Padre Island and made 21 cuts completely through the island causing significant devastation to the island's sensitive ecosystem, dramatically altering the landscape (Sugg and Pelissier, 1968). Additionally, hurricane storm surge and waves induce barrier island rollover or landward migration of islands (Stone et al., 1997).

The SURGEDAT Storm Surge Database provides storm surge (peak height) and location of storms around the world since 1880. Figure 3-5 displays storm surge magnitudes occurring in the study area (SURGEDAT, 2016). The figure provides estimated locations of maximum storm surge; however, storm surges typically inundate larger areas of a coastline greatly beyond the peak surge location.

As an example, Berg (2009) reported Hurricane Ike produced a maximum storm surge of 14.5 feet in Chambers County. However, surge effects of the hurricane were experienced for most of the U.S. Gulf coastline, with more than 124 miles of coastline inundated by more than 6.6 feet of storm surge. As a comparison, Hurricane Harvey made landfall within the project area along the northern end of San José Island, immediately east of Rockport. It produced storm surge levels from 6 to 10 feet in the back bays between Port Aransas and Matagorda, including Copano Bay and Aransas Bay. The TCOON gauge at Port Aransas registered 5.3 feet mean higher high water and Packery Channel registered 4.7 feet mean higher high water. The USGS surveyed a high-water mark near Port Aransas of 6.4 feet above ground level (Blake and Zelinsky 2018).

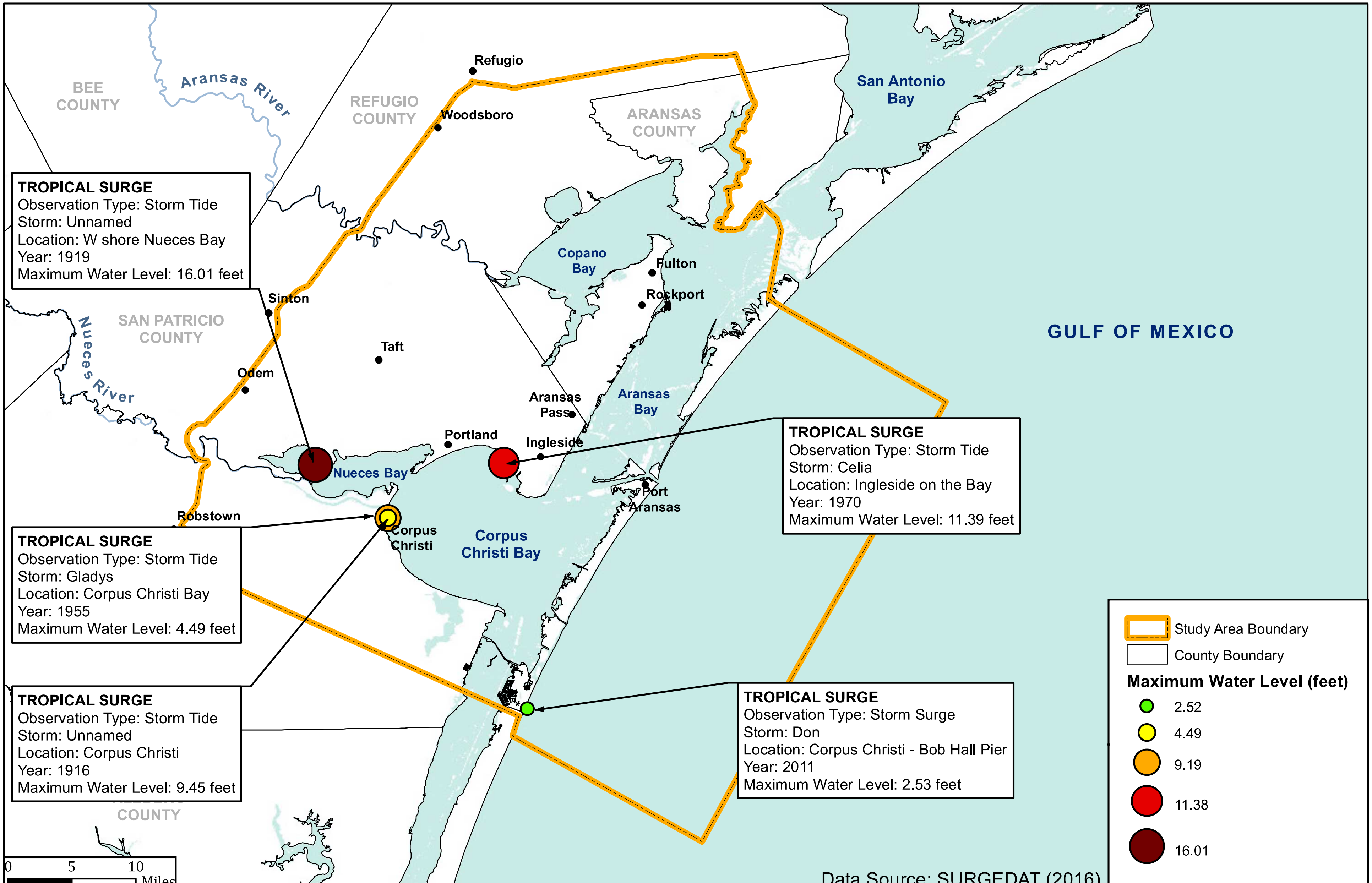
Blake and Zelinsky (2018) also reported that water levels of 3.5 feet mean higher high water were measured on the Gulf side of the barrier island near Bob Hall Pier. Inundations from 4 to 7 feet above ground level were likely along the barrier island from Port Aransas to Matagorda. However, there we no tide gauge observations from this area.

3.2.5 Water and Sediment Quality

Section 305(b) of the CWA requires states to report the quality of their surface waters every 2 years. Water and sediment quality along the Texas coast are measured by a variety of organizations. The TCEQ monitors water and sediment quality of bays and estuaries throughout the State with support from the EPA. The EPA, NOAA, and USFWS joined with academia and State agencies to conduct synoptic surveys of coastal ecosystem health through the EPA's National Coastal Assessment. The assessment was first conducted in 2001 and most recently sampled in 2010 (EPA, 2015).

3.2.5.1 Water Quality

The TCEQ completed its most recent report of surface water quality for CWA sections 305(b) and 303(d) in March 2020. The EPA approved the 2020 Texas 303(d) list in May 2020 (TCEQ, 2020a). These reports compare monitored water quality to criteria established by the state. They are intended to ensure the State's waters are fishable and swimmable in accordance with goals of the CWA. Criteria are published in the



PROJECT NO. PCA20166	Port of Corpus Christi Authority Corpus Christi Ship Channel Deepening Project	N W E S	FIGURE
DATE CREATED Date: 9/7/2021			
DATUM & COORDINATE SYSTEM NAD83 State Plane (feet) Texas South Centra	**Storm Surge Locations and Magnitudes**		3-5
FILE NAME Name: Fig_3-5_Storm Surge			
PREPARED BY KLC			

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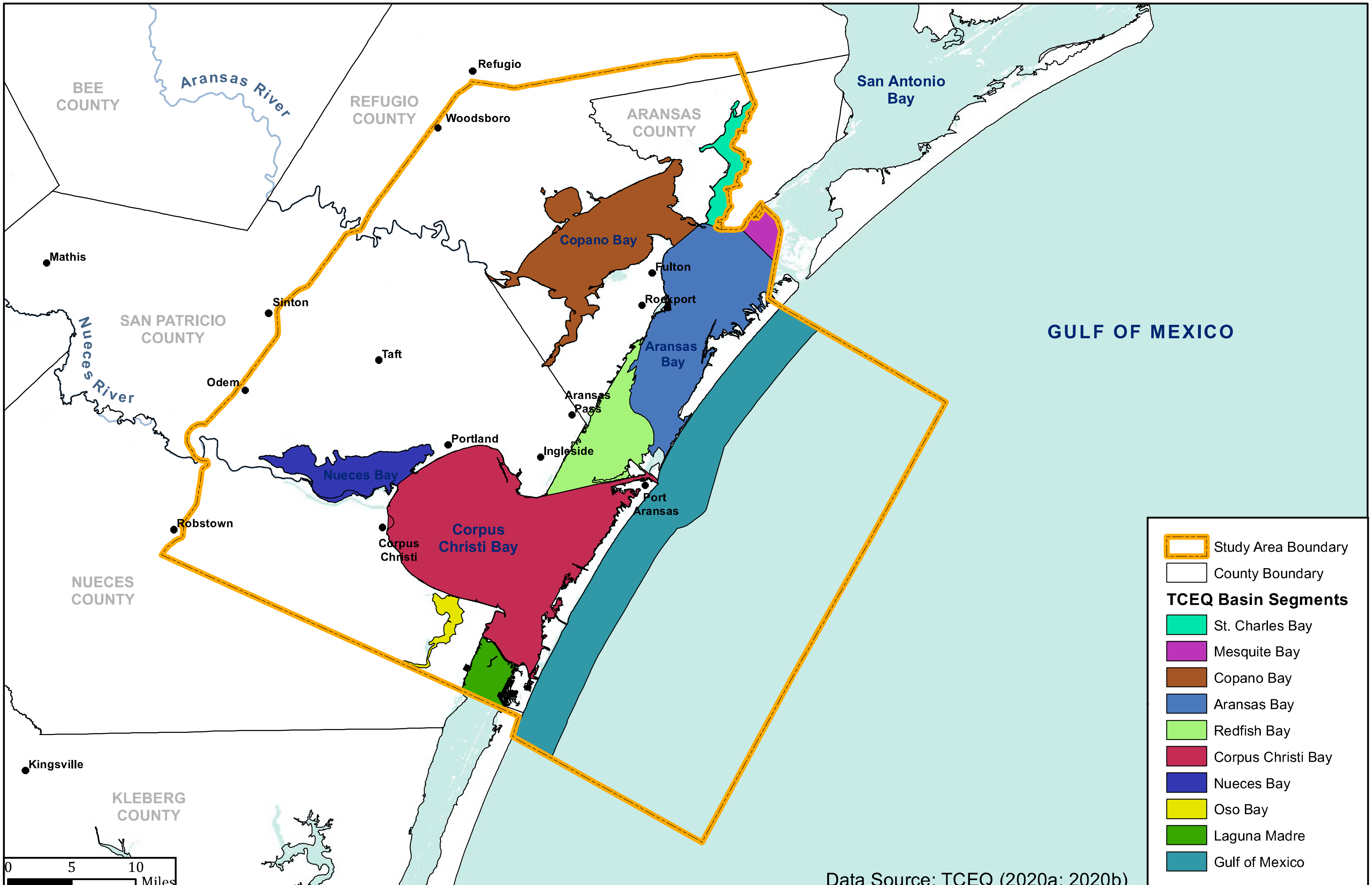
State's water quality standards, which are developed with assistance from an advisory group and approved by the EPA (TCEQ, 2018). Reports have historically focused on water-quality issues created by regulated discharges of treated wastewater. However, in recent years they have also considered impacts from stormwater runoff and habitat modification.

TCEQ evaluates water bodies based on Surface Water Quality Monitoring (SWQM) segments, each of which are given a unique identifier. There are 10 SWQM segments found within the study area, several of which the geography only partially overlaps with the study area boundaries (Figure 3-6). This includes nearshore oceanic waters of the Gulf, extending offshore from the barrier island shoreline to the limit of Texas' jurisdiction (9 nautical miles). The 2020 Texas 303(d) list identifies waters which are considered impaired for which the state plans to develop total maximum daily load (TMDL) criteria (TCEQ, 2020a). The report includes waters in which TMDLs have already been adopted, waters in which other management strategies are underway, and waters for which TMDLs or other management strategies are planned.

According to TCEQ (2020a, 2020b), six of the 10 SWQM segments found within the study area exhibit some level of impairment, including nearshore oceanic waters of the Gulf (Table 3-7). These impairments include elevated heavy metals concentrations, elevated bacterial loads, and decreased dissolved oxygen (DO) levels. They can affect biological resources (i.e., finfish and oysters) and human health (i.e., oyster consumption, bacteria contamination from swimming). The 303(d) list includes Category 4 and Category 5 impairments. For Category 4, the required standard is not supported for one or more designated uses but does not require the development of a TMDL. For Category 5, the water body does not meet applicable water quality standards for one or more designated uses by one or more pollutants and a TMDL has or will be developed (TCEQ 2020a, 2020b).

The TCEQ Texas Integrated Reports (2020a, 2020b) also includes water bodies with concerns for use attainment and screening levels. Of the 10 SWQM segments found within the study area, four were found to have levels of concern for at least one impairment parameter (Table 3-8). Impairments included increased chlorophyll *a* concentrations, bacterial loading, and nutrient loading (i.e., copper, phosphorus). Potential sources (non-point source) are also provided for each area of concern. For every impairment, municipal and/or residential sources are thought to be at least partially responsible for elevated levels.

Sampling, analysis, and evaluation of sediment, water, and elutriate for the CCSCIP, Entrance Channel, and Extension, were conducted in accordance with MSPRA Section 103 to evaluate the potential for adverse environmental effects associated with dredging and open water ocean placement of new work sediments. There were no exceedances of the marine water quality screening criteria for site waters. For the elutriate samples, one sample (Dredged Material Management Unit [DMMU] CCNew-01) exceeded the minimum screening criteria for beta-hexachlorocyclohexane but was below the target detection limit, and therefore, was not considered for additional evaluation (Montgomery and Bourne, 2018).



PROJECT NO.	PCA20166
DATE CREATED	Date: 9/7/2021
DATUM & COORDINATE SYSTEM	NAD83 State Plane (feet) Texas South Central
FILE NAME	Name: Fig_3-6_TCEQ Surface WQ Segments
PREPARED BY	KLC

Port of Corpus Christi Authority
Corpus Christi Ship Channel Deepening Project

TCEQ Surface Water Quality Segments

N W E S

FIGURE 3-6

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Table 3-7
2020 TCEQ Surface Water Quality Segments and Impairment Status

Segment ID	Segment Name	Segment Type(s)	Impaired Status?	Impairment Category* (Within Study Area)
2473	St. Charles Bay	Estuary	No	
2463	Mesquite Bay	Estuary	No	
2472	Copano Bay	Estuary	No	
2472OW	Copano Bay	Oyster Waters	Yes	5c – Bacteria in Oyster Waters
2471	Aransas Bay	Estuary	No	
2483	Redfish Bay	Estuary	No	
2481	Corpus Christi Bay	Estuary	No	
2481OW	Corpus Christi Bay	Oyster Waters	No	
2481CB	Corpus Christi Bay	Recreational Beaches	Yes	5a – Bacteria in Water
2482	Nueces Bay	Estuary	Yes	5c – Copper in Water
2482OW	Nueces Bay	Oyster Waters	Yes	4a – Zinc in Edible Tissue
2485	Oso Bay	Estuary	Yes	5b – Depressed DO in Water
2485OW	Oso Bay	Oyster Waters	Yes	4a – Zinc in Edible Tissue 5a – Bacteria in Oyster Waters
2491	Laguna Madre	Estuary	Yes*	*(none in study area)
2491OW	Laguna Madre	Oyster Waters	Yes*	*(none in study area)
2501	Gulf of Mexico	Ocean	Yes	5c – Mercury in Edible Tissue

Source: TCEQ (2020a, 2020b).

Table 3-8
2020 TCEQ Water Bodies with Concerns for Use Attainment and Screening Levels

Segment ID	Segment Name	Parameter(s)	Level of Concern* (Within Study Area)	Potential Sources (Non-Point Source)
2472	Copano Bay	Chlorophyll *a* in Water	CS	Municipal, Residential
2483A	Conn Brown Harbor	Copper in Water	CN	Marina Boat Maintenance
2482	Nueces Bay	Chlorophyll *a* in Water	CS	Crop Production, Upstream, Urban Runoff/Storm Sewers
2485	Oso Bay	Bacteria in Water (Recreational Use)	CN	Municipal, Upstream, Urban Runoff/Storm Sewers, Residential Districts, Upstream, Urban Runoff/ Storm Sewers
		Chlorophyll *a* in Water	CS	Residential Districts
		Total Phosphorus in Water	CS	Upstream Urban Runoff/Storm Sewers

Source: TCEQ (2020c, 2021a).

*CS = Concern for water quality based on screening levels; CN = Concern for near-nonattainment based on numeric data

3.2.5.2 Hypoxia

Hypoxia is defined as depressed DO in the water column, with concentrations below 2 milligrams per liter (Dauer et al., 1992). These conditions have been well documented for the Corpus Christi Bay system. It was first documented in 1988 (Montagna and Kalke, 1992), and later confirmed occurring in the summers in the southeastern region of Corpus Christi Bay (Nelson and Montagna, 2009; Ritter and Montagna, 1999). The phenomenon occurs in bottom waters in an area approximately 22 square miles in size. Its impacts have been documented for macrobenthic infauna, including reduced biomass, abundance, and diversity (Montagna and Froeschke, 2009).

Oso Bay is an enclosed secondary bay off Corpus Christi Bay, with a surface area of approximately 7 square miles, which is also experiencing hypoxia. There are three major wastewater treatment plants that discharge into Oso Creek and Oso Bay, which are likely contributing to its hypoxic conditions. As shown in Table 3-7, Oso Bay is currently listed as impaired due to “Depressed DO in Water”. TCEQ’s TMDL Program has assessed DO concentrations and their effect on aquatic life in Oso Bay and have prepared a Use Attainability Analysis for the bay (TCEQ, 2020d).

3.2.5.3 Sediment Quality

Average particle size distribution (average percent composition) for the CCSC and New Work ODMDS are provided in Table 3-9. Historically, excavated channel sediments can be characterized as predominantly sand with some silt and clay. The New Work ODMDS contains a higher percentage of sand, characterized as fine sand (EPA and USACE, 2008).

Table 3-9
Partial Size Distribution (Average Percent Composition)

Location	Sand	Silt	Clay
CCSC	60.7	18.3	20.9
New Work ODMDS	96.1	3.9	–

Source: EPA and USACE (2008).

On September 24, 1992, a Regional Implementation Agreement was executed between EPA Region 6, and the Galveston District. This Regional Implementation Agreement was updated in November 2003 (EPA and USACE, 2003) and describes protocols for evaluating dredged material quality. These protocols describe chemical parameters that must be analyzed, as well as required detection limits that must be included. Since this agreement sediment evaluations have followed this guidance. Prior to development of the Regional Implementation Agreement, dredged material from the CCSC was evaluated for offshore placement suitability. Testing was also performed for metals, organics, toxicity, and bioaccumulation assessments. Table 3-10 provides a history of sediment quality assessments for the CCSC. This indicated the material was suitable for offshore placement without special management conditions (EPA and USACE, 2008).

Table 3-10
Sediment Quality Assessment History

Date	Type of Testing
August 1980	Toxicity and Bioaccumulation Assessment
March 1982	Pre-Dredging Bulk Analysis
June 1984	Pre-Dredging Bulk Analysis
April 1985	Toxicity and Bioaccumulation Assessment
March/April 1990	Pre-Dredging Bulk Analysis
September 1995	Toxicity and Bioaccumulation Assessment
January 1999	Pre-Dredging Bulk Analysis
August 2002	Toxicity and Bioaccumulation Assessment

Source: EPA and USACE (2008).

Findings from the most recent sediment quality assessment analyzed PAHs (polycyclic aromatic hydrocarbon), organochlorine compounds, and PCBs (polychlorinated biphenyl) and were all found to be below detection limits or were detected at low levels. However, when compared to the Effects Range Low, results revealed that there were exceedances at one or more locations, but only in the Inner Harbor (USACE, 2003).

Sediment, water, and elutriate sampling for the CCSCIP was conducted in accordance with MSPRA Section 103 to evaluate the potential for adverse environmental effects associated with dredging and open water ocean placement of new work sediments. Toxicity testing included the elutriate bioassays and whole sediment toxicity bioassays. The bioaccumulation studies showed no significant bioaccumulation and that sample tissue concentrations did not exceed U.S. Food and Drug Administration action limits for any test organisms. No potential for adverse bioaccumulation effects were found for project sediments (Montgomery and Bourne, 2018).

3.2.6 Freshwater Inflow

Fresh water from streams, combined with irrigation and wastewater return flows, rainfall, and groundwater seepage, mixes with saline Gulf waters to create estuaries on the Texas coast. Dramatic swings in freshwater inflow, sediment, and nutrient loading occur in Texas estuaries. Extended droughts, which reduce freshwater inflow, are punctuated by episodic severe flooding from late summer and early fall tropical storms and hurricanes.

Each estuary is unique because of variation in total amounts, seasonal distribution, and manner of freshwater delivery (Longley, 1994; Powell et al., 2002). When freshwater inflow is reduced, estuarine salinities increase, affecting flora and fauna adapted to lower salinities. Reduced sediment loading may allow marshes to subside and shorelines to retreat. Changes in nutrient loading impact plants and animals forming the base of the estuarine food web.

The Nueces River watershed is the primary source of freshwater inflow into the Corpus Christi Bay system (Nueces BBEST, 2011). Nueces freshwater inflow peaks slightly during June and September during periods with higher rainfall with low rates of inflow from November through March. Although it is the primary source of freshwater to the Corpus Christi Bay system, freshwater from the Nueces watershed does not substantially influence salinities outside of Nueces Bay (Pulich et al., 2002; TWDB, 2011).

The TWDB has calculated average freshwater inflow into the Corpus Christi Bay system over the period from 1941 through 2014 (TWDB, 2021d). The annual median values for:

- Gauged flows (Nueces River near Mathis, Gauge 08211000 and Oso Creek at Corpus Christi, Gauge 08211520) = 129,000 ac-ft,
- Modeled flows from ungauged coastal watersheds = 19,100 ac-ft, and
- Return flows (primarily treated wastewater treatment plant effluent) = 45,100 ac-ft.

Reservoir construction and increased water use have reduced freshwater inflows and shifted the ecological condition of the Nueces estuary. Pre-20th century conditions in the estuary were summarized beginning with an 1877 description of conditions in the Nueces Delta (Nueces BBEST, 2011):

> "…the lower Nueces Delta, where the Nueces River drained into Nueces Bay was described as being a large recently accreted mud flat, several miles in extent, fit for only alligators and mud-snakes. The area immediately above the lower Delta was heavily forested and entwined with 'thousands of snags and water soaked logs', indicating a history of immense floods that occurred in the lower floodplain of the Nueces River watershed (BOR, 2000). The upper Nueces Delta in 1877 was a boggy area filled with pools of low-salinity brackish water. Confirmation of historical low salinities (0.5–5) that occurred in the area is also indicated by the current presence of *Rangia* middens in the Delta, the remains of foraging activities of Native American who inhabited the area up until the early 19th century. *Rangia* is only present in other Texas estuaries where mean salinities are less than 12 (Montagna and Kalke, 1995) but need salinities less than 10 for larval survival (Hopkins, et al., 1973; LaSalle and Cruz, 1985)."

Since the 1980's when Choke Canyon Reservoir was impounded, freshwater inflows, particularly from floods, have declined. Salinities can exceed 40 ppt in Nueces Bay during July and August (Nueces BBEST, 2011).

Inflows from the Nueces watershed are controlled to a substantial extent (except during flooding) by the water right permit (Certificate of Adjudication No. 21-3214) for Choke Canyon Reservoir. It is jointly held by the City of Corpus Christi, the Nueces River Authority, and the City of Three Rivers (Nueces BBEST, 2011). An Agreed Order, which is part of the water right, was amended in 2001. It describes how the city will provide freshwater inflow to the Nueces estuary through the Nueces River and the Rincon Bayou.

Freshwater inflow targets in the Agreed Order are illustrated in Table 3-11. In the table, "capacity" refers to the combined capacity of Choke Canyon Reservoir and Lake Corpus Christi. "Pass-Through" refers to water that flows into the reservoir system that can be allowed to "pass-through" the reservoir system to the bay.

Table 3-11
Agreed Order Monthly "Pass-through" Targets for Freshwater Inflows to the Nueces Estuary*

Month	Capacity ≥ 70%	40% ≤ Capacity < 70%	30% ≤ Capacity < 40%	Capacity < 30%
Jan	2,500	2,500	1,200	0
Feb	2,500	2,500	1,200	0
Mar	3,500	3,500	1,200	0
Apr	3,500	3,500	1,200	0
May	25,500	23,500	1,200	0
Jun	25,500	23,000	1,200	0
Jul	6,500	4,500	1,200	0
Aug	6,500	5,000	1,200	0
Sep	28,500	11,500	1,200	0
Oct	20,000	9,000	1,200	0
Nov	9,000	4,000	1,200	0
Dec	4,500	4,500	1,200	0

Source: Nueces BBEST (2011).

* Values are in ac-ft

The Nueces BBEST (2011) developed freshwater inflow recommendations for the Nueces estuary in 2011 (Table 3-12). The recommendations recognized interannual variation of inflows creates long term healthy ecological conditions. Recommendations included an annual freshwater inflow of 750,000 ac-ft. This would occur in one out of four years to duplicate wet year conditions and lower salinities to a target of 10 ppt. The recommendations recognized dry conditions occur and there will be years when it is acceptable for the annual freshwater inflow to drop below an annual inflow of 30,000 ac-ft (5 percent of the years).

Table 3-12
Nueces Bay and Delta Inflow Regime Recommendation*

Condition (Target Salinity)	Nueces Bay Freshwater Inflow Regime (Attainment)			Recommendations		Historical Attainment (percent)		
	One Overbanking Event Per Year of 39,000 ac-ft; Maximum Discharge of 3,600 cubic feet per second			Annual Total	Attainment	1941-2009	1941-1982	1983-2009
High (10)	125,000 ac-ft (20%)	250,000 ac-ft (25%)	375,000 ac-ft (20%)	750,000	25%	22	26	15
Base (18)	22,000 ac-ft (60%)	88,000 ac-ft (60%)	56,000 ac-ft (75%)	166,000	80%	67	81	44
Subsistence (34)	5,000 ac-ft (95%)	10,000 ac-ft (95%)	15,000 ac-ft (95%)	30,000	95%	94	100	85
	Nov Dec Jan Feb	Mar Apr May Jun	Jul Aug Sept Oct					
	Winter	Spring	Summer Fall					

Source: Nueces BBEST (2011).

* "Note: The management goal for a sound environment is the base condition, and subsistence should not be a target level, but only occur rarely during drought conditions. We recommend one overbanking event each year with a peak flow of 3,600 cfs measured at the USGS streamflow gaging station at Calallen Dam with a central tendency volume of 39,000 ac-ft. The overbanking event is intended to count only toward the seasonal attainment. Thus, the water volume entering the bay/delta in one season is independent of the volume entering the bay/delta in the preceding or subsequent season. For example, if a season has twice the inflow recommended by the BBEST, the extra inflow will not count towards the inflow needs for the subsequent season. Moreover, the volume of water entering the bay/delta in a year is independent of the volume entering the bay/delta in the preceding year."

Other sources of freshwater inflow in the study area include the Guadalupe, Mission and Aransas rivers. The Guadalupe River enters San Antonio Bay and much its freshwater flows to the south into Aransas Bay (Guadalupe BBEST, 2011). The Mission and Aransas rivers flow into Copano Bay of the Aransas Bay which is a secondary bay in the Aransas Bay system.

The TWDB has calculated average freshwater inflow into the Aransas Bay system over the period from 1941 through 2014 (TWDB, 2021e). The annual median values for:

- Gauged flows (Copano Creek near Refugio, Gauge 08189200, Mission River near Refugio, Gauge 08189500, Aransas River near Skidmore, Gauge 08189700, and Chiltipin Creek at Sinton, Gauge 08189800) = 1,350 ac-ft,
- Modeled flows from ungauged coastal watersheds = 1,970 ac-ft, and
- Return flows (primarily treated wastewater treatment plant effluent) = 152 ac-ft.

Guadalupe River flows dominate salinities in the Mission-Aransas estuary (Chen, 2010; Guadalupe BBEST, 2011). Peak inflows, primarily from the Mission and Aransas rivers have been recorded in September and October. A secondary peak in inflow occurs in May and June. An analysis intended to protect the brackish water mussel, *Rangia cuneata*, and Eastern oysters in the Mission-Aransas estuary, The Guadalupe BBEST recommended combined freshwater inflows from the Guadalupe, Mission, and Aransas rivers of:

- Guadalupe River freshwater inflows from July to September of 450,000 to 800,000 ac-ft and from the Mission and Aransas rivers of 1,000 to 110,000 acre-feet in 14 percent of the years to protect oysters, and

- From March to May, Guadalupe River freshwater inflows of 550,000 to 925,000 ac-ft and Mission and Aransas rivers flows of 50,000 to1,000,000 ac-ft in 12 percent of the years to protect *Rangia*.

3.2.7 Groundwater and Surface Water Hydrology

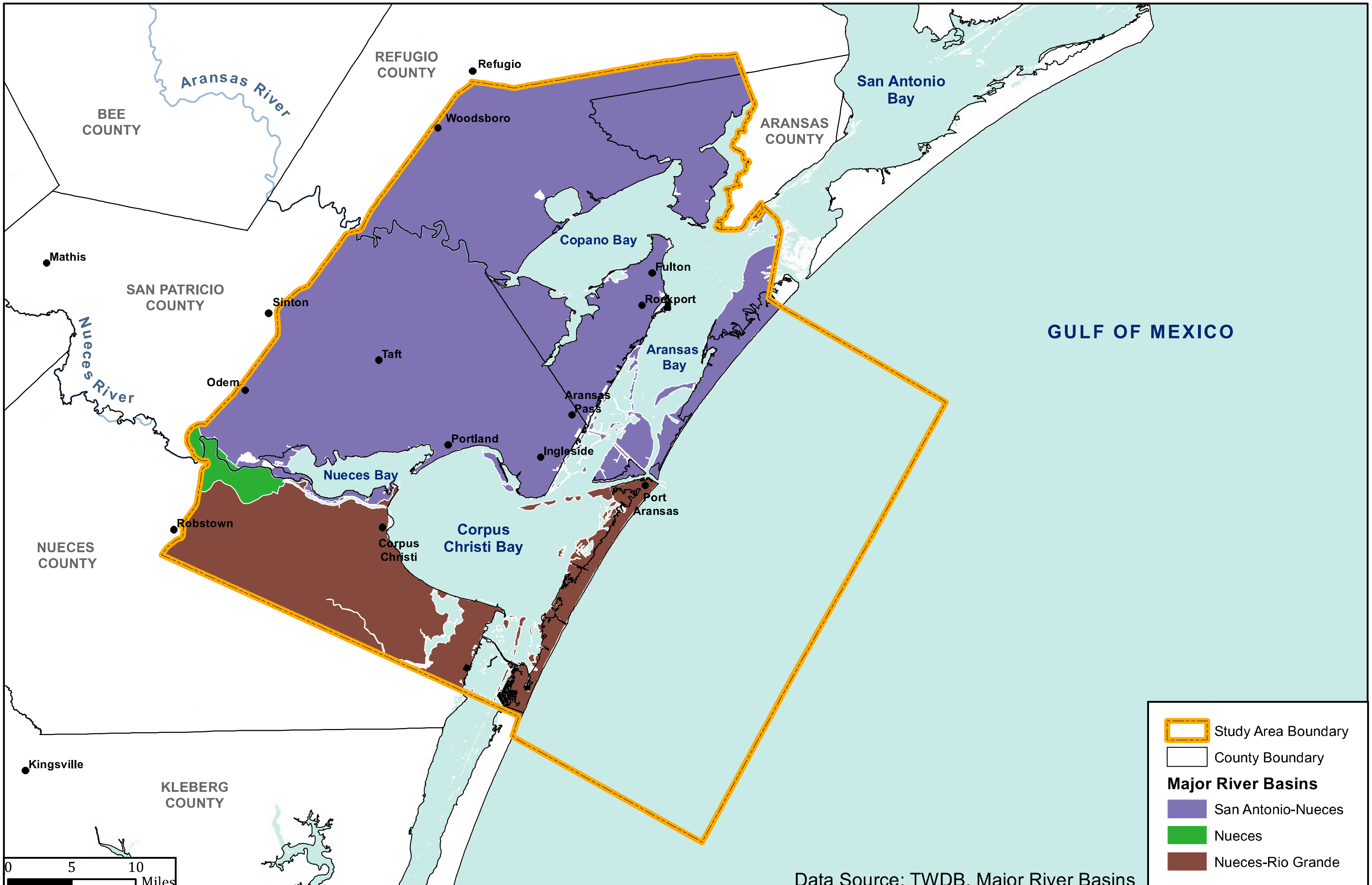
The study area spans portions of the Middle and Lower coast river basin regions, including portions of three major Texas river basins. The major river basins that overlap with the study area are the San Antonio-Neches River Basin, the Nueces River Basin, and the Nueces-Rio Grande River Basin (Figure 3-7). The EPA does not designate any sole source aquifers within the study area (George et al., 2011).

A sole source aquifer is an aquifer that has been designated by the EPA as the sole or principal source of drinking water for an area. The primary source of drinking water in the study area is surface water, including Choke Canyon Reservoir, Lake Corpus Christi, Lake Texana, and the Colorado River (City of Corpus Christi, 2021a). Water from Lake Texana and the Colorado River are transported from the Lavaca and Colorado River basins via the Mary Rhodes pipeline.

San Antonio-Nueces River Basin. The San Antonio-Nueces River Basin is located between the San Antonio and Nueces River basins. The basin drains approximately 3,100 square miles from Karnes County down to Copano Bay and Aransas Bay along the Gulf coast. The two largest river systems within the basin are the Aransas and Mission rivers, which flow approximately 28 miles and 41 miles, respectively. Additional tributaries include Aransas Creek and Poesta Creek (Nueces River Authority, 2010).

Nueces River Basin. The Nueces River Basin extends from Edwards County to Nueces Bay in the Gulf near Corpus Christi. The main river systems within the basin include the Atascosa and Frio rivers, which converge into the Nueces River. Branching from these major rivers are tributaries, such as San Miguel Creek, Hondo Creek, Sabinal River, and Leona River. The basin stretches 315 miles and has a drainage area of 16,700 square miles. The major reservoirs along the Nueces River include Choke Canyon Reservoir and Lake Corpus Christi covering 47,891 surface acres (TCEQ, 2016).

Part of the Nueces and its tributaries flow into the crevices of the Edwards Aquifer Balcones Fault Zone. This results in stream flows that consists mostly of stormwater downstream of the recharge zone (TCEQ, 2016). The water levels in the artesian zone have decreased due to drought and water demand. This has negatively impacted habitats that rely on flows from the San Marcos and Comal springs (USACE, 2012b). The Nueces River Tidal section starts at the confluence with Nueces Bay in Nueces County for 12 miles to Calallen Dam in Nueces/San Patricio County.



PROJECT NO. PCA20166

DATE CREATED Date: 9/7/2021

DATUM & COORDINATE SYSTEM NAD83 State Plane (feet) Texas South Central

FILE NAME Name: Fig_3-7_Major River Basins

PREPARED BY KLC

Port of Corpus Christi Authority
Corpus Christi Ship Channel Deepening Project

Major River Basins

FIGURE 3-7

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Nueces-Rio Grande River Basin. The Nueces-Rio Grande Basin is located between the Nueces River and the Rio Grande basins. The basin drains approximately 10,442 square miles from Webb County down to the Laguna Madre, Baffin Bay, and Oso Bay along the Gulf coast. The two largest river systems in the basin are Petronila Creek and Arroyo Colorado River, which flow approximately 58 miles and 89 miles, respectively (Nueces River Authority, 2010).

3.2.8 Soils (Prime and Other Important Unique Farmland)

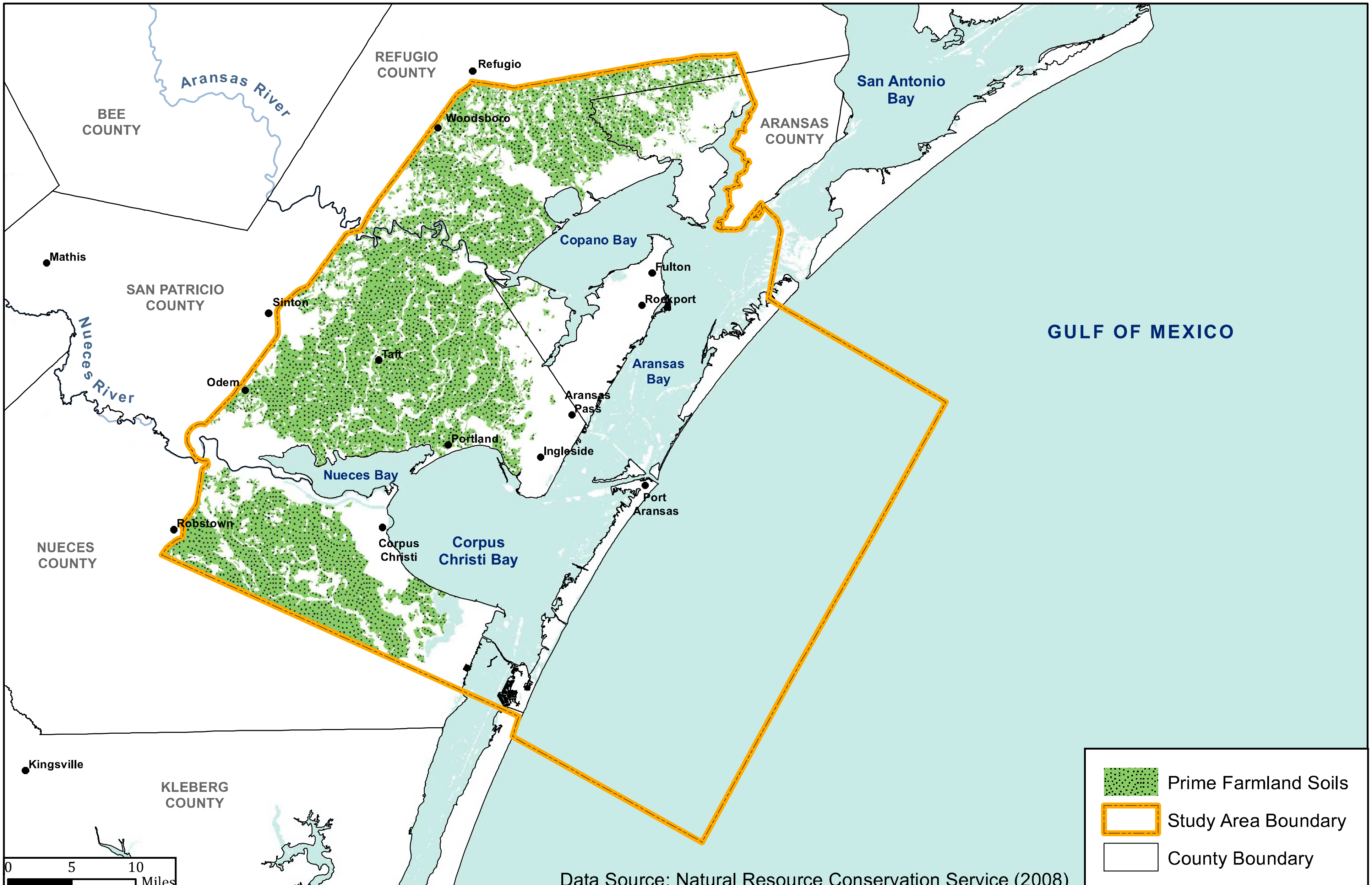
Soils and prime and unique farmlands found in the study area (Figure 3-8) are influenced by soil types found in San Patricio and Nueces counties. The majority of San Patricio and Nueces counties is in the Gulf coast plain with dominant soils being in the Victoria-Orelia-Edroy series (Natural Resources Conservation Service, 2008). The Victoria clay has a high shrink-swell potential and in undisturbed areas, forms gilgai depressions (Soil Conservation Service, 1965). The southwestern corner of Nueces County lies within the Rio Grande plain, but soils are dominated by Nueces-Sarita-Falfurrias soils. The Gulf coast saline prairie is dominated by Mustang-Daggerhill-Barrada soils, which are on low coastal terraces and plains along the barrier islands (Natural Resources Conservation Service, 2008).

The coast is predominantly open grassland and used for rangelands and wildlife habitat. Most of the prime farmlands in this area reside on historic open grassland areas with scattered trees and shrubs. Prime farmland soil classes in the area include Banquete clay, Calallen sandy clay loam, Clareville loam, Clareville clay loam, Colmena fine sandy loam, Cranell sandy clay loam, Czar sandy clay loam, Monteola clay, Odem fine sandy loam, Orelia fine sandy loam, Palalote sandy loam, Pharr fine sandy loam, Raymondville clay loam, Raymondville complex, Sinton loam, Sinton clay, Victoria clay, and Willacy fine sandy loam. Because of the slope and fine soil, erosion is a major problem. Corn, sorghum, and cotton are important agricultural crops in the region (Soil Conservation Service, 1965, 1979).

3.2.9 Energy and Mineral Resources

The project area has numerous natural resources, including oil and gas, sulfur, salt, shell, clay, sand, magnesium, and bromine. Among these the most significant is oil and gas (Brown et al., 1976). Oil, natural gas, and natural gas liquids are major factors in the economy of the area. They serve not only for fuel, but also for raw material and for many petrochemical processes. The Corpus Christi area has various mineral resources. These resources contribute to the regional economy either directly through the value of raw material, or indirectly through the industries they support, supply, and attract.

The nearest conventional source of industrial calcium carbonate is approximately 150 miles inland in central Texas. Within the project area, shell occurs as discrete reefs and banks mixed with bottom sand and mud in the shallow bays. The oyster *Crassostrea* is the main source of shell (Brown et al., 1976).



PROJECT NO. PCA20166	
DATE CREATED Date: 9/7/2021	
DATUM & COORDINATE SYSTEM NAD83 State Plane (feet) Texas South Centra	
FILE NAME Name: Fig_3-8_Prime Farmlands	
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Port of Corpus Christi Authority
Corpus Christi Ship Channel Deepening Project

Prime Farmlands

N W E S

FIGURE 3-8

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Parts of certain reefs support living oysters, while others are composed entirely of dead shells. The physical and chemical properties of shell make it suitable for use as aggregate, road base, and the production of lime, cement, and chemicals.

Sand deposits in the area have the potential for industry or specialty uses such as foundry sands, glass sands, and chemical silica. Common clays are used in the manufacture of brick and tile. The production of oil and natural gas plays a prominent role in the economy of the Corpus Christi area.

According to the Railroad Commission of Texas (RRC) records, the exploration and production of oil and gas within a 1-mile radius of the project area includes 479 records of oil and gas exploration and production (RRC, 2021). These records indicate the following well records for the project area:

- 12 cancelled or abandoned drilling locations;
- 197 dry holes;
- 58 gas wells;
- 1 injection/disposal well;
- 4 oil wells;
- 23 oil/gas wells;
- 29 permitted drilling locations;
- 101 plugged gas wells;
- 28 plugged oil wells; and
- 25 plugged oil/gas wells.

The presence of significant reserves of petroleum and the large-scale processing and refining capacities in the region have resulted in an abundance of pipelines for the transmission of raw petroleum and petroleum products. According to the RRC records, there are 52 pipeline systems in the project area. Forty-four are listed as active and eight are listed as abandoned. More than half of the pipeline systems transport petroleum products across the project area (RRC, 2021).

3.2.10 Hazardous, Toxic, and Radioactive Waste

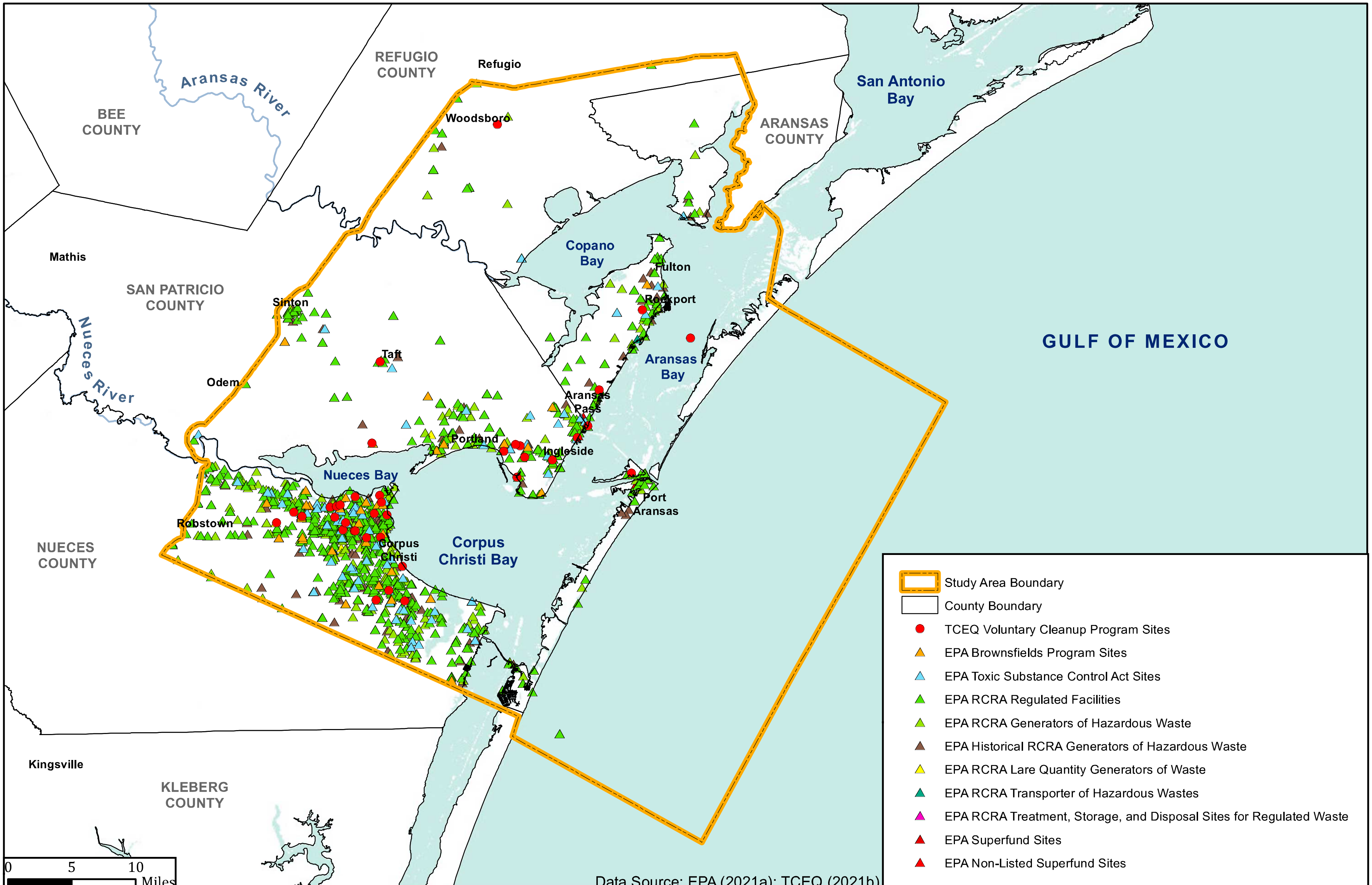
The presence of potential Hazardous, Toxic, and Radioactive Waste (HTRW) concerns within the preferred project study area including hazardous materials, hazardous waste, and potential contamination by current or past industrial or other activities are discussed below. HTRW includes any material listed as a "hazardous substance" under the Comprehensive Environmental Response, Compensation and Liability Act (CERCLA), 42 USC 9601 et seq. Potential HTRW concerns were identified through a review of State and Federal databases cataloguing permitted facilities and activities regulated by agencies such as the TCEQ and the EPA.

Industrial and commercial development is prominent within the study area from Copano Bay to the northern portion of Laguna Madre. It includes Aransas, Refugio, San Patricio, and Nueces counties. Rockport, San Patricio, and Nueces counties contain the largest volume of regulated sites. They are centrally located around the cities of Robstown, Ingleside, Portland, and Corpus Christi. According to the TCEQ and EPA, these commercial and industrial activities and associated HTRW concerns are most prominent along the coast between Rockport and Corpus Christi. This area contains the highest volume of regulated sites (Figure 3-9) (EPA, 2021a; TCEQ, 2021b).

The Port is the third largest U.S. port and the largest exporter of crude oil. The Port includes cargo shipping and receiving facilities for offshore drilling, wind turbine production, steel and steel pipe production, and heavy machinery. In addition, several facilities in and around the port contribute to increasing volumes of chemicals, crude oil, and petroleum products (Port, 2019a).

The industrial land uses in the project area since as early as the 1910s has the potential to impact the chemical composition of deposited sediments. Specifically, petroleum hydrocarbons and VOCs used and/or stored in terminal storage facilities, shipyards, and other industries in the project area are potential contaminants in the deposited sediment. In addition, over 7,165 emergency response records were identified since 2001 for unauthorized releases/spills of oil and hazardous substances that were reported to the National Response Center (EPA, 2021a).

Regulated HTRW activities within the study area include facilities regulated by the State under the TCEQ Voluntary Cleanup Program (VCP), the TCEQ Industrial Hazardous Waste Division and Industrial Hazardous Waste Corrective Action Program, the TCEQ Petroleum Storage Tank Program, and Leaking Petroleum Storage Tank (LPST) Program, the TCEQ Dry Cleaners Registration Program as well as under the EPA Assessment Cleanup and Redevelopment Exchange System for Brownfields sites, the EPA Base Realignment and Closure Program, the EPA CERCLA, Superfund Enterprise Management System (SEMS) Superfund Program, the EPA Federal Insecticide, Fungicide, and Rodenticide Act, the EPA Toxic Substances Control Act, the EPA Resource Conservation and Recovery Act (RCRA) Waste Generator Program, the EPA RCRA Waste Transporter Program, the EPA RCRA Waste Treatment, Storage and Disposal Facility Program, and the EPA Emergency Response Notification System (ERNS). Each regulated facility has the potential to improperly use, store, handle, transport, and dispose of or release hazardous materials and hazardous waste in a manner to impact sediments and/or soils within and adjacent to the CCSC and the preferred project.



PROJECT NO. PCA20166

DATE CREATED Date: 9/7/2021

DATUM & COORDINATE SYSTEM NAD83 State Plane (feet) Texas South Central

FILE NAME Name: Fig_3-9_HazMatLocations

PREPARED BY KLC

Port of Corpus Christi Authority
Corpus Christi Ship Channel Deepening Project

Regulated and Hazardous Materials Facilities

FIGURE 3-9

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Federal and State records were searched using a third-party research company, Banks Environmental Data. A total of 14,827 environmental records were identified within the study area. Table 3-13 summarizes the databases and environmental records found. Of those records, most were identified in the EPA ERNS database (7,164 records), TCEQ Institutional Control (IC) database (2,314 records), TCEQ LPST database (1,915 records), and TCEQ Hazardous Waste generator database (1,547 records). These four databases account for 87.27 percent of the environmental records found. Environmental records found in the ERNS database include emergency response activities due to a release or spill of a regulated substance or petroleum product. Environmental records found in the TCEQ IC database are included for known environmental impacts where a deed recording has been used in part or whole to address the environmental impact. This may include sites that are deed recorded as commercial or industrial use only or physical controls used to contain known environmental contamination in place. The TCEQ LPST database contains environmental records for sites where a known release has occurred from a petroleum storage tank system either in operation or when being removed from service. The TCEQ Hazardous Waste database includes environmental records for facilities that generate, use, store, or dispose of hazardous wastes.

Table 3-13
Environmental Records Identified within Study Area

Database	Definition	Number of Records
Federal Databases		
National Priority List (NPL)	List of high priority hazardous waste sites in the U.S. eligible for long-term remedial action financed under the federal Superfund program or SEMS database.	5
Delisted NPL	List of all sites that have been deleted from the EPA NPL list (SEMS database).	0
SEMS (CER SEMS)	SEMS is a database that tracks sites under the CERCLA, that are either proposed, listed, or under review currently to be a part of the NPL.	14
SEMS NFRAP (CER SEMS NFRAP)	From the SEMS database, No Further Remedial Action Planned (NFRAP) sites are removed.	84
RCRA CORRACTS (RCRA COR)	Contains sites that are registered hazardous waste generators or handlers that fall under the RCRA and subject to corrective action activity.	105
RCRA Non-CORRECTS TSP (RCRA TSD)	Contains all treatment, storage, and disposal of hazardous material sites that fall under the RCRA.	113
RCRA Generators (RCRA GEN)	Contains all Hazardous Waste Generators subject to the RCRA.	325
Federal Brownfields (FED BWN)	Contains sites that assist the EPA in collecting, tracking, and updating information of sites in relation to the Small Business Liability Relief and Brownfields Revitalization Act.	43
Federal Institutional Control (FED IC)	Brownfield Management System sites that have had ICs placed on them. ICs are administrative restrictions that minimize the potential for human exposure to known contamination by ensuring appropriate land or resource use.	5
Federal Engineering Control (FRE EC)	Brownfield Management System sites that have had Engineering Controls placed on them. Engineering Controls are physical. Engineering Controls are	0

Database	Definition	Number of Records
	physical methods or modifications put into place on a site to reduce or eliminate the possibility of human exposure to known contamination.	
ERNS List (ERNS)	Stores information on unauthorized releases of oil and hazardous substances that have been reported to the National Response Center since 2001.	7,165
	State Databases	
State/Tribal Equivalent NPL (ST NPL)	Contains sites determined by the TCEQ that may constitute an imminent and substantial endangerment to public health and safety or to the environment due to the release or threatened release of hazardous substances into the environment.	12
State/Tribal Equivalent CERCLIS (ST CER)	This database is not currently available from this state. If this state does make this database available in the future, Bank Environmental Data will obtain it for reporting purposes.	0
State/Tribal Disposal or Landfill (SWLF)	Contains all solid waste permitted facilities, regulated biomedical waste facilities, transfer stations, construction and demolition landfills, and non-hazardous industrial waste disposal.	189
State/Tribal Leaking Storage Tank (LPST)	Contains information on leaking storage tanks, equipment failures, compliance, and releases in the state.	1,915
State/Tribal Storage Tank (Petroleum Storage Tank)	Contains information on above and underground storage tanks, compliance, and releases in the state.	2,314
State/Tribal Institutional Control (ST IC)	Includes VCP or Innocent Operator Program sites that have been remediated and have had ICs placed on them. ICs are administrative restrictions that minimize the potential for human exposure to known contamination by ensuring appropriate land or resource use.	20
State/Tribal Engineering Control (ST EC)	Includes VCP or Innocent Operator Program sites that have been remediated and have had Engineering Controls placed on them. Engineering Controls are physical methods or modifications put into place on a site to reduce or eliminate the possibility of human exposure to known contamination.	4
State/Tribal Voluntary Cleanup (VCP)	Sites that private parties and government entities have voluntarily investigated and cleaned up under the state's VCP.	135
State/Tribal Brownfield (ST BWN)	Brownfield Certified sites are sites that have entered or completed the Brownfields Certificate Program.	6
State/Tribal Hazardous Waste	Contains information on facilities which store, process, or dispose of hazardous waste as maintained by the Industrial and Hazardous Waste Permits section of the TCEQ.	1,547
RCRA (RCRA)	All sites that fall under the RCRA and are not classifiable as treatment, storage, disposers of hazardous material, hazardous waste generator, or subject to corrective action activity.	718
Dry Cleaners (DRYC)	Dry Cleaner data houses both the Dry Cleaner Remediation Program information and PERC (perchloroethylene) information released by the TCEQ. The Dry Cleaner Remediation Program database contains records funded for state-lead cleanup of dry cleaner related contaminated sites.	108
State/Tribal Municipal Settings Designation (MS)	Contains all sites that have been certified that designated groundwater at the property is not used as potable water, and is prohibited from future use as potable water because that groundwater is contaminated in excess of the applicable potable-water protective concentration level.	0

3.2.11 Air Quality

This section presents the applicable regulatory framework and existing ambient air quality within the study area.

3.2.11.1 Regulatory Content – National Ambient Air Quality Standards

The Clean Air Act (CAA), which was last amended in 1990, regulates air emissions from area, stationary, and mobile sources. The CAA requires the EPA to establish National Ambient Air Quality Standards (NAAQS) for pollutants considered harmful to public health and the environment. The CAA establishes two types of national air quality standards: primary standards and secondary standards.

Primary standards define the maximum levels of pollutants, with an adequate margin of safety, that the EPA judges necessary to protect public health. This includes the health of “sensitive” populations such as asthmatics, children, and the elderly. Secondary standards define the maximum levels of pollutants that the EPA judges necessary to protect public welfare. This includes protection against decreased visibility, and damage to animals, crops, vegetation, and buildings. Air quality is generally considered acceptable if pollutant levels are less than or equal to these established EPA standards on a continuing basis (EPA, 2021b).

The EPA has set NAAQS for seven principal pollutants, referred to as “criteria” pollutants. They are carbon monoxide (CO), nitrogen dioxide (NO_2), ozone (O_3), lead (Pb), inhalable particulate matter (PM) with an aerodynamic diameter less than or equal to a nominal 10 microns (PM_{10}), fine particulate matter with an aerodynamic diameter less than or equal to a nominal 2.5 microns ($PM_{2.5}$), and sulfur dioxide (SO_2) (EPA, 2021b). The NAAQS are further defined in 40 CFR Part 50. The NAAQS standards for these criteria pollutants are provided in Table 3-14.

CO is a colorless and practically odorless gas primarily formed when carbon in fuels is not burned completely. Transportation activities, indoor heating, industrial processes, and open burning are among the anthropogenic (man-made) sources of CO (EPA, 2021c).

NO_2, nitric oxide, and other oxides of nitrogen are collectively called nitrogen oxides (NO_x). These pollutants are interrelated, often changing from one form to another in chemical reactions. NO_2 is the pollutant commonly measured in ambient air monitors. NO_x is generally emitted in the form of nitric oxide, which is oxidized to NO_2. The principal anthropogenic sources of NO_x are fuel combustion in motor vehicles and stationary sources such as boilers and power plants. Reactions of NO_x with other atmospheric chemicals can lead to the formation of O_3 (EPA, 2021d).

Table 3-14
EPA National Ambient Air Quality Standards

Pollutant		Primary/Secondary	Averaging Time	Level
Carbon Monoxide (CO)		primary	8 hours	9 ppm
			1 hour	35 ppm
Lead (Pb)		primary and secondary	Rolling 3-month average	0.15 μg/m^3
Nitrogen Dioxide (NO_2)		primary	1 hour	100 ppb
		primary and secondary	1 year	53 ppb
Ozone (O_3)		primary and secondary	8 hours	0.070 ppm
Particulate Matter (PM)	$PM_{2.5}$	primary	1 year	12.0 μg/m^3
		secondary	1 year	15.0 μg/m^3
		primary and secondary	24 hours	35 μg/m^3
	PM_{10}	primary and secondary	24 hours	150 μg/m^3
Sulfur Dioxide (SO_2)		primary	1 hour	75 ppb
		secondary	3 hours	0.5 ppm

Source: EPA (2021b).

ug/m^3 = microgram per cubic meter; ppb = parts per billion; ppm = parts per million

Ground-level O_3 is a secondary pollutant formed from daytime reactions of NO_x and VOCs, rather than being directly emitted by natural and anthropogenic sources. VOCs, which have no NAAQS, are released in industrial processes and from evaporation of organic liquids such as gasoline and solvents. Ozone contributes to the formation of photochemical smog (EPA, 2021e).

Lead is a heavy metal that may be present as dust or fumes. Dominant industrial sources of lead emissions include waste oil and solid waste incineration, iron and steel production, lead smelting, and battery and lead alkyl manufacturing. The lead content of motor vehicle emissions, which was the major source of lead emissions in the past, has significantly declined with the widespread use of unleaded fuel (U.S. Energy Information Administration [EIA], 2021a).

The NAAQS for particulate matter is based on two different particle-diameter sizes: PM_{10} and $PM_{2.5}$. PM_{10} are small particles that are likely to reach the lower regions of the respiratory tract by inhalation. $PM_{2.5}$ is considered to be in the respirable range. This means these particles can reach the alveolar region of the lungs and penetrate deeper than PM_{10}. There are many sources of particulate matter, both natural and anthropogenic. These include dust from natural wind erosion of soil, construction activities, industrial activities, and combustion of fuels (San Joaquin Valley Air Pollution Control District, 2021).

SO_2 is a colorless gas with a sharp, pungent odor. SO_2 is emitted in natural processes. These include volcanic activity and by anthropogenic sources such as combustion of fuels containing sulfur and the manufacture of sulfuric acid (Minnesota Pollution Control Agency, 2021).

The CAA also requires the EPA to assign a designation to each area of the U.S. regarding compliance with the NAAQS results of the ambient air quality monitoring data for that area. The EPA categorizes the level of compliance or noncompliance with each criteria pollutant as follows (EPA, 2021f):

- Attainment – area currently meets the NAAQS.
- Maintenance – area currently meets the NAAQS but has previously been out of compliance.
- Nonattainment – area currently does not meet the NAAQS.

Ozone nonattainment areas are further classified as extreme, severe, serious, moderate, or marginal depending on the severity of nonattainment. The Port is stationed near downtown Corpus Christi in Nueces County, Texas and the preferred project is located in Nueces, San Patricio, and Aransas counties. The current NAAQS for ozone is calculated as the fourth highest daily maximum 8-hour average. This is averaged over the past three calendar years, and per Table 3-14 may not exceed 0.070 ppm. As of year-end 2018, the Corpus Christi airshed is in attainment of NAAQS for ozone. It has a 3-year average value of 61 ppb (using data from years 2016, 2017, and 2018) at two of the active monitoring stations Continuous Ambient Monitoring Stations 4 and 21 in Corpus Christi closest to the project area (Corpus Christi Air Quality Group, 2019). The airshed has experienced an overall decreasing trend in ozone values (Figure 3-10).

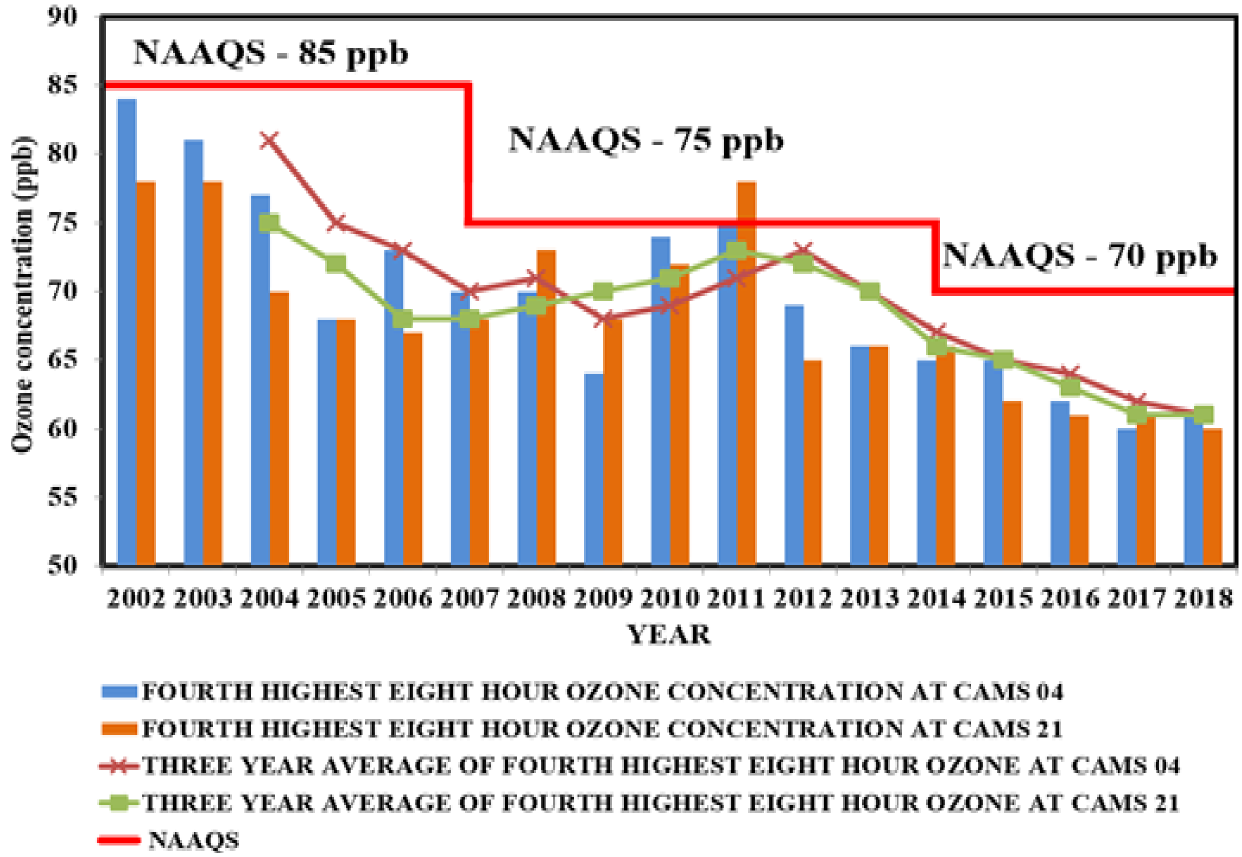
Additionally, TCEQ (2021c) notes that San Patricio and Nueces counties were designated attainment/ unclassifiable under the 2015 eight-hour ozone NAAQS, effective January 16, 2018. EPA designates areas in attainment of the NAAQS as “attainment/unclassifiable”, areas with not enough data to make a determination as “unclassifiable”, areas that do not meet the standard as “nonattainment”, and former nonattainment areas that now meet the standard as “attainment”.

3.2.11.2 Air Quality Baseline Condition

3.2.11.2.1 Baseline Emissions from Vessels and Fuel Transfer Operations

A TCEQ study used Automatic Identification System data associated with lightering for oil imports to estimate the number of lightering events per year (TCEQ, 2015). The study assumed complete product transfer (i.e., the whole vessel’s capacity) from the ship-to-be-lightered to lightering vessels.

Data from the U.S. Census Bureau (U.S. Census Bureau, 2021a) indicated that the 2019 Crude Oil Exports was 35,571,725 metric tons. The typical capacity of VLCCs is about 2,000,000 barrels. Assuming a typical conversion of 7.33 barrels of crude oil weighs about 1 metric ton, the number of lightering events in 2019 is estimated to be 130.4.



Source: Corpus Christi Air Quality Group (2019).

Figure 3-10. Corpus Christi Ozone Design Trends at TCEQ Regulatory Monitors, Continuous Ambient Monitoring Stations 4 and 21

Table 3-15 provides the baseline emissions (for 2018 and 2019) from lightering events based on oil export rate reported by the U.S. Census Bureau (2021a). Contaminants include NO_x, VOC, CO, PM_{10}, $PM_{2.5}$, and SO_x (sulfur dioxides).

Table 3-15
Emissions from Lightering Events Pre-Project

Quantity	Emissions (tons)					
	NO_x	VOC	CO	PM_{10}	$PM_{2.5}$	SO_x
Tons Emissions per Lightering Event	0.54	45.00	0.10	0.05	0.05	0.33
Emissions for 71.4 Lightering Events per year (2018)	38	3,181	7	4	4	23
Emissions for 130.4 Lightering Events per year (2019)	70	5,868	13	7	7	43

Source: U.S. Census Bureau (2021a).

3.2.11.2.2 Baseline Emissions from Current Vessel Calls

Baseline for emissions from current vessel calls are mostly from offshore VLCC transfer. The throughput at the berths in Harbor Island and Ingleside are expected to be the most representative area to estimate a baseline for emissions from vessel calls. Therefore, the vessel calls are expected to be a function of the lightering events at the berths in Harbor Island and Ingleside. For the present work, it was assumed 50 percent of the 2019 lightering events (discussed above) as a surrogate for the baseline emissions from vessel calls at the Port. Note that the current baseline of lightering is mostly from Suezmax vessels, but they are expected to increasingly occur via VLCCs. Table 3-16 provides the estimated baseline emissions from vessel calls.

Table 3-16
Emissions from Vessel Calls

Quantity	Emissions (tons)					
	NO_x	VOC	CO	PM_{10}	$PM_{2.5}$	SO_x
Tons Emissions per Lightering Event	0.54	45.00	0.10	0.05	0.05	0.33
Emissions from Current Vessel Calls (**based on 65 Lightering Events/year)	35	2,934	7	4	4	22

Note: Emissions from vessel calls are estimated assuming emissions from 65 lightering events per year. See text for more details.

3.2.11.3 Greenhouse Gas Emissions

Greenhouse gases (GHG) include carbon dioxide (CO_2), methane (CH_4), nitrous oxide (N_2O), and fluorinated gases such as hydrofluorocarbons, perfluorocarbons, sulfur hexafluoride (SF_6), and nitrogen trifluoride. Typically, only CO_2, CH_4, and N_2O are emitted by most facilities. Collectively, these gases are reported as carbon dioxide equivalent (CO_{2e}), with a weighting factor for CH_4, N_2O as 25 and 298 respectively. The combustion of fossil fuels from the operation of electric generating power plants, transportation vehicles, industrial and residential sources, and agriculture typically increase in GHG emissions with economic activity. However, due to recent efforts there has been a significant reduction in GHG emissions globally (EPA, 2021g).

A majority of the GHG emissions from the Port are from stationary and mobile source combustion emissions. Utilizing electric vehicles and alternate fuel sources would result in reduced GHG emissions and a smaller carbon footprint. The Port conducted an Air Emissions Inventory study to estimate Port-related mobile source emissions that occurred in 2017 (Port, 2019b). These estimates can be treated for the present scope as the baseline GHG emissions.

The Port (2019b) study included GHG emissions from the following source categories:

- Ocean-going vessels

- Commercial harbor craft
- Recreational vessels
- Cargo handling equipment
- Locomotives
- Heavy-duty vehicles

The 2013 CO_{2e} emissions were reported to be 391,663 metric tons. The GHG emissions (as CO_{2e}) emissions was reported to be 396,615 metric tons during 2017, which is about a 1 percent increase in comparison to the 2013 CO_{2e} emissions (Port, 2019b).

3.2.12 Noise

3.2.12.1 Human Environment

The study area is comprised of open Gulf waters in the offshore extent of the project. Approaching land, it consists of a typical ocean access harbor area. It is dominated by sound from activities that would occur in a harbor with significant ocean-going commercial vessels and pleasure craft activity. Watercraft currently operate in the channel and contribute to the baseline noise conditions. These include sport/recreation boats, barges, tugboats, dredging vessels, and freight ships as large as VLCC vessels (Moda Midstream, 2019). As of December 2021, the Port exported an average of 1.97 million barrels of crude oil per day by way of shipping through this channel (Port, 2022b).

The land uses surrounding the channel include some densely populated residential areas. Including the northeast shore of Port Aransas, which consists of many single detached homes as well as mid-rise residential uses. These residential uses are immediately adjacent to the existing channel toes. Other residential uses exist along the southwest shoreline of Ingleside on the Bay, and near the southeast shoreline of Mustang Island. These are the closest residential receptors to dredged material deposit sites. There are also residential uses approximately 1,600 feet inland from the channel at the Port.

Highway 361 passes through Port Aransas and Harbor Island. It is anticipated to be a primary source of road traffic noise in these areas. There is also a ferry which connects Highway 361 from Port Aransas to Harbor Island. It operates frequent trips traversing the channel to transport motor vehicles. The ferry boats would also be expected to contribute to the overall noise profile at the areas of Port Aransas close to Highway 361.

There are other land uses immediately adjacent to the existing channel. These include large heavy industries on Harbor Island, near Ingleside on the Bay, and along the length of the channel through the Port. These are primarily petrochemical storage, distribution, and processing facilities. They would be expected to be significant contributors to the overall noise profile of the surrounding areas.

Other portions of the shorelines surrounding the channel are largely undeveloped with little human activity and include existing dredged material placement sites. When active, dredging activities in these areas would be expected to be significant contributors to the overall noise profile. The sound sources for the offshore potion of the channel include periodic infrequent channel maintenance dredging, more daily frequent ocean-going vessels transit, and ambient wind- and wave-generated noise.

3.2.12.2 Baseline Ambient In-Air Noise Monitoring

Ambient noise or the background sound level is defined as "the sound level that is present in the environment, produced by noise sources other than the source under impact assessment" (Ministry of the Environment, 2013). Sound pressure levels are typically described in terms of decibels (dB) or A-weighted decibels (dBA) relative to a reference sound pressure of 20 micropascals. A-weighted sound pressure levels are commonly used to describe noise impacts at human receptors. They are used to quantify the average sensitivity of the human ear to sound across the frequency range of human hearing. It is also common to describe sound levels as equivalent sound levels (L_{eq}) over a period of time. Common time intervals for such metrics include one hour ($L_{eq,1h}$), 16-hour day ($L_{eq,16h}$), and 8-hour night ($L_{eq,8h}$). For a given sound measurement, L_{90} represents the sound pressure level that is exceeded for 90 percent of the measurement period. It is therefore often referenced to describe the quieter background sound levels during a measurement period. Similarly, L_5 represents the sound pressure level that is exceeded 5 percent of the time, L_{10} represents the sound pressure level that is exceeded 10 percent of the time, and so on. Table 3-17 summarizes sound pressure levels from a number of noise sources.

The nearest human receptors to the CDP are at residential areas bordering the channel, including residences in Port Aransas (south side of the channel), Ingleside (north side of the channel), and the south side of Mustang Island (north of proposed dredged material placement sites). Accordingly, three areas were examined during the long-term (LT) baseline monitoring study conducted October 13 to 16, 2020: Channel View Condominiums in Port Aransas (LT-1; GPS coordinates: 27.838393, –97.054407), Pioneer RV Beach Resort on the South side of Mustang Island (LT-2; GPS coordinates: 27.782464, –97.096579), and Bahia Marina in Ingleside (LT-3; GPS coordinates: 27.830720, –97.225367). Figure 3-11 shows the harbor and long-term baseline monitoring locations.

Dominant sound sources varied at each location. At Channel View Condominiums (LT-1), sound sources were observed to include nearby periodic construction activities, occasional local road traffic, and wind. At Bahia Marina (LT-3), ambient noise sources were observed to include docking of sport/recreation boats, local road traffic, and birds. At the Pioneer RV Beach Resort (LT-2), noise sources included activities of people on the boardwalk, golf carts, and local road traffic. It was noted that shipping activities from the channel contributed relatively little to the overall sound levels in the study area. All monitoring locations were partially exposed to winds, which reached up to 24 mph at times. High winds are typical of coastal areas, where wind can be a significant source of noise. In particular, areas that are closer to the Gulf would

Table 3-17
Approximate Reference Sound Pressure Levels from Various Noise Sources

Sound Pressure Level (dBA)	Source Description
120	Jet take-off at a distance of 200 feet
110	Riveting machine, cut-off saw
100	Electric furnace area, dance club
90	Subway train 20 feet away, jackhammer 50 feet away
80	Heavy truck 50 feet away
70	Freight train 100 feet away, vacuum cleaner 10 feet away
60	Normal speech at a distance of 5 feet, dredging vessel 300 feet away
50	Large electrical transformer 200 feet away, light road traffic 100 feet away
40	Private business office
30	Soft whisper at a distance of 5 feet
20	Voice over studio
0	Threshold of human hearing

Source: Long (2014).

be subjected to high wind speeds on a regular basis and noise levels in these areas are strongly correlated to wind speed, as shown in figures 3-12–3-14. Wind speed data was obtained from Weather Underground (2020) as recorded at the Mustang Beach Station (27.82ºN, 97.07ºW) for LT-1 and LT-2 and Corpus Christi International Station (27.67ºN, 97.29ºW) for LT-3.

Stationary noise monitoring equipment collected baseline levels for a minimum of 48 hours at each location. Noise measurements were conducted with Larson Davis 831C octave band sound level meters/noise analyzers for intervals of one hour. Field calibrations with acoustic calibrators were conducted for all the measurements. All instrumentation components, including microphones, preamplifiers and field calibrators have current laboratory certified calibrations traceable to the National Institute of Standards and Technology. Microphones were fitted with windscreens. Measured noise levels at the LT monitor locations are summarized as follows:

- LT-1 – Channel View Condominiums: Measured sound levels were as low as 44 dBA to 53 dBA during periods of low winds, and without construction activity. The daytime 16-hour L_{eq} was 69 dBA and the nighttime 8-hour L_{eq} was 64 dBA. Raw sound pressure level data for this monitoring location is included in Figure 3-12.
- LT-2 – Pioneer RV Beach Resort: Typically, about 43 dBA to 60 dBA during periods of low winds. The daytime 16-hour L_{eq} was 77 dBA and the nighttime 8-hour L_{eq} was 65 dBA. Raw sound pressure level data for this monitoring location is included in Figure 3-13.

PROJECT NO. PCA20166	Port of Corpus Christi Authority Corpus Christi Ship Channel Deepening Project	N W E S	FIGURE
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DATUM & COORDINATE SYSTEM NAD83 State Plane (feet) Texas South Centra	**Long-Term Sound Level Monitoring Locations**		3-11
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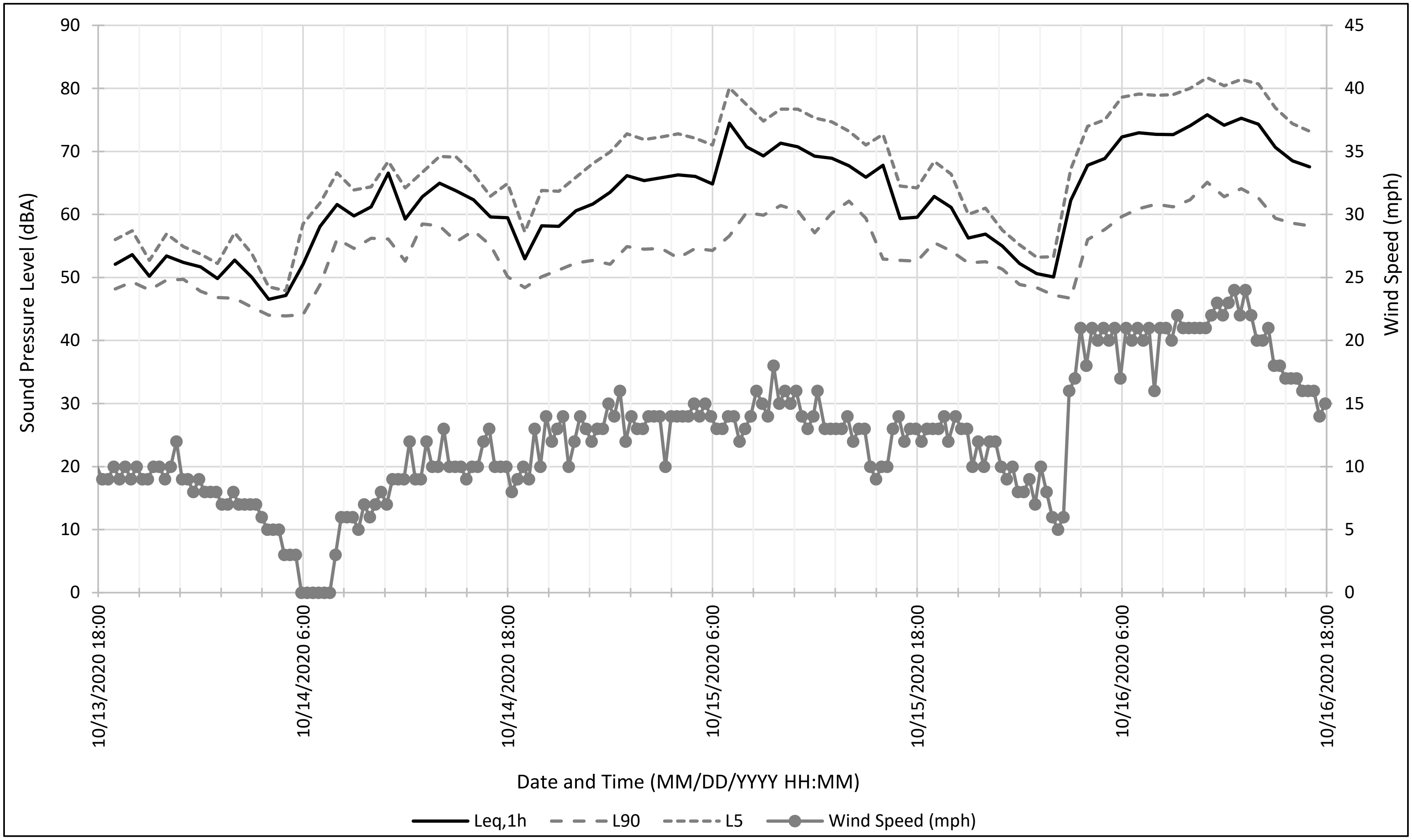


Figure 3-12. Baseline Sound Pressure Levels Measured at Channel View Condos, Port Aransas (LT-1)

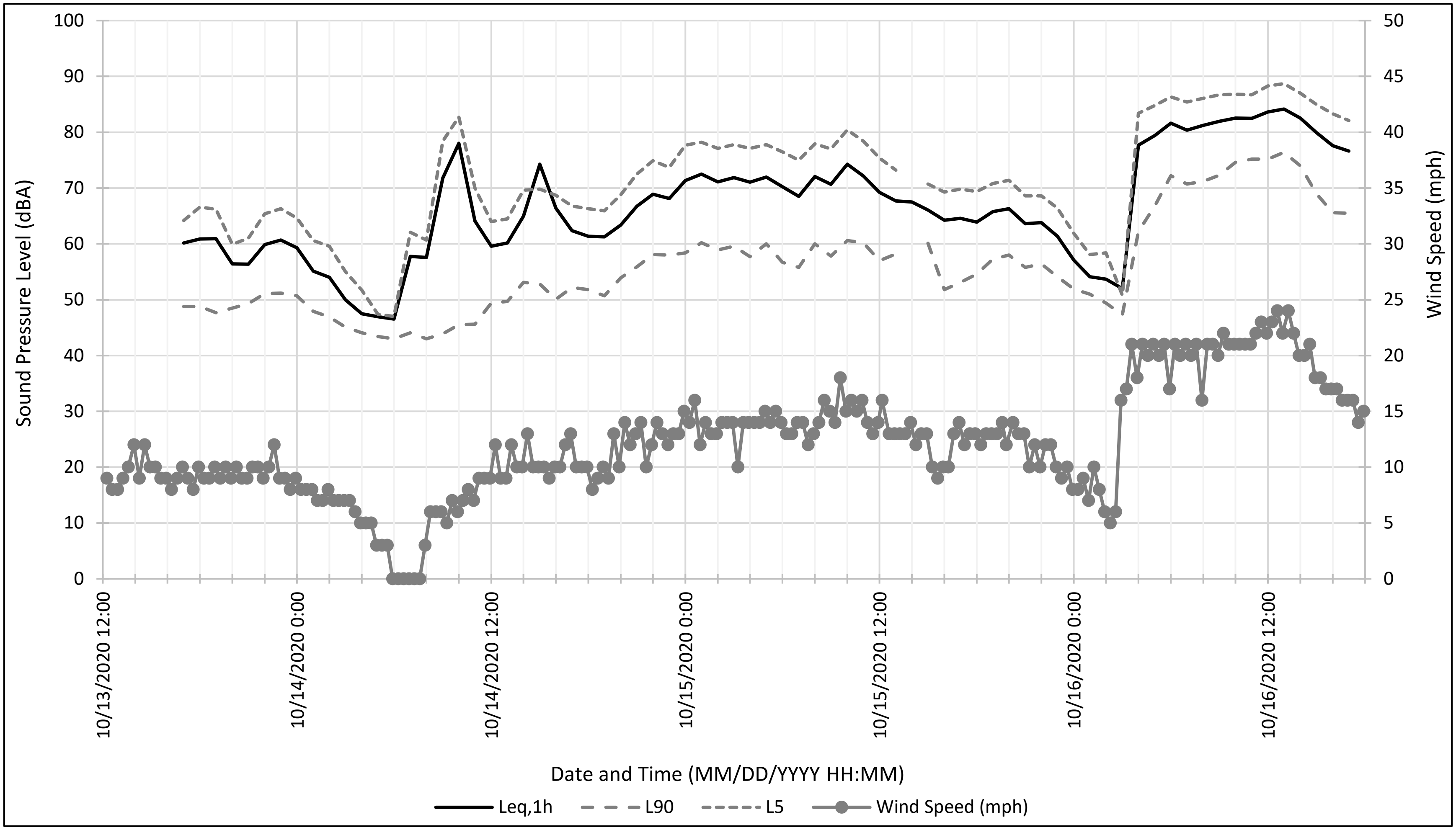


Figure 3-13. Baseline Sound Pressure Levels Measured at Pioneer RV Beach Resort, Port Aransas (LT-2)

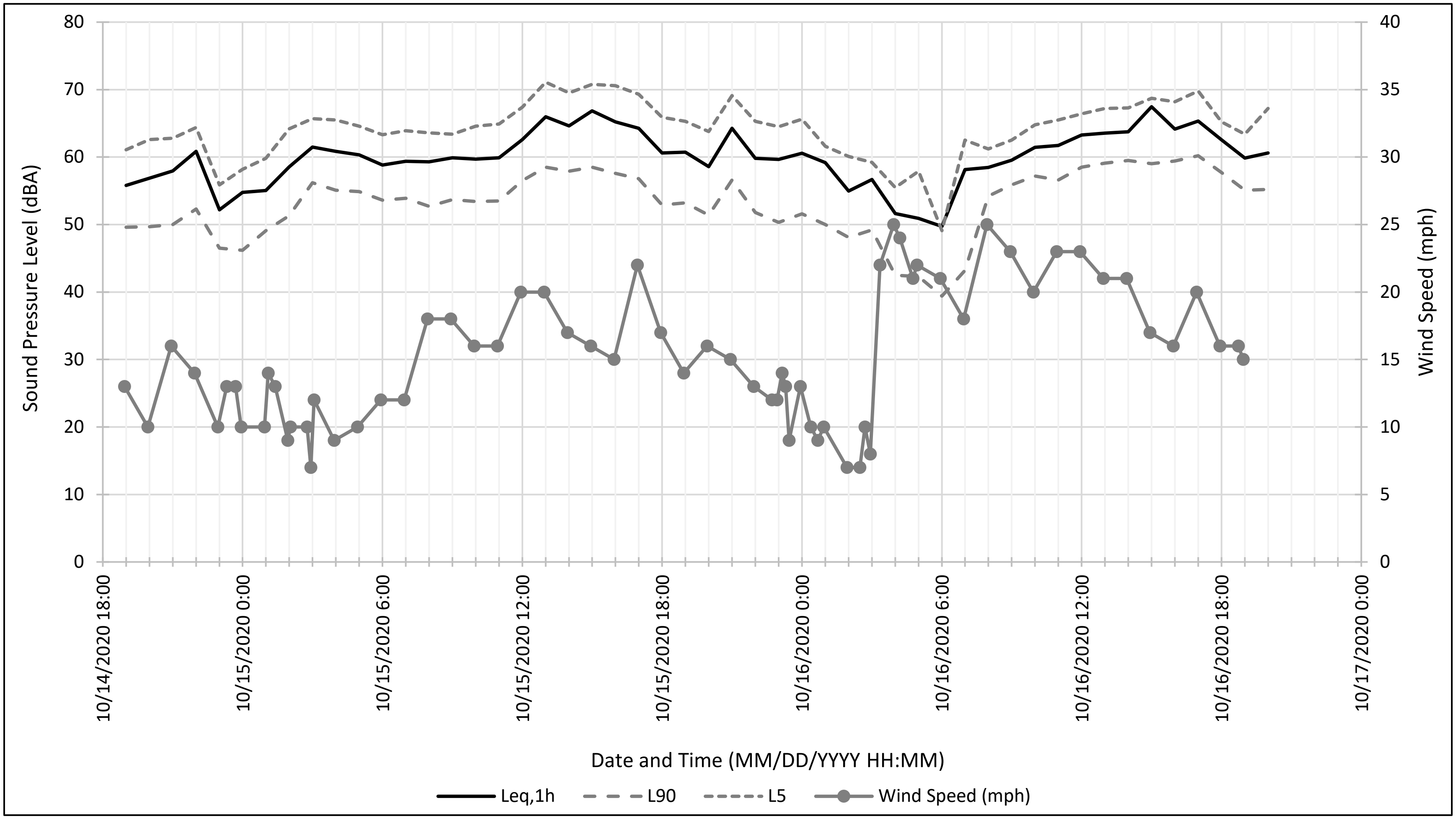


Figure 3-14. Baseline Sound Pressure Levels Measured at Bahia Marina, Ingleside on the Bay (LT-3)

- LT-3 – Bahia Marina: Typically, about 39 dBA to 50 dBA during periods of low winds. The daytime 16-hour L_{eq} was 62 dBA and the nighttime 8-hour L_{eq} was 58 dBA. Raw sound pressure level data for this monitoring location is included in Figure 3-14. At each location, long-term data was collected in one-hour intervals. The $L_{eq,1h}$, L_5, and L_{90} metrics were collected.

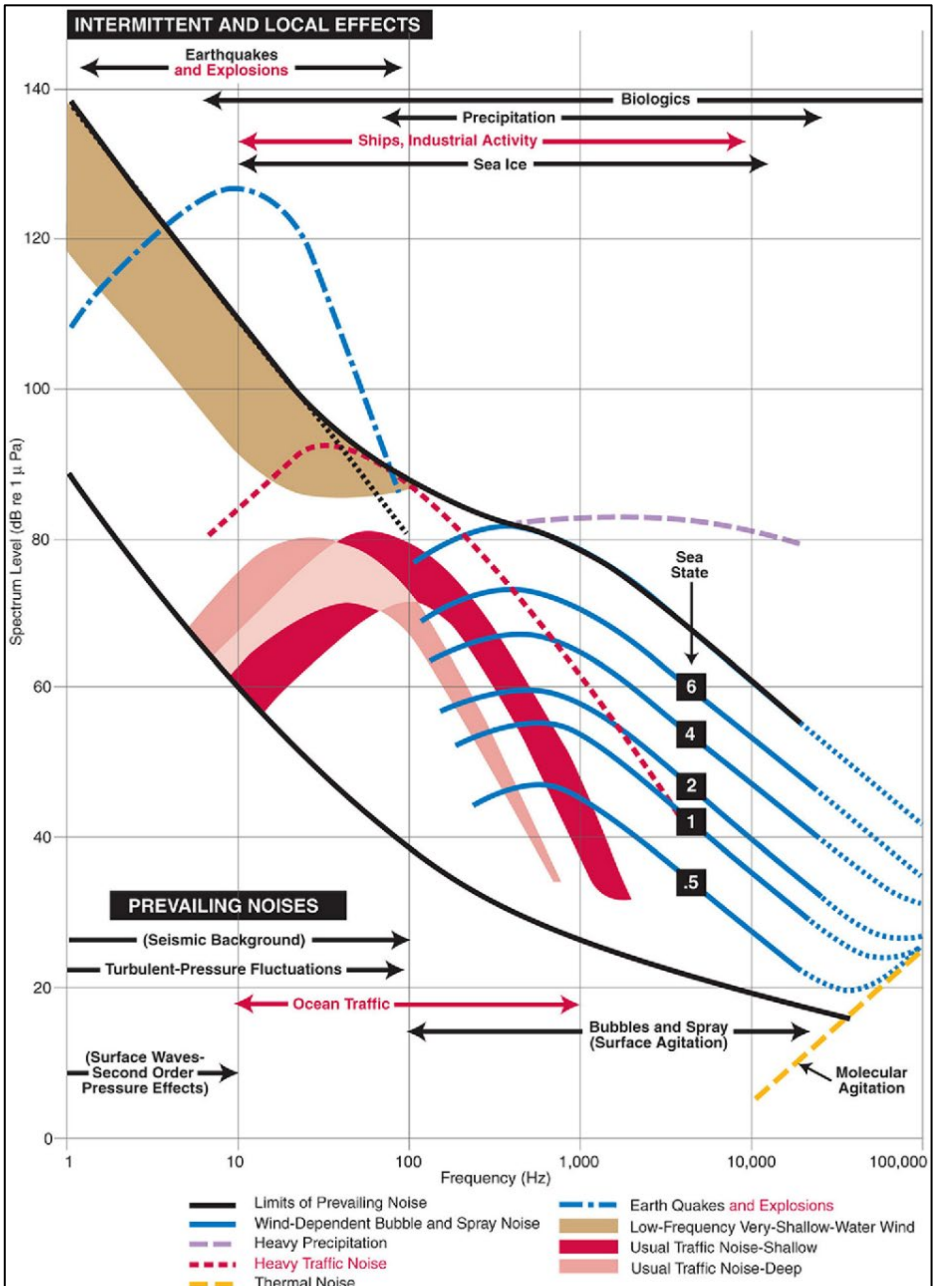
Maintenance dredging occurs regularly throughout the existing channel. The entrance and jetty channel segments proposed for deepening under the preferred action are dredged approximately every 2 to 4 years. For residences located along the north shoreline of Port Aransas (i.e., directly adjacent to the channel), maintenance dredging activities are understood to occur approximately 300 feet away or greater. At this distance, sound pressure levels from dredging vessels are estimated to be up to approximately 60 dBA, or lower when averaged over a 1-hour period as the vessels pass by.

3.2.12.3 Underwater Noise

The project area currently includes busy ship activity, which is typically the primary source of underwater noise in a port or harbor apart from ambient sound generated from natural physical processes (wind waves, rain, currents, fauna). A variety of watercraft currently operate in the channel and contribute to the baseline underwater noise conditions. These include sport/recreation boats, barges, tugboats, dredging vessels, bulk cargo carriers, and tankers as large as VLCCs.

