Texas Coastal Management Program

Section 309 Assessment and Strategies Report

2006 - 2010

PREPARED BY
THE TEXAS GENERAL LAND OFFICE

Introduction

The National Oceanographic and Atmospheric Administration (NOAA) approved the Texas Coastal Management Program (CMP) on January 10, 1997. The Texas General Land Office (GLO) is the lead administrative agency for the CMP. Section 309 of the Coastal Zone Management Act (CZMA) allocates funds to encourage states and territories with federally approved coastal management programs to develop projects that will effect program enhancements in one or more of the following nine enhancement areas: wetlands, public access, coastal hazards, cumulative and secondary impacts, energy and government facility siting, marine debris, ocean resources, special area management plans, and aquaculture. As a condition of receiving grant funds under §309, Texas must submit a §309 Assessment and Strategies Report (Report) to NOAA's Office of Ocean and Coastal Resource Management (OCRM) every five years. The Report presents an analysis for each enhancement area, identifies needs, and outlines how the CMP plans to use §309 funds to address those needs over the next five years.

NOAA approved Texas' Report for 2001 – 2005 on July 30, 2001. In its 2001 Report, the Coastal Coordination Council (Council), the governing body of the CMP, identified four of the nine priority enhancement areas as being of high priority. These included wetlands, public access, cumulative and secondary impacts, and coastal hazards. The Council ranked the remaining five enhancement areas as low priorities to the state. In addition to the four high priority areas, the 2001 Report allowed for funds to be spent on projects that addressed conditions placed on the approval of the Texas Coastal Nonpoint Source Pollution Control Program (Coastal NPS).

On September 8, 2005, the Council revisited and approved the §309 priority rankings for 2006-2010. The Council elected to focus on the same four enhancement areas as in 2001, ranking wetlands, public access, cumulative and secondary impacts, and coastal hazards as high priorities. Energy and government facility siting and aquaculture were moved from low to medium priorities. Aquaculture was changed primarily in response to the U.S. Ocean Commission Report, which detailed the potential for large-scale growth of aquaculture activity, both in the coastal zone and the Gulf of Mexico. Energy and government facility siting was changed in response to the increase in proposed Liquefied Natural Gas (LNG) terminals in the U.S and the increasing interest in the development of infrastructure to support wind power. Ocean resources, marine debris, and Special Area Management Plans (SAMP) remain as low priorities.

This Report is separated into three components: Summary of Past §309 Efforts, 2001 – 2005; Enhancement Area Analyses; and Enhancement Strategies, Tier 1 and Tier 2. The summary component first provides a brief description of the projects undertaken with §309 funds from 2001-2005. The analyses component presents an up-to-date assessment and outlines needs for each of the nine enhancement areas. Lastly, the strategies component proposes projects to enhance each high-priority area approved by the Council for 2006-2010. Tier 1 projects represent those projects that the Council approved for first year funding. Tier 2 projects are included for future consideration by the Council.

There are six Tier 1 projects, including a project designed to support the implementation of the National Coastal Management Performance Measurement System (NCMPMS), a program aimed at quantifying the national impact of the CZMA. There are five Tier 2 projects.

While all projects described within this report will be considered for funding under §309 of the CZMA, they are not guaranteed of funding, nor is this report exclusive of projects to be approved for funding.

Wetlands

Armand Bayou Watershed Group

Armand Bayou is located adjacent to the western shoreline of Galveston Bay in the highly urbanized greater Houston area. It is an environmentally significant area that contains remnants of the region's original ecosystems, including wetlands, bottomland forest, and grass prairies. It is also one of the last bayous in the Houston area that is not channelized. The integrity of this valuable area is threatened by development within the watershed. The Council approved funds to create the Armand Bayou Watershed Working Group (ABWWG) to develop a comprehensive watershed management plan that would act as the blueprint to protect, preserve, and enhance the ecological integrity of the Armand Bayou watershed while improving the quality of life in the community.

Sediment Monitoring in Galveston Bay

This project is an ongoing, five-phased effort to reinstitute sediment load monitoring, conduct associated research, and develop sediment budgets for water bodies in the Galveston Bay system. Objectives include: characterizing the historic discharge and sediment data at two sites along the Trinity River, the main source of freshwater input to Galveston Bay; assessing changes in channel and floodplain morphology, alluvial sedimentation, and sediment delivery at the river mouth following completion of the Lake Livingston dam; evaluating the sediment inputs from upland erosion, tributaries, and bank erosion downstream of Lake Livingston; characterizing the channel and floodplain sediment above and below the lake and dam site; identifying the difference in sediment transport to the upper delta before and after the dam placement; and determining the sediment sources that could replenish the stream sediment supply that are near the river channel or in the lake. This information will help determine what steps are necessary to maintain the integrity of Galveston Bay. It will also assist in developing new policies and regulations for sediment/freshwater inflow to bays and estuaries.

Phases one and two of this study addressed the effects of the Lake Livingston dam on downstream processes, in particular the delivery of sediment to the lower Trinity River and the Trinity Bay estuary, and ultimately, Galveston Bay. In phases three and four (i.e. *Relative Importance of Fluvial and Non-Fluvial Sediment Sources in Galveston Bay*), the focus turned to identifying the major sediment sources for the Trinity River delta and Trinity Bay. Plans for the fifth phase are to resolve issues raised by results obtained during the first four phases of the project with respect to the effects of various human and natural controls on sediment transport and storage in the lower Trinity River. Phase five objectives include two carryovers from ongoing work as well as additional objectives: continued sediment monitoring with increasing focus on major tributaries Long King and Menard Creeks; additional sediment "fingerprinting" via magnetic susceptibility for the work currently underway; assessment of geomorphic changes in the past 50 years in Long King and Menard Creeks; evaluation of the effects of channel slope, flow, and water withdrawals from the Trinity River on sediment transport capacity in the lower river; examination of constraints imposed by geologic history and controls on geomorphic changes and sediment fluxes in the lower Trinity, particularly ancestral valley morphology and

bedrock control of channels; and determination of the role of Holocene sea level change in controlling sediment delivery to Trinity Bay and the Trinity River delta.

Status and Trends of Wetlands on Texas Barrier Islands
In response to increased pressure on Texas' coastal wetlands, the Council funded a series of studies to use historical data and recent aerial photographs supported by field surveys to determine spatial and temporal changes in marshes, mangroves, seagrass beds, tidal flats, and water bodies on barrier islands and peninsulas along the Texas coast. Project results will improve the understanding of wetland changes on Texas barriers, pinpoint wetlands threatened by erosion, subsidence, and other processes, and provide site-specific information for implementing restoration and protection projects.

Five studies were funded under this objective in the following areas: the upper Texas coast, including the Chenier Plain, Bollivar Peninsula, Galveston Island, Follet's Island, and Christmas Bay to Matagorda Bay; the Texas Coastal Bend, including San Jose, Mustang, and North Padre Islands; Padre Island National Seashore (PINS); and South Padre Island. Studies in the Chenier Plain, Texas Coastal Bend, and PINS are ongoing and results will be posted to the GLO's website upon completion. Results from the remaining study areas are available to the public and were presented at the *Coastal Zone '05* conference in New Orleans.

Monitoring Design Criteria and Biological Indicators for Seagrass Monitoring in the Coastal Bend Bays and Estuaries Program (CBBEP) Study Area
This project is an ongoing, two-phased effort to determine the critical physical and chemical environmental factors necessary for the restoration of seagrass beds in the lower Texas coast. It's objective is to identify the plant, water column, and landscape indicators that provide the most critical information on water quality criteria that is relevant to successful maintenance and growth of seagrasses. It will also allow investigators to generate data to assess the relative value of various indicators with respect to cost, inherent variability on spatial and temporal scales, and effort.

The project will focus on Redfish Bay in the Mission-Aransas estuarine system and utilize East Flats in Corpus Christi Bay as a reference site. Redfish Bay and East Flats support extensive seagrass meadows that contain all five species of seagrass common to the Texas coast (*Halodule wrightii, Ruppia maritime, Thalassia testudinum, Syringodium filiforme,* and *Halophila engelmanii*).

Public Access
City of Galveston Public Access
The City of Galveston revised its beach access plan in 2004, resulting in significant changes to access points within its jurisdiction. The Council approved funds to create and publish, for public distribution, maps of revised access points for the City of Galveston beaches in Galveston County. The new maps will illustrate all public beach access points and describe the type of access available at each location. The maps are available to the public on the City of Galveston's website and printed copies have been distributed throughout the city. In addition, new beach access signs, delineating new access points, have been designed, printed, and installed.

Cumulative and Secondary Impacts

Oyster Reef Mapping in Lavaca Bay

In the 2002 §303(d) list of impaired water bodies, approximately 20 bay segments in Texas were listed for not meeting oyster-use criteria due to bacterial contamination. Lavaca Bay, in Calhoun County, was included because the Department of State Health Services' (DSHS) Shellfish Safety Division had a prohibited classification for oyster harvesting. The prohibition is based on insufficient data to determine the commercial viability of oyster harvesting in Lavaca Bay.

A two-phased mapping project was approved by the Council for funding to determine the extent of oyster reefs within Lavaca Bay. Phase one funds were used to purchase a boat, outfit it, and begin collecting raw data using a side-scan sonar and a sub-bottom profiler. Phase two work included data analysis and the generation of associated maps of the bay system. The final report and map layers are available to the public on the GLO website.

Nueces Bay Zinc in Oyster Tissue Total Maximum Daily Load (TMDL) and *Nueces Bay/Inner Harbor Zinc Monitoring*

Two projects were funded to support the Texas Commission on Environmental Quality's (TCEQ) effort to develop a model to assess zinc in oyster tissue in support of a TMDL study for Nueces Bay. The first project, *Nueces Bay Zinc in Oyster Tissue TMDL*, had three objectives: (1) acquire existing data and information necessary to support modeling and assessment activities; (2) perform the modeling and assessment activities necessary to determine current and allowable loadings of the constituent (zinc) of concern; and (3) allocate the total loadings to appropriate pollutant sources. TCEQ is using this model to determine if a TMDL is feasible or if the source of zinc is a legacy pollutant. Since the project was completed, a draft Nueces Bay Zinc TMDL has been prepared and is currently undergoing an in-house review.

In summary, the TMDL determined 33 percent of the zinc load was derived from nonpoint sources and 67 percent was derived from point sources. The majority of the point source load (66 percent) was determined to result from once-through cooling process water taken from the Corpus Christi Inner Harbor by the Nueces Bay Power Station (Permit #WQ0001244-000) and discharged into Nueces Bay. The zinc load reduction focused on the controllable point sources with further investigations to determine the specific origins of the nonpoint sources.

The model developed by TCEQ took into account the significant amount of water (25 million gallons/day) that the Nueces Bay Power Station circulated between the Inner Harbor and Nueces Bay. Since the development of the model, however, the power station was idled in 2003. A second, two-phased project, *Nueces Bay/Inner Harbor Zinc Monitoring*, was initiated to determine what effects, if any, the idling of the power station had on zinc concentrations in the sediment and water column of Nueces Bay. This study is ongoing and results will be made available upon completion.

Armand Bayou TMDL

The Council approved funds to characterize the physical and biological factors controlling the complex diurnal oxygen signatures of Armand Bayou, a highly urbanized water body located in Houston, during the summer months. Two mechanisms had been proposed as probable causal factors for the low summertime dissolved oxygen (D.O.): eutrophication and reduced re-aeration

due to stratification. The objective of the study was to collect data to look for possible effects of both of these mechanisms on summertime D.O. The analysis and the raw data may be found in the final report on the GLO website.

Nitrogen and Phosphorous Concentrations in the Coastal Bend Bays
Prior to receiving conditional approval from NOAA of the Coastal NPS Program in July 2003, Texas had requested a dryland rowcrop exemption for the lower coast. The information Texas provided, however, was insufficient to justify the exemption. As a result, the Council approved funds to determine nitrogen and phosphorus concentrations in the Coastal Bend bays and estuaries. It involved the compilation of the existing nutrient database and related parameters; analysis of space-time distribution of nutrients in the Coastal Bend bays; acquiring and compiling existing sonde measurements of salinity, temperature and D.O.; reviewing agricultural loading estimates for the area, and reviewing the technical basis for NOAA "findings," used to deny the exemption request. This report was provided to NOAA for their use; however, NOAA determined that there still was not enough justification to grant the exemption, and it was denied in the conditional approval of the program.

Training for Local Governments on Best Management Practices
This project also addressed the Coastal NPS Program and was conducted after receiving conditional approval from NOAA. Under the urban management measures relating to roads, highways, and bridges, NOAA stated that Texas did not adequately address construction and maintenance of roadways that were not under the Texas Department of Transportation's jurisdiction or were not covered under the Phase I/II stormwater permitting requirements. To begin addressing these concerns, the Council approved funds for the Texas Transportation Institute to hold training courses for local governments on how to implement best management practices during road construction and maintenance projects.

Bacteria Source Tracking in Copano Bay
Copano Bay is listed on the state's 303(d) list of impaired waters for oyster harvesting. The DHSH and TCEQ were interested in determining where the contamination was originating from in order to develop a TMDL for Copano Bay. If the source were non-human in origin (as expected), DHSH could use the data to begin reviewing changes in oyster harvesting rules in Copano Bay. The Council approved funds for a two-phased project to determine the source of bacterial contamination in Copano Bay through bacteria source tracking.

Under phase one, two sampling events were analyzed. In the second phase, two additional sampling events were analyzed, and a final report was completed that summarized the four sampling events funded with Council funds and four sampling events that were analyzed using CBBEP funding. Both antibiotic resistance profiling and pulsed field gel electrophoresis results suggest a human/sewage contribution to fecal contamination of Copano Bay; wildlife and gulls, as assessed by antibiotic resistance profiling, were found to contribute relatively little contamination (in terms of *E. coli*) compared with human/sewage, cow, and horse; livestock appear to contribute to fecal contamination at many stations under certain environmental conditions, such as rainfall and high river water flow; and isolates identified as duck were found in areas known to be colonized by either migratory or resident ducks suggesting these birds contribute to fecal contamination of the bay. Additional studies are needed to examine loadings

and sources in the contributing rivers (Mission and Aransas Bays and Copano Creek). The final report has been forwarded to the DSHS for review and action. DSHS will determine if further action with regard to closing or opening the bay is warranted.

Bacteria Loadings Watershed Model in Copano, Port, and Mission Bays
The Council approved funds for the development of a bacteria loadings watershed model for Copano, Port, and Mission Bays. This project will apply a GIS bacteria loadings model previously developed for the Galveston Bay area to the Copano Bay watershed. The objective of the project is to quantify the bacteria loadings in the watershed, using a runoff model that incorporates land-use land-cover data, event meant concentrations (EMCs), precipitation data, digital elevation models, and other pertinent data, as deemed necessary. In addition, the project will incorporate results from the project *Bacteria Source Tracking in Copano Bay*.

This project will result in the identification of major bacteria sources in the watershed, quantification of the total bacteria loadings from the major sources, and an estimate of the load reductions necessary to achieve water quality standards in Copano Bay, and the Aransas and Mission Rivers. Results from the bacteria source tracking work will be incorporated to confirm the various sources of bacteria and to recommend implementation measures necessary to achieve the load reductions.

Oso Bay/Laguna Madre TMDL
The Council approved funds to collect additional water quality and biological data necessary for TCEQ to develop site-specific D.O. criteria for Oso Bay and the Laguna Madre. Four sites in Oso Bay (TCEQ stations 13442, 17118, 17119, and 17120) and six sites in the Laguna Madre were sampled for routine field parameters, 24-hour dissolved oxygen, and 5-day carbonaceous biochemical oxygen demand (CBOD5). In addition, a habitat assessment of the Laguna Madre was conducted, including benthic and nekton biological sampling. To date, TCEQ is still in discussions with EPA about the development of the site-specific criteria.

Laguna Madre Dissolved Oxygen TMDL
This project build upon work started in the *Oso Bay/Laguna Madre TMDL* project. Under the previous project, stations within the Laguna Madre were being used as reference sites for comparison with stations in Oso Bay, within the Corpus Christi/Nueces Bay complex. During this project, however, TCEQ found that these reference stations had D.O. problems of their own. Therefore, it was determined that additional D.O. monitoring was needed so that either a TMDL could be implemented for the Laguna Madre or that site-specific criteria for D.O. in the Laguna could be developed.

Primer on Urban Growth
In June 2005, the Council approved the use of surplus funds to develop an introductory booklet on urban growth issues. The object of the publication is to stress the importance of urban form and its impact both on environmental quality and quality of life. The publication focuses on imperviousness and the utility of decreasing imperviousness on a watershed scale. Environmentally, the publication stresses preservation of natural areas and the implementation of best management practices with an emphasis on low impact development.

The publication will put tools and resources into the hands of local municipal officials to illustrate the interrelationships of environmental and quality of life issues, thus facilitating informed decisions as their municipality grows. The message is similar to EPA's "Protecting Water Resources with Smart Growth."

Feasibility Study for Habitat Restoration Modification in the Arroyo Colorado
The Arroyo Colorado is a water body that has historically received most of its flow from the Rio Grande River. Currently, however, the primary source of flow is irrigation runoff and wastewater treatment plant discharge. These factors have contributed to the decline in both water quality (D.O.) and habitat. The Council approved funds to examine the issues necessary to achieve successful habitat restoration in the Arroyo Colorado. This project is an offshoot of the TCEQ's work on TMDLs for this water body and will result in a determination of what areas of the Arroyo Colorado are most appropriate to restore. The anticipated restoration will have a two-fold effect: portions of the Arroyo will be restored for wildlife; and the D.O. levels in the restored areas will be improved, which may decrease the need for a TMDL to be implemented.

Cedar Lakes Oyster Water Use Assessment
The Council approved funds to collect water quality data to provide adequate, up-to-date information to reassess the Cedar Lakes area for oyster use. Reassessment of the Cedar Lakes area will either support the DSHS's restricted classification of the shellfish growing area and the 303(d) listing or support an approved or conditionally approved classification and removal of the segment from the 303(d) list of impaired waters. If the restriction and the listing were supported, the next step for this project would be to develop a bacteria loadings model in pursuit of a TMDL that addresses the secondary and cumulative impacts to Cedar Lakes. If the segment is reclassified, as indicated by the second option above, then the segment would be removed from the 303(d) list, and no further action would be necessary.

Spotted Seatrout/Seafood Consumption Safety Study for Galveston Bay
The Council approved funds to support the DSHS analysis of spotted seatrout in the Galveston Bay complex for polychlorinated biphenyls (PCBs) to determine if PCB levels exceed DSHS's health-based assessment comparison values. Based upon the information collected, DSHS will make the determination if human health is at risk and will determine if fish consumption advisories are needed for Galveston Bay. This project will also determine if these areas should be listed on the state's 303(d) list. If it's determined that these areas stay on the 303(d) list, TCEQ will begin development of a TMDL to reduce the amount of PCBs in the water.

Matagorda Bay 24-Hour Dissolved Oxygen Monitoring to Support TMDL Development
The Council approved funds to support TCEQ's monitoring project to identify the causes of low D.O. values in Matagorda Bay/Powderhorn Lake, Tres Palacios Bay/Turtle Bay, Conn Brown Harbor, and Carancahua Bay. This will be accomplished by developing a TMDL for the impaired water bodies. These water bodies are included in the Draft 2004 Texas Water Quality Inventory and 303(d) list of impaired waters for non-support of aquatic life due to depressed levels of D.O. and high pH values. This project will address the secondary and cumulative impacts of point and nonpoint sources of pollution to the bay

Coastal Hazards

Texas Coastal Erosion Data Network

Texas A&M University at Galveston (TAMUG) received funds from the Council to create the Texas Coastal Erosion Data Network (TCEDN) (http://coastal.tamug.edu/). The TCEDN was created to provide a centralized clearinghouse for information about coastal erosion in Texas, including past and present projects, research, and web links. Through subsequent §306 grants, TAMUG has continued to update the information on the website about coastal erosion and has begun adding data on other coastal resources, such as oyster reefs.

Bolivar Flats and Big Reef Sand Survey

TAMUG received funds from the Council to conduct hydrographic and seismic survey work in the vicinity of Bolivar Roads, near Galveston Bay, to determine quantities of available beach nourishment sand. There are two areas of study: Big Reef (adjacent to the northeast end of Galveston Island) and Bolivar Flats, an accreting area on the north side of the north jetty. The GLO's Coastal Erosion Planning and Response Act Program (CEPRA) is using the results of this study to determine the most appropriate locations along Galveston County to conduct beach nourishment and erosion response projects.

Sand Source Survey

TAMUG received funds from the Council to investigate two potential sand sources called Sand Source Nos. three and four, identified in the report "Reconnaissance Geotechnical and Geophysical Investigations to Identify Offshore Sand Sources for Beach Nourishment in Galveston County, Texas" prepared by Coastal Planning and Engineering, Inc. in July 2004. TAMUG will focus on Sand Source Nos. three and four in order to quantify the potential volumes of sand for beach nourishment purposes. This project will include data collection, geophysical fieldwork and data generation, geologic and geophysical interpretation, surface grab samples and coring, and archeological and submerged structures investigation as part of a larger scale project under the CEPRA Program. TAMUG will prepare a final report with geologic, geophysical, and archeological interpretations and conclusions on the general location, estimated volumes, and distribution of the sand bodies in the area that may be used as potential sand sources for future beach nourishment projects.

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Enhancement Area Analyses

Wetlands

Section 309 Programmatic Objectives

I. Protect and preserve existing levels of wetlands, as measured by acreage and functions, from direct, indirect, and cumulative adverse impacts, by developing or improving regulatory programs.

II. Increase acres and associated functions (e.g., fish and wildlife habitat, water quality protection, flood protection) restored wetlands, including restoration and monitoring of habitat for threatened and endangered species.

III. Utilize non-regulatory and innovative techniques to provide for the protection and acquisition of coastal wetlands.

IV. Develop and improve wetlands creation programs.

Resource Characterization

1. Extent of coastal wetlands.
The following estimates are based on Moulton et. al., 1997 (Texas Coastal Wetlands: status and trends, mid-1950s to 1990s) and Texas Parks and Wildlife Department (TPWD), 1999 (Seagrass Conservation Plan for Texas). Seagrass status and trends data are in the Seagrass Conservation Plan for Texas (TPWD, 1999).

Wetlands Type	**Extent (acres & year of data)**	**Trends (± acres/year)**
Tidal	566,570 acres/1992	- 1,600 acres/year
Non-tidal		
Freshwater	3,323,282 acres/1992	- 4,082 acres/year
Publicly Acquired Wetlands	10,523 acres/2002 - 2005	+3,507 acres/year
Restored Wetlands	1,123 acres/2002 - 2005	+374 acres/year
Created Wetlands	4,736 acres/variable dates	
Other-Seagrass	235,000 acres/1994	Variable, depending on region

2. If information is not available to fill in the above table, provide a qualitative description of wetlands status and trends based on the best available information. Also, identify any ongoing or planned efforts to develop quantitative measures for this issue area. Provide explanation for trends.

Section 309 funds are currently being used to develop wetland status and trends information for all Texas barrier islands and peninsulas. Data that are currently available are for the central Texas coastal barriers from Matagorda Bay to San Antonio Bay (White et. al., 2002), for the

upper coast in the Galveston and Christmas Bay area (White et. al., 2002), and for the Freeport to East Matagorda Bay and South Padre Island areas (White et. al., 2005). These studies used 2001 or 2002 aerial photography to update the 1950s and 1979 National Wetland Inventory information, including information in the Moulton et al. (1997) report.

In general, on the upper coast, in the Galveston Island, Bolivar Peninsula, and Follett's Island areas, estuarine emergent marsh (salt and brackish marshes) had a total net loss of 3,833 acres from the 1950s to 2002. Since the mid-1950s, there has been a systematic net loss of about 17 percent of estuarine marsh habitat on barrier islands on the upper coast. Estuarine marshes on Galveston Island decreased by 32 percent and on Bolivar Peninsula and Follet's Island by about 10 percent from the mid-1950s to 2002. Non-tidal or freshwater, palustrine wetlands also decreased by 1,081 acres during the same time period. On the central coast, estuarine marshes increased by 380 acres between the 1950s and 2001, but palustrine wetlands decreased by 341 acres during the same time period. Losses of marshes in the Galveston Island and Bolivar Peninsula area on the upper coast were primarily caused by human-induced faulting and subsidence, development, and erosion. Gains in estuarine marshes in the Matagorda Bay area are at least partly the result of the creation of a delta from the diversion of the Colorado River into Matagorda Bay in the early 1990s. Marshes developed on sediment dredged from the diversion channel in the western arm of Matagorda Bay. In the Freeport to East Matagorda Bay area, estuarine marshes increased by 1,462 acres from the 1950s to 2002. Palustrine marshes also increased by 1,540 acres during the same time period. On South Padre Island, estuarine marshes were relatively stable while estuarine scrub/shrubs or mangroves increased from 30 acres in the 1950s to 230 acres in 2002. Wetland status and trends information for other barriers and peninsulas is currently being developed and should be available in 2006.

Status and trends information on freshwater, non-tidal wetlands in the lower Galveston Bay watershed has been developed for the Galveston Bay Estuary Program (GBEP) (Jacob and Lopez, 2005). According to Jacob and Lopez (2005), the lower Galveston Bay watershed lost at least 3.1 percent of its natural, freshwater wetlands between 1992 and 2002. Most of the loss occurred in Harris County, which lost at least 13 percent of its natural, freshwater wetlands, with over half of the loss occurring between 2000 and 2002. Development in Galveston, Ft. Bend, and Brazoria counties suggest similar losses in the next two to five years. In a similar study of estuarine and marine habitats in the lower Galveston Bay watershed, Webb (2005) estimated that 2,913 acres of estuarine emergent wetlands were lost between 1995 and 2002. Losses of estuarine marsh were primarily due to erosion and subsidence.

On the central coast, seagrasses increased only slightly, from 11,163 acres in the 1950s to 11,374 acres in 2001, for a net increase of 211 acres (White et. al., 2002). Seagrasses on the upper coast decreased dramatically, from 2,491 acres in the 1950s to 286 acres in 2002 (White et. al., 2004). The decrease was primarily the result of human-induced subsidence and sea level rise, excessive nutrients, tropical storms, and dredging. Recently, seagrasses are starting to recover as a result of wetland restoration efforts in the West Bay area of Galveston Island. There were no seagrasses reported in this area in 1979, but there were 286 acres in the area in 2002 (White et. al., 2004).

To address the need for seagrass monitoring and mapping, a key implementation requirement in the Seagrass Conservation Plan for Texas (1999), a state Seagrass Monitoring Workgroup continues to meet to discuss ongoing and future monitoring projects. The University of Texas Marine Science Institute in Port Aransas conducted seagrass monitoring, as a part of the Environmental Protection Agency's Regional Environmental Monitoring Assessment Program, in Redfish Bay and lower Laguna Madre of the Corpus Christi area from 2002 to 2004. Several biotic and abiotic indicators at 30 sites were measured semiannually. It was determined that the most critical measurements were the seagrass parameters of percent seagrass cover, above- and below-ground biomass, and epiphyte biomass. The long-term goal of this project is to create a seagrass monitoring program for Texas.

A seagrass mapping project is currently planned by the TPWD for the Coastal Bend area, including Aransas and Corpus Christi Bays and upper Laguna Madre. Color digital aerial photography at a scale of 1:24, 000 is being acquired for the project area.

3. Describe direct and indirect threats to coastal wetlands, both natural and man-made. For threats that are identified as high or medium, provide the following information: characterize the scope of the threat, describe recent trends, and identify impediments to addressing the threat.

Threat	**Significance**
Development/fill	High
Alteration of Hydrology	Low
Erosion	High
Pollution	Medium
Channelization	Medium
Nuisance or exotic species	High
Freshwater input	High
Sea level rise and subsidence	High

Development/Fill

Loss of freshwater wetlands may be attributed, in part, to rural and urban development and conversion to agriculture. Loss to urban land use was greatest in the Houston and Beaumont-Port Arthur areas. Loss to rural development was greatest in Orange, Jefferson, Chambers, Galveston, Harris, Brazoria, and Nueces counties. The loss to agriculture was greatest in Chambers, Harris, Brazoria, Matagorda, and Refugio counties. Urban land-use gained 528,700 acres between 1955 and 1992 or a 160 percent increase. Agriculture, the largest land-use category, experienced a 618,313-acre net loss even though 98,000 acres of palustrine vegetated (freshwater) wetlands, mostly emergent and forested, were lost to agriculture (Moulton et al., 1997). Currently, probably not many wetlands are being converted to agriculture. The public's desire to live on or near water and the increasing need for fertile agricultural land are impediments to addressing the threat of further wetland fill or development. Inland freshwater wetlands of the mid to upper Texas coast are under extreme pressures from development. These wetlands are extremely important to a variety of wetland wildlife. Recently, the Mottled Duck has seen rapid declines in numbers in Texas, and efforts are underway by a variety of conservation organizations to reverse this decline.

