4.0 ENVIRONMENTAL CONSEQUENCES

4.1 WATER QUALITY

4.1.1 Water Exchange and Inflows

Under the No-Action alternative, water exchange and inflows would continue as they are described in Section 3.2.1.

The preferred alternative would have minimal impacts on water exchange and inflows. A study was conducted by the Texas Water Development Board (TWDB) which demonstrated changes in tidal amplitude of 0.06 feet (<0.72 inch) or less (Matsumoto et al., 2001) as projected for 106 sites around the project area. Based on the recommendations of the Hydrodynamic and Salinity Modeling Workgroup, the Cumulative Impact Workgroup, and the RACT, the study included the opening of Packery Channel and modifications to the JFK Causeway.

4.1.2 Salinity

Under the No-Action alternative, salinity would continue to be as is described in Section 3.2.2.

Like changes in tidal amplitude, the changes in salinity with the preferred alternative would also be minimal relative to existing conditions (Matsumoto et al., 2001), especially for an estuarine system. During normal to dry periods, the change in monthly average salinity would be as follows:

- Nueces Bay – from an increase of 0.11 ppt to a decrease of 0.33 ppt
- Corpus Christi Bay – from an increase of 0.38 ppt to a decrease of 0.41 ppt
- Upper Laguna Madre – from an increase of 0.04 ppt to a decrease of 0.28 ppt

During wet periods, the change in monthly average salinity would be as follows:

- Nueces Bay – from an increase of 0.09 ppt to a decrease of 3.22 ppt
- Corpus Christi Bay – from an increase of 0.12 ppt to a decrease of 4.25 ppt
- Upper Laguna Madre – from no increases to a decrease of up to 4.12 ppt.

As an examination of Matsumoto et al. (2001) will demonstrate, the larger decreases noted for the wet periods only occurred for a few months after an extremely wet period when salinities in Nueces Bay were reduced to around 1 ppt and were limited to portions of the bay.

4.1.3 Water and Elutriate Chemistry

Under the No-Action alternative, there would be no construction dredging; therefore, there would be no new work material for placement. While no turbidity or possibility for the release of undesired chemicals would occur, because there would be no placement, no chance for the decrease in long-term turbidity would result from the development of seagrass beds and wetlands in the BU sites where none exist now. The use of the new work material from the preferred alternative for BU sites would allow the

creation of approximately 935 acres of unvegetated and vegetated shallow water habitat, including seagrass beds, with a long-term concomitant decrease in turbidity.

Under the No-Action alternative, the effects of maintenance material disposal on water quality would be as it is presently, as described in Section 3.2.3. There should be very little change with the preferred alternative. While there will be more maintenance material, the source of the maintenance material will not change and the method of placement will not change. There is the possibility of contamination of the maintenance material by a spill or other event, as there is now, but deepening and widening the channel and adding barge lanes should increase safety and decrease the probability of a spill. Additionally, the USACE routinely tests the elutriates prepared from maintenance material according to ITM and Green Book protocols before dredging to ensure that there are no causes for concern. As noted in Section 3.2.3, Tier I and Tier II evaluations indicated that past testing of maintenance material elutriates with chemical analyses and water column bioassays has indicated no cause for concern.

The No-Action alternative may or may not affect DO concentrations in the water column at PAs (Brown and Clark, 1968; Pearce, 1972; Hopkins, 1972; May, 1973; Windom, 1972; Wakeman, 1974). May (1973) found that although the water column DO did not change, there was a temporary decrease in DO at the water/sediment interface in the areas of mud flow. He also found little apparent difference in the immediate oxygen demand between recently deposited sediments from dredged material placement and other sediments. May (1973), Jones and Lee (1978), Peddicord (1979), and Lee (1976) agree that high total oxygen demand, as measured in the laboratory, does not necessarily lead to oxygen depletion upon placement since only a small part of the oxygen demand is exerted at placement. This would apply to both the No-Action and preferred alternatives.

The most obvious impact of the No-Action alternative to the estuarine water column is turbidity associated with maintenance dredging and placement, which has been shown to reduce primary production in laboratory studies (Sherk, 1971). Field studies, however, have shown essentially no biological impacts from turbidity (Odum and Wilson, 1962; May, 1973). May (1973) found that on a still day, the turbidity plume from an open-bay PA was detectable from an aircraft only a little more than 1 mile down current. On days when winds caused natural turbidity in an estuarine system, the plume was not detectable more than a few hundred yards down current from active disposal in an open-bay PA. Use of deflectors to direct the material toward the bottom and the use of deeper water for the open bay sites should reduce turbidity and any associated impacts. However, significant detrimental environmental effects have not been noted in past construction and maintenance operations and are not expected with the preferred alternative.

4.1.4 Brown Tide

Under the No-Action alternative, brown tide conditions would continue as described in Section 3.2.4. No changes in brown tide conditions are expected from the preferred alternative.

4.1.5 Ballast Water

The most likely existing foreign and domestic sources of ballast water that may potentially be discharged into Corpus Christi are from liquid and bulk vessels from foreign and domestic last ports of

call coming to Corpus Christi to load cargo. The largest potential foreign sources are from within Mexico (15.4 percent), the West Indies/Caribbean group (1.8 percent), the Northern South America/Caribbean group (1.6 percent) and the Central America group (1.1 percent). The largest potential domestic sources of ballast water are from the states of Texas (37 percent), Florida (21.1 percent), and Louisiana (5.7 percent). About 20 percent of the Texas calls originated from the lightering zones in the open Gulf of Mexico. Compared with 1998 discharge estimates (13.51 mcy), potential ballast water discharge volume from foreign and domestic sources in year 2026 (15.67 mcy) increase for the No-Action alternative by 16 percent (Carangelo, 2001).

There are no significant existing container ship calls at Corpus Christi and that condition would likely continue under the No-Action alternative.

Under the preferred alternative, an estimated 3.8 percent decrease in all liquid and bulk vessel calls is anticipated with the CCSCCIP. Because of the efficiencies to be realized with the deepened channel, vessel trips in the Inner Harbor will decrease 3.8 percent between 2006–2056 with and without the preferred alternative (see economic appendix for details). Focusing on the liquid and bulk ships that come into port in ballast to take on cargo and compared with 1998 estimates, potential ballast water discharge volume for liquid and bulk ships in year 2026 (15.20 mcy) would increase 12.5 percent for the preferred alternative which is a 3 percent decrease from the No-Action alternative.

Container vessels represent a new shipping modality for Corpus Christi with identified trading regions including Europe, Central America, the Caribbean, and Latin America and the domestic Gulf of Mexico ports of call might also be contacted en route to Corpus Christi. The majority of these regions or ports currently, and are expected to in the future, trade directly or indirectly with Corpus Christi via the liquid and bulk vessel calls. No significant change in the existing mix of the ports or world regions that may potentially be sources of ballast water that could potentially be discharged into Corpus Christi is attributed to the preferred alternative. An estimated 1.57 mcy of ballast water could potentially be discharged annually from future container ship use of the proposed La Quinta Trade Gateway.

The combined estimate for year 2026 bulk and tanker vessels and future container vessels indicates 16.74 mcy of ballast water may potentially be discharged annually into Corpus Christi (Carangelo, 2001). Although this represents a potential 6.8 percent increase over the No-Action alternative, some container ships may require ballast discharge, but many do not (Hebert Engineering, 1999). Therefore, the preferred alternative is unlikely to present any significant increase or decrease in ballast water introductions compared with the No-Action alternative.

4.2 SEDIMENT QUALITY

4.2.1 Surficial Sediments

The quality of surficial sediments from the project area is discussed in Section 3.3.1. These are the surficial sediments that will be dredged during project construction. The discussion in Section 3.3.1 indicates no cause for concern with the construction material, except from the Inner Harbor, which will be placed in a UCPA. The CW and the RACT have determined that the construction material

from the other reaches of the CCSC are of sufficient quality to be used for beneficial uses, except for the fine material from the upper bay which will continue to go into open-bay, unconfined placement.

4.2.2 Maintenance Material

The existing maintenance material was described in Section 3.3.2. The quantity and quality of this material would not be expected to change with the No-Action alternative. Additionally, it would not be expected to change with the preferred alternative. While slightly more maintenance material is estimated with the preferred alternative, the source of the maintenance material will not change and the method of placement will not change. As noted above, project actions should increase safety and decrease the probability of a spill. The USACE also routinely tests the maintenance material according to ITM and Green Book protocols before dredging to ensure that there are no causes for concern. As noted in Section 3.3.2, past testing of maintenance material with chemical analyses, whole mud bioassays, and bioaccumulation studies has indicated no cause for concern.

4.3 COMMUNITY TYPES

4.3.1 Submerged Aquatic Vegetation/Seagrasses

SAV is an important component in the Corpus Christi Bay estuary complex. As noted below, project impacts can be both negative (e.g., removal of seagrass beds) and positive (e.g., creation of SAV habitat).

The No-Action alternative would not directly impact SAV since there will be no dredging of new work material; however, it would not provide any net benefits to SAV since it would not provide a new 50-year DMM/BU Plan, with projects for SAV habitat creation and protection. Dredged maintenance material from the existing channels would continue to be placed in existing PAs, which includes confined, partially confined, and open-bay placement areas and would have minimal positive or negative impacts on SAV.

Continued industrial expansion coupled with increased ship traffic expected under the No-Action alternative increases the probability for collisions and hazardous materials spills, which could negatively impact SAV communities.

In general, SAV in this area can occur in shallow areas in water depths less than –4 feet MLT. The Mitigation and RACT workgroups determined that the –4-foot MLT bathymetric contour would be used to determine the worst-case scenario of impact to unvegetated bottom, that is potential SAV habitat, and seagrass vegetated habitat within the footprint of the proposed channel. The results of the survey indicate that bay bottom with water depths less than –4 feet MLT comprise approximately 45 acres that would be impacted by the preferred alternative.

Of the 45 acres, only 5 acres of patchy SAV, dominated by shoalgrass and lesser amount of manateegrass, would be directly impacted by the project. In lieu of actual surveys of the coverage of seagrass, the potential impacts to SAV, based on aereal coverage of seagrasses, field verification and water depth, are conservative and worst case. The impacts to SAV are associated with a spit on the north

end of PA 13 and are due to the dredging of the La Quinta Channel extension. The construction of BU Site GH west of PA 13 could also impact up to 4 acres of SAV habitat; however, this impact will be avoided by the plan to separate Site GH from PA 13 by several hundred feet. Net positive impacts to SAV at Site GH would result from the creation of approximately 200 acres of shallow-water habitat suitable for colonization by SAV. The planting of 15 acres of seagrass within Site GH will be conducted as mitigation for the direct loss to the 5 acres of SAV during project construction.

The construction of other BU sites would have no direct negative impacts to existing SAV beds other than possibly SAV beds in Red Fish Cove which could experience some short-term, minimal effects from turbidity associated with channel dredging and the placement of dredged material for BU Site I. However, Site I would create approximately 163 acres of suitable SAV habitat and create approximately 15 acres of marsh habitat. Site P, primarily a wavebreak structure, should protect approximately 45 acres of existing SAV.

Altogether, the BU sites would result in the creation of approximately 935 acres of new habitat suitable for colonization by SAV, creation of approximately 26 acres of marsh, and the protection of approximately 45 acres of existing seagrass habitat. Other SAV beds in the area are either distant enough or protected from dredging activities by islands or levees and would not be impacted by dredging or placement activities.

The changes in salinity (seasonally and locally decreased by up to 4 ppt in wet periods and less than 1 percent during normal-to-dry periods) and tidal range (increased 0.04–0.06 feet) predicted in the TWDB simulation (Matsumoto et al., 2001) could cause some slight adjustment in the distribution of SAV. Although impossible to quantify, this change could cause a slight increase in the areal extent of SAV. However, the predicted changes in salinity and tidal range are very small and well within the tolerances and natural ranges of the common SAV species (Stutzenbaker, 1999). In fact, these values are much smaller than the effects of seasonal tides, so it is unlikely that they will cause an appreciable change in SAV distribution.

Potential indirect impacts could be caused by reduced photosynthetically active radiation conditions associated with increased total suspended solids; however, these would be short-term and localized, so impacts should be minimal. These impacts could be further minimized if dredging in close proximity to existing beds is scheduled to avoid seasonally high growth periods.

4.3.2 Coastal Wetlands

4.3.2.1 Salt Marshes/Estuarine Shrublands/Sand Flats/Mud Flats/Algal Mats

A shoreline erosion study (PIE, 2001a) that investigated the potential impacts on shoreline erosion from the preferred alternative was conducted for the PCCA at the request of the RACT. The potential impacts of the No-Action and the preferred alternatives were investigated for several factors that could potentially affect shoreline erosion.

The expected industrial expansion coupled with increased ship traffic for the No-Action alternative would raise the potential for collisions and hazardous materials spills, which could negatively impact coastal wetland communities. This potential would be reduced with the preferred alternative.

None of these habitats occurs within the footprint of the preferred alternative. However, dredging activities associated with the deepening and widening of the channel, maintenance dredging, and operation of the improved ship channel could have impacts on these habitats in the project area. A Section 404(b)(1) Evaluation is located in Appendix A which evaluates wetland impacts according to the Clean Water Act.

PIE (2001a) considered the differences in impacts on shoreline erosion between existing conditions and the preferred alternative for several factors including tidally induced current velocity, sea level rise, pressure field effects (draw-down), wind waves, vessel wakes, and channel morphology. PIE (2001a) concluded that, currently, the main factors contributing to shoreline erosion in this area were wind-generated waves and sea level rise.

Neither the existing or proposed conditions had consistently positive or negative impacts on shoreline erosion. However, the study concluded that overall, the CCSCCIP would slightly increase shoreline erosion, although compared with existing erosion, the effect would probably not be detectable (PIE, 2001a). The study found that, at the proposed La Quinta Channel extension, although there would be changes to the dynamics of the shoreline (due only to changes in the channel morphology), there may not be any net resultant shoreline erosion since the rates of accretion tend to offset the shoreline retreat. The greatest impacts would occur on the shorelines facing the channels, which support little, if any, vegetation. The impacts are discussed in detail in PIE (2001a).

The proposed BU sites would protect some areas of existing shoreline vegetation from erosion as well as result in creating 26 acres of marsh and protecting approximately 45 acres of seagrass habitat. None of the BU sites should negatively impact salt marshes or estuarine shrublands, tidal flats, or algal mats, but most would create and/or protect these habitats, primarily salt marshes and flats.

4.3.3 Open Water/Reef Habitat

These habitats and impacts on them are described in Section 3.4.3 and discussed in Sections 4.1 and 4.4.1.2. Impacts to water quality are expected to be minimal. No significant impacts are expected for recreational and commercial fisheries. Temporary and local impacts may occur during construction and maintenance dredging.

4.3.4 Coastal Shore Areas/Beaches/Sand Dunes

The current channel enters the Gulf of Mexico, separating San Jose Island to the north from Mustang Island to the south. The channel extends into the Gulf, protected on both northern and southern sides by rock jetties. The presence of the jetties impacts the shoreline by blocking the predominant north-to-south longshore drift. There is no beach nourishment program in place, and none has been identified or requested. Occasionally, the partially confined PA 2 adjacent to the channel on San Jose Island is used as a placement area for sandy maintenance material from a portion of the Lower Bay

and can be directed to overflow onto the beach area just north of the jetty. A pipeline dredge is used to clear maintenance material from the Lower Bay on those infrequent occurrences when the rest of the Entrance Channel does not need dredging. PIE (2001b) concluded that, currently, the main factors contributing to shoreline erosion in this area were wind-generated waves and sea level rise.

The preferred alternative would deepen and extend the channel into the Gulf of Mexico with no change to the width of the channel at the jetties (i.e., outlet to the Gulf); however, the channel would be widened by 100 feet on the north side near the Inner Basin to allow a greater turning radius into the Redfish Bay portion of the channel. Beach nourishment is not part of the proposed BU program, so the preferred alternative does not differ from the current practice in this regard. Wind-generated waves and sea level rise would not change as a result of the preferred alternative. The amount of sediment that could pass seaward due to the extension of the channel will not increase significantly. However, deepening of the channel may result in an approximately 5 percent increase in the trapping efficiency of the channel translating into a sediment loss of 3,000 to 5,000 cubic yards per year from the longshore drift system (PIE, 2001b). This impact is expected to be insignificant to the adjacent shoreline. The preferred alternative may increase the peak velocities in the Lower Bay reach of the CCSC, indicating a marginal increase in tidal flux causing an increase in the sediment input from the ocean to the bay. Shoreline erosion or accretion due to the preferred alternative will not be significantly or noticeably impacted according to PIE (2001b).

4.4 FISH AND WILDLIFE RESOURCES

4.4.1 Finfish and Shellfish

Under the No-Action alternative, finfish and shellfish communities will continue as described in Section 3.5.1.

One impact that would increase during project construction is water column turbidity, but it would be local. Several field studies of turbidity from TSS associated with dredging operations have concluded that dredging had no substantial effects on nekton (Flemer et al., 1968; Ritchie, 1970; Stickney, 1972; Wright, 1978); however, other studies have shown that elevated turbidities can suffocate and reduce growth rates in adult and juvenile nekton and reduce viability of eggs (Moore, 1977; Stern and Stickle, 1978). Detrimental effects were generally recognized at TSS concentrations greater than 500 milligrams per liter (mg/l) and for durations of continuous exposure ranging from several hours to a few days. Turbidities exceeding 500 mg/l have been observed around maintenance dredging and placement operations (EH&A, 1980), and such turbidities may affect some aquatic organisms. For example, Clark and Wilbur (2000) include a figure that shows some mortality to estuarine and anadromous fish eggs and larvae at concentrations of 500 mg/l for durations as short as 24 hours. Adult estuarine and anadromous fish exhibited no effects, even sublethal, with one exception, at concentrations $\leq$500 mg/l for up to 16 days. In a study in Corpus Christi Bay, Schubel et al. (1978) reported TSS values greater than 300 mg/l but only in a relatively small area near the bottom. They also stated that TSS in Corpus Christi Bay from maintenance dredging is not greater than that from shrimping and affect the bay for much shorter time periods. May (1973) found that TSS was reduced by 92 percent within 100 feet of the discharge point, by 98 percent at 200 feet, and that concentrations above 100 mg/l were seldom found

beyond 400 feet from the placement point. Turbidities can be expected to return to near ambient conditions within a few hours after dredging ceases or moves out of a given area.

