4.0 ENVIRONMENTAL CONSEQUENCES AND MITIGATION

This chapter discusses the impacts to the environment of the alternatives advanced for evaluation in this EA, and any measures proposed to mitigate for impacts to sensitive resources that would be a consequence of project implementation. Since the proposed project consists of new work dredging to deepen an existing navigation channel, and 20 years of operation and maintenance (O&M) of the improved channel, any new and initial impacts to ecological resources would occur primarily during the new work dredging to construct the project. Maintenance dredging for the deepened channel would only occur in areas initially impacted by new work dredging, and areas of the existing channel already receiving maintenance dredging. Therefore, maintenance dredging for the deepened channel would not produce any geographically new impacts, and would consist of the same periodic disturbances experienced during the current and planned maintenance dredging of the authorized CCSC.

4.1 PHYSICAL ENVIRONMENT IMPACTS

The following subsections describe the potential physical environment impacts of the alternatives advanced for evaluation in this EA.

4.1.1 Topography and Soils

No Action Alternative

The No Action Alternative would continue to result in periodic changes in topography from regular channel maintenance dredged material placement at placement areas (PA) and beneficial use (BU) sites.

Preferred Alternative

The preferred alternative would not impact existing topography and soils other than impacts resulting from the placement of dredge materials as described below.

Dredged Material Placement

The dredging of the channel would not impact surface topography, but would have minor bathymetric changes discussed in Section 4.1.3. The total amount of dredged material that would be generated from the construction of the Preferred Alternative is estimated to be approximately 39 MCY of new work material, and approximately an extra annual 0.5 MCY of maintenance material. The new work material would be placed or used to raise levees in existing PAs or be used beneficially as described in Section 2.4.2. The maintenance material would be placed in the existing PAs, including the existing maintenance Offshore Dredged Material Disposal Sites (ODMDS).

While local changes would occur to topography during construction of the Preferred Alternative, these changes would occur in existing and planned PAs and BU sites which are, or would be either islands or offshore placement sites, located away from the mainland. In the case of BU sites involving repair of eroded shorelines or restoring subsided land, topography would be restored to former conditions. These uses would not alter topography or drainage patterns surrounding inhabited areas or land-based agricultural or water resources. As a result, the Preferred Alternative would be expected to have no impacts on the regional physiography and topography of the study area.

Under this alternative, no significant impacts to native surface soils within the project area would occur. A large portion of the new work material removed from the bottoms of the bay and Gulf of Mexico would be sands and some clays. However, this would represent a small percentage of the bay and Gulf bottoms' sediments, which are

primarily from the Holocene deposits and Beaumont Formation covering much of Corpus Christi Bay and the Gulf outside of the bay. A portion of the new work materials would be used beneficially to restore shorelines. Considering this information, the Preferred Alternative would result in no significant adverse impacts to topography or soils.

the 20-year maintenance period, no impacts would be anticipated as a result of periodic maintenance dredging and placement events, as the capacity of existing PAS is anticipated to accommodate the incremental increase in maintenance material projected from the proposed deepening project.

4.1.2 Geology

No Action Alternative

The No Action Alternative would not impact geology within the study area.

Preferred Alternative

Dredging to deepen the channel would minimally impact the local geology by redistributing existing bay and Gulf bottom clays, sands and sediments, causing local temporary increases in turbidity, and potential increases of local shoaling rates within the CCSC. Net changes to the local or regional nature of the existing geology of the study area would be minimal. Additionally, there would be no impacts or changes to geologic hazards such as faults and subsidence.

Dredged Material Placement

Over the 20 year maintenance period, no new impacts would occur as a result of periodic maintenance dredging and placement events. Maintenance activities would only affect areas previously disturbed during the initial construction of the project.

4.1.3 Bathymetry

No Action Alternative

The No Action Alternative would have the same changes to local bathymetry from maintenance dredging of the existing and authorized CCSC over the next 20 years. These would be limited changes within the existing and authorized CCSC.

Preferred Alternative

Constructing channel improvements under the Preferred Alternative would result in local bathymetric changes within and adjacent to the existing and authorized CCSC. The change would be limited to deepening the authorized 54 foot-deep CCSC to 80 feet. These changes would be small compared to the scale of regional bathymetry. Deepening CCSC within the existing CCSC footprint would be expected to result in a reduction in drawdown wave heights for existing vessels.

Dredged Material Placement

While local changes to bathymetry and topography would occur from construction of the proposed channel deepening and placement features, these changes would be expected to have minimal impacts on the regional bathymetry of the submerged portions of the study area.

Levee-raising and use of existing PAs and BU sites would not result in new changes to bathymetry. Use of the existing ODMDS would result in a periodic change of bathymetry. However, as it is a dispersive site, the change would be temporary and within the planned and permitted boundaries. Multiple Placement Fate (MPFATE) modeling of dredged material was performed to verify the ODMDS could accommodate the planned new work placement quantity without excessive mounding. MPFATE is a USACE program used to assess whether planned placement at an offshore sites does not accumulate in a way which would pose a navigational hazard, and stays within site boundaries. MPFATE modeling is included in Engineering Appendix of the Section 408 Report.

Over the 20 year maintenance period, no new impacts would occur as a result of periodic maintenance dredging and placement events. Maintenance activities would only affect areas previously disturbed during the initial construction of the project.

4.1.4 Physical Oceanography

The following subsections described impacts of the alternatives on physical oceanographic processes in the Bay or Gulf of Mexico.

No Action Alternative

Changes in existing tidal range, current patterns, or water levels will occur when the Federally authorized 54-foot Channel Improvement Project is constructed. There may be localized changes to currents and tidal levels within the Bay and offshore adjacent to the jetties. However, these changes will be small and less than significant, as concluded in the 2003 FEIS. These small changes would represent the future without project condition against which impacts of the Preferred Alternative were compared.

Preferred Alternative

A hydrodynamic computer modeling analysis was completed earlier in the study to assess the impacts of the Preferred Alternative on tides, water levels, and current patterns. An analysis has been conducted to estimate the impacts of the proposed project on the tides and associated current patterns within Corpus Christi Bay. The analysis consists of applying a hydrodynamic model to simulate the tides in the bay with and without the project and comparing the results. Three channel configurations were used in the analysis and are: the existing conditions (EC), new project conditions (55' Project) and future project (75'/77' Project) conditions.

The 75' Project impacts on the tides in Corpus Christi Bay were assessed using the Delft3d modeling system (Deltares, 2010). Withinthe Delft3D modelling package, a large variation of coastal and estuarine physical and chemical processes can be simulated. These include waves, tidal propagation, wind- or wave-induced water level setup, flow induced by salinity or temperature gradients, sand and mud transport, water quality and changing bathymetry (morphology). The Delft3D model has been used for other components of the project evaluation and therefore it was also the logical choice for the tidal analysis. For the tide simulations, the model was incorporated in the 2D-H mode.

The approach for the application of the model included these four steps:

1. Model configuration to existing conditions;
2. Model Calibration to measured tides, flows and velocities;
3. Model Configuration and simulation for the 55' Project and 75' Project Conditions; and
4. Comparison of 55' Project and 75' Project simulated tides

The model grid spanned all bay systems from Copano and Aransas Bays in the north to the Laguna Madre and Baffin Bay in the south, including Corpus Christi and Nueces Bays, and extended beyond the 77 foot contour in the Gulf of Mexico. The model was calibrated using the existing channel 45-foot channel condition, using historical tide, velocity and discharge data from local gages and stations from National Oceanic and Atmospheric Administration (NOAA) and the Texas Water Development Board (TWDB). Tidal movement, bay currents and velocities were simulated for conditions with the currently authorized 54-foot Federal project in place, and conditions with the Preferred Alternative constructed. The details of the hydrodynamic modeling are provided in Engineering Appendix of the Section 408 Report.

At the time modeling was conducted, an 85-foot depth was analyzed based on assumption of conservative loading and under-keel clearance conditions such as maximum possible loaded draft, and open seas climatic conditions throughout all segments. As the study progressed, these conditions were refined to more project and segment-specific assumptions, such as planning for the predominant American Petroleum Institute (API) gravity weight of crude oil to be exported. This resulted in a shallower planned design depth of -77 feet MLLW for the open water sections of channel in the Gulf of Mexico and a design depth of -75 feet MLLW for the sheltered sections of the proposed channel. The design depths are increased to 80 feet and 78 feet respectively to allow for two feet of advanced maintenance dredging and one foot of overdredge. However, the effects of interest are greater with deeper channel depth, and the modeling conducted would reflect a greater magnitude of impact than the final 78 to 80-foot depth of the Preferred Alternative. Although the difference in results between the modeled and final depths would not be expected to be great, the modeled depth conservatively estimates the effects of the 78 to 80-foot depth of the Preferred Alternative. The key findings of the analysis are:

- Figure 4.1.4-1 illustrates the comparison of tidal elevation at a location of greatest change, which is in the center of Corpus Christi Bay during a spring tide period. The increases in the spring tide range varied from approximately 4 to 7 percent in Aransas and Copano Bay and 9 to 12 percent in Redfish, Corpus Christi and Nueces Bay. These increases equate to less than one inch at Redfish Bay and generally less than one-half inch in Aransas, Copano Corpus Christi and Nueces Bay. For example, in Corpus Christi Bay near the Port of Corpus Christi where the tide range is on the order of 0.90 feet, the tide range will increase to 0.99 feet.

  As previously discussed in Section 3.1.4.1, spring tide occurs right after new and full moons, and represents the greatest change in tide. The spring-tide increases equate to less than one-half inch at Redfish and Aransas Bay and up to 4 inches in Corpus Christi and Nueces Bay. As this is tidal range, the 4-inch increase would equate to 2 inches during high tide and 2 inches during low tide during the spring tidal cycle.
- The spring-tide tidal prism would increase by approximately 8 percent. This means approximately a 8 percent-greater volume of water would be exchanged in the bay during spring tides.
- The velocity magnitudes in the entrance channel will be lower. The average speeds will decrease from 2.0 fps to 1.7 fps and the peak speeds during maximum spring tides will decrease from 5.0 fps to 4.4 fps.
- The most notable change in maximum velocity magnitudes when comparing the difference between the 75' Project and 55' Project is at the inshore end of the project near the basin and along the CCSC.
- Figure 4.1.4-2 illustrates the change in maximum velocity from the No Action condition with the Preferred Alternative channel in place, in the vicinity of the channel. Current velocities throughout the bays away from the channel would slightly increase on the order of less than 0.5 foot per second (fps). In the project area, velocities would decrease by 0.3 to 0.6 foot per second (fps) or much less (i.e. hundredths of fps). The current patterns would not be expected to change given this small velocity change.
- The area of greatest change would be a very-localized area at the end of the Preferred Alternative at Harbor Island, where the deepening ends relatively suddenly to transition to the 54-foot depth of the authorized channel upstream. The difference is on the order of 0.5 fps or less, and is attributable to the contraction of the modeled channel depth of 75 feet to 54 feet. The transitions in depth and width would

occur in approximately a 200-ft to 250-ft long sections; a change in 21 feet of depth would therefore result in a longitudinal slope of be in the range of 1:9.5 to 1:12. This gradual transition would result in the slight increase in velocity noted above.

- Focusing on the entrance channel through the jetties, the magnitude of velocities in the entrance channel through the jetties would be similar, or slightly lower. The average speeds would decrease from 1.67 fps to 1.60 fps and the peak speeds during maximum spring tides would decrease from 3.8 fps to 3.7 fps.

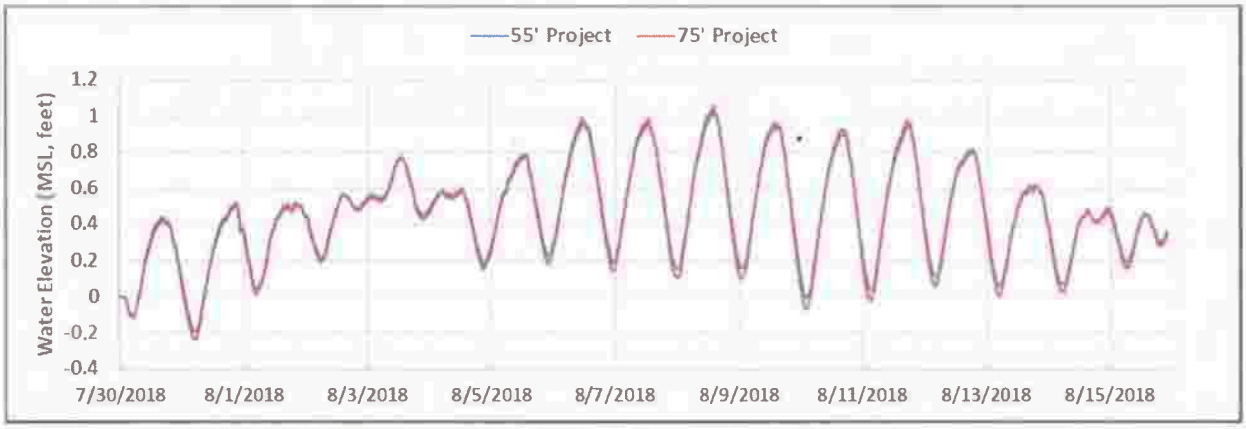


Figure 4.1.4-1 Tide Comparison at Location 1 (Center of Corpus Christi Bay)

Figure 4.1.4-2 Difference in Maximum Velocity Magnitude (75' Project minus 55' Project)

The maximum diurnal or semi-diurnal tidal variation ranges between approximately one to two feet. .The change in tidal prism would result in approximately two inches of increase or decrease in a maximum diurnal or semi-diurnal tidal variation. Although the change in the tidal prism volume is 27 percent, the percent changes in velocity are much smaller due the greater channel cross sectional area of the Preferred Alternative to carry this flow. Given the very small nature of the changes in maximum velocities throughout the bays and Gulf of Mexico, the small and localized nature of change within and directly adjacent to the channel, and the expected negligible change in current patterns, the impacts to the estuary's hydrodynamic regime from the Preferred Alternative would be negligible. The average velocities oer a tide cycle in the bay range from of 0.07 fps from 1.67 fps, and in the peak velocities range from of 0.1 fps from 3.8 fps through the entrance channel and pass. They will increase, 4 percent and 3 percent, respectively, and would represent less than significant changes. It should be noted that changes in maximum velocity occur only during spring tides, and changes would be even smaller during the rest of the astronomical tidal cycle. It should also be noted that the changes would be expected to be smaller with the final 80-foot design depth of the Preferred Alternative. The implications of these small changes to aquatic fauna are discussed in Section 0. In summary, this analysis indicates that with the Preferred Alternative, there would be an increase in the tidal prism and range that would result in small increases in tidal elevation/water level, and minor changes in bay and channel velocities, during spring tide. Considering this, the Preferred Alternative would not result in significant adverse impacts on tides, currents, and water levels.

4.1.4.1. Salinity

No Action Alternative

Gradual changes in ambient salinity could occur due to the rise forecasted for relative sea level changes discussed in the next section. However, no project induced changes to the existing salinity patterns would occur.

Preferred Alternative

The impact of the proposed deepening the CCSC on salinity patterns in the Corpus Christi Bay system is not expected to be significant. Deepening of navigation channels have the potential to change salinities in estuarine systems by either changing circulation patterns or increasing salt intrusion by allowing deeper, more saline water to move further into the estuary through density currents in estuaries where salinity is stratified (USACE 1987). However, salinity modeling previous Federal navigation projects have typically indicated small and less than significant changes on the order of a few parts per thousand (ppt) at maximum and mainly less than 1 or 2 ppt for projects that deepened channels, typically by 5 to 10 feet. These include projects at Matagorda Ship Channel, Houston Ship Channel, Miami Harbor, Delaware River, Sacramento River, Saint Johns River, Savannah Harbor, and Charleston River (Bellino and Spechler 2013, USACE 1995, USACE 2004, USACE 2011a and b, USACE 2012, USACE 2015a, USACE 2018c). This also includes the current authorized Federal project for the CCSC (USACE 2003). Monitoring data reviewed for the Corpus Christi Bay National Estuary Program also indicated that salinity stratification is slight, generally averaging less than 0.6 ppt per meter, with no apparent correlation between mean salinities and ship channels, suggesting that density currents as a mechanism of salinity intrusion are rarely important in Corpus Christi Bay (Ward and Armstrong 1997b). Salinity modeling was conducted to confirm the expectation that the proposed deepening would not alter salinity significantly.

To model the potential impacts of the Preferred Alternative, the Deltares Delft three dimensional (3-D) modeling system was used to develop a model of the estuary system including Corpus Christi, Nueces, Redfish, Aransas, and Copano Bays. The model was calibrated to low flow and high flow conditions using the existing CCSC dimensions (e.g. 45 feet deep), historical salinity data derived from Texas Water Development (TWDB) datasondes, and vertically stratified data collected for this study by the Conrad Blucher Institute (CBI) at Texas A&M University-Corpus Christi. Following calibration, the model mesh representing the channel was modified to two channel modification conditions: the depth and width of the current Federally-authorized channel

dimensions (e.g. 54-foot deep channel), and 2) the proposed channel depth and width of the Preferred Alternative. Simulations were executed for low and high flow conditions to provide results at various locations in the estuarine system. Figure 4.1.4-3 shows the location of the results, and Table 4.1.4-1 provides the with-project induced changes of the Preferred Alternative.

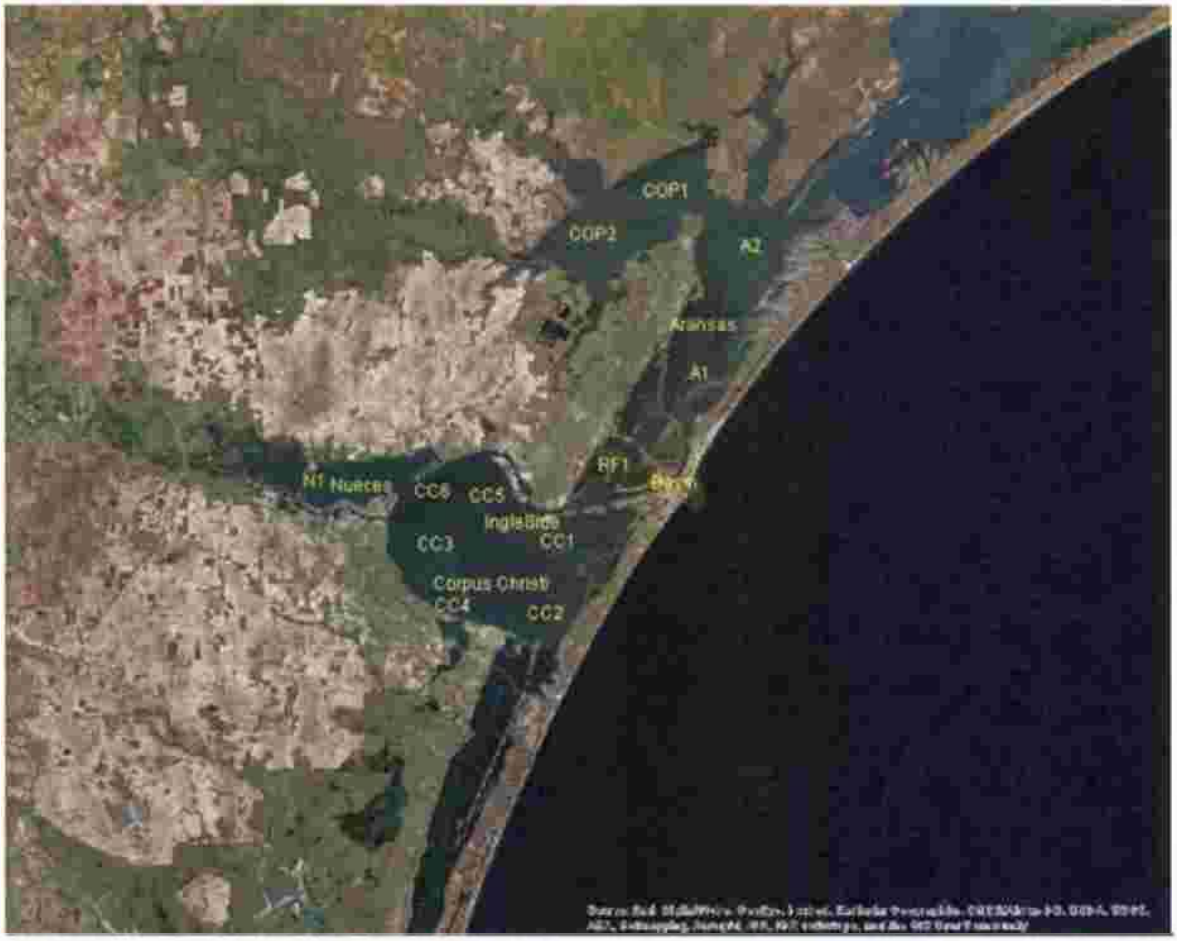


Figure 4.1.4-3 Locations of Salinity Modeling Results

Table 4.1.4-1 With-Project Salinity Changes for the Preferred Alternative

Location	Average Increase (ppt)	Increase In Maximum (ppt)
CC3	0.37	0.47
Corpus Christi	0.38	0.52
CC4	0.33	0.46
CC2	0.35	0.40
N1	0.26	0.29
Nueces	0.25	0.32
CC6	0.24	0.29
CC5	0.32	0.40

Ingleside	0.32	0.47
CC1	0.36	0.53
Basin	0.05	0.06
RedFish Bay	0.21	0.09
A1	0.37	0.44
Aransas Bay	0.28	0.31
A2	0.11	0.12
COP1	0.08	0.08
COP2	0.07	0.08

The results indicate that the Preferred Alternative would increase salinity slightly by less than 0.4 ppt on average, and at maximum, 0.52 ppt or less. At less than 1 ppt, the magnitude of change is negligible and would be less than significant given the wide salinity tolerances of estuarine species, which are an order of magnitude or more. Therefore, the Preferred Alternative would not have significant, adverse impacts on salinity in the Corpus Christi Bay system.

4.1.4.2. Relative Sea Level Change

No Action Alternative

The predicted change for a 50-year period under the intermediate RSLC scenario from Section 3.1.4.3 was approximately 1.25 feet, gradually occurring throughout this period. Under the No Action alternative, this change would increase the actual average available draft in the authorized 54-foot channel, which would be a relatively small, but positive effect for navigation. However, MLLW is a tidal datum, and the datum (i.e. the point at which elevation is zero feet) would be expected to be periodically updated by NOAA, as has been done in the past with data from newer epochs (multi-year time period defined for a historical data set), and move upward with the increase in sea level. Since the maintenance of the Federal channel is predicated on the authorized depth relative to this datum, it would be expected that the maintained depth would also move upward with updates to the datum. Therefore, it would be expected that any depth advantage gained due to RSLC would be offset by future maintenance occurring only until shoaling reaches a 54-foot authorized depth that would be higher than it is today. Considering this, no significant impacts on the channel in the No Action alternative, either positive or negative, would be expected.

