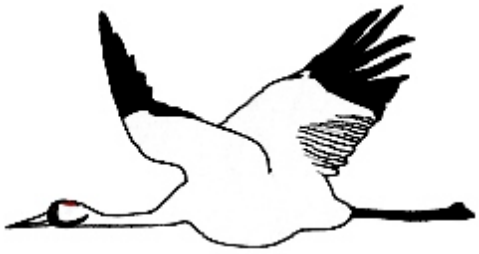

The Texas National Estuarine Research Reserve

Site Nomination and Application for Predesignation Assistance

October 15, 2003

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Texas National Estuarine Research Reserve

Site Nomination and Application for Predesignation Assistance

October 15, 2003

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LIST OF ACRONYMS

ANWR	Aransas National Wildlife Refuge
BBL	Unit of measurement for oil (barrel = 42 US gallons)
CBBF	Coastal Bend Bays Foundation
CBGA	Coastal Bend Guides Association
CBLT	Coastal Bend Land Trust
CBSC	Coastal Bend Shell Club
CCA	Coastal Conservation Association
CCBNEP	Corpus Christi Bay National Estuary Program
CCC	Coastal Coordination Council
CFR	Code of Federal Regulations
CMP	Coastal Management Plan
CNRAs	Coastal Natural Resource Areas
CZMA	Coastal Zone Management Act
EDF	Environmental Defense Fund
ERD	Estuarine Reserves Division
EIS	Environmental Impact Statement
GIS	Geographic Information System
GIWW	Gulf Intracoastal Waterway
GLO	Texas General Land Office
GPS	Global Positioning System
IOTB	Ingleside-on-the-Bay
K-12	Kindergarten through twelfth grade
MCF	Unit of measurement for gas (1000 cubic feet)
MNWR	Matagorda Island National Wildlife Refuge
MOU	Memorandum of Understanding
MP	Management Plan
NEAC	Nueces Estuary Advisory Committee
NEPA	National Environmental Policy Act
NERR	National Estuarine Research Reserve
NERRS	National Estuarine Research Reserve System
NMFS	National Marine Fisheries Service
NOAA	National Oceanic and Atmospheric Administration
NWP	Nationwide Permit (U.S. Army Corps of Engineers)
NWS	National Weather Service
OCRM	Ocean and Coastal Resource Management
OMSA	Offshore Marine Supply Association
OPUS	Organization for the Protection of an Unblemished Shoreline
OSPR	Oil Spill Prevention and Response Program
OSPRA	Oil Spill Prevention and Response Act of 1991
PCCA	Port of Corpus Christi Authority
PINS	Padre Island National Seashore
PSF	Permanent School Fund
RRC	Texas Railroad Commission
SES	Site Evaluation Subcommittee

SLB	School Land Board
STAC	Scientific and Technical Advisory Committee
SPMWD	San Patricio Municipal Water District
SSC	Site Evaluation Committee
STCZAC	South Texas Coastal Zone Advisory Committee
STSSN	Sea Turtle Stranding and Salvage Network
SWCD	Soil and Water Conservation District
TABS	Texas Automated Bouy System
TAC	Texas Administrative Code
TAMU	Texas A&M University
TAMU - CC	Texas A&M University - Corpus Christi
TCOON	Texas Coastal Oceanic Observation Network
TCEQ	Texas Commission of Environmental Quality (formerly TNRCC)
TCMP	Texas Coastal Management Program
TMMSN	Texas Marine Mammal Stranding Network
TNC	The Nature Conservancy
TNRCC	Texas Natural Resource Conservation Commission
TNRIS	Texas Natural Resources Information Service
TPWD	Texas Parks and Wildlife Department
TRC	Texas Railroad Commission
TSA	Texas State Aquarium
TSFA	Texas Seafood Association
TSPA	Texas Seafood Producers Association
TSN	Turtle Stranding Network
TSSWCB	Texas State Soil and Water Conservation Board
TWDB	Texas Water Development Board
TWOA/AWO	Texas Waterway Operators Association/American Waterway Operators
TxDOT	Texas Department of Transportation
USACE	United States Army Corps of Engineers
USCG	United States Coast Guard
USEPA	United States Environmental Protection Agency
USFWS	United States Fish and Wildlife Service
USGS	United States Geological Survey
USNPS	United States National Park Service
UTA	University of Texas at Austin
UTMSI	University of Texas Marine Science Institute

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EXECUTIVE SUMMARY

This document describes the process and outcome of the work to nominate a site within the Texas coastal zone for the of the National Estuarine Research Reserve System (NERRS). The NERRS program is administered by the U.S. Department of Commerce, National Oceanic and Atmospheric Administration (NOAA), as authorized under Section 315 of the Coastal Zone Management Act of 1972. The overall mission of this program is to promote stewardship of the nations estuaries through science and education using a system of protected areas. Although national in scope, individual sites are state owned and managed with oversight and coordination provided by NOAA.

The selection of a candidate Texas National Estuarine Research Reserve (NERR) site was initiated by the University of Texas Marine Science Institute (UTMSI). The University of Texas at Austin sought the assistance of the Texas General Land Office (GLO) to coordinate the site selection process and prepare the site nomination package. The site selection process was accomplished through the work of two standing committees, tasked with identifying, evaluating, and selecting a candidate site, as well as developing appropriate local, state, federal, and private partnerships that will ultimately define the NERR. The Site Selection Committee (SSC) provided overall guidance to the process and the Site Evaluation Subcommittee (SES) provided technical guidance in evaluating sites. Membership in both committees included individuals from state and federal agencies, state, federal and local public officials (state officers and legislators), academic institutions, private groups (e.g., private industry and environmental groups), and the general public. The process also included a public hearing to solicit comment and input from local residents and landowners in Rockport, Texas.

The proposed Texas NERR site was selected from a group of 65 sites, within the Western Gulf of Mexico biogeographical subregion of the Louisianian Biogeographic Region, that represent key estuarine areas within the state's coastal zone. The proposed site (236,641 acres) consists of a combination of approximately 166,131 acres of state-owned coastal habitat, including estuarine intertidal marsh and shallow open-water bottoms and approximately 66,718 acres of estuarine marsh and non-tidal coastal plain habitat that is part of the Aransas and Matagorda Island National Wildlife Refuge. The site also encompasses the Buccaneer Ranch Cove Preserve (279 acres), a 257 acre parcel under conservation by The Nature Conservancy (Johnson Ranch), and a 3,256 acre private parcel (Fennessey Ranch) bordered on three sides by the Mission River that is proposed by the owner as a conservation area. The entire proposed site includes a diverse suite of estuarine and non-estuarine habitats (many of high quality) that form an intact coastal watershed. The site also includes a number of archaeological sites (i.e., indian middens) and supports significant faunal and floral components. The site is relatively rural with limited industrial and community impacts.

Upon acceptance of the Texas NERR nomination by NOAA, UTMSI will proceed with development of drafts of an Environmental Impact Statement and Management Plan for the site. It is anticipated that appropriate management agreements will be developed during this phase of site designation to address the educational, research and management objectives of the NERR. The overall goals, objectives, and policies of the Texas NERR will be scoped during the Environmental

Impact Statement process and addressed in the Management Plan. Landholding partnerships in the Texas NERR are anticipated to include: USFWS (federal), GLO, TxDOT, TPWD, Coastal Bend Land Trust, The Nature Conservancy, and the Fennessey Ranch. Local administrative partnerships in the Texas NERR are anticipated to include: Aransas County, and the City of Rockport.

INTRODUCTION

Overview of the National Estuarine Research Reserve System (NERRS)

The National Estuarine Research Reserve System (NERRS) is administered by the U.S. Department of Commerce, National Oceanic and Atmospheric Administration (NOAA), as authorized under Section 315 of the Coastal Zone Management Act of 1972. The overall mission of the NERRS program is to promote stewardship of the nations estuaries through science and education using a system of protected areas. This is to be achieved by building federal, state, and community partnerships and promoting management and stewardship of our estuarine and coastal habitats through scientific understanding linked with public education. This is accomplished through a combination of research, education, and public outreach. The reserves serve as laboratories and classrooms where the effects of both natural and human activity can be monitored and studied.

Designation of a NERR site does not result in the total preservation of the area, precluding any further development that may be advantageous to the people in general. Each NERR develops its own management plan that takes into consideration the beneficial consumptive (resource harvest) and non-consumptive uses (recreational) and the compatibility with adjacent land uses. To meet this end, the following goals have been identified as being key to the national NERRS:

- Ensure a stable environment for research through long-term protection of important estuarine habitat;
- Address significant coastal management issues;
- Enhance public awareness and understanding of estuarine areas and provide suitable opportunities for public education and interpretation;
- Promote federal state, public and private use of the reserve(s) when conducting estuarine research;
- Conduct and coordinate estuarine research within the national system and provide information necessary for improved understanding and management of estuarine areas for public use and benefit; and
- Provide federal funding to assist with the management of NERR sites.

NERR Program Policy for Adding New Systems

There are currently 25 sites in the NERRS (Figure 1), scattered among 16 of a total of 29 recognized biogeographic subregions of the country (Figure 2). The Estuarine Reserves Division's (ERD) policy for establishing new reserves is:

1. ERD is committed to completion of a system of reserves representing the diverse biogeographic and typological character of the estuaries of the U.S. and estuarine-like systems of the Great Lakes;

2. The first priority for use of NOAA funding is to support the operation of designated reserves, system-wide projects benefitting designated reserves, and development of reserves in states that currently have a formal commitment from the office of Ocean and Coastal Resource Management (OCRM) to proceed with the designation process;
3. Additional reserves (beyond the existing 27 designated and proposed reserves and the Texas nomination) will be considered by OCRM only when:
    - sufficient funds are appropriated to provide new reserves continuing operations support after designation;
    - and sufficient federal staff and resources are available to adequately support new designation and operation activities;
4. Priorities for accepting new nominations are:
    - First priority will be given to nominations that incorporate both a biogeographic sub-region and an estuary type not represented by existing or developing reserves (see NOAA regulations at 15 CFR.921) (Figure 2).
    - Second priority will be given to nominations that incorporate either a biogeographic sub-region and an estuary type not represented by existing or developing reserves.
    - Third priority will be given to nominations within the already represented sub-region that do not add a new estuary type to the system, but add significant research and educational assets to the system.

The proposed Texas NERR site will represent an addition to the national network that meets all of the above listed criteria. The proposed site also represents a unique combination of high quality and relatively unimpacted estuarine habitats and non-tidal wetland and upland habitats that together compose an intact coastal watershed.

Figure 1. National Estuarine Research Reserve System as of March 2003.

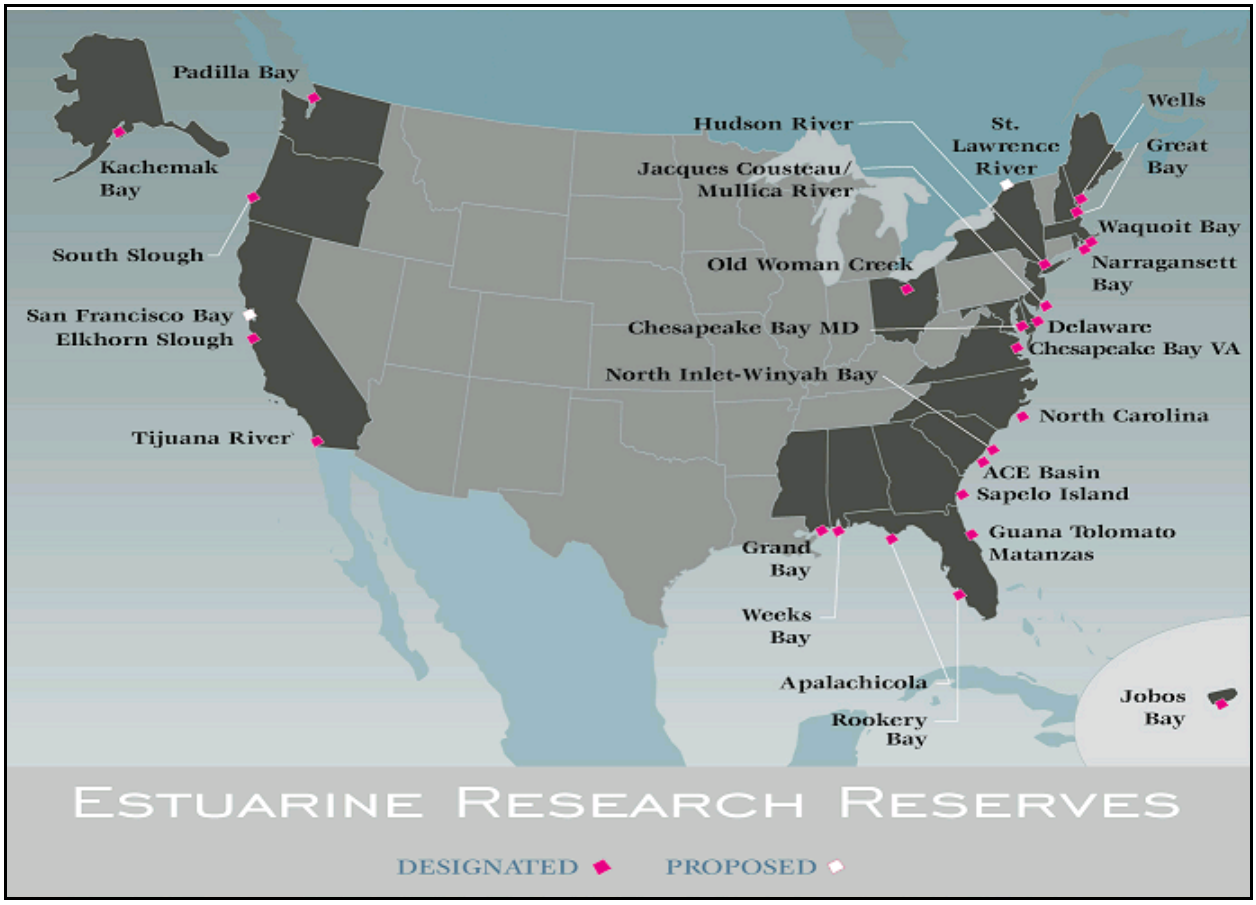
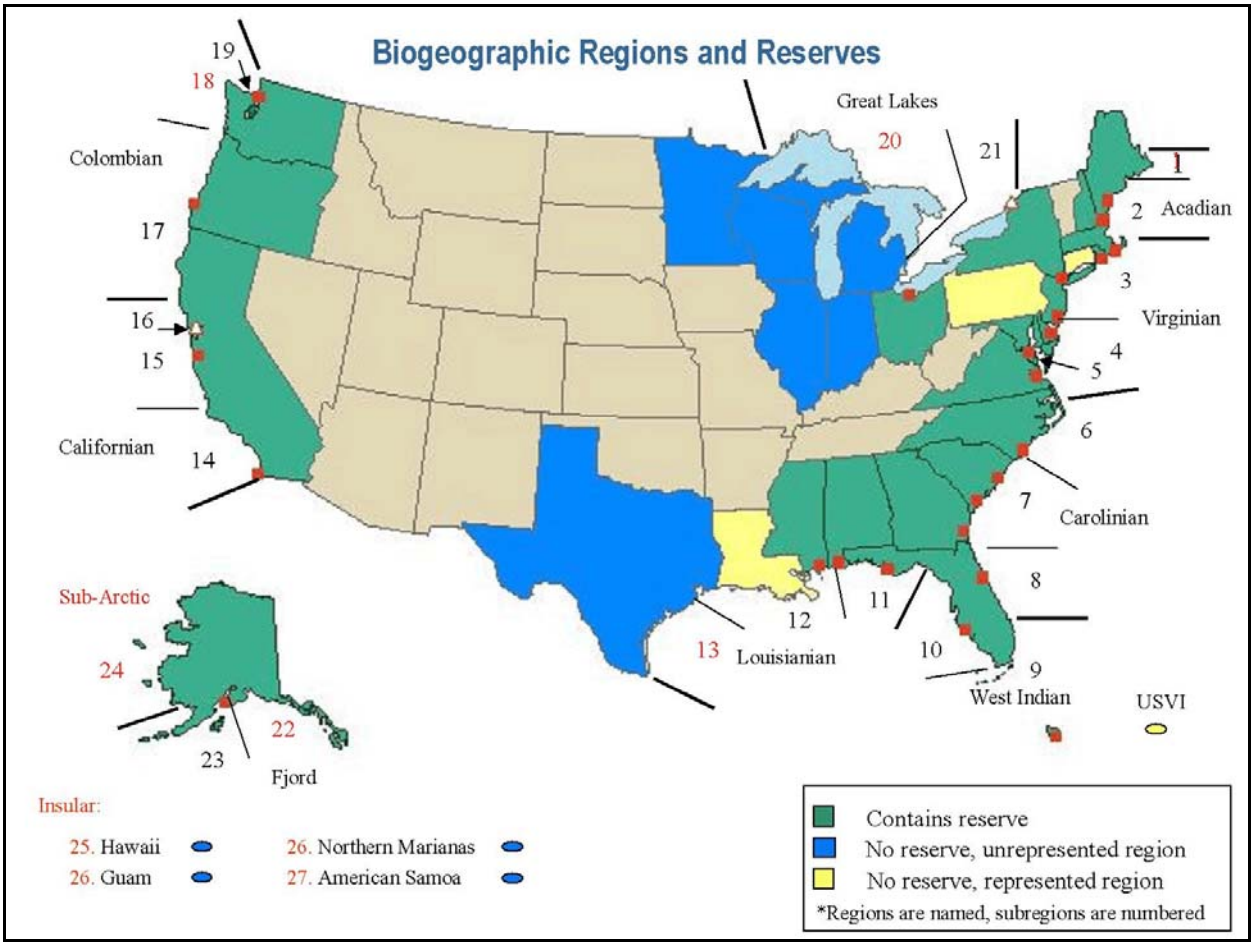