Erosion

Approximately 1,125 acres of coastal wetlands are lost each year to erosion and submergence along the Texas Gulf Coast, near bay margins, and within alluvial valleys (Morton and Paine, 1990). Historical analyses of maps and aerial photographs indicate that losses are accelerating and that human activities are either directly or indirectly responsible. Natural decreases in sediment supply have been exacerbated by river basin projects that reduce the volume of sediment transported to the coast and coastal structures and navigation projects that prevent redistribution of littoral sediments along the shoreline (Morton and Paine, 1990). In addition, boat traffic causes substantial erosion along some navigation channels. Methods used to slow the rate of coastal erosion include human modifications such as jetties and groins that trap littoral sediments updrift of the shoreline structures but can exacerbate erosion and cause scouring on the downdrift side.

Pollution

Coastal wetlands are altered by pollutants from upstream and local runoff and, in turn, change the quality of water flowing through them. Wetlands are capable of assimilating and purging pollutants from the water, but amounts of sediment, nutrients, and pesticides from watersheds that overload a wetland's assimilative ability can drastically alter the biological makeup of a wetland. Submerged aquatic vegetation (SAV), including seagrass, is especially sensitive to nonpoint-source (NPS) pollution. The loss of SAV can often be attributed to reductions in water transparency from excessive suspended solids and nutrients that enter the water column as a result of poor watershed management, reducing transmitted light below critical levels. Suspended solids can directly reduce water transparency, and excessive nutrients accelerate growth of light-absorbing algae in the water column. Some discharges into coastal waters are immediately toxic to coastal wetlands. Discharges of oil, for example, can seriously degrade coastal wetlands; less apparent is the sometimes slow degradation of wetland quality due to urban or agricultural runoff of NPS pollutants, including sediment, nutrients, oxygen-demanding compounds, and oil and grease. Information on the cumulative effects of these pollutants on coastal wetland quality is limited. Overall, it is difficult to characterize the scope and trends of the pollution threat because of the diffuse nature of the sources. This is also one of the impediments to addressing the threat. Another impediment is in the realm of public education -- i.e. demonstrating to the average citizen that their actions can negatively impact coastal wetlands.

Channelization

Construction continues on the Packery Channel project in Nueces County. The project consists of construction of a channel between the Laguna Madre and the Gulf of Mexico across North Padre Island. The project consists of dredging a 12-foot-deep by 122-foot-wide channel to connect the existing Packery Channel to the Gulf of Mexico and dredging the existing channel to a depth of –7 feet mean sea level and a width of 80 feet. The project will also add two rock jetties at the Gulf end of the Channel. The proposed project will impact 5.4 acres of seagrass and 17.8 acres of marsh. Compensatory mitigation for impacts from the Packery project will primarily occur at Shamrock Island, near Packery Channel in Corpus Christi Bay. Shamrock Island is one of the most important bird rookeries on the coast. The mitigation project will consist of the construction of a rock breakwater to help stabilize Shamrock Island and create sheltered areas leeward of the breakwater for colonization of 15.6 acres of seagrasses.

Nuisance or Exotic Species

The introduction and proliferation of exotic species in coastal Texas has contributed to the degradation of estuarine habitats and threatens many native plant and animal species. Coastal resource managers recognize that nuisance or invasive species are one of the most serious environmental threats on the coast. Significant populations of nutria, *Myocaster coypus,* eat vegetation in fresh, brackish, and tidal marshes, especially on the upper coast. Grass carp, *Ctenopharyngodon idella*, which were introduced to control aquatic vegetation, have established a reproducing population in the Trinity River/Galveston Bay system and are eating native vegetation. However, triploid grass carp, when permitted, have been used as a biological control for nuisance, aquatic vegetation. Giant Salvinia, *Salvinia molesta*, which is a floating aquatic fern native to southeastern Brazil, is spreading in southeast Texas. Giant Salvinia often causes anoxic oxygen levels of 2.0 ppm or lower and pH of 5.0 in small lakes and ponds that are covered with the plants, sometimes up to two feet thick. The water hyacinth, *Eichhornia crassipes,* another floating aquatic native to South America, also replaces native vegetation and disrupts waterway use. In addition, the Chinese tallow tree, *Sapium sebiferum*, has been one of the most vigorous biological invaders in Texas, especially in southeast coastal Texas. It can become established and thrive in a variety of habitats, including freshwater and brackish wetlands, bottomland hardwood forests, and coastal prairies. Other harmful invasive plants include hydrilla, *Hydrilla verticillata*, Brazilian pepper, *Schinus terebinthifolius,* alligator weed, *Alternanthera philoxeroides,* saltcedar, *Tamarix ramossissima*, and others. Other harmful invasive animals include the red imported fire ant, *Solenopsis invicta*, the channeled apple snail, *Pomacea canaliculata,* and others.

A comprehensive list of the number and kind of invasive species for the entire Texas coast has not been compiled. However, a report prepared for GBEP on Galveston Bay invasive species (Gossett et al., 2004), lists 296 aquatic and terrestrial invasive species as current or future threats to the lower Galveston Bay watershed.

The number of routes of entry by exotics in Texas include shipping through release of ballast water, agriculture, ranching and seeding, horticulture and aquaculture, the aquarium and pet trades, recreation, and biological control. Single species can be screened for invasiveness before being permitted to enter the State. For inadvertent introductions, like those in ballast water, addressing the general route or pathway is more feasible. Exotic or invasive plants can be controlled through stopping plant entry at the borders, monitoring and detection, improving existing laws and regulations, expanding the use of native species, eradicating small infestations, herbicide treatments, prescribed burns, mowing, and other methods.

In Texas, there is no single authority that addresses invasive species policies and regulations. The TPWD and Texas Department of Agriculture are the primary state agencies working with invasives. Public awareness of the problem in Texas is low and needs to be increased. Gossett et al. (2004) found that a majority of the programs to combat invasive species in the lower Galveston Bay watershed target eradication and control of terrestrial plants, while some attention is given to aquatic plants. Programs aimed at monitoring and assessment and that maintain detailed geo-referenced data describing aquatic and terrestrial species are lacking, as are large-scale public outreach/education efforts, programs restoring aquatic habitats degraded by invasive species, and general research related to impacts.

Gossett et. al. (2004) state that invasive species "represent a considerable risk to the human uses of the Galveston Bay system and the human and natural communities in the watershed." They also indicate that control of some of the species is already a financial burden on resource management agencies and individuals. This regional assessment could probably be applied to the entire Texas coast.

Freshwater Input

Coastal wetland communities also show well-defined salinity gradients both from north to south along the coast and within each estuarine system. Freshwater, intermediate, and brackish-water marshes are most extensive along the upper coast in the Beaumont-Port Arthur and Houston-Galveston areas, where freshwater inflows are typically much higher than on the lower coast. Salt marshes are extensive south of the Galveston Bay area. Within each estuarine system, freshwater marshes and bottomland hardwoods occupy river drainages and deltas, grading into intermediate and brackish-water marshes near the estuary. Saltwater marshes are most common on the bay side of barrier islands and peninsulas and along the mainland shores of narrow bays.

Wetlands can be degraded or destroyed by modifications in water level and nutrient and sediment status. Decreased water levels, which may occur when wetlands are filled, expose anaerobic soil to the air. A reduction in water levels adversely impacts wetland vegetation that has specifically adapted to life in anaerobic soils. When this occurs frequently, wetland plants are out-competed by upland species. The combination of reduced water quantity, aerobic soil, and upland vegetation eventually causes wetland loss.

Wetlands may also be lost as a result of total inundation, such as with reservoir construction. Reservoir construction has two major direct impacts on natural bottomland ecosystems: (1) destruction of bottomlands through inundation; and (2) modification of the hydroperiod in the reservoir pool, thus contributing to changes in plant communities adjacent to the reservoir's periphery. Reservoir construction also causes numerous adverse impacts to downstream environments. Adverse downstream impacts include: (1) reduced flooding below the dam, which results in the loss of hydrophytic plant species; (2) reduction in silt and nutrient inputs to downstream bottomlands; (3) excessive bed and bank scour from irregular releases of large quantities of water; (4) loss of bank-stabilizing vegetation; (5) disruption of normal feeding and spawning cycles of fish that utilize floodplains; (6) elimination of high flows in bottomlands, which prevents the input of bottomland nutrients into the aquatic system: (7) reduction in instream flows to coastal estuaries, causing major changes in the salinity gradient; (8) encouragement of conversion of downstream bottomland forests to agricultural lands or monoculture pine plantations as a result of decreased flooding; and (9) potential negative effects to plant communities as a result of higher water releases and subsequent flooding of forests during growing season (Neal and Jemison, 1990).

In recognition of the importance of fresh water to the state, including the bay-estuary-lagoon system, the Texas Legislature directed the TWDB to develop a Texas Water Plan as a guide to the conservation and development of the state's water resources. The first Texas Water Plan, adopted in 1969, called for an estimated 2.5 million acre-feet of supplemental freshwater inflows annually to Texas' bay-estuary-lagoon system. The TWDB regularly updates the plan to meet current water

needs and anticipated future needs. The plan currently emphasizes water supply, treatment, distribution, conservation, and the collection and treatment of wastewater.

In preparation for the Texas Water Plan, the 64th Texas Legislature directed the Texas Water Development Board (TPWD), in cooperation with the then Texas Water Quality Board (now TCEQ), TPWD, and GLO, to collect comprehensive physical, chemical, and biological data on the effects of freshwater inflows upon the bay-estuary-lagoon system. The comprehensive studies and data resulted in a series of reports covering the state's seven major estuarine systems. The results included preliminary estimates of freshwater inflows needed from major Texas rivers to meet management alternatives for coastal ecosystems.

The 69th Texas Legislature, in 1985, assigned the responsibility for water rights permitting to the Texas Water Commission (now the TCEQ) and authorized the TPWD to be a party in hearings on applications for permits to store, take, or divert water. The Legislature also directed the Water Commission to consider effects on the bay-estuary-lagoon system for all water rights permits. In response to House Bill 2 (1985), Senate Bill 683 (1987), Senate Bill 1 (1997), and other legislative directives, the TWDB and TPWD have jointly established and maintained a continuous data collection and evaluation program and conducted studies and analyses to determine bay conditions that provide a sound ecological environment. To achieve the goal of a sound ecological environment in coastal bays, special conditions are required in state permits for storage, taking, or diversion of water. These conditions regulate the quantity and timing of water use and are designed to ensure that salinity and nutrient levels and sediment supplies are adequate through time to provide an environment for the maintenance of bay-estuary-lagoon wetlands and organisms.

In 2002, the TWDB prepared a state water plan, *Water for Texas-2002*. In the plan, the TWDB made numerous, detailed policy recommendations regarding conservation programs by water suppliers and agricultural users; however, the findings and recommendations make no mention of wetland conservation, even though wetlands provide significant natural resource services related to water supply and quality.

The major impediment to providing sufficient freshwater input to maintain coastal wetlands is the many competing uses for freshwater, including municipal, industrial, and agricultural uses. A comprehensive educational and conservation program that helps the public understand the important link between adequate freshwater inflows to the bays and estuaries and coastal fisheries and their wetland habitats is one solution. Also, innovative approaches to providing freshwater, such as wastewater reuse, are also needed to balance the many competing uses for the freshwater resource.

The recent status and trends information on coastal wetlands of the central coast (White, et al., 2002) is being used by the Lower Colorado River Authority (LCRA) to help determine the impacts to coastal wetlands of transferring freshwater from the lower Colorado River to San Antonio. The LCRA is supplementing the status and trends data with more current and detailed wetland information for the Colorado River delta in Matagorda Bay. All the wetland information will assist the LCRA in deciding whether the transfer of up to 150,000 ac-ft of

freshwater from the Colorado River to San Antonio will occur, based at least partly on potential impacts to coastal wetlands and other habitats.

Although the TPWD, TWDB, and TCEQ recently completed freshwater inflow studies for all seven of Texas major estuarine systems, studies on sediment transport to maintain wetland systems were not included in the inflow studies. The TWDB Section 309 studies currently being funded will help determine the sediment needs of wetlands and other habitats in the Galveston Bay system. Sediment budget data will assist in developing any new policies

Sea Level Rise and Subsidence

Between the 1950's and 1989, subsidence (primarily from groundwater withdrawal and oil and gas production) and sea level rise converted 26,400 acres of emergent wetlands in the Galveston Bay system, or about 30 percent of the total gross loss (88,500 acres), to open water and barren flats (White et. al., 1993). Losses are pronounced on the north and west side of the bay, including the San Jacinto and Trinity River fluvial-deltaic areas, where together almost 8,900 acres of vegetated wetlands have been replaced by open water and flats since the 1930's (White and Tremblay, 1995). Subsidence is the overriding cause of wetland loss along the river delta marshes, such as those of the San Jacinto River, which is near the center of maximum subsidence resulting from groundwater withdrawal and oil and gas production in the Houston area (White and Calnan, 1990; White and Tremblay, 1995). In the Neches River valley, a combination of factors, including subsidence, relative sea-level rise, fault movement, channel dredging, spoil disposal along levees, and impoundment of sediments along streams, has probably contributed to wetland loss (White and Calnan, 1990; White and Tremblay, 1995).

White and Morton (1995) report that thousands of acres of marsh on the upper coast have been lost as a result of fault activation and subsidence since the 1950's. Thirty-nine faults with a cumulative length of more than 87 miles were mapped by White and Morton (1995). Fault movement may have been related to oil and gas production and associated formation water.

Overall, the subsidence rate in the Galveston-Houston area has decreased, as industries have converted from using primarily groundwater to using primarily surface water. However, relative sea-level rise and impoundment of sediments behind dams in rivers and streams still contribute to coastal wetland loss.

Management Characterization

1. Within each of the management categories below, identify changes since the last assessment.

Management Category	***Changes since last assessment***
Regulatory program	I. Significant
Wetland protection polices and standards	Moderate
Assessment methodologies	None
Impact analysis	None
Restoration/enhancement programs	Significant
SAMPS	None (Not permitted by state law)
Education/outreach	Moderate

Management Category	*Changes since last assessment*
Wetlands creation programs	Moderate
Mitigation banking	None
Mapping/GIS tracking systems	Moderate
Acquisition programs	Significant
Publicly funded infrastructure restrictions	None

2. For categories with changes provide the following information for each change: characterize the scope of the change; describe recent trends; identify impediments to addressing the change.

Regulatory Programs

Since the last assessment in 2001, the U.S. Supreme Court decision in Solid Waste Agency of Northern Cook County (SWANCC) v. the Army Corps of Engineers eliminated Clean Water Act (CWA) jurisdiction over isolated waters that are intrastate and non-navigable, where the sole basis for asserting CWA jurisdiction is the actual or potential uses of the waters as habitat for migratory birds that cross state lines in migration. The Court continued to recognize the CWA's jurisdiction over traditional navigable waters and their tributaries and wetlands adjacent to them. The SWANCC ruling focused on a relatively narrow type of water or wetland—those that are isolated, non-navigable, and intrastate.

Wetlands on the Texas coast that are currently non-jurisdictional or "isolated" as a result of the SWANCC decision can primarily be categorized as palustrine emergent or freshwater marshes, palustrine scrub-shrub or freshwater wetlands dominated by woody vegetation less than 20 feet in height, and palustrine forested wetlands. These palustrine emergent wetlands include dune swale wetlands on barrier islands and peninsulas, coastal wet prairie, and wetlands associated with pimple mounds or "pothole" wetlands that are found primarily in Southeast Texas.

Based on geographic information system (GIS) calculations that include the latest National Wetland Inventory (NWI) information (1992), status and trends data on wetlands of the central Texas coast (White et al., 2002), Federal Emergency Management Agency (FEMA) 100-year floodplain data, and U.S Geological Survey (USGS) hydrology data, there are approximately 100,273 acres of "isolated" wetlands, or approximately 10 percent of the total wetlands in the Texas coastal zone, which includes parts of 16 Texas coastal counties. Of the total acreage of isolated wetlands, 12,475 acres or approximately 16 percent of the total, are in protected areas, such as national wildlife refuges, state parks and wildlife management areas. The estimate is primarily for palustrine emergent wetlands in the coastal zone that are not in the 100-year floodplain (the Galveston District, Corps of Engineers, considers wetlands in the 100-year flood plain as adjacent wetlands and not isolated). The estimate includes the palustrine scrub-shrub and palustrine forested categories but does not include the palustrine-farmed category. Refugio County is the only Texas coastal county that is not included in the estimate, because there is currently no digital 100-year floodplain information for Refugio County. The estimate does not include palustrine emergent wetlands or dune-swale wetlands on most barrier islands and peninsulas since the majority of these wetlands are in the 100-year floodplain. The accuracy of the estimate for isolated wetlands is, at least in part, dependent on the limitations of the NWI data. Wetland boundaries on NWI maps are not exact but are, in most cases, generalized. The NWI maps are derived from aerial interpretation of color infrared photography with varying

limitations due to photo quality, seasonality, the ability to field check the interpretations, the ease or difficulty of interpreting specific wetland types, and other factors.

The Galveston District, Corps of Engineers, estimates (Fred Anthamatten, personal communication) that approximately 40 percent of the wetlands in the District are no longer jurisdictional.

The only published study to attempt to determine the extent of isolated wetlands on the Texas coast was the U.S. Fish and Wildlife Service (USFWS) preliminary assessment of geographically isolated wetlands in the U.S. (Tiner et. al., 2002). The USFWS evaluated nine study sites in their Southwest Region and determined that, of the total wetlands identified in the two study areas on the Texas coast, the extent of isolated wetlands for both sites was greater than 47 percent (each study area included four USGS quadrangles). Of the nine study sites, the Mustang Bayou site on the upper Texas coast had from 77 to 86 percent (9,726 to 10,863 acres) isolated wetlands, and the St. Charles Bay site on the lower coast had approximately 47 percent (17,823 acres) isolated wetlands.

Recent status and trends information, based on 2001 and 2002 aerial photography, that is currently being developed for Texas barrier islands and peninsulas and for wetlands in the lower Galveston Bay watershed will provide some baseline data for assessing the impact of SWANCC on coastal wetlands. Additional coastal wetland status and trends studies will be needed to help monitor the extent of coastal wetland loss since the SWANCC decision in 2001 and to help determine the possible changes to regulatory programs that are needed to address this issue.

The City of Galveston is currently considering the development of a local ordinance for protecting coastal wetlands on Galveston Island. Current wetland information from the White et al. (2002) report for wetlands on Galveston Island will be a part of a Geohazards Map being developed by the University of Texas, Bureau of Economic Geology (BEG) for the City of Galveston. The wetland information will assist the City in planning for future development on the Island by requiring future developers to avoid/minimize impacts to coastal wetlands.

The CMP is focusing on isolated wetlands in the coastal zone. The Council recently formed an executive committee Isolated Wetlands Workgroup to assist in determining the authority of the council regarding the regulation of isolated wetlands. The Workgroup requested that a legal analysis be developed to help in determining the Council's authority over isolated wetlands. A legal analysis was drafted by the GLO Legal Services. Legal Services determined that the Council has authority to review the consistency of a private developer's activities causing impacts to coastal wetlands if such activities require a listed governmental action, such as a Corps permit.

From a regulatory perspective, local governments, with current information on status and trends and functions and values of wetlands within their jurisdiction, are considering or are developing ordinances to protect the resource from future development. From a state or federal perspective, status and trends information and a mitigation tracking database being created for NOAA's NCMPMS, can be used to update mitigation guidelines and/or policies. In addition, wetland status

and trends information is currently being used by Corps' permit applicants in assessing cumulative impacts, especially on the barrier islands.

In addition, the 2004 Coastal Issues Conference that was held in Corpus Christi from March 10 to12, 2004 highlighted the issue of isolated wetlands on the Texas coast by providing panel discussions under the title "Wetlands Management Post-SWANCC." The speakers in the four panels focused on regulatory issues, other states and local perspectives, wetland values and the landowners/managers viewpoints, and wetland functionality and scientific issues.

Wetland Protection Standards

Texas continues to improve and streamline the wetland permitting process. As of October 1, 2001, the Permit Service Center (PSC) (formally the Permitting Assistance Office) became operational as a central receiving point for a consolidated permit application for one federal and four state agencies for all projects in the lower half of the Texas coast. Duties of the PSC include the receipt and tracking of applications, screening applications for administrative completeness, and forwarding applications to the appropriate state and/or federal agencies for processing. In 2002, the PSC also began screening applications for technical completeness as well. In 2003 and 2004, the PSC established an interagency permit tracking system that links participating permitting agencies. The PSC will soon expand to the upper coast.

Wetland Restoration/Enhancement Programs

The GLO continues to implement the CEPRA Program that is authorized and funded by the Texas Legislature. A total of 27 projects (CEPRA Cycle 1) were approved in the first biennium, many of which include wetland restoration, protection, and enhancement, as important components of the projects. Cycle 2, in 2002, included 41 projects, and Cycle 3 in 2004 funded 20 projects. By leveraging state funds with federal, local, and other funding sponsors, the projects are helping to stem erosion on both bay and Gulf shorelines and preserving and restoring coastal wetlands.

The Texas Prairie Wetland Project is a partnership of the TPWD, Natural Resource Conservation Service, Ducks Unlimited, USFWS, and private landowners that works to restore and enhance wetland acres along the freshwater and agricultural wetlands of the Texas coast. This program has been active since 1992 and has restored or enhanced well over 30,000 acres (total not included in table showing acres of restored wetlands because it is not known how many acres are in coastal zone and have been restored since last assessment) by providing consistent winter water for wildlife.

Ducks Unlimited's MARSH Program (Matching Aid to Restore State's Habitat) works with public land managers (TPWD and USFWS) to restore or enhance wetlands. To date this program has restored 42,000 acres statewide (total not included in table showing acres of restored wetlands because it is not know how many acres are in the coastal zone and have been restored since the last assessment), with the majority of these acres occurring on the coast. These projects include moist soil units, terracing, and marsh restoration.

The Gulf Coast Joint Venture (GCJV) will continue to play a leading role in conserving migratory birds and their habitats along the coast. The GCJV, through its initiative teams will be an outlet for project prioritization and funding coordination through all conservation partners.

In the Galveston Bay area, many individual and coordinated wetland restoration and acquisition efforts, including several that were identified in the Habitat Conservation Blueprint (1998) (a Section 306 funded project to identify potential wetland restoration sites in the Galveston Bay area) have been completed or are near completion. Lester and Gonzalez (2005) have identified 103 fringing wetland and submerged aquatic vegetation restoration sites in the lower Galveston Bay watershed since 1973. However, data describing the acreage and date of restoration are currently incomplete. Especially significant, in terms of coastal wetland conservation, is the effort to restore and preserve the West Galveston Bay Conservation Corridor. In 2004, a conservation partnership of local non-profits, the TPWD, the USFWS, and others received a total of $2 million from a Coastal Wetland Planning Protection and Restoration Act (CWPPRA) grant and a North American Wetland Conservation Act (NAWCA) grant to acquire 3,000 acres of coastal tallgrass prairie/wetlands/upland habitats and restore 42 acres of estuarine marsh in the Hitchcock area of the West Bay Conservation Corridor of the Houston/Galveston area. The 3,000 acres is in addition to the 5,000 acres already protected and restored in the Corridor area, with support from CWPPRA and NOAA Coastal Impact Assistance Program (CIAP) funding. All these efforts are in recognition that coastal wetland loss within the Corridor has occurred at rates among the highest within the Galveston Bay system.

Other wetland restoration/enhancement projects that have been planned or implemented since the last assessment in 2001, include the lower coast projects of Goose Island State Park marsh (22 acres); a central coast project at Mad Island marsh (12 acres); and upper coast projects at Jumbile Cove marsh (15 acres, Phase II), Pierce marsh (45 acres), Delehide Cove marsh (51 acres), San Jacinto Monument marsh (115 acres), Jarboe Bayou (unknown acreage), North Deer Island (147 acres), Starvation Cove marsh (11 acres restoration and 100 acres acquisition), Moses Lake marsh (5 acres), Armand Bayou coastal prairie (418 acres), Dickinson Bay Bird Island marsh (5 acres); and Bessie Heights (220 acres) and McFaddin marshes (15 acres) in the Beaumont/Port Arthur area.

The numerous restoration/enhancement programs and projects are helping coastal management programs achieve their restoration/protection goals for coastal wetlands and other habitats. For example, one of the priority goals of the Galveston Bay Plan (1995) was to create or restore 15,000 acres of wetlands in 10 years. Between 1995 and 2000, over 4,500 acres of emergent marshes and 200 acres of seagrass were restored and created through public-private partnerships in the Galveston Bay system, short of the initial goal set by the Galveston Bay Program but still significant. An additional 835 acres of marshes have been restored since 2001. These restoration programs generally make good use of volunteers, and over time, as an educational tool, should provide additional protection for the resource.

Education/Outreach

A change in the wetlands education/outreach category from the 2001 assessment occurred in 2002 when the GLO updated and reprinted the popular, Texas Coastal Wetlands: A Handbook for Local Governments. The Handbook was originally printed in 1996, with funding from the Environmental Protection Agency.

The TPWD continues to publish the bi-yearly newsletter, Texas Wetland News (www.tpwd.state.tx.us/wetlands/publications). The newsletter includes articles on many aspects of Texas wetlands. Also, the TPWD has made available 25 Wetland Discovery Trunks (educational

materials for loan) at various sites around the state for teachers and people who are working with youth (www.tpwd.state.tx.us/edu/trunks/wetlandstrunk.phtml). The trunks include activity ideas, background information, the "Texas Treasures: Wetlands" pamphlet, and basic field equipment for studying local wetlands.

Since the previous assessment in 2001, CMP grants have funded several wetland education projects, including the Marsh Mallow: 4-H School Enrichment project and projects at Texas A&M University-Galveston, Wetlands Study Center and the Challenger Seven Coastal Wetland Study Center at Challenger Seven Park in Harris County.

The Texas Coastal Wetlands Guidebook (Moulton and Jacob, 2001), a popular publication that was partially funded by a CMP grant, is being used to train Master Naturalists on coastal wetlands.

Wetlands Creation Programs

Dredged material is, in some cases, being used as a resource rather than treated as a waste. For example, it is being used beneficially to create 4,250 acres of estuarine salt marsh in the Galveston Bay system over the 50-year life of the project to deepen and widen the Houston Ship Channel and in creating and protecting 60 acres of seagrass and over 426 acres of estuarine marsh from the widening and deepening of the Corpus Christi Ship Channel.

Mitigation Banking

There are six approved mitigation banks within the Galveston District, Corps of Engineers. The total available credits from the six banks, as of October 2003, are 4,568.63 acres. However, all six banks were approved prior to the last Section 309 assessment. The last mitigation bank was approved in April 2000.

Mapping/GIS Tracking Systems

Recent mapping of wetlands on Texas barrier islands and peninsulas (White et. al., 2002 and 2004) involves the use of digital, color infrared (CIR), 1 meter resolution aerial photographs, taken in November or December 2001 or February 2002. The digital images are registered to USGS orthophoto quarter quadrangles. Historical distribution is based on 1950s black and white and 1979 CIR photographs. Interpretation and mapping were completed on screen in a GIS (ArcInfo and ArcView) at a scale of 1:8,000 and 1:5,000. Current-status maps were used to make direct comparisons with the historical GIS maps to determine habitat trends and probable causes of trends. Wetlands were mapped in accordance with the classification by Cowardin, et al. (1979). Field sites were examined to characterize wetland plant communities, define wetland map units, and ground-truth delineations. Interpretations of wetlands were supported by Light Detection and Ranging (LIDAR) data acquired in the spring of 2002. The LIDAR images provide detailed elevation data that help differentiate between high and low marshes and flats, and areas that are transitional between uplands and wetlands.

Mapping of habitat change in the lower Galveston Bay watershed (Lester and Gonzalez, 2005) involves overlaying the 1992 NWI information onto aerial photography (1999-2000 true color Lamberts; 0.5 m resolution). Areas of wetland loss were identified as those areas identified by the 1992 NWI as a wetland that was shown on the current aerial photography as being converted into manmade structures.

Innovative wetland mapping/tracking systems that are currently being used to measure changes in ground elevation or subsidence and resulting wetland change in the Houston/Galveston area is radar interferometry. Using a series of satellite radar images, staff at the University of Texas Center for Space Research has measured changes in ground elevation in the Galveston Bay area during 1996 to 1999. Suspicion is that this subsidence, about 4.5 cm/year, was related to a small gas field in the Seabrook, Texas area. Gas production and reservoir pressure data suggest a relationship between ground movement and hydrocarbon production. Subsidence of this magnitude can also adversely impact marsh vegetation, as noted in the discussion on sea level rise and subsidence.