The impact of a gradual 1.25-foot increase in sea level on use of the existing and new PAs and BU sites 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. For PAs consisting of emergent confined disposal facilities (CDF), overtopping would not be expected to be an issue given the typical dike elevations and the 1.25 feet of increase. For both CDFs and BU sites, dike protection typically consisting of riprap armoring would eventually have to be reviewed and adjusted for the higher elevation of significant waves. These would be upward adjustments to the armored elevation and stone sizing made in the future by the USACE during the O&M life of the current channel. For lower elevation marsh dikes and marsh cell fill, rising sea level would eventually make dikes vulnerable to overtopping during storm events at higher tides, and would inundate marsh cell interiors above the optimal marsh elevation, if no adjustments were made. Overtopping would subject lower dikes to more storm wave erosion, and deeper marsh inundation would likely result in more open water and less functional marsh area. However, dike crests can be raised and armored relatively easily through supplemental placement of dredged material and riprap. Adjustments in maintenance material placement can be easily made to fill sections of marsh cells to higher elevations. These adjustments can be programmed into the few repair events that all PAs and BU sites (existing and new) would be expected to experience through their lifespan from storm events and wear and tear, and more frequent periodic

channel maintenance. For both CDF and BU site drainage and dewatering, the outlet works, such as spillbox weirs can be adjusted, replaced, or revised to allow for higher decanting elevations in conjunction with deeper placed material consolidation. In summary, readily-anticipated changes can be made in the existing and new FA and BU site O&M to adjust for the gradual increase in sea level.

Preferred Alternative

Similar to the channel in the No Action alternative, RSLC would not be expected to result in any significant impacts on the performance or operation of the channel under the Freferred Alternative for the same reasons discussed for the No Action alternative.

Dredged Material Placement

The impact of a gradual 1.25-foot increase in sea level on new placement and BU sites is not expected to result in any significant impacts on the performance or operation of the channel under the Freferred Alternative. Several of the beneficial use features are under water. Other new features that are surrounded by levees have a 2-ft freeboard that would mitigate the impact of a 1.25-foot RSLC. In summary, the impact on new BUs and PAS would be similar to the impact on existing BUs and FAs as described above and is expected to be minimal or mitigated by currently planned designed features and maintenance activities.

4.1.5 Water and Sediment Quality

The following sections describe effects to water and sediment quality from the No Action and Freferred Alternatives

4.1.5.1. Water Quality

No Action Alternative

Water exchange and inflows would remain the same and no construction would occur under the No Action Alternative. Feriodic maintenance dredging and dredged material placement for the authorized channel and the short-term and local effects due to increases in turbidity related to these activities would also continue according to the 2003 FEIS.

Preferred Alternative

Deepening the channel would result in minimal impacts, but would not be expected to degrade the long-term water quality in or near the channel and would be similar to effects during normal maintenance dredging operations and planned placement area construction in the No Action Alternative. Water column mixing during dredging and placement activities would temporarily affect the temperature, salinity, and density distribution patterns that would return to their previous condition following completion of dredging, resulting in minimal impacts.

Temporary changes in dissolved oxygen (DO), nutrients, and contaminant levels could occur from mixing and disturbance of sediments into the water column for the preferred alternative. Short-term decreases in DO concentration could occur during and right after dredging due to the movement of anoxic water and sediments in the water column. Temporary DO decreases could result from the short-term increases in organic material in the water column, and the associated aerobic decomposition. Contaminants present in the surface sediments would be suspended in the water column during dredging and placement activity. Most of the contaminants detected in sediment and elutriate results have been below screening thresholds and, therefore, levels of sediment contaminants are expected to be primarily low. Disturbed sediment would settle, and DO, nutrient, and contaminant concentrations would return to pre-dredging levels after dredging ceases and impacts would be

minimal. Short-term effects are expected from deepening the channel due to temporary changes in DO, nutrients, and contaminant levels.

Short-term increases in turbidity could result from dredging although several studies have shown that dredge-induced turbidity plumes are typically localized and spread less than a thousand meters from their sources and dissipate to ambient water quality within several hours after dredging is completed (Higgins et al., 2004). Studies of dredging operation effects on suspended sediments have indicated the greatest majority of re-suspended sediments resettle close to the dredge within an hour (Anchor Environmental CA L.P., 2003). Therefore, only temporary, minor effects as a result of increased turbidity are expected from dredging.

The Preferred Alternative would not be expected to result in more suspension and dispersal of sediments as compared to the No Action Alternative, or more than what natural storm, flood, and tidal events could cause. Flooding, large tidal events, and storms can increase suspended sediments over much larger areas and for longer intervals than dredging activities (Higgins et al., 2004).

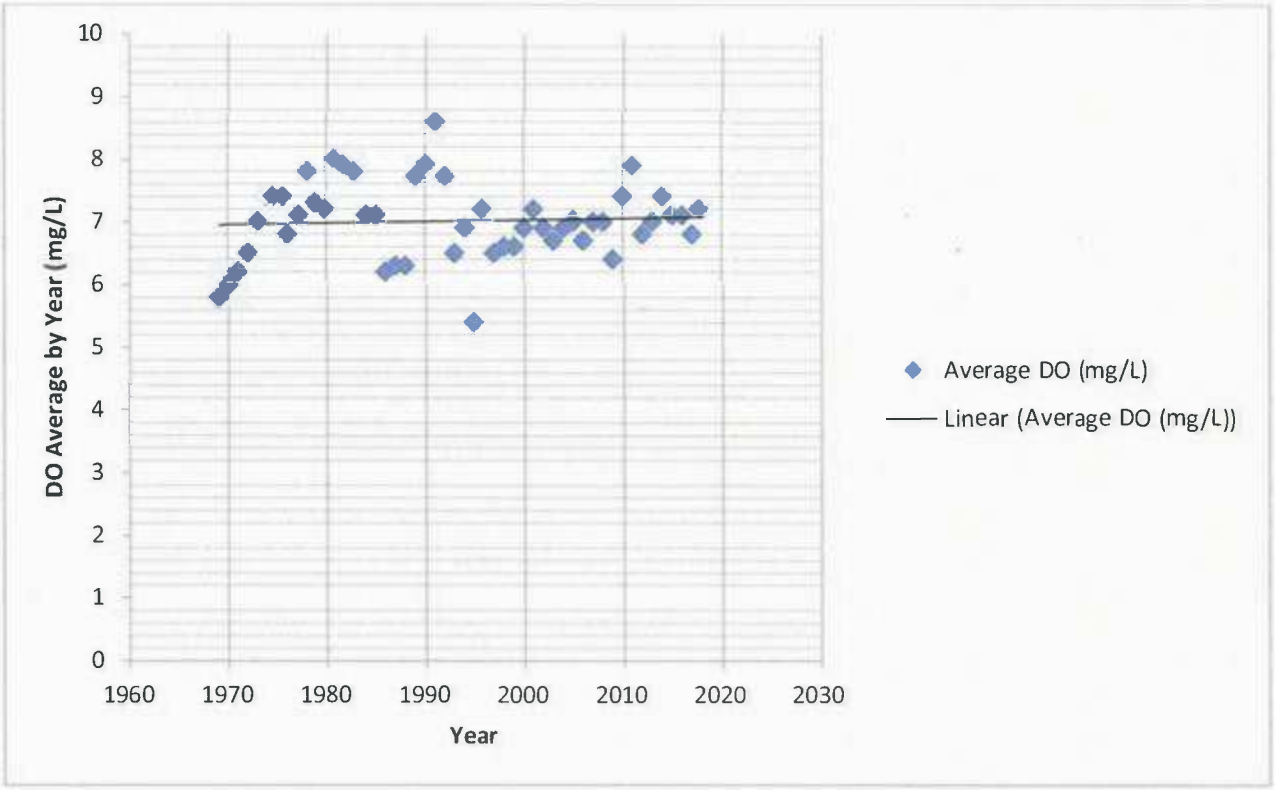
Regarding long term changes in DO due to the deepened channel geometry, past studies and data does not indicate such deepening would have long term, long-lasting effects on DO in the bay system as was the case with channel deepening in the lower James River and Elizabeth River modeling study and the largest change of average DO was 0.6 mg/L during summer (Shen et al., 2017). During the RCAP 2004 study, for the 2 sites nearest to the project location (Site 346 near the La Quinta Junction and Site 328 west of Harbor Island), Site 328 had a DO (mg/L) bottom concentration between 2.0 and 5.0 mg/Land was given a fair EPA rating and Site 346 had a DO (mg/L) bottom concentration greater than 5.0 mg/L with a good EPA rating per the RCAP 2004 study (Nicolau and Nunez 2006). Data that spans 1989, the year in which the deepening of the CCSC to its current 45-foot depth was completed, was reviewed. Table 1 below represents measured DO concentrations averaged by year from TCEQ water quality Stations 13426 and 13468 between the years 1969 and 2018 Station 13426 is located in the Red Fish Bay between Aransas Pass and Port Aransas. Station 13468 is located in the Gulf of Mexico at Port Aransas. Chart 1 illustrates a marginally decreasing trend in DO concentrations that reflects the expected minimal effects on DO for deepening a channel. Chart 2 illustrates a slightly increasing trend in DO concentrations and expected minimal change in DO for the Preferred Alternative.

Table 1: Average DO by Year at Stations 13426 and 13468

Year	Station 13426	Station 13468
	Average DO (mg/L)	
1969	-	5.8
1970	-	6.0
1971	8.9	6.2
1972	8.0	6.5
1973	7.7	7.0
1974	8.7	7.4
1975	7.7	7.4
1976	8.4	6.8
1977	7.8	7.1
1978	6.9	7.8
1979	7.5	7.3
1980	7.9	7.2
1981	8.2	8.0

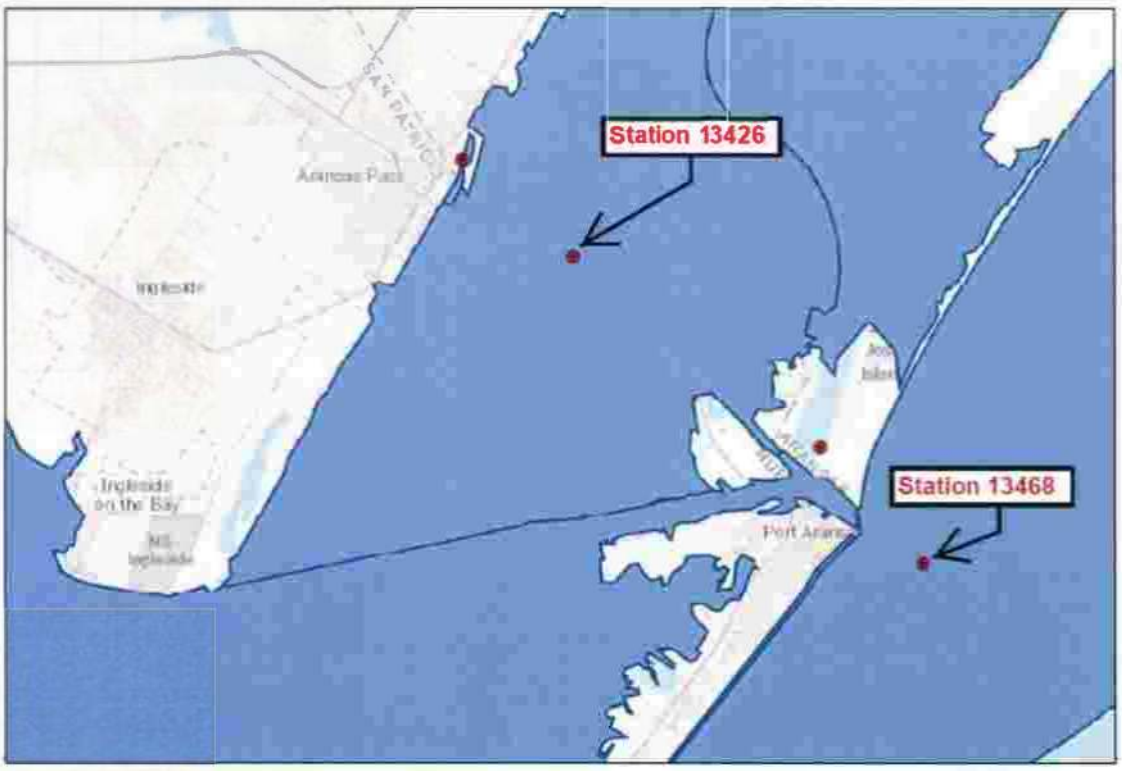
Year	Station 13426	Station 13468
	Average DO (mg/L)	
1982	8.0	7.9
1983	7.7	7.8
1984	7.3	7.1
1985	6.7	7.1
1986	6.8	6.2
1987	7.2	6.3
1988	6.7	6.3
1989	7.0	7.7
1990	7.4	7.9
1991	6.5	8.6
1992	7.5	7.7
1993	7.2	6.5
1994	9.2	6.9
1995	5.1	5.4
1996	6.9	7.2
1997	10.3	6.5
1998	7.2	6.6
1999	8.0	6.6
2000	6.1	6.9
2001	6.8	7.2
2002	7.7	6.9
2003	6.9	6.7
2004	7.5	6.9
2005	7.6	7.0
2006	6.3	6.7
2007	8.1	7.0
2008	6.4	7.0
2009	7.2	6.4
2010	7.6	7.4
2011	6.6	7.9
2012	6.6	6.8
2013	6.4	7.0
2014	7.5	7.4
2015	6.9	7.1
2016	6.6	7.1
2017	7.8	6.8
2018	-	7.2

Chart 1: DO Average by Year at Station 13468



TCEQ Surface Water Quality Web Reporting Tool (https://www80.tceq.texas.gov/SwqmisPublic/public/default.htm, accessed 9/12/2018)

TCEQ Monitoring Station Locations



TCEQ Surface Water Quality Viewer (2018)

Based on this data, the deepened channel is not expected to negatively influence DO long term. The CCSC is a well-mixed channel due to the passage of ship traffic averaging 12 calls of deep draft vessels per day according to economic analysis data. Therefore little to no stratification of the water column is expected.

Dredged Material Placement

Water quality effects at the placement end of the dredging operations are expected to be localized and temporary.

4.1.5.2. Sediment

No Action Alternative

No change in impacts to sediment quality would occur. Only periodic maintenance dredging and dredged material placement already performed for the existing channel would occur over the next 20 years, and would include the temporary and localized suspension of bottom sediments associated with those actions. Periodic maintenance testing conducted by the USACE would ensure sediment quality is appropriate for the planned placement under existing maintenance program.

Preferred Alternative

The existing and most recent sediment quality data discussed in Section 3.1.5.2 do not indicate contaminant issues for the channel segment of the Preferred Alternative. This includes the material most recently tested for the New Work ODMDS, which was sampled from the sediment strata between the existing 45-foot channel or undredged bay bottom and a 54-foot depth for the authorized Federal project. This strata is the top in-situ geological strata of the bay and Gulf bottom. Construction of the channel for the Preferred Alternative would dredge new work materials below this strata, and be even less exposed to potential human impacts. Therefore, dredging would involve uncontaminated sediments. The authorized Federal project included an entrance channel extension to the approximate -54 feet MLLW contour in the Gulf, and the Preferred Alternative would extend outward of that to the -80 feet MLLW contour. The sediments in this extension would be comprised of the undredged Gulf bottom down to the project depth. This segment of Gulf bottom would be expected to be similar to the authorized Federal project entrance channel extension in terms of sediment chemistry, as it is away from past potential industrial impact further inland, and only subjected to passage by transiting vessels. Therefore, similar to the results for the authorized Federal project entrance channel extension, the extension for the Preferred Alternative would not have any sediment quality issues. Considering this information, construction dredging for the Preferred Alternative would involve uncontaminated sediments, and no adverse impacts due to contaminants from dredging these sediments would occur.

Dredged Material Placement

Sediment testing for the authorized Federal project for Marine Protection, Research and Sanctuaries Act (MPRSA) Section 103 approval to dispose sediments offshore included biotoxicity and bioassay testing for whole sediment and elutriate to assess potential impacts to aquatic organisms in sediment and the water column during and after placement. This testing indicated no issues and supported offshore disposal of these sediments. Therefore, placement of dredged material for the Preferred Alternative would not be expected to have adverse aquatic impacts due to sediment chemistry when placed into existing PAs, used for raising or building PA or BU site containment dikes, used to restore shorelines, or otherwise beneficially used.

4.2 BIOLOGICAL RESOURCES IMPACTS

The following sections describe the anticipated impact to biological resources within the project area and the mainland surrounding the project area.

4.2.1 Vegetation and Habitats

The geospatial data for the proposed project channel, the proposed dredged material placement sites, and the geospatial data for aquatic habitat mapping described in Section 3.2.1 was used estimate the areas of impact to mapped habitat from the Preferred Alternative. The following sections describe impacts to vegetation and habitats from the No Action Alternative and Preferred Alternative.

4.2.1.1. Terrestrial

No Action Alternative

Under the No Action alternative, no impacts to terrestrial vegetation would result.

Preferred Alternative

No impacts to terrestrial vegetation would result from deepening the channel for the Preferred Alternative. Dredging of the channel would occur within the existing channel that is routinely dredged for maintenance, and consists entirely of open water and existing shallow and deep bay bottom.

Dredged Material Placement

Impacts to vegetation in upland dredged material placement areas are possible at proposed placement areas SS1, SS2, PA4, PA6, and SJI. Sites PA4, PA6, SS1, and SS2 are bay islands that have been either partially or entirely constructed with dredged materials. Vegetation at these sites is composed of typical estuarine or salt-marsh herbaceous species that would likely be temporarily impacted by dredged material placement. Many of these species are well adapted to a regularly fluctuating coastal environment, and grow quickly in flooded and disturbed environments. Temporary impacts as a result of dredged material placement would likely be short-lived and easily overcome by species accustomed to recolonization of flooded and sediment-laden areas.

4.2.1.2. Wetlands

No Action Alternative

Under the No Action alternative, no new impacts to wetlands or WOUS are anticipated.

Preferred Alternative

As shown in

Figure 3.2.1-1, there are no tidal wetlands mapped within the footprint of the existing channel. Impacts to wetlands would be completely avoided during construction of the proposed channel for the Preferred Alternative, as deepening would occur completely within deep water marine habitat. No dredging of the channel would take place in any wetland areas. However, dredging will occur within Waters of the U.S. (WOUS) but will remain within the existing channel constituting deeper WOUS. No other special aquatic sites (e.g., coral reef, refuges,

mud flats) would be impacted by the channel deepening. Table 4.2.1-1 summarizes the area of WOUS affected by the proposed channel of the Preferred Alternative, and the type of impact to Gulf or bay bottom. Of 1,728 acres of WOUS, approximately 1,265 acres or 73 percent, would be within the existing toes of the currently authorized Federal project channel, meaning the proposed action would mostly involve dredging a channel bottom at a depth of -54 feet MLLW to -77 feet MLLW (plus 2 feet advanced maintenance and 1 foot of allowable overdredge).

Dredged Material Placement

The proposed placement sites are in a variety of upland, aquatic habitat, and deep open water habitats. Wetlands and WOUS would not be affected by dredged material placement unless specifically targeted for restoration, beneficial use, or wetland habitat creation. Placement within BU sites M3, M4, M9 and M10 would involve filling of open water habitats within Corpus Christi Bay and permanent conversion of those habitats to estuarine or tidal marsh (beneficial use). Placement of fill at BU sites B1-B6 and the NW ODMDS would not result in impacts to wetlands. Wetlands present within the remaining placement areas would be avoided when possible, or specifically targeted for restoration where appropriate. To estimate the areas of WOUS consisting of open water, a land, shoreline and water geospatial data set sourced from ESRI and Texas Department of Transportation (TXDOT) was used and found to match aerial imagery well. To estimate the wetlands potentially present in the proposed placement sites, the NWI data described in Section 3.2.1 was used to identify potential mapped wetland habitat. Habitat features were clipped using the placement footprints and reviewed using a current ESRI aerial (2017) to verify the nature of mapped features, since NWI mapping may include extraneous disturbed or manmade features such as artificial ponds or active placement areas, or areas may have been eroded or developed since the mapping. Since open water was being calculated with a different dataset, the deep water feature data from NWI was not used.

Table 4.2.1-2 summarizes the acreage of mapped wetlands and the results of aerial review to determine the nature of mapped features. The comment column explains the nature of the wetland feature and consideration of the proposed placement. In several cases, the NWI identified features in an active PA. In others, the feature had eroded away. In various cases, the BU feature is a shoreline restoration that would protect resources in the interior of the BU feature, such as M4, and most of the acreage identified would be comprised of habitat that would not be directly impacted. The bottom of the table summarizes, after considering the aerial review and nature of the proposed BU or placement, the acreage that would likely be impacted. For each impact at each site, measures that could minimize or replace the impacted habitat are identified. Note that the total site acreage (5,251 acres) is exceeded by the sum of all habitat types, including WOUS (5,861 acres). This signifies that some mapped areas overlap, partly due to coming from different sources, but also because wetlands and seagrass can occur as subsets of shallow open water. Of the 721.5 acres of mapped features not inside of an active PA and not eroded, most (512.2 acres) is the beachline proposed for restoration on San Jose Island, and 68 acres would be avoided or integrated into planned restoration at M4. The remaining 141.5 acres would be estuarine intertidal unconsolidated shore, which is topographically high tidal and wind-tidal flats, at BU site SS1.

4.2.1.3. Submerged Aquatic Vegetation (SAV)

No Action Alternative

Under the No Action alternative, no direct, immediate impacts to SAV would occur. However, gradual erosion of island shorelines at Harbor Island and Dagger Island and sea level rise could expose large areas of seagrass to more natural and man-made erosive forces and loss of large areas of SAV. Dagger Island is a low-lying island composed of accreted sand, mud and shell that has experienced erosion and subsidence attributed to various natural and human causes including natural wind fetch waves, vessel wakes, and historic sea level rise (Chaney and Blacklock 2003, TPWD 2018d). It is the subject of various restoration projects and plans by TPWD, TGLO,

and USACE to prevent further island loss to protect the interior seagrass and marsh area (TGLO 2017, USACE and TCEQ 2017, USACE 2018d). Harbor Island has experienced gradual erosion over many years, being located in Aransas Pass and subject to a variety of frequent tidal currents, vessel wakes, tropical storm surge flows and wave forces. Figure 4.2.1-1 below illustrates the progression of this erosion at PA 4 on Harbor Island using a series of historical aerials available through Google Earth. The aerials were used to demarcate the shoreline changes from 1985 through 2017. Shoreline retreat is clearly visible, especially along the narrower, western end of PA 4. Referencing Figure 3.2.1-2, there is a large area of mapped seagrass behind Harbor Island. This is the area to the north of PA 4 seen in Figure 4.2.1-1. At the rate of recession seen in the 32 years documented by the aerial imagery, the shoreline could be breached, and seagrass areas exposed to the same erosive forces could result in losses of SAV. At the western end of Harbor Island where proposed placement SS1 would be located, aerials were also used to demarcate the shoreline changes from 1956 through 2017. Figure 4.2.1-2 shows the gradual retreat of the shoreline at this location. Between 1956 and 1979, there was a large loss of land mass as the shore retreated into former areas of seagrass. The shoreline changes have been smaller since, but still show some overall retreat. If no intervention was taken, the retreat would be expected to continue, with areas of open water replacing former seagrass area.