Figure 2. Map of existing NERR sites in biogeographic regions and sub regions.



Purpose and Benefits of a Texas NERR

The purpose of a Texas NERR is to join a national network of sites to provide opportunities for long-term research, education, and interpretation in a number of ways that would not ordinarily be possible. The proposed site will also involve the cooperation and interaction of a unique combination of federal, state, local and private partners. Protecting representative natural habitats through joint federal-state partnerships and utilizing operation and management plans developed to increase awareness and stewardship of the resources assures benefits that can be enjoyed by all people of Texas. The designation of a Texas NERR would also represent a significant addition to the national network of NERR sites because of unique estuarine types not currently represented in the NERR system. The Texas NERR site will use existing authorities and will not create new rules or regulations for protection. These existing protections will ensure a stable environment for long-term research.

A NERR site will represent an area where long-term and short-term research projects and programs can be initiated, thereby contributing to a better understanding of the biotic and physical nature of these habitats. The existence and proposed use of a NERR site (including the use of available facilities) will be an attractive aspect of research proposals submitted for funding by potential researchers. As part of the national NERR network of sites, the Texas NERR will also be part of long-term water quality and biotic monitoring programs that represent an unprecedented effort to compare similar aspects of multiple sites. A system for real-time access of remote water quality monitoring equipment, for example, is currently being planned for each NERR site. An additional benefit is that the Texas NERR will provide opportunities to study the interactions between human activities and natural estuarine processes to develop better methods to further minimize impacts.

An established reserve will also allow for the development of interpretive and educational programs that will be attractive to both local and regional school systems. Schools of all levels (K-12, colleges and universities) can be encouraged to use the site's physical facilities (e.g., pavilions, classrooms) and associated interpretive areas (e.g., nature trails, etc.) for single or multiple field trips. Tours of more remote portions of the reserve can be developed and offered (e.g., boat tours through the site). Local schools may be encouraged to use the site's facilities and habitats as sites for long-term monitoring and assessment programs that can be coordinated with the site's educational programs. Schools may, for example, adopt an area of the site that they revisit throughout the academic year where students participate in making observations about an area or collect data on the quality of a portion of the site (e.g., water quality monitoring). As for any use of the site for research, the value of the establishment of a NERR site lies in the long-term presence of the site and the availability of facilities.

The proposed Texas site is composed of a combination of state, federal, and privately owned properties that will allow for shared resources (e.g., personnel, technical assistance) among respective agencies. Additional resources (e.g. personnel, funds) will undoubtedly be contributed by many other governmental agencies, non-governmental organizations, industries, and citizens groups that have supported the Texas NERR initiative. These groups have been highly supportive of the NERR process through their participation on one or both of the two site selection committees,

and will continue to contribute to the remaining tasks required to designate and operate a Texas NERR site.

Background and History of the Texas NERR Initiative

The Texas Coastal Management Program (CMP) coordinates state, local, and federal programs for the management of Texas coastal resources. Many different government programs have been created piecemeal over the last few decades, often to address a single natural resource, activity, or problem. In the late 1980's, Texas coastal communities began calling for a more coordinated approach to coastal issues. The CMP is based primarily on the Coastal Coordination Act of 1991 (33 TEX. NAT. RES. CODE ANN. §201 et. seq.) as amended by HB 3226 (1995), which calls for the development of a comprehensive coastal program based on existing statutes and regulations. Key elements of the Coastal Coordination Council and its implementation regulations (31 TAC §§ 501-506) detail the general provisions, goals and policies, boundaries, state procedures, and federal procedures for the Coastal Management Plan. The National Oceanic and Atmospheric Administration's Office of Ocean and Coastal Resource Management (NOAA) approves coastal management plans under the authorization provided by the Coastal Zone Management Act. On January 10, 1997, the state of Texas received federal approval of the CMP (62 Federal Register pp. 1439-1440). As of 2003, 34 states and territories have coastal programs approved by NOAA.

Dr. Paul Montagna of the Marine Science Institute, The University of Texas at Austin, began inquiries into obtaining a NERRS site for Texas. Texas is wholly in the Western Biogeographic Region (Bioregion number 13), which is not currently represented in the NERRS. In 1997, however, NOAA was discouraging expansion of NERRS. In March 1999, Dr. Montagna met with Dr. Mary Ann Rankin (Dean of College of Natural Sciences), Dr. Peter Riley (Associate Dean, College of Natural Sciences) and Mr. Russ Guillette (Development Officer, College of Natural Sciences) and received permission to speak with the Governor's Office on behalf of The University of Texas at Austin to begin the process to establish a NERRS site in Texas. Initial conversations with Governor George Bush's staff led to a series of meetings with state agencies and coastal interest groups to determine the state government and public reaction to a NERRS program in Texas. In May 2001, representatives from The University of Texas (Dr. Montagna, Ms. Mary Abell, and Ms. Gwen Grigsby) met with Cindy Gonzales, Director of Higher Education, in the Governor Rick Perry's office to solicit a request for a NERRS site in Texas. In subsequent meetings, letters of support from many Texas institutions were proffered (Appendix 1). In summary, these letters stated that there was a need for a NERRS site in Texas and that The University of Texas Marine Science Institute was ideally located to be the lead agency. By the fall of 2001, forces began to align to make a Texas NERRS site possible. A considerable number of people and institutions within the State wanted a NERRS program, and NOAA had received a substantial budget increase allowing for system expansion. In October 2001, Governor Rick Perry sent a letter to NOAA requesting a site (Appendix 2). In November 2001 Acting Under Secretary Scott Gudes responded that the Western Gulf of Mexico was unrepresented and that NOAA would entertain a nomination for a site based in Texas (Appendix 2). The first award for assistance to develop the NERRS site was received from NOAA in September 2002. By that time, the site selection process described in this document was well underway.

SITE SELECTION PROCESS

Steps in the NERR Site Selection Process

As outlined by the NERRS program, states interested in selecting a NERR site must comply with the following sequence of steps:

1. The lead agency submits a letter expressing interest in selecting and nominating a NERR.

2. A site selection process is implemented to identify a potential site or sites and must include:
   - establishment and use of a set of selection criteria
   - the development of physical and biological characterizations of sites considered for selection, and
   - the use of public participation in the process, including a public hearing.

3. The Governor of the state submits a site selection document and nomination letter requesting consideration of the selected site.

In the case of the Texas NERR initiative, the first step was taken with a letter from the Governor's office to NOAA (Appendix 2). Correspondence from the Governor's office to the NERR program office then proceeded and advanced the initiative (Appendix 2). The second step, which is the approach and details of the components of the selection process, are detailed in the following sections. This document is part of the third step.

Definition and Role of the Site Selection Committees

Two committees were formed to assist UTMSI with the numerous tasks associated with identifying, evaluating, and selecting a candidate site or sites, as well as identifying and developing appropriate local, state, federal, and private partnerships that will ultimately define the Texas NERR. The Site Selection Committee (SSC) was formed to provide overall guidance to the process and the Site Evaluation Subcommittee (SES) was formed to provide technical guidance to site selection process. The overall approach taken toward the formation of these committees was to identify and invite participation from as many agencies, organizations, groups, and individuals as possible, such that the broadest possible base of expertise and input could be drawn upon during this and future steps in the NERR process. The selection process began on August 29, 2002 with the initial meeting of the SSC, followed by three SES meetings (19Sept02, 17Oct02, 12Dec02), and culminated with the second SSC meeting held on January 23, 2003. The agenda, list of attendees, summary of comments, detailed comments, and comments made on exclude sites from the 29Aug02 SSC meeting are provided in Appendix 3. The attendees, and member score sheets from the 19Sept02 SES meeting are provided in Appendix 4. The attendees, notes, and member score sheets from the 17Oct02 SES meeting are provided in Appendix 5. The attendees, and notes from the 12Dec02 SES meeting are provided in Appendix 6. The agenda, attendees, notes, preliminary questions and comments, boundary comments, and logo drawings from the 23Jan03 SSC meeting are provided in Appendix 7.

Site Selection Committee

The site selection process is designed to start with the input from the widest possible stakeholder group and continuously narrow down nominated sites to a final selection. A Site Selection Committee (SSC) was formed by compiling lists of community leaders identified by civic, environmental, and industrial organizations. A total of 347 people were invited representing academia, agriculture, citizen and non-governmental groups, industry, and local, state and federal government. A SSC workshop was held 29 August 2002 at the UTMSI campus in Port Aransas, Texas and 112 of those invited attended. The purpose of the workshop was to introduce the NERR program to stakeholders and nominate potential sites.

Site Evaluation Subcommittee

A smaller, Site Evaluation Subcommittee (SES) was formed to evaluate sites against the preliminary and full site selection criteria. The SES is composed of two members from each stakeholder group plus two members from the lead agency (Table 1). The members of the lead agency primarily function as the staff for the subcommittee. During the course of the site selection process, this committee met on three occasions (apart from the SSC meetings): 19 September 2002, 17 October 2002, and 12 December 2002. Attendance to SES meetings are in Appendix 8.

Table 1. Members of the Site Evaluation Subcommittee.

Name	Organization	Representing
Dr. Chris Onuf	U.S. Geological Survey	Federal
Dr. Roger Zimmerman	National Marine Fisheries Service	Federal
Mr. James Gresham	BNP, Inc.	Industrial
Mr. James Fox	Fishing Guides	Industrial
Mr. Paul Carangelo	Port of Corpus Christi Authority	Local
Mr. Ron Massey	City of Corpus Christi	Local
Mr. Ray Allen	Coastal Bend Bays & Estuaries Program, Inc.	Non-governmental
Mr. Carter Smith	Nature Conservancy of Texas	Non-governmental
Ms. Tammy Brooks	Texas General Land Office	State
Mr. Beau Hardegree	Texas Parks & Wildlife-Resource Protection Div.	State
Ms. Kay Jenkins	Texas Parks & Wildlife Department	State
Ms. Charlotte Kucera	Texas Department of Transportation	State
Mr. Scot Sullivan	Texas Department of Transportation	State
Dr. Hudson DeYoe	The University of Texas Pan American	University
Dr. Elizabeth Smith	Texas A&M University-Corpus Christi	University
Mr. Larry Hyde	University of Texas at Austin	Host
Dr. Paul Montagna	University of Texas at Austin	Host

Development of the Site Selection Criteria

Site Selection Criteria and Process

The following describes the site selection criteria to identify the best location for the proposed Texas National Estuarine Research Reserve (NERR). These criteria are modified from standard operating procedures obtained from Estuarine Reserves Division to reflect the unique ecological characteristics of the habitats in the Western Gulf of Mexico biogeographic subregion.

The criteria fall into the five major categories:

1. Environmental Representativeness
2. Value of the Site for Research, Monitoring, and Stewardship
3. Suitability of the Site for Education and Interpretation
4. Acquisition and Accessibility Considerations
5. Management Considerations

These categories reflect the major considerations associated with addressing the goals of the National Estuarine Research Reserve System (NERRS) program. The format used in presenting each selection criterion includes a (1) brief description and/or definition of the criterion with underlying assumptions about its use and (2) scoring levels. The mechanisms for compiling, evaluating, and weighting the resulting scores are described below.

An important criteria at the outset of the site selection and site nomination process is whether there is an existing NERRS site located in the particular biogeographic region under consideration. There are currently no NERRS sites in Texas or the entire Western Gulf of Mexico region (Figure 2). This means the proposed Texas site is of high value to the NERRS Program.

Description of Region. The Texas site will represent the Western Gulf Biogeographic Subregion (Figure 3). The area considered lies wholly in Texas, and comprises most of the Texas coast. The Subregion is bounded by the border with Mexico to the southwest and the border of Galveston Bay to the northeast. This area includes six major bay-estuarine systems and two river systems (Figure 4). The major bay-estuarine systems are Lavaca-Colorado Estuary, Guadalupe Estuary, Mission-Aransas Estuary, Nueces Estuary, and Laguna Madre Estuary. Laguna Madre is actually two different systems: Upper Laguna Madre/Baffin Bay and Lower Laguna Madre. Texas follows the traditional system of naming an estuary for the river(s) that dilute sea water. In NOAA publications, these systems are named after the primary bay (Matagorda Bay, San Antonio Bay, Aransas Bay, Corpus Christi Bay, and Laguna Madre, respectively). The two riverine estuaries are: the Brazos River and the Rio Grande. Three of the ecosystems (Mission-Aransas Estuary, Nueces Estuary, and Laguna Madre Estuary) were included in the Corpus Christi Bay National Estuary Program study area. Redfish Bay, within the Mission-Aransas Estuary, is considered a high priority site for conservation in the Northern Gulf of Mexico by The Nature Conservancy (Beck et al. 2000).