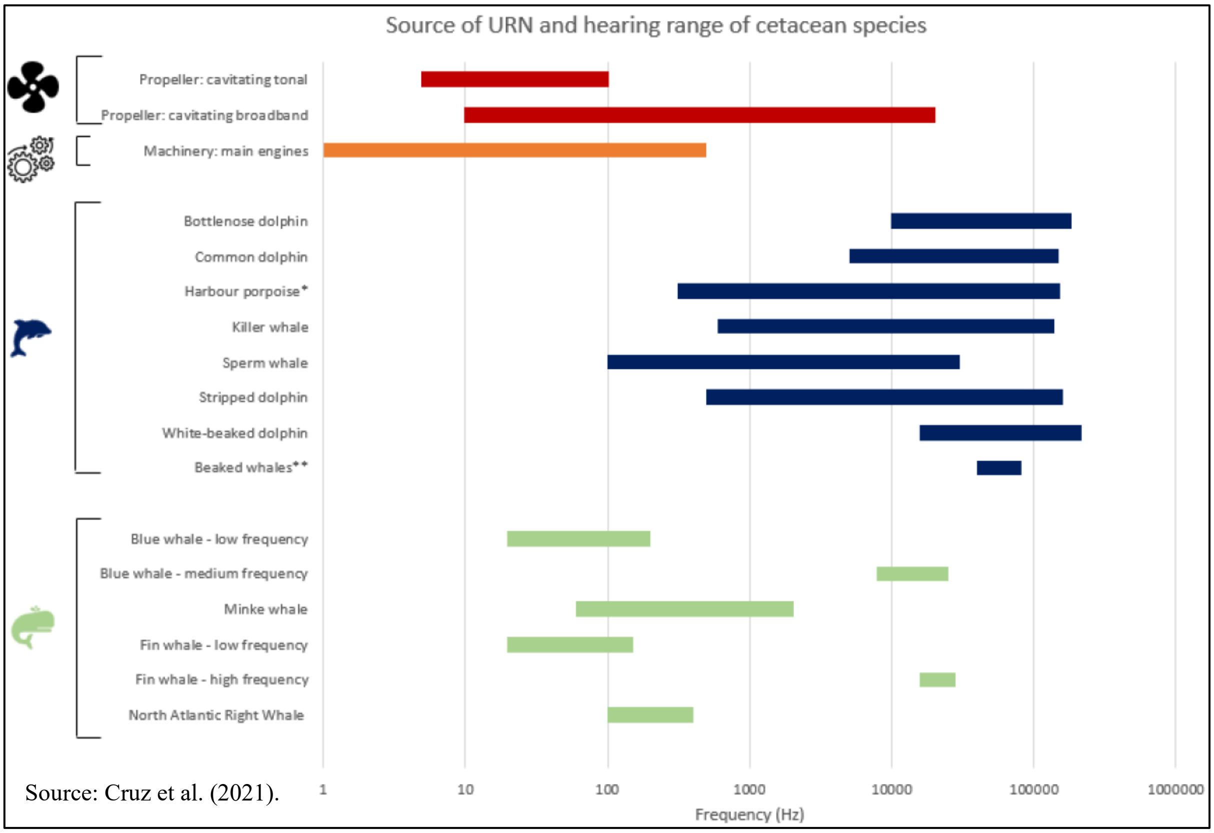
Some studies have estimated ambient sound in the environment due to wind waves and associated phenomena, summarized in Wenz curves shown in Figure 3-15. Wind-generated underwater noise has two main regimes: the mid-frequency (about 200 hertz to 10 kilohertz) sound from spray and bubbles from breaking waves, and the very low frequency sound in very shallow water (<65.6 feet) generated from uncertain causes, but thought to be due to greater interaction with the sea bottom. The mid-frequency noise can be wind-speed dependent as show in the Figure 3-15, where sea state is the Beaufort scale of increasingly severe wind wave conditions and weather ranging from calm seas at less than 1 knot wind speed (State 0.5) to strong wind/breeze of 22 to 27 knots and 9 foot waves (NOAA, 2023a). Port Aransas' monthly average wind speed ranges from 11 to 14 knots) which is associated with Sea State 4 and 3-foot waves (WeatherWX, 2023). This means that on average, wind likely dominates the soundscape from 500 hertz to 10 kilohertz over typical commercial vessel traffic and peaks at 70 dB in the 500 hertz range, as shown in Figure 3-15. At lower frequencies, at depths greater than 66 feet, commercial vessel traffic would be expected to dominate between 10 and 500 hertz, peaking at a little over 80 dB in the general soundscape.

Commercial ships generate underwater noise from vessel waves in much the same manner as wind, but mainly from propeller cavitation which creates a very low-pressure zone around the propeller and causes cavitation bubbles to collapse and pop to generate sound, and machinery noise from engines. The typical spectrum of propeller and machinery noise of ships are shown in Figure 3-16 against reported hearing ranges of cetaceans (Cruz et al., 2021). Of note, the ship noise spectrum does not overlap much with the Common Bottlenose Dolphin (*Tursiops truncates truncatus*) hearing spectrum, which could explain the common observation of dolphins escorting large commercial vessels at either the bow or stern, and not exhibiting avoidance behavior. A study of underwater noise from modern commercial ships found tanker sound to be predominantly below 40 hertz, and measured sound levels at approximately 1.9 miles to vary between 109 and 112 dB at the point of closest approach (McKenna et al., 2012).



Source: National Research Council (2003)

Figure 3-15. Wenz Curves



Source: Cruz et al. (2021).

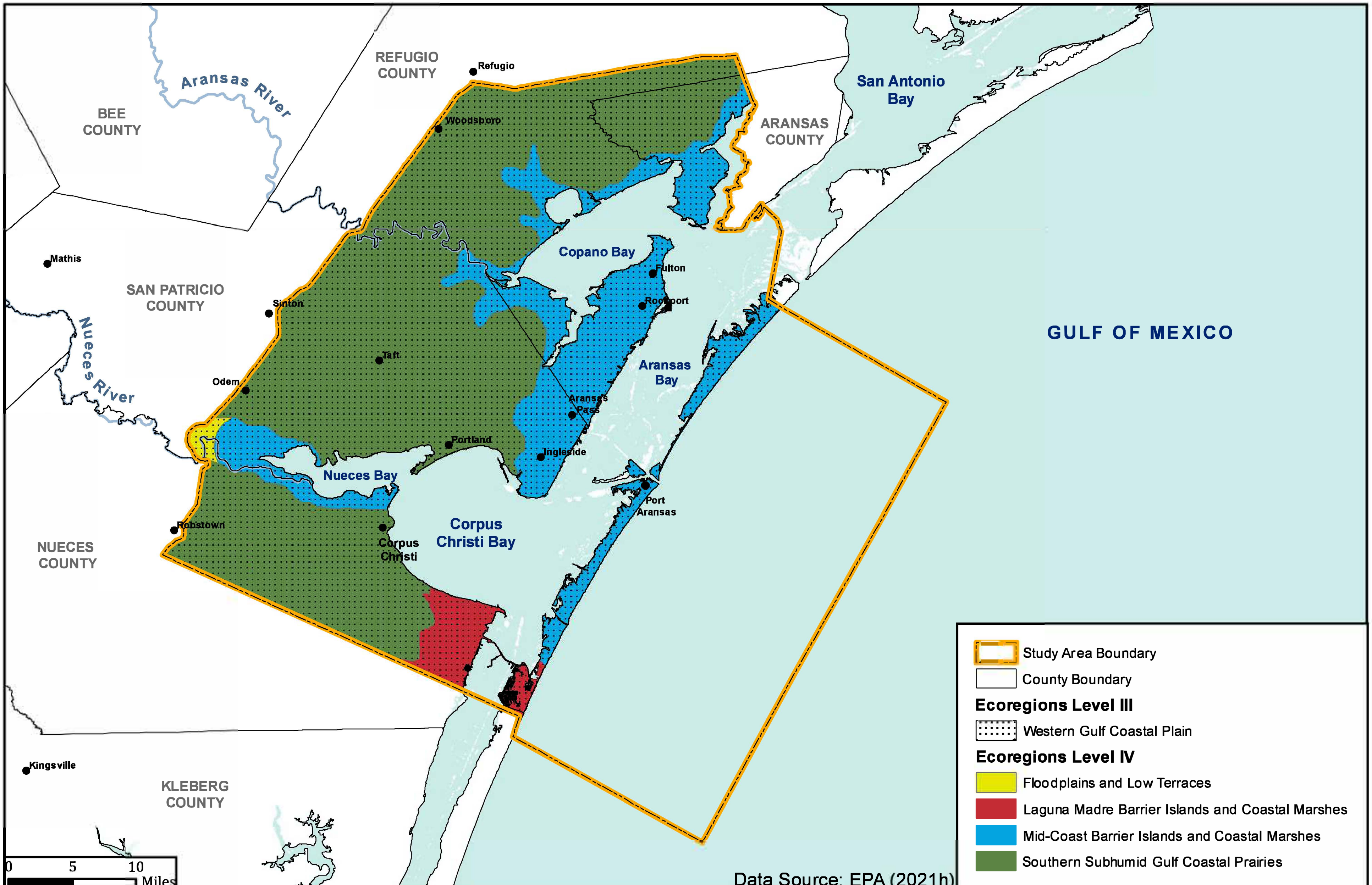
Figure 3-16. Typical Noise of Ships and Marine Species

3.3 ECOLOGICAL AND BIOLOGICAL RESOURCES

3.3.1 Ecoregions

The study area is located entirely within the Western Gulf coastal plain (EPA level III ecoregion). This is a low-elevation area adjacent to the Gulf (Figure 3-17) (Griffith et al., 2004; EPA, 2013). Due to its nutrient-rich soils and abundance of rain, much of the land has been converted to cropland and pastures for livestock. About a third of the State's population resides within 100 miles of the coast along with a large part of the State's industry. The large expanses of intact wetlands and coastal marshes along the coast are also important rest stops and wintering habitats for waterfowl and migrating birds. The warm Gulf waters are home to a variety of fish and shellfish. The marshes and wetlands provide an abundance of habitat for birds and migrating waterfowl (Griffith et al., 2007).

The Western Gulf coastal plain can be further categorized into nine distinct EPA level IV ecoregions (Griffith et al., 2004, 2007). These level IV ecoregions are divided based on similarities of soils, vegetation, climate, geology, wildlife, and human factors. The following sections describe the four level IV ecoregions found within the study area.



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Port of Corpus Christi Authority
Corpus Christi Ship Channel Deepening Project

Ecoregions

FIGURE 3-17

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3.3.1.1 Mid Coast Barrier Islands and Coastal Marshes

Stretching from Galveston Bay to Corpus Christi Bay, this ecoregion generally receives less annual precipitation than the Texas-Louisiana marshes. This region is characterized by barrier islands, tidal marshes, dunes, and salt/brackish/freshwater marshes. Cordgrass (*Spartina* spp.), saltgrass/shoregrass (*Distichlis* spp.), and sedges (*Cyperaceae* spp.) are typically found in marsh habitats. Little bluestem (*Schizachyrium scoparium*) and sea oats (*Uniola paniculata*) are found on sandy barrier islands. During the fall, endangered Whooping Cranes (*Grus americana*) migrate to the brackish marshes of Aransas National Wildlife Refuge (NWR) to feed on blue crabs (Griffith et al., 2007). This is the most dominant coastal ecoregion within the study area, including the entire barrier island strip from Packery Channel to Matagorda Island.

3.3.1.2 Floodplains and Low Terraces

This ecoregion consists of Holocene floodplains and alluvial deposits. Bottomland forests are the dominant vegetation type in this region. Large swaths of these floodplain woodlands have been converted to cropland, pastures, and forests. Freshwater flows through these historic floodplains have also been redirected for municipal, industrial, and agricultural uses. Combined with recent droughts in Texas and the Southwest, the Nueces River has experienced greatly diminished flows. This affects the salinity and productivity of downstream estuaries and bays (Griffith et al., 2007). Only a small portion of the study area contains this ecoregion type, occurring in the uppermost reaches of the Nueces River delta.

3.3.1.3 Southern Subhumid Gulf Coastal Prairies

Generally drier than the northern humid Gulf Coastal Prairie, this region only receives about 26 to 37 inches of rain annually. The regional soil temperature is hyperthermic meaning it stays above 71.6°F. Decades of fire suppression, overgrazing, and other disturbances have led to an increased abundance of woody and thorny-scrub plants. These include honey mesquite (*Prosopis glandulosa*), huisache (*Acacia farnesiana*), and blackbrush (*Vachellia rigidula*). Prairie grassland species such as seacoast bluestem (*Schizachyrium littorale*), Gulf muhly (*Muhlenbergia capillaris*), and switchgrass (*Panicum virgatum*) can still be found but in less abundance than described in historical records (Griffith et al., 2007).

3.3.1.4 Laguna Madre Barrier Island and Coastal Marshes

This ecoregion is categorized by tidal mud flats, barrier island, seagrass meadows, and hypersaline lagoons. Seagrass meadows grow in the shallow, clear waters along the Laguna Madre. The seagrass beds serve as a productive nursery habitat for Red Drum and grazing for sea turtles and Redhead Ducks (*Aythya americana*). Seacoast bluestem, sea oats, and other grassy vegetation can be found along the 113-mile-long island, the longest barrier island in the world. Ponds and marshes are populated with cordgrass, cattails (*Typha* spp.), and bulrush (*Seirpus* spp.). Sea turtles including the Leatherback (*Dermochelys coriacea*), Green (*Chelonia mydas*), Hawksbill (*Eretmochelys imbricata*), and Kemp’s Ridley (*Lepidochelys kempii*) are dependent on the sandy barrier islands for nesting habitat (Griffith et al., 2007). The study area includes only the northern-most reaches of this ecoregion along the Texas coast.

3.3.2 Wetlands

Wetlands are an important landscape feature that occur almost worldwide. Wetlands have also been converted or altered heavily in developing and developed regions. Wetlands exhibit unique ecological functions such as aquifer recharge features, water quality filters, habitat provision, flood retention and reduction, biogeochemical cycling (e.g., carbon sequestration, nutrient retention and uptake), sediment retention, and erosion protection, for example (Mitsch and Gosselink, 2000). Loss of wetlands and their important ecological functions highlight the need for wetland conservation and restoration.

3.3.2.1 Non-tidal Wetlands

Non-tidal wetlands within the study area include depressional wetlands and palustrine fringe wetlands. Depressional wetlands are located inland of the tidal zone. Palustrine fringe wetlands are associated with the upper reaches of river systems in the study area, including the Nueces, Mission, and Aransas rivers. Depressional wetlands are regionally known as prairie potholes and are generally low topography divots within the prairie mosaic landscape. Rainfall and groundwater sources contribute to depressional wetland hydrology. These, along with poorly drained soils that increase water holding times and result in a hydrophytic vegetation community (Cowardin et al., 1979). These wetland types are also converted for agricultural uses, often in the form of upland cattle stock tanks (Moulton et al., 1997). Included within the depressional category are PAs with earthen levees and poor drainage. The USFWS National Wetlands Inventory (NWI) geospatial maps identify several placement actions targeting BU that are mapped as wetlands (USFWS, 2021a). Depressional wetlands are often dominated by herbaceous vegetation, and common wetland plant species include spike rush (*Eleocharis* spp.), smartweed (*Polygonum hydropiperoides*), various sedges (*Carex* spp.), soft rush (*Juncus effusus*), and cattail (*Typha latifolia*). Some woody species can also be found in depressional wetlands, such as: black willow (*Salix nigra*), rattlebush (*Sesbania drummondii*), eastern baccharis (*Baccharis halimifolia*), and the non-native Chinese tallow (*Triadica sebifera*).

Palustrine fringe and riverine wetlands are also common within the study area. They are located within the alluvial floodplains of the larger river systems and above the influence of tides. Like depressional wetlands, the plant communities are primarily herbaceous in nature. However, later successional scrub-shrub and forested types are found in smaller amounts within the study area (USFWS, 2021a). These wetlands include low-lying areas within floodplains and areas adjacent or abutting riverbanks. Wetland hydrology is often provided through a direct hydrologic nexus to riverine features or by seasonal and temporary flooding. While the sources of hydrology differ, there are often similarities between wetlands lying adjacent to lakes or rivers and isolated wetlands of the same class in the same region (Cowardin et al., 1979).

3.3.2.2 Tidal Wetlands

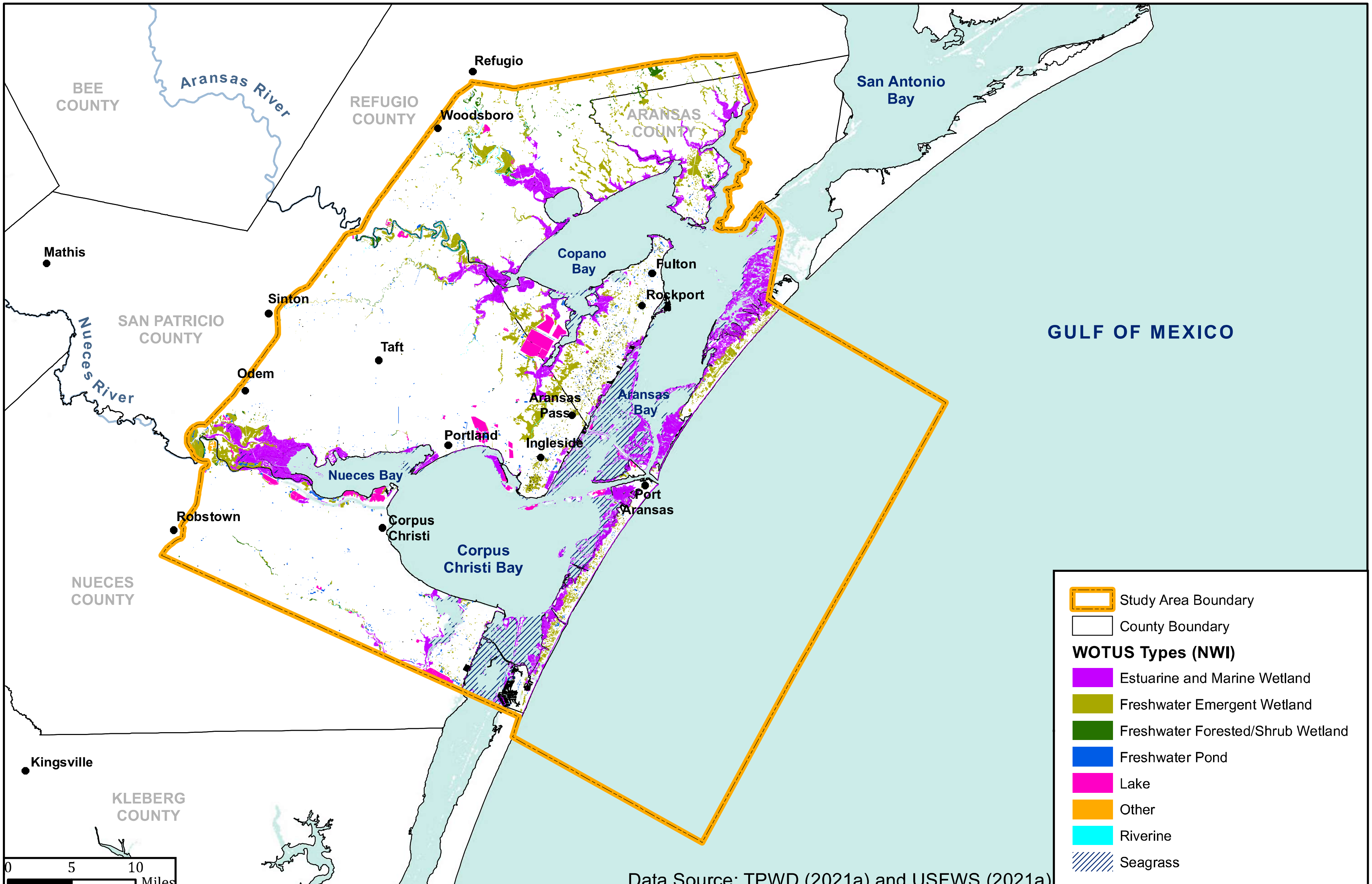
Tidal wetlands include features that are in the brackish transition. These are areas between freshwater and tidally influenced saltwater marshes all the way to the subtidal unconsolidated bottom of bay systems, known as deepwater habitats. Not including persistently inundated bay bottoms or the marine environment, estuarine emergent wetlands are the most prevalent within the study area. These are followed by intertidal unvegetated mud or sand flats and estuarine shrubs (USFWS, 2021a). Common herbaceous species that occur in estuarine wetlands include glasswort (*Salicornia depressa*), salt marsh bulrush (*Scirpus maritimus*), smooth cordgrass, saltgrass (*Distichlis spicata*), and sea-oxeye daisy (*Borrichia frutescens*). Black mangrove is the primary estuarine shrub species. Coastal estuarine wetlands of the bay systems within the study area play an important part in sustaining the health and abundance of life within the ecosystem. They are extremely important natural resources that provide essential habitat for fish, shellfish, and other wildlife (Rozas and Minello, 1998; Sather and Smith, 1984; Turner, 1977). Coastal wetlands also serve to filter and process agricultural and urban runoff and buffer coastal areas against storm and wave damage.

Tidal wetlands include tidal flats. Tidal flats are irregularly inundated, generally unvegetated (except for algal mats), and are important for micro and microbenthic infauna, fish, wading birds, and shorebirds. Tidal flats have declined in the region by as much as 55 percent, with most of those losses being near Harbor Island and Mustang Island (White et al., 2006). Geospatial data from the NWI was used to map existing estuarine and coastal wetland features in the study area (Figure 3-18).

3.3.2.3 Seagrass

Submerged aquatic vegetation (SAV) includes the true seagrasses such as shoal grass, turtle grass, manatee grass, and clover grass. It also includes widgeon grass (*Ruppia maritima*) which is not considered a true seagrass because it also grows in freshwater environments. Seagrasses typically occur in water shallower than 4 feet mean low tide (MLT). In the study area, they occur primarily in Redfish Bay and the Upper Laguna Madre in large, contiguous tracts. They also occur along the bay side of Mustang Island and San José Island inlets and shallow, relatively low energy areas (TPWD, 2021a). Seagrass communities generate high primary productivity and provide refuge for numerous species including shrimp, fish, crabs, and their prey. Animal abundances in seagrass beds can be two to 25 times greater than in adjacent unvegetated areas (TPWD, 1999). All five taxa are found within the study area, with shoal grass being the most abundant seagrass species across the bay systems (Congdon and Dunton, 2019).

There are approximately 41,583 acres of seagrass within the study area boundary (TPWD, 2021a). The net acreage of seagrass within the combined estuarine systems has remained relatively stable since 1958. However, there has been fragmentation of this habitat and some local losses in Redfish Bay/Harbor Island. Seagrass beds dominated by turtle grass in southern Redfish Bay decreased in 2017 following Hurricane



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DATUM & COORDINATE SYSTEM	NAD83 State Plane (feet) Texas South Central
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PREPARED BY	KLC

Port of Corpus Christi Authority
Corpus Christi Ship Channel Deepening Project

Wetlands and other Waters of the U.S.

FIGURE
3-18

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Harvey and coverage remained low following Winter Storm Uri in 2021 (Congdon and Dunton, 2019; Capistrant-Fossa, 2023). However, in 2022 seagrass canopy cover increased suggesting that seagrass has begun to recover from both storms (Capistrant-Fossa, 2023). It remains to be seen whether the loss of slow growing turtle grass will lead to colonization by more opportunistic species like shoal grass and manatee grass (Congdon and Dunton, 2019). Seagrass beds in Nueces Bay are limited to the shoal grass and widgeon grass species (Pulich et al., 1997).

The most currently available geospatial data for seagrass mapping was downloaded from the NOAA and TPWD Geographic Information System (GIS) data sites. This data was combined to provide mapping of seagrass (TPWD, 2021a). Figure 3-18 shows the seagrass mapped in the study area. Within the preferred project footprint, the depth of the existing channel, side slopes, and regular maintenance are not conducive to supporting seagrasses. Therefore, the preferred project location is currently devoid of seagrass. There areonly several small seagrass areas mapped adjacent to the channel in the shallow margins of dredge spoil islands near Ingleside, Texas (TPWD, 2021a).

3.3.2.4 Wetland Trends

Several factors threaten wetland environments. These include increasing upland and coastal developments, subsidence, hydrologic modifications, geomorphic changes to barrier islands, and sea level change. Increased exchange with Gulf waters will increase salinity, impacting marsh vegetation and erosion, and negatively affecting estuarine wetland systems. Historic wetland trends in the region include extensive losses of tidal flats from the 1950's through 1979. However, many of the losses resulted in net gains of seagrass beds (White et al., 2006). Between 1992 and 2015, the U.S. gained around one million acres of wetland and deepwater habitats. Due to regional differences in habitat conservation and wetland restoration, Texas saw almost no net gain in wetland acreage during that period (Dahl, 2011; Moulton et al., 1997). In fact, wetland losses may be increasing along the Atlantic and Gulf coasts. Total wetland acreage in Texas remained somewhat stable between 1992 and 2015. Net wetland acreage in Atlantic and Gulf Coast watersheds decreased by almost 120,000 acres during that same period (Dahl, 2011; Stedman and Dahl, 2008). Both freshwater and estuarine wetlands are declining in Atlantic and Gulf Coastal watersheds (Dahl, 2011). This trend is exacerbated by extreme weather events such as Hurricane Harvey, which can cause sedimentation or destruction of coastal wetlands (Palaneasu-Lovejoy et al., 2013).

3.3.3 Aquatic Resources

3.3.3.1 Freshwater Habitats and Fauna

The watershed for the Corpus Christi Bay system lies in a semi-arid region of Texas. No major rivers flow into the study area. The Nueces River basin, which drains 16,700 square miles of south-central Texas, and flows into the Corpus Christi Bay system, provides most freshwater habitat in the study area. Major springs arise in the western portion of the Nueces River watershed. However, much of the streamflow in the watershed is captured by Choke Canyon Reservoir, impounded in 1982, and Lake Corpus Christi, impounded in 1958 (Nueces BBEST, 2011). Ninety-seven percent of the annual rainfall in the Nueces basin evaporates, is transpired or soaks into the ground before it reaches Lake Corpus Christi.

The water right permit (Certificate of Adjudication No. 21-3214) for Choke Canyon Reservoir is jointly held by the City of Corpus Christi, the Nueces River Authority, and the City of Three Rivers. The permit influences freshwater habitat in the 40-mile reach of the Nueces River downstream of Lake Corpus Christi (Nueces BBEST, 2011). Except when flooding, freshwater habitat in this reach is controlled by the water right permit. The permit allows releases from Lake Corpus Christi of water which is required for municipal and industrial use and for meeting freshwater inflow targets to the bay.

The Nueces River has an extensive watershed and is known to harbor over 60 freshwater fish species (Fishes of Texas, 2021). However, there is limited exchange between the freshwater habitat and the estuary. Freshwater habitat in the Nueces River ends at a saltwater barrier at Calallen. The tidally influenced portion of the Nueces River begins at this saltwater barrier and extends 12 miles downstream to Nueces Bay.

Movement of aquatic organisms between freshwater habitat and the Nueces River tidal is restricted by this barrier. The exception is during flooding and when the City of Corpus Christi is required to pass water over the barrier. From January 1, 2000 through October 5, 2021, there was no flow from the river into the Nueces River tidal over 27 percent of the time (USGS, 2021a).

Other freshwater streams flowing into the study area include the Aransas and Mission rivers flowing into Copano Bay. The Mission River tidal extends about 19 miles upstream of Copano Bay. The portion of the river above tidal influence extends about 9 miles upstream of the tidal reach (Nelson and Tolan, 2008). Since January 1, 2000, the freshwater reach of the Mission River has had no flow for four percent of the time (USGS, 2021b). The Fishes of Texas database reports 41 species of freshwater and estuarine fish have been reported from this basin (Fishes of Texas, 2021).

The Aransas River tidal extends about 6 miles upstream of Copano Bay and the reach above tidal extends upstream another 35 miles (Nelson and Tolan, 2008). Fifty-seven species of estuarine and freshwater fish have been documented from the Aransas River basin (Fishes of Texas, 2021). The City of Beeville's wastewater treatment plant effluent provides a continuous source of freshwater to the Aransas River.

Oso Creek, which flows into Oso Bay then into Corpus Christi Bay, is effluent dominated. The creek receives treated effluent from several wastewater treatments from Robstown to Corpus Christi. It is tidally influenced along its entire length (Nicolau, 2001).

3.3.3.2 Estuarine Habitats and Fauna

Estuarine habitats in the study area include Copano, Aransas, and Corpus Christi bays, and a small portion of the Upper Laguna Madre. The Copano-Aransas Bays Estuary has an average depth of 6.5 feet and has a total water surface area of 179 square miles. The Corpus Christi Bay Estuary has an average depth of 7.9 feet and has a total water surface area of 172 square miles (Armstrong et al., 1987). These systems provide important nursery habitat for numerous commercially and recreationally important estuarine-dependent fish and shellfish species. Also providing habitat for marine mammals, reptiles, resident birds, wintering waterfowl, shorebirds, and other avian species (Armstrong et al., 1987; Britton and Morton, 1989; Tunnell and Judd, 2002). The following sections describe the dominate types of estuarine habitat present within the study area.

3.3.3.2.1 Open Bay

The open bay is comprised of phytoplankton and nekton. Phytoplankton (microscopic algae) are the major primary producers (plant life) in the open bay. They take up carbon through photosynthesis and nutrients for growth. Phytoplankton are fed upon by zooplankton (small crustaceans), fish, and benthic consumers. Zooplankton are important because they form the basis of the food web and are the source of food for larval and juvenile fish. Nekton (organisms that swim freely in the water column) assemblages consist mainly of secondary consumers, which feed on zooplankton and smaller nekton (Armstrong et al., 1987; Britton and Morton, 1989). Diverse and abundant phytoplankton and nekton communities occur throughout the entire study area and are discussed below.

Plankton Assemblages

In Aransas Bay, diatoms make up most phytoplankton assemblages composed mainly of *Coscinodiscus* spp. in the winter and *Rhizosolenia alata* in the summer. Blue-green and green algae dominate the upper portions of the Mission-Aransas Estuary, whereas diatoms dominate the lower estuary. Diatoms (*Thalassionema nitzschioides*, *Thalassiothrix frauenfeldii*, and *Chaetoceros* spp.) make up over 70 percent of the phytoplankton community in Corpus Christi Bay. In Nueces Bay and the Upper Laguna Madre, the same diatoms dominate abundance, especially during the winter months, followed by the dinoflagellate *Ceratium furca* (Hildebrand and King, 1977; Tunnell et al., 1996). Salinity appears to be the controlling factor of phytoplankton abundance. Low salinities correspond with high phytoplankton numbers. High salinities (greater than 60 ppt) correspond with low to nonexistent numbers, as occurs in some areas of the Upper Laguna Madre (Armstrong et al., 1987; Hildebrand and King, 1977).

Armstrong et al. (1987) and Tunnel et al. (1996) describe the dominant zooplankton in Copano and Aransas bays as calanoid copepod *Acartia tonsa* with maximum abundances occurring in the winter and spring. Barnacle nauplii and *Acartia tonsa* dominated zooplankton assemblages in Corpus Christ and Nueces bays. This occurred during every season except late winter and early spring when the dinoflagellate *Noctiluca scintillans* dominated. Calanoid copepods, especially *Acartia tonsa,* were the dominant species in Oso Bay and the Upper Laguna Madre with peak abundance occurring in the spring (Armstrong et al., 1987; Tunnell et al., 1996).

Nekton Assemblages

The study area bay systems support a diverse nekton population including fish, shrimp, and crabs. Some are resident species, spending their entire life in the bay. Others are migrants spending only a portion of their life cycle in the estuary (Armstrong et al., 1987; Tunnell et al., 1996; Buskey, 2018). Many of these species are estuarine dependent. They migrate through passes from the Gulf to use the SAV in the bay system as nursery habitat (Tunnell and Judd, 2002; Buskey, 2018). With respect to the Upper Laguna Madre, the hypersaline waters can affect fish osmotic balance and decrease DO. However, fish occupying these areas are euryhaline (able to tolerate a wide range of salinities) and better able to cope with the harsh conditions (Gunter, 1967).

Dominant nekton inhabiting the study area include blue crab, white shrimp, brown shrimp, pink shrimp (*Farfantepenaeus duorarum*), Atlantic Croaker, Bay Anchovy (*Anchoa mitchilli*), Code Goby (*Gobiosoma robustum*), Black Drum, Gulf Menhaden, Hardhead Catfish (*Arius felis*), Pinfish (*Lagodon rhomboides*), Sheepshead, silversides (*Menidia* sp.), Southern Flounder, Spot, and Spotted Seatrout (Nelson et al., 1992; Tunnell et al., 1996; Pattillo et al., 1997; EPA, 2021i). Table 3-18 describes the common estuarine/marine species found in the study area.

Table 3-18
Common Estuarine and Marine Fish Species Within the Study Area

Common Name	Scientific Name	Habitat
INVERTEBRATES		
Brown shrimp	*Farfantepenaeus aztecus*	G, P
Pink shrimp	*Farfantepenaeus duorarum*	G, P
White shrimp	*Litopenaeus setiferus*	G, P
Grass shrimp	*Palaemonetes* sp.	G
Blue crab	*Callinectes sapidus*	W
FISH		
Bay Anchovy	*Anchoa mitchilli*	W
Gulf Menhaden	*Brevoortia patronus*	P
Hardhead Catfish	*Arius felis*	W
Striped Mullet	*Mugil cephalus*	W
Silversides	*Menidia* sp.	E
Sheepshead Minnow	*Cyprinodon variegatus*	E
Sheepshead	*Archosargus probatocephalus*	G, P
Pinfish	*Lagodon rhomboides*	W, G
Silver Perch	*Bairdiella chrysoura*	P
Spotted Seatrout	*Cynoscion nebulosus*	G, P
Spot	*Leiostomus xanthurus*	W

Common Name	Scientific Name	Habitat
Atlantic Croaker	*Micropogonias undulatus*	G, P
Black Drum	*Pogonias cromis*	P
Code Goby	*Gobiosoma robustum*	G
Southern Flounder	*Paralichthys lethostigma*	P

Source: EPA (2021i); Page et al. (2013); Pattillo et al. (1997); and Tunnel and Judd (2002).

W = widespread throughout the study area, depending on life stage;

G = SAV; P = estuarine-dependent, migrate through Gulf passes; E = estuarine

These species are ubiquitous along the Texas coast and are unaffected by salinity changes. Seasonal differences occur in abundance, with the fall usually the lowest in biomass and number. Newly spawned fish and shellfish begin migrating into the bays in winter and early spring with the maximum biomass during the summer (Pattillo et al., 1997; Buskey, 2018).

3.3.3.2.2 Open-Bay Bottom

The open-bay bottoms in the study area include all unvegetated subtidal areas with various sediment types. These are open systems that greatly interact with the overlying waters and adjacent habitats (Armstrong et al., 1987; Tunnell and Judd, 2002). Benthic organisms are divided into two groups. Epifauna, such as crabs and smaller crustaceans that live on the surface of substrate, and infauna, such as mollusks and polychaetes that burrow into the substrate (Green et al., 1992). Mollusks and other infaunal organisms are filter feeders that strain suspended particles from the water column. Other infauna, such as polychaetes, feed by ingesting sediments and extracting nutrients. Many of the epifauna and infauna feed on plankton, which are fed upon by numerous fish and birds (Armstrong et al., 1987; Lester and Gonzales, 2011).

The distribution of benthic macroinvertebrates is primarily influenced by bathymetry and sediment type (Calnan et al., 1989). Mud (silt and clay) is the dominant sediment type throughout this bay-estuary-lagoon system. Sandier sediments occur along bay margins and are more common in the Laguna Madre and Redfish Bay. Benthic macroinvertebrates found in these sediments are primarily polychaetes (including *Polydora caulleryi*, *Tharyx setigera*, and *Mediomastus ambiseta*), bivalves, crustaceans (including *Listriella clymenellae*), and gastropods (Montagna and Froeschke, 2009; White et al., 1983).

Benthic samples were also collected in the study area as part of the EPA National Coastal Assessment Program (EPA, 2021i). These samples were dominated primarily by polychaetes, amphipods, and gastropods, same as were observed by White et al. (1983) and Montagna and Froeschke (2009). Polychaetes dominated the samples, including *Paleanotus heteroseta*, *Aricidea fragilis*, *Capitella capitata*, *Mediomastus* sp., *Tharyx annulosus*, *Paraonides lyra*, and *Asychis elongata* (EPA, 2021i).

3.3.3.2.3 Oyster Reef

Most oyster reefs are subtidal or intertidal and found near passes and cuts, and along the edges of marshes. Within the study area there are a total of 3,551 acres of Eastern oyster found within Copano Bay, Aransas Bay, Mesquite Bay, and Redfish Bay/Harbor Island, growing perpendicular to the shoreline. There are some small patch reefs scattered in Nueces and Corpus Christi bays. Most oyster reefs in Corpus Christi Bay are dead. However, living oyster reefs were found in Nueces Bay and the intertidal zone (Texas General Land Office [GLO], 2021; Pulich et al., 1997; Tunnell et al., 1996).

Oyster reefs are formed where a hard substrate and adequate currents are plentiful, and they are ecologically important. Currents carry nutrients to the oysters. They filter sediment and waste from the water. Oysters can filter water 1,500 times the volume of their body per hour, which, in turn, influences water clarity and phytoplankton abundance (Lester and Gonzalez, 2011; Powell et al., 1992). Due to their lack of mobility and their tendency to bioaccumulate pollutants, oysters are an important indicator species for determining contamination (Lester and Gonzalez, 2011).

Average salinities in the study area range from 30 to 36 ppt, with dry years having salinity levels above 32 ppt and wet years around 25.5 ppt (Montagna et al., 2021). While oysters can survive in salinities ranging from 5 to 40+ ppt, they thrive within a range of 10 to 25 ppt where pathogens and predators are limited. The low-salinity end of the range is critical for osmotic balance. Oysters can survive brief periods of salinities less than 5 ppt by remaining tightly closed. Oysters will remain closed until normal salinities are reestablished or until they deplete their internal reserves and perish. In contrast, predators, such as oyster drills (*Thais haemastoma*), welks, and crabs reduce oyster populations during extended periods of high salinities (Cake, 1983). *Perkinsus marinus* (Dermo) is the most common and deadly oyster pathogen in the bays bordering the Gulf. It is a primary factor affecting habitat suitability.

Many organisms, including mollusks, barnacles, crabs, gastropods, amphipods, polychaetes, and isopods, are found living on oyster reefs, forming a very diverse community (Sheridan et al., 1989). Oyster reef communities are dependent upon food resources from the open bay and marshes. Many organisms feed on oysters, including fish such as black drum, crab, and gastropods, such as the oyster drill (Lester and Gonzales, 2011; Sheridan et al., 1989). When oyster reefs are exposed during low tides, shore birds will use the reef areas for resting (Armstrong et al., 1987).

Currently some commercial harvesting of oysters occurs in Aransas Bay, but none in Corpus Christi Bay or the Upper Laguna Madre (pers. comm., D. Topping [TPWD], 2016). In Texas, all molluscan shellfish must be harvested from areas that have been approved or conditionally approved as designated by the Texas Department of State Health Services (TDSHS). This status is subject to change to prohibited or restricted by the TDSHS at any time due to extreme weather conditions, oil spills, and red tides. Currently, oysters are approved for harvesting from much of Corpus Christi, Aransas, and Copano bays (TDSHS, 2021).

Globally, an estimated 85 percent of oyster habitat has been lost with the remaining populations in poor condition. In the last 100 years there has been an estimated 88 percent decline in oyster biomass in the United States (Baggett et al., 2014). Gulf oyster landings are the highest in the world; however, overall oyster biomass and abundance has suffered serious declines (Beck et al., 2011; Zu Ermgassen et al., 2012). This decline has been mainly due to overharvesting. However, other factors include coastal development and dredging causing habitat loss or degradation, diseases, sedimentation, and pollution (Baggett et al., 2014; Beck et al., 2011; Coen and Luckenbach, 2000). In the study area, there has been a significant decline in oyster reef habitat from the historic to the current extent. Aransas Bay has exhibited an 88 percent decline and Corpus Christ Bay a 91 percent decline over the last 120 years (Baggett et al., 2014).

3.3.3.2.4 Jetty Communities

Jetty communities occurring within the study area include the Aransas Pass and Packery Channel jetties. Found along the mouth of inlets, these granite jetties serve to stabilize channels by extending into the Gulf beyond sandbars and breaking waves (Fikes and Lehman, 2010). These man-made jetties exhibit a diverse rocky shore community that can effectively transport larva into and out of these passes (Britton and Morton, 1989).

Jetty communities are comprised of stone crab (*Menippe adina*), porcelain crab (*Petrolisthes armatus*), hermit crab (*Clibanarius vittatus*), tree oysters (*Isogonom bicolor*), horse oyster (*Ostrea equestris*), fragile barnacle (*Chthamalus fragilis*), striped barnacle (*Balanus amphitrite*), ivory barnacle (*Balanus eburneus*), lined periwinkle (*Nodilittorina lineolata*), Atlantic Needlefish (*Strongylura marina*), Sergent Major (*Abudefduf saxatilis*), common octopus (*Octopus vulgaris*), false limpet (*Siphonaria pectinata*), sea lettuce (*Ulva fasciata*, *Gelidium crinale*, *Pandina vickersiae*), red sea urchin (*Arbacia punctulata*), anemones (*Bunodosoma cavernata*, *Anthopleura krebsi*, *Aiptasiomorpha texaensis*), common hydroids (*Bougainvilla inaequalis*, *Obelia adichotoma*, *Gonothyraea gracilis*), (Britton and Morton, 1989). Numerous macroalgae inhabit this rocky intertidal habitat including *Gelidium pusillum*, *Gracilaria tikvahiae*, *Grateloupia filicina*, and *Hypnea musciformis* (Fikes and Lehman, 2010). Gorgonian (soft) corals, known to be successful in jetty environments, can also be found including *Leptogorgia virgulate*, *Leptogorgia setacea*, and *Leptogorgia hebes* (Williamson et al., 2011).

3.3.3.2.5 Offshore Bottom Communities

There are few seagrasses or attached algae found in the offshore sands due to the strong currents and unstable sediments. Most of the bottom surface is populated with macroinfauna such as an occasional hermit crab (Paguroidea), portunid crab (Portunidae), or ray (Batoidea). Even though there is little life on the sand surface, the overlying waters are highly productive. Phytoplankton are abundant, including microscopic diatoms, dinoflagellates, and other algae (Britton and Morton, 1989).

Much of the faunal diversity lies buried in the sand and relies on phytoplankton for food. Bivalves found in offshore sands include the blood ark (*Anadara ovalis*), incongruous ark (*Anadara brasiliana*), southern quahog (*Mercenaria campechiensis*), giant cockle (*Dinocardium robustum*), disk dosini (*Dosinia discus*), pen shells (*Atrina serrata*), common egg cockle (*Laevicardium laevigatum*), crossbarred venus (*Chione cancellata*), tellins (*Tellina* spp.), and the tusk shell (*Dentalium texasianum*). One of the most common species occurring in the shallow offshore sands is the sand dollar (*Mellit quinquiesperforata*), followed by several species of brittle stars (*Hemipholis elongata*, *Ophiolepis elegans*, and *Ophiothrix angulata*). Many gastropods are common, including the moon snail (*Polinices duplicatus*), ear snail (*Sinum perspectivum*), Atlantic auger (*Terebra dislocata*), Salle's auger (*Terebra salleano*), scotch bonnet (*Phalium granulatum*), distroted triton (*Distrosio clathrata*), wentletraps (*Epitonium* sp.), and whelks (*Busycon* spp.). Crustaceans inhabit these waters, including white and brown shrimp (both commercially harvested species), rock shrimp (*Sicyonia brevirostris*), blue crabs, mole crabs (*Albunea* spp.), speckled crab (*Arenaeus cribrarius*), box crab (*Calappa sulcata*), calico crab (*Hepatus epheliticus*), and pea crab (*Pinotheres maculatus*). The most abundant infaunal organisms with respect to the number of individuals are polychaetes (Capitellidae, Orbiniidae, Magelonidae, and Paraonidae) (Britton and Morton, 1989).

3.3.3.2.6 Artificial Reefs

In the Gulf, two types of artificial reefs exist: those structures placed to serve as oil and gas production platforms and those intentionally placed to serve as artificial reefs (Gulf of Mexico Fisheries Management Council [GMFMC], 2004). The more than 4,500 oil and gas structures in the Gulf form unique reef ecosystems. These ecosystems extend throughout the water column, providing a large volume and surface area, dynamic water-flow characteristics, and a strong profile (Ditton and Falk, 1981; Dokken, 1997; Stanley and Wilson, 1990; Vitale and Dokken, 2000). Fish are attracted to oil platforms because these structures provide food, shelter from predators and ocean currents, and a visual reference, which aids in navigation for migrating fishes (Bohnsack, 1989; Duedall and Champ, 1991; Meier, 1989; Vitale and Dokken, 2000). The size and shape of the structure affect community characteristics of pelagic, demersal, and benthic fishes (Stanley and Wilson, 1990). Many scientists believe that the presence of oil platform structures allows fish populations to grow, which increases fishery potential (Scarborough-Bull and Kendall, 1994).

Artificial reefs are colonized by a diverse array of microorganisms, algae, and sessile invertebrates. These include shelled forms (barnacles, oysters, and mussels), as well as soft corals (bryozoans, hydroids, sponges, and octocorals) and hard corals (encrusting, colonial forms). These organisms (referred to as the biofouling community) provide habitat and food for many motile invertebrates and fishes (GMFMC, 2004).

Some species associated with platforms are not dependent on the biofouling community for food or cover. These include the Red Snapper (*Lutjanus campechanus*), Atlantic Spadefish (*Chaetodipterus faber*), Lookdown (*Selene vomer*), Atlantic Moonfish (*Selene setapinnis*), Creole-fish (*Paranthias furcifer*), Whitespotted Soapfish (*Rypticus maculatus*), Gray Triggerfish (*Balistes capriscus*), and Lane Snapper

(*Lutjanus synagris*), all transients (move from platform to platform). Resident species (always found on the platforms), include Red Snapper, Large Tomtate (*Haemulon aurolineatum*), and some large groupers. Other resident species are dependent upon the biofouling community for food or cover. These include numerous blennies, Sheepshead, and small grazers (butterflyfishes, Chaetodontidae). Highly transient, large predators associated with these structures include Barracuda (*Sphyraena barracuda*), Almaco Jack (*Seriola rivoliana*), Hammerhead Sharks (*Sphyrna* spp.), Cobia (*Rachycentron canadum*), mackerels (Scombridae), other jacks (*Caranx* spp.), and the Little Tunny (*Euthynnus alletteratus*) (GMFMC, 2004).

A total of 15 active oil and gas platforms occur within the study area, far fewer than are found in the northern Gulf (EIA, 2021b). In addition, the TPWD operates the Texas Artificial Reef Program that insures the continued enrichment of the Texas Gulf fishery and fishing opportunities (Stephan et al., 1990). There are three TPWD artificial reef sites that occur within the study area. These include Boatmen's Reef, located 4.7 miles from Aransas Pass; Lonestar Reef, located 8.8 miles from Mustang Island; and Mustang Island-775 Reef, located 10.6 miles from Mustang Island. These reefs are each 40 acres in size and are at depths from 60 to 73 feet. The materials of these nearshore reefs consist of barges and/or boats, well heads, concrete culverts, and reef pyramids. The Mustang Island Liberty Ship Reef site is located 18.1 miles from Mustang Island, just outside the study area. This artificial reef site consists of two Liberty Ships including: the Charles A. Dana (bow and stern) and the Conrad Weiser, Rachael Jackson. Water depth at this site ranges from 108 to 111 feet (TPWD, 2021b).

3.3.3.3 Commercial and Recreational Fisheries

The TPWD Rockport Marine Laboratory collects commercial and recreational fisheries data for the study area. Ten years (2011 to 2020) of commercial data and 6 years (2014 to 2020) of recreational fisheries data were obtained from Darin Topping (in September 2021) and Mark Fisher (in October 2021) at the Rockport Marine Laboratory. Species included in the commercial fisheries data are Black Drum, flounder, Sheepshead, mullet, and other. Shellfish include blue crab, eastern oyster, brown and pink shrimp, white shrimp, and other. Species included in the recreational fisheries data are Spotted Seatrout, Red Drum, Southern Flounder, Red Snapper, and King Mackerel (*Scomberomorus cavalla*). It should be noted that although only a small portion of the Upper Laguna Madre occurs within the study area, TPWD assesses the system as a whole and data are not extractable based on the subset of the region.

3.3.3.3.1 Commercial Fisheries

Commercial landings for bay systems within the study area from 2011 to 2020 averaged 3.83 million pounds of fish with an average value of $6.11 million. Shellfish averaged 5.78 million pounds with an average value of $18.1 million (Table 3-19). Table 3-19 shows TPWD commercial landings and value (ex-vessel value) for bay systems withing the study area from 2011 to 2020 (pers. comm. D. Topping [TPWD], 2021).

Table 3-19
Commercial Landings and Values Within the Study Area, 2011 to 2020

Bay System	Fish		Shellfish		Total Combined	
	Pounds	Value	Pounds	Value	Pounds	Value
Aransas Bay	616,437	$2,719,954	16,241,390	$52,193,240	16,857,827	$54,913,194
Corpus Christi Bay	1,901,462	$4,902,240	951,578	$1,953,925	2,853,040	$6,856,165
Upper Laguna Madre	8,970,802	$10,693,393	152,009	$241,795	9,122,811	$10,935,188
Average	3,829,567	$6,105,196	5,781,659	$18,129,653	9,611,226	$24,234,849

Source: Personal communication with Darin Topping (September 7, 2021) from the TPWD, Rockport Marine Lab, Rockport, Texas.

Of the bay systems included in the study area, the Upper Laguna Madre had the highest commercial finfish harvest of all bays on the Texas coast, with 43.8 percent of the total finfish landings. This was followed by Corpus Christi Bay with the fourth highest (9.3 percent) and Aransas Bay with the sixth highest (3.0 percent). Black Drum is the most commercially caught species in the Upper Laguna Madre representing 52.3 percent of the total catch. Other species included Southern Flounder (3.12 percent), Sheepshead (2.0 percent), and mullet (1.97 percent). In Corpus Christi Bay, the "fish other" category represents 19.2 percent of the total catch, Southern Flounder represents 16.2 percent, and Sheepshead 11.5 percent. Southern Flounder represents 20.9 percent of the total commercial catch from Aransas Bay, followed by "fish other" at 13.6 percent, and Sheepshead at 13.5 percent (pers. comm. D. Topping [TPWD], 2021).

Aransas Bay had the third-highest commercial shellfish harvest of all bay systems in Texas with 17.9 percent of the landings. Corpus Christi Bay had the sixth-highest commercial shellfish harvest with 0.7 percent. The Upper Laguna Madre had the least with 0.1 percent. In Aransas Bay, Eastern oyster is the most commercially sought species at 22.5 percent. This is followed by blue crab at 18.2, and "shellfish other" category at 12.7 percent of all Texas bay systems. In Corpus Christi Bay, the "shellfish other" category represents 20.78 percent and brown and pink shrimp represent 11.1 percent of the commercially landed shellfish on the Texas coast. Almost no shellfish species are commercially sought from the Upper Laguna Madre (pers. comm. D. Topping [TPWD], 2021).

The TPWD divides the Gulf off the Texas coast into five grid zones (17 through 21 from north to south). Grid zones 19 and 20 occur within the study area. From 2011 to 2020, a total of 4.95 million pounds of finfish were commercially harvested, with a value of $18.3 million. Commercially harvested species include black drum, flounder, mullet, Cobia, grouper, snapper, and other. Snapper make up most of the commercial harvest, followed by grouper (Serranidae), Cobia, and mullet (pers. comm. D. Topping [TPWD], 2021).

Shrimp and blue crab are also commercially harvested from this area of the Gulf. The data are only available Gulfwide, not by grid zone through TPWD. Gulf shrimp landings data for Texas were obtained through the NOAA Fisheries Office of Science and Technology, Commercial Landings Query. From 2010 to 2020, a total of 760.8 million pounds of shrimp were commercially harvested in the Gulf with a value of $1.9 billion. Brown shrimp comprised the majority of the commercial shrimp harvest in the Gulf, 499.7 million pounds with a value of $1.2 billion. This was followed by white shrimp at 256.5 million pounds with a value of $688.1 million and pink shrimp at 4.5 million pounds with a value of $12.4 million (NOAA, 2021h).

3.3.3.3.2 Recreational Fisheries

Recreational fishing is economically and biologically important in the study area. During 2014 to 2020, recreational bay fishing represented 12.1 percent of the Upper Laguna Madre catch, 10.8 percent of the Aransas Bay catch, and 7.6 percent of the Corpus Christi Bay catch. The most sought species in the study area was Spotted Seatrout, followed by Red Drum, “no particular species” category, and Black Drum (pers. comm. M. Fisher [TPWD], 2021).

Private boat fishing is those using privately owned and rental boats, including fishing tournaments. Guided boat fishing is those using a professional fishing guide with 10 or fewer people. Annual bay private boat fishing pressure for all Texas bays is fourth-greatest from the Upper Laguna Madre, sixth-greatest from Aransas Bay, and least from Corpus Christi Bay. Guided boat fishing is third- and fourth-greatest from Upper Laguna Madre and Aransas Bay, fifth-greatest from Corpus Christi Bay (pers. comm. M. Fisher [TPWD], 2021; Green and Campbell, 2010).

Offshore recreational fishing is also popular along the Texas coast. Of all bay systems on the Texas coast, offshore of Corpus Christi Bay ranks second with 24.9 percent of the total Gulf recreational catch. Of species collected offshore from Corpus Christi Bay, anglers primarily sought Red Snapper (52 percent), King Mackerel (13 percent), “no particular species” category (10 percent), and Spotted Seatrout (8 percent). From 2014 to 2020, both private boat and guided boat fishing pressure was the second highest off Corpus Christi Bay for all the Texas coast (pers. comm. M. Fisher [TPWD], 2021).

3.3.3.4 Invasive Species in Ballast Water

Ballast water is fresh or seawater held in the ballast tanks or cargo holds of ships. The ballast adds weight and provides stability and maneuverability during the voyage of the ship. Ballast may also be added so the ship can sink low enough to pass under bridges and structures. Usually, the ballast is added to the ship at port when the cargo is off-loaded and released when the ship takes on cargo. The ballast is then kept during transportation until the next port-of-call. The ship’s ballast tank may contain mixtures of water from multiple ports. The release of ballast water at foreign ports may introduce non-native or invasive species to new environments (Hawaii-Department of Land and Natural Resources, 2021).

Aquatic invasive species lack natural predators and biological controls. They can flourish in their new environments, outcompeting native species and spreading to new waterways. Aquatic invasive species can also clog water supply pipelines, deplete fisheries, and harm human health. Species such as zebra mussels

(*Dreissena polymorpha*), quagga mussels (*Dreissena bugensis*), and green crabs (*Carcinus maenas*) are thought to have been spread by ship ballast. The EPA, USGS, and the Texas Invasive Plant and Pest Council have identified a list of invasive species that could potentially occur within the study area. Not all have necessarily been introduced through ballast water alone (Table 3-20) (EPA, 2001a; Texas Invasive Plant and Pest Council, 2021; USGS, 2021c).

Table 3-20
Invasive Species with Potential to Occur in the Study Area

Common Name	Scientific Name	Native Environment
COELENTERATES		
Australian spotted jellyfish	*Phyllorhiza punctata*	Marine
CRUSTACEANS		
Harpacticoid copepod	*Nitokra hibernica*	Freshwater-marine
Calanoid copepod	*Eurytemora affinis*	Freshwater-marine
Harris mud crab	*Rhithropanopeus harrisii*	Freshwater-marine
Pacific white shrimp	*Litopenaeus vannamei*	Marine
Asian tiger shrimp	*Penaeus monodon*	Marine
Green crab	*Carcinus maenus*	Marine
Marine swimming crab	*Charybdis helleri*	Marine
Water flea	*Daphnia lumholtzi*	Marine
Chinese mittencrab	*Eriocheri sinensis*	Marine
Malaysian prawn	*Macrobrachium rosenbergii*	Marine
FISHES		
Inland Silverside	*Menidia beryllina*	Freshwater-marine
Mozambique Tilapia	*Oreochromis mossambicus*	Freshwater-brackish
Blueback Herring	*Alosa aestivalis*	Freshwater-marine
American Shad	*Alosa sapidissima*	Freshwater-marine
Tessellated Blenny	*Hypsoblennius invemar*	Marine
Regal Demoiselle	*Neopomacentrus cyanomos*	Marine
Orangemouth Corvina	*Cynoscion xanthulus*	Marine
Lionfish	*Pterois volitans/miles*	Marine
Grass Carp	*Ctenopharyngodon Idella*	Freshwater
MOLLUSKS		
Asian clam	*Corbicula fluminea*	Freshwater
Mexilhao mussel	*Perna perna*	Marine
Green mussel	*Perna viridis*	Marine-brackish
Giant ramshorn	*Marisa cornuarietis*	Freshwater
Giant applesnail	*Pomacea maculate*	Freshwater
Zebra mussel	*Dreissena polymorpha*	Freshwater
Quagga mussel	*Dreissena bugensis*	Freshwater

Common Name	Scientific Name	Native Environment
AQUATIC PLANTS		
Alligatorweed	*Alternanthera philoxeroides*	Freshwater
Dotted duckweed	*Landoltia punctate*	Freshwater
Water lettuce	*Pistia stratiotes*	Freshwater
Hydrilla	*Hydrilla verticillate*	Freshwater
Giant Salvinia	*Salvinia molesta*	Freshwater
Water hyacinth	*Eichhotnia crassipes*	Freshwater
Water spinach	*Ipomoea aquatica*	Freshwater
Purple loosestrife	*Lythrum salicaria*	Freshwater
MAMMALS		
Nutria	*Myocastor coypus*	Semi-aquatic

Source: EPA (2001a); Texas Invasive Plant and Pest Council (2021); USGS (2021c).

The National Ballast Information Clearinghouse is managed by the USCG. It is used to collect data on the management of ballast water from commercial ships operating in WOTUS. The purpose of the National Ballast Information Clearinghouse is to quantify the amounts and origins of ballast water discharged in U.S. waters and record any treatment measures used to reduce the likelihood of distributing invasive species. According to the National Ballast Information Clearinghouse (2021) ballast water reporting database, between January 1, 2018 and June 24, 2021, there have been 6,618 Ballast Water Management reports submitted to the Port. Of the submitted Ballast Water Management reports, 4,815 were discharges within the Port. Of those, 2,320 reports had some method of treatment system in place for the ballast water (National Ballast Information Clearinghouse, 2021). Ballast water management methods can include mid-ocean ballast exchange, filtration, or treating the water with chlorine, ultraviolet lights, or heat (EPA, 2001a).

3.3.4 Wildlife Resources

Blair (1950) categorized Texas into seven biotic provinces based on climate, vegetation types, and terrestrial vertebrates. The seven biotic provinces in Texas are: Austroriparian, Texas, Tamaulipan, Chihuahuan, Navahonian, Kansan, and Balconian.

The study area is located within the Tamaulipan (lower Texas coast) biotic province. The Tamaulipan climate is semiarid and hot with little moisture for plant growth. The Tamaulipan Biotic Province is characterized by neotropical and plains species. Wildlife habitats include upland prairies, thornbrush scrub, salt marshes, tidally influenced lowlands, barrier islands, saline lagoons, and coastal prairies (Jahrsdoerfer and Leslie, 1988). Within the Tamaulipan biotic province, there are approximately 61 mammal species, over 300 bird species, 38 snake species, 19 lizard species, and at least five amphibian species (Blair, 1950).

3.3.4.1 Amphibians

Amphibians common to the study area are the green treefrog (*Hyla cinerea*), American bullfrog (*Rana catesbeiana*), Strecker's chorus frog (*Pseudacris streckeri*) and the southern leopard frog (*Rana sphenocephala*), Gulf Coast toad (*Bufo nebulifer*), sheep frog (*Hypopachus veriolosus*), Hurter's spadefoot (*Scaphiopus hurterii*), and Rio Grande chirping frog (*Syrrhophus cystignathoides* (Dixon, 2000; TPWD, 2021c).

3.3.4.2 Reptiles

Snakes commonly found within the study area include Texas Ratsnake (*Elaphe obsoleta*), Rough Green Snake (*Opheodrys aestivus*), Eastern Hog-nosed Snake (*Heterodon platirhinos*), Eastern Garter Snake (*Thamnophis sirtalis sirtalis*), Western Cottonmouth (*Agkistrodon piscivorous leucostoma*), Texas Coral Snake (*Micrurus tener*), Diamond-backed Watersnake (*Nerodia rhombifer rhombifer*), Southern Copperhead (*Agkistrodon contortrix contortrix*), Speckled Kingsnake (*Lampropeltis getula holbrooki*), Gulf Saltmarsh Snake (*N. clarkii clarkii*), Texas Indigo Snake (*Drymarchon melanurus erebennus*), and Western Diamond-backed Rattlesnake (*Crotalus atrox*). Terrestrial turtles found within the study area include the Snapping Turtle (*Chelydra serpentina*), Red-eared Slider (*Trachemys scripta elegans*), Diamondback Terrapin (*Malaclemys terrapin littoralis*), Ornate Box Turtle (*Trachemys ornata ornata*), and Texas Spiny Softshell (*Apalone spinifera emoryi*). Sea turtles within the study area include Loggerhead Sea Turtle (*Caretta caretta*), Green Sea Turtle, Hawksbill Sea Turtle, Kemp's Ridley Sea Turtle, and Leatherback Sea Turtle. Lizards found in the study area include the Green Anole (*Anolis carolinensis*), Eastern Six-lined Racerunner (*Aspidoscelis sexlineata sexlineata*), Mediterranean Gecko (*Hemidactylus turcicus turcicus*), Western Slender Glass Lizard (*Ophisaurus attenuatus attenuatus*), Great Plains Skink (*Plestiodon obsoletus*), Prairie Lizard (*Sceloperus consobrinus*), Texas Spiny Lizard (*S. olivaceus*), and Texas Tree Lizard (*Urosaurus ornatus ornatus*) (Dixon, 2000; TPWD, 2021c).

3.3.4.3 Mammals

Mammals likely to occur in the study area include tricolored bat (*Perimyotis subflavus*), barrier island Texas Pocket Gopher (*Geomys personatus personatus*), Padre Island Kangaroo Rat (*Dipdomys compactus compactus*), Long-tailed Weasel (*Mustela frenata*), American Badger (*Taxidea taxus*), Nine-banded Armadillo (*Dasypus novemcinctus*), Swamp Rabbit (*Sylvilagus aquaticus*), Eastern Cottontail (*Sylvilagus floridanus*), Northern Raccoon (*Procyon lotor*), Eastern Spotted Skunk (*Spilogale putorius*), Striped Skunk (*Mephitis mephitis*), Bobcat (*Lynx rufus*), Feral Pig (*Sus scrofa*), and White-tailed Deer (*Odocoileus virginianus*). The Atlantic Bottlenose Dolphin (*Tursiops truncates truncatus*) is the only commonly occurring marine mammal in the study area. West Indian Manatee (*Trichechus manatus*) can occur within the study area, but their presence is occasional and ephemeral. Other Marine mammals that may occur within offshore extents of the study area include the Gulf of Mexico Bryde's Whale (*Balaenoptera edeni*), Sperm Whale (*Physeter macrocephalus*), Sei Whale (*Balaenoptera borealis*), and Blue Whale (*Balaenoptera musculus*) (Davis and Schmidly, 1994a; TPWD, 2021c).

3.3.4.4 Birds

Common year-round avian species within the study area include Great Blue Heron (*Ardea herodias*), Turkey Vulture (*Cathartes aura*), Red-tailed Hawk (*Buteo jamaicensis*), Black-bellied Whistling-duck (*Dendrocygna autumnalis*), Willet (*Tringa semipalmata*), Laughing Gull (*Leucophaeus atricilla*), Black Skimmer (*Rynchops niger*), Killdeer (*Charadrius vociferus*), Mourning Dove (*Zenaida macroura*), Belted Kingfisher (*Ceryle alcyon*), Blue Jay (*Cyanocitta cristata*), American Crow (*Corvus brachyrhynchos*), Tufted Titmouse (*Baeolophus bicolor*), Carolina Wren (*Thryothorus ludovicianus*), Little Blue Heron (*Egretta caerulea*), Sanderling (*Calidris alba*), Least Sandpiper (*C. minutilla*), White Ibis (*Eudocimus albus*), Roseate Spoonbill (*Platalea ajaja*), Royal Tern (*Sterna maxima*), Sandwich Tern (*S. sandvicensis*), Northern Mockingbird (*Mimus polyglottos*), Northern Cardinal (*Cardinalis cardinalis*), Lark Sparrow (*Chondestes grammacus*), Red-winged Blackbird (*Agelaius phoeniceus*), Western Meadowlark (*Sturnella magna*), Great-tailed Grackle (*Quiscalus mexicanus*), Brown-headed Cowbird (*Molothrus ater*), and House Sparrow (*Passer domesticus*) (Bryan et al., 2006; Lockwood and Freeman, 2014; Sibley, 2000).

The study area is located within the Central Flyway corridor which is used by millions of migratory bird species in the spring and fall. Winter residents and migrants include Blue-winged Teal (*Anas discors*), Mallard (*Anas platyrhynchos*), Gadwall (*Anas strepera*), Green-winged Teal (*Anas crecca*), Wood Duck (*Aix sponsa*), Northern Pintail (*Anas acuta*), Ring-necked Duck (*Anas collaris*), Lesser Scaup (*Aythya affinus*), Common Merganser (*Mergus merganser*), Ruby-crowned Kinglet (*Regulus calendula*), Cedar Waxwing (*Bombycilla cedrorum*), Yellow-rumped Warbler (*Dendroica coronata*), Chipping Sparrow (*Spizella passerina*), Field Sparrow (*S. pusilla*), Vesper Sparrow (*Pooecetes gramineus*), Savannah Sparrow (*Passerculus sandwichensis*), White-throated Sparrow (*Zonotrichia albicollis*), Dark-eyed Junco (*Junco hyemalis*), and American Goldfinch (*Carduelis tristis*). Summer residents expected to occur in the study area include the Yellow-billed Cuckoo (*Coccyzus americanus*), Common Nighthawk (*Chordeiles minor*), Chimney Swift (*Chaetura pelagica*), Eastern Kingbird (*Tyrannus tyrannus*), Scissor-tailed Flycatcher (*T. forficatus*), Purple Martin (*Progne subis*), Barn Wallow (*Hirundo rustica*), Summer Tanager (*Piranga rubra*), Indigo Bunting (*Passerina cyanea*), Painted Bunting (*Passerina ciris*), and Dickcissel (*Spiza americana*) (Bryan et al., 2006; Lockwood and Freeman, 2014; Sibley, 2000).

3.3.4.5 Insects

Common insect species found along the Gulf Coast include the field cricket (*Gryllus* spp.), American cockroach (*Periplaneta americana*), wheel bug (*Arilus cristatus*), leaf-footed bug (*Leptoglossus phyllopus*), dog-day cicada (*Tibicen spp.*), green lacewing (*Chrysoperla* spp.), ground beetle (*Scarites subterraneus*), June beetle (*Phyllophaga* spp.), firefly (*Photinus* spp.), boll weevil (*Anthonomous grandis*), Asian tiger mosquito (*Aedes albopictus*), deer fly (*Chrysops* spp.), house fly (*Musca domestica*), giant swallowtail

(*Heraclides cresphontes*), cloudless sulphur (*Phoebis sennae eubule*), snout butterfly (*Libytheana* spp.), checkered skipper (*Pyrgus communis*), prairie alligator (*Anisomorpha ferrunginea*), common termite (*Reticulitermes claripennis*), yucca moth (*Tegeticula yuccasella*), monarch butterfly (*Danaus plexippus*), honey bee (*Apis mellifera*), paper wasp (*Polistes carolina*), and the red imported fire ant (*Solenopsis invicta*) (Drees and Jackman, 1998).

3.3.5 Protected Resources

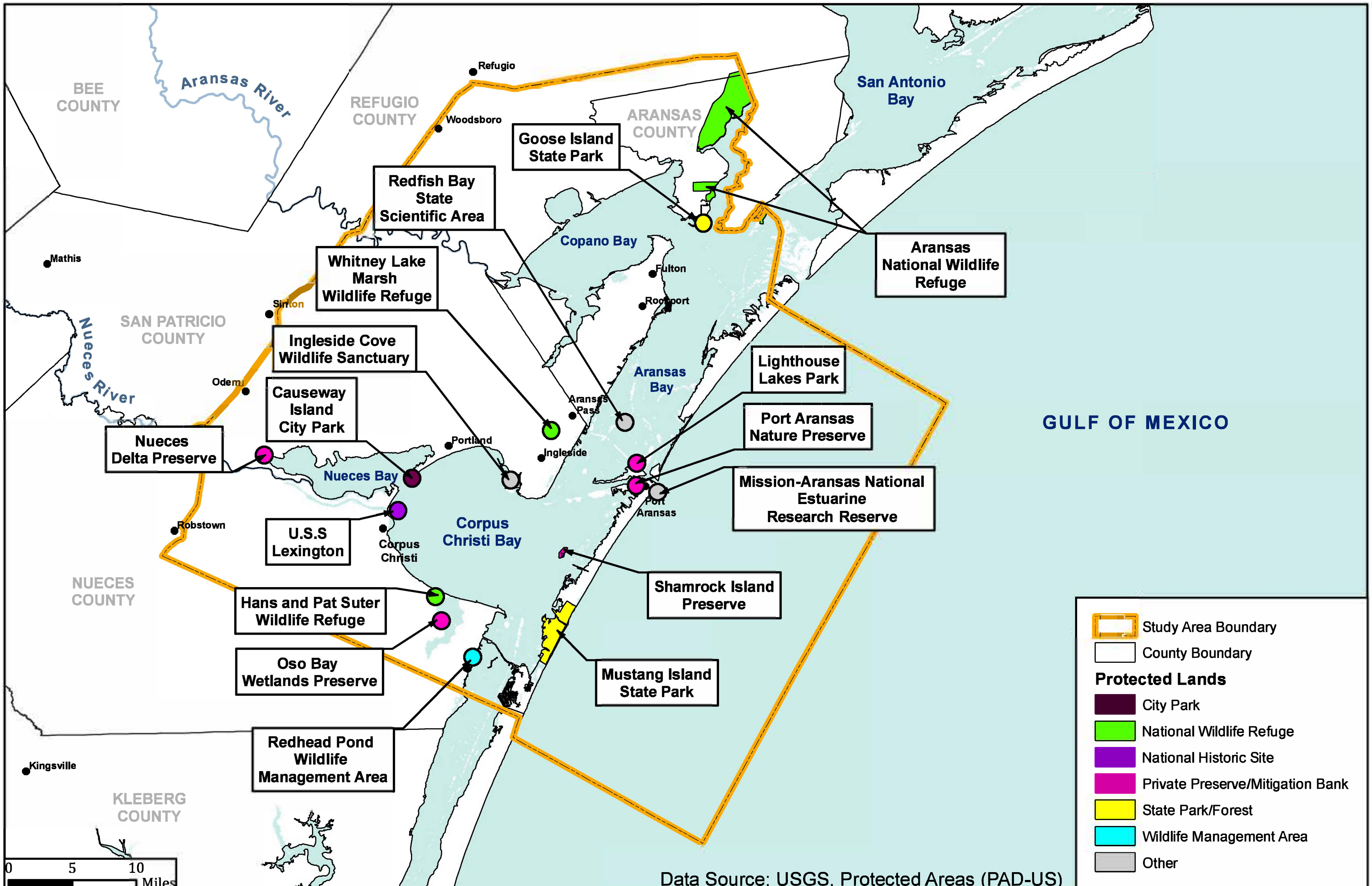
3.3.5.1 Protected Lands

Protected lands have been established within the study area to protect the natural and cultural resources of Texas (Figure 3-19). Some of these areas provide opportunities such as hunting, fishing, camping, kayaking, wildlife viewing, hiking, and education. Administration of these areas is provided under Federal and State governance or by private organizations. Within the study area are Aransas NWR (USFWS), Goose Island State Park (TPWD), Nueces Delta Preserve (Coastal Bend Bays and Estuaries Program), Shamrock Island Preserve (The Nature Conservancy), Mustang Island State Park (TPWD), Redhead Pond Wildlife Management Area, Redfish Bay State Scientific Area (TPWD), Ingleside Cove Wildlife Sanctuary (TPWD), Mission-Aransas National Estuarine Research Reserve (University of Texas), Oso Bay Wetlands Preserve (City of Corpus Christi), Hans and Pat Suter Wildlife Refuge (City of Corpus Christi), USS Lexington (City of Corpus Christi), Causeway Island City Park (Coastal Bend Bays and Estuaries Program), Port Aransas Nature Preserve (City of Port Aransas), Lighthouse Lakes Park (Nueces County Coastal Parks), and Whitney Lake Marsh Wildlife Refuge (City of Ingleside) (City of Corpus Christi, 2021b, 2021c; Coastal Bend Bays and Estuaries Program, 2021; Nueces County Coastal Parks, 2020).

3.3.5.2 Threatened and Endangered Species

The Endangered Species Act (ESA) was passed in 1973. The purpose of the ESA is to protect and recover imperiled species and their ecosystems. Species may be Federally-listed as “Endangered” or “Threatened”. Endangered means that the species is at risk throughout all or a significant portion of its range. Threatened means that the species is at risk of being endangered within the foreseeable future. The USFWS and NMFS are the Federal agencies responsible for implementing the ESA. USFWS is responsible for bird, terrestrial and freshwater species, and NMFS is responsible for marine species (USFWS, 2013a).

The USFWS and NMFS have identified 23 Federally-listed threatened and endangered species within Nueces San Patricio, Refugio, and Aransas counties (USFWS, 2021b; NOAA, 2021i). Species are listed in Table 3-21. Inclusion in the list does not imply that the species occurs within the area, but only acknowledges the potential for its occurrence.



PROJECT NO. PCA20166 DATE CREATED Date: 2/27/2023 DATUM & COORDINATE SYSTEM NAD83 State Plane (feet) Texas South Central FILE NAME Name: Fig_3-17_Protected Lands PREPARED BY KLC	Port of Corpus Christi Authority Corpus Christi Ship Channel Deepening Project **Protected Lands**	N W E S	FIGURE 3-19

Date Saved: 2/27/2023 9:44:59 AM Path: H:\ENVIRONMENTAL\Final_Exhibits\EIS Figures\Fig_3-17_Protected Lands.mxd

Table 3-21
Federally-Listed Endangered and Threatened Species of Potential Occurrence in the Nueces, San Patricio, Refugio, and Aransas Counties, Texas

Common Name	Scientific Name	Federal Status
PLANTS		
Slender rush-pea	*Hoffmannseggia tenella*	E
South Texas ambrosia	*Ambrosia cheiranthifolia*	E
Black lace cactus	*Echinocereus reichenbachii* var. *albertii*	E
BIRDS		
Northern Aplomado Falcon	*Falco femoralis septentrionalis*	E
Piping Plover	*Charadrius melodus*	T
Red Knot	*Calidris canutus rufa*	T
Whooping Crane	*Grus americana*	E
Eastern Black Rail	*Laterallus jamaicensis jamaicensis*	T
Attwater's Greater Prairie Chicken	*Tympanuchus cupido attwateri*	E
MAMMALS		
Ocelot	*Leopardus pardalis*	E
Blue Whale	*Balaenoptera musculus*	E
Fin Whale	*Balaenoptera physalus*	E
Humpback Whale	*Megaptera novaeangliae*	T
Sei Whale	*Balaenoptera borealis*	E
Sperm Whale	*Physeter macrocephalus*	E
West Indian Manatee	*Trichechus manatus*	T
FISH		
Giant Manta Ray	*Manta birostris*	T
REPTILES		
Green Sea Turtle	*Chelonia mydas*	T
Hawksbill Sea Turtle	*Eretmochelys imbricata*	E
Kemp's Ridley Sea Turtle	*Lepidochelys kempii*	E
Leatherback Sea Turtle	*Dermochelys coriacea*	E
Loggerhead Sea Turtle	*Caretta caretta*	T

Source: USFWS (2021b, 2021c) and NOAA (2021i).

E = Endangered; T = Threatened

Threatened or endangered species in which one or more project feature or construction activity are likely to affect include Ocelot (*Leopardus pardalis*), West Indian Manatee, Northern Aplomado Falcon (*Falco femoralis septentrionalis*), Piping Plover (*Charadrius melodus*), Red Knot (*Calidris canutus rufa*), Whooping Crane (*Grus americana*), Eastern Black Rail (*Laterallus jamaicensis jamaicensis*), Attwater's Prairie Chicken (*Tympanuchus cupido attwateri)*, Green Sea Turtle, Hawksbill Sea Turtle, Kemp's Ridley Sea Turtle, Leatherback Sea Turtle, Loggerhead Sea Turtle, Blue Whale, Fin Whale (*Balaenoptera physalus*), Humpback Whale (*Megaptera novaeangliae*), Sei Whale, Sperm Whale, slender rush-pea

(*Hoffmannseggia tenella*), South Texas ambrosia (*Ambrosia cheiranthifolia*), and black lace cactus (*Echinocereus reichenbachii* var. *albertii*).

There is Federally designated Critical Habitat for Piping Plover within the study area.

A Biological Assessment of the study area describing the Federally-listed species likely to occur, and the potential impacts associated with the preferred actions has been prepared and is attached as Appendix D1. A Biological Opinion from NMFS and a Biological Conference and Opinion from USFWS can also be found in appendices D2 and D3, respectively.

Slender rush-pea. The Federally endangered slender rush-pea is a small, perennial legume with compound leaves and delicate yellow-orange flowers (TPWD, 2016). It is found in only two Texas counties, Kleberg and Nueces in coastal prairie habitat. The largest population can be found at the St. James cemetery in Bishop, Texas. Much of its historical range has been converted to croplands and individuals must compete with non-native grasses such as the Kleberg and King Ranch bluestem (USFWS, 2008a). Populations of the slender rush-pea are unlikely to be found within the study area due to lack of suitable habitat.

South Texas ambrosia. The Federally endangered south Texas ambrosia is a perennial herbaceous plant with gray-green leaves and yellow inflorescence flowers. They are associated with native grasses such as Texas grama (*Bouteloua rigidiseta*) and buffalograss (*Bouteloua dactyloides*) in native grasslands and savannahs habitats (TPWD, 2021d). The primary threat to the south Texas ambrosia is habitat loss, agricultural conversion of prairie, competition with non-native grasses, and urban development (USFWS, 2010a). South Texas ambrosia can be found in Nueces and Kleberg counties. Suitable habitat does not occur within the study area, the species are not likely to be found within the study area.

Black Lace Cactus. The Federally endangered black lace cactus is a small columnar shaped cactus with pink flowers found in mesquite brush openings in saline sandy-loan soils (USFWS, 2009). The species are only found in three counties in Texas: Jim Wells, Kleberg, and Refugio. The primary threat to this species is habitat loss and collection. Populations of the species are well-documented. Suitable habitat for the black lace cactus is not found within the study area, the species are not likely to be found within the study area.

Northern Aplomado Falcon. The Federally endangered Northern Aplomado Falcon are medium-sized grassland birds of prey. They have a distinct dark 'cummerbund', a dark crescent facial mark, and steely gray dorsal plumage. The falcons are strong fliers and have been observed exhibiting cooperative hunting techniques. Breeding pairs do not construct nests but instead utilize old or newly built nests from other falcons and corvids. Reasons for their decline can be attributed to degradation of habitat due to overgrazing, prairie dog control, and pesticide usage (Campbell, 2003). There has been a reintroduction effort to bring back populations of aplomado falcons to south Texas, sightings have been noted in Nueces and San Patricio Counties (eBird, 2021). Populations of the Northern Aplomado Falcon are likely to occur within the study area.

Piping Plover. The Federally threatened Piping Plover is a small shorebird that inhabits coastal beaches and tidal flats. Approximately 35 percent of the known global population of Piping Plover winters along the Texas Gulf Coast, where they spend 60 to 70 percent of the year (Campbell, 2003). The Piping Plover population that winters in Texas breeds on the northern Great Plains and around the Great Lakes. The species is a rare to uncommon migrant and winter resident in coastal areas of south Texas (Lockwood and Freeman, 2014). The Piping Plover is likely to occur within the study area.

Red Knot. The Federally threatened Red Knot is a medium-sized, stocky, short-necked sandpiper with a rather short straight bill. The *rufa* subspecies is one of three subspecies occurring in North America. They have one of the longest distance migrations known, travelling between its breeding grounds in the central Canadian Arctic to wintering areas that are primarily in South America (USFWS, 2014a). During migration and winter in Texas, Red Knots may be found feeding in small groups, on sandy, shell-lined beaches, and to a lesser degree, on flats of bays and lagoons (Oberholser, 1974). It is an uncommon to common migrant along the coast, and rare to casual inland, primarily in the eastern half of the state. Red Knots are very rare summer visitors and are rare and local winter residents on the coast (Lockwood and Freeman, 2014). The wintering population in Texas is estimated to be approximately 2,000 individuals (USFWS, 2015a). The Red Knot is likely to occur in the study area.

Whooping Cranes. Federally endangered Whooping Cranes are tall, white birds with a medium sized bill and black primary feathers. Whooping Cranes migrate during the daytime and roost at night in croplands and wetland areas on their 2,400-mile journey to the Texas Gulf Coast. During the winter, the cranes are found along the Gulf Coast wetlands and uplands feeding on blue crabs, clams, and wolfberry (Campbell, 2003). The population of Whooping Cranes have rebounded within the last decade with up to 506 individuals wintering along the Texas coast in 2019–2020 (USFWS, 2020a). Current threats to wild cranes include powerline collisions, shooting, disease, loss of habitat, and severe weather (USFWS, 2012). The population of Whooping Cranes are likely to occur in the study area.

Eastern Black Rail. Federally threatened Eastern Black Rail are small black birds with white speckling on their back and wings with long dark legs and red eyes. Along the Gulf coast, Eastern Black Rails are found in higher elevation salt, brackish or freshwater wetlands and marshes. Eastern Black Rails are threatened by habitat loss, invasive species, changes to hydrology, mangrove encroachment, and habitat fragmentation (USFWS, 2021d). Populations of Eastern Black Rail are likely to occur within the study area.

Attwater's Greater Prairie Chicken. The Federally endangered Attwater's Greater Prairie Chicken are medium sized upland birds known for their courtship displays. The males congregate at breeding grounds called leks in the springtime, inflate air sacs located on their necks, and produce low 'booming' calls to attract females. The main threats to the Attwater's Greater Prairie Chicken are loss of grassland prairie habitat, depredation, invasive fire ants, and poor brood survival. The Attwater's Greater Prairie Chicken require unfragmented tallgrass prairie habitat maintained by periodic wildfires. Common plant species associated in suitable habitat include little bluestem, big bluestem (*Andropogon gerardi*), and switchgrass

(*Panicum virgatum*) (USFWS, 2010b). The prairie chicken current range exists further inland within upland habitats. They are extremely rare outside of their known and documented areas. It is highly unlikely that the Attwater's Greater Prairie Chicken occurs within the study area.

Ocelot. Federally endangered Ocelots are medium-sized, spotted cats found in thorny scrub and oak-grassland habitat of south Texas (Campbell, 2003). In addition to Texas, they are found in 22 countries from Central to South America (International Society for Endangered Cats, 2018). Ocelots are nocturnal hunters and prefer woodlands with thick canopy cover. The fragmentation of habitat by roadways has led to increased collision mortalities and reduced dispersal rates (USFWS, 2016). The population of Ocelots are not found outside of the Lower Rio Grande Valley in Texas; therefore, it is unlikely to occur in the study area.

Blue Whale. The Blue Whale is the largest whale species in the world and can weigh over 330,000 pounds. They are found worldwide and migrate thousands of miles between foraging areas where they feed primarily on krill (NOAA, 2021j). There are only two documented records of Blue Whale in the Gulf. The only documented Texas record was an individual stranding between Freeport and San Luis Pass in 1940 (Schmidly, 2004). The Blue Whale is not expected to occur within the study area.

Fin Whale. The Federally-listed Fin Whale is the second largest whale in the world. Fin Whales are typically found in higher latitudes during the summer and spring. They migrate several thousand miles south to warmer equatorial waters to mate and calve. Fin Whales are found year-round in the Gulf although there has only been one recorded incidence in Texas in 1951 (Schmidly, 2004). Historically, Fin Whales were hunted, but today face threats such as collisions with vessels, habitat degradation, and reduced prey abundance from overfishing (NOAA, 2021k). The Fin Whale is not expected to occur in the study area.

Humpback Whale. The Humpback Whale has one of the longest migration routes of any whale species. They travel as much as 3,000 miles in the span of 36 days. Because of the ban on commercial whaling the population of humpbacks have been steadily increasing. They still face threats from ship strikes and entanglement in fishing gear (NOAA, 2021l). The only documented observation of a humpback in Texas waters was in 1992 near the Bolivar Jetty in Galveston. The species is rare in the Gulf (Schmidly, 2004) and is unlikely to occur in the study area.

Sei Whale. This migratory species can commonly be found in higher latitudes during the summer and equatorial waters in the winter and fall. Sei Whales are protected under the Marine Mammal Protection Act (MMPA) of 1972 and the ESA of 1973. They currently face threats from ship collisions, entanglement with fishing gear and habitat degradation (NOAA, 2021m). Sei Whales can be found in the Gulf Sea and Caribbean Sea but no records exist for Texas (Schmidly, 2004). The Sei Whale is not expected to occur in the study area.

Sperm Whale. Sperm Whales are proficient divers and often spend most of their time in deep waters feeding. The average dive can last for 35 minutes and can reach depths of over 1,312 feet (NOAA, 2021n). Sperm Whales are the most common species of whale in the Gulf. Sightings and stranding occur regularly along the Texas Gulf Coast. Although Sperm Whales are known to occur in the Gulf, they typically inhabit deep offshore waters (Schmidly, 2004). Sperm Whales are not likely to occur in the study area.

West Indian Manatee. The Federally threatened West Indian Manatee is an aquatic mammal. They inhabit brackish water bays, large rivers, and salt water, and feed upon submergent, emergent, and floating vegetation with the diet varying according to plant availability (Davis and Schmidly, 1994b; USFWS, 2008b). Historically, the manatee inhabited the Laguna Madre, Gulf, and tidally influenced portions of rivers. Currently manatees are extremely rare in Texas waters and the most recent sightings are likely individuals migrating or wandering from Mexican waters. Historical records from Texas waters include Cow Bayou, Sabine Lake, Copano Bay, the Bolivar Peninsula, and the mouth of the Rio Grande (Davis and Schmidly, 1994b). The West Indian Manatee could potentially occur within the study area, but likely as a transient and not a resident.

Giant Manta Ray. Giant Manta Rays are a Federally-listed threatened species and are known as the world's largest species of rays. Manta Rays have a large diamond shaped body with black backs, mostly white bellies, elongated pectoral fins and two long lobes which extend from their mouth. Adult manta rays can have a wingspan of 29 feet and weigh up to 5,300 pounds. The main threat to Giant Manta Rays is commercial fishing, bycatch, and habitat loss. Giant Manta Rays are filter feeders and can often be found foraging in shallow coastal waters or open oceans where they feed on zooplankton within the water column. Giant Manta Rays can dive to depths of 3,280 feet (NOAA, 2021o). Nearshore, Manta Rays have been observed along sandy bottom areas, reefs, and seagrass beds (USFWS, 2021e). Giant Manta Rays are migratory and found worldwide in tropical, subtropical, and temperate waters and commonly found offshore and inshore near coastlines. Within U.S. waters, Giant Manta Rays can be found as far north as Long Island, New York, the Gulf, and the Caribbean Islands (NOAA, 2021o). The Flower Garden Banks National Marine Sanctuary, located approximately 100 miles from the Texas coastline, has been observed to serve as habitat and nursery for juvenile Manta Rays (Stewart et al., 2018). Giant Manta Rays are likely to occur within the study area.

Green Sea Turtle. Federally threatened Green Sea Turtle is widely distributed throughout the world in the tropic and sub-tropic oceans. In the Atlantic and Gulf, they are found inshore from Texas to Massachusetts. Green Sea Turtles are the largest of the hard-shelled turtles typically 3 to 4 feet long and weighing from 300 to 350 pounds. Their diet consists of sea grasses and algae (NOAA, 2021p). In 2021, only one nest was documented on South Padre Island (National Park Service [NPS], 2021a). The Green Sea Turtle is likely to occur in the study area.

Hawksbill Sea Turtle. The Federally endangered Hawksbill Sea Turtle is widely distributed in the Caribbean Sea and western Atlantic Ocean. Representatives of at least some life history stages regularly occur in southern Florida and the northern Gulf (especially Texas), south to Brazil. The hawksbill generally inhabits coastal reefs, bays, rocky areas, passes, estuaries, and lagoons, where it occurs at depths of less than 70 feet. Like some other sea turtle species, hatchlings are sometimes found floating in masses of marine plants (e.g., *Sargassum* rafts) in the open ocean. In the continental U.S., the hawksbills typically occur in Florida and Texas. Most of these sightings involve post-hatchlings and juveniles and are primarily associated with stone jetties. These small turtles are believed to originate from nesting beaches in Mexico (NOAA, 2021q). The only documented nest on the Texas coast was found in 1998 at the South Padre Island National Seashore and remains the only recorded nest in Texas (NPS, 2020a). The Hawksbill Sea Turtle is likely to occur in the study area.

Kemp's Ridley Sea Turtle. The Federally endangered Kemp's Ridley Sea Turtle inhabits shallow coastal and estuarine waters. Observed usually over sand or mud bottoms where prey can be found. Adults are primarily restricted to the Gulf, although juveniles may range throughout the Atlantic Ocean since they have been observed as far north as Nova Scotia (USFWS, 2015b). Kemp's Ridley occurs in Texas in small numbers. In many cases, they may be in transit between crustacean-rich feeding areas in the northern Gulf and breeding grounds in Mexico. Almost the entire population of Kemp's Ridley nests on a 16-mile stretch of coastline near Rancho Nuevo, Tamaulipas, Mexico, approximately 190 miles south of the Rio Grande. Nesting in Texas occurs on a much smaller scale but makes up the majority of the nests (NOAA, 2021r). In 2021, a total of 182 nests have been documented along the entire Texas coast, with the majority occurring at the Padre Island National Seashore. Nests have been documented in San José Island, Mustang Island, and North Padre Island (north of the Padre Island National Seashore) (NPS, 2021a). This species is likely to occur within the study area.

Leatherback Sea Turtle. The Federally endangered Leatherback Sea Turtle is probably the most wide-ranging of all sea turtle species. It occurs in the Atlantic, Pacific, and Indian oceans; as far north as British Columbia, Newfoundland, Great Britain, and Norway; as far south as Australia, Cape of Good Hope, and Argentina (USFWS, 2013b). The leatherback is mainly pelagic, inhabiting the open ocean. They seldom approach land except for nesting, reproduction, or when following concentrations of jellyfish, when it can be found in inshore waters, bays, and estuaries (NOAA, 2021s; TPWD, 2021e). They can dive to depths of 4,200 feet and stay down for up to 85 minutes. Leatherbacks nest primarily in tropical regions and only sporadically in some of the Atlantic and Gulf states of the continental U.S. (NOAA, 2021s). In the Atlantic and Caribbean, the largest nesting assemblages occur in the U.S. Virgin Islands, Puerto Rico, and Florida (NPS, 2020b; NOAA, 2021s). Until 2008, leatherback nests had not been recorded in Texas for 80 years when one nest was located at Padre Island National Seashore (NPS, 2020b). Leatherbacks are rare along the Texas coast and tend to keep to deeper offshore waters where their primary food source, jellyfish, occurs (TPWD, 2021e; NPS, 2020b). Currently, there are no documented leatherback nests on the Texas coast (NPS, 2021a). Since Leatherback Sea Turtles are mainly pelagic, this species is unlikely to occur in the study area.

Loggerhead Sea Turtle. The Federally endangered Loggerhead Sea Turtle is widely distributed in tropical and subtropical seas. They are found in the Atlantic Ocean from Nova Scotia to Argentina, Gulf, Mediterranean Sea, and Indian and Pacific oceans (although it is rare in the eastern and central Pacific) (NOAA, 2021t). In the continental U.S., loggerheads nest along the Atlantic coast from Florida to as far north as New Jersey. They nest sporadically along the Gulf coast, including Texas (NOAA, 2021t; NPS, 2020c). Loggerhead populations have been in decline due to humans (shrimp trawling) and predators (NPS, 2020c). They prefer shallow inner continental shelf waters and occurring very infrequently in the bays. They can often be seen around offshore oil rig platforms, reefs, and jetties where they feed on crabs, mollusks, jellyfish, and Portuguese man-o-war (NPS, 2020c; NOAA, 2021t). Currently, one loggerhead nest has been documented on the Padre Island National Seashore (NPS, 2021a). Due to their habitat preference, it is unlikely that the Loggerhead Sea Turtle would occur in the study area. This species is likely to occur within the study area.

The Texas Legislature has authorized regulations under the Texas Administrative Code 65.175 and 65.176, pertaining to the management, regulation and protection of native species deemed to be state threatened or endangered. TPWD has identified 38 State-listed threatened and endangered species within Nueces, San Patricio, Refugio, and Aransas counties (Table 3-22; TPWD, 2023a). Inclusion in the list does not imply that the species occurs within the area, but only acknowledges the potential for its occurrence. TPWD regulations prohibit the taking, possession, transportation, or sale of any animal species designated as threatened or endangered. State law prohibits the commerce and collection of any listed plant species from public lands without a permit issued by the TPWD. In addition, some species listed as threatened or endangered under state law are also listed under Federal regulations.