Preferred Alternative

The proposed channel for the Preferred Alternative would have no direct impacts on seagrasses as they are not present within the project footprint. During construction, no significant indirect impacts would be expected to seagrass from temporary turbidity. This is because the new work dredging is limited to a segment of the CCSC that is still separated from the seagrass areas by Harbor Island, the dredging would occur in the deeper part of the existing CCSC, and turbidity would be limited in extent to the area around the dredging activity due to the nature of hydraulic dredging discussed in Section 4.1.5.1.

Table 4.2.1-1 Channel Impacts to Gulf, Estuarine Bottom and WOUS

Channel Impacts to Waters of the U.S.		Channel Acres		
Segment	**Impact**	**Toe to Toe**	**Total Including Side Slope**	**Side Slope Acreage**
New Entrance Channel Extension	Deepening from natural depth (varies -62 ft to -80 ft MLLW) to -77 ft MLLW + 2 ft adv. maint.+ 1 ft overdredge **(-80 ft MLLW)**	639.6	770.3	130.7
CCSCIP Authorized Entrance Channel Extension	Deepening from -56 ft MLLW to -77 ft MLLW + 2 ft adv. maint + 1ft overdredge **(-80 ft MLLW)**	160.7	272.4	111.7
Existing Channel	Deepening from -56 ft MLLW to -77 ft MLLW +2 ft adv. maint +1 ft overdredge (-80 ft MLLW) and from -54 ft MLLW to -75 ft MLLW +2 ft adv. maint +1 ft overdredge **(-78 ft MLLW)**	428.2	685.5	257.3
Turning Basin (area outside of the existing basin footprint) and Flare	Deepen portions of the Lydia Ann Channel from between -54 ft MLLW to **-75 ft MLLW**	36.1	-	-
TOTAL		1,265	1,728	

Table 4.2.1-2 Area of Mapped Aquatic Habitat in Proposed Dredged Material Placement Sites

Site ID	Total Site Acres	Mapped Habitat					Open Water WOUS (acres)
		Wetland			Seagrass		
		Acres	Predominant Type	Comment	Acres	Comment	
B1	124.0	-	-	-	-	-	124
B2	124.0	-	-	-	-	-	124
B3	124.0	-	-	-	-	-	124
B4	124.0	-	-	-	-	-	124
B5	124.0	-	-	-	-	-	124
B6	124.0	-	-	-	-	-	124
M3	361.3	-	-	-	17.1	Restoration of larger area to create estuarine/aquatic habitat including elevations suitable for seagrass establishment.	361.3

Site ID	Total Site Acres	Mapped Habitat					Open Water WOUS (acres)
		Wetland			Seagrass		
		Acres	Predominant Type	Comment	Acres	Comment	
M4	685.9	68.0	Estuarine and Marine Wetland	Interior wetlands would be avoided and placement to restore shoreline would be integrated with exterior wetlands. Design of project elements will be coordinated to support TPWD's existing permitted project.	559.0	Interior acreage would not be impacted except at fringes. BU feature would protect this from further loss. Design of project elements will be coordinated to support TPWD's existing permitted project.	554.7
M9	329	-	Estuarine and Marine Wetland	-	3.1	Restoration of larger area to create estuarine/aquatic habitat including elevations suitable for seagrass establishment.	329
M10	770	-	Estuarine and Marine Wetland	-	2.5	Restoration of larger area to create estuarine/aquatic habitat including elevations suitable for seagrass establishment.	770
NW_ODMDS	1,180.4	-	-	-	-	-	1,180.4
PA4	163.1	51.5	Freshwater Emergent Wetland	Identified within active PA or Feature appears to have eroded away	0.01	Minor impact. BU would protect much larger seagrass area from future losses.	35.7
PA6	331.9	174.6	Lake	Identified within active PA	-	-	2.1
SJI	265.7	512.2	Estuarine and Marine Wetland	Consists entirely of shoreline to be restored	-	-	107.8
SS1	325	141.5	Estuarine and Marine Wetland	Would be replaced by created upland to protect seagrass area behind it from future loss	96.8	Restoration of shoreline to bolster against future erosion of much larger area of seagrass behind feature	134.9
SS2	94.8	36.5	Estuarine and Marine Wetland	Eroded away during Harvey	-	-	-
TOTALS	5,251.4	984.3			679.0		4,219.9
						Sum of all Habitats	**5,883.2**
Summary of Aerial Review of Mapped Habitat							
		262.6	Portion inside an active PA or eroded away		559.0	Portion in interior to be largely avoided	

Site ID	Total Site Acres	Mapped Habitat					Open Water WOUS (acres)
		Wetland			Seagrass		
		Acres	Predominant Type	Comment	Acres	Comment	
						except at fringes, and would be protected by proposed BU.	
		721.7	Portion not inside an active PA (WOUS)		22.7	Portion that BU can be reconfigured to replace impacted seagrass acreage	
		512.2	Portion to directly restore as beach or dune (SJI)				
		68.0	Portion avoided or that would be integrated (M4)				
		141.5	Portion that would be impacted		96.8	Remaining portion that would be impacted by SS1	
		141.5	Portion that would be directly impacted by BU feature (SS1)				
Sum of Estimated Wetlands, Seagrass, and Open Water WOUS that would be impacted							
						Wetland WOUS	721.7
						Seagrass WOUS	119.5
						Open Water WOUS	4,219.9
						Total WOUS	5,061.1

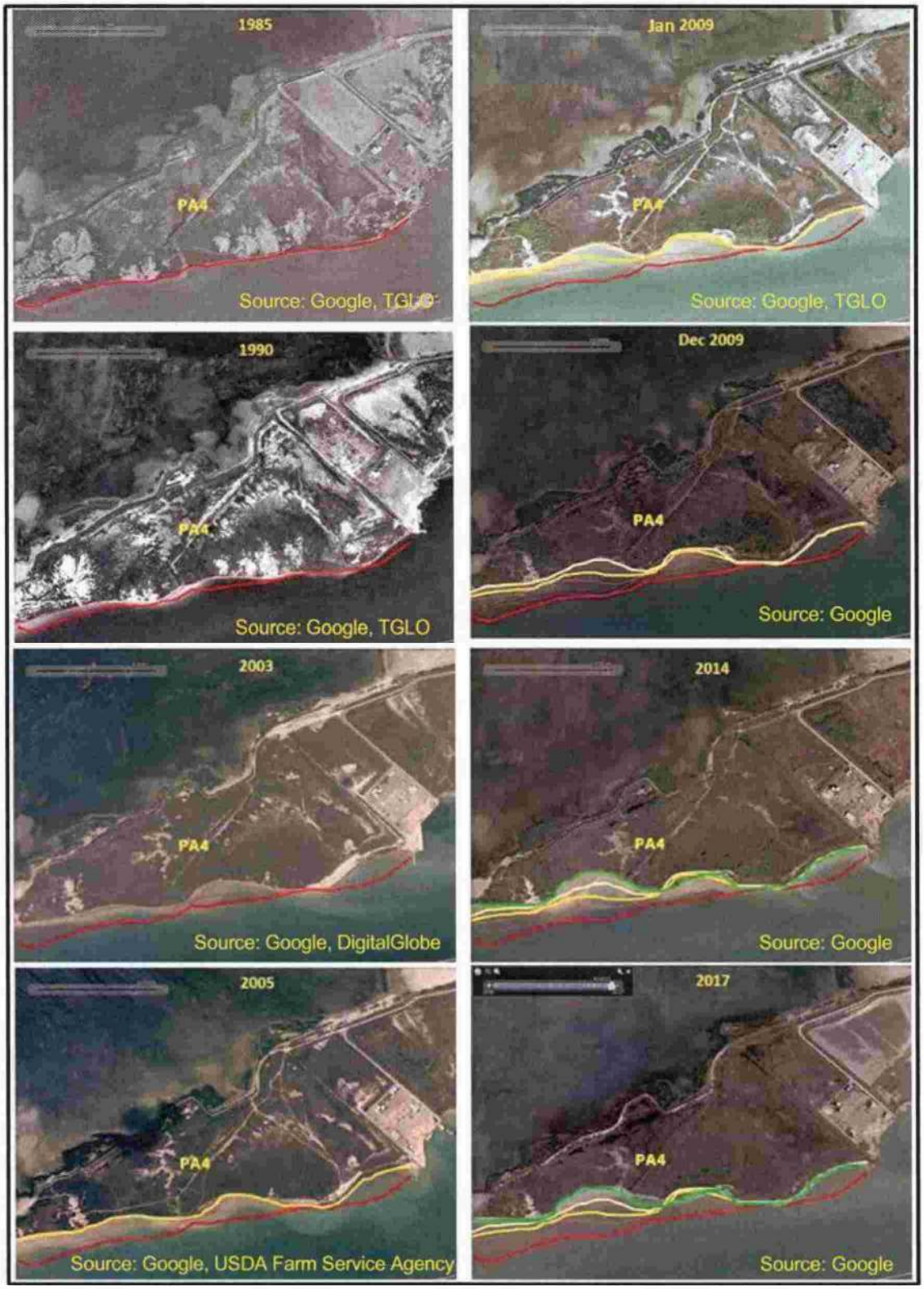


Figure 4.2.1-1 Shoreline Retreat at PA4 on Harbor Island

Figure 4.2.1-2 Shoreline Retreat at West End of Harbor Island

Dredged Material Placement

The proposed dredged material placement sites contain areas where seagrass has been mapped. Table 4.2.1-2 summarizes the acreage of mapped seagrass. Similar to the wetlands, aerial imagery was reviewed to ascertain the nature of these areas. Of the 679 acres of mapped seagrass, 559 acres would be grasses in the interior portion of a BU site being restored for protection of interior resource, and 22.7 acre would be within larger areas being restored to provide habitat conducive to either intertidal marsh or seagrass. The remaining 96.8 acres would be within the shoreline restoration of SS1, which would benefit larger areas of seagrass by offering protection. All of these areas are BU sites where dredged material would beneficially be used to either 1) restore deep open water areas to shallow bathymetry to support either establishment of intertidal marsh or seagrasses, or 2) restore eroding shorelines that would protect large areas of seagrass. Therefore direct impacts to seagrass within the placement

footprint would be offset by the ecological restoration that could either allow more area for the reestablishment of seagrasses or protect them from erosion. The proposed BU sites PA4 and SS1 would use new work material to restore eroding shoreline and land at Harbor Island that currently protects a large area of seagrass behind the island. This would help protect hundreds of acres of seagrass that could be exposed to erosive forces if the shoreline is allowed to be breached with continued erosion that could occur under the No Action Alternative. Though SS1 would impact some existing seagrass at the margins of the eroding land mass, the BU would restore lost land mass that allowed a large area behind the original shoreline in 1956 to become open water as discussed under the No Action Alternative. This BU would bolster protection of the larger seagrass area behind the current shoreline. The proposed BU site M4 would consist of providing material for any of the restoration projects at Dagger Island that aim to restore shoreline and subsided island land mass to protect the large seagrass areas for from further future loss that could occur under the No Action Alternative. For BU sites M9 and M10, the minor amounts of seagrass fringing the existing PAs 9 and 10 would be impacted by placement. However, this placement would be used to create larger areas suitable to restore tidal marsh or seagrass. Considering the nature and objective of these BU sites to protect or provide more area conducive to seagrass, the proposed placement would be expected to positively impact seagrass and not result in significant adverse impacts to this resource.

4.2.1.4. Tidal Flats and Beaches

No Action Alternative

Under the No Action alternative, no new immediate impacts to tidal flats and beaches would occur. However, Hurricane Harvey severely eroded several areas in the region causing breaches in protective shoreline that could expose beach and tidal flats to further or accelerated erosion. Two examples are at San Jose Island, and the sand flats at Salt Island at the Port Aransas Nature Preserve located on Mustang Island. At San Jose Island, landfall of the hurricane caused massive erosion of the beach and dune system at the south end of the island, and significant erosion along the entire foreshore. Figure 4.2.1-3 shows aerial imagery before and after Hurricane Harvey. Note the large erosion cuts in the August 2017 photo that breached the dune line after Hurricane Harvey. An oblique aerial view of a large dune breach is shown in Figure 4.2.1-4. Some of these former dune areas have appeared to turn into tidal flat areas by degradation of the primary frontal dunes. Approximately six major breaches ranging in size between approximately 15 and 35 acres resulted, and an estimated 7.5 million cubic yards of sand was lost on the whole island according to post-storm Light Detection and Ranging (LiDAR) analysis (FEMA 2018). Barrier islands such as San Jose, and their dune systems, provide important storm protection of the mainland and bayside resources (such as marsh, algal flats, and seagrass) by absorbing storms' wind and wave energy, diminishing these forces leeward of the barrier island. Without any repair of the beach and primary frontal dunes, future storms could accelerate erosion across the barrier island, and would provide less protection to habitat behind it, such as algal and wind tidal flats on San Jose Island, and tidal marsh and seagrasses on Harbor Island. Additionally, the beach and dune system provide important habitat for T&E species described in Section 3.2.4 and constitutes critical State coastal zone resources described in Section 3.2.6. Besides hurricane damage, the Gulf-side shorelines, on Mustang and San Jose Islands experienced an average erosion of 2 or more feet per year from 1930 to 2012, as described in Section 3.2.6. Therefore over the long term, these barrier island beaches can be expected to retreat gradually, resulting in loss of beach and the associated coastal habitats.

At Salt Island in the Port Aransas Nature Preserve, the hurricane breached the shoreline on the north that used to protect the sand tidal flats to the south in the interior of this site from tidal currents and vessel wakes from the pass and CCSC located north of the site. Figure 4.2.1-5 shows pre and post-Hurricane Harvey aerials with white arrows pointing to the breaches in the 2018 photograph. With three cuts now providing channels into the interior of Salt Island, daily tidal current flows and vessel wakes from the north can enter and further erode sand flat material away. Previously, tidal exchange only came from smaller protected cuts to the south. The sand flats are

also Piping plover critical habitat described in Section 3.2.4. Without repair of these breaches, daily inflow from tides and vessel wakes from the north could wear away material, reducing the area of tidal flats.

Figure 4.2.1-3 South End of San Jose Island Before and After Hurricane Harvey

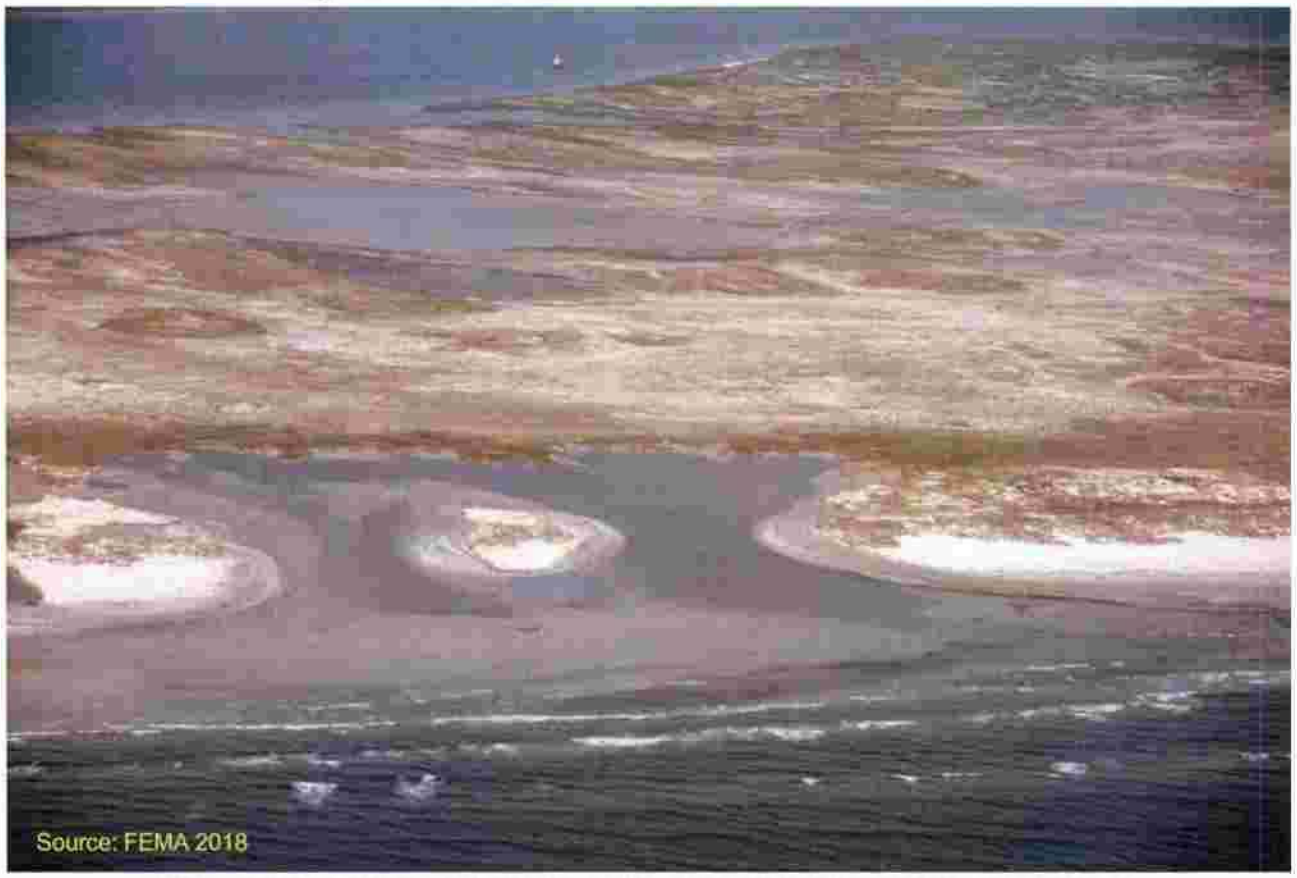


Figure 4.2.1-4 View of a Major Dune Breach at South End of San Jose Island

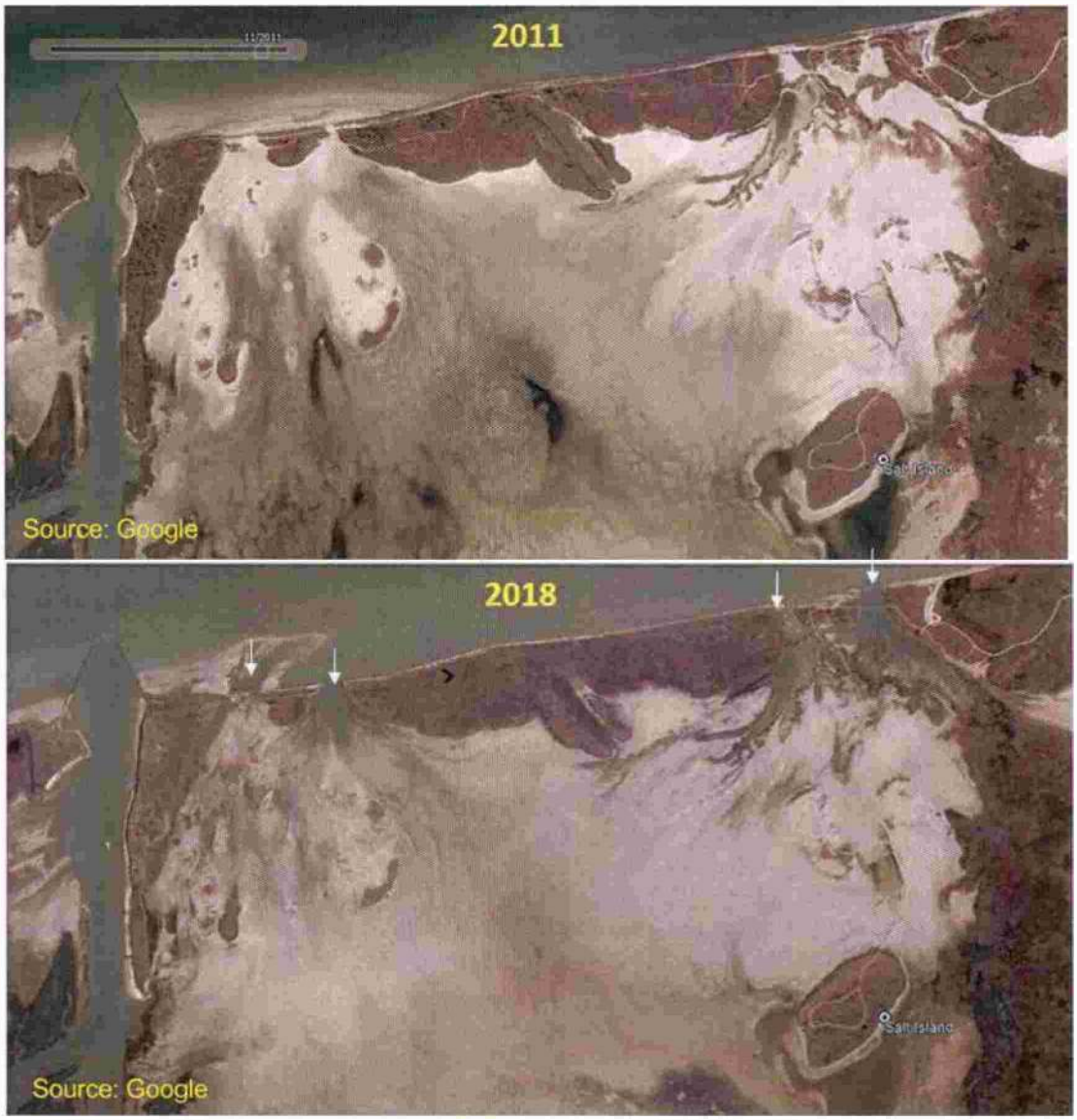


Figure 4.2.1-5 Salt Island Area on Mustang Island with Shoreline Breaches (white arrows) following Hurricane Harvey

Preferred Alternative

The proposed channel of the Preferred Alternative does not directly impact any tidal flats or beaches. Therefore construction dredging to implement the proposed channel deepening would not impact these resources. The effects from proposed dredged material placement are discussed below.

Dredged Material Placement

As discussed in Section 3.2.1.4, minor areas of tidal flats were mapped by the national estuary program on the fringes of Pelican Island, PA 9 and PA 10, Harbor Island near SS1, and near SS2. The proposed dredged material placement for the Preferred Alternative at Pelican Island (M3), PA 9 and PA 10 (M9 and M10) would use

material to build containment dikes along the fringes and outward of these sites and then fill them with dredged material to create tidal marsh or seagrass extensions to these sites. Since the flats on these sites were created from previous dredged material placement to construct the original PAs, as discussed in Section 3.2.1.4, it is expected that material used to create containment dikes of the extension could similarly result in creating flat, barren, unconsolidated shoreline that formed these flats. Containment dikes can be designed or graded to provide similarly flat areas. At proposed BU site SS1, dredged material would be placed then armored to repair the eroded shoreline at Salt Island described in the No Action Alternative, to protect the sand flats.

At San Jose Island, the SJI BU site would be proposed to place compatible sand material to restore the dune system and repair the eroded beach line and foreshore. Also, proposed BU sites B1 through B3 would consist of feeder berms constructed of suitable dredged material placed offshore in the zone where waves and shoreward currents would gradually transport material and indirectly nourish (i.e. feed) the beach with restorative sediments. Similarly, BU sites B4 through B6 would also provide feeder berms to indirectly nourish the Mustang Island beach. Since these sites are designed to be dispersive to gradual provide shore material, they will not be permanent. However, these sites are proposed as O&M options to be used for future compatible dredged maintenance material. In this context, these BU sites could help offset the long term erosion discussed in the No Action Alternative.