Figure 3. Western Gulf of Mexico biogeographic subregion.

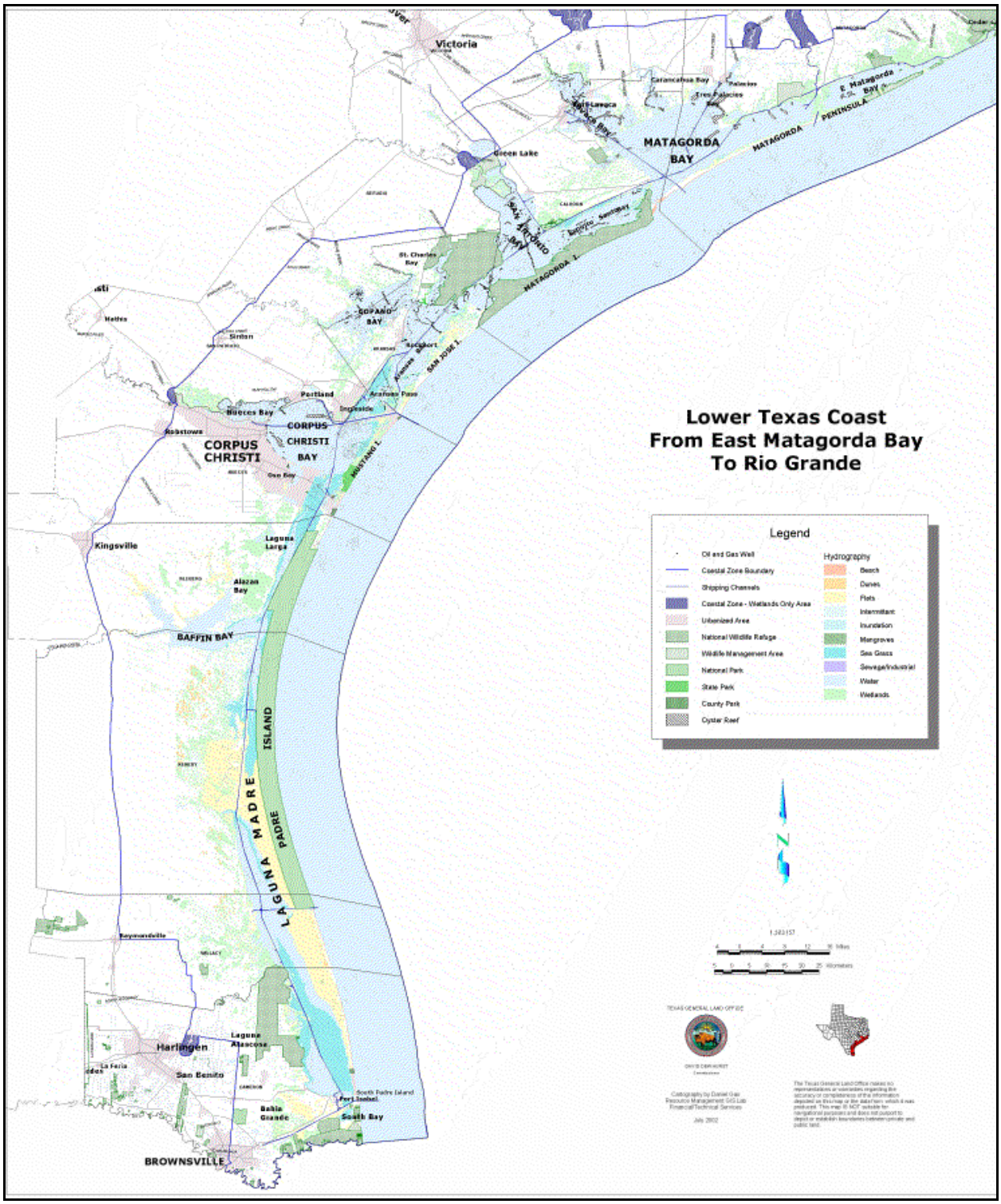
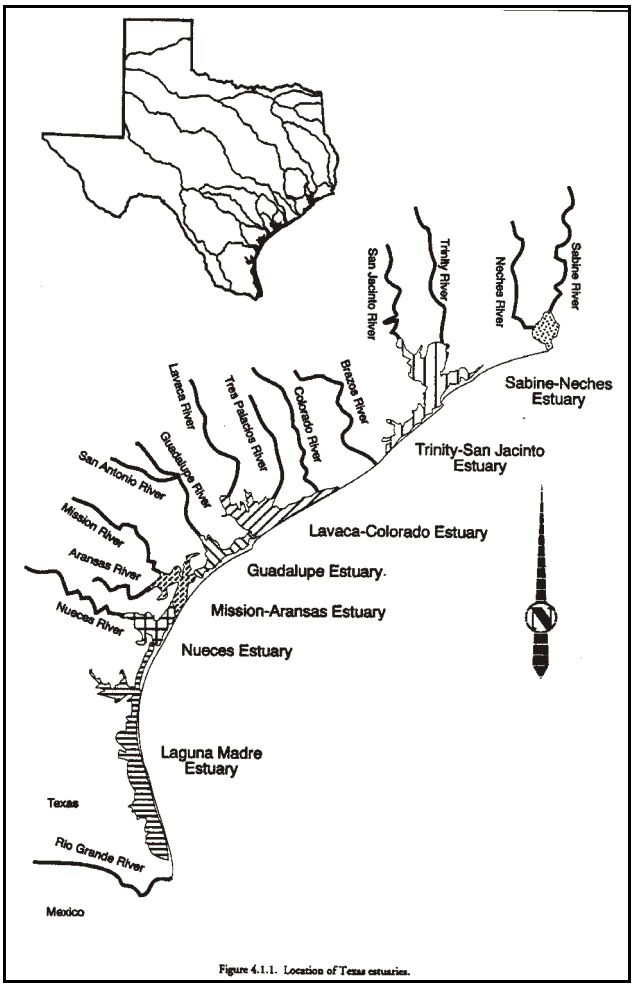


Figure 4. Major estuaries on the Texas coast.



Preliminary Site Screening Process

Because the Western Gulf Biogeographic Subregion is large, 65 sites were nominated. Thus, it was appropriate to use a simplified procedure to screen proposed sites to eliminate those areas that are clearly not suitable candidates prior to the application of the full suite of site selection criteria. A preliminary screening was desirable to reduce the sites considered to three to five sites, thus reducing the amount of time and effort required to apply the full suite of criteria to all sites. A candidate site which did not appear to meet each of the following criteria was eliminated from the site selection process.

1. The candidate site is a representative estuary in the biogeographic region or subregion.

2. The proposed boundaries of the candidate site includes sufficient land and water area to maintain the integrity of the ecosystem.

3. The candidate site consists of publicly owned lands and/or demonstrates sufficient potential for management control and sufficient protections are in place for long-term research, monitoring, and resource protection.

4. The candidate site is accessible for research, education, and stewardship.

5. The candidate site is suitable for long-term research, monitoring, and stewardship activities.

6. The candidate site is suitable for education, training, and interpretation activities.

7. The candidate site is suitable to address key local, state, and regional coastal management issues.

A workshop was held with the Site Selection Committee (SSC) to nominate potential sites using the above site selection criteria. The SSC included all potential stakeholders (approximately 100 people). During the SSC workshop, the site selection criteria was applied to estuaries along the Texas coast. A Site Evaluation Subcommittee (SES) of about 15 people was then formed to evaluate the nominated sites based on the criteria below. Because the number of sites was expected to be large, the first task of the SSC was to apply the screening criteria to reduce the number of sites to three to five nominated sites before applying the full criteria by the SES. For the nominated sites, the SES evaluated the sites in a workshop environment. All SES members were familiar with the nominated sites and many have first-hand knowledge of the characteristics of each site. After the SES selected the top two or three sites, the SSC reconvened to determine which site was the most suitable for nomination to the Governor for the Texas NERR.

During the evaluation workshop, the SES used a collaborative approach for scoring each site against the selection criteria. During committee discussion, the committee as a whole assessed each site, taking individual assessments and scores into account. Members were asked to reach consensus as a group on each criterion. The criteria scores were averaged and the top two or three sites were referred to the SSC.

During the final site selection workshop, the SSC was presented with a description of the SES activities and recommendations. The SSC broke up into groups and through discussion came to an overwhelming consensus that the Mission-Aransas estuary was the best site for recommendation to the Governor for nomination.

Preliminary Site Screening Criteria

The Western Gulf of Mexico Biogeographic Subregion is large and complex, extending over 300 miles from the U.S.-Mexico border to the southwestern border of Galveston Bay, and comprising six major bay-estuarine systems and two river systems (Figure 4). Thus, a preliminary site screening was conducted and greatly streamlined the site selection process. A simple raw score was used to narrow the field of sites to three to five sites that were scrutinized in detail through the final site selection process. The following preliminary screening criteria was used:

1. The candidate site is a representative estuary in the Western Gulf Biogeographic Subregion.
   1.1. Overall ecological composition and balance (richness and evenness).
   1.2. Ecological integrity.
2. The proposed boundaries of the candidate site includes sufficient land and water area to maintain the integrity of the ecosystem.
3. The candidate site consists of publicly owned lands and/or demonstrates sufficient potential for management control and sufficient protections are in place for long-term research, monitoring, and resource protection.
4. The candidate site is accessible for research, education, and stewardship.
   4.1. Current or potential accessibility by boat or vehicle.
   4.2. Distance of site from marine facilities and educational institutions.
5. The candidate site is suitable for long-term research, monitoring, and stewardship activities.
   5.1. Relative isolation of site from normal public, commercial, military, and recreational use.
   5.2. The site attracts a broad range of research, monitoring, and stewardship interests.
6. The candidate site is suitable for education, training, and interpretation activities.
   6.1. Relative isolation of site from normal public, commercial, military, and recreational use.
   6.2. The site attracts a broad range of education interests.
7. The candidate site is suitable to address local, state, and regional coastal management issues, e.g., fisheries habitat restoration and enhancement, vegetated habitats (seagrass, marsh, mangrove), climate change effects, freshwater inflow effects and requirements, and biodiversity.

Scoring for preliminary site screening criteria:

3 Points The site is well suited for preliminary criteria.

2 Points The site is moderately suited for preliminary criteria.

1 Point The site is marginally suited for preliminary criteria.

0 Points The site is not suited for preliminary criteria.

Detailed Site Selection Criteria

1. Environmental Representativeness: Ecosystem/Ecological Characteristics

1.1. Ecosystem Diversity. To determine the representativeness of a candidate site relative to ecosystem types of NERRS Program Regulations (15 CFR Part 921), sites were evaluated using the following ecological, biological, physical, and chemical characteristics. Sites having a high diversity of major ecosystem types were considered to have a higher relative value for protection and management.

Group I - Upland

1. Maritime Forest-Woodland
2. Coastal Shrublands
3. Coastal Grasslands
4. Coastal and Barrier Islands

Group II - Intertidal

1. Coastal Marshes
2. Coastal Mangroves
3. Intertidal Beaches
4. Intertidal Mud and Sand Flats
5. Intertidal Blue-Green Algal Flats

Group III - Subtidal

1. Subtidal Soft Bottoms
2. Subtidal Plants
3. Subtidal Oyster or Worm Reefs

3 Points The site has a high diversity of ecosystem composition, possessing at least one representative habitat from each of the three ecosystem groups.

2 Points The site has a moderate diversity of ecosystem composition, possessing at least one representative habitat from two of the three ecosystem groups.

1 Point The site has a low diversity of ecosystem composition, possessing at least two representative habitats from only one of the three main ecosystem groups.

0 Points The site has a very low diversity of ecosystem composition, possessing only a single habitat type within any one of the three main ecosystem groups.

1.2. Uniqueness of Habitat. Research Reserves are ecological reference sites of features representative of the different coastal biogeographic regions, thus it is important to include unique or rare habitat types in site selection criteria. Unique habitat is defined as a habitat type of limited known occurrence within the biogeographic region.

3 Points The site contains one or more unique or rare habitat types within its boundaries.

0 Points The site contains no unique or rare habitat types within its boundaries.

1.3. Importance of Habitat for Significant Flora and Fauna. An indicator of the ecological value of an estuary is the degree to which it is used by resident and transient fauna, and the presence of state or federally listed floral and faunal species. Important habitats include:

1. Fish and shellfish spawning and nursery grounds (includes use by freshwater, resident estuarine, or estuarine-dependent marine species)

2. Migratory bird and/or waterfowl habitats
3. Bird nesting and/or roosting area
4. Critical mammal habitat
5. Non-game animals (amphibians, reptiles, etc.)
6. State or federally listed species (animal or plant - including candidate species)

3 Points The site supports at least four to six of the above faunal and floral components, and/or is a very important site for any threatened or endangered species.

2 Points The site supports at least three to six of the above faunal and floral components.

1 Point The site supports one or two of the above faunal and floral components.

0 Points The site does not support significant faunal and floral components.

1.4. Drainage Basin and Freshwater Inflow Interface. In Western Gulf of Mexico estuaries, a critical physical factor in ecosystem function is the presence and amount of riverine influence. Thus, it is imperative that a site encompass a river, stream, bayou, or deltaic network of features with sources of freshwater inflow from adjacent drainage basins.

3 Points The site has significant freshwater inflow.

0 Points The site does not have significant freshwater inflow.

1.5. Oceanic Influence and Degree of Tidal Mixing. Another important physical factor affecting the biotic structure of Western Gulf of Mexico estuaries is the level of oceanic influence and resulting tidal mixing. Thus, in addition to salinity gradients, degree of oceanic influence from nearby passes or connections to the Gulf of Mexico is an important consideration in evaluating candidate sites.

3 Points Oceanic influence is great, with a 25 ppt or greater range of salinity within site boundaries (e.g., 0-25 ppt, 5-30 ppt).

2 Points Oceanic influence is large, with a 15-24 ppt range of salinity within site boundaries (e.g., 0-15 ppt, 5-25 ppt, 10-30 ppt).

1 Point Oceanic influence is small, with a 6-14 ppt range of salinity within site boundaries (e.g., 0-8 ppt, 10-22 ppt, 25-32 ppt).

0 Points The site has no direct, or an indirect connection to the sea.

2. Value of the Site for Research, Monitoring, and Stewardship

2.1. Suitability of Site for Long-Term Research. This criterion measures the types of long-term research a site can support, as defined by the following six research areas:

1. Ecological
2. Physical and chemical
3. Geological
4. Rare or listed species
5. Archeological and/or paleontological
6. Habitat restoration and resource management issues

3 Points The site can support five to six of the research areas.

2 Points The site can support four or five of the six.

1 Point The site can support two or three of the six.

0 Points The site can support one or none of the six.

2.2. Previous, Current, and/or Future Research Programs. Research Reserve programs are designed to develop new or to augment on-going estuarine research, thus an important consideration in site selection is the degree to which a site has been used for research, or the potential of a site to support future research. Equal weight was given to sites with great research potential as for sites that currently support research.

