Permit Application – Blocks 18 and 19

Cedar Bayou and Vinson Slough Hydraulic Restoration Project

Description of Project

This project description was developed to summarize the scope of the Cedar Bayou and Vinson Slough Hydraulics Restoration Project. Additionally, several project components are presented to assist regulatory agencies and the public in the understanding of important project details and relevant issues associated with project implementation. The project description is presented and summarized within the following sections:

1 Executive Summary
2 Project Purpose and Need
3 Nature of Activity
4 Alternatives Analysis
5 Environmental Impact Assessment
   5.1 Habitat Characterization
   5.2 Endangered Species
   5.3 Salinity Assessment
6 Monitoring Plan
7 Construction BMPs

1 Executive Summary

The purpose of the project is to restore the historical hydraulic connection between Cedar Bayou, Vinson Slough, and their connection to the Gulf of Mexico. Historical navigation charts from the 1800s and aerial photography from the 1900s show that a dynamically sustainable hydraulic connection between Cedar Bayou, Vinson Slough, and the Gulf existed up to the 1979 emergency closure of the passes during the Ixtoc I Oil Spill. Dredging projects in 1987 and 1995 have sought to restore the opening of the passes without long term success.

A set of numerical modeling tools now available in the coastal engineering field have made possible the execution of a hydraulic and coastal engineering analysis that identified two key components to maintaining a long term opening between the Gulf and these passes:

1. A hydraulic connection between Vinson Slough and Cedar Bayou at their confluence with the Gulf of Mexico must be established to maximize flow from the passes and minimize sediment deposition at the mouth, and
2. Restoration of an ebb delta at the mouth of the passes to reduce sedimentation into the opening of the passes and to allow sediment bypassing across the mouth of the pass.

A hydraulic and coastal engineering analysis was conducted to identify the best-performing alternative solution to re-establish the hydraulic connection while at the same time beneficially using material removed from the passes. This solution consists of dredging a straight Cedar Bayou channel to the Gulf and connecting Vinson Slough to Cedar Bayou bayward of the Gulf mouth of Cedar Bayou, as historically occurred from the 1800s to 1979. The proposed dimensions for both the Cedar Bayou and Vinson Slough channels are 100 ft wide by 6 ft deep with 4H:1V side slopes. The dredged material –identified as beach-quality sand through a geotechnical investigation – will be placed offshore of the mouth to create an ebb shoal at the mouth of the pass.

It is important to note what this project will not do. These include the following:

- The Cedar Bayou and Vinson Slough channel are not intended for navigational purposes. Warning signs will be posted to restrict navigation at the Cedar Bayou mouth as part of this project.
- The project does not propose creating emergent features in the Gulf of Mexico or turning submerged lands in to uplands.
- No construction related activities are proposed that impact existing marsh or seagrasses.

Descriptions of the functionality of the major design elements of the proposed project are given below.

Cedar Bayou Channel

The Cedar Bayou channel is to be dredged as a straight channel connecting upper Cedar Bayou with the Gulf of Mexico. Without dredging the Cedar Bayou channel, the hydraulic connection between the Gulf and Cedar Bayou cannot maintain itself and will be lost. The dimensions of the channel were optimized to find a balance between a flow rate that would self-scour the channel and a channel layout with the minimum footprint, dredging volume, and impact to surrounding habitat.

Vinson Slough Channel
The hydraulic analyses showed that the connection of Vinson Slough to Cedar Bayou is critical for Cedar Bayou to maintain itself as a self-scouring, stable channel. When Vinson Slough is connected to Cedar Bayou, it increases flow into both channels and increases the velocity – especially the ebb velocity at the mouth of the inlet – which aids in channel stability by flushing the mouth of sediment. Also, the Vinson Slough channel is required to re-introduce flow into the Vinson Slough marsh system which was cut off from its connection to the Gulf of Mexico and Cedar Bayou after the 1979 emergency closure and further after the 1995 dredging project.

Ebb Delta (Shoal) Creation with Dredged Sediment
The dredge disposal sites from the 1987 and 1995 dredging events were a contributing factor to the relatively rapid closure of the inlet following the dredging. Material dredged during the proposed project should be utilized in a manner that helps increase channel stability. Historical evidence and an understanding of coastal inlets shows that an ebb delta existed offshore of the mouth of Cedar Bayou during times when it was open. Ebb deltas are an important feature of stable coastal inlets, as they allow for bypassing of longshore sediment transport around the mouth of the inlet without silting the mouth of the inlet. Therefore, it is proposed to place material dredged from the Cedar Bayou and Vinson Slough channels (shown to be beach quality sand through recent geotechnical field studies) in a manner that will promote the formation of an ebb delta offshore of the mouth of the Cedar Bayou inlet. The ebb delta acts to promote inlet stability in two ways:

1. The ebb delta allows sediment bypassing around the inlet mouth by routing the longshore current and longshore sediment transport across the ebb shoal instead of directly at the inlet mouth. This reduces sediment deposition at the mouth and increases inlet stability.
2. An ebb delta offshore of the mouth of the inlet causes waves to break over the ebb delta instead of directly at the inlet mouth. This results in decreased wave setup at the mouth of the inlet and reduces hydraulic resistance to the ebb tidal flow out of the mouth of the inlet, which in turn helps increase self-scouring at the inlet mouth and increases inlet stability.

To construct the project, a total of approximately 503,350 cy of material will be removed out of 58.5 acres. The dredge template is shown in Sheet 2, and excavation shown on sheet 3. The material will be placed over a total of 85.5 acres; 454,850 cy will be placed in 67 acres of nearshore Gulf bottom for the ebb delta construction (Sheet 5), and 48,500 cy are to be placed on 18.5 acres of the upper beach (Sheet 3).

The proposed Cedar Bayou and Vinson Slough channel dimensions are 6 ft deep (-5.62 ft NAVD88) with a bottom width of 100ft and 4H:1V side slopes. The channels are dredged from 47.5 acres positioned to prevent impacts to adjacent wetlands along the channel banks and submerged vegetation. The channel layouts and cross-sections are shown in Sheet 2.

The material dredged from the channels and used to form an ebb delta will be placed into the water from both sides of the dredging area to provide the material for the formation of a submerged delta. The construction template for placement of dredged material will be limited by the design footprint and will not exceed +2 ft NAVD88, with a crest width of 100 ft and side slopes of between 20H:1V to 30H:1V depending on the wave climate during placement. The delta placement templates cover 67 acres of nearshore Gulf bottom. After completion of dredged material placement, the construction template will transform into a typical submerged offshore delta through wave action.

Material in the 1995 dredging project disposal site located at the mouth of Vinson Slough is to be removed from an existing elevation of about +14 ft NAVD88 to an elevation of about +6 ft NAVD88 (approximate elevation of adjacent areas). This will be accomplished using earthmoving equipment. The area of the 1995 disposal mound to be removed is 11 acres and contains 48,500 cy of sediment. Sheet 3 shows the plan view area of the disposal mound to be removed and the new placement area. This action will turn 11 acres of unvegetated sandy upland into 6 acres of upper beach and 5 acres of submerged land.

Sediment removed from the 1995 disposal area will be placed in the form of a beach nourishment. The proposed construction template is shown in plan view in Sheet 3 and in cross-section in Sheet 4. The beach template will have a berm height of +6 ft NAVD88 starting at the seaward edge of the exiting dune features. The material will not be placed on existing vegetation. The berm width is approximately 200 ft terminating in a 20H:1V seaward slope down to the existing bottom. The entire 48,500 cy removed from the 1995 disposal site will be placed over 18.5 acres of beach at the beach placement site.

It is anticipated that dredging will be conducted with a hydraulic cutterhead-type dredge. However, the contractor may use other dredging equipment (excluding a hopper dredge but including a mechanical dredge) if justified by cost and no environmental impact. Construction activities are proposed to begin after April 15 and will be completed prior to October 15; no work is proposed to occur during the whooping crane wintering season (October 15th to April 15th). It is not possible to construct the project outside of the turtle nesting season (March 15th to September 30th) due to the whooping crane nesting window. Therefore, if required, a turtle monitoring plan will be implemented prior to and during beach construction activities.

The proposed project will not impact existing marsh or vegetated areas along Cedar Bayou or Vinson Slough. However, the proposed project will impact habitat of sea turtles, brown pelican, piping plover, and the whooping crane. To mitigate impacts to the whooping crane, construction will occur outside the whooping crane wintering season. Shoreline monitoring by USFWS and volunteers will be used to minimize impacts to nesting sea turtles. A pipeline or cutterhead-type dredge will be used to minimize dredging impacts to sea turtles in the water. Construction traffic will drive above the tide line and at a reduced speed to minimize impacts to brown pelicans and piping plovers.

No maintenance dredging is proposed at this time, as it is not possible to estimate the details of any future maintenance – future dredging may be along the same alignment proposed in this project, or may be along a completely new alignment or utilize a new cross-sectional configuration. Therefore, any future activity will be proposed either as an addendum to this permit, or will be permitted under a new application. Guidance on the best course of action at that time will be solicited from the appropriate regulatory agencies.

2 Project Purpose and Need

The purpose of the project is to restore the historical hydraulic connection between Cedar Bayou, Vinson Slough, and their connection to the Gulf of Mexico. Historical navigation charts from the 1800s and aerial photography from the 1900s show that a dynamically sustainable hydraulic connection between Cedar Bayou, Vinson Slough, and the Gulf existed up to the 1979 emergency closure of the passes during the Ixtoc I Oil Spill. Dredging projects in 1987 and 1995 have sought to restore the opening of the passes without long term success.

A set of numerical modeling tools now available in the coastal engineering field have made possible the execution of a hydraulic and coastal engineering analysis that identified two key components to maintaining a long term opening between the Gulf and the passes:

1. A hydraulic connection between Vinson Slough and Cedar Bayou at their confluence with the Gulf of Mexico must be established to maximize flow from the passes and minimize sediment deposition at the mouth, and
2. Restoration of an ebb delta at the mouth of the passes to reduce sedimentation into the opening of the passes and to allow sediment bypassing across the mouth of the pass.

3 Nature of Activity

The proposed Cedar Bayou and Vinson Slough Hydraulic Restoration Project will restore the dynamically sustainable hydraulic connection between Cedar Bayou, Vinson Slough, and the Gulf of Mexico which were lost after an emergency closure by mechanical equipment performed to protect wetlands and the Texas Coastal Bend Bay system during the 1979 Ixtoc I Oil Spill. A hydraulic and coastal engineering analysis was conducted to identify the best-performing alternative solution to re-establish the hydraulic connection while at the same time beneficially using material removed from the passes. This solution consists of dredging a straight Cedar Bayou channel to the Gulf and connecting Vinson Slough to Cedar Bayou bayward of the Gulf mouth of Cedar Bayou, as historically occurred from the 1800s to 1979. The proposed dimensions for both the Cedar Bayou and Vinson Slough channels are 100 ft wide by 6 ft deep with 4H:1V side slopes. The dredged material –identified as beach-quality sand through a geotechnical investigation – will be placed offshore of the mouth to create an ebb shoal at the mouth of the pass. These two components – connecting Vinson Slough with Cedar Bayou and creating the ebb shoal offshore of the mouth of the pass – were identified in the coastal engineering analysis as key components to maintaining a long term opening between the Gulf and the passes.

This proposed configuration was developed through a series of hydraulic and coastal engineering analyses. The analyses were performed to identify the forces controlling the opening and closing of the Cedar Bayou / Vinson Slough system, and consisted of reviewing historical data and studies, analyzing the historical geomorphology of the project site through historical charts and aerial photography, new bathymetric and geotechnical data field collection efforts, and numerical modeling of wind and tide-induced currents, waves, and sediment transport. After an understanding of the coastal processes in the project vicinity, several alternatives were developed and tested with analytical and numerical models. The optimal alternative – the best hydraulically performing alternative with the least cost and size – was selected as the preferred alternative and is the design layout described in this application.

A technical review team was consulted throughout the analysis process to review the analyses and provide technical support. The technical review team consisted of representatives from Texas General Land Office (TGLO), Texas Parks and Wildlife Department (TPWD), Coastal Bend Bays & Estuaries Program (CBBEP), US Fish and Wildlife Service (USFWS), US Army Corps of Engineers – Galveston District (USACE), and Aransas County.