Table 3-22
State-Listed Endangered and Threatened Species of Potential Occurrence in the Nueces, San Patricio, Refugio, and Aransas Counties, Texas

Common Name	Scientific Name	State Status
AMPHIBIANS		
Black-spotted Newt	*Notophthalmus meridionalis*	T
South Texas Siren (Large Form)	*Siren* sp.1	T
Sheep Frog	*Hypopachus variolosus*	T
BIRDS		
Reddish Egret	*Egretta rufescens*	T
White-faced Ibis	*Plegadis chihi*	T
Wood Stork	*Mycteria americana*	T
Swallow-tailed Kite	*Elanoides forficatus*	T
White-tailed Hawk	*Buteo albicaudatus*	T
Nothern Aplomado Falcon	*Falco femoralis septentrionalis*	E*
Attwater's Greater Prairie Chicken	*Tympanuchus cupido attwateri*	E*
Eastern Black Rail	*Laterallus jamaicensis jamaicensis*	T*

Common Name	Scientific Name	State Status
Whooping Crane	*Grus americana*	E*
Piping Plover	*Charadrius melodus*	E*
Rufa Red Knot	*Calidris canutus rufa*	T*
Sooty Tern	*Onychoprion fuscatus*	T
Tropical Parula	*Setophaga pitiayumi*	T
Texas Botteri's Sparrow	*Peucaea botterii texana*	T
FISH		
Shortfin Mako Shark	*Isurus oxyrinchus*	T
Oceanic Whitetip Shark	*Carcharhinus longimanus*	T*
MAMMALS		
Ocelot	*Leopardus pardalis*	E
White-nosed Coati	*Nasua narica*	T
Blue Whale	*Balaenoptera musculus*	E*
Sei Whale	*Balaenoptera borealis*	E*
Sperm Whale	*Physeter macrocephalus*	E*
Gulf of Mexico Bryde's Whale	*Balaenoptera ricei*	E
North Atlantic Right Whale	*Eubalaena glacialis*	E
West Indian Manatee	*Trichechus manatus*	T
REPTILES		
Green Sea Turtle	*Chelonia mydas*	T*
Hawksbill Sea Turtle	*Eretmochelys imbricata*	E*
Kemp's Ridley Sea Turtle	*Lepidochelys kempii*	E*
Leatherback Sea Turtle	*Dermochelys coriacea*	E*
Loggerhead Sea Turtle	*Caretta caretta*	T*
Texas Tortoise	*Gopherus berlandieri*	T
Texas Horned Lizard	*Phrynosoma cornutum*	T
Texas Scarlet Snake	*Cemophora lineri*	T
PLANTS		
Slender rush-pea	*Hoffmannseggia tenella*	E*
South Texas ambrosia	*Ambrosia cheiranthifolia*	E*
Black lace cactus	*Echinocereus reichenbachii* var. *albertii*	E*

Source: TPWD (2023a).

E = Endangered; T = Threatened; * = Federally-listed

3.3.5.3 Essential Fish Habitat

The Draft EIS served to initiate Essential Fish Habitat (EFH) consultation under the Magnuson-Stevens Fishery Conservation and Management Act (MSFCMA). Congress enacted amendments to the MSFCMA (Public Law 94-265) in 1996 that established procedures for identifying EFH and required interagency coordination to further the conservation of Federally managed fisheries. The MSFCMA is necessary to prevent overfishing, to rebuild overfished stocks, to ensure conservation, to facilitate long-term protection of EFH, and to realize the full potential of the Nation's fishery resources. The MSFCMA protects fish and shellfish that occur in U.S. waters, the highly migratory species of the high seas, the species that dwell on or in the continental shelf appertaining to the United States, and the anadromous species, which spawn in U.S. rivers or estuaries and constitute valuable and renewable natural resources (U.S. Department of Commerce, 2007). Rules published by the NMFS (50 CFR sections 600.805–600.930) specify that any Federal agency that authorizes, funds, or undertakes, or proposes to authorize, fund, or undertake an activity that could adversely affect EFH is subject to the consultation provisions of the above-mentioned act and identified consultation requirements.

EFH is defined as "those waters and substrate necessary to fish for spawning, breeding, feeding, or growth to maturity." EFH is separated into estuarine and marine components. The estuarine component is defined as "all estuarine waters and substrates (mud, sand, shell, rock, and associated biological communities); subtidal vegetation (seagrasses and algae); and adjacent intertidal vegetation (marshes and mangroves)." The marine component is defined as "all marine waters and substrates (mud, sand, shell, rock, and associated biological communities) from the shoreline to the seaward limit of the Exclusive Economic Zone" (200 nautical miles from the coast) (GMFMC, 2004). Adverse effect to EFH is defined as, "any impact, which reduces quality and/or quantity of EFH…" and may include direct, indirect, site-specific or habitat impacts, including individual, cumulative, or synergistic consequences of actions.

Within areas identified as EFH, Habitat Areas of Particular Concern may be designated. This focuses conservation priorities on areas that are important to the life cycles of Federally managed species and may warrant more-targeted protection measures. Designation of specific Habitat Areas of Particular Concern is based on ecological function, habitats sensitive to human-induced environmental degradation, stressors of development activities, and habitat rarity (Dobrzynski and Johnson, 2001). No Habitat Areas of Particular Concern are designated in the study area (NOAA, 2021u).

EFH within the study area include both estuarine (bay) and marine (Gulf) habitat. The categories of EFH that occur within the study area include estuarine water column, estuarine mud and sand bottoms (unvegetated estuarine benthic habitats), estuarine shell substrate (oyster reefs and shell substrate), estuarine emergent wetlands, seagrasses, and mangroves. Additionally, portions of the project located in marine waters include the marine water column, unconsolidated marine water bottoms, and natural structural features. Table 3-23 lists the species that NMFS and the GMFMC identify in the study area that have EFH. The table describes the relative abundance and adult and juvenile presence of EFH managed species occurring in the study area. Relative abundance is defined as follows (Nelson et al., 1992):

- Highly Abundant: Species numerically dominant relative to others
- Abundant: Species often encountered in substantial numbers relative to others
- Common: Species generally encountered but not in large numbers and not evenly distributed over specific salinity zones

Table 3-23
Adult and Juvenile Presence for Identified Essential Fish Habitat Within the Study Area by Species

Common/Scientific Name*	Bay (Estuarine)		Marine (Gulf)	
	Juvenile	Adult	Juvenile	Adult
Brown shrimp (*Farfantepenaeus aztecus*)	common to highly abundant year-round nursery area	not present	spawning area year-round	major adult area spring, summer, fall
Pink shrimp (*Farfantepenaeus duorarum*)	common Aug-Jun	not present	nursery area year-round	present year-round spawning area in summer
White shrimp (*Litopenaeus setiferus*)	abundant July-Oct common Nov-Jun nursery area	common Apr-Jun abundant Sept-Nov	not present	present year-round spawning Mar-Oct
Blacknose Shark (*Carcharhinus acronotus*)	not present		present	
Spinner Shark (*Carcharhinus brevipinna*)	not present		present	
Silky Shark (*Carcharhinus falciformis*)	not present		present	
Finetooth Shark (*Carcharhinus isodon*)	present		present	
Bull Shark (*Carcharhinus leucas*)	common Mar-Oct	present	present	
Blacktip Shark (*Carcharhinus limbatus*)	not present		present	
Tiger Shark (*Galeocerdo cuvier*)	not present		present	
Lemon Shark (*Negaprion brevirostris*)	present		present	not present

Common/Scientific Name*	Bay (Estuarine)		Marine (Gulf)	
	Juvenile	Adult	Juvenile	Adult
Atlantic Sharpnose Shark (*Rhizoprionodon terraenovae*)	present		present	
Scalloped hammerhead shark (*Sphyrna lewini*)	present		present	
Bonnethead Shark (*Sphyrna tiburo*)	present		present	
Red Grouper (*Epinephelus morio*)	not present		nursery area year-round	adult occurrence
Gag Grouper (*Mycteroperca microlepis*)	not present		not present	adult occurrence
Scamp (*Mycteroperca phenax*)	not present		not present	adult occurrence
Cobia (*Rachycentron canadum*)	nursery area year-round	not present	nursery area year-round	present summer
Dolphin (*Coryphaena hippurus*)	not present		present year-round	
Greater Amberjack (*Seriola dumerili*)	not present		present year-round	adult and spawning area year-round
Lesser Amberjack (*Seriola fasciata*)	not present		not present	present
Red Snapper (*Lutjanus campechanus*)	nursery area year-round	not present	nursery area year-round	not present
Gray Snapper (*Lutjanus griseus*)	nursery area	present year-round spawn Jun-August	not present	major adult area year-round spawn Jun-August
Lane Snapper (*Lutjanus synagris*)	present Jun-Nov nursery area	not present	nursery area	not present

Common/Scientific Name*	Bay (Estuarine)		Marine (Gulf)	
	Juvenile	Adult	Juvenile	Adult
Vermilion Snapper (*Rhomboplites aurorubens*)	not present		nursery area	not present
Red Drum (*Sciaenops ocellatus*)	common year-round nursery area	common year-round	spawning area fall and winter	present year-round spawning area fall and winter
Little Tunny (*Euthynnus alletteratus*)	not present		present	
King Mackerel (*Scomberomorus cavalla*)	not present		nursery area year-round	present year-round spawning area May-Nov
Spanish Mackerel (*Scomberomorus maculatus*)	nursery area year-round	common Apr-Oct	nursery area year-round	present year-round spawning area summer and fall
Sailfish (*Istiophorus platypterus*)	not present		present	

Source: Nelson et al. (1992); NMFS (2009); NOAA (2013b and 2021u).

* Species according to Page et al. (2013).

- Rare: Species present but not frequently encountered
- Not Present: Species not found in area

Due to the nature and extent of potential direct and indirect impacts to EFH, a separate EFH Assessment has been prepared and is presented in Appendix E. The EFH Assessment provides detailed information on EFH habitat/community types, life-history characteristics of Federally managed species, and impacts associated with the Applicant's Preferred Alternative. Coordination with NMFS and GMFMC regarding the EFH Assessment and recommendations is discussed in Section 11.9.

3.3.5.4 Migratory Birds

The Migratory Bird Treaty Act of 1918 makes it illegal to kill, capture, possess, transport, buy, sell, or trade any migratory bird parts (bones, feathers, etc.), nest, or eggs without prior authorization by the USFWS (USFWS, 2020b). There are protected areas such as NWRs, Wildlife Management Areas, state parks, dredge islands, and managed bird islands within the study area. These areas provide nesting habitat and support rookeries for migratory birds. The USFWS Information for Planning and Consulting website lists 59 migratory species that may have the potential to occur within the study area (Table 3-24) (USFWS, 2021b). Twenty-two of the 59 species are found year-round in the study area such as Bald Eagle (*Haliaeetus leucocephalus*) and Clapper Rail (*Rallus crepitans*). Five species including American Oystercatcher (*Haematopus palliatus*) and Hooded Oriole (*Icterus cucullatus*) have breeding range within the study area.

Twenty-two species such as Dunlin (*Calidris alpina articola*) and Hudsonian Godwit (*Limosa haemastica*) winter along the coast. There are 10 migrant species such as the Black Scoter (*Melanitta nigra*) and Common Loon (*Gavia immer*) that migrate through the study area.

Table 3-24
Migratory Birds Listed by the USFWS that May be Found Within the Study Area

Common Name	Scientific Name	Season(s)
American Golden Plover	*Pluvialis dominica*	Migrating
American Oystercatcher	*Haematopus palliates*	Breeding
Audubon's Oriole	*Icterus graduacauda*	Breeding
Bald Eagle	*Haliaeetus leucocephalus*	Year-round
Black Rail	*Laterallus jamaicensis*	Year-round
Black Scoter	*Melanitta nigra*	Migrating
Black Skimmer	*Rynchops niger*	Year-round
Black-legged Kittiwake	*Rissa tridactyla*	Migrating
Bonaparte's Gull	*Chroicocephalus philadelphia*	Wintering
Brown Pelican	*Pelecanus occidentalis*	Year-round
Buff-breasted Sandpiper	*Calidris subruficollis*	Migrating
Burrowing Owl	*Athene cunicularia*	Year-round
Cassin's Sparrow	*Aimophila cassinii*	Year-round

Common Name	Scientific Name	Season(s)
Chestnut-collared Longspur	*Calcarius ornatus*	Migrating
Clapper Rail	*Rallus crepitans*	Year-round
Common Loon	*Gavia immer*	Migrating
Common Tern	*Sterna hirundo*	Year-round
Curve-billed Thrasher	*Toxostoma curvirostre*	Year-round
Double-crested Cormorant	*Phalacrocorax auritus*	Year-round
Dunlin	*Calidris alpina articola*	Wintering
Gull-billed Tern	*Gelochelidon nilotica*	Year-round
Harris's Hawk	*Parabuteo unicinctus*	Year-round
Herring Gull	*Larus argentatus*	Wintering
Hooded Oriole	*Icterus cucullatus*	Breeding
Hudsonian Godwit	*Limosa haemastica*	Wintering
King Rail	*Rallus elegans*	Year-round
Lark Bunting	*Calamospiza melanocorys*	Wintering
Le Conte's Sparrow	*Ammodramus leconteii*	Wintering
Least Tern	*Sterna antillarum*	Year-round
Lesser Yellowlegs	*Tringa flavipes*	Wintering
Long-billed Curlew	*Numenius americanus*	Wintering
Long-tailed Duck	*Clangula hyemalis*	Migrating
Magnificent Frigatebird	*Fregata magnificens*	Year-round
Marbled Godwit	*Limosa fedoa*	Wintering
Mountain Plover	*Charadius montanus*	Wintering
Nelson's Sparrow	*Ammodramus nelson*	Wintering
Northern Gannet	*Morus bassanus*	Wintering
Pomarine Jaeger	*Stercorarius pomarinus*	Wintering
Prothonotary Warbler	*Protonataria citrea*	Year-round
Red Phalarope	*Phalaropus fulicarius*	Migrating
Red-breasted Merganser	*Mergus serrator*	Wintering
Red-necked Phalarope	*Phalaropus lobatus*	Migrating
Red-throated Loon	*Gavia stellate*	Wintering
Reddish Egret	*Egretta rufescens*	Year-round
Ring-billed Gull	*Larus delawarensis*	Wintering
Royal Tern	*Thalasseus maximus*	Year-round
Ruddy Turnstone	*Arenaria interpres morinella*	Wintering
Seaside Sparrow	*Ammodramus maritimus*	Year-round
Semipalmated Sandpiper	*Calidris pusilla*	Migrating
Short-billed Dowitcher	*Limnodromus griseus*	Wintering
Sooty Tern	*Onychoprion fuscatus*	Wintering
Sprague's Pipit	*Anthus spragueii*	Year-round
Surf Scoter	*Melanitta perspicillata*	Wintering
Swallow-tailed Kite	*Elanoides forficatus*	Breeding
Varied Bunting	*Passerina versicolor*	Breeding

Common Name	Scientific Name	Season(s)
Whimbrel	*Numenius phaeopus*	Wintering
White-winged Scoter	*Melanitta fusca*	Wintering
Willet	*Tringa semipalmata*	Year-round
Wilson's Plover	*Charadrius wilsonia*	Year-round

Source: USFWS (2020b).

3.3.5.5 Marine Mammals

The MMPA of 1972 was established to prevent the decline of marine mammal species and populations. It prohibits the taking (harassment, injury, killing) and importing of marine mammals and products into the United States. The MMPA applies to all marine mammal species and implementation is shared with NMFS (whales, dolphins, seals, and sea lions) and the USFWS (polar bear, sea otters, marine otter, walrus, and manatees) (NOAA, 2019a).

Bay and estuarine waters along the Texas coast are home to the Atlantic Bottlenose Dolphin, also known as the Common Bottlenose Dolphin. No other species of marine mammal regularly inhabits these waters as part of their natural range. However, the Federally threatened West Indian Manatee occurs as an occasional drifter within these waters. Details for these two species are outlined in subsequent sections.

In addition to bay and estuarine waters, several marine mammal species have the potential to occur within the nearshore waters within the study area (Table 3-25). For the most part, species distributions are relatively unknown and under-studied. Species are considered to have potential to occur within the study area only if they are known to occur within nearshore continental shelf waters.

Table 3-25
Marine Mammal Species Likely to Occur within the Study Area

Common Name	Scientific Name	Stock	Population Estimate[1]	Strategic Stock	Federal Status
Sperm Whale	*Physeter macrocephalus*	Gulf of Mexico	763	Yes	Endangered
Cuvier's Beaked Whale	*Ziphius cavirostris*	Gulf of Mexico	74	No	CITES Appendix II/ MMPA Protected
Common Bottlenose Dolphin	*Tursiops truncatus*	Gulf of Mexico, Western Coastal	20,161	No	CITES Appendix II/ MMPA Protected
		Laguna Madre	80	Yes	
		Nueces Bay/Corpus Christi Bay	80	Yes	
		Copano Bay/Aransas Bay/San Antonio Bay/Redfish Bay/Espiritu Santo Bay	55	Yes	

Common Name	Scientific Name	Stock	Population Estimate[1]	Strategic Stock	Federal Status
Atlantic Spotted Dolphin	*Stenella frontalis*	Gulf of Mexico	Unknown	No	CITES Appendix II/ MMPA Protected
Clymene Dolphin	*Stenella clymene*	Gulf of Mexico	129	No	CITES Appendix II/ MMPA Protected
Killer Whale	*Orcinus orca*	Gulf of Mexico	28	No	CITES Appendix II/ MMPA Protected
Dwarf Sperm Whale	*Kogia sima*	Gulf of Mexico	186	No	CITES Appendix II/ MMPA Protected
Pygmy Sperm Whale	*Kogia breviceps*	Gulf of Mexico	186	No	CITES Appendix II/ MMPA Protected
Risso's Dolphin	*Grampus griseus*	Gulf of Mexico	2,442	No	CITES Appendix II/ MMPA Protected
Pilot Whale, Short-finned	*Globicephala macrorhynchus*	Gulf of Mexico	2,415	No	CITES Appendix II/ MMPA Protected
West Indian Manatee[2]	*Trichechus manatus*	Florida	4,834	Yes	Threatened

Source: NOAA (2021v); NMFS (2020); USFWS (2014b).

[1] Population Estimates represent "Best Available Estimates (N_{best})" as documented by NOAA NMFS for 2019 stock assessments.

[2] West Indian Manatee stock assessment reports are prepared by USFWS. The population estimate represents a minimum population estimate.

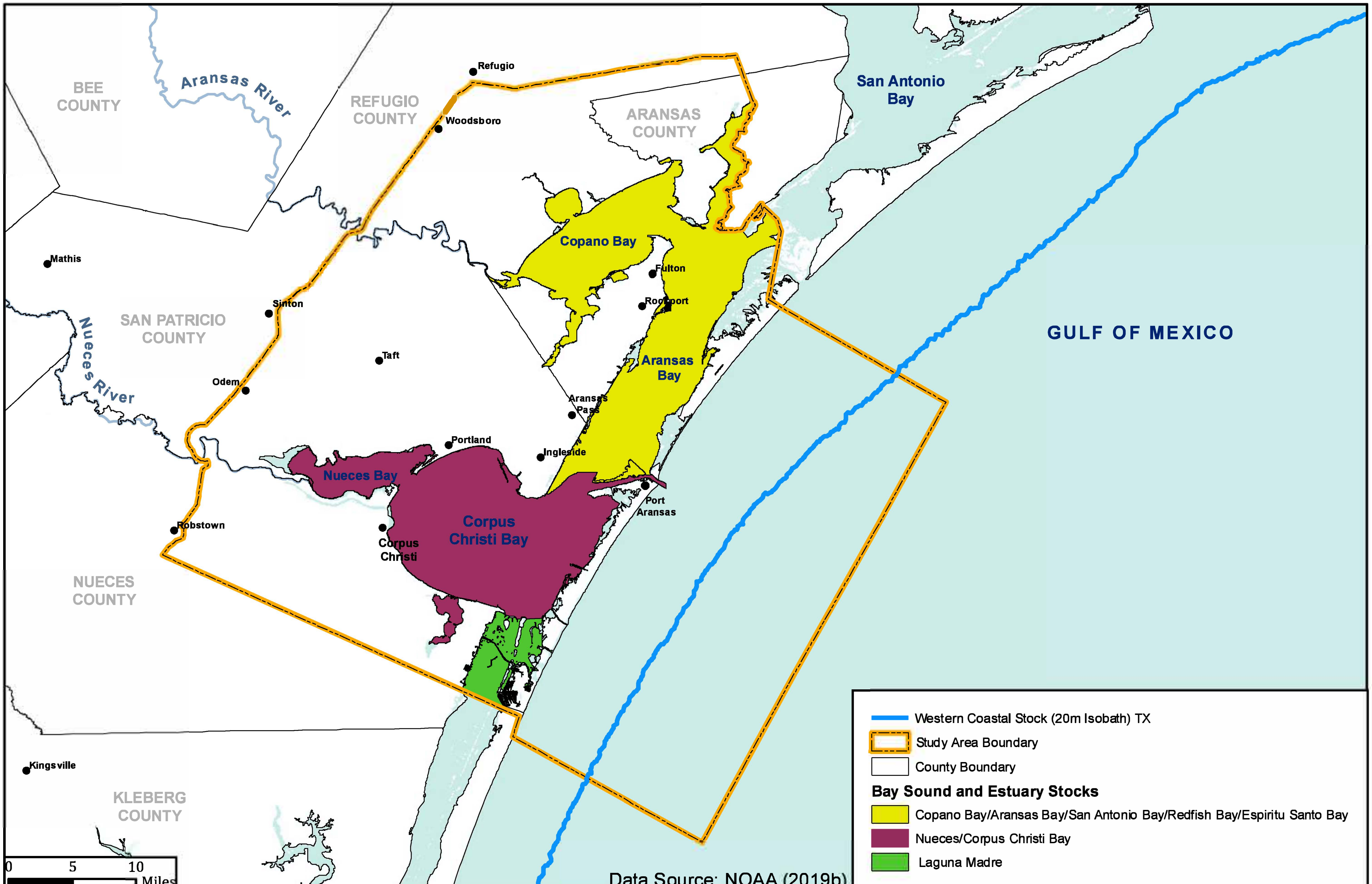
CITES Appendix II = Convention on International Trade in Endangered Species of Wild Fauna and Flora, lists species that are now threatened with extinction but that may become so unless trade is closely controlled.

Bottlenose Dolphin

Common Bottlenose Dolphin are the only marine mammals that regularly inhabit the bays and estuaries within the study area. Bottlenose Dolphins inhabiting bay, sound, and estuary habitats of the northern Gulf are divided by the NMFS into 31 geographically defined stocks for management purposes (NMFS, 2020).

Three of these bay, sound, and estuary stocks are found within the study area: 1) Laguna Madre, 2) Corpus Christi and Nueces bays, and 3) Redfish, Aransas, Copano, San Antonio, and Espiritu Santo bays (Figure 3-20). All three of these stocks are recognized as "strategic stocks".

Bordering the Texas bay, sound, and estuary stocks is the Western Coastal Stock. This is a nearshore coastal stock inhabiting a geographically defined region. Includes from the barrier islands to the 20-meter isobath and extends from the southern tip of Texas to the Mississippi River Delta. This coastal region represents a management zone where genetically distinct offshore and coastal/nearshore ecotypes could potentially coexist. This region also includes areas where coastal and bay, sound, and estuary populations may overlap (NMFS, 2013). The Western Coastal Stock is not recognized as a "strategic stock."



PROJECT NO. PCA20166

DATE CREATED Date: 6/1/2022

DATUM & COORDINATE SYSTEM NAD83 State Plane (feet) Texas South Central

FILE NAME Name: Fig_3-18_Dolphin Stock Locations

PREPARED BY KLC

Port of Corpus Christi Authority
Corpus Christi Ship Channel Deepening Project

Common Bottlenose Dolphin Stock Locations

FIGURE 3-20

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Although geographically defined stocks have been established, delineating biologically meaningful boundaries between and within coastal and bay, sound, and estuary Bottlenose Dolphin stocks is difficult. This is due to the fluid and complex social system of the species. Evidence of long-term site fidelity in bay, sound, and estuary habitats has been observed by many researchers focused on observing individual animals (Hubard and Swartz, 2002). NMFS has placed emphasis on protecting stable resident communities that would be at greatest risk from localized impacts. This includes the three recognized strategic stocks within the study area. However, fine-scale characterization of Texas stocks remains insufficient to delineate biologically significant boundaries or to determine population abundance trends (NMFS, 2013).

Seasonal distribution patterns are evident throughout Texas bays, inlets, and nearshore waters. The likely differential use of some habitats by multiple stocks or communities of dolphins along the coast complicates defining these patterns. Seasonal changes likely reflect a combination of within bay and coastal movements. Seasonal changes in density have been attributed to a combination of north-south migration along the coast influenced by water temperature and more localized shifts in distribution influenced by prey movements in and out of the estuary during various times of the year (Weller, 1998).

3.4 CULTURAL RESOURCES

The proposed PCCA CDP is subject to both Federal and State regulations concerning cultural resources. At the Federal level, the preferred project is subject to Section 106 of the National Historic Preservation Act of 1966, as amended (Section 106). Under this law, Federal agencies must consider how their actions might affect significant cultural resources, "significant" meaning those that are eligible for or are listed on the National Register of Historic Places (NRHP). Section 106 does not prohibit impacts to cultural resources; it only requires that an agency know the effects of their action and take those effects into account as part of their decision-making process through avoidance and preservation where possible or meaningful mitigation if avoidance is not possible. The USACE's issued PCCA CDP Record of Decision under NEPA would be one such Federal action that invokes Section 106. By law, the USACE must consult with local interested parties, including State Historic Preservation Officers (SHPO) to determine how best to manage cultural resources relative to the preferred action.

In addition, under the Antiquities Code of Texas, archaeological resources located on lands owned or managed by the State of Texas or a political subdivision thereof must be identified and managed in consultation with the Texas Historical Commission (THC). Significant archaeological sites, called State Antiquities Landmarks (SALs) must be identified and assessed prior to allowing ground-disturbing activities within these public lands. The proposed PCCA CDP is located within lands that the GLO manages, making the project subject to State-level archaeological resource regulatory oversight.

The Federal and State cultural resource laws have significant overlap. An important distinction is that the State law is limited to the direct physical impact footprint whereas Federal agencies must take direct and indirect effects into account. As a result, Federal cultural resource compliance often includes properties that are farther away from the preferred project footprint.

3.4.1 Cultural History Overview

3.4.1.1 Prehistoric

Humans arrived in the Americas between 16,000 and 14,500 years before present (BP) (Gilbert et al., 2008; Pitblado, 2011). The resulting Paleoindian Period is currently estimated to last until about 8500 BP. Diagnostic Paleoindian projectile points were lanceolate-shaped and fluted for hafting to wooden spears. Paleoindian-period hunters used atlatls (spear throwers) to increase their throwing force and range. This allowed them to hunt large game such as mammoth, mastodons, bison, camel, and horse (Black, 1989; Hofman et al., 1989). Following the Paleoindian Period, the Archaic period broadly dates from 8500 to 1250 BP (Hofman et al., 1989; Perttula, 2004). Increased numbers of ground and pecked stones, roasting pits, and stone-lined hearths at archaeological sites of this period suggest that people relied more heavily on specialized processing of plant foods (Hofman et al., 1989). Settlement patterns shifted from nomadic bands of hunter-gatherers to more permanent settlements based around productive fishing and hunting grounds (Ricklis et al., 2012). The subsequent Late Prehistoric period corresponds with the introduction of the bow and arrow. Beginning around 1000 to 300 BP, the Toyah culture corresponds with the time when bison herds returned to the Southern Plains. Toyah artifacts include a distinctive kit of flaked stone Perdiz arrow points, beveled knives, end scrapers, and drills, all of which were useful in processing hides (Kenmotsu and Boyd, 2012).

3.4.1.2 Historic and Post-European-Contact Period

The Texas Coast's Historic Period begins in the early 16th century when the first European explorers visited the region. In 1519, the Governor of Jamaica authorized an expedition to explore the Gulf Coast between Florida and Mexico in the hopes of finding a waterway to Asia. Lieutenant Alonso Álvarez de Piñeda led four ships on the voyage and produced the first known chart of the Gulf Coast that includes the study area region (Weddle, 2021; Morris, 2021). Piñeda is credited with naming Corpus Christi Bay (Leatherwood, 2021a). In 1528, Álvar Núñez Cabeza de Vaca and his crew were wrecked on the Texas coast and over the next six years, they walked overland to Mexico City, visiting the study area along the way. In 1684, Robert Cavelier, Sieur de La Salle and 300 crew and settlers sailed from France to find the mouth of the Mississippi River and set up a permanent settlement (Bruseth and Turner, 2005). The earliest known map thought to depict the Copano Bay region, from LaSalle's voyage, provides possible evidence La Salle reached Aransas and Corpus Christi bays (Dowling et al., 2010).

In 1746, Colonel José de Escandón built the fort Aranzazu at Live Oak Point to defend the bay from the French. On the opposite side of the bay, the Spanish founded the port of El Cópano, the first seaport in Texas. El Cópano remained unpopulated until the 19th century. In 1766, Garza Falcón settled the area and provided a report describing Padre Island. As tensions rose between the French and Spanish, a military expedition led by Ortiz Parilla set camp along the Laguna Madre, referring to it as Playa de Corpus Christi. Parilla's expedition produced a map, including an accurate depiction of Padre Island and Corpus Christi Bay, Mustang Island, Copano Bay, and San José Island (Lipscomb, 2021; Seiter, 2020).

The Karankawa people were the primary occupants of the region when European explorers arrived. These people seasonally occupied the barrier islands in the Gulf Coast and retreated to the Texas inlands in the off season. They navigated between the islands and the Texas interior maritime pathways on large dugout canoes and fishing, hunting, and foraging were their main form of subsistence (Lipscomb, 2021). The Karankawa were known to have clashed with both Spanish and French explorers and settlers. They resisted conversion to Catholicism and the Spaniards justified their eradication as an opportunity to gain control of the Texas coast. When Texas fell under Mexican control in 1821, white settlers waged constant war against the Karankawa. To survive, many of them took Mexican last names or allied themselves with white ranchers and assimilated into those communities (Lipscomb, 2021; Seiter, 2020).

In the 1780s, Governor Bernardo de Gálvez established a port of entry and customhouse in what is now Refugio County. The port served Refugio and neighboring towns, and its formidable reputation encouraged settlement in the area (Long, 2021a; Leffler, 2021). White settlers were not permanently established in the Corpus Christi Bay area until 1839 when a trading post was established on the west shore of Corpus Christi Bay (Long, 2021a, 2021b). The town was small with no more than 20 reported residences.

The United States acquired the Texas Republic in 1845 and sent the U.S. Army to Corpus Christi to enforce its claim. The seven-month encampment spurred the growth of Corpus Christi. Corpus Christi's shortcomings compared to other Texas coastal communities became increasingly clear during the second half of the 19th century. It lacked both access to fresh water and a deep-water port, making it somewhat of a lawless frontier town. However, by the 1860s, the population had grown to 1,200 and new schools and businesses were built (Long, 2021b).

The Civil War reached the study area in the summer of 1862. The Texas coast was under Union blockade, but some commerce was able to continue through the port at Corpus Christi. The blockade was reinforced by two shallow draft vessels which entered the interior waterways of Corpus Christi, captured several Confederate ships, and converted them into Union gunboats. After civilians fled the area, Confederate ground forces engaged the Union fleet and managed to drive them back. The city was cut off from supplies and residents were faced with starvation until the war ended 3 years later (Delaney, 2021). While the war had devastated Aransas County's economy, Corpus Christi and the surrounding areas supported sheep and cattle ranching. Rockport was founded in 1867 and eventually developed into a deep-water harbor, as was Aransas Pass in 1920 (Long, 2021a). Corpus Christi was used as a shipping center during a cattle boom in the 1870s, revitalizing the post-war economy. Starting in 1919, Corpus Christi dredged its main sea channel to allow access to larger steamers in support of the growing cattle trade. Construction was completed on the port in 1926 (Long, 2021b). Rockport's shipbuilding industry boomed during World War I and World

War II (Long, 2021a). In 1965, the Port began dredging the navigational channels that were upgraded as part of the current undertaking (Long, 2021b).

The proposed CDP crosses the GIWW, a significant inland navigational and commercial waterway. The GIWW parallels the Gulf coast, as it passes through the barrier Mustang and San José islands into Nueces Bay. It is a 1,100-mile-long, shallow-draft canal system and interior waterway that runs continuously from the Port of Brownsville, Texas to Saint Marks, Florida. Engineers and government leaders formulated the first concepts for a system of interconnecting canals as early as 1808. The first plans for the Texas portion were developed in 1875, but the railroad industry successfully hindered it well into the 20th century. The oil boom pushed canal development further, but the GIWW did not reach the study area until 1941 (Leatherwood, 2021b). Construction began in earnest when the United States entered World War II and the GIWW was expanded and extended to its current dimensions during the war (TxDOT – Maritime Division [MRD], 2020; Leatherwood, 2021b).

In 1938 Congress authorized funds to triple naval air strength and construct new naval air stations (NAS). The Navy chose a location in Flour Bluff, fifteen miles southeast of Corpus Christi as one such NAS. With the start of World War II, NAS Corpus Christi became a supply base for vessels involved in coastal patrol. During the 1950s, the Navy constructed more runways and navigation systems at NAS Corpus Christi. In 1954, the first F9F-2 Panther jet aircraft began flying from NAS Corpus Christi. In 1956, the USS *Antietam* arrived, allowing pilots to become carrier qualified. By the mid-1960s, the Navy discontinued seaplane operations, including landings in Corpus Christi Bay (Coletta, 1985).

3.4.2 Overview of Known Cultural Resources in the Study Area

The following section summarizes previously recorded archaeological sites, surveys, cemeteries, NRHP properties or districts, and other cultural resources within the study area that have been recorded in various databases. Detailed information about these databases and about individual resources are presented in Appendix F1.

3.4.2.1 Terrestrial Resources

The THC Atlas (2021) records six NRHP listed Districts and 14 NRHP listed properties within the study area. Most of these resources are individual residences, commercial buildings, and other structures that are far away from the CDP project's Area of Potential Effects (APE). Previous CDP cultural resource coordination resulted in a determination that none of these resources is likely to be affected by the preferred action. In addition, 39 previously known historic-age cemeteries are mapped within the study area. The closest of these cemeteries is 1.6 miles from the CDP project vicinity and none of these resources is likely to be affected by the preferred action. The THC's Atlas also includes information about all recorded terrestrial archaeological field projects including reconnaissance and intensive surveys as well as testing-level and data recovery excavations. None of the previously conducted terrestrial projects directly overlaps the CDP APE. However, 33 projects are located within 3,000 feet of it. The THC records identify 677 previously recorded terrestrial archaeological sites within the overall study area. These sites date from the earliest human occupation of the region through the mid-20th century. Three previously recorded terrestrial sites (41NU92, 41NU153, 41NU210) are located within the proposed CDP's APE and are discussed in detail in Appendix F1.

3.4.2.2 Underwater and Maritime Resources

According to the THC Atlas (2021), underwater archaeologists have conducted 46 surveys within the study area (Appendix F1). These surveys cover nearly 31,000 acres of submerged lands in the study area. This equates to less than 2 percent of the study area's two-million-acre study area footprint. The THC lists five archeologically documented shipwreck sites within 3,281 feet of the proposed CDP APE: 41AS119, 41NU252, 41NU264, 41NU282, and 41NU292. These sites are summarized in Table 3-26 and discussed in more detail in Appendix F1.

Table 3-26
Summary of Documented Shipwreck Sites

Trinomial	Summary	NRHP Eligibility
41AS119	136-foot-long wooden-hulled steamer (possibly THC Shipwreck 1528, an unidentified shipwreck that sank between 1884 and 1900)	Undetermined; Recommended for avoidance (Gearhart, 2019)
41NU252	SS *Mary*, iron-hulled sidewheel steamer in service from 1866 to its sinking in 1876	Listed SAL and eligible for NRHP (Pearson and Simmons, 1995; Enright et al., 2003)
41NU264/ 41NU292	SS *Utina*, World War I-era, Ferris-design wooden-hulled cargo steamer which foundered in 1921. 41NU264 is wreckage from the main hull, 41NU292	41NU264: Not Eligible for NRHP; 41NU292: Undetermined for NRHP (Pearson and Simmons, 1995; Schmidt and Hoyt, 1995; Enright et al., 2003)
41NU282	SS *Baddacock*, steel-hulled tug built and wrecked in 1920	Undetermined (Arnold, 1995)

Potential for Submerged Prehistoric Cultural Resources

The Gulf of today is 200 to 300 feet higher than it was when the first humans arrived on the North American continent during the closing centuries of the last Ice Age more than 14,000 years ago. At that time, much of the Earth's water was locked up in ice sheets and glaciers. At the height of the Ice Age, the Texas coast was roughly 100 miles farther out than it is today. The modern-day Corpus Christi Bay Estuary was not coastal at all. It was composed of inland prairie terraces and river valleys that were probably like the environment surrounding Kenedy or Poteet, Texas of today. This phenomenon of rising sea levels over a period of thousands of years has distinct implications for the archaeological and cultural record of the study area. Paleoindian occupants in the study area would not have been coastal peoples. Sites of this age submerged in the study area would be prairie Paleoindian occupation sites of inland peoples. These inland sites would have been clustered along paleochannels that are now inundated by Gulf waters (Joy, 2020).

Known Shipwrecks

THC records list 149 recorded shipwrecks within the study area (THC Atlas, 2021). Fifty-four of those are nearest to the proposed segments of the CDP APE. Twenty-seven correspond with entries in NOAA's Automated Wreck and Obstruction Information System (AWOIS) (NOAA, 2021w) databases. An additional 31 AWOIS shipwreck records are mapped in the study area but do not correspond with THC shipwrecks. This brings the total number of recorded shipwrecks in the study area to 180. These are individually listed in Appendix F1 (see Table 10), including THC Shipwreck Number and/or AWOIS Record Number, the year each was lost, a trinomial (if the shipwreck is also an archaeological site), SAL status, what type of vessel, and its estimated position accuracy (i.e., how large of a radius surrounding its recorded position could the wreck actually be located).

Overall, shipwrecks are distributed across the Corpus Christi Bay system at an average of one every 204 surveyed acres. Recorded shipwrecks are more frequent within Aransas and Corpus Christi bays and within the Gulf study area portions. The greatest density of recorded shipwrecks is in the vicinity of the bay entrance at Aransas Pass, due to the intense vessel traffic through the pass as well as the navigational hazards that endangered those ships prior to more permanent jetties being constructed (USACE, 2003). Known shipwrecks are less common in Copano and Redfish bays and are least common within Laguna Madre. Most of the previously recorded shipwrecks within the study area wrecked sometime after 1950. Only six recorded shipwrecks (four percent) date to 1850 or earlier. These data suggest that previously unknown and unrecorded shipwrecks within the study area are more likely date within the last 70 years. With that said, Redfish Bay shipwrecks are more often older than those in Corpus Christi Bay or the Gulf. Unrecorded shipwrecks within Redfish Bay could be older as well.

Potential for Submerged Aircraft

In 1990, the United States Navy Naval History and Heritage Command's Underwater Archaeology Branch, included protection of submerged naval aircraft 1990s (Coble, 2001; Neyland and Grant, 1999). Currently, no submerged aircraft are known within the study area. At domestic NAS locations, the greatest potential for losses comes from operational flights (such as ferry flights) or training flights. It is currently unknown where dive bombing ranges for NAS Corpus Christi were located. It can be assumed that at least some were in the surrounding bays, as pilots would have needed to be proficient at bombing targets on the water's surface. Additionally, the introduction of the torpedo bombing training schedule for pilots in 1944 suggests another bombing range in the bays specifically for torpedo bombing practice. It is currently unknown if any training losses occurred; however, as demonstrated by similar accidents aboard USS Wolverine (IX-64) and USS Sable (IX-81) off Chicago during World War II, potential for losses cannot be ruled out (Naval History and Heritage Command, 2020).

3.4.3 Regulatory Coordination and Field Investigations Conducted

The PCCA included a preliminary background assessment of the proposed CDP (Cartellone and Pelletier, 2019) in their USACE permit application package for the project (SWG-2019-00067). In accordance with 33 CFR Part 325, Appendix C, the USACE, Galveston District's staff archaeologist reviewed the proposed CDP plans and the preliminary background assessment. The USACE concluded that the permit area was "… likely to yield archeological sites eligible for listing in the National Register of Historic Places (historic properties," (letter, Androy to Garza, June 15, 2020). Additional field investigations would be needed to assess the project's effects on historic properties. Specifically, the USACE prescribed terrestrial archaeological survey along the SJI and MI beach nourishment corridors. Marine archaeological survey would also be required for all nearshore berms (B1–B9) and all new cut areas along the CCSC.

The USACE also consulted with the Texas SHPO (called the THC) in their capacity as the Lead Federal Agency under 36 CFR 800. Cultural resource reviewers with the THC offered their comments on the preferred project in July of 2020 (see Appendix B8), also calling for the same terrestrial and marine archaeological surveys prior to construction. The THC later clarified that dedicated historic architectural survey would not be necessary to conclude that the project would not have an adverse effect on non-archaeological cultural resources in the vicinity (e.g., historic-age buildings, districts, and neighborhoods email, Hernandez to Miller, Vitale, and Dobson-Brown, August 14, 2020).

3.4.3.1 Terrestrial Archeological Survey

In the fall 2021, archaeologists from Terracon Consultants, Inc. (2022) intensively surveyed those portions of the CDP's APE along Mustang and San José islands shoreline (Appendix F2). The 995-acre pedestrian survey consisted of walking transects spaced less than 100 feet apart and hand troweling areas of interest. These terrestrial investigations documented a mix of modern and historic debris but no evidence of any significant cultural resources extending into the APE. Although, there are shipwrecks and previously documented sites recorded within the APE these were not observed by surveyors and may have been mislocated or affected by human development/natural erosion processes. Cultural resource reviewers at the USACE, Galveston District (DA Permit Application: SWG-2019-00067) and the THC (Tracking Number: 202208549) determined that no terrestrial historic properties would be affected by the preferred project (letter, Androy to Wolfe, March 31, 2022). However, if cultural materials are encountered during construction or disturbance activities, work should cease in the immediate area; work can continue where no cultural materials are present.

3.4.3.2 Marine Archeological Survey

From 2021–2022, underwater archaeologists from RECON Offshore, working under Texas Antiquities Permit 30317, conducted an underwater survey of the portions of the CDP APE that had the potential to contain significant cultural resources (Burns et al., 2023; Appendix F3). Archeologists collected magnetometer and side-scan sonar data within 2,730.8 acres of submerged lands to assess the CDP's effects to historic properties.

The surveyors found eight magnetic anomalies and three side-scan sonar contacts associated with the SS *Mary* (41NU252), four magnetic anomalies and one side-scan sonar contact associated with the wreck of the *Utina* (41NU264 and 41NU292), and one side-scan sonar contact buffer associated with 41AS119 near, but outside of the APE. The archaeologists, in consultation with the THC, USACE, and PCCA developed and/or updated (as applicable) 164-foot avoidance buffers around these identified resources. With the CDP designs avoiding these buffers, the USACE concluded that the CDP would have no adverse effect on underwater historic properties (Burns et al., 2023; letter, Androy to Wolfe, April 19, 2023). The THC concurred with those findings on May 12, 2023 (Tracking Number: 202307362).

If any unexpected discoveries occur during construction for any site other than 41NU252, work should halt or move until consultation with the PCAA and THC can be conducted.

3.5 SOCIOECONOMIC CONDITIONS

This section describes the social and economic environment as well as the community resources in and surrounding the project area, as shown in Figure 3-21, and within the socioeconomic Region of Influence (ROI). Specific information provided in this section includes demographics, environmental justice, socioeconomic resources, land use, recreation, and community resources. The ROI for the socioeconomic analysis is defined as Nueces, Aransas, and San Patricio counties as the project is in these three counties. They encompass the area within which the primary social and economic impacts of the project are likely to occur. Information presented in this section is provided at the county, city, and census tract levels where appropriate. The cities of Corpus Christi, Port Aransas, Fulton, Rockport, Aransas Pass, Ingleside, Ingleside on the Bay, and Portland are also located with the ROI. Information on these cities is therefore provided where appropriate throughout this section. Additionally, information on the city of Corpus Christi is provided below as this is the closest large urban area to the project's footprint and may be influenced by the project. Unless stated otherwise, dollar values are adjusted to 2023 dollars in this section using historical Gross Domestic Product tables produced by the U.S. Office of Management and Budget (OMB, 2023).

3.5.1 Population

In 2021, Texas had the second largest residential population amongst all U.S. states behind California, with 28.9 million residents. Between the Decennial Census taken in 2010 and, American Community Survey (ACS) estimates of 2021, the population of Texas increased by over 4.5 million as Texas annual population grew 1.6 percent (U.S. Census Bureau, 2018, 2022a).

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PREPARED BY	KLC

Port of Corpus Christi Authority
Corpus Christi Ship Channel Deepening Project

Community Facilities and Resources Proximate to the Project Area

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FIGURE 3-21

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The three counties within the ROI each grew during this period. Population growth ranged from 1.51 percent in Nueces County, where the project is primarily located, to 0.34 percent on average annually in San Patricio. Nueces County is also the most populous county in the ROI, with 353,594 estimated residents (U.S. Census Bureau, 2011, 2022a).

Several cities fall within the ROI including Corpus Christi, Port Aransas, Fulton, Rockport, Aransas Pass, Ingleside, Ingleside on the Bay, and Portland. All of these cities, except for Port Aransas, experienced population growth during this period; the population of Port Aransas declined by approximately 11.2 percent over the last decade, decreasing from approximately 3,444 to 3,058 residents. Of the cities within the ROI, the three cities with the largest populations are Corpus Christi, Portland, and Ingleside. These three cities have seen population growth rates between 2.45 percent and 0.07 percent annually during this period. The City of Corpus Christi is the most populous city in the ROI, with 318,168 estimated residents. Portland,

the second most populous city, also had the highest rate of population growth within the ROI during this period, increasing from approximately 15,257 residents to 19,914 residents (30.5 percent). A detailed breakdown of population trends within the ROI and Texas is presented in Table 3-27 (U.S. Census Bureau, 2011, 2022a).

Table 3-27
Population Trends within the ROI and Texas, 2006 to 2010 and 2017 to 2021

Geographic Area	2006 to 2010[1]	2017 to 2021[1]	Percent Change
Texas	24,311,891	28,862,581	18.7
Aransas County	23,247	24,149	3.9
Fulton Town	1,197	1,398	16.8
Rockport City	8,717	10,264	17.7
Nueces County	334,370	353,594	5.7
Corpus Christi City	229,324	318,168	6.3
Port Aransas City	3,444	3,058	–11.2
San Patricio County	66,100	68,600	3.8
Aransas Pass City[2]	8,281	9,101	9.9
Ingleside City	9,502	9,573	0.7
Ingleside on the Bay City	673	787	16.9
Portland City	15,257	19,914	30.5

Source: U.S. Census Bureau (2011, 2022a).

[1] Five year estimate from ACS 2011 and 2021 Survey.

[2] The city limits of Aransas Pass occupy all three counties. Because the mainland part of the city is predominantly located within San Patricio County, Aransas Pass is represented as San Patricio County for this report's statistical tables.

3.5.1.1 Employment by Industry

In Aransas County, the top five sectors by number of jobs provided in 2021 (the most recent year of data) were accommodation and food services (13.6 percent of total number of jobs), retail trade (11.4 percent), construction (10.6 percent), local government (8.1 percent), and real estate, rental, and leasing (7.4 percent). Altogether, the top five sectors make up over 50 percent of all employment in Aransas County. Each of the top five sectors represent a larger share of local employment in the ROI than they do in the state. This indicates the potential for more specialization in this sector at the ROI level compared to the state (Bureau of Economic Analysis [BEA], 2022a, 2022b).

In Nueces County, the top five sectors by number of jobs provided in 2021 were healthcare and social assistance (14.6 percent), retail trade (10.0 percent), accommodation and food services (9.6 percent), construction (8.4 percent), and local government (7.6 percent). Like Aransas County, the top five sectors make up over 50 percent of all employment in and each of the top five sectors represent a larger share of local employment in the county than they do in the state. This indicates the potential for more specialization in this sector at the ROI level compared to the state (BEA, 2022a, 2022b).

In San Patricio County, the top five sectors by number of jobs provided in 2021 were construction (18.9 percent), local government (12.5 percent), retail trade (10.7 percent), accommodation and food services (9.6 percent), and other services (5.9 percent). Like the other two counties in the proposed ROI, the top five sectors make up over 50 percent of all employment in San Patricio County. Construction, local government, retail trade, and accommodation and food services each represent a larger share of local employment in the ROI than they do in the state. This indicates the potential for more specialization in this sector at the ROI level compared to the state (BEA, 2022a, 2022b).

In Texas, the top five sectors by employment in 2021 were healthcare and social assistance (9.5 percent), retail trade (9.4 percent), professional, scientific, and technical services (7.3 percent), accommodation and food services (7.2 percent), and local government (7.2 percent). Out of the top five industries in Texas, the only one that does not have a major employment presence in one of the counties in the ROI is professional, scientific, and technical services. Construction appears to have an outsized impact on employment in the ROI compared to the rest of the state. The construction industry is one of the top five sectors in all three counties in the ROI. It falls outside of the top five sectors in Texas at large. A detailed breakdown of employment by industry within the proposed ROI is shown in Table 3-28 (BEA, 2022a, 2022b).

3.5.1.2 Income and Poverty

The median household income in the ROI was obtained from 5-Year ACS estimates for 2017 through 2021 and adjusted for inflation to 2023 dollars (Table 3-29). For Aransas County it is $57,746; for Nueces it is $66,679; and San Patricio County it is $66,740. These values are all between 11.6 and 23.5 percent lower

Table 3-28
Employment by Industry within the ROI and Texas (2021)

Industry	Texas		Aransas County		Nueces County		San Patricio County	
	Count	%	Count	%	Count	%	Count	%
Total employment (number of jobs)	18,276,115	–	11,511	–	213,351	–	30,396	–
Farm employment	270,931	1.5	114	1.0	923	0.4	889	2.9
Forestry, fishing, and related activities	63,733	0.3	596	5.2	658	0.3	396	1.3
Mining, quarrying, and oil and gas extraction	316,530	1.7	313	2.7	3,911	1.8	1,315	4.3
Utilities	59,858	0.3	(D)	(D)	761	0.4	137	0.5
Construction	1,289,423	7.1	1,219	10.6	17,997	8.4	5,739	18.9
Manufacturing	957,204	5.2	143	1.2	7,582	3.6	1,418	4.7
Wholesale trade	652,452	3.6	(D)	(D)	6,102	2.9	401	1.3
Retail trade	1,709,148	9.4	1,311	11.4	21,432	10.0	3,255	10.7
Transportation and warehousing	996,392	5.5	(D)	(D)	7,632	3.6	935	3.1
Information	261,237	1.4	50	0.4	1,673	0.8	210	0.7
Finance and insurance	1,243,782	6.8	619	5.4	10,715	5.0	1,083	3.6
Real estate and rental and leasing	864,050	4.7	852	7.4	9,023	4.2	991	3.3
Professional, scientific, and technical services	1,337,529	7.3	(D)	(D)	11,539	5.4	1,075	3.5
Management of companies and enterprises	225,877	1.2	(D)	(D)	1,569	0.7	140	0.5
Administrative and support and waste management and remediation services	1,249,373	6.8	729	6	12,728	6.0	1,631	5.4
Educational services	302,514	1.7	(D)	(D)	2,590	1.2	214	0.7
Healthcare and social assistance	1,744,911	9.5	(D)	(D)	31,113	14.6	1,285	4.2
Arts, entertainment, and recreation	292,674	1.6	279	2.4	3,264	1.5	377	1.2
Accommodation and food services	1,322,298	7.2	1,569	13.6	20,389	9.6	2,918	9.6
Other services (except government and government enterprises)	1,027,985	5.6	785	6.8	11,661	5.5	1,781	5.9
Federal civilian	212,816	1.2	36	0.3	5,992	2.8	94	0.3
Military	175,469	1.0	48	0.4	2,632	1.2	138	0.5
State government	380,932	2.1	90	0.8	5,154	2.4	176	0.6
Local government	1,318,997	7.2	936	8.1	16,311	7.6	3,798	12.5

Source: BEA (2022a, 2022b).

Note: (D) is used in cells to show avoidance of disclosure of confidential information; estimates from geographic areas with this designation are included in higher-level totals.

Table 3-29
Income and Poverty Levels within the ROI and Texas (2023 Dollars)

Geographical Area	Median Household Income	Per Capita Income	Percent of Households with Incomes Below Poverty Level (Last 12 months)	Percent of People with Incomes Below Poverty Level (Last 12 months)
Texas	$75,472	$38,403	10.7	14.0
Aransas County	$57,746	$39,829	14.8	22.5
Fulton Town	$47,112	$52,070	2.5	10.5
Rockport City	$66,679	$33,200	10.6	17.9
Nueces County	$67,257	$33,434	13.2	17.2
Corpus Christi City	$66,472	$47,427	13.0	17.0
Port Aransas City	$66,740	$31,983	4.1	10.4
San Patricio County	$62,241	$30,159	13.2	15.7
Aransas Pass City	$71,345	$31,737	11.8	19.1
Ingleside City	$94,300	$44,478	8.5	10.1
Ingleside on the Bay City	$92,421	$40,712	2.2	4.1
Portland City	$75,472	$38,403	6.0	7.9

Source: U.S. Census Bureau (2022b); OMB (2023).

than the median household income at the state level. Median household income in cities in the table are comparable to those at the county level, with the exceptions of Rockport City, Ingleside on the Bay, Portland City, and Fulton Town. Of these, Rockport City, Ingleside on the Bay, and Portland city all have median household incomes at least $10,000 above the county household median. In addition, Ingleside on the Bay and Portland have median household incomes greater than any of the other cities or counties in the ROI and greater than the State of Texas at $94,300 and $92,421, respectively. Fulton Town, in contrast, has the lowest median household income of the cities surveyed in the ROI, and has a household median income that is more than $10,000 lower than the county median (U.S. Census Bureau, 2022b; OMB, 2023).

Per capita income was also obtained using ACS 5-year estimates for 2017 through 2021. It is highest in Aransas County ($39,829) among the three counties in the ROI. The per capita income at $28,564 is $33,200 and $31,983 in Nueces and San Patricio counties, respectively. Of these three counties, in addition to having the highest per capita income of the ROI counties, only Aransas County has a per capita income higher than the State of Texas ($38,403). The cities of Rockport and Port Aransas have the highest percapita incomes amongst all the cities and counties in the ROI at $48,700 and $47,427, respectively. Aransas Pass has the lowest per capita income of all cities in the ROI at $30,159 (U.S. Census Bureau, 2022b; OMB, 2023). Identifying percentages of families and people that have incomes below the poverty level is important to determine the sensitivity of areas to events that may adversely impact persons with low income.

In 2021, the national poverty threshold for unrelated individuals was $13,788 (equivalent to $15,457 in 2023 dollars) while the poverty level for a family of four was $27,740 (equivalent to $31,099 in 2023 dollars) (U.S. Census Bureau, 2022c; OMB, 2023). The percentage of households with incomes below poverty levels ranges between 13.2 and 14.8 percent within the three counties of the ROI. Fulton and Ingleside on the Bay have the lowest percentage of households with incomes below the poverty level (2.5 and 2.2 percent, respectively). Corpus Christi has the highest percentage of households with incomes below the poverty level (13 percent) amongst all cities in the ROI. Each of the counties in the ROI has 15.7 percent of their populations with incomes below the poverty level, ranging from 15.7 percent (San Patricio) to 22.5 (Aransas County). However, despite San Patricio County having the lowest total percent of individuals living below the poverty level of the three counties, Aransas Pass has the largest percentage of persons in poverty of the cities within the ROI, with 19.1 percent of people below the poverty level (U.S. Census Bureau, 2022b). The percent of persons and household in poverty are listed in Table 3-29.

3.5.1.3 Labor Force and Unemployment

Within the ROI, unemployment trended downwards between 2013 and 2023, with a sharp increase between 2019 and 2020, followed by a decrease between 2020 and 2022 (Table 3-30 and Figure 3-22). Texas at large has experienced a smaller decrease in the unemployment rate over the last five years (9.3 percent decrease) compared to the counties in the ROI. Aransas County saw the largest decrease in unemployment over this period (23 percent decrease), followed by San Patricio County (22 percent decrease) and Nueces County (14.5 percent decrease). The Corpus Christi Metropolitan Statistical Area (13 percent decrease), and the City of Corpus Christi (17 percent decrease) both showed large decreases in unemployment over this period as well. Before 2020, the unemployment rate has generally decreased since 2013 across all the geographic areas within the ROI from highs above 7 percent in some areas (San Patricio County) to lows ranging from 4.1 to 5.4 percent (Figure 3-22) (Bureau of Labor Statistics, 2023). Due to economic conditions related to the 2020 COVID-19 pandemic, unemployment rates have hit new highs in the last few years, but these rates declined over the following 2 years into 2022.

3.5.1.4 Race and Ethnicity

According to the 5-year ACS estimates for 2017 through 2021, the majority of individuals residing in the three county ROI identify their race as white alone (Table 3-31), ranging from 72 percent of the population in Nueces County to 87 percent of the population in Aransas County. These populations represent a greater share of the population compared to those identifying as white alone within the State of Texas (64 percent).

Conversely, the percentage of the ROI county populations who identify their race as Black, Asian, Native American and Alaskan Native, Native Hawaiian and Other Pacific Islander, and Other Single Race is lower than that of the State of Texas. All three counties have relatively large Hispanic or Latino populations. In Aransas County, 29 percent of the population identifies as Hispanic or Latino, compared to between 65 and 59 percent of the population residing in Nueces and San Patricio counties, respectively. Nueces County and

Table 3-30
Labor and Employment within the ROI and Texas

Geographic Area	Labor Force 2022	Employment 2022	Un-employment Rate 2017	Un-employment Rate 2022	5 Year Change in Unemployment Rate, 2017 – 2022
Texas	14,662,558	14,092,833	4.3%	3.9%	–9.3%
Aransas County	9,294	8,806	6.9%	5.3%	–23.2%
Nueces County	164,095	156,419	5.5%	4.7%	–14.5%
San Patricio County	29,297	27,535	7.7%	6.0%	–22.1%
Corpus Christi Metropolitan Statistical Area	149,038	142,152	5.3%	4.6%	–13.2%
City of Corpus Christi	148,442	142,509	4.8%	4.0%	–16.7%

Source: Bureau of Labor Statistics (2023).

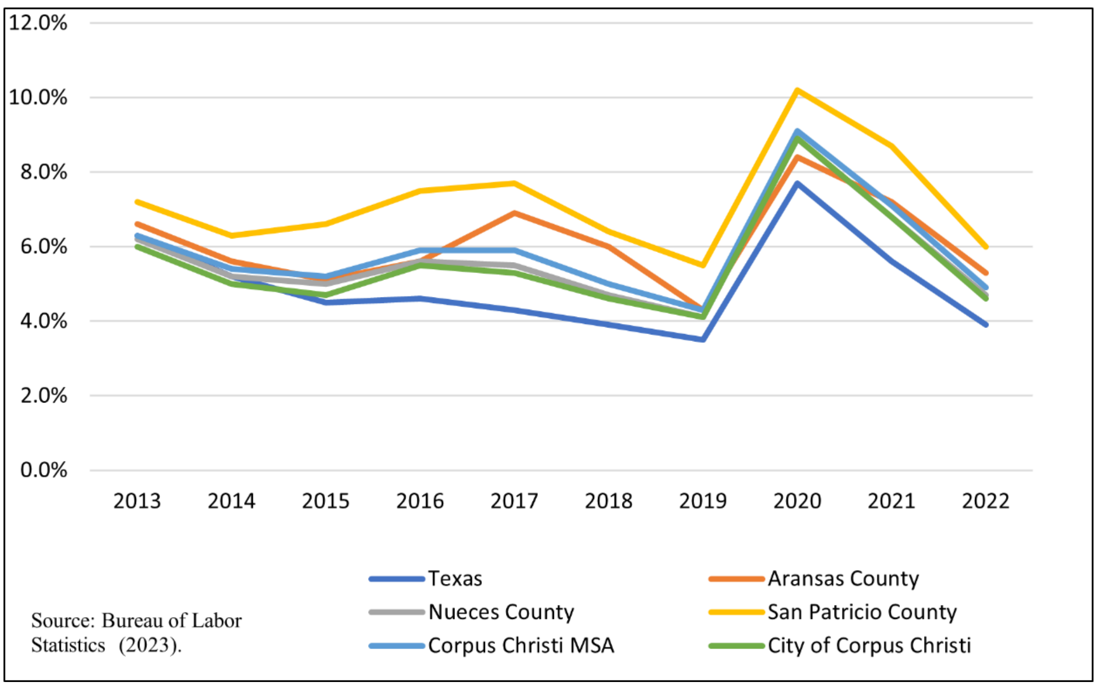


Figure 3-22. Trends in Unemployment Rate within the ROI and Texas

San Patricio County have majority-minority populations, meaning the majority of their residents identify themselves as part of racial or ethnic categories other than Non-Hispanic White Alone. Comparatively, only one-third of residents in Aransas County identify themselves as something other than Non-Hispanic White Alone. This indicates a relatively small minority population resides in this county compared to the other two counties in the ROI. Amongst the cities in the ROI, the city of Corpus Christi has the highest minority population (72 percent) in the ROI while the city of Port Aransas (15 percent) has the lowest minority population in the ROI. (U.S. Census Bureau, 2022a).

Table 3-31
Race and Ethnicity within the ROI and Texas

Geographic Area	Total Population	Race					Ethnicity	Minority[2]
		White	Black or African American	Asian	Other Single Race[1]	Two or More Races	Hispanic or Latino	
Texas	28,862,581	64%	12%	5%	8%	11%	40%	59%
Aransas County	24,149	87%	0%	1%	4%	7%	29%	34%
Fulton Town	1,398	67%	0%	19%	5%	10%	14%	41%
Rockport City	10,264	91%	0%	0%	2%	7%	29%	31%
Nueces County	353,594	72%	4%	2%	4%	18%	65%	72%
Corpus Christi City	318,168	72%	4%	2%	4%	18%	64%	72%
Port Aransas City	3,058	97%	0%	0%	0%	3%	13%	15%
San Patricio County	68,600	81%	2%	1%	4%	12%	59%	63%
Aransas Pass City	9,101	73%	6%	1%	5%	16%	44%	57%
Ingleside City	9,573	86%	3%	0%	3%	8%	51%	55%
Ingleside on the Bay City	787	87%	0%	0%	0%	13%	27%	29%
Portland City	19,914	84%	2%	2%	3%	9%	42%	48%

Source: U.S. Census Bureau (2022a).

[1] Includes the following Census Bureau categories: American Indian and Alaskan Native, Native Hawaiian and Other Pacific Islander, and Some Other Race.

[2] Minority population is defined as the population that identifies as other than Non-Hispanic White Alone.

3.5.1.5 Housing

According to the latest U.S. Census 5-year estimates for the years 2017 through 2021, housing availability is relatively high within the ROI compared to the State of Texas. In Aransas County, 32.7 percent of all housing units are vacant. In Nueces and San Patricio counties, vacancy rates are 13.9 percent and 18.4 percent, respectively. These are higher vacancy rates than reported in the State of Texas, which has a housing vacancy rate of 10.4 percent. More occupied housing units are occupied by the unit's owner than by renters in the ROI, with owner-occupancy rates of 79.1 percent in Aransas County, 58.9 percent in Nueces County, and 66.7 percent in San Patricio County. Table 3-32 shows detailed information on housing units in the ROI. Among renter-occupied units in the ROI, the majority of units rent for less than $1,500, with 93 percent in Aransas County, 80 percent in Nueces County, and 73 percent in San Patricio County. The median rent, in 2021 dollars, is higher than the sate median ($1,146) in San Patricio County but is lower than the state median in Aransas County and Nueces County. Median rents in Aransas County, Nueces County, and San Patricio County in 2021 dollars are $914, $1,094, and $1,134, respectively. Table 3-33 provides detailed information on rent within the ROI (U.S. Census Bureau, 2022d).

Table 3-32
Housing Occupancy within the ROI and Texas

Geographic Area	Total Housing Units	Occupied Housing Units	Percent Owner-Occupied Units	Percent Renter-Occupied Units	Vacant Housing Units	Percent of Units Vacant
Texas	11,433,880	10,239,341	62.4	37.6	1,194,539	10.4
Aransas County	15,542	10,452	79.1	20.9	5,090	32.7
Nueces County	150,840	129,845	58.9	41.1	20,995	13.9
San Patricio County	29,165	23,808	66.7	33.3	5,357	18.4

Source: U.S. Census Bureau (2022d).

Table 3-33
Rental Values of Occupied Units within the ROI and Texas (2021 Dollars)

Market Values	Texas		Aransas County		Nueces County		San Patricio County	
	Count	Percent	Count	Percent	Count	Percent	Count	Percent
Occupied Units Paying Rent	3,667,459	–	2,025	–	51,263	–	6,982	–
<$500	198,728	5.4%	117	5.8%	3,710	7.2%	1,037	14.9%
$500 – 999	1,152,735	31.4%	1,060	52.3%	17,150	33.5%	1,708	24.5%
$1,000 – 1,499	1,407,813	38.4%	701	34.6%	20,149	39.3%	2,352	33.7%
$1,500 – 1,999	616,163	16.8%	107	5.3%	6,712	13.1%	1,264	18.1%
$2,000 – 2,499	196,141	5.3%	37	1.8%	2,743	5.4%	531	7.6%
$2,500 – 2,999	50,594	1.4%	3	0.1%	492	1.0%	35	0.5%
>$3,000	45,285	1.2%	0	0.0%	307	0.6%	55	0.8%
Median (dollars)	$1,146	–	$914	–	$1,094	–	$1,134	–

Source: U.S. Census Bureau (2022d).

Table 3-34 shows the market values of owner-occupied units within the ROI. The majority of owner-occupied housing was valued at less than $200,000 between 2017 and 2021 for all three counties. In general, housing values in lower value brackets have been trending downward. Many of the higher brackets have been trending upwards in the counties in the ROI. For example, Nueces County experienced growth in all brackets from $150,000 and above, while the share of housing in all brackets below $150,000 decreased between the ACS 5-year estimates for 2016 through 2020 and the ACS 5-year estimates for 2017 through 2021 (U.S. Census Bureau, 2021b, 2022d).

Table 3-34
Market Values of Owner-Occupied Units within the ROI and Texas (2021 Dollars)

Market Value	Aransas County			Nueces County			San Patricio County		
	Percent 2016-2020*	Percent 2017-2021*	Annual Percent Change	Percent 2016-2020*	Percent 2017-2021*	Annual Percent Change	Percent 2016-2020*	Percent 2017-2021*	Annual Percent Change
Less than $50,000	15.2	16.2	1.0	8.7	8.1	–0.6	16.4	14.3	–2.1
$50,000 to $99,999	15.5	16.5	1.0	21.9	19.6	–2.3	23.6	22.7	–0.9
$100,000 to $149,999	10.9	9.4	–1.5	20.1	19.9	–0.2	17.4	15.6	–1.8
$150,000 to $199,999	13.0	12.1	–0.9	19.0	19.2	0.2	19.5	20.4	0.9
$200,000 to $299,999	24.3	22.5	–1.8	17.5	18.7	1.2	14.5	16.8	2.3
$300,000 to $499,999	13.1	15.0	1.9	8.8	9.8	1.0	7.2	8.0	0.8
$500,000 to $999,999	7.2	7.1	–0.1	3.2	3.8	0.6	1.5	1.9	0.4
$1,000,000 or more	0.8	1.1	0.3	0.8	0.8	0.0	0.1	0.3	0.2
Median (dollars)	$183,200	$184,900	0.9	$148,100	$155,400	4.9	$129,400	$141,900	9.7

Source: U.S. Census Bureau (2021b, 2022d).

* Data in these columns represent an estimate of information obtained from the Census' 5-Year ACS using survey results obtained over the period noted in the column's title.

3.5.2 Community and Recreational Resources

3.5.2.1 Community Resources

3.5.2.1.1 Police

In the Rockport-Fulton area of Aransas County, the Rockport Police Department has 22 full time peace officers, nine patrol officers, four sergeants, four detectives, one C.I.D. commander, one patrol commander, and one police chief. The Fulton Police Department has one police chief (Rockport-Fulton Chamber of Commerce, 2023).

In San Patricio County, the Aransas Pass Police Department has one station, located at 600 Cleveland Boulevard #B and has 28 sworn officers (pers. comm., Gina Villarreal [Aransas Pass Police Department] October 2, 2020). The Ingleside Police Department has one station, located at 2425 8th Street. It has two patrol sergeants and 11 patrol officers (City of Ingleside, 2021a). The Portland Police Department has one station, located at 1900 Billy G. Webb Drive. The criminal investigations division has one lieutenant, one sergeant detective, four corporal detectives, one evidence technician, and one records clerk. The patrol division has one lieutenant, four sergeants, four patrol corporals, one special assignment corporal, 17 patrol officers, one school resource officer sergeant, and two school resource officers (City of Portland, 2023).

In Nueces County, the Port Aransas Police Department is the closest department to the project area (see Figure 3-21). It is located at 705 West Avenue A and has three patrol sergeants and 13 patrol officers (City of Port Aransas, 2023a). The Corpus Christi Police Department has four stations: the Main Station at 321 John Sartain Street; the Charlie Substation at 1501 Holly Road; the Bluff Substation at 1456 Waldron Road; and the Annaville Substation at 1925 Tuloso Road. The Main Station has 67 officers, the Charlie Substation has 62 officers, the Bluff Substation has 43 officers, and the Annaville Substation has 42 officers (pers. comm., Lt. Michael Pena, [Corpus Christi Police Department], August 18, 2020). The Main Station is the closest station in Corpus Christi to the project area.

3.5.2.1.2 Fire

Fire service in Aransas County is provided countywide. The county fire service is a volunteer fire department with 112 volunteers, 26 fire trucks, and 8 fire stations (Rockport-Fulton Chamber of Commerce, 2023).

In San Patricio County, the Aransas Pass Fire Department is also close to the project area. The station is located at 600 West Cleveland Boulevard. The Aransas Pass Fire Department is made up of 15 employees: one Fire Chief, one Assistant Chief-Fire Inspector, an Administrative Assistant, three Captains, three Drivers/Operators, and six Firefighters (City of Aransas Pass, 2023).

Within Nueces County, the Port Aransas Fire Department is the closest fire department to the project area (see Figure 3-21). It is a volunteer fire department located at 202 E Avenue C. According to Port Aransas Municipal Code, the Port Aransas Volunteer Fire Department staff includes a department chief, an assistant chief, and not less than twenty volunteer firefighters (City of Port Aransas, 2017). The Corpus Christi Fire Department serves the area around the Port. There are 18 different fire stations within Corpus Christi. Across these stations, there are 414 fire fighters employed. On a daily basis, a minimum of 98 firefighters are on duty across all stations. There are 21 frontline units being operated by the Corpus Christi Fire Department, with more in reserve. Each of these units is operated by a minimum of three to four people. The Corpus Christi Fire Department also operates 12 frontline medic units (pers. comm., Assistant Chief Rick Trevino [Corpus Christi Fire Department], August 18, 2020). The closest station to the Port within Corpus Christi is Fire Station 1, located at 514 Belden Street.

3.5.2.1.3 Hospitals

The nearest Level I Trauma Centers to the preferred project area are the Brooke Army Medical Center in Fort Sam Houston Texas (146 miles from the Port) and University Hospital in San Antonio, Texas (155 miles from the Port). Corpus Christi is home to two Level II (Major) Trauma Centers: CHRISTUS Spohn Hospital Corpus Christi – Shoreline, located at 600 Elizabeth Street, and Corpus Christi Medical Center – Bay Area, located at 7101 South Padre Island Drive. The former is two miles from the Port and has 575 staffed beds, while the latter has 152 staffed beds (American Hospital Directory, 2023; Corpus Christi Medical Center, 2023a). Corpus Christi has one Level III (Advanced) Trauma Center: Driscoll Childrens Hospital. There are also three Level IV (Basic) Trauma Facilities in Corpus Christi: CHRISTUS Spohn

Hospital Corpus Christi South, The Corpus Christi Medical Center – Northwest, and The Corpus Christi Medical Center – Doctors Regional (TDSHS, 2023). There are no hospitals in Port Aransas, Aransas Pass, or Ingleside. However, there are nearby emergency rooms in Portland (ER 24/7 Portland, affiliated with Corpus Christi Medical Center; formerly called Northshore Emergency Center) and Padre Island (Surepoint Emergency Center) (Corpus Christi Medical Center, 2023b; Surepoint Emergency Center, 2023).

3.5.2.1.4 Schools

Corpus Christi Independent School District serves approximately 33,400 students at 56 campuses around the project area. The district has 36 elementary schools, ten middle schools, eight high schools, and two special campus schools. The Corpus Christi Independent School District employs 2,228 total teacher full-time equivalents and has a student-to-teacher ratio of 22-to-1 for kindergarten through grade four, 25-to-1 for grade five, 27-to-1 for grades six through eight, and 27-to-1 for high school. The district employs approximately 2,100 certified full-time instructors and 1,900 auxiliary instructors (Corpus Christi Independent School District, 2023). The Port Aransas Independent School District is comprised of three schools: one elementary school, one middle school, and one high school (Port Aransas Independent School District, 2023). It serves approximately 530 students, employs approximately 47 teacher full-time equivalents, and has a student-to-teacher ratio of 11-to-1 (Texas Education Agency, 2022).

Aransas Pass Independent School District is comprised of four schools: two elementary schools, one middle school, and one high school (Aransas Pass Independent School District, 2023). Aransas Pass Independent School District serves approximately 1,700 students and employs 114 full time teachers, with a student teacher ratio of 14.6-to-1. Ingleside Independent School District is comprised of five schools: one primary school, two elementary schools, one middle school, and one high school (Ingleside Independent School District, 2023). It serves approximately 2,000 students and employs 134 total teacher full-time equivalents, with a student to teacher ratio of 14.8-to-1. Portland, Texas is part of Gregory-Portland Independent School District, which has one pre-kindergarten center, four elementary schools, one middle school, and one high school (Gregory Portland Independent School District, 2023). It serves approximately 4,700 students, employs 342 total teacher full-time equivalents, and has a student to teacher ratio of 13.8-to-1 (Texas Education Agency, 2022).

Rockport and Fulton make up Aransas County Independent School District, which has four schools: two elementary schools, one middle school, and one high school (Aransas County Independent School District, 2023). It serves approximately 3,000 students, employs 207 total teacher full-time equivalents, and has a student to teacher ratio of 14.5-to-1 (Texas Education Agency, 2022).

3.5.2.2 Recreational Resources

3.5.2.2.1 Recreational Facilities

One of the major economic drivers in the ROI is tourism. Corpus Christi's travel industry contributed $1.44 billion in spending to the local economy, generated $132.7 million in tax revenue, and employed an estimated 12,750 individuals in 2022. Within Nueces County at large, travel employment accounted for approximately 5.8 percent of all employment in the county (Dean Runyan Associates, 2023).

While roughly 27 percent of the travel spending in Corpus Christi was business related in 2022, most of the tourism spending in the region was for leisure (Dean Runyan Associates, 2023). U.S. Travel News ranked Port Aransas City and Corpus Christi as the 6th and 12th Best Places to Visit in Texas, respectively, in 2023 (Von Tersch, 2023). The popularity of this area is due in part to its proximity to Corpus Christi Bay, Mustang Island, North Padre Island, and the Gulf. In addition, the region boasts access to popular outdoor recreational activities including boating, fishing, camping, horseback riding, water skiing, etc. There are several marinas in the Corpus Christi Bay area and Port Aransas that offer recreational and commercial fishing.

Some of the most visited sites in the Corpus Christi area include North Beach on Surfside Blvd., where the USS Lexington Museum and the Texas State Aquarium are located (Forbes Media, LLC, 2023). The Corpus Christi Museum District consists of the Museum of Asian Cultures, Corpus Christi Museum of Science and History, and the South Texas Institute for the Arts. The city is also near King Ranch, which is one of the world's largest ranches.

Public Parks and Beaches

There are numerous public parks and beaches in the area. There are over 190 city parks in Corpus Christi that provide various amenities to the public. The Bayfront beaches (North Beach and McGee Beach) were recognized nationally as some of the best restored beaches in 2010 and 2012 by the American Shore and Beach Preservation Association (American Shore and Beach Preservation Association, 2023). North Beach is located near the Harbor Bridge and the USS Lexington Aircraft Carrier, and the Texas State Aquarium are located in this general area (Visit Corpus Christi, 2021a). McGee Beach is located along the seawall and has numerous venues for various activities (Visit Corpus Christi, 2021b).

Beaches on Padre Island and Mustang Island in the Gulf offer numerous recreational activities to visitors and local residents. Padre Island is the longest undeveloped barrier island in the world. It is 70 miles in length and one of the most critical conservation areas in Texas. It has more than 130,000 acres of beach, dunes, and grassland habitats and is home to rare sea turtles and numerous migratory birds (NPS, 2021b; The Nature Conservancy, 2020).

Within less than a mile of the project area, the closest public parks are Roberts Point Park, located on the northwest tip of Mustang Island near the ferry landing, and IB Magee Beach Park located on the northeast tip of Mustang Island.).

Roberts Point Park is a 50-acre city waterfront park featuring pavilions, jetty fishing, an observation tower, and amphitheater. It forms a shelter around the municipal small craft harbor that hosts recreational motor and sail boats (City of Port Aransas, 2023b)

IB Magee Beach Park is a 167-acre Nueces County Coastal Park with recreational vehicle pads and campsites, picnic facilities, and fishing pier (Nueces County Coastal Parks, 2018). It was damaged by Hurricane Harvey in 2017 and remained closed in 2018.

Another recreational facility close to the channel is the Port Aransas Nature Preserve, which is approximately one mile from the proposed terminus near Harbor Island. This city-owned nature preserve has hike-and-bike trails, pavilions, and an observation deck with sand flat, salt marsh and other habitats, and is home to the Leonabelle Turnbull Birding Center (Port Aransas Nature Preserve, 2018; Port Aransas South Jetty, 2020).

The region also has a number of popular beach clubs, including Ingleside Beach Club and Executive Surf Club (The Green Voyage, 2023).

Boating and Fishing

There are numerous businesses along Corpus Christi Bay that cater to boating and recreational fishing, as well as some smaller businesses near the Portland/Ingleside communities in the northern part of the Corpus Christi Bay and near Port Aransas on the eastern side of the bay. These include Brass Turtle Lodge and boat ramp, Bahia Marina and boat ramp within Ingleside on the bay. The closest marina to the project area is the City Marina in Port Aransas, which includes 200 boat slips, eight boat ramps and other amenities (City of Port Aransas, 2011, 2023c). This marina is located on the north side of Port Aransas directly adjacent to the project area. There are also a number of private boat docks and slips located to the east of this marina. Several of these docks are located adjacent to private homes on the north side of Port Aransas. According to the Port Aransas Chamber of Commerce Port Aransas is known as the “Fishing Capital of Texas” offering bay and shallow water fishing along with deep water fishing and hosts over 20 fishing tournaments annually. The Chamber also notes that dolphin tours, themed boat cruises, sailing regattas, and small boat recreation, such as kayaking, kiteboarding, and parasailing are all offered or practiced in the local area (Port Aransas Chamber of Commerce and Tourist Bureau, 2021).

In addition, the State of Texas has 81 paddling trails. The oldest official trail, Lighthouse Lakes Paddling Trail, sits within the ROI in Redfish Bay near the City of Aransas Pass. From the starting point of Lighthouse Lakes Park, kayakers can explore nearly seven miles of mangrove-lined waterways. The

Mustang Island Paddling Trail also sits within the ROI, near Corpus Christi. The trail follows the shoreline of Mustang Island and is a popular site for both fishing and bird watching (TPWD, 2023b).

Bird Watching

There are a number of places for bird watching in this general area. Of particular note, Padre Island is a very popular place for bird watching. Over 380 different species visit this island on the Central Flyway migratory route (NPS, 2021b). Other primary locations for bird watching activities that are located close to the project area include:

- Leonabelle Turnbull Birding Center – located on the northern part of Mustang Island in Port Aransas. In 2006, the *Texas Parks and Wildlife Magazine* named the Birding Center #1 of the Top Ten Boardwalks in Texas. Portions of the area were damaged by Hurricane Harvey and are currently being restored (City of Port Aransas, 2023d).
- Pelican Island – located between Ingleside on the Bay and Port Aransas. This island has a bird sanctuary that is owned by the Port (USFWS, 2005).
- The Great Texas Coastal Birding Trail includes several trail loops within the ROI. These include the Corpus Christi Bay Loop, around the city of Corpus Christi; the Mustang Island Loop, including Port Aransas; and the Aransas Loop, which includes the coast around Ingleside, Aransas Pass, Rockport, and Fulton (TPWD, 2023c).

Additional areas for birdwatching in the Corpus Christi area included Blucher Park, Hans and Pat Suter Wildlife Refuge, Hazel Bazemore County Park, and the South Texas Botanical Garden and Nature Center (Visit Corpus Christi, 2021c).

3.5.3 Land Use

3.5.3.1 Surrounding Current Land Use

The existing land use within the project area varies greatly from residential to industrial. Through the interpretation of aerial photography, it was determined that land use along the preferred project channel is predominantly either: 1) undeveloped, uninhabited natural, or created (through dredged material) islands or 2) maritime industry and port-related properties and facilities. The nearest residence to the project area (preferred project footprint and immediate vicinity) is approximately 300 feet southwest of the CCSC in the Port Aransas community where the channel traverses the pass between San José Island and Mustang Island. Only two miles of the project channel through the pass near Port Aransas has adjacent mixed residential, institutional, and commercial land uses. The surrounding terrestrial area in Port Aransas is already substantially developed with residential, recreational, and other land uses.

3.5.3.2 Local Land Use Plans and Policies

Land Use Plans and projects located within the ROI and applicable to the PCCA CDP are discussed below. These plans are organized by city for cities within the ROI that are identified above. Additional plans for these geographic areas may be available but are not discussed below as they do not have a close nexus to the work being proposed on this project.

3.5.3.2.1 City of Corpus Christi

Comprehensive Plan: The City of Corpus Christi's latest Comprehensive Plan was published in September 2016 "in order to guide, regulate, and manage future development and redevelopment" within the city "to assure the most appropriate and beneficial use of land, water and other natural resources consistent with the public interest." This plan has a 20-year time horizon and will be built upon by sub area plans and plans addressing specific city-wide issues, such as utilities, as needed (City of Corpus Christi, 2016). This comprehensive plan includes the adoption of eight elements which contain their own sets of goals and policies:

- Natural Systems, Parks and Recreation
- Resilience and Resource Efficiency
- Housing and Neighborhoods
- Diversifying the Economy and Strengthening the Workforce
- Transportation and Mobility
- Community Infrastructure Facilities and Services
- Future Land Use, Zoning and Urban Design
- Stewardship and Implementation of the Plan

Some goals of these elements that are related to this project include maintaining parks, beaches, recreational areas, and other green public spaces and offering residents an array of water-based recreation opportunities. Additionally, the plan outlines a goal requiring implementation of a comprehensive housing policy to advise the city on the development of quality housing for all residents. This goal requires that quality housing meets the diverse needs of households at all income levels. Finally, the plan notes that Corpus Christi has a diversified economy of well-paying jobs that builds on existing industry strengths. It notes that a plan goal is to require that unemployed or underemployed workers have access to training and support services. This will enable them to improve their employment status and qualify for jobs offered by local employers. The plan also notes that PCCA continues to be a major economic engine for Corpus Christi (City of Corpus Christi, 2016).

The existing land use map depicted in this plan shows the northernmost portion of land on Mustang Island that is within the city limits of Corpus Christi and is classified primarily as either vacant land or conservation/preservation land. Some parcels depicted agricultural/rural, commercial, and high-density single-family land. The future land use map for Padre Island/Mustang Island depicted in this plan shows the northernmost portion of land on Mustang Island that is within the city limits of Corpus Christi is classified as planned development or permanent open space (City of Corpus Christi, 2016).

Strategic Parks and Recreation Master Plan: The City of Corpus Christi (2022) Parks, Recreation and Open Space Master Plan reflects current sentiments that residents have about City parks. It provides direction regarding operations and maintenance cost savings, and the expenditure of future funds to maximize the benefit of parks and recreation opportunities for Corpus Christi residents. This Master Plan provides guidance to City staff and elected officials for the timeframe of 2022 to 2023. The purpose of this Master Plan is to provide an assessment of Corpus Christi's parks and recreation system while the goals of the plan are to:

- Point out opportunities and recommend alternatives for improving the park system;
- Look at the potential growth of Corpus Christi over the next 5 to 10 years, assessing where additional facilities will be needed as the city grows, and assessing what types of facilities are most needed;
- Guide Corpus Christi staff in acquiring land to meet future park and open space needs, specifically in terms of regional parkland;
- Prioritize key recommendations of the Parks and Recreation Master Plan so that the most significant deficiencies are addressed as quickly as possible; and
- Guide Corpus Christi staff and city leaders in determining where and how parks funding should be allocated over the next 5 to 10 years.

The primary functions of this Master Plan are to assess the current state of Corpus Christi's parks, recreation, and open space system; define needs and deficiencies in the system; and establish goals and priorities for improving the system. In addition to performing these primary functions, the Master Plan also identifies changing trends locally, regionally, and nationally and identifies citizen needs and opinions. The islands south of Ingleside and islands south of the channel between Port Aransas and Corpus Christi Bay are listed as Agricultural/Rural lands in the Corpus Christi Future Land Use Plan section of this document (City of Corpus Christi, 2012).

3.5.3.2.2 City of Port Aransas

Existing Zoning and Land Uses: The City of Port Aransas' Official Zoning map, adopted in March 2010, lists various land uses throughout the city's municipal boundary. Land use zoning within the City of Aransas, on the south side of the Corpus Christi shipping channel, Harbor Island, and the Aransas Pass shipping channel is listed as tourist/recreational, single-family residential, commercial, and parks and open space. Most of the zoning between Harbor Island and the Aransas Pass shipping channel is listed as commercial and parks and open space with a relatively small amount of land listed as single-family residential (City of Port Aransas, 2010). The entirety of Harbor Island is zoned as "HI" or "Harbor Island" with an existing land use map published by the City of Aransas Pass listing the zoning on Harbor Island as entirely Heavy Industry (City of Port Aransas, 2005a). Existing land uses on Harbor Island include ship and oil drilling platform docks, laydown areas for heavy equipment and construction supplies, a ferry terminal, roadways, and natural/open space, including marshland and sandy shorelines.

Parks and Open Space Plan: The mission of the Parks and Recreation Department, as set out in this plan is "to enhance the City's recreational resources and provide the environment wherein a wide variety of services, facilities, and leisure activities can enrich the lives of residents, visitors, and guests of Port Aransas." One notable goal outlined in this plan is to enhance the experience of residents and guests in the area of parks and recreation. The plan noted that no city parks have boat access ramps although there are several parks that are located close to the Corpus Christi channel or in other places adjacent to water bodies. Roberts Point Park is located on the north side of the City of Port Aransas immediately adjacent to the Port's ship channel. This park has a fishing pier and several granite jetties that are used for fishing. The Port Aransas Nature Preserve is located just west of Port Aransas and the park shares its northern-most border with the shipping channel over a distance of half a mile (City of Port Aransas, 2011).

The 10-year action plan outlined in the Parks and Open Space Plan identifies \$50,000 to \$200,000 in spending that is to be allocated for spending at the Nature Reserve and Roberts Point Park to increase access for fishing areas. Finally, Port Aransas' City Marina is a 200 boat-slip marine located in the northern portion of Port Aransas and provides direct access for boaters to the channel (City of Port Aransas, 2005b).

3.5.3.2.3 City of Aransas Pass

Comprehensive Plan: The Comprehensive Plan for Aransas Pass was adopted in 2018. This plan noted that "like its neighbors in the Coastal Bend, Aransas Pass housing stock sustained serious damages from Hurricane Harvey." The plan goes on to note that both single-family and multifamily were impacted by wind and water damage from this storm in 2017, but that the community is now recovering from these impacts. This plan sets housing goals to "achieve or preserve high-quality multifamily housing, more homes near the harbor, new starter homes and workforce housing among other goals" to help recover effectively from this disaster. The plan notes that Aransas Pass needs more housing of all types and is pursuing an implementation plan to achieve this. Comments received during the planning process noted that city residents wanted to create housing targeted at first-time homebuyers, seniors, workforce housing, subsidized affordable housing, and high-end ownership. The plan identified a multitude of structures aimed at addressing these desires including construction of standard single-family homes, garden homes, condominiums, townhomes, and tiny houses (City of Aransas Pass, 2018).

According to the plan, approximately 89 percent of the land in Aransas Pass' is made up of agriculture/undeveloped (30 percent), single family (19 percent), semi-developed (22 percent), and right-of-way (18 percent) land uses. The next largest land-use category is commercial with seven percent and institutional land uses at 1.6 percent. The plan goes on to note that Aransas Pass has more land than usual for a city its size devoted to transportation because almost 3.7 miles of railroad runs through the city. Recreational, industrial, institutional, multifamily, utility, and public land uses all account for under 5 percent each (City of Aransas Pass, 2018).

3.5.3.2.4 City of Ingleside

Comprehensive Master Plan: The City of Ingleside adopted its Comprehensive Master Plan in January 2016. This plan is intended to guide future development, redevelopment, and community enhancement efforts in the city. It serves as a framework for community discussion on the real and perceived challenges facing Ingleside currently and in the future. Naval Station Ingleside closed in the early 2000s resulting in a decline in population which recovered by the year 2010. This plan notes that adding more residents and businesses in the coming years is a priority. It mentions the city's deep-water port access as an opportunity and prime factor in attracting industries to locate in the city. The plan notes that Ingleside's heavy industrial uses are focused along the shoreline where there is deep water access for large ships, plus in other areas with large tracts accessible to highways and/or rail. The area of Ingleside located most closely to the project's channel deepening is zoned as heavy industrial in the city's future land use map (City of Ingleside, 2016).

Parks and Open Space Master Plan: The Parks, Recreation and Open Space Master Plan is designed to identify parks and recreation needs given anticipated population growth and establish goals for improvements to the parks system for the next from 2021 through 2031. The planning area includes six parks. Of these, Cove Park is the closest to the Project area, located adjacent to Corpus Christi Bay on the southern side of Ingleside. There are no parks directly adjacent to the navigation channel on the bay. Cove Park is a five-acre waterfront park situated on the southern edge of the City of Ingleside and has water-accessed based amenities such as a boat ramp and fishing pier. There are no plans to expand park or recreation access to an area that would be adjacent to the navigation channel for the PCCA (City of Ingleside, 2021b).

3.5.3.2.5 City of Rockport

Comprehensive Master Plan: Following the destruction of Hurricane Harvey, the City of Rockport developed a new Comprehensive Plan to guide the city's recovery and development from 2020 through 2040 with support from Texas A&M University's Texas Targets Community program. The plan notes that "Rockport undertook extensive damages [from the hurricane]…more than 1,500 structures were damaged" and "According to city officials, Rockport's population [was] down 20% since Harvey made landfall" as of 2019. Like the other cities in the ROI, Rockport's Comprehensive Master Plan focuses on sustainable and resilient development. The city is prioritizing increasing the availability of housing and continuing economic recovery with an emphasis on culture and tourism (City of Rockport, 2019).