Acquisition Programs

Funds from NOAA's CIAP have been used to acquire wetlands and other coastal habitats, including bottomland hardwoods and other riparian vegetation. Since 2002, the CIAP has funded a total of 10 acquisition projects for a total of approximately 4,332 acres of coastal habitat. These are projects where acquisition has already occurred. The projects are coast wide and range from 1,490 acres of coastal wetlands and prairie in the Virginia Point area of the Galveston Bay system to 2.4 acres or wetlands for the City of Shoreacres on Galveston Bay.

Proposed wetland and riparian habitat acquisition sites in the Houston/Galveston area are 70 to 80 acres of prairie wetlands near the City of Pasadena and Clear Lake, 100 acres of wetlands/uplands near Starvation Cove on Galveston Island, and over 35 acres of riparian woodlands along Armand Bayou near the City of Pasadena. Other significant upper coast acquisition projects, including the 3,000 acres of coastal prairie/wetlands/uplands in the West Bay Conservation Corridor, are described in the section on restoration/enhancement programs.

On the lower coast, in the Nueces River delta of the Corpus Christi area, the CBBEP has acquired approximately 2,956 acres of coastal wetland and riparian habitats, with funds from Environmental Protection Agency Supplemental Environmental Project Settlements and CIAP. The CMP grant program funded the acquisition of 20 acres of oak motte habitat at the City of Ingleside in the Corpus Christi area and an unknown acreage of estuarine marsh/upland habitats in the Charlie's Pasture area of Port Aransas on Mustang Island.

In 2005, staff of the GLO, TPWD, and the proposed National Estuarine Research Reserve will be drafting a Coastal Estuary Land Conservation Program (CELCP) Plan to help the state in assessing and selecting priority land conservation projects. It is anticipated that one of the priority habitats for protection/acquisition will be coastal wetlands.

Coastal wetland acquisition programs are critical for protecting threatened resources, such as SWANCC or freshwater wetlands. Preservation may be the only opportunity to protect wetlands and other habitats that serve as refuges for birds and other wildlife. The Galveston Bay Program reports that almost 3,000 acres of wetlands have been protected/acquired by the Program and their partners between 2001 and 2005. However, in many coastal areas, such as on barrier islands, fee simple acquisition is becoming very expensive, and other mechanisms, such as conservation easements, may be more feasible.

Conclusion

1. Identify priority needs or major gaps in addressing the programmatic objectives for this enhancement area that could be addressed through a 309 strategy.

The loss of regulatory protection for wetlands determined to be isolated from waters of the U.S. (isolated wetlands) as a result of the SWANCC decision is an impediment to protecting and preserving existing levels of wetlands in Texas. To continue to provide adequate protection for wetlands now considered isolated or non-jurisdictional, as well as jurisdictional wetlands, there is a need to fund research that supports local, state, and federal restoration and acquisition programs (including grant programs) and to develop other non-regulatory approaches to protecting the resource. Texas is a private-lands state, where approximately 97% of the land is privately owned and managed (TPWD, 1997). Non-regulatory and innovative voluntary programs to encourage land owners to conserve wetlands, including using existing incentive programs and many of the acquisition, restoration, and educational programs described in this assessment, have been and will continue to be successful in restoring and protecting the resource (TPWD, 1997).

The success of all these programs will benefit from an understanding of the status and trends of wetlands and their function in coastal watersheds. The Council continues to fund status and trends work for marshes, mangroves, tidal flats and water bodies on barrier islands and peninsulas along the Texas coast. Additional status and trends data for inland wetlands are needed. This information is of particular significance because it would include areas dense with isolated wetlands and would help determine the extent of loss in these areas. In addition, quantifying the functionality of wetlands in terms of the benefits they provide to coastal communities is an effective way to earn support for greater regulatory and non-regulatory protections.

Furthermore, this information is needed by state and federal programs regulating jurisdictional wetlands, and may be used to update mitigation guidelines and policies and assist permitting decisions. Local government may also use this information to develop ordinances to protect the resource from future development.

Texas would benefit from the development of a data management system to store coastwide status and trends information, including restoration and mitigation projects. NOAA found in its §312 evaluation of the CMP that "there is no consistent coastwide data on wetland loss by type, which is essential to setting management priorities." A database developed to store NCMPMS data could act in this capacity, leading to more informed decision-making. The NCMPMS requires the tracking of wetland and other habitat loss by type within the coastal zone, and could easily be expanded to include other information relevant to enhancing the state's ability to protect wetlands.

2. What priority was this area previously and what priority is it now for developing a 309 strategy and designating 309 funding and why?

Previous Assessment: HIGH **This Assessment: HIGH**

Coastal wetlands are important to the state because of their many functions and values. Wetland loss in Texas continues to be significant. Threats to the resource include development, erosion,

water-quality degradation, changes in freshwater inflow, subsidence and sea level rise, invasive or exotic species, and others. Council and other initiatives will help protect, preserve, enhance, and restore this valuable resource.

Public Access

Section 309 Programmatic Objectives

I. Improve public access through regulatory, statutory, and legal systems.

II. Acquire, improve, and maintain public access sites to meet current and future demand using innovative funding and acquisition techniques.

III. Develop or enhance a Coastal Public Access Management Plan, which takes into account the provisions of public access to all users of coastal areas of recreational, historical, aesthetic, ecological, and cultural use.

IV. Minimize potential adverse impacts of public access on coastal resources and private property rights through appropriate protection measures.

Resource Characterization

1. Provide a qualitative and quantitative description of the Current status of public access in your jurisdiction. Also, identify any ongoing or planned efforts to develop quantitative measures to assess your progress in managing this issue area.

The last coastwide inventory of public access in Texas was conducted in 1998-1999. The data originates from two sources, CBBEP and the CMP. In 1998, CBBEP hired a contractor to survey beach and bay access points in six counties surrounding Corpus Christi Bay (Nueces, San Patricio, Kenedy, Kleberg, Aransas, and Refugio counties). In 1999, the GLO hired a contractor to survey access points in the remaining twelve coastal counties (Orange, Jefferson, Chambers, Galveston, Harris, Brazoria, Calhoun, Jackson, Matagorda, Victoria, Willacy, and Cameron).

This coastwide inventory, which included close to 360 access areas, updated coastal recreational information that is more than 20 years old. The inventory included information on recreational activities available at each site, associated amenities, and location. Based on this inventory, Galveston, Brazoria, and Nueces counties had the largest number of public access points, while Jackson, Kleberg, and Willacy counties had the fewest number. Kenedy County had no access points.

In 2003, GLO conducted an inventory of the types of access along public beaches adjacent to the Gulf of Mexico. The inventory simply identified Gulf-facing beaches as either pedestrian only or vehicular type beaches. From the table below, the 2003 inventory showed that Galveston County has the longest (23 miles) pedestrian-only beaches (approximately 40 percent of its shoreline) and Kenedy County had the longest (47.5 miles) vehicular-only beaches (100 percent of its shoreline). Most counties had a combination of both pedestrian and vehicular beaches, with the exception of Calhoun, Chambers, Jefferson, Kenedy, Kleberg, and Willacy counties, which have all vehicular beaches. Aransas County's beaches are inaccessible by public road or ferry and therefore not subject the Open Beaches Act (OBA).

Miles of Gulf Beach Access

County	Shoreline lengths (Miles)	Pedestrian (Miles)	Vehicular (Miles)	Inaccessible (Miles)
Aransas	**20.3**	**0**	**0**	**20.3**
Brazoria	**29.3**	**2**	**27.3**	**0**
Calhoun	**37.3**	**0**	**37.3**	**0**
Cameron	**31.75**	**7.4**	**24.35**	**0**
Chambers	**1.1**	**0**	**1.1**	**0**
Galveston	**57**	**23**	**34**	**0**
Jefferson	**33**	**0**	**33**	**0**
Kenedy	**47.5**	**0**	**47.5**	**0**
Kleberg	**22**	**0**	**22**	**0**
Matagorda	**60.8**	**0.5**	**31.8**	**28.5**
Nueces	**21.5**	**0.8**	**20.7**	**0**
Willacy	**13.4**	**0**	**13.4**	**0**

With the advancement of GIS techniques, the GLO conducted a reassessment of the length of Gulf and Bay shorelines in 2005. The new assessment estimates that Texas has 387 miles of Gulf shoreline and 3,858 miles of bay-estuary-lagoon shoreline.

Shoreline Access-Related Grants Funded for Cycles 6 – 10

State/County/Local Parks

Fort Travis Park Interpretive Wetland Trail – cleaning two trails and constructing overlook decks at Fort Travis Seashore Park. (cycle 6)

Padre Balli Park Interpretive Area – enhancing the beach entranceway and providing an interpretive history of Padre Balli. (cycle 6)

Padre Balli Park Interpretive Area (Phase II) – further enhancement to beach entranceway. (cycle 6)

Restroom facilities at Cove Harbor Park – providing needed public restroom facilities and infrastructure. (cycle 6)

Park Restrooms and Pavilion Additions to West Chambers Boat Ramp and Park – a 2,500 s.f. open-air pavilion with picnic tables, barbecue pits, and restrooms. (cycle 6)

Wildlife Viewing Overlook at Falcon Park – Conservation easement and construction of a wildlife viewing overlook. (cycle 6)

Construction of Cabanas at Isla Blanca Park – Cabanas. (cycle 6)

Isla Blanca County Park Additional Restrooms and Walkover – larger restrooms and walkover to access the restroom facilities. (cycle 7)

San Jacinto Park (Fort San Jacinto Historical Point) – creation of a new park at eastern tip of Galveston Island. (cycle 7)

Matagorda Bay Jetty Park Public Bathrooms – restroom facilities with water fountain and outdoor showers. (cycle 8)

Matagorda Bay Nature Park Trail – nature trail connecting environmental learning center and nature lodge to a coastal wetland area. (cycle 8)

Town of South Padre Island Treasure Island Circle Beach Park – parking area, two shelters, restroom facilities, water and foot shower, and benches. (cycle 8)

Fulton Park Shoreline Access – public restrooms and drinking water. (cycle 8)

Matagorda Bay Nature Park Public Restrooms and Sheriff/Ranger Station – public restroom, and Sheriff and LCRA ranger substation. (cycle 9)

Matagorda County Jetty Park Picnic Pavilions and Interpretive/Directional Kiosk – six picnic pavilions and kiosk. (cycle 9)

Public Beaches

Pathways 2000 Phase II – pedestrian , bicycle paths, and walkways to public beaches. (cycle 7)

City of Galveston Public Access Enhancement – new maps showing revised public beach access points. (cycle 8)

Pathways 2000 Phase III - pedestrian , bicycle paths, and walkways to public beaches. (cycle 10)

University Beach Marina Park Access – public beach access along Corpus Christi Bay shoreline. (cycle 10)

Fishing Piers

Kaufer-Hubert Memorial Park Pier Renovation – renovation of an existing 500’ public fishing pier.

Riviera Beach Park Pier Renovation – fishing pier renovation. (cycle 7)

Palacios Public Fishing Pier – 350 foot fishing pier in South Bay Park. (cycle 8)

Port Lavaca Causeway Fishing Pier Renovation – repair fire damaged and deteriorated pier. (cycle 8)

Fulton Fishing Pier Improvement Project – repair deteriorated T-head and pier. (cycle 10)

Washington Park Interpretive Fishing Pier Phase I – replace three deteriorated picnic shelters, six picnic tables, public access, and repair fishing pier. (cycle 10)

Disabled Access

Accessible Bayou Nature Trail on Dickinson Bayou in Paul Hopkins Park –ADA accessible nature trail. (cycle 7)

Bayshore Park Picnic and Interpretive Trail – concrete ADA accessible nature trail and picnic structures. (cycle 7)

Corpus Christi Beach Boardwalk – ADA boardwalk along Corpus Christi Beach. (cycle 7)

Port Aransas Park Enhancement Project – includes the construction of an ADA accessible walkway. (cycle 7)

Port Arthur Boardwalk, Phase III – ADA boardwalk. (cycle 7)

Accessible Bayou Nature Trail on Dickinson Bayou in Paul Hopkins Park (Phase II) - ADA accessible nature trail. (cycle 8)

Laguna Heights Walkway and Bird Blind – ADA accessible walkway. (cycle 8)

Boardwalks/Walkways

Challenger Seven Coastal Wetland Study Center – for excavation, site work, water flow, plantings, a boardwalk, safety features, public access, an outdoor teaching structure, and interpretive signage. (cycle 6)

Whitecap Boulevard Hike & Bike Trail – pedestrian public access enhancement to Laguna Madre and the Intracoastal Waterway to Gulf Beach. (cycle 6)

Gambusia Nature Trail Boardwalk Renovation – Nature Trail boardwalk renovation in Sea Rim State Park. (cycle 6)

Paradise Pond Access Enhancement – boardwalk with viewing platforms. (cycle 6)

Pathways Pedestrian & Bicycle Paths and Walkways – construction of a ¾ mile walkway along Bob Smith Drive to provide safe access to the public beach in the City of Jamaica Beach. (cycle 6)

Bayfront Peninsula Restoration Project – includes the replacement of an approximately 350 linear foot timber walkway with a concrete cap bayfront walkway. (cycle 7)

Other

Bayfront Peninsula Improvements – A Shoreline Access Project – a 625 s.f. public restroom facility to accommodate the many local residents and visitors who utilize and visit the City of Port Lavaca Bayfront Peninsula. (cycle 6)

Aransas Pass Community Park and Nature Area Kayak Trail Facilities – kayak trails in the City of Aransas Pass Community Park. (cycle 7)

Atkinson Island Interpretive Canoe Trail – public access and canoe trails in Upper Galveston Bay. (cycle 9)

Rockport Harbor Bayfront Improvement Project – repair damaged bulkhead, replace deteriorated tables, cabanas, water fountains, barbeque grills, trash receptacles, and information signage. (cycle 10)

2. Briefly, characterize the demand for public access within the coastal zone, and the process for periodically assessing public demand.

Texas is the second most populous state in the country, with close to 22 million people, and has the third fastest growth rate for a coastal state (BIDC, 2003). Approximately 25 percent of the state's population is contained within the state's 18 coastal counties. All but three of these coastal counties have shown an increase in population from 2000 – 2004. Refugio, Kenedy, and Jefferson decreased in population, ranging from –5.2 percent to –0.8 percent. Cameron, Brazoria, Chambers, and Aransas counties had the highest growth rates, ranging from 7.8 percent to 10.2 percent.

The demand for recreational use of the coast comes from both residents and tourists and remains high. According to the Texas Department of Economic Development (TDED), tourism is a $40.4 billion dollar business in Texas. Coastal tourism, which represents about 25 percent of the state's travel industry, generated approximately $14.7 billion dollars in 2003. There is currently no process to periodically assess public demand for public access within the coastal zone.

3. Identify any significant impediments to providing adequate access, including conflicts with other resource management objectives.

Since 1999, nine separate geotextile tube shore protection projects have been installed along the upper Texas coast, and as of March 2003, cover a total of 7.34 miles of the Gulf shoreline from Follets to High Island. The geotextile tubes are sand-filled tubes of geotextile fabric with an oval width of approximately 12 ft. The tubes rest on a fabric scour apron that has sand filled anchor tubes along each edge. The total width of the projects are approximately 30 ft. and are generally placed parallel to the shoreline along the seaward edge of the foredunes. Specially designed dune walkovers have to be used for public access over the project to prevent damage to the tubes. Studies conducted by the BEG from May 2000 to March 2003, have shown that the placement of geotextile tubes seaward of the natural line of vegetation has resulted in a narrowing of the Gulf beach in front of the projects. In some areas along Bolivar Peninsula, beach nourishment has not been adequate to maintain a beach width that would not restrict dune walkovers during high tides.

Since the last assessment, there has been an increased concern for ADA access to the Gulf shoreline. Currently, the ADA does not provide clear guidelines or requirements for providing adequate access to the Gulf shoreline for persons with disabilities. This summer (2005), the Council for Disability Rights plans to propose new guidelines which will include detailed criteria for newly constructed and altered trails that will include beach access.

4. Please explain any deficiencies or limitations in data.

Types of Public Access

Access Type	Current Numbers	Change Since Last Assessment
State/County/Local Parks (#)	108	0
Beach/shoreline Access Sites (#)	293	213
Recreational Boat (power or non-power) Access Sites (#)	200	-9
Designated Scenic Vistas or Overlook Points (#)	Not tracked	Not tracked
State or Locally Designated Perpendicular Rights-of-Way (i.e. street ends, easements) (#)	63	-12
Fishing Points (i.e. piers, jetties) (#)	95	5
Coastal Trails/Boardwalks (#)	22	0
ADA Compliant Access (#)	146	43
Dune Walkovers (#)	55	N/A
Public Beaches with Water Quality Monitoring and Public Notice (% of total beach miles) (under the Beach Act)	144 mi. (37%)	144 miles
Number Closed due to Water Quality Concerns (# of beach mile days)	Not tracked	Not tracked
Number of Existing Public Access Sites that have been Enhanced (i.e. parking, restrooms, signage - #)	Not tracked	Not tracked

The loss of state or locally designated perpendicular rights-of-way is a concern of the state. The numbers in this chart are, in part, a reflection of the increase in geotextile tube projects along the Texas coast. It is a requirement, however, that local governments with an approved beach access

and dune protection plan provide access to the gulf beach for those portions restricted to vehicular traffic every ½ mile and enough parking to accommodate one automobile for every 15 linear feet of shoreline, as stipulated in the GLO beach/dune rules. Any change in public accessibility of the Gulf shoreline must be reconciled with this standard.

5. Does the state have a Public Access Guide or website?

In 2002, the GLO released the first edition of the *Texas Beach & Bay Access Guide*, with a second edition released in 2003. The *Texas Beach & Bay Access Guide* is designed to help users locate a variety of public access sites, National Wildlife Refuges, and Wildlife Management Areas along the Texas coast. The guide divides the Texas coast into five areas: Southwest Texas (Jefferson and Orange Counties), Houston-Galveston (Brazoria, Chambers, Galveston, Harris, and Matagorda Counties), the Golden Crescent (Calhoun, Jackson and Victoria Counties), the Coastal Bend (Aransas, Kenedy, Kleberg, Nueces, Refugio and San Patricio Counties), and the Lower Rio Grande Valley (Cameron and Willacy Counties). Each section includes location maps and grids showing available activities and facilities. The maps show the general location of marinas, county/state/federal parks, boat ramps, and areas of recreational interest. The grids provide information about available activities such as fishing, swimming, wildlife viewing, picnicking, camping, and windsurfing along with available facilities such as boat ramps, boat docks, piers, restrooms, showers, electricity and lighting, fresh water, concessions, fees, ADA access, Gulf access, and access to bays, rivers, and lakes. More information regarding the Public Access Guide can be found at **http://www.glo.state.tx.us/coastal/access**. The GLO makes its publication available free to the public through its website at **http://www.glo.state.tx.us/coastal/pubs.html**. The GLO website is updated when needed.

Management Characterization

1. Within each of the management categories below, identify changes since the last assessment.

Management Category	Changes since last assessment
Statutory, Regulatory, Legal Systems	Significant
Acquisition Programs	None
Comprehensive Access Planning (including GIS and Databases)	Moderate
Operation and Maintenance Programs	None
Innovative Funding Techniques	None
Public Education and Outreach	Moderate
Beach water quality monitoring and/or pollution source identification and remediation programs.	Significant

Statutory, Regulatory, Legal Systems

The 78th Texas Legislature amended the OBA in June 2003, transferring authority to the Texas Land Commissioner to strictly and vigorously enforce the prohibition against encroachments on and interferences with the public beach easement. Prior to the amendment, the Texas Office of the Attorney General had the enforcement authority.

An additional amendment to the OBA in June 2003 included a new rule for the temporary suspension of submission of requests that the Attorney General file a lawsuit against a property owner for the removal of a structure that encroaches on or interferes with the public beach easement as a result of a meteorological event. Known as the "Moratorium" rule, the rule gives the Texas Land Commissioner the authority to issue an order to suspend, for a period of two years from the date the order is issued, the submission of a request that the state attorney general file a suit under the OBA to obtain a temporary or permanent court order or injunction, either prohibitory or mandatory, to remove a structure from a public beach. Land Commissioner Jerry Patterson issued Moratorium Orders on June 8, 2004 for 116 homes that were determined to be wholly within the public beach easement.

Title 31 of the Texas Administrative Code (TAC), §15.6, was amended in October 2003 to give coastal governments the authority to authorize the construction of structural shore protection projects that conforms with the policies of the Council.

Comprehensive Access Planning (Including GIS and Databases)

In 2002, the GLO released the first edition of the *Texas Beach & Bay Access Guide*, which provides information on the types of activities (i.e. boating, fishing, and wildlife viewing) and facilities (i.e. restrooms and electricity or lighting) that can be found at each access point along the Texas coast. The guide also provides the location of each access site. An updated second edition of the guide was released in 2003. This information may be accessed through the publication or in GIS format at http://www.glo.state.tx.us/gisdata/gisdata.html. Other than the *Texas Beach and Bay Access Guide* there have been no comprehensive efforts to support or conduct access planning.

Public Education and Outreach

The GLO maintains a coastal access website at **http://www.glo.state.tx.us/coastal/access** with the latest information on the *Texas Beach and Bay Access Guide*. In addition, numerous guides have been distributed through mail order, exhibitions, coastal conferences, community workshops, and other outreach and education events. The GLO received a $55,824 grant from the Texas Department of Transportation to print additional copies of the *Texas Beach & Bay Access Guide.* While this is not a 309 change, this supplementary funding will enhance the state's ability to market the Texas coast by distributing more copies of the guide, thus reaching more citizens who are considering traveling to the Texas coast.

Beach Water Quality Monitoring and/or Pollution Source Identification and Remediation Programs.

In response to declining water quality at our nation's coastal beaches, Congress enacted the Beaches Environmental Assessment and Coastal Health Act (BEACH Act) in October 2000, to protect the public health at our nation's beaches.

The BEACH Act requires that states, in cooperation with the Environmental Protection Agency (EPA), develop and implement a program to monitor, for pathogens and pathogen indicators, coastal recreation waters adjacent to beaches that are used by the public and to notify the public if water quality standards for pathogens and pathogen indicators are exceeded. The BEACH Act requires the EPA to publish performance criteria for monitoring and assessing coastal recreation waters and for promptly notifying the public when those waters exceed applicable water quality standards. The act also authorizes the EPA to award grants to help governments implement beach monitoring and notification programs that are consistent with the performance criteria. Under the BEACH Act, Congress authorized the appropriation of up to $30 million per year to coastal states to develop and implement the BEACH Act.

Beginning in November 2000, the GLO rejuvenated its Texas Beach Watch Program with funds from the CMP. The Beach Watch Program got its start in August 1998 but had stalled in early 1999 due to budgetary constraints. One requirement of the BEACH Act is that the Governor of each coastal state, tribe and territory appoint a lead state agency to develop and implement the BEACH Act. In July 2001, the Governor appointed the GLO as the lead state agency. The GLO was appointed because of its existing Beach Watch Program.

Since receiving funding through the BEACH Act, the GLO monitored 162 stations at 58 beaches in seven counties along the Texas coast. Counties where beaches are monitored include Jefferson, Galveston, Brazoria, Matagorda, Aransas, Nueces, and Cameron. In addition, Beach Watch signs were designed and delivered to local governments for installation at monitored beaches. Finally, in May 2005, the Beach Watch Program completed its public notification site. As a result, the general public can now find information about the beaches being monitored and whether an advisory is recommended.

From September 2003, when sampling began using BEACH Act funds, to May 31, 2005, over 9,800 sampling events have been conducted, with about 600 events being above the recommended EPA criteria of 104 colony forming units/100 ml.

Conclusion

1. Identify priority needs or major gaps in addressing the programmatic objectives for this enhancement area that could be addressed through a 309 strategy.

The last coastwide inventory of public access in Texas was conducted in 1998-1999 for the *Texas Beach & Bay Access Guide*. Since that time, there have been significant changes to the public access landscape. New access sites have been created, others have been lost and new obstacles have arisen. In addition, pressure to increase and maintain public access along the

coast is being felt in the form of increasing coastal populations and tourism. There is a need to conduct a comprehensive inventory of coastal public access in Texas to support access planning, particularly in the identification of underserved areas and ADA accessibility needs. With U.S. legislation pending that could designate public beaches as recreation facilities (therefore subject to accessibility standards under the ADA) local governments may be required to have every dune walkover ADA compliant.

In addition, local governments, particularly rural governments on the cusp of burgeoning metropolitan areas, are in need of assistance to preserve open space to meet the demands of an increasing coastal population. Innovative tools and techniques developed to assist land conservation at the local level would increase the likelihood of securing adequate public access for the future.

Texas would benefit from the development of a data management system to store coastwide public access information. A database developed to store NCMPMS data could act in this capacity, leading to more informed decision-making. The NCMPMS requires the tracking of public access sites by category, and could easily be expanded to include other information relevant to enhancing the state's ability to address public access issues.

2. What priority was this area previously and what priority is it now for developing a 309 strategy and allocating 309 funding and why?

Last Assessment: HIGH **This Assessment: HIGH**

Public Access is still an important priority for Texas. People continue to migrate to the coast for recreational travel and for establishing permanent residences. Thus, there is a vested interest by local governments, their citizens, and visitors in maintaining high quality facilities. Communities depend upon their beaches and bays to attract recreational travelers to boost their economies. Tourists expect and depend on coastal infrastructure to provide them with first-rate amenities. Texas has an extensive coastline, the third highest market share of nature-based travel, and is the number one bird watching destination in the country. In order to keep pace with population growth and the continually expanding coastal tourism industry, the coastal region must update and maintain shoreline access infrastructure to address the public's current and future needs for adequate and accessible public access.

Cumulative and Secondary Impacts

Section 309 Programmatic Objectives

I. Develop, revise or enhance procedures or policies to provide cumulative and secondary impact controls.

Resource Characterization

1. Identify areas in the coastal zone where rapid growth or changes in land use require improved management of cumulative and secondary impacts. Provide the following information for each area: type of growth or change in land use, rate of growth or change in land use, and types of cumulative and secondary impacts.

Texas has experienced significant population growth. Nowhere is this more evident than in the coastal counties, where approximately 25 percent of the state's 20 million people reside.

Coastal counties where significant growth or changes in land use have occurred are Harris, Brazoria, Galveston, Nueces, San Patricio, Aransas, and Cameron. Over the years the Galveston Bay area has become increasingly urbanized. About 20 percent of the 3.9 million people in the five-county area around the Galveston Bay system live within two miles of the bay and its tidally influenced tributaries. The Houston-Galveston metropolitan area boasts heavy industry, internationally significant shipping and transportation activities, high-rise office and residential buildings, single-family subdivisions, and apartment complexes. Galveston Island is, for the most part, highly developed as a recreational/resort area, with single- and multi-family housing developments and industry also present. The Port of Houston is the largest U.S. port in foreign waterborne commerce, second in total tonnage, and 8th largest in the world in size. Industrial activities, especially petroleum and petrochemical industries, are common around the Houston Ship Channel. Other heavy industry is located in the Texas City and Brazos port areas. The majority of growth in this area, between 1990 and 2005, has occurred north and west of Houston proper. However, a recent trend has seen expanded growth eastward into Chambers County, a predominately rural population and southward into Galveston and Brazoria counties. In Galveston and Harris counties, over 90 percent is considered urban and in Brazoria County, the urbanized area is approximately 71 percent.[1]

Cumulative and secondary impacts in the Galveston Bay area occur primarily from point source discharges of wastewater, NPS pollution, dredging, and subsidence. Most of the streams receive treated domestic and industrial wastewater, as well as agricultural and urban runoff. Nutrient levels, especially of phosphorus, are consistently elevated in the tidal areas. Depressed D.O. levels occur in some tidal segments. Bacteria levels are frequently elevated and may cause non-attainment of the fishable and swimmable standards. As of November 1, 2003, 58.7 percent (306.2 square miles) of the Galveston Bay complex does not support or only partially supports shellfish harvesting[2].

[1] U.S. Census Bureau, Census 2000

[2] Seafood and Aquatic Life Group, Department of State Health Services

The population of the Corpus Christi region, approximately 400,000 in 2000, has not grown to the extent that the Houston-Galveston area has. Land use in the area is dominated by agricultural and ranching activities, although petrochemical industries occur along the Corpus Christi Ship Channel. Corpus Christi is the nation's 5th largest port in total tonnage. Hotels, housing developments, and condominiums are abundant on north Padre Island, Mustang Island, and adjacent bayside areas. Development in these areas has continued to increase as the retirees and urbanites move to warmer climates and seek coastal vacation homes. Cumulative and secondary impacts occur primarily from point source discharges of wastewater, reduced amounts of freshwater inflow in semiarid regions prone to drought, unknown nonpoint sources of bacteria (suspected to be natural, although failing septic systems and urban run-off may be a factor) and dredging. Phosphorus is of concern in the Nueces River tidal segment. Elevated levels of some heavy metals have been found in sediments of the tidal section. As of November 1, 2001, 36.9 percent (179.4 square miles) of the Corpus Christi Coastal Bend bays system (including San Antonio, Copano, Corpus Christi, Nueces, and Baffin Bays and the Laguna Madre) does not support shellfish harvesting.