It is important to note what this project will not do. These include the following

- The Cedar Bayou and Vinson Slough channel are not intended for navigational purposes. Warning signs will be posted to restrict navigation at the Cedar Bayou mouth as part of this project.
- The project does not propose creating emergent features in the Gulf of Mexico or turning submerged lands in to uplands.
- No construction or construction related activities are proposed that impact existing marsh or seagrass.

Descriptions of the functionality of the major design elements of the proposed project are given below.

Cedar Bayou Channel

The Cedar Bayou channel is to be dredged as a straight channel connecting upper Cedar Bayou with the Gulf of Mexico. Without dredging the Cedar Bayou channel, the hydraulic connection between the Gulf and Cedar Bayou cannot maintain itself and will be lost. The straight channel cut is important to reduce hydraulic resistance; a meandering or bending channel increases the hydraulic resistance and therefore reduces channel stability. The dimensions of the channel were optimized with results from numerical modeling to find a balance between a flow rate that would self-scour the channel and a channel layout with the minimum footprint, dredging volume, and impact to surrounding habitat.

Vinson Slough Channel

The hydraulic analyses showed that the connection of Vinson Slough to Cedar Bayou is critical for Cedar Bayou to maintain itself as a self-scouring, stable channel. When Vinson Slough is connected to Cedar Bayou, it increases flow into both channels and increases the velocity – especially the ebb velocity at the mouth of the inlet – which aids in channel stability by flushing the mouth of sediment. Also, the Vinson Slough channel, when connected to Cedar Bayou, will re-introduce flow into the Vinson Slough marsh system which was cut off from its connection to the Gulf of Mexico and Cedar Bayou after the 1979 emergency closure and further after the 1995 dredging project.

Ebb Delta Creation with Dredged Sediment

The dredge disposal sites from the 1987 and 1995 dredging events were a contributing factor to the relatively rapid closure of the inlet following the dredging. Material dredged during the proposed project should be beneficially used to increase channel stability. Historical evidence and an understanding of coastal inlets shows that an ebb delta existed offshore of the mouth of Cedar Bayou during times when it was widely open. Ebb deltas are an important feature of stable coastal inlets, as they allow for bypassing of longshore sediment transport around the mouth of the inlet without silting the mouth of the inlet. Therefore, it is proposed to place material dredged from the Cedar Bayou and Vinson Slough channels (shown to be beach quality sand through recent geotechnical field studies) in a manner that will promote the formation of an ebb delta offshore of the mouth of the Cedar Bayou inlet. The ebb delta acts to promote inlet stability in two ways:

1. The ebb delta allows sediment bypassing around the inlet mouth by routing the longshore current and longshore sediment transport across the ebb shoal instead of directly at the inlet mouth. This reduces sediment deposition at the mouth and increases inlet stability.
2. An ebb delta offshore of the mouth of the inlet causes waves to break over the ebb delta instead of directly at the inlet mouth. This results in decreased wave setup at the mouth of the inlet and reduces hydraulic resistance to the ebb tidal flow out of the mouth of the inlet, which in turn helps increase self-scouring at the inlet mouth and increases inlet stability.

The proposed Cedar Bayou and Vinson Slough Hydraulic Restoration Project will be constructed to meet the following design criteria, as specified by the project partners:

- Restore the historic hydraulic connection between the Gulf of Mexico and the Cedar Bayou
- Restore the historic hydraulic connection between Vinson Slough and the Gulf of Mexico
- Minimize maintenance requirements

Similar dredging projects have been constructed at Cedar Bayou four times in the past, with two of the projects undergoing the USACE 10/404 permitting process in 1987 and 1995. The permitting history for Cedar Bayou is as follows:

- Permit withdrawn: Permit Application Number 17763, submitted in 1986.
- Permit Application Number 17763(01), submitted in 1987.
    - Dredging volume: 300,000 cy
    - Dredge dimensions: depth 6.0 ft below MSL; width at base: 60 ft
    - Dredge disposal areas: Levees along the west side of channel; Gulf beach disposal to southwest of Gulf connection on beach.
    - Expiration date: December 31, 1990
- Permit Application Number 17763(02), submitted in 1995.
    - Approximate dredging volume: 300,000 cy
    - Dredge dimensions: depth 6.0 ft below MSL; width at base: 60 ft
    - Dredge disposal areas: Levees along the west side of channel; Gulf beach disposal to southwest of Gulf connection at mouth of Vinson Slough.
    - Expiration date: December 31, 2005.

Proposed Project Dimensions:

Detailed project plans and cross-sections are given in the attached Sheets 1 – 6. The detailed dimensions of the project are shown on the plan sheets and described in this section.

To construct the project, approximately 503,350 cy of material will be removed from 58.5 acres. The dredge template is shown in Sheet 2, and the excavation plan shown on Sheet 3. The material will be placed over a total of 85.5 acres; 454,850 cy will be placed in 67 acres for the ebb delta construction (Sheet 5), and 48,500 cy are to be placed on 18.5 acres of the upper beach

(Sheet 3). Dredging will be conducted with a hydraulic dredge. The specific type and size of dredge is to be determined by the contractor; it is expected that a cutterhead-type dredge will be employed for the work.

The main Cedar Bayou channel is shown in plan view and cross-section on Sheet 2. The channel is proposed to be cut to a depth of -6 ft MSL (-5.62 ft NAVD88) with a bottom cut width of 100 ft and side slopes of 4:1. The channel cut requires 175,050 cy of material to be cut from 21 acres over a total length of 6,175 ft. The excavated material in the main channel of Cedar Bayou consists of beach quality sand with a median grain size diameter of approximately 0.15mm, and has a silt and clay content of no more than 5% (see Subsurface Investigation and Laboratory Testing Program for Proposed Cedar Bayou Project).

The Vinson Slough channel is shown in plan view and cross-section on Sheet 2. The channel is proposed to be cut to a depth of -6 ft MSL (-5.62 ft NAVD88) with a bottom cut width of 100 ft and side slopes of 4:1. The channel cut consists of 279,800 cy of material to be cut over 26.5 acres over a total length of 7,115 ft. The excavated material is similar to that from Cedar Bayou – it consists of beach quality sand with a median grain size diameter of approximately 0.15mm, and has a silt and clay content of less than 5% (see Subsurface Investigation and Laboratory Testing Program for Proposed Cedar Bayou Project).

On both channels, the dredging side slopes are 4H:1V. These slopes are expected to adjust to more natural slopes over time. Measurements of the existing Cedar Bayou channel show that the existing slopes vary from 100H:1V to 3H:1V, with the slope generally steeper on the Gulfward side than the bay side. Based on this, the side slopes in Cedar Bayou and Vinson Slough will adjust relative to hydrodynamic forces, sediment input, and sediment characteristics. The slopes of the newly dredged channel will not differ from the existing slopes, which vary from 100H:1V to 3H:1V, after equilibrating with the hydrodynamic forcing.

The elevated sand mound at the mouth of Vinson Slough (the 1995 dredge disposal mound) is to be removed from an existing elevation of about +14 ft NAVD88 to an elevation of about +6 ft NAVD88. This will be accomplished using earthmoving equipment. The area of the 1995 disposal mound to be removed is approximately 11 acres and contains 48,500 cy of sediment. Sheet 3 shows the plan view area of the disposal mound to be removed.

The material dredged from the Cedar Bayou and Vinson Slough channels (454,850 cy) is to be used in the creation of the ebb delta. Material removed from the 1995 dredge disposal site (48,500 cy) will be trucked and placed on the beach in the form of a beach nourishment.

The ebb delta will be formed from dredged sediment placed from the Cedar Bayou and Vinson Slough channels into the footprint as shown in Sheet 5. During construction, the maximum elevation of placed sand will not exceed +2.0 ft NAVD88. It is expected that the constructed template will rapidly transform into a submerged delta. Sheet 6 Section D shows a typical construction template cross-section and the same cross-section transformed to the typical delta shape after wave forcing. The construction template has a 100 ft crest width constructed to +2 ft NAVD88 with side slopes of 20H:1V to 30H:1V depending on the wave conditions during and after material placement. The northeast delta, Delta A, is approximately 2450 ft long and contains 304,800 cy placed over approximately 41 acres. The southwest delta, Delta B, is approximately 1660 ft long and contains approximately 150,050 cy placed over approximately 26 acres. The shape of the construction template will be modified in plan view and cross-section through coastal processes. Sheet 6 shows the expected cross-section after being worked by waves. The crest will become submerged, and the material will migrate in the southwest direction. When the Cedar Bayou channel is opened, flow from the channel will interact with the coastal processes to create the offshore ebb shoal. Ebb shoals are dynamic morphologic features and change dimensions with changing conditions. Therefore, it is not possible to give the exact dimensions of the post-construction ebb delta as it will constantly change.

Sediment removed from the 1995 disposal area will be placed in the form of a beach nourishment. The proposed construction template is shown in plan view in Sheet 3 and in cross-section in Sheet 4. The beach template will have a berm height of +6 ft NAVD88 starting at the seaward edge of the exiting dune feature. The material will not be placed on existing vegetation. The berm width is approximately 200 ft terminating in a 20H:1V seaward slope down to the existing bottom. The entire 48,500 cy removed from the 1995 disposal site will be placed over 18.5 acres in the beach site.

Dimensions of all the work elements are summarized in Table 1.

Table 1. Area and volume of dredging and dredged material placement activities.

Dredging Activity			Material Placement Activity		
Location	Dredging Area [acres]	Dredging Volume [cy]	Location	Placement Area [acres]	Placement Volume [cy]
Cedar Bayou	21	175,050	Delta A	41	304,800
Vinson Slough	26.5	279,800	Delta B	26	150,050
1995 disposal	11	48,500	Beach	18.5	48,500
Total	58.5	503,350	Total	85.5	503,350

Construction is proposed to begin after April 15 and to be completed prior to October 15; no work is proposed to occur during the whooping crane wintering season (October 15th to April 15th). It is not possible to construct the project outside of the turtle nesting season (March 15th to September 30th) due to the whooping crane nesting window. Also, it is expected that excavation of the Cedar Bayou mouth and construction of the ebb delta will have a minimal impact on turtles swimming offshore or attempting to nest. Therefore, if required, a turtle monitoring plan will be implemented prior to and during beach construction activities. A detailed evaluation and discussion of endangered species impacts and a habitat characterization of the region was developed and is discussed in Section 5.

Construction is to occur in the following sequence. The dredge will enter Cedar Bayou from Mesquite Bay via the GIWW. The dredging will begin at Station 0+00 and progress to Station 47+50 at the junction with the Vinson Slough channel. Before the Vinson Slough channel dredging begins, the 1995 dredge disposal mound will be excavated with land-based equipment and trucked to the beach placement site. Then the Vinson Slough channel will be dredged from Vinson Slough Station 100+00 to 171+00. The Cedar Bayou and Vinson Slough dredged material will be pumped to the delta placement locations and placed in a manner similar to beach nourishment placement. The placement location (delta A or B) will depend on the wave and wind conditions and may vary from day to day. Finally, the channel will be connected to the Gulf by dredging from Station 47+50 to Station 75+00. All barge and maintenance access to the site will be through the Cedar Bayou channel or from the Gulf.

Materials and equipment for project construction will be staged in upland areas away from the lower beach and dune system and transported to the work site as needed. The number of vehicles transiting the project site will be kept to a minimum, and all vehicles will use the same pathway whenever possible. After construction, all mud, wind tidal flats, and other project areas seaward of the mean high tide line shall be restored to pre-construction contours and all ruts will be leveled.

A monitoring program is proposed to evaluate the behavior of the project. Based on the monitoring program, adaptive management of the channel will be employed. No maintenance dredging is proposed at this time, as it is not possible to estimate the details of any future maintenance due to the complexity of the hydrodynamic forces at the project site – future dredging may be along the same alignment proposed in this project, or may be along a completely new alignment or utilize a new cross-sectional configuration. Therefore, any future activity will be proposed either as an addendum to this permit, or will be permitted under a new application. Guidance on the best course of action at that time will be solicited from the appropriate regulatory agencies and results of the monitoring plan.

4 Alternatives Analysis

An alternatives analysis was performed to determine the best configuration to restore the hydraulic connection between Cedar Bayou and the Gulf of Mexico. Once the best configuration was determined, several dredged material placement alternatives were analyzed. The analysis is summarized in this section. For more details on the alternatives analysis of the channel configuration, please see the attached report "Restoration of Cedar Bayou and Vinson Slough Phase 1, Technical Feasibility: Hydraulic and Alternatives Analysis" (Phase 1 report).