The benthos at the proposed BU sites, which would have been used as a food source by local predators, would be temporarily lost due to burial, but the area of the BU sites is small compared with the entire project area and overall productivity recovers very quickly. Notwithstanding the potential harm to some individual organisms, compared with the existing condition, no significant impact on nekton populations is anticipated from the construction and maintenance dredging and placement operations with the preferred alternative.

The preferred alternative represents a small increase in habitat for those nekton species common in deeper offshore waters, which periodically invade the bay through the deep channel corridor (Breuer, 1962). Channel deepening and widening would also result in a slight increase in the availability of feeding and nursery area for demersal fish (Breuer, 1972).

The effects of maintenance dredging for the preferred alternative would generally be the same as those discussed for the No-Action alternative. Maintenance material would be primarily silt or sandy silt, which settles less readily and causes more turbidity than construction material which would be largely clay and sand. The overall effect would be reflective of the current maintenance dredging with the addition of the volume of the La Quinta extension and widening of the Corpus Christi Ship Channel.

In the unlikely event of an oil spill, however low the probability (see Section 2.2.2 for discussion of spill analysis), adult crustaceans such as shrimp, crabs, and adult finfish are probably mobile enough to avoid most areas of high oil concentrations. Their behavior, however, may be affected by some of the aromatic constituents of oil and become lethally disoriented. Larval and juvenile finfish and shellfish tend to be more susceptible to oil than adults. Juveniles could be affected extensively by an oil spill during their period of active immigration. Serious impacts to shrimp could also affect the commercial shrimping industry in the area, particularly the Laguna Madre if the oil spill is severe and widespread.

Although potentially severe damage could result from an oil spill, the chances of one occurring actually decrease with a wider and more efficient channel that increases navigation safety. This is from the use of fewer, more-heavily-ladened vessels instead of numerous smaller vessels to import the projected crude oil needs of existing and planned refineries. Since oil spills are a function of ship traffic, modern hull designs, and probability for accidents, the fewer trips made with the preferred alternative would decrease the threat of spills.

4.4.2 Recreational and Commercial Fisheries

Under the No-Action alternative, recreational and commercial fisheries will continue as described in Section 3.5.1.1.

Temporary and minor adverse effects on recreational and commercial fisheries may result from altering or removing productive fishing grounds and interfering with fishing activity. However, the evaluation of effects on the aquatic communities of the region (Section 4.4.1.3) concluded that no significant impacts to food sources for nekton were likely. Therefore, reductions of nekton standing crops

would not be expected from the preferred channel expansion plans. In particular, major species of the nekton assemblage, including the sciaenid fishes and penaeid shrimp, should not suffer any significant losses in standing crop. Recreational and commercial fishing would, therefore, not be expected to suffer from reductions in the numbers of important species.

Dredging associated with the construction of the preferred alternative would result in temporary adverse effects on bay bait shrimping by displacing the bait shrimp along the channel, possibly interfering with trawling. Shrimpers may move their efforts, but less productive shrimping in other portions of the channel may result. Thus, loss of revenues to both bait shrimpers and dealers may occur. However, this would be similar to what occurs during maintenance of the channels under the No-Action alternative, with the exception of the extension into the Gulf and the La Quinta extension. Dredging associated with the maintenance of the preferred alternative would essentially be the same as the No-Action alternative.

The temporary adverse effects on bait shrimping resulting from construction dredging will be countered by the fact that an expanded channel is expected to result in a decrease in oceangoing ship traffic through the CCSC, due to the use of more-heavily-ladened vessels carrying the projected future throughputs. A decrease in oceangoing ship traffic will result in less interference to all recreational and commercial fishing activity taking place in the CCSC, particularly bay bait shrimping.

Repeated dredging and placement operations may temporarily reduce the quality of recreational and commercial fisheries in the vicinity of dredging operations. This may result from decreased water quality and increased turbidity during dredging and loss of attractiveness to game fish in the area resulting from loss of benthic animals. This is not a permanent condition; the quality of fishing in the vicinity of the channel and the placement areas should steadily improve after dredging is completed and would likely be similar to maintenance dredging under the No-Action alternative.

The direct effects of construction dredging on bay recreational fishing will again be similar to existing maintenance dredging except for the BU sites and the La Quinta Channel extension. The impact will be temporary, potentially resulting in local disturbances to both boat and wade-bank fishing, particularly along the edges of the channels. After initial construction, disturbed boat and wade-bank fishing areas along the CCSC and the La Quinta Channel extension should return to preconstruction conditions. However, recreational fishing at these locations, while locally important, does not constitute a significant portion of the overall recreational fishing effort in the study area. The additional habitat created by construction in the BU sites should provide additional recreational fishing opportunities. Construction activity in this portion of the channel should not significantly affect overall fishing in the general project area.

Construction dredging in and near the Aransas Pass inlet can potentially interfere with recreational fishing activity which is often concentrated there. The physical activity of dredging and the resulting local turbidity increases would combine to temporarily decrease the success rate and aesthetics of fishing in this area. However, impacts are expected to be similar to existing routine maintenance dredging operations.

The placement of dredged material in the designated offshore placement site may result in a localized effect on shrimp trawling and bottom fishing, as well as a slight disturbance to sport fishing for pelagic species. The topographic relief created by offshore placement in BU Site ZZ will result in the temporary loss of 1.83 square miles of Gulf bottom during construction of BU Site ZZ. However, NOAA charts indicate a sunken vessel exists in the site, which may inhibit shrimping there due to the possibility of hangs. In addition, the size of the area is small when compared with the total remaining similar bottom habitat available for fishing and shrimping. Creation of the topographic relief features at BU Site ZZ and Site MN should provide more diversity of habitat, which has the potential to become a fish haven. The placement of maintenance material in EPA-designated PA 1 may result in an isolated effect on shrimp trawling and bottom fishing, as well as a slight disturbance to sport fishing for bottom fishes. However, this effect should be similar to the No-Action alternative.

4.4.3 Aquatic Communities

Under the No-Action alternative, aquatic communities will continue as described in Section 3.5.1.2.

Benthic organisms will be buried and epibenthic nekton may be excluded from the immediate area of the open-bay PAs 14A – 17B by the deposition or flow of material across the bay bottom. The majority of these PAs have been used for construction and maintenance dredged materials placement for at least 25 years, and many for a longer period. Because of the prior use history, changes in sediment texture, and frequency of maintenance dredging, the PAs may not be similar to undisturbed areas of equivalent depth (Ray and Clarke, 1999). Ray and Clarke (1999), comparing PAs 15A – 17B with reference sites located on the opposite side of the CCSC from the PAs, also found evidence for long-term impacts from dredged material placement but found that the differences were rather subtle, and might be attributable to changes in depth (PAs were shallower) and grain size (PAs' sediments were coarser). They note that PA and reference areas had similar benthic assemblages but that the PAs "have a greater proportion of surpulid polychaetes and less echinoderm biomass than reference areas." Confined PAs that have become emergent as a result of prior use constitute a permanent loss of aquatic habitat at that location. Except for the use of construction and maintenance materials for habitat creation, protection, and enhancement as a consequence of construction of the BU sites, only existing open-water, unconfined- or confined-in-bay, and upland sites are proposed for use in the preferred alternative. Consequently, new permanent loss of aquatic habitat is avoided or minimized.

Turbidity in estuarine and coastal waters is generally credited with having a complex set of impacts on a wide array of organisms (Thompson, 1973; Hirsch et al., 1978; Stern and Stickle, 1978; EH&A, 1978). Suspended material can play both beneficial and detrimental roles in aquatic environments. Turbidity from TSS tends to interfere with light penetration and thus reduce photosynthetic activity by phytoplankton and seagrasses. Such reductions in primary productivity would be localized around the immediate area of the maintenance dredge operations in the CCSC and at the offshore and open-bay placement sites, and would be limited to the duration of the plume at a given site. Conversely, the decrease in primary production, presumably from decreased available light, has been found to be offset by increased nutrient content (Morton, 1977). In past studies of the impacts of dredged material placement from turbidity and nutrient release, the effects are both localized and temporary (May, 1973; Odum and

Wilson, 1962; Brannon et al., 1978). Thus, due to the reproductive capacity and natural variation in phytoplankton populations, the impacts of dredged maintenance material placement anywhere within the project area are not expected to be significant.

Dredging represents two problems for aquatic communities: excavation and placement. Excavation removes organisms, but organisms can rapidly recolonize a hole (Montagna et al., 1998). Approximately 352 acres of deep-water bay bottom will be lost to construction of barge lanes (7 acres) and channel widening (352 acres). Placement of dredged material may cause ecological damage to benthos in three ways: 1) physical disturbance to benthic ecosystems; 2) mobilization of sediment contaminants, making them more bio-available; and 3) increasing the amount of suspended sediment in the water column (Montagna et al., 1998). Organisms that are buried must vertically migrate or die (Maurer et al., 1986). Although vertical migration is possible, most organisms do not survive (Maurer et al., 1986). Studies show that open-water placement in Mobile Bay, Alabama, resulted in reduced benthic biomass, reduced redox potential discontinuity depth, and altered sediment relief. However, effects were confined to within 1,500 meters of the discharge point, and benthos recovered within 12 weeks (Clarke and Miller-Way, 1992). In a study of open-bay PAs 14A – 17B, Ray and Clarke (1999) found that "although dredged material placement initially had substantial impacts on placement area sediments and infauna, the deposited materials were worked into the existing sediment and community recovery was complete within a year of the dredging operation." An example of the impact and recovery can be found at Ray and Clarke's Plot E, which had a pre-dredging biomass of 41 g/m^2. After dredging, the biomass dropped to 5 g/m^2 and then rose back to 41 g/m^2, while the reference area remained constant, near 79 g/m^2.

Repeated dredging in one place may prevent benthic communities from full development (Dankers and Zuidema, 1995). Excavation destroys the community that previously existed but creates new habitat for colonization (Montagna et al., 1998). Excavation can actually maintain high rates of macrobenthos productivity (Rhoads et al., 1978). By repeatedly creating new habitat via disturbance, new recruits continually settle and grow. However, these new recruits are always opportunistic, small, surface-dwelling organisms with high growth rates and densities. Large, deep-dwelling organisms that grow slower and live longer are lost to the area of repeated excavation. In this way, excavation may not cause a decrease in production, but rather a large shift in community structure (Montagna et al., 1998).

Placement of construction and maintenance material in the proposed offshore placement site would bury those benthic organisms incapable of escaping or burrowing up through the dredged material. Burial of benthic organisms will occur during initial construction placement but the material is virgin ocean bottom, similar to that which presently exists in the BU site and recolonization should be rapid. Benthic community structure and abundance will eventually return to pre-placement levels since these sites will be used once only for placement of construction material. Additionally, the BUW and the RACT determined that creation of the topographic relief feature would be beneficial overall. The offshore maintenance PA (PA 1) is a currently used, EPA-designated site and future maintenance impacts should be similar to existing impacts. Potential beneficial effects of the suspended material associated with dredging operations include a resuspension of nutrients, absorption of contaminants in the water column, and addition of a protective cover allowing certain nekton to avoid predation (Stern and Stickle, 1978). As with the various potential detrimental effects, the importance of each of these latter effects would vary

among groups and with the physiochemical parameters existing at the time and location of dredging and placement operations.

Effects of elevated turbidities on the adult stages of various filter-feeding organisms such as oysters, copepods and other species include depression of pumping and filtering rates and clogging of filtering mechanisms (Stern and Stickle, 1978). These effects are pronounced when TSS range from 100 mg/l to 1,000 mg/l and higher, but are apparently reversible once turbidities return to ambient levels.

A few scattered oyster reefs exist in Corpus Christi Bay as described in Section 3.4.3 and most of the reefs are dead. The nearest is Long Reef, which is approximately 3,000 feet away from PA 13 and 4,000 feet away from PA 15. No live oysters occur on Long Reef, but it is a valuable hard-structure resource. PA 13 is a UCPA and the effluent is returned to La Quinta Channel. Although PA 15 is an unconfined, open-water site, it is located in deeper water and is presently used frequently for maintenance dredging. Furthermore, the discharge point is submerged to minimize the spread of dredged material. There are some additional scattered reefs in the vicinity of PA 18, but this site is not presently in use and will not be used with the preferred alternative. Therefore, adverse impacts to oyster resources are not expected to occur as a result of construction or maintenance dredging and placement operations.

In the unlikely event of an oil spill, benthic fauna may be killed, but phytoplankton may be adversely or favorably affected by oil spills. It is unlikely that an oil spill in the Corpus Christi area would result in significant, long-term impact to either phytoplankton, zooplankton, or benthic communities since these organisms have the ability to recover rapidly from a spill due primarily to their rapid rate of reproduction and to the widespread distribution of dominant species. Additionally, as noted above, the chances of a spill occurring actually decrease with the more efficient channel in the proposed project.

4.4.4 Essential Fish Habitat

Under the No-Action alternative, EFH will continue as described in Section 3.5.1.3.

EFH for adult and juvenile white shrimp, brown shrimp, red drum, Spanish mackerel, Gulf stone crab, juvenile pink shrimp, and gray snapper occur in the project area including estuarine emergent wetlands, estuarine mud, sand, sand and shell substrates, SAV, and estuarine water column. However, there is no shell substrate in the areas to be dredged for the preferred alternative. Only a few, scattered, mostly dead oyster reefs exist in Corpus Christi Bay and the nearest is Long Reef, which is approximately 3,000 feet from PA 13, a UCPA from which the discharge is returned to La Quinta Channel. The placement of the maintenance material will bury bay bottom presently used as open-water, unconfined PAs. On the other hand, construction of the preferred alternative will have more beneficial than detrimental impacts since, for example, the proposed BU sites are strategically placed to prevent shoreline erosion and preserve and create seagrasses.

Approximately 5 acres of seagrasses and 40 acres of shallow-bay bottom will be lost to the preferred alternative dredging operations. For mitigation, approximately 15 acres of seagrass will be planted at Site GH and 40 acres of shallow-bay bottom will be created. The BU sites will create approximately 935 acres of habitat suitable for recolonization by submerged aquatic vegetation and 26 acres of marsh creation. BU Sites MN and ZZ will create 1,590 acres of offshore topographic relief for

marine habitat as well. However, creation of the breakwaters and fringe levees to protect the BU site and existing special habitats will cause the permanent loss of 1,782 acre-feet of water column and 108 acres of existing bay bottom.

Juvenile brown shrimp and white shrimp will be temporarily and locally impacted by the loss of seagrasses and open-bay bottom, but will benefit by the creation of 935 acres of unvegetated and vegetated shallow water and marsh. Red drum are found throughout the project area in all life stages and will be temporarily and locally impacted from dredging and placement activities and permanently excluded from the lost water column, but will benefit from the creation of BU sites in the bay and offshore. Juvenile Spanish mackerel nurseries may be impacted temporarily and locally by dredging activities, but will benefit by a greater number of nursery sites created by the BU plan and adults will benefit from the offshore sites. Adult stone crabs may be impacted temporarily and locally by turbidity, but should not be permanently impacted by the preferred alternative dredging activities. They may, however, benefit from the creation of the stone breakwaters. Postlarvae and juveniles of pink shrimp will incur temporary and localized impacts in estuarine areas, but will benefit from the creation of BU sites. Adults inhabiting offshore waters near the project may be impacted by temporary turbidity, but will benefit from the creation of Sites MN and ZZ providing topographic relief. All life stages of gray snapper occur throughout the project area and may be temporarily and locally impacted from dredging activities, but will benefit from the creation of bay and offshore BU sites.

4.4.5 Wildlife Resources

The No-Action alternative would result in no immediate direct impacts to the terrestrial wildlife species or wildlife habitats at or near the proposed study area. Some of the habitats may change over time independent of the project. Commercial development and continued dredging and placement of dredged material occurring in the area could result in increased sedimentation and altered hydrology, which could have an impact on the aquatic community and, thus the food source of many coastal birds. The number of vessels in the area would decrease due to the preferred alternative, thereby decreasing the possibility of accidental oil or chemical spill in the area.

4.4.5.1 Dredging/Construction Activities

While dredging activities from the proposed project are unlikely to have a direct impact on terrestrial wildlife species, they may have an indirect impact. Such activities may cause temporary, local impacts to aquatic communities and habitats, including increased turbidity, which in turn may indirectly impact birds in the immediate vicinity of the activities by potentially reducing the availability of the food supply. These impacts are local and temporary and are not expected to be significant considering the size of the bay and the mobility of birds. The slightly increased possibility of accidental spills of oil, chemicals, or other hazardous materials during construction dredging activities also poses a threat to the aquatic community and, thus, the food source of many coastal birds in the area. Phytoplankton and zooplankton assemblages, which make up the foundation of the aquatic food chain, could be affected by a spill. While adult shrimp, crabs and fish are mobile enough to avoid areas of high concentrations of pollutants, larval and juvenile finfish and shellfish are more susceptible. Decreased marine traffic would reduce the

potential for accidents and spills, and is otherwise not expected to have a direct effect on aquatic habitat. These effects would be short-term, however.

The noise of equipment and increased human activity during dredging activities may disturb some local wildlife, particularly birds, especially during the breeding season. Such impacts, however, should be temporary and without significant long-term implications. Salinity effects are not anticipated. Most infaunal organisms in the area are relatively tolerant of salinity fluctuations and would probably remain unaffected by any salinity changes related to dredging activities.