South Padre Island and the lower Laguna Madre in Cameron County are highly developed recreational/resort areas with high-rise condominiums, hotels, motels, single-family homes, and supporting facilities, such as marinas, restaurants, and shopping areas. Cameron County's population has increased by 30 percent between 1990 and 2000. In addition, counties landward of the CMP Boundary within the Rio Grande Valley have increased by 50 percent, which does not include the large number of undocumented immigrants. Cumulative and secondary impacts occur primarily from NPS pollution, including untreated sewage, dredging, and shoreline construction. As of November 1, 2003, shellfish-growing areas in South Bay support shellfish harvesting.

An additional 46.9 percent (448.1square miles) of the shellfish harvesting areas along the Texas coast do not support or only partially support the designated use.

Texas continues to lose coastal wetlands and submerged aquatic vegetation, both from direct impacts and from cumulative and secondary impacts, primarily from dredging, NPS pollution (increased nutrients), and shoreline construction. Recent estimates of wetland loss show that estuarine emergent wetlands decreased by 9.5 percent (30,400 acres) between the mid-1950s and the early 1990s and palustrine emergent wetlands decreased by 29 percent (235,129 acres) during that same period Almost all submerged aquatic vegetation has been lost from the Galveston Bay system. However, parts of West Galveston Bay appear to be re-vegetating, both naturally and as a result of restoration efforts. In addition, both the upper and lower Laguna Madre have undergone dramatic changes in the amounts of submerged aquatic vegetation since the 1950s, primarily in response to salinity regime modifications (Seagrass Conservations Plan for Texas, TPWD 1999).

One of the most significant changes in the last five years is the U.S. Supreme Court decision in SWANCC v. the Army Corps of Engineers, which eliminated CWA jurisdiction over isolated waters that are intrastate and non-navigable. The SWANCC decision is discussed in greater detail in the Wetlands portion of this report. Hundreds of acres of isolated wetlands are being lost in the

coastal areas of Texas. Most of this loss is occurring in the Houston-Galveston area with limited mitigation required.

2. Identify areas in the coastal zone, by type or location, which possess sensitive coastal resources and require a greater degree of protection from the cumulative or secondary impacts of growth and development.

Area	**Cumulative and Secondary Impact Threats**
Coastal wetlands	NPS pollution, dredge and fill, some shoreline construction
Submerged aquatic vegetation	Dredging, increased nutrients, some shoreline construction
Oyster reefs	Dredging, point and NPS pollution
Tidal sand and mud flats	Dredge and fill, some shoreline construction
Coastal preserves	NPS pollution
Critical dune areas	Construction and fill
Shore areas	Shoreline construction
Submerged lands	Dredging and residential dock construction.
Endangered/Threatened species critical habitat	Dredging, construction and fill

Management Characterization

1. Identify significant changes in the state's ability to address cumulative and secondary impacts since the last assessment. Provide the following information for each change: characterize the scope of the change, describe recent trends, identify impediments to addressing the change, and identify successes in improved management.

Since the last assessment, Texas received conditional approval on its Coastal NPS Program from NOAA and EPA in July 2003.

There are a number of management measures that Texas must address before receiving full approval of the Coastal NPS Program. Areas in which conditions must still be met include new and existing development; watershed protection; new and operating onsite disposal systems; roads, highways, and bridges; and hydromodification.

The Council funded a number of projects using Coastal NPS funds to address cumulative and secondary impacts from NPS pollution. These included funding the implementation of water quality management plans on agricultural lands along the Texas coast; development and implementation of the Clean Texas Marina Program; several wetland restoration projects that address NPS pollution; installation of sanitary and bilge water pump outs; development of the Texas Coastal Watershed Center in support of the national Nonpoint Education for Municipal Officials (NEMO) program; and several education and outreach projects.

Like other states, Texas has increased its focus on the development of management plans aimed at the restoration of surface water quality. The primary objective is to address water bodies, including coastal waters, which are on the federal CWA §303(d) list as impaired and not

currently meeting designated, beneficial water uses. In addition to other state and federal funds, §309 funding has been used to support this state priority. Examples include funds for the development of a TMDL for Oso Bay and the Laguna Madre (D.O.), Copano Bay (bacteria), Nueces Bay (zinc), and Armand Bayou (D.O.).

Conclusion

1. Identify priority needs or major gaps in addressing the programmatic objectives for this enhancement area that could be addressed through a 309 strategy.

The amount of shoreline hardening that has occurred in Texas' bays and estuaries over the past 10 years is unknown. The last coast-wide inventory was completed in 1995 (BEG, Environmental Sensitivity Index project). The permitting agencies, primarily the U.S. Corps of Engineers, are required to consider cumulative and secondary impacts when permitting shoreline structures; e.g., bulkheads, revetments, and docking facilities. Without current information on the extent of shoreline hardening in Texas, it is difficult to accurately determine the cumulative impacts of a proposed activity. Furthermore, the secondary impacts of shoreline hardening are not well understood. An analysis of past projects and their impacts on the natural shoreline environment would assist the predictive capabilities of permitting decisions in the future.

In addition, rapid development along the coast, especially in rural areas, is a difficult issue for local governments working to balance growth with preservation of natural resources. Encroachment into and destruction of natural habitats is causing an increase in cumulative and secondary impacts along the coast. Local governments are in need of assistance. Providing technical assistance to local governments will increase the likelihood that officials employ sustainable planning techniques to maintain the integrity of the natural environment.

Texas would benefit from the development of a data management system to store coastwide information related to cumulative and secondary impacts. A database developed to store NCMPMS data could act in this capacity, leading to more informed decision-making. The NCMPMS requires the tracking certain information relative to cumulative and secondary impacts, and could easily be expanded to include other information relevant to enhancing the state's ability to address cumulative and secondary impact issues.

2. What priority was this area previously and what priority is it now for developing a 309 strategy and designating 309 funding and why?

Previous Assessment: HIGH **This Assessment: HIGH**

Rapid growth and changes in land use in the coastal zone continues to have adverse effects on Coastal Natural Resource Areas (CNRAs). For example, coastal wetlands and submerged aquatic vegetation continue to be lost and significant changes in natural communities resulting from NPS pollution, dredging, and shoreline construction are occurring. Comprehensive baseline data and characterization is needed to help the state develop and enhance procedures and policies to address cumulative and secondary impacts.

Coastal Hazards

Section 309 Programmatic Objectives

I. Direct future public and private development and redevelopment away from hazardous areas, including the high hazard areas delineated as FEMA V-zones and areas vulnerable to inundation from sea and Great Lakes level rise.

II. Preserve and restore the protective functions of natural shoreline features such as beaches, dunes, and wetlands.

III. Prevent or minimize threats to existing populations and property from both episodic and chronic coastal hazards.

Coastal Hazards Characterization

1. Characterize the general level of risk in your state from the following coastal hazards:

Hurricanes, Flooding, and Storm Surges

Coastal storms represent a major threat to people, property, and the natural environment along the Texas coast. The state's wide continental shelf and gently sloping shoreline make Texas more vulnerable to property damage resulting from coastal storms. In fact, a hurricane or tropical storm hits the Texas coast about once every two years. In 1961, Hurricane Carla (category 4) caused a storm tide of nearly 15 feet in Galveston and 21 feet in Port Lavaca. In 1983, Hurricane Alicia's (category 2) 102-mph winds and storm tide of 11 feet resulted in flooding and erosion on the upper Texas coast. Tropical Storm (TS) Josephine in October 1996 impacted the upper Texas coast with high tides and did tremendous damage to homes and caused severe beach erosion. In September 1998, TS Frances devastated beachfront property along the Texas coast. High tides destroyed dunes and homes, resulting in thousands of tons of debris scattered along the beach. TS Frances caused severe erosion of the upper Texas coast, especially in Galveston, Brazoria and Jefferson counties.

In August 1999, Hurricane Bret (category 3) hit an uninhabited part of the south Texas coast between Corpus Christi and Brownsville, but due to the location of landfall, damage to property was much less than if it had hit a populated area of the coast. In June 2001, TS Allison caused extensive flooding and beach erosion along the upper Texas coast. In July 2003, Hurricane Claudette (category 1) impacted the middle Texas coast at Matagorda Island, just east of Port O'Connor. Impacts from Claudette included damage to homes and severe beach erosion.

In late August 2005, Hurricane Katrina made landfall in the New Orleans area as a category 4 hurricane. One day prior to landfall, Hurricane Katrina intensified to a category 5 with winds of 150 kts. Hurricane Katrina was one of the strongest storms to impact the Gulf Coast in the past 100 years. Although the focus of the devastation felt by Katrina was along the central Gulf Coast, tides, as much as 8 feet above normal, caused erosion and property damage along much of the Texas coast.

In September 2005, coastal evacuation plans were implemented in response to Hurricane Rita (category 3 at landfall). Serious logistical problems and long delays were experienced in direct relationship to the population growth and infrastructure development along the Texas coastal area. While landfall was east of the Houston-Galveston metropolitan area, the impacts of the storm relative to the coastal area evacuations created widespread disruptions throughout eastern Texas.

Coastal flooding is also a threat to public safety and natural resources, particularly since elevations of the Texas coast are generally low (less than 10 feet). The only exception is in dune areas along the coastal bend and lower coast, where dunes may reach 40 feet above mean sea level. The low elevation in conjunction with the gentle landward slope of the Texas coast increases the potential threat from storm surge, particularly on portions of the upper Texas coast that lack adequate protection from dune systems to absorb associated wave energy. This problem is exacerbated by high rates of erosion and subsidence in some areas (e.g., 4.63 mm/yr in Galveston). The U.S. Army Corps of Engineers will be developing a SLOSH model for Texas as part of a gulf-wide effort to map the extent of storm surge and quantify flood potentials. In addition, the BEG has completed lidar surveys for most of the Texas coast, with a focus on the more developed areas of the coast. The lidar data collected is processed into one-meter digital elevation models, which are available upon request.

Texas leads the nation in National Flood Insurance Program (NFIP) paid claims. In Texas, from January 1, 1978 to December 31, 2004, the NFIP has paid 167,549 claims totaling $2.7 billion. Of the total claims paid, approximately 67 percent ($1.8 billion) were along the Texas coast. During the 2004 hurricane season (June 1 – November 30), the NFIP paid Texas flood insurance policy holders approximately $46.5 million to recover from storm damage. One hundred and sixty three (163) communities along the Texas coast are subject to flooding. Only eight of these do not participate in the NFIP.

Erosion

Erosion is a serious hazard on the Texas coast. Many homes, highways, and commercial establishments along the coast are threatened by continual shoreline erosion. Several processes contribute to long-term (chronic) or short-term (storm-induced) shoreline erosion. These processes include climate, tides, relative sea-level change, coastal storms, and the amount and rate of sediment dispersal. Coastal erosion affects both Gulf and bay shorelines, resulting in the loss of agricultural, industrial, and residential land and wetlands. Erosion is attributable to sea level rise and to the fact that sediment removal by wave energy exceeds that supplied to the beach by currents. Historical climatic changes (from wetter to drier), and construction of reservoirs on Texas' streams, have decreased the volume of sediments carried to the Texas coast by rivers. Approximately two-thirds of Texas bay shores are eroding at rates of two to nine feet per year. Approximately 62 percent of the Gulf facing shoreline is eroding at rates of two to 10 feet per year with some areas, particularly along the extreme western end of Galveston Island, which has erosion rates greater than 10 feet per year.

Jetties, groins, and breakwaters, which are designed to trap sediments, can accelerate localized coastal erosion. By withholding sand that would normally be carried downdrift to shorelines they create a deficit in the sand supply. In some areas, structures that are designed to protect the shorefront become exposed from erosion and end up obstructing beach access. Removal of

sediment from the coast, including commercial extraction of sediments from coastal rivers, dredging and disposal of sediment in confined or upland areas, and using improper beach cleaning techniques is also of concern.

In 1991, the 72nd Texas Legislature passed Senate Bill 1053, designating the GLO as the lead state agency to draft a plan to help respond to Texas' eroding shoreline problems. The *Texas Coastwide Erosion Response Plan: A Report to the 75th Texas Legislature* outlines rules and guidelines for erosion avoidance and remediation and prepares for future erosion response. It describes the state's existing policies for managing coastal erosion and methods of erosion response for bay and Gulf shorelines. It also proposes new state policies, one of which is to establish a state-funding source for erosion response projects. This funding would help Texas attract federal money for coastal erosion projects. The plan discusses different methods of shore protection, mechanisms for funding erosion response, and provides seven policy recommendations for improving erosion response. It also lists eight criteria for ranking coastal erosion, and highlights nine critical erosion areas along the Texas coast and includes recommendations for their improvement.

In 1999, the 76th Texas Legislature created the CEPRA and put the GLO in charge of its administration. The 76th Legislature provided $15 million in state appropriations for cycle 1 in the 2000-2001 biennium to begin restoring and preserving eroding beaches, dunes, wetlands and bay shorelines along the Texas coast. This program represents the first-ever coastal erosion program in Texas and entails a coordinated effort of state, federal, and local entities to conduct, in the first cycle, 42 erosion response projects and studies. For cycle 2, funded in the 2002-2003 biennium, the 77th Texas Legislature provided an additional $15 million in state appropriations, and 53 priority projects and studies were funded. For cycle 3, funded in the 2004-2005 biennium, the 78th Texas Legislature provided an additional $7.32 million in state appropriations, and 18 priority projects and studies are currently underway. In cumulative terms, implementation of the CEPRA program through the first three funding cycles has involved 31 project partners working with the GLO on 113 projects and studies spanning 14 coastal counties. Project partners have included federal and state agencies, local governments, property owners associations, estuary programs, and non-profit organizations.

The BEG is working with the GLO to identify and quantify eroding areas through the Texas Shoreline Change Project (TSCP). The overall goal of the TSCP is to establish a state-of-the-art regional shoreline-monitoring and shoreline-change analysis program that will help solve coastal erosion and storm hazard problems along the bay and Gulf shorelines of Texas. The TSCP will do the following: 1) provide Texas with a comprehensive, up-to-date, digital data base of historical shoreline positions and average annual rates of shoreline change and make the data available to the public through the internet, 2) provide a regional framework for conducting local studies related to specific erosion control projects, 3) provide data for assessing the susceptibility of the coast to episodic erosion and flooding by storms, and 4) make available observations on the causes of shoreline change and make them understandable to the general public through the internet and paper reports.

Sea Level Rise/Subsidence

Coastal recession and erosion is directly related to sea level rise. Since Texas has a wide continental shelf and the beaches are relatively flat, any rise in sea level can result in a significant shoreline recession. For example, the relative rise in sea level in Galveston has been measured at 0.63 cm/year.

Subsidence is a primary contributor to shoreline loss, loss of wetland habitat, and erosion. Dikes, dams, levees, and seawalls have altered the natural landscape in many places, sometimes affecting wetlands by diverting water from its natural course. In some areas of Texas, groundwater pumping, oil and gas extraction, and sediment consolidation has led to subsidence. This impact alone has led to the loss of about 24,600 acres of marshland, existing since approximately the 1950s, in the Galveston Bay area.

Geologic Hazards (Including Earthquakes and Tsunamis)

Texas is at low risk for experiencing geologic hazards such as earthquakes or tsunamis.

2. If the level of risk or state of knowledge about any of these hazards has changes since the last assessment, please explain. Also, identify any ongoing or planned efforts to develop quantitative measures for this issue area.

A state committee has been formed to address subsidence issues in Texas. So far, the committee has had three meetings. With the exception of the Houston-Galveston Subsidence District, created by the Texas Legislature in 1975, Texas does not have the vertical data to measure subsidence. As a result, we are not able to determine how significant subsidence is in Texas at this time. Texas A&M University is forming a program to start collecting vertical data, and the recently created state committee will decide who, at the state level, will be responsible for monitoring vertical changes.

As a requirement of the NCMPMS, Texas will assess and implement the performance and contextual measures developed by OCRM for coastal hazards. Baseline data will be collected for these measures for the period of Oct. 1, 2007 to Sept. 30, 2008. Data will be collected annually thereafter and reported to OCRM to be compiled nationally across all state coastal management programs. There are currently no other ongoing or planned efforts to develop quantitative measures for this issue.

3. Summarize the risks from inappropriate development in the state, e.g., life and property at risk, publicly funded infrastructure at risk, resources at risk.

Development in the coastal zone is inherently risky. Inappropriate development, however, can directly and indirectly intensify the level or risk. The risks associated with inappropriate development can include loss of state natural resources (CNRAs), loss of publicly funded infrastructure such as roads, loss of private property, and loss of life. Direct impacts may occur as a result of constructing in areas naturally prone to a higher degree of risk, such as barrier islands or in close proximity to the LOV on the gulf facing shoreline. Indirect impacts may occur from loss of natural resources as a result of development, such as wetlands or dune systems, which act as natural buffers to storm activity.

Management Characterization

1. In the table below, indicate significant changes to the state's hazards protection programs since the last assessment.

Mechanism	Changes since Last Assessment
Building setbacks/restrictions	**None**
Methods for determining setbacks	**None**
Repair/rebuilding restrictions	**Significant**
Restrict "hard" shoreline protection structures	**Significant**
Promotion of alternative shoreline stabilization methods	**Moderate**
Renovation of shoreline protection structures	**None**
Beach/Dune protection	**None**
Permit compliance program	**None**
Inlet management plans	**None**
SAMP's	**None (Prohibited by state law)**
Local hazards mitigation planning	**None**
Local post-disaster redevelopment plans	**None**
Disclosure requirements	**None**
Publicly funded infrastructure restrictions	**None**
Public education and outreach	**None**
Mapping/GIS/tracking of hazard areas	**None**

2. For categories with changes: summarize the change, specify whether it was a 309 or other CZM driven change and specify funding sources, and characterize the effect of the changes in terms of both program outputs and outcomes.

Repair/Rebuilding Restrictions

The 78th Texas Legislature in 2003 approved House Bill 1457, which gives the Texas Land Commissioner the authority to issue a two-year moratorium (Temporary Order) on removing structures from the public beach that have become seaward of the line of vegetation after a storm. While a Temporary Order is in effect, a local government may allow repairs to a house if the local government determines that the repair is solely to make the house habitable; complies with rules adopted by the Land Commissioner; does not increase the footprint of the house or involve the use of concrete, Fibercrete, or other impervious materials seaward of the line of vegetation; does not include the construction of an enclosed space below the base flood elevation and seaward of the natural line of vegetation; and does not include construction underneath, outside or around the house, other than for reasonable access to the house. The GLO issued the first set of Temporary Orders on June 8, 2004 for 116 homes that were seaward of the line of vegetation (LOV). These Temporary Orders are scheduled to expire on June 8, 2006. This is not a 309 change.

Prior to House Bill 1457, structures that became seaward of the natural line of vegetation (i.e., on the public beach), were subject to legal action by the state Attorney General for removal.

Restrict "Hard" Shoreline Protection Structures
Coastal governments began installing geotextile shore protection projects along the Gulf coast. Since these types of projects were subsidized with federal dollars and new to Texas, in 2001, the GLO drafted guidelines, approved by the Council, to establish criteria for Council members to determine whether these types of projects were consistent with Council policies and with state statutes and regulations. The criterion establishes guidelines for the size, use, and placement of geotextile shore protection projects, and only governmental entities would qualify to conduct these types of projects. This was not a 309 change.

Conclusion

1. Identify priority needs or major gaps in addressing the programmatic objectives for this enhancement area that could be addressed through a 309 Strategy.

The Department of Emergency Management's (DEM) State of Texas Mitigation Plan states that 26 percent (5,421,473) of the state's population is vulnerable to tropical storms and hurricanes, with an estimated property loss in excess of $20 billion depending upon the area affected. In light of the recent increase in storm activity in the Gulf of Mexico and the destruction caused by Hurricanes Rita and Katrina, it is critical that Texas begin to examine the adequacy of its framework for mitigating natural hazards at all levels of government, including an assessment of existing efforts and opportunities for increased collaboration between the state and local governing bodies (e.g., DEM and CMP). In addition, it would be beneficial to assess the effectiveness of construction codes and land use planning policies as well as identify best practices and emerging technologies to improve efforts to mitigate, prepare for, and respond to coastal natural hazards in the coastal zone.

A significant impediment to reducing the impacts of coastal hazards is a lack of public understanding and acceptance of the risks involved in building on a barrier island and living in a coastal environment. Prior to Hurricane Rita, it had been approximately 23 years since Texas had been severely impacted by a major hurricane of category 2 or above. Most property owners and developers in Texas have become complacent to the potential dangers of developing along the Texas coastline. Larger scale development and higher scale homes are being constructed in areas that offer little or no protection from a major storm. Encroaching development can further exacerbate the loss of dunes by preventing the natural landward migration of the dune system, effectively increasing the risk to coastal communities. An analysis of the status and trends of the beach/dune system is needed in Texas, particularly in the more developed areas of the coast, to help state and local officials and interest groups understand the dynamics of the system, identify critical trends, and prioritize their efforts in a manner most effective for the resource.

Texas is expected to double in population in the next few decades. With this increased population there will come an increased demand for coastal development for homes, condominiums, and resorts. Current state law does not restrict the location of development landward of the LOV. In

addition to potential adverse impacts to the beach/dune system from development (e.g., direct loss), structures located adjacent to the LOV may become seaward of the LOV as a result of erosion. Consequently, these structures become directly exposed to storm and high tide events without the protection offered by dunes and dune vegetation and may require appropriate actions by the state for removal from the public beach easement as mandated by the OBA. One potential solution to this problem is the adoption of development setbacks along the Texas coast. Information on the viability of setbacks, however, is lacking. An unbiased cost/benefit analysis to determine the economic advantages or disadvantages of setbacks from the shoreline would be beneficial and would allow for an informed discussion of setbacks at the state level as a potential alternative.

Beach nourishment is increasingly being used in Texas to slow shoreline retreat. The Gulf shoreline suffers some of the highest erosion rates in the nation due to a shortage of new sediments in its coastal waters (exceeding 10 ft/yr in certain locations). The identification of potential sand sources is critical to beach nourishment remaining a viable option. Previous studies have supported research on specific sand sources at specific sites. These offshore sand source investigations have enabled Texas to secure valuable information for specific areas and ensure that work will be continued in future years. The compilation of the knowledge gained from these individual investigations into a single protocol to guide future research efforts on offshore sand sources by state agencies and local governments would be beneficial and would encourage the use of beach nourishment as an alternative to coastal armoring.

Texas would benefit from the development of a data management system to store coastwide coastal hazard information. A database developed to store NCMPMS data could act in this capacity, leading to more informed decision-making. The NCMPMS requires the tracking of certain activities relative to reducing coastal hazards, and could easily be expanded to include other information relevant to enhancing the state's ability to address coastal hazard issues.

2. What priority was this area previously and what priority is it now for developing a 309 strategy and designating 309 funding and why?

Previous Assessment: HIGH **This Assessment: HIGH**

Changing land use patterns, population growth, relative sea level rise, limited regulation of construction practices and reduced institutional history on storm response may be exponentially increasing the vulnerability of the Texas coast to natural hazards. In addition, increased attention to technological hazards as a source of potential terrorist activities has created a dilution of resources available to focus on coastal natural hazards.

Tropical Atlantic hurricane forecast from Colorado State University indicates that the Tropical Atlantic will be experiencing the most active hurricane seasons on record for the next several years. The 2005 Hurricane Season resulted in two catastrophic storms (Katrina and Rita), both reaching Category 5 status. Although weakening occurred prior to landfall, the two storms resulted in significant impacts to coastal communities and the environment. With the potential for storms striking along the Texas Coast predicted to increase over the next several years, Texas needs to adopt a more proactive approach in mitigating and preparing for high-category storms.

Aquaculture

Section 309 Programmatic Objectives

I. Enhance existing procedures and long-range planning processes for considering the siting of public and private marine aquaculture facilities in the coastal zone.

II. Improve program policies and standards, which affect aquaculture activities and uses so as to facilitate siting while ensuring the protection of coastal resources and waters.

Resource Characterization

1. Briefly describe the state's aquaculture activities.

According to information collected by the Texas Aquaculture Association (TAA), Texas farmers produced 11,791 metric tons (26 million pounds) of aquaculture products in 2004, generating an estimated farm-gate value of $42.5 million and contributing more than $127 million to the state's economy. The major products were marine shrimp, sport fish (red drum), catfish, hybrid striped bass, tilapia, aquatic plants, and crawfish. The Texas Department of Agriculture reported 19 new aquaculture facilities in 2003 -- mostly catfish. Depressed shrimp prices and increased farm-gate prices for catfish has further stimulated catfish production. The channel catfish is currently the largest aquaculture production crop in Texas at 5,215 metric tons in 2004 ($6.9 million farm-gate value). The second largest and most valuable crop is the Pacific white shrimp, which set a state production record in 2003 at 4,081 metric tons ($18 million farm-gate value) and 3,600 metric tons in 2004 worth $15.88 million. Over the last 14 years, the Texas shrimp aquaculture industry has produced 31,264 metric tons of shrimp with a farm-gate value of approximately $187 million, contributing $561 million to the state's economy.

Some coastal shrimp farms have converted to hybrid striped bass production. In 2004, 907 metric tons of hybrid striped bass was produced ($3.5 million farm-gate value, according to TAA figures). The Texas coast is home to three red drum aquaculture facilities, covering 185 surface hectares and producing approximately 1,360 metric tons annually ($6.3 million farm-gate value). The state also has a large aquatic plant, or water garden industry, with significant sales of ornamental fish. Water gardens generate an estimated $7 million in sales annually in Texas.

The state is seeing a growing interest in the potential for offshore aquaculture in the Gulf of Mexico. While no offshore aquaculture facilities currently exist in Texas state waters, it is believed that it could help alleviate the U.S. seafood trade deficit, which stood at $7.38 billion in 2004. The USDA is predicting $7.4 billion deficit in 2005.

2. Briefly describe environmental concerns. Also, describe any use conflicts and future threats.

Environmental concerns of the Texas aquaculture industry are three-fold. First, discharges from aquaculture production facilities have the potential to discharge total suspended solids (TSS). Prior to regulations and permitting of certain shrimp farms in the coastal zone, there were incidents when uncontrolled TSS discharges caused turbidity and sedimentation problems in

localized areas that may contain sensitive seagrasses. The potential for TSS adverse impacts has been greatly reduced by the establishment of TSS effluent limitations into permits. In turn, the limitations have resulted in advances in wastewater management at shrimp farms and decreases in the volume of discharge of wastewater. Among the advances are re-circulation and reuse of wastewater and constructed wetlands for sedimentation and polishing.

There have been two accidental releases (both in the 1990s) of exotic Pacific white shrimp to Texas. The potential ecological impacts of this introduction are unknown. In addition, the presence of two viral diseases: Taura Syndrome Virus and White Spot Syndrome Virus potentially pose a threat to native shrimp stocks and pond stocks. Another disease, the Yellowhead Virus, was misdiagnosed in Texas in 1995 as a false positive. It has been shown since that the Yellowhead Virus has never been in Texas and for the most part has been confined to the Eastern Hemisphere.

In response to the threat of introduced viruses, TPWD has tested wild shrimp for exotic diseases. TPWD has found viruses in native shrimp (a white-spot-like virus) since 1997 as a part of the routine monitoring program of nine Texas bays. TPWD collected and tested shrimp specimens for viruses each month from 1997 to 2000. The virus has not been found in pond-raised shrimp. According to the TPWD, the most likely source of this virus is through imported shrimp being sold for bait or from processing plant wastes. TPWD has again begun collecting shrimp specimens from Texas bays to monitor for viral infection.

Texas has traditionally been a major supplier of shrimp to the U.S. seafood market. The Texas commercial shrimping industry supports 15,000 jobs and contributes $600 million per year to the state's economy. Texas shrimp farmers also contribute significantly to the state's economy. In the last 13 years, the Texas shrimp aquaculture industry produced 27,664 tons or 61 million pounds of shrimp with a farm-gate value of approximately $171 million, generating a $513 million economic impact on the state's economy. Imports of shrimp to the United States increased 76 percent from 1954 to 1993. The development of aquaculture in Ecuador, China, and Thailand has substantially increased imports of shrimp. These imports have an impact on prices paid to Texas shrimpers and shrimp farmers. As supply increases from imports, market forces drive the price of Texas shrimp lower. Economic viability of Texas shrimpers and shrimp farmers in the future will be affected in part by the amount of total shrimp available in worldwide markets (TPWD, 1997). Other potential use conflicts, such as with recreation and navigation, are minimal.

Management Characterization

1. Identify significant changes in the state's ability to address the planning for and siting of aquaculture facilities since the last Assessment. Provide the following for each change: characterize the scope of the change, describe recent trends, identify impediments to addressing the change, and identify successes.