3 Points The site has a long history of well documented research projects in a wide variety of topics. Data is readily available. Or, not having been studied, offers great potential for future research program development.

2 Points The site has had major and well documented research projects, generating data that is readily available. It has not had a long history of research. Or, not having been studied offers good potential for research program development.

1 Point The site has had only minor research and monitoring projects generating limited data that may be difficult to obtain. Or, not having been studied, offers only limited potential for future research.

0 Points The site has no known history of research and monitoring, and offers limited potential for future research.

2.3. Suitability of Site for Environmental Monitoring. Research Reserves are ideally and uniquely suited to conduct large scale and long-term environmental monitoring. Existing and developing monitoring programs within the NERRS include the System-Wide Monitoring Program (SWMP), aquatic invasive species monitoring, monitoring of long-term climatological and environmental trends including sea level rise and global climate change, and additional monitoring driven by local issues. Considerations included the accessibility of the site for monitoring equipment installation, maintenance, and data download, and the overall logistical ease or difficulty presented by a site for environmental monitoring programs.

3 Points The site is ideally suited for providing time line environmental data to assess long-term resource trends or ecological characteristics for a wide range of needs.

2 Points The site is adequate for providing time line environmental data to assess long-term resource trends or ecological characteristics for many needs.

1 Point The site is marginal for providing time line environmental data to assess long-term resource trends or ecological characteristics.

0 Points The site is unsuitable for providing time line environmental data.

2.4. Suitability of the Site for Stewardship Program Development. Research Reserves develop environmental stewardship programs. Thus, it is necessary to determine the suitability of proposed sites to stewardship program activities, e.g., resource management, habitat delineation and restoration, environmental monitoring, determination of biological diversity, and potential for partnering with local, state, and federal resource agencies. An important consideration for environmental stewardship is the degree to which public access is limited at a site, e.g., number of roads, boat ramps, water access to bays and bayous, etc.

3 Points The site is ideally suited, overall, to stewardship program development.

2 Points The site is adequate for stewardship program development.

1 Point The site is only marginally suited for stewardship program development.

0 Points The site is unsuitable for stewardship program development.

3. Suitability of the Site for Training, Education, and Interpretation

3.1. Value of Site for Environmental Education and Interpretation Programs. Well-developed education and outreach programs are a critical consideration. The ideal site should be well-suited for programs directed at "K through grey," with particular consideration given to the program areas listed below. On-going and new education and outreach programs should also be considered, including decision-maker workshops, training programs, translation of research studies and results, and integration with other education and outreach programs.

1. Kindergarten through high school education programs
2. High school and undergraduate students working independently or in small groups
3. Graduate students
4. Professional development programs for teachers
5. Education programs and workshops for coastal decision-maker audiences
6. Potential and capcity for interpretation targeted to the general public

3 Points The site is well suited to provide for programs in all of the areas listed.

2 Points The site well suited for high school, higher education and coastal decision-maker audiences (areas 2-5), but not well suited for pre-high school (1) or the general public (6).

1 Point The site is well suited only for higher education (3) and possibly coastal decision-maker audiences (5).

0 Points The site is not well suited to support education and interpretation programs.

3.2. Diversity and Quality of Education and Interpretation Opportunities. Another important consideration is the degree to which a site can provide a well-rounded education program, with the ability to emphasize each of the following disciplines:

1. Ecology
2. Physics and chemistry
3. Geology
4. Archeology and/or paleontology
5. History and Culture
6. Coastal and estuarine natural resource management

3 Points The site is well suited for education in all of these areas.

2 Points The site is well suited for education in areas 1-3 and 6.

1 Point The site is marginally suited for education in areas 1-3 and 6.

0 Points The site is not well suited for education in any of these areas.

3.3. Diversity and Availability of Target Audiences. No matter how well suited a site may be for education and interpretation programs, it is useless in this regard if the audiences do not exist, or the site is inaccessible. Thus, the value of a site correspondingly increases with the size and availability of its target audiences.

1. Kindergarten through high school students
2. Undergraduate students
3. Graduate students
4. Teachers
5. Coastal decision-makers
6. Interpretation potential /capacity to target the general public

3 Points All of these audiences exist and can easily access the site.

2 Points Some of these audiences exist, and/or most can access the site.

1 Point Only a few of these audiences exist, and/or some would have difficulty accessing the site.

0 Points Only one or two of these audiences exist and the site is largely inaccessible.

3.4. Previous, On-going and Future Education and Interpretation Programs. It is likely that sites with existing education programs have the necessary infrastructure in place to further expand their programs, thus it is valuable to rate sites based on the presence of these programs. However, in an area as large and relatively pristine as the Western Gulf Biogeographic Region, numerous excellent sites exist where virtually no education or interpretation programs have been developed. Thus, the potential for education and interpretation program development at a pristine site should be considered as well.

3 Points The site has a long history of education and interpretation. OR, the site offers excellent potential for future education and interpretation program development.

2 Points The site has a good but short history of education and interpretation, but is otherwise well suited for education/interpretation program development OR, the site offers good potential for future education and interpretation program development.

1 Point The site has had only had a minor amount of education and interpretation being conducted. OR, the site offers fair potential for future education and interpretation program development.

0 Points The site offers no significant potential for education and interpretation program development.

4. Acquisition and Accessibility Considerations

4.1. Land Ownership. It has been demonstrated that research reserves are easier to acquire and manage if they have few property owners. Thus, it is a valuable consideration to assess the number of property owners of a site.

3 Points The property is relatively undivided.

2 Points The property is divided with few property owners.

1 Point The property is divided with many property owners.

4.2. Publicly Owned Lands and Feasibility of Land Acquisition. The ease of land acquisition and management increases correspondingly to the proportion of area that is in public or non-governmental organizations (NGOs) ownership and the degree to which there is interest in transferring properties or management control. Note: Federal lands already in protected status may not comprise a majority of the key land and water areas of a research reserve(15 CFR 921.1(g)).

3 Points Greater than 50% of the site is currently owned by the state, federal, or local governments, or by NGOs, and these entities have an interest in participating in a reserve.

2 Points State, federal, or local governments, or NGOs own 25-50% of the site with the remainder in the hands of a few owners who have an interest in participating in a reserve.

1 Point State, federal, or local governments, or NGOs own less than 25% of the site with the remainder in the hands of a few owners who have an interest in participating in a reserve.

0 Points The site is owned by a large number of owners with little potential interest in sale, donation, or environmental easement.

4.3. Availability of Facilities. Given that sites with existing facilities and facility-related infrastructure may meet the objectives of the research reserve more quickly, it is of benefit for sites to have established facilities. However, consideration also should be given to sites with excellent potential that do not have facilities.

3 Points The site has existing structures and facilities that can be used for reserve activities.

2 Points The site has proximity to or limited existing structures and/or facilities that can be used for reserve activities.

1 Point The site is away from existing facilities, but has excellent potential for the development of facilities for reserve activities.

0 Points The site has limited potential for the development facilities for reserve activities.

4.4. Proximity and Accessibility of Site to Researchers, Educators, and Resource Management Decision Makers. Accessibility of the site through infrastructure and locality is important to the ultimate success of research reserve programs. Thus, consideration should be given to the proximity of the site to urban centers, schools, research and higher education institutions, and resource management agencies. Also, availability, adequacy, and potential for roads, boardwalks, boat landings, docks, etc. is an important consideration in evaluating the accessibility of a site.

3 Points The site can be accessed by user groups during a single day trip. There are good roads, points for boat access, etc. at the site.

2 Points The site is relatively isolated and utilization would require an overnight stay, but accommodations are readily available. There are adequate roads, points for boat access, etc. at the site.

1 Point The site is relatively isolated and reasonable accommodations for an overnight stay are limited. There are limited roads, points for boat access, etc. at the site.

0 Points The site is extremely isolated and accommodations to utilize the site are not available.

5. Management Considerations

5.1. Land and Water Access. It is beneficial to research reserve management if site characteristics naturally limit access. This allows the research reserve to better direct public use toward program goals. Thus, by strategically placing roads, boat ramps, docks, camping areas, reserve facilities, etc. the research reserve establishes and maintains some control over how the site is used. Historical controls of public use through state or federal regulation also is a useful consideration.

3 Points The site is relatively isolated and of a size that can be controlled. Historically, access has been controlled, and can easily be controlled in the future due to the presence of limited access points by boat or vehicle.

2 Points The site is not very isolated, but has a limited number of access points. Historically, site access has not been controlled, but the site is of a size that it can be controlled in the future.

1 Point Site access will be difficult to control due to the large number of access points. Historically, site access has not been controlled and it is unclear whether it can be controlled in the future.

0 Points Site access cannot be controlled due to the large number of access points, lack of historical controls, the size of the area, and/or dense adjacent development.

5.2. Compatibility with Existing Management Practices and Consumptive and Non-Consumptive Uses. It is possible that existing management practices such as habitat manipulation, best management practices, and historic and current consumptive and non-consumptive uses might be in conflict with foreseeable management practices implemented by a reserve. Therefore sites with fewer management practice issues are more likely to maintain both public support and the integrity of the site.

3 Points Existing management practices and consumptive and non-consumptive uses would not be in conflict with any foreseeable management policy of a research reserve.

2 Points Small areas of unique habitat, endangered species, or threats to the integrity of the ecosystem exist at the site, creating the potential for limited restrictions on existing management practices and/or consumptive and non-consumptive uses.

1 Point Larger areas of unique habitat, endangered species, and threats to the integrity of the ecosystem exist at the site, creating the necessity for some restrictions on existing management practices and/or consumptive and non-consumptive uses.

0 Points Large areas of unique habitat and threats to the integrity of the ecosystem at the site will require restrictions on existing management practices and/or consumptive and non-consumptive uses.

5.3. Compatibility With Adjacent Land and Water Use. It is more likely that research reserve programs would be successful if a site is located adjacent to lands and waters where compatible land and water use practices are employed, thus it is useful to assess the degree to with adjacent land use is compatible with research reserve programs.

3 Points All or most land and water use adjacent to the site is compatible with reserve programs, and will impose no negative impacts on the reserve.

2 Points A large to moderate amount of the land and water adjacent to the site is compatible with reserve programs. Incompatible land- and water-use practices on adjacent lands either could be negotiated or would have only minor impacts on reserve programs.

1 Point Some of the land and water adjacent to the site is currently used for activities that would have negative impacts on a reserve and may not be negotiable.

0 Points A large percentage of the land and water adjacent to the site is currently used for activities that would have negative impacts on a reserve and would lead to conflicts.

5.4. Ability to Address Local, State, and Regional Coastal Management Issues. A goal is to improve coastal management through research, education, and interpretation, thus it is important that a site be relevant to local, state, and regional coastal management issues. Solutions to these issues may require either application of land management practices or habitat manipulations to perform meaningful research and assessment. The site should offer both adequate control areas plus areas where demonstration projects and habitat manipulations can be accommodated to study many of the issues of concern. Thus, a site where coastal management issues arise and can be addressed would be of greater value than sites where these issues do not arise. Significant coastal management issues include the following:

1. wetlands development
2. wetlands mitigation/restoration/creation
3. dredging and spoil disposal
4. beneficial uses of dredged materials
5. shoreline erosion
6. commercial and/or recreational fisheries
7. waterfowl and other wildlife management
8. best management practices for habitat protection and restoration
9. best management practices to limit impacts from agricultural or development
10. best methods to control pestiferous insects or undesirable vegetation
11. pollutant effects on water quality and living resources
12. climate change effects, e.g climatic and sea-level change
13. prehistoric and early historic settlement and land use

14. freshwater inflow effects
15. marine transportation
16. oil and gas development

3 Points The site is highly appropriate for investigating coastal zone management issues.

2 Points The site is appropriate for investigating coastal zone management issues.

1 Point The site is minimally appropriate for investigating coastal zone management issues.

0 Points The site is not appropriate for investigating coastal zone management issues.

5.5. Development and Water Quality Impacts. Development and water quality impairment can have major effects on research reserve ecological integrity and program priorities, and the research reserves ability to serve as a national ecological reference site. Thus, sites with minimal development and water quality impairments are desirable.

3 Points The site is relatively undisturbed and the watershed contains low intensity development, and/or the land is in protected status.

2 Points The site is relatively undisturbed and the watershed contains moderate development.

1 Point The site has been moderately disturbed and the watershed contains relatively intensive development.

0 Points The site has been extremely disturbed and the watershed contains very intensive development.

5.6. Adequate Surveillance and Enforcement. Resource protection and long-term research and monitoring programs are more likely to succeed if there is adequate surveillance of the research reserve and enforcement of existing regulations. Thus it is important to assess the likelihood that a site would have adequate surveillance and enforcement activities following designation into the NERRS.

3 Points A majority of the land and water in the site currently has adequate surveillance and enforcement activities.

2 Points Up to half of the land and water in the site currently has adequate surveillance and enforcement activities.

1 Point A small amount of the land and water in the site currently has adequate surveillance and enforcement activities.

0 Points A majority of the land and water in the site currently has inadequate surveillance and enforcement activities.

5.7. Future Development Plans. Future development plans on or adjacent to research reserves can have major effects on research reserve programs, thus it is important to assess the likelihood that a site would remain undisturbed following designation into the NERRS.

3 Points	A majority of the land adjacent to the site is currently undeveloped and is very unlikely to be developed in the future.
2 Points	Up to half of the land adjacent to the site is currently undeveloped and is not likely to be developed in the future.
1 Point	A small amount of the land adjacent to the site is currently undeveloped and is not likely to be developed in the future, with limited levels of development on other lands.
0 Points	A majority of the land adjacent to the site is developed and the area is likely to continue to be developed in the future.

Scoring sheets were used by the SES to track application of the criteria to different systems. Below are examples of the scoring sheets for the preliminary and final site selection evaluation criteria.