Considering that most of the sites described would be directly beneficial for tidal flat or beach resources, and that minor flat areas resulting from construction of the existing PAs could result or be recreated, the proposed placement would not be expected to result in significant, adverse impacts to tidal flat or beach resources.

4.2.1.5. Open Water

No Action Alternative

Under the No Action alternative, no new impacts to open deep water marine habitat would occur.

Preferred Alternative

New work dredging to construct the proposed channel for the Preferred Alternative would only have temporary effects to the open water column described under Section 4.1.5.1 for water quality. There would be no permanent impact or loss of open water habitat due to construction of the proposed channel. The acreage of open water was described

Dredged Material Placement

The proposed dredged material placement at BU sites M3, M9 and M10 would convert open water marine habitat to other forms of shallow water or periodically inundated aquatic habitat such as seagrass or tidal marsh. Placement at BU sites PA4, SS1, SS2 and M4 would convert some current open water areas to shoreline and land mass, to restore former areas of coastal shoreline and island land mass that protect other aquatic resources. Construction of BU feeder berms B1 through B6 would temporarily fill part of the water column with sands meant to nourish beaches shoreward of the berms, but would typically still leave 18 feet of depth, and would therefore not permanently remove open water habitat. Similarly, the planned use of the existing and approved NW ODMDS would be a placement of new work material which would temporarily fill part of the water column, and has been modeled using the USACE MPFATE computer software to ensure adequate dispersive capacity of the site and planned placement. Considering the planned placement, purposes, and ubiquity of open water marine habitat in the project area, no significant adverse effects to this type of habitat would occur.

4.2.1.6. Hard Bottom Oyster Reef Habitat

No Action Alternative

Under the No Action alternative, no new impacts to hard bottom oyster reef resources would occur.

Preferred Alternative

As shown in

Figure 3.2.1-1, there is no mapped reef in the project footprint of the proposed channel for the Preferred Alternative. No direct impacts would occur. Also, no significant indirect impacts from new work dredging would occur due to the limited extent of turbidity effects during hydraulic dredging discussed in Section 4.1.5.1 and the distance to the nearest mapped reef 9 or more miles away in the upper part of Corpus Christi Bay.

Dredged Material Placement

There is no mapped reef within the footprint of any of the dredged material placement sites proposed for use in the Preferred Alternative. No direct impacts to oyster reef would occur due to the use of these sites. No significant adverse effects on oyster reef would result from the proposed placement for the Preferred Alternative.

4.2.2 Wildlife

4.2.2.1. Terrestrial

No Action Alternative

Under the No Action alternative, no impacts to terrestrial wildlife are anticipated.

Preferred Alternative

The deep water marine environment within the project footprint does not contain any terrestrial resources that may be impacted by the Preferred Alternative. No impacts to terrestrial wildlife or habitat would result from the channel deepening. Channel dredging will occur within the existing channel that is routinely dredged for maintenance.

Dredged Material Placement

Terrestrial wildlife may be temporarily impacted by dredged material placement on PAs PA4, PA6, SS1, SS2, and SJI. Construction and placement activities may cause some temporary, localized avoidance in typical species expected to occur in this area such as shorebirds, amphibians, and reptiles. Wildlife accustomed to tidal habitat will be highly mobile and able to avoid impacts as a result of collision with construction equipment. Additionally, the above placement areas are located a short distance away from the existing CCSC, and terrestrial wildlife in the bay will likely be adapted to regular channel traffic and maintenance activities. Therefore, impacts to habitat and temporary displacement similar to impacts that may occur during routine, maintenance channel dredging are the most likely impacts as a result of dredged material placement in terrestrial areas.

4.2.2.2. Aquatic

Aquatic habitat within the project area includes open-bay water, open-bay bottom, and intertidal habitats. Temporary and minimal impacts to aquatic life in the project area and immediate project vicinity similar to what occurs during existing channel maintenance dredging could occur as a result of increased turbidity, lower dissolved oxygen, sedimentation, noise, light, and vessel activity during the construction period. Turbidity may temporarily affect the respiration, foraging, and/or reproductive capability of some species. Dredge operation vessel traffic could increase wave activity and water uptake/discharge, while dredging activities may also result in temporary avoidance of the project area and a temporary and very localized reduction in marine life production. Dredging activities would be intermittent and localized. These impacts are considered temporary and of short duration.

4.2.2.2.1. Benthic

The benthic species found in Corpus Christi and Aransas bays are dominated by polychaetes (Flint and Kalke 1986), and Flint and Younk (1983) found channel stations (15 m deep) had lower species numbers, densities and species diversity than shoal stations (<3.5 m deep). It can be assumed that dredging would result in mortality to the benthic infaunal community present within the dredged material footprint, and the turbidity and settling resulting from dredge operations has the potential to smother sessile benthic organisms or inhibit filtration functions necessary for feeding and respiration. The temporary suspension of organic material during dredge operations may cause temporary lower dissolved oxygen which may cause temporary displacement of mobile organisms and may stress or cause mortality to sessile organisms. These effects would be temporary and minor due to the nature of hydraulic dredging as suspended sediments would be expected to return to background levels within a short timeframe and would also be similar to what occurs during current channel maintenance dredging.

The recolonization of disturbed areas by opportunistic species has been reported many times (Grassle and Sanders, 1973 Thrush and Dayton 2002, Ray 2001, Kaiser et al. 1998, Thistle 1981). Lewis et al. (2001) studied dredging impacts to a Florida bayou benthic habitat and found that while dredging significantly reduced benthic diversity and density ($P<0.05$), the impact was localized and short-term.

As the CCSC is already an existing active navigational channel which undergoes routine maintenance dredging, the benthic community that is present is likely adapted to frequent dredging disturbance. As such, the impact to benthic infauna would be considered a temporary, short-term impact.

Dredged Material Placement

Placement of dredged material for the Preferred Alternative would be expected to have adverse impacts to benthic organisms when placed into existing PAs, used for raising or building PA or BU site containment dikes, used to restore shorelines, or otherwise beneficially used; though the disturbance would be expected to be temporary as recruitment of benthic organisms into the placed sediment would be relatively rapid. Wilber et al. (2008) studied the response of benthic infauna to large scale disturbance by dredged material placement at eight paired (placement and reference) areas in Corpus Christi Bay in the mid-1990s. The authors concluded that after approximately one year after placement there was no longer a difference in total infaunal abundance, taxa richness or the biomass of annelids and molluscs between the placement and reference areas. They stated that the differences in community structure between placement and reference areas returned to pre-placement levels only one year after the disturbance.

4.2.2.2.2. Phytoplankton and Macroalgae

Macroalgae within the dredge footprint as well as phytoplankton in the water column would be entrained in the operations and would not survive. Additionally, the temporary increased turbidity would interfere with light penetration and would reduce the photosynthetic activity of phytoplankton and macroalgae found in the immediate area of the dredging operations as well as at the placement sites. The effect of turbidity would be limited to the spatial and temporal extent of the plume, and would be expected to be localized and temporary.

Dredged Material Placement

Placement of dredged material for the Preferred Alternative would be expected to have adverse impacts to existing benthic macroalgae when placed into existing PAs, used for raising or building PA or BU site containment dikes, used to restore shorelines, or otherwise beneficially used. No impact from placement of dredged material other than localized and temporary turbidity impacts would be expected to phytoplankton.

4.2.2.2.3. Zooplankton

Impacts to free-floating or limited-mobility pelagic fauna (zooplankton, and fish eggs and larvae) would be temporary and minor. These impacts, such as entrainment into cutterheads or vessel cooling water intakes and discharges would be temporary and minor. This is due to the amount of water exchange involved being volumetrically insignificant compared to the Bay. The ubiquity and high turnover in populations of these types of fauna would quickly replace any impacted organisms. These temporary impacts are the same that occur during maintenance dredging.

The increased depth of the proposed project would slightly alter the currents through the channel. Smith and Stoner (1993) used a two-dimensional computer model to investigate the long-term net advective transport of larvae through Aransas Pass and found that non-tidal transport and larval retention mechanisms in adjacent shallow waters can dominate long-term net transport associated with the ebb and flood of the tide. In their model for Aransas Pass a + 1 cm s^{-1} change in current speed changes transport by $\pm$290 x 103 larvae h^{-1}. Brown et al (2000) found that passive particles that are transported into the CCSC at the current depth tend to remain in the channel. Therefore no impact to larval recruitment would be expected from the proposed project.

Dredged Material Placement

Placement of dredged material for the Preferred Alternative would not be expected to have adverse impacts to existing zooplankton when placed into existing PAs, used for raising or building PA or BU site containment dikes, used to restore shorelines, or otherwise beneficially used.

4.2.2.2.4. Typical Fish Assemblages and Nonmanaged Species

Impacts to typical fish assemblages and nonmanaged species would be the same as those expected to commercial and recreational fisheries, which is described in Section 4.2.4.

Dredged Material Placement

Impacts to typical fish assemblages and nonmanaged species due to dredged material placement would be the same as those expected to commercial and recreational fisheries, which is described in Section 4.2.4.

4.2.2.2.5. Oyster Reefs

As discussed in Section 3.2.1.6, oyster reefs are not found within or immediately adjacent to the channel for the Preferred Alternative. Therefore no impact to oyster reefs would be expected from constructing the channel for the Preferred Alternative.

Dredged Material Placement

Placement of dredged material for the Preferred Alternative would not be expected to have adverse impacts to oyster reefs when placed into existing PAs, used for raising or building PA or BU site containment dikes, used to restore shorelines, or otherwise beneficially used as material would not be placed over existing oyster reefs.

4.2.3 Essential Fish Habitat

EFH has been described over broad spatial scales throughout the coastal Gulf of Mexico region; therefore it is difficult to propose any large scale project without impacting EFH for some species.

The majority of impacts to managed species and their associated EFH would be limited to the estuarine benthic environment where the actual dredging would take place, as well as temporary impacts to the water column as a result of increased turbidity. The life stages anticipated to be most impacted are the eggs and larval stages, with those utilizing benthic habitats within the dredged footprint expected to have 100 percent mortality. The majority of the juvenile and adult lives stages present in the project footprint are primarily forage and pelagic species capable of detection and avoidance behavior when exposed to unfavorable conditions. It is expected that construction of the proposed project would not have any direct impacts to juvenile and adult fish other than a temporary displacement; individuals would re-inhabit temporarily affected areas upon dredging completion. Some species might be attracted to the area if lighting is used at night, but this would be a temporary and minimal impact to water column EFH. No aquatic vegetation has been identified in the dredged areas, but is found in limited areas of adjacent buffer zone; therefore minimal impacts to seagrass and the nursery habitat it provides to juvenile fish may occur from the proposed project if quantifiable turbidity and sedimentation occur in these limited areas. Only minimal impacts to benthic EFH are expected to occur.

The dredging would occur in the estuary of Corpus Christi Bay, which is a nursery area for some species known to inhabit the GOM. The degradation of coastal and estuarine EFH habitats is associated with the following:

- Temporary disturbance and displacement of fish species;
- Increased sediment loads and turbidity in the water column and perhaps in limited SAV areas;
- Temporary loss of benthic food items to fisheries; and
- Limited sediment transport and re-deposition.

For the purposes of this project, most of the above effects are temporary and likely either offset by environmental protection guidelines, or are negligible considering the localized effect of the actions compared to the proportional area of the Gulf that would be unaffected. In this sense, the coastal and marine environmental degradation from the proposed action would have minor effects on designated EFH or commercial fisheries.

Turbidity generated by the project could affect the foraging behavior of visual predators and the efficiency of filter feeders. The turbidity plume would be expected to migrate only a short distance and cover a small area

relative to the total pelagic habitat area available to managed species, and dissipate quickly due to prevailing water circulation and the nature of hydraulic dredging proposed to be used. The impact to the water column EFH would be considered minor and short-term.

Deposition of suspended sediments could partially or entirely bury shellfish and other sessile organisms, but is not expected to impact oyster habitat as there is none in close proximity to the project. There are no known areas of commercially important sessile organisms.

The proposed project is not in or near any of the areas identified as HAPC. These areas are all located offshore. Therefore, no impacts to HAPC are anticipated through the completion or maintenance of the proposed project.

4.2.4 Commercial and Recreational Fisheries

No commercial or recreational fishing would be allowed to occur within and near the dredging operations. The commercial fishing widely done in Corpus Christi Bay is trawling for shrimp species. The trawlers typically avoid active shipping lanes and would be required to avoid the areas of dredging and placement operations. Blue crab is another shellfish species frequently landed, but the eastern oyster is a very minor component of the total landings in Corpus Christi Bay. The entire length of CCSC is documented as restricted for shellfishing and is therefore closed to the harvest of molluscan shellfish. Due to the closure, the project will not impact commercial shellfishing.

All recreational fishing would not be allowed within and near the dredging and placement operations. The CCSC system already supports extensive vessel traffic and is a focal point for commercial marine transport in the Corpus Christi Bay system. While the recreational landings associated with Corpus Christi Bay contribute a considerable amount to the State total, the majority of this is shore-based fishing and not done within or near the project area. Any recreational fishing that is done within the project area could resume upon completion of dredge operations. Therefore, no disruption to recreational fishing is expected to occur during the initial construction or periodic maintenance dredging events.

Dredged Material Placement

Placement of dredged material for the Preferred Alternative would not be expected to have significant adverse impacts to commercial and recreational fish stocks when placed into existing PAs, used for raising or building PA or BU site containment dikes, used to restore shorelines, or otherwise beneficially used similar to the preferred alternative impacts. Pelagic fish are highly mobile species that could move out of the temporary areas of discharge where placement would occur to build in-water containment dikes. Use of diffusers, downspouts, spill barges and controlled opening of scow or hopper doors would focus the placement of material at in-water sites to limit the area of disturbance and turbidity. Temporary effects to water quality for in-water placement are described in Section 4.1.5.1. The same construction techniques that have been used successfully in the past in Corpus Christi Bay and elsewhere in Texas and the nation for building ecologically beneficial use sites would be employed. The proposed placement includes several BU sites that would result in the creation or protection of tidal marsh and seagrasses, which are important nursery habitats to many managed and game fish species. The proposed placement is not expected to result in significant adverse effects commercial or recreational fisheries.

4.2.5 Threatened and Endangered Species

The following sections describe alternatives' impacts on T&E species found in the project area, and any critical habitat identified in the project area.

4.2.5.1. Species

No Action Alternative

The No Action alternative would not result in new, increased, or unexpected threats to rare, threatened, and endangered species in the project area.

Preferred Alternative

Federally listed T&E species that may be present within the project area include the Kemp's ridley sea turtle, loggerhead sea turtle, green sea turtle, Piping plover, and Rufa Red knot. Other species listed are not likely to occur in the vicinity of the project due to lack of suitable habitat or the area is beyond their known range limits. The project area does not involve habitat required for oceanic species (e.g. Blue whale, coral). Impacts to threatened and endangered species as a result of channel deepening would be both minor and temporary. The CCSC already experiences high traffic volumes and routine maintenance dredging, and any organisms inhabiting or traversing the marine environment of the channel would likely be adapted to regular disturbance as a result of these activities. Except for the Loggerhead turtle, there is no designated critical habitat for any of the listed species within the channel footprint. For species using estuarine habitats, the specific habitat required for regular use by most of those species is not present within the channel footprint, including those for the Piping plover, Red knot, and West Indian manatee. Therefore, constructing the Preferred Alternative would not impact these species. The effects of the project on federally listed species are considered in detail in the BA provided in Appendix B.

Hydraulic cutterhead dredges (non-hopper) would be anticipated to be used primarily for construction of the Preferred Alternative channel. Non-hopper dredges are not known to take sea turtles (NMFS 2003). As such, new work dredging for construction the channel of the Preferred Alternative would have no direct effects on any listed sea turtle species within the area when dredged by hydraulic cutterhead. Avoidance of use of transient forage habitat in the Bay by sea turtles due to dredging noise and light would be the same as currently occurs during periodic maintenance dredging. This may effect but is not likely to adversely affect sea turtle species using the Bay for transient foraging habitat, as plenty of directly adjacent habitat would be available during the temporary construction. Given the transient use and the temporary nature of the construction, occurrence of the effect would be unlikely but possible. Hopper dredging may be used for channel segments where material and placement is more suitable for hopper dredging. In those cases, material would be transported and placed by hopper dredge. The impact was determined in the BA to be one that may affect but is not likely to adversely affect Loggerhead species that use critical habitat there when Sargassum is present. This determination follows the recent clarification to the 2007 Gulf of Mexico Regional Biological Opinion (GRBO) on hopper dredging, discussed in Appendix xxx (NMFS 2016). The best management practices (BMP) recommended in the GRBO would be employed when hopper dredging.

The Preferred Alternative channel deepening is not expected to have indirect effects on the transient and forage habitat for the several turtle species that may use the area through inducing or increasing other vessel or dredging activity that would result in takes of these mobile species. The numbers of vessels and transits required to ship crude oil would decrease due to the elimination and reduction of lightering.

Dredged Material Placement

Dredged material placement as a result of regular channel maintenance has likely acclimatized regional wildlife to this type of impact, which is anticipated to be minor and temporary. Wildlife species accustomed to tidal habitat present in the selected placement areas will be highly mobile and able to avoid negative impacts as a result of collision with construction equipment; therefore, impacts to threatened and endangered species habitat are more

likely than impacts to individuals of these species. Dredged material will be controlled at each placement site with diffusers, downspouts, spider barges, and scows to ensure targeted, focused sediment discharge. Mapped habitat conducive to foraging by turtle and manatee species in proposed placement sites is seagrass. In all but one of these cases, the proposed placement is BU to restore or protect habitat that would benefit these species, including seagrass protection by SS1 and M4, and tidal marsh creation in M3. In the case of the contingency site M2, if it were constructed, the same bathymetric transition on the dike slope that led to seagrass growth on the fringe of PA 13 would be replaced on the constructed dike of M2 to allow seagrass to recolonize. As discussed in Section 3.2.4.1, manatee is expected to occur only rarely as a transient species, and placement would not be expected to significantly impact this species.

For beach nesting habitat used by either Loggerhead or Kemp's ridley sea turtles, dune and beach restoration of SJI would involve placement of sands in dune breaches and along the eroded foreshore that could temporarily disturb use of beach habitat by the species. Placement of material would occur as a shifting point or segment of placement activity that would move along the shore as the dredge progresses, which would make the disturbance localized and limited in extent. However, the restoration would ultimately benefit the species by restoring large area where beach completely eroded away by Hurricane Harvey, and would restore an eroded foreshore that could be susceptible to more loss. Similarly, this restoration would benefit Piping plover as they also rely on back beach and sand flat habitat for roosting, sheltering, and feeding. Construction of the offshore feeder berms B1 through B6 would not directly impact nesting habitat, but could result in temporary disturbance of sea turtles in nearshore waters, during nesting migration. However, these features would also ultimately benefit these sea turtles as their purpose is to nourish beaches that have been identified as historically eroding 2 feet or more (TGLO 2014). The shoreline restoration of SS2 would protect the tidal sand flat habitat present there from further erosion during storms. Similarly, this restoration would also benefit Piping plover. Impacts on Piping plover critical habitat are discussed further in the next section. Measures would be taken during construction dredging and placement to minimize disturbance to these species as much as practicable.

4.2.5.2. Critical Habitat

No Action Alternative

The No Action alternative would have no impact on loggerhead Sargassum critical habitat. The No Action alternative would have no direct impact on Piping plover critical habitat.

Preferred Alternative

Approximately 10.57 nautical miles of the Preferred Alternative channel and the proposed NW ODMDS are located within loggerhead LOGG-S-2 Sargassum final critical habitat. Construction impacts and vessel traffic associated with the Preferred Alternative would not greatly exceed the present impacts from the existing ship channel and regular maintenance of this channel. Dredged material placement at the NW ODMDS could potentially create a minor, short-lived turbidity plume within the sargassum feeding area that would temporarily displace foraging turtles; however, a 2016 NMFS memo from Roy E. Crabtree dated March 4, 2016 to Alvin B. Lee, USACE, South Atlantic Division, clarifying the activities under the 2007 GRBO (NMFS 2016) with respect to the new critical habitat found for offshore ocean disposal within the boundaries of the Sargassum critical habitat (NMFS 2016):

> "the sediments would be expected to settle quickly, and therefore interaction time with the Sargassum and materials associated with its habitat would be of very short duration and any effects would be insignificant. Thus, offshore ocean disposal is not likely to adversely affect the Sargassum critical habitat."

Dredged Material Placement

Placement areas SS2, SJI, and the NW ODMDS are located partially or entirely within USFWS designated final critical habitat. As previously discussed, impacts to critical habitat as a result of dredged material placement at NW ODMDS will be temporary and largely insignificant. Dredged material placement within Piping Plover critical habitat on San Juan Island and Salt Island will be highly specific, targeted placement aimed to restore beachfront erosion that occurred during Hurricane Harvey in 2017 as shown in Figure 4.2.1-3 and Figure 4.2.1-4. Barrier islands damaged in major hurricane events may be more susceptible to erosion from other, more minor events, or even from normal wave activity that occurs after beach integrity is compromised (Sallenger et al., 2006). Additionally, sediment removal, erosion, and island breaching occur more frequently in narrower beaches with little to no dune development (Houser et al., 2008). Bolstering these beaches would protect against further degradation and erosion as a result of normal tidal activity, channel traffic, and large storm events that may affect the region. Therefore, placement of dredged material at SJI and SS2 would not be expected to negatively impact protected Piping plover critical habitat, but would rather preserve critical habitat in the appropriate spatial arrangement as originally designated by USFWS.

Potential impacts to critical habitat are discussed in further detail in a separate biological assessment, presented in Appendix B.

4.2.6 Invasive Species

No Action Alternative

No changes in the potential for invasive species being propagated or being introduced would occur. Cargo vessels would continue to transit international routes and adhere to International Maritime Organization (IMO) and United States Coast Guard (USCG) rules regarding discharge of ballast water. The IMO regulations from the Ballast Water Management (BWM) Convention, came into force in 2017, and regulate those in transit in many international waters, requiring combinations of management plans, intake and discharge location requirements, and some treatment in the first of regulations, and stricter treatment and organism-level standards in the second phase. Stateside, all vessels would be subject to USCG Ballast Water Management Regulations as applicable in 33 CFR Part 151 Subpart D for the protection to the spread of non-indigenous species. Such standards include treatment systems, organism-level standards, and certification.

Preferred Alternative

Deepening of the CCSC would not result in any changes to vessel operations with respect to ballast water discharge other than to reduce vessel numbers needed to export oil. The proposed project would allow for fewer larger vessels than the current or authorized channel would support which would theoretically reduce chances for introduction. However, existing regulations in force with or without the preferred alternative would mainly be responsible for reducing the risk from invasive species.

Dredged Material Placement

Placement of dredged material for the Preferred Alternative would not be expected to have adverse impacts from the propagation of invasive species when placed into existing PAs, used for raising or building PA or BU site containment dikes, used to restore shorelines, or otherwise beneficially used.