3.5.4 Environmental Justice

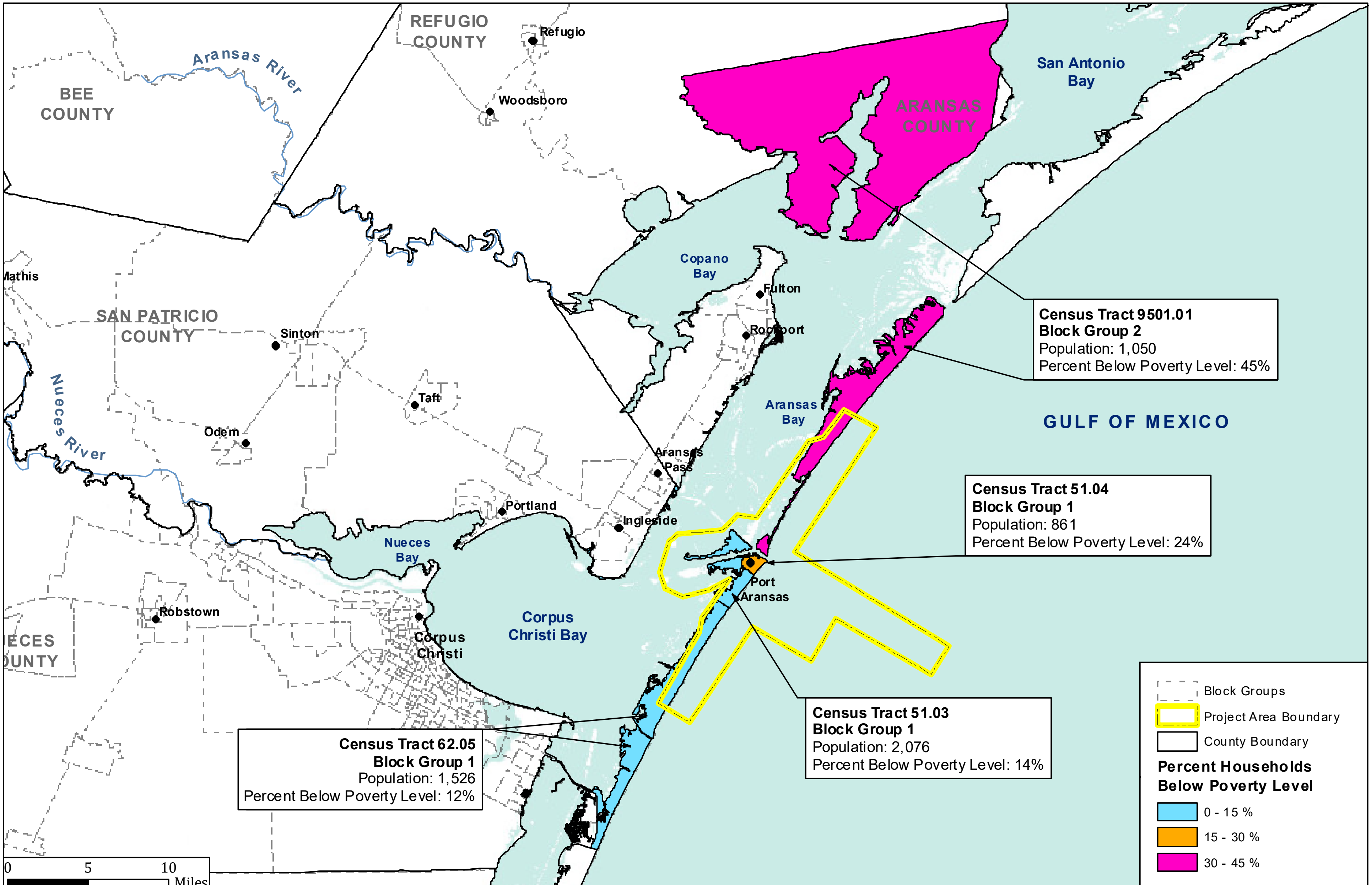
On 11 February 1994, President Clinton issued Executive Order (EO) 12898, *Federal Actions to Address Environmental Justice in Minority Populations and Low-Income Populations*. Executive Order 12898 directs agencies to address environmental and human health conditions in minority and low-income communities to avoid the disproportionate placement of any adverse effects from Federal policies and actions on these populations. The general purposes of this EO are to:

- Focus the attention of Federal agencies on human health and environmental conditions in minority communities and low-income communities with the goal of achieving environmental justice;
- Foster nondiscrimination in Federal programs that substantially affect human health or the Environment; and
- Improve data collection efforts on the impacts of decisions that affect minority communities and low-income communities and encourage more public participation in Federal decision-making by ensuring documents are easily accessible (e.g., available in multiple languages and made readily available).

As defined by the *Environmental Justice Guidance under NEPA* (Council on Environmental Quality [CEQ], 1997a), "minority populations" include persons who identify themselves as Asian or Pacific Islander, Native American or Alaskan Native, Black (not of Hispanic origin), or Hispanic. Race refers to census respondents' self-identification of racial background. Hispanic origin refers to ethnicity and language, not race, and may include persons whose heritage is Puerto Rican, Cuban, Mexican, and Central or South American.

A minority population exists where the percentage of minorities in an affected area either exceeds 50 percent or is meaningfully greater than in the general population. Low-income populations are identified using the Census Bureau's statistical poverty threshold, which is based on income and family size. The Census Bureau defines a "poverty area" as a census tract with 20 percent or more of its residents below the poverty threshold. An "extreme poverty area" is defined as one with 40 percent or more below the poverty level. A census tract is a small geographic subdivision of a county and typically contains between 1,200 and 8,000 persons (U.S. Census Bureau, 2023). As discussed in section 3.5.1.2 Income and Poverty, the poverty guideline for a family of four people as defined by the U.S. Department of Health and Human Services was $27,740 in 2021 ($31,099 in 2023 dollars), the year the latest city and census tract-level statistics are available through the ACS (U.S. Census Bureau, 2022c; OMB, 2023).

Multiple political and statistical geographic units of analysis are used for the environmental justice work for this project. This is to show broad state and county and acute, project site specific census tract and block group minority, and low-income statistics. The census tract and block groups are located within or adjacent to the project area as shown in Figure 3-23. However, it should be noted that the channel deepening



PROJECT NO. PCA20166

DATE CREATED Date: 12/11/2023

DATUM & COORDINATE SYSTEM NAD83 State Plane (feet) Texas South Central

FILE NAME Name: Fig_3-21_Block Groups by Households Below Poverty Level

PREPARED BY KLC

Port of Corpus Christi Authority

Corpus Christi Ship Channel Deepening Project

Block Groups Within or Adjacent to the Project Area by Percent of Households Living Below Poverty Level

FIGURE 3-23

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Path: H:\ENVIRONMENTAL\Final_Exhibits\EIS Figures\Fig_3-21_Block Groups by Households Below Poverty Level.mxd identified in the Applicant's Preferred Alternative only extends to Harbor Island. Therefore, it is only located adjacent to a subset of the census tracts and block groups listed below (block groups 005102.1, 006200.1 and 005102.2 in Nueces County, Texas and block group 009501.01 in Aransas County, Texas).

Only one of the census tracts, Census Track 9501.01 in Nueces County, is a poverty area. None of the census tracts is an extreme poverty areas identified by the U.S. Census Bureau 5-Year ACS estimate for 2017 through 2021, as shown in Table 3-35. Census tract (950101.2) is also the only census tract with individual poverty level greater than the county in which it is located (Aransas). No household poverty levels within the census tracts are equal to or greater than to their county or state levels. Census Tract 9501.01 and Block Group 2 within it have a relatively high number of households living below the poverty level compared to the county within which they are located (Aransas). Block Group 1, Census Tract 51.04 in Nueces County has 24 percent of its households living below the poverty level which is greater than the level of households for this same statistic within Nueces County. Figure 3-23 shows these block groups within and adjacent to the project area (U.S. Census Bureau, 2022e).

Table 3-35
Minority and Low Income Statistics (2023 Dollars)

Geography	Population	Percent Minority*	Median Household Income	Percent of Individuals Living Below Poverty Level	Percent of Households Living Below Poverty Level
Texas	28,862,581	59	75,472	11	13
Aransas County	24,149	34	$57,746	17	19
Census Tract 9501.01	1,681	3	$41,346	29	34
Block Group 2	1,050	0	$40,344	(D)	45
Nueces County	353,594	72	$66,679	14	17
Census Tract 51.03	2,076	20	$74,107	8	14
Block Group 1	2,076	20	$74,107	(D)	14
Census Tract 51.04	5,070	64	$113,210	6	7
Block Group 1	861	4	$59,147	(D)	24
Census Tract 62.05	1,526	14	$90,479	7	12
Block Group 1	1,526	14	$90,479	(D)	12

Source: U.S. Census Bureau (2022e), OMB (2023).

* Minority population is defined as the population that identifies as other than Non-Hispanic White Alone.

Note: (D) means that information is not disclosed for this statistic at this geographic level.

The State of Texas, Nueces County and Census Tract 51.04 in Nueces County have majority-minority populations as shown in Table 3-35 and Figure 3-24. In comparison, the remainder of the census tracts and block groups do not have minority populations that are this high. The remaining census tracts and block groups have minority populations that are between 3 and 20 percent of the total population of their respective statistical geographic areas (U.S. Census Bureau, 2022e).

3.6 NAVIGATION

3.6.1 Recreational Boating and Ferries

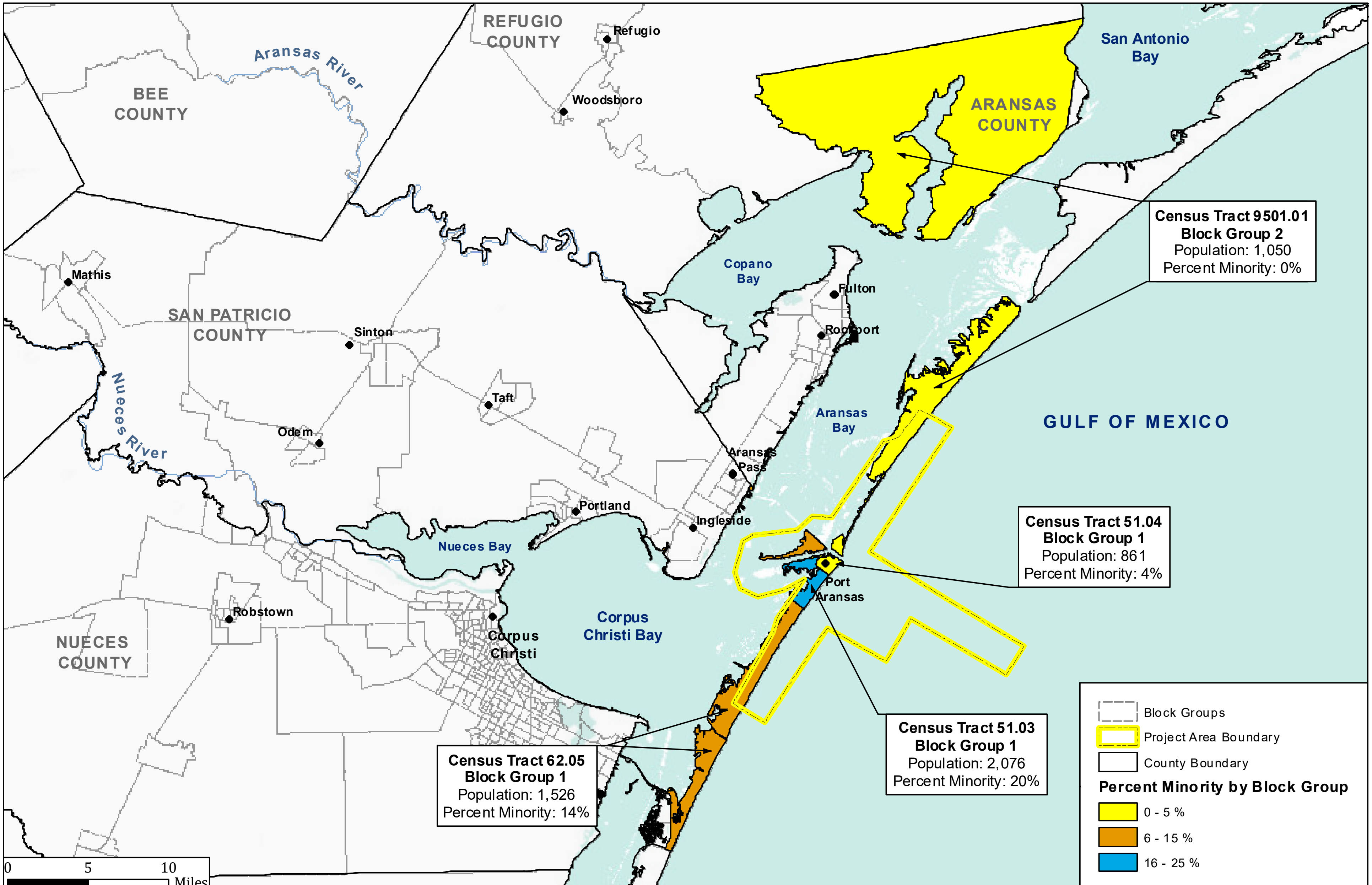
There are numerous businesses along Corpus Christi Bay that cater to boating and recreational fishing. Some smaller businesses are located near the Portland/Ingleside communities in the northern part of Corpus Christi Bay and near Port Aransas on the eastern side of the bay. Fishing, boating, and other water related activities are very popular, and both Corpus Christi and Port Aransas have large sport fishing fleets (USACE, 2003).

TxDOT operates a ferry service that links State Highway 361 with Port Aransas. The Port Aransas route runs between two and six ferries a day, depending on traffic and season and operates 24 hours a day, 365 days a year, weather permitting. The ferries cross the CCSC between Aransas Pass at the mainland and Port Aransas at Mustang Island. The ferry route is approximately a quarter-mile long and typically takes less than 10 minutes to cross the channel (TxDOT, 2023).

3.6.2 Marine Transportation

The CCSC provides deep water access from the Gulf to the Port via Port Aransas, Redfish Bay, and Corpus Christi Bay. Access points include the La Quinta Channel, the GIWW, and the Rincon Canal (Figure 3-25). The waterway extends from deep water in the Gulf through the Port Aransas jettied entrance to the Corpus Christi Turning Basin and the landlocked industrial areas within the city known as the Inner Harbor. The La Quinta Channel extends from the CCSC near Ingleside, Texas. It runs parallel to the eastern shoreline of Corpus Christi Bay to the San Patricio Turning Basin (TxDOT-MRD, 2021).

The Port was listed as the fourth largest port in the U.S. in total tonnage in 2019. In 2019, 111 million tons were traded (USACE, 2021a). The Port is currently the largest U.S. producing crude oil export port averaging 1.63 million barrels/day in 2021 (Port, 2022b; TxDOT-MRD, 2021). Tonnage by commodity for the Corpus Christi Waterway (CCSC and adjacent channels) in 2019 is provided in Table 3-36 (USACE, 2021b).



PROJECT NO.	PCA20166
DATE CREATED	Date: 12/11/2023
DATUM & COORDINATE SYSTEM	NAD83 State Plane (feet) Texas South Central
FILE NAME	Name: Fig_3-22_Block Groups by Percent Minority
PREPARED BY	KLC

Port of Corpus Christi Authority
Corpus Christi Ship Channel Deepening Project

Block Groups Within or Adjacent to the Project Area by Percent Minority

N W E S

FIGURE 3-24

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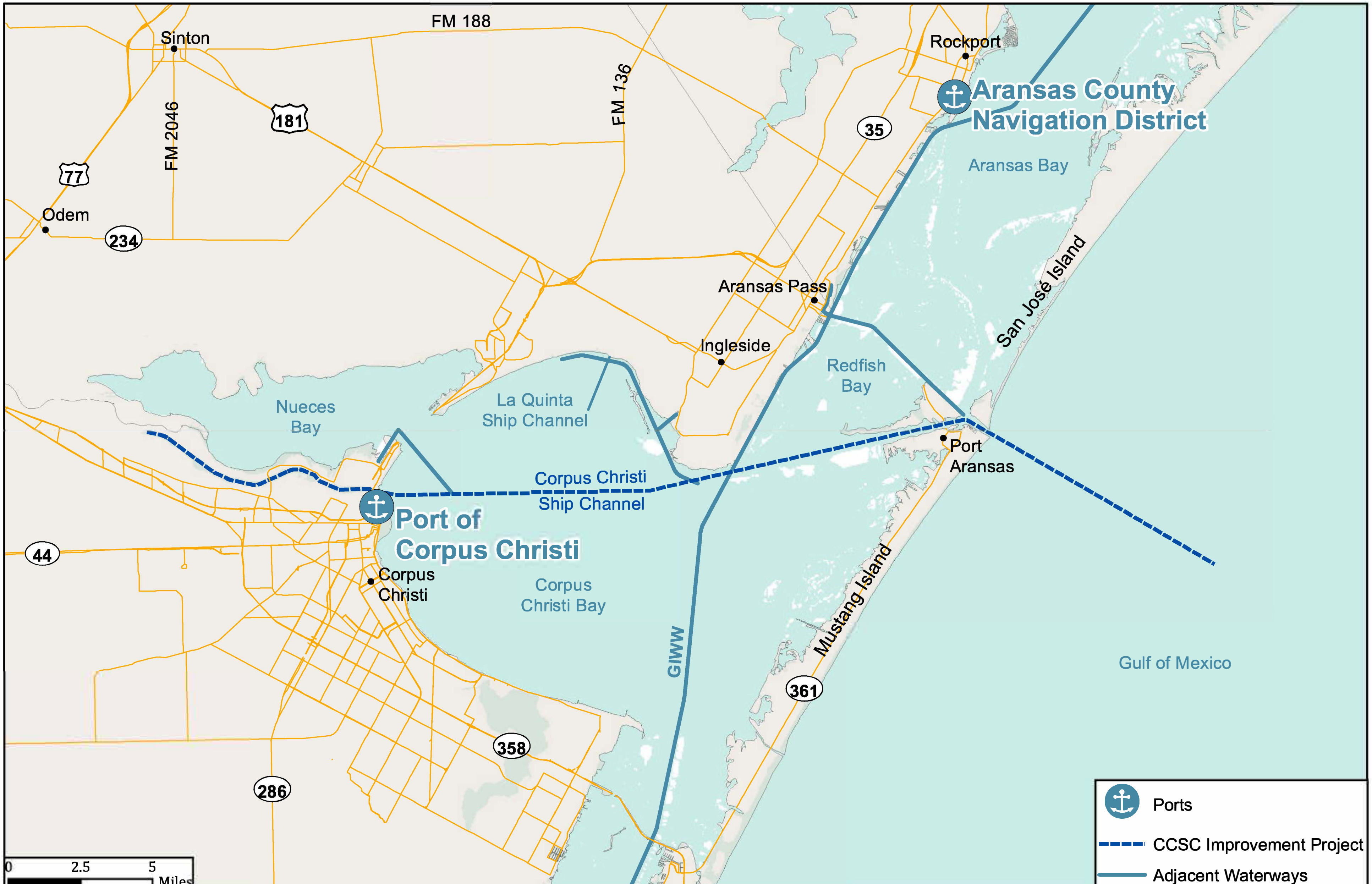

PROJECT NO.	PCA20166
DATE CREATED	Date: 9/8/2021
DATUM & COORDINATE SYSTEM	NAD83 State Plane (feet) Texas South Central
FILE NAME	Name: Fig_3-23_Navigation Channels
PREPARED BY	KLC

Port of Corpus Christi Authority
Corpus Christi Ship Channel Deepening Project

Corpus Christi Ship Channel Improvement Project and Adjacent Waterways

N W E S

FIGURE 3-25

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Table 3-36
Corpus Christi Waterway Tonnage of Commodities by Type for 2019

Commodity	Tonnage
Aggregate	1,944,919
Chemicals	6,609,469
Crude Petroleum	57,361,104
Grains	1,716,316
Iron/Steel	1,130,669
Ores/Minerals	3,966,720
Other Commodities	530,109
Petroleum	37,843,271
Total	111,102,577

Source: USACE (2021b).

The CCSC was the first waterway in Texas to be completed to a 45-foot depth. Since the completion of the –45-foot project, the size of ships using the waterway has steadily increased. Currently, vessels must be light-loaded to traverse the waterway. The channel reach between the Corpus Christi Harbor Bridge and Ingleside is only 400 feet wide and is subject to strong crosswinds and currents. The reach between Ingleside and the jetties is 500 feet wide and is semi-protected by emergent DMPAs (USACE, 2003).

The maximum draft allowed for vessels to load at the present time is 45 feet with a positive tide reading. Crude oil tankers of up to VLCC size and bulk carriers routinely transit the CCSC with drafts up to 45 feet. The current channel depth requires that large crude carriers, importing foreign oil, remain offshore and transfer their cargo into smaller crude tankers for the remainder of its voyage. This lightering operation takes place in the Gulf where the two ships, the mother ship, and the lightering ship, come together to transfer the cargo. This operation also occurs in reverse when VLCCs are reverse lightered by smaller tankers to reach full capacity with domestic oil for export. Table 3-37 presents the total trips by draft for maritime vessels transiting the CCSC in 2019 (USACE, 2021b).

Table 3-37
Total Trips by Draft for Marine Vessels Transiting the CCSC for 2019

Vessel Draft (feet)	Number of Trips	Vessel Types
40 to 45	499	– Tanker – Self-Propelled Dry
35 to 39	816	– Tanker – Self-Propelled Dry – Liquid Barge – Other (cranes, etc.)
30 to 34	681	– Tanker – Self-Propelled Dry – Liquid Barge – Dry Cargo Barge

Vessel Draft (feet)	Number of Trips	Vessel Types	
25 to 29	1142	− Tanker − Self-Propelled Dry − Liquid Barge	− Dry Cargo Barge − Towboat
20 to 24	479	− Tanker − Self-Propelled Dry − Liquid Barge	− Dry Cargo Barge − Towboat − Other (cranes, etc.)
15 to 19	307	− Tanker − Self-Propelled Dry − Liquid Barge	− Dry Cargo Barge − Towboat − Other (cranes, etc.)
10 to 14	3,855	− Tanker − Self-Propelled Dry − Liquid Barge	− Dry Cargo Barge − Towboat − Other (Cranes, etc.)
5 to 9	7,544	− Tanker − Self-Propelled Dry − Liquid Barge	− Dry Cargo Barge − Towboat
<5	4,819	− Tanker − Self-Propelled Dry − Liquid Barge	− Dry Cargo Barge − Towboat

Source: USACE (2021b).

The largest vessels accommodated by the currently authorized –54-foot project are Aframax and Suezmax vessels. They are more laden but not fully loaded to their maximum design drafts. Additionally, the current channel accommodates only partially loaded VLCCs (USACE, 2015a).

The CCSC was authorized for improvements in the WRDA of 2007. It was subsequently reauthorized for updated project costs in the Water Resources Reform and Development Act of 2014 (WRDA, 2007; Water Resources Reform and Development Act, 2014). The WRDA 2007 authorized improvements will deepen the waterway by 7 feet and extend the channel 2 miles further into the Gulf. The channel will be widened to 530 feet in the Upper and Lower Bay reaches. Barge lanes will be constructed from the CCSC junction with the La Quinta Channel to the entrance of the channel at Inner Harbor. These will be 200 feet wide and 14 feet deep on both sides of the CCSC (TxDOT-MRD, 2021).

The CCSCs Upper Bay segment (mile 12 to mile 22) is characterized by the intersection of deep-draft ship traffic coming from the Gulf and inland waterway tug and barge traffic traveling on the GIWW. Congestion in the waterway has brought about traffic management rules governing maximum beam and draft to avoid collisions. However, this manifests in vessel delays affecting deep-draft ocean-going vessels and shallow-draft tow barges. As a result, the WRDA 2007 authorized improvements to the CCSC will include a barge shelf to separate the traffic and reduce the congestion induced delay cost (TxDOT-MRD, 2021). Table 3-38 provides a comparison between the existing CCSC project and the WRDA 2007 CCSCIP.

Table 3-38
CCSC Existing and CCSCIP Details

Project Feature	CCSC	CCSCIP
Channel Length	36 miles	38 miles
Channel Depth (MLLW)		
Barge Lanes	N/A	14 feet
Inshore Channels	47 feet	54 feet
Offshore Channel	49 feet	56 feet
Channel Width		
Barge Lanes	N/A	400 feet
Inshore Channels	400 feet	530 feet
Offshore Channel	700 feet	700 feet

Source: TxDOT-MRD (2021).

Dredging of the CCSCIP was initiated in 2019. This included the deepening and widening of the CCSC from the Gulf to Harbor Island (from the offshore to part of the inshore channels). Construction of the CCSCIP is scheduled to be accomplished over multiple years under multiple dredging contracts.

The CCSC and La Quinta Channel are the main components for commercial marine transport in the Port channel system. Heavy industries, petrochemical plants, and other terminals are accessed through the CCSC and La Quinta Channel. These comprise the major deep draft navigation channels for the Port. Areas adjacent to the CCSC are important to commercial transportation destinations inland. The CCSC has two principal segments that contain deep draft berths adjacent to the channel. There is the segment at Ingleside that connects with the La Quinta Channel, and the Inner Harbor segment above the Harbor Bridge. Barges (or tows) and other shallow draft shipping traffic, carry cargo through the GIWW and the Port marine transportation system to cargo terminals and industrial facilities (AECOM, 2020).

There are other smaller shallow draft channels that intersect the CCSC and the deeper parts of Corpus Christi Bay. These are used by commercial fishing boats and recreational vessels. Vessels using the channel system transport a wide variety of cargo. This includes crude oil and petrochemical products such as gasoline, liquefied natural gas, solvents, and ethylene. There are vessels that also transport containerized cargo. Such as finished goods, bulk cargo including agricultural products, grains, and coal, and heavy project cargo including offshore oil exploration platforms and wind turbine parts (Port, 2021a).

Several of the major midstream industries are currently undergoing major expansions. This will result in an increase in crude oil exports. Crude oil is delivered via pipeline from the Eagle Ford and Permian Basins to multiple locations at the Port. Crude Oil inventories exported at the Port have increased from an average of 306,000 barrels per day in 2017 to 1.63 million barrels per day in 2021 (Port, 2022b). This is expected to increase vessel calls of the current tanker fleet used in the existing channel.

3.6.3 Harbor Island Vicinity

In the Harbor Island area of the CCSC, vessel traffic is comprised of all deep and shallow draft vessels. These vessels enter or exit the Port from the La Quinta and Inner Harbor facilities. Shallow draft barges connect to the Lydia Ann Channel, the local recreational and small vessel traffic of the marinas, the TxDOT ferry, and the few commercial facilities on Mustang Island and Harbor Island. The local traffic is concentrated along the most inland 2 miles of the proposed deepening reach, just inland of the jetties. Local recreational boat and small craft traffic berth primarily at the Port Aransas Marina, Cline Point marina, and the University of Texas Marine Science Institute boat basin, all along Mustang Island (Google Earth, 2021; Microsoft, 2021; Nueces County Appraisal District, 2021). Only limited local commercial vessel traffic currently berths around the Harbor Island area. This includes offshore vessels, platforms, and wind farm. As well as other project cargo at the Aransas Terminal Company (formerly Gulf Copper Harbor Island shipyard) and tugs and other support vessels along the Aransas Channel (eastern) side of Harbor Island (Aransas Terminal Company, n.d.; Freeman, 2018; Port, 2021b). As previously discussed, the TxDOT ferry runs from Harbor Island to Mustang Island to continue State Highway 361 near the inland most end of the preferred project reach.

Current vessel pilot rules for the CCSC have transit restrictions for large tanker dimensions that include Suezmax and VLCC vessels currently calling at the Port. This includes one-way traffic during night transit in Cut A (the segment containing Harbor Island) and B for all Category 1 Tankers (>748 feet length overall plus >120 feet beam plus >40.9 feet draft). Daylight-only passage for criteria that includes >900 feet length overall and >130,000 deadweight tons (Aransas-Corpus Christi Pilot Board, 2021). Both the Suezmax and VLCC vessel types meet at least one or more of those criteria. Therefore, these types of transit restrictions are present in the existing channel proposed for deepening.

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4.0 ENVIRONMENTAL CONSEQUENCES

Section 4.0 presents the environmental impacts of the proposed alternatives, including the No-Action Alternative, Alternative 1 (Applicant's Preferred Alternative), Alternative 2, and Alternative 3.

The USACE is required to consider the No-Action Alternative during the permit evaluation and assessment of impacts to comply with USACE regulations and NEPA. With the No-Action Alternative, it is assumed that no project would be permitted to achieve the Applicant's objective. The No-Action Alternative forms the basis against which all other alternative plans are measured. The No-Action Alternative condition considers those projects that have been completed (existing), are under construction, or have been authorized for construction. For the CDP, the No-Action Alternative includes the deepening and widening of the –54 foot CCSCIP from the Gulf to the Inner Harbor, building and operating a crude oil export terminal on land owned by the PCCA on Harbor Island, and constructing facilities and pipelines for marine transport vessels by Axis Midstream.

An impact is defined as change to the human or natural environment as a result of an action. The potential environmental consequences anticipated associated with each alternative are described in this section. Examination of existing environmental conditions provides the context for understanding the potential environmental impacts of the preferred project, as they presently exist and as they would exist under implementation of each of the alternatives. Impacts can be beneficial or adverse, can be a primary result of an action (direct) or a secondary result (indirect), and can be permanent or long lasting (long-term) or temporary and of short duration (short-term). An impact is a direct result of an action which occurs at the same time and place or an indirect result of an action which occurs later in time or in a different place and is reasonably foreseeable. Impacts can vary in degree from a slightly noticeable change to a total change in environment.

4.1 PHYSICAL RESOURCES

4.1.1 Coastal Processes

4.1.1.1 Sediment Transport

While regional fluvial sediment supply and the Gulfwide sediment distribution patterns would not change due to the Applicant's Preferred Alternative, localized impacts could occur. The fluvial sediment supply that nourishes the Gulf has been highly altered due to extensive reservoir construction, changes in land use, and instream sand and gravel mining (Dunn and Raines, 2001). The reduction in sediment supply to bay shorelines has resulted in regional sediment sinks. This loss has resulted in or caused the disintegration of marsh systems, deltas, inlets, bird islands, oyster reefs, and other eco-geomorphologic systems (Moya et al., 2012). None of the project alternatives would change the status of the Texas coast as a sediment-starved system or diminish the need to identify more opportunities to use dredged material beneficially.

Sediment transport and shoreline change in the region have also been impacted by on-going sea level rise. The rate of RSLC and subsequent sediment transport impacts would not be directly affected by the project alternatives. Sediment transport modeling conducted for this project is included as Appendix G.

4.1.1.1.1 No-Action Alternative

Under the No-Action Alternative, there would be no direct impacts to sediment transport. The regional Gulf currents that transport sediments along the coast would continue with or without project alternatives (Freese and Nichols, Inc., 2016). However, under the No-Action Alternative, maintenance dredging of the CCSC would continue. These maintenance dredging activities would result in redistribution of existing sediment and localized increases in turbidity.

4.1.1.1.2 Alternative 1: Channel Deepening (Applicant's Preferred Alternative)

The impacts on the local geology during dredging associated with channel deepening would include redistribution of existing sediment, localized increases in turbidity, and potential increases of scouring and shoaling rates within the CCSC. Net impacts on local geology would be minimal from these operations. The specific bathymetry at a site fluctuates seasonally with the longshore transport, typically with wider beaches in the spring and summer and narrower beaches in the fall and winter. This is expected to continue after the construction of the project. Additionally, no impacts or modifications to geologic hazards, such as faulting and subsidence, are expected.

Modeling of the Inner Channel indicates that shoaling rates were comparable to that with the No-Action Alternative. However, the model predicted a 5 to 10 percent increase in sedimentation in certain reaches in the Inner Channel under the Applicant's Preferred Alternative because of deeper channel depths. Overall, both 2D and 3D model results indicate that the project impact on sedimentation rates in the Inner Channel is limited to less than 10 percent (W.F. Baird and Associates [Baird], 2022a).

Modeling of the Outer Channel indicated that the deeper channel resulting from the Applicant's Preferred Alternative further channelizes the ebb flow, resulting in increasing sedimentation farther offshore in the channel. In total, the model predicted that sedimentation in the Outer Channel increases from approximately 95,000 cy per year under the No-Action Alternative to approximately 214,000 cy per year under the Applicant's Preferred Alternative. This is approximately 2.25 times higher, primarily a result of a deeper longer channel (Baird, 2022a).

Approximately 400,000 cy of additional (incremental) maintenance material over the current responsibility for the authorized CCSC would be generated over a period of 20 years after construction of this alternative (AECOM, 2018). Therefore, the magnitude of impacts related to maintenance dredging would increase.

Beneficial use options under this alternative include nine nearshore berms located along the shorelines of San José and Mustang islands. Six nearshore berms are proposed to be placed along San José Island (B1–

B6), with a cumulative volume of 4.81 mcy. The berms would be submerged and located seaward of the islands, within the littoral transport zone. The berms would have a height of 6 to 7 feet and would be located at an approximate depth of –31 feet. In total the nearshore berms would have a total length of approximately 31,000 feet. The north jetty extends roughly 3,800 feet past the nearshore berms. Beach restoration on San José Island on the order of 2.0 mcy is also proposed where the Gulf shoreline was breached by Hurricane Harvey. This would extend the beach width and introduce additional sand to the littoral system.

Three nearshore berms are proposed for Mustang Island (B7–B9), with a cumulative volume of 3.85 mcy. The nearshore berms would be submerged and located seaward of the islands, within the littoral transport zone. The berms would have a height of 6 feet and would be located at an approximate depth of –28 feet. In total the berms would have a total length of approximately 30,000 feet. There are no structures located south of Aransas Pass that are expected to impede sediment transport south of the CCSC entrance. Two mcy of direct beach nourishment is proposed for Mustang Island. Beach nourishment on Mustang Island on the order of 2 mcy is also proposed. This would extend the beach width and introduce additional sand to the littoral system.

Model simulation results show that little to no sediment from the beach nourishment and nearshore berms settles in the channel. Predicted total settlement is less than 600 cy, suggesting that the beach nourishment and nearshore berms make small contributions to channel sedimentation compared to the overall sedimentation (Baird, 2022a).

The New Work ODMDS is located 4.5 miles from the entrance to Aransas Pass, significantly further offshore than the proposed nearshore berms, and outside of the littoral zone. The depth of closure in the vicinity of the CDP is estimated to be roughly –28 feet NAVD88. The New Work ODMDS has bathymetry ranging from –37 to –59 feet MLLW. The New Work ODMDS is located beyond the depth of closure for the channel site.

Modeling was conducted to evaluate potential contribution from New Work ODMDS sediments to channel sedimentation. The predicted maximum increase in sedimentation due to the New Work ODMDS is approximately 1,200 cy, and therefore was concluded that the contribution from the New Work ODMDS sediment to channel sedimentation is small in comparison with the overall sedimentation (Baird, 2022a).

The impact of hurricanes on channel sedimentation was assessed by conducting 1-month model runs using hurricane Harvey data. Predicted total sedimentation was about 2.3 times higher for the Applicant’s Preferred Alternative when compared to the No-Action Alternative. Results indicate that individual hurricane events could result in sedimentation volumes several times higher than the average annual sedimentation in the outer channel. In contrast, the impact of hurricanes on the inner channel sedimentation are small (Baird, 2022a).

4.1.1.1.3 Alternative 2: Offshore Single Point Mooring

Under Alternative 2, there would be no impacts to longshore sediment transport. Crude oil pipelines are proposed that extend from the shoreline at the interface of San José Island to multiple deep-water offshore port facilities (SPM) . These have the potential to interrupt localized sediment distribution. Installation of the pipelines may require trenches to be jetted, resulting in short-term increases in turbidity and redistribution of sediments. Maintenance dredging activities within the channel would continue, resulting in redistribution of existing sediment and localized increases in turbidity.

4.1.1.1.4 Alternative 3: Inshore/Offshore Combination

Similar to Alternative 2, there would be no impacts to longshore sediment transport under Alternative 3. Crude oil pipelines extending from the shoreline at the interface of San José Island to multiple deep-water offshore port facilities have the potential to interrupt localized sediment distribution. Installation of these pipelines may require trenches to be jetted, resulting in short-term increases in turbidity and redistribution of sediments. Maintenance dredging activities within the channel would continue, resulting in redistribution of existing sediment and localized increases in turbidity.

4.1.1.2 Shoreline Change

To analyze impacts to rates of Gulf shoreline change, the individual factors causing deposition or erosion need to be considered, including sediment supply and littoral drift. While regional rates of Gulf shoreline erosion would not change due to the alternatives, the Applicant's Preferred Alternative could result in localized shoreline change. Severe weather events, such as coastal storms and hurricanes, can have potential impacts on shorelines, but these impacts would occur regardless of project alternative. None of the alternatives, including the No-Action Alternative, have an impact on other factors impacting shoreline change, including sea level rise and subsidence. Sediment transport modeling conducted for this project is included as Appendix G.

4.1.1.2.1 No-Action Alternative

Under the No-Action Alternative, there would be no impacts to Gulf shoreline change. Localized rates of shoreline change would remain the same for both San José and Mustang islands. Beach nourishment activities unrelated to this project have the potential to impact shorelines in the project area.

4.1.1.2.2 Alternative 1: Channel Deepening (Applicant's Preferred Alternative)

While there would be no impacts to shorelines from the channel dredging activities under Alternative 1, associated BU activities may result in localized impacts to shorelines. Beneficial use activities considered for this project that have the potential to affect Gulf shorelines are limited to beach nourishment/restoration (SJI and MI) activities and nearshore berms (B1–B9).

Some of the dredged material from the channel deepening may be used to nourish the Gulf beach of San José Island. Dredged material may also be used to nourish the Gulf shoreline of Mustang Island. The nourishment would widen the shoreline and advance the beach seaward, causing the nourished beach to extend further into the active transport zone.

Six nearshore berms are proposed along San José Island (B1–B6), with a cumulative volume of 4.81 mcy, and three nearshore berms are proposed along Mustang Island (B7–B9), with a cumulative volume of 3.85 mcy. Information regarding the potential for beach nourishment and sand accumulation are detailed in Section 4.1.1.2. However, shorelines along this portion of the Texas coast have been relatively stable from the 1930s to 2019. The shoreline movement rate near Aransas Pass ranges from –2.0 to +2.0 feet per year. Shoreline change on San José Island ranges from –1.9 to +0.8 feet, and Mustang Island ranges from –1.4 to +1.7 feet (Pain and Caudle, 2020).

Beach nourishment activities seek to return the beach profiles to pre-Harvey conditions. The bathymetry would also return to profiles similar to pre-Harvey condition as additional sediments would be added to the shoreline. Since these activities would occur inside the depth of closure, the sediments would be in the littoral zone and experience natural processes like aeolian, cross-shore, and longshore sediment transport.

Two numerical models were used to assess the stability of the nearshore berms and beach nourishment (xBeach and CSHORE). In both models, the dune is stable and predicted profile changes with and without the nearshore berm are identical, indicating that the nearshore berm has little influence on beach stability. Both models predict little to no change in the beach profile (Baird, 2022a).

4.1.1.2.3 Alternative 2: Offshore Single Point Mooring

There would be no impacts to shorelines from the channel dredging activities under Alternative 2. Localized rates of shoreline change would remain the same for San José and Mustang islands.

4.1.1.2.4 Alternative 3: Inshore/Offshore Combination

There would be no impacts to shorelines from the channel dredging activities under Alternative 3. Localized rates of shoreline change would remain the same for San José and Mustang islands.

4.1.2 Physical Oceanography

4.1.2.1 Bathymetry/Tides/Currents and Circulation

4.1.2.1.1 No-Action Alternative

There would be no impacts to physical oceanography systems by implementing the No-Action Alternative. Minor alterations from maintenance dredging of the existing channel and placement of maintenance dredged material at PAs and the ODMDS would continue. There may be localized changes to currents and tidal levels within the bays and offshore adjacent to the jetties. However, these changes would be small as concluded in USACE (2003).

4.1.2.1.2 Alternative 1: Channel Deepening (Applicant's Preferred Alternative)

Deepening of navigation channels can alter circulation patterns and increase the tidal range and tidal prism within bay systems (USACE, 1987). Alternative 1 would result in these types of local bathymetric changes within and adjacent to the existing CCSC. These changes would be small compared to the scale of regional bathymetry.

Use of the New Work ODMDS would result in a periodic bathymetry change over an area up to 1.36 square nautical miles. The site is dispersive, and the change would be temporary and within the planned and permitted boundaries. Multiple Placement Fate (MPFATE) was used to assess whether planned placement at an offshore site would pose a navigational hazard. The model is also used to assess whether placed material stays within site boundaries. MPFATE modeling of dredged material indicated the New Work ODMDS could accommodate the planned new work placement quantity without excessive mounding. The median mound height was 7.6 feet after 1 to 2 years of long-term dispersion simulations (Freese and Nichols, Inc., 2021a). This is well below the Corpus Christi ODMDS Site Management and Monitoring Plan mound height threshold of 11 feet (EPA and USACE, 2018).

Vessel wake magnitude is a function of vessel characteristics, speed, and channel geometry (Baird, 2022b; Appendix H). As the distance between the vessel hull and channel bottom is increased, a reduction in drawdown wave heights from vessel passage would be expected (Schiereck, 1993). Therefore, deepening the CCSC would be expected to reduce drawdown wave heights for existing non-VLCC vessels, which have a shallower draft. Modeling results for Suezmax and VLCC traffic indicate that there would be very little change in bed morphology as a result of the CDP (Baird, 2022b).

Short-term hydrodynamic modeling indicates that channel deepening is unlikely to change mean water levels in the bay. However, the model predicted that high tide would increase by less than 0.79 inches in Corpus Christi Bay and Redfish Bay. The maximum increase of high tide occurs at Humble Basin which is about 1.57 inches. The model predicted that low tide would drop by less than 1.57 inches in Corpus Christi Bay and Redfish Bay. The maximum drop of low tide occurs in the Inner Channel near Humble Basin which is 3.94 inches (Baird, 2022c).

Short-term hydrodynamic modeling predicted tidal amplitude increases of about 11 percent in Redfish Bay, 8 percent in Corpus Christi Bay, 7 percent in Nueces Bay, and 3 percent at Rockport (Table 4-1). The tidal amplitude at the Inner Channel near Port Aransas has the largest increase, which is about 17 percent. There is no major change in tidal amplitudes in Aransas Pass and the Outer Channel. The model predicted that the average tidal range increase is about 1.57 inches at the Inner Channel near Port Aransas, ranging from 0.12 to 0.35 inches (Table 4-2). The average tidal range increase at Corpus Christi Bay and Redfish Bay is less than 0.79 inches, ranging from –0.04 to 1.57 inches. A noticeable impact on the tidal range is limited to the navigation channel from Point Mustang to the inner basin (Baird, 2022c).

Table 4-1
Relative Increase of Tide Amplitudes with Applicant's Preferred Alternative
Compared to the No-Action Alternative Under Short-term Model

Location (Station)	Tidal Range Increase (percent)			
	Period 1	Period 2	Period 3	Average
Outer Chanel	0	0	0	0
Aransas Pass	0	–1	0	0
Inner Channel	16	18	16	17
Redfish Bay	11	10	11	11
Corpus Christi Bay	7	9	9	8
USS Lexington	8	8	9	8
Nueces Bay	6	7	7	7
Packery Channel	5	4	7	5
Rockport	4	2	4	3

Source: Baird (2022c).

Table 4-2
Projected Change of Tidal Range with Applicant's Preferred Alternative
Compared to the No-Action Alternative Under Short-term Model

Location (Station)	Tidal Range Change (inches)			Percentage of Average Change
	Mean	Minimum	Maximum	
Outer Chanel	–0.04	–0.12	0.08	0
Aransas Pass	0. 04	–0.31	0.79	0
Inner Channel	1.49	0.12	3.54	16
Redfish Bay	0.47	–0.01	1.18	8
Corpus Christi Bay	0.43	0	1.57	7
USS Lexington	0.43	0	1.57	7
Nueces Bay	0.31	–0.24	1.18	4
Packery Channel	0.16	–0.12	0.39	4
Rockport	0.12	–0.01	0.79	3

Source: Baird (2022c).

Additional long-term hydrodynamic modeling indicates similar impacts to mean water levels as predicted by the short-term model. The model predicted that the tidal amplitude at the Inner Channel near Port Aransas had the largest increase of about 15 percent (Figure 4-1). The increase in tidal amplitudes were found to be approximately 10 percent in Redfish Bay, 9 precent in Corpus Christi Bay, 7 percent in Nueces Bay, and 3 percent in Rockport. The model predicted that the average increase in tidal range is approximately 1.38 inches at the inner channel near Port Aransas, and the average tidal range increase at Corpus Christi Bay and Redfish Bay is less than 0.79 inches (Table 4-3). These were consistent with the short-term model (Baird, 2022c).

Table 4-3
Projected Change of Tidal Range with Applicant's Preferred Alternative
Compared to the No-Action Alternative Under Long-term Model

Location (Station)	Tidal Range Change (inches)			Average Change (%)	Increase of Tide Amplitude (%)
	Mean	Minimum	Maximum		
Outer Chanel	0	–0.71	0.51	0	0
Aransas Pass	0	–0.55	0.67	0	0
Inner Channel	1.33	–0.04	3.11	13	15
Redfish Bay	0.71	–0.08	1.50	8	10
Corpus Christi Bay	0.71	–0.08	1.38	8	9
USS Lexington	0.71	–0.16	1.42	8	9
Nueces Bay	0.47	–0.24	1.06	6	7
Packery Channel	0.20	–0.28	0.63	6	8
Rockport	0.08	–0.12	0.24	1	3

Source: Baird (2022c).

The model also looked at the impact of Alternative 1 on current speed (Table 4-4). There would be no major impact on currents in Corpus Christi Bay, Redfish Bay, and Nueces Bay. The model predicted that Alternative 1 would reduce current speeds through the deepened navigation channel. The mean current speed at Aransas Pass is reduced by about 0.213 feet per second and the maximum current speed is reduced up to 0.614 feet per second. The current speed increases in the CCSC from Port Aransas to Ingleside where the water depth remains unchanged. The current speed at the Inner Channel near Port Aransas increases by about 0.09 to 0.19 feet per second, up to 0.36 feet per second (Baird, 2022c).

Additional long-term modeling also demonstrates no major impact on currents in Corpus Christi Bay, Redfish Bay, and Nueces Bay. Channel deepening would reduce current speeds through the proposed dredge area and increase the current speed in the Corpus Christi Channel from Port Aransas to Port Ingleside where the water depth remains unchanged (Baird, 2022c).

Figure 4-1. Mean Tide Range Change Caused by the Applicant's Preferred Alternative Compared to the No-Action Alternative Under Long-term Modeling

Table 4-4
Projected Change of Averaged Current Speed with Applicant's Preferred Alternative Compared to the No-Action Alternative

Location (Station)	Flow Speed Change (feet per second)			Percentage
	Mean	Minimum	Maximum	
Outer Chanel	–0.052	–0.607	0.413	–17
Aransas Pass	–0.213	–0.614	0.289	–14
Inner Channel	0.095	–0.190	0.344	8
Redfish Bay	0	–0.020	0. 020	1
Corpus Christi Bay	0.003	–0.010	0.013	3
USS Lexington	0	–0.013	0.020	0
Nueces Bay	0.003	–0.030	0.030	2
Packery Channel	0.003	0	0.007	0
Rockport	0	–0.007	0.007	0

Source: Baird (2022c).

4.1.2.1.3 Alternative 2: Offshore Single Point Mooring

Potential impacts of Alternative 2 to physical oceanography would be like those described for the No-Action Alternative. In addition, Alternative 2 would affect only a small amount of Gulf bottom at the locations of the moorings, but this area is expected to be minor.

4.1.2.1.4 Alternative 3: Inshore/Offshore Combination

Potential impacts of Alternative 3 to physical oceanography would be like those described for the No-Action Alternative. Like Alternative 2, this alternative would affect only a small area of Gulf at the locations of the offshore moorings, but this area is expected to be minor.

4.1.2.2 Salinity

4.1.2.2.1 No-Action Alternative

Gradual changes in salinity could occur due to the forecasted RSLR discussed in Section 4.1.3.2. Corpus Christi Bay has slightly lower salinity than the Gulf. Modeling indicates that a small increase in RSLR could result in an increase in the median salinity for Corpus Christi Bay. However, Nueces Bay can have higher salinity than the Gulf during times with low freshwater inflow. A similar increase in RSLR could result in a decrease in salinity for Nueces Bay (Brown et al., 2019).

Inland water supply and land use practices could alter freshwater flow into the bays. Changes in salinities within the inshore boundaries of the project area could occur with the changes to freshwater inflows.

Changes to freshwater inflows and associated salinity impacts would continue to occur regardless of project alternative, including the No-Action Alternative.

4.1.2.2.2 Alternative 1: Channel Deepening (Applicant's Preferred Alternative)

Deepening of navigation channels can alter circulation patterns and increase saltwater intrusion by allowing deeper, more saline water to move further into the estuary (USACE, 1987). Salinity modeling for previous Federal navigation projects indicate minor, long-term changes, typically less than 1 ppt, for channel deepening projects. These include projects in Texas such as the Matagorda Ship Channel, Houston Ship Channel, and the CCSCIP (USACE, 1995, 2003, 2019a). However, in specific high inflow events, such as those associated with storm surge, the magnitude can be much larger.

Salinity modeling indicates that a change in the tidal prism associated with channel deepening increases the exchange of saltwater between Corpus Christi and Nueces bays. This increase in tidal exchange results in an increase in the average salinity for Nueces Bay (Brown et al., 2019).

Salinity modeling for the CDP (Appendix I) indicates that the preferred action would result in a –0.2 percent to 0.0 percent average change across various locations across the Corpus Christi Bay system (Table 4-5). Aransas Pass exhibited the largest potential range of changes (–3.0 to 2.2 ppt). Channel deepening may also cause small changes in salinity (about ±3 ppt) at the outlet of Nueces Bay during high flow periods from the Nueces River (Baird, 2022c).

Table 4-5
Projected Salinity Changes with Applicant's Preferred Alternative

Location (Station)	Salinity Change (ppt)			Percentage
	Mean	Minimum	Maximum	
Outer Chanel	0	–1.1	1.9	0
Aransas Pass	–0.1	–3.0	2.2	–0.2
Inner Channel	–0.1	–2.7	1.2	–0.2
Redfish Bay	0	–0.2	0.2	0
Corpus Christi Bay	0	–0.1	0.1	0
USS Lexington	0	–0.3	0.1	0
Nueces Bay	0	–0.4	0.3	0
Packery Channel	0	–0.2	0.1	–0.1
Rockport	0	–0.1	0.1	0

Source: Baird (2022c).

Table 4-5 lists the average, minimum, maximum, and percentage salinity change at selected stations. Some localized changes in salinity of less than ±3 ppt in the proposed dredge area and connected navigation channels may occur. Additional long-term salinity modeling also showed that channel deepening would not cause significant salinity changes on average, but it may cause short-term changes in the range of ±3 ppt in the proposed dredge area and connected navigation channels (Baird, 2022c).

4.1.2.2.3 Alternative 2: Offshore Single Point Mooring

There would be no direct or indirect impacts to salinity patterns under Alternative 2. Similar impacts resulting from the currently authorized CCSCIP would continue to occur under Alternative 2.

4.1.2.2.4 Alternative 3: Inshore/Offshore Combination

There would be no direct or indirect impacts to salinity patterns under Alternative 3. Similar impacts resulting from the currently authorized CCSCIP would continue to occur under Alternative 3.

4.1.3 Climate Setting

4.1.3.1 Climate Change

Climate-related extremes impacting ecosystems and humans include droughts, heat waves, and floods. Predicted global climate changes are summarized by the IPCC (2021). Climate changes occur on time scales longer than the 50-year period of analysis and over broader geographic areas than the project area. These changes would continue to influence coastal climate in Texas regardless of the project alternatives.

Texas climate is expected to experience increasing temperature, unpredictable trends in precipitation, increased extreme rainfall events, and unpredictable drought trends (Nielsen-Gammon, Banner et al., 2020). According to the Southern Climate Impacts Planning Program (2017), higher temperatures, increased droughts, flooding, and more frequent, intense hurricanes are expected in Texas. However, these projections would not be impacted by any of the project alternatives, including the No-Action Alternative.

Impacts related to climate change are limited to increased carbon dioxide emissions due to an increase in the number of vessels and reverse lightering operations with all alternatives.

4.1.3.2 Relative Sea Level Change

USACE guidance requires incorporating projected RSLC in Civil Works studies and projects following policy in Engineering Regulation 1100-2-8162, *Incorporating Sea Level Change in Civil Works Programs* (USACE, 2013), and evaluation procedures in Engineering Pamphlet 1100-2-1, *Procedures to Evaluate Sea Level Change: Impacts, Responses, and Adaptation* (USACE, 2019b). USACE guidance specifies evaluating alternatives using "low," "intermediate," and "high" rates of future sea level change, which are synopsized as the following:

- Low – The historic rate of local mean sea level change, best determined by local tide records (preferably with at least a 40-year data record).

- Intermediate – The rate of local mean sea level change using the modified National Research Council (NRC) Curve I. It is corrected for the local rate of vertical land movement.
- High – The local mean sea level change using the modified NRC Curve III. It is corrected for the local rate of vertical land movement.

USACE (2019b) recommends an expansive approach by considering changes over periods longer than the typical 50-year assumed lifespan of a project, because many projects can remain in service much longer. Therefore, changes over minimum 20-, 50-, and 100-year planning horizons should be considered.

The tide gage nearest to the project area with a 40-year data record is located at Rockport, Texas (NOAA gage No. 8774770). The tide gauge data shows relative sea level has been rising at a rate of 0.23 inches per year with a 95 percent confidence interval of ±0.02 inches per year based on monthly mean sea level data from 1937 to 2020 (Gauge #8774770). This is equivalent to a rise of 1.92 feet over the course of 100 years (NOAA, 2021f). IPCC (2021) states that the mean rate of global sea level rose at an average rate of about 0.07 inches per year during the twentieth century. Using this rate (0.07 inches per year) for the Modified NRC curves, the observed subsidence rate can be estimated at 0.23 – 0.07 = 0.16 inches per year. NRC curves can be used to compute future rates of RSLC over a 20-, 50-, and 100- year period of analysis. The predicted change between the years 2020 and 2120 for the project area is summarized in Table 4-6.

Table 4-6
Estimated RSLC Over 100 Years (2020 – 2120)

Tide Gauge	Period (Years)	RSLR Rate/ Year* (inches per year)	Subsidence Rate/Year (inches per year)	NRC Curve (feet)**		
				Low	Intermediate	High
Rockport, TX	20	0.23	0.16	1.74	1.93	2.54
Rockport, TX	50	0.23	0.16	2.25	2.78	4.45
Rockport, TX	100	0.23	0.16	3.09	4.54	9.11

* Source: NOAA gage no. 8774770 (Rockport, Texas) (NOAA, 2021f).
** Source: NRC Curve data obtained using USACE's Sea-Level Change Curve Calculator (USACE, 2021c). Values are relative to NAVD88.

Under the No-Action Alternative, no large impacts on the channel with the No-Action Alternative, either positive or negative, would be expected. The impact of a gradual increase in sea level on use of the existing and new PAs and placement actions targeting BU to maintain the currently authorized channel would mainly come from effects of higher water levels on the function and maintenance of these sites. These include containment dike overtopping and protection, site drainage, and dewatering. Adjustments can be programmed into the few repair events that all PAs and placement actions targeting BU (existing and new) would be expected to experience through their lifespan from storm events and wear and tear, and more frequent periodic channel maintenance. In summary, changes to existing and new PAs, as well as changes to BU actions (i.e., elevations, extents, or frequencies), can be made to account for the gradual increase in sea level.

With respect to climate change impacts on performance of the purpose (navigation and shipping efficiency) and preferred action (channel deepening) of the Applicant's Preferred Alternative, sea level change is the primary effect to consider. This would not have a negative effect on the performance of the deepened channel as more depth in the channel would result from the forecasted change.

The impact of a gradual increase in sea level on new placement actions targeting BU is not expected to result in any large impacts on the performance or operation of the channel under Alternative 1. Several of the potential BU features are underwater. Other potential BU features are surrounded by levees, but the height of those levees might not be able to mitigate the impact of RSLC beyond a 20-year planning horizon. The impact on new placement actions targeting BU would be similar to the impact on existing BU sites as described in the No-Action Alternative and is expected to be minimal.

The impact of a gradual increase in sea level on the New Work ODMDS would not result in any impacts on the performance or operation of the channel. The impact on new placement sites would be like the impact on existing PAs as described in the No-Action Alternative and is expected to be minimal.

RSLC would not be expected to result in any large impacts on the performance or operation of the channel under alternative 2 and 3 for the same reasons discussed for the No-Action Alternative.

4.1.3.3 Severe Storms and Hurricanes

There would be no direct impacts to coastal processes such as severe storms and hurricanes by implementing any of the project alternatives, including the No-Action Alternative. However, forecasted changes in severe storms and hurricanes may have different impacts on the considered alternatives.

Regional climate modeling for the Atlantic forecasts a substantially reduced number of hurricane and tropical storm events, but higher intensity and rainfall rates associated with each event, especially near the storm center. While modeling supports a substantial decrease (about 25 percent) in the overall number of Atlantic hurricane and tropical storm events in the twenty-first century, it also projects the maximum intensity of Atlantic hurricanes would increase by approximately 5 percent, and the frequency of very intense hurricanes (Category 4 and 5) would increase by greater than 90 percent (NOAA, 2022a).

With the effects of climate change on hurricane storm frequency and intensity, it is estimated there would be a 30 percent increase in potential storm damage in the Atlantic by 2100, where the damage potential of the more intense Category 4 and 5 hurricanes outweighs the decrease in damage potential from the reduced frequency of weaker storm events. This estimate does not include the influence of future sea level change or other important factors such as coastal development or changes in building practices (Bender et al., 2010).

4.1.3.4 Storm Surge Effects

Barrier islands and coastal wetlands have historically protected coastal Texas from tropical and hurricane storm surges. However, these natural buffers are prone to future erosion, fragmentation, and loss, resulting from continued coastal development and reduced sediment delivery. Impacts related to storm surge exacerbate these existing stressors and can result in major changes to barrier island shorelines.

4.1.3.4.1 No-Action Alternative

Hydrodynamic storm surge modeling using SWAN+ADCIRC was conducted by the Harte Research Institute (HRI) using two synthetic Category 4 storms to evaluate storm surge impacts in and around Corpus Christi Bay with “ongoing dredging project conditions” under the currently permitted deepening and widening. Compared to the existing channel configuration more water would be allowed to enter the bay. This increases the storm surge water levels, as well as slightly increases the inundation extent. There would be an increase in area inundated of between 220 to 319 acres in small areas throughout the study area. The maximum elevation gain of storm surge compared to existing conditions is 2.0 inches during ongoing dredging project conditions (Subedee and Gibeaut, 2021).

Additional review of HRI’s modeling report was completed to validate the results (Baird, 2021a). Baird did not find any issues with HRI’s application of model parameters or inputs for the ADCIRC/SWAN models used in its study.

Indirect impacts may include increased storm surge heights due to increased tidal amplitude and velocities resulting from higher water surface elevation with RSLC.

4.1.3.4.2 Alternative 1: Channel Deepening (Applicant’s Preferred Alternative)

There is the potential for preferred project features to increase storm surge impacts in the project area. The increase in the channel cross-sectional area associated with the proposed channel deepening is anticipated to allow more surge to propagate into the channel. Peak velocities and water levels would be expected to increase. There is a high likelihood of increases in velocity in the deepened barge lanes (Brown et al., 2019).

Hydrodynamic storm surge modeling using SWAN+ADCIRC was conducted by HRI on the –54-foot channel configuration using two synthetic Category 4 storms to evaluate storm surge impacts in and around Corpus Christi Bay with “planned future conditions” representing Alternative 1. Compared to the existing channel configuration, this alternative would allow more water to enter the bay. This increases the storm surge water levels, as well as slightly increases the inundation extent. There would be an increase in area inundated of between 447 to 492 acres in small areas throughout the study area. The maximum elevation gain of storm surge compared to existing conditions is 3.5 inches for this alternative. A hotspot of increased storm surge elevation of 4 to 12 inches was identified adjacent to Harbor Island for this alternative (Subedee and Gibeaut, 2021).

Additional review of HRI's modeling report was completed to validate their results (Baird, 2021a). The reviewers did not find any issues with HRI's application of model parameters or inputs for the ADCIRC/SWAN models used in its study.

Beach nourishment activities, including nourishment and nearshore berms, have the potential to offset erosion effects and attenuate waves energy. There would be no impacts to surge related to the placement of dredged material in the New Work ODMDS.

4.1.3.4.3 Alternative 2: Offshore Single Point Mooring

Similar to the No-Action Alternative, there would be no direct impacts to storm surge under Alternative 2 outside of indirect impacts from RSLC.

4.1.3.4.4 Alternative 3: Inshore/Offshore Combination

Similar to the No-Action Alternative, there would be no direct impacts to storm surge under Alternative 3 outside of indirect impacts from RSLC.

4.1.4 Water and Sediment Quality

Water and sediment quality in the project area would be affected by water use, treatment of municipal and industrial wastewater, nonpoint source pollution, and a variety of other activities in the area. Local, State, and Federal regulations along with availability of funding for wastewater and nonpoint source pollution management would also play a key role in future water and sediment quality. The effects of the considered alternatives on water and sediment quality would be localized and temporary.

4.1.4.1 Water Quality

4.1.4.1.1 No-Action Alternative

Water quality trends are not expected to be affected with the No-Action Alternative. TCEQ will continue to monitor surface water quality, how water quality meets Texas Surface Water Quality Standards, and report on water quality status every two years. Based on the results of continued monitoring, the next Texas Integrated Report of Surface Water Quality is anticipated to be completed in 2022. The report will provide updates for each of the SWQM segments, including the four found within the project area.

Turbidity would increase during maintenance dredging and placement activities for the CCSC. Measurable increases in turbidity would be temporary, lasting only days after dredging activity is completed and would not extend far beyond the area where sediment is being disturbed (Greene, 2002).

Flooding from storms may mobilize nutrients, metals, and synthetic organic hydrocarbons and transport them as nonpoint source pollution into estuarine waters and wetlands. Tidal flushing with Gulf waters may decrease nutrient and plankton concentrations and increase transparency. Inversely, increased human population growth and coastal development may increase nutrient loading, create algal blooms, and decrease transparency in estuaries (Paerl, 2006).

4.1.4.1.2 Alternative 1: Channel Deepening (Applicant's Preferred Alternative)

Measurable impacts from chemical contaminants such as heavy metals, synthetic organic compounds, and nutrients are not expected to occur with dredging activities associated with Alternative 1. This conclusion is based on pre-dredging bulk analyses and toxicity and bioaccumulation assessments conducted from 1980 to 2002, as described in Section 3.2.5. Results from those assessments show that no extensive or severe contamination occurs in the sediments within the CCSC, and that dredged material was suitable for offshore placement without special management conditions (EPA and USACE, 2008; USACE, 2003). Most of the material to be dredged will be new work material, which is unlikely to have been exposed to contaminants or pollution.

Updated sampling, chemical analysis, and bioassessment for offshore disposal of dredged material was completed for the inner channel in January 2023 in accordance with MPRSA Section 103. Elutriates were generated from the four project sediment composites. Project elutriates, site water samples and water samples collected from the Reference Area and New Work ODMDS were analyzed. Metals were not detected in concentrations above the criteria maximum concentrations or Texas Surface Water Quality Standards. Pesticide analytes, Total PCBs, and PAHs were not detected above the method detection limit (MDL) in the site water and elutriate samples tested (Terracon Consultants, Inc., 2023a; Appendix J2).

Updated sampling, chemical analysis, and bioassessment for offshore disposal of dredge material was also completed for the outer channel in January 2023 in accordance with MPRSA Section 103. Elutriates were generated from the five DMMU sediment composites. Project elutriates, site water samples and water samples collected from the Reference Area and New Work ODMDS were analyzed. Metals were not detected in concentrations above the criteria maximum concentrations or Texas Surface Water Quality Standards, with the single exception of copper in water sample CDP_01. Pesticide analytes were reported below the MDL in the site water and elutriate samples tested. Total PCBs, and PAHs were not detected above the MDL in the site water and elutriate samples tested (Terracon Consultants, Inc., 2023b; Appendix J3).

Nitrogen and phosphorus, major nutrients for algal growth, may be dissolved in sediment porewater and adsorbed to clay and silt particles. These nutrients may be released into the water column, and possibly stimulate planktonic or benthic algal growth, during dredging activities associated with channel deepening and maintenance. Short-term suspension of nutrients into the water column during dredging and dredged material placement may create localized temporary increases in algal chlorophyll (Katz et al., 2018). Potential increases are not expected to be extensive or persistent enough to impact the project area under Alternative 1.

Localized increases in turbidity at the proposed placement sites would occur, in particular the nearshore berms proposed in front of Mustang Island and San José Island. In addition, short-term, localized increases in nutrients may occur when sediment is placed at actions targeting BU. No long-term impacts would be anticipated.

Site management plans must be developed for the New Work ODMDS designated pursuant to Section 102I) of the MPRSA of 1972. An existing ODMDS Management Plan exists for the CCSC (EPA and USACE, 2018). A new Site Management Plan will be developed for the expansion of the CCSC ODMDSs.

A Sampling Analysis Plan for MPRSA Section 103 evaluation of sediment was developed to determine if the new work material sediments proposed to be dredged are acceptable for disposal in the New Work ODMDS. Included in that plan is the biological testing of sediment, including sediment toxicity and bioaccumulation (Freese and Nichols, Inc., 2021b; Appendix J1). Based on the results of the sampling, testing, and evaluation of the sediment, the CCSCIP analysis concluded that no adverse environmental effects would be expected from dredging or placement of the sediment from the project areas in the New Work ODMDS (EPA concurrence February 2024; Appendix B8).

4.1.4.1.3 Alternative 2: Offshore Single Point Mooring

No major water quality impacts are expected under Alternative 2. Installation of crude oil pipelines extending from the shoreline at the interface of San José Island to multiple offshore SPMs has the potential to cause localized, temporary increases in turbidity and total suspended solid concentrations due to suspended sediments in the water column. Placement and retrieval of anchors during pipe-laying could also result in localized increases in turbidity. Anchor chains connecting buoys to the seafloor could also disturb surface sediments causing resuspension of sediments. Continued trends in water quality, as described under the No-Action Alternative, are expected to occur.

4.1.4.1.4 Alternative 3: Inshore/Offshore Combination

Water quality impacts under Alternative 3 would be similar to those outlined under Alternative 2.

4.1.4.2 Hypoxia

4.1.4.2.1 No-Action Alternative

Hypoxia reoccurs in Corpus Christi Bay every summer in the bottom waters but is more prevalent in the southeastern portion of the bay than any other region including the project area (Morehead and Montagna, 2004). Dissolved oxygen would continue to be a parameter analyzed as part of TCEQ’s surface water quality monitoring, and TMDLs will be developed for those segments that do not meet Texas surface water quality standards. Currently, the Oso Bay water quality monitoring segment is the only one identified as having depressed DO in water, and that segment falls outside of the project area.

Global climate change may be contributing to reduced oxygen concentrations in coastal waters through increasing temperatures which reduce oxygen solubility (IPCC, 2021). Projected increases in average temperature are not likely to cause major changes in DO concentrations in the project area.

4.1.4.2.2 Alternative 1: Channel Deepening (Applicant's Preferred Alternative)

Dredging may cause some mixing of bottom water and porewater with low oxygen and oxygenated water higher in the water column, resulting in lowered oxygen concentrations. Possible episodes of lowered DO concentrations would be localized, temporary, and expected to return to pre-dredging conditions within a day after dredging and dredged placement activities have ceased (Van de Velde et al., 2018).

Nitrogen and phosphorus, major nutrients for algal growth, may be dissolved in sediment porewater and adsorbed to clay and silt particles. These nutrients may be released into the water column, and possibly stimulate planktonic or benthic algal growth after dredging and dredged disposal activities. These occurrences may lead to increased bacteria and zooplankton in the water column, which can in turn result in lowered DO concentrations. These localized periods of reduced DO are not expected to be geographically extensive or persistent enough to impact the project area.

4.1.4.2.3 Alternative 2: Offshore Single Point Mooring

Impacts related to changes in DO concentrations under Alternative 2 would be short-term and localized during installation of crude oil pipelines. Elevated turbidity and total suspended solids along with lowered DO concentrations might result from mixing low oxygen bottom water with water higher in the water column while placing anchors and chains for the SPM. Conditions would be expected to return to pre-construction conditions within a day after activities have ceased.

4.1.4.2.4 Alternative 3: Inshore/Offshore Combination

Impacts related to changes in DO, turbidity, and total suspended solids would be similar to those described under Alternative 2.

4.1.4.3 Sediment Quality

Sampling of any current or future channel maintenance material would be routinely conducted to determine sediment quality prior to actual dredging. Prior to placement of maintenance material, the material must meet all environmental criteria and regulatory requirements pursuant to MPRSA (40 CFR 220–228). A Sampling Analysis Plan for MPRSA Section 103 evaluation of sediment was developed to determine if the new work material sediments proposed to be dredged are acceptable for disposal in the New Work ODMDS. Included in that plan is the biological testing of sediment, including sediment toxicity and bioaccumulation (Freese and Nichols, Inc., 2021b; Appendix J1). This testing was completed by PCCA in 2023 (Terracon Consultants, Inc., 2023a, 2023b; appendices J2 and J3).

4.1.4.3.1 No-Action Alternative

Sediment composition and quality are not expected to change with the No-Action Alternative. Maintenance dredging would continue as planned for the CCSC, and dredged material would continue to be placed in the Maintenance ODMDS. CCSC dredged material has been found suitable for offshore placement without special management conditions (EPA and USACE, 2008).

4.1.4.3.2 Alternative 1: Channel Deepening (Applicant's Preferred Alternative)

Only beach quality sands from the CCSC should be placed as direct beach nourishment at locations previously breached by Hurricane Harvey. However, nearshore berms could be supplied with sands containing silt or clay that have the potential to settle out prior to equilibration of the beach profile. Localized changes in sediment particle size distribution may result from placement of dredged material at actions targeting BU, including nearshore berm features.

Previous assessments found that CCSC material in the project area is of sufficient quality to be used for beneficial uses (USACE, 2003). Material from the CCSC has been evaluated for offshore placement suitability multiple times since 1980, and testing indicated the material in the project area is suitable for offshore placement without special management conditions (EPA and USACE, 2008). Localized changes in sediment particle size distribution may result from placement of dredged material within the New Work ODMDS.

Sampling, analysis, and evaluation of sediment, water, and elutriate for the CCSCIP, Entrance Channel, and Extension were conducted in accordance with MPRSA Section 103 to evaluate the potential for adverse environmental effects associated with dredging and open water ocean placement of new work sediments. Previous results of the sampling, testing and evaluation of the CCSC Entrance Channel and Extension sediment, site water, and elutriate, as well as toxicity and bioaccumulation testing, a lines of evidence analysis concluded that no adverse environmental effects would be expected from dredging or placement of the sediment from the project area into the New Work ODMDS (Montgomery and Bourne, 2018).

Updated sampling, chemical analysis, and bioassessment for offshore disposal of dredged material was completed for the inner channel in January 2023 in accordance with MPRSA Section 103 (Terracon Consultants, Inc., 2023a; Appendix J2). The report presents the results of the investigations completed between February/March 2022 and the January 2023 (re-sampling event) for the Inner Harbor/Port Aransas Channel deepening DMMUs CDP-06 through CDP-09, including applicable data for the offshore Reference Area and New Work ODMDS area. The re-sampling event conducted in January 2023 included DMMUs CDP-06 and CDP-07, the offshore Reference Area, and New Work ODMDS area for appropriate data comparison (Terracon Consultants, Inc., 2023a).

Sediment grain size distributions among the project DMMU subsamples ranged from 15.4 percent to 72.0 percent silt, 6.3 percent to 63.7 percent sand, and 1.5 percent to 53.5 percent clay. It was noted that there is an apparent variance in the composition of the sediment collected from the New Work ODMDS when comparing the March 2022 and January 2023 samples. This variance is due to the natural heterogeneity of sediment, mixing of the sediment due to tidal movements and the deposition of material into the New Work ODMDS from various dredging events that occurred between the two sampling events (Terracon Consultants, Inc., 2023a).

Sediment chemistry analyses were performed on the discrete subsamples from CDP-06 through CDP-09, including two duplicate samples collected from CDP-07 (Core #2) and CDP-09C (Core #2). Sediment chemistry analyses were performed on the Reference composites and the New Work ODMDS composites collected during respective sampling events completed in March 2022 and January 2023 (Terracon Consultants, Inc., 2023a).

Most of the 13 metals analyzed were detected at concentrations above the laboratory reporting limit (LRL) in the samples tested. The metals detected above the LRL were each below their respective threshold effects level (TEL) and (or) effects range-low (ERL), following TCEQ regulatory standards. Pesticides and PCBs were not detected above the MDLs in the 2023 samples tested. The 15 PAH analytes tested were detected below the LRLs in the samples tested. (Terracon Consultants, Inc., 2023a).

The following measured sediment chemistry parameters exceeded the TEL, ERL, or LRL:

- Pesticide analytes chlordane (technical), dieldrin, y-BHC (lindane), and toxaphene were reported with MDLs in at least one sample that exceeded the respective TEL and/or ERL.
- Total phenol was detected above the LRL in CDP-06-6C and the ODMDS composite (January 2023).
- The four semivolatile organic compound analytes (bis[2-ethylhexyl] phthalate, di-n-butyl phthalate, di-n-octyl phthalate, and total phenol) were detected above the LRLs in CDP-07-7C. Semivolatile organic compound analyte di-n-butyl phthalate was detected above the LRL in CDP-07-7A.
- Bis(2-ethylhexyl) phthalate was detected above the LRL in CDP-08-8A, CDP-08-8C, and CDP-09C (Core 1) and total phenol was detected above the LRL in CDP-09 (Core 2).
- Di-n-butyl phthalate was detected above the LRL in the Reference composite (March 2022) and ODMDS composite (March 2022).

Additional toxicity testing for those samples that exceeded the TEL, ERL, or LRL via Water Column and Whole Sediment bioassays. Results indicated that there we no significant differences between the project sediments and the reference sediment observed. The same results were not statistically different than the control (Terracon Consultants, Inc., 2023a).

Updated sampling, chemical analysis, and bioassessment for offshore disposal of dredge material was also completed for the outer channel in January 2023 in accordance with MPRSA Section 103 (Appendix J3).

The report presents the results of the investigation completed in August 2022 for the Offshore Extension/Outer Channel deepening Dredged Material Management Units CDP-01 through CDP-05, and sampling at the offshore Reference Area. The report includes the results of the New Work ODMDS composite collected during the February/March 2022 Inner Harbor/Port Aransas channel field sampling effort (Terracon Consultants, Inc., 2023b).

Sediment grain size distributions among the project DMMU subsamples ranged from 1.4 percent to 47.2 percent silt, 9.2 percent to 90.3 percent sand, and 5.9 percent to 57.5 percent clay. Sediment chemistry analyses were performed on the five DMMU composite samples from CDP -01 through CDP-05, including one duplicate composite sample collected from CDP-03 (Core #2), the Reference Area composite, and the New Work ODMDS composite (Terracon Consultants, Inc., 2023b).

Most of the 13 metals analyzed were detected at concentrations above the LRL in the samples tested. The metals detected above the LRL were each below their respective TEL and (or) ERL. Total PCBs were not detected above the MDL (U-qualified) in the composite samples tested. The 15 PAH analytes tested were detected below the MDLs (U-qualified) in the composite samples tested. MDLs for the PAH compounds were below applicable TELs and ERLs and below target detection levels specified in the SAP (Terracon Consultants, Inc., 2023b).

USACE has reviewed the reports and screened the proposed project through the EPA MPRSA regulations at 40 CFR 225–228, and they requested concurrence from the EPA. Based on the results of the sampling, testing, and evaluation of the sediment, the analysis concluded that no adverse environmental effects would be expected from dredging or placement of the sediment from the project areas in the New Work ODMDS (EPA concurrence February 2024; Appendix B8).

4.1.4.3.3 Alternative 2: Offshore Single Point Mooring

Impacts to sediment quality are not expected under Alternative 2.

4.1.4.3.4 Alternative 3: Inshore/Offshore Combination

Impacts to sediment quality are not expected under Alternative 3.

4.1.5 Groundwater and Surface Water Hydrology

The project area spans portions of two major Texas river basins. The major river basins that overlap with the project area include the San Antonio-Neches River Basin and the Nueces-Rio Grande River Basin.

4.1.5.1 No-Action Alternative

There would be no impacts to watershed and river basin hydrology under the No-Action Alternative. Regardless of the project, impacts to surface hydrology could include severe droughts and increased freshwater usage. Agriculture, municipal, industrial, and commercial demands could diminish reservoir storage and freshwater inflows to coastal bays and estuaries. Without sufficient freshwater flows and saltwater barriers, salinity levels in estuaries would transition from a brackish to saltwater ecosystem. Rising sea level and saltwater intrusion into bays, rivers, and creeks can cause changes in habitat.

4.1.5.2 Alternative 1: Channel Deepening (Applicant's Preferred Alternative)

There would be no direct impacts to watershed and basin hydrology from channel deepening activities under Alternative 1.

Associated BU activities may result in localized impacts to hydrology. Beach nourishment activities on Mustang Island and San José Island may have very localized effects on surface hydrology, but impacts would not extend beyond the dredged material placement sites. This sediment placement might alter local sheet flow during rainfall events but would not block or interfere with any existing stream channels or other permanent inland waterbodies. No long-term impacts to watershed hydrology are anticipated to result from these placement actions targeting BU project features.

The placement of dredged material for actions targeting BU may change local hydrology if containment levees are built on uplands. Containment levees may change patterns of sheet flow from rainfall runoff towards the bay. These impacts are expected to be localized and would continue for several years during the marsh restoration and stabilization process. Placement actions targeting BU are not expected to impact any permanent bodies of inland waters like freshwater streams or ponds.

Offshore placement of dredged material in New Work ODMDS would not result in direct impacts to watershed and basin hydrology.

4.1.5.3 Alternative 2: Offshore Single Point Mooring

Similar to the No-Action Alternative, there would be no impacts to watershed and river basin hydrology under Alternative 2.

4.1.5.4 Alternative 3: Inshore/Offshore Combination

Similar to the No-Action Alternative, there would be no impacts to watershed and river basin hydrology under Alternative 3.

4.1.6 Soils (Prime and Other Important Unique Farmland)

Prime and unique farmlands were mapped using the Natural Resources Conservation Service Web Soil Survey website (Natural Resources Conservation Service, 2022). The Natural Resources Conservation Service database was used to calculate prime farmland impacts associated with DMPAs and construction right-of-way.

Most of the project area is composed of soils that are classified as “not prime farmland,” with a negligible amount classified as “farmland of statewide importance.” None of the alternatives would impact prime farmlands or farmlands of statewide importance. For Alternative 1, none of the proposed dredged material placement sites are located on prime farmland or farmland of statewide importance. Alternatives 2 and 3 do not involve dredging or placement of dredged material and would have minimal impacts.

4.1.7 Energy and Mineral Resources

4.1.7.1 No-Action Alternative

The No-Action Alternative would have no discernable direct impact on energy and mineral resources. Large quantities of sand and sediment may be available from maintenance dredging of existing ship channels and from future channel deepening and/or widening projects. In the absence of project activity, the existing patterns of area shoreline erosion are expected to continue.

4.1.7.2 Alternative 1: Channel Deepening (Applicant’s Preferred Alternative)

Similar to the No-Action Alternative, Alternative 1 would have no discernable direct impacts on energy and mineral resources. The expansion of the Port facility to accommodate larger-capacity vessels would provide additional capacity for import/export of energy and mineral resources. It is anticipated that oil and natural gas production would continue to be a prominent industry and employer in the region. Alternative 1 would provide capacity and transportation improvements that would continue to support the import/export of petroleum-based commodities.

Large quantities of sand and sediment may be available from maintenance dredging of existing ship channels and from future channel deepening and/or widening projects. In the absence of project activity, the existing patterns of area shoreline erosion are expected to continue.

4.1.7.3 Alternative 2: Offshore Single Point Mooring

Similar to the No-Action Alternative, Alternative 2 would have no discernable direct impacts on energy and mineral resources. The addition of an offshore mooring and pipeline for the Port facility to accommodate larger-capacity vessels would provide additional capacity for import/export of energy and mineral resources. It is anticipated that oil and natural gas production would continue to be a prominent industry and employer in the region. Alternative 2 would provide capacity improvements that would continue to support the import/export of petroleum-based commodities.

Large quantities of sand and sediment may be available from maintenance dredging of existing ship channels and from future channel deepening and/or widening projects. In the absence of project activity, the existing patterns of area shoreline erosion are expected to continue.

4.1.7.4 Alternative 3: Inshore/Offshore Combination

Similar to the No-Action Alternative, Alternative 3 would have no discernable direct impacts on energy and mineral resources. The expansion of the Port facility to accommodate larger-capacity vessels would provide additional capacity for import/export of energy and mineral resources. It is anticipated that oil and natural gas production would continue to be a prominent industry and employer in the region. Alternative 3 would provide capacity and transportation improvements that would continue to support the import/export of petroleum-based commodities.

Large quantities of sand and sediment may be available from maintenance dredging of existing ship channels and from future channel deepening and/or widening projects. In the absence of project activity, the existing patterns of area shoreline erosion are expected to continue.

4.1.8 Hazardous, Toxic, and Radioactive Waste

As industrial activity continues to increase to accommodate future anticipated demands for petroleum commodities in the U.S., additional indirect HTRW impacts would occur regardless of the preferred project. Natural environmental changes including continued sea level rise and hurricane storm surges would continue to degrade natural and man-made seawalls, levees, and barrier islands in the project area leaving industrial port facilities more susceptible to damage increasing the potential for the release of waste materials into the environment. Catastrophic events causing major damage to industrial facilities may increase over time. Disturbances of HTRW from these natural events are not directly related to the preferred project; however, should natural events occur during the development of the project that exacerbate the influence of tide, flow or circulation, the best management practices deployed during project construction would be selected to conservatively protect water quality and the environment under adverse weather conditions (i.e., hurricanes or similar wind and precipitation events). Best management practices developed by the USACE and EPA including resuspension control measures may be used to reduce impacts to the water column during construction activities (Bridges et al., 2008).

4.1.8.1 No-Action Alternative

The No-Action Alternative would result in no direct impacts on hazardous materials associated with regulated facilities and shipping traffic. Indirect and current impacts from past and current industrial activities within the project area would continue to affect maintenance dredging activities planned for the currently authorized channel, and dredged material would continue to be placed in the Maintenance ODMDS. CCSC dredged material has been found suitable for offshore placement without special management conditions (EPA and USACE, 2018). In the absence of project activity, the existing historic impacts related to area industry are also expected to continue. Best management practices developed by the USACE and EPA including resuspension control measures may be used to reduce impacts to the water column during ongoing maintenance dredging (Bridges et al., 2008).

4.1.8.2 Alternative 1: Channel Deepening (Applicant's Preferred Alternative)

Deepening the CCSC would result in direct and indirect impacts related to hazardous materials. According to a review of regulatory agency database records included in Section 3.2.10, industrial activity has caused measurable impacts to the surface water, sediment, soil, and groundwater in localized areas within the project area. The nature and potential for any HTRW site to impact the surrounding environment varies considerably. The majority of the regulated facilities and incident locations identified in the regulatory agency database review do not pose an environmental concern for the project. Initially, construction of Alternative 1 would require handling of additional dredged materials potentially impacted with HTRW by current and past regulated facilities. All dredged material is expected to be placed at potential BU sites as allowable based on chemical composition of dredged materials. Best management practices developed by the USACE and EPA including resuspension control measures may be used to reduce impacts to the water column and environment during construction activities (Bridges et al., 2008).

Post construction, the capability of fully loading VLCCs at Harbor Island would result in a localized increase in indirect impacts from HTRW resulting from the use of the deeper berths for handling, storage, and transfer of petroleum products and other hazardous materials at Harbor Island. The risk of a vessel spill offshore or nearshore would be reduced, which would allow larger ships to transfer product at the Port, reducing the need to lighter or off load product offshore. Freight truck and freight rail traffic at the Port are anticipated to increase over time, which would increase the risk of fuel spills or other HTRW releases.

4.1.8.3 Alternative 2: Offshore Single Point Mooring

No major HTRW impacts are expected under Alternative 2. There are no direct impacts within the existing CCSC under this alternative. Best management practices may be used to reduce impacts to the water column during ongoing maintenance dredging (Bridges et al., 2008).

There would be a low probability for encountering HTRW during construction offshore. The placement of multiple deep-water port facilities (SPMs) would result in localized direct HTRW impacts from handling, storage, and transfer of petroleum products and other hazardous materials at each deep-water port facility. Operational impacts may include increased risk of hazardous materials spill from vessels offshore.

4.1.8.4 Alternative 3: Inshore/Offshore Combination

The combined inshore/offshore Alternative 3 would result in possible direct impacts related to HTRW at the Port as well as offshore at the mooring location. Best management practices may be used to reduce impacts to the water column during ongoing maintenance dredging (Bridges et al., 2008).

While there are no direct impacts within the existing CCSC under this alternative, the handling, storage, and transfer of petroleum products and other hazardous materials during partial loading of VLCCs at Ingleside and Harbor Island would result in a localized direct impact at port facilities. The placement of

SPMs would result in localized direct HTRW impacts from handling, storage, and transfer of petroleum products and other hazardous materials at each deep-water port facility. Operational impacts may include increased risk of hazardous materials spilling from vessels offshore.

4.1.9 Air Quality

4.1.9.1 No-Action Alternative

Under the No-Action Alternative, no dredging would be performed, and the channel would remain at its –54-foot depth. Though no construction emissions would result, air emissions associated with light-loading of VLCCs would continue. The VLCCs would require lightering vessels to fully load them at sea which would involve the transit of Suezmaxes and the relatively uncontrolled emissions of loading them at sea.

The transfer of crude oil involves emissions from the cargo holds and transfer hose connections and valves that are either controlled during loading or escape as fugitive emissions. Most of these emissions occur from the displacement of vapors in the tank being filled. At onshore terminal facilities, air permits require vapor recovery controls capable of 95 percent or more recovery of these emissions. These systems typically use adsorption, refrigeration, or thermal destruction to control emissions. However, offshore loading and lightering have limited options for emission controls, typically consisting of submerged loading (where the fill hose is immersed in the liquid) and vapor balancing systems. Currently, few states require any lightering-related controls in their state waters, and there are no State or Federal regulations addressing lightering operations emission controls in the Gulf beyond 12 nautical miles from shore where lightering would take place (Sturtz et al., 2017). Therefore, lightering emissions in the Gulf are relatively uncontrolled.

The Sturtz et al. (2017) study was used to derive emissions rates per lightering event that were used to estimate emissions associated with lightering activity. The lightering in that study were predominantly VLCCs and the Corpus Christi lightering zone was one of the top three sources of lightering activity used. Thus, the vessel type and distances for lightering vessel transit and meeting would be very similar. The emissions data was assumed appropriate to use for deriving lightering emissions for this project area. A per-lightering event emissions rate was derived from the data and used to calculate emissions using an estimate of lightering vessels needed, conducted for the air quality, noise, and navigation impact analysis. However, the Sturtz et al. (2017) study did not include estimates of GHG emissions. To do this, an estimate was conducted using data from industry publications and other port air emissions inventories, and the distances to the Corpus Christi region lightering locations. Engine horsepower and maximum and average vessel speeds were sourced from literature on Suezmax vessel operation (California Air Resources Board, 2022; Adland et al., 2020; Agrawal 2008). Emissions rates methodology, including load factor calculations and base emissions and weighting factors for CO_2, CH_4, and N_2O were obtained from the Port of Los Angeles and Port of Long Beach 2022 air emissions inventory (Starcrest Consulting Group LLC, 2023). The average distance to the two designated Corpus Christi region lightering points (Corpus Christi 1 and 2) was obtained from the NOAA Marine Cadastre National Viewer (NOAA, 2023b). Lightering involves the transit of the lightering vessel, a Suezmax in this case, and pulling alongside the ship to be lightered, VLCC in this case, and idling at anchorage or slowly traveling (called "slow steaming") with the ship to be lightered during the cargo transfer of oil. GHG emissions during lightering will primarily be produced by transit and either idling or slow steaming. For purposes of the estimate, slow steaming, a conservative assumption, was used. Also, because in either the No-Action or action alternative scenarios, the VLCC would transit to the existing and planned terminals, the difference in emissions between them would be due to Suezmax lightering transit and slow steaming emissions. Therefore, the GHG estimate focused on Suezmax lightering emissions.

The estimate of lightering vessels needed relied on U.S. crude oil exports for reference (neutral growth) and high oil price cases conducted by the EIA (2021c), and historic crude oil export data gathered by the U.S. Census Bureau (2021a). Peak year crude export tonnage for Corpus Christi was derived from EIA-forecasted crude exports, and projections of the increasing crude export share comprised by the Port. Information on currently planned and potential future crude exporting berths from various permits, news, and midstream company release and from PCCA were used to apportion the exports to terminal locations (e.g., Ingleside, Harbor Island). The details and references for the estimate are discussed in Section 4.5 for navigation impacts. The estimate provided a range of VLCCs, and lightering vessels needed under the No-Action Alternative. Lightering vessels would be expected to be Suezmax vessels with the 54-foot Federal channel as they allow their near-full loading and would be required on a one-to-one basis for VLCCs. Because the action alternatives would not be expected to change the demand for crude oil, they would not change the total VLCCs needed. Therefore, analysis focused on lightering vessels. The estimate of annual lightering vessel counts for the highest lightering vessel count case is presented in Table 4-14. The operational emissions estimate for the No-Action Alternative are presented in Table 4-15.

4.1.9.2 Alternative 1: Channel Deepening (Applicant's Preferred Alternative)

4.1.9.2.1 Dredged Material Fugitive Emissions

Previous evaluation and testing of dredged material for the CCSCIP does not indicate the dredged material in the CCSC within the project area would pose concerns from fugitive emissions due to contaminants. Details on sediment testing can be found in Sections 3.2.5 and 4.1.4 and is briefly summarized here. This segment does not have heavy industry located on its banks and past maintenance material testing has not shown any signs of contamination (Montgomery and Bourne, 2018). The evaluation of previous testing results to determine further testing needed for the CCSCIP ruled out several volatile and semivolatile chemical groups including VOC, ethers, and organonitrogens, and nonvolatiles like dioxin. Testing for the remaining chemicals at the CCSC in the lower bay, Entrance Channel, and proposed channel extension, did not indicate issues with metals, polycyclic aromatic hydrocarbons, pesticides, or other chemical groups. With respect to fugitive dust, material placed either in a wet, slurry form during hydraulic dredging or underwater during hopper dredging would preclude an airborne particulate pollutant concern. Solids-to-water content in dredged material being placed by hydraulic or hopper dredging is typically only 10 to 20 percent (USACE, 2015b). For these reasons, dredged material does not pose fugitive emission concerns.

4.1.9.2.2 Emissions From Construction Equipment

The Applicant's Preferred Alternative would require dredges and supporting equipment to construct this alternative. Primary emissions would be from dredging material, transporting it, and placing material at dredged material PA or BU sites. Emissions were estimated in the following manner.

Dredging and Dredge Placement

Volumes to be dredged and geotechnical data by segment were obtained from data submitted by the Applicant. Placement areas to be used for BU and other dredged material placement were obtained from the PCCA's DMMP. The DMMP contained more capacity for placement than required new work dredging volumes. The dredging volume by segment was matched and paired up to the DMMP to identify volumes and dredged material types (e.g., sand, clay, silt) that would be generated from each segment to a PA, considering practical factors such as distance, material proposed or needed for placement or construction at the PAs, volumes and PA capacities. This resulted in a list of volumes by segment that would go to a PA.

Proposed Dredging Methods and PA Construction

Dredging and placement of deep draft navigation projects can be accomplished with a wide variety of methods and equipment and combinations. Project proponents leave specific means and methods open to dredging contractors to avoid overly restrictive costly bidding, variations in bidders' dredging fleet, and to encourage creativity in efficient construction. Therefore, the Applicant's plans contain several potential dredging techniques or do not specify a single method for several segments. However, dredging at the scale and in the environment required is normally limited to large hydraulic cutter suction dredge (CSD) or hopper dredging for most applications. The permit application and plans, and supplemental information submitted by the Applicant were reviewed to identify the proposed construction techniques required or expected for dredged material placement and BU. In several cases, the dredging method proposed could include mechanical or hydraulically-placed CSD dredging, and would practically depend on volume, type of material desired (e.g., sands), and the proposed constructed feature (i.e., dike, nourishment, interior fill). In other cases, a method was not specified, but could practically include either CSD with pipelines or hopper depending on distance from the dredged segment to a PA, such as the New Work ODMDS.

From the preceding information, practical dredging methods were selected considering the range of Applicant-proposed methods, distance from to the PA from the matched dredged segment, material type, and PA feature being built. The selected methods also considered usability in proposed BU features, and methods used in previous CCSC deepening projects, and other deep draft projects in the USACE Galveston District. The selected methods also considered various methods for offloading and transferring material for the given method such as hopper pump-out to shore in beach nourishment. In general, these factors resulted in the following types of dredging for the indicated segments:

- Segment 1 – Most offshore segment (entrance channel extension) – hopper dredging in open Gulf waters to place at the New Work ODMDS.
- Segment 2 – Middle offshore segment – hopper dredging in outer portions and hydraulic CSD with pipeline in inner portions to build nearshore berms, nourish beaches, restore Gulf shoreline, and place less BU-usable material in the New Work ODMDS.
- Segment 3 – Jetties channel – CSD to nourish beaches and restore Gulf shoreline.
- Segments 4, 5, and 6 – the Aransas Pass and Harbor Island segment – CSD with pipeline and mechanical dredging to construct placement dikes and rebuild shorelines, fill PA interiors, and in limited instances pump less usable material to the New Work ODMDS.

In this manner, dredging methods consistent with the proposed DMMP, past practice on the CCSC and other State deep draft navigation projects, and industry techniques (e.g., beach nourishment) were identified for the preferred project segments.

Dredging Equipment, Productivity, and Activity

Each dredge and placement method requires support equipment such as booster pumps, tugs, crew boats, and excavators to move unpropelled dredges (e.g., CSD), transport, then place dredged material. Dredge equipment necessary to do the proposed dredging and placement defined for each segment, was identified. Equipment assemblies were defined, considering industry practice and assemblies identified in previous deep draft navigation projects in the State. The State deep draft navigation projects were the recent Houston Ship Channel Expansion Channel Improvement Project, the Freeport Harbor Channel Improvement Project, and the Sabine Neches Waterway (USACE, 2010, 2012c, 2019c). This resulted in a series of standard hopper, CSD, and mechanical dredging equipment assemblies to address each segment and array of PAs, listed in Table 4-7. Similarly, dredge equipment horsepower was derived by reviewing equipment and HP assumptions from the State deep draft navigation project estimates and considering the needed volume and productivity. Given the required cubic yardage, the largest class of CSD (30-inch discharge and above) and hopper dredges (greater than 12,000 cy) would be required.