The Texas Department of Agriculture has the authority to regulate aquaculture facilities through license, fee, and marketing; however, TPWD retains control over all exotic species (TPWD, 1997). The TCEQ initially adopted National Pollutant Discharge Elimination System (NPDES)

permitting rules for aquaculture production facilities in 1997. The TCEQ changed NPDES to the Texas Pollutant Discharge Elimination System (TPDES), as delegated by the Environmental Protection Agency (EPA). Within the Texas coastal zone, all shrimp production facilities must be authorized by individual TPDES permit. Non-shrimp facilities or short-term research facilities that discharge less than 30-days annually and produce small quantities of food are exempt from individual permit requirements consistent with TPDES requirements. However, such facilities must notify the TCEQ and are subject to case-by-case review. A general permit to authorize discharges from these smaller aquaculture operations is in the later stages of processing and is targeted for issuance prior to the end of 2005. The TCEQ, the TDA, and the TPWD developed an MOU in 2001, which governs coordination by the agencies on aquaculture regulatory matters. The TPWD assesses the suitability of a site for discharge and provides recommendations to the TCEQ during the permitting process. For facilities requiring permits, chemotherapeutic drugs should be limited to those either currently approved or authorized within an FDA Investigational New Animal Drug (INAD) Study.

Rules that have been adopted in response to the potential for native shrimp stocks to be affected by diseases carried among the Pacific White Shrimp allow TPWD biologists to quarantine diseased exotic shellfish and require operators to immediately notify TPWD regarding any mortalities of farm-raised exotic shellfish, have their exotic shellfish certified as disease-free by a department-approved disease specialist, and show they possess or have applied for the appropriate TCEQ permit. Finally, a 1980s rule provides criteria for taking of broodfish from public waters for their use in aquaculture. This rule establishes collection notification and reporting requirements, permit issuance, revocation and denial terms and criteria, restitution values, and appeal procedures (TPWD, 1997).

In June 2004, the EPA finalized federal effluent limitation guidelines at 40 CFR 451 that establish regulations for specific types of aquaculture operations. The regulations include requirements for INADs, extralabel drug usage, reporting of spills and structural failures, and the development and implementation of a Best Management Practices plan to address solids controls, materials storage, structural maintenance, record-keeping, and training requirements. These new requirements are proposed to be included in individual TPDES Permits, as applicable.

Conclusion

1. Identify major gaps in addressing the programmatic objectives for this new enhancement area that could be addressed through a 309 Strategy.

The new rules, discussed above, are a culmination of a three-year effort by the TCEQ, TPWD, and the TDA to address some of the environmental concerns of on-shore or near-shore aquaculture raised by the aquaculture industry. The agencies are operating under a MOU that is designed to better manage aquaculture discharges, introductions, and disease monitoring. Together, with the implementation of the CMP, the industry should be allowed to operate under the new rules for a period of time before an assessment of their effectiveness can be ascertained

2. What priority was this area previously and what priority is it now for developing a 309 Strategy and designating 309 funding and why?

Previous Assessment: LOW **This Assessment: MEDIUM**

In addition to state efforts in aquaculture, the U.S. Ocean Commission Report and the President's U.S. Ocean Action Plan suggest promotion of aquaculture as a national policy. The Ocean Commission Report acknowledged the potential of aquaculture, especially offshore aquaculture, to meet the growing demand for seafood. The commission highlighted the lack of a clear, consistent regulatory regime for projects located in offshore waters. The Bush administration has filed federal legislation proposing to open coastal waters – up to 200 miles offshore – to aquaculture. The administration is looking at oil and gas platforms in the Gulf of Mexico as potential sites for offshore aquaculture activities.

The CMP is seeing, for the first time, permit applications for offshore aquaculture facilities come before it for consistency review. Currently, the state does not have a framework in place for permitting these operations because of the lack of information available regarding the potential impacts of offshore aquaculture. Because of the anticipated expansion of offshore aquaculture facilities into Texas waters, the lack of available scientific data regarding the potential impacts of these facilities, and current holes in how these operations are permitted, the Council is moving this area from a low to a medium priority.

Energy and Government Facility Siting

Section 309 Programmatic Objectives

I. Enhance existing procedures and long-range planning processes for considering the needs of energy-related and government facilities and activities of greater than local significance.

II. Improve program policies and standards, which affect the subject uses and activities so as to facilitate siting while maintaining current levels of coastal resource protection.

Management Characterization

1. Identify significant changes in the state's ability to address the siting of energy and government facilities since the last Assessment. Provide the following information for each change: characterize the scope of the change, describe recent trends, identify impediments to addressing the change, and identify successes.

There have been no significant changes in the state's ability to address the siting of energy and government facilities.

Conclusion

1. Identify priority needs of major gaps in addressing the programmatic objectives for this enhancement area that could be addressed through a 309 Strategy.

The Texas coast has been and continues to be a major center for oil and gas exploration and related manufacturing infrastructure. Two thirds of all U.S. petrochemical production and almost a third of the nation's petroleum industry occur on the Texas Gulf Coast (Texas Comptroller of Public Accounts, 1996). The combined distillation capacity of Texas' 26 refineries totals nearly 4.5 million barrels per calendar day, equaling about 26 percent of the nation's refining capacity. Texas has the second largest crude oil proved reserves (including federal offshore) in the nation with 4,583 million barrels and ranks second in crude oil production behind federal offshore areas with a daily production rate of 1.1 million barrels. Petroleum infrastructure is extensive with a large network of crude oil, product, and liquefied petroleum gas (LPG) pipelines and storage facilities. Texas is home to two of the Strategic Petroleum Reserve's (SPR) four storage facilities: Bryan Mound near Freeport, Texas, and Big Hill near Winnie, Texas. Numerous ports line the Texas Gulf Coast, enabling the state to receive tankers carrying imports of crude oil and petroleum products. About 49 percent of all homes in Texas use electricity for heating, followed by natural gas with a 43 percent share (tonto.eia.doe.gov/oog/info/state/tx.html).

Texas, along with most of the country, is experiencing a burst of activity surrounding LNG. As of August 2005, Texas has five facilities approved by the Federal Energy Regulatory Commission (FERC), three proposed to FERC, one in the early planning stage, and six offshore along the Texas/Louisiana border and one offshore along the Texas/Mexico border. LNG is natural gas, primarily methane, which has been cooled to its liquid state at -260°F (162.2°C). Large tracts of

uplands are required for the construction of the onshore facilities, storage tanks, and pipeline infrastructure. The vessel berthing areas must be able to accommodate at least two vessels. A typical modern LNG ship is 975 feet long, 140 feet wide with a draft of 39 feet. Given the number of approved and potential onshore sites, the impacts to CNRAs could be significant.

With offshore terminals, the issues involve the regassification methods used by the facility. The typical method uses seawater to warm the liquid back to gas and then the super cooled water is released. There is little information about the possible impacts that these releases would have on fisheries and other marine life. It is argued that the entrainment, rapid temperature change and exposure to anti-fouling biocides by fish eggs and larvae could have detrimental effects on commercial and recreation fisheries

Breakthroughs in technology, like three-dimensional seismography, are expected to support a vigorous growth of the energy industries into the next decade. The primary tool used to consider the siting of these facilities and many others are Resource Management Codes (RMCs). RMCs are available in an electronic format, at (www.glo.state.tx.us/coastal/rmc/). These codes are lists of specific actions to be taken to avoid resource impacts on any given state tract management unit on submerged state-owned lands. They are coordinated among the state and federal resource agencies and updated each time a state tract is nominated for lease sale. Oil and gas companies, seismic operators, consultants and the public use these codes to site their new facilities. The U.S. Navy has also used these codes in siting facilities associated with their Mine Warfare Center of Excellence in Corpus Christi, Texas.

The major gap in addressing the programmatic objectives for this enhancement area is that RMCs do not exist for privately owned lands above tidal influence in the coastal zone, the availability of the codes could be improved, and the codes need to be updated.

Another issue that may be on the horizon for all states is wind energy. Information regarding the impacts to lands and wildlife, specifically birds, where the turbines are constructed, is limited. Locating turbines offshore needs further evaluation. State and federal agencies have expressed concerns that these structures may adversely affect wildlife, particularly Neotropical migratory birds that use the shoreline during fall and spring migrations. Currently, Texas has one proposed offshore wind energy facility and one facility proposed for onshore on private land.

2. What priority was this area previously and what priority is it now for developing a 309 Strategy and designating 309 funding and why?

Previous Assessment: LOW **This Assessment: MEDIUM**

The majority of energy or government facility siting, which is likely to impact CNRAs is occurring or expected to occur primarily on state-owned submerged lands. The state's existing wetlands protection program addresses impacts to these areas. Efforts to streamline wetlands permitting will also address this concern. Given the number of proposed LNG terminals along the Texas coast and the increasing interest in wind power, this enhancement area was elevated to a medium priority. Texas needs to begin examining ways to minimize potential impacts through

coordination with state and federal agencies, as well as the companies prosing to construct the facilities. This coordination will lead to the improved siting of facilities in the coastal zone.

Marine Debris

Section 309 Programmatic Objectives

I. Develop or revise programs that reduce the amount of marine and/or lake debris in the coastal zone.

Marine/Lake Debris Characterization

1. In the table below, characterize the extent of marine debris and its impact on the coastal zone.

The information below is based on the annual beach cleanup reports published by the Ocean Conservancy (formerly known as the Center for Marine Conservation).

Source	**Impact (Significant/Moderate/Insignificant)**	**Type of Impact (Aesthetic, resource damage, etc.)**
Recreational boaters	Insignificant	Aesthetic, resource damage
Commercial fishing	Insignificant	Aesthetic, resource damage
Offshore (operational, galley)	Moderate	Aesthetic, resource damage
Beachgoers	Significant	Aesthetic, resource damage, economic
Land-based (medical, sewage)	Insignificant	Aesthetic, resource damage, health
Storm drain	Moderate	Aesthetic, resource damage

2. If any of the sources above or their impacts have changed since the last assessment, please explain.

The prevailing currents in the Gulf of Mexico dump thousands of tons of trash on the Texas coast every year. Trash from offshore sources is declining, while land-based marine debris is increasing. Annex V of MARPOL, the Marine Plastic Pollution Research and Control Act, and GLO rules have helped to reduce marine debris originating offshore. The state continues to focus its resources on educational campaigns and waste reduction efforts statewide to reduce marine debris originating from land sources.

Local efforts are always underway for removal of derelict vessels. These efforts are undertaken on a case-by-case basis by local governments, NGOs, or state agencies using available funds or grant funding from a wide variety of sources. The CMP and CIAP have funded projects to remove derelict vessels in various areas of the coast. Also, TPWD has a program to remove old, abandoned crab pots from Texas bays. TPWD, TCEQ and GLO's Oil Spill Division conduct occasional cleanups along the upper Texas coast to remove buckets that wash ashore from offshore oil rigs.

3. Do you have beach clean-up data? If so, how do you use this information?

Each year, the GLO Adopt-A-Beach Program (ABB) conducts a fall beach cleanup comprised of volunteers. The Ocean Conservancy, formerly the Center for Marine Conservation, provides data cards for the volunteers to record the types of debris that they pick up during the event. The Adopt-A-Beach Program sends the data cards to the Ocean Conservancy, who then analyze and compile the data. A report is compiled from the data and the information is then used to identify the activities and general sources causing the debris. The final information is then used to educate the public, business, industry and government officials about the marine debris problem. AAB education efforts include a CD-ROM on beach litter, an AAB newsletter distributed to more than 2,000 people, visits to elementary schools, booths at community festivals and environmental fairs, and presentations at national and international conferences.

Years of data collection from the beach cleanups have helped to identify the sources of the debris on our coastline. The top 10 list of debris collected from Texas beaches is: 1) caps/lids, 2) cigarettes and cigarette filters, 3) food wrappers and containers, 4) plastic beverage bottles, 5) bags, 6) beverage cans, 7) cups/plates/utensils, 8) straws/stirrers, 9) glass beverage bottles, and 10) rope.

Years of data collection from the beach cleanups have helped to identify the sources of the debris on our coastline. Prior to the passage of the MARPOL Annex V Treaty, the majority of trash found on Texas beaches was from ocean-based sources. According to The Ocean Conservancy, land-based sources now contribute 70% of all trash found in the ocean. Texas data matches the above referenced material. Cleanup data and other Adopt-A-Beach program information can be accessed at www.texasadoptabeach.org.

Management Characterization

1. In the table below, identify significant state ocean management programs and initiatives developed since the last assessment.

Category	New Program/Initiative
State/local program requiring recycling	**None**
State/local program to reduce littering and wasteful packaging	**None**
State/local regulations consistent with Marine Plastic Pollution Research and Control Act	**None**
Marine debris concerns incorporated into harbor, port, marina and coastal solid waste management plans	**None**
Education and outreach programs	**Yes**

2. For the changes identified above, characterize the scope of the change, describe recent trends, identify impediments to addressing the change, and identify successes.

The Texas Sea Grant Extension Program is engaged in a monofilament recovery and recycling project throughout the coast as well as inland marinas.

Conclusion

1. Identify priority needs or major gaps in addressing the programmatic objectives for this enhancement area that could be addressed through a 309 Strategy.

Many of the state's programs dealing with reduction of marine debris at the source are voluntary rather than regulatory. Enforcement is lacking.

2. What priority was this area previously and what priority is it now for developing a 309 Strategy and designating 309 funding and why?

Previous Assessment: LOW **This Assessment: LOW**

This programmatic area remains a low priority for strategic planning purposes. However, the state will continue to commit resources to better address the problem, particularly in education and outreach.

Ocean Resources

Section 309 Programmatic Objectives

I. Develop and enhance regulatory, planning, and intra-governmental coordination mechanisms to provide meaningful state participation in ocean resource management and decision-making processes.

II. Where necessary and appropriate, develop a comprehensive ocean resource management plan that provides for the balanced use and development of ocean resources, coordination of existing authorities, and minimization of use conflicts. These plans should consider, where appropriate, the effects of activities and uses on threatened and endangered species and their critical habitats. The designation of specific marine areas should be considered.

Resource Characterization

1. In the table below, characterize ocean resources and uses of state concern and specify existing and future threats or use conflicts.

Resource or Use	Threat or Conflict	Degree of Threat	Anticipated Threat or Conflict
Resources			
Fisheries	Overfishing; bycatch; brown/red tide; water quality impairments	**Medium**	Loss of nursery habitat; spills/kills; freshwater inflows; NPS
Oil and gas		Low	Regulatory restrictions based on production impacts
Endangered species	Dredging and dredged material placement; development; marine debris; bycatch in commercial fisheries	High	Invasive species
Sand/gravel and dredged material	Burial; non-beneficial disposal	Medium	
Uses			
Commercial shipping, navigation, and dredging	Endangered species; Essential Fish Habitat; disposal of dredged material	Medium	Erosion
Commercial fishing/shrimping	Damage to fishery resources; imports; bycatch; marine debris; seafloor disturbance; seafood contamination	Medium	Spills/kills; regulatory restrictions
Oil/gas production	Marine debris; spill potential	Low	Rig removal could reduce fishery habitat

Resource or Use	Threat or Conflict	Degree of Threat	Anticipated Threat or Conflict
Uses			
Recreational fishing/boating	Marine debris; commercial fishing/shrimping; seafood contamination	Low	Limited public access
Shoreline use	Marine debris; sea level rise; sediment deficit; erosion	High	Spills/kills

2. Describe any changes in the resources or relative threat to the resources since the last assessment.

The bulk of the changes in the above table are in response to state and federal priorities and changes seen in the resources affected. Freshwater inflow rates are important to sustaining fishery resources but are coming under increasing pressure as the state's population grows. The CMP has not and is not planning on funding studies related to freshwater inflows at this time.

In terms of the state's fisheries, bycatch in commercial fisheries threatens endangered and threatened species, such as endangered and threatened sea turtles that inhabit the Gulf of Mexico. Commercial shrimping has continued to suffer depressed prices as a result of increased shrimp imports. Seafood contamination, such as bioaccumulation of mercury in larger commercial and recreational species, is threatening both commercial and recreational fishing.

Removal of offshore oil and gas rigs threatens to eliminate this habitat unless the rigs are converted to artificial reefs through the Rigs to Reef Program of TPWD. Some experts have expressed concern over potential mercury contamination of fish found near rigs; however, studies cited by TPWD suggest that mercury bio-accumulation around rigs turned into artificial reefs structures is not occurring at any rate different than that of reef fish found Gulf-wide. Lastly, recreational fishing and boating is dependent upon adequate public access. In some places along the coast, access is becoming increasingly difficult to provide as development outpaces government's ability to provide public access points. This issue is addressed in the public access strategy portion of this report.

Management Characterization

1. In the table below, identify state ocean management programs and initiatives developed since the last assessment.

Program	Status	$ 309
Statewide comprehensive ocean management statute	No	
Statewide comprehensive ocean management plan	No	
Single purpose statutes related to ocean resources	No	
Statewide ocean resources planning/working groups	No	
Regional ocean resources planning efforts	No	

Program	Status	$ 309
Ocean resources mapping or information system	Yes	
Dredged material management planning	No	
Habitat research, assessment, monitoring	No	
Public education and outreach efforts	No	

2. For categories with changes: summarize the change, specify whether it was a 309 or CZM driven change and specify funding the funding source, and characterize the effect of the changes in terms of both program outputs and outcomes.

The following efforts are neither §309 nor CZM driven changes. However, they are programs developed since the last assessment and are on-going efforts.

The Oil Spill Division of the GLO has mapped 6,000 miles of Texas shoreline and characterized it as far as sensitivity (using NOAA's environmental sensitivity index) and identified priority areas in terms of habitat (working with the TPWD). This information is used primarily for planning in responding to oil spills but also is distributed nationally and internationally on CD and via the worldwide web. The agency works with TPWD, Texas Department of Transportation, and the TCEQ on this project.

The agency also maintains seven Texas Automated Buoy System (TABS) buoys along the Texas coast to collect data on near-surface water currents to assist in responding to oil spills. Information collected by these buoys is used in predictive modeling so researchers can develop water current forecasts. The agency also has become involved in the Gulf Coastal Ocean Observing System, which is seeking to assemble a similar system for the Gulf of Mexico region.

Conclusion

1. Identify priority needs or major gaps in meeting the programmatic objectives for this enhancement area that could be addressed through a 309 Strategy.

Texas lacks a comprehensive, statewide ocean management plan and would benefit from a coordinated effort to manage the state's ocean resources and mitigate current and anticipated threats. In addition, localized oceanographic data is still needed in the vicinity of dredged navigation channels and their dredged material disposal areas in order to better evaluate the influences of channels on coastal processes and the fate of dredged material. Such data would allow better for planning to reduce dredging frequency, benefiting both endangered sea turtles and the general environment.

2. What priority was this area previously and what priority is it now for developing a 309 Strategy and designating 309 funding and why?

Previous Assessment: LOW **This Assessment: LOW**

To some extent, the objectives in this area are being addressed indirectly through coordination activities in other priority areas. Examples include the MOA with the Corps for ongoing federal maintenance projects, the interagency coordination of EPA research grant funds, and the Adopt-A-Beach program to characterize marine debris. Also, through consistency provisions of the CZMA, the Council comments on offshore activities and potential impacts.

The Council has ranked this area as a low priority because the Texas CMP is relatively new and there are other, more immediate areas of concern that have been assigned the higher priorities in this assessment. The Council anticipates that this area will be moved up in priority level as other areas are fully addressed.

Special Area Management Planning

Section 309 Programmatic Objectives

I. Develop and implement special area management planning in coastal areas applying the following criteria:

- Areas with significant coastal resources (e.g., threatened and endangered species and their critical habitats, wetlands, waterbodies, fish and wildlife habitat) that are being severely affected by cumulative or secondary impacts;
- Areas where a multiplicity of local, state, and federal authorities hinder effective coordination and cooperation in addressing coastal development on an ecosystem basis;
- Areas with a history of long-standing disputes between various levels of government over coastal resources that has resulted in protracted negotiations over the acceptability of proposed uses;
- There is a strong commitment at all levels of government to enter into a collaborative planning process to produce enforceable plans;
- A strong state or regional entity exists which is willing and able to sponsor the planning program.

Resource Characterization

1. Using of the criteria listed above, identify areas of the coast subject to use conflicts that can be addressed through special area management planning (SAMP).

The Texas Legislature amended the Coastal Coordination Act in 1995 to specifically prohibit the Council from developing or approving a special area management plan, including a plan for an area designated under the national estuary program.

Management Characterization

1. Identify areas of the coast that have or are being addressed by a special area plan since the last Assessment:

This section is not applicable, as development and approval of SAMPs by the Council is prohibited by statute.

2. Identify any significant changes in the state's SAMP programs since the last Assessment. Provide the following information for each change: characterize the scope of the change, describe recent trends, identify impediments to addressing the change, and identify successes.

This section is not applicable, as development and approval of SAMPs by the Council is prohibited by statute.

Conclusion

1. Identify priority needs or major gaps in addressing the programmatic objectives for this enhancement area that could be addressed through a 309 Strategy.

The CMP, as approved by NOAA, includes a prohibition on Council development and approval of SAMPs.

2. What priority was this area previously and what priority is it now for developing a 309 Strategy and designating 309 funding and why?

Previous Assessment: N/A **This Assessment: N/A**

Status and Trends of Inland Wetlands and Aquatic Habitats

Objective

The GLO may contract with the BEG to determine spatial and temporal changes in inland marshes, mangroves, tidal flats, forested and riparian wetlands, and water bodies in the following areas: Corpus Christi-Coastal Bend, Beaumont-Port Arthur, Bay City-Freeport, Brownsville-Harlingen, and San Antonio Bay.

Program Change

This project builds upon an ongoing, coast-wide effort to study the status and trends of wetlands and aquatic habitats on barrier islands by extending that effort to inland environments on the Texas coast. Inland wetland status and trends data are of particular importance since palustrine or freshwater wetlands are no longer protected by regulations under the CWA. The loss of regulatory protection for these wetlands highlights the need to provide up-to-date information to local, state, and federal restoration and acquisition programs to ensure adequate protection for the resource. This project will provide regional characterizations for inland wetlands that will inform individual program priorities and/or strategies for restoration and acquisition.

The GLO has prepared a draft plan to implement the CELCP in Texas (published in the Texas Register on June 16, 2006, for 30-day public comment period) "for the purpose of protecting important coastal and estuarine areas that have significant conservation, recreation, ecological, historical, or aesthetic values, or that are threatened by conversion from their natural or recreational state to other uses." The draft plan is intended to establish a process for identifying and ranking qualified projects within the state to be considered for grant funding in an annual national competitive selection process. Pending approval, the Texas CELCP Plan must be updated every five years. Project findings will be used by the state sponsors (GLO, TPWD, and the Mission-Aransas National Estuarine Research Reserve) to update the following required elements of the plan: a map or description of the geographic extent of coastal and estuarine areas within the state; identification of "project areas" that represent the state's priority areas for conservation; and a description of existing plans, or elements thereof, that are incorporated into the plan.

The CIAP, administered by the Minerals Management Service (MMS), will provide an estimated $60 million each year for Texas from FY 2007-2010. Included in the proposed projects for these funds will likely be a contingent of wetland restoration and acquisition projects. Data from this project may be used to assess the relative merit of these types of projects nominated for CIAP funding over the course of its implementation.

Project findings will be reviewed and phased into the CMP grant program guidance document, as appropriate. In addition to assessing the relative merit of projects proposed for funding, the inclusion of this information may take form as revised scoring criteria to prioritize projects

proposed in areas of identified need or as specific requests for proposals. The grants program has moved in this direction with the inclusion of state identified research needs in the cycle 12 grant guidance.

In addition, project findings will be reviewed and incorporated into the next update to the Texas Coastwide Erosion Response Plan. The plan is updated periodically (as funding permits) to guide the implementation of the CEPRA program and includes a description of the geologic setting of the Texas coast; a summary of coastal geology information provided through studies and reports conducted under CEPRA; an evaluation of the effects of erosion response projects constructed since the initial plan was written; and recommendations for modifications to the Texas strategy for erosion response. The CEPRA program is currently seeking funding through CIAP to perform its next update of the plan in FY 08. As previously mentioned, this project will produce base maps for inland wetlands and other aquatic habitats by region as well as identify critical trends to inform wetland restoration and acquisition efforts.

The CBBEP has an aggressive acquisition and restoration program overseen by a committee of coastal stakeholders and encompassing 12 coastal counties in the Coastal Bend. The work proposed during the first year of this project will cover the Corpus Christi-Coastal Bend area, with results available through a final report in FY 08. Under the direction of TCEQ, CBBEP will incorporate the project findings into the development of their acquisition and restoration strategy for the Corpus Christi-Coastal Bend region, which is scheduled for update in FY 08/09.

From a regulatory perspective, wetlands status information will be used by state and federal resource agencies to update the RMCs for state-owned tracts in bays and estuaries. RMCs are assigned by state and federal resource agencies (including the GLO for seismic activities) and represent development guidelines for avoiding and/or minimizing adverse impacts to natural resources, such as wetlands, for activities within state-owned tracts (primarily mineral exploration and development activities). Specifically, the RMCs assist state land lessees during the Corps permitting process by informing a prospective operator of the restrictions that may be included in a Corps permit (e.g., an “ME” code means the prospective operator is to “avoid marshes and other sensitive resource areas”). RMCs are updated by the resource agencies each time an activity is proposed on a state tract. Updates are based on the latest resource inventory available. Project findings will be promoted to state and federal agencies through regional workshops and other outreach efforts (see below) to facilitate the timely update of the RMCs.

In addition, project findings will be actively promoted to other state agencies with wetland regulatory management programs for potential use. TCEQ may use this information (i.e., mapping) as it develops a wetland monitoring strategy to inventory surface water quality, as required by the EPA. The Permit Assistance Group (PAG), consisting of the U.S. Army Corps of Engineers and state natural resource agencies, offers an excellent resource for the dissemination and use of information resulting from this project, such as the update of RMCs. Furthermore, wetland status and trends information may be used by the PAG in the development of mitigation guidelines, particularly in the identification of those areas of greatest need of protection or those areas most appropriate for restoration and/or acquisition to meet mitigation requirements.

A key element to affecting change at the local, state, or federal level will be the aggressive promotion of project findings to coastal stakeholders. Following the completion of the final report for each study area, an issue-specific workshop will be held in that area to promote an understanding of the results to city and county officials, relevant state and federal agencies, NGOs, non-profit organizations, universities and other public and private interests. It is anticipated that these workshops will provide a venue for the exchange of information and ideas on how to best address the issues raised by this project, particularly at the local level. Emphasis will be placed on the importance of inland wetlands in mitigating storm surge/damage and water quality protection. Such connectivity may facilitate revised local, city or county ordinances to better protect or minimize impacts to the resource. The Sea Grant Extension Program, along with GLO staff, located in each of the proposed study areas will be positioned to assist in the workshop.

Furthermore, the Deputy Commissioner for Coastal Resources, GLO, and chair of the Council's Executive Committee has encouraged the Associated Director of Sea Grant to enhance the relationship between the Council and the state's applied coastal research community. To this end, the Sea Grant Associate Director is establishing CARRT, consisting of representatives from state universities, academic institutions and natural resource agencies. The CARRT will expand the project findings into recommendations for further applied research, supported by the CMP grants program, as well as provide additional outreach to the local and state decision makers on the implications of the findings and suggested actions to be taken to mitigate any critically negative trends identified.

Anticipated Effect of Change

Coastal managers often lack accurate, up-to-date data from which to base their decisions. This project will not only provide an update of the current status of inland wetlands but will also forecast future changes. It is anticipated that this information will identify those inland wetlands and other aquatic habitats most threatened by erosion, subsidence, development and other processes and will facilitate the adoption of proactive measures, either regulatory or non-regulatory in nature, by state and local authorities and/or coastal programs to protect, restore and maintain those resources.

Appropriateness of Change

Coastal wetlands are disappearing at an alarming rate. The TPWD estimates that 35 percent of the state's coastal marshes were lost between 1950 and 1979 (TPWD, 1988). Recent estimates (based primarily on 1992 or earlier photography) of wetland loss, coast wide, show that freshwater wetlands declined by 29 percent and forested wetlands declined by 11 percent. Even more recently, but on a more localized or regional scale, the lower Galveston Bay watershed lost at least 3 percent of its freshwater wetlands between 1992 and 2002, with most of the loss (13 percent) occurring in Harris County. Over half of the loss in Harris County occurred between 2000 and 2002, and the rate of development in Galveston and Brazoria counties suggest similar losses in the next two to five years. At a time when both rapid development and the loss of regulatory protection is causing even more dramatic losses than in the past, up-to-date wetland

status and trends information is needed to accurately characterize the status of coastal inland wetlands and to provide information for strategies that can be developed to manage the resource.