4.3 HUMAN ENVIRONMENT IMPACTS

A summary of potential human impacts within the Community Study Area cities and counties located within or directly adjacent to the proposed project are presented in the section below. The scope of this review includes an analysis of the area's socioeconomics, environmental justice, community and recreation resources, visual and aesthetics, air quality, noise and vibration, and cultural resources as well as other categories.

4.3.1 Socioeconomics

No Action Alternative

Under the No Action Alternative, the Community Study Area, as described in Section 3.3, Aransas, Nueces and San Patricio Counties, and other communities within or near the project area would continue to have the same population and economic trends. According to Texas Water Development Board population projections, a population increase is expected for the cities of Aransas Pass, Corpus Christi, and Port Aransas. Aransas, Nueces and San Patricio counties populations are projected to have an 8 percent, 26 percent, and 14 percent increase in population, respectively, between 2010 and 2040 regardless of the proposed project. The locations of these resources would generally follow development and land use plans identified by surrounding cities and these counties.

In 2018, the Port of Corpus Christi is exceeding records for total tonnage moved through the Port, and is experiencing 50 billion dollars in ongoing development for projects in and around the CCSC, much of it driven by the energy sector, including crude oil from shale exploration (CITE Express News and CITE POCC). As discussed under Section 1.3, crude oil exports have grown greatly since 2015. According to trade data from the U.S. Economic Census, crude oil from petroleum and bituminous minerals vessel exports is anticipated to increase from 15.6 million tons in 2017 to a projected 21.6 million tons in 2018 (United States Census Bureau 2018a). A PCCA-commissioned study, *The Economic Impacts of the Port of Corpus Christi, 2015*, analyzed the economic impact of marine cargo activity at the POCC, both public and private, and estimated impact by commodity sector (Port of Corpus Christi 2015). The study estimated a multiplier of 0.02 jobs per 1,000 tons of crude oil exported for direct port and terminal related jobs generated. Based on this multiplier and the increase in crude oil exports from the Census data, direct port and terminal related jobs are anticipated to increase from 312 to 432 jobs between 2017 and 2018. These jobs are only those directly involved in transferring crude oil at marine terminals, and do not account for the thousands of indirect jobs from other related crude extraction and transporting activities in Corpus Christi and Texas, such as upstream shale field development, and midstream pipeline transport and storage. Labor force statistics in 2013 indicated that Texas had 46,571 jobs in drilling oil and gas wells, 103,838 jobs in extraction, and 128,330 jobs in support and oil/gas operations (State of Texas, Office of the Governor 2016). As discussed in Sections 1.1.2 and 1.3, much of the crude oil is destined for export, and the POCC is the top crude oil-exporting port, accounting for approximately half of the national tonnage exported.

Under the No Action Alternative, economic growth due to regional industrial and petroleum industry (e.g. extraction, transmission, refining) activities would be expected to occur in response to increasing national demand and markets for these commodities (crude oil, refined products, iron and steel). Port development and activity would be expected to grow in response. Therefore, industrial, refining, and port-related employment related to these activities would be expected to also grow. To export the large volumes of crude oil produced in the State, pipelines, storage tank farms, marine terminals, and ship channels part of the logistics chain needs to move crude to export markets. Concerns about negative economic effects of bottlenecks in this logistics chain due to the rapid growth in exports have surfaced, but are being addressed through pipeline and terminal projects (Ngai and Sims

2017, Blas 2018, Ngai et al 2018, Druzin 2018). Since Corpus Christi accounts for approximately half of the nationally-exported amount of crude oil, deepening of the CCSC (proposed project) would be a critical part of this export movement and efficient shipping through this channel, which is important to the continued growth in jobs at the Port and other crude oil related job in Texas. Under the No Action Alternative, the 54-foot channel would still be draft limited for the VLCCs, and shipping of crude would be less efficient compared to the Preferred Alternative. This would result in increased transportation costs to producers and shippers. The proposed project is needed to better accommodate growth that is currently occurring and that is anticipated. Under the No Action Alternative, no property would be removed from the tax rolls; therefore, the tax base would not be affected.

Preferred Alternative and Dredge Material Placement

The Preferred Alternative would likely have a negligible effect on population growth trends within the Community Study Area, surrounding cities, and counties in which the project is located, as discussed under the No Action alternative. Therefore, the demand for community facilities, services, and housing would increase at a rate that is consistent with the projected population and economic growth. The resources needed for infrastructure and housing would generally follow development and land use plans identified by municipalities and the local regional metropolitan plan. In the short term, construction of the Preferred Alternative would be performed by one of the few large dredging firms located throughout the U.S, who would use their existing crews and equipment, as this type of activity is specialized and limited, especially at the scale required. Construction of the Preferred Alternative would not have any significant impact on local job generation. However, it would have positive long term economic impact on local and State crude oil export activity.

The Port of Corpus Christi reached a new milestone for tonnage in the first nine months of 2018. The largest increase experienced was in tonnage of crude oil, which was approximately 11 percent (Port of Corpus Christi 2018). As discussed for the No Action Alternative, export of crude oil through the Port was estimated to generate a direct increase in jobs of from 312 to 432 jobs between 2017 and 2018, given the exported tonnage, and job generation rates from the economic impact study. This activity also supports thousands of jobs in Texas that produce and transport the crude oil from the field to the Port. If economic growth continues within the Port of Corpus Christi future increase in jobs would be anticipated. As discussed in the No Action Alternative, the ship channel is an important part of the logistics chain for exporting crude oil, and efficient operation of marine transport of the oil is necessary to keep up with the growth to avoid bottlenecks in this chain. It is also necessary to keep regional businesses that depend on exporting crude oil, and the POCC, competitive. The proposed project is expected to improve infrastructure to allow for more efficient and cost effective crude oil exporting. Therefore, positive economic impacts from decreased transportation costs would provide an economic benefit to existing businesses in the Port of Corpus Christi, surrounding areas, and the State. The proposed project would support future economic growth within the community, and the State. Under the Preferred Alternative, no property would be removed from the tax rolls as the channel deepening will occur entirely in the existing channel and offshore waters of the Gulf of Mexico. Therefore, the tax base would not be affected.

No socioeconomic impacts would be expected as a result of maintenance dredging events over the 20-year maintenance period since maintenance of the Preferred Alternative would be performed as part of the current maintenance dredging done for the existing channel.

4.3.2 Environmental Justice

As shown in Table 3.3.2-1, the study area is 82.7 percent White. The median household income for the Community Study Area census tracts was $62,103, more than two times above the 2018 HHS poverty level. Therefore, the study area is not considered a high minority or low-income area.

No Action Alternative

No environmental justice issues within the Community Study Area are anticipated to occur under the No Action Alternative.

Preferred Alternative and Dredge Material Placement

Because this the proposed channel deepening would occur within the existing CCSC, Corpus Christi Bay and Gulf of Mexico, minority and low-income individuals or families living within the Community Study Area would not be anticipated to have adverse changes to the demographic, economic, or community cohesion characteristics within their respective neighborhoods as a result of the proposed project. The local economy which encompasses the Community Study Area would likely benefit from the proposed project through the benefits discussed in Section 4.3.1 as a result of the proposed project. As shown in Table 3.3.2-1, the demographics of Port Aransas and Aransas Pass, the two cities closest to the Preferred Alternative, and the individual census tracts in the Community Study Area, all indicate percent White ethnicity ranging between 80.3 percent and 88.5 percent. Given the effects discussed, and the demographics not indicating a high minority or low-income area, the proposed action would not result in disproportionately high and adverse impacts on minority and low-income persons living within the Community Study Area. Over the 20 year maintenance period, no EJ impacts would result from maintenance dredging given the demographics surrounding the proposed project, and because maintenance dredging is already performed in the existing channel.

4.3.3 Community and Recreational Resources

This section describes the effects of alternatives on resources used by the community for services and recreation.

No Action Alternative

Under the No Action Alternative, no impacts would occur to community and recreational resources from new construction, and the same existing conditions and pattern of use of these resources as they are today would continue to occur. Vessel traffic in future years in the CCSC would be anticipated to increase. The potential for commercial and recreational vessel encounters would increase accordingly, although the frequency of commercial vessel passage has not been shown to be a concern to interfering with recreational use of the rest of Corpus Christi Bay.

Preferred Alternative

The Preferred Alternative would not have any direct physical impact to land-based community and recreational resources as the alternative would be located in open water and placement islands. The Section 204 economic analysis also corroborated the expectation that the number of vessel calls would be reduced with a shift to the largest forecasted vessels, which would reduce the frequency of vessel wake events. Therefore, reduced impacts to land-based or waterborne recreation would be expected. Periodic maintenance dredging and placement events over the next 20 years would result in similar impacts as all affected areas would be previously disturbed by initial construction activities.

This project is anticipated to take approximately two and a half years and a number of hydraulic dredges are expected to be used in the deepening of the channel. These dredges would operate next to the navigation channel and would therefore not impede recreational usage of the Bay.

Some of the dredging would occur adjacent to existing communities and recreational resources. This includes the western portion of the project in the section of the Corpus Christi Ship Channel between Port Aransas and the Harbor Island area. Part of the placement of dredge material would include beneficial uses such as creating marsh extensions at Pelican Island, restoring the eroded shoreline and provide armoring to protect the seagrass area at Harbor Island, and restoring the shoreline at Port Aransas Nature Preserve that became eroded in the aftermath of Hurricane Harvey.

The Port Aransas area includes the Nueces County Park, Roberts Point Park, and the Port Aransas Community along the perimeter of the channel. The Preferred Alternative would not affect these existing recreational resources as the project is located in an existing ship channel which will be deepened. The Preferred Alternative would not affect the delivery of local services near or within the proposed project area. As discussed in Section 4.3.6.1, it is not anticipated that there will be any impacts to surrounding roadways or rail transportation from the Preferred Alternative. Therefore, to the Preferred Alternative would not affect travel patterns or demands, and would not have an impact to the delivery of local services to the communities near the project area.

4.3.4 Visual and Aesthetic Resources

The deepened channel will be for the most part located within the same footprint as the existing channel with minimal widening. Once completed, the channel will be submerged and like the existing channel it will not alter existing views.

New placement sites would be either be submerged or beneficial use restoration sites. The restoration sites' aesthetics will commensurate with the surrounding natural coastal environment.

No Action Alternative

Existing characteristics of the viewsheds for the proposed project area are discussed in Section 3.3.3. The study area for visual and aesthetic resources consists of viewsheds within the project area looking out from the existing shoreline in residential areas, public facilities, access roads, and parks. Under the No Action Alternative residents will continue to have an unobstructed view of the CCSC and the marine vessels that navigate this channel.

Preferred Alternative

In the short-term, during construction of the proposed project, dredging activities would be visible to and heard by local residents, shoreline residents, and recreational watercraft users that have a view of the construction activities. However, views from the vantage points discussed are limited and it is likely that few residents or recreationalists using the CCSC near Port Aransas, Harbor Island and La Quinta would be impacted from visual and aesthetic changes during construction of the proposed project.

In the long-term, construction of this project is not expected to change surrounding land use. Placement of dredged material would be consistent with existing land use. Some dredged material placement areas would eventually become areas for wildlife. The addition of the dredged material to BUs would help create habitat for different species of shorebirds and other animals. Therefore, these BUs when finished could serve as recreational areas for anglers and birdwatchers.

Other potential BU sites such as the Dagger Island Shoreline Protection Project will focus on the protection of shallow aquatic habitat.

In summary, the proposed project is expected to allow existing ships and VLCCs to transport more tonnage, reducing the number of marine vessels navigating through CCSC. Therefore, the view of the marine vessels if not desirable to some local residents or recreationalists would improve if not remain the same. Periodic maintenance dredging and placement events over the next 20 years would result in similar impacts as all affected areas would have been previously disturbed by initial construction activities.

Dredged Material Placement

Proposed dredged material placement sites within Corpus Christi Bay and offshore would be designed to be similar or blend with the existing environment and vegetation that already exist in the areas surrounding the proposed sites. In the case of new BU sites, new habitats will be created and existing habitat will be rehabilitated or enhanced as described below:

- **Marsh Creation and Restoration**: BU site M3 adjacent to existing Pelican Island BU sites 7 and 8, would convert featureless bay bottom to 330 acres of tidal marsh. BU site M4 would restore eroding shoreline to protect and enhance seagrass and marsh habitat at Dagger Island.
- **Shoreline Restoration**: SS1 would restore eroded shoreline and would protect the large seagrass area behind the western portion of Harbor Island. It would restore the eroding shoreline to its historic profile. SS2 would restore shoreline breaches along the Port Aransas Nature Preserve as a result of Hurricane Harvey. SJI would use sand materials to restore dunes and beach on San Jose Island. All of these would restore previous natural features in the viewshed.
- **Beach Renourishment:** Feeder Berms B1 through B6 are offshore under water features which would nourish eroding shoreline by dispersing beach sand material shoreward to nourish eroding beaches indirectly. They will not be visible above water.

Upland Placements: PA6 will consist of the construction of additional height (8 feet) to the existing dike to add capacity to an existing placement area which would then be filled in the interior. This would be designed as a continuation of the existing PA feature and would not block nor drastically change the current viewsheds from land. The visual impact of this feature is expected to be minimal because PA6 is an existing upland PA, the 8-foot dike raise would be over 1.5 miles away from the nearest residences and would be negligibly perceptible.

PA 4 – Harbor Island Shoreline Restoration is an existing upland placement area. It will positively impact the viewshed in this area because it will reestablish eroded shoreline and land loss around the existing PA4 on Harbor Island, and would bolster protection of the large seagrass area behind Harbor Island from future impacts as described in Section 4.2.1.3.

In summary, visual and aesthetic impact of placement areas are expected to be positive in most cases or be minimal for a few features as noted above.

4.3.5 Existing Infrastructure

The proposed channel deepening project will be completed mostly with the footprint of the existing channel. Other the need for pipeline relocation, no other infrastructure impact is anticipated.

No Action Alternative

Under the No Action Alternative, no impact is anticipated to existing infrastructure.

Preferred Alternative

Under the Preferred Alternative, no impact is anticipated to existing infrastructure from the proposed channel improvements or new work dredge material placement areas. Conflicts with existing infrastructure (e.g. pipelines, oil and gas production) are not anticipated. Coordination with the Port of Corpus Christi and its stakeholders is ongoing to address pipeline relocation for ongoing and planned channel dredging projects.

Dredged Material Placement

The locations of known pipelines were reviewed further before determining the location of the planned dredge material placements. As a result, the locations of active pipelines were avoided to the extent possible. If the placement of dredged materials was proposed to encroach into the location of a pipeline, mitigation measures would be put in place to minimize or eliminate the potential for adverse impact.

The following placement areas were identified as being of potential concerns because of their locations related to known natural gas pipelines (active or abandoned). Review of the Texas Railroad Commission database led to the following determinations:

Feeder Berms

- Feeder Berms 3: This feeder berm is the northernmost planned feeder berm. Two natural gas pipelines cross the proposed location of FB3.
  - Pipeline crossing 1 is located toward the southern boundary of FB3. It is an abandoned 10¾-inch pipeline and therefore will not be relocated for the purpose of the project.
  - Pipeline crossing 2 is located along the northern end of the placement area. It has a diameter of 8.63 inches and was determined to be in service.
- Feeder Berm 6: This feeder berm is the southernmost planned feeder berm. Two natural gas pipelines also cross the proposed location of FB6. Both pipelines are in service.

Both feeder berms are only 6 feet tall and are designed to be erodible, thus they will eventually disappear. As a result, they will not warrant any pipeline relocation because no adverse impacts to existing pipeline infrastructure are anticipated during and after construction.

Upland Placement Area

- M2 Levee extension PA13 for Upland Placement: This BU crosses the location of an abandoned natural gas pipeline that has since been removed from the ground.

Marsh Creation Areas

- M3 Pelican Island 7 and 8 - This placement area has been preliminary located over several natural gas pipelines. The pipelines identified are in service and most of the pipelines have a diameter of approximately 3 inches.

  To avoid potential adverse impact during the placement of dredged materials, AECOM will conduct marine magnetometric surveys in this area to accurately locate the pipelines in the vicinity of M3. During the next phase of design development for this BU site, AECOM will modify the footprint of M3 to avoid impact to existing infrastructure that will be identified as a result of the surveys.

Because these marsh areas consist of the placement of 3 to 4 feet of sandy material over the location of the pipelines, the volume and weight of sediments is not expected to adversely impact these pipelines. However, this placement area will be adjusted during the final design phase to avoid the pipelines that have been identified.

- M4 Marsh Creation Near Dagger Island – This placement area has also been preliminary located two several natural gas pipelines. One pipeline with a diameter of 12.75 inches is identified as being in service. The other pipeline with a diameter of 16 inches is identified as abandoned. AECOM will conduct marine magnetometric surveys in this area to accurately locate the active pipelines in the vicinity of M4. During the next phase of design development for this BU site, AECOM will modify the footprint of M4 to avoid impact to existing infrastructure that will be identified as a result of the surveys.

4.3.6 Traffic and Transportation

4.3.6.1. Surface Transportation

Existing surface transportation in the Corpus Christi region were discussed in Section 3.3.6.1. Potentials impact to the regional surface transportation infrastructure are discussed below.

No Action Alternative

Under the No Action Alternative, no impact would occur to surface transportation, road and rail infrastructure detailed in Section 3.3.6.1.

Preferred Alternative

Under the Preferred Alternative, no direct impact to surface transportation, including road and rail would occur as the channel modifications are all in water. No indirect impacts to surface transportation are expected from the Preferred Alternative either, because the action is proposed to serve landside terminal activity that would be constructed without the deepening. Also, this terminal activity is based on the anticipated volume of crude oil that will come to the Port via pipelines. The capacity of these pipelines are planned to handle anticipated crude oil production from the Permian and Eagle Ford basins. If oil production were to increase beyond the current forecast, it's highly likely that the current trend will continue toward building more pipelines than resorting to rail, trucking or other surface transportation mode.

Another concern is related to potential disruptions to the Port Aransas State Highway 361 Ferry operations. Vessel traffic, maintenance dredging and similar activities are common within the CCSC segment where the ferry is used to transport passengers and vehicles across the entrance channel from Port Aransas to Aransas Pass. The ferries operate 24-hours a day, 365 days. Typically, a ferry will depart from each terminal every 10-20 minutes and the ride across the ship channel takes about 10 minutes. The Port Aransas Ferry is operated by the Texas Department of Transportation (TXDOT) and channel operations are continually monitored and coordinated such as to minimize potential disruptions to its day to day operations. New work dredging through this segment of channel would require provisions to minimize 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 two years for the existing channel. Long term, the channel deepening stops just downstream of the ferry landing to provide access to the terminal being planned at Harbor Island. Ferry trajectory and operation may be adjusted to such as to minimize the potential impact of VLCC operations at Harbor Island.

Dredged Material Placement

Dredge material placement areas are not planned in the immediate vicinity of the ferry crossing. As a result, no direct adverse impacts to ferry operations is anticipated. Activities related to the construction and maintenance of the placement areas may temporarily impact the ferry's frequency of operation.

4.3.6.2. Marine Transportation

No Action Alternative

Under the No Action Alternative, no channel improvements would be constructed. Therefore, the current navigation restrictions, and the associated deficiencies, would continue.

Preferred Alternative

During the construction phase under the Preferred Alternative, dredged vessels and equipment would be required to move out of the active channel to maintain an open shipping lane when vessels are approaching the CCSC. The channel deepening planned under the Preferred Alternative would improve the efficiency of shipping in the CCSC as it is the main purpose of the proposed project. The Preferred Alternative would thereby reduce costs for shippers due to increased efficiency resulting from the use of fully loaded and larger vessels which will lead to less vessel traffic. It would also eliminate some lightering vessel activity which would reduce smaller vessel transits. Therefore, marine transportation conditions are expected to improve under the Preferred Alternative scenario.

With respect to tonnage, the Preferred Alternative would not result in a net increase of container tonnage over that already projected and accounted for in the 204f study, because the Preferred Alternative does not alter the terminal facilities that determine the throughput capacity. Therefore, vessel calls would not increase due to the proposed project. As discussed earlier, fewer vessel calls would be expected to transport the same container tonnage, since the deeper draft reduces light-loading, and the improved channel allows more efficient use of larger vessels. Vessel tonnage could increase due to market demands; however the deepened channel would have the capacity to handle that increase more efficiently than under the No Action Alternative scenario.

Periodic maintenance dredging and placement events over the next 20 years would not result in any new or additional adverse impacts to channel navigation as the maintenance activities would preserve the proposed channel conditions.

Dredged Material Placement

The locations of dredge material placement areas were selected so as not to impede the navigation channel. The placement areas will be constructed and maintained to prevent materials stored within their boundaries from being released within the limits of the navigation channel. As a result, no direct adverse impact to navigation is anticipated. Activities related to the construction and maintenance of the placement areas may temporarily impact the navigation channel similarly to current maintenance operations conducted for the authorized channel.

4.3.7 Hazardous, Toxic and Radioactive Waste (HTRW)

The previous chapter identified potential hazardous material and hazardous waste sites. It was determined that:

- All but one of the sites identified are located inland;
- No active cleanup sites were located directly in channel;

- Sites mapped adjacent to the channel were either closed or required no further action; and
- Previous spill records located within search radius and in Corpus Christi Bay was limited to one 2006 report of unknown sheen. No long term or significant impact to sediment or water would be expected.

No Action Alternative

The No Action Alternative would have no impact on hazardous materials associated with regulated facilities in the area. However, maintenance dredging of the channel and the placement of dredged materials at existing placement areas would continue under the No Action Alternative.

Preferred Alternative

In general, the findings outlined in Chapter 3 have not indicated that residual contamination is a problem within the planned construction and potential dredged material placement areas of the project. Prior to excavation or placement of any sediment from the proposed project area, sediment samples would be collected and analyzed to determine the potential presence of contamination. Currently, based on the findings of the environmental database searched described in Chapter 3, the probability of encountering contaminated sites or toxic substances during project construction of the channel or during dredged material placement is considered low. Information compiled by this assessment indicates additional investigations are not warranted at this time.

Other potential hazardous materials sites in the project area include pipelines, and oil and gas facilities. Data from the Port of Corpus Christi and other sources were reviewed to identify the location of oil and gas sites, and pipelines within the project area. All known oil and gas sites and pipelines would be avoided or accommodated during construction with the appropriate access gaps until they are relocated. Therefore, no impact to these facilities is expected from the Preferred Alternative. Potential impacts of dredge material placement on existing pipelines are being investigated and will be avoided or minimized based on the findings of these investigations.

Periodic maintenance dredging and placement events over the next 20 years would not result in any new or additional impacts as all affected areas would have been previously disturbed by initial construction activities.

Dredged Material Placement

Because no known areas of hazardous waste disposals or contamination were identified within the placement areas, adverse impacts are not anticipated. In addition, since the placement areas are avoiding the identified pipelines, no spills are anticipated that could result in new releases of oil other hazardous materials. Prior to construction, contractors will be provided with a map showing the location of known pipelines and will be directed to avoid impact and confirm the location of pipelines are close to the planned placement areas. In addition, contractors will be required to implement due diligence processes to avoid potential areas of hazardous waste disposal.