First, the no-action alternative was considered for the entire project (i.e., not constructing the project). If no action were taken, Vinson Slough will remain closed and sealed from the Gulf of Mexico. Cedar Bayou currently has a small connection with the Gulf of Mexico. Without the connection to Vinson Slough, and given the state of the Cedar Bayou Channel, the hydraulic connection to the Gulf is negligible and unstable - it is unlikely to remain open. Therefore, the no-action alternative does not meet the project goals of restoring the historical hydraulic connection between Cedar Bayou, Vinson Slough, and the Gulf of Mexico.

Channel Alternatives
During the initial feasibility study phase, seven alternative Cedar Bayou channel configurations were developed. In addition to the various channel alignments and connection configurations with Vinson Slough, various channel widths and depths were developed. All the alternatives were evaluated with analytical and numerical models to determine the best-performing alternative. In the Phase 1 report, the Alternative 1b configuration was selected as the best

performing alternative as it provided the largest increase in flow rate along with a large ebb tide velocity at the mouth of the inlet. Both of these features increase the ability of the inlet to self-scour and increase the channel's stability. The Alternative 1b alignment consists of the straight Cedar Bayou channel to the Gulf, and a Vinson Slough channel cut to intersect the Cedar Bayou channel landward of the Gulf. This is the proposed alignment, as shown in Sheet 2.

Once the alignment was selected, a hydraulic stability analysis was performed to determine the optimum channel dimensions. The stability analysis was based on a balance between the tidal flow potential through the channel and the channel's hydraulic resistance. The channel dimensions were optimized to maximize the flow rate and channel stability while at the same time minimizing the dredge cut footprint and dredging volume. The optimal channel configuration is described above in Section 3.

Dredged Material Placement Alternatives

Once the optimal channel configuration was determined, the preliminary design of the dredged material disposal area was undertaken. Not disposing of material (the no-action alternative) is not feasible, as dredging requires placing the material in some location. Three disposal alternatives were considered: 1) barging the material offsite (barging), 2) placement of material in levees along the channel (levees), and 3) placement of the material to form an offshore ebb delta (delta).

The barging alternative consists of pumping the dredged material into barges and shipping the material to an off-site location. The dredged material is beach-quality sand. Therefore, it was considered for placement on a nearby beach that is currently experiencing erosion so that it could be used beneficially. However, no immediate placement areas (beach sites) were available. In addition, transportation of the sediment by barges would require shipping the material on the order of 30 or more miles. Transportation and barge costs alone make this alternative unfeasible. In addition, the transit time for barges to travel from the dredge site to disposal site and back (assumed 30 miles) makes the number of barges to keep up with dredge production rate unfeasible. Finally, if the barges were to be shipped through the GIWW, an access channel would likely be required to be dredged across Mesquite Bay; this access channel can be avoided if fully-loaded sand barges are not going to transit the bay. All these factors combined together make the use of barge disposal unfeasible.

A second alternative for placement of the dredged material is in levees adjacent to the Cedar Bayou channel that were constructed for dredge material disposal during the 1959 Cedar Bayou dredging project. The conditions and capacity of these levees are currently unknown. Observations during recent site visits indicated that the levees were in various states of disrepair, and that the disposal sites have become upland habitat. Using these areas for a disposal site will require repair of the levees that likely do not have sufficient capacity to hold the required dredged volumes. Also, use of this area would require clearing of the upland habitat – existing levees cover approximately 155 acres. It is assumed the entire leveed area would be required due to the likely capacity limitations from previous disposal at the site. This option is not feasible due to the impact 155 acres of upland habitat.

The third alternative considered is using the dredged material to create an ebb delta offshore of the mouth of the Cedar Bayou inlet in the Gulf. The alternative was developed based on an understanding of the morphology of tidal inlets around the world. Most stable unjettied (and some that are jettied) tidal inlets have an ebb shoal offshore of the inlet mouth. The ebb shoal acts to allow sediment bypassing around the mouth of the inlet and increases inlet stability. Therefore, construction of an ebb delta would be beneficial to the project in that it allows for increased inlet stability.

The material placement configuration was designed as a balance between an efficient placement methodology developed to reduce cost, while at the same time creating a shape that will be modified by coastal processes to form an ebb delta. The placement cost will be on the same order of magnitude as that for the previous 1987 and 1995 placement, as the placement procedure and pumping distances are similar. The construction template covers 67 acres. Placement of material will take place in a manner similar to a beach nourishment project.

The volume of an ebb delta offshore of the mouth of an inlet is related to the flow rate through the inlet (Walton and Adams, 1976)[1]. The stable ebb delta volume for the proposed Cedar Bayou channel was computed based on an empirical equation developed from data compiled by Walton and Adams. Based on the modeled flow rate through the proposed Cedar Bayou channel (tidal prism of approximately 1,044,000 m^3), the ebb delta volume that is expected to be maintained by the proposed channel is 300,000 cy ± 50,000 cy. The total amount of sediment to be placed to form the offshore delta is 454,850 cy. Therefore, between 100,000 and 200,000 (25% to 45%) of the placed material will be bypassed to the downdrift beach, while the other 55% to 75% of the material placed is expected to remain in the ebb delta.

After evaluating the three dredged material disposal alternatives, it was determined that delta placement had the most benefits to the project with the least cost, and with the least area impacted. The final configuration of the delta placement alternative is shown in Sheet 5.

1995 Disposal Site Removal Alternatives

Construction of the Vinson Slough channel requires dredging through the 1995 dredged disposal site, which consists of beach-quality sediment placed in a mound up to about +14 ft NAVD88. This material must be moved either through dredging or some other means. Two alternatives were considered for the removal of this sediment: 1) dredging and delta placement or 2) excavation and beach placement.

Dredging the 1995 disposal site will remove the material in the channel template, but would leave the remaining material in place. This is undesirable for two reasons. When dredged, the channel will have high banks through the disposal site, which increases the likelihood of sedimentation from channel slope adjustment. Second, much of the material will remain in place, which will impede Vinson Slough from establishing a stable channel by restricting the ability of Vinson Slough to naturally meander.

The second alternative is to move the material above the surrounding existing ground at the 1995 disposal site and place it on the beach in the form of a beach nourishment to the southwest of the inlet (downdrift of the longshore current). This is proposed to be constructed by using an

---

[1] Walton, T.L. and Adams, W.D., 1976. Capacity of inlet outer bars to store sand. Proceedings of 15th Engineering Conference,ASCOE, Honolulu, Hawaii, pp. 1919-1937.

excavator to remove the material and trucking it to the beach placement site. The trucking route should be established with coordination from agencies as to avoid sensitive habitat areas and specifically vegetated areas. This alternative allows for dredging of the Vinson Slough channel without the risk of high sedimentation rates from the disposal mound. The area of sediment removal along with the beach placement template is shown in plan view on Sheet 3. The beach placement cross-sections are shown on Sheet 4.

5 Environmental Impact Assessment

5.1 Habitat Characterization of Project

A habitat characterization of the Cedar Bayou dredging and disposal footprint was conducted to define the types of habitat affected by dredging. Using ArcGIS, a shapefile of the dredging and disposal template was overlaid on a 2006 digitized aerial photograph of the project site. Area of affected habitat was then computed from what was impacted by the template overlay. The following habitats were identified as being potentially affected by the Cedar Bayou project.

- Existing open water tidal channel
- Emergent sand beach
- Gulf bottom

Using aerial photography from 2006, all acreage within the proposed dredge area is non-vegetative consisting of open water within the Cedar Bayou and Vinson Slough tidal channels, a short portion of open Gulf bottom, and bare sand/mud flat that make up the beach and emergent tidal shoals. Table 2 summarizes the individual acreages of potentially affected habitats within the dredging and disposal templates.

Table 2. Summary of estimated habitat acreages affected by the Cedar Bayou dredging and dredge material disposal templates.

Type of Habitat	Acreage
Existing open water channel	7
Emergent sand beach	58
Gulf bottom	79
Total Acreage	**144**

5.2 Endangered Species Assessment

All environmental data described in this section was obtained from Texas Parks & Wildlife, U.S. Fish & Wildlife Services, and the National Park Service from the following sources:

- http://www.tpwd.state.tx.us/huntwild/wild/species/endang/index.phtml
- http://www.fws.gov/southwest/es/EndangeredSpecies/lists/
- Personal communications with Donna Shaver (Chief, Division of Sea Turtle Science and Recovery, Padre Island National Seashore, National Park Service) dated March 23, 2007.
- Personal communications with Tom Stehns (USFWS Biologist and US Whooping Crane Coordinator at The Aransas National Wildlife Refuge) dated March 16, 2007.
- Personal communications with Mary Orms (USFWS) dated March 7, 2007; March 13, 2007

The Endangered Species List published by the United States Fish and Wildlife Department identifies 13 endangered (E), threatened (T), or similarity to a threatened (SAT) species within Aransas and Calhoun Counties, listed in Table 3. Of the 13 listed species, 8 may occur within the proposed project site.

Table 3. Endangered and Threatened Species of Aransas and Calhoun Counties.

SPECIES	LISTING
Reptiles and Amphibians	
American Alligator (*Alligator mississippiensis)*	SAT
Green Sea Turtle (*Chelonia mydas)*	E,T
Hawksbill Sea Turtle (*Eretmochelys imbricata*)	E
Kemp's Ridley Sea Turtle *(Lepidochelys kempii)*	E
Leatherback Sea Turtle (*Dermochelys coriacea*)	E
Loggerhead Sea Turtle (*Caretta caretta)*	T
Birds	
Attwater's Greater Prairie Chicken (*Tympanuchus cupido attwateri)*	E
Bald Eagle (*Haliaeetus leucocephalus*)	T
Brown Pelican (*Pelecanus occidentalis*)	E
Piping Plover (*Charadrius melodous*)	E,T
Whooping Crane (*Grus Americana*)	E
Mammals	
Gulf Coast Jaguarundi (*Herpailurus (=Felis) yagouaroundi cacomitli*)	E
Ocelot (*Leopardus (=Felis) pardalis*)	E

4.1.1 Reptiles and Amphibians

4.1.1.1 American Alligator

Biology and Ecology:

The American alligator (*Alligator mississippiensis)* has been declared recovered and was removed from the federal endangered species list in 1987. However, this species continues to be federally listed as threatened due to its similarity of appearance to the American crocodile (USFWS, http://ecos.fws.gov/servlet/SpeciesProfile?spcode=C000).

The American alligator is considered Nearctic since it is found from the Virginia-North Carolina border southward to the Rio Grande River in southern Texas.

Alligators are usually found in freshwater such as ponds, slow-moving rivers, swamps, marshes, and lakes. They can tolerate salt water but only for brief periods because they do not have salt glands. Female alligators generally remain in a small area while males occupy areas greater than two square miles. Both males and females extend their home ranges during the courting and breeding season (Schechter, http://animaldiversity.ummz.umich.edu/accounts/alligator/a._mississippiensis).

Alligators hunt primarily in the water and consume fish, turtles, snakes, and small mammals as adults and insects, snails, and small fish when they are young (smaller than six feet).

The American alligator does not migrate but will undergo periods of dormancy when the weather becomes cold. They may excavate a cave in a waterway leaving a portion of it above water during this time. These tunnels are often as long as 65 feet and provide protection during extreme hot or cold weather. However, in areas where water level fluctuates, alligators dig themselves into hollows, which fill with water.

The breeding season for the American alligator occurs between April and August. Alligators hatch in early August living in small groups. Juvenile alligators are defended aggressively by the mother for the first few years of life. Sexual maturity is reached during the sixth year.

There have been no known sightings of the American alligator in the vicinity of the proposed project.

Critical Habitat:
No critical habitat has been designated for this species.

Potential Effects of Proposed Project:
Because American alligators do not prefer saltwater, it is not likely that this project will directly or indirectly affect this species.

Conservation Measures:
Because no potential affects to the American Alligator will occur from this proposed project, no additional conservation measures are needed.

Conclusion:
The proposed project is not likely to adversely affect the American alligator in either the project or action areas.