Dredging productivity was derived from various sources. New work dredging data from the past three years on cubic yards and contract performance start and end dates from past USACE dredging contracts were reviewed (USACE, 2022b). This included: dredging for the ongoing CCSCIP; other Texas, Gulf Coast and Atlantic deep draft channels; and the variety of dredge methods proposed. This also included assumed productivities from air quality or general conformity estimates from the CCSCIP and State's deep draft navigation projects (USACE, 2003, 2010, 2012c, 2019c). Appropriate rates were selected considering this

Table 4-7
Equipment Type and Count In Each Equipment Assembly
Used for Emissions Estimation

Assembly	Equipment (Count)	
Hopper 1	– Hopper Dredge (1) – Crew/Survey Boat (1) – Trawler (1)	
Hopper 2	– Hopper Dredge (1) – Crew/Survey Boat (1) – Dozer (3) – Front end loader (2) – Excavator (1)	– Field Truck (1) – Light Towers (2) – Welder (2) – Trawler (1)
Cutter 1	– 30-inch Cutter Suction Dredge (1) – Anchor Barge (2) – Derrick Barge (1) – Tender Tug (4) – Tow Tug (1) – Crew/Survey Boat (1)	– Dozer (3) – Front end loader (2) – Excavator (1) – Field Truck (1) – Light Towers (2) – Welder (2)
Cutter	– 30-inch Cutter Suction Dredge (1) – 30-inch Booster (1) – Anchor Barge (2) – Derrick Barge (1)	– Spill Barge (1) – Tender Tug (4) – Tow Tug (1) – Crew/ Survey Boat (1)
Bucket 1	– Mechanical Dredge (1) – Crew/Survey Boat (1) – Tow Tug (4)	– Excavators (1) – Dozer (2)

information, placement distances and material type. Support equipment usage rates were derived by reviewing assumed usage data and rates from the State deep draft navigation projects, and a DMMP air emissions estimation technical report (USACE, 2014b) and selecting appropriate values. This provided the horsepower and operational hours necessary to estimate emissions, in conjunction with load factors and emissions factors discussed in the next paragraph.

Dredging Emissions Factors

Emissions estimates require load factors which represent the fraction of total rated horsepower that equipment uses on average. Load factors were derived by reviewing general conformity estimates for the State deep draft navigation projects and selecting the more appropriate or average values (USACE, 2012c, 2019c). Selection considered similarity in dredge size and technique assumed, and dredged material type. Emissions estimates also require emissions factors for the criteria pollutants to convert horsepower and operational duration into mass of pollutant emitted (e.g., grams, tons). All equipment is anticipated to use diesel engines that would be compliant with 40 CFR Parts 89, 1039 and 1042 that govern the type of construction and marine equipment engines that would be used in construction. The EPA has two relevant broad categories of diesel propulsion for which emission standards and estimation methods are developed: Marine Vessel and Non-Road. Equipment was categorized accordingly. EPA defines emissions standards in a tiered approach, where older standards are assigned lower tier numbers (e.g., 0, 1) and more stringent ones, higher numbers (e.g., 3, 4). The dredging and construction industry fleets are mixtures of older and newer equipment meeting the various tiered standards. From Table 4-7, Hopper Dredge. Crew/Survey Boat, Trawler, 30-inch CSD, 30-inch Booster, Tender Tug, and Tow Tug were assigned age-weighted marine emissions factors from the Port Houston Air Emissions Inventory (Port Houston, 2017). These emissions factors were derived from population surveys of the harbor vessel fleet that performs maintenance dredging on the Houston Ship Channel. They reflect a mixture of Tier 0 through 3 equipment, with most in Tiers 0 and 2, for the marine vessel engine sub-Categories 1 and 2 relevant for dredges, tugs and other support vessels. This would be the same population of contract dredge vessels that perform work on the CCSC and therefore were used. Table 4-8 provides the weighted emission factors by vessel type (Port Houston, 2017).

Table 4-8
Weighted Emission Factors by Harbor Vessel Type for Category 1 and Category 2 Vessels*

Equipment Type/Pollutant	NO_x	PM_{10}	$PM_{2.5}$	SO_x	VOC	CO
Mai– - large dredge	9.3	0.23	0.22	0.004	0.1	1.8
Mai– - small dredge	9.3	0.23	0.22	0.004	0.1	1.8
Dredge auxiliary	7.3	0.23	0.22	0.004	0.1	1.7
Mai– - large tug	8.7	0.23	0.22	0.004	0.1	1.7
Mai– - small tug	8.7	0.23	0.22	0.004	0.1	1.7
Tug auxiliary	7.3	0.23	0.22	0.004	0.1	1.7
Miscellaneous	9.1	0.23	0.22	0.004	0.1	1.8

Source: Port Houston (2017).

* grams per horsepower per hour

The rest of the sources were assigned the Non-Road category. Tier 1 standards for Non-Road equipment have been applicable since the late 1990s. This tier reflects the likely oldest equipment to still be in use and likely overestimate the age of equipment given the fleet age mixture but represents a conservative assumption for estimating emissions. Therefore, emissions factors generally reflecting Tier 1 were assumed. Table 4-9 provides the Tier 1 Non-Road emission factor obtained from EPA (EPA, 2021j).

Table 4-9

Tier 1 Non-Road Criteria Pollutant Emissions Data*

Horsepower/Pollutant	NO_x	PM_{10}	$PM_{2.5}$	SO_x	VOC	CO
(11 ≤ hp < 25)	7.1	0.60	0.58	0.005	1.0	4.9
(25 ≤ hp < 50)	7.1	0.60	0.58	0.005	1.0	4.1
(50 ≤ hp < 100)	6.9	0.60	0.58	0.005	1.0	8.5
100 ≤ hp < 175	6.9	0.60	0.58	0.005	1.0	8.5
175 ≤ hp < 300	6.9	0.40	0.39	0.005	1.0	8.5
300 ≤ hp < 600	6.9	0.40	0.39	0.005	1.0	8.5
600 ≤ hp < 750	6.9	0.40	0.39	0.005	1.0	8.5
>750	6.9	0.40	0.39	0.005	1.0	8.5

Source: EPA (2021j).

* grams per horsepower (hp) per hour

During the feasibility study phase, the CCSCIP was scheduled for construction in five contracts over 5 years and 522 days dredging distributed over that period (USACE, 2003). The rate of production would imply multiple overlapping dredges assumed to perform dredging. The actual schedule has been adhering to a 5-year period (USACE, 2021d), but over four contracts. However, the dredging days have been more continuously distributed over these days based on contract lengths. It is assumed the CDP would be similarly executed given the very similar amounts and likely similar procurement. A dredging schedule distributing the dredging quantities required for each project segment was developed for this estimate. Because of the shorter length over which the CDP volume is distributed compared to the CCSCIP, three instead of four contracts were assumed (Table 4-10). From Applicant data, dredging activity is expected to be divided into six channel segments with each channel segment expected to handle dredge volumes indicated in Table 4-10. The bulk of the dredging activity is expected to be conducted in years 2 and 3. Dredging activity in Channel Segment 2 is expected to be conducted during both years 2 and 3. Segments 1 and 2 are expected to be under Contract A, segments 3 and 4 under Contract B, and segments 5 and 6 would be under Contract C.

Table 4-10

CDP Dredge Construction Volumes by Year Used for Emissions Estimate

Contract	Segment	Total (cy)	Annual Dredge Volume (cy) in Year Indicated				
			1	2	3	4	5
A	1	9,617,390	9,617,390				
	2	20,308,762		10,154,381	10,154,381		
B	3	2,105,041			2,105,041		
	4	2,851,897				2,851,897	
C	5	2,951,614				2,951,614	
	6	8,448,886					8,448,886
Total		46,283,590	9,617,390	10,154,381	12,259,422	5,803,511	8,448,886

Table 4-11 provides the total estimated construction emissions. Emission estimates for each engine have been based on horsepower hours, calculated by multiplying horsepower by load factor by operating hours, multiplied by emission factors in units of grams per horsepower hour. Emission factors have been chosen for marine and other nonroad engines to be relatively conservative (i.e., to be relatively higher in order to calculate reasonably worst-case emission levels). As a result, the estimated emissions are expected to be conservatively higher.

Table 4-11
CDP Estimated Dredge Construction Emissions Estimate

Channel Segment	Dredge Volume (cy)	Emissions (tons)					
		NO_x	PM_{10}	$PM_{2.5}$	SO_x	VOC	CO
1	9,617,390	589	15	14	0.3	6	114
2	20,308,762	933	23	22	0.4	11	185
3	2,105,041	226	6	6	0.1	6	68
4	2,851,897	383	11	10	0.2	7	100
5	2,951,614	625	17	17	0.3	12	158
6	8,448,886	1,074	31	29	1.0	25	309
Total	46,283,590	3,830.4	102.9	98.6	1.7	66.1	933.9

The construction emissions are temporary and would be distributed over the construction period. Table 4-12 provides the criteria pollutants emissions by year of construction activity. Although Corpus Christi is in attainment of NAAQS, this puts emissions in the context of annual airshed emissions used for comparing general conformity impacts. The estimated emissions were compared to regional emissions for Nueces and San Patricio counties listed in the PCCA 2017 Air Emissions Inventory (Port, 2019b) (Table 4-13). When compared to the major regional emissions in Nueces and San Patricio counties, most temporary pollutant emissions are minor percentages, and the NO_x is a small percentage (Table 4-13). For example, peak year NO_x emissions due to construction activity is only 6.15 percent of the regional emissions. CO, VOC, PM and SO_x contribute 0.76 percent, 0.14 percent, 0.11 percent and 0.05 percent, respectively, of the regional emissions.

Table 4-12
Criteria Pollutant Emissions by Each Year of Construction

Year	NO_x	PM_{10}	$PM_{2.5}$	SO_x	VOC	CO
1	588.82	14.60	13.96	0.25	6.35	114.10
2	466.74	11.64	11.14	0.20	5.28	92.35
3	692.64	18.13	17.37	0.31	10.86	160.30
4	1,008.36	27.83	26.68	0.47	18.96	258.26
5	1,073.85	30.67	29.44	0.50	24.64	308.91

Table 4-13
Comparison of Approximated Emissions to Regional Emissions

Pollutant	Annual Emissions (tons)		
	CDP		Nueces and San Patricio Counties Regional*
	Peak Year	Percent of Regional Emissions	
PM	30.7	0.11	29,086
SO_x	0.5	0.05	975
NO_x	1,073.8	6.15	17,475
VOC	24.6	0.14	17,873
CO	308.9	0.76	40,457

Source: Port (2019b).

*SO_x reported as SO2 which is typically 98 percent of SO_x

The regional emissions information did not include Aransas County, but it is expected to comprise a relatively smaller portion of regional emissions given the sparser industry and development.

Dredging would be a one-time activity that would not continue past completion. Since the emissions estimated in Table 4-12 are temporary in nature and are expected to last only for a period of five years during the construction phase of this project, the air impacts are minor and short-term. Additionally, the dredging/construction operations affect air quality only in the immediate vicinity of dredging activities. Each dredging operation would be independent of the other, although, there may be some temporal overlap. Simultaneous dredging would occur with large distances between them due to navigation and dredge spacing requirements, and the nature of dredge procurement and operations.

Ozone is the NAAQS pollutant of most concern for the Corpus Christi airshed (Corpus Christi Air Quality Group, 2019). As discussed in Section 3.2.11, the principal ozone precursors are NO_x and VOC. Peak year emissions of NO_x are 1,074 tons, would be expected during the fifth year of construction. The average reduction in lightering emission reductions is estimated to be 221 tons of NO_x. Therefore, these peak emissions would be offset due to lightering emissions reductions in less than 5 years. For VOC, the average reduction in lightering emission reductions is estimated to be 18,405 tons. The emissions reductions were far greater for VOC because of elimination of the relatively uncontrolled nature of lightering at sea and the relatively high generation of VOC vapor during this loading activity. Therefore, the peak VOC construction emissions would be offset due to lightering emissions reductions in the first year. Previous research has shown Corpus Christi ozone formation to be more sensitive to VOC emissions than to NO_x (Farooqui et al., 2013). The reduction in lightering emissions beyond years 1 and 5 for VOC and NO_x, respectively, would continue to result in positive benefits to air quality (i.e., lower lightering emissions post dredging project) in the project area.

As discussed in Section 3.2.11, the Corpus Christi region is in attainment of NAAQS for all criteria pollutants. In summary, due to the magnitude and temporary nature of the construction dredging emissions, Alternative 1 would not be expected to jeopardize attainment. Given the small percentage of regional emissions, and their temporary nature, the construction dredging emissions under Alternative 1 are not expected to have adverse long-term impacts to air quality in the area.

4.1.9.2.3 Operational Emissions

Under Alternative 1, the same VLCCs loaded under the No-Action Alternative would still be loaded, except lightering events would be reduced as the deepened channel would allow full loading at the Harbor Island terminals. Therefore, the impact assessment focused on the change in lightering activity. For VLCCs originating at Harbor Island, the lightering activity and associated emissions would be eliminated. For VLCCs originating at Ingleside, Alternative 1 would eliminate the lightering if those terminals made arrangements with Harbor Island terminals to top off light-loaded VLCCs instead of continuing lightering or using offshore SPMs to top off. It is more likely arrangements with Harbor Island terminals or SPM providers would be made, as lightering would be expected to be more costly, due to the extra vessel costs.

Table 4-14 summarizes the lightering demand under the No-Action Alternative, and for Alternative 1 under both assumptions related to topping off.

Table 4-14

Expected Lightering Demand No-Action Alternative and Alternative 1

Scenario	Annual Suezmax Lightering Vessel Count		
	Ingleside	Harbor Island	Total
No-Action Alternative	234	292	526
Alternative 1			
Assuming No Topping Off at Harbor Island but Ingleside lightering continues	234	0	234
Assuming Topping Off at Harbor Island	0	0	0
Average	–	–	117

Based on the change in lightering demand, the reduction in associated emissions can be estimated. Since, the number of lightering events translate to air emissions, the baseline emissions and Alternative 1 lightering demand can be estimated. Those can be used to predict the air quality impacts due to the (reduced) lightering events under Alternative 1. Table 4-15 provides the key data and results from the lightering demand reduction calculations due to increased draft under Alternative 1. The largest emissions reductions in terms of mass are VOC and CO_{2e}, as they are the primary emissions produced during lightering: VOC during loading, and CO_{2e} primarily during transit and idling or slow steaming during cargo transfer.

Table 4-15
Comparison of No-Action Alternative and Alternative 1 Lightering Emissions

Description/Alternative	Emissions (tons)						
	NO_x	VOC	CO	PM_{10}	$PM_{2.5}$	SO_x	CO_{2e}*
Tons Emissions per Lightering Event	0.54	45	0.1	0.05	0.05	0.33	6.33
No-Action Alternative (Lightering Events)	284	23,670	53	26	26	174	3,332
Alternative 1							
Assuming No Topping Off at Harbor Island	126	10,530	23	12	12	77	1,482
Assuming Topping Off at Harbor Island	0	0	0	0	0	0	0
Average Reduction in Lightering Emissions	221	18,405	41	20	20	135	2,591
Average Percent Reduction	78 percent						

*CO_{2e} is CO_2 equivalents including methane and nitrous oxide contribution in addition to carbon dioxide. Values given in metric tons for comparison to regional inventories.

4.1.9.3 Alternative 2: Offshore Single Point Mooring

4.1.9.3.1 Construction Emissions

Under this alternative, an assumed array of eight SPMs would be constructed requiring two 30-inch pipelines for each cluster of two SPMs for a total of eight pipelines. Insofar as onshore facilities (storage tanks, pumps etc.) would be similar to onshore terminals, the main difference in construction would be the offshore portion of pipelines and SPMs. Emissions from construction of would primarily be produced by the pipeline installation that would typically involve a 60- to 75-foot construction corridor, a pipelayer barge or vessel and a jet trench sled that trenches and buries the pipe under 3 feet of cover. Primary emitters are the pipelaying vessel or self-propelled barge engines, crane systems to lay pipe, and power generation to supply jet trench electric motors. On-shore facilities supporting the SPMs would involve primarily Non-Road equipment such as excavators, dozers, cranes, and dump trucks that would, similar to Alternative 1, have engines complying to 40 CFR 89, 1039, and 1042. These emissions have not been calculated but would be similar to diesel engine criteria pollutants under Alternative 1 and would be temporary.

4.1.9.3.2 Operational Emissions

Under Alternative 2, all loading of VLCCs would take place at an array of SPMs, instead of at onshore Harbor Island terminals. Therefore, full loading of VLCCs at SPMs would occur under this alternative. Although this would eliminate the need for lightering vessels, the loading of crude would take place 15 miles away from shore, where the more stringent vapor controls required on onshore terminals such as Harbor Island, would not be feasible that far offshore. Information from the Maritime Administration application for one of the offshore SPM terminals being planned in the Corpus Christi area was reviewed (Bluewater Texas Terminal, 2019a). The Maximum Achievable Control Technology (MACT) determination required for Maritime Administration permitting concluded that controls that are used at onshore facilities or that could be used in nearshore applications, were not feasible for an SPM far offshore. These were controls such as vapor recovery onboard, via pipeline, or on work boats. The MACT determination concluded that bottom filling (i.e., submerged filling) and VOC management were the MACT control proposed. These would essentially be the same controls available to and used by lightering vessels (EPA, 2001b).

Lightering vessels similarly run pump and hoses to the VLCC cargo hold as SPM buoys do. Though submerged filling reduces vapor loss and reduction factors for other petroleum products are described in AP-42 literature used in the Sturtz et al. (2017) study, it did not indicate a modification to factor calculations for crude oil during submerged filling (EPA, 2008a). Therefore, the lightering emissions in the Sturtz et al. (2017) study were assumed to be representative of loading using submerged filling. Given that loading at SPMs would take place under essentially the same conditions and types of controls, it was assumed that Alternative 2 loading emissions would be similar to lightering emissions. Although lightering emissions are dominated by VOC emissions during loading, the main difference between SPM and lightering emissions would be that vessel transit emissions wouldn't occur with SPMs, because oil is pumped via pipeline to the SPM. Therefore, to estimate the portion of lightering emissions that SPM loading emissions would be similar to, the percent emissions that loading emissions comprise lightering emissions in the Sturtz et al. (2017) study was calculated. These emissions, product transfer, and ballasting, were 99.53 percent of all VOC emissions, and produce none of the other criteria pollutants (e.g., NOx, CO). The other pollutants are less than 2 percent by weight of the VOC emissions.

Because this alternative involves fully loading a VLCC at an SPM instead of the partial-loading involved in lightering, the VOC emissions per loading event would be expected to be greater than the emissions derived from Sturtz et al. (2017). The study estimated emissions from lightering event data from 2014 when lightering was dominated by import lightering, as the crude export ban was lifted in 2016. This involved transferring oil from VLCCs to the lightering vessel with smaller total amounts transferred (50,000 to 500,000 barrels) instead of the 1,000,000 barrels expected per event in reverse lightering needed for crude exporting under the action alternatives. For Alternative 2 specifically, full loading of approximately 2,000,000 barrels at SPMs would occur per event. Therefore, the emissions per loading event under Alternative 2 would be expected to be greater than the per-lightering event data derived from the Sturtz et al. (2017) study. A more barrel-specific recreation of the emissions calculations for this reverse lightering scenario would be required to estimate the potential emissions more accurately. However, as a conservatively low estimate, the per-lightering event emissions is assumed.

Considering this, emissions under Alternative 2 would be approximately 99.5 percent of the 23,670 annual tons of No-Action VOC emissions, or 23,559 tons of VOC, annually. It is likely that the VOC emissions would be greater than the No-Action Alternative, due to full loading taking place at SPMs instead of half of the loading taking place at an onshore terminal. All other criteria pollutants from lightering would be eliminated, including CO_{2e}. Therefore, this Alternative 2 would result in continuation and potentially an increase of most of the loading emissions, comprised primarily of VOC, as the No-Action Alternative, with no reduction compared to Alternative 1.

4.1.9.4 Alternative 3: Inshore/Offshore Combination

4.1.9.4.1 Construction Emissions

Under Alternative 3, VLCCs would still half-load at onshore terminals, but SPMs would be assumed to be used to fully load them offshore. For purposes of this analysis, it was assumed a two SPM array would provide the sufficient availability to top off VLCCs. This would involve the same construction techniques and emitters as Alternative 2 but would be one-fourth the amount of construction. The emissions have not been estimated but would be similar diesel engine criteria pollutants as Alternative 1 and would be temporary.

4.1.9.4.2 Operational Emissions

Under Alternative 3, the channel would not be deepened to full VLCC depth, and VLCCs would load to half capacity at Ingleside and Harbor Island but top off at offshore SPMs. For purposes of this analysis, it was assumed a two SPM array would provide sufficient availability to top off VLCCs. Like Alternative 2, this would eliminate the reverse lightering, but the VOC emissions control would be limited to that similarly used in lightering. The difference would be that loading would be limited to approximately half of what Alternative 2 would involve per event. Under this alternative, the emissions would be expected to more closely match No-Action Alternative emissions, and again consist of the 23,559 tons of VOC, annually and not expected to likely be greater. Similar to Alternative 2, emissions other than VOC, would be reduced, including CO_{2e}, through the elimination of transit and slow steaming or idling during lightering.

4.1.9.5 Greenhouse Gas Emissions

Absent of any of the action alternatives, VLCCs would continue to call at existing and planned terminals, using lightering. The GHG emissions of the No-Action and Alternative 1 were presented in Table 4-15. Alternatives 2 and 3, because they eliminate the lightering vessel transit and slow steaming, would reduce GHGs the same as Alternative 1. To put these reductions in context, the annual average reduction of 2,591 metric tons of CO_{2e} would be approximately 0.65 percent of the estimated 2017 regional emissions of 396,615 metric tons CO_{2e} presented in Section 3.2.11.3, which would be a small positive effect.

4.1.10 Noise

4.1.10.1 No-Action Alternative

Under the No-Action Alternative channel deepening would not occur and reverse-lightering would continue. Noise sensitive receptors would be limited to the same residences stated previously along Aransas

Pass and near Harbor Island. No permanent noise sources would be installed as part of the No-Action Alternative.

Elevated noise levels may occur under the No-Action Alternative creating short-term noise increases during maintenance dredging while long-term increases due to increasing ship traffic would occur over time. Therefore, the No-Action Alternative would have no major noise impacts in the immediate future.

Under this alternative in the future, continued increasing ship traffic along the channel would result in more sound-generating events from vessels and higher average noise levels due to the higher traffic required to meet the demand.

Under the No-Action Alternative, VLCC terminals currently being planned and permitted would be present. These would have noise sources associated with the loading and transit of VLCCs and lightering vessels. Those projects have separate NEPA analyses being performed that are not part of this CDP. However, information from these permits and literature to frame the nature of these noise sources is discussed in the next subsections. This is done to contrast any effects that channel deepening or other action alternatives may have on the nature of those noise sources.

4.1.10.1.1 Vessel Loading

The loading noise attributable to Harbor Island terminals in the worst-case (nearest) distance (approximately 1,100 feet from sensitive receptors) is not expected to cause any noise issues. The typical pump arrangement in a loading facility places the pumps closer to the storage tanks providing a setback from the berth. Based on terminal permit information, this means the pumps range from 750 to 900 feet away from the midship of the tanker at berth, with vapor recovery units even further at 1,250 feet (Lloyd Engineering, Inc., 2020). Noise from the pumps is estimated to be 72 dBA at 50 feet and the same for the vapor recovery units (Aspen Environmental Group, 1992). Therefore, the cumulative sound level at the midship with the cumulative sound of a pump and vapor recovery unit would drop to 49 dBA from the source location:

$$Pump\ Sound\ at\ 900\ feet = 72 - \left|20\log\left(\frac{50}{900}\right)\right| = 46.9dBA$$

$$Vapor\ Recovery\ Sound\ at\ 1250\ feet = 72 - \left|20\log\left(\frac{50}{1250}\right)\right| = 44dBA$$

$$Cumulative\ Sound\ at\ Tanker\ Midship = 10\log(10^{\frac{46.9}{10}} + 10^{\frac{44}{10}}) = 48.7dBA$$

Considering the distance from the tanker's midship to the nearest sensitive receptor the noise level is further attenuated to 42 dBA. Note that this estimate assumes unshielded conditions without any physical obstructions (known as "free-field" conditions), and the actual noise levels are expected to be lower due to screening from the vessel itself. Other terminal sounds such as boat docking and tugs would occur at Harbor Island, as the terminals would operate with the 54-foot channel depth currently being dredged.

In the No-Action Alternative, VLCCs would be loaded to approximately half their capacity. The remaining capacity would be loaded in the Gulf by lightering Suezmax vessels. It is highly likely these lightering vessels would be loaded at the Harbor Island terminals themselves since the same grade and product would be required. Therefore, the time spent in berth loading would be approximately the same as loading a VLCC fully, except that the loading time would be split between a VLCC and Suezmax. However, the sound levels discussed in the previous paragraph, are not expected to cause noise issues.

4.1.10.1.2 Vessel Transit

Under the No-Action Alternative, VLCCs would continue to transit the channel escorted by four to five tugs, similar to existing conditions. A typical tugboat produces a sound pressure level of 80 dBA to 87 dBA at a distance of 50 feet. While escorting a VLCC, the shortest distance to sensitive receptors is 420 feet, which is the distance from the center of the channel to residences along Cline Point. Based on this, the worst-case short duration sound level at residential receptors is estimated to be 62 dBA to 69 dBA from a tugboat This would be similar to noise levels from tugboats already used to escort crude carriers, including VLCCs, through the channel.

4.1.10.2 Alternative 1: Channel Deepening (Applicant's Preferred Alternative)

Under Alternative 1, VLCCs could be fully loaded from berths at Harbor Island. Any VLCCs partially loaded at Ingleside could then be fully loaded at Harbor Island, which in turn would eliminate the need for reverse lightering. All dredged material under this alternative would be transported to potential BU sites.

4.1.10.2.1 Dredging Impacts

Dredging equipment is anticipated to include two dredges to be used potentially simultaneously, with one used for offshore dredging and the other used for inshore dredging. Most likely it would be a combination of two CSDs or a CSD and a hopper dredge. It is more likely that hopper dredging would be used for outside of the jetties (approximately 3,000 feet offshore). The total time for the project related dredging work is anticipated to be approximately 4 to 5 years for the whole channel length based on the anticipated dredging fleet. However, more critical to sensitive receptor noise, it is anticipated to last 1.5 to 2 years inside of the jetties. During dredging activities there would be an increase of noise emissions along Aransas Pass and Harbor Island between the project limits which currently have two residential areas directly adjacent to the channel.

Noise emission levels of a standard CSD vary from 80 dBA to 90 dBA at 50 feet, depending on the engine components and the configuration of the dredge (USACE, 2005). It is expected that noise from the inshore CSD would range from 64 dBA to 74 dBA at the most sensitive receptors based on a 6 dBA reduction in sound level per doubling of distance under free-field conditions. However, it must also be noted that these noise levels are only to be present on a short-term basis, ranging from a couple of weeks to around 2 months within the critical distance. As a result, there would be no permanent increase to noise levels at the noise-sensitive receptors, and would be similar to the current maintenance dredging that occurs every 1 to 3 years. In the event that noise complaints are received, additional noise reducing measures could be implemented during quiet hours.

4.1.10.2.2 Dredged Material Placement Impacts

Dredged material would be placed at a combination of potential BU sites and the New Work ODMDS. The identified placement sites are generally located far from the nearest sensitive receptors (distances far exceeding 1,000 feet), however, the placement location at Mustang Island is much closer having a 300-foot buffer to the first line of residential areas. The loudest noise producing equipment near the site would be dozers which typically have a sound pressure level of 80 dBA to 85 dBA at 50 feet (USACE, 2000). Based on the free-field propagation characteristics of sound the estimated sound levels at the nearest residences are 64 dBA to 69 dBA on a short-term basis (approximately three months at Mustang Island). Additionally, the residential areas closest to the placement actions targeting BU experience relatively high background noise due to wind and waves, which would decrease the audibility of material placement noise and associated potential for annoyance.

The New Work ODMDS is approximately 20,000 feet from shore in the Gulf. Dredged material is anticipated to be deposited at the ODMDS using tug-towed scows, hopper dredge, or a slurry pipe with a booster pump (approximately 3 miles from shore). Of these three options, the most significant noise would be produced by the booster pump. Noise levels from the booster pump are similar to those emitted from CSDs, which are approximately 80 dBA to 90 dBA at a distance of 50 feet (USACE, 2005). Accordingly, the material placement noise levels at the nearest residential areas are estimated to be approximately 28 dBA to 38 dBA. These sound levels are low and would generally be inaudible compared to the background sound levels from waves, wind, and typical human activity including road traffic. Therefore, placement of dredged material for construction of Alternative 1 is not expected to pose major adverse impacts.

4.1.10.2.3 Operations Impacts

After completion of the channel deepening, operations are not expected to change the sound profile that already exists in the area. Channel deepening would eliminate the need for lightering Suezmax vessels, which would consequently eliminate associated noise emissions due to the transit and loading of the Suezmax vessels. VLCCs may either be partially loaded at Ingleside terminals and topped off at Harbor Island terminals, or fully loaded at Harbor Island terminals. The total noise levels due to loading are expected to be similar to the No-Action Alternative, except that a higher proportion of the total loading time may occur at Harbor Island terminals. Also, approximately the same number of VLCCs would traverse the channel as the No-Action Alternative, except that they would be fully loaded. Thus, with the elimination of lightering Suezmax vessels, the cumulative impacts of vessel transit noise in the channel would decrease. Vessel loading and transit noise levels are estimated in sections below.

4.1.10.2.4 Vessel Loading

Channel deepening would allow VLCCs to be fully-loaded at Harbor Island terminals instead of half-loaded. This would mean a longer duration spent in berth for a VLCC. However, this would eliminate the loading time needed for a Suezmax vessel that would likely load at Harbor Island under the No-Action Alternative. Therefore, the total loading time at berth would not be expected to change under Alternative 1 for vessels originating at Harbor Island. If VLCCs from Ingleside arrange to top off at Harbor Island, there would be increased loading events. However, the noise levels for loading described under the No-Action Alternative are not expected to present issues given their low decibel levels. Therefore, channel deepening under Alternative 1 is not expected to impact noise levels from loading or pose noise issues. Other terminal sounds such as boat docking and tugs would exist without the channel deepening and be intermittent. These noise sources are not affected by channel deepening in Alternative 1 and are thus, not considered.

4.1.10.2.5 Vessel Transit

VLCCs would continue to transit the channel, escorted by multiple tugs, as they would under the No-Action Alternative. Crude carrier vessel transit noise experienced at Ingleside and Harbor Island would be reduced slightly with the elimination of lightering vessel noise from Suezmax vessels. The traffic volume of crude carriers is anticipated to decrease since, for the same production volume of crude oil, fewer ships would need to be loaded in the channel. Therefore, vessel transit noise is not expected to increase due to Alternative 1.

4.1.10.3 Alternative 2: Offshore Single Point Mooring

Alternative 2 would involve offshore loading and the CCSC would remain at –54 MLLW. To meet the projected oil export demand, multiple deep water port facilities (SPMs) would be constructed. VLCCs would be fully loaded offshore eliminating the need for lightering, and crude carriers would no longer need to traverse the CSCC. Under this alternative, dredging of the channel would not be required and the impacts associated with dredged material placement would not be present as a result. Underwater trenching would be required to allow for the installation of pipelines, which would produce noise underwater near the site but would not be a major source of airborne noise. Additionally, due to the large distance from the offshore facilities to the nearest sensitive receptors (approximately 15 miles) operational noise impacts would be negligible.

4.1.10.4 Alternative 3: Inshore/Offshore Combination

Similar to Alternative 2, Alternative 3 would not require channel deepening as the CCSC would remain –54 MLLW. To meet the projected oil export demand, multiple deep water port facilities (SPMs) would be constructed. This alternative differs from Alternative 2 as instead of fully loading at the offshore facilities, VLCCs would be partially loaded at inshore facilities at Ingleside and Harbor Island then travel through the CCSC to the offshore facility to be topped up. Alternative 3 would also no longer require the dredging of the channel and the impacts associated with dredged material placement would not be present as a result. Since VLCCs would still need to traverse the channel, operational noise impacts would be similar to those of Alternatives 1 and 2, except that VLCCs would only be partially loaded and thus the total duration of loading activities and associated noise emissions would be reduced.

4.2 ECOLOGICAL AND BIOLOGICAL RESOURCES

The following sections describe ecological and biological resources that could be impacted from the various alternatives (Table 4-16).

Table 4-16
Summary of Potential Aquatic Resource Impacts (acres)
Associated with the Applicant's Preferred Alternative

Project Component	Footprint	Open Water[1]	Seagrass[2]	Oysters[3]	Flats/ Beach[4]	Estuarine[5]	Palustrine[6]	Source
SS1	297.41	219.45	0.01	0	34.64	3.92	21.04	Applicant
SS2	45.21	13.74	0	0	24.20	1.25	11.25	Applicant
PA4	170.79	42.14	3.46	0	2.80	0.75	41.75	Applicant
HI-E	138.73	13.12	3.41	0.10	23.21	10.69	48.42	Applicant
SJI	441.23	163.29	0	0	199.01	0	0	Applicant
MI	362.21	205.58	0	0	124.11	0	0	Applicant
Channel Deepening/ Extension	1,182.33	1,182.33	–	–	–	–	–	NOAA (2010)
B1–B9	1,585.82	1,585.82	–	–	–	–	–	NOAA (2010)
New Work ODMDS	1,180.00	1,180.00	–	–	–	–	–	NOAA (2010)
Total	5,403.60	4,605.47	6.88	0.10	407.97	16.61	122.46	

[1] Open Water (E1UBL M1UBL, M2USN)
[2] Seagrass (E1ABL)
[3] Oysters (E1ABL)
[4] Flats (E2ABN, E2EM1N(1) E2USN, UPL [tidal flats above the high tide line were classified as upland])
[5] Estuarine (E2M1P, E2SS3N)
[6] Palustrine (PEM1C(1))

4.2.1 Wetlands and SAV

Trends of wetland loss within the project area are expected to continue due to climate change stressors (sea level rise, temperature increases, salinity changes, and wind and water circulation changes) combined with increased development and hydrologic alterations. As sea levels rise, tidal wetlands along the shoreline would shift landward, causing changes in the distribution of wetlands along the coast (Guannel et al., 2014). Non-tidal wetlands would also be impacted as rising seawater inundates river systems and low-lying palustrine wetlands are converted to tidal saline wetlands. Urban areas and hardened shorelines represent a barrier to landward migration of wetlands that can lead to wetland loss, although the protection of wetland migration corridors could increase the adaptive capacity of these valuable ecosystems (Borchert et al., 2018). Depressional wetlands located further inland within the study area would likely be more resilient to change, although urban development, hydrological modification and drought would remain as threats. These wetland trends are expected to continue irrespective of which alternative is selected.

4.2.1.1 No-Action Alternative

No direct impacts to wetlands or SAV under the No-Action Alternative would occur. Without potential BU placement to serve as a protective barrier in some areas, SAV may have a higher risk for loss. The ongoing erosion of shorelines at Harbor Island combined with sea level rise could expose large areas of SAV to more erosive forces, leading to the loss of SAV over time. Climate change stressors and increased development would likely continue the trend of wetland loss and the migration of estuarine systems landward under the No-Action Alternative.

4.2.1.2 Alternative 1: Channel Deepening (Applicant's Preferred Alternative)

As shown in Figure 3-18, there are no wetlands mapped within the footprint for proposed channel deepening. Channel deepening would occur withing the existing CCSC, therefore impacts to wetlands would be avoided during construction of Alternative 1. Compensatory mitigation to offset unavoidable impacts to wetlands and SAV as a result of placement actions must be implemented. The CDP will permanently impact 44.63 acres of special aquatic sites requiring mitigation to offset these permanent losses. These include 21.04 acres of palustrine wetlands, 16.61 acres estuarine wetlands, 6.88 acres of SAV, and 0.10 acres of live oysters. The PCCA proposes to utilize SS1 to construct their Permittee responsible mitigation (PRM) site. The objective of mitigation is restoration through the reestablishment of 32.94 acres of estuarine wetlands, 42.08 acres of palustrine wetlands, and 6.88 acres of SAV (Triton Environmental Solutions, 2023; Appendix K). The mitigation proposed by PCCA is summarized in Section 6.0. Indirect impacts from turbidity would be limited in time and space to the area around the dredging, and no major impacts would be expected to wetlands from temporary turbidity increases during construction.

At the proposed placement sites, wetland delineations were conducted by Mott MacDonald (2021, 2022) and SAV surveys by Triton Environmental Solutions (2021a, 2022a). The results of these surveys are discussed below. Wetland impacts are presented by BU site and organized by tidal and non-tidal impacts in Table 4-17 and Table 4-18.

The proposed placement actions targeting BU include a variety of upland, aquatic habitat, and deep open water habitats. Wetlands impacts would result from dredged material placement for enhancement targeting BU. Placement of fill at nearshore berms (B1–B9) would not result in impacts to wetlands. Table 4-17 summarizes the direct impacts of tidal and non-tidal wetlands (Mott MacDonald, 2021, 2022). The TPWD Ecological Mapping Systems of Texas is a 33-foot spatial resolution land classification map of Texas, created from satellite imagery and ground data samples (TPWD, 2020). Ecological Mapping Systems of

Texas land cover descriptions are provided in Table 4-18 to describe the corresponding landform for each wetland NWI type.

Table 4-17

Summary of Direct Wetland and Seagrass Acreage Impacts from Placement Area Construction

Site	Estuarine[1]	Palustrine[2]	Seagrass[3]	Footprint Total
SS1	3.92	21.04	0.01	297.41
SS2	1.25	11.25	0	45.21
PA4	0.75	41.75	3.46	170.79
HI-E	10.69	48.42	3.41	138.73
SJI	0	0	0	441.23
MI	0	0	0	362.21
Total	16.61	122.46	6.88	1,455.58

[1] Estuarine (E2EM, E2SS)

[2] Palustrine (PEM)

[3] Seagrass (E1ABL)

Table 4-18

Tidal and Non-Tidal Wetland Types Delineated within Placement Areas

Resource Type	NWI Classification	TPWD Ecological Mapping Systems of Texas
Tidal	E2EM1N	Coastal: Salt and Brackish Low Tidal Marsh
	E2EM1N1	Texas Salt and Brackish Tidal Flats
	E2EM1P	Coastal: Salt and Brackish High Tidal Marsh
	E2SS3N	Coastal: Mangrove Shrubland
Non-tidal	PEM1C	Interdunal Wetland; Sea Oxeye Daisy Flats; Texas Saline Coastal Prairie
	PEM1C1	Texas Saline Coastal Prairie
	PSS1C	Non-native Invasive Brazilian Peppertree Shrubland
	PSS3C	Coastal: Mangrove Shrubland

Source: Mott MacDonald (2021, 2022); TPWD (2020).

Delineated wetlands were described as either estuarine or palustrine. The high tide line elevation, determined to be +2.7 feet NAVD88, acted as the dividing line between tidal estuarine wetlands and non-tidal palustrine wetlands (Mott MacDonald, 2021, 2022). Estuarine wetlands are described as consisting of deepwater tidal habitats and adjacent tidal wetlands that are semi-enclosed by land with partial or sporadic access to the open ocean. Palustrine wetlands are described as including all non-tidal wetlands dominated by trees, shrubs, emergent vegetation, and some areas lacking such vegetation (USFWS, 2022a). Also included are wetlands in tidal areas with salinity below 0.5 ppt (Mott MacDonald, 2021, 2022). Placement areas would result in direct impacts to 16.61 acres of tidal (estuarine) emergent and shrub scrub wetlands, and 122.46 acres of freshwater (palustrine) emergent and shrub scrub wetlands (Mott McDonald, 2021, 2022).

Tidally influenced estuarine wetlands were dominated by smooth cordgrass and were bounded by black mangrove or unvegetated shoreline. Other dominant estuarine wetland plants were dwarf glasswort (*Salicornia bigelovii*), pickleweed (*Sarcocornia ambigua*), shoreline seapurslane (*Sesuvium portulacastrum*), and saltgrass/shoregrass (*Distichlis* spp.). Palustrine wetland plant communities were dominated by emergent species like salt meadow cordgrass (*Spartina patens*), Gulf cordgrass (*Spartina spartinae*), sea-oxeye daisy, glasswort, saltgrass, and Gulf dune paspalum (*Paspalum monostachyum*). Palustrine shrubland species primarily included sumpweed (*Iva frutescens*), eastern baccharis, and Brazilian peppertree (*Schinus terebinthifolia*) (Mott McDonald, 2021, 2022).

The proposed placement sites for BU include areas where SAV has been mapped. Each BU site included a 500-foot survey buffer that increased the total survey area in the direction of open water and estuarine marsh. Table 4-19 summarizes the acreage of mapped SAV along with the percent frequency by species at each BU site. Five estuarine SAV species occur in the project area, including shoal grass, widgeon grass, turtle grass, clover grass, and manatee grass. Proposed BU sites HI-E, SS1, and PA4 contained SAV, with SS1 having the highest total acreage and species diversity. Placement of fill at nearshore berm sites B1–B9 would not result in impacts to SAV. Construction of SS1, PA4, and HI-E would result in direct impacts to 6.88 acres of SAV (Triton Environmental Solutions, 2021a, 2022a). Within the survey area, three SAV beds were delineated within SS1 with five species identified, however the SAV beds were primarily composed of shoal grass, widgeon grass, and turtle grass. Four SAV beds were delineated within the PA4 and HI-E PAs and SAV was primarily comprised of shoal grass and widgeon grass, although clover grass and turtle grass were present in trace amounts in PA4. No SAV was delineated in placement sites SS2, MI, or SJI.

Wetland and SAV impacts would occur at proposed placement sites. Indirect impacts could occur during construction due to turbidity increases or physical disturbances. Best management practices used during construction, such as turbidity curtains, silt fencing, or construction matting, should avoid and minimize these indirect impacts. It should be noted that dredged material would be used at all PAs to either: 1) convert deep open water areas to protect adjacent shallow bathymetry that support or can establish tidal wetlands or SAV, or 2) restore eroding shorelines that would protect larger extents of SAV. For example, some of the proposed BU sites would restore eroding shoreline and upland near Harbor Island that may offer protection to SAV present across Redfish Bay. This action may help protect SAV that could be exposed if the shoreline is breached with the continued erosion expected under the No-Action Alternative. Other proposed placement sites would convert open water areas to create tidal estuarine wetlands or SAV habitat. Considering the beneficial use nature and objective of these PAs to protect or provide more area conducive to tidal wetlands or SAV establishment, Alternative 1 may positively impact tidal wetlands and SAV. During construction and operations there is some chance of spills which may also impact wetlands or SAV.

Table 4-19
Summary of Total SAV Impacts by BU Site

BU Site	SAV Type	Percent Frequency	Total Direct Impacts (Acres)
HI-E	Widgeon grass	29.9	3.41
	Shoal grass	15.8	
SS2	–	–	–
SS1	Shoal grass	21.9	0.01
	Widgeon grass	11.0	
	Turtle grass	10.8	
	Clover grass	<1.0	
	Manatee grass	<1.0	
PA4	Shoal grass	39.5	3.46
	Widgeon grass	10.8	
	Clover grass	<1.0	
	Turtle grass	<1.0	
MI	–	–	–
SJI	–	–	–
		Total	6.88

Source: Triton Environmental Solutions (2021a, 2022a).

4.2.1.3 Alternative 2: Offshore Single Point Mooring

Potential impacts of Alternative 2 to wetlands and SAV would be similar to those described under the No-Action Alternative. This alternative would eliminate further dredging of the channel and the impacts associated with dredged material placement, however BU projects to repair vital beach and island habitats would not take place. It is assumed that any pipelines that would transport crude to the offshore terminals would be installed using HDD as much as possible thereby avoiding or minimizing any impacts to wetlands and SAV; however, there is some chance of increased turbidity during construction which may also impact wetlands or SAV. During construction and operations there is some chance of spills which may also impact wetlands or SAV.

4.2.1.4 Alternative 3: Inshore/Offshore Combination

Potential impacts of Alternative 3 to wetlands and seagrass would be similar to those described for the No-Action Alternative and Alternative 2. VLCC vessels would be partially loaded at inshore facilities in Ingleside and Harbor Island and then fully loaded at an offshore terminal. There would be no impacts associated with dredged material placement, however BU projects to repair vital coastal habitats would not take place. Similar to Alternative 2, it is assumed that the pipeline supplying crude would be installed with

HDD technologies and would avoid or minimize wetland and SAV impacts; however, there is some chance of increased turbidity during construction which may also impact wetlands or SAV. During construction and operations there is some chance of spills which may also impact wetlands or SAV.

4.2.2 Aquatic Resources

4.2.2.1 Freshwater Habitats and Fauna

There are no freshwater streams or reservoirs in the project area. Within the study area, Rincon Bayou, the Nueces River, and Gum Hollow are freshwater streams flowing into Nueces Bay. The freshwater stream contributing most of the freshwater flow in the study area is the Nueces River. It is separated from the estuary by a saltwater barrier dam. There is no perennial flow in Rincon Bayou. Except during floods, freshwater is pumped from the Nueces River above the saltwater barrier dam into Rincon Bayou. Freshwater is pumped into Rincon Bayou to satisfy permitted freshwater inflow requirements for Nueces Bay. There appears to be perennial flow in Gum Hollow, but the freshwater reach is separated from the estuary by a low dam near the Nueces Bay shore.

Oso Creek flows into Oso Bay and is tidally influenced along its length. Perennial freshwater contributions to Oso Creek are from treated municipal wastewater discharges. Chiltipin Creek, Copano Creek, and the Aransas and Mission rivers flow into Copano Bay. The freshwater reaches of these streams are more than 30 miles from the project area.

The No-Action Alternative would not directly or indirectly impact freshwater habitats and fauna since there are no freshwater streams or reservoir in the project area.

Under Alternative 1, tidal prism and salinities are expected to increase with increased channel depth (Brown et al., 2019). Barriers at the mouths of the Nueces River, Rincon Bayou, and Gum Hollow would prevent any increases in salinity in the freshwater portions of these streams. Brown et al. (2019) state impacts are expected to be minimal beyond the Rockport area which is between the project area and streams entering Copano Bay. Salinity increases are therefore not expected to impact freshwater streams entering Copano Bay. Proposed BU of dredged sediment for estuarine habitat enhancement would not occur in the vicinity of freshwater habitats and would not affect freshwater habitats or fauna in the project area. All construction, operations, and maintenance would take place in or near the project area where there are no freshwater streams or reservoirs.

Alternatives 2 and 3 are not expected to directly or indirectly impact freshwater habitat in the project area.

4.2.2.2 Estuarine Habitats and Fauna

4.2.2.2.1 No-Action Alternative

Under the No-Action Alternative, there would be no direct impacts to estuarine habitats and fauna resources would remain as described in Section 3.3.3. Existing conditions and associated changes to estuarine habitats and fauna would continue. Indirect impacts are described below.

The significance of the predicted global climate change is the possibility of increasing sea levels, coastal flooding, changing estuarine salinity regimes, and associated impacts to biological communities. Indirect impacts due to climate change stressors, and USACE dredging and maintenance dredging operations would continue to have an impact to the aquatic communities.

Trends of tidal wetland loss would continue. Increased development, hydrologic alterations, drought, flooding, and temperature extremes could affect wetlands. Sea level change and climate change, including changes to hydrology, nutrient inputs, flood or tide timing and intensity could have a variety of impacts on wetlands.

Marshes throughout the study area are declining and would likely continue this trend as sea level change continues. According to the NOAA Sea Level Rise Viewer (2022b) 3-foot scenario model, tidal marsh appears to decrease in the study area compared to present day. There is a potential that marshes would migrate inland in response to rising sea levels in areas where the elevation and topography are conducive for establishment (Borchert et al., 2018; Guannel et al., 2014; Murdock and Brenner, 2016; Scavia et al., 2002). However, due to urban development of low-lying areas in the study area the likelihood marsh migration and establishment would be prevented (Borchert et al., 2018).

It is anticipated that future rising sea levels would force the landward migration of wetlands and marsh and cause major spatial shifts in the natural habitats along the coast. Fisheries habitat modeling in Galveston Bay with a 3.3-foot rise in sea level showed that as sea level changes the total footprint of suitable habitat for early life stages of blue crab, brown shrimp, Southern Flounder, and Red Drum would increase, threefold. This increase would have a positive impact on fisheries, helping to offset reductions as wetlands are lost (Guannel et al., 2014).

Other studies suggest that with a rise in sea level, salt marshes initially declined, before transitioning from low level marsh to tidal flat then to open water. This change was followed by a net increase in habitat quality resulting from marsh fragmentation (Fulford et al., 2014). This mirrors the effect on nursery production, which studies have shown is initially negatively affected by sea level change, but ultimately may produce positive changes in production due to the increase in marsh-edge habitat resulting from fragmentation. This salt marsh fragmentation correlated with a positive effect on nursery fish production (Chesney et al., 2000; Minello et al., 2003; Park et al., 1989). Organic matter and nutrients are generated and utilized by fish and shrimp at the marsh edge, which benefits nekton productivity while the marsh is disintegrating. In the long-term it is harmful. After the marsh disintegrates, there is reduced organic productivity and less (or no) nursery habitat (Chesney et al., 2000; Rozas and Reed, 1993; Zimmerman, 1992).

Under the No-Action Alternative, it is likely that rising sea levels benefits most fish species (including commercial and recreational fisheries) due to larger areas of available habitats if new marshes are created. Undeveloped areas would most likely support landward migration of wetlands as sea level changes. According to Jim Tolan of the TPWD, who serves on the Association of Fish and Wildlife Agencies Climate Change Committee, their consensus is that as long as there is sufficient habitat, fisheries and oyster reefs should adapt with little net change associated with RSLC (pers. comm. J. Tolan [TPWD], 2020). In addition, Watson et al. (2017) indicated that the vulnerability of Spotted Seatrout, Red Drum, and blue crab to sea level change appears low since they have the ability to adapt to the projected changes.

Increasing salinities in many areas are anticipated with global climate change resulting from sea levels causing barrier islands to migrate inland (Scavia et al., 2002). Increases in salinity in wetland habitats may cause small reductions in the health and biological productivity and may cause additional stress on some marsh vegetation, which could cause some habitat-related impacts to organisms that use those areas. However, most organisms occupying these environments are ubiquitous along the Texas coast and can tolerate a wide range of salinities (Pattillo et al., 1997). Therefore, no adverse effects on fauna are expected due to salinity changes.

Under the No-Action Alternative, oyster reefs would continue as described in Section 3.3.3. See Section 4.2.2.2.2 (Oyster Reef) for a more detailed discussion of turbidity impacts to oysters.

Turbidity associated with maintenance dredging and activities associated with authorized deepening and widening projects would continue during and for a short time after dredging. Benthic organisms would continue to be buried by open-bay and ocean disposal of dredged material. No long-term effects to turbidity with the No-Action Alternative are anticipated. See Section 4.2.2.2.2 (Open Bay and Jetty Communities) for a more detailed discussion of turbidity impacts.

Under the No-Action Alternative, increased ship traffic and lightering would be expected which could slightly increase the probability of a petroleum spill. However, as described in Section 4.2.2.2.2, in the unlikely event a petroleum spill should occur, adult shrimp, crabs, and finfish are generally motile enough to avoid most areas of high oil concentration.

In the absence of BU placement to serve as protective barriers, the loss of habitat would continue which could impact estuarine habitats and fauna. The ongoing erosion of shorelines at Harbor Island and Dagger Island combined with rising sea levels could expose large areas of estuarine habitat to erosive forces, leading to the loss estuarine habitats and fauna over time.

4.2.2.2.2 Alternative 1: Channel Deepening (Applicant's Preferred Alternative)

Dredging and placement activities conducted under Alternative 1 would directly affect the estuarine habitats and fauna in the project area. Channel dredging (inshore and offshore) would impact 1,182 acres of open water/bottom habitat through excavation (NOAA, 2010). For Gulf side placement actions, nearshore berms (B1–B9) would impact 1,586 acres of open water/bottom habitat (NOAA, 2010), MI and SJI beach nourishment placement would impact 275.19 acres of open water/bottom habitat (Mott MacDonald, 2021, 2022) and the ODMDS would impact 1,180 acres of open water/bottom habitat (NOAA, 2010).

Direct aquatic resource impacts from inshore PA construction include 563.85 acres of open water/bottom habitat, 16.61 acres of tidal wetlands, 122.46 acres of freshwater wetlands, 84.85 acres of unconsolidated shorelines (tidal sand flats/algal flats/beach), 6.88 acres of seagrass, and 0.10 acres of oyster reef (Mott MacDonald, 2021, 2022; Triton Environmental Solutions, 2021a, 2022a).

Open Bay and Jetty Communities. During construction of Alternative 1, temporary disturbances and impacts to plankton and nekton assemblages would occur.

Turbidity in estuarine and coastal waters can have a complex set of impacts on organisms (Hirsch et al., 1978; Stern and Stickle, 1978; Wilber et al., 2005; Wright, 1978). The release of sediment during dredging causes sediment plumes. The extent of the plume is determined by the direction and strength of the currents and winds, and the particle size. Suspended material can play beneficial and detrimental roles in aquatic environments. Turbidity from suspended solids interferes with light penetration and reduces photosynthetic activity by phytoplankton and algae (Wilber and Clarke, 2001). Such reductions in primary productivity would be localized around the immediate area of the dredging and placement operations and would be limited to the duration of the plume. Conversely, the decrease in primary production, presumably from decreased available light, can be offset by an increase in nutrients that are released into the water column (Morton, 1977; Newell et al., 1998). Nutrients may act to enhance the area surrounding dredging, increasing productivity. Studies of turbidity and nutrients associated with dredging found the effects are both localized and temporary (May, 1973). Due to the capacity and natural variation in phytoplankton and algal populations, the impacts to phytoplankton and algae from project construction, dredging within the project area, dredged material placement of new work and maintenance material, and placement of material for placement actions targeting BU would be temporary.

Reduced light penetration due to turbidity may have a short-term impact on zooplankton populations since they feed on the phytoplankton (Armstrong et al., 1987; Valiela, 1995). Such reductions would be localized around the immediate area of dredging and placement operations. Impacts to zooplankton from project construction would be temporary.

Teeter et al. (2003) found the area of high turbidity extended roughly to the edge of the fluid mud flow, or about 1,300 to 1,650 feet from the dredge discharge pipe. Modeling of dredged material discharge in the

Laguna Madre, Texas, determined that turbidity caused by dredging was short lived and therefore impacts to the estuarine and offshore water column would be minimal (Teeter et al., 2003). Turbidity can be expected to return to near ambient conditions within a few months after dredging ceases.

Increased suspended sediments can impact juvenile and adult finfish by disrupting foraging patterns, reducing feeding, and loss of habitat for feeding and reproduction. However, these would be temporary and occur only during project construction (Clarke and Wilber, 2000; Newcombe and Jensen, 1996). Fine particles can coat the gills of juvenile and adult finfish, ultimately resulting in asphyxiation (Clarke and Wilber, 2000; Wilber and Clarke, 2001). However, finfish and shellfish are motile enough to avoid highly turbid areas (Newcombe and Jensen, 1996; Collin and Hart, 2015). Under most conditions, exposure to sediment plumes would be for short durations (minutes to hours) (Clarke and Wilber, 2000; Newcombe and Jensen, 1996; Wilber and Clarke, 2001).

Effects of elevated turbidities on the adult stages of various filter-feeding organisms such as oysters, copepods, and other species include reduced filtering rates, and clogging of filtering mechanisms interfering with ingestion, respiration, and abrasion (Newcombe and Jensen, 1996; Wilber and Clarke, 2001; Stern and Stickle, 1978). These effects tend to be more pronounced when total suspended solid concentrations are greater than 100 milligrams per liter but are apparently reversible once turbidities return to ambient levels (Newcombe and Jensen, 1996). More sensitive species and life stages (i.e., eggs, larvae, and fry) tend to be more impacted by longer exposure to suspended sediments than less sensitive species and older life stages (Germano and Cary, 2005; Newcombe and Jensen, 1996; Wilber and Clarke, 2001; Wilber et al., 2005). Many crustaceans (such as shrimp and crabs) are less impacted by elevated suspended sediments since these organisms reside on or near the bottom where sedimentation naturally occurs (Wilber and Clarke, 2001; Wilber et al., 2005). Higher turbidity may also provide a refuge for juvenile shrimp and fish from predation (Wilber and Clarke, 2001; Collin and Hart, 2015). Species less tolerant to elevated turbidities (i.e. Bay Anchovy, juvenile Gulf Menhaden, Atlantic Croaker, and silversides) could experience long-term impacts as a result of project construction, dredging, and placement activities with Alternative 1 compared to the No-Action Alternative whereas more tolerant species (i.e. Penaeid shrimp, Spot, Toadfish [*Opsanus beta*], and Hogchoker [*Trinectes maculatus*]) may not experience long-term impacts (Clarke and Wilber, 2000).

Based hydrodynamic and salinity modeling analysis by Baird (2022c), minor increases in salinity are anticipated because of Alternative 1 compared to the No-Action (Appendix I). Average salinity levels are anticipated to increase less than 1 ppt in the Corpus, Nueces, Redfish, and Aransas bays. Near the channel deepening, a salinity change of ±3 ppt can be expected (Baird, 2022c). The salinity increase, as a result of Alternative 1, is not expected to alter fauna. Most organisms occupying these environments are ubiquitous along the Texas coast and can tolerate a wide range of salinities (Pattillo et al., 1997) (see Table 3-3 for salinity tolerances of common fish and shellfish).

Aransas Pass is the main route for larval transport of estuarine dependent species from the Gulf to local estuaries. Changes in hydrology due to the deepening of the CCSC could impact the recruitment of estuarine dependent species (Buskey, 2018; Valseth et al., 2021). Valseth et al. (2021) studied the potential impact that deepening the channel could have on the transport of Red Drum larvae through Aransas Pass. Their passive particle modeling indicated a slight reduction of the maximum velocity due to channel deepening. Baird (2022c; Appendix I) found that under Alternative 1 current speeds are expected to decrease an average of 0.23 feet per second with the deeper entrance channel. Drought, wet, and normal conditions for the –47 foot channel (current conditions) and the –70 foot channel were modeled by Valseth et al. (2021). It was found that the changes in channel bathymetry had little effect on recruitment of Red Drum larvae, with the model predicting a slight increase in the number of larvae entering the estuary with the decreased velocities. The modeling only looked at passive particles and did not take into account larvae with weak swimming capabilities. The slight decrease in velocity with Alternative 1 is not anticipated to have an impact on recruitment of estuarine dependent species.

Vessel traffic would be expected to decrease with Alternative 1 compared to the No-Action Alternative. Vessels would be capable of fully loading at Axis and Harbor Island terminals (see Section 4.5 for further discussion), slightly decreasing the probability of a petroleum spill. In the unlikely event a petroleum spill should occur, adult shrimp, crabs, and finfish are probably motile enough to avoid most areas of high oil concentration. Larval and juvenile finfish and shellfish tend to be more susceptible to petroleum than adults and could be affected extensively by a spill during active immigration periods. Due to their lack of mobility, they are less likely to avoid these areas and could be negatively impacted if a spill were to occur. An oil spill in the project area could result in impacts to phytoplankton, algal, and zooplankton. However, since these organisms can recover rapidly from a spill, due primarily to their rapid rate of reproduction and to the widespread distribution of dominant species, long-term impacts would not be expected (Hjermann et al., 2007; Kennish, 1992).

Dredged material is to be used beneficially in placement actions targeting BU. This habitat could have the potential to be more productive than the open water habitat that would be lost under Alternative 1. Marsh creation has been shown to have a positive benefit to bay systems (Rozas et al., 2005). Refer to the BU Monitoring Plan (Port, 2023; Appendix C2) for information regarding planting that is proposed at BU site SS1.

Open Bay Bottom and Offshore Bottom Communities. Alternative 1 would alter benthic habitat through permanent habitat loss associated with placement activities. Excavation removes benthic organisms, whereas placement smothers or buries benthic communities. Dredging and placement of dredged material may cause ecological damage to benthic organisms in three ways: (1) physical disturbance to benthic ecosystems and organisms; (2) mobilization of sediment contaminants, making them more bio-available; and (3) increasing the amount of suspended sediment in the water column (Montagna et al., 1998). Dredging can reduce species diversity by 30 to 70 percent and the number of individuals by 40 to 95 percent. A similar reduction in benthic fauna biomass is expected within the boundaries of dredged areas (Newell et al., 1998).

Recolonization of areas impacted by dredging and dredged material disposal occurs through vertical migration of buried organisms through the dredged material, immigration of post larval organisms from the surrounding area, larval recruitment from the water column, and/or sediments slumping from the side of the dredged area (Bolam and Rees, 2003; Maurer et al., 1986; Newell et al., 1998). The response and recovery of the benthic community from dredged material placement is affected by many factors. These include environmental (e.g., water quality, water stratification), sediment type and frequency, and timing of disposal. Communities in these dynamic ecosystems are dominated by opportunistic species tolerant of a wide range of conditions (Bolam et al., 2010; Bolam and Rees; 2003; Newell et al., 2004; Newell et al., 1998). Although change may occur, these impacts would be temporary in some dredging and disposal areas (Bolam and Rees, 2003). Shallower, higher-energy estuarine habitats can recover between 1 and 10 months, while deeper, more-stable habitats can take up to 8 years to recover (Bolam et al., 2010; Bolam and Rees, 2003; Newell et al., 1998; Sheridan, 1999; Sheridan, 2004; Wilber et al., 2005; VanDerWal et al., 2011). The release of nutrients during dredging may also enhance benthic communities outside the immediate PA if the dredged material is not contaminated (Newell et al., 1998).

Because of the constant re-creation of “new” habitat via disturbance, new recruits continually settle and grow. Therefore, disturbed communities are dominated by small, surface-dwelling organisms with high growth rates. Consequently, dredged material placement from Alternative 1 may result in a shift in community structure rather than a decrease in production (Bolam and Rees, 2003; Montagna et al., 1998). Productivity could be enhanced following benthic community shift depending on the timing of dredged material disposal (Bolam and Rees, 2003).

Oyster Reef. A total of 0.10 acres of live oyster reef habitat occurs in the footprint of placement site HI-E and would be directly impacted by the CDP. It should be noted that this survey included a buffer beyond the direct project footprint (Triton Environmental Solutions, 2021a). As described in the Port’s mitigation plan (Triton Environmental Solutions, 2023; Appendix K), the Port plans to relocate these oysters from HI-E to the mitigation site within placement site SS1. They will be placed along the northwestern boundary, which is oriented adjacent to the proposed estuarine mitigation site and near a previously delineated live oyster reef. GLO (2021) indicates 32 acres of mapped oyster reef habitat occur in the remainder of the project area and 3.17 acres of oysters were mapped within a 500-foot construction buffer of the inshore PAs (Triton Environmental Solutions, 2021a, 2022a). These oyster areas could be indirectly impacted by increased turbidity during construction of placement site HI-E. Water column turbidity would increase during project construction that could affect survival or growth of oysters nearby. Temporary impacts to oysters include reduced filtering rates and clogging of filtering mechanisms, causing abrasion, and interfering with ingestion and respiration (Newcombe and Jensen, 1996; Stern and Stickle, 1978; Wilber and Clarke, 2001). As described in Section 3.3.3.2.3, oysters can tolerate relatively high salinities, temperatures, and increased water depths However, some oyster predators (stone crabs [*Menippe mercenaria*] and oyster drills) and diseases (Dermo) may occur more frequently or in higher concentrations with higher temperatures and salinities (Cake, 1983; Murdock and Brenner, 2016; Soniat and Kortright, 1998).

The slight increase in salinity that is expected resulting from Alternative 1 is not anticipated to cause any long-term impacts to oyster reefs in the project area. Increased nutrients from dredging activities could cause algal blooms that could impact oysters however potential changes in nutrients are expected to be localized and limited to a short time period.

As discussed in above, modeling indicates that channel deepening would increase the average salinity in the Corpus Christ Bay system by less than 1 ppt (Baird, 2022c). The slight salinity changes resulting from Alternative 1 are not anticipated to cause any long-term impacts to oyster reefs in the project area as oysters can tolerate a wide range of salinities as described in Section 3.3.3.2.3. Increased nutrients from dredging activities could cause algal blooms that could impact oysters. Since oysters are filter-feeders, temporary increases in algal concentrations may have positive as well as negative effects on oysters. The historic loss of oysters in this system justifies increased awareness while activities are being monitored to avoid and minimize impacts to oysters.

Commercial and Recreational Fisheries. Alternative 1 would temporarily disrupt fish distribution and localized commercial and recreational fishing in the immediate vicinity of project during construction. Temporary impacts to economically important species and their prey may occur due to increased turbidity. During project construction and dredging, east-west migration across the project area may be disrupted; however, once dredging operations are completed the fish community would return and commercial and recreational fishing activities would continue. These impacts are expected to be temporary and conditions in the project area should return to pre-construction conditions once the project is completed.

Turbidity impacts to commercial and recreational fisheries would be as described above (Open Bay and Jetty Communities). Fishing grounds in other portions of the project area would be available to recreational and commercial fishing during the dredging and placement operations; therefore, fishing opportunities would remain available at other locations. Use of most aquatic habitats in dredged and PAs by recreational and commercial fish species are expected to resume after work is complete. Therefore, no long-term effects are expected. In addition, dredged material is to be used beneficially within placement actions targeting BU and the habitat improvement could potentially be more productive than present habitat. Therefore, recreational and commercial fisheries may benefit from the higher productivity associated with placement actions targeting BU, creating an overall positive benefit to the bay system when compared with the No-Action Alternative (Rozas et al., 2005). In addition, the proposed mitigation site at SS1 will provide 75.12 acres wetland and SAV habitat that would create a positive benefit to the bay system.

Artificial Reefs. No artificial reefs are located within the project area. Of the three artificial reefs located in the study area, the closest to the project area is Boatmen's Reef which located within 0.3 miles of the project area boundary, 1.3 miles from the channel deepening footprint and 1.5 miles from the New Work ODMDS

(TPWD, 2021b). Water column turbidity would be expected to increase during project construction and associated maintenance dredging, although it would be temporary. No long-term impacts to artificial reefs are anticipated with Alternative 1.

4.2.2.2.3 Alternative 2: Offshore Single Point Mooring

Potential impacts to estuarine habitats and fauna resulting from water column turbidity caused during construction (pipeline and SPM placement) of Alternative 2 would be similar to those described for dredging under Alternative 1. Pipelines would be installed via HDD which would help minimize impacts. Impacts would be short-term and would be expected to cease following construction. No long-term impacts would be expected.

Alternative 2 would directly affect offshore aquatic communities by loss of some offshore bottom habitat for placement of the SPMs. The amount of offshore bottom habitat impacted by construction of moorings is not expected to be major and therefore impacts are expected to be negligible.

Vessel traffic traversing the CCSC would be expected to be less with this alternative and remain the same offshore. This could decrease the potential for spills of crude oil or other petroleum products during transfer operations to and from vessels that could temporarily impact the aquatic community. It could take longer for spill response teams to access a spill occurring offshore in the vicinity of the SPMs due to the distance offshore and the area more subject to prevalent offshore wind and waves. However, in the unlikely event a spill should occur, spill impacts would be similar to those described under Alternative 1.

The anchor leg configuration of the SPMs could act as a fish attractant (similar to an artificial reef as described in Section 3.3.3.2.6) providing food, shelter from predators and ocean currents, and a visual reference, which aids in navigation for migrating fishes (Bohnsack, 1989; Duedall and Champ, 1991; Meier, 1989; Vitale and Dokken, 2000). This could provide long-term offshore benefits.

Alternative 2 would have less impacts to the estuarine habitats and fauna than Alternative 1 since there would not be a need for dredging and ship traffic in the CCSC would be reduced. However, in the absence of BU placement to serve as protective barriers, the loss of habitat would continue which could impact estuarine habitats and fauna. The ongoing erosion of shorelines in the project area combined with rising sea levels could expose large areas of estuarine habitat to erosive forces, leading to the loss estuarine habitats and fauna over time.

4.2.2.2.4 Alternative 3: Inshore/Offshore Combination

Potential impacts to estuarine habitats and fauna resulting from turbidity caused during construction of Alternative 3 would be similar to those described for Alternative 1, except that there would be no dredging of the channel and no BU placement of dredged material either inshore or offshore. Pipelines would be installed via HDD which would help minimize impacts. Impacts would be short-term and would be expected to cease following construction. No long-term impacts would be expected.

Vessel traffic is not anticipated to increase with Alternative 3. Vessels will still go to Harbor Island or Axis to half load then go to the offshore SPM to top off. Similar to Alternative 2, impacts associated with spills would increase offshore during transfer operations to and from vessels and response times could take longer. In the unlikely event a spill should occur, impacts would be similar to the other alternatives. No long-term impacts would be expected.

The anchor leg configuration of the SPMs could act as a fish attractant as described for Alternative 2, providing long-term benefits offshore.

It is anticipated that Alternative 3 would have less impacts to the estuarine habitats and fauna than Alternative 1 due to the lack dredging and dredged material placement, but slightly more than Alternative 2 due to partial vessel loading at inshore facilities then traversing the channel to the offshore facility to be fully loaded. However, in the absence of BU placement to serve as protective barriers, the loss of habitat would continue which could impact estuarine habitats and fauna. The ongoing erosion of shorelines in the project area combined with rising sea levels could expose large areas of estuarine habitat to erosive forces, leading to the loss estuarine habitats and fauna over time.

4.2.3 Invasive Species in Ballast Water

4.2.3.1 No-Action Alternative

Under the No-Action Alternative, invasive species in ballast water would remain as described in Section 3.3.3.4. Due to increased development within Corpus Christi Bay, vessel traffic would be expected to increase within the CCSC. Foreign and domestic vessels will continue to exchange ballast waters during loading/unloading activities. The USCG will continue to manage the National Ballast Information Clearinghouse and collect data on the management of water from ships with ballast tanks operating within the U.S. (National Ballast Information Clearinghouse, 2022). Invasive species would continue to be a nuisance to wildlife and the natural environment. Controlling invasive species will continue to be managed by State, Federal, and private organizations. As a result of climate change and warming waters, the range of tolerance for invasive marine species can shift to higher latitudes. Increased flooding and rising sea levels can change salinity of local waterbodies and introduce aquatic invasive species to newly inundated habitat expanding their range (EPA, 2008b). However, the USCG mandatory ballast water management protocols (33 CFR 151 subparts C and D) are in place and all vessels, foreign and domestic, equipped with ballast water tanks that operate within U.S. Waters are required to comply with the protocols.

4.2.3.2 Alternative 1: Channel Deepening (Applicant's Preferred Alternative)

Vessel traffic within the CCSC is expected to decrease with Alternative 1 compared to the No-Action Alternative. USCG protocols for documenting and managing ballast water release would continue to exist. Modifications of the CCSC would allow larger ships to traverse the channel reducing the amount of vessel trips as lightering of vessels is no longer required. Partially loaded VLCCs at Ingleside would be able to top off at Harbor Island. Only berths at Axis and Harbor Island would be capable of fully loading VLCCs. Therefore, most ballast water exchanges would be located around Harbor Island and Ingleside. Marine invasive species would still be able to spread throughout Corpus Christi Bay. While the risk of introducing invasive species may increase, the overall risk would be less than the No-Action Alternative. The dredge material placement alternatives are not expected to influence the transfer or spread of invasive species in ballast water to the ecosystem. The mitigation plan calls for the relocation of oysters and transplant of seagrass from impacted areas to the mitigation site. The species would be moved with in-situ water (Triton Environmental Solutions, 2023; Appendix K). Special care should be taken to prevent the transfer of invasive species.

4.2.3.3 Alternative 2: Offshore Single Point Mooring

Alternative 2 would allow vessels to be loaded entirely offshore. Since vessels will not be traversing the CCSC, there are lower risks associated with introducing invasive species to the offshore ecosystem compared to the No-Action Alternative. USCG protocols would not be applicable since ballast water would be exchanged away from the traditional ports. VLCCs would be fully loaded offshore at the SPMs and ballast water would be released away from mainland. The offshore SPM would be located more than 15 miles from the Gulf-side shoreline. Invasive species potentially released by ballast water offshore would rarely impact the Corpus Christi Bay ecosystem.

4.2.3.4 Alternative 3: Inshore/Offshore Combination

Under this Alternative, VLCCs will be partially loaded inshore and then fully loaded at the offshore SPM. This does not eliminate the need to exchange ballast water within the ports and still carries the potential to introduce invasive species. VLCCs will be partially loaded at Axis and Harbor Island before traversing to the offshore SPM to be fully loaded. Therefore, some ballast water exchanges would be located at Axis and Harbor Island. Marine invasive species would still be able to spread throughout Corpus Christi Bay. The volume of exchanged ballast water in the Bay would be less than completely loading VLCC vessels (Alternative 1) but more than with Alternative 2. The ballast water exchange and introducing invasive species be similar to the No-Action Alternative. USCG protocols for documenting and managing ballast water release would continue to be applied to vessels with ballast tanks.

4.2.4 Wildlife Resources

4.2.4.1 No-Action Alternative

There would be no new direct impacts to wildlife from implementing the No-Action Alternative. The CCSC would maintain its currently authorized –54-foot MLLW. Wildlife can be affected as vessel traffic causes shoreline erosion, vessel strikes, vessel noise, and pollution spills. Maintenance dredging would continue which can increase turbidity, reducing the foraging efficiency of seabirds, sea turtles, and marine mammals, and possibly injuring sea turtles (Dickerson et al., 2004; Lammers et al., 2001). Impacts of these activities would continue in the future. Demand to move crude oil into or out of the CCSC may increase in the future. If lightering and reverse lightering increases, vessel traffic in the CCSC may also increase. If vessel traffic increases in the CCSC in the No-Action Alternative, the probability of impacts to wildlife from vessel noise, vessel strikes, and pollution spills would increase.

Turbidity from maintenance dredging could temporarily reduce the foraging success of certain seabirds, sea turtles, and marine mammals (Cook and Burton, 2010; Kjelland et al., 2015). Increased noise associated with dredging may affect resident Bottlenose Dolphin (David, 2006). If vessel traffic increases, there may be an increased probability of vessel strikes for sea turtles and marine mammals.

Wildlife would experience indirect impacts as human development encroaches on or near wildlife habitat, decreasing abundance and species diversity. Recreational boating, which may increase with human development can lead to increased disturbances of, and collisions with wildlife. Some habitats may change over time. Without additional shoreline protection or BU, marsh and beach habitat would continue to erode or subside from RSLR and shoreline recession. Wildlife would relocate to other areas causing loss of biodiversity, tourism, recreation for the region.

Impacts to wildlife under the No-Action Alternative resulting from the current level of commercial and recreational vessel traffic, maintenance dredging, and human development are expected to occur in all the alternatives.

4.2.4.2 Alternative 1: Channel Deepening (Applicant’s Preferred Alternative)

Alternative 1 would temporarily cause localized increases in turbidity and lower DO during dredging operations. The increase in turbidity within the CCSC can affect fish abundance within the area and the foraging rates of marine species (Kjelland et al., 2015). The decrease in visibility can negatively impact foraging activity and efficiency of seabirds (Cook and Burton, 2010). Sea turtles and other slow moving marine species may be directly impacted by dredging activities (Dickerson et al., 2004). Reduced DO which reduces fish abundance may temporarily reduce forage availability for piscivorous seabirds and marine mammals.

The CDP is designed to allow larger oil tankers and vessels to traverse part of the CCSC. This is expected to reduce the amount of vessel traffic compared to the No-Action Alternative. This might lower the risk of lethal interactions and disturbances caused by vessel traffic. It is not known if disturbance would be changed by changes in underwater noise. Less vessel traffic may reduce the frequency of noise production however, it is not known how the VLCCs and the large tugboats required to maneuver them may affect the level of underwater noise. Vessel wake analysis conducted by Baird (2022b; Appendix H) indicate that the CDP would have minimal impacts to the shorelines along the CCSC.

Beneficial placement of dredge material along shorelines would increase beach and wetland habitat and protect interior habitat from shoreline erosion. Placement actions targeting BU would create nesting and foraging sites for birds and wildlife. Proposed placement site SS2 is specifically intended to protect Piping Plover Critical Habitat and Red Knot habitat. The mitigation plan would involve the relocation of oysters and transplant of seagrass from the impacted areas to the SS1 mitigation site (Triton Environmental Solutions, 2023; Appendix K). Additional oyster reefs and seagrass meadows within the mitigation area would provide habitat and forage for a variety of wildlife including fish, birds, and sea turtles.

Impacts resulting from maintenance dredging and human development under Alternative 1 are expected to be the same as the No-Action Alternative. Impacts from marine vessel traffic may be reduced if reverse lightering trips in the bay decline.

4.2.4.3 Alternative 2: Offshore Single Point Mooring

Due to the distance of Alternative 2 from the mainland, there would be little effect on terrestrial wildlife species. This alternative would not require dredging of the channel. There would be no dredged material used for BU to increase or protect shoreline habitat. Placing a dredge pipeline across Redfish Bay increases the possibility of damage to habitat used by birds and terrestrial and marine wildlife. Construction of the pipeline requires access to the surface of the bay to monitor drilling. Required monitoring activities could temporarily disturb birds and terrestrial and marine wildlife near the area of pipeline construction both in the bay and in the Gulf.

Except for Bottlenose Dolphin, large marine mammals like whales are not common in this part of the Gulf and are unlikely to be impacted by this alternative (Baumgartner et al., 2001). Birds are known to use artificial structures in the Gulf as temporary resting areas during their migration and some may rest on the SPM system. Structures associated with the SPM may provide a resting place for migrating birds but may also put birds at risk of colliding with the structures during night circulation events (Russell, 2005).

Impacts resulting from maintenance dredging and human development under Alternative 2 are expected to be the same as the No-Action Alternative. Impacts from marine vessel traffic may be reduced if reverse lightering trips in the bay decline.

4.2.4.4 Alternative 3: Inshore/Offshore Combination

Since the CCSC would not be deepened and a SPM would be constructed offshore for Alternative 3, expected impacts to wildlife would be similar to those described under the No-Action Alternative and Alternative 2.

4.2.5 Protected Resources

4.2.5.1 Protected Lands

Protected lands are spaces receiving legal protection because of their recognized natural, scenic, or cultural values. The Texas coast and Corpus Christi area contain many important natural, historical, and cultural resources managed by Federal, State, and local governments or privately-owned organizations.

4.2.5.1.1 No-Action Alternative

There would be no direct impacts to protected lands under the No-Action Alternative. Federal- and State-owned lands would continue to be managed for conservation and recreational purposes. A general recession trend has been observed in the analysis of the historical shoreline positions within the project area and the annual shoreline change modeling (Baird 2022b; Appendix H). Protected lands like parts of Aransas NWR, Nueces Delta Preserve, and Mustang Island State Park with low-lying tidally affected shores are expected to experience conversion of tidal wetlands to open water with RSLR, shoreline recession, and coastal development. With RSLR, these lands may be inundated to a greater extent and more frequently from storm surge. Infrastructure like docks and boat ramps in protected lands on the coast could be damaged or destroyed by RSLR, shoreline recession, and storm surges. As more development occurs along the coast, the risk of property damage from and storm surges are increased.

4.2.5.1.2 Alternative 1: Channel Deepening (Applicant's Preferred Alternative)

Channel deepening associated with Alternative 1 would not directly impact protected lands within the project area. The Port Aransas Nature Preserve should benefit from placement of sediment at proposed placement site SS2. Placement of dredged material for potential BU should restore two shoreline breaches and land at the Port Aransas Nature Preserve at Charlie's Pasture. BU actions may also help attenuate wave energies that can affect Redfish Bay State Scientific Area.

Vessel wake analysis conducted by Baird (2022b; Appendix H) indicate that the CDP would have minimal impacts to the shorelines along the portion of the CCSC proposed to be deepened in this alternative. If the frequency of lightering and reverse lightering trips declines, shoreline erosion generated by vessel wakes may also decrease. Decreased erosion from vessel traffic may benefit some protected lands, like Causeway Island City Park or Redfish Bay State Scientific Area.

RSLR, shoreline development, and storm surge would continue to impact protected lands under Alternative 1 as described for the No-Action Alternative.

4.2.5.1.3 Alternative 2: Offshore Single Point Mooring

There are no designated offshore protected lands or marine preserves in the study area off the Texas coast. Due to the proposed 15 miles from the mainland, Alternative 2 would have no direct effects on protected lands. Since there would not be BU of dredged materials associated with this alternative, there would be no beneficial effects to protected lands. Pipeline construction may impact seagrass and marsh within the Redfish Bay State Scientific Area, but construction methods such as HDD may avoid and minimize those potential impacts. Impacts from pipeline construction may result primarily from access along the surface of the bay needed to monitor the drilling operation.

RSLR, shoreline development, and storm surge impacts as described under the No-Action Alternative would continue if Alternative 2 is implemented. If marine vessel traffic declines as reverse lightering is reduced, impacts to protected lands in the bay may decline.

4.2.5.1.4 Alternative 3: Inshore/Offshore Combination

Since there would be no dredging within the CCSC and the proposed SPM would be 15 miles from land, there would be no direct impacts to protected lands from the implementation of Alternative 3. Impacts of this alternative would be similar to those described for Alternative 1 and the No-Action Alternative.

4.2.5.2 Threatened and Endangered Species

4.2.5.2.1 No-Action Alternative

Dredging of the CCSC would continue to maintain its currently authorized –54-foot MLLW. Maintenance dredging would continue to have an impact on threatened and endangered species such as sea turtles and shorebirds. Dredging can temporarily increase turbidity and reduce DO within the water column (Stern and Stickle, 1978; Wilber et al., 2005). These effects can impact marine mammals and sea turtles. Turbidity could temporarily reduce the foraging success, cover seagrass, and cause marine species to relocate to adjacent areas (Cook and Burton, 2010; Kjelland et al., 2015). The use of dredging vessels, particularly hopper dredges, could entrain and potentially injure or kill sea turtles (Dickerson et al., 2004). If scheduling conflicts cannot be avoided, qualified biologists can be utilized to maintain safe interactions with construction activity and protected wildlife.

Development within Corpus Christi Bay would increase vessel traffic throughout the region and along the CCSC without the CDP. Increased vessel traffic could potentially lead to increased collision with marine mammals and sea turtles. More vessel traffic can cause disturbance with foraging shorebirds and wildlife.

Indirect effects from climate change and shoreline erosion would continue to impact vulnerable species within the project area.

The Gulf shoreline along the middle Texas coast is generally considered stable (Paine and Caudle, 2020). However, without beach nourishment and BU, some retreat of the Mustang Island and San José Island shoreline may result from sea level rise and storm surges. These shorelines serve as foraging, nesting, and wintering habitat used by Northern Aplomado Falcon, Red Knot, Piping Plover, and Whooping Crane. Federally-listed sea turtles such as Kemp's Ridley, green, and loggerhead also use these beaches as nesting sites. Without the BU placement near the Port Aransas Nature Preserve, the wetlands and saltwater marsh may continue to be converted into open water (NOAA, 2022b). This would impact the wintering population of Federally-listed Whooping Cranes, Red Knots, and Piping Plovers commonly found on the preserve and along the beaches.

4.2.5.2.2 Alternative 1: Channel Deepening (Applicant's Preferred Alternative)

As described with maintenance dredging under the No-Action Alternative, dredging to deepen the channel can temporarily increase turbidity. Increased turbidity can reduce sea turtle and shorebirds feeding efficiency, but those impacts are expected to be localized and temporary (Johnson, 2018). The use of dredging vessels, particularly hopper dredges, could entrain and potentially injure or kill sea turtles (Dickerson et al. 2004). By utilizing biological observers or other best management practices, harm to threatened and endangered species can be avoided. Other methods such as using turtle deflector, relocation trawling, or limiting the use of hopper dredging to December to March can reduce impacts to sea turtles and marine mammals (NMFS, 2007).

Dredging and dredged material placement may disturb shorebirds such as Piping Plover and Red Knots. Scheduling dredge and placement actions targeting BU outside of the wintering period of listed shorebirds and nesting period for sea turtles can prevent these disturbances. Best management practices may be used to reduce impacts to the water column from resuspension of fine sediments during ongoing maintenance dredging or construction dredging activities (Bridges et al., 2008). Additional information can be found in Appendix D.

Alternative 1 would involve dredged material placed on actions targeting BU along the CCSC. A threatened and endangered species survey performed by Triton Environmental Solutions (2021b, 2022b) observed Piping Plovers and Red Knots utilizing PAs within the project area. Materials placed within these PAs would temporarily bury foraging grounds for these shorebirds and construction activity may disturb shorebirds. Any potential action targeting BU that nourish beaches and intertidal shorelines would likely yield longer term benefits that are greater than short-term, localized impacts. Material placed at the potential BU sites could potentially benefit Federally-listed species such as Piping Plovers and Red Knots which forage along tidal flats and beaches. Designated Piping Plover Critical Habitat can be found throughout the project area on Mustang Island, San José Island, Port Aransas, and along Corpus Christi Bay. The placement of dredged material along offshore PAs could potentially increase shoreline habitat within designated Critical Habitat. Beneficial material placement near Harbor Island would also provide shoreline protection, marsh nourishment at Port Aransas Nature Preserve, and potentially benefit Whooping Crane wintering habitat. The mitigation plan would involve the relocation of oysters and transplant of seagrass from the impacted areas to the mitigation site at SS1 (Triton Environmental Solutions, 2023; Appendix K). Additional oyster reefs and seagrass meadows within the mitigation area would provide habitat and forage for a variety of wildlife including manatees, cranes, and sea turtles.

The CDP is designed to allow VLCCs to traverse the CCSC which would lead to less vehicular traffic. Less traffic could lower incidences of vessel strikes and noise disturbance to marine mammals and sea turtles within the bay. However, larger vessels like VLCCs going through the CCSC would produce larger wakes, which could degrade shoreline Critical Habitat for Piping Plover. However, vessel wake analysis conducted by Baird (2022b; Appendix H) indicate that the CDP would have minimal impacts to the shorelines along the CCSC. Transporting larger quantities of crude oil through the CCSC and at Harbor Island can also increase risk of larger oil spills. An uncontained spill can negatively impact Federally-listed species and designated Critical Habitats.

4.2.5.2.3 Alternative 2: Offshore Single Point Mooring

Except for maintenance dredging described in the No-Action Alternative, there would be no other dredging and placement activities associated with Alternative 2. Direct and indirect impacts associated with maintenance dredging would be the same as the No-Action Alternative. Excessive underwater noise from driving pilings for the offshore facility can interfere with marine mammal communication and harass sea turtles (Peng et al., 2015). Without dredging, there would be no benefits associated with BU of dredged material within the bay, which are associated with Alternative 1. Since crude oil transport would not occur within the CCSC, the volume of vessel traffic would decrease. The risk of ship collision and potential environmental damage associated with collisions would decrease. Reduced ship traffic would reduce noise and potential threatened and endangered species disturbance within the bay. The transfer of crude oil by pipeline can increase the risk of chemical spills in deep water. If oil spills are not immediately contained, the spill can spread to nearby coastlines. Shorebirds such as Piping Plovers and Red Knots that forage and roost on shorelines would be particularly vulnerable. An oil spill may also directly impact sea turtles and their nesting habitat.

4.2.5.2.4 Alternative 3: Inshore/Offshore Combination

Except for maintenance dredging described in the No-Action Alternative, there would be no other dredging and placement activities associated with Alternative 3. Direct and indirect impacts associated with maintenance dredging would be the same as the No-Action Alternative. Conversely, there would be no benefits associated with BU of dredged material along the bay, which are associated with Alternative 1. Increased vessel traffic between the CCSC and offshore SPM could increase the risk of vessel strikes and noise interference with marine species. Excessive underwater noise from driving pilings for the offshore facility can interfere with marine mammal communication and harass sea turtles (Peng et al., 2015). Larger vessels such as VLCCs going through the CCSC to be partially loaded would produce larger wakes which could degrade shoreline Critical Habitat for Piping Plovers. The transfer of crude oil overseas or by pipeline may increase the risk of a spill which would impact coastal shorelines and shorebirds.

4.2.5.3 Essential Fish Habitat

EFH for brown, pink, and white shrimp; Gulf stone crab; Blacknose, Spinner, Silky, Finetooth, Bull, Blacktip, Tiger Lemon, Atlantic Sharpnose, Scalloped Hammerhead, and Bonnethead sharks; Red and Gag Grouper; Scamp; Cobia; Dolphin; Greater and Lesser Amberjack; Red, Gray, Lane, and Vermilion Snapper; Red Drum; Little Tunny; King and Spanish Mackerel; and Sailfish occur in the project area. The categories of EFH that occur within the study area include estuarine water column, estuarine mud and sand bottoms (unvegetated estuarine benthic habitats), estuarine shell substrate (oyster reefs and shell substrate), estuarine emergent wetlands, seagrasses, and mangroves. Additionally, portions of the project located in marine waters include the marine water column, unconsolidated marine water bottoms, and natural structural features. EFH and all impacts associated with the CDP are described in detail in Appendix E. The following sections provide a summary of the impacts described in the EFH Assessment (see Appendix E).

4.2.5.3.1 No-Action Alternative

Under the No-Action Alternative, EFH would remain as described in Section 3.3.5.3. Existing conditions and associated changes to aquatic communities would continue. Trends in wetland loss, declining marshes, RSLR, and increasing salinity and water temperatures would continue. Impacts from maintenance dredging include increased water column turbidity during and for a short time after dredging and placement, and burial of benthic organisms. No long-term effects are expected.

4.2.5.3.2 Alternative 1: Channel Deepening (Applicant's Preferred Alternative)

Alternative 1 could temporarily reduce the quality of EFH in the vicinity of the project area and some individuals may be displaced. Impacts would be similar to those described in sections 4.2.1 and 4.2.2. Channel dredging (inshore and offshore) would impact 1,182 acres of open water/bottom habitat through excavation (NOAA, 2010). For Gulf side placement actions, nearshore berms (B1–B9) would impact 1,586 acres of open water/bottom habitat (NOAA, 2010), MI and SJI beach nourishment placement would impact 275.19 acres of open water/bottom habitat (Mott MacDonald, 2021, 2022) and the ODMDS would impact 1,180 acres of open water/bottom habitat (NOAA, 2010).

Direct aquatic resource impacts from inshore PA construction include 563.85 acres of open water/bottom habitat, 16.61 acres of tidal wetlands, 122.46 acres of freshwater wetlands, 84.85 acres of unconsolidated shorelines (tidal sand flats/algal flats/beach), 6.88 acres of seagrass, and 0.10 acres of oyster reef (Mott

MacDonald, 2021, 2022; Triton Environmental Solutions, 2021a, 2022a). As a result, this could impact food available to Federally managed species.

Since fish are motile, it is anticipated they would temporarily shift their feeding habitat to undisturbed areas until suspended solids decline after dredging (Clarke and Wilber, 2000; Collin and Hart, 2015). Feeding habits of shrimp would not be impacted since shrimp typically reside on or near the bottom where sedimentation naturally occurs (Wilber and Clark, 2001; Wilber et al., 2005).

Dredging and placement activities are not expected to cause direct mortality to juvenile and adult pelagic finfish. These life stages are motile and can avoid highly turbid areas associated with project construction (Clarke and Wilber, 2000; Collin and Hart, 2015). Penaeid shrimp use deeper water of the bay as a staging area prior to migrating to the Gulf during certain times of the year (GMFMC, 2004). The displacement of juvenile and adult finfish and shrimp during project construction would likely be temporary. Individuals should return once the project is completed. Juvenile and adult finfish and shrimp would experience minimal direct impacts from dredging and placement activities. Juvenile penaeid shrimp could be impacted due to their preference for burrowing in soft, muddy areas, although these are usually in association with plant/water interfaces.

Demersal eggs and larval finfish may be lost to physical abrasion, burial, or suffocation during dredging and placement due to their limited motility and sensitivity to elevated suspended sediments (Newcombe and Jensen, 1996; Wilber and Clark, 2001; Stern and Stickle, 1978; Germano and Cary, 2005; Wilber et al., 2005). Larvae in the latter stages of development are capable of some motility, which may allow for movement away from dredging and placement activities. Predatory fish that feed on larvae of Federally managed species may be temporarily displaced as a result of dredging and placement. Under Alternative 1, the slight decrease in velocity is not anticipated to have an impact on recruitment of Federally managed species (Valseth et al., 2021).

Anticipated increases in turbidity may negatively impact the ability of some finfish to navigate, forage, and find shelter (Newcombe and Jensen, 1996; Clarke and Wilber, 2000). However, these impacts would be short lived (Clarke and Wilber, 2000; Wilber and Clarke, 2001; Newcombe and Jensen, 1996; Teeter et al., 2003). Shrimp spend at least some of their life cycle in areas where they are exposed to turbid conditions and could move from an area when it becomes inhospitable. Many crustaceans (such as shrimp and crabs) are not impacted by elevated turbidities since they typically reside among soft substrates (Wilber and Clark, 2001; Wilber et al., 2005). Finfish, shrimp, and other marine organisms are accustomed to fluctuations in turbidity and would not be substantially affected by the temporary increase in turbidity during construction activities associated with Alternative 1.

Dredge material that is suitable for actions targeting BU is not expected to pose contamination issues that could affect Federally managed species (Terracon Consultants, Inc., 2023a, 2023b; see Appendix J2 and J3). Vessel traffic would be expected to decrease with Alternative 1 compared to the No-Action Alternative, slightly decreasing the probability of a petroleum spill. Oil or other chemical spills may adversely impact Federally managed species. In particular, less mobile larval and juvenile finfish could be affected by a spill. Larval and juvenile finfish could be affected extensively by a spill if it occurred during their active migration periods. However, the risk of spills associated with changes in ship traffic under Alternative 1 would not be much greater than that expected under the No-Action Alternative.