4.3.8 Air Quality

Impacts to air quality associated with the alternatives would result from construction emissions, emissions from long term maintenance dredging, and indirect changes to vessel emissions resulting from operational changes. The following subsections describe those changes and impacts.

4.3.8.1. Construction Air Emission Analysis

General Conformity (GC) is a Federal/state program designed to ensure that actions taken by Federal entities do not hinder states' efforts to meet the NAAQS. It is codified by the Code of Federal Regulations (CFR), Title 40, Part 93 (40 CFR 93). The definition of a Federal action in 40 CFR 93.152 includes "...a permit, license, or other approval for some aspect of a nonfederal undertaking, (and) the relevant activity is the part, portion, or phase of the nonfederal undertaking that required the federal permit, license, or approval." (USEPA, 2010) With regard to a dredging project such as the proposed project, the Federal Action is the Section 10/404 permit, and Section 408 permits issued by the USACE authorizing the dredging, and any work that depends on the issuance of the permits is subject to GC review.

No Action

No construction emissions would result under the No Action alternative, as there would be no new work dredging.

Preferred Alternative

Temporary emissions would result from the hydraulic dredge pumps, spud, and ladder engines, tug boats used to propel dredges, scows, and support barges, hydraulic booster pumps, and crew boats from the new work dredging operation itself. Other emissions would result at the placement areas and BU sites from the use of marsh buggies and dozers to shape the material into dikes, dunes, or berms. These would be temporary emissions of NOx, VOC, CO, PM_{10}, PM_{25}, and other diesel engine exhaust pollutants that would last for the duration of construction period, estimated to be three years. As described in **Section 3.3.8**, the Corpus Christi region is in attainment of all NAAQS standards. The applicability of GC is outlined in 40 CFR §93.153, and lists only Nonattainment or Maintenance areas as applicable under GC rules. None of the subject counties of San Patricio, Nueces or Aransas County are in any designated Nonattainment or Maintenance Area. (USEPA REF) Therefore, GC requirements do not apply and an analysis of emissions to determine if they exceed the GC threshold, is not required.

Dredged Material Placement

Construction emissions at placement areas during active dredging are those produced by the hydraulic dredge and booster pumps, and tug boats pushing scows discussed in the previous paragraph. The only other placement site-associated emissions would be from the use of marsh buggies and dozers to shape the material into dikes, dunes, or berms, also previously discussed in the preceding paragraph. As discussed previously, GC requirements do not apply as the Corpus Christi region is in attainment of all NAAQS standards.

4.3.8.2. Operational Air Emission Analysis

Operational air emissions are those emissions resulting from the use of the CCSC and the related terminal facilities. These emissions include those associated with harbor (tugs, lightering vessels etc.) and ocean-going vessels (bulk liquid tankers etc.), and terminal equipment (pumps, loading arms, cranes, etc.). The impacts of the various alternatives on operational air emissions relate to how the proposed channel deepening is expected to influence these air emission activities through changes in commodity transport efficiency, cargo tonnage, and vessel calls. These impacts can be considered indirect effects.

It is important to note that increases in cargo tonnage, especially crude oil, are already projected to occur at the Port of Corpus Christi (POCC) with the existing channel under the No Action Alternative, and will be accommodated by the continuing development of terminal facilities already planned at the POCC. These increases would occur in the No Action alternative, irrespective of the proposed action, and the resulting impacts

to operational air emissions from terminal equipment and related cargo surface transport activity (e.g. pipeline operations, truck, rail) would also occur in the No Action alternative. This is discussed in detail in this section under Terminal Emissions for the No Action Alternative.

To assess the potential indirect operational effects, the types of cargo and commodities that could be impacted, were considered. The POCC and CCSP enable transport of commodities of all types, as described in Section 1.3. However, this is limited within the segment of the CCSC involved in the proposed action, because of the types of terminals located directly on this channel segment. The existing terminals on this segment primarily process bulk liquid crude oil, and a few are for servicing or constructing offshore oil platforms. Although part of the long term purpose is to provide the capability to accommodate future changes in cargo and vessels of all commodities, and deepening the CCSC to the La Quinta Junction will make it easier in the future to extend the deepening into the La Quinta Channel, the proposed action will not have indirect effects on cargo of the La Quinta Channel until such deepening is extended there. Currently there are no plans to do so, and cargos at La Quinta Channel terminals do not currently have a need for vessels drafting as deep as the proposed action, although that can change in the future. Similarly, the offshore platforms serviced or anchored at terminals in the proposed segment do not currently require heavy lift vessels drafting as deep as the proposed deepening. Therefore, the operational analysis focused on effects on crude oil transport.

The following discusses the operational air emissions impacts of the alternatives.

No Action Alternative

Vessel Emissions

The impacts of the No Action alternative on operational air emissions are related to the effects of lack of channel deepening on cargo transport efficiency. Oil exporting, which began in practicality in 2016, has been occurring at terminals from Ingleside to the Inner Harbor, using Aframax and Suezmax-sized vessels on the existing 45-foot CCSC. Aframax tankers have a capacity of approximately 750,000 barrels and a maximum draft of 50 feet. Suezmax tankers have a capacity of approximately 1,000,000 barrels and a maximum draft of 66 feet. This requires them to be light-loaded in the existing channel, meaning they are not loaded to maximum capacity. Under the No Action alternative, the currently-authorized Federal project would be built with the channel deepened to -54 feet MLLW which would allow fully-loaded Aframax and mostly-loaded Suezmax vessels. However, it is anticipated that at this depth, exporters would be incentivized to use reverse-lightered VLCCs that have a fully-loaded capacity of 2 million barrels drafting close 80 feet, to export oil as it becomes economical to do so. As discussed in Section 1.3, a terminal test-sailed a VLCC in 2017 to Ingleside in preparation of configuring berths and loading arms to accommodate this size of vessel. Lightering, which refers to the transfer of oil from larger deeper drafting vessels anchored in deeper waters to smaller shallower drafting vessels that can transit to shallower waters or channels, has been used in importing oil to the U.S. to overcome draft limitations. Reverse lightering is the opposite, with smaller vessels transferring oil to larger vessels for export. In this case, it is anticipated VLCCs would come in to a crude terminal empty and with a shallow draft, fill up halfway to a 54-foot draft, steam to a lightering zone in the Gulf of Mexico while smaller Aframax or Suezmax lightering vessels would also fill up to a 54-foot draft, meet the VLCC at the lightering zone and transfer their cargo to finish fully loading the VLCC. This involves multiple vessels including the VLCC, the lightering vessels, lightering support vessels that handle the fenders and transfer hoses, and trips to a lightering zone that can be 20 or more miles offshore, to fully load one vessel.

The transfer of crude oil and other volatile cargo involves fugitive emissions from the cargo holds and transfer hose connections and valves that are either controlled during loading, or escape as emissions. The majority of these emissions occur from displacement of vapors in the tank being filled. At onshore loading facilities, terminal

air permits require vapor recovery controls capable of 95% or more recovery of these emissions. These systems typically employ adsorption, refrigeration, or thermal destruction to control emissions. However, controls during offshore loading and lightering are more limited, and typically consist of submerged loading (where the fill hose is below the liquid level) and vapor balancing systems. Currently, only very 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 of Mexico beyond 12 nautical miles from shore where lightering would take place (Sturtz et al. 2017). As a result, lightering emissions in the Gulf of Mexico are relatively uncontrolled. The TCEQ, the state agency responsible for air quality, commissioned a study in 2017 to understand the magnitude of lightering emissions in the Gulf, as these may provide ozone precursors such as VOCs and NO_x that may contribute to ozone formation in State nonattainment areas (Sturtz et al. 2017). This information was used to estimate a magnitude of lightering emissions that would occur under the No Action Alternative. The TCEQ study analyzed these lightering emissions in detail using the following elements of information to quantify the nature of lightering activity, and the potential emissions:

- Automatic Identification System (AIS) Data – Vessel tracking system required of all vessels above a certain size that would include all vessels involved in lightering. Historical time-stamped positioning/transit tracks, vessel name/identification and other vessel characteristics.
- IHS/Lloyd's Register Fairplay vessel characteristic database – Cross referencing of specific vessels with AIS data, vessel size, tonnage, and liquid capacity.
- EPA Compilation of Air Pollutant Emission Factors (AP-42) – emissions factors for typical crude oil lightering transfers and ballasting vapor emissions in mass of emissions per volume loaded.
- Engine emissions factors for vessel, auxiliary, and pump engines from previous port emissions inventories for vessel engine emissions during transfer operations and transit.
- Operational information from regulations, expert elicitation, and previous marine emissions inventories.

The TCEQ study analyzed and used this information to characterize the nature, frequency, and operational profile of VLCCs being lightered, the number and size of vessels supporting the lightering, and the associated emissions from each source, including distances, durations, engine sizes and loads. The study found that lightering activity was concentrated between Pascagoula, Mississippi and Corpus Christi at designated lightering rendezvous points, with Galveston 1 and 2 and Corpus Christi being the top three most popular points. The estimated emissions showed that VOC emissions were by far the dominant emission, constituting between 80 and 850 times the tons of emissions of the other pollutants (e.g. NO_x, CO), and are associated with loading and ballasting losses. The non-VOC emissions were associated with engine and pump emissions, during transit and loading operations. The emissions rates and results were used for this study to derive pollutant emissions per lightering event under the following premises: 1) the VOC emissions during loading and ballasting are the principle emissions during lightering, 2) the non-VOC emissions (NO_x, CO, PM etc.) calculated are representative of what would occur during lightering under this study. This is because Corpus Christi lightering point emissions was one of the top three sources of lightering activity used in the TCEQ study and the distances for lightering vessel transit and meeting would be very similar if not the same. A summary of the key emissions factors and results from the TCEQ study, and loading assumptions for this study are provided in Table 4.3.8-1 below, and per-lightering emissions derived from the result are provided in Table 4.3.8-2.

Table 4.3.8-1 VOC Emissions Factors from TCEQ Study and CCSC Deepening Assumptions

Source[a]	Emission Factor	Units
Loading	0.61	lb/10^3 gal of product transferred
Ballasting[b]	1.1	lb/10^3 gal of ballast water
CCSC Deepening Lightering Event Quantities and Assumptions		
Quantity	**Quantity**	**Units**
VLCC Full Capacity	2,000,000	barrels
Volume to fully load half-loaded VLCC	1,000,000	barrels
	42,000,000	gallons
VOC emitted loading	25,620	lbs
	12.81	***tons***
% of tanker's volume capacity assumed ballasted	40%	
VLCC ballasted volume	800,000	barrels
	33,600,000	gallons
VOC emitted ballasting	36,960	lbs
	18.48	***tons***
TOTAL VOC PER EVENT	***31***	***tons***

Source: Sturtz et al. 2017

a. Assumes crude oil at 60°F and Reed Vapor Pressure of 5 psia.
Represents typical value based on observations of fully loaded and partially loaded vessels.

b. Typically, individual cargo tanks are ballasted about 80%, and a total vessel 15% to 40%, of total capacity.

Table 4.3.8-2 Derivation of Emissions per Lightering Event from TCEQ Study

Quantity	Emissions (tons)					
	NO_x	VOC	CO	PM_{10}	$PM_{2.5}$	SO_x
daily emissions	0.41	34.06	0.08	0.04	0.04	0.25
yearly emissions	149.65	12,432	29	15	15	91
number of annual events	279					
tons emissions per event	**0.54**	**45**	**0.10**	**0.05**	**0.05**	**0.33**

The crude oil export data from U.S. Census data provides exported tonnage through August 2018, which was used to extrapolate a current annual export for 2018. The annual export rate has been significantly increasing each year since 2015, as discussed in Section 1.3. This export rate was used to estimate an equivalent number of VLCCs and associated lightering events, and calculate emissions using the per-lightering information in Table 4.3.8-2. The resulting emissions are shown for all pollutants in Table 4.3.8-3 below. One potential substantial operational difference between the TCEQ study and the CCSC project is the proportion of VLCC capacity lightered. The TCEQ study described lightering activity occurring from VLCCs and Ultra Large Crude Carriers (ULCC), which are even larger than VLCCs. However, based on the very small world fleet (estimated at 4), it is not expected that much lightering activity would occur with ULCCs. Therefore it is assumed the vast majority of lightering in the Gulf, at least the Texas portion, would occur with VLCCs. The TCEQ study analyzed 2014 AIS data, which would have been associated with lightering for oil imports, and the study assumed complete product transfer (i.e.

the whole vessel's capacity) from the ship-to-be-lightered (STBL) to lightering vessels. For the CCSC study, which is planning for VLCCs to be reverse-lightered for export, the VLCC is assumed to first be loaded to half its capacity as discussed earlier in this section. Because of this, the VOC emissions for the current export rate, which is by far the major lightering emission, was also estimated using the source emission factor (EF) used in the TCEQ study and is shown in Table 4.3.8-3 below. With future commodity growth, the potentially lightering emissions would also go up. To estimate the associated emissions, a forecasted rate used in the economic analysis for the Section 204(f) study which assumed a rate of 4 VLCCs loaded per week was used to estimate the emissions for a future export rate. Estimated emissions for this case are also shown in Table 4.3.8-1.

Table 4.3.8-3 Estimated Emissions

Current Export Rate							
Crude oil export at POCC at current 2018 rate	19,614,986	annual metric tons (MT)					
	392,300	barrels per day (BPD) assuming 7.3 barrels/MT					
	2,746,098	barrels per week					
VLCC loading based on export	1.37	VLCCs per week					
	71.4	lightering events per year					
	Annual Emissions (tons)						
Case	NO_x	VOC	CO	PM_{10}	$PM_{2.5}$	SO_x	
using per lightering event emissions	38	3,181	7	4	4	23	
using source EF (VOC)*	-	2,234	-	-	-	-	
Future Export Rate							
Crude oil export at assumed future rate	4	VLCCs per week					
	8,000,000	barrels/week					
	1,142,857	BPD					
VLCC loading based on export	208	annual VLCCs					
	Annual Emissions (tons)						
	NO_x	VOC	CO	PM_{10}	$PM_{2.5}$	SO_x	
using per lightering event emissions	112	9,268	22	11	11	68	
using source EF (VOC)*	-	6,508	-	-	-	-	

*Source VOC EF from Table 4.3.8-1

Under the No Action Alternative, the lightering activity would continue and grow, as the projected increase in export tonnage grows. Only a portion of the vessel loading would occur at an onshore terminal to load a VLCC half-way as previously described. The rest of the loading of a VLCC would occur offshore through lightering with the associated uncontrolled emissions. Based on the above estimate, approximately between 2,200 tons and 3,200 tons of VOCs, and approximately 40 tons of NO_x, both ozone precursors, would be emitted from lightering at current export rates. Other smaller amounts of criteria pollutants listed above would be emitted. Under a future export rate, this could range approximately between 6,500 tons and 9,300 tons of VOC and approximately 110 tons of NO_x.

The TCEQ study assumed a Reid Vapor Pressure (RVP) of 5 pounds per square inch absolute (psia) as a typical crude oil vapor pressure, which likely reflects the heavier, imported crude oil which comprised the majority of

crude oil handled through vessels prior to the last two to three years. The crude oil being exported at the POCC is predominantly Eagle Ford and Permian Basin crude. West Texas Intermediate (WTI) crude, which reflects Permian Basin oil, has a typical RVP ranging from 6.5 to 9 psia, and Eagle Ford has an RVP 6.5 to 9.3 psia (Sutton 2015, Andrews 2014). This RVP range is higher than that assumed in the TCEQ study, and would actually result in greater emissions than estimated.

Apart from the lightering emissions and VLCC vessel transit emissions, emissions from Aframax, Suezmax and other vessels carrying other commodities (e.g. refined products, grain, iron pellets), into the POCC via the CCSC, would continue as before.

The overall impact of the No Action Alternative would be an adverse impact on air quality due to the relatively uncontrolled lightering emissions. The TCEQ study stated that Gulf lightering emissions probably impacted ozone formation in the Houston-Galveston-Brazoria (HGB) nonattainment zone. Given this and the prevailing wind direction from the southeast, it would be expected that these influence ozone formation in the Corpus Christi area as well. To get a sense of the significance of these emissions, regional inventory emissions for the Corpus Christi area from a modeling study of Texas urban areas was used (Farooqui *et al.* 2013a). Of the maximum listed total daily tons of 204.7 tons for NO_x and 168.6 tons for VOC, the estimated No Action lightering emissions (converted to daily figures) constituted approximately 0.05 percent of regional NO_x, and between 3 to 5 percent of regional VOC emissions. Therefore, the adverse impact would be small or minor in the context of regional emissions. In the context of marine category emissions, however, they would be expected to represent a significant increase over current POCC emissions for VOC emissions. A marine category engine emissions modeling and inventory study indicated a range of 1,516 to 2,324 tons annually for NOx, and 47 to 72 tons annually for hydrocarbons (HC) which accounts for VOC emissions (Farooqui *et al.* 2013b). This would make CCSC study estimates constitute approximately 1.4 percent of NO_x, but between 28 and 38 times the VOC emissions of marine category vessels. This results from the relatively small amount of VOCs emitted from marine engine exhaust compared to those produced from lightering. Therefore, the adverse impact would be significant in the context of marine category emissions in the region, due to the VOC emissions.

Terminal Emissions

Terminals are separate facilities planned as separate projects from the ship channel they are on. These facilities are planned in response to changes in the amount of commodity requiring marine transport, which in turn is driven by market forces such as demand for the commodity in the region or hinterland served by the port. The presence of a deep draft channel is expected to be a reason terminals are built in a particular port. However, once a deep draft channel is in place, and industries and their related commodities are established, growth in the amount exported and terminals to ship it from, is expected to be driven by market demands for the commodity, rather than being induced by subsequent channel modifications. Rather, channel modifications are usually made in response to changing cargo movement driven by changing markets. This has been the case in the POCC, as evidenced by crude oil export terminals being developed on the existing 45-foot deep channel, and the 54-foot authorized Federal project planned in response to changing demand of oil and other cargos prior to 2003. The demand to export oil has increased for reasons discussed in Section 1.2 and 1.3, including Permian and Eagle Ford shale development, planned pipeline and terminal infrastructure in the POCC region, and development of overseas export markets. These factors have driven the demand to ship via VLCC. Considering this, the planned crude oil export terminals would commence operations, pumping and storing crude oil in their above ground storage tanks, and pumping crude via loading arms to VLCC, Suezmax, and Aframax vessels at terminal berths. Future terminal capacity would be expected to be developed in response to further Permian oil field development and growth. Loading and storage emissions would be controlled by measures required for permitted marine terminal facilities, such as floating roof tanks and seals, and vapor recovery units for the storage and loading arms.

The Preferred Alternative

Vessel Emissions

The 80-foot channel deepening of the Preferred Alternative would allow VLCCs to be full loaded. This would eliminate the emissions from lightering that would have occurred under the shallower channel of the No Action Alternative. Therefore, the Preferred Alternative would result in the reduction of VOC emissions by between approximately 2,200 tons and 3,200 tons, and NO_x emissions by approximately 40 tons, at current export rates, compared to the No Action Alternative. Other smaller amounts of criteria pollutants listed above would be also be reduced. Under a future export rate, the Preferred Alternative could reduce between approximately 6,500 tons and 9,300 tons of VOC and approximately 110 tons of NO_x compared to the No Action Alternative. Another expected effect would be to allow Suezmax vessels to be more fully loaded, which would reduce the number of vessel calls necessary to carry crude oil transported by this vessel class. Once VLCC use for exports is established, it would be expected that Suezmax vessels would be primarily used for heavy crude oil imports.

Apart from the lightering emissions and VLCC vessel transit emissions, emissions from Aframax and other vessels carrying other commodities (e.g. refined products, grain, iron pellets), into the POCC via the CCSC, would continue as before, as they would not require a deeper draft afforded by the Preferred Alternative.

The overall impact of the Preferred Alternative would be a small, but positive impact on air quality due to eliminating the relatively uncontrolled lightering emissions. In the context of regional emissions, the impact would not be significant, but in the context of marine engine sources, the impact would be significant.

Terminal Emissions

The Preferred Alternative will not add or alter any berths or terminal facilities such as storage tanks, loading arms, pumps, or other landside equipment that creates new cargo tonnage to be loaded or increases the number of berths. Therefore, the Preferred Alternative does not directly impact terminal emissions. As explained for the No Action Alternative, terminals are separately planned projects, and the driving factors behind their development and growth are largely external to the channel. Also as previously explained, the oilfield development, planned pipeline and terminal infrastructure in the POCC region, and continued overseas crude market development, are what's expected to create the demand for more oil export capacity and new terminals. The deepening of the Preferred Alternative will allow more efficient use of the crude export terminal because it will allow faster and more complete loading of VLCCs (thereby increasing berth availability). However, the Preferred Alternative is not expected to have substantial indirect effects that create demand for more commodity to be exported through the POCC and more terminals. It is expected to impact the efficiency of processing the required throughput of crude oil by eliminating light loading and reducing the vessels needed to carry the forecasted demand. Therefore, it is not expected to significantly and adversely impact air emission sources of terminal facilities.

Conclusion

Considering the above effects, there would not be a significant adverse impact on air quality from the Preferred Alternative, but it would have a small positive impact by reducing vessel transit and lightering emissions.

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4.3.8.3. Greenhouse Gas Emissions and Climate Change

The scientific community has correlated climate change to increased greenhouse gas emissions. The following describes impacts of the alternatives on the generation of greenhouse gases (GHG). Also, for the preferred alternative, the main impact of climate change on project performance of the Preferred Alternative is discussed.

No Action Alternative

The No Action Alternative would not allow full-loaded VLCCs, which would require reverse lightering and the associated vessel emissions. This would lead to increased CO_2 emissions compared to the Preferred Alternative due to an increase in the number of vessels as well as the number of reverse lightering operations. These impacts would be a result of shipper resorting to using light-loaded VLCCs and more associated lightering vessels to handle more cargo instead of using fewer larger vessels or fully loaded vessels to accommodate the same forecasted cargo. In addition, increased offshore reverse lightering operations would contribute to additional CO_2 emissions.

Preferred Alternative

In contrast to the No Action Alternative, the deeper channel of the Preferred Alternative would accommodate the use of fully loaded vessels and larger vessels thereby reducing vessel traffic and reverse lightering operations which would contribute to less CO_2 emissions. Therefore, the Preferred Alternative would have a positive impact on GHG emissions. As reverse lightering emissions overall are a relatively small portion of regional emissions as discussed in Section 4.3.8.2, the impact would be relatively small but positive. Therefore, no long term adverse impacts and a small positive long term impact on GHG would result from the Preferred Alternative.

With respect to climate change on impacts on performance of the purpose (navigation and shipping efficiency) and proposed action (channel deepening) of the Preferred Alternative, sea level rise 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.

Dredged Material Placement

Emissions of CO2 associated with the placement of dredges materials during construction and maintenance activities are expected to be limited to the brief periods associated with these activities as compared to the vessel operations described above. As a result, the impact associated with dredge material placement will be a minor impact on GHG but will enable more efficient shipping, which would reduce GHG over the long term.