Texas NERR Preliminary Site Selection Criteria and Scoring Sheet

Preliminary Criteria	**Site I**	**Site II**
1. Environmental Representativeness of Western Gulf Biogeographic Subregion		
1.1. Ecosystem diversity		
1.2. Ecological integrity/uniqueness		
2. Sufficient Land and Water Area to Maintain the Integrity of the Ecosystem		
3. Site Consists of Publicly Owned Lands and/or Sufficient Potential for Management Control		
4. Site Is Accessible for Long-term Research, Education, and Stewardship		
4.1. Current or potential accessibility by boat or vehicle		
4.2. Distance marine facilities and educational institutions		
5. Site Is Suitable for Research, Monitoring, and Stewardship Activities		
5.1. Relative isolation of site from normal public, commercial, military, and recreational use		
5.2. Site attracts a broad range of research, monitoring and stewardship activities		
6. Site Is Suitable for Education, Training, and Interpretation Activities		
6.1. Relative isolation of site from normal public, commercial, military, and recreational use		
6.2. Site attracts a broad range of education interests		
7. Suitable to Address Coastal Management Issues		
Total Score:		

Texas NERR Site Selection Criteria and Scoring Sheet

Criteria	Site I	Site II
1. Environmental Representativeness and Ecological Characteristics of Site		
1.1. Ecosystem Diversity		
1.2. Uniqueness of Habitat		
1.3. Importance of Habitat for Significant Flora and Fauna		
1.4. Drainage Basin and Fresh Water Flow Interface		
1.5. Oceanic Influence and Degree of Tidal Mixing		
Averaged Score:		
2. Value of Site for Research, Monitoring, and Stewardship		
2.1. Suitability of Site for Long-Term Research		
2.2. Previous, Current, and/or Future Research Programs		
2.3. Suitability of the Site for Environmental Monitoring		
2.4. Suitability of the Site for Stewardship Program Development		
Averaged Score:		
3. Suitability of Site for Training, Education, and Interpretation		
3.1. Value of Site for Environmental Education, and Interpretation Programs		
3.2. Diversity and Quality of Education and Interpretation Opportunities		
3.3. Diversity and Availability of Target Audiences		
3.4. Previous, On-going, and Future Education and Interpretation Programs		
Averaged Score:		
4. Acquisition and Accessibility Considerations		
4.1. Land Ownership		
4.2. Publicly Owned Lands and Feasibility of Land Acquisition		
4.3. Availability of Facilities		
4.4. Proximity and Accessibility to Researchers, Educators, and Decision Makers		
Averaged Score:		
5. Management Considerations		
5.1. Land and Water Access		
5.2. Compatibility With Existing Management Practices and Uses		
5.3. Compatibility With Adjacent Land and Water Use		
5.4. Ability to Address Key Local, State, and Regional Coastal Management Issues		
5.5. Development and Water Quality Impacts		
5.6. Adequate for Surveillance and Enforcement		
5.7 Future Development Plans		
Averaged Score:		
Total Score:		

Application of Site Selection Criteria

The eleven workgroups from the first SSC nominated a total of 65 sites from within six major estuarine ecosystems (Table 2). This included nearly every named geographic area in the Western Gulf of Mexico Biogeographic Region. From north to south, the major estuarine systems are 1) the Matagorda Bay Area inclusive of the Lavaca-Colorado Estuary from East Matagorda Bay to Pass Cavallo, 2) the San Antonio Bay Area inclusive of the Guadalupe Estuary from Espiritu Santo Bay to Carlos Bay, 3) the Aransas Bay Area inclusive of the Mission-Aransas Estuary from Aransas Bay to Redfish Bay, 4) the Corpus Christi Bay Area inclusive of the Nueces Estuary, 5) the Upper Laguna Madre Area including Baffin Bay, and 6) the Lower Laguna Madre Area including from Mansfield Pass to the Rio Grande. Only three sites (all from the Corpus Christi Bay Area were nominated by all eleven groups. However, seven sites from the Aransas Bay Area received nominations from ten groups. Along with nominations, each group commented on the desirable and undesirable characteristics of each site (Appendix 3).

A summary of nominations indicates there was a consensus on the most desirable locations (Table 3). All eleven groups nominated at least three components within the Aransas and Corpus Christ Bay areas. In fact, the Aransas and Corpus Christi areas were the only areas for which all eleven groups nominated at least one component site. The Aransas area had the highest total number of nominations (133) followed by the Corpus Christi area (80).

Groups were also asked to identify areas deemed inappropriate for the NERR site (Table 4). Lavaca Bay was mentioned most often followed by East Matagorda Bay. The Aransas area did not receive any negative votes. Comments on inappropriate sites are found in Appendix 3.

Table 2. Sites nominated during the SSC Workshop, 29 August 2002.

Nominated Sites From Workshop (North to South)	Group Number											Total
	1	2	3	4	5	6	7	8	9	10	11	
Matagorda Bay Area: East Matagorda Bay to Pass Cavallo												
Tres Palacios Bay	✓	✓	✓		✓							4
Carancahua Bay	✓	✓	✓									3
Lavaca Navidad River							✓					1
Lavaca Delta (Uplands)							✓					1
Lavaca Delta (Wetlands)							✓					1
Lavaca Bay							✓					1
East Matagorda Bay		✓	✓									2
West Matagorda Bay		✓	✓				✓					3
Matagorda Bay	✓	✓	✓									3
Matagorda Ship Channel		✓	✓				✓					3
Pass Cavallo		✓					✓	✓			✓	4
Gulf of Mexico	✓	✓	✓				✓					4
San Antonio Bay Area: Espiritu Santo Bay to Carlos Bay												
Guadalupe River	✓	✓			✓			✓	✓		✓	6
Guadalupe Delta (Uplands)	✓	✓			✓			✓	✓			5
Guadalupe Delta (Wetlands)	✓	✓			✓			✓	✓			5
Green Lake	✓	✓			✓			✓				4
Mission Lake	✓	✓	✓		✓			✓	✓		✓	7
Guadalupe Bay	✓	✓	✓		✓			✓	✓		✓	7
Hynes Bay	✓	✓	✓		✓			✓	✓		✓	7
Espiritu Santo Bay		✓	✓				✓	✓			✓	5
San Antonio Bay	✓	✓	✓		✓			✓	✓		✓	7
Mesquite Bay			✓		✓					✓		3
Carlos Bay			✓		✓					✓		4
Gulf of Mexico	✓	✓	✓		✓						✓	5

Nominated Sites From Workshop (North to South)	Group Number											Total
	1	2	3	4	5	6	7	8	9	10	11	
Aransas Bay Area: Mesquite Bay to North Redfish Bay												
Mission River	✓	✓	✓	✓		✓	✓	✓	✓	✓	✓	10
Mission Delta (Upland)	✓	✓	✓	✓		✓	✓	✓	✓	✓	✓	10
Mission Delta (Wetlands)	✓	✓	✓	✓		✓	✓	✓	✓	✓	✓	10
Aransas River	✓	✓	✓	✓		✓	✓	✓	✓	✓	✓	10
Aransas Delta (Uplands)	✓	✓	✓	✓		✓	✓	✓	✓	✓	✓	10
Aransas Delta (Wetlands)	✓	✓	✓	✓		✓	✓	✓	✓	✓	✓	10
Mission Bay	✓	✓	✓	✓		✓	✓	✓	✓	✓		9
Copano Bay	✓	✓	✓	✓		✓	✓	✓	✓	✓	✓	10
St, Charles Bay	✓	✓	✓	✓	✓	✓	✓			✓		8
Port Bay	✓		✓	✓		✓		✓	✓	✓	✓	8
Aransas Bay	✓		✓	✓	✓		✓	✓	✓	✓	✓	9
Estes Flats	✓		✓		✓	✓		✓			✓	6
Redfish Bay	✓	✓	✓	✓		✓		✓	✓	✓	✓	9
South Bay	✓		✓	✓		✓		✓				5
Cedar Bayou			✓	✓	✓					✓		4
Gulf of Mexico			✓	✓			✓	✓		✓		5
Corpus Christi Bay Area: South Redfish Bay to Nueces Delta												
Nueces River	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	11
Nueces Delta (Upland)	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	11
Nueces Delta (Wetlands)	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	11
Nueces Bay	✓	✓	✓	✓			✓		✓	✓	✓	8
Oso Bay			✓						✓	✓		3
Corpus Christi Bay		✓				✓	✓		✓	✓	✓	6
Shamrock Cove		✓		✓	✓	✓	✓			✓	✓	7
East Flats	✓	✓	✓	✓	✓	✓	✓			✓	✓	9
Aransas Pass		✓	✓	✓		✓			✓	✓	✓	7
Gulf of Mexico		✓	✓	✓			✓		✓	✓	✓	7

Nominated Sites From Workshop (North to South)	Group Number											Total
	1	2	3	4	5	6	7	8	9	10	11	
Upper Laguna Madre												
Upper Laguna Madre	✓		✓	✓	✓	✓	✓	✓	✓	✓	✓	10
Laguna Salada	✓		✓	✓	✓	✓	✓	✓	✓		✓	9
Cayo del Grullo	✓		✓	✓	✓	✓	✓	✓	✓		✓	9
Alazan Bay	✓		✓	✓	✓	✓	✓	✓	✓		✓	9
Baffin Bay	✓		✓	✓	✓	✓	✓	✓	✓		✓	9
Gulf of Mexico	✓			✓	✓			✓				4
Lower Laguna Madre												
Arroyo Colorado				✓		✓	✓	✓		✓	✓	6
Lower Laguna Madre	✓			✓		✓	✓	✓		✓	✓	7
Brownsville Channel				✓		✓	✓	✓		✓	✓	6
South Bay	✓			✓		✓		✓		✓	✓	6
Brazos Santiago Pass	✓			✓		✓		✓		✓		5
Rio Grande River	✓			✓			✓			✓		4
Rio Grande Delta (Uplands)	✓			✓			✓					3
Boca Chica	✓			✓						✓		3
Gulf of Mexico	✓			✓			✓	✓		✓	✓	6

Table 3. Summary of (Table 2) SSC Workshop results, 29 August 2002.

Category Summarized	Matagorda Bay Area	San Antonio Bay Area	Aransas Bay Area	Corpus Christi Bay Area	Upper Laguna Madre	Lower Laguna
Number of estuarine ecosystem components	12	12	16	10	6	9
Number (and percent) of components nominated by 8/11 groups	0 (0%)	0 (0%)	12 (75%)	5 (50%)	5 (83%)	0 (0%)
Number (and percent) of groups nominating at least one component	7 (64%)	9 (82%)	11 (100%)	11 (100%)	10 (91%)	7 (64%)
Number (and percent) of groups nominating at least three components	4 (36%)	7 (64%)	11 (100%)	11 (100%)	9 (82%)	7 (64%)
Average number of component nominations	2.5	5.4	8.3	8	8.3	5.1
Total nominations (components × average nominations)	30	65	133	80	50	46
Rank (based on total)	6	3	1	2	4	5

Table 4. Inappropriate sites identified during the SSC Workshop, 29 August 2002.

Inappropriate Sites (North to South)	Group Number											Total
	1	2	3	4	5	6	7	8	9	10	11	
Matagorda Bay Area												
Lavaca Bay	X	X	X	X	X						X	6
East Matagorda Bay	X				X			X		X		4
West Matagorda Bay										X		1
Matagorda Bay										X		1
Matagorda Ship Channel										X		1
Pass Cavallo										X		1
San Antonio Bay Area												
Espiritu Santo Bay										X		1
San Antonio Bay							X			X		2
Aransas Bay Area												0
Corpus Christi Bay Area												
Nueces Bay				X		X		X				3
Oso Bay	X				X							2
Corpus Christi Bay	X		X	X				X				4
Shamrock Cove	X											1
Aransas Pass				X								1
Upper Laguna Madre												
Upper Laguna Madre		X										1
Laguna Salada		X								X		2
Cayo del Grullo		X								X		2
Alazan Bay		X								X		2
Baffin Bay		X								X		2

Inappropriate Sites (North to South)	Group Number											Total
	1	2	3	4	5	6	7	8	9	10	11	
Lower Laguna Madre												
Landcut to Port Mansfield								X				1
Arroyo Colorado		X										1
Lower Laguna Madre		X										1
Port Isabel Bay Area					X							1
Brownsville Channel		X			X							2
South Bay		X										1
Brazos Santiago Pass		X			X							2
Rio Grande River		X			X			X				3
Rio Grande Delta (Uplands)		X			X			X				3
Boca Chica		X			X			X				3

Because the number of sites nominated (65) was so high, the sites were pooled by major ecosystem (Table 3) to apply the preliminary screening criteria. Thus, during the first SES workshop, the SES applied the preliminary criteria to the seven areas. Each criteria was discussed, then each member scored all sites on a 0 to 3 relative scale (Appendix 4). All votes were tallied for a score for each criteria-site cell. The maximum score for each criteria was 33 (=11 members × 3 points). Subcommittee members shared individual assessments and opinions with one another prior to voting. Members also consulted the SSC work group comments.

During the preliminary criteria SES workshop, three preliminary criteria were deemed neutral because the committee felt the same score was applicable to all seven sites (Table 5). All sites were deemed sufficiently large, such that they all received the same score for Criteria 2. Criterion 6.1 (isolation from normal use) was identical to Criteria 5.1, so was not scored. All sites were deemed equally appropriate for addressing coastal management concerns, so this criterion was not scored.

Although there was sometimes a wide disparity for scores given a site for a specific criteria, more often there were very similar scores among sites (Appendix 4). The Aransas Bay Area had the highest number of points, followed by the Corpus Christi Bay and San Antonio Bay Areas (Table 5).

There was a remarkable consensus between the SSC workshop group results (Table 3) and the SES workshop results (Table 5). Using very different methods, both groups arrived at virtually the same ranks for major areas (Table 6). In both cases, the Aransas Bay area ranked number one followed by the Corpus Christi Bay area, and San Antonio Bay area. Upper and Lower Laguna Madre were ranked 4 and 5 by both methods, but switched order in both groups. Both groups ranked the Matagorda Bay area last (6th).

A letter was presented to the SES from the Port of Corpus Christi Authority requesting that areas surrounding the Corpus Christi Ship Channel be excluded from the Research Reserve (Appendix 9). This area includes the southern half of Nueces Bay, the northern half of Corpus Christi Bay (including Shamrock Cove and East Flats), and all of southern Redfish Bay. This area was also noted as inappropriate because of the high population and existing industrial use, and hence not selected as an appropriate site. The only nominated sites (from Table 2) remaining are the Nueces River, Nueces Delta and Oso Bay. Although the Nueces River and Delta received unanimous nominations from all eleven work groups at the SSC workshop, this area was not included in the final site boundary because of its lack of representativeness, and water use issues. Other areas that were not included in the site selection and listed as inappropriate (with a nomination by 3 or more groups) are as follows: Lavaca Bay, East Matagorda Bay, Corpus Christi Bay, Nueces Bay, Rio Grande River, Rio Grande Delta, and Boca Chica (Table 4).

Table 5. Summary of Site Evaluation Subcommittee scores, 19 September 2002.

Preliminary Site Selection Criteria and Scoring Sheet	Matagorda Bay Area	San Antonio Bay Area	Aransas Bay Area	Corpus Christi Bay Area	Upper Laguna Madre	Lower Laguna Madre
1. Environmental representativeness of Western Gulf Biogeographic Region						
1.1 Ecosystem diversity	22	27	31	27	17	18
1.2 Ecological integrity/uniqueness	21	28	31	20	29	30
2. Sufficient land and water area to maintain the integrity of the ecosystem	33	33	33	33	33	33
3. Site consists of publically owned lands and/or sufficient potential for management control	22	32	24	15	23	25
4. Site is accessible for long-term research, education, and stewardship						
4.1. Current or potential accessibility by boat or vehicle	16	20	30	30	22	20
4.2. Distance marine facilities and educational institutions	13	20	32	32	23	21
5. Site is suitable for research, monitoring, and stewardship activities						
5.1. Relative isolation of site from normal public, commercial, military, and recreational use	26	32	14	10	26	24
5.2. Site attracts a broad range of research, monitoring and stewardship activities	14	18	28	28	26	24
6. Site is suitable for education, training, and interpretation activities						
6.1. Relative isolation of site from normal public, commercial, military, and recreational use						
6.2. Site attracts a broad range of education interests	19	15	25	33	20	26
7. Suitable to address coastal management issues						
Total Score:	186	225	248	228	219	221
Rank:	6	3	1	2	5	4

Table 6. Comparison of ranks from the first SSC and first SES workshops.