Alternative 1 would result in permanent loss of open-bay bottom habitat. The potential harm of some individual organisms from turbidity-related impacts would be minimal compared to existing conditions and would not substantially reduce populations of Federally managed species. Since impacts would be temporary, no mitigation would be anticipated for Federally managed species. These species are motile and avoid areas of dredging and placement activities and would return after these activities are completed (Clarke and Wilber, 2000).

Dredged material is to be used beneficially for actions targeting BU (see Appendix C). This habitat could potentially be more productive than the open-water habitat that would be lost because of Alternative 1. Federally managed species may benefit from the higher productivity of the marsh, creating an overall positive benefit to the bay system when compared with the No-Action Alternative (Rozas et al., 2005).

Compensatory mitigation to offset unavoidable impacts to wetlands, SAV, and oysters must be implemented. These include 21.04 acres of palustrine wetlands, 16.61 acres of estuarine wetlands, 6.88 acres of SAV, and 0.10 acres of oyster reef. The PCCA will utilize SS1 to construct the mitigation site. The objective of mitigation is restoration through the reestablishment of 32.94 acres of estuarine wetlands, 42.08 acres of palustrine wetlands, 6.88 acres of SAV, and 0.10 acres of oyster reef (Triton Environmental Solutions, 2023; Appendix K). Creation of EFH at the mitigation site could benefit Federally managed species from the higher productivity of marsh, SAV, and oyster reef habitats. The mitigation proposed by PCCA is summarized in Section 6.0.

NMFS provided EFH Conservation Recommendations on the project in August 2022. Coordination with NMFS with respect to the MSFCMA was concluded in November 2022. NMFS provided additional EFH Conservation Recommendations on the project in February 2024 that will be addressed in the Record of Decision (see Appendix B8).

4.2.5.3.3 Alternative 2: Offshore Single Point Mooring

Impacts would be similar to those described in Section 4.2.2.2.3. Potential turbidity impacts to EFH resulting from construction of Alternative 2 would be similar to those described for Alternative 1. However, there would be no dredging of the channel and no placement of dredged material inshore or offshore. Pipelines would be installed via HDD which would help minimize disturbance of the bay bottom or water column. Any impacts would be short-term and expected to cease following construction.

Alternative 2 would directly affect offshore aquatic communities by loss of some bottom habitat for placement of the SPMs. At this time, the amount of offshore bottom habitat to be impacted by construction of moorings is not known but is not expected to be major. Vessel traffic traversing the CCSC would be expected to be less with this alternative and remain the same offshore. This would decrease the potential for spills of crude oil or other petroleum products during transfer operations to and from vessels. Possible spills affecting EFH would likely be temporary. The anchor leg configuration of the SPMs could serve as a fish attractant, providing long-term benefits to some Federally managed species.

It is anticipated that Alternative 2 could have less impacts to the EFH than Alternative 1 due to the lack dredging, dredged material placement, and fewer vessels traversing the ship channel. Beneficial use associated with maintenance dredging would continue. However, in the absence of actions targeting BU associated with Alternative 1, the loss of habitat could continue. The ongoing erosion of shorelines in the project area combined with rising sea levels could expose large areas of estuarine habitat to erosive forces, leading to the loss of EFH and possibly Federally managed species over time.

4.2.5.3.4 Alternative 3: Inshore/Offshore Combination

Impacts would be similar to those described in Section 4.2.2.2.4. Potential impacts to EFH resulting from turbidity caused during construction of Alternative 3 would be similar to those described for Alternative 1. However, there would be no dredging of the channel and no placement of dredged material either inshore or offshore. Pipelines would be installed via HDD which would help minimize impacts. Impacts would be short-term and expected to cease following construction. No long-term impacts would be expected.

Vessel traffic is not anticipated to increase with Alternative 3. Impacts associated with spills would remain the same offshore during transfer operations to and from vessels. Response times offshore could take longer than onshore response times, increasing damage potential if a spill occurred. Long-term impacts associated with spills would not be expected. The anchor leg configuration of the SPMs could act as a fish attractant thus providing long-term benefits to some Federally managed species.

It is anticipated that Alternative 3 could have less impacts to EFH than Alternative 1 due to the lack dredging and dredged material placement. Impacts could be slightly more than Alternative 2 due to partial vessel loading at inshore facilities then traversing the channel to the offshore facility to be fully loaded. Beneficial use associated with maintenance dredging would continue. However, in the absence of actions targeting BU associated with Alternative 1, the loss of EFH could continue. The ongoing erosion of shorelines in the project area combined with rising sea levels could expose large areas of estuarine habitat to erosive forces, leading to the loss of EFH and possibly Federally managed species over time.

4.2.5.4 Migratory Birds

4.2.5.4.1 No-Action Alternative

The No-Action Alternative would cause no new direct impacts to migratory birds. The CCSC will maintain its currently authorized –54-foot MLLW. Marine vessel traffic would continue which would contribute to shoreline erosion and pollution spills affecting migratory bird habitat. Maintenance dredging would continue which can temporarily increase turbidity and disperse prey, possibly reducing the foraging efficiency of some sight-feeding migratory seabirds like terns and pelicans for short periods of time (Cook and Burton, 2010). Migratory birds may have to forage further from their nests or roosts for food during maintenance dredging. Turbidity and noise would be temporary and localized and would not extend far beyond the area of disturbance. Vessel traffic in the CCSC would continue to increase as demand increases in the No-Action Alternative, the probability of impacts to migratory birds from shoreline erosion and pollution spills may increase. The potential for these impacts would continue in the future.

Migratory birds would experience indirect impacts as human development continues to encroach on or near their habitat, possibly reducing their abundance and species diversity. Recreational boating and shoreline angling which may increase with human development can lead to increased disturbances of loafing, foraging, and nesting migratory birds. Some habitats may change over time. Without additional shoreline protection or BU, marsh and beach habitat would continue to erode or subside from RSLR and shoreline erosion. Milder winters and warmer springs may shift migration patterns for birds to earlier in the year, affecting access to food and nesting habitat along the Texas Central Flyway (Wormworth and Mallon, 2006). Some migratory birds would relocate to other areas, impacting regional biodiversity and tourism from wildlife watching.

Impacts to migratory birds under the No-Action Alternative resulting from the current rates of maintenance dredging and human development are expected to be the same for all the alternatives.

4.2.5.4.2 Alternative 1: Channel Deepening (Applicant's Preferred Alternative)

Alternative 1 would dredge the CCSC from –54 feet MLLW to –75 feet MLLW. Dredging the CCSC to –75 feet MLLW would temporarily cause localized increases in turbidity and lower DO. The increase in turbidity within the CCSC may temporarily affect fish abundance within the area and the foraging rates of migratory species that are sight-feeders (Cook and Burton, 2010). Reduced DO which reduces fish abundance may temporarily reduce forage availability for piscivorous migratory seabirds. Migratory birds may have to forage further from their nests or roosts for food and resting areas during dredged material placement.

Deepening part of the CCSC would allow larger ships to traverse the channel and potentially reduce the amount of vessel trips compared to the No-Action Alternative. This might lower the frequency of possible disturbance caused by vessel traffic. Less vessel traffic may reduce the frequency of noise production however it is not known how the VLCCs, and the large tugboats required to maneuver them may affect the level of noise disturbance. Larger vessels such as VLCCs going through the CCSC with their tugboats may affect shoreline erosion and degrade or reduce the amount of shoreline for use by migratory birds.

Beneficial placement of dredge material along shorelines would increase beach and wetland habitat and protect interior habitat from shoreline erosion. Migratory birds would benefit from dredge material placement at actions targeting BU from restored shorelines. Placement actions targeting BU along the CCSC may increase nesting habitat for species such Least Terns and Black Skimmers. Proposed placement site, SS2, is specifically intended to protect Piping Plover sand flat Critical Habitat. Beneficial use may also increase foraging and wintering habitat for migratory species such as plovers, sandpipers, and curlews that would utilize nourished tidal flats and beaches. The mitigation plan would involve the relocation of oysters and transplant of seagrass from the impacted areas to the mitigation site at SS1 (Triton Environmental Solutions, 2023; Appendix K). Additional oyster reefs and seagrass meadows within the mitigation area would provide habitat and forage for shorebirds such as terns, oystercatchers, and herons.

Impacts to migratory birds under Alternative 1 resulting from the current level of maintenance dredging and human development are expected to be the same as the No-Action Alternative.

4.2.5.4.3 Alternative 2: Offshore Single Point Mooring

Due to the distance of the project from the mainland, Alternative 2 may have little effect on migratory shorebirds and songbirds. This alternative would not require dredging of the channel. There would be no dredged material used for BU to increase or protect shoreline habitat. Placing a pipeline across Redfish Bay increases the possibility of damage to habitat used by migratory birds. Construction of the pipeline requires access to the surface of the bay to monitor drilling. Required monitoring activities could temporarily disturb migratory birds during pipeline construction in the bay.

Migrating birds are known to use artificial structures like oil rigs in the Gulf as temporary resting areas during their migration and some may rest on the SPM system. Structures associated with the SPM may provide a resting place for migrating birds but may also put birds at risk of colliding with the structures during night circulation events (Russell, 2005; Ronconi et al., 2014).

Impacts to migratory birds under Alternative 2 resulting from the current level of maintenance dredging and human development are expected to be the same as the No-Action Alternative. Vessel traffic in the CCSC is expected to be reduced because of the elimination of lightering and reverse lightering. Reduced vessel traffic may decrease shoreline erosion and pollution incidents from marine vessels in the bay.

4.2.5.4.4 Alternative 3: Inshore/Offshore Combination

Since the CCSC would not be deepened and a SPM would be constructed offshore for Alternative 3, migratory birds would experience similar impacts to those described for the No-Action Alternative and Alternative 2.

4.2.5.5 Marine Mammals

The Atlantic Bottlenose Dolphin, also known as the Common Bottlenose Dolphin, is the only species of marine mammal that regularly inhabits the estuarine waters of the project area as part of their natural range. However, the Federally threatened West Indian Manatee occurs as an occasional drifter within these waters. Several marine mammal species have the potential to occur within the nearshore waters within the project area, but distributions of these populations are relatively unknown and understudied (see Section 3.3.5.5).

4.2.5.5.1 No-Action Alternative

Vessel traffic would be expected to increase over time with the No-Action Alternative, subsequently increasing the probability of a petroleum spill. However, in the unlikely event a petroleum spill should occur, marine mammals are motile enough to avoid most areas of high oil concentration. With the increase in vessel traffic, the potential for ship strikes also increases for marine mammals. Marine mammals are susceptible to disturbance by anthropogenic noise from shipping activity, and with increased vessel traffic, the potential for increased noise from shipping activity subsequently increases.

4.2.5.5.2 Alternative 1: Channel Deepening (Applicant's Preferred Alternative)

Alternative 1 would be expected to result in a decrease in shipping traffic compared to the No-Action Alternative. The likelihood of petroleum spills, ship strikes, and noise disturbance are anticipated at decreased levels. During dredging activities associated with channel deepening the potential for marine mammal disturbance is further increased. Dredging and placement activities has the potential to disturb marine mammals and cause them to alter their routes from construction activities and elevated turbidity. While these temporary impacts would likely cause marine mammals to avoid portions of the project area, they would not restrict access to foraging habitat.

Marine mammals are susceptible to ship strikes and disturbance by anthropogenic noise from shipping activity. Alternative 1 is expected to result in a decrease in shipping traffic once the deepened channel is complete, thus decreasing the potential of vessel strikes.

Activities associated with placement actions targeting BU, including underwater noise and increased turbidity, have the potential to impact Bottlenose Dolphins by causing them to avoid portions of the project area. In some cases, activities may cause Bottlenose Dolphins to avoid foraging areas, including emergent wetland margins and SAV beds. All three stocks of Bottlenose Dolphin managed within the project area have the potential to be impacted by placement activities (see Section 3.3.5.5).

Impacts to the West Indian Manatee could be slightly greater with Alternative 1 due to their preference for shallow coves and bays along the shoreline, especially in habitat that contains SAV. Several potential BU placement sites are known to contain SAV. West Indian Manatee can potentially become injured from impingement or entrainment during dredging activities associated with channel deepening and during maintenance dredging. These potential impacts to manatees can be avoided or minimized with appropriate best management practices.

4.2.5.5.3 Alternative 2: Offshore Single Point Mooring

While no channel deepening will take place under Alternative 3, the construction of a SPM facility is anticipated to result in a decrease in shipping traffic within the CSCC than with the No-Action Alternative. Therefore, the likelihood of petroleum spills, ship strikes, and noise disturbance within Corpus Christi Bay are anticipated at decreased levels. Large vessel traffic would be limited to the offshore portion of the project area. Transferring crude oil by pipeline to the offshore facilities can increase the risk of an oil spill in deep water. An oil spill in deeper waters would be difficult to contain and could impact marine mammals.

4.2.5.5.4 Alternative 3: Inshore/Offshore Combination

While no channel deepening will take place under Alternative 3, the construction of a SPM facility is anticipated to result in shipping traffic similar to the No-Action Alternative. Therefore, the likelihood for petroleum spills, ship strikes, and noise disturbance are anticipated to remain the same. Potential impacts for Alternative 3 would differ from Alternative 2 in that increased large vessel traffic would include both inshore and offshore portions of the project area. The potential for impacts to nearshore marine mammals is slightly increased with Alternative 3 over Alternative 2.

4.2.6 Hazardous Wildlife Attractants on or Near Airports

Due to the increasing concern about aircraft-wildlife strikes, the Federal Aviation Administration has implemented standards, practices, and recommendations for holders of Airport Operating Certificates issued under Title 14, CFR Part 139, Certification of Airports, Subpart D (Part 139), to comply with the wildlife hazard management requirements of Part 139. Airports that have received Federal grant-in-aid assistance must use these standards.

Certain land-use practices, such as waste disposal facilities, water management facilities, golf courses, agricultural cropland, and DMPAs can act as attractants to wildlife that pose a strike hazard. Some natural areas, such as wetlands, may attract wildlife associated with aircraft strikes. According to the Memorandum of Agreement between the Federal Aviation Administration and the USACE, the top five bird groups involved in damage-inducing aircraft strikes are gulls, geese, hawks, ducks, and vultures. In addition, white-tailed deer are by far the most struck mammal species (Federal Aviation Administration, 2003).

When considering proposed dredged spoil, beneficial use features, and mitigation areas, developers must consider whether the preferred action would increase wildlife hazards to aircraft. The Federal Aviation Administration recommends minimum separation criteria for land-use practices that attract hazardous wildlife to the vicinity of airports. These criteria include land uses that cause movement of hazardous wildlife onto, into, or across the airport’s approach or departure airspace or air operations area.

The minimum separation criteria include:

- Perimeter A: For airports serving piston-powered aircraft, hazardous wildlife attractants must be 5,000 feet from the nearest air operations area;
- Perimeter B: For airports serving turbine-powered aircraft, hazardous wildlife attractants must be 10,000 feet from the nearest air operations area; and
- Perimeter C: 5-mile range to protect approach, departure, and circling airspace.

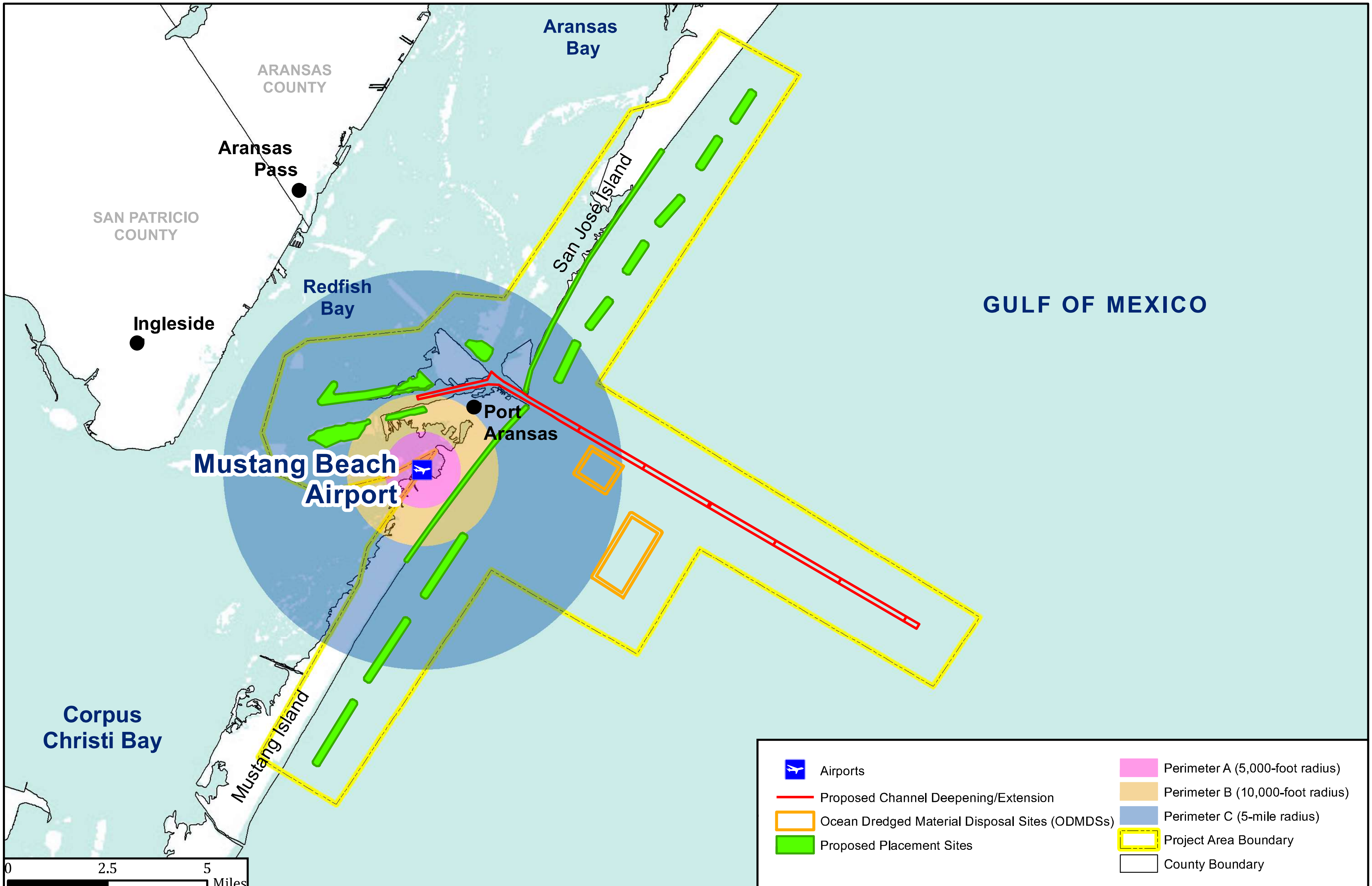
There are five public-use airports within the study area that must be considered for beneficial use actions that could increase hazards associated with wildlife. These include: McCampbell-Porter Airport (Ingleside), Mustang Beach Airport (Port Aransas), Hunt Airport (Portland), Aransas County Airport (Rockport), and Corpus Christi International Airport (Corpus Christi). Only one of these occur within the above described separation criteria (Table 4-20 and Figure 4-2). Mustang Beach Airport sells 100LL fuel (AirNav, 2022).

Table 4-20
Public Use Airports in the Study Area

Name	City	County	Perimeter	Nearby BU Site	Distance (miles)
Mustang Beach	Port Aransas	Nueces	A	MI	0.6

Source: AirNav (2022).

It was assumed that a separation distance of 10,000 feet for any of the hazardous wildlife attractants would apply in addition to the 5-mile range to protect approach, departure, and circling airspace. Mustang Beach Airport is located within all three perimeters. The project features involving beach/shoreline restoration (MI, SJI, and HI-E), nearshore berms (B1, B7, and B8), and shoreline stabilization (SS1 and SS2), could create an increase in bird nesting and foraging habitat which could increase the number and species of birds associated with aircraft strikes. A copy of the FEIS and notification letter will be sent to the Federal Aviation Administration.



PROJECT NO.	PCA20166
DATE CREATED	Date: 1/30/2024
DATUM & COORDINATE SYSTEM	NAD83 State Plane (feet) Texas South Central
FILE NAME	Name: Fig_4-2_Airport Locations
PREPARED BY	KLC

Port of Corpus Christi Authority
Corpus Christi Ship Channel Deepening Project

Hazardous Wildlife Attractants on or Near Airports

FIGURE 4-2

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4.3 CULTURAL RESOURCES

The following section summarizes the CDP's alternatives' expected impacts to cultural resources; more specifically: 1) recorded and unrecorded archaeological sites, features, and artifacts; 2) non-archaeological historic-age objects, buildings, structures, and districts; and 3) Traditional Cultural Properties. Cultural resource reviewers with the THC offered their comments on the preferred project in July of 2020 (see Appendix B8), calling for terrestrial and marine archaeological surveys prior to construction. The THC later clarified that dedicated architectural history survey would not be necessary to conclude that the project would not have an adverse effect on non-archaeological cultural resources in the vicinity (e.g., historic-age buildings, districts, and neighborhoods). Consultation with the USACE in their capacity as the Lead Federal Agency and the SHPO under 36 CFR 800 was completed in May 2023 (see Appendix B8).

4.3.1 No-Action Alternative

Under the No-Action Alternative, the CCSC would not deepen or extend into the Gulf. Continued maintenance dredging within the existing CCSC would not likely impact archaeological or non-archaeological Historic Properties (cultural resources listed in the NRHP or eligible for listing in the NRHP).

Sea levels in the project area are expected rise as described in Section 4.1.3.2. Additionally, routine erosional pressures like prevailing water currents, vessel traffic wakes, as well as catastrophic losses from extreme weather events would continue to alter the existing shoreline and expose recorded and unrecorded cultural resources in and around the San José, Mustang, and Harbor Island shorelines, and their associated barrier islands, to further damage (Rockman et al., 2016). Previously permitted PCCA actions would continue according to their approved plans.

4.3.2 Alternative 1: Channel Deepening (Applicant's Preferred Alternative)

The PCCA summarized the proposed CDP components and impacts in an initial archaeological assessment report (Cartellone and Pelletier, 2019). State and Federal cultural resource regulators reviewed the project's potential to affect significant cultural resources. The reviewing agencies commented that the proposed CDP was not likely to affect non-archaeological historic-age cultural resources, but an intensive survey was necessary to assess certain project components' impacts to terrestrial and underwater archaeological resources. After these recommendations, terrestrial and underwater archaeologists surveyed those undetermined areas. Their field data indicates that the CDP's proposed alternative would have no adverse effect on historic properties.

4.3.2.1 Channel Dredging Activities

Dredging associated with channel deepening could damage or destroy any archaeological cultural resources (e.g., shipwrecks, inundated terrestrial pre-contact sites, etc.). Incidental impacts would also be expected from temporary anchoring and other activities associated with the channel dredging. After crews have deepened and formed the channel to its prescribed contours, the sediments surrounding it will invariably slump and erode until an equilibrium is reached (Quinn, 2006). This delayed action could damage larger features such as shipwreck hulls and/or displace deposits of smaller artifacts and features (e.g., debris scatters, pre-contact occupation sites, etc.).

Archaeological Cultural Resources. Geological data suggest that most of the sediment proposed for dredging is not likely to have pre-contact-period archaeological cultural resources because these sediments were deposited after the landform was inundated (Davis, 2017).

There are three recorded archaeological Historic Properties, or likely Historic Properties, within 250 feet of the proposed channel dredging activity components: 41NU252, 41NU264, and 41NU292. All of these sites are historic-age shipwrecks. 41NU252 is the wreck of Steamship *Mary*, a Morgan Line iron-hulled sidewheel steamer that sank in 1876. Steamship *Mary* is a listed SAL and has been determined to be eligible for listing in the NRHP (THC Atlas, 2022). Archaeologists first recorded the *Mary* wreck in 1987 and have revisited and reassessed the site during earlier CCSC improvement projects (Enright et al., 2003; Pearson and Simmons 1994, 1995; THC Atlas, 2022). In 2003, PBS&J conducted a survey in the area for the CCSCIP and noted that 41NU252 would be negatively impacted by the dredging activity.

41NU264 and 41NU292 are two separate archaeological sites that archaeologists believe are likely associated with the wreck of the early 1900s, wooden-hulled, bulk oil transport *Utina*, which sank off the South Jetty off Port Aransas in 1920. According to site records, Site 41NU292 corresponds with the vessel and 41NU264 is related wreckage (THC Atlas, 2022). Archaeologists first recorded the wreck site in 1991, then revisited and reassessed sites 41NU264 and 41NU292 during earlier CCSC improvement projects (James and Pearson, 1991; Pearson and Simmons, 1994, 1995; Schmidt and Hoyt, 1995; Enright et al., 2003). Although initially considered eligible for inclusion in the NRHP (Schmidt and Hoyt, 1995), later investigations have revised the site's NRHP eligibility status to "Undetermined" (Enright et al., 2003). 41NU264 is, however, a listed SAL, suggesting it is a resource of some significance. 41NU292's NRHP eligibility status is also "Undetermined," pending a more intensive assessment.

Underwater archaeologists surveyed portions of the CDP APE in 2021–2022 and documented 17 submerged remote sensing targets that warranted avoidance. These anomalies are associated with previously recorded Sites 41NU252, 41NU264/41NU292, and 41AS119. Survey data and subsequent regulatory consultation (see Section 3.4.3.2) leads to a finding that the proposed dredging activities would avoid each of these anomalies (Burns et al., 2023; letter, Androy to Wolfe, April 19, 2023; THC Concurrence Tracking Number 202307362). This indicates that the proposed CDP dredging activities would have no adverse effect on historic properties.

Non-Archaeological Cultural Resources. There are two recorded non-archaeological Historic Properties in the vicinity of the proposed channel dredging corridor: the Tarpon Inn (National Register Reference #79003002) and the Aransas Pass Light Station District (National Register Reference # 77001423).

This historic hotel was built in 1886 from surplus Civil War-era barracks materials. The Tarpon Inn served vacationers, particularly anglers, from then on. Hurricanes repeatedly damaged the hotel over the decades, but it was rebuilt and reconfigured each time. The hotel was listed on the NRHP in 1979 (Beck, 1979). Because Alternative 1 would take place under water and in a corridor that has historically been used for merchant vessel traffic, the proposed channel dredging activities are not likely to affect the Tarpon Inn's historical setting or its sense of place.

Aransas Pass Light Station District stands just outside of CDPs APE. The lighthouse stands on Harbor Island, approximately 0.5 miles north of the northern terminus, overlooking the Lydia Ann Channel of the GIWW. The property's National Register Nomination Form (Holland, Jr., 1977) states that the district has several historically significant buildings that are remnants of Texas' second oldest-surviving lighthouse.

The district's period of significance extends from 1857 to 1938 and includes the original brick light tower, a brick keeper's house, a wooden assistant's dwelling, storage structures, wharves, and other support facilities. The district's recorder (Holland, Jr., 1977) noted "A bayou slices through the property and gives access to the station's structures. It is an integral part of the scene and any effort to widen it would have an adverse effect upon the historical setting of the light station." Though the channel deepening corridor is near this District's boundaries, no dredging is proposed that is likely to alter the site, or the bayou.

4.3.2.2 Dredged Material Placement

Dredged material placement activities would involve a range of offshore (dredges, barges, tugs, etc.) and onshore (cranes, trucks, dozers, compactors, etc.) equipment physically placing the materials dredged from the Gulf bottom in suitable locations along the existing shoreline. The construction equipment could affect cultural resources on or near the ground surface while the weight and compression of the added sediments could also physically displace them. The dredged material placement could also alter the prevailing terrain in a manner that could change a non-archaeological historic-age site's original setting, in turn changing its sense of place.

Scientists have studied the effects that intentional archaeological site burial has on long-term preservation. The SHPO conclusion and general recommendation is that intentional burial can effectively preserve archaeological deposits if 1) proposed impacts are light (e.g., foot traffic, golf carts, etc.); 2) the fill used is composed of the same type of soil as that which contains the site deposits; and 3) the fill is between 3.3 to 6.6 feet thick (THC-Archaeology Division, 2014). Most of the dredged placement activities under the Alternative 1 meet the latter two criteria and, depending on the placement methods, potentially meet the first. This suggests that this alternative's dredged placement activities would benefit recorded and unrecorded cultural resources in the vicinity by burying them under sediment, protecting them from erosion and/or looting (among other effects). The proposed nearshore berms (B1–B9), in particular, would likely help unrecorded cultural resources in un-surveyed areas along the San José and Mustang island shorelines because the sediments would be deposited naturally and gradually through longshore transport (vs. mechanical means).

Archaeological Cultural Resources. Most of the proposed dredge placement activities would restore earlier landform contours that had eroded away relatively recently (PA6, SS1, SS2, PA4, SJI, and MI). In some instances, such as the HI-E, the landform itself only dates to the late 1960s, suggesting that it is not likely to hold archaeological cultural resources to begin with. As a result, an archaeological survey was not needed for the government to conclude that the proposed dredge placement activities at PA6, SS1, SS2, PA4 were not likely to affect significant cultural resources. Likewise, the two ODMDS sites have been archaeologically surveyed and found to be devoid of archaeological resources. No further investigations were needed to confirm that these activities would have no impact on significant cultural resources.

The proposed SJI and MI components and their associated nearshore berms (B1–B9) require field surveys to assess project-related effects.

Two previously recorded terrestrial archaeological sites are mapped less than 600 feet from the Mustang Island beach nourishment corridor (MI): 41NU92 and 41NU153. No data are available online through the Atlas regarding 41NU92; however, the CDP terrestrial archaeology report describes the site as a burial of a male in his early twenties of European or Amerindian descent (Terracon Consultants, Inc., 2022). Site 41NU153 is listed as a possible Civil War-era “torpedo searcher”/anti-torpedo raft that was lost in 1865). When it was first documented in 1975, site recorders mention that if 41NU153 indeed were the remnant of an intact “torpedo,” it would be one of only two known in the United States at that time (THC Atlas, 2022).

Site 41AS91, a large (388 acres), historic-age site, is mapped just west of the proposed San José Island beach nourishment corridor (SJI) boundary. Archaeologists first (1995) interpreted 41AS91 as the structural remains of a Mexican American-War-era supply depot. Later (2001) investigators concluded it instead was a 1934 factory remnant (THC Atlas, 2022). Though 41AS91’s NRHP eligibility is still undetermined, the recorders in 2001 recommended the site be avoided or investigated more thoroughly if future actions could impact the site. Heavy equipment used for SJI dredge placement activities could damage components of 41AS91 or the dredge material itself could displace some part of the site.

Terrestrial archaeologists surveyed 955 acres of the Mustang and San José islands’ shoreline for the CDP in 2021 (Terracon Consultants, Inc., 2022). The surveyors observed that the investigated portions of the APE did not contain any significant cultural resources; crews did not find any evidence of Sites 41AS91, 41NU292 or 41NU153 within the CDP’s APE. Cultural resource reviewers at the USACE, Galveston District (DA Permit Application: SWG-2019-00067) and the THC (Tracking Number: 202208549) determined that no terrestrial historic properties would be affected by the preferred project (letter, Androy to Wolfe, March 31, 2022).

Non-Archaeological Cultural Resources. None of the proposed placement sites are likely to physically affect either the Tarpon Inn or the Aransas Pass Light Station Historic Properties. The prescribed dredge material placement would alter the surrounding topography. In some situations, this could adversely affect non-archaeological cultural resources' historical setting or feeling. The Tarpon Inn and Aransas Pass Light Station are not likely to be impacted because they are more than a half mile from the nearest PA (0.75 miles and 0.55 miles, respectively) and the dredge placement activities would restore conditions that had relatively recently washed away; they are not altering a historic setting.

Furthermore, beach nourishment activities (MI and SJI) are likely to extend the current shoreline seaward, protecting the islands from rising sea levels and reducing hurricane-related storm surge. This would have a beneficial and preservative effect on the Tarpon Inn, which has a history of hurricane damage (Beck, 1979), and the Light Station District, whose associated bayou is "integral" to its historical significance (Holland, Jr., 1977).

4.3.3 Alternative 2: Offshore Single Point Mooring

Alternative 2 would not need any additional dredging or dredge material placement along the eroded and lowered shorelines in the vicinity of the CCSC. No additional cultural resource impacts within the CCSC would result from continued maintenance dredging. As with the No-Action Alternative, natural and artificial pressures would continue to alter the existing shoreline and expose recorded and unrecorded archaeological resources in and around the San José, Mustang, and Harbor Island shorelines and their associated barrier islands to further damage.

Unlike the No-Action Alternative, Alternative 2 does prescribe new infrastructure: up to eight SPMs anchored 15 miles offshore connected to onshore pump facilities through underwater pipelines. Currently, this Alternative 2 is only conceptual and no formal engineering plans (even preliminary) have been developed. As a result, it is not possible to assess such an alternative's specific effects on cultural resources.

It is expected that if this alternative were to be carried forward, all planning and development would follow relevant environmental and cultural resource regulations. Archaeologists would likely conduct an offshore survey to find significant cultural resources that could be impacted through construction. It is expected that the alternative's underwater pipeline(s) and SPM sites would be designed to avoid significant cultural resources through HDD or shifting their placement. Alternative 2 may require an offshore anchorage to account for weather, sea state, maintenance, and vessel coordination. Engineers could site and configure such a component to avoid impacts to significant cultural resources.

If this alternative would negatively affect significant cultural resources, those effects would be mitigated in consultation with local, State, and/or Federal agencies and consulting parties.

4.3.4 Alternative 3: Inshore/Offshore Combination

Alternative 3 would not need any additional dredging or dredge material placement along the eroded and lowered shorelines in the vicinity of the CCSC. No added impacts to archaeological resources within the CCSC would result from continued maintenance dredging within the existing channel. As with the No-Action Alternative, natural and artificial effects would continue to alter the existing shoreline and expose recorded and unrecorded archaeological resources in and around the San José, Mustang, and Harbor Island shorelines and their associated barrier islands to further damage.

Alternative 3 would require similar infrastructure, except that only two SPMs would be required. Currently, this alternative is only conceptual and no formal engineering plans (even preliminary) have been developed. As a result, it is not possible to assess such an alternative's specific effects on cultural resources.

It is expected that, like the Alternative 2, if this alternative were to be carried forward, all planning and development would follow relevant environmental and cultural resource regulations and all components would be designed to avoid significant cultural resources or the developers would mitigate any adverse effects in consultation with local, State, and/or Federal agencies and consulting parties.

4.4 SOCIOECONOMICS

Impact intensities for socioeconomics are based on the definitions for socioeconomic-specific indicators for negligible, minor, moderate, and major impacts:

- No impact: no discernible or measurable impact;
- Negligible: the impact on socioeconomics would be at the lowest levels of detection, barely measurable, with no perceptible consequences;
- Minor: a few individuals, groups, businesses, properties, or institutions would be affected. Impacts would be small and localized. These impacts are not expected to substantively alter social and/or economic conditions. An example could include a noticeable effect on several properties in a neighborhood;
- Moderate: many individuals, groups, businesses, properties, or institutions would be affected. Impacts would be readily apparent and detectable in local and adjacent areas and would have a noticeable effect on social and/or economic conditions in the socioeconomic ROI; an example could include a noticeable disruption of a group of businesses that could affect revenues or jobs; and
- Major: a large number of individuals, groups, businesses, properties, or institutions would be affected. Impacts would be readily detectable and observed and have a substantial influence on social and/or economic conditions in the ROI. An example could include a substantial community-wide effect that disrupts business revenues or jobs.

Impact durations are also considered. Short-term impacts are those occurring during the planned construction period. Some of the expected operational socioeconomic impacts are considered long-term to permanent, lasting up to the 20-year analysis period.

4.4.1 No-Action Alternative

Under the No-Action Alternative, the CDP would not occur, and the channel depth would remain at –54 MLLW. Operations at the Port would continue with VLCCs partially loaded and reserve-lightered offshore. The following section describes the specific socioeconomic conditions under the No-Action Alternative.

Employment and Income. Economic trends occurring within the ROI would be expected to continue. Industries expected to maintain the largest share of employment include trade, construction, and some service industries (e.g., health care). In addition, economic growth due to the regional industrial and petroleum industry (e.g., extraction, transmission, refining) activities would also be expected to increase in response to increasing demand for commodities such as crude oil and refined products, iron, and steel. Development and activity at the Port would be expected to grow in response under the No-Action Alternative. Therefore, industrial refining and Port-related employment would be expected to grow. Under the No-Action Alternative, the 54-foot channel would remain draft limited for the VLCCs, and the shipping of crude oil through the channel would continue to occur.

Population. Populations in Aransas, Nueces, and San Patricio are predicted to increase by 100, 50, and 33 percent, respectively between 2010 and 2050 (Texas Demographic Center, 2019). The populations of Aransas Pass, Corpus Christi, and Port Aransas are also expected to increase. Population growth would generally follow development and land use plans identified by cities and counties in the ROI.

Housing. Trends in housing stock, value, and availability are expected to continue throughout the ROI. Housing availability is relatively high, with vacancy rates above 13 percent, and median rent between $914 and $1,134 per month (2021 dollars), which is slightly below median rent in Texas at $1,146 per month (U.S. Census Bureau, 2022d).

Community and Recreational Resources. Community services are expected to be similar to levels discussed in Section 3.5.2.1. As population grows throughout the ROI, these service levels would adjust to reflect population changes. Recreation activities and visitation are expected to follow trends described in Section 3.5.2.2.

Land Use. Land use within the project area is expected to follow trends described in Section 3.5.3. Areas closest to the channel include a mix of maritime industry, Port-related properties, residential, commercial, recreational, nature preserve, and undeveloped areas. Existing land use patterns would be expected to continue under the No-Action Alternative.

Environmental Justice. Minority and low-income populations live and work near the CCSC, as described in Section 3.5.4. While these populations would experience similar effects to industrial activities (e.g., air emissions, noise) as the general population, environmental justice populations may have unique vulnerabilities that make them more susceptible to adverse effects resulting from industrial activities. These conditions are expected to continue under the No-Action Alternative.

4.4.2 Alternative 1: Channel Deepening (Applicant's Preferred Alternative)

The following section describes the specific socioeconomic impacts expected to occur in the ROI as a result of the implementation of Alternative 1.

Employment and Income. Dredging is a specialized service and would be performed by one of the few large U.S. dredging firms. The dredging firm would use their existing crews and equipment and would likely bring in workers from outside the ROI during the short-term.

The deepening of the channel is expected to increase the amount of crude oil products that move through the Port, which would increase the need for additional workers. Therefore, employment and income are expected to increase at the Port and within the industries that support Port operations under Alternative 1 in the long-term. A PCCA-commissioned study, The Economic Impacts of the Port of Corpus Christi, 2015, analyzed the economic impact of public and private marine cargo activity at the Port and estimated impact by commodity sector (Martin Associates, 2016). The study estimated a multiplier of 0.02 port and terminal-related jobs generated per 1,000 tons of crude oil exported. While the specific amount of additional crude oil that might be supported by Alternative 1 is unknown, any additional crude oil exports supported by the alternative could support additional jobs and income in the ROI.

During the long-term, project related employment would support local household income and result in additional economic impacts circulating throughout the regional economy (e.g., indirect jobs, sales and tax receipts for local governments). The oil and gas and transportation and warehousing industries would be the primary beneficiaries of the CDP. Additionally, there may be some minor benefits to the regional economy resulting from proposed beach nourishment, potentially increasing long-term impacts to employment and income in the tourism industry.

Population. During the short-term, there would be additional non-local construction personnel that would relocate to the ROI and this in-migration of non-local construction workers would temporarily increase the population of the study area. However, it is possible that these personnel would live onboard the dredges that they operate. In this case, the short-term impacts to local population would be negligible.

As discussed in the Employment and Income section above, long-term employment is expected to increase. This increase would likely drive a minor amount of migration into the ROI over time as businesses that benefit from Alternative 1 increase staffing. Since increased employment is expected to be minor, long-term population growth under Alternative 1 would be similar to those projected for the No-Action

Alternative. In the short-term, the population would increase only by the amount of non-local construction workers that relocate to the study area for the duration of the construction period.

Housing. There would likely be no impact to housing in the short-term since dredging crews are expected to live aboard their ships. As described above in the Employment and Income section, it is expected that there would be a minor long-term increase in employment and population with the CDP. However, the increase in population resulting from the preferred project would be minor over time and would be comparable to the population projections described under the No-Action Alternative. Given the current supply of vacant housing as described in Section 3.5.1.5 relative to the negligible increase in population in the short-term and similar to the No-Action Alternative in the long-term, it is expected that housing supply and prices over the long-term would be, at most, negligibly affected by the minor change in population. Additionally, as described in section 4.1.9.2.3 above, the same VLCCs loaded under the No-Action Alternative would still be loaded and would still transit the area, except lightering events would be reduced as the deepened channel would allow full loading at the Harbor Island terminals. It is therefore anticipated that property values already account for the visual impacts from VLCCs transiting the project area.

Community and Recreational Resources. During the construction period, it is possible that additional demand may be placed on local law enforcement, coast guard, fire, ambulatory, and medical services. This demand might arise in the event of an accident at the project site, to facilitate the movement of large equipment, or the temporary closure of project work sites in the public domain. Law enforcement support may be needed temporarily to divert boat traffic around dredging operations. To reduce potential need for law enforcement and emergency response crews, light plants would be used during low light to improve safety for waterborne traffic. The need for this coordination and support from local law enforcement is likely to be short-term and minor, lasting only for a period of days during setup and takedown of project equipment or when dredge equipment is operating close to water-based recreation access points. Additionally, during preparation for placement of dredged material onshore, law enforcement and public safety personnel may be temporarily required to assist in the closure of public spaces. It is expected that the need for these personnel would be short-term, lasting from days to several weeks and require only enough man-power necessary to maintain exclusion of the public from specific PAs. Therefore, impacts to public safety and law enforcement personnel are expected to be minor in the short-term, and any impacts to law enforcement staffing could be partially mitigated through coordination with project staff.

Many areas receiving placement of dredged material on beaches are uninhabited. However, placement of dredged material will occur along public beaches on Mustang Island near Port Aransas. Dredged material would be transported to a designated location via pipeline, scow, hopper, and associated dredging support equipment. Areas of active earthwork would require a temporary buffer during the placement activities. To avoid impacting sensitive resources outside the dredged material PAs, PCCA would combine the creation of any new proposed berms with other temporary cofferdams, silt fencing, or similar devices, mitigating impacts to recreation users and other nearby communities. Recreational beach users might be excluded from PAs during placement operations. Recreational beach users may temporarily relocate to alternative beach recreation sites for the duration of the dredged material placement operations.

Dredging that would occur under Alternative 1 is located close to several marinas and boat ramps. Closure of these amenities as a result of the preferred project's construction is not expected. Dredging through the Harbor Island junction would require provisions to lessen disruption to use. This may include dredging during the off-peak periods of ferry operation. Furthermore, dredges would operate next to the navigation channel and are not expected to impede recreational boat traffic. Some recreational anglers' fish along the channel or from piers near the proposed dredge operations. Their use may be temporarily impacted during the short-term by increased turbidity associated with dredging. In some cases, anglers can move to other areas to fish. PCCA would implement best management practices to minimize potential impacts to fish habitat, such as turbidity curtains during dredging and construction, window restrictions, and biological monitors. These impacts would be localized around the immediate dredging and PAs. Therefore, it is expected that these impacts would be minor given the short duration of the project's construction.

Similarly, offshore placement of dredged material may temporarily impact recreational fishing. It is expected that anglers can temporarily relocate. However, this would result in increased costs to anglers in the short-term. During the long-term, impacts are likely to be negligible as anglers become acclimated to the location of the new offshore dredged material placement locations.

During the long-term, the deepening of the channel would create additional jobs in the study area and result in larger ships transiting the CCSC. This increase in total employment would likely place some additional demand on community services. However, the potential increased demand on community services is expected to be offset by increased employment, income, and associated taxes. Larger ships transiting the CCSC could create additional demand for emergency services to reduce the risk of in-channel vessel collision. However, this risk would be reduced by slow vessel speed, multiple tug assist, and one way transit when bringing VLCCs in the Port, reducing the need for additional emergency services and associated economic impact.

Land Use. Beach nourishment activities may result in short-term, minor adverse impacts to land use. However, over the long-term, the land use would not change along the beaches. Placement of dredged material would help protect existing land uses by restoring beaches that were eroded during past storms and provide future storm resiliency. Therefore, there would be minor, adverse short-term impacts and long-term benefits to land uses as a result of Alternative 1.

Environmental Justice. Air quality, visual, and noise impacts would be felt greatest by those residing close to dredging operations, which includes block group 1, Census Tract 51.04 that has 24 percent of households below poverty and block group 1, Census Tract 51.03 that has 14 percent of households below poverty within Nueces County. These two block groups have 4 percent and 22 percent minority populations, respectively (U.S. Census Bureau, 2022e). Adverse impacts from dredging may include intermittent, short-term impacts to local air quality from engine fumes emanating from dredging equipment or vessels used during dredging operations as described in Section 4.1.9. As described in Section 4.1.10 there would be noise impacts to sensitive receptors in these two block groups. Dredging crews would be expected to use best management practices to reduce noise and air emissions from construction equipment to the extent practicable, reducing potential impacts to local communities. This includes additional noise controls that can be implemented during quiet hours. Due to close proximity to communities, there is the potential for visual impacts, particularly when lights are being used by dredging crews.

Dredged material placement would occur in close proximity to all types of communities, including communities with both low- and non-low-income households and communities with relatively high minority and relatively low minority populations. Placement of dredged material is expected to result in short-term adverse impacts but provide long-term benefits for recreation, benefiting local communities that utilize these resources in the long-term. Placement of dredged material at SS1 and SS2 may result in temporary noise and visual impacts during the short-term construction of the islands. Short-term, adverse impacts to visual resources from placement of dredges material are not likely to be mitigated. However, they would ultimately result in long-term benefits to minority and low-income communities as a result of improved viewsheds and recreational resources, such as beaches, which are more resilient to erosion from storm events.

Adverse noise, air quality, and visual resources impacts may be distributed equally amongst all demographics. However, low-income and minority communities may have vulnerabilities such as limited access to health care or a relatively higher level of chronic health conditions that make them more susceptible to adverse impacts from the preferred project. Additional heightened disease susceptibility and health disparities in these communities as compared to higher income or non-minority communities add to this effect (Abara et al., 2012; Cushing et al., 2015; Prochaska et al., 2014). Additionally, individuals in these communities may not have the financial, social, or cultural resources to adapt to changes in air quality, noise, or viewshed impacts that than other sectors of the population might have. Additionally, individuals in low-income or minority communities may rely more on subsistence fishing as compared to higher income or non-minority communities. Construction of Alternative 1 may temporarily impact shoreline fishing, such as a fishing pier on the south side of the channel, several granite jetties at Robert’s Point Park, and the fishing pier at Magee Beach Park in Port Aransas. Thus, construction of this alternative may result in disproportionate and adverse short-term impacts to minority or low-income individuals that depend on these areas for subsistence fishing.

In the long-term, the deepening of the CCSC would continue to allow for the transit of VLCCs to deepwater berths on Harbor Island. Transit of these ships may continue to adversely impact the viewshed of residents who live near the channel. There is expected to be a long-term beneficial impact to air quality and a long-term reduction in noise due to reduced lightering of Suezmax vessels.

Mitigation of potential environmental justice impacts can occur through the implementation of construction best management practices such as the use of a project safety plan as well as noise mitigation measures. While there are no majority-minority or majority-low-income populations identified at the census block group level near the project area, there is the possibility that individuals and households within these classifications may still reside close to the project's construction area. Due to this factor, and historic factors that create vulnerabilities within these populations, it is noted that Alternative 1 has the potential for disproportionately high and adverse impacts to minority and low-income communities. However, it is expected that short-term adverse impacts would be mitigated to the extent practicable to reduce or eliminate potential environmental justice impacts and long-term impacts would be beneficial to low-income and minority populations in the project area. Therefore, it is expected that there would be low to no potential for adverse environmental justice impacts to occur under this alternative.

4.4.3 Alternative 2: Offshore Single Point Mooring

Alternative 2 proposes the construction and operation of a multi-buoy, SPM system consisting of multiple sets in an array of SPM buoys. These facilities would be used to fully load VLCCs offshore, eliminating the need for VLCCs to transit the CCSC.

Employment and Income. Construction of Alternative 2 would require construction personnel with specialized skills developing inshore, onshore, and offshore oil and gas pipelines and floating terminals. If construction personnel relocate to the ROI for the construction period, there could be a short-term minor beneficial impact on employment and income in the region. Given the specialized nature of the skills required by the construction workforce, it is likely that some portion of the workforce would need to relocate from outside the ROI during construction. These workers would provide an economic benefit to food and beverage establishments, grocery stores, clothing retailers, and hotels as they spend their income in the ROI.

Comparable to the operation of the proposed Bluewater Texas Terminal (Bluewater Texas Terminal, 2019b), it is anticipated that 50 to 100 personnel would be needed to operate facilities and vessels. While some of these personnel may relocate from outside of the ROI to take these jobs it is likely that some personnel would be hired locally given the strong oil and gas workforce and maritime industry in Corpus Christi. Employment of these personnel and their household spending would support local jobs, income, sales, and taxes. Overall, there would be minor short-term and long-term benefits to employment and income in the ROI.

Population. Under Alternative 2, construction would take place inshore and offshore. It would include the development of crude oil pipelines to transport crude oil from inshore to offshore facilities and several floating SPM facilities within deep water off the coast of Corpus Christi. While the number of construction personnel and construction timeframe for this alternative are not known, it is likely that construction of these facilities would require personnel with specialized skills If construction personnel relocate to the ROI, there could be a minor population increase. This alternative would likely be constructed similar to the floating SPM facility proposed by Bluewater Texas Terminal off the coast of Corpus Christi (Bluewater Texas Terminal, 2019b). Construction is anticipated to take 1.5 years to complete. If Alternative 2 is comparable, it is unlikely that construction workers would relocate their families to the ROI. Therefore, population impacts from the construction workforce would be limited to the number of construction workers and their families that relocate to the ROI during the construction period, resulting in short-term minor impacts to population.

During operation under Alternative 2, there would be employees that run the operations facility, SPM, and ocean-going support vessels. For spill prevention, there would be spill and fire response personnel. Based on employment figures published in the Bluewater Texas Terminal (2019b) project, it is assumed that 50 to 100 personnel would be required to operate this facility. If these personnel relocate to the ROI from other areas, there would be a minor long-term impact on population. Given the strong oil and gas workforce and maritime industry in Texas, and Corpus Christi in particular, it is likely that at least a portion of the operations workforce would come from within the ROI. Therefore, the long-term change in population is anticipated to be minor.

Housing. Under Alternative 2, additional workers that temporarily relocate to the ROI during the short-term would benefit housing rental markets and the hospitality industry. This may have some adverse impact on rental rates in the ROI. However, this impact is expected to be negligible during the short term as the portion of the workforce that relocate from outside the ROI is anticipated to have a minor impact on housing availability. Given that the operations workforce would likely be between 50 and 100 persons and a portion of this workforce already resides within the ROI it is likely that impacts to housing would be negligible over the long-term. Similar to Alternative 1, Alternative 2 is not likely to have an impact on property values as property values already account for visual impacts from VLCCs transiting the project area.

Community and Recreational Resources. Under Alternative 2, and similar to Alternative 1, it is possible that additional demand may be placed on local law enforcement, coast guard, fire, ambulatory and medical services during the construction period. This demand would arise only in the event of an accident, as requested by project management to facilitate the movement of large equipment, or to temporarily close work sites to the public. Law enforcement may be needed to divert traffic around onshore or offshore facilities during construction. However, the need for law enforcement support is likely to be short-term and minor.

During the operational phase of Alternative 2 there may be some additional burden on local public services such as law enforcement, coast guard, fire, ambulatory and medical services. However, this impact is expected to be minor given the likely small number of workers that would move from outside the ROI. There would also be lower risk activities taking place during the operational phase as compared to the construction phase. The preferred project would have continuous emergency monitoring and emergency response equipment and personnel, which would reduce impacts to community resources in the event of a spill or fire. Finally, taxes levied on both the operations business and the project operations workforce would support local community services. There would be no anticipated long-term impacts to recreation resources as a result of this alternative. Therefore, long-term impacts to community and recreational resources are anticipated to be minor.

Land Use. There would be no disturbance to surface land under this alternative except for the area used to initiate HDD for this project. Horizontal directional drilling would be used to construct the crude oil pipeline that would be used to transport oil from the inshore facility to the floating SPM facility. Given that this construction would occur in an area already used for industrial production, such as crude oil transfer, there would be no change in existing land use. Therefore, there are assumed to be no short-term or long-term impacts to land use associated with the construction or operation of Alternative 2.

Environmental Justice. As described in Section 3.5.4, only Nueces County is a majority-minority area and there is one relatively low-income block group in the ROI. There may be localized, intermittent and short-term air quality issues associated with fumes emanating from the construction equipment used in HDD for this pipeline from the Harbor Island terminal; however, there are no minority or low-income households located in the area of this drilling rig. Therefore, as the specific construction locations for construction and operations facilities under this Alternative would not be located near any minority or low-income communities as the pipe would be buried and HDD used in its construction and the horizontal drilling rig would be in an industrial area away from human habitation, this alternative is not anticipated to have the potential to produce any environmental justice impacts.

4.4.4 Alternative 3: Inshore/Offshore Combination

Similar to Alternative 2, Alternative 3 would result in the construction and operation of an array of SPM buoys. These facilities would be used to finish loading VLCCs offshore after they are partially loaded at inshore facilities in Ingleside and Harbor Island. VLCCs would transit the CCSC as described under Alternative 1. Additionally, crude oil would be pumped from shore-side crude oil refineries in Ingleside or Harbor Island to deep water port facilities located 15 miles offshore via pipelines using the same methods as described under Alternative 2. All operations and construction impacts described under Alternative 2 apply to Alternative 3.

Employment and Income. Impacts to employment would be the same as those described under Alternative 2. However, there may be some employment supported in the long-term as VLCCs partially load at Ingleside and Harbor Island prior to transiting to floating SPM facilities to finish loading crude oil. Alternative 3 would result in both short-term and long-term beneficial impacts to employment and income as a result of construction and operations related employment in the ROI.

Population. Impacts would be the same as those described under Alternative 2 with minor short-term impacts to population since the population would increase by only the amount of non-local construction workers that relocate to the ROI for the duration of the construction period. Long-term population changes would be minor and similar to Alternative 2.

Housing. Impacts to housing would be the same as those described under Alternative 2. Alternative 3 is therefore expected to have a negligible impact on housing, including short and long-term impacts to housing prices and supply. Similar to Alternative 1, Alternative 3 is not likely to have an impact on property values as property values already account for visual impacts from VLCCs transiting the project area.

Community and Recreational Resources. Impacts to community and recreational resources would be the same as those described Alternative 2. Therefore, under Alternative 3, impacts to community resources and recreation are anticipated to be minor during the short-term with minor impacts to community resources and no long-term impacts to recreational resources.

Land Use. Impacts to land use would be the same as those described under Alternative 2. Therefore, there would likely be a short-term, minor adverse impact to land uses along any crude oil pipeline corridor that is developed and long-term negligible impacts to land use at an inshore operations facility. The floating SPM facility would result in no short- or long-term changes to land use.

Environmental Justice. Environmental justice concerns under Alternative 3 would be similar to those described under Alternative 2. Additionally, the long-term benefits associated with Alternative 1 would also apply to Alternative 3 due to a reduction in reverse lightering of Suezmax vessels under Alternative 3 that would result in reduced noise and emissions from these vessels in the long-term. Therefore, there are anticipated to be no adverse environmental justice impacts in the short term and there is potential for beneficial environmental justice impacts in the long-term under Alternative 3.

4.5 NAVIGATION

The section describes the impacts of the alternatives on existing commercial and recreational navigation uses. The existing CCSC is a deep draft navigation channel constructed and maintained for commercial vessel traffic. Therefore, the primary effects of the alternatives are on commercial navigation.

4.5.1 No-Action Alternative

Under the No-Action Alternative, construction of the 54- to 56-foot deep channel through Ingleside would be completed by the CCSCIP. The existing VLCC traffic between Ingleside and the Gulf would continue to grow with the projected increase in exports driven by demand. These VLCCs would continue to be light-loaded, except that they would be loaded to approximately half-capacity. This operation would require a continuation of Aframax and Suezmax reverse lightering vessel traffic. However, since the VLCCs may be loaded to half-capacity, resulting from the CCSCIP deeper channel, the number of reverse lightering Suezmax transits may be reduced. In addition, permitting actions for VLCC marine terminals at Harbor Island are currently underway. When constructed, these terminals would serve the transit of VLCCs from

Harbor Island to the Gulf to meet the projected crude oil export increase. Depth restrictions associated with the CCSCIP channel geometries would require VLCCs at Harbor Island to be light-loaded to half-capacity. These light-loaded VLCCs would require reverse lightering within the Gulf, resulting in Suezmax reverse lightering vessel traffic, similar to Ingleside.

Current PCCA Board of Pilot Commission rules require one-way traffic restriction in Cut B (Port Aransas to Ingleside) for large tankers. These rules apply to tankers greater than 748 feet length overall, greater than 120 feet beam (width), and greater than 40.9 feet of draft (Aransas-Corpus Christi Pilot Board, 2021). VLCCs dimensions exceeds these criteria.

One-way VLCC traffic currently transiting between Port Aransas and Ingleside would continue, as well as future VLCC traffic between Port Aransas and Harbor Island. All other vessel traffic (e.g., bulk carriers, smaller tankers, etc.) would continue, along with an increase in traffic for those vessels carrying commodities forecasted to grow. In general, as the CCSCIP is completed with improved channel geometries, there should be traffic reductions of light-loaded vessels to move the same commodity shipment demands.

An estimate of VLCC and lightering vessel traffic attributable to expected crude oil export tonnage was conducted to support air and noise impacts and is summarized here. The estimate relied on forecasts of U.S. crude oil exports as a reference. High oil price cases conducted by the EIA (2021c) and historic crude oil export data gathered by the U.S. Census Bureau (2021c) informed this estimation. Since the lifting of the U.S. crude oil export ban in 2015, as discussed in Section 2.1, Gulf ports have dominated crude exports. This domination is a result of the proximity to the Permian Basin, the principal source for exported crude oil. Both the ports of Corpus Christi and Houston are the main crude oil exporting ports. The percent of total U.S. crude oil exported through Corpus Christi has grown from 29 percent in 2016 to 48 percent in 2020. With this historic growth rate, it is expected by the end of 2021 Corpus Christi will constitute 55 percent of the total U.S. crude oil export share. This share is projected to increase 81 percent at an assumed future endpoint and applied to the tonnage forecasted by EIA between 2020 and 2050.

The peak years' tonnage reference case and the high oil price case were then apportioned to the Corpus Christi existing and known planned crude export terminals. The VLCC and lightering vessel traffic numbers were derived from this apportioned projection. Under the high oil price case, the number of annual vessel transits from Ingleside and Harbor Island was estimated as 230 VLCCs/230 Suezmaxes and 290 VLCCs/290 Suezmaxes, respectively. Under the reference case, the number of annual vessels transits from Ingleside and Harbor Island was estimated as 140 VLCCs/140 Suezmaxes and 175 VLCCs/175 Suezmaxes, respectively. These estimates are an approximation relying on extrapolation of current trends for the purpose of demonstrating the potential magnitude of impacts and did not involve a port market analysis.

VLCC terminals at Harbor Island would exist under the No-Action Alternative. These terminals would be on either side of the SH 361 ferry crossing. Impacts to the ferry service during docking and egress of VLCCs and lightering vessels at these terminals would be addressed in separate NEPA processes for those terminals.

In summary, under the No-Action Alternative, VLCCs would continue less efficient export shipping of crude oil from Ingleside and Harbor Island. Lightering vessel traffic would continue movements from Ingleside and Harbor Island. One-way traffic restriction delays would continue to be imposed during VLCC transits.

4.5.2 Alternative 1: Channel Deepening (Applicant's Preferred Alternative)

Under Alternative 1, the channel from Harbor Island to the Gulf would be deepened to a depth allowing fully-loaded VLCCs to transit. This would eliminate the need for reverse lightering traffic originating from Harbor Island, and therefore, reducing vessel transits within the preferred project reaches. The range of vessel traffic reduction would be between 175 and 290 Suezmax transits at Harbor Island, in accordance with the No-Action Alternative estimations.

If the Ingleside terminals arrange for VLCCs to top off at the Harbor Island terminals or an offshore SPM, then Ingleside reverse lightering traffic would also be eliminated. The range of vessel traffic reduction would be between 140 and 230 Suezmax transits at Ingleside, in accordance with the No-Action Alternative estimations. Because of the cost of lightering operations, it is more likely that this would occur instead of continued lightering.

Alternative 1 does not widen the CCSC channel bottom and would only involve incidental side slope widening. Therefore, VLCCs would continue transiting with one way traffic restrictions, same as they would under the No-Action Alternative. However, elimination of the reverse lightering vessel transits under this alternative would increase channel availability compared to the No-Action Alternative. This potential outcome is further reinforced by the fact Suezmax vessels meet the length overall, beam, and draft criteria for one way traffic restriction.

The demand for crude oil is driven by global and domestic consumption and market forces. Furthermore, the demand for crude oil export capacity is driven by the presence of pipelines and crude oil export terminals. Marine vessel traffic is a function of these factors, and channel modifications are made in response to the resulting traffic. Therefore, this alternative is not expected to induce vessel traffic increases since terminals would be present under the No-Action Alternative.

The proposed CDP under Alternative 1 is not expected to adversely impact VLCC docking and egress times at the Harbor Island terminals. Therefore, no change in operating time impacts to ferry service from vessel docking and egress would be expected. However, the elimination of reverse lightering vessels at Harbor Island would reduce ferry operating time impacts caused by the lightering vessel docking and undocking events.

As evaluated and reported in LJA Engineering (2021), infrastructure features upgrades at the Port Aransas ferry facilities on Mustang Island and Harbor Island were recommended to TxDOT due potential impacts induced by waves and water level drawdowns generated by deep-draft vessel classes expected to use the proposed CDP, and the need for repairing or replacing existing ferry facility infrastructure.

A vessel wake analysis (Appendix H) was performed to assess bed and shoreline change induced by vessel transits resulting from the CDP (Baird, 2022b). An estimate of annualized bed and shoreline change resulting from vessel wakes was made by comparing the No-Action Suezmax transits versus the preferred project's VLCC transits. Results of the bed morphology analysis indicate a general scouring pattern on the channel shoulders, sedimentation along the top of the channel bank, and no sedimentation within the channel bed. The shoreline change analysis indicates that vessel induced wakes associated with the preferred project would minimally impact future evolution of shoreline along the ship channel.

Ship simulations were performed on the preferred project's laden VLCC vessel. These ship simulations took place at Seaman's Church Institute in November 2021 (Riben Marine, 2021) and February 2022 (Riben Marine, 2022; Appendix L). The November 2021 ship simulations was commissioned by PCCA and consisted of a 90 metric ton bollard pull (MTBP) tug. Port Pilot assessments of previous ship simulations studies for the preferred project recommended utilizing tugs of at least 90 MTBP and consideration of additional tugs of 120 MTBP. The basis for the recommendation was to complement the tug spread to safely manage the vessels during the most predominant environmental conditions within the project area. Therefore, the subsequent February 2022 ship simulations were performed at the direction of the USACE to include the evaluation of the larger more powerful 120 MBTP tug. The February 2022, ship simulations consisted of a total of 44 ship simulation runs over a period of four days. These simulations included emergency scenarios that simulated various combinations of ship and tug failures. The run data and participating Pilots feedback concluded five 120 MTBP rotor tugs would provide higher margins of safety. In addition, the use of these tugs would allow for operating fully loaded VLCCs for most environmental conditions. Therefore, it was concluded the preferred project's channel configurations with the underlying environmental conditions would be acceptable to safely operate fully loaded VLCC originating from the Harbor Island terminal.

A propeller scour assessment (Appendix M) to determine the potential for scour from the preferred action was performed, to include navigation simulations and propeller wash modeling (Baird, 2021b). Vessel maneuvers to assess propeller scour consisted of laden VLCCs and tugs directing wash to shoreline, structures, or slopes. For almost all areas modeled and assessed, the scour potential was either small or unlikely. The exception was along a shoreline wall of Harbor Island at the confluence of the CCSC and the Lydia Ann Channel, where there is larger scour potential. However, any scouring that may occur at this location can be mitigated with placement of armor protection.

A dynamic underkeel clearance assessment (Appendix N) was performed to assess the safety clearance of the preferred project's VLCC laden to 68 feet maximum draft (Baird, 2021c). The assessment consisted of analysis of measured water levels, assessments of modeled currents and waves, and modeling of vessel squat and wave response. The minimum underkeel safety clearance for the design operational wave conditions was calculated at 4.5 feet in the Jetty Channel and 5.2 feet in the Approach and Outer channels, which is compliant with the 2 feet safety clearance criterion established by the USACE (2006). Only, under extreme conditions of low-tide, significant wave heights and periods greater than 12 feet and 16 seconds, respectively, will the Outer Channel underkeel clearance not the meet the 2 feet safety criterion. However, it is assumed that larger tanker vessels would not be transiting through the ship channel during these extreme conditions.

It is anticipated the impacts on navigation under Alternative 1 would not be adverse. This is due to reductions in reverse lightering vessel traffic, no change to VLCC one-way transit restrictions, and no increases to VLCC vessel traffic.

4.5.3 Alternative 2: Offshore Single Point Mooring

Under Alternative 2, VLCCs would be loaded at the offshore SPMs (see Figure 2-2) and not at the Harbor Island terminals. This would eliminate both reverse lightering and VLCC vessel traffic originating from Harbor Island. Similar to Alternative 1, if the Ingleside terminals arrange for VLCCs to top off at an offshore SPM, then Ingleside reverse lightering traffic would be eliminated. Alternative 2 would also eliminate any operating time impacts to ferry service from VLCC docking and egress present in the No-Action Alternative.

However, it is highly unlikely that the terminal operators would abandon the No-Action Alternative's Harbor Island terminals and facilities after substantial investment to construct. If operators were to cease crude oil export, it would be expected that they would repurpose the terminals to serve other commodity traffic. As a result, some form of large commercial vessel traffic in the Harbor Island vicinity would continue.

The relocation of vessel traffic from the inshore sheltered waters to offshore SPMs would change the loading conditions for these vessels to an open sea environment. Given the open sea conditions, there is a greater potential for rougher weather conditions, operational delays, and unusual navigation safety risks to manage during loading. The SPMs would be located out of the navigation fairway leading to the CCSC Entrance Channel; therefore, the SPMs would not interact or interfere with existing vessel traffic.

Similar to Alternative 1, the SPMs would not be expected to induce vessel traffic in excess of the traffic volume resulting from the planned terminals. This is for the reason that, conceptually, the SPMs are designed to replace the crude oil throughput of those planned terminals.

4.5.4 Alternative 3: Inshore/Offshore Combination

Under Alternative 3, VLCCs would be partially loaded at Harbor Island and then fully loaded at offshore SPMs. This would eliminate reverse lightering vessel traffic from Harbor Island, eliminating transits between Harbor Island and the Gulf. Similar to Alternative 1, if the Ingleside terminals arrange for VLCCs to top off at an offshore SPM, then Ingleside reverse lightering traffic would also be eliminated.

The use of offshore SPMs would change the loading conditions for these vessels to a fixed open sea environment. Given the open sea conditions, there is a greater potential for rougher weather conditions, operational delays, and unusual navigation safety risks to manage during loading. The SPMs would be located out of the navigation fairway leading to the CCSC Entrance Channel; therefore, the SPMs would not interact or interfere with existing vessel traffic.

4.6 SUMMARY OF IMPACTS

Table 4-21 provides a summary of impacts for the alternatives.

Table 4-21
Summary of Impacts

Resource	No-Action Alternative	Alternative 1: Channel Deepening (Applicant's Preferred Alternative)	Alternative 2: Offshore Single Point Mooring	Alternative 3: Inshore/Offshore Combination
Physical Resources				
Sediment Transport	No impacts, regional Gulf currents that transport sediments would continue, maintenance dredging would result in redistribution of existing sediment and localized increases in turbidity	Sedimentation rates in the inner channel is limited to less than 10 percent increase; sedimentation in the outer channel is approximately 2.25 times higher; contribution of the New Work ODMDS sediment to channel sedimentation is small in comparison with overall sedimentation	No impacts to longshore sediment transport; short-term increases in turbidity and redistribution of sediments during installation of crude oil pipelines; maintenance dredging would result in redistribution of existing sediment and localized increases in turbidity	Same as Alternative 2
Shoreline Change	No impacts; ongoing beach nourishment activities have the potential to impact shorelines	No impacts; dune is stable and predicted profile changes with and without nearshore berm are identical	No impacts, localized rates of shoreline change would continue	No impacts, localized rates of shoreline change would continue
Bathymetry/Tides/ Currents and Circulation	No impacts; minor alterations from maintenance dredging; small, localized changes to currents and tidal levels	Use of New Work ODMDS would result in a periodic bathymetry change over an area up to 1.36 square nautical miles; noticeable impact on tidal range is limited to the Navigation Channel from Point Mustang to the inner basin; 15 to17 percent increase in tidal amplitude near Port Aransas; no major impact on bay currents or circulation	Similar to the No-Action Alternative; minor affects to a small amount of Gulf bottom at the locations of the moorings	Same as Alternative 2
Salinity	Gradual changes due to RSLR; small increase Corpus Christi Bay; small decrease Nueces Bay; changes in freshwater inflows could result in salinity changes	Change in tidal prism increases the exchange of saltwater between Corpus Christi and Nueces Bay; less than 1 ppt increase in the Corpus Christi Bay system; BU and offshore placement actions are not expected to impact salinity	No impacts	No impacts

Resource	No-Action Alternative	Alternative 1: Channel Deepening (Applicant's Preferred Alternative)	Alternative 2: Offshore Single Point Mooring	Alternative 3: Inshore/Offshore Combination
Relative Sea Level Change	RSLC expected at a rate of 0.23 inches per year over the next 100 years	Gradual increase in SLR on BU not expected to result in any major impacts on performance or operation of the channel	Not expected to result in any large impacts on performance or operation of the channel	Not expected to result in any large impacts on performance or operation of the channel
Severe Storms and Hurricanes	No impacts	No impacts	No impacts	No impacts
Storm Surge Effects	Increases in storm surge water levels and slight increases in the inundation extent expected; maximum elevation gain is 2 inches	Increases in storm surge water levels and slight increases in the inundation extent expected; maximum elevation gain is 3.5 inches; beach nourishment has the potential to offset erosion effects	No direct impacts anticipated; indirect impacts from RSLC	No direct impacts anticipated; indirect impacts from RSLC
Water Quality	Temporary turbidity increases during maintenance dredging activities; minor nutrient loading impacts	Material to be dredged suitable for offshore placement, no impacts from chemical contaminants anticipated; short-term suspension of nutrients during dredging and dredged material placement activities expected	Temporary increase in turbidity and total suspended solids during pipeline installation; disturbance of surface sediments from anchor chains; continued trends as described in the No-Action Alternative	Same as Alternative 2
Hypoxia	Continued hypoxic conditions during the summer in southeast portion of the bay	Localized and temporary lower DO expected during dredging in the water column; nutrients released in the water column during dredging may temporarily increase bacteria/ zooplankton resulting in lowered DO	Temporary increase in turbidity and total suspended solids during pipeline installation; short-term elevated turbidity, total suspended solids, and lowered DO during placement of anchors and chains	Same as Alternative 2
Sediment Quality	No impacts; maintenance dredging would continue; sediments are suitable for offshore placement	Material to be dredged is suitable for placement; testing of sediments has concluded that no adverse environmental effects would be expected	No impacts	No impacts

Resource	No-Action Alternative	Alternative 1: Channel Deepening (Applicant's Preferred Alternative)	Alternative 2: Offshore Single Point Mooring	Alternative 3: Inshore/Offshore Combination
Groundwater and Surface Water Hydrology	Impacts due to severe droughts, increased freshwater usage, SLR, and saltwater intrusion into bays, rivers, and creeks would continue	Localized temporary impacts associated with beach nourishment activities; actions targeting BU may change local hydrology temporarily during the marsh restoration and stabilization process	No impacts	No impacts
Soils (Prime and Other Important Unique Farmland)	No impacts	No impacts	No impacts	No impacts
Energy and Mineral Resources	No impacts	No direct impacts; provides additional capacity and transportation improvements for support of import/export of energy and mineral resources	Same as Alternative 1	Same as Alternative 1
HTRW	Impacts from past and current industrial activities would continue to affect maintenance dredging activities	Regulated facilities and incident locations do not pose an environmental concern; all dredged material to be placed at BU sites as allowable by EPA; increase in impacts resulting from deeper berths for handling petroleum products and other hazardous materials; risk of vessel spills reduced with product transfer at the Port	No direct impacts anticipated; localized impacts during handling, storage, and transfer of materials at each SPM	No direct impacts within the existing CCSC; localized impacts during handling, storage, and transfer of materials during partial loading at Ingleside and Harbor Island; localized impacts during handling, storage, and transfer of materials at each SPM
Air Quality	Emissions from lightering, 23,000 tons of VOC would continue offshore of Corpus Christi, more than annual Nueces and San Patricio counties regional onshore emissions of 17,873 tons	Impacts from construction emissions would be temporary that would be offset in 1 to 5 years for VOC and NO_x by annual reductions of 18,405 tons VOC and 221 tons NO_x from long-term positive impact of lightering reduction	Smaller one-time construction emissions than Alternative 1 but much greater long-term operational impacts from less emission-controlled SPM loading with at least 23,000 tons of annual VOC emissions offshore, and potentially greater than No-Action due to full loading of VLCC at SPM	Smaller one-time construction emissions than alternatives 1 and 2 but greater long-term impacts than Alternative 1 from less emission-controlled SPM loading similar to No-Action 23,000 tons of annual VOC emissions offshore, but less than Alternative 2 due to half-loading of VLCC at SPM

Resource	No-Action Alternative	Alternative 1: Channel Deepening (Applicant's Preferred Alternative)	Alternative 2: Offshore Single Point Mooring	Alternative 3: Inshore/Offshore Combination
Noise	Short-term elevated noise levels may occur during maintenance dredging; long-term increases due to increased ship traffic over time as demand increases are anticipated	Noise due to dredging would be similar to current maintenance dredging; placement of dredged material is not expected to pose adverse impacts; operations are not anticipated to change the current noise levels; vessel transit noise is not expected to increase	No long-term impacts are anticipated with the SPM; short-term impacts to underwater noise near the project site would be expected during construction; operational noise at the terminals would be similar to Alternative 1	No long-term impacts are anticipated with the SPM; short-term impacts to underwater noise near the project site would be expected during construction; operational noise at the terminals would be similar to Alternative 1 except that VLCCs would be partially loaded reducing noise emissions
Ecological and Biological Resources				
Wetlands and SAV	Impacts due RSLR, climate change stressors, and development would continue the trend of wetland loss and migration	Turbidity impacts during construction would be temporary; SAV occur at the proposed placement sites for BU: 3.32 acres at PA4 and 3.42 acres at HI-E; BU actions may help protect SAV that could be exposed if shorelines continue to erode; open water areas would be converted tidal estuarine wetlands or SAV creating a more productive habitat. Compensatory mitigation would re-establish 6.88 acres of seagrass via transplanting live seagrasses from the impacted area.	Impacts similar to those described under the No-Action Alternative; chance of temporary increase in turbidity during construction; change of spills during construction and operations	Same as Alternative 2
Freshwater Habitats and Fauna	No impacts	No impacts	No impacts	No impacts

Resource	No-Action Alternative	Alternative 1: Channel Deepening (Applicant's Preferred Alternative)	Alternative 2: Offshore Single Point Mooring	Alternative 3: Inshore/Offshore Combination
Estuarine Habitats and Fauna	Impacts due RSLR, climate change stressors, and the trend of wetland loss and migration would continue; temporary increase in turbidity during maintenance dredging and placement activities; benthic organisms would continue to be buried by disposal of dredged material; slight increase in petroleum spills with increase demand	Bay bottom habitat loss due to dredging and placement activities would occur; benthos would be affected until natural recovery occurs; temporary and localized turbidity impacts during construction and placement activities; slight increased probability of a petroleum spill; direct impacts to 0.10 acres oyster reef in HI-E are anticipated. 3.17 acres of oysters were mapped within a 500-foot buffer of PA sites and could be indirectly impacted; dredged material used beneficially has the potential to be more productive than the open water and bay bottom habitat what would be lost creating a positive benefit to the bay system. Compensatory mitigation would re-establish 0.10 acres of live oysters by relocating live oysters in the impacted area.	Turbidity impacts similar to those described under Alternative 1; some loss of offshore bottom habitat for SPM placement; if a spill were to occur offshore response time would be longer; anchor leg configuration could act as a fish attractant providing long-term offshore benefits; less impacts than Alternative 1 due to lack of dredging and dredged material placement, but no BU placement that could potentially benefit the overall system	Impacts similar to those described under Alternative 2; less impacts than Alternative 1 due to lack of dredging and dredged material placement, but slightly more than Alternative 2 due to partial vessel loading inshore then offshore top off, but no BU placement that could potentially benefit the overall system
Invasive Species in Ballast Water	Vessel traffic expected to increase which could increase the risk in the bay system	Vessel traffic expected to decrease that would reduce the overall risk	Lower risk due to vessels being loaded entirely offshore	Vessels would be partially loaded inshore, keeping the risk to the bay

Resource	No-Action Alternative	Alternative 1: Channel Deepening (Applicant's Preferred Alternative)	Alternative 2: Offshore Single Point Mooring	Alternative 3: Inshore/Offshore Combination
Wildlife Resources	Shoreline erosion, vessel strikes, noise, and spills would continue; temporary impacts due to turbidity from maintenance dredging; human development encroachment on wildlife would continue decreasing abundance and species diversity	Temporary and localized increases in turbidity and lower DO during dredging activities; reduced risk of lethal interactions with reduced vessel traffic; potential for larger ships/tugs to affect shoreline erosion, although modeling indicate minimal impacts; BU placement would positively impact wildlife, SS2 specifically intended to project Piping Plover Critical Habitat	Potential habitat damage during pipeline placement; potential for migrating birds to use artificial structures in Gulf as temporary resting areas, but may also put birds at risk of colliding with structures at night	Impacts similar to those described under the No-Action Alternative and Alternative 2
Protected Lands				
Protected Lands	Impacts due to RSLR would continue as wetlands convert to open water and more frequent storm surges; shoreline development could be impacted by RSLR, shoreline erosion, and storm surges	BU would provide benefits to the Port Aransas Nature Preserve; decreased erosion from less vessel traffic may benefit areas; impacts described in the No-Action would continue	Potential habitat impacts during pipeline placement; impacts described in the No-Action would continue	Impacts similar to those described under the No-Action Alternative and Alternative 1
Threatened and Endangered Species	Turbidity and reduced DO during maintenance dredging would continue; use of hopper dredged could impact sea turtles; potential impacts as ship traffic increases with demand; potential impacts due to continued shoreline retreat	Temporary and localized increases in turbidity during dredging activities; dredged material placement may disturb birds; temporary disturbances during placement of material at BU sites; BU sites could provide long-term benefits by increasing shoreline habitat and protecting marshes; less vessel traffic would decrease potential strikes and noise disturbances	Similar to the No-Action Alternative; short-term impacts due to underwater noise during construction; potential for impacts due to continued shoreline retreat with no BU	Impacts similar to those described under the No-Action Alternative and Alternative 2

Resource	No-Action Alternative	Alternative 1: Channel Deepening (Applicant's Preferred Alternative)	Alternative 2: Offshore Single Point Mooring	Alternative 3: Inshore/Offshore Combination
EFH	Trends in wetland loss, declining marshes, RSLR, and increasing salinity and water temperatures would continue; temporary turbidity during maintenance dredging would continue; burial of benthic organisms would continue	Bay bottom habitat loss due to dredging and placement activities would occur; benthos would be affected until natural recovery occurs; temporary and localized turbidity impacts during construction and placement activities; slight increased probability of a petroleum spill; direct impacts to 0.10 acres oyster reef in HI-E are anticipated. 3.17 acres of oysters were mapped within a 500-foot buffer of PA sites and could be indirectly impacted; dredged material used beneficially has the potential to be more productive than the open water and bay bottom habitat what would be lost creating a positive benefit to the bay system. Compensatory mitigation would re-establish 6.88 acres of seagrass via transplanting live seagrasses from the impacted area. Compensatory mitigation would re-establish 0.10 acres of live oysters by relocating live oysters in the impacted area.	Turbidity impacts similar to those described under Alternative 1; some loss of offshore bottom habitat for SPM placement; if a spill were to occur offshore response time would be longer; anchor leg configuration could act as a fish attractant providing long-term offshore benefits; less impacts than Alternative 1 due to lack of dredging and dredged material placement, but no BU placement that could potentially benefit the overall system	Impacts similar to those described under Alternative 2; less impacts than Alternative 1 due to lack of dredging and dredged material placement, but slightly more than Alternative 2 due to partial vessel loading inshore then offshore top off, but no BU placement that could potentially benefit the overall system
Migratory Birds	Shoreline erosion, noise, and spills would continue; temporary impacts due to turbidity and noise from maintenance dredging; human development encroachment would continue decreasing abundance and species diversity	Temporary and localized increases in turbidity and lower DO during dredging activities; potential for larger ships/tugs to affect shoreline erosion, although modeling indicate minimal impacts; BU placement would positively impact wildlife, SS2 specifically intended to project Piping Plover Critical Habitat	Potential habitat damage during pipeline placement; potential for migrating birds to use artificial structures in Gulf as temporary resting areas, but may also put birds at risk of colliding with structures at night	Impacts similar to those described under the No-Action Alternative and Alternative 2

Resource	No-Action Alternative	Alternative 1: Channel Deepening (Applicant's Preferred Alternative)	Alternative 2: Offshore Single Point Mooring	Alternative 3: Inshore/Offshore Combination
Marine Mammals	Increased vessel traffic with demand increases potential for petroleum spill, vessel strikes, and noise	Reduced ship traffic lessens the possibility of spills, vessel strikes, and noise disturbances; dredging and placement activities may temporarily disturb mammals and cause to alter routes during construction; placement for BU may cause mammals to avoid portions of foraging areas; potential for manatee to be impacted during dredging activities, can be avoided by using best management practices	Decreased vessel traffic decreases potential for petroleum spill, vessel strikes, and noise; increased risk of spills offshore during crude oil transfer	Impacts similar to those described under Alternative 2 except increased vessel traffic inshore and offshore has the potential to impact mammals
Hazardous Wildlife Attractants on or Near Airports	No impacts	BU project features involving beach/shoreline restoration, nearshore berms, and shoreline stabilization, could create an increase in bird nesting and foraging habitat which could increase the number and species of birds associated with aircraft strikes	No impacts	No impacts
Cultural Resources	RSLR, currents, vessel wakes, extreme weather events would continue to expose cultural resources; no impacts due to maintenance dredging	No impacts likely but an intensive survey is necessary to assess impacts to terrestrial and underwater archaeological resources; during channel dredging activities, potential impacts to three historic properties (41NU252, 41NU264, and 41NU292); during dredged material placement for BU, potential benefit to offshore sites; potential impact to two terrestrial sites (41AS91 and 41NU153)	No project impacts; impacts similar to those described under the No-Action Alternative	No project impacts; impacts similar to those described under the No-Action Alternative

Resource	No-Action Alternative	Alternative 1: Channel Deepening (Applicant's Preferred Alternative)	Alternative 2: Offshore Single Point Mooring	Alternative 3: Inshore/Offshore Combination
Socioeconomics				
Employment and Income	Economic growth expected to increase as demand increases	Short-term increase in workers/income during construction; long-term employment and income would increase with increase in crude oil products moved through the Port; project related employment would support increase in local income throughout the regional economy	Short-term and long-term benefits are anticipated; short-term benefit on employment and income with influx of construction personnel; 50 to 100 personnel would be needed to operate the facility providing benefits long term	Impacts similar to those described under Alternative 2; short-term and long-term beneficial impacts as a result of construction and operations related employment
Population, Housing, Community and Recreational Resources, Land Use	Population growth would continue increasing trends in housing, recreational activities, and land use	Short-term increases of population during construction with non-local workers coming into the area; no impacts to housing or land use over the long-term; temporary and short-term impacts to community and recreational resources; community resource demand long-term may be burdened, but offset with increased employment and taxes	Short-term increases during construction due to influx of workers and their families; long-term population change, housing impacts, and community and recreational resources minor; no short-term or long-term impacts to land use anticipated	Impacts similar to those described under Alternative 2

Resource	No-Action Alternative	Alternative 1: Channel Deepening (Applicant's Preferred Alternative)	Alternative 2: Offshore Single Point Mooring	Alternative 3: Inshore/Offshore Combination
Environmental Justice	Vulnerabilities that make them more susceptible to adverse effects from increased industrial activities that are expected	Overall, there is a low to no potential for adverse impacts; short-term impact to local air quality and noise during construction and dredged material placement, however a long-term benefit with reduced noise and improved air quality due to reduced lightering; long-term benefits as a result of improved viewsheds and recreational resources from BU; short-term impacts during construction to minority or low-income individuals that depend on subsistence fishing; long-term viewshed impacts for residents living near the channel; best management practices would be utilized	No impacts	Impacts similar to those described under Alternative 2; long-term benefits due to a reduction in reverse lightering resulting in reduced noise and air emissions
Navigation	Less efficient export shipping; lightering vessel traffic would continue from Ingleside and Harbor Island; one-way traffic restriction delays would continue	No adverse impacts are anticipated due to the reduction in reverse lightering vessel traffic, no change to VLCC one-way transit restrictions, and no increases to VLCC vessel traffic	SPMs would not be expected to induce vessel traffic in excess of the traffic volume resulting from the planned terminals; the SPMs are designed to replace the crude oil throughput of those planned terminals	Reverse lightering eliminated from Harbor Island and if Ingleside terminals arrange to top off offshore then Ingleside reverse lightering eliminated; greater potential for operational delays due to rough weather offshore

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5.0 CUMULATIVE IMPACTS

This section discusses the potential cumulative effects (impacts) of the preferred action (Alternative 1), and alternatives 2 and 3, when combined with impacts that have already occurred, or are still occurring, in the project area due to past, present, and reasonably foreseeable projects or actions. This section provides the following information:

- A description of the cumulative effect analysis (CEA),
- Identification of temporal and spatial boundaries for the CEA,
- Summary of key resources to retained for evaluation, and a description of the types of impacts that were included in the cumulative effect assessment,
- A description of past, present, and reasonably foreseeable future projects and activities that may contribute to cumulative effects in the study area, and
- A discussion of potential cumulative impacts to resources in the study area when considering potential impacts of past, present, and reasonably foreseeable future projects in conjunction with the preferred action (Alternative 1), or alternatives 2 or 3.

5.1 METHODS

A general approach and suggested analytical techniques are provided in the CEQ's (1997b) publication, *Considering Cumulative Effects Under the National Environmental Policy Act*. For purposes of this EIS, cumulative impacts were discussed in further detail if the potential indirect and direct effects would result in temporary adverse or positive impacts to the resource. In addition, the health of the resource was taken into consideration.

The President's CEQ regulations define cumulative effects as:

> *"…the impact on the environment which result from the incremental impact of the action (project) when added to other past, present, and reasonably foreseeable future actions regardless of what agency (Federal or non-Federal) or person undertakes such other actions. Cumulative impacts can result from individually minor but collectively significant actions taking place over a period of time"* (40 CFR 1508.7).

Impacts include both direct effects (caused by the action and occurring at the same time and place as the action), and indirect effects (caused by the action but removed in distance and later in time, and reasonably foreseeable). Cumulative effects (impacts) include both direct and indirect, or induced, effects that would result from the project, as well as the effects from other past, present, and reasonably foreseeable future actions not related to, or caused by, the preferred action. Cumulative effects may be adverse or beneficial. The CEA considers the magnitude of the cumulative effect on the resource health. Health refers to the general overall condition, stability, or vitality of the resource and the trend of that condition. Laws, regulations, policies, or other factors that may change or sustain the resource trend were considered to determine if more or less stress on the resource is likely in the foreseeable future.

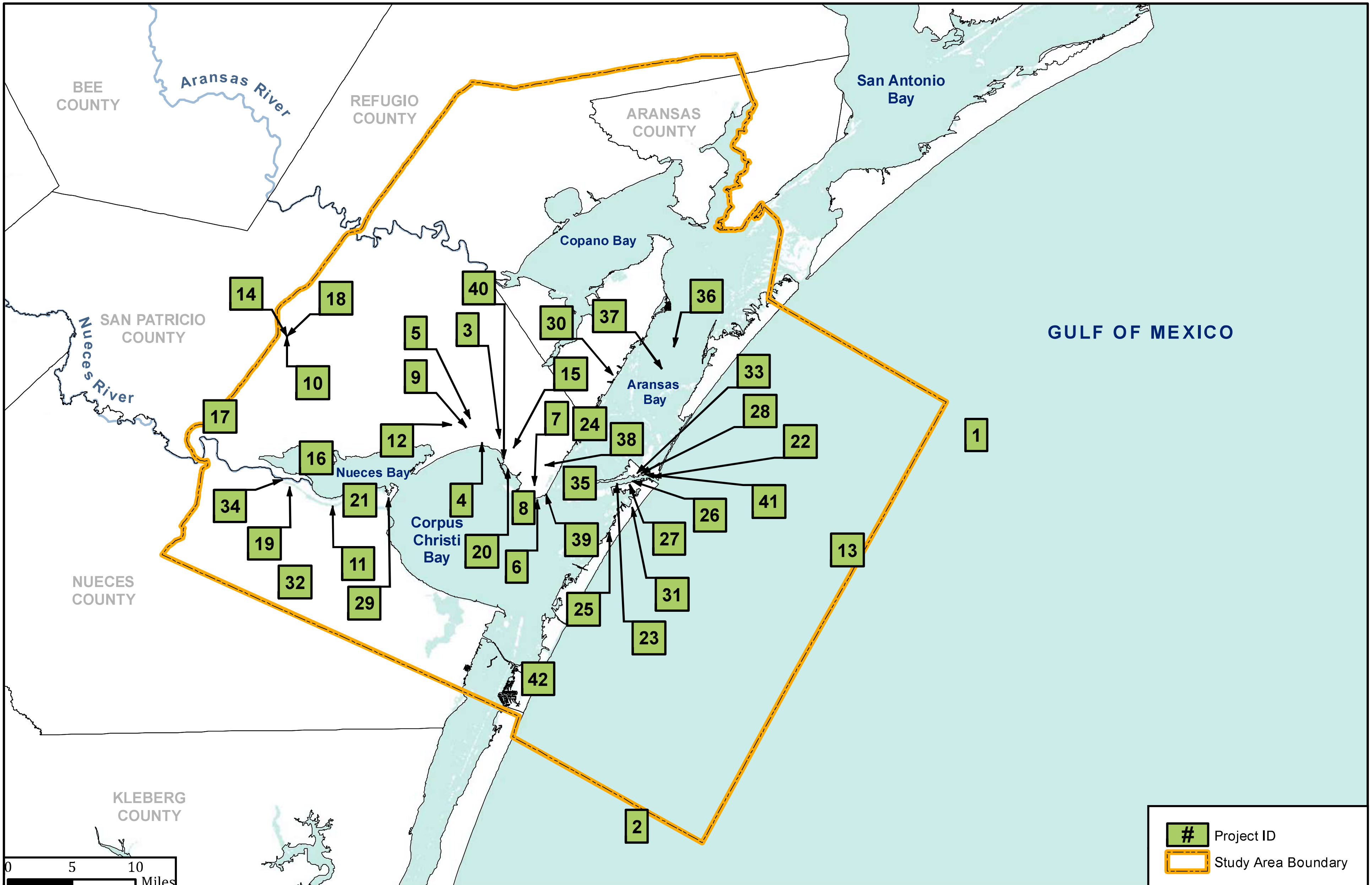
Cumulative effects can result from individually minor but collectively significant actions taking place over time. Cumulative effects of the preferred project would be the incremental effects that the project's direct or indirect effects have on that resource in the context of other past, present, and reasonably foreseeable future effects on that resource from unrelated activities. Cumulative impacts may also occur when disturbances or impacts are spatially or temporally close, where the effects of one are not dissipated before the next occurs, or when the timings of disturbances are close that their effects overlap.

5.2 CUMULATIVE EFFECTS SCOPING

CEQ (1997b) suggests to scope for the cumulative effects, which includes the identification of key resources that the preferred action (and alternatives) may impact. This involves considering the direct and indirect effects of a preferred action(s), which resources are affected, and which effects are important from a cumulative perspective. This is done to focus the analysis on key resources relevant to the effects of the preferred action(s), and not include those effects that are irrelevant or inconsequential to decisions about the preferred action or alternatives. Based on information in Section 4.0 (Environmental Consequences), key resources that were evaluated for cumulative effects include:

- Coastal Processes
- Physical Oceanography
- Water Quality
- Energy and Mineral Resources
- Air Quality
- Noise
- Wetlands and SAV
- Aquatic Resources
- Wildlife Resources
- Threatened and Endangered Species
- Migratory Birds
- Cultural Resources
- Socioeconomics
- Navigation

Scoping also includes establishing the spatial and temporal boundaries of the CEA and resource impacts. For this CEA, the study area (Figure 5-1) is considered the spatial boundary and it includes substantial portions of four counties, four bays, portions of several coastal watersheds, three barrier islands, and offshore extents. For a temporal boundary, projects considered for the CEA included projects that have been completed approximately within the past 5 years (2016 to 2020) or might be constructed approximately within the next 5 years.