4.3.9 Noise

No Action Alternative

Under the No-Action alternative, there would be no construction dredging noise. There would still be noise along the channel from maintenance dredging which has been periodically conducted for many years, producing a temporary impact amid the other marine sound sources. In the long term, noise would continue as described in Section 3.3.9, with the same soundscape and general noise sources as before. There would be no large-scale changes in the numbers of new noise sources, but gradual growth and development in industrial, commercial, and residential areas would occur.

Preferred Alternative

Temporary impacts to the sound environment from the Preferred Alternative would result from construction dredging. At the point of dredging, the sound produced would be similar in sound level to the maintenance dredging that occurs periodically, as hydraulic suction dredges would be anticipated to be used. The dredge plant, consisting of the hydraulic dredge with engines for pumps, ladders, and auxiliary power, would be the major source, and would move along the project alignment as construction proceeded. Levels would vary and be intermittent. However, near areas of potential, sensitive receptors described in Section 3.3.9, construction would normally occur during daylight hours when construction sound is more tolerable. The noise impacts to the sensitive receptors would not last for a long duration, as the dredge will move along the channel. The closest residential area at Aransas Pass between the jetties is 300 feet away.

Long term intermittent impacts would result from maintenance dredging activities, which would also be similar in sound level to the maintenance dredging that occurs periodically. There would be no substantial change in current maintenance dredging impacts on sound. Provisions and specifications that require the contractor to make reasonable efforts to control construction and maintenance dredging noise would be included in construction plans and specifications. Other long term impacts to noise may result from a reduction in vessels required to ship the crude oil, which would reduce the frequency of vessel transit noise. Considering, this, no significant adverse impacts would occur from implementing the channel of the Preferred Alternative.

Dredged Material Placement

At the areas of placement, noise from dozers, marsh buggies etc. will occur at existing PAs, BU sites, and new locations of beneficial use in the Bay. These areas will have substantial distance away from developed areas. Noise would temporarily be produced from temporary placement and construction activity associated with the use of existing and new PA and BU sites. However, most sites are or would be located a mile or more away from inhabited or residential areas with potential sensitive receptors and all would be a half mile or more away. At typical dozer, backhoe and loader sound pressure levels of 80-85 dBA, sound would decay to 50 dBA or less due to inverse square law attenuation over this distance. No significant adverse impacts would occur from the planned dredged material placement.

4.3.10 Cultural Resources

A review of potential cultural resources associated with the project area is described in Chapter 3 and the findings are summarized below:

- No currently designated historical sites would be directly impacted by the preferred alternative;
- New work dredging largely in existing channel would avoid most potential for submerged cultural resources. Existing sidescan and magnetometry surveys would be reviewed in areas of incidental widening to ensure adequate coverage to clear these areas; and
- Investigation and surveillance if needed would be performed for undiscovered submerged marine cultural resources (e.g. shipwrecks) in new in-water placement sites.

These findings led to the following conclusions.

No Action Alternative

Under the No Action Alternative there would be no new impacts to cultural resources.

Preferred Alternative

Results of the cultural resources survey discussed in Section 3.3.10 indicated that two previously recorded archeological sites and 12 shipwrecks are situated within direct impact areas of proposed placement. Both of the archeological sites have been assessed as not significant applying the NRHP Criteria for Evaluation (36 CFR 60.4 [a-d]). Two of the previously recorded shipwrecks were classified as State Archaeological Landmarks, suggesting that they may be eligible for listing in the NRHP. Both vessels, the Cardena and the Mary Lorena, were characterized as merchant sailing ships, and both are situated inside of the proposed beach nourishment area immediately north of Aransas Pass. Cultural resources surveys would be required to determine if those resources still are present in the impact areas and to determine if they are eligible for listing in the NRHP. Additionally, if unidentified cultural resources are encountered during construction of the project, work would be suspended in that area until the resources are further evaluated.

Dredged Material Placement

Also, potential impacts on planned placement areas (including BUs and ODMDS) that would be used for dredged materials from the deepened channel and its maintenance over 20 years would not result in any impact on cultural resources.

4.3.11 Safety and National Security

In light of national and world events, global concern regarding acts of international terrorism, leading to heightened domestic and international security at U.S. ports. Security at the Port of Corpus Christi relies on continuous alertness, open communication, and cooperative partnerships with the USCG, U.S. Customs and Border Protection, and numerous other law enforcement and regulatory agencies at the Federal, State, and local levels. These efforts have increased port security by requiring more stringent vessel inspections, deploying additional monitoring vessels, and increasing terminal owner/operator security measures.

The USCG has established security zones for certain areas within the Port of Corpus Christi Inner Harbor. A security zone is defined as an area of land, water, or land and water which is so designated for such time as is necessary to prevent damage or injury to any vessel or waterfront facility, to safeguard ports, harbors, territories, or waters of the U.S. or to secure the observance of the rights and obligations of the U.S. Recreational vessels and unauthorized vessels/persons are excluded from these areas without the express permission from the USCG and violators may be subject to civil penalties, fines and/or imprisonment.

The Preferred Alternative is not located with the Inner Harbor security zone. Therefore, no revisions to the security zone boundary are required. No adverse impacts to national security would occur as result of 20 years of O&M for the proposed deepened channel.

One aspect of national security that would be positively impacted long term by the Preferred Alternative is energy security. Permian and Eagle Ford oil is used both domestically by refinery capacity geared to process it, and exported to international markets. In a relatively short time span of three years, the U.S. has become a net exporter of crude oil, and a top producer in the world, in part due to exploration of these fields. The ability to efficiently export domestic oil supports the investment in, and development of domestic fields that can help contribute to energy independence by developing a resource that can be used domestically. The Preferred Alternative increases the efficiency of exporting oil.

4.4 MITIGATION

The proposed channel of the Preferred Alternative would not directly impact oyster reef, seagrass, wetlands, or other special aquatic sites (e.g. mud flats). However, the proposed dredged material placement will involve areas of wetlands and seagrass, and minor areas of existing PAs previously identified as wind tidal flats. These were described in detail in Sections 4.2.1.2, 4.2.1.3, and 4.2.1.4. These impacts would occur in the course of constructing beneficial use sites that would restore estuarine aquatic resources, including wetlands and seagrass, or restore eroded shorelines that protect large areas of these resources. The following discusses the mitigating or beneficial actions for these resources.

4.4.1 Proposed Wetland Mitigation

As discussed in Section 4.2.1.2, approximately 141.5 acres of mapped wetlands were not wetland types being directly restored by the proposed BU (e.g. San Jose Island beach), or avoided or integrated into the restoration (e.g. M4). This was 141.5 acres of irregularly flooded estuarine intertidal unconsolidated shore identified as classification of E2USP, which is topographically high tidal and wind-tidal flats, at BU site SS1. The proposed SS1 conceptual design is to hydraulically construct an armored dike to a crest elevation of +4 ft MLLW to the historical extent of the southwestern Harbor Island shoreline, which is outward of the current shoreline, then fill behind the new dike to match existing elevation of the adjacent existing shoreline. It is in this manner that the newly restored land mass would be integrated with the wind tidal flats of the existing shoreline. The existing flat feature is identified as only being irregularly inundated, and therefore would be expected to be topographically high. Because of this integration and elevation, it is not anticipated that this wind tidal flat area would be eliminated. Given the planned crest elevation and fill, the restored land mass should serve to extend the unconsolidated shore feature. Therefore, no mitigation is currently proposed.

4.4.2 Proposed Seagrass Mitigation

As discussed in Section 4.2.1.3, approximately 120 acres of seagrass were not areas that would be avoided or would be protected by the planned placement. Approximately 22.7 acres are in BU sites M3, M9, and M10, that would create far larger areas (330, 329, and 770 acres, respectively) for estuarine aquatic habitat restoration of tidal marsh, seagrass or both. These sites would consist of armored dikes to a 5 ft or 6 ft MLLW crest height filled in the interior to lower elevations to support either tidal marsh plants or seagrass. Any one of these sites could be configured during final design to contain 22.7 or more acres of seagrass if desired to offset the impacts to small scattered patches of seagrass. The remaining 97 acres would be impacted by the construction of the shoreline restoration at SS1. Since this proposed BU has the objective to restore the former shoreline land mass and prevent the current one from eventually being breached, it will protect and benefit hundreds of acres of seagrass behind Harbor Island by preventing exposure tidal flow and vessel wake erosive energy from Aransas Pass as discussed in Section 4.2.1.3. Therefore no specific mitigation is identified for SS1 impacts since it is being proposed as a protective feature specifically for seagrass areas.

5.0 CUMULATIVE IMPACTS

This chapter discusses the cumulative impacts expected to result from the proposed action, in addition to impacts that have already occurred in the project area due to projects and development relevant to the impacts, and the impacts of relevant projects that are expected to occur in the project area and are reasonably foreseeable. This chapter summarizes the detailed cumulative impact discussion and analysis. This chapter provides the following information:

- The definition of cumulative impacts and an introduction to cumulative impact analysis
- A discussion of the methodology used, a summary of direct and indirect impacts, and a description of the types of impacts that were included in the cumulative impact assessment
- A description of past, present, and reasonably foreseeable future projects and activities that may have cumulative impacts to the project area and the surrounding region
- A discussion of cumulative impacts of those projects and activities relevant to the impacts included in the cumulative impact assessment.

5.1 INTRODUCTION

For purposes of this EA, cumulative impacts were discussed in further detail if the indirect and direct impacts have more than insubstantial temporary adverse or positive impacts than insubstantial temporary adverse or positive impacts to the particular resource. In addition, the health of the resource was taken into consideration.

The President's Council on Environmental Quality (CEQ) regulations defines 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). Cumulative impacts can result from individually minor but collectively significant actions taking place over a period of time. 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 projects (past, present, and reasonably foreseeable future actions) not related to or caused by the proposed action. The cumulative effects analysis 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 a period of time. Cumulative effects of the proposed 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 the occurrence of disturbances are so close that the effects of one are not dissipated before the next occurs, or when the timings of disturbances are so close that their effects overlap.

5.2 METHODOLOGY

No standard approach or methodology is provided by NEPA or CEQ regulations to quantify cumulative effects, or to define the geographic area for which cumulative impacts should be assessed. A general approach and suggested analytical techniques are provided in the CEQ's 1997 publication, *Considering Cumulative Effects Under the National Environmental Policy Act*. Where these were useful and appropriate, they were considered. The first step in the general approach is to scope for the cumulative effects, which involves the following sub-steps:

- Identify the primary cumulative effects issues associated with the proposed action and define the assessment goals.
- Establish the geographic scope for the analysis.
- Establish the time frame for the analysis.
- Identify other actions affecting the resources, ecosystems, and human communities of concern.

The first step and associated sub-steps are discussed in Section 5.3 and includes a summary of the direct and indirect effects, which effects were carried forward in the cumulative impact analysis, what their geographic scopes are, what the other actions affecting the resources are, and the timeframe for analyzing these actions. Parameters addressed in the scoping included ecological, physical, chemical, socioeconomic, and cultural resources and attributes.

The second step is to describe the affected environment, and consists of the following sub-steps:

- Characterize the resources, ecosystems, and human communities identified in scoping in terms of their response to change and capacity to withstand stresses.
- Characterize the stresses affecting these resources, ecosystems, and human communities and their relation to regulatory thresholds,
- Define a baseline condition for the resources, ecosystems, and human communities.

This first sub-step was done implicitly in describing the Affected Environment in Chapter 3, but a general discussion is provided in Section 5.4 for the cumulative impacts analysis. The second sub-step was carried out in the Affected Environment Chapter 3, by discussing the pertinent regulatory thresholds and statuses for the various resources, where applicable. Both of those sub-steps are also partially addressed in the discussion of trends for the resources in the cumulative impact analysis. The last sub-step was explicitly carried out for all resources in the Affected Environment Chapter 3, by discussing the existing conditions of the physical, biological, and human environmental resources of the project area. The baseline condition and general health of the resource, where appropriate are summarized in Table 5.3.5-1.

The third step in the general approach is to determine the environmental consequences. The following sub-steps were accomplished in this analysis:

- Identify the important cause-and-effect relationships between human activities and resources, ecosystems, and human communities.
- Determine the magnitude and significance of cumulative effects.

The first sub-step was carried out in the cumulative impact analysis. Where quantitative data was practical, and reasonably available or estimable for the past, present, and reasonably foreseeable actions, it was used.

Otherwise, the discussion of the magnitude and significance of the effects was qualitative, employing knowledge of the scale of projects, resources, and impacting agents (e.g. air or water emitters, size of development) to provide perspective the effects against the resources impacted. Because the cumulative impact analysis did not identify substantial contributions from the proposed action to cumulative impacts, mitigation of effects or monitoring of them was not part of the analysis.

5.3 CUMULATIVE EFFECTS SCOPING AND SUMMARY OF DIRECT AND INDIRECT IMPACTS

The first step in the CEQ's suggested general approach is to scope for the cumulative effects, of which the first sub-step is to identify the significant cumulative effects issues associated with the proposed action and define the assessment goals. This involves defining the direct and indirect effects of the proposed action, which resources are affected, and which effects are important from a cumulative perspective. This is done to focus the analysis on meaningful impacts relevant to the effects of the proposed action, and not include those effects that are irrelevant or inconsequential to decisions about the proposed action and alternatives. To accomplish this step, this section summarizes and discusses the direct and indirect effects detailed in Chapter 4, and which of those effects were carried forward in the cumulative impact analysis. The second sub-step in scoping is to identify the geographic scope for the analysis. This is also discussed in this section for the effects carried forward in the cumulative impact analysis.

Table 5.3.5-1 lists all the resource areas examined in this EA, summarizes the direct and indirect impacts, and indicates if the resource was carried forward in the cumulative impact analysis. Generally, if a more than an insubstantial temporary positive or adverse direct or indirect impact was identified in these resource categories, considering the status or health of the resource, then the resource discussion was carried forward to the cumulative impact analysis section. The subsections below synopsize the reasoning for focusing on the effects carried forward in the cumulative impact analysis relative to the direct and indirect impacts to the physical, human and biological environments. Discussion regarding rationale for the expected indirect effects for some resources is also provided in support of Table 5.3.5-1. A more detailed discussion of the resources, impacts, and reasoning are provided in Appendix E.

5.3.1 Physical Environment Impacts

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5.3.2 Biological Impacts

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5.3.3 Human Environment Impacts

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5.3.4 Relevant Past and Present Actions

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5.3.5 Reasonably Foreseeable Actions

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Table 5.3.5-1 Summary o Direct and Indirect Impacts of the Proposed Action

Current Status and/or Health of Resource	Direct Impacts	Indirect Impacts*	Resource/Issue to be Included in Cumulative Effects Analysis
Physical Resources			
Topography, Soils, Geology, Bathymetry			
• The alteration of Galveston Bay for navigation and dredged material placement has been an ongoing activity since the mid to late 19th Century.	• Permanent, relatively small changes to topography, soils, geology, and bathymetry within channel deepening and widening areas and at dredged material placement areas would be negligible compared to size and regional nature of these attributes in Galveston Bay. • Negligible effects on the water circulation patterns of Galveston Bay are expected. No impacts expected to daily tidal exchange.	• No indirect impacts are expected.	■
Water and Sediment Quality			
• TCEQ water quality segment within BSC listed as impaired for dioxin and PCBs in edible fish tissue, and for bacteria concerns; no PCBs have exceeded limits in sediment.	• Temporary and localized impacts to water quality expected during dredging and disposal activities.	• Temporary and indirect impacts to water and sediment quality (outside of excavation and placement areas) and immediate project vicinity could occur as a result of increased turbidity, sedimentation, and vessel activity during the construction period.	■
• Of many constituents analyzed, only oil and grease was repeatedly above screening levels in BSC sediment. • Dioxin present in BSC and in Galveston Bay sediments.	• No impacts from chemical constituents expected from construction since new work material is expected to be native, uncontaminated clays and sands. • Temporary, localized dispersal of sediments during maintenance dredging and placement. • Long-term impacts during maintenance dredging not expected, considering similarity of levels between dredged and placement areas, the maintenance dredging that already occurs under No Action, and greater surface sediment movement from storms, floods, and tides.	• No indirect impacts are expected.	■
Biological Resources			
Terrestrial Vegetation and Wildlife			
• Only periodically disturbed volunteer upland vegetation is present on existing upland PAs within project footprint.	• Only minor direct impacts to disturbed volunteer upland vegetation around levee edges during construction.	• Only disturbed volunteer upland vegetation would be affected.	■
• Existing PAs function primarily as temporary colonial water bird foraging habitat. • Other terrestrial species present are common.	• Temporary disturbance of foraging and nesting similar to maintenance dredging expected during construction. • Temporary impacts would be avoided/ minimized through similar measures implemented during maintenance dredging and previous projects, such as scheduling around migratory or nesting season windows.	• No indirect impacts are expected.	■
Wetlands			
• Channel in open water; no wetlands impacted. • Historically, about 33,000 acres of marsh lost in Galveston Bay from 1950's-1989 per GBNEP analysis.	• Approximately 9.5 acres of impacts to salt marsh would occur. • Only temporary vegetation impacts expected in construction corridor.	• No indirect impacts to wetlands	■
Aquatic Wildlife and Essential Fish Habitat			
• Project footprint comprised primarily of unvegetated shallow bay bottom. • Galveston Bay supports productive commercial and recreational finfish and shellfish fisheries. • No submerged aquatic vegetation (SAV) observed during benthic survey of project footprint or listed in previous mapping.	• Permanent alteration of bay bottom habitat would occur in dredged areas of the channel and dredged material placement areas. • No impacts to SAV are expected as a result of this project. • Temporary effects to benthic species from dredging and placement through impingement, entrainment, and burial, but would be expected to quickly recover and are common throughout Galveston Bay. • Temporary effects to fish species through impingement, entrainment, and burial would largely be avoided by species mobility.	• Temporary and indirect impacts to aquatic life within the project area and immediate project vicinity could occur as a result of increased turbidity, sedimentation, noise, light, and vessel activity during the construction period. • Temporary and indirect impacts to wildlife species that feed on benthic organisms or other fish could be indirectly and temporarily impacted but, it is likely they would move to other areas to look for food.	■

Current Status and/or Health of Resource	Direct Impacts	Indirect Impacts*	Resource/Issue to be Included in Cumulative Effects Analysis
• Oyster reef found along BSC, primarily on south edge. • EFH is located within the project area for several fishery species and oysters.	• The majority of impacts to managed species and their associated EFH would be limited to the estuarine benthic environment as well as temporary impacts to the water column as a result of increased turbidity. • Approximately 4.6 acres of oyster habitat would be impacted by preferred channel alternative.	• Temporary and indirect impacts to oyster reefs near the project area as a result of temporary increased turbidity during dredging and placement operations. • Accretion of oyster reefs in areas adjacent to the BSC modifications is probable considering the high occurrence of this habitat within close proximity of other anthropogenic activity in Galveston Bay.	■
Threatened and Endangered Species			
• Sea turtles and piping plover are most likely to occur within the project area due to the available habitat type but piping plover habitat is not present in the specific project footprint. • No designated critical habitat for any listed species is located in the project area.	• The proposed project will not affect sea turtles and piping plover. • The project would have no effect on any other federally-listed threatened and endangered species or their critical habitat.	• Negligible temporary and indirect impacts are expected to endangered species because of temporary impacts to fish, benthic or other food sources during the dredging and disposal operations.	■
Invasive Species			
• Shipping operations throughout the Galveston Bay System currently result in ballast water discharges in Galveston Bay. In addition, invasive plant species are present on existing PAs and on surrounding shoreline.	• No direct impacts on invasive species propagation would occur.	• No additional potential created for introduction and spread of invasive marine species. No indirect impacts are expected.	■
Coastal Zone Management Resources			
• The entire project is located within the limits of the Coastal Management Zone.	• The proposed project is not expected to impact or significantly degrade natural resources or water quality.	• No indirect impacts are expected.	■
Human Environment			
Socioeconomics			
• The proposed project area is in open water, but lies within a 5-census tract area, with a population of approximately 19,000 people.	• Communities within or near the project area would continue to have the same population trends.	• No indirect impacts are expected.	■
Environmental Justice			
• Study area is not considered a high minority or low-income area. The EJ Index study showed a very low potential for EJ impacts based on the populations that currently exists in the Bayport Community Study Area.	• Continued economic benefit from shipping activity and jobs generated at BSCCT. No impacts on environmental justice populations expected.	• No indirect impacts are expected.	■
Community and Recreational Resources			
• No terrestrial community or recreational resources in project footprint. • Houston Yacht Club (HYC) operates sailing/race course close north of BSC. • Upper Bay area used for recreational boating, wind surfing and fishing.	• Temporary localized disruption to recreation activities during construction not expected to be substantial.	• Eventual reduction in vessel transit frequency allowed by proposed channel improvements would reduce frequency of recreational/commercial vessel interactions; however this has not been identified as critical problem and events are too randomized to reliably predict consequences.	■
Visual and Aesthetic Resources			
• The study area for visual and aesthetic resources consists of viewsheds within the project area looking out from the existing shoreline in residential areas or public parks.	• Long-term visible changes to horizon view would not be substantially perceptible by shoreline residents due to distance and low profile.	• No indirect impacts are expected.	■
Existing Infrastructure			