Dredging activities for the channel improvement would occur within 1,500 feet of several rookeries, most of which are infrequently used by a small number of birds. Table 4.4-1 provides information on nesting activities at these rookeries. Pelican Island, located just south of the CCSC, is a major brown pelican nesting area (see Section 4.5.2). Apart from the brown pelican, several species of heron, egret, tern, and gull also nest there. The Point of Mustang rookery occurs just to the east of Pelican Island. However, this rookery has not been active since 1994, when 30 pairs of least terns and 56 pairs of black skimmers were recorded. The Corpus Christi Channel rookery lies just to the west of Pelican Island. Seven pairs of great blue herons, 8 pairs of gull-billed terns, 160 pairs of least terns, and 60 pairs of black skimmers nested at this rookery in 2000. No birds have nested at the West Harbor Island rookery just north of Point of Mustang on the north side of the CCSC since 1994 when 42 pairs of least terns were recorded (GLO, 2000; FWS, 2001; TXBCD, 2001).

Rookeries occur on two placement areas adjacent to La Quinta Channel: Ingleside Point (Berry Island) and La Quinta (Table 4.4-1). Eight great blue heron nests, 2 great egret nests, 5 gull-billed tern nests, 15 least tern nests, and 170 black skimmer nests were recorded at these two rookeries in 1999. Least terns have not nested at the Castors Cut rookery since 1990, when 5 nests were recorded (FWS, 2001; TXBCD, 2001). A least tern colony is located at Tule Lake just south of and adjacent to the Tule Lake turning basin (TXBCD, 2001). However, this rookery has been used just twice since 1973: 14 nests were recorded in 1983 and 6 nests in 1993 (FWS, 2001).

The dredged material would be deposited in several areas as DMM/BU sites. At several sites, these beneficial use areas will be bordered by levees. Construction of these sites and levees would have similar impacts to the dredging activities in that they would be unlikely to have a direct impact on terrestrial wildlife species but may have an indirect impact. Temporary impacts to aquatic communities and habitat from increased sedimentation and turbidity would be expected. This in turn may impact birds in the area by potentially reducing the availability of their local food supply temporarily. This impact may be more noticeable at sites located near known bird rookeries. For example, sites R and S would be located adjacent to and on the south side of the Corpus Christi Channel rookery, while sites CQ and GH would be located to the south of the Ingleside Point rookery and to the west of the La Quinta rookery, respectively. Noise and increased human activity during construction may temporarily impact terrestrial wildlife in areas adjacent to the BU sites. These impacts are expected to be minor and short term.

TABLE 4.4-1

NUMBER OF NESTS OF COLONIAL WATERBIRDS
AT SELECTED ROOKERIES IN THE STUDY AREA

Rookery / ID	Common Name	Scientific Name	1995	1996	1997	1998	1999	2000
Tule Lake / 614-142	Least tern	*Sterna antillarum*						
La Quinta Spoil Islands /	Great blue heron	*Ardea herodias*	1			8	7	
614-160 (PA 13)	Great egret	*Ardea alba*					2	
	American oystercatcher	*Haematopus palliatus*				2		
West Harbor Island / 614-181	Least tern	*Sterna antillarum*						
Ingleside Point/Berry Island /	Great blue heron	*Ardea herodias*			5		1	
614-182	Gull-billed tern	*Sterna nilotica*			3		5	
	Least tern	*Sterna antillarum*			56		15	
	Black skimmer	*Rynchops niger*			95	70	170	
Point of Mustang / 614-183	Least tern	*Sterna antillarum*						
	Black skimmer	*Rynchops niger*						
Pelican Island / 614-184	Brown pelican	*Pelecanus occidentalis*	1,500	900	1,350	1,375	1,100	873
	Great blue heron	*Ardea herodias*	58	30	103	62	50	31
	Great Egret	*Ardea alba*	26	50	130	25	116	33
	Snowy egret	*Egretta thula*	66	30	130	59	84	40
	Little blue heron	*Egretta caerulea*	13	20	7	36	33	
	Tricolored heron	*Egretta tricolor*	378	150	550	343	261	301
	Reddish egret	*Egretta rufescens*	124	30	115	48	34	10
	Cattle egret	*Bubulcus ibis*	1,000	120	234	109	165	70
	Black-crowned night-heron	*Nycticorax nycticorax*	130	50	200	82	86	36
	White ibis	*Eudocimus albus*	68	40	81	75	311	140
	White-faced ibis	*Plegadis chihi*	309	15	123	63	47	53
	Roseate spoonbill	*Ajaia ajaja*	110	100	66	48	62	100
	Laughing gull	*Larus atricilla*	11,400		9,310	8,000	5,700	4,600
	Gull-billed tern	*Sterna nilotica*	4	5			8	3
	Caspian tern	*Sterna caspia*		1			18	
	Royal tern	*Sterna maxima*	20	10			218	660
	Sandwich tern	*Sterna sandvicensis*	10	5			108	780
	Forster's tern	*Sterna forsteri*						
	Least tern	*Sterna antillarum*					1	2
	Black skimmer	*Rynchops niger*	200	100	30	70	56	140
Corpus Christi Channel Spoil /	Great blue heron	*Ardea herodias*	10			1		7
614-185 (PA 9, PA 10)	Gull-billed tern	*Sterna nilotica*						8
	Least tern	*Sterna antillarum*					110	160
	Black skimmer	*Rynchops niger*			75			60
Castors Cut / 614-203	Least tern	*Sterna antillarum*						

Source: Texas Colonial Waterbird Database (FWS, 2001).

4.4.5.2 Operational Activities

Once the initial dredging activities associated with the project have been completed, little further impact is anticipated. Maintenance dredging activities would have similar temporary impacts as the initial dredging, but on a much smaller scale and for a shorter term. A decrease in the number of vessel trips in the project area for the with-project conditions as compared with the without-project conditions would reduce the potential for erosion of some of the PAs with rookeries. Decreased vessel traffic would also reduce the potential for accidental chemical or oil spills. Such spills pose a threat to the aquatic community and, thus, the food source of many coastal birds in the area. Impacts from noise and human activity are unlikely to be a factor.

The BU sites would provide a substrate for seagrass beds, thus increasing the habitat for some aquatic species, which in turn could locally increase the food source for birds in the area. In addition, BU Site Pelican is expected to have a beneficial impact on the Brown Pelican. Placement of maintenance dredged materials will continue on the south side of Pelican Island for ongoing rookery island enhancement. Also, rock revetment on the northeastern corner of the island for erosion protection will be replaced. A 2,200-linear-foot hydraulically filled embankment will extend bayward from the east end of the island for shoreline erosion protection and to prevent a land bridge from forming across Pelican Island to Mustang Island to keep predators away.

4.5 THREATENED AND ENDANGERED SPECIES

A Biological Assessment (BA) has been prepared for this project for the purpose of fulfilling the USACE requirements as outlined under Section 7(c) of the Endangered Species Act of 1973 as amended and can be found in Appendix C. The BA will be reviewed by NMFS and FWS for their Biological Opinion and to ensure that all potential project impacts have been discussed and coordinated with the appropriate agencies during various workgroup meetings.

4.5.1 Flora

There are no records of occurrence in the TXBCD database for any Federally endangered, threatened or Species of Concern in areas likely to be impacted by the current ship channel including dredged material placement areas (i.e., No-Action alternative). The habitats of the endangered species in the bay area's county lists are not likely to occur in areas impacted by the current practice. Of the SOC species, only roughseed purslane habitat (dunes and brackish swales and marshes) might be affected by dredged material placement on PA 2 (San Jose Island by the jetty) which can overflow to the beach. However, this species is not known to occur at PA 2.

The TXBCD database (Element Occurrence Records on USGS quads) was reviewed and no Federally endangered, threatened or SOC species that appear in the county lists for the study area were noted in areas that may be impacted by the proposed project. The proposed project would not impact the habitats of any of the endangered species. Of the SOC species, only roughseed purslane, which occurs in dunes and brackish swales and marshes along the coast, might be in the Gulf shore beach dune habitat close enough to the dredging activities to be affected by disturbances (from dredged

material placement) in this area. However, there is no difference from the potential impacts of the current practice.

4.5.2 Fauna

The No-Action alternative would result in no immediate direct impacts to any endangered species or endangered species habitat at or near the proposed project site, although some of the habitats may change over time independent of the project. Commercial development and continued dredging and placement of dredged material occurring in the area could result in increased sedimentation, which could have an impact on the brown pelican and other birds, as well as sea turtles. A decrease in the number of vessels in the area would reduce the potential for collision with any sea turtles in the area. Decreased erosion would also be expected from the decrease in boat traffic. Such increase in sedimentation or decrease in boat traffic would be less under the No-Action alternative than under the preferred alternative.

4.5.2.1 Construction Activities

A major brown pelican colony is located on Pelican Island, which is approximately 1,500 feet south of the CCSC (GLO, 2000; FWS, 2001; TXBCD, 2001). A total of 1,100 pairs of nesting brown pelicans was recorded at this rookery in 1999 and 873 pairs in 2000 (FWS, 2001; Table 4.4-1). Because of the proximity of this island to the CCSC, erosion from boat traffic may be a problem; however, the reduction in the number of vessels due to the project would lead to a decreased possibility of chemical or oil spills, diminishing the effect on the nekton community and, thus, the food source of the brown pelican. Loafing brown pelicans were encountered on Pelican Island outside of the nesting season as well as during the nesting season during PBS&J's surveys for the piping and snowy plover (PBS&J, 2001). Pelican Island is a designated PA for maintenance material only and will not receive construction material.

The white-faced ibis, a Federal SOC and State-threatened species, and the State-threatened reddish egret also nest on Pelican Island. In 1999, 47 nesting pairs of white-faced ibis and 34 pairs of reddish egret were recorded at this rookery, while in 2000, 53 pairs of white-faced ibis and 10 pairs of reddish egret were recorded (FWS, 2001; Table 4.4-1). Dredging activities in the area could indirectly impact these two species if they take place during the nesting season by potentially reducing the availability of the food supply. Noise during construction may also have an impact on the rookeries. The decreased possibility of chemical or oil spills would reduce impacts to the nekton community and, thus, the food source of the white-faced ibis and reddish egret.

PBS&J conducted a piping plover survey in the Corpus Christi Bay study area between September 2000 and April 2001 (PBS&J, 2001). The USACE and PBS&J met with the FWS and TPWD in Corpus Christi in the summer of 2000 to discuss the methods and areas of interest, relative to a piping plover and snowy plover survey. One-meter color infrared digital orthophoto quarter quadrangles of the study area were examined and potential areas of tidal elevation change were discussed. Areas within the study area, for which there was a paucity of data or where the resource agencies felt there might be impacts, were selected by the FWS and TPWD for an intensive 8-month survey. Results of the survey are in Appendix C. The piping plover and snowy plover have been recorded at several places near the CCSC, including East Flats, Harbor Island, Point of Mustang, and Pelican Island (PBS&J, 2001) (Figure 4-1). The minor changes in salinity and tidal amplitude as a result of the preferred alternative are

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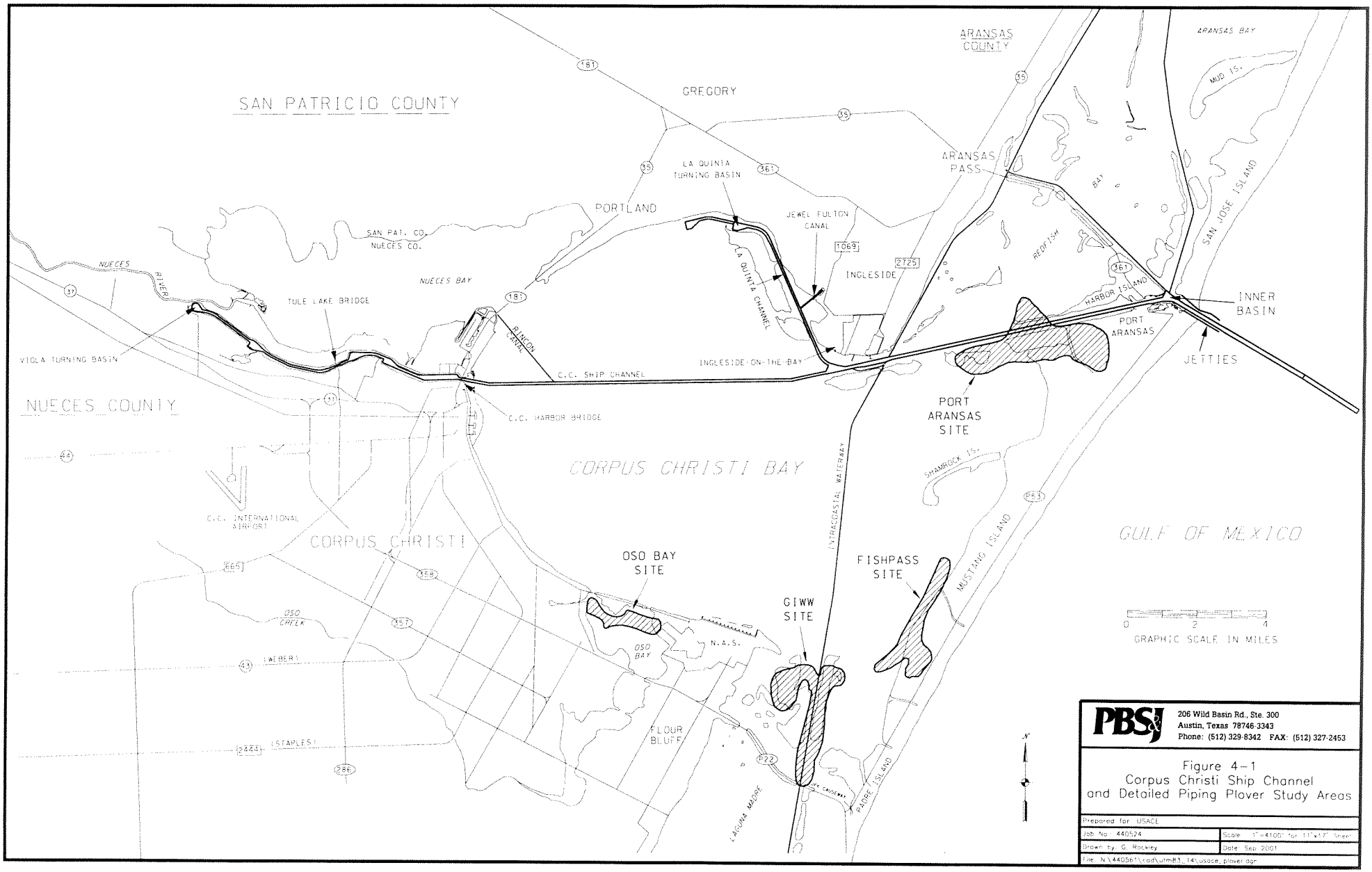

PBS&J
206 Wild Basin Rd., Ste. 300
Austin, Texas 78746-3343
Phone: (512) 329-8342 FAX: (512) 327-2453

Figure 4-1
Corpus Christi Ship Channel
and Detailed Piping Plover Study Areas

Prepared for: USACE	
Job No. 440524	Scale: 1"=4100' for 11"x17" sheet
Drawn by: G. Rackley	Date: Sep 2001
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expected to have no impact on these two plovers. No designated critical habitat for the piping plover would be impacted and none of the above areas will receive any construction material.

Four species of sea turtle, Kemp's ridley, loggerhead, green turtle, and hawksbill have been recorded from Corpus Christi Bay (Shaver, 2000). In offshore waters, in addition to these species, leatherback sea turtles have also been recorded. Leatherback sea turtle strandings were also found in the project area (Heinly, 1990). If present in the area, sea turtles may be in danger of being sucked into the hopper during dredging in the entrance channel. Dredging activities could have an impact on these species through an increase in sedimentation and turbidity. Sedimentation may impact food sources for the turtles, and turbidity could affect primary productivity. This would be short term, however. No concerns relative to chemical compounds in new work materials were noted in sections 3.2 and 3.3. The decreased possibility of chemical or oil spills would be expected to have a positive effect on turtles both directly and indirectly through a reduced threat to their food source. A decrease in the number of vessels would result in a lower incidence of collision with sea turtles. Nesting habitat for sea turtles is confined to the Gulf beaches. Hence, nesting habitat and nesting activities are not expected to be negatively impacted by dredging.

Terrestrial reptiles such as the Gulf salt marsh snake (a Federal SOC) and the State-threatened Texas tortoise have been recorded from areas in the study area (TXBCD, 2001). No impact on these species is anticipated, however. The Texas diamondback terrapin (SOC), an inhabitant of brackish and saltwater coastal marshes, lagoons, and tidal flats, has also been recorded in the study area (TXBCD, 2001). The minor changes in salinity and tidal amplitude as a result of the project are expected to have no impact on this terrapin.

The No-Action alternative appears to have no significant detrimental effect on the listed candidate species. The PA located offshore could be beneficial to the dusky shark, sand tiger shark, night shark, and goliath grouper. The change in the bathymetry has the potential to aggregate fish, which would be a food source to these species. The TXBCD State-threatened opossum pipefish is not common in the dredged or placement areas, therefore no impacts are expected.

As noted for the No-Action alternative above, the preferred alternative appears to have no significant detrimental effect on the listed candidate species. The BU site located at the offshore placement area, could be beneficial to the dusky shark, sand tiger, night shark, and goliath grouper. The change in the bathymetry has the potential to aggregate fish, which would be a food source to these species. The deepened and widened channel area represents an increase in habitat for those nekton species common in deeper offshore waters which periodically invade the bay through the deep channel corridor (Breuer, 1962). The TXBCD State-threatened opossum pipefish has the potential to be positively impacted through the creation of emergent wetlands planted with *Spartina* in the BU sites. This fish has been reported in *Spartina* marshes and in *Sargassum* mats in the Gulf of Mexico (Hoese and Moore, 1998).

4.5.2.2 Operational Activities

Once the initial dredging activities associated with the project have been completed, little further impact is anticipated. Maintenance dredging activities would have similar temporary impacts as

the existing without project practices. A decrease in the number of vessels in the area and the erosion protection features there may reduce the potential for erosion of the Pelican Island brown pelican rookery. Additionally, the proposed placement of routine maintenance material on Pelican Island, as at present, will be beneficial. Decreased boat traffic compared with future without-project traffic projections would also reduce the potential for accidental chemical or oil spills, as well as the potential for collision mortality for sea turtles. Impacts from noise and human activity are unlikely to be a factor.