PROJECT NO.
PCA20166

DATE CREATED
Date: 4/19/2022

DATUM & COORDINATE SYSTEM
NAD83 State Plane (feet) Texas South Central

FILE NAME
Name: Fig_5-1_Cumulative Impact Projects

PREPARED BY
KLC

Port of Corpus Christi Authority
Corpus Christi Ship Channel Deepening Project

Past, Present, and Reasonably Foreseeable Actions

N W E S

FIGURE
5-1

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5.3 PAST, PRESENT, AND REASONABLY FORESEEABLE ACTIONS

Most actions were identified primarily through a comprehensive review of the USACE regulatory permit database for permits within the four counties within the study area (Nueces, San Patricio, Refugio, and Aransas counties). Figure 5-1 represents all past, present, and future actions selected for the CEA. Individual project documents, such as public notices, draft and final Environmental Assessments and EISs, Records of Decision, newspaper articles, planning documents, and project websites or fact sheets, were also reviewed for impacts to the resource areas. No attempts were made to verify or update those documents, and no field data were collected to verify the impacts described in the above documents. Thus, this analysis recognizes that some of the projects are undergoing revisions that may alter their eventual environmental impact, but it has relied upon the best available information in existing published documents. Quantitative impact estimates were included, where possible, and summed across projects, but in many cases, only qualitative information was available.

In some cases, detailed information regarding past, present, and reasonably foreseeable actions were limited, especially regarding cumulative impacts. In these cases, qualitative assessments were completed when possible. There is also a level of uncertainty involved in assessing impacts of projects that are either proposed or in progress. Most of the reasonably foreseeable projects are planned, but do not have definitive implementation schedules due to a variety of factors including funding constraints and permitting. Furthermore, projects are often delayed or altered between the time they are announced and when they are completed, or sometimes abandoned. Therefore, there could be differing impacts to those that are included in CEA based on the information that is publicly available.

A determination was then made based on the location (spatial bounds analysis), timing (temporal bounds analysis) the criticality of the resources impacted, and the potential overlap of impacts resulting from the CDP. Based on these screening criteria, a list of relevant past, present, and reasonably foreseeable projects was then generated. Table 5-1 includes the projects included within the CEA and Figure 5-1 illustrates the approximate location of these projects. To organize discussions on the cumulative analysis, projects have been compiled into the nine CEA project groups below:

1. Offshore Oil and Gas Terminals
2. Onshore Storage and Fabrication Terminals
3. Utility, Gas, and Petroleum Pipelines
4. Maintenance and Navigation Dredging
5. Bulkheads, Breakwaters, Boat Ramps, and Marinas
6. Transportation Projects
7. Commercial and Recreational Development

8. Desalination Facilities
9. Ecosystem Restoration

Table 5-1
Past, Present, and Reasonably Foreseeable Projects

Project ID	Project Name	CEA Project Group*	Action Type
1	Bluewater Texas Terminal/Midway Tank Terminal	1	Deepwater Port/ Storage Terminal/Pipeline
2	Texas Gulf Terminals Inc./Laguna Madre and Gulf of Mexico	1	Deepwater Port/Storage Terminal/Pipeline
3	Ingleside Ethylene LLC/La Quinta Channel	2	Ethylene Pipeline Installation
4	Corpus Christi LNG, LLC/Terminal Project	2	Liquid Natural Gas Terminal
5	Cheniere Liquids Terminal LLC/La Quinta Channel	2	Dredging/Boat Slip/Bank Stabilization/Dock
6	Flint Hills Resources/CCSC	2	Maintenance Dredging
7	Enbridge Ingleside Oil Terminal, LLC/CCSC	2	Dredging/Boat Slip
8	Corpus Christi Liquefaction, LLC/La Quinta Channel	2	Private Navigation Dredging
9	Port of Corpus Christi/La Quinta Channel	2	Container Terminal
10	Oxy Ingleside Energy Center (Moda)/Corpus Christi Bay	2	Commercial Development
11	Plains All American LP/Corpus Christi Terminal	2	Liquid Petroleum Storage Terminal
12	Gulf Coast Growth Venture	2	Petrochemical Complex
13	Newfield Exploration Company/Gas Pipeline	3	Gas Pipeline/Abandonment
14	Infinity Engineering & Consulting/Trilogy Midstream	3	Direction Drill Pipeline
15	Epic Y-Grade Pipeline LP/Robstown to Ingleside	3	Pipeline
16	Corpus Christi Infrastructure LLC/Nueces Bay)	3	Pipeline
17	Enterprise Products Operating LLC/Dean Expansion	3	Pipeline
18	Harvest Midstream/Kinney Bayou	3	Utility Line
19	Flint Hills Resources, LLC/CCSC	3	Pipeline
20	Kiewit Offshore/La Quinta Channel	4	Dredging/Bulkhead
21	AccuTRANS Inc./CCSC	4	Bulkhead/Dredging
22	Corpus Christi Ship Channel Deepening and Widening Project	4	Dredging
23	Corpus Christi Ship Channel Project	4, 5	Dredging/Breakwaters
24	City of Aransas Pass/Conn Brown Harbor	5	Boat Ramp/Dredging/ Pier/Docking Structures
25	PA Waterfront/Corpus Christi Bay	5	Residential Development/ Marina
26	City of Port Aransas/CCSC	5	Rock Revetment

Project ID	Project Name	CEA Project Group*	Action Type
27	City of Port Aransas/CCSC	5	Marina
28	TxDOT Port Aransas Ferry	6	Transportation Project
29	TxDOT/Harbor Bridge/CCSC	6	Transportation/Bridge
30	De Ayala Properties/Redfish Bay	7	Residential Development
31	Pelican Cove Development, LLC	7	Residential Development/Commercial
32	Seven Seas Water Corporation/Harbor Island	8	Desalination Plant
33	Port of Corpus Christi/CCSC	8	Desalinization Plant
34	City of Corpus Christi/Inner Harbor Desal Project	8	Desalinization Plant
35	TPWD/Dagger Island	9	Breakwater/Bank Stabilization
36	GLO/Texas Coastal Resiliency Masterplan	9	Various restoration projects and actions
37	Coastal Bays Bend and Estuaries/Various Restoration Projects	9	Various restoration projects and actions
38	Axis Midstream/Midway to Harbor Island	2, 3	Storage Terminal/Pipeline
39	South Texas Gateway Terminal LLC/Redfish Bay	2, 4	Dredging/Industrial Development
40	Subsea 7 (US) LLC/Loadout Facility	2, 4	Facilities and Maintenance Dredging
41	Port of Corpus Christi/Harbor Island Terminal	2, 4	Dock/Turning Basin/Terminal
42	City of Corpus Christi/Packery Channel Dredging	4, 9	Maintenance Dredging/Beach Nourishment

* 1 = Offshore Oil and Gas Terminals; 2 = Onshore Storage and Fabrication Terminals; 3 = Utility, Gas, and Petroleum Pipelines; 4 = Maintenance and Navigation Dredging; 5 = Bulkheads, Breakwaters, Boat Ramps, and Marinas; 6 = Transportation Projects; 7 = Commercial and Recreational Development; 8 = Desalination Facilities; 9 = Ecosystem Restoration

5.3.1 Offshore Oil and Gas Terminals

5.3.1.1 Bluewater Texas Terminal/Midway Tank Terminal (SWG-2020-00159)

Bluewater Texas Terminal LLC proposes to construct, own, operate, and eventually decommission the Bluewater Project, which would export crude oil from the two SPM buoys located in Federal waters off the coast of Corpus Christi, Texas. The proposed offshore Bluewater Deepwater Port would serve the purpose of exporting abundant domestic crude oil supply from major shale basins. The crude oil would be delivered from a multi-use terminal located south of Taft, Texas and transported via two 30-inch pipelines to the offshore SPM buoys. The multi-use terminal would be constructed regardless of the construction of the CDP. Therefore, the multi-use terminal is not considered to be a connected action.

The project is expected to have a 50-year life before decommissioning of the project components is anticipated to occur. Decommissioning of the project would consist of removal of both SPM buoy systems;

plugging and abandonment of onshore and inshore pipelines; removal of the offshore pipelines installed via jetting located on State-owned submerged lands; plugging and abandonment of offshore pipelines located outside of State-owned submerged lands; and removal or repurposing of the Harbor Island terminal. The type and severity of impacts would need to be reevaluated at the time of decommissioning to account for changes between the time the EIS is published and the time the project is decommissioned that would affect the natural or social environment.

5.3.1.2 Texas Gulf Terminals Inc./Laguna Madre and Gulf of Mexico (SWG-2018-00563)

The Texas Gulf Terminals Inc. deepwater port (offshore component) would be located approximately 12.7 nautical miles off the coast of North Padre Island (Kleberg County, Texas) and consist of 14.71 miles of two new parallel 30-inch diameter crude oil pipelines, which terminate as a SPM buoy. The SPM buoy system would be positioned in water depths of approximately 93 feet and consist of a pipeline and manifold, catenary anchor leg mooring system, and other associated equipment.

The inshore components associated with the project includes 5.74 miles of two new 30-inch diameter crude pipelines and onshore valve station used to connect the onshore project components to offshore project components. The inshore portions of the proposed pipeline infrastructure cross the Laguna Madre, the GIWW, and extend across North Padre Island to the mean high tide line located at the interface of North Padre Island and the Gulf. Additionally, the inshore project components include the installation of an onshore valve station on North Padre Island to allow for the isolation of portions of the proposed pipeline infrastructure for servicing, maintenance, and inspection operations.

Onshore components associated with the project include the construction and operation of an onshore storage terminal facility, booster station, and approximately 6.36 miles of two new 30-inch diameter parallel crude pipelines within Nueces and Kleberg counties, Texas. The onshore storage terminal facility would occupy approximately 150 acres in Nueces County, and would consist of all necessary infrastructure to receive, store, measure, and transport crude oil through the proposed inshore and deepwater port pipeline infrastructure. The proposed booster station would occupy approximately 8.25 acres in Kleberg County.

5.3.2 Onshore Storage and Fabrication Terminals

5.3.2.1 Ingleside Ethylene LLC/La Quinta Channel (SWG-2012-00496)

This project included the Ingleside Ethylene LLC Ethane Cracker facility, Ethylene Pipeline, and San Patricio Pipeline. The permit application requested permission to install an approximately 114.9 mile long, 8-inch diameter ethylene pipeline within a 75-foot-wide work corridor from their ethane cracker facility near Ingleside, San Patricio County, Texas to the Markham Hub near Clemville, Matagorda County, Texas. This project involved crossing 14 navigable waters utilizing HDD under Regional General Permit SWG-1998-02413. An additional 85 crossings of non-navigable waters or wetlands were conducted by open trench under Nationwide Permit 12, and nine waters were affected by temporary fill under Nationwide

Permit 33 for temporary access roads and workspace necessary for conducting HDD boring operations under specific waters. Finally, 42 waters were avoided by use of HDD or by rerouting of the proposed pipeline. A project completion report with as-built drawings was provided to the USACE Corpus Christi Regulatory Field Office and was found to be in compliance with the permitted plans.

5.3.2.2 Corpus Christi LNG/Terminal Project (SWG-2007-01637)

This project involved construction of an LNG terminal, initially for import, and later for export. This project resulted in permanent total impacts to 27.45 acres of habitats including 9.17 acres of seagrass, 6.72 acres of black mangrove, 5.91 acres of smooth cordgrass, 0.99 acre of vegetated tidal flats, and 2.76 acres of non-vegetated tidal flats. A 23-mile-long, 48-inch-diameter pipeline to convey natural gas to the facility would also be constructed and less than 0.01 acre of wetlands will be permanently impacted by construction of the pipeline. A mitigation plan for seagrass impact was submitted.

Modifications were proposed to increase dredging in the marine berth and to revise the design of the Corpus Christi LNG Terminal, including the site layout as well as a phased approach to the construction of the facility. The project site is in Corpus Christi Bay adjacent to the La Quinta Turning Basin of the La Quinta Channel, and on the northern shore of Corpus Christi Bay, approximately 2 miles south of Gregory, Texas.

Under an amendment, two new dredging areas (Northern and Southern Dredge Areas) with 12.7 additional open water impacts and two DMPAs were added to the project to provide export capacity. Dredging would be conducted by either hydraulic or mechanical methods with dredged material placed in existing DMPAs 9, 10, and 13, as well as the additional DMPAs Good Hope and Copano. These PAs are all upland except DMPA BU sites 9 and 10, which are adjacent to proposed extensions of these PAs for the Applicant’s Preferred Alternative. USACE had findings of minimal or no impact related to dredging and dredged material placement, impact to seagrass, oyster, or other sensitive habitat, EFH, Federally managed fisheries, and cultural resources. The primary cumulative impact would be the dredging temporary impacts of construction.

5.3.2.3 Subsea 7 (US) LLC/Loadout Facility (SWG-2007-00201)

This project includes the construction of pipe fabrication and load-out facility located along east side of La Quinta Channel between Oxy-Chem and Kiewit Offshore Services, Ltd. in Ingleside, Texas. The project will include the dredging of 400-foot by 300-foot (8.1 acres) of a 1,100-foot by 300-foot (11.0 acres) vessel slip and vessel slip approach to a depth of –30 MLT with an additional 2 feet of overdredge for pre-maintenance. Approximately 339,534 cy of material will be removed and placed in an authorized upland area. WOTUS excavated for drainage with outfall into the bay, with 2.6 acres of fill into WOTUS. Also included is installation of slope protection on north and south slopes of vessel slip and installation of two 15-foot by 15-foot mooring structures with catwalks measuring 3.5-foot by 3-foot by 172.5-foot. A 10-year maintenance dredging program and Good Hope DMPA were added to authorization. The construction phase expires 31 December 2023, and maintenance dredging expires 31 December 2030.

5.3.2.4 Cheniere Liquids Terminal LLC/La Quinta Channel (SWG-2014-00848)

This project proposes to construct a crude condensate storage and marine loading terminal. Primary project features include a dual vessel berthing area capable of mooring and loading barges and ships, two docks, an onsite DMPA located in uplands, and various landside support infrastructure, such as storage tanks, roads, parking areas, administrative buildings that would be constructed in uplands. The proposed vessel berth would be dredged to –45 feet MLT plus 2 feet advanced maintenance and 2 feet allowable overdredge. Approximately 2.6 mcy of stiff clay would be dredged using both mechanical and hydraulic methods in association with the approximately 40-acre basin proposed for the berthing area. A rock revetment would be constructed along the side slopes of the proposed berth, with approximately 20,000 cy of rock material placed across approximately 2 acres below the annual high tide line.

The two proposed docks and associated marine structures would be 130 feet wide and 185 feet long. Construction (dredging and excavation) of the proposed berthing area would result in impacts to 2.87 acres of SAV and 0.67 acre of estuarine wetlands located on the La Quinta Channel shoreline. In addition, 0.04 acre of SAV and 0.10 acre of estuarine wetlands near the proposed top of slope may be impacted by equipment accessing the construction area or by long-term sloughing along the top of slope.

5.3.2.5 South Texas Gateway Terminal LLC/Redfish Bay (SWG-2006-02562)

The project included hydraulically and/or mechanically dredging approximately 4.2 mcy of material within a 71.92-acre area for the construction of a vessel berthing basin, installation of pile-supported structures (including loading platforms, walkways, breasting dolphins, and mooring dolphins) totaling approximately 1.98 acres, and discharge of riprap totaling approximately 16.98 acres into non-vegetated navigable WOTUS. The basin will berth two vessels at a time (up to a VLCC size vessel). Dredging activities will impact approximately 0.44 acres of SAV. A dredge flair at the intersection of the GIWW and the CCSC was required to safely moor vessels. Upland site development includes facilities, storage tanks, and a new upland confined DMPA.

According to the permit application, the preferred project was designed to minimize and avoid adverse impacts to WOTUS. According to the SAV survey, 0.44 acre of scattered seagrass would be impacted. Buckeye is in the process of compensatory mitigation actions for the 0.44 acre of seagrass. Buckeye is working to improve tidal exchange in a 60-acre tidal system that includes tidal channels, tidal wetlands, mangroves, SAV, and algal flats. In 2023, the Buckeye facility was sold to Gibson Energy.

The proposed expansion of the dredging area is of such limited extent that no marine investigation for historic properties is warranted. Preliminary indications are that no known threatened and endangered species or their Critical Habitat will be affected by the proposed work. Initial determination is that the project would not have a substantial adverse impact on EFHs or Federally managed fisheries in the Gulf. A variety of best management practices would be required as per the USACE permit to avoid and minimize potential impacts to sea turtles, manatees, and Smalltooth Sawfish (*Pristis pectinata*). According to the public notice, no adverse impact to wetlands were anticipated from constructing the upland DMPAs.

5.3.2.6 Port of Corpus Christi/La Quinta Trade Gateway Terminal (SWG-2001-02261)

PCCA constructed a bulk materials and bulk liquids roll-on roll-off dock on 1,114 acres along the extension of the La Quinta Channel identified in the CCSCIP. The multi-purpose dock and terminal facility will be designed to handle a wide variety of general cargo including containers, military cargo, wind turbines, steel pipe, and more. PCCA hydraulically dredged 1,250,000 cy over 29.5 acres of bay bottom to a depth of –43 feet MLT. The area dredged included unvegetated bay bottom (27.1 acres) and low-density seagrass (2.4 acres).

The project also involved the discharge of fill into 4 acres of jurisdictional wetlands along the existing shoreline, construction of a marginal wharf 3,700 feet by 140 feet for berthing and unloading container ships, construction a container yard, intermodal terminal, road and rail access corridor, buffer zone, DMPA, and other ancillary facilities. PCCA proposed to create 27.1 acres of shallow water unvegetated bay bottom and plant seagrass (7.2 acres) and saltmarsh cordgrass (6.6 acres) as mitigation within the proposed 200-acre BU site GH that will be constructed as part of the CCSCIP.

5.3.2.7 Oxy Ingleside Energy Center (Enbridge)/Corpus Christi Bay (SWG-2014-00381)

Enbridge (formerly Moda Midstream) proposes to mechanically grade and fill an approximately 464.5-acre area that includes approximately 27.67 acres of palustrine wetlands adjacent to Corpus Christi Bay. The purpose of the project is to provide an area for the future expansion of the facility for storage and other terminal-related operations for the loading of crude oil, condensate and liquefied petroleum gas and liquefied natural gas onto ships. The expansion includes construction of a 135.18 acre condensate storage area, a 28.16 acre truck loading area, an 85.87 acre propane and butane sphere area, a 68.67 acre liquefied petroleum gas and LNG refrigeration area, a 70.11 acre oil tank storage area, a 6.79 acre utility corridor, a 41.57 acre pipeline corridor, and 24.69 acres of new roadway within the project site. The project site would be graded and leveled along existing contours to preserve existing site drainage. Impacts to palustrine wetlands would be mitigated at a 1:1 ratio on site.

In 2019, Oxy Ingleside Energy Center, LLC (which was purchased by Moda Midstream, but is now Enbridge) requested a permit to increase the permitted width of the West Ship Basin from 390 feet wide to 475 feet and add a 1,700-foot-diameter turning basin adjacent to the CCSC. Dredged material will be placed into existing approved disposal areas. Potential disposal sites for dredged material include upland areas, in bay areas and BU Site No. 6. The project would increase the currently permitted dredge area by 18.2 acres. No mitigation is proposed because no wetlands are reported to be present in the proposed site. No known threatened and endangered species or their Critical Habitat will be affected by the proposed work. Previous cultural investigation indicated no impact. In 2021, the Indigenous Peoples of the Coastal Bend, Karankawa Kadla Tribe of the Texas Gulf Coast and Ingleside on the Bay Coastal Watch Association filed a lawsuit against USACE regarding cultural resource impacts (Gonzales, 2021).

5.3.2.8 Plains All American Pipeline LP/Corpus Christi Terminal (SWG-2014-00260)

Plains All American Pipeline LP proposes to construct a liquid petroleum export terminal and storage facility that would accommodate Aframax ships (830 feet by 145 feet) and ocean-going barges. The terminal would consist of a 165-foot by 16-foot pipe rack and a 215-foot by 20-foot access trestle, a 60-foot by 125-foot loading platform with fendering system, six mooring dolphins, and four breasting dolphins. An estimated 514,557 cy of material will be hydraulically and mechanically dredged from 0.04 acre of wetlands and 12.66 acres of open water to a depth of –46 feet MLT and placed in one of the following DMPAs: Tule Lake DMPA Cells A, B & C, Suntide DMPA, South Shore DMPA Cells A, B & C, DMPA No. 1, DMPA No. 4, DMPA No. 5, or the Herbie Mauer DMPA.

Plains All American Pipeline LP is requesting to mechanically dredge an initial 185-foot-wide by 460-foot-long portion of the basin to –46 feet MLT with 2.5:1 slope to begin construction on the terminal facility while awaiting use of the hydraulic dredge for the remainder of the basin. Approximately 60,000 cy of mechanically dredged material will be placed in an onsite upland PA immediately adjacent to the work site. The onsite PA would be located within a detention pond that will be drained prior to dredging, with best management practices utilized to ensure proper control of erosion and sedimentation. Once de-watered, the material will be placed on the upland area of the property located south of the railroad tracks. The dredging profile would consist of a gradual slope (2.5:1) to the newly established shoreline and would be armored with a 50-foot-wide revetment mattress consisting of articulating concrete blocks with a fabric underlay along approximately 1,260 feet of shoreline.

5.3.2.9 Port of Corpus Christi/Harbor Island (SWG-2019-00245)

PCCA is proposing to construct a terminal facility with vessel berths on Harbor Island that would accommodate up to two VLCCs deep-draft water borne vessels for the transportation of crude oil. Work in WOTUS would include: dredging two deep draft vessel berths at a slope of 3:1 to the CCSC authorized depth of –54 feet MLLW, plus 4 feet of advanced maintenance dredging, plus 2 feet of allowable overdredge, totaling –60 feet MLLW; shoreline protection with articulated block mat to stabilize the 3:1 slopes; 725 linear feet of bulkhead; 1,275 feet of cellular wall; breasting structures, jetty platforms, access structures, and associated terrestrial structures. PCCA estimates that approximately 6.5 mcy of dredged material would be dredged mechanically and/or hydraulically for the construction of the facility. Permanent impacts to WOTUS are estimated at 1.85 acres.

PCCA is proposing to use the New Work ODMDS to discharge dredged material resulting from the construction of the terminal facility. PCCA is also proposing to discharge dredged material into disposal sites M3, M4, M6, M9, and M10. PCCA has stated that they have avoided and minimized the environmental impacts minimizing sediment suspension by avoiding the bottom stockpiling and over-filling of the dredge bucket as well as not taking multiple bites with the dredge. A turbidity curtain, surface booms, oil-absorbent pads, and similar environmental containment materials and supplies will be kept on site to be immediately deployed as necessary. PCCA has proposed no mitigation for the project.

5.3.2.10 Gulf Coast Growth Venture/Petrochemical Facility

Gulf Coast Growth Venture is a joint venture between ExxonMobil and Saudi Basic Industries Corporation, which involves the construction and operation of a petrochemical complex covering approximately 1,000 acres in San Patricio County, near Gregory, Texas. The facility includes a steam cracker, capable of producing 1.8 million tons per year of ethylene, and three derivative units. Gulf Coast Growth Venture produces polyethylene – used in the production of medical supplies, food packaging, agricultural film, and building and construction materials; and monoethylene glycol – used to manufacture polyester clothing, paints, and automotive coolants. Gulf Coast Growth Venture conducts continuous emissions and leak detection monitoring. Also, the project funded two air monitors that are maintained and operated by an independent third party (Gulf Coast Growth Venture, 2022). This facility is operational as of July 2021.

5.3.2.11 Port of Corpus Christi/Carbon Capture and Blue Hydrogen

In 2021, Howard Energy and PCCA signed a non-biding Memorandum of Understanding to help convert Howard Energy's Javelina Refinery facility into a carbon neutral, blue hydrogen production facility (De Luna, 2021). The production of hydrogen would be performed without atmospheric release and would identify uses for the residual carbon dioxide (Blum, 2021).

5.3.3 Utility, Gas, and Petroleum Pipelines

5.3.3.1 Newfield Exploration Company/6-inch Gas Pipeline (SWG-2007-1408)

Newfield Exploration Company proposes to retain impacts associated with the decommissioning in place and removal of segments of a 6-inch-diameter pipeline. The entire length of the pipeline was flushed and capped. The segment of the pipeline located within the Aransas Fairway was then removed by pulling and jetting where necessary. Newfield Exploration Company proposes to leave the segments located on either side of the Aransas Fairway decommissioned in place at approximately 3 feet below the mudline. Newfield Exploration Company has stated that they have avoided and minimized the environmental impacts by there being no water bottom disturbances caused by those pipeline segments to be decommissioned in place. The project site is within the bottom of the Gulf where no special aquatic sites are present.

5.3.3.2 Axis Midstream/Midway to Harbor Island (SWG-2018-00789)

Axis Midstream Holdings, LLC proposes to construct a series of facilities and pipelines to store, transport, and load crude oil into marine transport vessels. The project components are composed of: The Midway Tank Farm (Midway Facility) located south of the City of Taft, Texas; The Aransas Pass Staging Facility (Aransas Facility) located west of the City of Aransas Pass; a pipeline bundle that would connect the Aransas and Midway Facilities; Harbor Island Loading Terminal located on the west side of the CCSC on Harbor Island in Port Aransas, Texas; and a pipeline bundle that would connect the Aransas and Harbor Island terminals.

The installation of the proposed Midway to Aransas pipeline bundle would result in 13.94 acres of temporary trench and fill impacts in WOTUS, including wetlands. The construction of the proposed Aransas Facility would total 16.8 acres of permanent fill impacts to WOTUS, specifically estuarine wetlands. The installation of the proposed Aransas to Harbor Island pipeline bundle would result in 18.58 acres of temporary trench and fill impacts to WOTUS; specifically, 7.81 acres to SAV, 0.002 acres to small stands of smooth cordgrass, 10.65 acres are to unvegetated tidal sand flats, 0.41 acres are to black mangrove, and 0.11 acres to estuarine wetlands.

The construction of the vessel berth would result in 70 acres of new work material being dredged and placed onsite for shoreline restoration, BU, and/or in one of the identified PAs. Disturbances such as turbidity, which is a result from the construction activities, are temporary in nature and Axis Midstream Holdings, LLC would utilize TCEQ Best Management Practices during those activities to further minimize impacts to aquatic features. Turbidity curtains would be installed within the existing oilfield canals prior to trenching operations. Within open water areas the curtains would be installed after spoil piles have been deposited. To compensate for the unavoidable impacts to the aquatic environment, Axis Midstream Holdings, LLC is proposing a conceptual permittee-responsible in-kind compensatory mitigation that would occur in two separate locations.

5.3.3.3 Epic Y-Grade Pipeline LP/Robstown to Ingleside (SWG-2018-00941)

Epic Y-Grade Pipeline LP proposes 60 aquatic resources crossing using open-cut method from the construct of approximately 41.2 miles of new 30-inch-diameter crude oil pipeline within a newly constructed 100-foot right-of-way utilizing Nationwide Permit 12. They also propose to HDD bore under four Section 10 waters (a perennial tidal stream of Corpus Christi Bay [S-17], Kinney's Bayou [S-19], Rincon Bayou [S-3], and the Nueces River [S-2] utilizing Nationwide Permit 12). Epic Y-Grade Pipeline LP proposes approximately 23.9 acres of temporary impacts and approximately 2.3 acres of conversion impacts to palustrine forested wetlands into palustrine emergent wetlands. Epic Y-Grade Pipeline LP has proposed 5 acres of compensatory mitigation for the conversion of palustrine forested wetlands (2.3 acres) into palustrine emergent wetlands.

5.3.3.4 Corpus Christi Infrastructure LLC/Nueces Bay (SWG-2019-00290)

Corpus Christi Infrastructure LLC proposes five aquatic resource crossings using open-cut trenching methods and the HDD boring under Nueces Bay utilizing a Nationwide Permit 12. They propose approximately 8.57-acres of temporary impacts to four emergent wetlands and one stream crossing.

5.3.3.5 Enterprise Products Operating LLC/Dean Expansion (SWG-2019-00875)

Enterprise Products Operating LLC proposes to temporarily place fill material into and to perform work within WOTUS during the construction of a pipeline. The construction will consist of a total of seven aquatic resource crossings, specifically five via open trenching cutting methods and two HDD. They also propose temporary impacts to approximately 14.08 acres of emergent wetlands, 0.04 acre of scrub/shrub wetlands and 0.40 acre of open water (ponds) during the construction activities associated with seven single and complete WOTUS pipeline crossings.

5.3.3.6 Harvest Midstream/Kinney Bayou (SWG-2019-00461)

Harvest Midstream proposes to install a new 24-inch-diameter crude oil pipeline via HDD a bore approximately 771 feet long under Kinney Bayou. Installation would be within an existing 30-foot right-of-way easement and temporary workspaces will be located on each end of HDD crossing. No filling of jurisdictional waters is anticipated.

5.3.3.7 Flint Hills Resources, LLC/Corpus Christi Ship Channel (SWG-2019-00461)

This project is also referred to as the Flint Hills Resources P-13 IC4/NC4 Connectivity Project. Flint Hills Resources, LLC proposes two aquatic resources crossings via open-cut trenching method during the installation of approximately 3,370 linear feet of gaseous pipeline. They propose 4.7 acres of temporary impacts to palustrine emergent wetlands.

5.3.4 Maintenance and Navigation Dredging

5.3.4.1 Corpus Christi Ship Channel Project (–47 foot MLLW Authorized Depth)

The CCSC is a consolidation of past improvements of Port Aransas and the channel from Aransas Pass to Corpus Christi. The CCSC project channel system also includes La Quinta Channel, Jewel Fulton Canal, and Rincon Canal. The history of Federal involvement in navigation improvements in the Corpus Christi Bay area began with the Rivers and Harbors Act of June 18, 1878. In August 1968, authorization of major improvements to the CCSC included increasing existing channels and basins to a 45-foot depth, a deep-draft turning area, a deep-draft mooring area and mooring facilities, and widening of the channels and basins at certain locations. The non-dredged northward extension of the Inner Basin at Harbor Island and the non-dredged west turnout between the La Quinta Channel and the main channel of the waterway was deauthorized. The –47 foot project was completed in 1989 (USACE, 2003).

The –47 foot authorized depth Federal navigation project consisted of channels and turning basins suitable for oceangoing vessels and rubble-stone jetties. The channel began in the Gulf about 4.3 miles offshore, passed through the jettied inlet, and extended about 21 miles westward to Corpus Christi. Continuing west, the channel extended about 8.5 miles through the Inner Harbor before terminating at the Viola Turning Basin. The north and south jetties are 11,190 and 8,610 feet long and extend into the Gulf from San José (formerly St. Joseph's) and Mustang islands, respectively, and stabilize the natural inlet of Aransas Pass. The stone dike on San José Island connects with the north jetty and extends 20,991 feet up the island. The La Quinta Channel extends off the CCSC near Ingleside, Texas, and runs parallel to the eastern shoreline of Corpus Christi Bay for 5.5 miles to the La Quinta Turning Basin (USACE, 2003).

5.3.4.2 Corpus Christi Ship Channel Deepening and Widening Project (–54 foot MLLW Authorized Depth)

Authorized by WRDA in 2007, this iteration of CCSC improvements is also part of the No-Action condition. This project includes deepening of the CCSC from Viola Basin to the end of the jetties in the Gulf to –52 feet, deepening of the remainder of the channel to –54 feet, widening of the Upper Bay and Lower Bay reaches to 530 feet, construction of barge lanes across the Upper Bay portion of the CCSC, and extension of the La Quinta Channel at –39 feet. The existing channel will be extended an additional 10,000 feet into the Gulf to reach a –54-foot contour. Minor widening is necessary in a 100-foot-wide area on the northern side of the channel from in the Inner Basin to allow for a better turning radius when entering the Gulf or the Lower Bay portion of the channel (USACE, 2003).

The Lower Bay will be deepened from –45 feet to –54 feet MLLW. The eastern portion of this channel segment is currently wider than the selected 530 feet and no widening will be necessary in this reach. The western half is approximately 500 feet in width and will be widened to 530 feet. The Upper Bay is currently 400 feet wide and –45 feet in depth. This reach will be deepened to –54 feet MLLW and widened to 530 feet. Barge lanes will be constructed on both sides of the channel and will extend 200 feet from the toe of slope of the main channel and will be dredged to a depth of –12 feet MLLW. The Inner Harbor will be deepened to –54 feet MLLW. The channel width will range between 300 and 400 feet. Several minor modifications will be made to the turning basins to ensure that they meet USACE navigation requirements. The La Quinta Channel at the current depth of –39 feet will be extended approximately 7,400 feet beyond its current limit. The channel will measure 300 feet wide at the toe and a second turning basin with a 1,200-foot radius will be constructed. No changes will be made to the existing channel (USACE, 2003).

The project would use existing confined upland sites, one existing offshore (open water) site, and eight existing bay (open water) sites for meeting the capacity requirements. However, the project may utilize all existing upland sites as needed during the life of the project to maintain operational flexibility (USACE, 2003).

5.3.4.3 Flint Hills Resources/Corpus Christi Ship Channel (SWG-1996-02951)

For this project Flint Hills Resources is requesting a 10-year extension of time to perform previously authorized maintenance dredging, via hydraulic and/or mechanical, to a depth of –47 feet below MLT and plus 2 feet for allowable overdredge (totaling –49 feet below MLT). Flint Hills Resources is also proposing to add DMPA 13, Good Hope DMPA, Berry Island DMPA, and an on-site upland DMPA on Flint Hills Resources property as potential dredged material placement options. Flint Hills Resources is currently authorized (DA Permit 13667) to conduct maintenance dredging to a depth of –47 feet below MLT plus 2 feet allowable overdredge (totaling –49 feet below MLT). They are currently authorized to place dredged material in DMPA 1 and DMPA 10.

5.3.4.4 Enbridge Ingleside Oil Terminal, LLC/Corpus Christi Ship Channel (SWG-1995-02221)

The purpose of the project is to allow the berthing of deeper draft ships. The project consists of deepening the authorized depth of the berth areas for the existing Oxy Ingleside Energy pier from –45.7 feet MLLW to a total depth of –58.2 feet MLLW. Approximately 67 acres would be dredged, and approximately 478,489 cy of material would be removed and placed into existing upland PAs and Berry Island. The permit indicated that seagrasses present in the west slip area would not be disturbed. Preliminary findings include: no mitigation is proposed because seagrass present in the west slip area will not be disturbed; Section 401 water quality certification is required; and no threatened and endangered species, EFH, or cultural impacts are anticipated. Because no mitigation is proposed nor warranted and because of the absence of other impacts, this project will only be included in the cumulative impact evaluation for potential adverse impact during dredging.

5.3.4.5 Corpus Christi Liquefaction, LLC/La Quinta Channel (SWG-2005-01290)

PCCA proposes to dredge approximately 20 acres to –45 feet MLT with a 10-year maintenance dredging concurrence at the junction of the CCSC and the La Quinta Channel in Corpus Christi Bay in Nueces County. PCCAs stated purpose of the proposed work is to improve navigational safety and general maneuvering effectiveness for a variety of vessels representing multiple waterway users within the CCSC and transiting the La Quinta Channel to access existing and new facilities on the La Quinta Channel and La Quinta Channel Extension. PCCA is currently authorized to dredge approximately 1.4 mcy of material within a 20-acre area at the junction of the CCSC and La Quinta Channel to a depth of –45 feet MLT with an additional –2 feet of advanced maintenance and up to –2 feet of allowable overdredge for a total possible depth of –49 feet MLT.

In addition, PCCA proposes to add two additional dredging areas (Northern and Southern Dredge Areas) and adding two additional DMPA, the existing Good Hope DMPA and a new private Copano DMPA. The Southern Dredge Area is an approximate 15.11 acres, which includes 8.57 acres that overlap the currently authorized dredge area and 6.54 acres of new area. The southern modification would widen the existing 400-foot-wide channel up to an approximate 550-foot-width with a depth of –52 feet MLT plus 2 feet allowable overdredge. This would result in dredging approximately 157,500 cy of additional material. The Northern Dredge Area is an approximate 14.87-acre area, and the modification would widen the existing 400-foot-wide channel up to an approximate 500-foot width the required depth of –47 feet MLT plus up to 2 feet of allowable overdredge. This would result in dredging approximately 557,500 cy of material. Dredging would be conducted by either hydraulic or mechanical methods with dredged material placed in DMPAs 9, 10, and 13 as well as the additional DMPAs Good Hope and Copano.

The proposed Copano DMPA consists of three existing bauxite residue drying beds located near Copano Bay in Aransas County, Texas. The existing infrastructure and pipelines to hydraulically transport the dredged material extend from the La Quinta Channel shoreline to the Copano DMPA and is currently serviceable. The dredged material would be contained by existing levees surrounding the DMPA.

5.3.4.6 Kiewit Offshore/La Quinta Channel (SWG-2001-02106)

Kiewit Offshore is proposing a minor modification to currently authorized work in WOTUS as well as an extension of time to complete the previously authorized work and to conduct maintenance dredging events. The first modification involves deepening the 6.2-acre south loading area within the existing basin from –38 feet mean high water (or –40 feet MLLW) to –45 feet mean high water (or –47 feet MLLW). This work will permanently impact 1.1 acres of seagrass which was not present for the original authorization or subsequent interactions of amendments. Compensatory mitigation is required for the permanent impacts to seagrass which will require the discharge of fill material into 0.33 acres of unvegetated bay bottom for the construction of a breakwater at Ransom Island for the protection and enhancement of seagrasses. The second modification involves deepening the centrally located 4.5-acre deep water loading area within their existing basin from –85 feet mean high water (or –87 MLLW) to –100 feet MHW (or –102 feet MLLW). This involves 10-year maintenance dredging activities within the currently authorized and existing Kiewit Basin including the portion of the La Quinta Channel.

5.3.4.7 City of Corpus Christi/Packery Channel (SWG-2011-00159)

The City of Corpus Christi proposes a 10-year maintenance dredging plan of approximately 18,500 linear feet (3.5 miles) of the Packery Channel. The dredging would be to a depth of –14 feet NAVD 88 (–13.5 feet MLLW) plus 2 feet allowable overdredge within the outer reach of the 122-foot-wide channel section, and –7 feet NAVD 88 (–7.2 feet MLLW) plus 1-foot allowable overdredge within the outer reach of the 80-foot-wide channel section. No changes from the original Federal project dimensions are proposed.

Maintenance dredging would be conducted using hydraulic and/or mechanical methods from barges, and approximately 400,000 cy of material will be dredged.

Suitable beach-quality sand from the dredging activities will be placed along the Gulf beach between Packery Channel and Viento Del Mar, approximately 7,600 feet in length and a total of 90 acres. Nourishment of the beach would measure approximately 300 feet wide seaward of the existing seawall. If a cutterhead dredge is used, the dredged material will be transported to the Gulf beach through a temporary pipeline. If mechanical dredging is used, material will be placed in scows (barge vessels) and then the scows will be anchored offshore of the Gulf beach in deep water. The location of the scows offshore of the Gulf beach is currently unknown. The material will then be transported from the scows onto the beach using a temporary pump-out station and pipeline.

5.3.5 Bulkheads, Breakwaters, Boat Ramps, and Marinas

5.3.5.1 AccuTRANS Inc./Corpus Christi Ship Channel (SWG-2018-00272)

Construction of a new barge dock and dredging of a new docking basin. Construction will involve placement of approximately 0.4 acre of fill material for the installation of approximately 2,288 linear feet of bulkhead, and hydraulically dredging of approximately 178,600 cy of material within a 5.8-acre area to a depth of –16 to –20 feet MLLW. Dredged material will be placed in a Federally authorized and constructed upland-contained DMPA.

5.3.5.2 City of Aransas Pass/Conn Brown Harbor (SWG-2004-00003)

For this project USACE authorized the addition of a dual boat ramp, boat ramp approach, dredging, and associated loading pier/docking structures. To accommodate the additional boat ramp, the City of Aransas Pass was authorized to dredge approximately 1,250 cy of material from a 6,195-foot area to a depth of 12 feet below mean high water. The area dredged was utilizing mechanical dredging methods and the materials were placed in a previously authorized upland disposal area.

The City of Aransas Pass was authorized to construct a concrete/articulated block boat ramp immediately adjacent to an existing dual boat ramp. Approximately 2,600 square feet of boat ramp required excavation of uplands that were located landward of the bulkhead, and materials placed in a previously authorized upland disposal area. The concrete/articulated boat ramp involved the placement of approximately 130 cy of articulated concrete materials below the mean high water line. The Permittee was authorized to construct five new loading/docking piers to be installed on pilings and jettied in.

Construction was completed in 2013. During construction deviations from the permitted plans occurred. Construction deviations resulted in the as-built project footprint exceeding the overall permitted project dimensions. As determined by a USACE site visit on June 23, 2015, the shift in the project footprint resulted in additional impacts of approximately 280 square feet of open water and additional 390 square feet of seagrass, for a total of 670 square feet of additional impacts. To compensate for these additional impacts, the Permittee proposed the creation of an additional 2,101 square feet of seagrass mitigation at the currently permitted mitigation site.

The City of Aransas Pass plans to excavate approximately 532 square foot area of unvegetated uplands adjacent to an existing mitigation site, in preparation of wetland restoration and planting for an after-the fact permit (SWG-2004-00003). The mitigation site is located at the City of Aransas Pass Community Park in Aransas Pass, Texas. The proposed site will be situated immediately adjacent and contiguous with a large marsh and seagrass complex known as the Kiewit Mitigation Site. The mitigation site will be excavated and connected to an existing tidal channel. The tidal channel interconnects the large marsh and seagrass complex within the Kiewit Mitigation site to Redfish Bay.

5.3.5.3 City of Port Aransas/Corpus Christi Ship Channel (SWG-2002-01654)

The City of Port Aransas proposes to repair and modify an existing shoreline protection project that consists of graded riprap revetment. The proposed repair/modification would extend approximately 2,000 feet along the existing exposed toe of the revetment and would involve placing armor stone to permitted lines and grades. This work would also include placement of stone along the upper slope and crest of the existing revetment as needed to meet permitted lines and grades. Due to ongoing erosion and undermining at the site, additional stone would be required to provide a base to support the existing revetment and repairs. The amount of additional stone would vary along the exposed portion of the revetment due to varying levels of damage but would be the least amount necessary to accomplish the work and would likely average 3 cy per linear foot. Approximately 6,000 cy of graded riprap would be placed on existing revetment and bay bottom.

5.3.5.4 City of Port Aransas/Corpus Christi Ship Channel (SWG-2000-02968)

The project consists of the construction of a 56.42-acre marina adjacent to the Port Aransas Nature Preserve at Charlie's Pasture. The project will include excavating/mechanical dredging of the approximate 16.80-acre marina basin to a depth of –8 to –10 feet MLLW, which will result in 265,000 cy of material. Excavated dredge from the marina will be placed and contained within the 37.25-acre on-site DMPA. Once the marina is excavated, the next phase of the project will involve dredging approximately 36,000 cy of material (2.34 acres) from deep and shallow water habitats present within the entrance channel between the jetties to a depth of –11 feet MLLW. Dredged material associated with construction of the entrance channel will also be placed within the on-site DMPA.

The project will result in a loss of less than 0.10 acre of wetlands and no impacts to other special aquatic sites; as a result, compensatory mitigation is not required for the preferred project. The City of Port Aransas must obtain a Section 401 water quality certification from TCEQ. The permit area is likely to contain terrestrial cultural resources that could be eligible for inclusion in the NRHP. An investigation for the presence of potentially eligible historic properties is justified. No threatened or endangered species or EFH impacts are anticipated. With the limits of the CDP extended past the ferry crossing, the dredging limits for the marina project may overlap the dredging limits of the channel deepening and may encroach onto the channel's side slopes.

5.3.6 Transportation Projects

5.3.6.1 TxDOT Ferry (Aransas Pass to Port Aransas)

TxDOT operates a ferry that offers services from the mainland at Aransas Pass on SH 361 and crosses the CCSC to Port Aransas. Between two to six ferries are used based on demand, and the 0.25-mile route usually takes about 10 minutes. During busy periods in the summer or spring break, wait times can be substantially longer. Each ferry can carry up to 20 regular passenger vehicles. Combined vehicles, such as a truck towing a boat, may not be longer than 80 feet, wider than 13 feet or taller than 13 feet 6 inches. Single-axle vehicles may weigh no more than 20,000 pounds, tandem axles no more than 34,000 pounds and combination vehicles may not exceed a total of 80,000 pounds (TxDOT, 2023).

5.3.6.2 TxDOT/Harbor Bridge/Corpus Christi Ship Channel (SWG-2014-00408)

Replacement of the SH 181 bridge that crosses the CCSC. The 0.88 acre of impacts to tidal fringe wetlands would be mitigated by establishment of 2 acres of functional marine estuarine emergent wetland adjacent to the area of wetland impacts. Impacts to WOTUS include the permanent installation of 0.073 acre of fill material to support the construction of two, 34-foot by 22-foot bridge pier footings, with approximately 0.56 acre of temporary fill in Wetland 7 and adjacent aquatic resources for temporary construction access related activity. Upon completion of construction, all temporary fill material will be removed, and the site will be returned to pre-construction conditions. In addition, the project will include the re-alignment of an approximately 1,017-linear-foot portion of the existing, concrete-lined ditch (locally known as Salt Flat Ditch), which will involve permanently filling 1.02 acres of the existing ditch and excavating a new 4.9-acre, primarily unlined-earthen ditch to the west of the existing ditch alignment. No additional compensatory mitigation was permitted because of these permitted modifications.

5.3.7 Commercial and Residential Development

5.3.7.1 De Ayala Properties/Redfish Bay (SWG-2007-00652)

De Ayala Properties proposed to create a mixed-use marina development with direct access to the GIWW on a 46.72-acre tract, including a marina, hotel, condominiums, retail space and single-family residential development (SWG-2008-00652). De Ayala Properties states that the proposed marina design will include a canal system which will allow for water circulation by expanding the existing connection to the GIWW to take advantage of the predominant southeasterly breeze and allow water to move into and out of the canal. The proposed canal will have a uniform depth of –8 feet mean sea level and will vary in width from

100 feet at its narrowest point to 550 feet at its widest point. Approximately 56,551 cy of material are proposed to be mechanically excavated from jurisdictional areas and 183,585 cy of material from uplands during the creation of the proposed marina and canal. Additionally, De Ayala Properties proposes to construct approximately 4,430 linear feet of bulkhead within the proposed canal.

5.3.7.2 PA Waterfront/Corpus Christi Bay (SWG-2001-02279)

This project consists of the development of approximately 835-acre tract of land for a destination resort complex that will include residential housing, retail establishments, a marina, channels, and a golf course. The proposed work will result in the filling of 16.9 acres of jurisdictional areas, maintenance dredging of an entrance channel, and the excavation of 46.3 acres of jurisdictional areas and the conversion of 78.7 acres of uplands into manmade canals, channels, and expansion of the existing basin. The associated wetlands within the project area were determined to be immediately adjacent to the open waters of the canals, which are tidally influenced by Corpus Christi Bay, a Traditionally Navigable Water. Per the 2016 Jurisdictional Wetlands Delineation, the following impacts were identified: 45.21 acres of non-wetlands waters and 0.42 acres of wetlands.

5.3.7.3 Pelican Cove Development, LLC (SWG-2013-01011)

Pelican Cove Development, LLC will discharge approximately 17,500 cy of dredged fill material excavated from onsite sources into 3.42 acres of WOTUS for a combined commercial and residential development known as Pelican Cove. To compensate for the unavoidable impacts to 3.42 acres of WOTUS, Pelican Cove Development, LLC will create 3.52 acres of wetlands, enhance 3.11 acres of wetlands, and enhance 0.39 acre of upland buffers. The mitigation will also consist of the conversion of 4.28 acres of wetlands to deep marsh.

5.3.8 Desalination Facilities

5.3.8.1 Port of Corpus Christi Authority/Harbor Island and La Quinta Channel (SWG-2017-00521)

PCCA is proposing two separate desalinization plants to be constructed and operated on Port property. A 50 million gallon per day facility proposed to be constructed on Harbor Island near Port Aransas, and a 30 million gallon per day facility along the La Quinta Channel near Ingleside. The Port stated that the initial phase of the project would involve preparing preliminary designs, obtaining Marine Seawater Desalination Permits (TCEQ Forms 20775 and 20776) from TCEQ, and obtaining a Nationwide Permit 7 for outfall structures at both facilities under Section 404 of the CWA.

The USACE stated that the power generation needs for the project would be considered within the scope of review for the project. The USACE requested information on the power supply for the project, with a conservative estimate of 76 megawatts and 152 megawatts of power per day required for the 50 million gallon per day and 30 million gallons per day plants respectively. The USACE also determined review of the project would involve a larger scope than typically authorized by Nationwide Permit 7 for outfall and intake structures, with potential that an EIS may be required for the project due to its Public Water Resources Development mission statement.

Regarding the LaQuinta location, as of early 2023 the TCEQ Water Rights Permit application was going through a contested case hearing, and the TCEQ Intake Permit application was under review (Gonzales, 2022). As of late 2023, the City of Corpus Christi and PCCA initiated discussions of collaborating on the location since City of Corpus Christi is also interested in this location (Hami, 2023).

Regarding the Harbor Island location, as of late 2022 the TCEQ had issued a Discharge Permit, with a Water Rights permit application still in review. The EPA disagreed with the issuance of the Discharge Permit and filed an Interim Objection. As of early 2023, the TCEQ Discharge Permit was considered "draft" by EPA and did not represent an authorization (Clow, 2023).

5.3.8.2 City of Corpus Christi/Inner Harbor Desal Facility

In July 2020, the City of Corpus received funding from the TWDB to obtain permits for two sites (Inner Harbor and La Quinta Channel) and design and build a seawater desalination plant with a maximum capacity of 30 million gallons per day for municipal use at one of the two sites (TWDB, 2020). The proposed location within the Inner Harbor avoids direct impacts to coastal resources due the industrial setting. Engineering and design to minimize water quality impacts are underway. TCEQ has issued both permits needed for this facility including a draft Texas Pollutant Discharge and Elimination System permit (issued December 2023) and a water rights permit (issued in October 2022; City of Corpus Christi, 2023). An application for USACE authorization under Section 404 and Section 10 was submitted in May 2023 and is in the evaluation process. An application for USACE authorization under Section 404 and Section 10 is planned for submission in mid-2023 and is in the evaluation process.

5.3.8.3 City of Corpus Christi/LaQuinta Channel Desalination Facility

As of late 2023, the City of Corpus Christi and PCCA initiated discussions of collaborating on the location since City of Corpus Christi is also interested in this location (Hami, 2023). As previously mentioned, PCCA has submitted some permit applications for the site; TCEQ Water Rights Permit application was going through a contested case hearing, and the TCEQ Intake Permit application was under review (Gonzales, 2022).

5.3.8.4 City of Corpus Christi/Barney Davis Desalination Plant

In early 2023 the City of Corpus Christi indicated that they are considering a third site for a potential desalination project at the Barney Davis Power Plant owned by Talen Energy. The proposed project may have a target capacity of 20 million gallons per day (Gillaspia and Tamez, 2023). As this is a relatively new consideration, not much information is publicly available.

5.3.8.5 Corpus Christi Polymers Desalination Plant

Corpus Christi Polymers LLC, is proposing to operate a plastic resins manufacturing facility and has requested TCEQ to renew their Texas Pollutant Discharge and Elimination System permit to discharge treated wastewater, including those from desalination. Specifically, the renewal of Texas Pollutant Discharge and Elimination System Permit No. WQ0005019000 would authorize the discharge of reverse osmosis reject water, filter backwash, previously monitored effluents (process wastewater, utility wastewater, fire system [testing and flushing] water, and stormwater from Internal Outfall 101; and treated domestic wastewater from Internal Outfall 201), fire system (testing and flushing) water, utility wastewaters, and stormwater at a daily average flow not to exceed 38,500,000 gallons per day (TCEQ, 2023).

5.3.9 Ecosystem Restoration

5.3.9.1 TPWD/Dagger Island (SWG-2017-00295)

This project involves the placement of dredged and fill material at two sites within the Dagger Island complex. The placement of fill material at Site 1 involves construction of an approximately 2,912-foot-long nearshore breakwater along the southeast shoreline of the existing island. The breakwater will consist of approximately 2,068 cy of graded stone. Activity at Site 2 involves the construction of an approximately 28-acre containment area within the historic island footprint for the placement of suitable dredged material to construct a BU site.

The containment levees will be constructed using in situ materials excavated from within the BU site. The borrow areas will be located within the contained area, parallel to the containment levees, and will serve as temporary access channels for the shallow-water barges constructing the levees. Once the containment levees have settled and stabilized, approximately 423,066 cy of dredged material will be discharged into the containment area to construct the BU site.

Following a settlement period of at least 1 year, the BU site will be contoured with heavy equipment based on topographic reference data from a nearby ecological reference, Ransom Point Island. Over a 5-year post-construction period, the BU site will be monitored for the successful establishment of approximately 4.2 acres of intertidal shoreline, 4.6 acres of tidal flats, 10.1 acres of smooth cordgrass dominated tidal marsh, 11.2 acres of high marsh, and 3.4 acres of palustrine open water. The oyster clusters currently located within the BU site will be relocated to an adjacent oyster reef prior to construction.

5.3.9.2 Texas Coastal Resiliency Master Plan (GLO)

The study area coincides with Region 3 of the Texas Coastal Resilience Master Plan and this area includes 27 ecosystem restoration projects (GLO, 2019). Most projects involve habitat protection, shoreline restoration or stabilization, and living shorelines. Also planned are bird island restoration and protections, hydrological improvements, oyster reef restoration, and stormwater improvements.

5.3.9.3 Coastal Bend Bays and Estuaries Program/ Various Projects

The Coastal Bend Bays and Estuaries Program implements various ecosystem restoration initiatives with the study area. For example, Project #2215 Protection and Restoration of Rookery Islands in Aransas Bay and Laguna Madre, Phase I; Project #2220 Shoreline Protection and Wetland Enhancement at Cohn Preserve (Mustang Island); and Project #2018 Triangle Tree Rookery Island Protection and Restoration are all projects that have potential to contribute benefits to resources in the study area (Coastal Bend Bays and Estuaries Program, 2022).

5.4 CUMULATIVE EFFECTS

Based on information in Section 4.0 (Environmental Consequences), key resources were evaluated for cumulative effects as discussed in Section 5.2. The following is a discussion of these key resources.

5.4.1 Coastal Processes

Beneficial use activities included in the CDP that have the potential to affect sediment transport and shorelines are limited to beach nourishment/restoration (SJI and MI) activities and nearshore berms (B1–B9). Nourishment would widen the shoreline and advance the beach seaward, causing the nourished beach to extend further into the active transport zone. Modeling of beach nourishment indicated up to a 5 percent loss of sediment from Mustang Island and up to a 2 percent loss from San José Island; negligible to no movement of nearshore berms are expected. ODMDS modeling indicated a relatively stable bathymetry following discharges, but channel sedimentation in the outer channel is 2.25 times greater when comparing the Applicant's Preferred Alternative versus the No-Action condition (Baird, 2022a). Other BU actions would restore and repair eroding bay shorelines. Propeller scour impacts may also impact shorelines and sediment deposition, but hardening can mitigate this impact if needed.

Changes to sediment transport and shorelines are possible with a wide range of past, present, and future actions in the area, and impacts can be both adverse and beneficial. Hardening shorelines (associated with marinas, residential developments) can prevent erosion, but that can also impact sediment transport. Dredging may alter sedimentation and erosion patterns. Any changes in commercial or recreational boat traffic, resulting from new infrastructure or dredging actions, can alter sedimentation and erosion through wakes and scour. Ecosystem restoration actions may have significant beneficial impacts on sediment transport and shoreline changes. Table 5-2 summarizes the potential cumulative effects on sediment transport and shoreline change. Transportation and desalination projects are not expected to contribute to cumulative impacts on sediment transport and shoreline changes.

Table 5-2
Summary of Potential Cumulative Effects on Sediment Transport and Shoreline Change

CEA Project Group	Potential Cumulative Impact (Preferred Action)	Potential Cumulative Impact (Alternatives 2 and 3)
#1: Offshore Oil and Gas Terminals	Impacts on sediment transport and shorelines from jetting during pipeline installation may contribute to adverse cumulative effects in conjunction with the preferred action.	Impacts on sediment transport and shorelines from jetting during pipeline installation may contribute to adverse cumulative effects in conjunction with alternatives 2 and 3.
#2: Onshore Storage and Fabrication Terminals	Impacts on sediment transport and shorelines from dredging, shoreline modification, or increases or decreases in ship traffic associated with a facility, may contribute to both adverse and beneficial cumulative effects in conjunction with the preferred action.	No dredging would occur under alternatives 2 and 3. A reduction in ship traffic and wake energy under Alternative 2 may help contribute to beneficial effects to shoreline change through reduced erosion. However, the lack of dredging for these alternatives would also mean there would be no opportunity for BU actions and potential beneficial cumulative impacts.
#3: Utility, Gas, Petroleum Pipelines	Impacts on sediment transport and shorelines from jetting during pipeline installation may contribute to adverse cumulative effects in conjunction with the preferred action.	Impacts on sediment transport and shorelines from jetting during pipeline installation may contribute to adverse cumulative effects in conjunction with alternatives 2 and 3.
#4: Maintenance and Navigation Dredging	Impacts on sediment transport and shorelines from dredging, or improved ship traffic associated with dredging, may contribute to both adverse and beneficial cumulative effects in conjunction with the preferred action.	Alternative 2 would not be applicable as it is fully offshore and Alternative 3 does not include any dredging beyond existing conditions.
#5 Bulkheads, Breakwaters, Boat Ramps, and Marinas	Impacts on sediment transport and shorelines from dredging, shoreline modification, or boat traffic associated with a facility, may contribute to both adverse and cumulative effects in conjunction with the preferred action.	Alternative 2 would not be applicable as it is fully offshore and Alternative 3 does not include any inshore modifications over existing conditions.
#7: Commercial and Residential Development	Impacts on sediment transport and shorelines from dredging, shoreline modification, or boat traffic associated with a facility, may contribute to both adverse and cumulative effects cumulative effects in conjunction with the preferred action.	Alternative 2 would not be applicable as it is fully offshore and Alternative 3 does not include any inshore modifications over existing conditions.
#9: Ecosystem Restoration	Impacts on sediment transport and shorelines from restoration actions are likely to contribute beneficial cumulative effects in conjunction with the preferred action.	Alternative 2 or 3 are unlikely to contribute beneficially or adversely as no restoration activities are included with these alternatives.

5.4.2 Physical Oceanography

Local bathymetric changes within and adjacent to the existing CCSC are expected with CDP. These changes would be small compared to the scale of regional bathymetry. Use of the New Work ODMDS would result in a periodic bathymetry change in the PA, but those changes would be minor and insignificant.

When comparing the CDP with the No-Action conditions, modeling predicted tidal amplitude increases of about 10 percent in Redfish Bay, 9 percent in Corpus Christi Bay, 7 percent in Nueces Bay, and 3 percent at Rockport. The tidal amplitude at the Inner Channel near Port Aransas has the largest increase, which is about 15 percent. Additional modeling runs were performed by Baird that validate these impacts (Baird, 2022c).

There would be limited impacts to current speed with the CDP. Modeling predicted that there would be reduced current speeds in the Outer Channel and Aransas Pass. The current speed increases in the CCSC from Port Aransas to Ingleside where the water depth remains unchanged. Salinity modeling indicates that a change in the tidal prism associated with channel deepening increases the exchange of saltwater between Corpus Christi and Nueces bays. The results indicate that channel deepening would increase average salinity by less than 1 ppt in the Corpus Christi Bay system. This magnitude of change would appear negligible given the wide salinity tolerances of estuarine species (Baird, 2022c).

There is the potential for CDP features to increase storm surge impacts in the project area by allowing more surge to propagate into the channel. Compared to the existing channel configuration, modeling shows that the CDP increases the storm surge water levels by 3.5 inches, as well as increases the inundation extent by as much as 492 acres. In addition, a hotspot of increased storm surge elevation of 4 to 12 inches was identified adjacent to Harbor Island, which is a known location of other upcoming projects (Subedee and Gibeaut, 2021). Beach nourishment activities, including nourishment and nearshore berms, have the potential to offset erosion effects and attenuate wave energy.

Changes to bathymetry, tidal ranges, currents, salinity, or storm surge could occur from several kinds of past, present, and reasonably foreseeable actions, and any impacts are generally adverse. Infrastructure or navigation projects that involve channel dredging can contribute impacts to bathymetry, tidal range, currents, and hydrosalinity gradients. For example, comparing the Applicant's Preferred Alternative with the No-Action Alternative indicates a tidal amplitude increase at the Inner Channel near Port Aransas of up to 15 percent (Baird, 2022c). When considering the impacts of tidal amplitude of the No-Action condition (–54 feet MLLW authorized depth) over previous conditions (–47 feet MLLW authorized depth), modeling indicates up to 18 percent at the Inner Channel. These modeling results indicate that the Applicant's Preferred Alternative would result in a direct cumulative increase in tidal range, particularly at the Inner Channel near Port Aransas where it could be as high as 36 percent (Table 5-3).

Table 5-3
Cumulative Tidal Range Increases Associated with the Applicant's Preferred Alternative Condition Compared to the No-Action and Prior Authorization Depth (–47 foot MLLW)

Stations	Tide Amplitude Increase (%) Applicant's Preferred Alternative vs. No-Action	Tide Amplitude Increase (%) No-Action vs. –47 foot Project Depth	Cumulative Tide Amplitude Increase (%) Applicant's Preferred Alternative vs. –47 foot Project Depth
Outer Channel	0	0	0
Aransas Pass	0	–1	–1
Inner Channel	15	18	36
Redfish Bay	10	15	27
Corpus Christi Bay	9	16	26
USS Lexington	9	16	26
Nueces Bay	7	13	21
Packery Channel	8	14	22
Rockport	3	1	3

Source: Baird (2022c).

Other projects that include hardening shorelines could impact currents and tidal ranges. Desalination projects could contribute to increased salinities, particularly during drought. Ecosystem restoration actions have the potential to have beneficial effects, particularly to bathymetric restoration. Table 5-4 summarizes the potential cumulative effects on physical oceanography. Offshore terminals and pipeline projects are not expected to contribute to cumulative impacts on bathymetry, tidal ranges, currents, salinity, or storm surge. Transportation projects are not expected to contribute cumulative impacts to physical oceanography.

Table 5-4
Summary of Potential Cumulative Effects on Physical Oceanography

CEA Project Group	Potential Cumulative Impact (Preferred Action)	Potential Cumulative Impact (Alternatives 2 and 3)
#1: Onshore Storage and Fabrication Terminals	Dredging or hardening or shorelines from other projects could contribute to cumulative impacts through altered bathymetry, increased currents, associated impacts to the hydrosalinity gradients. Dredging and hardened shorelines can also contribute to adverse cumulative impacts by altering storm surge potential.	Since no dredging or significant bathymetric alteration is involved with these alternatives, no contribution to cumulative impacts would be expected.

CEA Project Group	Potential Cumulative Impact (Preferred Action)	Potential Cumulative Impact (Alternatives 2 and 3)
#4: Maintenance and Navigation Dredging	Dredging from other projects could contribute to cumulative impacts through altered bathymetry, increased currents, and associated impacts to the hydrosalinity gradients. Dredging can also contribute to adverse cumulative impacts by altering storm surge potential. . When considering tidal range impacts of the CDP, as well as past impacts to tidal range created by the –47 foot project and No-Action condition (–54 foot project), there will be a direct cumulative impact to tidal ranges, particularly near Harbor Island.	Since no dredging or significant bathymetric alteration is involved with these alternatives, no contribution to cumulative impacts would be expected.
#5: Bulkheads, Breakwaters, Boat Ramps, and Marinas	Dredging or hardening or shorelines from other projects could contribute to cumulative impacts through altered bathymetry, increased currents, and associated impacts to the hydrosalinity gradients. Dredging and hardened shorelines can also contribute to adverse cumulative impacts by altering storm surge potential.	Since no dredging or significant bathymetric alteration is involved with these alternatives, no contribution to cumulative impacts would be expected.
#7: Commercial and Residential Development	Dredging or hardening or shorelines from other projects could contribute to cumulative impacts through altered bathymetry, increased currents, and associated impacts to the hydrosalinity gradients. Dredging and hardened shorelines can also contribute to adverse cumulative impacts by altering storm surge potential.	Since no dredging or significant bathymetric alteration is involved with these alternatives, no contribution to cumulative impacts would be expected.
#8: Desalination Facilities	During extreme drought conditions, there is a possibility that brine discharges could contribute to hydrosalinity gradient impacts in conjunction with channel deepening.	Since no dredging or significant bathymetric alteration is involved with these alternatives, no contribution to cumulative impacts would be expected.
#9: Ecosystem Restoration	Restoration of eroded areas may beneficially alter bathymetry, and this could contribute beneficial cumulative effects in conjunction with BU actions. Restoration of some areas may reduce potential impacts of increase storm surge potential.	Since no dredging or significant bathymetric alteration is involved with these alternatives, no contribution to cumulative impacts would be expected.

5.4.3 Water Quality

Temporary and localized impacts to water quality (in the form of increased turbidity) may result during dredging and placement. There would be limited spatial (several hundred feet, approximately 1,000 feet) and temporal (several hours) ranges of turbidity effects and related sediment movement. However, to allow for a more comprehensive evaluation, the geographic scope used for water and sediment quality in the cumulative impact analysis was extended to the Entrance Channel and the Lower Bay up to the La Quinta Junction area near Ingleside. Turbidity due to dredging in the immediate vicinity of the CDP and PAs was also considered. Impacts to sediment or sediment quality are not expected as sampling results for the –54-foot channel and the CDP indicated no issues with contaminants. The testing conducted on the –54-foot project and the CDP supported offshore disposal (USACE, 2003; EPA and USACE, 2008; Terracon Consultants, Inc., 2023a, 2023b). New work material located below –54 feet MLLW are not exposed to potential human impacts; therefore, chemical impacts during dredging and placement from the preferred action are not expected.

Past, present, and reasonably foreseeable actions in the area could contribute similar temporary and localized impacts to water quality. Actions that require dredging or marine construction could increase turbidity temporarily and locally. Any increases in boat or ship traffic can also contribute to turbidity levels. Ecosystem restoration projects could help improve turbidity by establishing vegetation or slowing erosion. For those concurrent activities that have turbidity impacts, localized and temporary cumulative impacts could result. These localized and temporary cumulative impacts from turbidity have the potential to impact seagrass and fisheries, which can impact recreational fishing or affect foraging of wildlife (such as gulls and terns). Table 5-5 summarizes the potential cumulative effects on water quality.

Table 5-5
Summary of Potential Cumulative Effects on Water Quality

CEA Project Group	Potential Cumulative Impact (Preferred Action)	Potential Cumulative Impact (Alternatives 2 and 3)
#1: Offshore Oil and Gas Terminals	Pipeline construction has the potential to contribute to localized and temporary increased turbidity levels if actions occur concurrently. Inshore ship traffic may be reduced which may decrease the likelihood of contributing turbidity through operations. If operational, these projects have some chance of spill impacts.	No dredging would occur under alternatives 2 and 3. Offshore construction has the potential to contribute to localized and temporary increased turbidity levels if actions occur concurrently. Inshore ship traffic may be reduced under Alternative 2, which may decrease the likelihood of contributing turbidity through operations. There is an increased risk of cumulative impacts in offshore extents since these projects are in Gulf waters. If operational, these projects have some chance of spill impacts.
#2: Onshore Storage and Fabrication Terminals	Construction impacts of other projects could contribute to localized and temporary increased turbidity levels if actions occur concurrently. Any resultant changes to ship traffic could also contribute to turbidity. If operational, these projects have some chance of spill impacts.	No dredging would occur under alternatives 2 and 3. Inshore pipeline construction has the potential to contribute to localized and temporary increased turbidity levels if actions occur concurrently. Inshore ship traffic may be reduced under Alternative 2, which may decrease the likelihood of contributing turbidity impacts through operations. If operational, these projects have some chance of spill impacts.

CEA Project Group	Potential Cumulative Impact (Preferred Action)	Potential Cumulative Impact (Alternatives 2 and 3)
#3: Utility, Gas, Petroleum Pipelines	If construction occurs concurrently, then temporary and localized cumulative impacts could result; however, HDD technology can avoid and minimize turbidity. If operational, these projects have some chance of spill impacts.	If inshore pipeline segment construction occurs concurrently, then temporary and localized cumulative impacts could result; however, since these projects occur offshore, they are unlikely to contribute to cumulative effects. Also, HDD technology can avoid and minimize turbidity impacts. If operational, these projects have some chance of spill impacts.
#4: Maintenance and Navigation Dredging	Construction impacts of other projects could contribute to localized and temporary increased turbidity levels if actions occur concurrently. Any resultant changes to ship traffic could also contribute to turbidity.	No dredging would occur under alternatives 2 and 3. Inshore pipeline construction has the potential to contribute to localized and temporary increased turbidity levels if actions occur concurrently. Inshore ship traffic may be reduced under Alternative 2, which may decrease the likelihood of contributing turbidity impacts through operations.
#5: Bulkheads, Breakwaters, Boat Ramps, and Marinas	Construction impacts of other projects could contribute to localized and temporary increased turbidity levels if actions occur concurrently. Any resultant changes to boat traffic could also contribute to turbidity.	No dredging would occur under alternatives 2 and 3. Inshore pipeline construction has the potential to contribute to localized and temporary increased turbidity levels if actions occur concurrently. Inshore ship traffic may be reduced under Alternative 2, which may decrease the likelihood of contributing turbidity impacts through operations.
#6: Transportation Projects	If construction occurs concurrently, then temporary and localized cumulative impacts could result. Stormwater runoff from roadways could contribute to water quality impacts over the project life and that could contribute cumulative effects if a spill occurred with the preferred action.	No dredging would occur under alternatives 2 and 3. Inshore pipeline construction has the potential to contribute to localized and temporary increased turbidity levels if actions occur concurrently. Inshore ship traffic may be reduced under Alternative 2, which may decrease the likelihood of contributing turbidity impacts through operations.
#7: Commercial and Residential Development	Construction impacts of other projects could contribute to localized and temporary increased turbidity levels if actions occur concurrently. Any resultant changes to boat traffic could also contribute to turbidity.	No dredging would occur under alternatives 2 and 3. Inshore pipeline construction has the potential to contribute to localized and temporary increased turbidity levels if actions occur concurrently. Inshore ship traffic may be reduced under Alternative 2, which may decrease the likelihood of contributing turbidity impacts through operations.
#8: Desalination Facilities	During extreme drought conditions, there is a possibility that brine discharges could contribute to hydrosalinity gradient impacts in conjunction with channel deepening.	Since no dredging or significant bathymetric alteration is involved with these alternatives, no contribution to cumulative impacts would be expected.

CEA Project Group	Potential Cumulative Impact (Preferred Action)	Potential Cumulative Impact (Alternatives 2 and 3)
#9: Ecosystem Restoration	Construction impacts of other projects could contribute to localized and temporary increased turbidity levels if actions occur concurrently; however, long-term water quality improvements could result from restoration actions and may decrease adverse cumulative impacts.	Alternative 2 or 3 are unlikely to contribute beneficially or adversely as no restoration activities are included with these alternatives. Inshore pipeline construction has the potential to contribute to localized and temporary increased turbidity levels if actions occur concurrently.

5.4.4 Energy and Mineral Resources

The preferred action would provide additional capacity to export energy resources. Additionally, sand can be considered a mineral resource and the preferred action would dredge and place substantial volumes of sand in the study area.

Past, present, and reasonably foreseeable actions in the area could contribute similar effects to energy and mineral resources in the study area. Much of the port-related infrastructure is associated with energy resources, and several actions involve dredging of sands. Ecosystem restoration actions could impact sand as a mineral resource in that BU actions would use sands and potentially retain more sands within the bay through reduced erosion. Table 5-6 summarizes the potential cumulative effects on energy and mineral resources. Transportation projects, bulkheads, breakwaters, marinas, developments, and desalination facilities are unlikely to contribute to cumulative impacts.

Table 5-6

Summary of Potential Cumulative Effects on Energy and Mineral Resources

CEA Project Group	Potential Cumulative Impact (Preferred Action)	Potential Cumulative Impact (Alternatives 2 and 3)
#1: Offshore Oil and Gas Terminals	These projects would increase the capacity to export energy resources if in combination with the preferred action.	These projects would increase the capacity to export energy resources if in combination with the Alternative 2 or 3. No dredging would occur under alternatives 2 and 3.
#2: Onshore Storage and Fabrication Terminals	These projects would increase the capacity to export energy resources if in combination with the preferred action.	These projects would increase the capacity to export energy resources if in combination with the Alternative 2 or 3. No dredging would occur under alternatives 2 and 3.
#3: Utility, Gas, Petroleum Pipelines	These projects would increase the capacity to export energy resources if in combination with the preferred action.	These projects would increase the capacity to export energy resources if in combination with the preferred action.
#4: Maintenance and Navigation Dredging	If associated with petrochemical facilities, these projects would increase the capacity to export energy resources if in combination with the preferred action.	If associated with petrochemical facilities, these projects would increase the capacity to export energy resources if in combination with Alternative 2 or 3. No dredging would occur under alternatives 2 and 3.

CEA Project Group	Potential Cumulative Impact (Preferred Action)	Potential Cumulative Impact (Alternatives 2 and 3)
#9: Ecosystem Restoration	Restoration actions can impact sand resources by helping retain them within the bay through reduced erosion. Beneficial cumulative impacts are possible with the preferred actions BU initiatives.	Alternative 2 or 3 are unlikely to contribute beneficially or adversely to sand resources as no restoration activities are included with these alternatives.

5.4.5 Air Quality

The preferred action would impact air quality during construction through heavy equipment emissions, but those impacts are expected to be minor, temporary, and localized. During operations, the preferred action is expected to reduce lightering events. Since lightering can result in air impacts, a reduction in lightering may imply a reduction in air quality impacts over no action.

Past, present, and reasonably foreseeable actions in the area could contribute similar effects to air quality. For those projects constructed concurrently, there may be a chance of temporary and localized cumulative impacts. For those projects that result in an increase in surface or marine traffic, there could be a potential contribution to air quality impacts. Table 5-7 summarizes the potential cumulative effects on air quality.

Table 5-7
Summary of Potential Cumulative Effects on Air Quality

CEA Project Group	Potential Cumulative Impact (Preferred Action)	Potential Cumulative Impact (Alternatives 2 and 3)
#1: Offshore Oil and Gas Terminals	Other than minor, temporary, and localized construction impacts, these projects are expected to reduce ship traffic and lightering events – which could yield cumulative benefits to air quality.	No dredging would occur under Alternatives 2 and 3. Other than minor, temporary, and localized construction impacts, these projects are expected to reduce ship traffic and lightering events – which could yield cumulative benefits to air quality.
#2: Onshore Storage and Fabrication Terminals	If construction occurs concurrently, then temporary and localized cumulative impacts could result. If there are increases in ship traffic due to any facilities, then additional cumulative effects are possible. Air impacts from industrial facilities could contribute cumulative impacts in conjunction with the preferred project; however, a reduction in lightering and inshore ship traffic would reduce contributions to cumulative impacts. Carbon capture and blue hydrogen projects have potential to reduce air impacts.	Since these projects occur offshore, they are unlikely to contribute to cumulative effects. No dredging would occur under alternatives 2 and 3.

CEA Project Group	Potential Cumulative Impact (Preferred Action)	Potential Cumulative Impact (Alternatives 2 and 3)
#3: Utility, Gas, Petroleum Pipelines	If construction occurs concurrently, then temporary and localized cumulative impacts could result.	If inshore pipeline segment construction occurs concurrently, then temporary and localized cumulative impacts could result; however, since these projects occur offshore, they are unlikely to contribute to cumulative effects.
#4: Maintenance and Navigation Dredging	If construction occurs concurrently, then temporary and localized cumulative impacts could result. If there are increases in ship traffic due to any facilities, then additional cumulative effects are possible.	No dredging would occur under alternatives 2 and 3. If associated with petrochemical facilities, these projects would increase the capacity to export energy resources if in combination with Alternative 2 or 3.
#5: Bulkheads, Breakwaters, Boat Ramps, and Marinas	If construction occurs concurrently, then temporary and localized cumulative impacts could result. Any resultant increases to boat traffic could also contribute to air quality impacts.	Since these projects occur offshore, they are unlikely to contribute to cumulative effects.
#6: Transportation Projects	If construction occurs concurrently, then temporary and localized cumulative impacts could result. Any resultant increases to traffic could also contribute to air quality impacts.	Since these projects occur offshore, they are unlikely to contribute to cumulative effects.
#7: Commercial and Residential Development	If construction occurs concurrently, then temporary and localized cumulative impacts could result. Any resultant increases to traffic could also contribute to air quality impacts.	Since these projects occur offshore, they are unlikely to contribute to cumulative effects.
#8: Desalination Facilities	If construction occurs concurrently, then temporary and localized cumulative impacts could result.	Since these projects occur offshore, they are unlikely to contribute to cumulative effects.
#9: Ecosystem Restoration	If construction occurs concurrently, then temporary and localized cumulative impacts could result.	Alternative 2 or 3 are unlikely to contribute beneficially or adversely to sand resources as no restoration activities are included with these alternatives.

5.4.6 Noise

The preferred action would result in noise impacts during construction (from dredging and PA construction or improvements). Noise impacts would also occur during operations and ship loading. Since lightering would decrease with the preferred action, the associated noise impacts may also decrease. These noise impacts could impact areas near Harbor Island and Port Aransas where residential areas occur next to the channel. Noise may also result in temporary and localized impacts to marine mammals.

If reasonably foreseeable actions are constructed concurrently, there may be a chance of temporary and localized cumulative noise impacts. For past, present, and reasonably foreseeable actions that result in increased operational noise or in an increase in surface or marine traffic, there could be a potential contribution to noise impacts. Table 5-8 summarizes the potential cumulative effects on noise.

Table 5-8
Summary of Potential Cumulative Effects on Noise

CEA Project Group	Potential Cumulative Impact (Preferred Action)	Potential Cumulative Impact (Alternatives 2 and 3)
#1: Offshore Oil and Gas Terminals	If pipeline construction occurs concurrently, then temporary and localized cumulative impacts could result.	No dredging would occur under alternatives 2 and 3. If construction occurs concurrently, then temporary, and localized cumulative impacts could result.
#2: Onshore Storage and Fabrication Terminals	If construction occurs concurrently, then temporary and localized cumulative impacts could result. If any facilities are near the preferred action, then there could be some potential for cumulative noise impacts in that area during operation.	No dredging would occur under alternatives 2 and 3. If inshore pipeline segment construction occurs concurrently, then temporary and localized cumulative impacts could result; however, since these projects occur offshore, they are unlikely to contribute to cumulative effects.
#3: Utility, Gas, Petroleum Pipelines	If construction occurs concurrently, then temporary and localized cumulative impacts could result.	If inshore pipeline segment construction occurs concurrently, then temporary and localized cumulative impacts could result; however, since these projects occur offshore, they are unlikely to contribute to cumulative effects.
#4: Maintenance and Navigation Dredging	If construction occurs concurrently, then temporary and localized cumulative impacts could result. If there are increases in ship traffic due to any facilities, then additional cumulative effects are possible.	No dredging would occur under alternatives 2 and 3. If inshore pipeline segment construction occurs concurrently, then temporary and localized cumulative impacts could result; however, since these projects occur offshore, they are unlikely to contribute to cumulative effects.
#5: Bulkheads, Breakwaters, Boat Ramps, and Marinas	If construction occurs concurrently, then temporary and localized cumulative impacts could result. Any resultant increases to boat traffic could also contribute to noise impacts.	If inshore pipeline segment construction occurs concurrently, then temporary and localized cumulative impacts could result; however, since these projects occur offshore, they are unlikely to contribute to cumulative effects.
#6: Transportation Projects	If construction occurs concurrently, then temporary and localized cumulative impacts could result. Any resultant increases to traffic could also contribute to noise impacts.	If inshore pipeline segment construction occurs concurrently, then temporary and localized cumulative impacts could result; however, since these projects occur offshore, they are unlikely to contribute to cumulative effects.
#7: Commercial and Residential Development	If construction occurs concurrently, then temporary and localized cumulative impacts could result. Any resultant increases to traffic could also contribute to noise impacts.	If inshore pipeline segment construction occurs concurrently, then temporary and localized cumulative impacts could result; however, since these projects occur offshore, they are unlikely to contribute to cumulative effects.
#8: Desalination Facilities	If construction occurs concurrently, then temporary and localized cumulative impacts could result.	If inshore pipeline segment construction occurs concurrently, then temporary and localized cumulative impacts could result; however, since these projects occur offshore, they are unlikely to contribute to cumulative effects.
#9: Ecosystem Restoration	If construction occurs concurrently, then temporary and localized cumulative impacts could result.	If inshore pipeline segment construction occurs concurrently, then temporary and localized cumulative impacts could result; however, since these projects occur offshore, they are unlikely to contribute to cumulative effects.

5.4.7 Wetlands and SAV

The preferred action would impact both tidal and non-tidal wetlands through placement activities only; dredging the channel is not expected to directly impact wetlands. Although wetland impacts would result from placement activities, some of these impacts would be associated with BU. Across all PAs, there could be up to 16.61 acres of estuarine (or tidal) wetland impacts and 122.46 acres of palustrine (or non-tidal) impacts (Mott MacDonald, 2021, 2022).

Submerged aquatic vegetation was delineated within three PA footprints (HI-E, SS1, and PA4) and include shoal grass, widgeon grass, turtle grass, clover grass. A total of 6.88 acres of SAV would be impacted through inshore PA construction (Triton Environmental Solutions, 2021a, 2022a).

Past, present, and reasonably foreseeable actions with dredging or construction activities, and resultant turbidity, can potentially impact nearby wetlands and SAV. Pipeline installation can also have direct impacts to wetlands and SAV; however, HDD installation methods can avoid and minimize potential impacts when implemented. Increases in ship traffic from other projects also have potential to impact wetlands and SAV through wake energies. Desalination projects could have impacts to wetlands or SAV during extreme drought conditions by contributing to increased salinities. Any wetland loss also implies a loss of important ecological functions, such as aquifer recharge features, water quality filters, habitat provision, flood retention and reduction, biogeochemical cycling (e.g., carbon sequestration, nutrient retention and uptake), sediment retention, and erosion protection, for example (Mitsch and Gosselink, 2000). Loss of wetlands and their important ecological functions highlight the need for wetland conservation and restoration. Last, restoration actions, particularly those targeting wetlands and SAV conservation, can yield benefits to wetland and SAV resources in the region. Table 5-9 summarizes the potential cumulative effects on wetlands and SAV.

Table 5-9
Summary of Potential Cumulative Effects on Wetlands and SAV

CEA Project Group	Potential Cumulative Impact (Preferred Action)	Potential Cumulative Impact (Alternatives 2 and 3)
#1: Offshore Oil and Gas Terminals	Pipeline construction and dredging has the potential to contribute to localized and temporary increased turbidity levels if actions occur concurrently, and that can impact wetlands and SAV; however, HDD technology can avoid and minimize impacts. Since inshore ship traffic may decrease with these projects, cumulative effects of scour and erosion of wetlands and SAV may be reduced. If operational, these projects have some chance of spill impacts.	No dredging would occur under alternatives 2 and 3. Pipeline construction has the potential to contribute to localized and temporary increased turbidity levels if actions occur concurrently, and that can impact wetlands and SAV; however, HDD technology can avoid and minimize impacts. Since inshore ship traffic may decrease with these projects, cumulative effects of scour and erosion of wetlands and SAV may be reduced. If operational, these projects have some chance of spill impacts.

CEA Project Group	Potential Cumulative Impact (Preferred Action)	Potential Cumulative Impact (Alternatives 2 and 3)
#2: Onshore Storage and Fabrication Terminals	Pipeline construction and dredging has the potential to contribute to localized and temporary increased turbidity levels if actions occur concurrently, and that can impact wetlands and SAV; however, HDD technology can avoid and minimize impacts. Any resultant increases to ship traffic from these projects could also contribute to turbidity. For those projects with BU components, there may be some likelihood of beneficial cumulative impacts. If operational, these projects have some chance of spill impacts.	No dredging would occur under alternatives 2 and 3. Inshore pipeline construction has the potential to contribute to localized and temporary increased turbidity levels if actions occur concurrently and that can impact wetlands and SAV. Inshore ship traffic may be reduced under Alternative 2, which may decrease the cumulative effects of scour and erosion of wetlands and SAV. If operational, these projects have some chance of spill impacts.
#3: Utility, Gas, Petroleum Pipelines	Pipeline construction and dredging has the potential to contribute to localized and temporary increased turbidity levels if actions occur concurrently, and that can impact wetlands and SAV; however, HDD technology can avoid and minimize impacts. If operational, these projects have some chance of spill impacts.	If inshore pipeline segment construction occurs concurrently, localized, and temporary increased turbidity levels can occur, and that can impact wetlands and SAV; however, since these projects occur offshore, they are unlikely to contribute to cumulative effects. Also, HDD technology can avoid and minimize impacts. If operational, these projects have some chance of spill impacts.
#4: Maintenance and Navigation Dredging	Dredging impacts of other projects could contribute to localized and temporary increased turbidity levels if actions occur concurrently and that can impact wetlands and SAV. Any resultant changes to ship traffic could also contribute to turbidity and erosion.	No dredging would occur under alternatives 2 and 3. Inshore pipeline construction has the potential to contribute to localized and temporary increased turbidity increased levels if actions occur concurrently and that can impact wetlands and SAV. Inshore ship traffic may be reduced under Alternative 2, which may decrease the likelihood of contributing turbidity through operations.
#5: Bulkheads, Breakwaters, Boat Ramps, and Marinas	Construction impacts of other projects could contribute to localized and temporary increased turbidity levels if actions occur concurrently and that can impact wetlands and SAV. Any resultant changes to boat traffic could also contribute to turbidity and erosion.	Inshore pipeline construction has the potential to contribute to localized and temporary increased turbidity levels if actions occur concurrently and that can impact wetlands and SAV. Inshore ship traffic may be reduced under Alternative 2, which may decrease the likelihood of contributing turbidity through operations.
#6: Transportation Projects	If construction occurs concurrently, then temporary and localized cumulative impacts could result. If these projects result in direct wetland impacts, then that could contribute cumulative effects.	If inshore pipeline segment construction occurs concurrently, then temporary and localized cumulative impacts could result; however, since these projects occur offshore, they are unlikely to contribute to cumulative effects.

CEA Project Group	Potential Cumulative Impact (Preferred Action)	Potential Cumulative Impact (Alternatives 2 and 3)
#7: Commercial and Residential Development	Construction impacts of other projects could contribute to localized and temporary increased turbidity levels if actions occur concurrently and that can impact wetlands and SAV. Any resultant changes to boat traffic could also contribute to turbidity or erosion.	Inshore pipeline construction has the potential to contribute to localized and temporary increased turbidity levels if actions occur concurrently and that can impact wetlands and SAV. Inshore ship traffic may be reduced under Alternative 2, which may decrease the likelihood of contributing turbidity through operations.
#8: Desalination Facilities	During extreme drought conditions, there is a possibility that brine discharges could contribute to hydrosalinity gradient impacts in conjunction with channel deepening, which could contribute cumulative impacts to wetlands and SAV	If inshore pipeline segment construction occurs concurrently, then temporary and localized cumulative impacts could result from increased turbidity; however, since these projects occur offshore, they are unlikely to contribute to cumulative effects.
#9: Ecosystem Restoration	Construction impacts of other projects could contribute to localized and temporary increased turbidity levels if actions occur concurrently; however, restoration actions and may decrease adverse cumulative impacts to wetlands and SAV with the preferred actions BU sites.	Alternative 2 or 3 are unlikely to contribute beneficially or adversely as no restoration activities are included with these alternatives. Inshore pipeline construction has the potential to contribute to localized and temporary increased turbidity levels if actions occur concurrently.

5.4.8 Aquatic Resources

The CDP would directly affect the estuarine habitats and fauna in the study area by the loss of bay bottom habitat and other aquatic resources due to dredging and placement activities. Channel dredging (inshore and offshore) would impact 1,182 acres of open water/bottom habitat through excavation. For Gulf side placement actions, nearshore berms (B1–B9) would impact 1,586 acres of open water/bottom habitat (NOAA, 2010), MI and SJI beach nourishment placement would impact 275.19 acres of open water/bottom habitat (Mott MacDonald, 2021, 2022) and the ODMDS would impact 1,180 acres of open water/bottom habitat (NOAA, 2010).

Direct aquatic resource impacts from inshore PA construction include 563.85 acres of open water/bottom habitat, 16.61 acres of tidal wetlands, 122.46 acres of freshwater wetlands, 84.85 acres of unconsolidated shorelines (tidal sand flats/algal flats/beach), 6.88 acres of seagrass, and 0.10 acres of oyster reef (Mott MacDonald, 2021, 2022; Triton Environmental Solutions, 2021a, 2022a).

Construction impacts, mainly through turbidity increases, may impact aquatic fauna. Dredging and placement would have direct impacts to benthic communities, although benthic organisms would colonize the new bay and Gulf substrates. There would also be direct impact to 0.10 acres of oyster reef from constructing HI-E.

Past, present, and reasonably foreseeable actions with dredging or construction activities, and resultant turbidity, can potentially impact aquatic fauna. Pipeline installation can also have direct impacts to aquatic fauna, particularly benthic organisms; however, horizontal directional drilling can avoid and minimize potential impacts. Desalination projects could have impacts to aquatic fauna during extreme drought conditions by contributing to increased salinities. Restoration actions can yield benefits to aquatic faunal resources in the region. Table 5-10 summarizes the potential cumulative effects on aquatic resources.

Table 5-10
Summary of Potential Cumulative Effects on Aquatic Recourses

CEA Project Group	Potential Cumulative Impact (Preferred Action)	Potential Cumulative Impact (Alternatives 2 and 3)
#1: Offshore Oil and Gas Terminals	Pipeline construction and dredging has the potential to contribute to localized and temporary increased turbidity levels if actions occur concurrently, and that can impact aquatic resources; however, HDD technology can avoid and minimize impacts. Since inshore ship traffic may decrease with these projects, cumulative effects of turbidity on aquatic resources may be reduced. If operational, these projects have some chance of spill impacts.	No dredging would occur under alternatives 2 and 3. Pipeline construction has the potential to contribute to localized and temporary increased turbidity levels if actions occur concurrently, and that can impact aquatic resources; however, HDD technology can avoid and minimize impacts. Since inshore ship traffic may decrease with these projects, cumulative effects of turbidity on aquatic resources may be reduced. Offshore structures may serve as refugia for aquatic resources in the Gulf which could yield beneficial. cumulative effects. If operational, these projects have some chance of spill impacts.
#2: Onshore Storage and Fabrication Terminals	Pipeline construction and dredging has the potential to contribute to localized and temporary increased turbidity levels if actions occur concurrently, and that can impact aquatic resources; however, HDD technology can avoid and minimize impacts. Any resultant changes to ship traffic from other projects could also contribute to turbidity and erosion which can impact aquatic resources. If operational, these projects have some chance of spill impacts.	No dredging would occur under alternatives 2 and 3. Inshore pipeline construction has the potential to contribute to localized and temporary increased turbidity levels if actions occur concurrently, and that can impact aquatic resources; however, HDD technology can avoid and minimize impacts. Since inshore ship traffic may decrease with these projects, cumulative effects of turbidity on aquatic resources may be reduced. If operational, these projects have some chance of spill impacts.
#3: Utility, Gas, Petroleum Pipelines	If construction occurs concurrently, then temporary and localized cumulative impacts could result; however, HDD technology can avoid and minimize impacts. If operational, these projects have some chance of spill impacts.	If inshore pipeline segment construction occurs concurrently, then temporary and localized cumulative impacts could result; however, since these projects occur offshore, they are unlikely to contribute to cumulative effects. Also, HDD technology can avoid and minimize impacts. If operational, these projects have some chance of spill impacts.