Meeting	Area Rankings					
	Matagorda Bay Area	San Antonio Bay Area	Aransas Bay Area	Corpus Christi Bay Area	Upper Laguna Madre	Lower Laguna Madre
Site Selection Committee (8/29/02)	6	3	1	2	4	5
Site Evaluation Subcommittee (9/17/02)	6	3	1	2	5	4

Based on the consensus that was built previously (Table 6), the full suite of site selection criteria was applied to the top three ranked systems (San Antonio Bay Area, Aransas Bay Area, and Corpus Christi Bay Area). Each bay area was split into two sub-areas so that different parts of the systems could be considered independently. The sub-areas primarily consisted of a primary bay (closest to the connection with the Gulf of Mexico), and secondary bay (closest to the river source of freshwater inflow), or a minor bay (not directly connected to a river source or Gulf inlet).

A second SES meeting was held on 17 October 2002 in which 13 members attended. The two components of the Aransas Bay area ranked at the top (Table 7). The primary bays (including St. Charles Bay, Aransas Bay, and northern Redfish Bay) scored a total of 166 points. The secondary bays (including the Aransas River, Mission River, Copano Bay and Mission Bay) scored 164 points, just a little short of scores received by the primary bays.

In applying the site selection criteria, there were two fundamental principles for choosing the most appropriate location for a NERR site: 1) That all representative habitats are included and 2) that the site is relatively undisturbed by human activities. Because of the structure of Texas estuaries it is important to include a primary and secondary bay, a river, a pass, a delta, mangroves, mudflats, seagrasses, oysters, beaches, and coastal prairie. Typically, rivers, marshes, deltas and oyster reefs only occur in secondary bays. Typically, important fish habitats, e.g., mangroves, seagrasses and passes only occur in primary bays. Thus, the structure of Texas estuaries and the nearly identical ranks of the primary and secondary bays of the Mission-Aransas Estuary indicate that the best site for the proposed Texas NERR is the entire Mission-Aransas Estuary.

It is not surprising that the Mission-Aransas Estuary has been chosen by the selection process as the best choice for a NERR site. The estuary has all of the structural components of a typical Western Biogeographic Region estuary. It is one of the smallest areas with all representative habitats contained in an ecologically contiguous unit. It is also a relatively pristine estuary along the Texas coast, due to a low human population density. Finally, it is likely to be the only estuary without major dams or reservoirs on its two major rivers.

Table 7. Site Selection Criteria and total scores, 17 October 2002.

Criteria	San Antonio Bay Area		Aransas Bay Area		Corpus Christi Bay Area	
	Guadalupe R, D; San Antonio B (83K ac)	Mesquite B (8K ac)	Mission R, D, B; Aransas R; Copano B (47K ac)	St. Chas, Carlos, Aransas, Redfish Bs (72K ac)	Nueces R, D, B (15K ac)	Shamrock, East Flats, SE CC B (10K ac)
1. Environmental Representativeness and Ecological Characteristics						
1.1. Ecosystem Diversity	39	28	39	39	34	22
1.2. Uniqueness of Habitat	35	19	39	36	21	22
1.3. Importance of Habitat for Significant Flora and Fauna	36	27	36	38	31	28
1.4. Drainage Basin and Fresh Water Flow Interface	39	0	39	0	38	3
1.5. Oceanic Influence and Degree of Tidal Mixing	10	14	27	36	11	33
Averaged Score:	31.8	17.6	36.0	29.8	27.0	21.6
2. Value of Site for Research, Monitoring, and Stewardship						
2.1. Suitability of Site for Long-Term Research	33	17	35	39	28	22
2.2. Previous, Current, and/or Future Research Programs	32	16	34	35	34	22
2.3. Suitability of the Site for Environmental Monitoring	20	19	34	35	23	20
2.4. Suitability of the Site for Stewardship Program Development	25	28	33	36	36	30
Averaged Score:	27.5	20.0	34.0	36.3	30.3	23.5
3. Suitability of Site for Training, Education, and Interpretation						
3.1. Value of Site for Environmental Education, and Interpretation Programs	21	21	33	39	25	26
3.2. Diversity and Quality of Education and Interpretation Opportunities	31	20	38	38	30	26
3.3. Diversity and Availability of Target Audiences	23	15	30	38	31	25
3.4. Previous, On-going, and Future Education and Interpretation Programs	26	17	33	37	25	25
Averaged Score:	25.3	18.3	33.5	38.0	27.8	25.5

Criteria	San Antonio Bay Area		Aransas Bay Area		Corpus Christi Bay Area	
	Guadalupe R, D; San Antonio B (83K ac)	**Mesquite B (8K ac)**	**Mission R, D, B; Aransas R; Copano B (47K ac)**	**St. Chas, Carlos, Aransas, Redfish Bs (72K ac)**	**Nueces R, D, B (15K ac)**	**Shamrock, East Flats, SE CC B (10K ac)**
4. Acquisition and Accessibility Considerations						
4.1. Land Ownership	29	39	24	30	22	36
4.2. Publicly Owned Lands and Feasibility of Land Acquisition	26	39	13	13	13	26
4.3. Availability of Facilities	16	21	35	38	26	28
4.4. Proximity &Accessibility to Researchers, Educators, and Decision Makers	18	18	37	39	28	37
Averaged Score:	22.3	29.3	27.3	30.0	22.3	31.8
5. Management Considerations						
5.1. Land and Water Access	24	33	27	18	38	22
5.2. Compatibility With Existing Management Practices and Uses	26	26	39	39	39	39
5.3. Compatibility With Adjacent Land and Water Use	26	39	26	26	26	13
5.4. Ability to Address Local, State, and Regional Coastal Management Issues	39	39	39	39	39	39
5.5. Development and Water Quality Impacts	26	39	39	39	26	26
5.6. Adequate for Surveillance and Enforcement	26	26	26	26	39	26
5.7 Future Development Plans	26	39	39	39	26	13
Averaged Score:	27.6	34.4	33.6	32.3	33.3	25.4
Total Score:	134	120	164	166	141	128

Thus, the SES first draft of the Proposed Texas NERR site is based in the Mission-Aransas Estuary to include:

1) Water: State submerged lands of the Mission-Aransas Estuary (including Copano, Mission, Port, St. Charles, Aransas, and northern Redfish Bays and the mouth of the Aransas River and tidal segments of the Mission River). To the south, the boundary would start north of the Aransas Pass shrimp channel. Part of Lydia Ann Channel would be included. All navigation channels and the Intracoastal Waterway will be declared "in-holdings" for which traditional and existing uses are expected to continue in the future. This simply means that stations for long-term research projects will not be set up in or along channels where maintenance dredging or disposal is expected to occur in the future.

2) Land: The Aransas National Wildlife Refuge (ANWR), Goose Island State Park, Fennessey Ranch (adjacent to the Mission River), and parcels owned by The Coastal Bend Land Trust (near the mouth of Copano Bay), and The Nature Conservancy (tract adjacent the ANWR). NOAA rules state that Federally protected lands can make up to 50% of total area of a NERR site. The federally protected ANWR and Matagorda Island make up 27% of the total area. Mesquite Bay is included so that Cedar Bayou, which connects to the Gulf of Mexico, can provide access to research offshore.

The SES met again on 12 December 2002 to review the first draft of the site boundaries. There was extensive discussion on two issues: size of the proposed area and inclusion of the Nueces Delta.

The proposed site in the first draft of the boundary is quite large, nearly 250,000 acres. More than half is open water. The holdings are wholly contained by seven property owners, all of whom want to be part of the program. There was a concern that the site is too large and that it contains a highway (the causeway between Rockport and Holiday Beach) and the GIWW. Concern was raised over the future for both road and channel maintenance or expansion. After discussion, the SES recommended the entire system as proposed.

A discussion of core and buffer areas ensued. Buffer areas are within the proposed boundary and likely to have greater human use or activities in the future. Those more internal areas within the boundary where fewer human activities would occur are the core areas, which are more appropriate for long-term research. The buffers are thus composed of three easily identifiable landmarks. The Gulf Intracoastal Waterway, which bisects Aransas Bay and its designated spoil areas are buffers. The Highway 35 Causeway, which would require maintenance and likely future replacement is a buffer. The many small oil and gas wells that are dispersed throughout all Texas bays are also buffer areas.

Another area of interest is the University of Texas Marine Science Institute (UTMSI) location at the tip of Mustang Island in Port Aransas, which is included in the boundary as a buffer. The UTMSI already has extensive laboratory, office, housing, and visitors' facilities as well as operating a fleet of vehicles and small boats. It is intended that the UTMSI will serve as the headquarters of the Texas NERR program.

The last issue was to reconsider the Nueces Delta. The Nueces Delta was the only site to receive unanimous recommendations at the first site selection meeting. However, the Delta is primarily in private ownership and has been degraded because of freshwater inflow diversion, thus it did not score as highly as the Mission-Aransas Estuary. The Delta did rank third among all sites considered during the SES ranking. The reasons the Delta was unanimously nominated in the first SSC meeting are compelling. The Delta probably has the most extensive long-term research programs than any where else in the Western Gulf Biogeographic Region. The Delta is also the focal point for restoration projects in the Coastal Bend region. The City of Corpus Christi has spent nearly $5,000,000 to restore freshwater inflow to the Delta by diverting fresh water from the Nueces River to Rincon Bayou, which is the main stem of the Delta. The Coastal Bend Bay and Estuary Program (in partnership with The Nature Conservancy) has nearly $3,000,000 of local (non-federal) funds to purchase land in the Delta for conservation purposes. Since the Estuary Program recently made its first land purchase, there are wetlands now available in the Delta to include in the Proposed Texas

NERR. After discussion over the merits of having non-contiguous boundaries in the NERR, the SES agreed to recommend a satellite site in the Nueces Delta using two parcels owned by the State of Texas and the parcel owned by the Estuary Program. Although the SES recommended the Nueces Delta as a satellite site, the Delta will not be included in the final site boundary because of its degraded condition, lack of representativeness, and existing water uses.

FINAL SITE SELECTION COMMITTEE DECISION

The second, and final, Site Selection Committee (SSC) workshop was held January 23, 2003. Attending, were 92 committee members representing academia, agriculture, citizen and non-governmental groups, industry, and local, state and federal government. The SSC was presented with a description of the SES process, activities, and recommendations for the proposed site. The purpose of the workshop was to make final selection of the site based on SES site rankings and begin the scoping process on program management plan of the Texas NERR operations. It was thought that the SSC needed to have input in the management plan in order to make an appropriate decision on the actual site. The SSC was empaneled in smaller work groups of 8 to 10 people (Appendix 7) to facilitate discussion. At key decision points, the workgroups were asked to discuss topics among themselves and report a summary back to the group of the whole.

Site Approval

The first topic was to make decisions on the proposed boundaries. Comments about the proposed boundary expressed at the second SSC meeting on the 23rd of January 2003 are in Appendix 7. Two comments were made by the majority of the work groups: 1) All of ANWR should be included in the proposed site, and 2) inclusion of Matagorda Island and more offshore area. With the acceptance of these two comments a vote was conducted on the Texas NERR boundary area with ayes being near unanimous, no nays, and one abstention (a NOAA employee).

Site Use and Focus

During the second SSC meeting, participants were also asked to consider and provide input for four issues that would be discussed in the program management plan: program identity, site use and stewardship, research focus, and education focus. Additional comments and questions from the meeting are shown in Appendix 7. The results of these four discussions are summarized below.

Program Identity

During the second SSC meeting, program identity was discussed including program name and program logo. Several different acronyms for the program name were discussed and several elements for program logos were suggested (Table 8). A list of attendee, work group designations, and drawings of suggested logos provided by work groups are in Appendix 7.

Site Uses/Stewardship Focus

Twenty-four issues were identified regarding site use and stewardship focus (Table 9). The top four ranked issues for the Texas NERR was recreational use management, freshwater inflow,

commercial use management, conservation of habitats. These issues indicate there is a clear need to be concerned about relatively low-impact uses, primarily by recreational users. In addition, these issues will be analyzed in the management plan.

Table 8. Program identity and logo element suggestions from workgroups.

Groups	Program identity	Logo Elements
AA	Aransas NERR (ANERR), Karankawa NERR (KNERR), Copano NERR (CNERR), Mission Aransas Redfish Copano NERR (MARCNERR)	Map of Texas with whooping crane superimposed
BO	NERR south Texas (NERRST), Aransas Bay NERR (ABNERR), Mission Copano Aransas Bay NERR (MCABNERR), Mission Aransas NERR (MARNERR), Mission Aransas Redfish Copano NERR (MARCNERR), Mission NERR (MNERR), Karankaua NERR (KNERR)	Lydia Ann Lighthouse in background with Rosette Spoonbill in foreground.
BH	South Texas Estuary System NERR (STESNERR), Aransas Bay NERR (ABNERR), Corpus Christi Area Estuary System NERR (CCAESNERR)	Background of wind sheared oak. Foreground of marsh edge with whooping crane, blue crab and oyster shell
BP	Texas NERR (TxNERR)	Modified national NERR symbol incorporating Texas star
BT	Aransas Bay NERR (ABNERR), NERR Aransas County (NERRAC), Aransas Copano NERR (ACNERR), Copano Bay NERR (CBNERR), Lone Star NERR (LSNERR), Texas NERR (TXNERR), Copano Aransas Bay NERR (CABNERR), Mission Aransas NERR (MANERR), Aransas NERR (ANERR), Aransas Redfish Copano NERR (ARCNERR), Aransas Mission Copano Bay NERR (AMCBNERR)	Lighthouse in background. In foreground: angler fishing from boat with redfish jumping, reddish egret or shrimp
CU	Aransas Bay NERR (ABNERR), Mission Aransas NERR (MANERR), Mission Aransas Redfish NERR (MARNERR), Texas NERR (TXNERR)	Map of Texas with Texas flag superimposed to extent of the borders, whooping crane with Spartina at approximate location of NERR site. Map encircled by Texas National Estuarine Research Reserve (top) and Mission Aransas Estuary (bottom). Below circle TxNERR
OS	Mission Aransas NERR (MANERR), NERR Texas (NERRT), Mission Aransas Copano NERR (MACNERR), Western Gulf NERR (WGNERR).	Map of coastal bend with river flowing through logo and whooping crane standing in river and possibly incorporating silhouette of mission
RS	Mission Aransas NERR (MANERR), Bay of Aransas NERR (BANERR), Port Aransas River Delta NERR (PARDNERR), Protect Aransas Texas NERR (PARTNERR)	Whooping crane wearing cowboy hat in meandering river (see logo file). Or, Texas flag superimposed on redfish with Texas star instead of spot.
SP	Texas Aransas NERR (TexANERR), South Texas Aransas NERR (STAR-NERR)	Rectangle with national NERR symbol. Arch over top with Texas star
WC	Coastal Bend NERR (CBNERR), Texas NERR (TxNERR)	Stylized Texas flag. Horizontal line between red and white area transformed into a wave. Whooping crane in Spartina in left lower corner. TxNERR in lower right hand corner.

Table 9. Prioritization of Texas NERR site uses.