Impacts to fish from operational activities would be the same as those discussed above for construction activities.

4.6 HAZARDOUS, TOXIC, AND RADIOACTIVE WASTE

4.6.1 Hazardous Material Impacts to the Existing Environment from Project Activities

The impacts from hazardous material use and handling during dredging activities associated with the preferred alternative pose a minimal risk of impacts to the environment. Typical impacts may include leaks or small spills associated with excavation and dredging equipment. However, these impacts would be minimal and typically do not pose a significant risk to the environment. The owners/operators of the pipelines located within the ship channels will be notified of the proposed dredging activities, and relocations will occur to comply with USGS regulations. The pipeline relocations have a potential for temporarily impacting the transportation of petroleum.

A review of a regulatory agency database information search, an aerial photographic review, interviews with regulatory officials, and a site reconnaissance was conducted to determine the location and status of sites regulated by the State of Texas and the EPA. This assessment identified 257 regulated properties in the study area. The environmental impacts that have resulted from these facilities vary greatly. The vast majority of these facilities do not appear to pose an environmental concern to the project. However, according to TNRCC officials, the industrial activity adjacent to the Inner Harbor of the CCSC and the La Quinta Channel has caused measurable impacts to the groundwater adjacent to these waterways.

Although the discharge of groundwater containing chromium and petroleum hydrocarbons has been documented in the Inner Harbor, all dredged materials from the Inner Harbor will go to UCPAs.

Groundwater seepage which reportedly contains carbon tetrachloride and perchloro-ethane has migrated and is discharging into La Quinta Channel. This discharge has potentially impacted the sediment of the ship channel. However, chemical analysis of La Quinta Channel sediments has indicated no cause for concern.

A total of 57 petroleum pipelines are reported to cross the CCSC, and six pipelines are reported to cross La Quinta Channel Extension. The proposed project could impact each of the pipelines located within the proposed dredging depth. Therefore, pipeline relocations have been made part of the project and would occur before dredging has begun.

A total of 1,568 permitted well sites are reported in the project area. Since dredging operations will be limited to existing ship channels, no impacts to oil and gas wells are expected.

4.6.2 Hazardous Material Impacts to the Project from Operation Activities

According to the regulatory agency database review, the historic utilization of the existing channels has not resulted in significant impacts to the environment. Future use of the deeper channels is not expected to result in greater impacts to the environment.

4.7 HISTORIC RESOURCES

All project impact areas have been evaluated for potential effects to historic properties. High probability areas that had not been surveyed during previous archaeological investigations, including Ricklis (1999), Highley et al. (1977), Hoyt (1990) and James and Pearson (1991), were investigated in conjunction with preparation of this FEIS (Enright et al., in preparation). The investigations reported by Enright et al. were performed to aid in the assessment of environmental consequences to historic properties for the proposed CCSCCIP and included multiple marine remote-sensing surveys and diver assessments. Scopes of work for historic properties investigations were coordinated with the Texas SHPO. Copies of agency correspondence are provided in Appendix D. Certain project impact areas were excluded from survey due to their low potential to contain significant historic properties or because of extensive prior disturbance. Such areas include landlocked portions of the Inner Harbor Reach, existing upland placement areas, previously designated and approved open-bay and offshore placement areas, and BU's MN, ZZ, L, Pelican, and the western 20 percent of BU Site GH.

Cultural resource investigations conducted in conjunction with this study have determined that proposed improvements will impact one significant historic property, the wreck of the *SS Mary* (41NU252), which is located immediately adjacent the Entrance Channel between the Port Aransas Jetties. Site 41NU252 was determined eligible for the NRHP based on SHPO concurrence with investigations by Hoyt (1990) and Pearson and Simmons (1995). One other potential NRHP property, an unidentified shipwreck (41NU264), is located immediately adjacent the Entrance Channel just beyond the end of the Port Aransas Jetties. No adverse impacts to Site 41NU264 are expected due to the fact that the channel has been naturally scoured to exceed the project depth, and no additional dredging is anticipated adjacent the wreck. No impacts are anticipated to terrestrial cultural resources.

Proposed improvements to navigation for the CCSC and La Quinta Channel include a channel extension offshore at Aransas Pass, deepening of the entire CCSC from the Entrance Channel to the Inner Harbor, widening of the CCSC across the Upper and Lower Bay reaches, and the addition of a channel extension and a turning basin at the head of the La Quinta Channel. In conjunction with improvements, dredged material will be placed in existing mid-bay PAs and in new BU sites that will be created in the bay and offshore areas. The proposed CCSC improvements (described in Section 2.2.2) include deepening the existing channel from –45 feet MLT to –52 feet MLT, plus 2 feet over-dredging allotment and 2 feet advanced maintenance, and widening the toe-to-toe measurement to 530 feet along all reaches except the Inner Harbor and Entrance channels. A 200-foot wide, 12-foot deep barge shelf additionally will be added to either side of the CCSC from the La Quinta Junction to the Harbor Bridge.

The Entrance Channel will be dredged to the –56-foot isobar which will extend the channel approximately 10,000 feet into the Gulf of Mexico. The proposed channel widening and the addition of the barge shelves will increase the impact zone width to approximately 770 feet from the inner end of the Entrance Channel to the La Quinta Junction (the Lower Bay Reach) and to approximately 1,000 feet from the La Quinta Junction to the bay end of the Inner Harbor Channel (the Upper Bay Reach). The La Quinta Channel proposed improvements include extending the existing channel 7,200 feet, at a depth of –39 feet MLT and a width of 300 feet, and the creation of a turning basin.

The placement plan for new work and dredged material (Section 2.2.2) involves using a combination of existing upland and open-water PAs, existing and new BU's in Corpus Christi Bay and the Gulf of Mexico, and the creation of one new upland BU north of La Quinta Channel, The proposed creation of BU sites in the bay and offshore areas will total approximately 935 acres of the bay bottom and 1,590 acres of the Gulf of Mexico. A variety of BU sites are proposed for use (Figure 1-3), including breakwaters, new marsh areas protected by breakwaters, a new upland natural area, the enlargement of existing bird islands, and the use of existing offshore feeder berms. Descriptions of individual BU sites are provided in Sections 1.6 and below as they apply to each channel reach.

All open-bay, offshore, and terrestrial PAs (Figure 1-2) were designated and cleared for continuous use by the CCSC 45-Foot Project (U.S. Army Engineer District, Galveston, Texas 1979). PAs are listed below in the context of the channel reach to which each applies. The footprints of existing PAs are not expected to change as a result of the CCSCCIP; therefore, no new impacts are anticipated in those areas. Existing unconfined PAs proposed for use in Corpus Christi Bay total 4,050 acres. PA 1, a 500-acre unconfined placement area, previously designated in the Gulf of Mexico, is also proposed for use by the CCSCCIP. Existing upland PAs total approximately 2,300 acres.

4.7.1 Entrance Channel

The Entrance Channel segment of the CCSCCIP is comprised of several distinct elements for which potential effects to historic properties must be evaluated. These include the existing Jetty and Outer Bar channels, the proposed Offshore Channel Extension, creation of BU sites MN and ZZ, and use of the existing PAs 1 and 2. Existing channel segments are addressed together below, since the proposed improvements are the same to both the jetty and outer bar channel segments.

4.7.1.1 Previous Investigations

Five historic properties investigations have been conducted within portions of the Entrance Channel as defined above. EH&A's 1989 survey (Hoyt, 1990) covered the immediate vicinity of the *SS Mary* wreck (Site 41NU252). That study included a remote-sensing survey, diver evaluation, and a NRHP assessment of the site. The site was recommended as eligible for the NRHP based on their work.

CEI's 1991 survey (James and Pearson, 1991) included a remote-sensing survey of the Jetty and Outer Bar channels (from Station 210+00 to Station –30+00) and diving at several anomalies. CEI recommended 7 remote-sensing targets along the Entrance Channel, in addition to the known wreck site of the *SS Mary,* for archaeological avoidance or further investigation. Those 7 targets were designated with the numbers 16, 20, 23, 24, 25, 31 and 32. A diving assessment of Target 31, conducted

by CEI as part of the same project, revealed the presence of a potentially significant shipwreck, which was recorded as Site 41NU264. The other six targets were investigated by divers in 1993 (Pearson and Simmons, 1995). More extensive diver investigations of Target 31 (41NU264) and the *SS Mary* (41NU252) also were conducted during CEI's 1993 study.

In 1994, EH&A conducted additional diver investigations of Site 41NU264, believed incorrectly at the time to be the wreck of the *Utina* (Schmidt and Hoyt 1995). The site was thoroughly documented and was recommended as not eligible for the NRHP based upon the fact that better preserved examples of the *Utina* vessel type exist elsewhere. That site was recently proved by PBS&J to be misidentified. A shipwreck more closely matching the description of *Utina* has since been found south of 41NU264. The actual location of *Utina* is located well outside of the CCSCCIP impact area.

PBS&J's 2000 survey (Enright et al., in preparation) was conducted specifically for the CCSCCIP. That study included a remote-sensing survey of three areas: the proposed Outer Bar Channel Extension, the margins of the existing Outer Bar Channel, and the margins of the Inner Basin. The latter is located at the junction of the Jetty Channel and the Lower Bay Reach. PBS&J recommended four remote-sensing targets as potentially significant. Those targets were designated as anomalies M1, M2, M3 and M39. PBS&J conducted a close-order remote-sensing on the three targets that are located with the CCSCCIP impact area (M1, M2 and M3) and diver assessments of anomalies M1 and M3, both of which proved not to be archaeologically significant. Anomaly M2 is associated with the unidentified shipwreck at Site 41NU264. Anomaly M39 is associated with the suspected *Utina* wreck site and will not be affected by the CCSCCIP.

4.7.1.2 Environmental Consequences

Channel Extension

No adverse effects to historic properties are anticipated within the proposed Outer Bar Channel Extension Area. This area was surveyed by PBS&J in June 2000 (Enright et al., in preparation), and no potentially significant remote-sensing targets or historic properties were identified in this area. No adverse effects to historic properties are anticipated as a result of the channel extension.

Deepening of Existing Entrance Channel

Locations of three shipwrecks are known along the existing Entrance Channel. These vessels include Site 41NU252 (*SS Mary*), 41NU264 (unidentified vessel) and a vessel associated with Anomaly M39 (suspected location of the *Utina*; no site number yet assigned). Site 41NU252 is eligible for the NRHP. It is located along the south side of the Jetty Channel and will be adversely impacted by the CCSCCIP. Site 41NU264 is potentially eligible for the NRHP. It is located along the south side of the Outer Bar Channel, a short distance beyond the end of the jetties; however, no adverse impacts are anticipated at this site. The shipwreck at Anomaly M39 is located immediately adjacent the submerged seaward end of the southern jetty. The latter wreck is situated well clear of the Entrance Channel and will not be adversely impacted by the CCSCCIP.

The wreck of the *SS Mary* (41NU252) is located between the jetties at the base of the existing channel slope on the south side of the Jetty Channel. Although the exposed wreckage of the *SS Mary* is in very poor condition, it is eligible for designation as a State Archaeological Landmark under the criteria specified in The Antiquities Code of Texas, Section 191.091. The wreck was recommended by Hoyt (1990) as eligible for nomination to the National Register of Historic Places. Hoyt's recommendation was based on the *Mary*'s historic context, including the vessel's association with the Morgan Line steamship company owned by Charles Morgan (NRHP Criterion B: association with the lives of significant persons in the past), its service as a typical coastal steamer of the period (NRHP Criterion C: embodies the distinctive characteristics of a type, period or method of construction), and its construction by the innovative H&H Corporation (NRHP Criterion C). The THC subsequently concurred with that recommendation, thus the *Mary* is considered eligible for the NRHP.

Proposed channel deepening will adversely affect the wreck of the *Mary*. Based upon the position of the magnetic anomaly (Enright et al., in preparation), combined with positions of wreckage reported by Hoyt (1990), it appears that at least 16 feet of the *Mary's* stern should lie within the proposed dredging impact area of the CCSCCIP. Since the stern was never identified by divers, that portion of the vessel may have been impacted by the existing CCSC 45-Foot Project; however, a significant portion of the *Mary's* hull remains on the channel slope. The existing Jetty Channel depth at this location averages 52 feet MLT. On the south side of the channel, in the vicinity of the *Mary,* the channel has scoured to a depth of 55 feet MLT. Dredging to deepen the channel will impact sediments to a maximum depth of 56 feet MLT. Only minor slumping is expected before the channel slope again reaches equilibrium. Nevertheless, even minor slumping will adversely impact the *Mary* due to its proximity to the proposed new dredging.

Mitigation options for the *Mary* have been discussed in consultation with the Texas State Marine Archaeologist and the Texas SHPO (Stokes and Hoyt, 2000; Hoyt and Stokes, 2001). Data recovery is not feasible due to dangerous diving conditions, including currents in excess of 4 knots, proximity to ship traffic and near-zero visibility. The Galveston District USACE, therefore, recommends alternative mitigation measures, such as the preparation of a Texas maritime history curriculum module for use in public schools and construction of a museum display. A Memorandum of Agreement will be negotiated with the Texas SHPO, which details these alternative mitigation requirements.

A second shipwreck site (41NU264), considered potentially eligible for the NRHP, was discovered near the Outer Bar Channel by remote-sensing and diver investigations (James and Pearson, 1991; Pearson and Simmons, 1995). Site 41NU264 is located immediately adjacent the south side of the channel slightly seaward of the Aransas Pass jetties. This site was tentatively identified as the shipwreck of the *Utina* (Pearson and Simmons, 1995). Schmidt and Hoyt (1995:74-77) agreed with CEI's tentative identification of the site as the *Utina* and recommended that Site 41NU264 was not archaeologically significant based largely on the fact that several better-preserved examples of the *Utina* vessel type exist in the Sabine River. Recent information has come to light, however, which calls into question the identity of the vessel wrecked at Site 41NU264.

A more likely candidate for the *Utina* was discovered inadvertently by PBS&J during the summer of 2000 when, during a close-order magnetometer survey of Site 41NU264, another wreck was

discovered at the end of the south jetty. PBS&J designated the latter wreck site as Anomaly M39. A trinomial site number has not been assigned as of this writing. Dimensions of the side-scan sonar target associated with M39 closely match the size of the *Utina*. Furthermore, the *Utina* is known from historic documents, including photography, to have stranded on the Gulf end of the south jetty (Schmidt and Hoyt, 1995), precisely where M39 is located. Site 41NU264, on the other hand, is located in deep water between the jetties on the southern margin of the ship channel. A strong case can now be made that the vessel at Site 41NU264 is not the *Utina*. Given this new information, however, Site 41NU264 must once again be considered potentially eligible for the NRHP until such time as its identity can be firmly established.

No additional research or mitigation is recommended for Site 41NU264, as the project is not expected to impact the wreck. The northern limit of wreckage, as seen on recent side-scan sonar images recorded by PBS&J, is located 14 feet south of the proposed channel toe. A recent cross-section of the existing channel in the vicinity of the site documents scouring to a depth of 65 feet MLT. No additional dredging is anticipated adjacent the wreck, since deepening of the channel will only impact sediments to a depth of 56 feet MLT.

The potential for impacts to this Site 41NU264 from erosion associated with the draw-down effects of more heavily laden ships also was evaluated using the results of a shoreline erosion study prepared by the Port of Corpus Christi for this project (Shepsis, 2001). From that study, it can be deduced that pressure field waves created by the draw-down of passing ships will play a relatively minor role in shoreline erosion, as compared to sea level rise, for example, over the next 50 years. The erosional effects of draw-down are most significant in shallow water and along steep slopes. Bottom water velocity increases as the energy from the draw-down and return waves becomes concentrated by the narrowing water column in shoal areas. Post-project bottom slopes in the vicinity of 41NU264 are not expected to differ significantly from present conditions. Ships are expected to displace more water following completion of the project due to heavier loads; however, no appreciable change in erosion rates is expected at this site. Shallow areas having relatively flat slopes, tend to experience sediment movement both toward and away from the channel (Shepsis, 2001: 2-32). Extrapolating to a flat slope in deep water, where draw-down and return wave velocities should be significantly less, the net sediment transport under such conditions is expected to result in minimal erosion of the site.

BU Site MN

BU Site MN is proposed to be approximately 440 acres. It would be located just outside of the 30-foot isobath (approximately 6,500 feet offshore) and 10,000 feet south of the project channel centerline. No shipwrecks are charted in the area of BU Site MN. Communication with the Texas State Marine Archaeologist determined that no remote-sensing survey would be required over BU Site MN because of the low potential for wrecks in the area (Murphy, 2001). No environmental consequences are anticipated for historic properties within the proposed BU Site MN (Hoyt and Stokes, 2001).

BU Site ZZ

Creation of BU Site ZZ originally was proposed as part of the Navy Homeport Project. It is proposed to be approximately 1,150 acres and is located approximately 15,300 feet southeast of the southern Aransas Pass jetty. One shipwreck is recorded within the limits of BU ZZ on NOAA Chart 11307. The AWOIS database reports this wreck (AWOIS Record 7907) as a 42-foot modern fishing vessel, lying in approximately 51 feet of water. The wreck was first reported by a Local Notice to Mariners in 1986 and is not considered a potential historic resource. A remote-sensing survey was not conducted over BU ZZ as a previous EIS, prepared by the EPA (1988), found that the use of BU ZZ will not impact sites of historical importance. No environmental consequences are anticipated for historic properties within the proposed BU Site ZZ (Hoyt and Stokes 2001).

Existing PAs

Two existing PAs (1 and 2) would be used for placement of dredged material from the Entrance Channel Reach. PA 1 is an existing offshore placement area which was previously approved for use as part of the CCSC 45-Foot Project (USACE, 1979). It covers approximately 500 acres and is located 5,300 feet southeast of the southern Aransas Pass jetty. No shipwrecks are recorded in the vicinity of PA 1, and no significant historic properties are expected to exist there (Hoyt and Stokes, 2001). A remote-sensing survey was not conducted over PA 1 as a previous Environmental Impact Statement, prepared by the EPA (1989), found that use of PA 1 would not impact sites of historical importance. PA 2 is an existing upland placement area on San Jose Island, which was approved for continuous use as part of the CCSC 45-Foot Project (USACE, 1979). No modifications of the existing PA footprints are proposed. No adverse effects are anticipated for historic properties due to the use of either PA 1 or PA 2.