Current Status and/or Health of Resource	Direct Impacts	Indirect Impacts*	Resource/Issue to be Included in Cumulative Effects Analysis
• No municipal infrastructure located in project footprint. • Pipelines and other existing infrastructure are within the proposed project area. Six oil/gas pipelines cross the proposed project area.	• No impacts would occur from channel improvements. • Pipelines crossing PAs 14/15 would have access for existing oil and gas facility but would need to be relocated once there area is filled.	• No indirect impacts are expected.	■
Traffic and Transportation			
• No surface transportation in project footprint. • Navigation channel used by container and bulk liquid petrochemical terminals and traffic.	• No impacts to existing surface transportation, roadways, or rail. • Navigation efficiency would be improved in the BSC.	• No indirect impacts to surface transportation or traffic would occur, as induced growth from the channel improvements would not be anticipated. • Fewer, larger, more fully loaded ships would eventually replace current smaller, light-loaded fleet to carry same projected tonnage with reduced delays. The proposed project would reduce number of ships required to carry same amount of tonnage.	■
Hazardous, Toxic, and Radioactive Waste (HTRW)			
• Several HTRW sites are primarily large industrial sites along the BSC, and spills/releases associated with shipping in the BSC and HSC. • No sites found within project footprint.	• No direct impacts on HTRW sites expected. Probability of encountering contaminated sites or toxic substances during project construction is considered low.	• The increase in efficiency in the channel is likely to help reduce potential for spills and other releases within the BSC and HSC. • No other indirect impacts are expected.	■
Noise			
• Existing noise environment varies from residential to heavy industrial and is influenced by numerous noise generating sources, many of which are transportation-related (i.e. waterways, roadways, etc.). • Waterborne activities that contribute to project vicinity's ambient noise environment include operation of ships, barges, commercial fishing vessels, and recreation boats.	• Temporary impacts during construction during dredging within land cut would be similar to what currently occurs during periodic maintenance dredging. • Dredge placement would take place more than 1/2 mile away from mainland, so would be much less, if at all perceptible. • Change in channel centerline would not result in perceptible loudness difference from change in vessel sound proximity.	• No net increase in terminal activity above that already projected would result from channel improvement; therefore, associated sound would not be expected to change. • Increase in efficiency of ship entry/exit and reduced number of tugs required for transiting the channel would reduce sounds levels some, but vessel transit sound levels not substantial contributor to sound above ambient levels. • Fewer, larger ships to carry same tonnage would reduce in-channel noise events.	■
Air Quality			
• Project is in HGB nonattainment area currently classified as "severe" nonattainment" for 8-hour ozone standard. • Air quality in HGB region has been steadily improving since last decade. • Marine vessel emissions are expected to improve due to recent changes in national and international marine emission standards.	• Temporary emissions of diesel exhaust containing ozone precursors NO_x, and VOCs, and other pollutants during construction. NO_x emissions would exceed de minimis thresholds, but would be demonstrated in a General Conformity Determination coordinated with TCEQ to be in conformance with the SIP to ensure emissions do not jeopardize State CAA ozone compliance. • Reduction of inefficiency of transit into/out of BSC would result in minor reduction of current vessel transit emissions.	• Long-term decrease in air emissions with the increase of newer, larger, more fuel efficient, but fewer, container ships adhering to most recent and impending emission standards for marine engines. • Reduction in tug assist and hoteling emissions by increasing navigation efficiency and removing daylight navigation restrictions. • No net increase in terminal activity or the associated emissions expected as maximum tonnage that BSCCT can process would not change and since maximum tonnage was already projected in BSCCT FEIS to occur with current channel and planned facilities.	■
Cultural Resources			
• Two previously recorded archeological sites and 12 shipwrecks situated within direct impact areas. Both of the archeological sites have been assessed as not significant applying the NRHP Criteria for Evaluation (36 CFR 60.4 [a-d]). Two of the previously recorded shipwrecks were classified as State Archaeological Landmarks, suggesting that they may be eligible for listing in the NRHP. Both vessels, the Cardena and the Mary Lorena, were characterized as merchant sailing ships, and both are situated inside of the proposed beach nourishment area immediately north of Aransas Pass.	• Cultural resources surveys would be required to determine if any resources potentially eligible or eligible for listing in the NRHP are present in the impact areas.	• No indirect impacts are expected.	■

Table 5.3.5-2 Summary of Past and Present; and Reasonably Foreseeable Actions

[redacted]	[redacted]	Year Built/Projected to Start Building[2]	Construction Status[3]	Dredged Material Placement								
				Placement Area	Location		Type		Status			
					Terre-strial	Bay	[redacted]	[redacted]	Com-pleted	Being Filled	[redacted]
Past and Present Actions												
Houston-Galveston Navigation Channels (HGNC)	Deepen/widen existing 53 mi HSC to 45-ft X 535-ft Deepen existing 2.2 mi GSC to 45-ft	1998-2005 (HSC complete); 2011 (GSC complete)	Maintenance	Existing & future upland - See Table 5.3-3	X	X	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
Cedar Bayou Federal Navigation Channel (FNC)	Dredge 5 mi 15-ft X 105-ft barge channel	1931, 1975	Maintenance	Existing upland terrestrial PA 6 at Mi 5 (~4 mi upstream of Galveston Bay)	X		[redacted]			[redacted]	
Barbours Cut Terminal and Channel	Build container terminal - Dredge 1.6 mi 45-ft X side channel	1972	Maintenance	Spilmans Island		X	[redacted]				
Clear Lake Channel	Shallow draft recreational channel	Unknown	Maintenance	Unknown						[redacted]	
Bayport Ship Channel Container Terminal (BSCCT)	Build container & cruise terminals, dredge 7 container & 3 cruise berths, dredge cruise TB	2007 - ongoing	In progress – 4 container & 1 cruise berths, cruise terminal & TB built	Bayport Terminal DMPA #1 and #2 PA 14 & 15 200-acre BU marsh adjacent to PA 14	X	X X	[redacted] [redacted]	 [redacted]		[redacted]	 [redacted]
Existing Bayport Ship Channel (BSC)	Dredge 4 mi 45-ft X 305-ft side channel	1977	Maintenance	Atkinson Demo Marsh PA 14 & 15 Mid Bay		X X X	 [redacted] [redacted]	 [redacted]	X	 [redacted] [redacted]	
Odfjell Bulk Liquid Terminal	Petrochemical terminal with 2 wharves and 3 barge docks	1980-1989	Maintenance	Private upland placement site PA 14 & 15	X	X	[redacted] [redacted]			[redacted] [redacted]	
LBC Bulk Liquid Termina	Petrochemical terminal with 3 wharves and 5 barge docks	1978-late 1990's	Maintenance	Private upland placement site PA 14 & 15	X	X	[redacted] [redacted]			[redacted] [redacted]	
Expansion of PAs 14 and 15	Expand existing PAs by building new cells	2010-2012	N/A	Upland PA 14/15 connection Marsh Cells M7/8/9 Marsh Cells M10 Marsh M11		X X X X	[redacted]	 [redacted] [redacted] [redacted]		[redacted] [redacted] [redacted]	 X
HGAC TIP	Regional transportation improvements, includes roads/highways, rail, mass transit	2013-2016 (current TIP)	Various projects under construction or still in planning phases	N/A							
SH1 146 to Port Road Direct Connector	Direct connecting overpass between SH 146 and Port Road	2012	Completed	N/A							
Port Road Widening	Widening to 6-lane facility	2013 - ongoing	Construction, engineering, ROW acquisition	N/A							
Texas City Channel Deepening	Deepen channel from 45-ft to 45-ft (requires nominal widening)	2011	Maintenance	Shoal Point PA (SPPA) 2,3,4,5 Pelican Island PA PA 2C		X X X	 [redacted]	[redacted] [redacted] [redacted]		[redacted]	 X
Reasonably Foreseeable Actions												
Bayport Flare Easing	Widen Bayport Flare to 4005-ft radius Dredge 235-ft channel straightener	2013	Future	PAs 14, 15, other Atkinson Island cells (M7/8/9, M10 etc.), and Mid Bay		X	[redacted]				[redacted]
Barbours Cut Modernization	Upgrade terminal facilities and enlarge channel	2014	Future	Spilmans Island		X	[redacted]				[redacted]
Shoal Point Terminal	Construct container terminal, berths, & TB	unknown	Future	Swan Lake SPPA 1		X X		[redacted] [redacted]			X X
MMKP Exploration Cedar Point Prospect Well #1 & Pipelines	No detailed info available, but assumed to be exploration well and service pipeline installation	unknown	N/A	N/A							

1. Abbreviations: HSC = Houston Ship Channel, GSC = Galveston Ship Channel, TB = turning basin, PA = placement area
2. Denotes year construction and new work dredging to build channel, berth, terminal, or placement feature was completed or projected to start
3. Denotes construction status. For channels, maintenance means new work dredging is done and channel is being maintained.

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5.4 CUMULATIVE EFFECTS ANALYSIS

Text

5.4.1 Results

5.4.1.1. Water and Sediment Quality

Text

5.4.1.2. Aquatic Fauna and EFH

Text

5.4.1.3. Air

Text

5.5 CONCLUSIONS

Text

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6.0 COMPLIANCE WITH STATUTES AND REGULATIONS

6.1 NATIONAL ENVIRONMENTAL POLICY ACT (NEPA)

This EA has been prepared in accordance with CEQ regulations to aid in complying with NEPA. The environmental and socio-economic consequences of the proposed action have been analyzed in accordance with the NEPA and presented in this report.

6.2 FISH AND WILDLIFE COORDINATION ACT OF 1958

Text

6.3 MAGNUSON-STEVENS FISHERY CONSERVATION AND MANAGEMENT ACT (PUBLIC LAW 104-297)

The MSFCMA (PL 94-265), as amended, establishes procedures for identifying EFH and required interagency coordination to further the conservation of federally managed fisheries. Regulations codifying the Act in 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 Act and identifies consultation requirements. EFH consists of habitat necessary for spawning, breeding, feeding, or growth to maturity of species managed by Regional Fishery Management Councils (RFMC) in a series of FMP. The GMFMC is the RFMC applicable to the project location.

Text

6.4 NATIONAL HISTORIC PRESERVATION ACT OF 1966

Compliance with the National Historic Preservation Act of 1966, as amended, requires identification of all NRHP-listed or NRHP-eligible properties in the project's Area of Potential Effect (APE) and development of mitigation measures for those resources adversely affected in coordination with the Texas State Historic Preservation Officer (SHPO) and the Advisory Council on Historic Preservation (ACHP).

Text

6.5 CLEAN WATER ACT

Section 404 of the Clean Water Act (CWA) regulates dredge and/or fill activities in U.S waters. The proposed action would require dredging in U.S. waters. Since 1989, the USACE and EPA have implemented policy under the Section 404 program to achieve a Presidential goal of "no net loss" of wetlands. The Section 404 program is responsible for ensuring the Administration's policy regarding "no net loss" of wetlands by requiring permit applicants to make every effort to avoid and minimize aquatic resource impacts, and provide compensatory

mitigation to offset any permitted impacts. Therefore, impacts to wetlands and achieving no net loss of wetlands are important factors in complying with the CWA.

Text

The TCEQ is responsible for conducting Section 401 certification reviews of USACE Section 404 permit applications for the discharge of dredged or fill material into waters of the U.S., including wetlands, for the purpose of determining whether the proposed discharge would comply with State water quality standards. Text

Text

6.6 CLEAN AIR ACT

The Clean Air Act (CAA) contains provisions under the General Conformity Rule to ensure that actions taken by Federal agencies in air quality nonattainment and maintenance areas do not interfere with a state's plans to meet national standards for air quality. Under the General Conformity Rule (the Rule), Federal agencies must work with state, Tribal and local governments in a nonattainment or maintenance area to ensure that Federal actions conform to the air quality plans established in the applicable state or tribal implementation plan. The regulations codifying the Rule under 40 CFR Part 93, Subpart B, specify that no Federal agency shall engage in, support in any way or provide financial assistance for, license or permit, or approve any activity which does not conform to an applicable implementation plan.

Text

6.7 COASTAL ZONE MANAGEMENT ACT

The Coastal Zone Management Act (CZMA) of 1972, as amended, provides for the effective management, beneficial use, protection, and development of the resources of the nation's coastal zone. The CZMA directs Federal agencies proposing activities or development projects, 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. Requirements in the CZMA include demonstration of consistency with the objectives of the CZMA for Federal actions. The Texas Coastal Management Program (TCMP) is the State entity that participates in the Federal Coastal Zone Management Program (CZMP) created by the CZMA. The TCMP designates the coastal zone and coastal natural resource areas (CNRA) requiring special management in that zone, including coastal waters, waters under tidal influence, coastal wetlands, submerged lands and aquatic vegetation, dunes, coastal historic areas, and other resources. The Coastal Coordination Council (CCC), composed of several State agencies and local officials, administers the TCMP for the coordination of local, State, and Federal programs for the management of Texas coastal resources. The TCMP reviews all Federal actions that may affect natural resources in the coastal zone for consistency with the Federal goals and objectives. The DA Section 10/404 permit application would automatically prompt a review by the TxGLO for consistency with the TCMP.

Text

6.8 ENDANGERED SPECIES ACT

The Endangered Species Act (ESA) provides a program to conserve threatened and endangered plants and animals, and the habitats in which they are found. The lead agencies for implementing and administering the

ESA are the USFWS and the NMFS. The Act requires Federal agencies to consult with the USFWS and NMFS, to ensure that actions they authorize, fund, or carry out are not likely to jeopardize the continued existence of listed species or result in destruction or adverse modification of designated critical habitat of listed species. The Act also prohibits any action that causes an avoidable "taking" of any listed species of endangered fish or wildlife.

Text

6.9 MARINE MAMMAL PROTECTION ACT OF 1972

The Marine Mammal Protection Act (MMPA) was passed in 1972 and amended through 2007. It establishes a moratorium on the taking and importation of marine mammals and marine mammal products, with certain exceptions. It is intended to conserve and protect marine mammals and it established the Marine Mammal Commission, the International Dolphin Conservation Program, and a Marine Mammal Health and Stranding Response Program. While the Act itself does not specify requirements for Federal activities, including permitting, the regulations for the USACE regulatory policies under the CWA contained in 33 CFR Part 320 contain review provisions applicable to the MMPA. These regulations identify the various Federal statutes which require that Department of the Army (DOA) permits be issued before the CWA-regulated activities can be undertaken, and the related Federal laws, including the MMPA, and general policies applicable to the review of those activities. Review and consultation for the MMPA is also triggered via the ESA when actions involve marine mammals.

Text

6.10 NOISE CONTROL ACT

The Noise Control Act (NCA) of 1972 established a national policy to promote an environment for all Americans free from noise that jeopardizes their health and welfare. To accomplish this, the Act established a means for the coordination of Federal research and activities in noise control, authorized the establishment of Federal noise emissions standards for products distributed in commerce, and for the provision of noise emission and noise reduction information and labeling of such products. The Act directed Federal agencies to consult the USEPA whenever they developed noise control standards or regulations. The Act also directed Federal agencies engaged in any noise emitting activity to comply with Federal, state, interstate, and local requirements regarding environmental noise control and abatement to the same extent that any person is subject to such requirements. The Act did not establish requirements related to project planning, permitting or NEPA analysis. Apart from the requirement to follow existing Federal, state, interstate, and local noise-related regulations, there are no other relevant requirements under this Act applicable to this EA or the permit requested.

Text

6.11 EXECUTIVE ORDER 11990, PROTECTION OF WETLANDS

This EO directs Federal agencies to avoid undertaking or assisting in new construction located in wetlands, unless no practical alternative is available, and the proposed action includes all practicable measures to minimize harm to wetlands which may result from such use. The EO directs agencies to take such actions in carrying out its responsibilities in (1) acquiring, managing, and disposing of Federal lands and facilities; and (2) providing federally undertaken, financed, or assisted construction and improvement; and (3) conducting Federal activities and programs affecting land use, including but not limited to water and related land resources planning, regulating, and licensing activities. As discussed in Section 6.5, the CWA Section 404 program is responsible for

ensuring the Presidential policy to achieve "no net loss" of wetlands. This EO further strengthens the commitment for Federally-implemented and permitted projects to achieve no net loss of wetlands, primarily through avoidance of impacts. Therefore, impacts to wetlands and achieving no net loss of wetlands are important factors in complying with this EO.

Text

6.12 EXECUTIVE ORDER 12898, ENVIRONMENTAL JUSTICE IN MINORITY POPULATIONS AND LOW INCOME POPULATIONS

This EO directs Federal agencies to determine whether their programs, policies, and activities would have a disproportionate impact on minority or low-income population groups within the Project Area.

Text

6.13 EXECUTIVE ORDER 13186, THE MIGRATORY BIRD TREATY ACT

This EO directs Federal agencies to increase their efforts under the Migratory Bird Treaty Act (MBTA), Bald and Golden Eagle Protection Acts, Fish and Wildlife Coordination Act, the ESA of 1973, NEPA of 1969, and other pertinent statutes to avoid or minimize impacts on migratory bird resources. The 2006 Memorandum of Understanding (MOU) between the Department of Defense (DoD) and the USFWS developed pursuant to this EO does not explicitly specify permitting under the list of activities covered under the purpose and scope of the MOU, but does list natural resource management activities. The EO directs DoD to encourage incorporation of comprehensive migratory bird management objectives in the preparation of DoD planning documents, including NEPA analyses. The EO also directs DoD to, prior to starting any activity likely to affect migratory birds populations, 1) identify the species likely to occur in the area of the proposed action and determine if any species of concern could be affected by the activity, 2) assess and document the effect of the proposed action on species of concern through the NEPA process when applicable, and 3) engage in early planning and scoping with the USFWS to proactively address conservation, and initiate appropriate actions to avoid or minimize the take of migratory birds.

Text

6.14 COMPREHENSIVE ENVIRONMENTAL RESPONSE, COMPENSATION AND LIABILITY ACT OF 1980 (CERCLA)

As amended by the Superfund Amendments and Reauthorization Act (SARA) of 1986, CERCLAprovides for liability, compensation, cleanup, and emergency response for hazardous substances released into the environment and cleanup of inactive hazardous substances disposal sites. The HTRW investigation discussed in Section 3.3.7 did not identify any potential CERCLA sites within the project footprint for the proposed channel improvements or the existing PAs that would be used for dredged material placement under the Preferred Alternative.

Text

6.15 RESOURCE CONSERVATION AND RECOVERY ACT (RCRA)

This Federal law governs the management and disposal of solid waste. RCRA may impose substantial requirements on Federal projects that manage even small amounts of hazardous waste. The HTRW investigation

discussed in Section 3.3.7 did not identify any RCRA sites within the project footprint for the proposed action under the Preferred Alternative.

Text

6.16 EXECUTIVE ORDER 11988, FLOODPLAIN MANAGEMENT

This EO directs Federal agencies to avoid possible impacts associated with the modification of floodplains and to avoid support of floodplain development wherever there is a practicable alternative. In carrying out the activities described above, 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 EO also directs agencies to include adequate provision for the evaluation and consideration of flood hazards in the regulations and operating procedures for the licenses, permits, loan or grants-in-aid programs that they administer.

Text

6.17 FARMLAND PROTECTION POLICY ACT OF 1981 AND PRIME OR UNIQUE FARMLANDS

The purpose of the Farmland Protection Policy Act (FPPA) is to minimize the extent to which Federal programs contribute to the unnecessary and irreversible conversion of farmland to nonagricultural uses. The act requires among other things, agencies to identify and take into account the adverse effects of Federal programs on the preservation of prime and unique farmlands, and consider alternative actions, as appropriate that could lessen such adverse effects. The CEQ issued a memorandum "Analysis of Prime and Unique Agricultural Lands in Implementing the National Environmental Policy Act" that supplemented NEPA procedures to include analysis of these impacts in NEPA documents. The regulation codifying the Act in 7 CFR Part 658 specified procedures and criteria for the analysis of these impacts. The definitions in this regulation specify that farmland does not include land already used as water storage, which would include open water, and that the term "Federal program" does not include permitting for activities on private or non-Federal lands.

Text

6.18 COASTAL BEND BAYS AND ESTUARIES PROGRAM

The National Estuary Program (NEP) was established under Section 320 of the 1987 Clean Water Act (CWA) Amendments as an USEPA place-based program to protect and restore the water quality and ecological integrity of nationally significant estuaries. Section 320 of the CWA calls for each NEP to develop and implement a Comprehensive Conservation and Management Plan (CCMP) that contains specific targeted actions designed to address water quality, habitat, and living resources challenges in its estuarine watershed over the long-term.

Text

6.19 MEMORANDUM OF AGREEMENT (MOA) WITH THE FAA TO ADDRESS AIRCRAFT WILDLIFE STRIKES

Several Federal agencies, including the Department of the Army, signed a 2002 Memorandum of Agreement (MOA) with the Federal Aviation Administration (FAA) to adopt coordination procedures in order to minimize the risk that project features create the potential for aircraft-flight strike hazards. Project features that might

attract wildlife include wetland mitigation, such as those administered by the USACE under the CWA Section 404, or ecosystem restoration habitat. The memorandum recognizes the USACE's expertise in protecting and managing jurisdictional wetlands and their associated wildlife. It also directs signatory agencies to cooperatively review proposals to develop or expand wetland mitigation sites, or wildlife refuges that may attract hazardous wildlife, and diligently consider the siting criteria and land use practice recommendations stated in FAA Advisory Circular (AC) 150/5200-33 when planning such sites.

The FAA recommends separations when siting anyof the wildlife attractants, to accommodate aircraft movement. The recommended separation distance between the airport (typically applies to the edge of the airport's air operations area) and the attractant (i.e., mitigation feature) varies between 5,000-ft and 6 miles, depending on the type of aircraft served and attractant.

Text

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7.0 CONCLUSIONS

This chapter summarizes the impacts of the proposed action and presents the adverse environmental impacts that cannot be avoided, and the irreversible or irretrievable commitments of resources that would occur if the proposed action is implemented. The chapter concludes with the Applicant's assessment of the impact of the proposed action.

7.1 SUMMARY OF IMPACTS

Text

7.2 ADVERSE ENVIRONMENTAL IMPACTS THAT CANNOT BE AVOIDED

Text

7.3 CONCLUSION OF IMPACTS TO THE ENVIRONMENT

Text

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8.0 LIST OF PREPARERS

This chapter provides the list of personnel responsible for preparation of this EA, and a listing of agencies and persons consulted during its preparation.

8.1 LIST OF PREPARERS

Text

Topic/Area of Responsibility	Name/ Title	Years of Experience
Project Management and Quality Assurance Review		
Project Management; Alternatives Analysis; Technical Review; Air Quality and Noise; Water and Sediment Quality; Compliance with Statutes		
Quality Assurance Review		
Water and Sediment Quality		
Affected and Impacted Biological Resources; Aquatic Resources; Oyster Reef Surveys		
Section 404 and Section 10 Permitting and Coordination		
Community and Recreational Resources; Existing Infrastructure; Traffic and Transportation		
Section 404 and Section 10 permitting; Technical Review		
Air Quality		
AECOM continued		
Section 404 and Section 10 permitting; Wildlife and Habitat; Threatened and Endangered Species		
Socioeconomics; Environmental Justice; Visual and Aesthetic Resources; Hazardous, Toxic and Radioactive Waste		
Affected and Impacted Biological Resources; Aquatic Resources; Oyster Reef Surveys		
Affected and Impacted Biological Resources; Aquatic Resources; Essential Fish Habitat		
GBA		
Section 404 and Section 10 permitting; Quality Assurance Review; Alternatives Analysis		
Engineering and Design		
Section 404 and Section 10 permitting; Technical Review		
Engineering and Design Assistance		
Subcontractors		
HRA Gray and Pape, LLC		
Cultural Resources Survey		
Cultural Resources Survey		
Cultural Resources Survey		

Topic/Area of Responsibility	Name/ Title	Years of Experience
Starcrest Consulting Group, LLC		
Air Conformity Emissions Estimate, Draft General Conformity Determination, Operational Air Emissions Estimate		

8.2 LISTING OF AGENCIES AND PERSONS CONSULTED

Text

Federal Agencies

U.S. Army Corps of Engineers (USACE), Galveston District
U.S. Department of the Interior, U.S. Fish and Wildlife Service (USFWS)
National Oceanic and Atmospheric Administration, National Marine Fisheries Service (NMFS)
U.S. Department of Agriculture, Natural Resources Conservation Service (NRCS)
U.S. Environmental Protection Agency (USEPA)

State Agencies

Texas Parks and Wildlife Department (TPWD)
Texas Commission on Environmental Quality (TCEQ)
Texas General Land Office (TxGLO)
Texas Historical Commission (THC)

Specific personnel with subject matter knowledge on terminal and port activity pertinent to the project area were also consulted. The following lists those persons:

Persons Consulted

Text

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9.0 REFERENCES

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Appendix A

CWA Section 404 Compliance Forms – Section 404(b)(1) Guideline Short Form and Coastal Zone Consistency

Appendix B

Draft Biological Assessment

Appendix C

Agency Coordination

Appendix D

Responses to Comment

Appendix E

Essential Fish Habitat Assessment