Prioritization of Site Uses	AA	BO	BH	BT	BP	CU	OS	RS	SP	WC	Tot
Recreational use (e.g., fishing, hunting, camping etc,) management.		X		X		X		X			5
Maintenance/quality of adequate freshwater inflows.		X		X				X	X		4
Commercial use (e.g., fisheries, oil and gas) management.		X		X			X	X			4
Maintenance, enhancement, and conservation of reserve resources (e.g., finfish, shellfish, habitats, other?)				X		X	X		X		4
Local/upstream development, land uses changes and their potential impacts.				X		X		X			3
Exotic species management.		X					X		X		3
Navigation and associated maintenance.							X	X	X		3
Ground water export	X					X					2
Conservation of endangered species and critical habitat management									X	X	2
Interagency coordination of activities within the reserve.			X							X	2
Fire policy/procedure.		X					X				2
Remediation/restoration of damaged/altered habitats										X	1
Erosion		X									1
Municipal waste water issues						X					1
Ecotourism							X				1
Road/highway maintenance/replacement								X			1
Influencing management plans of private land owners that may impact reserve.									X		1
Land acquisition and boundary expansion.		X									1
Historical (e.g., archaeological) resource management.		X									1
Human use (e.g., non point source pollution)				X							1
Preserving cultural heritage.											0
Resource protection through administrative agreements with local, state and federal regulatory authorities											0
Potential opportunities for revenue generation.											0
Administrative goals and objectives.											0

Research Focus

The focus of research to be conducted in the Reserve was also discussed. Research focus topics were ranked by the number of times suggested by workgroups (Table 10). Freshwater inflow, and water quality were the top two items that groups identified as needing research.

Workgroups were asked to provide suggestions on how to promote research to outside investigators. One group stated that requests for proposals should be offered to universities and government agencies, while another group suggested that request for proposals should be offered to the local research community. A large number of the groups (5) stated that cooperative research and sharing of resources with other agencies in the area was important.

Workgroups were also asked to provide suggestions on how to implement research and monitor plans. It was suggested that:

- Important consideration in the development of a research program should include comparison between monitoring and research data. (AA)

- High priority should be given to a determination of baseline data and identification of inadequacies in this data. (RS)

- A good program will first require good baseline/historical data. High priority should be placed on ranking of potential impacts to the Reserve because it will drive research focus. (BH)

- Other important considerations include management of development within and adjacent to the NERR site. (BP)

All groups agreed that incentives (financial, facilities, and equipment) are required to attract and retain top talent. Workgroups were asked to provide suggestions on how to increase visibility and documentation of accomplishments. It was suggested that visibility should be maintained at the professional level through publications in leading journals (e.g., Contributions in Marine Science). Visibility can also be achieved by establishing strong links between science and management. If the reserve provides scientific information in response to management needs, the connection would increase visibility of research.

Table 10. Prioritization of research focus.

What should we study?	AA	BO	BH	BT	BP	CU	OS	RS	SP	WC	Tot
Freshwater inflow and sediment balance		X		X				X	X	X	5
Water quality assessment and monitoring		X		X		X		X	X		5
Land and water interactions (hydrology)	X	X							X		3
Monitoring of climate change and effects on habitats		X		X						X	3
Effects of oil and gas exploration					X			X	X		3
Research on impacted versus pristine habitat					X		X				2
Acquisition of baseline data			X						X		2
Restoration/mitigation studies					X			X			2
Barrier island systems		X									1
Birds community/habitat		X									1
Management of threatened, endangered, and sensitive species (habitat restoration and monitoring of species success)				X							1
Species specific issues				X							1
Non-point source pollution					X						1
Impacts of dredging					X						1
Fisheries biology (gaps in nursery aspects and recruitment)						X					1
Far sighted studies that foster improvement in estuarine productivity							X				1
Coastal erosion								X			1
Bay flow dynamics as related to fisheries and pollutants								X			1
Predictive models of temporal variation in the reserve										X	1
Pure research							X				1
Determination of ecosystem structure/biogeography									X		1

Education Focus

The focus of educational activities within the Texas NERR was discussed. Workgroups were asked to provide suggestions on how to disseminate information for educational purposes. It was suggested that:

- Federal and state regulatory agencies (offering high visibility to managers and decision makers). (CU)
- Public oriented programs such as Coastal Bend Bays and Estuaries Program (offering greater public visibility). (CU)
- Education of winter Texans/tourist offers the opportunity for dissemination of coastal environmental issues to others areas of the country (potential opportunities for revenue generation). (RS)

Workgroups were also asked to provide suggestions on what groups to target for education (Table 11). The majority of groups suggested that K-12 and winter Texans be targeted for educational outreach.

Workgroups were asked to provide suggestions on how to develop and foster educational programs (Table 12). Among the top suggestions were field trips, seminars, and scheduled events and festivals.

Workgroups were asked to provide suggestions on what topic should be emphasized in educational programs associated with the Texas NERR. It was suggested that:

- Habitat types (BO)
- Water quality training (BH)
- Importance of quality habitat (marsh, upland riparian, aquatic etc.) (BH)
- Public outreach (BT)
- Community education (BT)
- Information transfer to industry/commercial groups (BT)
- Teacher training activities (BT)
- Professional training for interpreter (BT)
- Birding (WC)
- Ecotourism (WC)

Other items mentioned by workgroups that should be noted about educational policy included:

- Professional outreach should be coordinated with interpretive staff from state, local and federal programs. (BO, BT)
- The management plan should provide a sound mechanism for the management of fiscal resources.(CU)
- Suitable access points must be determined and appropriate visitor centers developed. (OS)
- Site specific program development may be facilitated by judicious assistance to private land owners. (OS)
- Some mechanism should be devised to evaluate long-term (10-20 years) success of educational goals and objectives. Ultimately, education should foster a sense of ownership and self stewardship. (RS)

- Volunteer activities be should managed by a full-time volunteer coordinator. (SP)
- Note that two ANWR employees are dedicated to interpretive activities. (BT)

Workgroups were asked to provide suggestions on what educational programs existed that could be incorporated with the Texas NERR educational focus. The following programs were suggested: K-12, UTMSI, ANWR, TAMUCC, Early childhood development center, Texas Audubon Society, Texas State Aquarium, State Parks, Sea Grant, ANWR, Texas Commission on Environmental Quality, Adopt A Wetland, Program, TPWD, Earth Day/Bay Day, Great Texas Coastal Birding Trail, Chambers of Commerce, Texas Master Naturalist Program, Coastal Conservation Association, volunteer programs. Several workgroups also suggested operations which have existing facilities that provide the possibility of incorporation for the Texas NERR educational focus: Rockport Fulton, shoreline along Copano Bay, Welder Wildlife Reserve, Fennessey Ranch (pavilion available), ANWR (facilities available), UTMSI, and Nueces Delta.

Table 11. Prioritization of education focus.

What groups should we target?	AA	BO	BH	BT	BP	CU	OS	RS	SP	WC	Tot
K-12	X	X	X	X	X	X		X		X	8
Winter Texans (elder hostels)					X	X		X	X	X	5
General public				X			X	X			3
Teachers			X	X				X			3
Community colleges and universities				X	X				X		3
Special interest groups			X						X		2
Local government				X					X		2
Tourists					X				X		2
Commercial users (e.g., oil/gas and fisheries)									X	X	2
Regional conservation groups				X							1
Civic groups				X							1
Boy/girl scouts										X	1
Adults through continuing education		X									1

Table 12. Prioritization on educational program development.

How to develop programs that encourage public stewardship?	AA	BO	BH	BT	BP	CU	OS	RS	SP	WC	Tot
Field trips	X				X			X			3
Program speakers/seminars	X				X						2
Events and festivals (Hummingbird Festival, Shrimporee, Bay Fest, etc...)	X		X								2
Activities for K-12 with lesson plans, field guides, and programs similar to Sea Camp and Adopt A Wetland (while seeking synergistic opportunity rather than inefficient reinventing of existing programs)								X	X		2
Workshops (offering various incentives)	X										1
Trails with signs and information about habitat types/value, as well as dedicated interpretive centers	X							X			1
Mobile aquariums and ecosystem displays								X			1
Kayak trails								X			1
Web based resources for teachers								X			1
Family oriented programs									X		1
Regional outreach programs									X		1
Town hall meetings									X		1
Programs addressing the interests of scouting groups (girls and boys)									X		1
Distance learning workshops										X	1
Use signs to highlight significant ecological habitats (e.g., highway markers for historical sites)			X								1
Coordinate with Regional Education Service Centers to develop curricula that support the educational mission of NERR			X								1

PUBLIC PARTICIPATION

From the onset, considerable effort was made to include broad and diverse public and private participation in the site selection process. This approach reflected the view that any future Texas NERR would benefit from the creation of a broad base of support from the beginning. Participatory groups and individuals would have had the opportunity to provide input and support in the process from the beginning and would, therefore, develop a sense of "ownership" in the process and the future of the NERR project. The composition of both the SSC and SES reflected this effort to include a diverse range of participants. Invitations to participate in the process through membership in the SSC were sent to 374 people, representing a wide range of public and private groups and individuals that were believed to have interests in this effort. The resulting SSC includes representatives from local, state and federal agencies, private sector business (industrial and agricultural), environmental groups, and local, state and federal level elected officials. The SES is a smaller, technical working group. Included in this committee are representatives of regulatory agencies (State and federal), local governments, environmental interests, and private industry. The SES has been extremely valuable to the process through their active participation in subcommittee meetings and verbal and written support of the project. In addition, Dr. Montagna and Ms. Morehead of the UTMSI attended several user group meetings to inform them of the Texas NERR project. Agendas from these meetings are provided in appendix 10.

Public Meeting

A public meeting on the proposed Texas NERR site was held in Rockport, Texas, a location in the center of the proposed Texas NERR site. The meeting was held on 25 February 2003 at 2:00 p.m. at the Saltwater Pavilion in Rockport Beach. The meeting was a joint workshop of Aransas County, City of Rockport, and Aransas Navigation District elected officials. The public meeting was posted as required by the Texas Open Meetings Act. The meeting agenda is provided in Appendix 11. The meeting was attended by many people including local residents, land owners, and representatives of local industry.

The meeting was opened by the sponsor, the Aransas Navigation District, and then a presentation was made by Dr. Paul Montagna (UTMSI). The presentation included an overview of the NERR program to describe national level objectives, a summary of the Texas NERR initiative including the site selection process, and a description of the selected site. After the presentation, the meeting was opened for a question and answer period.

Overall, the comments made in response to the Texas NERR project were positive, with the majority of the questions pertaining to what types of research would be conducted. Further comments from the meetings are detailed in Appendix 12. News articles informing the public of the Texas NERR initiative are in Appendix 13.

Required Publicly Noticed Meeting

As required by Federal regulations, a second public meeting was held on June 11, 2003 at 2:00 p.m. at the Saltwater Pavilion on Rockport Beach. This meeting was held in a central location within the Proposed Research Reserve Boundary. The public was notified of the meeting through

posting in the Federal Register and advertisement in local newspapers (Appendix 14). The Federal Register notice was posted 23 days in advance. The first newspaper advertisement was posted 21 days in advance and a total of 12 different runs were made. In addition, approximately 420 letters were sent to affected landowners and user groups. Oil and gas lease holders were recognized as holding a property interest and an address list for notification by letter was obtained from the Aransas County tax rolls. Address's of oil and gas operators in Refugio, Calhoun, and Nueces County were obtained through the Texas Railroad Commission website and resulted in four additional companies. A list of attendees of the meeting and the minutes are provided in Appendix 15. The meeting was attended by many people including local residents, and land owners, as well as representatives of local industry, state agencies, conservation organizations and federal agencies.

The meeting was opened by Dr. Paul Montagna (UTMSI) and then a presentation was made by Nathalie Peter (NOAA) to provide an overview of the NERR program to describe national level objectives. Dr. Montagna gave a presentation describing the Texas NERR initiative, including the site selection process, and a description of the selected site. Jeb Boyt (GLO) gave a short presentation describing the state's view of the Texas NERR program. After the presentations, the meeting was opened for a question and answer period.

Overall, the comments made in response to the Texas NERR project were positive. A lot of past effort was made to communicate and educate the fishing sector about the project, consequently only one question was asked about fishing regulations. However, this was the first meeting that reached out to the oil and gas community, and the many questions pertained to what types of oil and gas regulations would be initiated by approval of the project. Participants were told that no new oil and gas regulations would be created by the Texas NERR project by UTMSI or GLO. One participant suggested that no drilling be allowed in the reserve. Dr. Montagna responded with a detailed explanation that existing regulations are working well because research has shown that oil and gas activities have minimal environmental impacts that are very localized, and new CMP regulations further inhibit activities in coastal natural resource areas (CNRAs). There were no suggestions that the proposed boundary should be changed or moved. Further comments from the meetings are detailed in Appendix 15.

TEXAS NERR SITE DESCRIPTION

Boundary

The proposed Texas NERR is located within the Mission-Aransas estuarine system in the southeastern sector of Texas (Figure 5). The proposed site incorporates parts of Nueces, Aransas, Refugio, San Patricio and Calhoun counties (Figure 6). This site encompasses the state submerged land of Redfish Bay, Aransas Bay, Port Bay, Copano Bay, Mission Bay, St. Charles Bay, Mesquite Bay, Cedar Bayou, and an area in the Gulf of Mexico adjacent to Cedar Bayou. State submerged land is composed of intertidal beach, flats, mangrove, and wetland habitats, and bay bottom, oyster reef, and seagrass submerged habitats (Table 13). The land within the proposed NERR site includes the Buccaneer Cove Reserve, Fennessey Ranch, Goose Island State Park, Johnson Ranch, Aransas National Wildlife Refuge, Matagorda Island National Refuge and a state land parcel in Mission Bay (Figure 7). The Federal lands within the site are the Aransas and Matagorda Island National Wildlife Refuges. These refuges total 66,718 acres and account for 27% of the total acreage. Supplemental

site information on the Johnson Ranch, Coastal Bend Land Trust, and Cedar Bayou is provided in appendices 16, 17, and 18 respectively. In addition, the University of Texas Marine Science Institute in Port Aransas is located within the boundary. The University of Texas Marine Science Institute's property is a total of 28.53 acres, with 21.53 ac on land and 7.2 ac in the marina and adjacent land. Further information on the UTMSI wetlands education center, site plan (acreage), and the history of the institute are provided in appendices 19, 20, and 21 respectively. The total area of the proposed site is 236,641 acres.

The boundary of the proposed site is set back 1000 feet from the shoreline (easement) along more densely populated areas and adjacent to private lands. The area affected by the setback consists of submerged state owned land that is dedicated to the permanent school fund, some of which is already leased to private landholders, or property owned by local government entities. Some of this property is leased from GLO to private landholders to accommodate structures such as docks, piers, cattle fences, etc. The 1000-foot setback will be addressed in public forums during the management plan development process because many private property owners and local governments may want the NERR boundary adjacent to their property to take advantage of the NERR program benefits. Federal funds for facilities, public access, and acquisition can not be used outside the NERR boundary. A major focus of the first scoping meeting for the environmental impact statement process will be used to discuss management issues and boundary scenarios associated with shorelines adjacent to private landholders. There is still a large amount of shoreline with critical mangrove, fringing marsh, and seagrass habitats. Using the Texas shoreline dataset generated by GLO staff (based on USGS 1:24000 scale hydro data, modified and updated by using DOQs (1995-96)) the total length of shorelines within the proposed NERR boundary is 1,596,584 feet or 302 miles.