4.1.1.2 Kemp's Ridley Sea Turtle

Biology and Ecology:
The Kemp's Ridley Sea Turtle (*Lepidochelys kempii)* is federally listed as an endangered species. It is the smallest of the sea turtles and adults reach maturity at about 10-15 years of age. Kemp's Ridley Turtles nest mostly during the daytime, often in groups called "arribadas". An individual Kemp's Ridley may nest as many as three times a season (USFWS and NMFS, 1992), with an average of 2.5 clutches per season. Clutch size averages around 100 eggs. Hatchlings emerge after about 50 days of incubation and hatchling emergence occurs during the night and day. Kemp's Ridleys are found in the Gulf of Mexico and Atlantic Ocean and some adjoining estuarine areas. Nesting occurs primarily near Rancho Nuevo, Tamaulipas, Mexico. Each year, some nests are also found at scattered locations between the Texas coast and Veracruz, Mexico.

Very rarely, Kemp's Ridleys nest at other locations in the U.S. outside of Texas. More Kemp's Ridley nests are consistently found at Padre Island National Seashore than at any other location in the U.S., making it the most important nesting beach in the U.S. for this species.

Historic nesting frequency of this sea turtle on the south Texas coast is poorly known. A total of 157 Kemp's Ridley nests have been documented along the Texas coast between 1979 and 2003.

The U.S. Fish and Wildlife Service at Aransas National Wildlife Refuge (and volunteers) detect, monitor, and protect sea turtle nests at along Matagorda Island. Detection involves weekday patrols to look for nesting activity and investigation of reports from patrollers. Patrollers (USFWS staff members and volunteers) use a truck or a vehicle similar to an ATV to search Matagorda Island beaches for sea turtle tracks and nesting Kemp's Ridley turtles each day, from April through mid –July. Sporadic monitoring occurs outside this time frame to monitor for stranded turtles.

The date of the nesting season varies slightly each year. In Mexico, Kemp's Ridley nests have been recorded as early as March and as late as August.

Critical Habitat:
No critical habitat has been designated for this species. There is an existing Recovery Plan for turtles that defines specific tasks that have been assigned to aid in the recovery efforts of turtles along Matagorda Island. There is no recovery plan for turtles along San Jose Island.

Potential Effects of Proposed Project:
There may be times when eggs, nesting turtles, hatchlings, and stranded turtles could be directly vulnerable to activities within the project action area.

Operation of all equipment on the beach can crush nesting turtles, stranded turtles, hatchlings, and some eggs, producing an immediate, lethal impact (Mann, 1977; NMFS and USFWS, 1991a, 1991b, 1992-1993; Ernest et al., 1998). Visitors are not permitted to operate their vehicles on Matagorda Island. The U.S. Fish and Wildlife Service at Aransas National Wildlife Refuge and Texas Parks and Wildlife do operate vehicles on the island. There is no vehicle access to San Jose Island.

Eggs could be crushed in nests that are not detected. Construction equipment could also remove sea turtle tracks, making it impossible for the USFWS to find a nest for investigation and protection.

Turtle hatchlings and smaller stranded sea turtles could become trapped in the ruts for short or long periods of time causing them to weaken, invert, or succumb due to predation, disorientation, crushing, or dehydration (Hosier et al., 1981; Fletemeyer, 1996; Ernest et al., 1998). The depth and slope of the ruts will influence the amount of impact. Deeper and more steeply sloped ruts will cause the greatest impact. Hosier et al. (1981) found that 10-15 cm deep tracks may serve as a significant impediment to loggerhead hatchlings. The smaller the turtle the more that it will be impacted by rut size.

Vehicles can also compact the sand, making it more difficult or impossible for nesting turtles to excavate a nest cavity leading to increased false crawls and nests with shallow egg chambers (Fletemeyer, 1996). Compaction could also make it more difficult for hatchlings to emerge from an undetected nest. Data on the level of compaction from beach driving necessary to inhibit or prevent nesting, or inhibit or prevent hatchling emergence is not available.

Operation of vehicles on the beach can cause indirect impacts to the sand that can adversely affect nesting and incubation habitat (Mann, 1977; NMFS and USFWS, 1991a, 1991b, 1992-1993; Ernest et al., 1998). Project vehicles can produce deeper ruts in the sand, which could affect movements of nesting females and hatchlings, however conservation measures will reduce this potential.

To reduce direct impacts that can occur from rutting, ruts will be back filled. However, since backfilling ruts and leveling of the beach surface may cause indirect and direct impacts (including compaction of sand, covering or removal of sea turtle tracks, and crushing of nests and turtles), existing methods used to fill ruts will be reviewed and monitored on a periodic basis by USFWS. There are no data to show that sand in these back filled areas is compacted enough to inhibit nesting. To further ensure that nesting sea turtle, hatchlings, tracks, and nests are protected during backfilling, a trained monitor will survey the area before backfilling taking place.

Vibrations and noise caused by construction equipment could frighten nesting turtles, causing them to abandon their nesting attempt (false crawl) (NMFS and USFWS 1991a, 1991b, 1992; Ernest et al., 1998). Vibrations could also harm incubating eggs. It is difficult to assess these areas as scientific data is lacking for the Kemps' Ridley related to construction vibrations or noise. From observations of traffic and wildlife interactions, in most instances seeing the vehicle at the waters edge would cause the sea turtle to move back into the water. One would expect this type of reaction of wildlife to man's presence (on foot or in a vehicle). The effect of vibrations from people or from equipment on the beach during a nesting event does not show a strong negative correlation to date. Vibrations could affect sea turtles either during nest site selection after exiting the water or once the eggs are laid. Vibrations could cause sea turtles to abandon a nesting attempt resulting in a false crawl and causing a sea turtle to re-enter the water and nest in another location. Once a sea turtle digs a nest cavity and begins laying her eggs, vibrations would not cause a sea turtle to abandon its nesting attempt since the turtle enters into a temporary trance where she is oblivious to outside vibrations. People driving on the beach often spot nesting sea turtles and can often approach them without disturbing the nesting activity, once she is laying the eggs. Through monitoring efforts during nesting season, all eggs are retrieved from each nest that is located and the eggs transported to an incubation facility. Therefore, vibrations from construction activities would not affect these eggs but could affect eggs that are not located and consequently excavated.

Construction lights can also cause direct and indirect impacts on nesting turtles leading to false crawls and can disorient hatchlings so that they crawl in the wrong direction rather than enter the sea, thereby becoming directly vulnerable to crushing, predation, and dehydration (NMFS and USFWS 1991a, 1991b; Fletemeyer, 1996).

Since nighttime transportation of heavy equipment is not permitted during the sea turtle nesting season, this light issue is confined to the dredge equipment. Nesting Kemp's Ridley turtles will most likely not be affected, as they are primarily daytime nesters. Lights from the dredge could indirectly cause false crawls and disorientation, if the lights are visible from the beach.

Dredging equipment can also cause direct and indirect impacts on turtles. Noise from dredging equipment could cause a turtle to abandon a nesting attempt resulting in a false crawl and causing a sea turtle to re-enter the water and nest in another location. The type of dredging equipment utilized during construction can also affect turtles. Since hopper dredges have been shown to harm turtles, the type of dredge will be limited to pipeline dredges.

Review of the construction template estimates that 6 acres of turtle nesting habitat could be effected long term as a result of the proposed project. Approximately 50 acres of habitat could be affected during construction activities.

Conservation Measures:
This project potentially may impact threatened and endangered sea turtles that occur in the action area, but monitoring of the action will be implemented to reduce the potential impact on these species, and help to ensure that the project is not likely to adversely affect these species. Currently the USFWS removes all sea turtle eggs that are located on Matagorda Island and transfers them to the incubation facility on the Padre Island National Seashore

Construction equipment that must travel along the beach will travel in caravans when possible, and truck numbers will be limited by implementing existing measures to decrease the amount of time that vehicles are traversing the beach during the sea turtle nesting season. As a beneficial effect to sea turtles, observers and vehicle operators from this project will provide additional observation and reporting opportunities and assist with USFWS efforts to detect, investigate, monitor, and protect nesting sea turtles, their nests, hatchlings, and stranded turtles.

To reduce the direct impacts that could occur from crushing/covering nests or turtles, all vehicle operators will attend a training class held by the USFWS. A USFWS trained monitor will conduct a morning patrol before construction equipment accesses the beach. Monitors or observers trained by USFWS personnel will travel in front of large vehicles and vehicles moving equipment, and drive at a reduced speed (15 mph maximum) to look for and help ensure that sea turtles, nests, and their tracks are protected. Observers will use a truck or a vehicle similar to an ATV during the sea turtle nesting and hatchling emergence season (April 1 through October 15). Vehicles will travel above the wet portion of the beach thereby reducing the chance of crushing stranded sea turtles.

Mitigation measures of night sky protection, use of directional and shielded lighting on the dredging equipment, prohibition of lighting on production facilities within the required setback of 500 feet from the dunes and other light-sensitive areas, and the night driving restrictions placed on operators of heavy equipment and trucks on the beach is thought to be adequate to prevent this impact, given current scientific data.

Conclusion:
The risk to a sea turtle in the action area of this project is reduced when looking at past nesting activity. Current nesting activity does not seem to indicate compaction from vehicles is causing a negative affect.

During 2002, 40 Kemp's Ridley nests were documented in the United States with 23 of these occurring within Padre Island National Seashore, which took place with approximately 500,000 visitors coming to the park. Looking at nesting data collected over the past 20 years for the action area, and given that most nests are found and removed from the beach by park staff, the potential impact of vibrations to eggs and crushing of nests would appear to be minimal.

Therefore, given the moderate potential to negatively impact this species in the action area (there are possibilities to directly impact this species), and the reduced possibility for impacts in the proposed project area, the overall conclusion for this evaluation is that the proposed project, with mitigation and conservation measures implemented, is not likely to adversely affect the Kemp's Ridley sea turtle.

4.1.1.3 Green sea turtle

Biology and Ecology:
The green sea turtle (*Chelonia mydas)* is federally listed as threatened in all of its range except the waters of Florida and the Pacific coast of Mexico, where it is endangered. It is circumglobal in tropical and sub-tropical waters. A green turtle fishery, operating almost exclusively within inshore waters (bays, estuaries, passes), began in Texas in the mid-1800's. By the early 1900's, the catch declined to such an extent that the turtle fishing and processing industry collapsed (Hildebrand, 1981). Although historic nesting by green turtles on the Texas coast is suspected, the first confirmed nest was not documented there until 1987 (Shaver, 2000).

Adult green turtles reach maturity at 30 to 50 years of age. Female green turtles nest at night. From one to seven clutches are deposited within a breeding season (the average number is usually two to three clutches) (NMFS and USFWS, 1991a). Average clutch size is usually 110-115 eggs. Hatchling emergence occurs at night. In this region, nesting sites include southern Florida and scattered locations in Mexico, although nesting occasionally occurs in south Texas.

Critical Habitat:
No critical habitat has been designated for this species at the proposed project site. There is an existing Recovery Plan for turtles that defines specific tasks that have been assigned to aid in the recovery efforts of turtles along Matagorda Island. There is no recovery plan for turtles along San Jose Island.

Potential Effects of Proposed Project:
There is the very small chance that this sea turtle can be directly impacted by construction equipment use on the beach, including crushing of stranded and nesting turtles and hatchlings and undiscovered nests. Impacts that are more indirect like noise and vibration to nests or hatchlings can cause similar changes in behavior, and therefore affect the species. Please see impacts associated with the Kemp's Ridley (above) for broader discussion of related project impacts.

Conservation Measures:
The USFWS protects and monitors this species occurrence and richness along Matagorda Island. No surveys are performed on San Jose Island. The conservation efforts related to this sea turtle, and the following species of sea turtle, are conducted to promote and enhance their recovery. Please consider the measures employed for use in the Kemp's Ridley sea turtle effort as measures used to assist this and other species of sea turtle, as they are conducted concurrently with the same monies, diligence and staff time. Please see measures employed for use on the Kemp's Ridley sea turtle as measures applicable to this species.

Conclusion:
Given the small potential to negatively impact this species in the action area (there are few possibilities to directly impact this species), and even less possibility in the proposed project area, the overall conclusion for this evaluation is that the proposed project, with mitigation and conservation measures implemented, is not likely to adversely affect the green sea turtle.

4.1.1.4 Atlantic Hawksbill sea turtle

Biology and Ecology:
The hawksbill (*Eretmochelys imbricata)* is federally listed as endangered. It occurs in tropical and subtropical seas of the Atlantic, Pacific, and Indian oceans. Young hawksbills occur with some regularity in Texas waters, since northern currents carry them from nesting beaches in Mexico (Hildebrand, 1981). Historic nesting by this species on the Texas coast is unknown.