Proposed Work Plan

The following outlines the general tasks for data collection and analysis at each proposed study area. One study area will be undertaken each year in the following order: year 1, Corpus Christi-Coastal Bend; year 2, Beaumont-Port Arthur; year 3, Bay City-Freeport; year 4, Brownsville-Harlingen; and year 5, San Antonio Bay.

1. Interpret and map wetlands and aquatic habitats on historical and recent aerial photographs, using and revising existing historical data where acceptable: Aerial photography will be scanned, georeferenced and entered into a GIS. Recent photography will be interpreted to determine status of wetlands and aquatic habitats. Where necessary, historical NWI datasets will be modified using historical aerial photography. Where historical NWI data are not available, habitat boundaries will be captured directly from 1950s aerial photography.
2. Process habitat delineations and enter into GIS: Line delineations of habitat boundaries are processed within the GIS to form habitat polygons. Where historical NWI data are available, existing digital databases will be modified using delineations derived from historical aerials. Resultant polygons are coded as to their appropriate habitat classification following the NWI Cowardin et al. (1979) classification system.
3. Field-check mapped wetlands: Habitat delineations are brought to the field to check mapping from aerial photography. Predefined checkpoints are located using field GIS and GPS software. Plant species identification is conducted at the field site and recorded along with the GPS position. Species samples are collected for identification and digital photographs taken where needed.
4. Conduct detailed quality control analysis of all (historical and current) GIS databases: Field data are reviewed in the office to confirm mapping from aerial photographs. Notes collected during field visits are used to revise habitat boundaries, where needed. Field site photographs are linked with the GIS to field site locations and viewed when assessing habitat classification. Species lists from field visits are reviewed to corroborate map classification. Vegetation samples collected in the field are identified and used to verify the habitat classifications where the samples were collected. Current status mapping is compared to historical habitat boundaries to ensure a level of consistency. The integrity of the GIS database is verified by applying topology to the datasets.
5. Analyze wetland trends, determine probable causes, and present write up results: Final versions of the habitat datasets are compared to determine the magnitude and location of wetland trends within the study area. Overlay analysis between the study time periods is conducted to provide a visual aid in determining trends. Analysis identifies areas of primary change and helps to determine focus areas. Change analysis within the GIS can also contribute information to probable causes of change. Habitat acreage is calculated and compared between time periods. Statistical analysis provides acreage totals for individual habitats. The GIS output is then considered relative to know physical and climatological information concerning the specific location within the Texas coast. Trends are calculated and probable causes for change are determined.

6. Complete final manuscript: Compilation of study introduction, methods, habitat classification, status, historical trends, and summary and conclusions into a report format.

The following tasks are proposed to utilize the information generated by this project to affect a program change by their respective year of implementation.

Year 1

1. Permit Assistance Group: Initiate discussions with the PAG to 1) establish a working relationship with GLO staff overseeing this and other associated studies to ensure an environment conducive to the utilization of this information, 2) establish contacts with staff of the participating resource agencies who may be able to use this information independently of the PAG, and 2) begin developing avenues for the application of this information to ensure timely results.

Year 2

1. Permit Assistance Group: Continue discussions with the PAG to 1) establish a working relationship with GLO staff overseeing this and other associated studies to ensure an environment conducive to the utilization of this information, 2) establish contacts with staff of the participating resource agencies who may be able to use this information independently of the PAG, and 2) begin developing avenues for the application of this information to ensure timely results.
2. Texas Coastwide Erosion Response Plan: Pending the approval of funding through CIAP to update the plan, findings from the Corpus Christi-Coastal Bend study area will be included in the plan update to inform wetland restoration efforts conducted under the CEPRA program.

Year 3

1. Wetland Monitoring Strategy: Present findings to TCEQ for review and potential use in the development of a wetland monitoring strategy to inventory surface water quality, as required by the EPA.
2. Permit Assistance Group: Present findings from the Corpus Christi-Coastal Bend study area to the PAG to better inform permitting and improve coastal decision-making.
3. Stakeholder Workshop: Conduct an issue specific workshop in the Corpus Christi-Coastal Bend study area to promote an understanding of the project findings to city and county officials, relevant state and federal agencies, NGOs, non-profit organizations, universities and other public and private interests.
4. CBBEP: Work with CBBEP to include the findings from the Corpus Christi-Coastal Bend study area into their restoration and acquisition strategy.
5. CMP Grants Program: Findings from the Corpus Christi-Coastal Bend study area will be reviewed and considered for inclusion in the cycle14 grant guidance to ensure the most effective use of CMP dollars to protect/enhance wetlands in Texas.

Year 4

1. Wetland Monitoring Strategy: Present findings to TCEQ for review and potential use in the development of a wetland monitoring strategy to inventory surface water quality, as required by the EPA.

2. Permit Assistance Group: Present findings from the Beaumont-Port Arthur study area to the PAG to better inform permitting and improve coastal decision-making.
3. Stakeholder Workshop: Conduct an issue specific workshop in the Beaumont-Port Arthur study area to promote an understanding of the findings to city and county officials, relevant state and federal agencies, NGOs, non-profit organizations, universities and other public and private interests.
4. CMP Grants Program: Findings from the Beaumont-Port Arthur study area will be reviewed and considered for inclusion in the cycle 15 grant guidance to ensure the most effective use of CMP dollars to protect/enhance wetlands in Texas.

Year 5

1. Wetland Monitoring Strategy: Present findings to TCEQ for review and potential use in the development of a wetland monitoring strategy to inventory surface water quality, as required by the EPA.
2. Permit Assistance Group: Present findings from the Bay City-Freeport study area to the PAG to better inform permitting and improve coastal decision-making.
3. Stakeholder Workshop: Conduct an issue specific workshop in the Bay City-Freeport study area to promote an understanding of the findings to city and county officials, relevant state and federal agencies, NGOs, non-profit organizations, universities and other public and private interests.
4. CMP Grants Program: Findings from the Bay City-Freeport study area will be reviewed and considered for inclusion in the cycle16 grant guidance to ensure the most effective use of CMP dollars to protect/enhance wetlands in Texas.
5. Texas CELCP Plan: The GLO will work with TPWD and the Mission-Aransas NERR to incorporate the results/recommendations from the Corpus Christi-Coastal Bend, Beaumont-Port Arthur, and Bay City-Freeport study areas into relevant elements of the Texas CELCP Plan.

Year 6

1. Wetland Monitoring Strategy: Present findings to TCEQ for review and potential use in the development of a wetland monitoring strategy to inventory surface water quality, as required by the EPA.
2. Permit Assistance Group: Present findings from the Brownsville-Harlingen study area to the PAG to better inform permitting and improve coastal decision-making.
3. Stakeholder Workshop: Conduct an issue specific workshop in the Brownsville-Harlingen study area to promote an understanding of the findings to city and county officials, relevant state and federal agencies, NGOs, non-profit organizations, universities and other public and private interests.
4. CMP Grants Program: Findings from the Brownsville-Harlingen study area will be reviewed and considered for inclusion in the cycle17 grant guidance to ensure the most effective use of CMP dollars to protect/enhance wetlands in Texas.

Year 7

1. Wetland Monitoring Strategy: Present findings to TCEQ for review and potential use in the development of a wetland monitoring strategy to inventory surface water quality, as required by the EPA.

2. Permit Assistance Group: Present findings from the San Antonio Bay study area to the PAG to better inform permitting and improve coastal decision-making.
3. Stakeholder Workshop: Conduct an issue specific workshop in the in the San Antonio Bay study area to promote an understanding of the findings to city and county officials, relevant state and federal agencies, NGOs, non-profit organizations, universities and other public and private interests.
4. CMP Grants Program: Findings from the San Antonio Bay study area will be reviewed and considered for inclusion in the cycle18 grant guidance to ensure the most effective use of CMP dollars to protect/enhance wetlands in Texas

Summary of Estimated Costs

Year 1	Year 2	Year 3	Year 4	Year 5	Year 6	Year 7	Total
$67,500	$135,000	$137,000	$137,000	$137,000	$2,000	$2,000	$617,500

Likelihood of Success

The BEG has successfully determined wetland status and trends in other areas of the Texas coast and is in the final phase of a coast-wide study of the status and trends of wetlands and aquatic habitats on the barrier islands/peninsulas of the Gulf of Mexico (White and others, 2002; 2004; 2005; 2006). It is likely that the information from this project will be used to guide and revise wetland restoration and acquisition programs. In addition, promotion and recognition of threatened wetlands and detrimental trends at the local and state levels will increase the likelihood of revised local, city or county ordinances to better protect or minimize impacts to the resource.

Fiscal and Technical Needs

Funding and staffing levels of the natural resource agencies in Texas are fixed until the end of the current biennium in September 2007. Mandatory requirements have been placed on state agencies to operate on reduced budgets. It is not known at this time if additional funding will be made available in the next biennium to undertake new or expanded program activities. Outside funding is needed to ensure the successful development of the CMP.

The Water Quality Protection and Storage Characteristics of Freshwater Wetlands in the Galveston Bay Watershed

Objective

The GLO may contract with GBEP to evaluate the capacity and role of freshwater wetlands in providing floodwater storage and in processing pollutants in the Galveston Bay system. This project would serve as a demonstration for other areas of the Texas coast.

Program Change

This project will result in an evaluation of the water quality characteristics and flood storage capacity of freshwater wetlands. The evaluation will demonstrate the economic and ecological value of protecting the freshwater wetland resources in the Galveston Bay watershed. Freshwater wetlands are of particular importance since they are no longer protected by regulations under the CWA. The loss of regulatory protection for these wetlands highlights the need to provide up-to-date information to local, state, and federal restoration and acquisition programs to ensure adequate protection for the resource.

The GLO has prepared a draft plan to implement the CELCP in Texas (published in the Texas Register on June 16, 2006, for 30-day public comment period) "for the purpose of protecting important coastal and estuarine areas that have significant conservation, recreation, ecological, historical, or aesthetic values, or that are threatened by conversion from their natural or recreational state to other uses." The draft plan is intended to establish a process for identifying and ranking qualified projects within the state to be considered for grant funding in an annual national competitive selection process. Pending approval, the Texas CELCP Plan must be updated every five years. Project findings will be used by the state sponsors (GLO, TPWD, and the Mission-Aransas NERR) to update the following required elements of the plan: identification of "project areas" that represent the state's priority areas for conservation; and a description of existing plans, or elements thereof, that are incorporated into the plan.

Project findings will be reviewed and phased into the CMP grant program guidance document, as appropriate. In addition to assessing the relative merit of projects proposed for funding, the inclusion of this information may take form as revised scoring criteria to prioritize projects proposed or as specific requests for proposals. The grants program has moved in this direction with the inclusion of state identified research needs in the cycle 12 grant guidance.

In addition, project findings will be used to update the Galveston Bay Habitat Conservation Blueprint (Blueprint). The Blueprint was developed by the Galveston Bay Foundation (GBF) and built upon the Galveston Bay Plan, a comprehensive conservation plan established under Section 320 of the CWA. The Blueprint identifies 170 potential habitat acquisition and restoration sites throughout the Galveston Bay watershed and is used by GBEP and local resource managers to guide acquisition and restoration efforts. The Blueprint is currently being updated; however, managers will reassess priorities, under the directive of TCEQ, upon completion of the final report.

From a regulatory perspective, project findings will be actively promoted to other state agencies with wetland regulatory management programs for potential use. TCEQ may use this information to clarify the water quality functions of wetlands as described in the Texas surface water quality standards under Section 303(c) of the CWA. The PAG offers an excellent resource for the dissemination and incorporation of information resulting from this project. Project findings will be presented to the PAG to elevate the importance of preserving coastal freshwater wetlands for coastal resource managers.

A key element to affecting change at the local, state, or federal level will be the aggressive promotion of project findings to coastal stakeholders. Following the completion of the final report, an issue-specific workshop will be held to promote an understanding of the results to city and county officials, relevant state and federal agencies, NGOs, non-profit organizations, universities and other public and private interests. It is anticipated that this workshop will foster dialogue on the importance of preserving freshwater wetlands and provide a venue for the exchange of information and ideas on how to best address the issues raised by this project, particularly at the local level. Emphasis will be placed on the importance of freshwater wetlands in mitigating storm surge/damage and water quality protection. Such connectivity may facilitate the revision of local, city or county ordinances to protect or minimize impacts to the resource and provide guidance on BMPs for storm water management, platting, and parkland and open-space planning within the Galveston Bay watershed. The Sea Grant Extension Program, along with GLO staff, located in each of the proposed study areas will be positioned to assist in the workshop.

In addition, the NEMO program (supported through the CMP grants program) is well suited to assist outreach and education of project findings to municipal leadership within the Galveston Bay Watershed. The NEMP program is hosted at the Houston area based Texas Coastal Watershed Program (TCWP), a collaboration between Sea Grant and Texas Cooperative Extension.

Anticipated Effect of Change

The Galveston Bay watershed lost about 35,000 to 45,000 acres (20 to 27 percent) of its wetlands from the mid-1950s to the 1990s. According to a recent GBEP study, wetland loss continues at a rapid rate, posing the greatest single threat to the Galveston Bay ecosystem. The study revealed that the watershed lost over 9,000 acres of freshwater wetlands between 1992 and 2002, with half of that loss occurring between 2000 and 2002. Continued rapid wetland loss will likely negatively impact water quality, reduce wildlife populations, and exacerbate flooding problems, with serious economic and ecological consequences. It is anticipated that this project will provide an independent evaluation of the water quality and storage characteristics of freshwater wetlands to establish the importance of protecting these wetlands, either through regulatory or non-regulatory means, within the Galveston Bay watershed.

Appropriateness of Change

Many local managers believe that freshwater wetlands provide significant temporary water storage during storm and heavy rainfall events, actually removing water from the system through

evaporation and transpiration during the summer months when tropical systems are common. Flooding is an increasingly critical issue in the Galveston Bay watershed. In 2001, the region was hit by Tropical Storm Allison, causing over $5 billion in damages and killing 22 people. Furthermore, freshwater wetlands are effective in attenuating waterborne pollutants. Outflow from these wetlands contributes to streams, rivers, and eventually, Galveston Bay. It is imperative that resource managers and regional planners evaluate the flood damage reduction water-quality protection capacity of freshwater wetlands within the watershed as the region prepares for large projected population growth.

Proposed Work Plan

Year 1

1. Select researcher(s) to conduct study: This study will involve the selection of an independent scientist or team of scientists, not affiliated with a local, state, or federal regulatory agency to ensure its scientific integrity and objectivity.
2. Develop detailed scope of work: Selected researcher(s) will work with GBEP to develop a scope of work for the study. The Work Plan will describe the methodology and identify the sites selected for the study, as well as an outreach and education plan for the findings.
3. Conduct first year activities and issue a one-year report: The selected contractor will issue a report for review by study participants and GBEP stakeholders providing data and analyses for the first year of the study. The report will also describe any substantive adjustments to the Work Plan necessary for the second year of the study.
3. Permit Assistance Group: Initiate discussions with the PAG to 1) establish a working relationship with GLO staff overseeing this and other associated studies to ensure an environment conducive to the utilization of this information, 2) establish contacts with staff of the participating resource agencies who may be able to use this information independently of the PAG, and 2) begin developing avenues for the application of this information to ensure timely results.

Year 2

1. Conduct second year activities and issue final report: The selected contractor will issue a report for review by study participants and GBEP stakeholders providing data and analyses for the first year of the study.
2. Actively disseminate study findings: Selected researcher(s) and GBEP will collaborate to actively disseminate the study findings through the outreach and education plan to include/in addition to the following activities:
    a. *Present findings to the Council.* Selected researcher(s) will present findings to the Council and its Executive Committee to help establish the long-term preservation of coastal freshwater wetlands as a high priority for coastal resource managers.
    b. *Present findings at the Galveston Bay Symposium and other relevant symposia.* Selected researcher(s) will present findings at these venues to help establish the long term-preservation of coastal freshwater wetlands as a high priority for coastal resource managers.
    c. *Host an issue-specific workshop on coastal freshwater wetland management.* GBEP will host an issue-specific workshop on coastal freshwater wetland management. The workshop will help to disseminate the study results, foster

dialogue on the importance of preserving freshwater wetlands, engage the state NEMO program, and identify ways to improve floodwater management.

3. Texas Surface Water Quality Standards: Present findings to TCEQ for review and potential use within the Texas surface water quality standards, specifically in the clarification of the water quality functions of wetlands.
4. Permit Assistance Group: Present findings to the PAG to better inform permitting and improve coastal decision-making.
5. Galveston Bay Habitat Conservation Blueprint: Work with TCEQ and the GBEP/GBF to update the Blueprint based on the results of this study.

Year 3

1. Texas CELCP Plan: The GLO will work with TPWD and the Mission-Aransas NERR to incorporate the project findings into relevant elements of the Texas CELCP Plan.
2. CMP Grants Program: Project findings will be reviewed and considered for inclusion in the cycle15 grant guidance to ensure the most effective use of CMP dollars to protect/enhance wetlands in Texas.

Summary of Estimated Costs

Year 1	Year 2	Total
$75,000	$80,000	$155,000

Likelihood of Success

GBEP is part of a network of 28 National Estuary Programs (NEP) working with local stakeholders to restore and protect estuaries and their natural resources. Being part of the NEP required the use of stakeholders in identifying and characterizing priority problems and developing solutions. GBEP, along with the Galveston Bay Council and many subcommittees, have successfully managed many projects to help address the priority problems in the Galveston Bay watershed. This project will help GBEP establish priorities and provide guidance to local governments.

Fiscal and Technical Needs

Funding and staffing levels of the natural resource agencies in Texas are fixed until the end of the current biennium in September 2007. Mandatory requirements have been placed on state agencies to operate on reduced budgets. It is not known at this time if additional funding will be made available in the next biennium to undertake new or expanded program activities. Outside funding is needed to ensure the successful development of the CMP.

Saving our Coastal Heritage – Texas Rural County Demonstration Project

Objective

The GLO may contract with the Trust for Public Land (TPL) to use GIS mapping to identify high priority areas for public access, habitat conservation and restoration, and other community identified priorities for Chambers County, a rural county in the lower watershed of Galveston Bay.

Program Change

While some general mapping of areas of concern for preservation and restoration has been accomplished previously, mapping and prioritization needs to be undertaken up and down the coast, on a more specific level, to evaluate and set priorities for targets for open space and habitat preservation in rural and suburban/urban areas. This mapping and prioritization will answer some critical questions needed for implementation:

- Which parcels are currently available?
- Which parcels do not have conflicting uses?
- Which parcels would achieve multiple conservation and public benefits?
- Which parcels fit into a community's plans and goals for open space preservation and public access?
- What funding mechanisms might be applicable for specific projects?

A key outcome of the GIS-based planning process will be the identification of land, the preservation or restoration of which would best accomplish the multiple community-identified coastal conservation goals. The identification of these parcels may guide acquisition, management, and restoration programs by incorporating these local priorities into local conservation finance initiatives and into scoring criteria for state and federal grant programs.

Anticipated Effect of Change

Land conservation is inherently opportunistic, depending as it does on willing sellers. A "greenprint" for land conservation, on a more local watershed or county level, can increase the likelihood of success by providing a set of priorities to guide local actions, and to strengthen the case for preservation funding. Additionally, a greenprint can enhance the potential for leveraging funds and for protecting contiguous or connected areas for greater habitat value for wildlife and for greater public access and enjoyment. By targeting Chambers County, TPL will be conducting greenprinting in a rural area in Texas for the first time. This will provide a model for work in other rural coastal counties. These rural counties typically do not have a model for community-based natural resource and public access planning. This planning will lead to multiple benefits, including:

- Increasing public access to the coast;
- Protecting valuable critical area habitats;
- Reducing the impacts of flooding on local communities;
- Protecting/improving water quality from runoff;

- Preserving the community's unique local heritage – the relationship between its people and the land and water where they live and work.

Appropriateness of Change

As previously mentioned, rural communities, outside of those covered by the estuary programs, do not have a model for community-based natural resource and public access planning. This project provides an opportunity for communities to interact with professionals to share ideas and develop strategies. The approach is based on the "Countryside Stewardship Exchange" program of the Countryside Institute. The exchange can help the local community recognize their needs and issues and provide an opportunity to explore the strengths of a regional or watershed approach. Public input will be considered along with relevant geographic data, using existing database and GIS sources, and a comprehensive analysis of conservation finance options for Chambers County to produce a coastal watershed plan, including an outreach plan and target objectives for public access and conservation. TPL will assist with initiating specific projects targeted by the plan.

Proposed Work Plan

Year 1: Watershed information collection and analysis

1. Stakeholder involvement: A local, broad-based Steering Committee will be formed to represent community interests in the County and participate in all phases of the project. The Steering Committee will establish criteria weightings and rankings for the GIS model, host larger public meetings to collect input, and identify unresolved issues and information needs to be addressed in the Implementation Plan. Likely participants will be county engineering and parks staff, large local landowners, city government staff, USFWS refuge system management, local nonprofits, Chambers-Liberty Counties Navigation District, Texas Cooperative Extension, U.S. Army Corps of Engineers, other state and federal agencies, and other coastal fisheries and agricultural interests.
2. Data collection and modeling: Salient data and information will be collected and formatted into a GIS, using existing database and GIS sources. Among the GIS data layers could be: topography, soil type, land cover, land ownership, planning and zoning boundaries, floodplain boundaries, census data, water quality information, and cultural resources. Existing GIS data resources would be used, including the Houston-Galveston Area Council, Texas Parks & Wildlife Department, Houston Wilderness, and others. Mapping will be used to identify high priority areas for public access, habitat conservation and restoration, and other community identified priorities.
3. Coastal watershed issues and priorities report: A Chambers County Coastal Watershed Issues Report will be developed to describe the current conditions in Chambers County, regarding public access, wetlands, and other community-identified issues.

Year 2: Implementation plan

1. Watershed stewardship exchange: This task will bring together communities and professionals to work, share ideas, and develop strategies to address implementation challenges. Local participants will include local managers and officials, citizen and conservation group representatives, and local technical experts. Outside experts (4 or 5)

with training and professional background that matches the needs of the community will be recruited to participate. The Exchange will consist of a short (approximately one-week) team visit from the invited experts, with presentations and briefings, study tours, and round table discussions. The Exchange will conclude with the development and presentation of findings, conclusions, and recommendations by the outside experts. It will provide for input from the local community at a much more involved level than previous regional, one-shot public meetings.

2. Conservation finance investigations: TPL will complete a comprehensive analysis of conservation finance options, encompassing a thorough review of the federal, state, and local government financing options that could be utilized to finance land conservation in Chambers County. The work would be compiled in a written report that would review the fiscal, economic and political background for Chambers County, and examine the legal background for a range of local revenue sources and the revenue raising capacity for these local sources. In addition, it would determine whether certain state or federal funding sources have been used for land conservation in this area and their potential for use.
3. Implementation action plan: The local steering committee will evaluate the results of the Stewardship Exchange and Conservation Finance Investigations and further tailor the recommendations to the culture and environment of the local community. A final report would be developed, including an outreach plan and target objectives for public access and conservation. TPL would assist with beginning the specific projects targeted by the plan.

Year 3: Evaluation

1. TPL will develop short-term and long-term evaluation techniques, using resources such as the *Evaluation Handbook* of the W. K. Kellogg Foundation. One year after the completion of the two-year planning process, and in advance of the next Section 309 review, an outside, third party, such as an academic institution, will be hired, in consultation with CMP staff, to conduct an evaluation. The evaluation will consider the efficacy of coastal greenprinting in accomplishing CMP goals and how effectively the Implementation Plan is being used.

Summary of Estimated Costs

Year 1	Year 2	Year 3	Total
$79,000	54,000	43,000	$176,000

Likelihood of Success

TPL will work extensively with local Chambers County officials in developing stakeholder involvement and coordinating meetings and facilities for stakeholders, as well as collection of information on County resources and issues. With the CMP and NOAA, TPL will devise the evaluation task of this project. The USFWS and Corps are major landowners in Chambers County and will be involved in discussions about appropriate public access. The TDA and Texas Cooperative Extension could be partners in developing agricultural and marine components of the Implementation Plan. GBEP is a partner with TPL on the Galveston Bay Land Conservation

Initiative, which would include this project, and could provide input and stakeholder participation. Local nonprofit groups, such as the Friends of Anahuac National Wildlife Refuge and the Upper Texas Coast Waterborne Education Center, will also be involved, providing input and especially facilitating outreach and education components of the Implementation Plan, along with the county marine extension agent. The broad base of stakeholders included in this project will increase the likelihood of its success.

Fiscal and Technical Needs

Funding and staffing levels of the natural resource agencies in Texas are fixed until the end of the current biennium in September 2007. Mandatory requirements have been placed on state agencies to operate on reduced budgets. It is not known at this time if additional funding will be made available in the next biennium to undertake new or expanded program activities. Outside funding is needed to ensure the successful development of the CMP.

Status and Trends of Coastal Vulnerability to Natural Hazards

Objective

The GLO may contract with Texas A&M University, Hazard Reduction and Recovery Center to evaluate the status and trends of coastal vulnerability to natural hazards in Texas.

Program Change

This project will evaluate the State of Texas Mitigation Plan (October 2004) for applicability to the CMP; assess local, state and federal resources available for mitigation, preparedness, response and recovery and evaluate their application to the CMP; evaluate the geographic relationship between current CMP boundaries and project impacts from various categories of hurricanes; assess the regulatory regime and effectiveness of construction codes and land use planning policies; identify best practices and emerging technologies related to building code and land use planning; assess the physical and social vulnerabilities of coastal populations; and assess the adoption of hazard mitigation technologies (e.g., hurricane shutters), issues related to the adoption of these technologies, and disaster planning by households and businesses so that effective outreach and education activities can be developed.

Project findings/recommendations will be directed at affecting meaningful change at both the state and local levels. An important element in this project will be the formation and utilization of a local advisory committee to better ensure that project activities have salience for evaluating, assessing and promoting changes in planning and management practices that promote hazard mitigation, environmental sustainability and resiliency. The advisory committee will consist of approximately 8-12 individuals and membership will be drawn from local planners, emergency managers, extension personnel and coastal managers. The advisory committee will provide critical practical input regarding current problems and issues facing local planners and managers grappling with the problems of coastal development. The committee will also provide important guidance for project activities allowing for a targeted focus on policy areas and implementation problems facing local officials. Most importantly, the committee will offer project staff insights to better ensure that project methodologies and tool development will provide information relevant for affecting policy and programmatic changes that will enhance coastal hazard mitigation and management.

Workshops targeting local and state stakeholder separately will be held during the final year of this project to disseminate project findings. In addition, web-based user workshop(s) will be held to provide an opportunity for locals to work hands-on with planners and project staff to facilitate the understanding and use of the tools available through the website. Advisory committee members will be actively involved in the planning of these workshops to maximize their impact on the target audience.

Furthermore, the GLO and the Texas Sea Grant Extension Program (having staff distributed along the coast that serve on local emergency planning committees) will conduct outreach and education on the findings separately from the proposed workshops to the DEM, the Texas Coastal Advisory Team (TCAT) (an advisory committee to DEM made up of coastal counties'

emergency managers), administrators of the flood and windstorm risk insurance pools, other appropriate governmental bodies, and the public through local hurricane awareness and preparation seminars and exhibits.

Coordination among the governing bodies at the state level is critical to maintaining an effective approach in mitigating coastal natural hazards. The DEM has no representation on the Council. It could therefore be argued that coastal natural hazards have not received the level of attention within the CMP commensurate to the potential threat they represent. The state stakeholder workshop(s) will present recommendations for greater coordination between the CMP and the state's emergency management programs, supporting the better integration of resources to mitigate, prepare for and respond to coastal natural hazards as well as encouraging CMP managers to engage more completely the issues surrounding coastal natural hazards.

In addition, project findings will be presented to the Council and its Executive Committee to cultivate discussion on the importance of mitigating coastal natural hazards. GLO staff will propose to the Executive Committee the establishment of a workgroup, consisting of DEM staff and members of the Executive Committee, to examine recommendations generated by this project and to consider steps to implement those recommendations.

Elements of this project will apply to and potentially support the GLO's eight-point *Plan for Texas Open Beaches* released by the commissioner on June 7, 2006, which includes requesting that the Texas Legislature grant counties the authority to establish building setback requirements for storm mitigation and to protect public access. Presently, only cities have this authority. Specifically, this project will characterize the physical and social vulnerabilities of coastal populations to natural hazards, including tropical storms, providing an independent assessment of the benefits of establishing setbacks on the Texas coast.

Anticipated Effect of Change

As mentioned above, it is anticipated that this project will lead to a functional coastal hazards program at the GLO. The effort will also improve regulatory coordination among agencies tasked with mitigating coastal natural hazards, allowing for the better integration of resources to mitigate, prepare for, respond to and recover from natural hazards impacting the Texas coast. Increased capacity, in this regard, will help authorities to address priority issues, such as inadequate construction codes or land use planning, and to more effectively promote and implement measures to reduce coastal storm impacts. In addition, this project will develop, in coordination with the advisory committee, methodologies and tools for local planners and mangers to affect policy and enhance coastal hazard mitigation and management.