4.7.2 Lower Bay

The Lower Bay Reach of the CCSCCIP is comprised of several distinct elements for which potential effects to historic properties must be evaluated. These include widening and deepening of the existing CCSC, creation of BU Sites I, R, S, L and Pelican, and use of the existing PAs 4-10. BU Site I would be located on the north side of the ship channel between Dagger Island and Pelican Island and would involve approximately 163 acres of bay bottom. BU sites R (201 acres) and S (121 acres) would be located on the south sides of existing PAs 9 and 10, respectively. BU Site L, proposed for the north side of Mustang Island east of Piper Channel, would consist of a rock revetment to serve as a marsh/ecosystem protection site. BU Pelican would consist of an armored barrier on the north and east sides of Pelican Island, to protect habitat from wind and wave erosion of PAs 7 and 8 and containment of routine placement of maintenance dredged material.

4.7.2.1 Previous Investigations

Four archaeological investigations have been conducted along the Lower Bay Reach. A remote-sensing survey conducted by CEI (James and Pearson, 1991) partially covered the CCSCCIP in the Lower Bay Reach using a 164-foot survey line interval. CEI recommended a single side-scan target (Sonar Target 40) as potentially significant. Target 40 did not have an associated magnetic anomaly and was recorded in 50 feet of water. It was investigated by archaeological divers as part of the same project;

however, divers were unable to locate an object at that location. Since Target 40 was mapped in an area which had been disturbed by dredging, no further investigation was recommended.

CEI conducted a remote-sensing survey along the GIWW across Corpus Christi Bay in 1994 (Pearson and Wells, 1995). One potentially significant target was identified at the intersection of the GIWW and the CCSC by their study. Target 1, as it was designated, was considered potentially associated with the wreck of the steamboat *Dayton* which occurred in the vicinity in 1845. CEI divers investigated Target 1 in 1996 (Pearson and James, 1997), determining that it was, instead, associated with a section of discarded dredge pipe. No further investigation of the target was recommended to follow that study.

PBS&J conducted a series of remote-sensing surveys, followed by diver investigations in 2000 and 2001 (Enright et al., in preparation). Those investigations were performed for the CCSCCIP and included, in the Lower Bay Reach, a remote-sensing survey of the area to be affected by channel widening and deepening, a remote-sensing survey of BU sites I, R and S, a close-order remote-sensing survey of 11 magnetic anomalies, and archaeological diver investigations on 7 anomalies. A total of 10 magnetic anomalies, designated M4-M13, were recommended as potentially significant following the survey along the CCSC through the Lower Bay Reach in June 2000. During the close-order survey of those 10 anomalies in December 2000, one additional potentially significant anomaly (M38) was discovered mid-way between M12 and M13. M38 also was surveyed using a close line interval at that time. Two additional anomalies (I1 and I3) were recommended as significant based on the results of BU surveys in June 2001.

Anomalies M4-M6, M8, and M10-M11 were recommended as not significant based on the results of the close-order survey. Archaeological divers investigated the remaining 7 anomalies, including M7, M9, M12, M13, M38, I1 and I3. Potentially significant archaeological remains were found at one location, Anomaly M38. All of the other anomalies have been recommended as not archaeologically significant based upon the results of diver investigations.

Anomaly M38 marks the location of a buried shipwreck which is consistent in its location, water depth, hull width and construction materials with the wreck of the steamboat *Dayton.* The *Dayton* is known from historic documents to have sunk in this vicinity in 1845 following a boiler explosion. Because of this possible associate, Anomaly M38 is recommended as potentially eligible to the NRHP.

4.7.2.2 Environmental Consequences

Channel Widening and Deepening

The location of one shipwreck has been documented in the vicinity of the CCSC along the Lower Bay Reach. Diving investigations conducted by PBS&J in 2001 at Anomaly M38 revealed suspected historic vessel remains buried beneath 6 feet of sediment. The identity of those remains has not been firmly established; however, they are consistent with the historic steamboat *Dayton* which blew up and sank in this vicinity in 1845. This site is considered potentially eligible for the NRHP. The northern edge of Anomaly M38 is located approximately 95 feet south of the projected new top of channel slope, thus the shipwreck associated with Anomaly M38 will not be adversely affected by the CCSCCIP.

BU Site I

BU Site I is proposed to be approximately 163 acres and is located on the north side of the CCSC between Dagger Island and Pelican Island. No shipwrecks are plotted in the vicinity of BU Site I. PBS&J's 2001 survey recommended avoidance or further investigation of two magnetic anomalies (I1 and I3) within Site I. Diver investigations cleared these sites as modern debris (Enright et al., in preparation). No adverse effects to historic properties are anticipated due to the creation of BU Site I.

BU Site R

BU Site R is proposed to be approximately 201 acres and is located on the south side of PA 9. PBS&J's 2001 survey of BU R did not locate any potential historic properties. No adverse effects to historic properties are anticipated due to the creation of BU Site R.

BU Site S

BU Site S is proposed to be approximately 121 acres and is located on the south side of PA 10. No shipwrecks are plotted in the vicinity of BU Site S. PBS&J's 2001 survey did not locate any potential cultural resource sites in this area. No adverse effects to historic properties are anticipated due to the creation of BU Site S.

BU Site L

The area proposed for construction of this rock revetment consists of made land. This location was not subjected to a cultural resource survey, as no disturbance of the natural bay bottom is expected. No adverse effects to historic properties are anticipated due to the creation of BU Site L.

BU Pelican

BU Pelican consists of a geotube placement atop previously deposited dredged material. The geotubes are meant to prevent material runoff from an adjacent placement area. A remote-sensing survey was deemed unnecessary as the natural bay bottom has already been covered by dredged material from the adjacent placement area. The presence of the geotubes will not impact the natural bay bottom in this area further (Hoyt and Stokes, 2001). No adverse effects to historic properties are anticipated due to the creation of BU Pelican.

Existing PAs

Seven existing PAs (4, 5, 6, 7, 8, 9 and 10) would be used for placement of dredged material from the Lower Bay Reach. These PAs were previously approved for continuous use as part of the CCSC 45-Foot Project (USACE, 1979). No modifications of the existing PA footprints are proposed, and no adverse effects are anticipated for historic properties due to their continued use.

4.7.3 Upper Bay

The Upper Bay Reach of the CCSCCIP is comprised of several distinct elements for which potential effects to historic properties must be evaluated. These include widening and deepening of the existing CCSC, creation of barge lane shelves on each side of the widened channel, creation of BU Site CQ, and use of the existing PAs 14A, 14B, 15A, 15B, 16A, 16B, 17A, and 17B (see Figure 1-2). BU Site CQ would be located south of Berry Island and west of the CCSC/La Quinta Channel junction (see Figure 1-3). Site CQ would use new work materials to create approximately 250 acres of shallow water habitat and emergent flats and 6 to 10 mounds of material placed in a northwest to southeast direction to decrease fetch.

4.7.3.1 Previous Investigations

Two archaeological investigations have been conducted along the Upper Bay Reach. A remote-sensing survey conducted by CEI (James and Pearson, 1991) partially covered the CCSCCIP in the Upper Bay Reach using a 164-foot survey line interval. CEI recommended a single side-scan target (Sonar Target 47) as potentially significant along this reach of channel. Target 47 did not have an associated magnetic anomaly and was recorded in 47 feet of water. It was investigated by archaeological divers as part of the same project; however, divers were unable to locate an object at that location. It was determined that Target 47 was a bottom scar. Target 47 was located in an area which had been disturbed by dredging. No further investigation was recommended.

PBS&J conducted a series of remote-sensing surveys, followed by diver investigations in 2000 and 2001 which included the Upper Bay Reach (Enright et al., in preparation). Those investigations were performed for the CCSCCIP and included a remote-sensing survey of the areas to be affected by channel widening and deepening and by construction of barge lane shelves along each side of the channel, a close-order remote-sensing survey of 9 magnetic anomalies, a remote-sensing survey of BU Site CQ, and archaeological diver investigations of 3 anomalies. A total of 9 magnetic anomalies, designated M14-M22, were recommended as potentially significant following the survey along the CCSC through the Upper Bay Reach in June 2000. No additional anomalies were recommended as significant based on the results of the BU Site CQ survey in June 2001. Anomalies M15-M16, M18-M20 and M22 were recommended as not significant based on the results of the close-order survey. Archaeological divers investigated the remaining 3 anomalies, including M14, M17 and M21. All three anomalies were recommended as not archaeologically significant based upon the results of diver investigations.

4.7.3.2 Environmental Consequences

Channel Widening and Deepening and Barge Lane Creation

There are no known historic properties or potentially significant remote-sensing targets located in this area. Four remote-sensing targets have been investigated by divers along the Upper Bay Reach (1 by CEI and 3 by PBS&J); however, all of those anomalies were determined not to be archaeologically significant. No adverse effects to historic properties are anticipated as a result of the proposed new dredging along this channel reach.

BU Site CQ

BU Site CQ (Figure 1-3) is proposed to be approximately 250 acres and is located to the south of Berry Island and west of the CCSC/La Quinta Channel junction. No potential historic properties are known to exist in this area, and PBS&J's 2001 remote-sensing survey did not locate any potentially significant remote-sensing targets there. No adverse effects to historic properties are anticipated due to the creation of BU Site CQ. .

Existing PAs

Eight existing, unconfined open-bay PAs (14A, 14B, 15A, 15B, 16A, 16B, 17A, and 17B) would be used for placement of maintenance material from the Upper Bay Reach. These PAs were previously approved for continuous use as part of the CCSC 45-Foot Project (USACE, 1979). No modifications of the existing PA footprints are proposed, and no adverse effects are anticipated for historic properties due to their continued use.

4.7.4 La Quinta

The La Quinta Reach is comprised of several distinct elements for which potential effects to historic properties must be evaluated. These include extending the existing channel 7,200 feet, construction of a turning basin adjacent the channel extension, creation of BU sites P, GH and E, and use of existing PA 13. Under the preferred alternative, no deepening of the existing La Quinta Channel would occur.

4.7.4.1 Previous Investigations

Two marine archaeological investigations have been conducted along the La Quinta Reach. A remote-sensing survey conducted by CEI (James and Pearson, 1991) partially covered the La Quinta Reach using a 164-foot survey line interval. CEI recommended one side-scan target (Target 53) and one magnetic anomaly (Target 84) as potentially significant along this reach of channel. Target 53 did not have an associated magnetic anomaly and was recorded in 50 feet of water. Target 84 did not have an associated sonar target and was recorded in 49 feet of water. Both targets were investigated by archaeological divers as part of the same project. Divers located only braided steel cable at both locations. No further investigations were recommended.

PBS&J conducted a series of remote-sensing surveys, followed by diver investigations in 2000 and 2001 which included the La Quinta Reach (Enright et al., in preparation). Those investigations included a remote-sensing survey of a 200-foot-wide area along each side of the channel, a remote-sensing survey of the proposed channel extension and turning basin (including the easternmost 80 percent of BU Site GH), a close-order remote-sensing survey of 14 magnetic anomalies, a remote-sensing survey of BU Site P, and archaeological diver investigations of 1 anomaly. A total of 14 magnetic anomalies, designated M24-M37, were recommended as potentially significant following the survey in June 2000. One additional anomaly (P1) was recommended as significant based on the results of the BU Site P survey in June 2001. Anomaly P1 is located in an area that will not be affected by creation of BU Site P. Anomalies M24 and M26-M37 were recommended as not significant based on the results of the

close-order survey. Archaeological divers investigated the remaining anomaly, M25. Anomaly M25 was recommended as not archaeologically significant based upon the results of diver investigations.

Previous terrestrial archaeological investigations encompassing portions of BU Site E include Corbin's (1963) investigations, a survey by McDonald and Dibble (1973), and survey and excavation conducted by Ricklis (1999). Ricklis revisited all of the sites recorded by the earlier two surveys. All ten sites investigated by Ricklis were deemed ineligible for NRHP listing or SAL designation. The THC concurred with this assessment (Ricklis, 1999).

4.7.4.2 Environmental Consequences

Channel Extension and Turning Basin Creation

There are no known historic properties or potentially significant remote-sensing targets located in any of these areas. Three remote-sensing targets have been investigated by divers along the existing La Quinta Channel (2 by CEI and 1 by PBS&J); however, all of those anomalies were determined not to be archaeologically significant. Furthermore, since no modifications are planned for the existing channel under the preferred alternative, there would be no adverse effects to historic properties there, should they exist. No adverse effects to historic properties are anticipated in association with either the channel extension or turning basin construction.

BU Site GH

BU Site GH is proposed to be approximately 200 acres and is located adjacent the south side of the proposed La Quinta Channel extension and west of PA 13. PBS&J's 2000 remote-sensing survey (Enright et al., in preparation) encompassed the easternmost 80 percent of BU Site GH. PBS&J did not survey the remaining 20 percent during the 2001 survey, because it was determined that no potentially significant anomalies were recorded by the 2000 survey and because THC's shipwreck database contained no indication of a wreck in the area (Murphy, 2001). The Texas SHPO concurred that a survey of the western 20 percent was not necessary due to the low probability for historic properties in the area. No adverse effects are anticipated for historic properties due to the creation of BU Site GH.

BU Site P

BU Site P is a rock breakwater proposed to be approximately 2,400 feet long. It would be located on the east side of the La Quinta Channel adjacent Ingleside-On-The-Bay. No historic properties are known to exist in this area. PBS&J's 2001 remote-sensing survey located one potentially significant remote-sensing target, designated P1; however, that target is located in an area which will be unaffected by project-related bottom disturbances. No adverse effects to historic properties are anticipated due to the creation of BU Site P.

BU Site E

BU Site E is located on the upland bay margin, northwest of the La Quinta Channel extension. Site E would involve the creation of a 100-acre upland natural area buffer between lands to the

west and the La Quinta Gateway Project. Portions of the area have been previously surveyed for terrestrial cultural resource sites, and all recorded sites have been determined not eligible for inclusion to the NRHP or as SALs. Coordination with the Texas SHPO concluded that those portions not surveyed have a low probability for the occurrence of significant archaeological sites; therefore, no further investigations are required. No adverse effect to significant historic properties are expected due to the creation of BU Site E.

Existing PAs

One existing PA (PA 13) would be used for placement of maintenance material dredged from the La Quinta Channel. PA 13 was previously approved for continuous use as part of the CCSC 45-Foot Project (USACE, 1979). No modifications of the existing PA footprints are proposed, and no adverse effects are anticipated for historic properties due to their continued use.

4.7.5 Inner Harbor

The Inner Harbor Reach is comprised of several distinct elements for which potential effects to historic properties must be evaluated. These include deepening the existing channel and use of existing confined upland PAs (IH-PA 1, IH-PA 3A, B, C, IH-PA 4, IH-PA 5, IH-PA 6 (Tule Lake), IH-PA 2 (Rincon), and IH-PA 8 (Suntide)).

4.7.5.1 Previous Investigations

Previous terrestrial archaeological investigations of the Inner Harbor area were conducted by Highley et al. (1977) for the Tule Lake Tract Project. The survey was conducted prior to disposal of fill resulting from harbor dredging activities (Highley et al., 1977). Two archaeological sites (41NU157 and 41NU158) were identified and recorded during that survey. Site 41NU157 was recommended for avoidance and was not to be covered. Site 41NU158 was recommended for intensive survey and shovel testing. It is not known whether the THC concurred with those recommendations. A later survey, conducted for a proposed dredge material site in Nueces County, overlapped a small portion of the western end of the Tule Lake survey area. The area resurveyed included previously recorded site 41NU157. Based on the reconnaissance results of the latter survey, the authors reported that no potential conflict with cultural resources was documented (Black and Highley, 1985).

PBS&J conducted a series of remote-sensing surveys, followed by diver investigations in 2000 and 2001 which included the Corpus Christi Bay portion of the Inner Harbor Reach east of the Harbor Bridge (Enright et al., in preparation). Those investigations were performed for the CCSCCIP and included a remote-sensing survey of a 200-foot-wide area along each side of the channel and a close-order remote-sensing survey of one magnetic anomaly. Anomaly M23 was recommended as potentially significant following the survey in June 2000; however, that recommendation was changed to not significant based on the results of the close-order survey. No marine remote-sensing surveys were required in the landlocked portion of this reach because the channel did not exist prior to 1934 and was not completed in it's present form until 1958. Historic navigation in this reach was not possible prior to 1934 and occurred under controlled circumstances after that date. The potential for occurrence of

significant historic shipwrecks along this reach, therefore, is considered to be low. The Texas SHPO has concurred that no marine remote-sensing survey is necessary along this reach.

4.7.5.2 Environmental Consequences

Channel Deepening

There are no known historic properties or potentially significant remote-sensing targets located in this area. One remote-sensing target, Anomaly M23, was recorded by PBS&J along the bay portion of this reach, between Light Beacon 82 and the Harbor Bridge; however, a close-order survey of that anomaly suggested that it was not archaeologically significant. Deepening of the existing channel will not impact the existing exposed shoreline; therefore, a terrestrial cultural resource survey of the shoreline was not required. The Texas SHPO did not require a remote-sensing survey of the Inner Harbor Reach west of the Harbor Bridge, due to the low probability that significant submerged historic properties would be present in that area. No adverse effects to historic properties are anticipated as a result of the Inner Harbor channel deepening.