Female hawksbill turtles nest mostly during the night, but rare daytime nesting is known. They nest an average of 4.5 times per season (up to 12 clutches); clutch size averages approximately 140 eggs (NMFS and USFWS, 1993). Hatchling emergence occurs at night. Hawksbills nest on scattered islands and beaches between 25 degrees North and South latitude including beaches in southeastern Florida and the states of Campeche and Yucatan in Mexico. Nesting does not regularly occur on the Texas coast.

Critical Habitat:
No critical habitat has been designated for this species at the project site. Please see loggerhead section above for more information.

Potential Effects of Proposed Project:
There is the remote chance that this sea turtle can be directly impacted by vehicle use on the beach, including crushing of stranded and nesting turtles and hatchlings and undiscovered nests. Impacts that are more indirect like noise and vibration to nests or hatchlings can cause similar changes in behavior and therefore affect the species. Please see impacts associated with the Kemp's Ridley (above) for broader discussion of related project impacts.

Conservation Measures:
Please see those measures employed for use on the loggerhead sea turtle as those measures also apply to this species.

Conclusion:
Given the remote potential to negatively impact this species in the action area (there are few possibilities to directly impact this species), and even less possibility in the proposed project area, the overall conclusion for this evaluation is that the proposed project, with mitigation and conservation measures implemented, is not likely to adversely affect the Atlantic hawksbill sea turtle.

4.1.1.5 Leatherback sea turtle

Biology and Ecology:
The leatherback sea turtle (*Dermochelys coriacea)* is federally listed as an endangered species. It ranges throughout the tropical waters of the Atlantic, Pacific, and Indian oceans, but has also been recorded from the North Atlantic, North Pacific, South Atlantic, and South Pacific. The leatherback is the largest and most pelagic sea turtle species and is normally found in the deeper waters of the Gulf of Mexico where it may undertake extensive migrations.

Nesting occurs primarily at night and diurnal nesting occurs only occasionally. They nest five to seven times per year, with an average clutch size of 110-116 eggs (NMFS and USFWS, 1992). Hatchling emergence typically occurs at night. Leatherback nesting grounds are distributed circumglobally.

No leatherback nests have been confirmed on the Texas coast since the 1930's.

Critical Habitat:
No critical habitat has been designated for this species.

Potential Effects of Proposed Project:
There is an unlikely chance that this sea turtle can be directly impacted by vehicle use on the beach, including crushing of stranded turtles and more indirect impacts like noise, vibration issues and effects on nesting attempts, and vehicle and project area lighting. Some changes in behavior can be expected from human interaction with this species, but actual occurrence in the park is rare. Please see impacts associated with the Kemp's Ridley (above) for broader discussion of related project impacts.

Conservation Measures:
Please see those measures employed for use on the loggerhead sea turtle, as those measures also apply to this species.

Conclusion:
Given the very remote potential to negatively impact this species in the action area (there are few possibilities to directly impact this species), and even less possibility in the proposed project area, the overall conclusion for this evaluation is that the proposed project, with mitigation and conservation measures implemented, is not likely to adversely affect the leatherback sea turtle.

4.1.1.6 Loggerhead sea turtle

Biology and Ecology:
The loggerhead sea turtle (*Caretta caretta)* is federally listed as a threatened species. It occurs in temperate and tropical waters of both hemispheres. The species inhabits the continental shelves and estuarine environments along the margins of the Atlantic, Pacific, and Indian oceans. Historic nesting frequency on the Texas coast is poorly known. Hildebrand (1981) suggested that nesting likely occurred within the last 300 years, but the earliest loggerhead nest that he was able to confirm for the Texas coast was found in 1977.

Adult loggerhead turtles reach maturity in 25 to 30 years. Loggerheads are nocturnal nesters, although some daytime nesting occurs. They nest from one to seven times within a nesting season (average of approximately 4.1 clutches); clutch size averages 100-125 eggs along the southeastern U.S. coast (NMFS and USFWS, 1991b). Hatchling emergence typically occurs at night. In the Gulf of Mexico, there are distinct nesting populations on the coast of the Florida panhandle and the Yucatan Peninsula. Scattered nests can be found occasionally along other areas of the U.S. Gulf coast including the Chandeleur Islands, Louisiana in the north and to the U.S./Mexico border in the south.

Loggerhead turtles sometimes inhabit nearshore Gulf of Mexico waters for foraging or migration. Additionally, a few occasionally nest at the national seashore and many more are found stranded there (Shaver, 1998b, 1999b).

As mentioned above in the Kemp's Ridley section, the USFWS detects, monitors, and protects Kemp's Ridley nests along Matagorda Island; no monitoring is performed along San Jose Island. This on-going program has expanded to include not only the Kemp's Ridley, but also the other four species of sea turtles that occur along the Texas coast. Detection for the following four species of sea turtles involves patrols to look for nesting activity, public education, and investigation of reports from patrollers, beach workers, in park contractors, and the public. Patrollers (USFWS staff members and volunteers) use a truck or a vehicle similar to an ATV to search Matagorda Island beach for sea turtle tracks and nesting turtles. Each day, from April through mid-July, they patrol the beach during daylight hours. The patrol season and procedures are designed primarily to detect nesting by Kemp's Ridley turtles, but the other sea turtle nests have also been documented as a part of the patrols and reports from the public.

Critical Habitat:
No critical habitat has been designated for this species at this park. There is no specific Recovery Plan task assigned for this or the remaining three species of sea turtles, however staff and volunteers conduct, support and assist in the daily patrols for this species to protect, document, and monitor nesting occurrence.

Potential Effects of Proposed Project:
There is the small chance that this sea turtle can be directly impacted by construction equipment use on the beach, including crushing of stranded and nesting turtles, hatchlings, and undiscovered nests. Impacts that are more indirect like noise, vibration to nests or hatchlings, and vehicle and project area lighting can cause similar changes in behavior and therefore affect

the species. Please see impacts associated with the Kemp's Ridley (above) for broader discussion of related project impacts.

Conservation Measures:
The conservation efforts related to this sea turtle, and the preceeding three species of sea turtle, are conducted to promote and enhance their recovery. Please consider the measures employed for use in the Kemp's Ridley sea turtle effort as measures used to assist this and other species of sea turtles.

Conclusion:
Given the minimal potential to negatively impact this species in the action area (there are few possibilities to directly impact this species), and even less possibility in the proposed project area, the overall conclusion for this evaluation is that the proposed project, with mitigation and conservation measures implemented, is not likely to adversely affect the loggerhead sea turtle.

4.1.2 Birds

4.1.2.1 Attwater's Greater Prairie Chicken

Biology and Ecology:
The Attwater's Greater Prairie Chicken (Tympanuchus cupido attwateri) is currently listed as endangered. Historically, an estimated 1 million APC's occupied over 6 million acres of coastal prairie habitat. In 1992, an estimated 456 individuals remained in 4 populations located in 5 Texas counties.

The Attwater's greater prairie chicken is a small bird with a short, rounded dark tail. They live on coastal prairie grasslands with tall species of grasses. They are about 17 inches long and the males have a large orange air sac on each side of the neck. Males can emit a "booming" sound, which is amplified by inflating the air sacs and can be heard 0.5 miles away. They gather in areas with bare ground or short grass to choose a mate, called a "booming groundor lek". Males dance and release their noise to attract the females. Females choose their mates and then lay usually 12 eggs during the nesting season. They live about 2 to 3 years. Their diet consists of small green leaves, seeds and insects.

The Attwater's Greater Prairie Chicken once inhabited coastal prairie grasslands of Louisiana and Texas. Habitat loss, due to range degradation, agriculture, and urban expansion, is the primary factor contributing to its decline.

Critical Habitat:
Essential habitat for this species is located within Austin, Colorado, Galveston, Victoria, Refugio, Goliad, and Aransas Counties. As of 1992, no Attwater's Greater Prairie Chicken remain in Aransas County. Habitat management initiated in 1976 on the Tatton Unit of the Aransas National Wildlife Refuge had helped to maintain a resident population there. However, brush invasion on the refuge and adjoining private lands has caused a continued decline in Attwater's Greater Prairie Chicken numbers on the Tatton Unit.

Potential Effects of Proposed Project:
The action and project areas for this proposed project does not include habitat that could be used for nesting, foraging, or resting by the Attwater's Greater Prairie Chicken. Therefore, no direct or indirect effects of the proposed project are likely to occur.

Conservation Measures:
Because no potential affects to the Attwater's Greater Prairie Chicken will occur from this proposed project, no additional conservation measures are needed.

Conclusion:
Based on the preceding analysis, the overall conclusion of the evaluation is that the proposed project is not likely to adversely affect the Attwater's Greater Prairie Chicken in either the project or action areas.

4.1.2.2 Bald Eagle

Biology and Ecology:
The Bald Eagle (Haliaeetus leucocephalus) is listed as threatened at both the state and federal levels. Bald Eagles declined due to a perception that they and other raptors were marauders that killed chickens, lambs, and other domestic livestock. Consequently, farmers, ranchers, and others killed large numbers of Bald Eagles to protect their livestock (USFWS, http://species.fws.gov/bio_eagl.html).

The Bald Eagle is the only eagle that is unique to North America and ranges over most of the continent, from the northern reaches of Alaska, Canada, and Newfoundland south into northern Mexico (USFWS, http://species.fws.gov/bio_eagl.html). Bald Eagles winter throughout its breeding range.

Bald Eagles prefer quiet coastal areas, rivers, or lakeshores with tall trees but can also be found around manmade reservoirs (TPWD, http://tpwd.state.tx.us/nature/ending/birds/baldeagl.htm). Bald Eagles forage primarily on fish, but will feed on almost anything they can catch, including ducks, rodents, snakes, and carrion.

Bald Eagles mate for life and build large nests in the tops of large trees near rivers, lakes, marshes, or other wetland areas. Bald Eagles often re-use nests year after year and normally have one clutch each year (USFWS, http://species.fws.gov/bio_eagl.html).

Bald Eagles range from north, northeast, east, southeast, and central portions of Texas. They are not observed in southwest or western Texas (Rappole and Blacklock, 1994). In Texas, Bald Eagles breed primarily in the northern and eastern portions of the state (TPWD, http://tpwd.state.tx.us/nature/ending/birds/baldeagl.htm). They were formerly common, breeding on the islands in Nueces Bay and elsewhere but are now considered a rare resident (Rappole and Blacklock, 1994). Bald Eagles prefer riparian habitat and oak woodlands (USFWS, 1977).

Critical Habitat:
No critical habitat has been designated for this species.

Potential Effects of Proposed Project:
The action and project areas for this proposed project do include a limited amount of habitat, oak woodland, which could be utilized by the Bald Eagle. However, no known nesting habitat for the Bald Eagle exists in the area and no sightings of a Bald Eagle have occurred in past. Therefore, no direct or indirect effects of the proposed project are likely to occur.

Conservation Measures:
Because no potential affects to the Bald Eagle will occur from this proposed project, no additional conservation measures are needed.

Conclusion:
Based on the preceding analysis, the overall conclusion of the evaluation is that the proposed project is not likely to adversely affect the Bald Eagle.

4.1.2.3 Eastern Brown Pelican

Biology and Ecology:
Eastern Brown Pelicans (Pelecanus occidentalis) are federally and state listed as endangered. At one time, this bird's population fell to less than 100 birds between 1967 and 1974 (TPWD, http://tpwd.state.tx.us/nature/endang/birds/bpelican.htm). It is a coastal inhabitant whose range includes the southern United States and northern South America - from North Carolina to Venezuela and Trinidad in the Atlantic and from British Columbia to Chile on the Pacific coast.

This species is found along salt bays, beaches, and oceans. It is generally found near shallow waters adjacent to the coast, especially on sheltered bays. Occasionally Brown Pelicans are seen well out to sea. Brown Pelicans feed almost entirely on fish including menhaden, smelt, and anchovies but can occasionally feed on crustaceans.

Brown pelicans nest in colonies on isolated islands where they are safe from predators. These islands may be either bare and rocky or covered with small mangroves, shrubs, or other trees. Stray individuals may appear on freshwater lakes inland. Nests may be a simple scrape, a heap of debris with a depression on the top, or a large stick nest located in a tree. Breeding season generally begins in early March and lasting until August. After the breeding season, flocks move north along both Atlantic and Pacific coasts. These birds return southward to warmer waters by winter. Small numbers of immatures regularly wander inland in summer, especially in the Southwest (Peterson Multimedia Guides, http://www.petersononline.com/birds/month/brpe/index.html).