Appropriateness of Change

Changing land use patterns, population growth, relative sea level rise, erosion, limited regulation of construction practices and reduced institutional history on storm response may be exponentially increasing the vulnerability of the Texas coast to natural hazards. The State of Texas Mitigation Plan includes five natural hazards of concern to Texas: floods, tornadoes, tropical storms and hurricanes, drought, and wildfires. The plan states that 26 percent

(5,421,473) of the state's population is vulnerable to tropical storms and hurricanes with an estimated property loss in excess of $20 billion, depending upon the area affected. In light of the recent increase in storm intensity and activity in the Gulf of Mexico and the destruction caused by Hurricanes Rita and Katrina, it is critical that Texas begin to examine the adequacy of its framework for mitigating natural hazards at all levels of government.

Proposed Work Plan

Year 1

1. Evaluate content and implementation of the State of Texas Mitigation Plan (October 2004) for applicability to the Coastal Management Plan.
    a. Conduct a detailed documentary analysis of both the Texas Mitigation Plan and the CMP, focusing on issues of compatibility, consistency, and the capacity of these plans to promote concerted actions that work toward coastal hazard mitigation. This assessment will also examine implementation strategies, again with a focus on issues of compatibility, consistency and potential effectiveness of promoting mitigation.
    b. Interview public officials at state, county and municipal levels and leaders in the private sector regarding their perceptions of the content and implementation of both the Texas Mitigation Plan and the CMP. The target areas for this subtask will be the Lake Sabine Study Area, which includes Chambers, Hardin, Jasper, Jefferson, Liberty, Newton, and Orange counties. These counties all contain areas subject to coastal hazards related to flooding, have substantial urban and rural populations, and areas of these counties are also "designated catastrophe areas" by the Texas Department of Insurance.
    c. Conduct analysis of interview data and prepare a report based upon interview results and documentary analysis assessing the applicability of the Texas Mitigation Plan, both in terms of its substantive content and implementation, to the CMP.
2. Assess the regulatory regime and effectiveness of construction codes and land use planning policies to mitigate potential impacts of coastal natural hazards.
    a. Initiate environmental scan of target area counties, preliminary assessment of the number and spatial boundaries of regulatory regimes related to building codes and land use planning policies, and secondary data gathering (e.g., collecting building codes, and various land use policies).
    b. Development of a purposive elite sampling frame and interview schedules. The elite sample will consist of state and local officials, building officials, builders and developers, construction firms, and environmental groups. These interviews will be critical to determine implementation issues and regime inconsistencies.
    c. Initiate the in depth interviews with members of the elite sample.
    d. Initiate the development of land use planning and building code assessment protocols related to quality, implementation, and enforcement.
    e. Begin initial stages of systematic data collection and processing of building codes and land use planning policies.

3. Evaluate the geographic relationship between current coastal management program boundaries and project impacts from various categories of hurricanes based on the latest coastal study area maps.
    a. Begin assembling physical hazard analyses related to coastal natural hazards (surge maps, inland flooding maps, flood plain maps, and wind field maps).
    b. Begin assembling and integrating coastal management and policy boundary files.
    c. Begin developing methodologies for displaying building code and land use planning policy assessments based on quality, implementation, and enforcement. This task must be undertaken in concert with the development of measurement protocols and data collection methodologies to ensure implementation and development for this task.
4. Assess the physical and social vulnerabilities of coastal populations to facilitate planning and policy development related to hazard mitigation and response.
    a. Initiate the assembling and integrating of physical hazard maps and analyses related to coastal natural hazards (surge maps, inland flooding maps, flood plain maps, and wind field maps).
    b. Initiate the assembling and integration of relevant coastal hazard physical vulnerability assessments undertaken by potential partnering agencies such as DEM's Hurricane Risk Area maps, the Texas State Department of Insurance's "designated catastrophe areas".
    c. Initiate the assembling and integration of data from the census and other governmental sources critical for assessing social vulnerabilities (i.e., transportation dependence, income, household structure, and critical facilities).
5. Advisory Committee.
    a. The first activity will be the formation of Status and Trends Project Advisory Committee. Membership will consist of planners, extension personnel, and coastal managers.
    b. Initial Advisory Committee meeting. The goals of the initial Advisory Committee meeting will be to provide members with an orientation to the project, its goals, methodologies and general expected outcomes; and obtain input from the committee with respect to a) local problems and issues, b) factors that enhance or inhibit effective management and mitigation policies, c) contradictory and complementary policy regimes d) elite sampling frame and instrument development.

Year 2

1. Evaluate content and implementation of the State of Texas Mitigation Plan (October 2004) for applicability to the Coastal Management Plan.
    a. Complete final report.
2. Assess the regulatory regime and effectiveness of construction codes and land use planning policies to mitigate potential impacts of coastal natural hazards.
    a. Continue and complete the environmental scan, the assessment of the number and spatial boundaries of regulatory regimes related to building codes and land use planning policies, and secondary data gathering activities (e.g., collecting building codes, various land use policies, etc.) for the target area counties.

b. Employ the sampling frame and interview schedules developed during Year 1, continue and complete the interviewing of the elite sample which consists of state and local officials, building officials, builders and developers, construction firms, environmental groups, etc. in the target area counties.
c. Complete the development of land use planning and building code assessment protocols related to quality, implementation, and enforcement.
d. Continue the systematic data collection and processing of building codes and land use planning policies for the targeted area.
e. Conduct analysis and report writing of data collection and measurement protocols.
f. Conduct analysis and report writing on regulatory regimes and effectiveness for target area.
g. Conduct assessment of possible application of measurement protocols to other coastal areas.

3. Identify best practices and emerging technologies related to building code and land use planning that could further mitigation potential impacts of coastal natural hazards
    a. Initiate website development.
4. Assess the local, state and federal resources available for mitigation, preparedness, response and recovery from coastal natural hazards and evaluate their application to the CMP
    a. During the elite survey work, federal, state, and local officials, along with the leaders of local civic organizations will be asked about innovative funding sources that can be utilized to enhance local mitigation, preparedness, response and recovery.
    b. The natural hazard literature, particularly the literature with a more applied focus, and the internet will be searched in order to identify potential resources that might be brought to bear on these issues.
    c. Sources will be identified and narrative discussions evaluating their potential utility will be provided on a web site devoted to identifying potential resources.
5. Evaluate the geographic relationship between current CMP boundaries and project impacts from various categories of hurricanes based on the latest coastal study area maps.
    a. Continue assembling physical hazard analyses related to coastal natural hazards (surge maps, inland flooding maps, flood plain maps, and wind field maps).
    b. Continue assembling and integrating coastal management and policy boundary files.
    c. Continue development and refinement of methodologies for displaying building code and land use planning policy assessments based on quality, implementation, and enforcement.
    d. Begin spatially analysis of these data and where necessary develop methodological tools to display these data and the results from the analyses.
    e. Begin the development of a web based system for making the findings available to prospective users.
6. Assess the physical and social vulnerabilities of coastal populations to facilitate planning and policy development related to hazard mitigation and response.

a. Continue with the assembling and integrating physical hazard maps and analyses related to coastal natural hazards (surge maps, inland flooding maps, flood plain maps, and wind field maps).
b. Continue the assembling and integrating of relevant coastal hazard physical vulnerability assessments undertaken by potential partnering agencies such as DEM's Hurricane Risk Area maps, the Texas State Department of Insurance's "designated catastrophe areas".
c. Continue assembling and integrating data from the census and other governmental sources critical for assessing social vulnerabilities (i.e., transportation dependence, income, household structure, and critical facilities).
d. Begin to spatially analyze these data and developing methodologies for identifying socially vulnerable populations.
e. Begin the development of a web based system for making the findings available to prospective users

7. Advisory Committee Activities:
    a. The advisory committee meeting will be held during the first thee months of the project year.
    b. The meeting will have three principal activities: 1) presentation previous years accomplishments, 2) presentation of plans for current year; and 3) obtaining comments, critiques, and suggestions from the advisory committee regarding how project activities and outcomes can be improved to facilitate and enhanced.

Year 3

1. Assess the regulatory regime and effectiveness of construction codes and land use planning policies to mitigate potential impacts of coastal natural hazards.
    a. Complete data collection and processing of building codes and land use planning policies for the targeted area.
    b. Complete analysis and report writing on regulatory regimes and effectiveness for target area.
    c. Complete final assessment of application of land use planning and building code assessment protocols to other coastal areas
2. Identify best practices and emerging technologies related to building code and land use planning that could further mitigation potential impacts of coastal natural hazards
    a. Continue website development and enhancement. Content will be continually updated as new best practices are discovered. We will particularly focus on best practices in terms of complementary policy implementation and a reduction of policy inconsistency based upon work undertaken in the target area.
3. Assess the local, state and federal resources available for mitigation, preparedness, response and recovery from coastal natural hazards and evaluate their application to the CMP
    a. As innovative funding opportunities are encountered, officials, be they state, local, or federal, as well as those in the private sector will be interviewed to better understand these opportunities and sources.
    b. The natural hazard literature, particularly the literature with a more applied focus, and the World Wide Web will be periodically searched in order to identify

additional potential resources that might be brought to bear on these issues. These potential resources will be analyzed and evaluated for their potential utility.

c. Continued website updating on innovative funding opportunities for programs on mitigation, preparation, response, and recovery

4. Evaluate the geographic relationship between current CMP boundaries and project impacts from various categories of hurricanes based on the latest coastal study area maps.
    a. Continue development and refinement of methodologies for displaying building code and land use planning policy assessments based on quality, implementation, and enforcement.
    b. Continue spatial analysis and refinement of data and where necessary continue develop methodological tools to display these data and the results from the analyses.
    c. Continue development and refinement of a web-based system for making the findings available to prospective users.
5. Assess the physical and social vulnerabilities of coastal populations to facilitate planning and policy development related to hazard mitigation and response.
    a. Continue spatial analysis and finalize methodologies for identifying socially vulnerable populations.
    b. Update and complete the development of a web-based system for making the findings available to prospective users.
6. Assess the adoption of hazard mitigation technologies (e.g., hurricane shutters), issues related to the adoption of these technologies, and disaster planning by households and businesses so that effective and targeted educational programs and policies can be developed.
    a. Qualitative interviewing of households and business regarding their adoption of mitigation technologies, natural hazard planning, and risk perceptions.
    b. Development of data collection instruments.
    c. Development of survey strategy, sampling frames, and procedures.
    d. Undertaking household and business surveys (data collection).
7. Advisory Committee Activities:
    a. The advisory committee meeting will be held during the first thee months of the project year.
    b. The meeting will have three principal activities: 1) presentation of previous years accomplishments, 2) presentation of plans for current year; and 3) obtaining comments, critiques, and suggestions from the advisory committee regarding how project activities and outcomes can be improved to facilitate and enhanced.

Year 4

1. Identify best practices and emerging technologies related to building code and land use planning that could further mitigation potential impacts of coastal natural hazards.
    a. Continue website development and enhancement. Content will be continually updated as new best practices are discovered. We will particularly focus on best practices in terms of complementary policy implementation and a reduction of policy inconsistency based upon work undertaken in the target area.

2. Assess the local, state and federal resources available for mitigation, preparedness, response and recovery from coastal natural hazards and evaluate their application to the CMP.
    a. As innovative funding opportunities are encountered, officials, be they state, local, or federal, as well as those in the private sector will be interviewed to better understand these opportunities and sources.
    b. The natural hazard literature, particularly the literature with a more applied focus, and the World Wide Web will be periodically searched in order to identify additional potential resources that might be brought to bear on these issues. These potential resources will be analyzed and evaluated for their potential utility.
    c. Continue updating website on innovative funding opportunities for programs on mitigation, preparation, response, and recovery
3. Evaluate the geographic relationship between current CMP boundaries and project impacts from various categories of hurricanes based on the latest coastal study area maps.
    a. Final refinements of methodologies for displaying building code and land use planning policy assessments based on quality, implementation, and enforcement will be completed.
    b. Final refinements on methodologies for displaying these data and the results from the analyses will be completed.
    c. Final refinements of a web based system for making the findings available to prospective users will be completed.
    d. Complete final report.
4. Assess the physical and social vulnerabilities of coastal populations to facilitate planning and policy development related to hazard mitigation and response. Finalization of the spatial analysis tools on social and physical vulnerability on the web-site
5. Assess the adoption of hazard mitigation technologies (e.g., hurricane shutters), issues related to the adoption of these technologies, and disaster planning by households and businesses so that effective and targeted educational programs and policies can be developed.
    a. Complete household and business surveys.
    b. Complete final report.
    c. Incorporate findings into and modify social vulnerability analysis as dictated by findings.
    d. Post results on project website.
6. Advisory Committee Activities:
    a. The advisory committee meeting will be held during the first thee months of the project year.
    b. The meeting will have three principal activities: 1) presentation previous years accomplishments, 2) presentation of plans for current year; and 3) obtaining comments, critiques, and suggestions from the advisory committee regarding how project activities and outcomes can be improved to facilitate and enhanced.

Year 5:

1. Advisory Committee Meeting: The annual meeting for the fifth year will begin with a general set of presentations of the accomplishments of the project to date, with particular emphasis on the web-based tools developed to facilitate the improvement of policy and

management activities at the local level. The advisory committee will then be activity involved in planning of workshops to facilitate the dissemination of project findings and training on the web-based tools and analysis capabilities generated as part of this project.

2. Local stakeholder workshop(s): Conduct workshop(s) that target local planning agencies, emergency management officials, elected officials, Sea Grant Extension and Cooperative Extension, additional public and private stakeholders, and the general public.
3. State stakeholder workshop(s): Conduct workshop(s)/presentations that target personnel from DEM, TCAT, windstorm and flood risk pool administrators, Sea Grant and Cooperative Extension hazard and policy specialists, and the GLO. Each agency/entity will be engaged separately to receive additional feedback prior to hosting a joint workshop with representatives from each agency/entity.
4. Web-based user workshop(s): Conduct user workshop(s) that offer an opportunity for local stakeholders to work hands-on with planners and researchers to facilitate their understanding of the tools and analysis capabilities of the website.
5. Executive Committee/DEM workgroup: Present project findings to the Council and its Executive Committee. GLO staff will propose to the Executive Committee the establishment of a workgroup, consisting of DEM staff and members of the Executive Committee, to examine recommendations generated by this project.
6. *Plan for Texas Open* Beaches: Setback Initiative: The GLO will evaluate the project findings to determine if the data is supportive of the GLO's initiative to grant counties the legislative authority to establish building setbacks for development. Relevant data will be extracted, such as the physical and social vulnerabilities analysis of coastal populations to natural hazards, to support this initiative.

Summary of Estimated Costs

Year 1	Year 2	Year 3	Year 4	Year 5	Total
$132,297	$130,403	$158,966	$192,890	$130,000	$744,556

Likelihood of Success

The active hurricane season in 2005 and the projected increase in storm intensity and activity over the next several years have created a public climate that is more receptive to coastal hazard mitigation needs than in the past. A comprehensive, statewide assessment of the status and trends of coastal vulnerability to natural hazards will help local and state emergency management personnel and coastal managers support this environment by providing the tools for assessing programmatic and policy weaknesses and recommendations on best practices that may be adopted along the Texas coast to reduce the impact of coastal natural hazards.

Fiscal and Technical Needs

Funding and staffing levels of the natural resource agencies in Texas are fixed until the end of the current biennium in September 2007. Mandatory requirements have been placed on state agencies to operate on reduced budgets. It is not known at this time if additional funding will be made available in the next biennium to undertake new or expanded program activities. Outside funding is needed to ensure the successful development of the CMP.

Status and Trends of Dune Volume, Morphology, and Vegetative Cover Along the Texas Gulf Shoreline

Objective

The GLO may contract with the BEG to evaluate the status and trends of dune volume, morphology, and vegetative cover along the more developed portions of the Texas gulf shoreline.

Program Change

This project will conduct and analyze airborne topographic lidar surveys in combination with new and historical optical imagery and ground surveys to understand the status and trends of the beach/dune system and to monitor the susceptibility of the coast to storm damage. Surveys will be conducted annually for five years to develop a time series for analysis of the short-term dynamics of the beach/dune system. A period of five years is necessary based on the research of Morton et al. (1994) who determined that beaches and dunes along Galveston Island took five years to recover from the effects of Hurricane Alicia in 1983.

In addition to detailed status and trends information, this project will present site-specific recommendations for restoration and acquisition projects based on identified critical trends (areas most threatened or viable for preservation or restoration) that will inform various program's priorities/strategies. While the final report will not be issued until FY 2014, annual reports will provide an up-to-date inventory, as well as any preliminary trends information, that may be used by the GLO to set priorities for its grant programs.

The CIAP will provide an estimated $60 million each year from FY 2007-2010. Included in the proposed projects for these funds will likely be a contingent of dune restoration and gulf-front acquisition projects. Data from this project may be used to assess the relative merit of these types of projects nominated for CIAP funding over the course of its implementation.

Project findings/recommendations will be reviewed and phased into the CMP grant guidance and selection process as appropriate. In addition to assessing the relative merit of projects proposed for funding, the inclusion of this information may take form as revised scoring criteria to prioritize projects proposed in areas of identified need or as specific requests for proposals. The grants program has moved in this direction with the inclusion of state identified research needs in the Cycle 12 grant guidance.

Project findings/recommendations will be incorporated into the next update of the Texas Coastwide Erosion Response Plan. The plan is updated periodically (as funding permits) to guide the implementation of the CEPRA program and includes a description of the geologic setting of the Texas coast; a summary of coastal geology information provided through studies and reports conducted under CEPRA; an evaluation of the effects of erosion response projects constructed since the initial plan was written; and recommendations for modifications to the Texas strategy for erosion response. The CEPRA program is currently seeking funding through CIAP to update the plan in FY 08. This project, both annually and upon completion, will

provide information critical to the plan and the success of the CEPRA program, including: detailed geologic data relating to the geomorphology of the beach/dune system, such as height, width, volume, continuity, composition, and vegetative cover; mapping of the shoreline, LOV, and the landward limit of the foredune, known as the critical dune line; monitoring of past CEPRA projects such as beach nourishment and dune restoration projects; and site-specific restoration recommendations based on critical trends observed in the data.

From the volumetric trends data, it will be possible to determine if Texas is experiencing a net gain or loss of its dunes in the areas surveyed to conclude if the framework currently in place to protect the resource is adequate or needs to be strengthened. If it is determined that Texas is experiencing a net loss, the GLO will consider the need for modifications to its beach/dune rules (TAC 31, Chapter 15) to strengthen protections for the resource to sustain a no net loss objective. The mitigation ratio for impacts to dunes in Texas is established at 1:1 and may be increased as a mechanism for offsetting a loss. This would require amendments to the beach/dune rules and the local beach access and dune protection plans. It would not require a statutory change.

An updated map will be able to be generated on an as needed basis to demark the LOV. The LOV designates the boundary between private property and the public open beach easement. The accurate demarcation of the LOV is critical in Texas as structures seaward of the LOV could be in violation of the OBA and subject to enforcement action. Several difficulties regarding the designation of the LOV exist along the Texas gulf coast, including artificial manipulation. To resolve these difficulties, mapping protocols with detailed digital elevation need to be developed. It is expected that clear, scientifically based protocols will aid the application and enforcement of the OBA at both the state and local levels for the benefit of the public and private property owners.

Procedures for conducting the geomorphic analysis will require the mapping of the landward limit of the foredune, know as the critical dune line. This line is another important demarcation and is established by local jurisdictions with approved beach access and dune protection plans. The Dune Protection Act (DPA) requires any person proposing development seaward of this line to attain a dune protection permit. Additionally, the DPA requires that the critical dune line be assessed after each major storm event. Depending upon the mapping outputs, the critical dune line may be refined to more accurately reflect the current condition of the dunes in Texas. This would require amendments to the beach access and dune protection plans for the affected areas.

Regional and local characterizations of the geomorphology of the beach/dune system will allow managers to delineate those areas in greatest need of protection, either to maintain the benefits from existing healthy dunes (storm surge protection and beach recovery) or to prevent further degradation. An analysis of the susceptibility of coastal areas to storm surge from loss of dune volume will apply to and potentially support the GLO's eight-point *Plan for Texas Open Beaches* released by the commissioner on June 7, 2006, which includes requesting that the Texas Legislature grant counties the authority to establish building setback requirements for storm mitigation and to protect public access. Presently, only cities have this authority. This would require an amendment to the OBA and potentially the DPA, as well as subsequent changes to the beach/dune rules and the beach access and dune protection plans for any local jurisdictions that establish a building setback. In addition, the identification of priority areas will assist local

authorities in determining appropriate setback distances to minimize the impact to private and public development.

Achieving meaningful change at the local level in the form of revised local, city or county ordinances (other than setbacks) to protect or minimize impacts to the resource is contingent upon fostering an understanding among the local municipalities of the project results. A workshop will be held in each regional study area (Sabine pass to the Colorado River, Aransas Pass to the north boundary of PINS, and Mansfield Channel to the Rio Grande) to promote an understanding of the project findings. In addition to local stakeholders, representatives from select state and federal agencies will be invited to attend. It is anticipated that these workshops will provide a venue for the exchange of information and ideas on how to best address the issues raised by this project.

The Deputy Commissioner for Coastal Resources, GLO, and chair of the Council's Executive Committee has encouraged the Associated Director of Sea Grant to enhance the relationship between the Council and the state's applied coastal research community. To this end, the Sea Grant Associate Director is establishing CARRT, consisting of representatives from state universities, academic institutions and natural resource agencies. The CARRT the will expand the project findings into recommendations for further applied research supported by the CMP grants program as well as provide additional outreach to the local and state decision makers on the implications of the findings and suggested actions to be taken to mitigate any critically negative trends identified.

Anticipated Effect of Change

It is well known that wide, high, and well-vegetated foredunes protect landward areas from storm damage and are a source of sand to speed beach recovery after a storm. Protection of natural foredunes and their enhancement is an excellent way to decrease the susceptibility of the shoreline to storm damage while improving the beach/dune environment. Up-to-date knowledge of the vegetation cover, volume, and morphology of foredunes is a dataset fundamental to achieving this goal. This project will increase our understanding of the dynamics of the beach/dune system and help to identify critical trends that will facilitate their protection and, in turn, mitigate potential impacts from coastal natural hazards such as storm damage.

Appropriateness of Change

Coastal populations are increasing exponentially and will likely continue to do so for the foreseeable future. Erosion, particularly on the upper Texas coast, is increasing due to sediment starvation, subsidence, sea level rise, and periodic storm events. The beach/dune system in some areas is literally being squeezed to the point of elimination from existing development. This phenomenon prevents the natural landward migration of the beach/dune system, and the eroding gulf shoreline, deteriorating the resource and exacerbating the risk to the coastal communities that continue to push toward the water's edge. An analysis of the status and trends of the beach/dune system is needed in Texas, particularly in the more developed areas of the coast, to help state and local officials and interest groups grasp the dynamics of their local system and prioritize their efforts in a manner most effective for the resource. In addition, increasing

fluctuations in the LOV from periodic storm events and erosion necessitates an accurate and consistent approach to determining the LOV to assist coastal managers in making critical decisions with regard to private vs. public property rights.

Proposed Work Plan

The following outlines the general tasks to be performed annually for five years along the more developed areas of the Texas coast, including Sabine pass to the Colorado River, Aransas Pass to the north boundary of PINS, and Mansfield Channel to the Rio Grande.

1. Lidar data acquisition and processing:
    a. Conduct logistical planning for aircraft operations: Acquire aircraft clearances for restricted airspace, such as military areas, airports, and wildlife refuges. Secure hangar space for field operations.
    b. Establish GPS ground reference stations and calibration targets in the study area: Where possible, the same ground reference points will be used as for past surveys. Calibration targets will also be resurveyed as needed using kinematic GPS techniques.
    c. Conduct lidar survey: For shoreline strips, a video camera will be used to guide the aircraft along the shoreline. At least two and as many as four passes will be made along the shoreline at a maximum altitude of 3,000 ft. The lidar instrument will be operated at a pulse rate of 25,000 per second. This will yield an average data point spacing of less than one meter.
    d. Process data into one meter digital elevation models: Processing the data involves first calculating, calibrating, and checking lidar X, Y, Z point data. After the lidar point data are processed, they are processed to yield a regularly spaced grid of elevations with a grid node spacing of one meter. A geoid model is applied to the grid so that elevations are relative to NAVD88, which approximates mean sea level. The horizontal datum is NAD83, and the coordinate system is UTM in meters. The grids are provided in an ASCII grid, non-integer format that can be imported into common GIS and image processing software.
2. Mapping of the shoreline, line of vegetation, critical dune line, and identification of altered areas
    a. Shoreline: By comparing tide gauge measurements with geodetic GPS surveys, a local mean sea level correction is determined and applied to the DEM's so that elevations are relative to a local tidal datum. A contour line for the shoreline is then constructed and cleaned of closed loops. The shoreline is provided as an ArcView polyline.
    b. Line of vegetation and seaward edge of foredune system: The DEM and reflected laser light intensity data from lidar surveys will be combined with visual imagery (color infrared provided by the GLO) and selected ground surveys. Digital technologies allow merging of various visual images with each other and with other data sets such as lidar data. In addition, some historic imagery will be used to assess temporal changes in the vegetation line or to reconstruct historic locations of the vegetation line prior to unnatural changes or dynamic natural processes.

c. Landward foredune boundary (critical dune line): This mapping will be accomplished through on-screen manual digitization of images that combine color infrared photography provided through the GLO and the lidar DEM. Hill shading, texturing, and 3-d views will aid in the interpretation of the line.
d. Identification of altered areas: Areas where the beach/dune system and natural line of vegetation have been unnaturally altered will be identified. The amount of alteration will be parameterized (e.g., beach width) through the comparison of natural settings.

3. Geomorphic, Volumetric, and Storm Susceptibility Analyses of the Beach/Dune System: Dimensions (e.g., height and width), continuity, volume, composition, and vegetative cover will be computed and combined in an index of storm-surge susceptibility. Indexes used in other coastal regions will be considered and possibly modified for use along the Texas coast.
4. Change Analysis: Data collected during this study and historic imagery and surveys will be used to assess temporal changes in the dune system and to reconstruct historic characteristics of the dune system prior to unnatural changes or dynamic natural processes. Alongshore and temporal rates of change will be computed for the appropriate dune parameters determined in task 3. Process-response relationships will be explored to explain the observed changes. Data analysis may include a time-lapse view of an area through sequential images to understand the rates and locations at which a dune parameter may change due to climatic variations or shoreline change, or become reestablished after events such as a storm washover.
5. Website Development and Maintenance: Data will be served through an ArcIMS website maintained at the BEG. Vector layers of GIS data will also be made available for download.
6. Report: A report describing the activities and principal findings of the project will be made available as a PDF file on the website.

The following tasks are proposed to utilize the information generated by this project to affect a program change, by their respective year of implementation.

Year 2

1. Texas Coastwide Erosion Response Plan: Pending the approval of funding through CIAP to update the plan, first year preliminary findings will be included in the plan update. Trends data, based on comparisons with historical information (e.g., aerial imagery), will be considered in addition to the various mapping outputs and findings related to the geomorphic, volumetric, and storm susceptibility analysis of the beach/system.

Year 3

1. CMP Grants Program: First year project findings will be reviewed and considered for inclusion in the Cycle 14 grant guidance document to ensure the most effective use of CMP dollars to mitigate coastal natural hazards.

Year 4

1. CMP Grants Program: Second year project findings will be reviewed and considered for inclusion in the Cycle 15 grant guidance document to ensure the most effective use of CMP dollars to mitigate coastal natural hazards.

Year 5

1. CMP Grants Program: Third year project findings will be reviewed and considered for inclusion in the Cycle 16 grant guidance document to ensure the most effective use of CMP dollars to mitigate coastal natural hazards.

Year 6

1. CMP Grants Program: Fourth year project findings will be reviewed and considered for inclusion in the Cycle 17 grant guidance document to ensure the most effective use of CMP dollars to mitigate coastal natural hazards

Year 7

7. CMP Grants Program: Fifth year project findings will be reviewed and considered for inclusion in the Cycle 18 grant guidance document to ensure the most effective use of CMP dollars to mitigate coastal natural hazards.
8. Beach/Dune Rules: The GLO will evaluate the project findings to determine if modifications to the beach/dune rules are necessary to sustain a no net loss objective for dunes in Texas.
9. *Plan for Texas Open* Beaches: Setback Initiative: The GLO will evaluate the project findings to determine if the data is supportive of the GLO's initiative to grant counties the legislative authority to establish building setbacks for development. Relevant data will be extracted, such as the storm susceptibility index, to support this initiative and to assist local authorities in determining appropriate setback distances to minimize the impact to private and public development.
10. Stakeholder workshops: An issue specific workshop will be hosted within each regional study area (Sabine pass to the Colorado River, Aransas Pass to the north boundary of PINS, and Mansfield Channel to the Rio Grande) to promote an understanding of the project findings.