Existing PAs

Nine existing, upland confined PAs (IH-PA 1, IH-PA 3A, B, C, IH-PA 4, IH-PA 5, IH-PA 6 (Tule Lake), IH-PA 2 (Rincon), and IH-PA 8 (Suntide)) will be used for placement of new material dredged to deepen the Inner Harbor Channel. Most of these existing PAs were created prior to any legal requirement for archaeological surveys, thus they were never surveyed for cultural resources. One exception is IH-PA 6 (Tule Lake). IH-PA 6 is proposed to cover 400 acres between Tule Lake and the Viola Channel. IH-PA 6 was surveyed for cultural resources as reported by Highley et al. (1977) and by Black and Highley (1985). Several cultural resources sites were recorded by those surveys; however, none of the recorded sites are located within the boundaries of IH-PA 6. The closest cultural resource site to IH-PA 6 is 41NU157. No modification of the existing PA footprints or levees will occur as a result of the CCSCCIP, and no adverse effects to historic properties are anticipated due to their continued use.

4.8 AIR QUALITY

Under the No-Action alternative, air quality would continue as described in Section 3.9.

Impacts on air quality from the project would result during construction and follow-on maintenance dredging activities.

4.8.1 Construction Dredging

The combustion of diesel fuel during construction dredging operations would result in air emissions of primarily nitrogen oxides (NO_x), carbon monoxide (CO), volatile organic compounds (VOC), particulate matter (PM), and sulfur dioxides (SO_2). The amount of fuel combustion emissions would be directly related to the type and size of equipment and the amount of dredging required. The total amount of new dredged material is estimated to be about 41 mcy. Based on the construction schedule under consideration, the construction dredging would be completed in segments with the first segment

completed in 2003 and the last in 2007. Emissions are estimated for each segment as summarized in Table 4.8-1.

4.8.2 Maintenance Dredging

Routine dredging would be required to maintain the channel at a depth authorized to accommodate larger vessels and tankers. Maintenance dredging would occur along different segments with each segment being relatively independent of the other. It is estimated that about 208 million cubic yards of sediment would be excavated over 50 years (i.e., an average of 4 mcy per year). The resulting emissions from this operation are estimated as shown in Table 4.8-2.

4.8.3 Expected Air Quality Impacts

Atmospheric dispersion modeling of emissions was not performed. There are dispersion modeling tools available to estimate local air quality impacts; however, these models are most accurate at estimating impacts from those facilities from which emissions occur at well-defined, stationary emission points. In the case of this project, local dispersion of emissions cannot be characterized with any degree of accuracy because they would be emitted from a variety of mobile sources that would operate intermittently. Additionally, the level of activity would be variable.

Regional dispersion models available to characterize VOC and NO_x, which are O_3 precursors and result in regional impacts, are not intended to estimate a specific project's contribution to regional O_3 concentrations. Therefore, regional dispersion models would not be useful in estimating the projects construction and operational impact on regional O3 concentrations.

It is expected that air contaminant emissions from construction dredging activities will result in minor short-term impacts on air quality in the immediate vicinity of the dredging site. Each dredging operation would be relatively independent of the other, although, there may be some overlap. In addition, these activities are considered one-time activities (i.e., the construction dredging activities would not continue past the date of completion). As a result, the impact on ambient air from construction dredging emissions would be of generally intermittent and relatively short-term duration. VOCs and nitrogen oxides can combine under the right conditions in a series of photochemical reactions to form ozone, possibly increasing ozone concentrations in the region. However, these reactions take place over a period of several hours with maximum concentrations of ozone often far downwind of the precursor sources. Due to the phased, one-time construction dredging, it is expected that there will be no long-term impacts to air quality in the area.

It is expected that air contaminant emissions from maintenance dredging activities will result in minor short-term impacts on air quality in the immediate vicinity of the dredging site. As previously noted, VOCs and nitrogen oxides can combine under the right conditions to form ozone, possibly increasing the concentration of ozone in the region. However these reactions take place over a period of several hours with maximum concentrations of ozone often far downwind of the precursor sources. The estimated emission rates for these and the other products of combustion are relatively minor and would be intermittent and of relatively short-term duration for each segment. Therefore,

TABLE 4.8-1

ANNUAL CONSTRUCTION DREDGING EMISSIONS
(TONS PER YEAR)

Activity	Completion Year	Estimated Duration (days)	PM	SO_2	NO_x	VOC	CO
La Quinta Extension and Turning Basin	2003	97	6.78	78.4	233	6.8	53.3
Entrance Channel Deepening	2004	31	2.29	26.4	78.4	2.30	17.97
Port Aransas to La Quinta Junction	2005	121	8.45	97.7	290	8.51	66.4
La Quinta Junction to Harbor Bridge Deepening and Widening	2006	224	13.6	157	466	13.7	107
Deepening of Inner Harbor	2007	49	5.02	58.0	172	5.1	39.5

TABLE 4.8-2

ANNUAL MAINTENANCE DREDGING EMISSIONS
(TONS PER YEAR)

Activity	Estimated Annual Duration (days)	PM	SO_2	NO_x	VOC	CO
Entrance Channel	5	0.39	4.52	13.42	0.39	3.07
Port Aransas to La Quinta Junction	10	0.68	7.81	23.16	0.68	5.31
La Quinta Junction to Harbor Bridge	13	0.80	9.23	27.39	0.80	6.28
Harbor Bridge to Turning Basin	4	0.45	5.20	15.42	0.45	3.53
La Quinta Channel	3	0.22	2.5	7.38	0.22	1.69
Total	35	2.53	29.3	86.77	2.55	121

emissions from the maintenance dredging are not expected to result in a serious impact to the regional air quality and they are not expected to differ significantly from present maintenance dredging.

Airshed pollutant loading determined by the magnitude of emissions expected to result from the project compared to area emissions can be used to estimate air quality impacts of the criteria pollutants. Based on available air emissions inventory information provided on the EPA's AIRData website (EPA, 2002b), the following tables (tables 4.8.3 and 4.8.4) provide a summary of emissions for the Nueces County and San Patricio County. The emissions data are available for area plus mobile source and for point source emissions, based on emissions inventory information for 1999. This emissions inventory provides a basis from which to compare the proposed project emissions.

TABLE 4.8-3
SUMMARY OF PEAK AIR EMISSIONS FROM CONSTRUCTION DREDGING ACTIVITIES COMPARED WITH NUECES AND SAN PATRICIO COUNTY EMISSIONS FOR 1999

Air Contaminant	Area and Mobile Source (tpy)	Point Source (tpy)	Total (tpy)	Estimated Peak Project Dredging Emissions (tpy)	Site Emissions % of Nueces County Emissions
NO_x	29,342	32,739	62,081	466	0.75
VOC	26,495	8,601	35,096	13.7	0.04
CO	119,655	9,465	129,120	107	0.08
SO_2	6,067	7,932	13,999	157	1.1
PM_{10}	41,227	1,748	42,975	13.6	0.03

TABLE 4.8-4
SUMMARY OF AIR EMISSIONS FROM MAINTENANCE DREDGING ACTIVITIES COMPARED WITH NUECES AND SAN PATRICIO COUNTY EMISSIONS FOR 1999

Air Contaminant	Area and Mobile Source (tpy)	Point Source (tpy)	Total (tpy)	Estimated Peak Project Dredging Emissions (tpy) *	Site Emissions % of Nueces County Emissions
NO_x	29,342	32,739	62,081	86.8	0.14
VOC	26,495	8,601	35,096	2.55	0.007
CO	119,655	9,465	129,120	121	0.09
SO_2	6,067	7,932	13,999	29.3	0.2
PM_{10}	41,227	1,748	42,975	2.53	0.006

* Assumes all maintenance dredging may occur in 1 year.

As shown on Table 4.8-3, construction dredging for the proposed project would result in an increase in emissions above those resulting from existing sources in the Nueces/San Patricio County area. Emissions of SO_2 may result in an increase of about 1.0 percent over existing area emissions. Emissions of NO_x, VOC, CO, and PM_{10} are expected to result in a less than 1 percent increase over

existing emissions based on available air emissions inventory information provided on the EPA's AirData website (EPA, 2002b).

As shown on Table 4.8-4, emissions during maintenance dredging are estimated to contribute less than 1 percent to total existing emissions for these counties.

The TNRCC and EPA's air quality permitting program applies to stationary sources of air emissions, and would therefore, not apply to emissions from the dredging activities. However, emissions are expected to comply with the National Ambient Air Quality Standards and the rules and regulations of the EPA and the TNRCC promulgated in support of the State's State Implementation Plan.

4.9 NOISE

Under the No-Action alternative, noise would continue as described in Section 3.10.

Impacts to the noise environment from the proposed project would result primarily during construction and maintenance dredging activities. The noise associated with construction and maintenance activities of this project is difficult to quantify. Heavy machinery, the major source of noise in construction, would move along the project route as construction and maintenance activities proceeded; these levels would thus vary and be intermittent. However, construction normally occurs during daylight hours when occasional loud noises are more tolerable. Noise sensitive areas include residential areas at Ingleside-On-The-Bay and recreational areas in the vicinity of Port Aransas and the jetties. These areas range from 400 to 800 feet from the CCSC. None of the noise sensitive areas is expected to be exposed to the construction and maintenance dredging activities for a long duration; therefore, any extended disruption of normal activities is not expected. Provisions and specifications that require the contractor to make reasonable efforts to control construction and maintenance dredging noise will be included in all plans. Since maintenance dredging will not increase significantly in comparison with existing conditions, relative to present maintenance, noise from maintenance dredging is not expected to increase significantly with the preferred alternative.

4.10 SOCIOECONOMIC RESOURCES

The following sections address economic impacts from the construction and operations and maintenance (O&M) phases of the proposed project. The Methodology section provides details on how socioeconomic impacts were estimated based on project details, an input-output model approach, research, and interviews.

4.10.1 No-Action Alternative

Without the preferred alternative, the Corpus Christi area (Nueces and San Patricio counties) would continue on its present course of economic development and diversification, of moderate population growth, and of fairly rapid commercial, residential, and industrial land development. The PCCA would continue to function as an important port for its industrial facilities and international commerce. The PCCA would also continue to develop its industrial properties but at a slower rate than it would with the preferred alternative. The container terminal would not be built in its proposed location without the

extension of the La Quinta Channel. Without the channel widening of the CCSC, safety concerns related to large vessel meetings would continue as would delays. Without the preferred alternative, the area would not take advantage of additional economic benefits related to the project in terms of an increase in the number of jobs, increased employee compensation, expanded indirect business taxes, increased value-added, and increased industrial housing development. No aesthetic or environmental justice impacts would occur with the No-Action alternative.

4.10.2 Methodology

Within the Socioeconomic Resources section, environmental consequences have been estimated through a variety of methods. One such method is qualitative analysis, which was conducted through review of government agency and private sector reports and other materials, review of local planning documents, research conducted over the internet, and through telephone discussions. Another technique includes quantitative analysis, through review of Census and economic data that pertains to the project study area. Also, a visual survey of the vicinity surrounding the proposed project area was conducted on August 16 and 17, 2001, as a source of information for land use analysis. The last technique (which is the main focus of this Methodology section) involves the use of an Input-Output Model for predicting project-related impacts to the economies of Nueces and San Patricio counties. A detailed discussion provided below outlines the approach taken by the Input-Output Model to estimate economic impacts within the two counties (Nueces and San Patricio) that encompass the project study area.

The analysis utilized a computer-based modeling program called Implan Professional (Version 2.0) (Implan). Implan uses industry and employment data from the target counties to predict indirect and induced effects from project implementation. This input-output model allows the analyst to develop a set of assumptions related to project details and predict how project-related expenditures would impact the economies of the target counties. The model predicts how dollars spent on the proposed project would affect specific industries within the regional economy as dollars are spent and re-spent locally. The results are expressed as indirect and induced impacts to employment, value-added, total output, the tax base, and employee compensation.

Indirect and induced impacts occur as goods and services are provided to the sectors that provide the goods and services directly for the industries that directly benefit from project-related expenditures. Value Added is a measurement of the value that is added to intermediate goods and services. It is equal to the total of employee compensation, proprietor income, other property income, and indirect business taxes. Total Output is a measure of the total value of purchases by intermediate and final consumers, or by intermediate outlays plus value-added. Employment impacts show the number of new jobs that would be created as a result of the project as project-related dollars are spent and re-spent within the regional economy, and new jobs are created in other industries within the target counties. Indirect business tax impacts measure the amount of local (county, city and other local taxing entities), and State sales taxes (combined) that would occur as a result of project-related expenditures.

Implan was used, along with specific proposed project-related information and a detailed set of assumptions, to predict the impacts. The details of the proposed project were analyzed to determine which portions of project-related expenditures would have an effect on the economies of the

two counties. It was determined that expenditures on dredging of the CCSC and the extension of the La Quinta Channel, and O&M expenditures would have an impact on economic activity within Nueces and San Patricio counties only as a secondary effect. The secondary effects of the dredging work would occur through expenditures for fuel for the dredges and through local spending by dredge employees. The expenditures on dredge fuel and local economy expenditures by dredge employees represents a relatively small percentage (approximately 12 percent of annual construction costs, and 14 percent of annual O&M costs) of the overall construction and O&M costs. The remainder of the dredging construction costs would very likely leak out of the regional economy as the dredging contractors hired for this project (chosen through a competitive-bid process) would likely be based outside of Nueces and San Patricio counties.

However, non-dredging construction activities that are part of the proposed project are likely to be conducted by locally-based contractors and locally-based workers. These construction activities include bank stabilization, levee building, dock and pipeline modifications/relocations. Expenditures on these non-dredging construction activities represent approximately 44 percent of the proposed-project construction budget.

Employment, output, value-added, and indirect business tax impacts from the proposed La Quinta container ship terminal are considered beyond the scope of this FEIS. The proposed La Quinta container ship terminal is not part of the proposed project considered in this FEIS.

To predict project-related impacts to the economies of Nueces and San Patricio counties, research was conducted to gather detailed project-related information, and a set of assumptions was developed to further clarify the details. The assumptions involved discussions with Port of Corpus Christi personnel and other key persons, and review of relevant dredging industry information, information relating to the Nueces and San Patricio County economies, and historical USACE data (La Rue, 2001). Below is a list of key assumptions and project-related details that were used as a basis for predicting economic impacts. All dollars presented in the Socioeconomics section are presented in 2001 dollars.

- The construction phase of the proposed project would be conducted over a 5-year period (from 2003 to 2007) and would involve a total construction cost of $190 million.
- The O&M phase would occur over a 45-year period from 2008 to 2053. O&M would be conducted once every 2 years and would take 2 months of work each time. Total expenditures on O&M would be $107 million.
- All construction and O&M operations would be completed by two types of dredges: a pipeline dredge and a hopper dredge. The pipeline dredge would be used for about 90 percent of the work (for both construction and O&M) and would be used for all work except the entrance channel. The hopper dredge would perform approximately 10 percent of the work (for both construction and O&M) and would work only on dredging of the entrance channel. During both construction and O&M, the ships would work 18- to 20-hour days, with workers working in shifts.
- The pipeline dredge would employ 50 people, and these employees would make an average wage of $300 per day (including all benefits). The hopper dredge would employ 20 people, and these employees would make an average wage of $425 per day (including all benefits). All dredge employees would not need housing, since they would be housed on the ships. All dredge employees would spend an average of $1,500 per month on groceries, entertainment, clothing, and other goods and services

bought within Nueces and San Patricio counties. These expenditures would be 70 percent in Nueces County and 30 percent in San Patricio County.

- The pipeline dredge would use 10,000 gallons per day of diesel fuel. The hopper dredge would use 4,000 gallons per day of diesel fuel. The current price of this fuel is 80 cents per gallon, and the fuel would be provided by fuel barges based in the Port of Corpus Christi (Nueces County).
- Construction related to levee building, bank stabilization, dock and pipeline modifications/relocations would occur over a 5-year period and would be conducted by locally-based contractors and workers (60 percent from Nueces County and 40 percent from San Patricio County).

Based on these project-related details and assumptions, the following data were used with Implan to predict project-related impacts within Nueces and San Patricio Counties.

- During the 5-year construction phase, dredge employees would spend $1.3 million per year in Nueces County and $589,000 per year in San Patricio County on local goods and services. During the 45-year O&M phase, dredging ship employees would spend $63,500 per year in Nueces County and $30,000 per year in San Patricio County on local goods and services. These dollar amounts were applied to employee compensation (within Implan), and indirect, induced, and total impacts to the two counties were predicted.
- During the 5-year construction phase, $2.7 million would be spent annually on diesel fuel for the dredges. During the 45-year O&M phase, $231,000 would be spent annually on diesel fuel for the dredges. All fuel expenditures were applied to Implan sector #38, Natural Gas and Crude Petroleum, and applied to Nueces County only.
- During the 5-year construction phase, $16.7 million would be spent annually for the construction budget for bank stabilization (rip-rap), levee building (geotube), and dock and pipeline modifications/relocations. Approximately $3.3 million would be awarded annually to contractors that would be based in Nueces County, and approximately $2.2 million would be awarded annually to contractors that are based in San Patricio County. All non-dredging construction costs were applied to Implan industry sector #51, New Highways and Streets (which most closely represents these industries).

4.10.3 Population

Approximately 70 workers would be needed annually for the dredging portion of the proposed project. These dredge workers would have little effect on the capacity of local communities to provide adequate housing, schools, and other services. Most of these workers' essential needs would be provided on-board the dredges. An estimated 170 non-dredging construction workers would be needed annually for the proposed project. Most of the non-dredging construction workers (excludes indirect and induced employment) are likely to come from the labor force that is already living within the two counties. Inmigration to the Nueces County and San Patricio County area would be fairly minimal.

The total employment (direct, indirect, and induced) that would occur in the two counties (excluding the dredge workers) would likely cause a very small increase in population. In Nueces County, approximately 205 total jobs would be created annually during the 5-year construction period. This employment increase represents less than 0.1 percent of the year 2000 county population (pop. 313,645). During the 45-year O&M period, approximately 1 total job would be created annually in Nueces County. In San Patricio County, approximately 95 total jobs would be created annually during the 5-year construction

period. This employment represents 0.1 percent of the year 2000 county population (pop. 67,138). During the 45-year O&M period, less than 1 total job would be created annually in San Patricio County.

The proposed project would produce a relatively small number of jobs during the short and long term and would not affect population growth beyond the capacity of the communities to provide adequate housing, schools, and services or otherwise adapt to growth-related social and economic changes. Also, there would be no displacement of residents or users of affected areas. There would be no project-related effects that would negatively affect community cohesion.