Eastern Brown Pelicans occur year-round along both the Gulf coast. Individuals utilize the coast for resting and foraging, and are typically found in the nearshore and washover habitats. Some individuals migrate south during the winter months and return during the breeding season. Brown Pelicans forage along the Gulf beach shoreline searching for fish near the surface of the water.

Brown Pelicans are generally found along the Gulf beach tide line in the morning hours and along the bay shoreline and washover channels in the afternoons. When observed in the washover channels, Brown Pelicans were generally associated with Double Crested Cormorants, gulls, and terns.

Critical Habitat:
No critical habitat has been designated for this species.

Potential Effects of Proposed Project:
The action area includes about 2 linear miles of Gulf beach habitat that is preferred by the Eastern Brown Pelican. However, the project area does not include any habitat utilized by this species.

Direct effects of the proposed project are associated with the construction activities associated with dredging and production activities and will occur only within the action area.

This vehicular traffic from construction equipment will displace Brown Pelicans causing them to take flight and either fly along the shoreline to another suitable location or fly offshore. This displacement will be temporary since shorebirds disturbed by park visitors are generally seen landing a short distance away and continuing to perform their pre-disturbance behavior.

No indirect effects of the proposed project are thought to occur.

Conservation Measures:
Construction traffic associated with the proposed project is directed to drive above the tide line. This area of the beach is generally farther away from the shorebirds that are found on the Gulf beach including Brown Pelicans. Additionally, construction equipment associated with this project will be grouped together prior to entering the beach and limited to no more than 15 mph despite a maximum posted speed limit of 25 mph. This should limit the amount of disturbance by limiting the disturbance to fewer instances. For example, instead of five trucks spaced a mile apart and therefore displacing an individual bird five times, the five trucks are grouped together so the individual is displaced only once.

Conclusion:
Based on the preceding analysis, the overall conclusion of the evaluation is that the proposed project is not likely to adversely affect the Eastern Brown Pelican in either the project or action areas.

4.1.2.4 Piping Plover

Biology and Ecology:
The Piping Plover (Charadrius melodus), one of the least common members of the plover family is considered threatened. The population is currently estimated to be approximately 1400 pairs (USFWS, http://pipingplover.gws.gov/overview.html).

The Piping Plover is a migratory shorebird, that breeds from Nova Scotia south to North Carolina and winters along the Gulf Coast from Florida to Mexico, along the Atlantic Coast from Florida to North Carolina, and in the Caribbean. They are found on sandy beaches, lakeshores, dunes, and often well above the water line (Sibley, 2000).

Piping Plovers breed along prairie rivers and on alkali wetlands of the Northern Great Plains, sandy beaches along Great Lakes shorelines, and Atlantic coast beaches. These birds nest in shallow depressions built in the sand with both parents incubating the eggs and exhibiting a monogamous mating system. Breeding generally occurs between March and August with both fledglings and parents leaving the nest by September. It is clear that direct interference of nests by vehicles, humans, and dogs significantly affects breeding success (TPWD, http://tpwd.state.tx.us/nature/ending/birds/piplover.htm). Piping Plovers disturbed during nesting by flooding or other disturbance may abandon the nest and establish an additional nest in the vicinity at a new location (USFWS, http://pipingplover.gws.gov/overview.html).

Piping Plovers forage mostly on benthic invertebrates, insects, and crustaceans found within the inter-tidal areas of ocean beaches, wash over areas, mudflats, sand flats, wrack lines, and shorelines of coastal ponds, lagoons or salt marshes. Piping Plovers have been documented defending feeding territories.

Critical Habitat:
No critical habitat has been designated for this species.

Potential Effects of Proposed Project:
The project area does not include habitat utilized by the Piping Plover. However, the action area includes 2 miles of Gulf beach habitat that is used by this species for foraging and resting. No known nesting habitat exists within the action or project areas. TPWD performed a piping plover habitat survey prior to the construction of the 1987 and 1995 dredging, and did not find piping plover or piping plover habitat in the project area.

Direct effects of the proposed project are associated with the equipment traffic necessary for construction, dredging, and production activities and will occur only within the action area.

Vehicular traffic related to construction activities will displace Piping Plover causing them to take flight and either fly along the shoreline to another suitable location or fly offshore. This displacement will be temporary since shorebirds disturbed by park visitors are generally seen landing a short distance away and continuing to perform their pre-disturbance behavior.

Approximately 56 acres of beach habitat will be temporarily affected by the proposed construction activities. Six acres of potential habitat of the Piping Plover may be lost as a result of this project.

Indirect effects of the proposed project may include impacts to benthic invertebrate populations that occur within the inter-tidal area of the Gulf beach. Benthic invertebrates are the primary food source for Piping Plovers. Affects may include changes in interstitial spaces between sand grains necessary for benthic organisms and crushing caused by compaction of the substrate associated with construction equipment.

Conservation Measures:
Vehicular traffic associated with the proposed project is directed to drive above the tide line. This area of the beach is generally farther away from the shorebirds that are found on the Gulf beach including Piping Plover and helps reduce impacts to benthic invertebrate populations. Additionally, vehicles associated with this project are grouped together prior to entering the beach and limited to no more than 15 mph. This should limit the amount of disturbance by limiting the disturbance to fewer instances.

Conclusion:
Based on the preceding analysis, the overall conclusion of the evaluation is that the proposed project is not likely to adversely affect the Piping Plover.

4.1.2.5 Whooping Crane

Biology and Ecology:
The Whooping Crane (Grus americana) is a very large and endangered crane. This species stands nearly 1.5 meters (5 feet) tall with a wingspan of 2.3 meters (7.5 feet). Males weigh on average 7.5 kg (16.5 lbs), while females weigh about 6.5 kg (14.3 lbs). It is the tallest North American bird and the only crane species found solely in North America.[1] This species' name comes from its whooping call.

Adults are white; they have a red crown and a long, dark, pointed bill while immature Whooping Cranes are pale brown. They have long dark legs which trail behind in flight and a long neck that is kept straight in flight. Black wing tips can be seen in flight on adult Whooping Cranes. The only other very large, long-legged white birds in North America are the Great Egret, which is over a foot shorter and one-seventh the weight of this crane, and the Wood Stork, which is about 30% smaller than the crane. Both are also very different in structure.

These birds forage while walking in shallow water or in fields, sometimes probing with their bills. They are omnivorous and slightly more inclinced to animal material than most other cranes. In their Texas wintering grounds, this species feeds on various crustaceans, molluscs, fish (such as eel), berries, snakes and aquatic plants. Potential foods of breeding birds in summer include frogs, mice, voles, flightless birds, fish, reptiles, dragonflies, damselflies, other aquatic insects, crayfish, clams, snails, aquatic tubers, berries, grasshoppers, and crickets. Waste grain is an important food for migratory birds.

The Whooping Crane is endangered mainly as a result of habitat loss. At one time, the range for these birds extended throughout midwestern North America. In 1941, the wild population consisted of 21 birds. Since then, the population has increased somewhat, largely due to conservation efforts. Recent estimates suggest that there are about 373 Whooping Cranes living in the wild, and another 145 living in captivity. The Whooping Crane is still one of the rarest birds in North America.

Their breeding habitat is the muskeg of the taiga; the only known remaining nesting location is Wood Buffalo National Park in Canada and the surrounding area. They nest on the ground, usually on a raised area in a marsh. The female lays 1 to 3 eggs, usually in late-April to mid-

May. The blotchy, olive-colored eggs average 62.4 mm (2.5 inches) in breadth and 98.4 mm (4 inches) in length, and weigh about 189 grams (6.7 oz). The incubation period is 29-35 days. Both parents brood the young, although the female is more likely to directly tend to the young. Usually no more than one young bird survives in a season. The parents often feed the young for 6-8 months after birth and the terminus of the offspring-parent relationship occurs after about 1 year.

Breeding populations winter along the coast of Texas near Corpus Christi on the Aransas National Wildlife Refuge, Matagorda Island, San Jose Island, and portions of the Lamar Peninsula and Welder Point, which is on the east side of San Antonio Bay.

Among the many potential nest and brood predators include American Black Bear (Ursus americanus), Wolverine (Gulo luscus), Gray Wolf (Canis lupus), Red Fox (Vulpes fulva), Lynx (Lynx canadensis), Bald Eagle (Haliaeetus leucocephalus), and Northern Raven (Corvus corax). Adults have very few predators, as even eagles are unlikely to be able to take one down. The Bobcat is the only natural predator known to be both powerful and stealthy enough to prey on adult Whooping Cranes away from their nesting grounds.

Critical Habitat:
Critical habitat for the Whooping Crane is located within the Aransas National Wildlife Refuge.

Potential Effects of Proposed Project:
The action and project area for the proposed project is located within the wintering critical habitat of the Whooping Crane.

Whooping Cranes utilize the Aransas National Wildlife Refuge from October 15th through April 15th. The proposed activities will occur outside this time frame; therefore, no direct effects to the Whooping Cranes will occur. However, the proposed project area is designated as critical habitat for the Whooping Crane. In recent years, there have not been any Whooping Crane sightings in the vicinity of the proposed project; therefore, no indirect effects are expected to occur as a result of the proposed project.

Conservation Measures:
Because the project activities will occur outside the Whooping Crane wintering season, no additional conservation measures are needed.

Conclusion:
Based on the preceding analysis, the overall conclusion of the evaluation is that the proposed project is not likely to adversely affect the Whooping Crane in either the project or action areas.

4.1.3 Mammals

4.1.3.1 Gulf Coast Jaguarundi

Biology and Ecology:
The Gulf Coast Jaguarundi (Herpailurus (=Felis) yagouaroundi cacomitli) is slightly larger than a domestic cat, weighing 8 - 16 pounds. Their coat is a solid color; either rusty-brown or charcoal gray.

Jaguarundis move in a quick weasel-like manner. They eat birds, rabbits, and small rodents, hunting during early morning and evening. Although Jaguarundis hunt mostly on the ground, they also climb trees easily and have been seen springing into the air to capture prey. Historical accounts from Mexico suggest that Jaguarundis are also good swimmers and enter the water freely. They are solitary (live alone) except during the mating season of November and December. Jaguarundis are active mainly at night, but also move around during the day, often going to water to drink at midday. They live 16 to 22 years in captivity.

Jaguarundis are endangered because the dense brush that provides habitat has been cleared for farming or for the growth of cities. Jaguarundis still exist in Mexico, but they are now very rare in Texas. People in the Lower Rio Grande Valley are working together to plant native shrubs and restore habitat for the Jaguarundi, Ocelot, migrating songbirds, and other animals.

The Jaguarundi is found in dense, thorny shrublands.
Critical Habitat:
No critical habitat has been designated for this species.

Potential Effects of Proposed Project:
While the site does contain elements similar to those found within ocelot habitat (dense brush and mesquite), there is no known history of the ocelot within the proposed project site. Therefore, no direct or indirect effects of the proposed project are likely to occur.

Conservation Measures:
Because no potential affects to the Gulf Coast Jaguarundi will occur from this proposed project, no additional conservation measures are needed.

Conclusion:
Based on the preceding analysis, the overall conclusion of the evaluation is that the proposed project is not likely to adversely affect the Gulf Coast Jaguarundi in either the project or action areas.

4.1.3.2 Ocelot

Biology and Ecology:
The Ocelot (*Leopardus (=Felis) pardalis*) are members of the cat family. Their fur is a creamy color covered with reddish-brown spots outline in black. They have two stripes extending from the inside corner of their eyes and over the back of their head. Ocelots are about 30 - 41 inches long and weigh 15 - 30 pounds.

Ocelots are carnivores whose diet consists primarily of rabbits, small rodents, and birds. They hunt at night and spend the day resting in thick brush. Ocelots live within an area (home range) of about 1 to 4 square miles. Females prepare a den for their kittens in thick brush. Mothers leave at night to hunt, but spend each day with their kittens at the den. The kittens begin hunting with their mother when they are about 3 months old. They stay with her until they are about a year old. Ocelots can live 20 years in captivity.

Ocelots are endangered because their habitat (the thick brush where they live) has been cleared for farming and growth of cities. Only about 30 to 35 Ocelots live in the shrublands remaining at or near the Laguna Atascosa National Wildlife Refuge near Brownsville, Texas. In 1995 it was estimated that 80 to 120 individuals lived in Texas.

Dense, thorny, low brush such as spiny hackberry, lotebush, and blackbrush offer the Ocelot the best habitat.