Summary of Estimated Costs

Year 1	Year 2	Year 3	Year 4	Year 5	Year 7	Total
$85,908	$266,000	$266,000	$266,000	$266,000	$6,000	$1,155,908

Likelihood of Success

Increasingly, the state of Texas is faced with difficult decisions regarding best practices for mitigating erosion and damage from storm activity, particularly with regard to coastal armoring and public vs. private property rights. Soft approaches, such as dune restoration and beach nourishment, offer an attractive alternative, where possible, for protecting local communities and maintaining the public interest, as guaranteed under the OBA. State managers are in need of up-to-date status and trends information to guide state-sponsored dune restoration and beach

nourishment projects and protection through permitting activities, particularly in the identification of critical dune areas (e.g., beach/dune permits). This need is echoed by local officials, who are increasingly turning to shoreline protection projects to safeguard their communities. The results of this project will identify critical areas (in terms of deteriorating dune systems) and facilitate appropriate decision-making regarding project placement and type.

Fiscal and Technical Needs

Funding and staffing levels of the natural resource agencies in Texas are fixed until the end of the current biennium in September 2007. Mandatory requirements have been placed on state agencies to operate on reduced budgets. It is not known at this time if additional funding will be made available in the next biennium to undertake new or expanded program activities. Outside funding is needed to ensure the successful development of the CMP.

National Coastal Management Performance Measurement System

Objective

The GLO may obtain the services of a qualified contractor to support the implementation of the NCMPMS.

Background

The CMP is tasked with implementing the NCMPMS, a program aimed at quantifying the national impact of the CZMA. The NCMPMS consists of performance and contextual measures. Performance measures track how well the Coastal Zone Management Program (CZMP) and National Estuarine Research Reserve System (NERRS) are achieving CZMA objectives. Contextual measures track environmental and socioeconomic factors influencing program actions. OCRM developed performance and contextual measures for each of the following six categories: coastal habitats, coastal water quality, public access, coastal hazards, coastal dependent uses and community development, and government coordination and decision-making.

The CMP must gather and report on data for each category annually, beginning in April of 2006. Information will be compiled across coastal management programs to identify regional or national coastal management trends, which will be used in communication materials and in directing National Coastal Management Program (NCMP) goal-setting activities. National or regional information will be distributed to Congress, the Office of Management and Budget (OMB), federal agencies, regional organizations, and other parties of interest. Individual program information will inform Section 309 assessments, Section 312 evaluations, annual grant negotiations, and other CMP and member agency programs.

Program Change

This project will support the implementation of the NCMPMS. Supporting activity may include working with CMP member agencies to: identify categories where additional or modified measures are necessary for program use; examine existing data sources and identify measures for which new or modified data is needed for reporting; develop collection methodology; establish data sharing and use agreements to provide access to information managed by member agencies; and collect and report on NCMPMS data. Information provided by the NCMPMS may significantly support statutory or administrative proposals, and would certainly require the establishment of new or revised memoranda of agreement/understanding to allow the collection of data from CMP member agencies and other entities.

Anticipated Effect of Change

Information collected through the NCMPMS will provide a baseline to identify coastal management trends at the national, regional, and state levels. In addition to directing NCMP goal-setting activities, national or regional trends will be used to illustrate program effectiveness

and justify the continued funding of the CZMA. Trends identified at the state level will promote more informed decision-making within various CMP programs, including §309 and §306/306A. Furthermore, the potential exists for the NCMPMS to serve as clearinghouse for important information to the State of Texas. Much of the information generated by the CMP member agencies lacks a centralized repository. A data management system developed to store information for the NCMPMS may act in this capacity. For example, NOAA found in its §312 evaluation of the CMP that "there is no consistent coastwide data on wetland loss by type, which is essential to setting management priorities." The NCMPMS requires the tracking of wetland and other habitat loss by type within the coastal zone. The CMP may develop additional measures to capture other incomplete data sets within wetlands, public access, cumulative and secondary impacts, and coastal hazards.

Appropriateness of Change

Section 309 funds may be used to gather, analyze, or report on measures of the NCMPMS. Obtaining the services of a qualified contractor to support these activities will aid the CMP in meeting the established reporting requirements. In addition, the measures developed by the OCRM are not designed to meet individual state program needs. Some measures may not be applicable to the CMP or additional measures may be required. It is important to examine the need to modify the NCMPMS, which will allow for the development of a program more reflective of the condition of the CMP and the coastal zone.

Proposed Work Plan

Year 1

1. Organize and facilitate workgroups with appropriate staff from CMP member agencies and other applicable organizations to improve data collection and reporting and to discuss additional measures that may help the member agencies better fulfill their mission in the Texas coastal zone.
2. Define the reach of the data collection effort; identify existing data sources for each measure deemed applicable to the CMP; Develop contacts for each applicable measure and make recommendations for data sharing and use agreements to facilitate future data collection; Collect supporting data for Phase II measures.
3. Develop a Microsoft Access database including data entry forms and data queries.
4. Analyze and report on data for Phase II, including measures for Public Access, Government Coordination and Decision Making, Coastal Habitat, and Coastal Water Quality.
5. Initiate development of a web-based reporting system, by which member agencies or other relevant entities may transfer data easily to the GLO for assimilation into a central database.
6. Issue final report.

Year 2

1. Define the reach of the data collection effort; identify existing data sources for each measure deemed applicable to the CMP; Develop contacts for each applicable measure

and make recommendations for data sharing and use agreements to facilitate future data collection; Collect supporting data for Phase III measures.
2. Analyze and report on data for Phase III, including measures for Public Access, Government Coordination and Decision Making, Coastal Habitat, Coastal Water Quality, Coastal Hazards, and Coastal Dependent Uses and Community Development.
3. Finalize and implement a web-based reporting system, by which member agencies or other relevant entities may transfer data easily to the GLO for assimilation into a central database.
4. Issue final report.

Summary of Estimated Costs

Year 1	Year 2	Total
$90,000	$90,000	$180,000

Likelihood of Success

As a mandatory component of the CMP, Texas must implement the NCMPMS to remain compliant.

Fiscal and Technical Needs

Funding and staffing levels of the natural resource agencies in Texas are fixed until the end of the current biennium in September 2007. Mandatory requirements have been placed on state agencies to operate on reduced budgets. It is not known at this time if additional funding will be made available in the next biennium to undertake new or expanded program activities. Outside funding is needed to ensure the successful development of the CMP.

Status and Trends in Public Access to Coastal Resources

Objective

The GLO may contract with the Texas Agricultural Experimental Station (TAES) to develop a detailed database for public access by county, develop a coastal access development strategy, make recommendations on improving public access by activity where necessary, and conduct a telephone survey of the Texas population to develop a rate of coastal visitation by travel distance zone from the coast.

Program Change

This project will investigate both the supply and demand aspects of coastal access in Texas. A comprehensive database of coastal public access sites will be developed and categorized by county, providing local and county level officials with a tool to identify public access needs within their jurisdiction, particularly along the bays and estuaries where the public's right to access the shoreline is not protected under existing law. A coastal access development strategy will also be developed, including recommendations as to whether access by type is sufficient or needs attention by the public and private sector. Providing insight to the current supply of coastal access may result in new or revised local ordinances or subdivision rules that rebalance public and private rights to access the shore. In addition, as efforts are made to develop other types of access opportunities using public land acquisition, negotiation of public easements to private land, or commercially provided access, this strategy will help public and private decision makers determine areas of highest projected need. TAES will work with Texas Sea Grant Marine Advisory staff to provide outreach to local officials, NGOs, and entrepreneurs to facilitate local recognition of public access issues and increase/maintain public access where needed. A telephone survey will also be conducted to generate estimates of visitation to the coast, by zone, in Texas. Such information will provide valuable information as to the relative importance of coastal public access to the Texas population, which may be used to leverage greater state and federal funding for increased public access opportunities.

Anticipated Effect of Change

There are an increasing number of challenges to maintaining public access to the coastal shoreline in Texas. Population growth will continue to place increased pressure on available public access as resources are used for private development and property values escalate, making it more difficult to acquire lands for the public benefit. Of primary concern are the bay and estuary shorelines, where public access is not protected as it is on Texas's gulf beaches under the OBA. This project will provide a quantitative and qualitative (including ADA accessibility) inventory of the state's coastal public access sites by county, allowing a perspective previously not available to public and private decision makers. Inclusion of the Texas Sea Grant Marine Advisory staff will help to ensure that the data, along with recommendations made by TAES, are realized at the local level, facilitating the identification and protection/enhancement of areas of highest projected need. Results will also be

promoted at the state level, particularly to state administered grant programs (e.g., the CMP grants program may choose to prioritize those areas of greatest need for public access funding).

A predictive understanding for the Texas population that visits the coast is not known; with the exception that visitation is expected to decrease as travel distance and cost increase. Since a sizable proportion of the Texas population resides inland and is less likely to visit the coastal areas, TAES will conduct a survey to ascertain the extent of decline in coastal visitation and use as a function of distance. This will provide insight to where political support for maintaining public access is the most vibrant.

Appropriateness of Change

There is a need to conduct a comprehensive inventory of coastal public access in Texas to support access planning, particularly in the identification of underserved areas and ADA accessibility needs. The last coastwide inventory of public access in Texas was conducted in 1998-1999 for the *Texas Beach & Bay Access Guide*. Since that time, there have been significant changes to the public access landscape. New access sites have been created, others have been lost and new obstacles have arisen. In addition, increased pressure to increase and maintain public access along the coast is being felt in the form of increasing coastal populations and tourism.

Proposed Work Plan

Year 1: Quantitative/qualitative inventory of public access sites

1. Project personnel will meet with CMP staff to reach a consensus on the meaning of the term "public access" and to reach an agreement on the quantitative and qualitative descriptors for describing each access site.
2. Two research assistants will visit each coastal county to follow up on each access site and gather the required information. Once collected, the data will be entered into a database. A quality control assurance mechanism will be used as a check on the data entry process.
3. Data will be made available to local and county level officials along the coast for ground-truthing.
4. A database file of Texas coastal access sites with agreed upon descriptors, including maps, will be provided to CMP staff.
5. Two workshops will be held to make the data available to initiate a discussion of the public access issues.

Year 2: Conduct telephone survey

1. An estimated 5,000 completed telephone surveys will be conducted regarding recreational use of the Texas coast as well as ascertaining the participation rate (percentage of population that participates) in coastal recreation activities. The results will provide a demand curve of volume of trips to the coast per unit of cost that will be useful for estimating the affects of increased gasoline prices and other cost constraints on participation.
2. The results of the survey will be compiled in report format.

3. TAES will collaborate with CMP staff to develop press releases and links to web pages that highlight research results and their implications for maintaining/increasing public access opportunities.

Year 3: Develop a strategic plan/Outreach to local leadership

1. Topics to be addressed will include an introduction detailing previous efforts in this area in Texas, related issues, and a general description of public access on the Texas coast. This will be followed by a summary of the data on the supply of public access sites by county and the extent of demand for coastal access by distance travel zone in Texas. Lastly, what is known about available access and the demand for coastal recreation will be viewed together using established planning standards to indicate where access needs are most critical.
2. Develop and distribute a paper version and web-based version executive summary of results.
3. Conduct two public workshops on the coast to present the results of the project and assist local leaders to understand the access supply and demand situation in their respective areas. The workshops will include presentation from various local leaders on "best practices" for providing public access.
4. Convene with Texas Sea Grant Marine Advisory Staff to present results and solicit their assistance with strategic public access initiatives along the coast.

Summary of Estimated Costs

Year 1	Year 2	Year 3	Total
$78,290	$87,876	$63,436	$229,602

Likelihood of Success

TAES will work to involve multiple stakeholders, including all state, regional, and local agencies with a coastal jurisdiction, in the development of a coastal access strategy. The inclusion of two public workshops and the outreach capabilities of the Texas Sea Grant Marine Advisory staff will help to ensure a fair representation and understanding of public interests, as well as facilitate the preservation and increase of public access opportunities. The ultimate success of this project will depend upon the quality of data collected and the effectiveness of which the data is translated to the local and state decision makers.

Fiscal and Technical Needs

Funding and staffing levels of the natural resource agencies in Texas are fixed until the end of the current biennium in September 2007. Mandatory requirements have been placed on state agencies to operate on reduced budgets. It is not known at this time if additional funding will be made available in the next biennium to undertake new or expanded program activities. Outside funding is needed to ensure the successful development of the CMP.

Secondary Impact Analysis of Hard Shoreline Structures in the Corpus Christi Bay Area

Objective

The GLO may contract with the BEG to conduct a cumulative and secondary impact analysis of hard structures along the bays and estuaries of the following areas: Galveston Bay, Corpus Christi/Copano Bay, Beaumont-Port Arthur, Brownsville-Harlingen, and San Antonio/Matagorda Bay.

Program Change

The BEG completed a coast-wide Environmental Sensitivity Index (ESI) map of the Texas shoreline in 1995. This project will modify the existing ESI map to identify and locate newly constructed hardened structures within the aforementioned bays and estuaries along the Texas coast. The modified map will be used to quantify and characterize shoreline change, related to hardening, between 1995 and the present. Results will be evaluated to determine possible secondary impacts associated with conversion to hardened shorelines.

A sampling of more severely impacted locations will be investigated to determine if the U.S. Army Corps of Engineers permits reflect possible impacts to these areas. This may lead to modifications of permitting guidelines and procedures if results indicate that the corps permits did not reflect possible impacts. In general, the results of this project may lead to revised guidelines and procedural improvements throughout the coastal area. These changes may be realized in acquisition, restoration, and management programs and local, city or county ordinances to protect or minimize impacts to the resource. The GLO will work to ensure that the data produced from this project is promoted to the appropriate state and local authorities and/or coastal programs to facilitate these changes.

Anticipated Effect of Change

It is often difficult for permitting agencies, or those agencies that review permits, to recognize the cumulative and secondary impacts associated with shoreline hardening on our bays and estuaries. An up-to-date inventory will provide decision makers with a regional perspective when reviewing activities that propose to alter the natural shoreline. In addition, an evaluation of the extent and impact of shoreline hardening over the past decade will highlight the need for modifications to existing permitting procedures.

Appropriateness of Change

Bay and estuarine shorelines, particularly fringe areas, are increasingly recognized as ecologically rich areas, the incremental hardening of which may lead to greater impacts than are currently realized by local and state entities. The modification of the existing ESI map is a practical and cost-effective alternative to determining the extent of hardening that has occurred over the past decade. The evaluation of cumulative and secondary impacts resulting from shoreline hardening, in conjunction with the investigations of past corps permits, will enhance

our understanding of shoreline hardening and allow for the examination of the adequacy of existing procedures to protect these resources.

Proposed Work Plan

The following outlines the general tasks for data collection and analysis at each proposed study area. One study area will be undertaken each year in the following order: year 1, Galveston Bay; year 2, Corpus Christi/Copano Bay; year 3, Beaumont-Port Arthur, year 4, Brownsville-Harlingen; year 5, San Antonio/Matagorda Bay.

1. Interpret and map hardened shorelines: Digital vertical aerial photography will be viewed within the GIS environment to determine sections of shoreline that have been hardened since the original 1995 ESI mapping. Priority areas will be those sections of shoreline that have been altered to increase the amount of hardened features, such as walls and riprap.
2. Process shoreline characterization and enter into GIS: Following the initial interpretation of aerial photography, the existing ESI map will be edited to reflect the modern shoreline.
3. Field-check modified ESI map: A fixed wing aerial survey of the bay shoreline will be conducted in order to verify the mapping of hardened structures. Hardened structures that are indistinguishable on aerial photos (i.e. exposed wall vs. exposed riprap) will be examined and photographed to determine the precise nature of the structure. Field site location will be collected using GPS. A small number of sites determined to be of high environmental impact will be investigated to determine if USACE permits reflect the potential impact caused by shoreline hardening.
4. Conduct detailed quality control analysis of modified shoreline GIS database: Data gathered during fieldwork will be compiled and compared to the initial mapping. Edits will be made where needed. Further refinements to character of hardened shoreline will be added.
5. Analyze trends and develop results: Statistical analysis of the completed shoreline will be conducted to determine linear distances of all ESI classification units. The results of the statistical analysis will be compiled into a quantitative status of the shoreline. Overlay analysis of the recent ESI map with the 1995 map will spatially locate sections of the shoreline that have changed to hardened structures. Results of the comparison will be analyzed to determine shoreline trends. Analysis will determine where the most sensitive shoreline types have changed through time.
6. Complete final manuscript: Compilation of study introduction, methods, habitat classification, status, historical trends, and summary and conclusions into a report format. Possible secondary impacts of shoreline change will be discussed.

Following the completion of the final report for each study area, an issue-specific workshop will be hosted within the respective region to present and promote an understanding of the results to local, state and federal stakeholders, including city and county officials, relevant state and federal agencies, non-profit organizations, universities and other public and private interests. It is anticipated that these workshops will provide a venue for the exchange of information and ideas on how to best address the issues raised by this project. The following outlines the workshops by their respective year of application.

Year 3: Galveston Bay
Year 4: Corpus Christi/Copano Bay
Year 5: Beaumont-Port Arthur
Year 6: Brownsville-Harlingen
Year 7: San Antonio/Matagorda Bay

Summary of Estimated Costs

Year 1	Year 2	Year 3	Year 4	Year 5	Year 6	Year 7	Total
$81,000	$90,000	$127,000	$92,000	$92,000	$2,000	$2,000	$486,000

Likelihood of Success

The BEG has successfully completed status and trends studies in other areas of the Texas coast and is in the final phase of a coast-wide study of the status and trends of wetlands and aquatic habitats on the barrier islands/peninsulas of the Gulf of Mexico (White and others, 2002; 2004; 2005; 2006). It is likely that this project will provide a clearer understanding of the extent and rate of shoreline hardening on Texas bays and estuaries and its relative environmental impact. The degree to which the results of this project will precipitate a program change is dependent upon the severity of impacts, the success of the outreach effort to local and state stakeholders, and stakeholder interest.

Fiscal and Technical Needs

Funding and staffing levels of the natural resource agencies in Texas are fixed until the end of the current biennium in September 2007. Mandatory requirements have been placed on state agencies to operate on reduced budgets. It is not known at this time if additional funding will be made available in the next biennium to undertake new or expanded program activities. Outside funding is needed to ensure the successful development of the CMP.

Coastal CHARM (Community Health and Resource Management) Circuit Rider

Objective

The GLO may obtain the services of a qualified contractor to work with local governments to facilitate sustainable local planning by providing neutral and credible information to local citizens and their elected officials.

Program Change

The Coastal Planning Circuit Rider (CPCR) will engage local communities through workshops held at communities along the Texas coast, and through factsheets, bulletins, web sites, and other outreach documents. The CPCR will also provide direct technical assistance to individual communities as requested and as time resources permit, or mediate technical assistance from appropriate university specialists. This project will provide communities with new tools that may lead to new and better local ordinances dealing with a more compact urban form, less loss of habitat, and thus less degradation of coastal water quality. This project will also aid local communities to develop sustainable growth plans. Part of those plans would likely include the identification of significant natural areas of local and regional interest.

Anticipated Effect of Change

It is anticipated that a professional extension specialist with the proper planning background will help coastal communities make connections between their planning decisions and susceptibility to cumulative and secondary impacts. The CPCR will be supported through the Texas Sea Grant College Program (Sea Grant), which has agents in most coastal counties and is connected to a dynamic repository of information at Texas A&M University (TAMU) and other Texas universities. Sea Grant has a model in place for delivery of university-based planning information and practices. Currently, however, on-the-ground human capital in this area is lacking. The CPCR would be based on the coast and serve to fill this gap. This project would work to ensure that coastal communities are fully aware of the complete range of planning options that might be available to them, and that they also have full knowledge of the potential environmental and quality of life impacts of particular development decisions.

Appropriateness of Change

Rapid urban growth is the single largest source of cumulative and secondary impacts in the coastal zone of Texas. Decisions associated with urban growth and land use are best left to local officials and citizens, but it is at the local level at which there is the least access to new ideas for dealing with these issues. Local elected officials and their staff may intend to maintain quality of life and the environment within their jurisdictions, but they generally lack the resources to affectively address issues. This project will capitalize on Sea Grant's established extension program to translate the science of sustainable planning into the hands of local officials and citizens on the Texas coast.

Proposed Work Plan

The following tasks include the general activities the CPCR would engage in over the course of three years. All tasks would be addressed concurrently and none are specific to any given year.

1. Develop factsheets, bulletins, website pages, and other outreach material: The CPCR will immediately be engaged in developing a series of outreach materials suitable for use by Texas coastal communities. Each piece may address a narrow or broad aspect of planning issues relating to urban form, coastal hazards, coastal tourism, etc., as they apply to Texas coastal conditions. All materials will be reviewed for scientific relevance and validity through an appropriate department at TAMU or another university.
2. Develop regional and local workshops along the Texas coast.
3. Provide direct technical assistance to communities as requested.

Summary of Estimated Costs

Year 1	Year 2	Year 3	Total
$100,000	$100,000	$100,000	$300,000

Likelihood of Success

There is an emerging awareness that community or urban issues cannot be separated from environmental issues (i.e. what makes a community stable and resilient will also make for a better environment). Communities along the Texas coast are anxious to learn how they can make their communities more interesting and viable places to live. A credible delivery system that puts the best available science in the hands of local officials will ensure that decisions are being made with an understanding of the complete range of planning options that are available to them.

Fiscal and Technical Needs

Funding and staffing levels of the natural resource agencies in Texas are fixed until the end of the current biennium in September 2007. Mandatory requirements have been placed on state agencies to operate on reduced budgets. It is not known at this time if additional funding will be made available in the next biennium to undertake new or expanded program activities. Outside funding is needed to ensure the successful development of the CMP.

Cost/Benefit Analysis of Building Setbacks from the Shoreline for Development

Objective

The GLO may obtain the services of a qualified contractor to evaluate the cost/benefit of building setbacks from the shoreline for development.

Program Change

This project will create a cost-benefit model that will allow the testing of different setback scenarios. Costs to be included in the model include costs of relocating buildings, reduction in local tax revenues, and increased litigation and administrative costs. Benefits to be included in the model include reduced insurance premiums, reduced administrative costs, reduced emergency costs, reduced cleanup costs, increased property value, increased recreation use, decreased property damage losses, reduced repetitive loss payments, and enhanced natural resources.

Project findings will apply directly to and potentially support the GLO's eight-point *Plan for Texas Open Beaches* released by the commissioner on June 7, 2006, which includes requesting that the Texas Legislature grant counties the authority to establish building setback requirements for storm mitigation and to protect public access (only cities currently have this authority). An unbiased assessment will better inform the Texas Legislature as to the need for setbacks on the Texas coast. Implementation would require amendments to the DPA and GLO beach/dune rules to take effect. In addition, a setback area could be designated as a new CNRA.

Anticipated Effect of Change

It is anticipated that this project will provide information critical to the GLO's initiative to grant counties the authority to establish building setbacks requirements. An unbiased analysis of the viability of setbacks on the Texas coast will allowing for an informed discussion at the state level of setbacks as a means of mitigating coastal hazards and protecting public access.

Appropriateness of Change

The population of the state of Texas is expected to double in the next few decades. Studies have shown that approximately 25% of the state population lives along the coastal region. With this increasing population there will come an increased demand for coastal development for homes, condominiums, and resorts. Current state law does not restrict the location of development landward of the LOV. In critical eroding areas, structures placed adjacent to the LOV may end up on the public beach easement (restricting public access) and may require appropriate actions by the state for removal from the public beach easement. In addition, the presence of structures adjacent to the LOV may materially weaken existing dune complexes; effectively reducing the protection these dunes offer coastal communities from storms.

Proposed Work Plan

1. Develop economic framework: Determine the entity(s) to which the costs and benefits are to accrue (costs borne by the Federal government vs. costs born by State or local government vs. costs borne by private individuals (i.e., social costs) can be very different). Conceptualize a framework that will eliminate the possibility of double counting costs and benefits as well as the best study horizon (years) and discount rate.
2. Create GIS database: Determine the availability of, and acquire, tax information. Extract elevation data and generate near-shore structures based on currently available (and projected 2006) lidar and digital aerial photography data. Add a unique identifier for each structure (tax ID). Overlay parcel plat maps on top of structure footprints to verify and transfer the tax ID number from the tax information to the data layer. Join tabular information to the near-shore structure spatial features via the tax ID. Generate proposed coastal setback lines based on the criteria of the project and analysis of the near-shore structures. Produce maps showing the near-shore structures and coastal setback lines.
3. Perform demographic analysis: Create generalized build-out model scenarios for the with and without setback conditions over a set period of time. Scenarios will be based on current trends and expert opinions of local officials, non-governmental organizations, and researchers.
4. Develop costs and benefits of setbacks: Determine costs, including cost of relocating buildings, reduction in local tax revenues, and increased litigation and administrative costs. Determine benefits, including reduced insurance premiums, reduced administrative costs, reduced emergency costs, reduced cleanup costs after storm events, increased property value, increased recreational use, decreased property damage losses, reduced repetitive losses, and enhanced natural resources.
5. Create cost-benefit model and perform analysis: Create a generalized cost/benefit model and perform a cost/benefit analysis using the data collected in Task 4. The results will incorporate sensitivity analysis as well as risk and uncertainty analysis.
6. Produce report: Produce a draft and final report that includes the background, approach, data collection, analysis, cost/benefit model, sensitivity analysis, and economic/financial optimization.
7. Implementation/outreach

Summary of Estimated Costs

Year 1	Total
$149,291	$149,291

Likelihood of Success

The *Plan for Texas Open Beaches* released by the commissioner of the GLO provided the political traction necessary to ensure the use of the information generated by this project. The final project findings and the position of the political leadership in Texas will dictate the degree to which this project will affect meaningful change.

Fiscal and Technical Needs

Funding and staffing levels of the natural resource agencies in Texas are fixed until the end of the current biennium in September 2007. Mandatory requirements have been placed on state agencies to operate on reduced budgets. It is not known at this time if additional funding will be made available in the next biennium to undertake new or expanded program activities. Outside funding is needed to ensure the successful development of the CMP.

Sand Source Investigation Protocols

Objective

The GLO may obtain the services of a qualified contractor to develop sand source investigation protocols for future erosion-related sand source investigations to be used by state resource agencies and other entities.

Program Change

This project will develop a protocol under which future erosion-related sand source investigations would be conducted by state resource agencies and other entities. This new protocol would facilitate permitting processes and provide guidance for stakeholders and private firms on how to search, register and validate the physical characteristics of offshore sand sources to be used for beach nourishment and habitat restoration projects. Documentation will be in the form of a guidance document that may be formally adopted by the state.

Anticipated Effect of Change

The guidance document will establish a set of protocols necessary for conducting effective sand source investigations and ensure that sand source data collected by individual projects can be fully utilized by a central sand source database for the Texas coast. It is anticipated that a formalized protocol will lead to more structured and timely investigations, which will allow for a more efficient use of state and local resources.

Appropriateness of Change

The gulf shoreline in Texas suffers some of the highest erosion rates in the nation due to a shortage of new sediments in its coastal waters. This negative sand budget threatens the state's coastal infrastructure and sensitive coastal habitats that could be destroyed by a major storm event. Sand resources are vital to nourish the state's beaches to mitigate the potential impact from future storm events. Previous studies have supported research on specific sand sources at specific sites. These offshore sand source investigations have enabled Texas to secure valuable information for specific areas and ensure that work will be continued in future years. The knowledge gained from these individual investigations has revealed the need for the development of a set of criteria to guide future research efforts on offshore sand sources.

Proposed Work Plan

1. Prepare scope of work for Professional Service Provider (PSP) to develop a sand source investigation protocol in consultation with state and federal resource agencies. Prepare and award work order to PSP for implementation of work.
2. Preparation of protocols with stakeholders, including the general conditions of sand sources and the need to avoid or minimize impacts to the environment, as well as permitting requirements for use of the sand sources in coastal erosion response projects.

Documentation will be in the form of a guidance document with process descriptions and standards of sand source investigation deliverables.

Summary of Estimated Costs

Year 1	Total
$60,000	$60,000

Likelihood of Success

High erosion rates along portions of the Texas coast, in combination with a recent increase in storm activity in the Gulf of Mexico, has increased the number of beach nourishment projects being proposed in Texas. As no formal guidance currently exists, it is very likely that state agencies and other entities (e.g., local government) will utilize this information to support and enhance their sand source investigation efforts.

Fiscal and Technical Needs

Funding and staffing levels of the natural resource agencies in Texas are fixed until the end of the current biennium in September 2007. Mandatory requirements have been placed on state agencies to operate on reduced budgets. It is not known at this time if additional funding will be made available in the next biennium to undertake new or expanded program activities. Outside funding is needed to ensure the successful development of the CMP.