However, when the proposed project is completed, it is likely that new industrial development would occur within the Inner Harbor and along the north side of Corpus Christi Bay. The deeper and wider ship channels would provide an additional benefit to industry, which would likely attract new companies to locate within the Corpus Christi Bay area. New industrial development would likely include petrochemical plants, bulk grain facilities, petroleum and natural gas refineries. Also, with the extension of the La Quinta Channel, there is a strong likelihood that a container ship terminal would be built on the land adjacent to the end of the channel extension (La Rue, 2001). The impact of these new industries on population growth (mostly through in-migration) within the two counties should be considered to be substantial. Reasonable, foreseeable, future actions are discussed in Section 5.0. If new industrial facilities are built as an indirect result of the proposed project, it is likely that a substantial increase in single-family homes would occur in San Patricio County (within and near the cities of Portland, Gregory, Ingleside, and Aransas Pass) where vacant land is available for such development and is located near such available industrial sites. Also, some new housing development would likely occur within the City of Corpus Christi (especially on the west side, along the IH 37 corridor). This increase in new residents within the two counties would also substantially increase the demand for commercial development, schools, roads, and other services.

4.10.3.1 Life, Health, and Safety

The channel widening aspect of the proposed project would provide relief of safety concerns and the associated vessel delays for ships traveling through the CCSC. Currently, the Port Aransas-Corpus Christi Pilots limit vessel meetings to combined beam width of 251 feet in the 400-foot reach. Additional criteria are that meetings are not permitted between vessels with combined loaded drafts in excess of 80 feet, and that vessels should have 3 feet of underkeel clearance. The proposed project to widen the CCSC to 530 feet and to deepen it to 52 feet would easily accommodate the vessels that are forecasted to use the CCSC, in a safe manner, and with minimal delays.

4.10.4 Employment

All dredging construction work would be performed over a 5-year period, from 2003 to 2007. Approximately 70 full-time dredge workers would be needed for the duration of this construction period. Of these 70 workers, approximately 50 full-time workers would be necessary for operations of a pipeline dredge (or cutter head dredge), and approximately 20 full-time workers would be needed for the operations of a hopper dredge. Indirect and induced employment would occur within the two counties as dredge workers spend some of their disposable income locally and as operation of the dredges would

necessitate expenditures on fuel that would be purchased from firms located in Nueces County (based in the Inner Harbor).

Within Nueces County, annual dredging worker expenditures would be approximately $1.2 million, and annual fuel expenditures would be approximately $2.6 million. From these local expenditures, indirect and induced job creation would result in approximately 40 new jobs annually, or 200 labor-years of employment during the 5-year construction period. Total employee compensation in Nueces County would be an estimated $1,021,000 annually, or $5,105,000 during the 5-year period. In San Patricio County, annual dredging worker expenditures would be approximately $589,000. From these local expenditures, indirect and induced job creation would result in approximately 5 new jobs annually, or approximately 20 labor-years of employment during the 5-year construction period. Total employee compensation in San Patricio County would be an estimated $71,500 annually, or $357,500 during the 5-year period.

Non-dredging construction jobs would likely be filled by locally-based construction companies and workers. During the 5-year construction period, approximately 175 full-time workers would be required to complete this work (within the two counties), and construction expenditures would be approximately $16.6 million (or $83 million for the 5-year period). In Nueces County, these construction expenditures would create approximately 165 total jobs (includes direct, indirect, and induced jobs) annually, or approximately 825 total labor-years of employment during the 5-year period. Total employee compensation in Nueces County would be an estimated $4.1 million annually, or $20.5 million during the 5-year period. In San Patricio County, these construction expenditures would create approximately 90 total jobs (includes direct, indirect, and induced jobs) annually, or approximately 450 total labor-years of employment during the 5-year period. Total employee compensation in San Patricio County would be an estimated $2.7 million annually, or $13.5 million during the 5-year period.

Dredging O&M activities would occur approximately every 2 years and would last for approximately 2 months, during the 45-year O&M phase. During these 2-month periods, approximately 70 full-time dredge workers would be required. It is likely that the dredging companies and workers hired for this work would not come from the two counties.

Within Nueces County, annual O&M dredge worker expenditures would be approximately $63,500 and annual fuel expenditures would be approximately $230,800. From these local expenditures, indirect and induced job creation would result in approximately 1 new job annually, or approximately 45 labor-years of employment during the 45-year O&M period. Total employee compensation in Nueces County would be an estimated $17,300 annually, or $778,500 during the 45-year period. In San Patricio County, annual O&M worker expenditures would be approximately $30,000. From these local expenditures, indirect and induced job creation would result in less than one job annually, or approximately 10 labor-years of employment during the 45-year O&M period. Total employee compensation in San Patricio County would be an estimated $3,600 annually, or $162,000 during the 45-year period.

The industries that would benefit directly (in terms of employment) from the proposed project during the construction and O&M phases would be dredging contractors and other construction

contractors that would be involved in non-dredging activities. Indirect and induced jobs created within the two counties would occur primarily in the following industries: Natural Gas and Crude Petroleum, Eating and Drinking, Miscellaneous Retail, Hospitals, Food Stores, Real Estate, Wholesale Trade, General Merchandise Stores, Auto Dealers and Service Stations, Banking, and Doctors and Dentists.

When the proposed project is completed, it is likely that new industrial development would occur within the Inner Harbor and along the north side of Corpus Christi Bay. The deeper and wider ship channels would provide an additional benefit to industry, which would likely attract new companies to locate within the Corpus Christi area. With the new channels in place, it would be more likely that new petrochemical plants, bulk grain facilities, petroleum and natural gas refineries would be built within the area. Also, with the extension of La Quinta Channel, it is very likely that a proposed container ship terminal would be built (La Rue, 2001). The impact of these new industries on employment within the two counties is unknown but would likely be substantial. This increase in employment may substantially increase the rate of inmigration, the demand for housing, schools, and other services within the two counties.

In summary, the proposed project would create approximately 370 total new jobs (direct, indirect, and induced employment) annually, or 1,850 labor-years of employment during the 5-year construction period. However, at least 70 of these would likely be filled by workers from outside the two-county area. During the O&M phase of the proposed project, approximately 71 total new jobs would be created annually, or approximately 3,195 labor-years of employment throughout the O&M phase. However, 70 of these total jobs would likely be filled by workers from outside the two counties.

Within Nueces County, all construction activities associated with the proposed project would create approximately 205 total jobs (direct, indirect, and induced jobs) annually, or 1,025 labor-years of employment during the 5-year construction period. This would represent a 0.1 percent impact on Nueces County annual employment. Employment associated with dredging during the 45-year O&M period would create approximately 1 job annually, or 45 labor-years of employment during the 45-year O&M period. This would represent a less than 0.1 percent impact on Nueces County employment.

Within San Patricio County, all construction activities associated with the proposed project would create approximately 95 total jobs (includes direct, indirect, and induced) annually, or 475 labor-years of employment during the 5-year construction period. This would represent a 0.6 percent impact on San Patricio County annual employment. Employment associated with dredging during the 45-year O&M period would create less than 1 total job annually, or approximately 10 labor-years of employment during the 45-year O&M period. This would represent a less than 0.1 percent impact on San Patricio County employment.

4.10.5 Economy

Economic effects to the Nueces County and San Patricio County economies would be moderate at the least, and substantial at best. Much of the construction budget would likely leak from the local economy, as construction dollars spent on dredging work would likely go to dredging companies that are located outside of the local economy. However, it is anticipated that most of the non-dredging

subcontractor work would be done locally, dredge workers would spend some of their disposable income locally, and dredge fuel would be purchased locally. Based on these assumptions, the following economic effects would accrue within Nueces and San Patricio counties.

In Nueces County, dredge employee expenditures and fuel expenditures would result in a total output (direct, indirect, and induced) effect of approximately $5.9 million on the county economy, or a $29.5 million effect for the 5-year construction period. These same expenditures would result in a total value-added effect of approximately $3.2 million on the county economy, or a $16 million effect for the 5-year construction period.

In San Patricio County, dredge employee expenditures would result in a total output effect of approximately $555,000 on the county economy annually, or a $2.8 million effect for the 5-year construction period. These expenditures would result in a total value-added effect of approximately $142,000 on the county economy, or a $710,000 effect for the 5-year construction period.

Within Nueces County, annual O&M dredge worker expenditures would result in a total output effect of approximately $76,000 on the county economy annually, or a $3.4 million effect for the 45-year O&M period. These expenditures would result in a total value-added effect of approximately $32,500 on the county economy annually, or a $1.5 million effect for the 45-year construction period.

Within San Patricio County, annual O&M dredge worker expenditures would result in a total output effect of approximately $3,600 on the county economy annually, or a $162,000 effect for the 45-year O&M period. These expenditures would result in a total value-effect of approximately $7,200 on the county economy, or a $324,000 effect for the 45-year construction period.

In Nueces County, during the 5-year construction period non-dredging construction expenditures would result in a total output effect of approximately $15.3 million on the county economy annually, or a $76.5 million effect for the 5-year construction period. These expenditures would result in a total value-added effect of approximately $7.0 million on the county economy, or a $35.0 million effect for the 5-year construction period. In San Patricio County, during the 5-year construction period construction expenditures would result in a total output effect of approximately $8.1 million on the county economy annually, or a $40.5 million effect for the 5-year construction period. These expenditures would result in a total value-added effect of approximately $3.3 million on the county economy, or a $16.5 million effect for the 5-year construction period.

4.10.5.1 Historical Perspective/Community Growth

Within Nueces and San Patricio counties, the social and economic effects accruing from the proposed project would simply contribute to the current development trends that have historically affected the regional economy. The increase in jobs, economic output, and the tax base would be fairly moderate and consistent with historical growth trends. The Port of Corpus Christi and its associated industries and international commerce currently serve an important role for the Corpus Christi area economy. These industries provide jobs, income, and a tax base for the area, and the effects reverberate within other industries such as housing, retail services, and wholesale trade. The proposed project would likely provide a boost to the development of industrial sites along the Inner Harbor and in San Patricio

County, near the cities of Portland, Ingleside, and Aransas Pass. Larger ships would be able to navigate the CCSC; providing cost savings for commercial vessels. In short, the Port of Corpus Christi would become a more attractive location for companies involved in industry and international commerce to conduct their business. This goal would be consistent with a steady historical trend towards increased reliance on these industries and these types of development within the region.

4.10.5.2 Tax Base

Within Nueces County, all construction activities associated with the proposed project would result in a total (direct, indirect, and induced effects) indirect business tax impact effect of approximately $745,000 on the county economy annually, or a $3.7 million effect for the 5-year construction period. During the O&M period, dredging-related expenditures would result in a total indirect business tax effect of approximately $3,000 on the county economy annually, or a $135,000 effect for the 45-year O&M period.

Within San Patricio County, all construction activities associated with the proposed project would result in a total indirect business tax impact effect of approximately $151,000 on the county economy annually, or a $755,000 effect for the 5-year construction period. During the O&M period, dredging-related expenditures would result in a total indirect business tax effect of approximately $700 on the county economy annually, or a $31,500 effect for the 45-year O&M period.

4.10.6 Land Use

The proposed project would have a very minimal impact on land use. Neither the CCSC channel improvements nor the La Quinta Channel extension would affect any shoreline land uses. All channel improvements would occur in open-water locations. The only land use implications for the proposed project relate to proposed DMM/BU sites (see sections 1.6 and 2.2.2) and indirect future land development that may occur as a result of the proposed project.

The BU sites would be created from dredged material in seven open-water locations near the Entrance Channel, and in Corpus Christi Bay and Redfish bays (see Figure 1-3). These BU areas would vary in their design but would generally consist of shallow water aquatic habitat areas surrounded by wave breaks created from construction material. The BU sites are located in areas of open water that would not create significant conflicts with recreational or commercial boating or other uses. The BU sites would positively impact the commercial and recreational boating and fishing industries or other uses, as they would create habitat for fledgling fish and other aquatic species leading to an increase in their populations. Each BU site is discussed briefly below in the Aesthetics section, and in more detail in Section 1.6.

The greatest long-term land use consequence of the proposed project would likely be a change in future land uses that would occur in response to the improvements to the CCSC and the extension of the La Quinta Channel. These future land uses are not considered part of the proposed project but would be far less likely to occur without it. The PCCA currently owns property along the Inner Harbor, along the north side of the Corpus Christi Bay, Harbor Island, San Jose Island, and along the western shoreline of Redfish Bay that is available for development for industrial sites. When the proposed

project is completed, the PCCA would have the deepest and widest ship channel along the Gulf of Mexico coast, providing a large incentive for new industrial development at all of the PCCA properties, based on navigation cost savings. Future industrial development may include oil and gas refineries, petrochemical plants, bulk grain facilities, offshore oil-platform construction companies, and/or a container terminal (La Rue, 2001). The long-term land use effects of these industrial facilities are largely unknown (and beyond the scope of this report); however, they would likely lead to a substantial increase in demand for new housing development, new roads, commercial services, schools, and other services within the two-county area. Below is a brief discussion of the possible land use implications of the proposed container terminal.

The PCCA has outlined, in its "La Quinta Gateway Preliminary Master Plan," a proposal for a container terminal to be located on an 1,100-acre tract of land known as the La Quinta property, and located adjacent to the proposed La Quinta Channel extension. The proposed container terminal site is bordered by the Sherwin Alumina plant to the east, and SH 361 to the north, and is between the cities of Portland (to the west) and Ingleside (to the east). The proposed project includes a containerized cargo marine terminal, consisting of a 295-acre marine terminal, 3,800 linear feet of wharf, nine gantry cranes, a 75-acre intermodal rail terminal, and a 127-acre buffer zone. The container terminal project would also require expanded road and rail capacity within the general area. Indirect consequences of the proposed container terminal would be an increase in demand for new housing development, new roads, commercial services, schools, and other services mostly within San Patricio County (within Portland, Gregory, Ingleside, and Aransas Pass) and, to a lesser extent, in Nueces County (PCCA, 2001b).

4.10.6.1 Aesthetics

The proposed project would have a minimal effect on the overall visual quality within the study area. There would be no significant effect to the appearance of the shorelines that are adjacent to the proposed channel improvements. Existing PAs, as discussed in Section 2.2.2, utilized for maintenance dredged material will not affect the visual quality of the study area. The only aspects of the proposed project that would affect the visual quality of the study area would be the BU areas.

BU Site GH consists of an armored levee and shallow water habitat. The shoreline areas that are closest to this BU site are existing industrial sites and areas that are slated for future industrial development. The BU site would also be visible from the Northshore Golf Course and other subdivisions along the southeastern shore of the City of Portland.

BU Site CQ would consist of a shallow lagoon area bordered on three sides by a rock breakwater. This feature would be visible looking southwest from homes and the marina located along the shoreline of Ingleside-On-The-Bay, but would not block views of other portions of the Corpus Christi Bay.

BU Site P would be a rock breakwater, visible from homes facing south along the Ingleside-On-The-Bay shoreline.

BU Site I consists of a triangular-shaped lagoon area (mix of open water, shallow water, and high marsh habitat), bordered on two sides by a breakwater/shore protection berm in Redfish Bay.

This feature would be directly visible from the Ingleside shoreline, which consists of industrial land uses in this area.

BU sites R and S consist of C-shaped armored wave breaks on the perimeter of shallow lagoon areas. These beneficial use areas would not be visible from the Ingleside-On-The-Bay shoreline but possibly would be visible from much more distant shorelines along the western shore of Mustang Island.

BU Site Pelican consists of a geotube breakwater and shoreline armor. This site will receive periodic maintenance material to maintain the existing rookery island. No impact to the visual quality of the area is expected.

BU Site L would consist of a shoreline protection armor on the south shore of the channel near Port Aransas to protect existing shoreline and habitat. This site will be visible from the channel and industrial sites at Harbor Island, as well as the county pier near Port Aransas.

BU Site E is an upland site northwest of the La Quinta Channel extension. It was requested by area residents as a buffer between the Northshore Golf Course and the proposed Gateway Terminal. Therefore, it will provide a benefit to the aesthetics of the area.

BU Site ZZ is completely submerged and would have no impact on the visual quality of the area.

BU site MN is completely submerged and would have no impact on the visual quality of the area.

4.10.6.2 Community Services

The proposed project would not affect the delivery of local services, including water, wastewater, or other utilities. No disruption to roads or rail transportation would result from the preferred alternative. The preferred alternative would result in no changes in traffic demand on local roads or highways and would not affect the delivery and quality of local services to the population living within the vicinity of the study area.

4.10.7 Environmental Justice

Within the study area, ethnicity and poverty figures are generally consistent with those of the region, with only a few notable exceptions. For example, there are seven of thirty-two census tracts within the study area, where the percentage of ethnic minorities is substantially higher than in either county or the state. Also, there are five census tracts within the study area where the percentage of the population living below the poverty line is substantially higher than for either county or the state. Therefore, the study area does have some areas that have disproportionately high percentages of ethnic minorities and persons of poverty status. However, this does not constitute a disproportionate impact under Executive Order 12898, as there are no disproportionately high and adverse human health or environmental effects that would accrue to these populations. The minority populations living within these

census tracts would likely experience no adverse changes to the demographic, economic, or community cohesion characteristics within their neighborhoods as a result of the proposed project. Also, there would be no physical changes to the environment or to land use within these census tracts. Generally speaking, the population living within these census tracts would benefit from the proposed project. These benefits would be manifested mainly in a slight increase in economic output, value added, jobs, and tax base within these communities.

No low-income or minority populations have been identified to experience disproportionately high and adverse human health or environmental effects as a result of the preferred alternative.

4.11 ANY ADVERSE ENVIRONMENTAL IMPACTS WHICH CANNOT BE AVOIDED SHOULD THE PREFERRED ALTERNATIVE BE IMPLEMENTED

The preferred alternative will result in adverse impacts to the benthos and fish of Corpus Christi Bay from dredging and placement of dredged material at the BU sites. Five acres of seagrass will also be impacted during construction. However, the BUW and the RACT determined that the BU sites will potentially provide higher value habitat; the impacted seagrasses will be mitigated by the creation of 15 acres of new seagrass area. Shoreline protection will provide benefits to existing marsh and seagrass habitats.