Critical Habitat:
No critical habitat has been designated for this species.

Potential Effects of Proposed Project:
While the site does contain elements similar to those found within Ocelot habitat (dense brush and mesquite), there is no known history of the ocelot within the proposed project site. Therefore, no direct or indirect effects of the proposed project are likely to occur.

Conservation Measures:
Because no potential affects to the Ocelot will occur from this proposed project, no additional conservation measures are needed.

Conclusion:
Based on the preceding analysis, the overall conclusion of the evaluation is that the proposed project is not likely to adversely affect the Ocelot in either the project or action areas.

5.3 Salinity Assessment

Historic salinity levels in Mesquite Bay were evaluated to determine the effect of opening Cedar Bayou on the essential fish habitat within the bay system. There exists approximately 700 acres of essential fish habitat within Mesquite Bay that could potentially be adversely affected by changes in salinity within the bay. Increases in salinity within the bay could result in an increased risk of dermo in existing oyster reefs. Dermo flourishes in waters where the temperature is above 20 °C and the salinity is above 20 ppt.

To evaluate the potential risk to essential fish habitat as a result of increased salinity levels within the bay as a result of opening Cedar Bayou, salinity records from the 1975 to the present for Mesquite Bay were obtained from Texas Parks and Wildlife. A time series of the available data obtained from Texas Parks and Wildlife is presented in Figure 1. During the time period of available data, the salinity range was between 5 and 45 ppt, with an average salinity between 20 and 25 ppt. As shown in the Figure, no clear trend exists between the opening of Cedar Bayou and changes in the salinity in Mesquite Bay, as during the 1987 opening, the salinity falls to around 5 ppt from about 20 ppt, while during the 1995 dredging, the salinity varies between about 15 ppt to about 27 ppt.

Figure 1 also shows the river flow data of the Guadalupe River measured at Victoria, TX. The Guadalupe River flows into San Antonio Bay which connects directly to Mesquite Bay. The fluctuations in salinity in Mesquite Bay follow the fluctuations in river inflow. Periods of increasing and high river inflow are followed by periods of decreasing and low salinity, while periods of decreasing and low river inflow are followed by high and increasing salinity levels. This indicates that the amount of freshwater entering Mesquite Bay via fresh-water inflows like rivers and rainfall control the salinity, apparently to a much larger extent than would the opening of Cedar Bayou, if any.

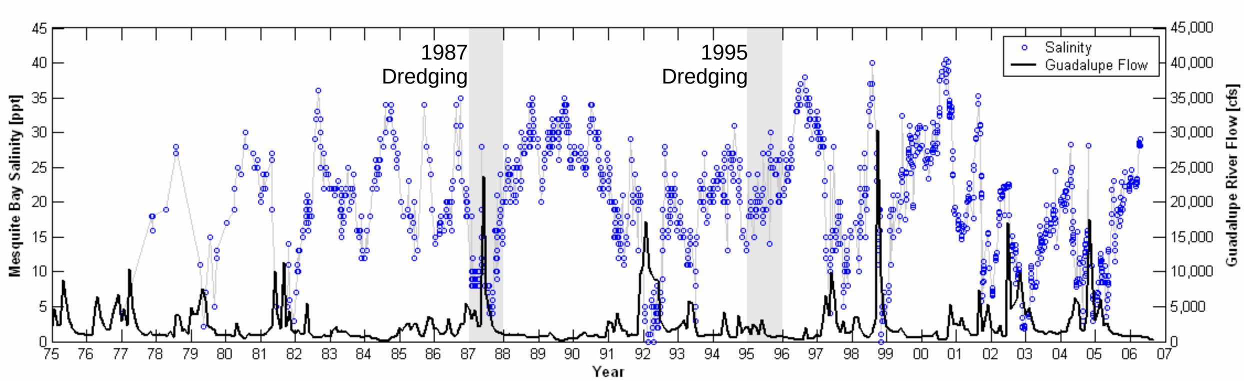

Figure 1. Historic salinity data obtained from Texas Parks and Wildlife and measured flow rate from the Guadalupe River at Victoria, TX from USGS.

To further explore the relationship between river flow rate and the salinity, the monthly mean flow rate (annual ensemble average flow) was removed from the Guadalupe River flow rate. The resulting quantity, called the de-trended flow rate, represents flow rates departure from average conditions. Negative de-trended flow rates indicate periods of low flow or drought, and positive de-trended flow rates indicate periods of high flow or floods.

After both the 1987 and 1995 dredging event, the salinity increases to approximately 30 ppt for a few years. While one may correlate this with the opening of Cedar Bayou, both periods are actually times of very low flow rate in the Guadalupe River. This is illustrated more clearly in Figure 2, which shows the Mesquite Bay salinity, de-trended Guadalupe River flow rate, and the net flow rate. The net flow rate is the cumulative de-trended flow from the Guadalupe River, where decreasing net flow indicates cumulative flow rates less than average (drought) and increasing net flow indicates cumulative flow rates greater than average (flood). The floods occur over a short period of time while the droughts occur over several years, and time of increasing drought correlate to increasing salinity levels in the Bay.

After both the 1987 and 1995 dredging events, the net flow rate decreases over several years, while at the same time, the salinity increases. This trend (decreasing net flow vs increasing or high salinity) is present throughout the data set, as is the converse (increasing net flow vs decreasing or low salinity). The fact that the salinity is most controlled by the freshwater inflow rate and apparently did not respond to the opening of Cedar Bayou in 1987 or 1995 lead to the conclusion that Mesquite Bay salinity will not be affected by the opening Cedar Bayou.

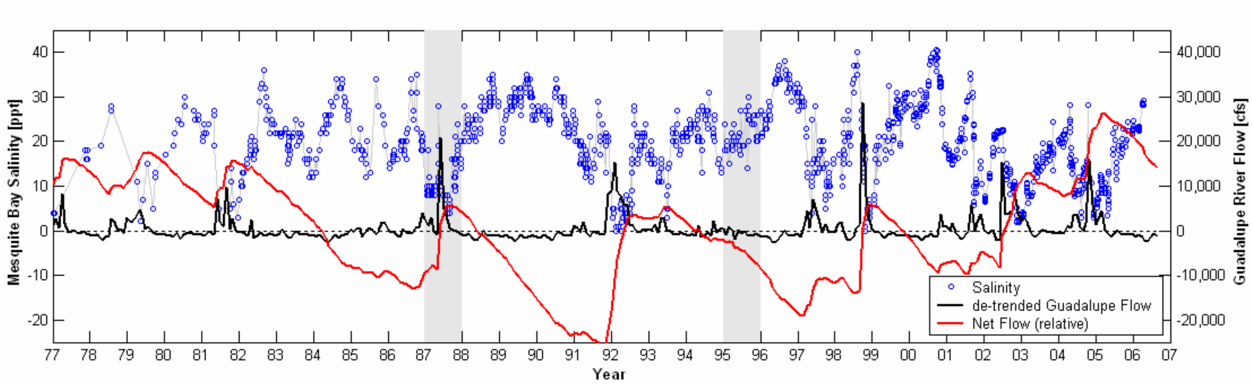

Figure 2. Salinity in Mesquite Bay, de-trended flow rate from the Guadalupe River, and net Guadalupe River flow rate.

6 Monitoring Plan

A monitoring plan was developed to evaluate and provide a mechanism to better understand the performance of the Cedar Bayou/Vinson Slough Hydraulic Restoration Project. The goal of the monitoring plan is to evaluate the changes to Cedar Bayou and Vinson Slough over a 5 year period.

The objectives of the monitoring plan are:

1. Evaluate the performance of Cedar Bayou/Vinson Slough by measuring the stability of the dredge cut, flow discharge through the bayou, and the size and functionality of the ebb delta.
2. Identify maintenance dredging requirements.
3. Determine project performance relative to success criteria developed for this project.

6.1 Success Criteria

The criteria of success for the Cedar Bayou/Vinson Slough project were developed in coordination with the project partners prior to the start of the engineering analysis and include:

1. Maintain Cedar Bayou and Vinson Slough both as an open inlet
2. Minimize maintenance requirements for Cedar Bayou and Vinson Slough
3. Increase flow between Mesquite bay, wetlands and the Gulf of Mexico though Cedar Bayou and Vinson Slough
4. Causes no adverse effects to adjacent beaches or properties

6.2 Data Collection

To determine the success of the project, the monitoring effort will include tasks related to evaluating the criteria of success. All data collection tasks will be conducted prior to construction and six months, one-year, two-years, three-years, four-years and five-years post construction. These tasks will include the following data collections efforts:

1. Site visit and ground level photography

2. Aerial photography
3. Topographic and bathymetric surveys
4. Flow discharge measurements

Site Visit and Ground Level Photography
Site visits and ground level photography of Cedar Bayou and Vinson Slough are required to document ground level changes to Cedar Bayou, Vinson Slough and the ebb delta. The observations and photographs will be used to assess annual storm damage to the pass and details of the pass's morphology over the five year monitoring period.

Ground level photography stations will be identified to maintain an accurate reference for comparison between photographs. Photography will consist of digital photographs, using the same high resolution camera, lens and setup to minimize inconsistencies between images. A qualitative analysis of the observations and ground level photographs will consist of documenting visual changes in turbidity, waterline, ebb delta location, channel width, channel slopes, and morphology of the pass.

Aerial Photography
Aerial photography will be required to determine shoreline and channel changes near Cedar Bayou and Vinson Slough and to validate if hypotheses of morphology and shoreline change in the project vicinity are correct

Aerial photos will coincide with a low tide events of similar elevations, such as a low tide that coincides with the MLLW elevation. The aerial photographs should include all of Vinson Slough, Cedar Bayou and the ebb delta and approximately 1 mile to the northeast and southwest of the mouth of Cedar Bayou. The photo should be conducted from the same altitude and plane orientation and have a minimum quality of 1 pixel per half a meter. The image will be rectified to the coordinate system NAD83 UTM Zone 14 meters for ease of comparison between photographs.

A qualitative and quantitative analysis of the aerial photographs will be conducted and will consist of documenting and measuring channel width and shoreline changes along the project site, documenting annual storm damage and interpreting morphologic changes that are not evident from the ground.

Topographic and Bathymetric Surveys
Surveys are required to track changes in alignment, volume and elevation of the channel and ebb delta. The topographic and bathymetric survey data will be used to determine the project service life, volumes, and schedule maintenance events, if any.

Topographic surveys will be conducted according to Corps of Engineers standards, and extend seaward to an elevation of -20ft NAVD88. The topographic survey will be taken in 500ft increments along the temporary baseline created by Frontier Surveying in 2006. The survey will be conducted using NAD83 State Plane (TX South Central 4204) feet and NAVD 88 feet horizontal and vertical datums, respectively.

To track the volume and elevation changes along the channel and ebb delta, each survey will be compared to the previous surveys. Volumetric changes and channel flow area changes will be determined based on the depths and volume changes along the pass and ebb delta.

Flow Discharge Measurements
Flow discharge measurements are required to determine how the excavation of Cedar Bayou and Vinson Slough changed the flow through Cedar Bayou and Vinson Slough. Flow discharge measurements will be used to determine the success of the project.

The flow along Cedar Bayou will be recorded using one or a combination of three methods.

7.1.1 The first method would utilize Acoustic Doppler Current Profilers (ADCPs) placed along the northern section of Cedar Bayou and the northern section of Vinson Slough. Measurement would take place for a minimum of 2 weeks.

7.1.2 The second method would incorporate three water surface elevation gages: one placed along the southern section of Cedar Bayou at the Gulf mouth, one at the northern section of Cedar Bayou near Mesquite Bay, and one at the bayward end of the Vinson Slough Channel. Using this option, the flow rate through Cedar Bayou will be determined by measuring the difference in water elevation between the northern and southern section of Cedar Bayou.

7.1.3 The third method would measure flow transects using an ADCP at the southern section of Cedar Bayou at the Gulf mouth, the northern section of Cedar Bayou near Mesquite Bay, and one at the bayward end of the Vinson Slough Channel. Flow transects will be measured over peak spring ebb and peak spring flood tides, and span at least 2 hours on either side of the peak flow time. Ideally, all three locations would be measured over the same time period, which would require 3 ADCP gages. This method would be best in conjunction with methods two.