CEA Project Group	Potential Cumulative Impact (Preferred Action)	Potential Cumulative Impact (Alternatives 2 and 3)
#4: Maintenance and Navigation Dredging	Dredging impacts of other projects could contribute to aquatic resource impacts if actions occur concurrently. Any resultant changes to ship traffic from these projects could also contribute to turbidity and erosion which can impact aquatic resources.	No dredging would occur under alternatives 2 and 3. Inshore pipeline construction has the potential to contribute to localized and temporary increased turbidity levels if actions occur concurrently, and that can impact aquatic resources; however, HDD technology can avoid and minimize impacts. Since inshore ship traffic may decrease with these projects, cumulative effects of turbidity on aquatic resources may be reduced.
#5: Bulkheads, Breakwaters, Boat Ramps, and Marinas	Construction impacts of other projects could contribute to localized and temporary increased turbidity levels if actions occur concurrently and that can impact aquatic resources. Any resultant changes to boat traffic could also contribute to turbidity and erosion.	Inshore pipeline construction has the potential to contribute to localized and temporary increased turbidity levels if actions occur concurrently, and that can impact aquatic resources; however, HDD technology can avoid and minimize impacts. Since inshore ship traffic may decrease with these projects, cumulative effects of turbidity on aquatic resources may be reduced.
#6: Transportation Projects	If construction occurs concurrently, then temporary and localized cumulative impacts could result. Stormwater runoff from roadways could contribute to water quality impacts over the project life and that could contribute cumulative effects. Ferry operations can result in turbidity and erosion. If projects result in direct aquatic resource impacts, then that could contribute cumulative effects.	No dredging would occur under alternatives 2 and 3. Inshore pipeline construction has the potential to contribute to localized and temporary increased turbidity levels if actions occur concurrently. Inshore ship traffic may be reduced under Alternative 2, which may decrease the likelihood of contributing erosion impacts through operations. Due to the offshore location of these alternatives, they are unlikely to contribute cumulative impacts in conjunction with transportation projects.
#7: Commercial and Residential Development	Construction impacts of other projects could contribute to localized and temporary increased turbidity levels if actions occur concurrently and that can impact aquatic resources. Any resultant changes to boat traffic could also contribute to turbidity or erosion.	No dredging would occur under alternatives 2 and 3. Inshore pipeline construction has the potential to contribute to localized and temporary increased turbidity levels if actions occur concurrently, and that can impact aquatic resources; however, HDD technology can avoid and minimize impacts. Since inshore ship traffic may decrease with these projects, cumulative effects of turbidity on aquatic resources may be reduced.
#8: Desalination Facilities	During extreme drought conditions, there is a possibility that brine discharges could contribute to hydrosalinity gradient impacts in conjunction with channel deepening, which could contribute cumulative impacts on aquatic resources.	If inshore pipeline segment construction occurs concurrently, then temporary and localized cumulative impacts could result from turbidity; however, since these projects occur offshore, they are unlikely to contribute to cumulative effects on aquatic resources.

CEA Project Group	Potential Cumulative Impact (Preferred Action)	Potential Cumulative Impact (Alternatives 2 and 3)
#9: Ecosystem Restoration	Construction impacts of other projects could contribute to localized and temporary increased turbidity levels if actions occur concurrently; however, restoration actions and may decrease adverse cumulative impacts to aquatic resources with the preferred action's BU sites.	Alternative 2 or 3 are unlikely to contribute beneficially or adversely as no restoration activities are included with these alternatives. Inshore pipeline construction has the potential to contribute to localized and temporary increased turbidity levels if actions occur concurrently and that can impact aquatic resources.

5.4.9 Wildlife Resources

Dredging associated with the preferred action would temporarily cause localized increases in turbidity and lower DO which can impact habitat use and foraging success. Sea turtles and other slow moving marine species may be directly impacted by dredging activities. Reduced DO can decrease fish abundance, and this may temporarily reduce forage availability for piscivorous seabirds and marine mammals. Larger vessels such as VLCCs, and the tugboats, may affect shoreline erosion and degrade or reduce the amount of shoreline for use by birds and terrestrial wildlife. Beneficial placement of dredged material along shorelines would increase beach and wetland habitat and could protect interior habitat from shoreline erosion. Beneficial use actions could provide additional wildlife habitat such as nesting substrates. Wildlife impacts from marine vessel traffic may be reduced if lightering decreases.

Past, present, and reasonably foreseeable actions with dredging or construction activities, and resultant ship traffic, can potentially impact wildlife resources. Noise and light during construction can also result in impacts to wildlife. Various infrastructure can convert potential wildlife habitats. Ecosystem restoration initiatives typically yield beneficial effects to wildlife resources. Table 5-11 summarizes the potential cumulative effects on wildlife resources.

Table 5-11
Summary of Potential Cumulative Effects on Wildlife Resources

CEA Project Group	Potential Cumulative Impact (Preferred Action)	Potential Cumulative Impact (Alternatives 2 and 3)
#1: Offshore Oil and Gas Terminals	Pipeline construction has the potential to contribute to localized and temporary impacts to wildlife if actions occur concurrently. Inshore ship traffic may be reduced which may decrease contribution to wildlife impacts. If operational, these projects have some chance of spill impacts.	Offshore construction has the potential to contribute to localized and temporary impacts to wildlife if actions occur concurrently. Inshore ship traffic may be reduced under Alternative 2, which may decrease chances of additional impacts. There is an increased risk of cumulative impacts in offshore extents since these projects are in Gulf Waters. Offshore structures may serve as refugia for wildlife in the Gulf which could yield beneficial cumulative effects. If operational, these projects have some chance of spill impacts.

CEA Project Group	Potential Cumulative Impact (Preferred Action)	Potential Cumulative Impact (Alternatives 2 and 3)
#2: Onshore Storage and Fabrication Terminals	Construction impacts of other projects could contribute to localized and temporary wildlife impacts if actions occur concurrently. Any resultant changes to ship traffic could also contribute to wildlife impacts. If operational, these projects have some chance of spill impacts.	Inshore pipeline construction has the potential to contribute to localized and temporary wildlife impacts if actions occur concurrently. Inshore ship traffic may be reduced under Alternative 2, which may decrease chances of additional impacts. If operational, these projects have some chance of spill impacts.
#3: Utility, Gas, Petroleum Pipelines	If construction occurs concurrently, then temporary and localized cumulative impacts could result; however, HDD technology can avoid and minimize impacts. If operational, these projects have some chance of spill impacts.	If inshore pipeline segment construction occurs concurrently, then temporary and localized cumulative impacts could result; however, since these projects occur offshore, they are unlikely to contribute to cumulative effects. Also, HDD technology can avoid and minimize impacts. If operational, these projects have some chance of spill impacts.
#4: Maintenance and Navigation Dredging	Construction impacts of other projects could contribute to localized and temporary wildlife impacts if actions occur concurrently. Any resultant changes to ship traffic could also contribute to wildlife impacts. Any BU associated with these projects could yield beneficial cumulative effects in conjunction with the preferred action.	Inshore pipeline construction has the potential to contribute to localized and temporary wildlife impacts if actions occur concurrently. Inshore ship traffic may be reduced under Alternative 2, which may decrease chances of additional impacts.
#5: Bulkheads, Breakwaters, Boat Ramps, and Marinas	Construction impacts of other projects could contribute to wildlife impacts if actions occur concurrently. Any resultant changes to boat traffic could also contribute to turbidity.	Inshore pipeline construction has the potential to contribute to localized and temporary wildlife impacts if actions occur concurrently. Inshore ship traffic may be reduced under Alternative 2, which may decrease chances of additional impacts.
#6: Transportation Projects	If construction occurs concurrently, then temporary and localized cumulative impacts could result. If these projects result in direct habitat impacts, then that could contribute cumulative effects.	If inshore pipeline segment construction occurs concurrently, then temporary and localized cumulative impacts could result; however, since these projects occur offshore, they are unlikely to contribute to cumulative effects.
#7: Commercial and Residential Development	Construction impacts of other projects could contribute to localized and temporary increased turbidity levels if actions occur concurrently. Any resultant changes to boat traffic could also contribute to wildlife impacts.	Inshore pipeline construction has the potential to contribute to localized and temporary wildlife impacts if actions occur concurrently. Inshore ship traffic may be reduced under Alternative 2, which may decrease chances of additional impacts.
#8: Desalination Facilities	During extreme drought conditions, there is a possibility that brine discharges could contribute to hydrosalinity gradient impacts in conjunction with channel deepening, which could contribute cumulative impacts on wildlife.	If inshore pipeline segment construction occurs concurrently, then temporary and localized cumulative impacts could result from noise and light.

CEA Project Group	Potential Cumulative Impact (Preferred Action)	Potential Cumulative Impact (Alternatives 2 and 3)
#9: Ecosystem Restoration	Construction impacts of other projects could contribute to localized and temporary wildlife impacts if actions occur concurrently; however, long-term improvements to wildlife resources could result from restoration actions and may decrease adverse cumulative impacts.	Alternative 2 or 3 are unlikely to contribute beneficially or adversely as no restoration activities are included with these alternatives. Inshore pipeline construction has the potential to contribute to localized and temporary wildlife impacts if actions occur concurrently.

5.4.10 Threatened and Endangered Species

The preferred action would result in temporary and localized increases in turbidity which can reduce sea turtle and shorebirds feeding efficiency. Dredging can also impact sea turtles. By utilizing biological observers or other best management practices, harm to threatened and endangered species can be avoided. Other methods, such as using turtle deflector, relocation trawling, or limiting the use of hopper dredging from December to March can avoid and minimize impacts. Noise related to construction activities such as dredging and pile driving can interfere with acoustic communication and harm auditory organs in wildlife species such as marine mammals, sea turtles and fish. Noise impact is expected to be temporary and localized. Construction noise can be reduced by utilizing air bubble curtains, temporary noise attenuation piles, filled fabric barriers, or cofferdams (Nuclear Regulatory Commission, 2012). Any spills can impact several Federally-listed species. If it is uncontained, an oil spill can harm wildlife and aquatic species. If not immediately contained, the spill can spread to nearby shorelines and impact sea turtles, shorebirds, and wildlife. Dredging and placement actions may disturb shorebirds such as Piping Plover and Red Knots. Triton Environmental Solutions (2021b, 2022b) observed Piping Plovers and Red Knots utilizing PAs and BU sites within the project area. Placement actions would temporarily impact foraging grounds and construction activities may disturb shorebirds and sea turtles via lights, turbidity, and noise. Scheduling dredge and BU placement activity outside of the wintering period of listed shorebirds and nesting period for sea turtles can avoid and minimize these disturbances. Beneficial use placement actions could potentially benefit State and Federally-listed species such as Piping Plovers and Red Knots by nourishing or restoring habitats because those areas are eroding or were damaged by storm events. Designated Piping Plover Critical Habitat can be found throughout the project area on Mustang Island, San José Island, Port Aransas, and along Corpus Christi Bay. Placement actions could potentially increase shoreline habitat within designated Critical Habitat on San José and Mustang islands (both of which were damaged by Hurricane Harvey). Similarly, Whooping Crane habitat may benefit from placement actions targeting BU as well, particularly areas that are routinely impacted by vessel wakes and erosion, or were damaged by discrete storm events.

Past, present, and reasonably foreseeable actions with dredging or construction activities, and resultant ship traffic, can potentially impact listed shorebirds, marine mammals, and sea turtles. Noise and light during construction can also result in impacts to these species. Various infrastructure projects can convert potential habitats for listed species. Ecosystem restoration initiatives typically yield beneficial effects on listed species. Table 5-12 summarizes the potential cumulative effects on threatened and endangered species.

Table 5-12
Summary of Potential Cumulative Effects on Threatened and Endangered Species

CEA Project Group	Potential Cumulative Impact (Preferred Action)	Potential Cumulative Impact (Alternatives 2 and 3)
#1: Offshore Oil and Gas Terminals	Pipeline construction has the potential to contribute to localized and temporary impacts to listed species if actions occur concurrently. Inshore ship traffic may be reduced which may decrease contribution to listed species impacts. If operational, these projects have some chance of spill impacts.	Offshore construction has the potential to contribute to localized and temporary impacts to listed species if actions occur concurrently. Inshore ship traffic may be reduced under Alternative 2, which may decrease chances of additional impacts. There is an increased risk of cumulative impacts in offshore extents since these projects are in Gulf waters. If operational, these projects have some chance of spill impacts.
#2: Onshore Storage and Fabrication Terminals	Construction impacts of other projects could contribute to localized and temporary listed species impacts if actions occur concurrently. Any resultant changes to ship traffic could also contribute to listed species impacts. If operational, these projects have some chance of spill impacts.	Inshore pipeline construction has the potential to contribute to localized and temporary listed species impacts if actions occur concurrently. Inshore ship traffic may be reduced under Alternative 2, which may decrease chances of additional impacts. If operational, these projects have some chance of spill impacts.
#3: Utility, Gas, Petroleum Pipelines	If construction occurs concurrently, then temporary and localized cumulative impacts could result; however, HDD technology can avoid and minimize impacts. If operational, these projects have some chance of spill impacts.	If inshore pipeline segment construction occurs concurrently, then temporary and localized cumulative impacts could result; however, since these projects occur offshore, they are unlikely to contribute to cumulative effects. Also, HDD technology can avoid and minimize impacts. If operational, these projects have some chance of spill impacts.
#4: Maintenance and Navigation Dredging	Construction impacts of other projects could contribute to localized and temporary listed species impacts if actions occur concurrently. Any resultant changes to ship traffic could also contribute to listed species impacts. Any BU associated with these projects could yield beneficial cumulative effects in conjunction with the preferred action.	Inshore pipeline construction has the potential to contribute to localized and temporary listed species impacts if actions occur concurrently. Inshore ship traffic may be reduced under Alternative 2, which may decrease chances of additional impacts.
#5: Bulkheads, Breakwaters, Boat Ramps, and Marinas	Construction impacts of other projects could contribute to listed species impacts if actions occur concurrently. Any resultant changes to boat traffic could also contribute to turbidity.	Inshore pipeline construction has the potential to contribute to localized and temporary listed species impacts if actions occur concurrently. Inshore ship traffic may be reduced under Alternative 2, which may decrease chances of additional impacts.

CEA Project Group	Potential Cumulative Impact (Preferred Action)	Potential Cumulative Impact (Alternatives 2 and 3)
#6: Transportation Projects	If construction occurs concurrently, then temporary and localized cumulative impacts could result. If these projects result in direct habitat impacts, then that could contribute cumulative effects.	If inshore pipeline segment construction occurs concurrently, then temporary and localized cumulative impacts could result; however, since these projects occur offshore, they are unlikely to contribute to cumulative effects.
#7: Commercial and Residential Development	Construction impacts of other projects could contribute to localized and temporary increased turbidity levels if actions occur concurrently. Any resultant changes to boat traffic could also contribute to listed species impacts.	Inshore pipeline construction has the potential to contribute to localized and temporary listed species impacts if actions occur concurrently. Inshore ship traffic may be reduced under Alternative 2, which may decrease chances of additional impacts.
#8: Desalination Facilities	During extreme drought conditions, there is a possibility that brine discharges could contribute to hydrosalinity gradient impacts in conjunction with channel deepening, which could contribute cumulative impacts on listed species.	If inshore pipeline segment construction occurs concurrently, then temporary and localized cumulative impacts could result from noise and light.
#9: Ecosystem Restoration	Construction impacts of other projects could contribute to localized and temporary listed species impacts if actions occur concurrently; however, long-term improvements to listed species resources could result from restoration actions and may decrease adverse cumulative impacts.	Alternative 2 or 3 are unlikely to contribute beneficially or adversely as no restoration activities are included with these alternatives. Inshore pipeline construction has the potential to contribute to localized and temporary listed species impacts if actions occur concurrently.

5.4.11 Migratory Birds

The preferred action would result in temporary and localized turbidity from dredging. Turbidity increases can decrease avian foraging success, and cause birds to relocate. Migratory birds may forage further from their nesting location or roosting area for resources during dredged material placement. Construction activities and noise near tidal flats and beach areas can temporarily displace shorebirds, gulls and terns, and wading birds. Turbidity and noise would be temporary and localized and would not extend far beyond the area of disturbance. The preferred action can also carry the potential risk of oil spills, which can negatively impact shorebirds and their habitats.

Migratory birds would benefit from dredged material placement at the placement actions targeting BU from expanded bird islands and beach nourishment. The proposed BU PAs along the CCSC would increase nesting habitat for species such Least Terns and Black Skimmers, as well as foraging and wintering habitat for migratory species such as plovers, sandpipers, and curlews that would utilize nourished tidal flats and beaches from nearshore PAs.

Past, present, and reasonably foreseeable actions with dredging or construction activities, and resultant ship traffic, can potentially impact migratory birds. Noise and light during construction can also result in impacts to these species. Various infrastructure can convert potential avian habitat. Ecosystem restoration initiatives typically yield beneficial effects on migratory birds. Table 5-13 summarizes the potential cumulative effects on migratory birds.

Table 5-13
Summary of Potential Cumulative Effects on Migratory Birds

CEA Project Group	Potential Cumulative Impact (Preferred Action)	Potential Cumulative Impact (Alternatives 2 and 3)
#1: Offshore Oil and Gas Terminals	Pipeline construction has the potential to contribute to localized and temporary impacts to migratory birds if actions occur concurrently. Inshore ship traffic may be reduced which may decrease contribution to avian impacts. If operational, these projects have some chance of spill impacts.	Offshore construction has the potential to contribute to localized and temporary impacts to migratory birds if actions occur concurrently. Inshore ship traffic may be reduced under Alternative 2, which may decrease chances of additional impacts. There is an increased risk of cumulative impacts in offshore extents since these projects are in Gulf Waters. Offshore structures may serve as refugia for fish in the Gulf which could yield beneficial cumulative effects on avian foraging opportunities. If operational, these projects have some chance of spill impacts.
#2: Onshore Storage and Fabrication Terminals	Construction impacts of other projects could contribute to localized and temporary migratory bird impacts if actions occur concurrently. Any resultant changes to ship traffic could also contribute to avian impacts. If operational, these projects have some chance of spill impacts.	Inshore pipeline construction has the potential to contribute to localized and temporary migratory bird impacts if actions occur concurrently. If operational, these projects have some chance of spill impacts.
#3: Utility, Gas, Petroleum Pipelines	If construction occurs concurrently, then temporary and localized cumulative impacts could result; however, HDD technology can avoid and minimize impacts. If operational, these projects have some chance of spill impacts.	If inshore pipeline segment construction occurs concurrently, then temporary and localized cumulative impacts could result; however, since these projects occur offshore, they are unlikely to contribute to cumulative effects. Also, HDD technology can avoid and minimize impacts. If operational, these projects have some chance of spill impacts.
#4: Maintenance and Navigation Dredging	Construction impacts of other projects could contribute to localized and temporary migratory bird impacts if actions occur concurrently. Any resultant changes to ship traffic could also contribute to avian impacts. Any BU associated with these projects could yield beneficial cumulative effects in conjunction with the preferred action.	Inshore pipeline construction has the potential to contribute to localized and temporary avian impacts if actions occur concurrently. Inshore ship traffic may be reduced under Alternative 2, which may decrease chances of additional impacts.
#5: Bulkheads, Breakwaters, Boat Ramps, and Marinas	Construction impacts of other projects could contribute to migratory bird impacts if actions occur concurrently. Any resultant changes to boat traffic could also contribute to disturbances to migratory birds.	Inshore pipeline construction has the potential to contribute to localized and temporary migratory bird impacts if actions occur concurrently.

CEA Project Group	Potential Cumulative Impact (Preferred Action)	Potential Cumulative Impact (Alternatives 2 and 3)
#6: Transportation Projects	If construction occurs concurrently, then temporary and localized cumulative impacts could result. If these projects result in direct habitat impacts, then that could contribute cumulative effects.	If inshore pipeline segment construction occurs concurrently, then temporary and localized cumulative impacts could result; however, since these projects occur offshore, they are unlikely to contribute to cumulative effects.
#7: Commercial and Residential Development	Construction impacts of other projects could contribute to migratory bird impacts if actions occur concurrently. Any resultant changes to boat traffic could also contribute to disturbances to migratory birds.	Inshore pipeline construction has the potential to contribute to localized and temporary migratory bird impacts if actions occur concurrently.
#8: Desalination Facilities	During extreme drought conditions, there is a possibility that brine discharges could contribute to hydrosalinity gradient impacts in conjunction with channel deepening, which could contribute cumulative impacts on birds.	If inshore pipeline segment construction occurs concurrently, then temporary and localized cumulative impacts could result from noise and light.
#9: Ecosystem Restoration	Construction impacts of other projects could contribute to localized and temporary wildlife impacts if actions occur concurrently; however, long-term improvements to migratory bird habitat could result from restoration actions and may decrease adverse cumulative impacts.	Alternative 2 or 3 are unlikely to contribute beneficially or adversely as no restoration activities are included with these alternatives. Inshore pipeline construction has the potential to contribute to localized and temporary migratory bird impacts if actions occur concurrently.

5.4.12 Cultural Resources

Generally, dredging associated with the preferred action (channel deepening) could damage or destroy any archaeological cultural resources (e.g., shipwrecks, inundated terrestrial pre-contact sites, etc.). Incidental impacts could also be expected from temporary anchoring and other activities associated with the channel dredging. Following construction channel erosion and slumping could damage features as well. However, the sediment proposed for dredging is not likely to have archaeological resources because these sediments were deposited after the landform inundation.

Placement activities could involve a range of offshore (dredges, barges, tugs, etc.) and onshore (cranes, trucks, dozers, compactors, etc.) equipment whose weight and actions can impact cultural resources. Placement could also alter a historic-age site’s original setting. Placement activities may also benefit cultural resources in the vicinity protecting them from erosion and/or looting by covering them. The proposed nearshore berms (B1–B9) may help protect cultural resources in un-surveyed areas along the San José and Mustang Island shorelines through longshore transport (vs. mechanical means).

There are three recorded archaeological Historic Properties within 250 feet of the proposed channel dredging activity components: 41NU252, 41NU264, and 41NU292 (prior investigations concluded that 41NU292 was likely a vessel hull and that 41NU264 is associated wreckage). These sites are all historic-age shipwrecks associated with the region's maritime history. 41NU252 is a listed SAL and has been determined to be eligible for listing in the NRHP; prior investigations noted that 41NU252 would be negatively impacted by dredging activity. Regarding 41NU264/41NU292, NRHP eligibility status was undetermined; however, it is a listed SAL, suggesting it is a resource of some significance. The site is located at least 280 feet from the channel, immediately off the seaward end of the south jetty, and may not be directly impacted by dredging.

There are two recorded non-archaeological Historic Properties in the vicinity of the proposed channel dredging corridor: the Tarpon Inn (NR Reference #79003002) and the Aransas Pass Light Station District (National Register Reference # 77001423). Because the preferred project would take place under water and in a corridor that has historically been used for merchant vessel traffic, the proposed channel dredging activities are not likely to affect the Tarpon Inn's historical setting or its sense of place. Also, no dredging is proposed that is likely to alter the site, or the bayou. None of the proposed placement sites are likely to physically affect either the Tarpon Inn or the Aransas Pass Light Station Historic Properties. The Tarpon Inn and Aransas Pass Light Station are not likely to be impacted because they are more than a half mile from the nearest PA (0.75 miles and 0.55 miles, respectively) and the dredge placement activities would restore conditions that had relatively recently washed away; they are not altering a historic setting.

Placement actions, specifically beach nourishment and nearshore berms on Mustang Island and San José Island, could impact two cultural sites: 41NU92 and 41NU153. No data are available online regarding 41NU92. Site 41NU153 was first recorded in 1974 as an anti-torpedo raft that was lost in 1865. Archaeologists noted bent rusty spikes protruding from the sand and charcoal and burned plants in the site vicinity. The site record states that the remnants are occasionally exposed and reburied under dunes from time to time, but the site's exact location is not known.

Site 41AS91 is a 388-acre historic-age site found northeast of the pass and immediately west of the SJI boundary. Heavy equipment used for the SJI dredge placement activities could damage components of 41AS91 or the dredge material itself could displace some part of the site. Underwater archaeologist Robert Gearhart recorded Site 41AS91 during a spring 2019 survey for a proposed SPM project in the Gulf off San José Island. The site is mapped within and just west of the nearshore berm B1. The 19th-century shipwreck site is completely submerged and lies outside the surf zone. Because it is in a low-dynamic environment, the hull is still approximately 75 percent intact. Gearhart recommended the site for avoidance; however, more detailed investigations would be needed to verify the site's eligibility for inclusion in the NRHP (THC Atlas, 2022).

Past, present, and reasonably foreseeable actions with dredging or construction activities, and resultant ship traffic erosion, can potentially impact cultural resources. Impacts can result directly from dredging, heavy construction equipment, and the weight of placed sediments. Indirect impacts could result from actions that induce erosion that can expose and degrade buried cultural resources. Table 5-14 summarizes the potential cumulative effects on cultural resources. Pipelines and desalination facilities are unlikely to contribute to cumulative impacts to cultural resources.

Table 5-14
Summary of Potential Cumulative Effects on Cultural Resources

CEA Project Group	Potential Cumulative Impact (Preferred Action)	Potential Cumulative Impact (Alternatives 2 and 3)
#1: Offshore Oil and Gas Terminals	Pipeline construction has the potential to contribute to cultural resource impacts. Inshore ship traffic may be reduced which may decrease erosion that can affect cultural resources.	Inshore pipeline construction has the potential to directly impact cultural resources. Inshore ship traffic may be reduced under Alternative 2, which may decrease chances of additional impacts from erosion. Offshore infrastructure construction would have a minor possibility of impacting shipwrecks or other nautical cultural resources.
#2: Onshore Storage and Fabrication Terminals	Construction impacts of other projects could contribute to cultural resource impacts. Any resultant changes to ship traffic could also contribute to cultural resource impacts.	Inshore pipeline construction has the potential to directly impact cultural resources. Inshore ship traffic may be reduced under Alternative 2, which may decrease chances of additional impacts from erosion. Construction impacts of other projects could contribute to cultural resource impacts, but offshore infrastructure construction would have a minor possibility of impacting shipwrecks or other nautical cultural resources.
#4: Maintenance and Navigation Dredging	Construction impacts of other projects could contribute to cultural resource impacts. Any resultant changes to ship traffic could also contribute to cultural resource impacts through erosion. Any BU associated with these projects could yield beneficial cumulative effects in conjunction with the preferred action's BU by potentially protecting cultural resources.	Inshore pipeline construction has the potential to directly impact cultural resources. Inshore ship traffic may be reduced under Alternative 2, which may decrease chances of additional impacts from erosion. Construction impacts of other projects could contribute to cultural resource impacts, but offshore infrastructure construction would have a minor possibility of impacting shipwrecks or other nautical cultural resources.
#5: Bulkheads, Breakwaters, Boat Ramps, and Marinas	Construction impacts of other projects could contribute to cultural resource impacts. Any resultant changes to boat traffic could also contribute to cultural resource impacts through erosion.	Inshore pipeline construction has the potential to directly impact cultural resources. Inshore ship traffic may be reduced under Alternative 2, which may decrease chances of additional impacts from erosion. Construction impacts of other projects could contribute to cultural resource impacts, but offshore infrastructure construction would have a minor possibility of impacting shipwrecks or other nautical cultural resources.

CEA Project Group	Potential Cumulative Impact (Preferred Action)	Potential Cumulative Impact (Alternatives 2 and 3)
#6: Transportation Projects	If these projects result in direct cultural resource impacts, then that could contribute cumulative effects.	Inshore pipeline construction has the potential to directly impact cultural resources. Inshore ship traffic may be reduced under Alternative 2, which may decrease chances of additional impacts from erosion. Construction impacts of other projects could contribute to cultural resource impacts, but offshore infrastructure construction would have a minor possibility of impacting shipwrecks or other nautical cultural resources.
#7: Commercial and Residential Development	Construction impacts of other projects could contribute to cultural resource impacts. Any resultant changes to boat traffic could also contribute to cultural resource impacts through erosion.	Inshore pipeline construction has the potential to directly impact cultural resources. Inshore ship traffic may be reduced under Alternative 2, which may decrease chances of additional impacts from erosion. Construction impacts of other projects could contribute to cultural resource impacts, but offshore infrastructure construction would have a minor possibility of impacting shipwrecks or other nautical cultural resources.
#9: Ecosystem Restoration	Construction impacts of other projects could contribute to cultural resource impacts; however, these projects could yield beneficial cumulative effects in conjunction with the preferred action's BU by potentially protecting cultural resources.	Alternative 2 or 3 are unlikely to contribute beneficially or adversely as no restoration activities are included with these alternatives. Inshore pipeline construction has the potential to contribute to cultural resource impacts.

5.4.13 Socioeconomics

The preferred action would occur in locations within and adjacent to census tracts with high and low minority populations, relatively high low-income populations, and census tracts that do not have relatively high low-income populations. Impacts to these census tracts are expected to be primarily adverse in the short-term and both adverse and beneficial in the long-term. The preferred action would provide employment opportunities for low-income households. Low-income and minority communities may have limited access to health care or a relatively higher level of chronic health conditions that make them more susceptible to adverse impacts. Additional heightened disease susceptibility and health disparities in these communities add to this effect. The fact that individuals in these communities may not have the financial, social, or cultural resources to adapt to changes in air quality, noise, or viewshed impacts that non-minority or higher income communities have also add to this effect. Additionally, construction of the preferred action may temporarily impact shoreline fishing, such as the fishing pier and several granite jetties used for fishing at Robert's Point Park and the fishing pier at Magee Beach Park in Port Aransas; thus, potentially resulting in disproportionate and adverse impacts to minority or low-income individuals that depend on fish for consumption. It is expected that short-term adverse impacts would be mitigated to the extent practicable (such as with best management practices) and long-term impacts would be beneficial to low-income and minority populations in the project area (by restoring habitat and eroded shorelines).

Past, present, and reasonably foreseeable actions all have the potential to result in both adverse and beneficial impacts to socioeconomics of the region. Many of these projects can create employment opportunities but some projects (such as industrial projects) can also contribute to noise and air impacts. For those projects located near low income or minority populations, they can be disproportionately affected. Table 5-15 summarizes the potential cumulative effects on socioeconomics.

Table 5-15
Summary of Potential Cumulative Effects on Socioeconomics

CEA Project Group	Potential Cumulative Impact (Preferred Action)	Potential Cumulative Impact (Alternatives 2 and 3)
#1: Offshore Oil and Gas Terminals	These projects have the potential to create employment opportunities in the region. Air and noise impacts of offshore projects are unlikely to contribute to cumulative impacts.	These projects have the potential to create employment opportunities in the region. Air and noise impacts of offshore projects are unlikely to contribute to cumulative impacts.
#2: Onshore Storage and Fabrication Terminals	These projects have the potential to create employment opportunities in the region. Air and noise impacts of these projects could contribute disproportionate cumulative impacts to low-income or minority populations if co-located near applicable census tracts.	These projects have the potential to create employment opportunities in the region. Air and noise impacts of offshore projects are unlikely to contribute to cumulative impacts.
#3: Utility, Gas, Petroleum Pipelines	These projects have the potential to create employment opportunities in the region. Air and noise impacts of these projects could contribute disproportionate cumulative impacts to low-income or minority populations if co-located near applicable census tracts. Similarly, concurrent temporary and localized turbidity increases could impact subsistence fishing.	These projects have the potential to create employment opportunities in the region. Air and noise impacts of offshore projects are unlikely to contribute to cumulative impacts. Similarly, concurrent temporary and localized turbidity increases could impact subsistence fishing.
#4: Maintenance and Navigation Dredging	These projects have the potential to create employment opportunities in the region. Temporary and localized turbidity increases could impact subsistence fishing.	These projects have the potential to create employment opportunities in the region. Air and noise impacts of offshore projects are unlikely to contribute to cumulative impacts.
#5: Bulkheads, Breakwaters, Boat Ramps, and Marinas	These projects have the potential to create employment opportunities in the region.	These projects have the potential to create employment opportunities in the region. Air and noise impacts of offshore projects are unlikely to contribute to cumulative impacts.

CEA Project Group	Potential Cumulative Impact (Preferred Action)	Potential Cumulative Impact (Alternatives 2 and 3)
#6: Transportation Projects	These projects have the potential to create employment opportunities in the region. Air and noise impacts of these projects could contribute disproportionate cumulative impacts to low-income or minority populations if co-located near applicable census tracts.	These projects have the potential to create employment opportunities in the region. Air and noise impacts of offshore projects are unlikely to contribute to cumulative impacts.
#7: Commercial and Residential Development	These projects have the potential to create employment opportunities in the region.	These projects have the potential to create employment opportunities in the region. Air and noise impacts of offshore projects are unlikely to contribute to cumulative impacts.
#8: Desalination Facilities	These projects have the potential to create employment opportunities in the region. Air and noise impacts of these projects could contribute disproportionate cumulative impacts to low-income or minority populations if co-located near applicable census tracts.	These projects have the potential to create employment opportunities in the region. Air and noise impacts of offshore projects are unlikely to contribute to cumulative impacts.
#9: Ecosystem Restoration	These projects have the potential to create employment opportunities in the region and could improve subsistence fishing.	These projects have the potential to create employment opportunities in the region.

5.4.14 Navigation

Dredging and placement activities during construction would have localized and temporary impacts to navigation that are expected to be minor. During the operations phase of the project, more fully loaded VLCCs would be capable of navigating the deeper channel which would lead to a decrease in the number of vessels crossing the ferry path compared to the existing conditions. The range of vessel traffic reduction would be between 175 and 290 Suezmax transits at Harbor Island, in accordance with the No-Action Alternative estimations. If the Ingleside terminals arrange for VLCCs to top off at the Harbor Island terminals or an offshore SPM, then Ingleside reverse lightering traffic would also be eliminated. The range of vessel traffic reduction would be between 140 and 230 Suezmax transits at Ingleside.

Navigation safety would be addressed by limiting the channel to one-way traffic when a VLCC would fill at capable terminals. Fully laden VLCCs would require the appropriate size and numbers of tugboats to assist maneuvering. These safety measures would impact other users of the channel, but some level of these types of impacts already occur when VLCCs half-fill at terminals along the La Quinta Channel and Ingleside.

Modeling was performed to assess vessel wakes, ship navigation safety, propeller scouring, and underkeel clearance with the proposed CDP. Vessel wake analysis indicated minimal impact to shoreline erosion along the channel. Ship simulations indicated that the proposed CDP configurations would be acceptable to safely operate fully loaded VLCC originating from the Harbor Island terminal; it was determined that five 120 MTBP rotor tugs would provide higher margins of safety. Propeller scour assessment indicates the potential for impacts was either small or unlikely; the exception was along a shoreline wall of Harbor Island at the confluence of the CCSC and the Lydia Ann Channel, where there is larger scour potential (which can be mitigated with armoring). The dynamic underkeel clearance assessment indicates that only under extreme conditions of low-tide, significant wave heights and periods greater than 12 feet and 16 seconds, respectively, will the Outer Channel underkeel clearance not the meet the 2 feet safety criterion.

When those safety measures are initiated near Harbor Island and Port Aransas, they may have effects on the Port Aransas SH 361 Ferry operations and users, including during times of high visitation and tourism (such as spring break, weekends, or summer months). Impact to the ferry operation by docking activities at Harbor Island are functions of the terminal projects that are being planned independently. The duration of typical VLCC docking operations at other berths within CCSC are estimated at 30 minutes. This would represent the interruption of two cycles of ferry crossings. It is expected that the terminal projects would coordinate with TxDOT to account for VLCC berthing operations.

Past, present, and reasonably foreseeable actions all have the potential to result in both adverse and beneficial impacts to navigation. Offshore terminals can reduce the number of ships entering CCSC. Onshore facilities and terminals could increase ship traffic due to increasing commerce or product demand. Dredging projects can reduce navigation risks but may also accommodate more traffic. Marinas, developments, transportation projects all have the potential to increase boat traffic and thus add to navigation risks. Restoration projects yield benefits to navigation and vice versa. Restoration benefits are often dependent upon dredging actions, while the restoration actions provide opportunities for cost effective placement. Table 5-16 summarizes the potential cumulative effects on navigation.

Table 5-16

Summary of Potential Cumulative Effects on Navigation

CEA Project Group	Potential Cumulative Impact (Preferred Action)	Potential Cumulative Impact (Alternatives 2 and 3)
#1: Offshore Oil and Gas Terminals	Inshore pipeline construction has the potential to contribute to localized and temporary navigation impacts if actions occur concurrently. Inshore ship traffic may be reduced which may be beneficial to navigation.	Inshore pipeline construction has the potential to contribute to localized and temporary navigation impacts if actions occur concurrently. Inshore ship traffic may be reduced under Alternative 2, which may be beneficial to navigation.
#2: Onshore Storage and Fabrication Terminals	Construction impacts of other projects could contribute to localized and temporary navigation impacts if actions occur concurrently. Any resultant changes to ship traffic from these projects could also contribute to navigation impacts. VLCCs entering CCSC may impact ship traffic associated with these facilities.	Inshore pipeline construction has the potential to contribute to localized and temporary navigation impacts if actions occur concurrently. Inshore ship traffic may be reduced under Alternative 2, which may be beneficial to navigation.

CEA Project Group	Potential Cumulative Impact (Preferred Action)	Potential Cumulative Impact (Alternatives 2 and 3)
#4: Maintenance and Navigation Dredging	Construction impacts of other projects could contribute to localized and temporary navigation impacts if actions occur concurrently. Any resultant changes to ship traffic from these projects could also contribute to navigation impacts. VLCCs entering CCSC may impact ship or boat traffic associated with these projects.	Inshore pipeline construction has the potential to contribute to localized and temporary navigation impacts if actions occur concurrently. Inshore ship traffic may be reduced under Alternative 2, which may be beneficial to navigation.
#5: Bulkheads, Breakwaters, Boat Ramps, and Marinas	Construction impacts of other projects could contribute to localized and temporary navigation impacts if actions occur concurrently. Any resultant changes to boat or ship traffic from these projects could also contribute to navigation impacts. VLCCs entering CCSC may impact ship or boat traffic associated with these projects.	Inshore pipeline construction has the potential to contribute to localized and temporary navigation impacts if actions occur concurrently. Inshore ship traffic may be reduced under Alternative 2, which may be beneficial to navigation.
#6: Transportation Projects	If construction occurs concurrently, then temporary and localized cumulative impacts could result. If these project result in direct wetland impacts, then that could contribute cumulative effects.	If inshore pipeline segment construction occurs concurrently, then temporary and localized cumulative impacts could result; however, since these projects occur offshore, they are unlikely to contribute to cumulative effects.
#7: Commercial and Residential Development	Construction impacts of other projects could contribute to localized and temporary navigation impacts if actions occur concurrently. Any resultant changes to boat or ship traffic from these projects could also contribute to navigation impacts. VLCCs entering CCSC may impact ship or boat traffic associated with these projects.	Inshore pipeline construction has the potential to contribute to localized and temporary navigation impacts if actions occur concurrently. Inshore ship traffic may be reduced under Alternative 2, which may decrease chances of additional impacts.
#9: Ecosystem Restoration	Construction impacts of other projects could contribute to localized and temporary navigation impacts if actions occur concurrently. Restoration projects can be beneficial to navigation as they can provide placement opportunities.	Alternative 2 or 3 are unlikely to contribute beneficially or adversely as no restoration activities are included with these alternatives. Inshore ship traffic may be reduced under Alternative 2, which may decrease chances of additional impacts.

5.5 CONCLUSION

Impacts of past, present, and reasonably foreseeable actions in the study area were described in general and qualitative terms for this CEA. Most effects from projects are assumed to occur primarily during construction, and those impacts are typically localized, temporary, and minor. Some projects are also assumed to have permanent impacts associated with their physical footprint, noise, air emissions, or induced traffic and growth, for example. The preferred action's impacts could contribute to cumulative effects where they overlap with impacts of past, present, and reasonably foreseeable actions. For example, comparing the Applicant's Preferred Alternative with the No-Action indicates a tidal amplitude increase at the Inner

Channel near Port Aransas of up to 15 percent increase (Baird, 2022c). When considering the impacts of tidal amplitude of the No-Action condition (–54 feet MLLW authorized depth) over previous conditions (–47 feet MLLW authorized depth), modeling indicates up to 18 percent at the Inner Channel. These modeling results indicate that the preferred action would result in a direct cumulative increase in tidal range, particularly at the Inner Channel near Port Aransas where it could be as high as 36 percent (see Table 5-3).

Despite potential temporary and permanent impacts associated with past, present, and reasonably foreseeable actions, it is also assumed that these projects were or would be implemented in compliance with applicable laws and regulations that exist to avoid and minimize project impacts. Last, beneficial cumulative impacts may also be expected when considering the preferred action's PAs and combined with restoration actions that are planned within the study area by State and Federal agencies, non-governmental organizations, and private entities.

Mitigative efforts or actions that decrease risks of potential cumulative effects of the Applicant's Preferred Alternative include:

- Agency and stakeholder coordination
- Implementation of one-way channel traffic
- Slower speeds requirements
- Appropriate tugboat assistance requirements
- Placement actions targeting BU
- Avoidance and minimization efforts
- Shoreline armoring

6.0 MITIGATION

The PCCA was required to propose a compensatory mitigation plan compliant with 33 CFR 332 Compensatory Mitigation for Losses of Aquatic Resources. A compensatory mitigation plan was prepared by the Applicant for impacts to wetlands, SAV, and oysters (Triton Environmental Solutions, 2023). The following section summarizes the mitigation plan, see Appendix K for more detailed information.

The proposed channel of the Applicant's Preferred Alternative would not directly impact oyster reef, seagrass, wetlands, or other special aquatic sites (e.g., mudflats). However, the proposed dredged material placement would involve areas of wetlands, seagrass, and oysters, and minor areas of existing PAs previously identified as tidal flats (see Section 4.2.1). These impacts would occur over the course of constructing BU sites that would restore and enhance estuarine aquatic resources, including wetlands and seagrass or restore eroded shorelines that protect large areas of these resources. Table 6-1 summarizes the proposed impacts by BU site:

Table 6-1
Summary of Proposed Impacts by BU Site (acres)

Site	Footprint	Open Water[1]	Seagrass[2]	Oysters[3]	Flats/ Beach[4]	Estuarine[5]	Palustrine[6]
SS1	297.41	219.45	0.01	0	34.64	3.92	21.04
SS2	45.21	13.74	0	0	24.20	1.25	11.25
PA4	170.79	42.14	3.46	0	2.80	0.75	41.75
HI-E	138.73	13.12	3.41	0.10	23.21	10.69	48.42
SJI	441.23	163.29	0	0	199.01	0	0
MI	362.21	205.58	0	0	124.11	0	0
Total	1,455.58	657.32	6.88	0.10	407.97	16.61	122.46

[1] Open Water (E1UBL M1UBL, M2USN)

[2] Seagrass (E1ABL)

[3] Oysters (E1ABL)

[4] Flats (E2ABN, E2EM1N(1) E2USN, UPL [tidal flats above the high tide line were classified as upland])

[5] Estuarine (E2M1P, E2SS3N)

[6] Palustrine (PEM1C(1))

The CDP will permanently impact 44.63 acres of special aquatic sites requiring mitigation to offset these permanent losses. These include 21.04 acres of palustrine wetlands and 23.59 acres of EFH including 16.61 acres estuarine wetlands, 6.88 acres of SAV, and 0.10 acres of live oysters. The PCCA proposes to utilize SS1 to construct their PRM site. All actions associated with the PRM site are to be conducted in accordance with the 2008 Final Compensatory Mitigation Rule (33 CFR 332.3).

The objective is restoration through the reestablishment of 32.94 acres of estuarine wetlands, 42.08 acres palustrine wetlands, 6.88 acres of SAV, and 0.10 acres of live oysters by returning historic functions to a degraded aquatic resource. The proposed mitigation site is 75.12 acres and would be contained within the SS1 footprint. The site would be surrounded by dredged material on three sides and connect to the bayward edge of Brown and Root Flats to the north, which would provide a critical hydrologic connection.

Table 6-2 presents a summary of proposed mitigation.

Table 6-2
Summary of Proposed Mitigation (acres)

Resource Feature	Direct Impacts	Mitigation Ratio	Mitigation Reestablishment
Palustrine Wetlands	21.04	2:1	42.08
Estuarine Wetlands	16.61	N/A[1]	32.94
Seagrass	6.88	1:1	6.88[2]
Live Oyster	0.10	1:1	0.10[3]
		Total	75.12[4]

[1] Estuarine mitigation determined by Hydrogeomorphic modeling.

[2] Seagrass acreage contained in tidal channels within the 32.94-acre estuarine mitigation area.

[3] Live oyster will be placed immediately adjacent to the PRMs boundary

[4] Total acres of special aquatic sites restored through PRM.

6.1 PROPOSED WETLAND MITIGATION

The Applicant proposes to beneficially place dredged material from the project across approximately 1,455.58 acres. Placement of material at SS1 would impact 3.92 acres of estuarine wetlands and 21.04 acres of palustrine wetlands. These wetlands would likely erode over time if the proposed placement does not occur. Placement of material at SS2 would impact 1.25 acres of estuarine wetlands and 11.25 acres of palustrine wetlands. The placement of material would restore the site to pre-Harvey elevations and contours. Placement of material at PA4 would impact 0.75 acres of estuarine wetlands and 41.75 acres of palustrine wetlands. Since these wetlands are in the confines of a former DMPA, they are considered of lower value than naturally occurring wetlands. The BU placement at PA4 would restore the shoreline along with PA4 and return the site’s functionality as a DMPA. Placement of material at HI-E would result in impacting 10.69 acres of estuarine wetlands and 48.42 acres of palustrine wetlands. The BU placement at HI-E would restore the shoreline along with PA4 and return the site’s functionality as a DMPA. The restoration of degraded DMPAs represents a reduction in project impact compared to the construction of new DMPAs. Placement of material at MI would not result in any impacts to wetlands. The BU placement at MI and SJI would nourish eroding beaches.

Altogether the BU placement across the six sites would impact 139.07 acres of wetlands. The PCCA proposes to utilize SS1 to construct their PRM site. All actions associated with the PRM site are to be conducted in accordance with the 2008 Final Compensatory Mitigation Rule (33 CFR 332.3).

The USACE Hydrogeomorphic model for the Northwest Gulf of Mexico Tidal Fringe Wetlands was applied to calculate compensation requirements for estuarine wetlands. Based on this analysis, the PCCA proposes to construct a 32.94 acre estuarine mitigation site within SS1 to fully compensate for direct estuarine wetland impacts. Additionally, the site would provide excess functional capacity units providing ecological lift as well as offset to temporal loss and potential cumulative effects.

The mitigation objective is restoration through the reestablishment of 32.94 acres of estuarine wetlands, 42.08 acres palustrine wetlands, 6.88 acres of SAV, and 0.10 acres of live oysters by returning historic functions to a degraded aquatic resource. The proposed mitigation site is 75.12 acres and would be contained within the SS1 footprint. The site would be surrounded by dredged material on three sides and connect to the bayward edge of Brown and Root Flats to the north, which would provide a critical hydrologic connection.

The PCCA proposed a 2:1 mitigation ratio for impacts to palustrine wetlands to ensure no net loss of wetland function. To compensate for 21.04 acres of unavoidable impacts, approximately 42.08 acres of palustrine wetlands would be restored.

6.2 PROPOSED SEAGRASS AND OYSTER MITIGATION

Through the BU placement across the six sites, the Applicant estimates the project would impact 6.88 acres of seagrass. Placement of material at PA 4, HI-E, and SS1 would impact 3.46 acres, 3.41 acres, and 0.01 acres of seagrass respectively. These impacts are necessary to restore the former DMPAs to a usable capacity as opposed to the creation of new DMPAs. Any new DMPA within the same distance from the preferred project as PA4 and HI-E would result in significantly more impacts to seagrass than the preferred project. Additionally, since the Applicant designed SS1 and PA4 to protect the Redfish Bay, approximately 2,400 acres of seagrass, the project benefits to regional seagrass, outweigh the impacts.

PCCA would relocate 6.88 acres of impacted seagrass from PA4, HI-E, and SS1 to fully compensate for unavoidable impacts. Seagrass plantings would be within the tidal channels (8.24 acres) that would be located within the estuarine mitigation site. These would provide a beneficial hydrologic connection to the mitigation site and adjacent tributary.

PCCA would relocate 0.10 acres of live oysters impacted at HI-E to the mitigation site for reestablishment. Oysters would be relocated to the northwestern boundary of SS1. This site is adjacent to the proposed estuarine mitigation site and near a previously delineated 1.88 acre oyster reef. Elevations at this site and live oysters immediately adjacent indicates suitable habitat conditions for relocation of the oysters.

Additional information regarding the mitigation work plan, maintenance plan, performance standards, monitoring requirements, long-term and adaptive management are detailed in Appendix K.

7.0 PERMITS AND APPROVALS REQUIRED

This FEIS has been prepared to satisfy the requirements of all applicable environmental laws and regulations. It has been prepared using the CEQ NEPA regulations (40 CFR Part 1500–1508) and the USACE's Engineering Regulation 200-2-2 – *Environmental Quality: Policy and Procedures for Implementing NEPA*, 33 CFR 230. In implementing the Applicant's Preferred Alternative, the USACE would follow provisions of all applicable laws, regulations, and policies related to the preferred actions. The following sections present brief summaries of Federal environmental laws, regulations, and coordination requirements applicable to this FEIS.

7.1 NATIONAL ENVIRONMENTAL POLICY ACT

NEPA requires that all Federal agencies use a systematic, interdisciplinary approach to protect the human environment. This approach promotes the integrated use of natural and social sciences in planning and decision-making that could have an impact on the environment.

NEPA requires the preparation of an EIS for any major Federal action that could have a significant impact on the environment (42 United States Code [USC] 4321–4347). The EIS must address any adverse environmental effects that cannot be avoided or mitigated, alternatives to the preferred action, the relationship between short-term resources and long-term productivity, and irreversible and irretrievable commitments of resources. According to 40 CFR 1502.9, a supplement to either a DEIS or FEIS must be prepared if an agency makes substantial changes in the preferred action that are relevant to environmental concerns, or there are significant new circumstances or information relevant to environmental concerns and bearing on the preferred action or its impacts.

The NEPA regulations provide for the use of the NEPA process to identify and assess reasonable alternatives to preferred actions that avoid or minimize adverse effects of these actions upon the quality of the human environment. "Scoping" is used to identify the range and significance of environmental issues associated with a proposed Federal action through coordination with Federal, State, and local agencies; the general public; and any interested individuals and organizations prior to the development of an EIS. The process also identifies and eliminates, from further detailed study, issues that are not significant or have been addressed by prior environmental review.

This FEIS has been prepared in accordance with the NEPA process for Federal regulatory approval of an action that may impact the environment. Specifically, this FEIS evaluates the likely environmental consequences of the proposed alternatives, as discussed in Section 4.0 and cumulative impacts of the proposed alternatives in Section 5.0.

7.2 SECTION 404 CLEAN WATER ACT

The Federal Water Pollution Control Act of 1972, as amended in 1977 via the CWA, authorizes the EPA to regulate activities resulting in a discharge to navigable waters. Section 404 of the CWA (33 USC 1344) normally requires a USACE permit for the discharge or deposition of dredged or fill material and for the building of structures in all waters of the United States, other than incidental fallback (a term that generally refers to material falling back into waters incidentally during an activity designed to remove material, but if in doubt should be clarified during the preparation or review of a permit application). Section 404(r) of the CWA exempts from Section 404 permitting requirements the discharge of dredge or fill material as part of the construction of a Federal project specifically authorized by Congress if information on the effects of such discharge is included in an EIS pursuant to NEPA. Pursuant to the provisions of Section 404(r), the process used for completion of this project would be consistent with the guidelines described in Section 404(b)(1) of the CWA. Criteria to be considered in evaluating the alternatives include cost, technology, environmental effects, and logistics. Guidelines prepared for the evaluation of dredge and fill material also indicate that actions subject to NEPA would, in all probability, meet the requirements of the analysis of alternatives specified by Section 404(b)(1) guidelines. As part of its review, the USACE consults with other agencies, including the USFWS and SHPO.

The PCCA has identified a mix of PAs for dredged material to be generated by the proposed CDP. These PAs are located within offshore, nearshore, inshore, and upland environments, with a total placement capacity of 64.6 mcy. The preferred project is anticipated to generate a total of 46.3 mcy of dredged material. Approximately 23.8 mcy of dredged material would be placed within the nearshore, in-shore, and upland PAs, which are governed by this regulation. These PAs include BU features for nearshore berms, beach renourishment, shoreline stabilization, and ecological habitats. The remaining volume of dredged material would be placed offshore within the Corpus Christi New Work ODMDS.

The requirements of the CWA apply to this study. The potential water quality impact resulting from this project are discussed in Section 3.2.5. The Section 404(b)(1) evaluation is included in Appendix O.

7.3 SECTION 401 OF THE CLEAN WATER ACT

The Federal Water Pollution Control Act of 1972, as amended in 1977 via the CWA, authorizes the EPA to regulate activities resulting in a discharge to navigable waters. Section 401 of the CWA specifies that any applicant for a Federal license or permit to conduct any activity that may discharge into navigable waters must obtain a certification that the discharge complies with applicable sections of the CWA (33 USC 1251 et seq.). Section 401 of the CWA requires certification that activities, including dredge and fill activities, would not violate water quality standards.

Pursuant to Section 401 of the Federal Water Pollution Control Act of 1972, the USACE, Galveston District will request water quality certification from the TCEQ for the preferred project.

7.4 SECTION 10 OF THE RIVERS AND HARBORS ACT

Section 10 of the Rivers and Harbors Act prohibits the construction of structures or obstructions in navigable waters without consent of Congress (33 USC 403). Structures include wharves, piers, jetties, breakwaters, bulkheads, etc. The Rivers and Harbors Act also considers any changes to the course, location, condition, or capacity of navigable waters and includes dredge and fill projects in those waters. The USACE oversees implementation of this law. Permission to install a feature or conduct dredging or filling requires the approval of the USACE Chief of Engineers.

The USACE recommended the technical analysis to support a 408 permit decision include tidal hydrodynamic, storm surge, salinity, sediment transport, nearshore berm, vessel wake, underkeel clearance, propeller scour, and tug/ship simulation analysis to evaluate the proposed alterations on the existing CCSC. The requirements of the Rivers and Harbors Act apply to this study. This EIS was prepared as part of the decision-making process regarding that permit. USACE will deny the permit, issue the permit, or issue the permit with conditions.

7.5 SECTION 14 OF THE RIVERS AND HARBORS ACT

The Rivers and Harbors Act of 1899, as amended in 1985, authorizes the USACE to approve alterations to public works projects operated and maintained by non-Federal sponsors known as Section 408 (33 USC 408). Under Section 408, any modification to a Federally maintained USACE project requires a 408 approval from the USACE Chief of Engineers. In general, the process is that the appropriate information regarding impacts to the preferred project is provided by the Applicant to the USACE for review. The USACE then makes a recommendation to USACE Headquarters regarding whether this is a minor or major modification. If minor, the USACE reviews and makes a decision on the approval and if major, the decision for approval or denial is made by USACE Headquarters. It has been determined that the CDP is a major modification, which requires a more-comprehensive review and evaluation.

To evaluate the CDP as part of the Section 408 process, proper evaluation and review of the project is required to ensure that the authorized function of existing public works projects are not impaired, Federal interests are maintained, and scope of services of the authorized purpose are not changed by the proposed alterations. The USACE recommended the technical analysis to support a 408 permit decision include tidal hydrodynamic, storm surge, salinity, sediment transport, nearshore berm, vessel wake, underkeel clearance, propeller scour, and tug/ship simulation analysis to evaluate the proposed alterations on the existing CCSC. The USACE Section 408 permit review is currently in process.

7.6 SECTION 103 OF THE MARINE PROTECTION, RESEARCH, AND SANCTUARIES ACT

Titles I and II of the MPRSA, also referred to as the Ocean Dumping Act, generally prohibits 1) transportation of material from the U.S. for the purpose of ocean dumping; 2) transportation of material from anywhere for the purpose of ocean dumping by U.S. agencies or U.S.-flagged vessels; and 3) dumping of material transported from outside the U.S. into the U.S. territorial sea. A permit is required to deviate from these prohibitions.

The EPA is charged with the development of ocean dumping criteria to be used during the evaluation of permit applications. The MPRSA provisions administered by EPA are published in Title 33 of the U.S. Code (33 USC 1401 et seq.).

Under Section 103 of the MPRSA, the USACE is authorized to "issue permits, after notice and opportunity for public hearings, for the transportation of dredged material for the purpose of dumping it into ocean waters, where the dumping will not unreasonably degrade or endanger human health, welfare, or amenities, or the marine environment, ecological systems, or economic potentialities."

The Corpus Christi New Work ODMDS was approved in 1989 and includes two areas, one for maintenance and the other for new work material. Material for this project would fall under the new work category. On September 15, 2015, the EPA modified 40 CFR Part 228 to allow other entities besides the USACE to seek permit approval by the EPA to dispose of dredged material into ocean waters pursuant to the MPRSA (Ocean Dumping Regulations). It is under this regulation that the PCCA is requesting the new work material dredged from the proposed CDP dredge footprint be approved for disposal at the Corpus Christi New Work ODMDS. PCCA is requesting to place a maximum of 22.5 mcy of new work material generated from the deepening of the Outer Channel Reach offshore in the Corpus Christi New Work ODMDS. New work material sediments have been tested according to the July 2021 Sampling and Analysis Plan that was approved by the EPA to ensure the dredge material is suitable for disposal in the Corpus Christi New Work ODMDS (Appendix J). All material transported for ocean disposal would have to meet the EPA's criteria for disposal into the Corpus Christi New Work ODMDS which considers the following: 1) the need for dumping; 2) the environmental impact of the dumping, including the effect of dumping on marine ecosystems, shorelines and beaches; the effect of the dumping on esthetic, recreational or economic values; 3) the adverse effect of dumping on other uses of the ocean including navigation, scientific study, fishing and resource exploitation activities; and 4) land-based alternatives to ocean dumping. MPRSA permits are subject to EPA review and concurrence.

The USACE reviewed the sediment testing reports from the Applicant and concluded that the appropriate criteria for evaluating the disposal of the maintenance dredged material into the New Work ODMDS was utilized and the material is suitable or ocean disposal. The USACE requested concurrence from EPA on the suitability of the material in a letter dated November 27, 2023 (see Appendix B8). The EPA reviewed the information provided by the USACE and concurred with the determination, concluding that the work described complies with the applicable subparts of 40 CFR Parts 225-228. Regarding concurrence on the suitability for ocean disposal of maintenance material from the Federal navigation channel, CCSC, and CDP, new physical, chemical and biological testing would be needed on a five-year period. The period starts from the suitability determination request date, and therefore, new testing will be required for Corpus

Christi prior to maintenance dredging planned for fiscal year 2028 (see EPA letter dated February 7, 2024, Appendix B8).

Title III of the MPRSA, also referred to the National Marine Sanctuaries Act, allows the Secretary of Commerce to designate any discrete area of the marine environment as a National Marine Sanctuary if certain conditions are met regarding the site's significance, existing State and Federal protections, and size and nature (16 USC 1431 et seq.). The National Marine Sanctuaries Act stipulates that if a Federal action is likely to destroy, cause the loss of, or injure a sanctuary resource, the Secretary must recommend reasonable and prudent alternatives that can be used by the agency, in implementing the action that will protect sanctuary resources. No National Marine Sanctuaries are located near the project area; therefore, the requirements of the act do not apply.

7.7 NATIONAL HISTORIC PRESERVATION ACT OF 1966

Compliance with Section 106 of the National Historic Preservation Act of 1966, as amended (54 USC § 306108), requires the consideration of effects of the undertaking on all historic properties in the project area and development of mitigation measures for those adversely affected properties in coordination with the SHPO, Native American Tribes, and the Advisory Council on Historic Preservation. Based on the USACEs initial review of the Applicant's permit application, it was determined that the proposed CDP has the potential to adversely affect historic properties. Coordination with the Texas SHPO regarding cultural resources was completed in May 2023 (see Appendix B8).

7.8 SECTION 7 OF THE ENDANGERED SPECIES ACT

The ESA, as amended, establishes a national policy designed to protect and conserve threatened and endangered species and the ecosystems upon which they depend (16 USC 1531–1544). The ESA is administered by the Department of the Interior, through the USFWS, and by the U.S. Department of Commerce, through the NMFS. Section 7 of the ESA specifies that any agency that proposes a Federal action that could jeopardize the "continued existence of any endangered species or threatened species or result in the destruction or adverse modification of habitat of such species" (16 USC 1536 Section 7(a)(2)) must participate in the interagency cooperation and consultation process.

A Final Biological Assessment was prepared describing the study area, Federally-listed threatened and endangered species of potential occurrence in the study area as identified by the NMFS and USFWS, and potential impacts of the preferred project on these protected species (Appendix D1). The preferred project was reviewed by the USFWS and the NMFS to determine compliance with the ESA.

The NMFS issued Biological Opinion on the preferred action in December 2022 (Appendix D2). NMFS concluded that the preferred action is likely to adversely affect but is not likely to jeopardize the continued existence of Green (North Atlantic and South Atlantic Distinct Population Segments), Loggerhead (Northwest Atlantic DPS), and Kemp's Ridley sea turtles, as well as giant manta ray. An Incidental Take

Statement was provided with this Biological Opinion which describes Reasonable and Prudent Measures NMFS consider necessary or appropriate to minimize the impact of incidental take associated with this action. The Incidental Take Statement specifies Terms and Conditions, including monitoring and reporting requirements which the Applicant must comply.

The USFWS issued a Conference and Biological Opinion on the preferred action in January 2023 (Appendix D3). The USFWS concurred with the USACEs determination that the project may affect, but will not likely adversely affect the Whooping Crane and leatherback sea turtle due to the conservation measures outlined in this Conference and Biological Opinion and presence of environmental monitors for the duration of the project. An Incidental Take Statement was provided with this Conference and Biological Opinion which describes the measures the USFWS considers necessary or appropriate to minimize the impact of incidental take associated with this action. The Incidental Take Statement specifies Terms and Conditions, including monitoring and reporting, that must be undertaken by the Applicant for the Kemp's Ridley Sea Turtle, Green Sea Turtle, Loggerhead Sea Turtle, Hawksbill Sea Turtle, Piping Plover, Piping Plover Critical Habitat, Red Knot, proposed Red Knot Critical Habitat, Eastern Black Rail, and West Indian manatee (Appendix D3).

7.9 MAGNUSON-STEVENS FISHERY CONSERVATION AND MANAGEMENT ACT

The MSFCMA (PL 94-265), as amended, provides for the conservation and management of the Nation's fishery resources through the preparation and implementation of Fishery Management Plans (16 USC 1801 et seq.). The MSFCMA calls for NOAA fisheries to work with regional Fishery Management Councils to develop Fishery Management Plans for each fishery under their jurisdiction.

One of the required provisions of Fishery Management Plan specifies that EFH be identified and described for the fishery, adverse fishing impacts on EFH be minimized to the extent practicable, and other actions to conserve and enhance EFH be identified. The MSFCMA also mandates that NMFS coordinate with and provide information to Federal agencies to further the conservation and enhancement of EFH. Federal agencies must consult with NMFS on any action that may adversely affect EFH. When NMFS finds that a Federal or State action would adversely affect EFH, it is required to provide conservation recommendations.

EFH is designated for the study area in which the preferred project is located. Consultation with NMFS was initiated with the release of the DEIS and receipt of any comments regarding EFH impacts. An EFH Assessment has been prepared for this project and was coordinated with NMFS (Appendix E). There are no Habitat Areas of Particular Concern designated in the project area (NOAA, 2021u). NMFS provided EFH Conservation Recommendations on the project in August 2022. Coordination with NMFS with respect to the MSFCMA was concluded in November 2022 (see Appendix B8).

7.10 FISH AND WILDLIFE COORDINATION ACT OF 1934

The Fish and Wildlife Coordination Act (16 USC 661–667(e)) provides for consultation with the USFWS, NOAA, and NMFS, and in Texas, with the TPWD whenever the waters or channel of a body of water are modified by a department or agency of the United States. Under this Act, the Federal department or agency shall consult USFWS and the State agency with a view to the conservation of wildlife resources. The Act's purposes are to recognize the vital contribution of our wildlife resources to the nation, and their increasing public interest and significance, and to provide that wildlife conservation receive equal consideration and be coordinated with other features of water resource development programs through planning, development, maintenance, and coordination of wildlife conservation and rehabilitation. This FEIS evaluates impacts to fish and wildlife as described in Section 4.2 for wildlife, aquatic, and protected resources. The preferred project has been coordinated with the USFWS and other State and Federal resource agencies through interagency meetings and consultation.

7.11 COASTAL ZONE MANAGEMENT ACT

The Coastal Zone Management Act (CZMA) of 1972, as amended, provides for the effective management, BU, protection, and development of the resources of the nation's coastal zone. The CZMA directs Federal agencies proposing activities within or outside of the coastal zone that could affect any land or water use or natural resource of the coastal zone, to assure that those activities or projects are consistent, to the maximum extent practicable, with the approved State programs. The CZMA also requires any non-Federal applicant for a Federal license or permit conducting an activity affecting land or water uses in the state's coastal zone to furnish a certification that the proposed activity will comply with the state's coastal zone management program.

The CZMA created the Coastal Zone Management Program (CZMP). The Texas Coastal Management Program (TCMP) is a State entity that participates in the Federal CZMP. The TCMP coordinates local, State, and Federal programs for the management of Texas coastal resources. The Coastal Coordination Advisory Committee, composed of several State agencies and local officials, administers the TCMP. The TCMP reviews all Federal actions that may affect any natural resource in the coastal zone for consistency with the Federal goals and objectives of the Federal CZMP. Federal actions include direct Federal actions (i.e., performed by or for a Federal agency) and indirect Federal actions (i.e., activities requiring Federal permits, approval, or financial assistance). The responsibility for these reviews belongs to the lead agency, the GLO. A Section 404 or Section 10 permit application will automatically trigger a review by the GLO for consistency with TCMP. Based on an evaluation of the preferred project's compliance with Federal goals and policies (Appendix P), the preferred project is consistent with the Federal goals and objectives of the CZMP. Any concerns expressed by the GLO will be addressed before the permit is granted. Coordination with the GLO regarding consistency with the goals and policies of the TCMP is ongoing. Additional information regarding the TCMP for the proposed CDP is provided in Appendix P.

7.12 CLEAN AIR ACT OF 1970

The CAA is a comprehensive Federal law that regulates air emissions from stationary and mobile sources across the U.S. Under the CAA, the EPA develops NAAQS to protect public health and to regulate emissions of hazardous air pollutants. NAAQS have been developed to maintain safe concentrations of ground-level ozone, particulate matter, nitrogen dioxide, sulfur dioxide, carbon monoxide, and lead. Corpus Christi is in attainment for all NAAQS.

Implementation of the CAA is primarily the responsibility of states through the development of SIPs. These Plans outline how each state will control air pollution in accordance with the CAA. An SIP is a collection of regulations, programs, and policies that a state will use to clean up polluted areas and is subject to EPA approval. State, local, and tribal governments also monitor air quality, inspect facilities under their jurisdictions, and enforce CAA regulations.

States must develop SIPs that explain how each state will implement CAA requirements via a collection of regulations. The General Conformity Rule Section 176(c) of the CAA ensures that the actions taken by Federal agencies in nonattainment or maintenance areas do not interfere with a state's plans to meet national standards for air quality (42 USC 7401 et seq.). Section 309 of the CAA authorizes EPA to comment on the environmental impact of any newly authorized Federal project for construction and any other major Federal agency action significantly affecting the quality of the human environment (42 USC 7401 et seq.).

The requirements of the CAA apply to this study. The potential air quality impacts resulting from this project are discussed in Section 4.1.9. No air quality permits are anticipated to be required for this project. Because the project is located in Aransas, San Patricio, and Nueces counties, and these counties have been designated in attainment or unclassifiable with the 2015 8-hour ozone standard, the General Conformity requirements are not applicable, and a General Conformity Determination will not be required.

7.13 MIGRATORY BIRD TREATY ACT AND MIGRATORY BIRD CONSERVATION ACT AND EXECUTIVE ORDER 13186

The Migratory Bird Treaty Act of 1918 (as amended) extends Federal protection to migratory bird species; among other activities non-regulated "take" of migratory birds is prohibited under this Migratory Bird Treaty Act in a manner similar to the ESA prohibition of "take" of threatened and endangered species. Additionally, EO 13186 "Responsibility of Federal Agencies to Protect Migratory Birds" requires Federal activities to assess and consider potential effects of their actions on migratory birds (including, but not limited to, cranes, ducks, geese, shorebirds, hawks, and songbirds). The effect of the preferred project on migratory bird species has been assessed.

Potential impacts of the alternatives to wildlife, including migratory birds, are evaluated in Section 4.2.5.4.

7.14 MARINE MAMMAL PROTECTION ACT OF 1972

The MMPA of 1972 (16 USC 1361 et seq.) established a national policy to prevent marine mammal species and population stocks from declining beyond the point where they ceased to be significant functioning elements of the ecosystems of which they are a part. The MMPA prohibits, with certain exceptions, the "take" of marine mammals in U.S. waters and by U.S. citizens on the high seas, and the importation of marine mammals and marine mammal products into the United States. In the MMPA, "take" is defined "as harass, hunt, capture, kill or collect, or attempt to harass, hunt, capture, kill or collect." The Department of Commerce, through the NMFS, is charged with protecting species that are known to occur in the Texas Gulf region such as whales, dolphins, and porpoises. Manatees are protected by the Department of the Interior through the USFWS.

The only marine mammals covered under the MMPA that have the potential to occur in the nearshore waters within the project area are Common Bottlenose Dolphins and West Indian Manatee. These are highly mobile species readily able to avoid dredging activities and vessels, and placement activity occurring in the water. The requirements of the MMPA apply to this study. Potential impacts to marine mammals are considered in Appendix D and Section 4.2.5.5 of this FEIS. Incorporation of the safeguards to protect marine mammal species during project implementation have been coordinated with the USFWS and NMFS are be included in the ESA BA for concurrence that the project complies with the MMPA. The NMFS issued Biological Opinion on the preferred action in December 2022 (Appendix D2). The USFWS issued a Conference and Biological Opinion on the preferred action in January 2023 (Appendix D3).

7.15 FEDERAL WATER PROJECT RECREATION ACT

The Federal Water Project Recreation Act, as amended, declares the intent of Congress that recreation and fish and wildlife enhancement be given full consideration as purposes of Federal water development projects if non-Federal public bodies agree to 1) bear not less than one-half the separable costs allocated for recreational purposes or 25 percent of the cost for fish and wildlife enhancement; 2) administer project land and water areas devoted to these purposes; and 3) bear all costs of operation, maintenance, and replacement (16 USC 460(L)(12)–460(L)(21)). Cost-sharing is not required where Federal lands or authorized Federal programs for fish and wildlife conservation are involved. This Act also authorizes the use of Federal water project funds for land acquisition in order to establish refuges for migratory waterfowl when recommended by the Secretary of the Interior and authorizes the Secretary to provide facilities for outdoor recreation and fish and wildlife at all reservoirs under agency control, except those within NWRs.

The provisions of the Federal Water Recreation Act apply to this study and information regarding recreation and fish and wildlife enhancement within this project area is contained in Section 4.4.

7.16 COASTAL BARRIER RESOURCES ACT AND COASTAL BARRIER IMPROVEMENT ACT OF 1990

The Coastal Barrier Resources Act (16 USC 3501 et seq.) and the Coastal Barrier Improvement Act of 1990 (PL 101-591) are Federal laws that were enacted on October 18, 1982, and November 16, 1990, respectively. The legislation was implemented as part of a Department of Interior initiative to minimize loss of human life by discouraging development in high-risk areas, reduce wasteful expenditures of Federal resources, and to preserve the ecological integrity of areas Congress designates as a Coastal Barrier Resources System and Otherwise Protected Areas. The laws provide this protection by prohibiting all Federal expenditures or financial assistance, including flood insurance, for residential or commercial development in areas so identified. Two types of units are included, System Units and Otherwise Protected Areas. System Units are predominately comprised of privately owned areas or areas that are held for conservation and/or recreation. Otherwise, Protected Areas are predominately conservation and/or recreation areas but may also contain private areas that are not held for conservation and/or recreation, these units are designated with a “P” at the end of the unit number.

Coastal Barrier Resources System designated units, T08 and T08P, are in the project area on San José Island where placement sites SJI and HI-E are located (USFWS, 2022b). Exceptions to the Federal expenditure restrictions include maintenance of constructed improvement(s) to existing Federal navigation channels and related structures (e.g., jetties), including the disposal of dredged material related to maintenance and construction. Thus, the Applicant’s Preferred Alternative is exempt from the prohibitions identified in this act.

7.17 FARMLAND PROTECTION POLICY ACT OF 1981 AND THE CEQ MEMORANDUM PRIME AND UNIQUE FARMLANDS

In 1980, the CEQ issued an Environmental Statement Memorandum “Prime and Unique Agricultural Lands” as a supplement to the NEPA procedures. Additionally, the Farmland Protection Policy Act, passed in 1981, requires Federal agencies to evaluate the impacts of Federally funded projects that may convert farmlands to nonagricultural uses and to consider alternative actions that would reduce adverse effects of the conversion.

No impacts to prime or unique farmland are anticipated for any of the proposed alternative actions, and therefore the provisions of the Farmland Protection Policy Act do not apply.

7.18 USACE DIRECTOR’S POLICY MEMORANDUM 2018-12

This FEIS is following the requirements listed in USACE Director’s Policy Memorandum 2018-12 (September 26, 2018) . The memorandum provided guidance to the USACE districts to streamline their environmental review process and decisions collaboratively with other Federal agencies where the USACE

Regulatory is a lead involved in preparing an EIS for a covered major infrastructure project. This guidance does not replace or contradict requirements of NEPA or USACE regulations.

This memorandum identifies three concurrence points in the environmental review process that requests the concurrence of Cooperating Agencies with authorization decision responsibilities (Appendix B2). These include Concurrence Point #1: purpose and need, completed by the USACE on March 25, 2020; Concurrence Point #2: alternatives to be carried forward for evaluation, completed by the USACE on July 1, 2020; and Concurrence Point #3: identification of the Applicant's Preferred Alternative, this has been completed in coordination with the agencies.

USACE Director's Policy Memorandum 2018-12 applies to this study. Full compliance is anticipated upon signature of the Record of Decision.

7.19 EXECUTIVE ORDER 11988, FLOODPLAIN MANAGEMENT

EO 11988 directs Federal agencies to evaluate the potential effects of preferred actions on floodplains. Such actions should not be undertaken that directly or indirectly induce growth in the floodplain unless there is no practicable alternative. Each agency has a responsibility to evaluate the potential effects of any actions it may take in a floodplain associated with the one percent annual chance event. The CDP is not expected to significantly affect floodplains.

7.20 EXECUTIVE ORDER 11990, PROTECTION OF WETLANDS

The purpose of EO 11990 is to "minimize the destruction, loss or degradation of wetlands and to preserve and enhance the natural and beneficial values of wetlands." To meet these objectives, this EO requires Federal agencies, in planning their actions, to consider alternatives to wetland sites and limit potential damage if an activity affecting a wetland cannot be avoided. The EO applies to:

- Acquisition, management, and disposition of Federal lands and facilities construction and improvement projects which are undertaken, financed, or assisted by Federal agencies; and
- Federal activities and programs affecting land use, including but not limited to water and related land resources planning, regulation, and licensing activities.

EO 11990 applies to this study. The potential effects of the study on wetlands are discussed in Section 4.2.1. Effects will be considered during the review of all permits required under the CWA (see Appendices A and O).

7.21 EXECUTIVE ORDER 12898, ENVIRONMENTAL JUSTICE

Environmental justice requires agencies to incorporate into NEPA documents an analysis of the environmental effects of their proposed programs on minorities and low-income populations and communities. Environmental justice is defined by EPA as "the fair treatment and meaningful involvement of all people regardless of race, color, national origin, or income with respect to the development, implementation, and enforcement of environmental laws, regulations, and policies. Fair treatment means that no group of people, including racial, ethnic, or socioeconomic group, should bear a disproportionate share of the negative environmental consequences resulting from industrial, municipal, and commercial operations or the execution of Federal, State, local, and tribal programs and policies."

EO 12898 applies to the study and the potential impacts to minority and low-income groups are described in Section 4.4 of this FEIS. Based on a demographic analysis of the study area and findings of an environmental justice review, the preferred project would not have a disproportionately high and adverse impact on any low-income or minority population.

7.22 EXECUTIVE ORDER 13045, PROTECTION OF CHILDREN

EO 13045 directs Federal agencies to ensure that its policies, programs, activities, and standards address disproportionate risks to children that result from environmental health risks or safety risks. Examples of risks to children include increased traffic volumes and industrial or production-oriented activities that would generate substances or pollutants that children may contact with or ingest. This FEIS has evaluated the potential for the preferred project to increase these risks to children, and it has been determined that children in the project area would not likely experience any adverse effects from the preferred project.

7.23 FEDERAL AVIATION ADMINISTRATION – HAZARDOUS WILDLIFE ATTRACTANTS ON OR NEAR AIRPORTS

In accordance with Federal Aviation Administration AC 150/5200-33 and the Memorandum of Agreement among the Federal Aviation Administration, the USACE, and other Federal agencies (July 2003), the preferred project was evaluated to determine if proposed land uses could increase wildlife hazards to aircraft using public use airports in the study area. Mustang Beach Airport is located within all three perimeters. The project features involving beach/shoreline restoration (MI, SJI, and HI-E), nearshore berms (B1, B7, and B8), and shoreline stabilization (SS1, SS1 EXT, and SS2) could create an increase in bird nesting and foraging habitat which could increase the number and species of birds associated with aircraft strikes. A copy of the FEIS and notification letter will be sent to the Federal Aviation Administration.

7.24 EXECUTIVE ORDER 13112, INVASIVE SPECIES

EO 13112 addresses the prevention of the introduction of invasive species and provides for their control and minimization of the economic, ecological, and human health impacts the invasive species causes. It establishes the Invasive Species Council, which is responsible for the preparation and issuance of the National Invasive Species Management Plan, which details and recommends performance-oriented goals and objectives and specific measures of success for Federal agencies.

Ship traffic would be expected to decrease with the Applicant's Preferred Alternative due to larger ships being able to traverse the CCSC, the decrease would be less than the predicted growth of ship traffic under the No-Action Alternative, and therefore, no additional impacts with respect to ballast water are expected. Furthermore, no changes in foreign ports of call are predicted.

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8.0 PUBLIC INVOLVEMENT, REVIEW, AND CONSULTATION

8.1 PUBLIC INVOLVEMENT PROGRAM

The USACE and PCCA involved the public through public meetings and other outreach throughout the history of the project. A proactive approach was taken to inform and involve the public, resource agencies, industry, local government, and other interested parties about the project and to identify any public concerns.

8.2 EARLY AGENCY COORDINATION

Several collaborative efforts were accomplished early in the process. The Applicant conducted an initial agency coordination meeting on September 21, 2018 to obtain the input of Federal, State, and local resource agencies, including the USACE, Galveston District, to help further develop dredged material placement that considered environmental impact and BU opportunities. Federal, State, and local stakeholders provided input on the initial planned PA use and preliminary BU concepts.

The USACE published the Joint Public Notice with TCEQ on August 1, 2019 which initiated the pre-scoping steps for the Lead, Cooperating, and commenting agencies (Appendix B3). By letter dated June 18, 2019, the USACE confirmed the project meets the definition of a covered project as defined in 42-USC 4370m(6)(A) of FAST-41. A FAST-41 Interagency Coordination Meeting was held on July 22, 2019 to discuss the development of the Coordinated Project Plan (CPP), as required by FAST-41. This meeting included the attendance of the FAST-41 Federal Permitting Improvement Steering Council (FPISC) Executive Director, the USACE Chief Environmental Review Permitting Officer, and the USACE District Commander, which they emphasized for the agencies to focus on delivering a reasonable and predictable schedule per the regulations. The USACE also held two webinars with the agencies on July 31, 2019 and August 1, 2019 to discuss the development of the initial CPP. Throughout the process, the USACE has coordinated updates of the CPP quarterly with the Cooperating Agencies.

8.3 SCOPING

On March 24, 2020, the USACE issued a memorandum: *Interim Army Procedures for National Environmental Policy Act (NEPA)* in response to the coronavirus (COVID-19) pandemic. The memorandum established interim Army NEPA procedures in consideration of the COVID-19 public health emergency. These interim NEPA procedures apply to all Army NEPA proponents responsible for NEPA compliance. In response to this memorandum, the USACE determined that the scoping meeting for the PCCA CDP would be moved to a virtual platform in accordance with this guidance.

A series of virtual public scoping meetings, hosted by the USACE, Galveston District, for the PCCA CDP was held online in June 2020 (Appendix B4). The first of this series of virtual public scoping meetings was held on Tuesday, June 9, 2020, utilizing PublicInput.com. This virtual meeting platform encountered numerous technical problems, severely restricting public access and participation in the virtual public scoping meeting. As a result of the technical problems encountered, the USACE adjourned the meeting early and publicly acknowledged and apologized for the technical problems on the project website (publicinput.com/PCCA-Channel-EIS).

To avoid postponement of the remaining scheduled meetings, virtual scoping meetings were scheduled on an alternative virtual platform, Cisco WebEx Events. Subsequent virtual public scoping meetings were hosted utilizing Cisco WebEx Events, and an additional virtual public scoping meeting was scheduled for Monday, June 15, 2020, to make up for the technical issues experienced during the June 9, 2020, virtual public scoping meeting. In total, five virtual public scoping meetings were held, with four meetings successfully hosted on Cisco WebEx Events. The virtual public scoping meetings were on the following dates and online platforms:

- June 9, 2020 (hosted on PublicInput.com)
- June 11, 2020 (hosted on Cisco WebEx Events)
- June 15, 2020 (hosted on Cisco WebEx Events). This was and additional meeting scheduled due to online technical issues experienced during the June 9, 2020 meeting
- June 16, 2020 (hosted on Cisco WebEx Events)
- June 18, 2020 (hosted on Cisco WebEx Events)

The purpose of the virtual public scoping meetings was to provide the public with information about the proposed project and to solicit comments and information to better enable the USACE to make a reasonable decision on factors affecting the public interest.

Because virtual scoping meeting were held in lieu of traditional in-person public scoping meetings due to the COVID-19 pandemic, the following measures were taken to accommodate to the greatest extent practicable: the public comment period was extended from 30 to 90 days; voicemail commenting through a project phone line; text message commenting through a project phone line; and online comment portal on a third-party project website (publicinput.com/PCCAChannel-EIS).

The virtual public scoping meetings began with opening remarks from Colonel Timothy Vail Commander of the USACE, Galveston District. Following opening remarks, the meeting proceeded with a presentation of the proposed project from the PCCA, and this presentation was followed by presentations about the EIS scoping process, the purpose and need of the proposed project, and known environmental concerns led by Mr. Jayson Hudson, a representative of the USACE. Comments were collected throughout the scoping comment period, which ended July 3, 2020.

An interagency scoping meeting took place prior to the public scoping meeting on May 14, 2020 (Appendix B5). The meeting was hosted virtually by the USACE via Cisco WebEx. The meeting was introduced by Colonel Timothy Vail, Commander, Commander of the USACE, Galveston District. Then Sean

Strawbridge, PCCA Chief Executive Officer gave an opening statement and Sarah Garza, PCCA's Director of Environmental Planning and Compliance provided an overview of the project, studies completed, and ongoing efforts. Jayson Hudson, USACE Regulatory Project Manager provided a presentation that covered the NEPA process, introduced the project and project team, identification of the Purpose and Need and potential alternatives, and a review of the EIS content and known environmental concerns. Agency representatives were given an opportunity to express their concerns and inform the USACE and PCCA of items that will need to be covered in the EIS and points of contact.

In addition to the scoping meetings, a project website was launched in May 2020 (https://pccaeisproject.com/) that contains project information as well as information about the NEPA process. The website provides members of the public the opportunity to sign up for the EIS mailing list and submit comments during comment periods.

8.4 DEIS PUBLIC MEETING

A public meeting for the DEIS was conducted on June 22, 2022, to provide information about the proposed CDP and to receive public input and comments on the DEIS (Appendix B6). An open house was conducted prior to the formal public hearing, which served as an opportunity for discussion with the USACE and consultants on the CDP. During the open house session, the public had the opportunity to view a short video and display stations which included information on the NEPA process, the DEIS, and background information of the proposed CDP. Attendees had the opportunity to provide verbal comments to a court reporter during the open house portion of the meeting if they did not wish to wait until the formal commenting portion of the public meeting. A court reporter was present at the formal public meeting to transcribe verbal comments. Written comments were collected throughout the comment period, which ended July 25, 2022. The comment period for the DEIS was extended to August 9, 2022. Comments from the public were reviewed and responded to and a summary is included in Appendix B7.

8.5 REQUIRED COORDINATION

The FEIS is being circulated to all known Federal, State, and local agencies. Interested organizations and individuals are also being sent the Notice of Availability. A list of those who are being sent a copy of this document, along with a request to review and provide comments, is provided in Appendix Q.

8.6 PUBLIC VIEWS AND RESPONSES

Public views and concerns expressed during this study have been considered during the preparation of the FEIS. The views and concerns were used to develop planning objectives, identify significant resources, evaluate impacts of various alternatives, and identify a plan that is socially and environmentally acceptable. Important concerns expressed included environmental, public involvement, alternatives, navigation/transportation, land use, recreation, and tourism (Appendix B4). The Applicant's Preferred

Alternative and alternatives are described in Section 2.0. The evaluation of project-related impacts takes into consideration the expressed objectives, views, and concerns of the resource agencies and public.

9.0 LIST OF PREPARERS

Key personnel responsible for preparation of the document are listed below:

Name/Title	Experience	DEIS Area of Responsibility
U.S. Army Corps of Engineers, Galveston District		
Jayson Hudson, Project Manager	25 years, Biologist	Regulatory Project Manager, Policy Analysis Branch
Bob Heinly, Deputy Chief, Regulatory Division	31 years, Marine Biology	Deputy Chief, Regulatory Division
Himangshu S. Das, PhD, Civil Engineer	24 years, Hydrology and Hydraulics, Coastal Engineering	Coastal Engineering Lead, Hydraulics and Hydrology
Aron Edwards, Operations	24 years, Marine Biology	Operations
Freese and Nichols, Inc.		
Tony Risko, P.E., Coastal Engineer	37 years, Coastal Engineering	Project Director, Quality Assurance Manager, Commercial and Recreational Navigation
Lisa Vitale, FP-C, Marine Biologist/Project Manager	27 years, Marine Biology, NEPA Compliance and Coordination	Project Manager, NEPA Document Manager, Marine Fisheries/EFH, Document Coordination, Word Processing, QA/QC
Tom Dixon, Senior Scientist/Project Manager	19 years, Wildlife and Protected Species	Deputy Project Manager, Wetlands and SAV, Threatened and Endangered Species, Alternatives Analysis, Cumulative Impacts, QA/QC
Dave Buzan, Aquatic Biologist	45 years, Aquatic Biology, Vegetation Analysis and Impacts	Water and Sediment Quality, Freshwater Inflow, QA/QC
Andrew Labay, FP-C, Aquatic Biologist	31 years, Aquatic Biology, Freshwater Fisheries	QA/QC
Ryan Fikes, Marine Biologist	20 years, Environmental Assessment and Impact Analysis	Sediment Transport, Shoreline Change, Salinity, Climate, SLR, Coastal Processes, Marine Mammals, Section 404(b) and TCMP preparation, Cumulative Impacts
Robert Chambers, P.G., Principal	30 years, Environmental Geology	QA/QC
Kelsey Calvez, Biologist	8 years, Biology and Geology	GIS Data
Aaron Petty, Aquatic Biologist	13 years, Environmental Assessment and Impact Analysis	Bathymetry, Tides, Currents and Circulation, Threatened and Endangered Species, Wildlife
Tam Tran, Wildlife Biologist	10 years, Environmental Assessment and Impact Analysis	Wetlands, Threatened and Endangered Species, Wildlife, Migratory Birds, Biological Assessment
Ryan Deal, GIT, Environmental Scientist	11 years, HTRW	HTRW Analysis, Energy and Mineral Resources

Name/Title	Experience	DEIS Area of Responsibility
Connor Kee, Geologist/Fluvial Geomorphologist	9 years, Geology	Geology, Soils, HTRW Analysis, Energy and Mineral Resources
Kim Buckley, P.G., Geomorphologist	22 years, Environmental Geology	Geology, HTRW Analysis, Energy and Mineral Resources, QA/QC
Carl Sepulveda, P.E., Coastal Engineer	29 years, Coastal Engineering	Hydraulics and Hydrology review, Alternatives Analysis, Air Quality, Noise, QA/QC
Jose Tapia, EIT	4 years, Coastal Engineering	Air Quality QA/QC
Kiara Horton, Coastal Engineer	3 years, Coastal Engineering	Alternatives Analysis
Abt Associates		
Lisa McDonald, PhD, Sr. Associate	29 years, Socioeconomics and Environmental Justice	Project Manager, QA/QC
Chris Dixon, AICP, Economist	12 years, Socioeconomics and Environmental Justice	Socioeconomics, Land Use, Recreation, Environmental Justice
Olivia Griot, Associate	7 years, Socioeconomics and Environmental Justice	Socioeconomics, Land Use, Recreation, Environmental Justice
Ama Terra		
Deborah Dobson-Brown, Architectural History Program Manager	37 years, Cultural Resources	Terrestrial Cultural Resources
Mason Miller, MA, Senior Archaeology Principal Investigator	22 years, Cultural Resources	Terrestrial and Marine Cultural Resources
Adam Parker, MA, Underwater and Terrestrial Archeologist	7 years, Cultural Resources	Terrestrial and Marine Cultural Resources
Sara Parkin, MA, Staff Archeologist	9 years, Cultural Resources	Terrestrial and Marine Cultural Resources
Paige Ritter, MHP, Architectural Historian	5 years, Cultural Resources	Terrestrial Cultural Resources
Jeffrey Cragle, GIS Specialist	11 years, GIS	GIS
Matthew Stotts, GIS Specialist	210 years, GIS	GIS
Leah Robertson, GIS Specialist	5 years, GIS	GIS
Baird		
Larry Wise, P.E., Senior Coastal and Marine Engineer	28 years, Coastal Engineering	Hydraulics and Hydrology, Hydrodynamic, Vessel Effects, Sedimentation Modeling Review, QA/QC
Fred Scott, Coastal Engineer	3 years, Coastal Engineering	Hydraulics and Hydrology Modeling Review
Yarzar Tun, Coastal Engineer	3 years, Coastal Engineering	Hydraulics and Hydrology Modeling Review, Sediment Transport, Hydrodynamic Modeling
Robert Narin, PhD, P.E., Coastal Engineer	27 years, Coastal Engineering	Hydraulics and Hydrology Modeling Review

Name/Title	Experience	DEIS Area of Responsibility
Wim van der Molen, PhD, Peng, Port Engineer	16 years, Port and Coastal Engineering	Vessel Underkeel Clearance Study
Alejandro Alcántar, Coastal Engineer	7 years, Coastal Engineering	Hydraulics Modeling
Patrick Joynt, MASc, Coastal Engineering	5 years, Coastal Engineering	Vessel Propeller Scour Modeling
Javier Reyes, Geologist, GISP	5 years, GIS and Geology	GIS, Geomatics
Qimiao Lu, PhD, Senior Modeler	33 Years, Coastal Engineering	Hydrodynamic and Salinity Transport Modeling
Sean Garber, B.E (civil), B.E (enviro), Coastal Engineer	18 years, Coastal Engineering	Coastal Process, Sediment Transport, Vessel Hydrodynamic Modeling
Jarrod Dent, Coastal Modeler	12 years, Coastal Engineering	Coastal Process, Sediment Transport, Vessel Hydrodynamic Modeling
Peter MacDermott, Remote Sensing Analyst	15 years, Geomatics and Remote Sensing	Hydrodynamic Modeling Grid Generation and Analysis
Mohammad Dibajnia, Ph.D., P.Eng., Coastal Engineer	37 years, Coastal, Estuarine, and River Engineering	Channel Sedimentation, Beach Nourishment Modeling
Trevor Elliott, P.Eng., M.A.sc. (Coastal Eng.), M.Eng. (Naval Architecture)	27 years, Coastal Engineering	Vessel Propeller Scour Modeling
Rebecca Quan, M.C.E, Coastal Engineering	9 years, Coastal Engineering	Hydrodynamic and Salinity Modeling, Beach Nourishment Modeling
Riley Twerdub, Environmental Engineering Student	7 months, Co-op student	Channel Sedimentation Modeling, Data Processing
Abigail MacKenzie, Junior Modeler	2 years, Coastal Engineering	Data Processing, Watershed-runoff Analysis
Onur Kurum, Ph.D., P.Eng., Coastal Engineer	13 years, Coastal Engineering	Coastal Process, Sediment Transport, Storm Surge
Mike Fullarton M.A.Sc., P.Eng. Coastal Engineer	22 years, Coastal and River Engineering	Hydrodynamic and Salinity Modeling Review and Resourcing
Cody McLaughlin, MASc, Coastal Engineering	12-month, Coastal Engineering	Data Processing, Meteorological Input Analysis
GHD		
Mikeila Morgan, Environmental Planner	13 years, Project Management, NEPA	Project Manager
Mike Masschaele, Engineer	15 years, Environmental Compliance	Noise Assessment
Ben Wiseman, Engineer	7 years, Environmental Compliance	Noise Assessment
Sube Subramanian, Engineer	19 years, Environmental Compliance	Air Quality Assessment
Suresh Iyer, PhD, Engineer	17 years, Environmental Compliance	Air Quality Assessment
Marc Kemper, Environmental Scientist	8 years, Environmental Compliance	Noise Assessment
Thomas Gillespie, Coastal Engineer	9 years, Coastal Engineering	Project Manager
Christopher Benjamin, Engineer	21 years, Water Resources	Technical Director

Name/Title	Experience	DEIS Area of Responsibility
Riben Marine		
Captain Jay Rivera, Marine Navigation/Transportation	14 years, Marine Transportation	Commercial and Recreational Navigation
Hollaway Environmental + Communications		
Leslie Hollaway, Chief Executive Officer	17 years, Public Communications	Public Involvement
Greg Sevcik, Creative Director	16 years, Graphic Designer	Public Involvement
Conner Stokes, Communications Technical Expert	8 years, Editor and Public Communications	Public Involvement

10.0 LIST OF AGENCIES, ORGANIZATIONS, AND PERSONS TO WHOM COPIES OF THE FINAL STATEMENT ARE SENT

A list of all Federal and State legislative representatives, agencies, organizations, and persons to whom the Notice of Availability will be sent is presented as Appendix Q.

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