4.12 ANY IRREVERSIBLE OR IRRETRIEVABLE COMMITMENTS OF RESOURCES INVOLVED IN THE IMPLEMENTATION OF THE RECOMMENDED PLAN

The labor, capital, and material resources expended in the planning and construction of this project are irreversible and irretrievable commitments of human, economic, and natural resources. The loss of 5 acres of seagrass from extending the La Quinta Channel is irreversible; however, this loss will be compensated in a mitigation plan prepared and accepted by the RACT. Deep-water bay bottom loss due to deepening and widening the channel, construction of barge lanes, and extension of La Quinta will be irretrievably lost.

4.13 RELATIONSHIP BETWEEN LOCAL SHORT-TERM USES OF MAN'S ENVIRONMENT AND THE MAINTENANCE AND ENHANCEMENT OF LONG-TERM PRODUCTIVITY

The preferred alternative would eliminate approximately 45 acres of shallow-water bay bottom including 5 acres of seagrass during construction of the channel and approximately 40 acres of bay bottom. Productivity of the sites removed during construction would be permanently lost from the ecosystem, while much of the bottom buried during construction of the BU sites will recover or be transformed into more productive seagrass habitat. The 5 acres of seagrass lost during construction will be mitigated by the construction and planting of 15 acres of seagrasses in BU Site GH. However, there will be a time lag before the BU sites become established and ecologically functional. There will be a temporary loss of productivity during that interim period. Creation of the BU site will, over the long-term, provide substantial long-term gains in productivity of the Corpus Christi Bay system.

4.14 MITIGATION

The Mitigation Workgroup (MW) was formed to assess the unavoidable direct impacts to productive estuarine habitats due to the preferred alternative and to propose the mitigation for those unavoidable impacts. Based on the conclusions of the RACT and MW, the USACE determined that impacts to seagrass and bottom shallower than –4 feet MLT (potential seagrass habitat) would be mitigated.

Impacts to estuarine habitats are estimated to be 45 acres of bottom shallower than –4 feet MLT. All potential direct impacts would be due to the proposed La Quinta Channel extension and a minimal area (less than 0.05 acre) on the western shoulder of PA 10. Eight of the 45 acres are located along the south side of the extension near PA 13. The balance, 37 acres, is located farther west along the north side of the channel extension and the new turning basin. An estimated 5 acres of seagrass vegetation are included in the total 45-acre estimate. The seagrass vegetation is predominantly shoalgrass and occurs within an 8-acre area located on the south side of the extension near PA 13. No impacts to bay bottom shallower than –4 feet MLT were identified at any other location within the proposed deepening, widening, and channel extension project or the proposed barge shelf.

Of the 45 acres of shallow-water habitat (>–4.0 feet MLT) that will be removed during project construction, 5 acres consist of seagrass habitat and 40 acres consist of shallow, unvegetated bay-bottom habitat. According to ER 1105-2-100, wetland resources must be fully mitigated to meet the administration's goal of no net loss of wetlands. Also, the significance of the resource shall be established based on monetary and non-monetary values. Seagrass is a significant resource based on non-monetary criteria, such as scarcity on a national or regional scale and institutional and public recognition of the ecological and aesthetic attributes.

While it may be argued that seagrass and shallow, nonvegetated bay-bottom habitat is not considered a wetland habitat, the FWS (1979) determined that wetland and subtidal aquatic habitat (seagrass) must be considered together in an ecological system. Furthermore, the FWS has a strong interest in preserving seagrass habitat because their policy designates this habitat as Resource Category 2 which is high value habitat for estuarine and marine species that is relatively scarce on a national scale or in the ecoregion. Their mitigation policy for this resource category is no net loss of in-kind habitat value.

In addition to resource agency recognition of seagrass habitat as a significant resource, the public has repeatedly expressed a strong desire to maintain and expand seagrass beds in the Corpus Christi Bay system. Evidence of this was provided by the Coastal Bend Bays & Estuaries Program (CBBEP) which has noted the public's desire for providing more of this valuable resource during their coordination efforts under the National Estuarine Program. More recent evidence was provided by the project non-Federal sponsor, which also recorded high public interest in protecting and expanding this resource during numerous project public meetings.

Seagrass habitat is important to the estuarine ecosystem in the project area, because the Corpus Christi Bay system is located in a region of relatively low rainfall, high evapotranspiration, and has

limited freshwater inflow. As a result of these limitations, there are few areas of emergent marsh (traditional wetland habitat) that can serve as nursery habitat and food source for many estuarine and marine species. Seagrass beds generally serve this purpose, but are restricted to shallow, clear, protected waters. Corpus Christi Bay, especially in the project area, does not provide optimal seagrass habitat because it is a relatively deep bay subject to high southeast winds for much of the year that create turbid conditions along the south facing shorelines. Therefore, seagrass beds are a relatively scarce resource in this area that should be preserved to the extent practicable. If preservation is not possible, loss of this resource should be fully mitigated.

The proposed La Quinta Channel Extension has been aligned to avoid most of the seagrass beds, leaving only 5 acres of loss to be mitigated in-kind. The 40 acres of shallow, nonvegetated bay-bottom habitat does not have as high a habitat value and can be mitigated out-of-kind, if necessary.

Based on requirements for in-kind mitigation for seagrass losses, the project area has little to offer for traditional mitigation in-kind. There are three possible options available: (1) buy nearby, privately-owned upland shoreline, scrape it down to the same elevation as the existing habitat, and transplant seagrass in the site; (2) scrape down upland habitat in the nearby fully confined PA 13 to the same elevation as the existing habitat and transplant seagrass in the site; or (3) transplant seagrass into the nearby BU Site GH being constructed with new work material dredged from the La Quinta Channel extension.

During coordination with the RACT and MW, the USACE determined that the third option was the most feasible for this project. The first option was not feasible because of the cost of the waterfront land and site preparation. The site consists of a high bluff facing the bay and would require removal of about 712,000 cy of material. More importantly, there is no assurance that landowners would be willing sellers since waterfront property possesses a high commercial or residential development value. Even though there is no land acquisition fee associated with the second option, it is even less viable since all of the capacity remaining in the fully confined PA 13 is needed for maintaining the La Quinta Channel throughout the 50-year life of the project.

The RACT and MW, which include the non-Federal sponsor and USACE, concluded the best mitigation plan would be to transplant seagrass into BU Site GH that would provide the necessary protected, shallow-water habitat. The USACE, in close coordination with the RACT and MW, determined that because it will take time for the transplanted seagrass to develop the same density and provide habitat values equivalent to natural seagrass beds, a ratio of 3:1 would be used for mitigation. This is a common ratio used by the resource agencies in other mitigation actions. This equates to transplanting a 15-acre seagrass bed inside BU Site GH as compensation for 5 acres of seagrass lost to project construction. To ensure success of the mitigation plan, the USACE, in close coordination, with the RACT and MW, prepared a seagrass monitoring plan with success criteria to use in evaluating the progress in seagrass development. This plan is described below.

MITIGATIVE PROCEDURES/CONDITIONS FOR SEAGRASS TRANSPLANTING EFFORTS

1. After final construction of beneficial use Site GH and following a sediment conditioning time of at least 90 days, an appropriate location for the mitigation will be selected within the eastern portion Site GH, and the mitigation area will be planted with shoal grass (*Halodule wrightii*). Prior to mitigation site selection or planting, a survey will be performed in the candidate mitigation site area to determine the topographic condition and elevation of the deposited material. If excessive relief is encountered then planting will occur after a subsequent survey indicates that the topographic relief, elevation and sediment stability is conducive to shoal grass transplant survival. Prior to conducting planting, the USACE (the Federal sponsor) will coordinate the results of the survey(s) and sediment stability appraisal(s) with the USACE, FWS, TPWD, NMFS and the non-Federal sponsor.

   If the topographic and elevation survey or sediment stability appraisal is determined to be unsuitable for seagrass growth, then the proper course of action will be taken after coordination has taken place. Agency recommendations may include allowing for additional site conditioning time prior to conducting a full scale planting of the site, relocation of the planting effort within the candidate mitigation area, grading of the area, or even conducting a pilot planting effort.

2. Transplant source areas will be identified and applicable permits obtained from the TPWD and/or GLO and/or private landowners. Staking of the approved transplant harvest areas will be in accordance with applicable permits.

3. Shoalgrass planting may be conducted between mid-March and mid-June, or between mid-September and mid-October. Plantings outside of these times will need to be coordinated between the USACE, FWS, TPWD, NMFS and non-Federal sponsor at least two weeks prior to commencement of those plantings. The transplanting technique will be coordinated with the USACE, NMFS, FWS, TPWD and the non-Federal sponsor when the specific location and configuration of the mitigation site is being established. Initial shoalgrass planting shall be completed within one year of completion of the mitigation site or during the first suitable planting time following determination that site is conducive to transplant survival. The location of the mitigation site will be marked by PVC pipe.

4. A planting unit will consist of live shoalgrass material contained in a 3-inch-diameter plug. No more than three 3-inch plugs of source material per square yard will be obtained from the designated transplant source areas. Incidental damage to source areas will be avoided. Alternate harvest techniques may be considered but they will require prior coordination with USACE, NMFS, FWS, TPWD and the non-Federal sponsor and, as necessary, permitted through TPWD and/or GLO and/or private landowners.

5. A transplant survival survey of the planted site will be conducted between 60 and 90 days after completion of the initial planting effort. Using acceptable survey methods, a minimum of 15 percent of all transplant units will be surveyed for the initial transplant survival survey. A written report detailing the survival results shall be submitted to the USACE within 30 days of survey completion. The report will be distributed by the USACE to the NMFS, TPWD, FWS and non-Federal sponsor. If at least 50 percent survival is not achieved, then the resource agencies shall be consulted to determine if the site should be modified prior to initiating a replanting

effort. If it is determined that site modifications are not necessary and that the site should be replanted, then replanting shall commence within 30 days (or within the next suitable planting period) once the agency-coordinated decision to replant the site has been made.

6. At least six transects will be established for the purposes of pre-construction, pre-plant plant elevation, or existing-bed condition surveys, and for post-planting monitoring surveys. The ends of each transect will be marked by PVC pipe. More transects may be established depending on the size or shape of the site selected, the transplanting plan and/or planting schedule. A minimum of two transects outside of the mitigation site in nearby seagrass beds and a minimum of four transects which cross the mitigation site is to be established and surveyed. The number and configuration of transects within the planting area will be coordinated with the USACE, NMFS, FWS, and TPWD and non-Federal sponsor after the size and configuration of the mitigation site has been established.

7. All transects located within the mitigation site shall be surveyed post-planting, at 6 months, 1 year, 2 years, and 3 years to determine success of mitigation. To determine success, three samples will be taken at 10-foot intervals along the transects; one on the interval and one three feet to each side of the interval. Seagrass will be identified to species. Coverage of seagrasses will be to species and will be calculated by using the frequency of occurrence of live seagrass at each sample along the transect. In addition to the percentage of vegetative cover, the monitoring surveys at all transects will note water depths (elevation) and any unusual sediment variations or other deposits.

8. If 2 years following planting the mitigation site is not as least 70 percent covered with shoalgrass, an additional planting effort will be made and those areas of the site not vegetated will be replanted to original specifications. The occurrence of manatee grass, if any, can be included in meeting the 70 percent coverage requirement.

9. The mitigation effort will be considered successful if the mitigation site is 70 percent covered by shoalgrass and/or manatee grass within three years following shoalgrass planting and if at least 48 percent of the total vegetative coverage is shoalgrass. If the mitigation is determined to be unsuccessful at the end of the three-year monitoring period, the Federal sponsor will be required to consult with the USACE, NMFS, FWS, TPWD and the non-Federal sponsor in order to determine if corrective measures are warranted. If it is apparent that the site is unlikely to support seagrass vegetation then a determination may be made to re-locate the mitigation project.

10. Some seagrasses currently exist nearby the proposed beneficial use Site GH. The survey of the transects established outside the mitigation area will be performed prior to constructing Site GH. The survey shall use a survey method similar to that used for the transects within the mitigation area and will also obtain information on the areal extent of the existing grassbeds. One purpose of the survey in the nearby seagrass beds is to obtain data to aid in the selection of the planting area within the mitigation site. This survey will be repeated within 30 days of completing construction of those portions of Site GH that could reasonably affect the existing nearby seagrass beds. If the survey results show that impacts have occurred to the existing seagrass beds, then the results will be provided within 30 days of completion of the survey to the USACE, TPWD, FWS and NMFS and the non-Federal sponsor. These agencies will

be consulted in order to determine an appropriate course of action to restore and/or mitigate the impacts.

11. The Federal sponsor will prepare monitoring reports detailing all required surveys. These monitoring reports will be submitted to the FWS, TPWD, and NMFS and non-Federal sponsor within 60 days of survey completion.

The mitigation plan also provides compensation for the loss of 40 acres of shallow, nonvegetated bay-bottom habitat in the 200-acre BU Site GH. Since this habitat is not considered to have as high a value as seagrass habitat, a ratio of 1:1 was used for compensation. This mitigation will be considered complete once the 40 acres of the 200-acre BU Site GH is constructed. There is no additional cost to construct the BU site that can be attributed to this mitigation plan since the BU site was designed to contain the remaining material from the proposed channel extension after completing upland BU Site E and stockpiling stiff clay material for future use in raising the levees in PA 13.

ER 1105-2-100 also requires that an incremental cost analysis of all recommended mitigation plans be performed to display variation in costs and identify and describe the least cost plan so that rational decisions regarding mitigation can be made. However, since only one feasible plan (as described above) is available that meets all mitigation requirements and is acceptable to the USACE, in close coordination with the RACT and MW, an incremental cost analysis is not possible. An alternative to the structured incremental cost analysis for seagrass mitigation that will provide a cost comparison for justifying the recommended plan is to calculate the costs for Options 1 and 2 and compare them to the cost for Option 3. This comparison is presented in Table 4.14-1. A cost analysis for mitigating shallow, nonvegetated bay bottom is not needed since there is no cost associated with designating this mitigation as part of BU Site GH.

TABLE 4.14-1
COST COMPARISON OF THREE OPTIONS TO MITIGATE THE
LOSS OF SEAGRASS DUE TO PROJECT CONSTRUCTION

Cost Factors (in dollars)	Option 1	Option 2	Option 3
Acquire Land	225,000	0	0
Acquisition Fees	12,000	0	0
Scrape Down/Prepare Site	5,340,000	2,040,400	0
Survey Elevations	58,000	58,000	0
Shoreline Protection	490,000	490,000	0
Transplant Seagrass on 15 Acres	67,500	67,500	67,500
Monitor Site for 3 Years	50,000	50,000	50,000
Total Cost	6,242,500	2,705,500	117,500

As shown in Table 4.14-1, Option 3 is the most economical mitigation plan of the three possible mitigation plans identified in the area. Options 1 and 2 have higher costs due to cost of acquiring privately owned land (Option 1) and the amount of material that must by removed to create a seagrass habitat. Option 2 has no acquisition fee since it would be constructed inside PA 13, which is owned by the non-Federal sponsor through a State land patent. Another cost identified for Options 1 and 2, but not

included in Option 3, is shoreline protection needed to provide a sheltered environment for seagrass growth. Seagrass transplanted into BU Site GH in Option 3 will be protected by a geotube/riprap barrier incorporated into the BU site design. The monitoring cost identified for all three options include only surveys to document seagrass survival and does not include any retransplanting costs, if needed. Therefore, Option 3 is the most economical and acceptable plan for mitigating the loss of seagrass during project construction.

Most of the in-bay BU sites will be protected from erosion by breakwaters and islands and should also be further stabilized by natural colonization by seagrasses, *Spartina*, and other estuarine organisms. The existing open-water, unconfined PAs are dispersive and the remainder are UCPAs, releasing no dredged material back into the environment, except small amounts as suspended solids. The offshore sites are dispersive, but BU Site MN and the topographic relief feature at BU Site ZZ are designed to provide variable elevation bottom structure providing in-place mitigation for lost bottom habitat.

Nonmotile organisms occurring in the sediments in the areas to be dredged will be placed in PAs or BU sites and will likely be buried. Benthos at the BU sites, existing open-water PAs, and the offshore sites will be buried during placement. However, the BU sites are designed to create more diverse habitat than presently exists in the deep-water, open-bay areas, providing in-place mitigation, and benthos at all open-water sites should rapidly recover to pre-placement conditions (Ray and Clarke, 1999).

4.15 ENERGY AND NATURAL OR DEPLETABLE RESOURCE REQUIREMENTS AND CONSERVATION POTENTIAL OF VARIOUS ALTERNATIVES AND MITIGATION MEASURES

NEPA regulations in 40 CFR 1502.16 (e) and (f) requires a discussion of project energy requirements and natural or depletable resource requirements, along with conservation potential of alternatives and mitigation measures in an EIS.

Under the No-Action alternative, the energy requirements for maintaining the channel will continue as before. However, the navigation requirements for energy (fuel) to transport commercial products will increase in the future as commerce increases and more one-way traffic increases congestion and navigation time into and out of the port. Air quality impacts are likely to increase with an increase in navigation traffic congestion and travel time along the channel.

The recommended alternative is expected to reduce energy (fuel) requirements for transporting products on a ton/mile basis by deepening and widening the channel. Ships can be more heavily loaded with cargo and two-way traffic in the channel will decrease congestion and reduce transit time into and out of the port.

Energy (fuel) will be required to construct the improved channel, but this is a short-term impact. Energy to maintain the improved channel is expected to increase slightly with the small increase in shoal material expected for the larger channel. This increase in fuel requirement is expected to be more than offset by fuel savings in ship traffic in the larger channel and should help reduce air quality impacts slightly over the No-Action alternative.

Increased efficiency in moving petroleum and other petroleum-based commodities to the local refineries is expected to help conserve natural or depletable resources in the future. The reduced energy requirements will result in lower (or at least a smaller increase in) transportation costs in the future, which reduces overall production costs for the consumer.