Flow discharge measurements will be performed utilizing the same measurement equipment, setup and procedure to reduce inconsistencies between data collection efforts. All measurements should be recorded during similar seasons and similar tidal cycles to reduce errors related to seasonal and tidal differences. Flow discharge measurements will be compared to preconstruction and post construction measurements to determine the discharge rate of change and whether the construction project was successful in increasing flow velocities in Cedar Bayou.

6.3 Evaluation of Project Performance and Reporting

The long-term success of the project will be evaluated in light of the criteria set forth in Section 2 through the monitoring activities. Results of each monitoring effort will be processed using standard procedures and analysis. Monitoring reports will be submitted one month after each monitoring event and will include all collected data, a comparative analysis, and recommendations for maintenance (if needed). At the conclusion of the 5-year monitoring program, a comprehensive report will be compiled that includes a long-term maintenance plan for Cedar Bayou and Vinson Slough.

7 Construction BMPs

Best Management Practices will be utilized during the construction of the project in accordance with Texas Commission on Environmental Quality (TCEQ) standards. Beach areas to receive excavated material will utilize temporary erosion control measures such as silt fencing and containment systems (berms and dikes) around the placement areas if the placed material is experiencing erosion and runoff.

Cedar Bayou/Vinson Slough Habitat Restoration – CEPRA IV Project

Texas Commission on Environmental Quality

Tier II
401 Certification Questionnaire

Cedar Bayou/Vinson Slough Habitat Restoration Project
Corps Permit No. ___________

I. Impacts to surface water in the State, including wetlands

A. What is the area of surface water in the State, including wetlands, that will be disturbed, altered or destroyed by the proposed activity?

Based on design calculations, 58.5 acres of existing tidal channel and beach will be dredged or excavated, 67 acres of nearshore Gulf bottom will be filled, and 18.5 acres of beach will be filled during the proposed project, for a total of 144 acres to be modified. These 144 acres may be affected during project construction; after construction the disturbance will cease. No wetlands will be disturbed by the project activities, as the selected alternatives were designed to prevent disturbance of vegetated areas and wetlands.

B. Is compensatory mitigation proposed? If yes, submit a copy of the mitigation plan. If no, explain why not.

No mitigation is proposed for the Cedar Bayou/Vinson Slough Habitat Restoration. During construction the project may displace or temporarily disturb open waters of the Gulf of Mexico. The project does not impact wetlands and provides added stability for the existing dynamic conditions in Cedar Bayou and Vinson Slough, no compensatory mitigation is warranted. In addition, the dredging of a hydraulic connection though Vinson Slough will help restore the historical circulation to Cedar Bayou and Vinson Slough. Therefore, the project has a net positive impact for the local environment.

C. Please complete the attached Alternatives Analysis Checklist.

The completed alternatives analysis checklist is attached.

II. Disposal of waste materials

A. Describe the methods for disposing of materials recovered from the removal or destruction of existing structures.

Removal or destruction of existing structures will not occur during this project.

B. Describe the methods for disposing of sewage generated during construction. If the proposed work establishes a business or a subdivision, describe the method for disposing of sewage after completing the project.

Temporary sanitary facilities will be required and will be provided by the contractor during construction.

C. For marinas, describe plans for collecting and disposing of sewage from marine sanitation devices. Also, discuss provisions for the disposing of sewage generated from day-to-day activities.

A marina is not a component of this project.

III. Water quality impacts

A. Describe the methods to minimize the short-term and long-term turbidity and suspended solids in the waters being dredged and/or filled. Also, describe the type of sediment (sand, clay, etc.) that will be dredged or used for fill.

Best Management Practices, defined by the Texas Commission on Environmental Quality (TCEQ) for soil stabilization and turbidity, will be incorporated into the project to maintain the water quality on site. Every effort will be taken to maintain water quality in accordance with the TCEQ water quality standards; however, during dredging and construction of the delta, turbidity standards may be temporarily exceeded.

Excavation operations will be performed in a method that minimizes disturbances or siltation of the neighboring waters and bottom. All channels will be excavated using a hydraulic dredge. Hydraulic dredging utilizes a suction cutterhead that confines the sediment removal activities to the bay bottom rather than the entire water column, such as would be the case during bucket (clam-shell) dredging; therefore suspended sediments at the dredging area are minimized. To further reduce the risk of high turbidity during the dredging operation, the native materials will be removed by placing the intake of the dredge at or below the surface of the material.

The proposed dredged material is primarily composed of granular sediments. A geotechnical investigation has shown the sediment in the area to be dredged is composed of sand with 2% to 5% fines (silt and clay). The majority of the dredged sediments will quickly fall out of suspension a short distance from the discharge end of the hydraulic dredge pipeline. Containment methods such as, but not limited to, silt fencing and temporary containment dikes will be utilized, as needed, to address this short term turbidity increase during the construction of the ebb delta. However, as construction will be occurring in the nearshore surf zone of the Gulf, the turbidity outside the placement area is not expected to be larger than the turbidity of surroundings.

B. Describe measures that will be used to stabilize disturbed soil areas, including: dredge material mounds, new levees or berms, building sites, and construction work areas. The description should address both short-term (construction related) and long-term (normal operation or maintenance) measures. Typical measures might include containment structures, drainage modifications, sediment fences, or vegetative cover. Special construction techniques intended to minimize soil or sediment disruption should also be described.

TCEQ Best Management Practices for soil stabilization will be observed. If turbidity problems are noted during construction, appropriate control measures such as temporary levees, berms, or silt fences will be implemented as appropriate.

Construction equipment will be limited to working on areas that are not vegetated in order to minimize disruption of the existing habitats.

C. Discuss how hydraulically dredged materials will be handled to ensure maximum settling of solids before discharging the decant water. Plans should include a calculation of minimum settling times with supporting data (Reference: Technical Report, DS-7810, Dredge Material Research Program, GUIDELINES FOR DESIGNING, OPERATING, AND MAINTAINING DREDGED MATERIAL CONTAINMENT AREAS). If future maintenance dredging will be required, the disposal site should be designed to accommodate additional dredged materials. If not, please include plans for periodically removing the dried sediments from the disposal area.

Excavated material that is to be deposited in the Gulf to create the ebb delta is sand with a median grain size diameter of approximately 0.15mm, with a silt and clay content of no more than 5%.

The placement procedure for material dredged from the Cedar Bayou main channel and Vinson Slough will be conducted to maximize the fall out of suspended sediments within the desired ebb delta fill area. Material discharged from the dredge pipeline settles through the water column and deposits on the bottom of the ebb delta. The coarser dredged materials will remain at the site and disperse based on the material’s physical properties and local hydrodynamics (tide current velocity and direction) of the placement site. Dredged material placement will be staged relative to the tide direction in order to maximize the settlement of dredged materials within the defined fill area. Specified measures will be implemented to ensure turbidity levels during construction remain within that allowed beyond the prescribed mixing zone.

D. Describe any methods used to test the sediments for contamination, especially when dredging in an area known or likely to be contaminated, such as downstream of municipal or industrial wastewater discharges.

No contamination testing is planned. Based on historical evidence, the hydraulic study and sediment borings, the material in Cedar Bayou and Vinson Slough is beach quality sediment that has been deposited along the mouth of Cedar Bayou either manually as dredge disposal sites in both 1987 and 1995 or by natural processes during storm events. The material is natural beach sand transported to the site naturally, and therefore, is not expected to be contaminated.

Tier II
Alternatives Analysis Checklist

I. Alternatives

A. How could you satisfy your needs in ways which do not affect surface water in the State?

The project goals are to open Cedar Bayou and minimize maintenance requirements for keeping the pass open. To accomplish the goal of opening the pass, the surface waters of the state must be affected.

To address the goal of opening the pass and minimizing maintenance requirements, engineering analyses were performed to quantify the hydraulic processes that control the opening and closing of the pass, wave transformation, tidal circulation, and to identify alternatives for opening the pass. The alternatives were evaluated based on their ability to maintain Cedar Bayou as an open pass with minimal maintenance requirements. The selected alternative is the result of an extensive analytical and numerical modeling analysis that analyzed the performance of several alternatives. This alternative was selected because it minimizes the processes that close Cedar Bayou by increasing the flow rate within the pass by 250%, connects Cedar Bayou to Vinson Slough, and creates a large ebb current velocity at the mouth of the pass.

The no-action alternative is the only alternative that does not affect the surface waters of the State. If no action is taken, the Cedar Bayou and Vinson Slough will continue to remain closed.

B. How could the project be re-designed to fit the site without affecting surface water in the State?

Dredging Cedar Bayou and Vinson Slough is a fundamental part of the alternative, as it reopens the pass and provides an important hydraulic connection between the passes and the Gulf of Mexico. It is possible that rather than depositing dredged material to create the ebb delta the material could be exported to an upland site, but this would reduce the positive effects of the delta which are to maintain wave driven sediment transport from plugging the mouth of the pass. This would increase the possibility of having to dredge the mouth of the pass more frequently.

C. How could the project be made smaller and still meet your needs?

No opportunities were identified that could realize size reduction of the project and still meet the project's purpose and need. Alternatives of various sizes and layouts were analyzed. The proposed project is the result of fine-tuning the geometric parameters of the dredge channel and fill placement, which allows the project goals to be met while minimizing the project size. The success of the project is judged by how long the channel remains open. Shown in the hydraulic and alternatives analysis (see attached Restoration of Cedar Bayou and Vinson Slough Phase 1, Technical Feasibility: Hydraulic and Alternatives Analysis; also referred to as the Phase 1 report), the proposed alternative provides the maximum flow rate for the smallest possible dredge cut. Dredging Cedar Bayou and Vinson Slough will increase the flow rates through the channels, helping them to remain open. Restoring the hydraulic connection between Vinson

Slough and Cedar Bayou is a vital part of the process that will help to maintain Cedar Bayou as an open channel. The construction of the ebb delta also seen on historical maps is also imperative in that it reduces sedimentation of the channel during flood conditions by reducing ebb currents near the mouth of Cedar Bayou.

D. What other sites were considered?

1. What geographical area was searched for alternative sites?

The proposed project is intended to open a specific, existing channel as designated by the project sponsors; there are no alternatives sites where the project could be located.

2. How did you determine whether other non-wetland sites are available for development in the area?

N/A

3. In recent years, have you sold or leased any lands located within the vicinity of the project? If so, why were they unsuitable for the project?

N/A

E. What are the consequences of not building the project?

The purpose of the proposed project is to restore the historical hydraulic connection between the Gulf of Mexico and Cedar Bayou and Vinson Slough in the Texas Bend Bay System. If no action is taken, Cedar Bayou will close, and Vinson Slough will not regain its connection with Cedar Bayou and the Gulf of Mexico. It is expected that the proposed project will increase flushing of the bays.

II. Comparison of alternatives

A. How do the costs compare for the alternatives considered above?

A detailed alternatives evaluation was performed to determine the preferred alternative. The selected alternative meets the performance, cost and longevity requirements defined by the project partners, while minimizing the dredged volume and area disturbed by the construction of the project. A more detailed description of the alternatives analysis is given in the attached Phase 1 report, and is summarized in Sections 3 and 4 of the Project Description of the permit application.

B. Are there logistical (location, access, transportation, etc.) reasons that limit the alternatives considered?

Alternatives were limited to the specific project site – the historic Cedar Bayou and Vinson Slough channels. Also the alternatives were limited to those that could maintain Cedar Bayou as an open channel while minimizing maintenance requirements and minimizing impacted areas. Alternatives were also limited by a fixed project budget.

C. Are there technological limitations for the alternatives considered?

No – the technological considerations associated with the various project alternatives will be described and detailed in the final design memorandum and project plans.

D. Are there other reasons certain alternatives are not feasible?

N/A

III. If you have not chosen an alternative which would avoid impacts to surface water in the State, please explain:

A. Why your alternative was selected, and

The selected alternative meets the objectives of the project sponsors and positively impacts Cedar Bayou and Vinson Slough and the local environment by restoring the historic hydraulic connection between the Gulf of Mexico and Cedar Bayou and Vinson Slough in the Texas Bend Bay System.

B. What do you plan to do to minimize adverse effects on the surface water in the State impacted.

BMP practices will be utilized during excavation and placement of the fill as required, such as silt curtains and fences or temporary fill containment berms. Activities will be limited to a confined work space and careful construction practices will be followed to ensure that any disturbance is confined only to the area needed to complete the project.

IV. Please provide a comparison of each criteria (from Part II) for each site evaluation in the alternatives analysis.

N/A – the project is limited specifically the historic Cedar Bayou and Vinson Slough Channels.