Table 13. Inventory of acreage and habitats for the proposed Texas NERR.

Water Habitat	**Area (ac)**
Beach	7
Flats	2,180
Mangroves	66
Seagrass	8,898
Water (bay bottom + oyster reef)	123,362
Ocean water	4,118
Wetlands	27,182
Oyster reef	2,165
Subtotal Water	165,813
Land	**Area (ac)**
Aransas NWR	55,826
Matagorda NWR	10,892
Goose Island State Park	231
Fennessey Ranch	3,256
Buccaneer Cove	279
Johnson Ranch	257
State Parcel 1 (Mission Bay)	58
UTMSI	29
Subtotal Land	70,828
Total (Water + Land)	236,641

Figure 5. Map and boundary of proposed Texas NERR.

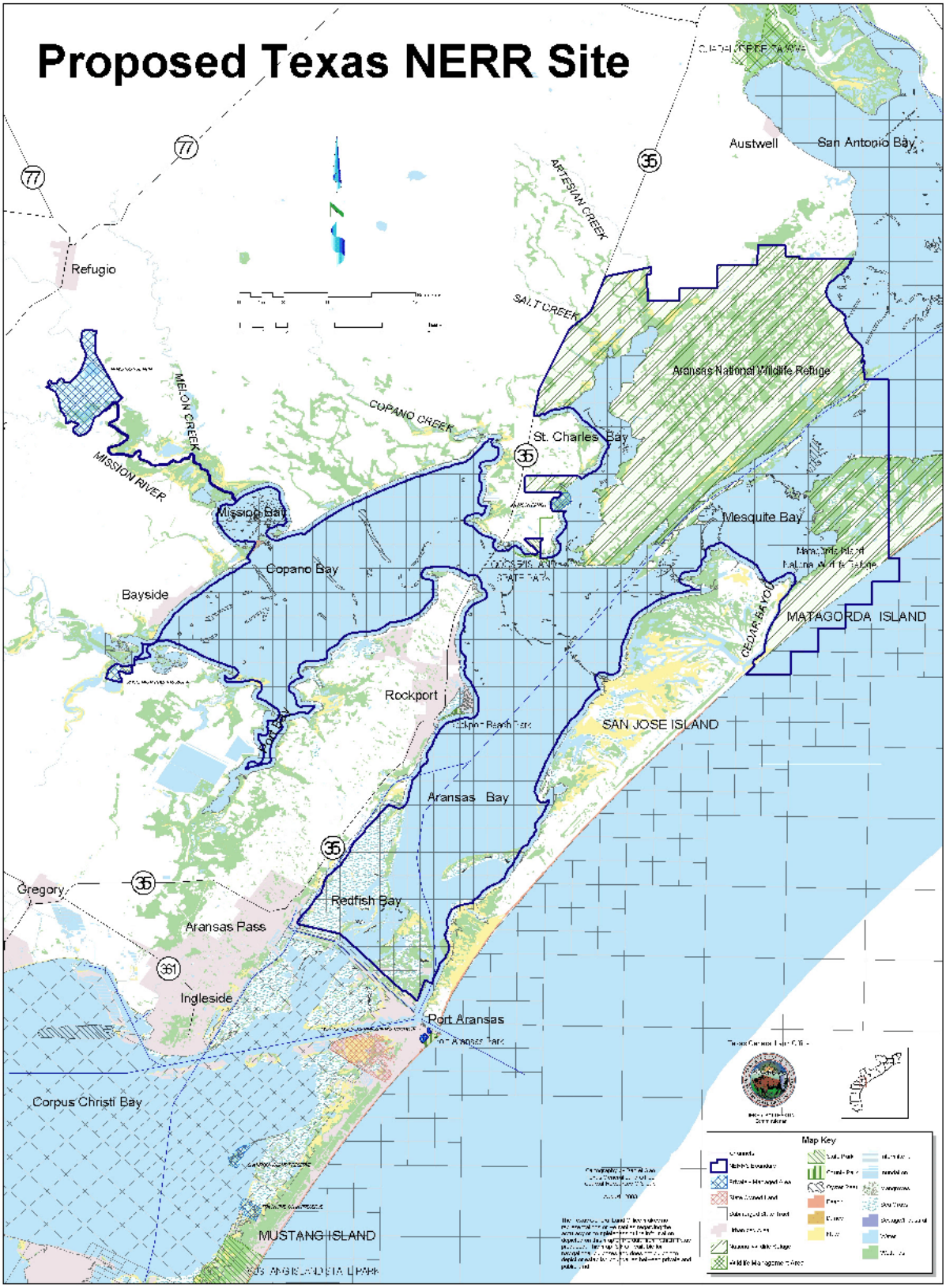


Figure 6. Political boundaries of the proposed Texas NERR site. Map provided by GLO.

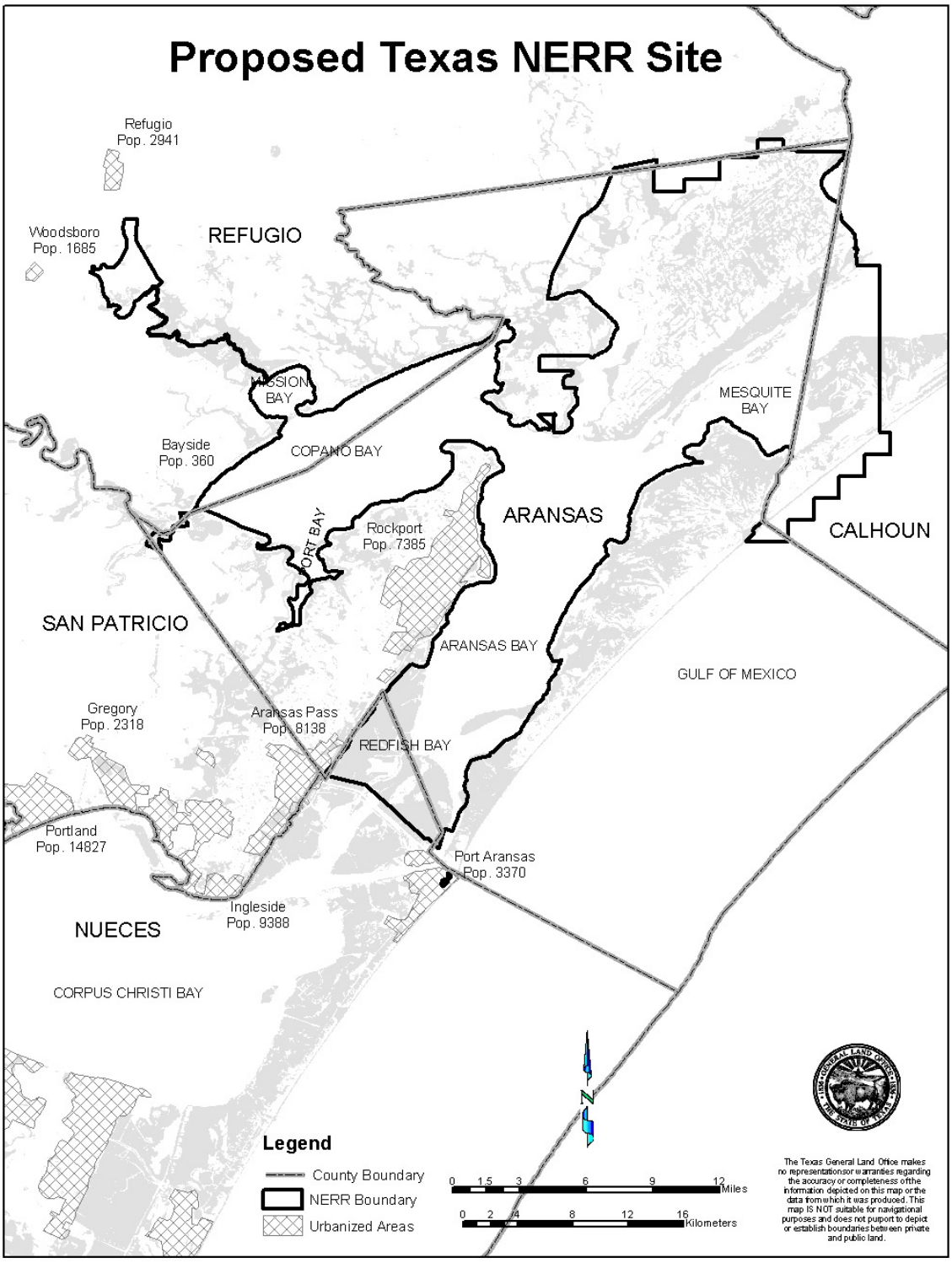
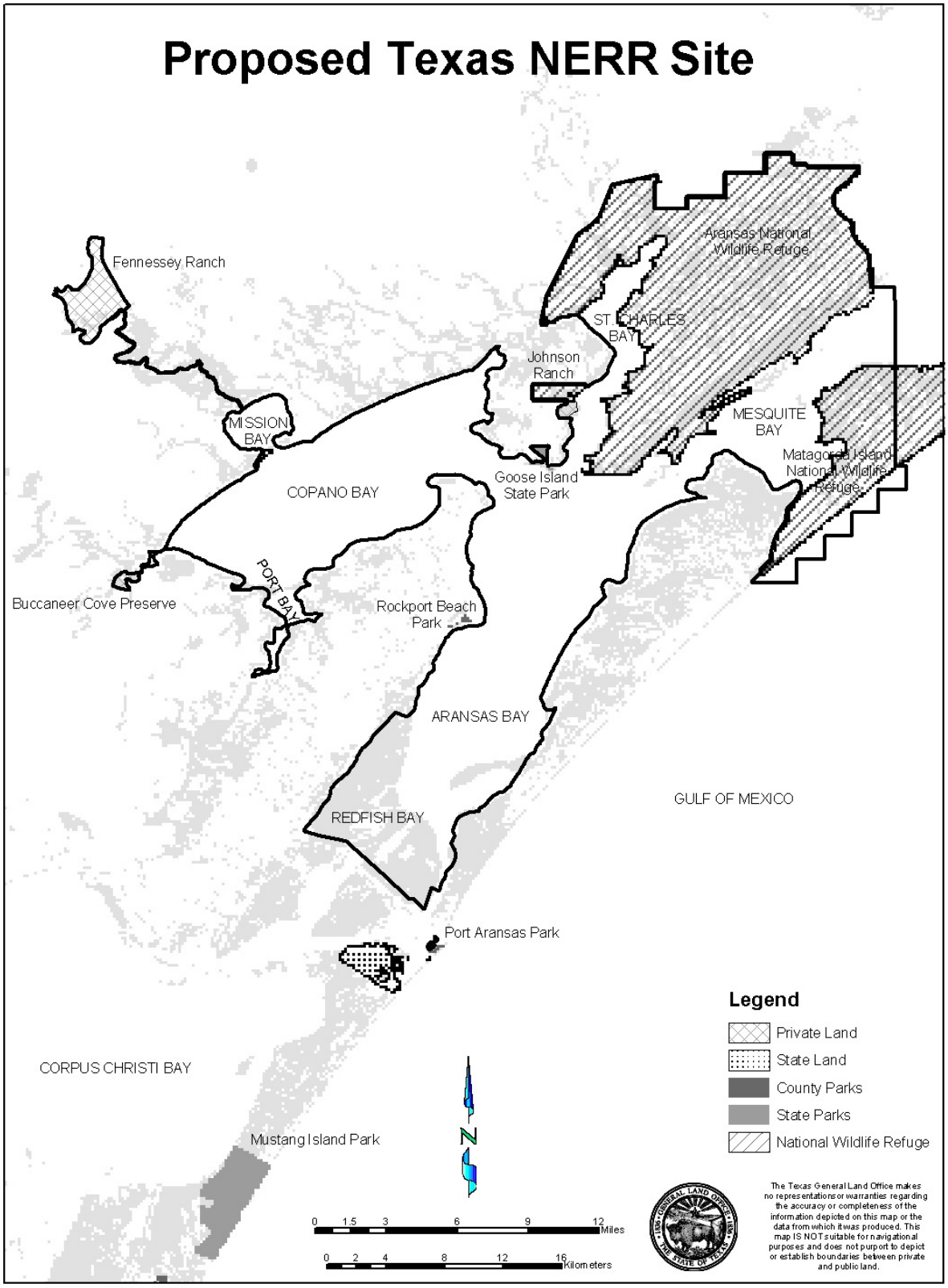


Figure 7. Land types in the proposed Texas NERR boundary. Map provided by GLO.



Physical Site Description

The proposed NERR site contains a typical Western Gulf of Mexico estuary (Diener 1975). The estuarine system is composed of tertiary, secondary and primary bays. Mission Bay is the only tertiary bay, and Copano, Port and St. Charles Bay are secondary bays. Mesquite, Aransas and Redfish Bay are primary bays because they are adjacent to the oceanic outlets. Copano Bay is a coastal plain estuary, composed of two drowned river mouths of the Mission and Aransas Rivers. Aransas, Redfish and Mesquite Bays are bar-built estuaries, in which an offshore sand bar partially encloses a body of water. Aransas Bay is the largest bay, followed by Copano and Mesquite Bay. The bay systems are shallow and the mean low water varies from 0.6 m in Mission Bay to 3 m in Aransas Bay (Chandler et al. 1981).

The land within the proposed NERR site is comprised of state and privately owned land. The Fennessey Ranch is privately owned and is designed to be environmentally sound as well as an economically viable business. The current economic base incorporates hunting, wildlife tours, photography, and cattle enterprises (Croffut and Smith 1997). It is composed of native tree/brush, prairie, freshwater wetlands, and Mission River riparian corridor. Wetlands at the Fennessey ranch cover about 500 acres, that are temporarily, seasonally and semipermanently flooded (White et al. 1998). Further information on the Fennessey Ranch is in Appendix 22.

Buccaneer Cove Preserve is located at the mouth of the Aransas River and contains 279 acres of wetlands such as estuarine tidal flats and brackish marshes. This area is owned and managed by the Coastal Bend Land Trust whose primary goals are preserving and enhancing native wildlife habitat in the Coastal Bend. Johnson Ranch is located on Lamar Peninsula adjacent to St. Charles Bay. The Johnson Ranch contains 245 acres of marshland, coastal prairie and oak motte habitat. These are valuable habitats for the whooping cranes, sandhill cranes, reddish egrets and other waterfowl. The state parcel of land in Mission Bay is also comprised of valuable wetland habitat. The Mission Bay state parcel, Buccaneer Cove Preserve, and Johnson ranch add 524 acres of essential habitat that is essential to the ecological functioning of the system.

Goose Island State Park is 321.4 acres and is located between Aransas and St. Charles Bay. The state park contains several habitats including live-oak thickets, tidal saltmarshes, and mud flats, which support migrant birds including rails, loons, grebes, common goldeneyes, red-breasted mergansers, and redheads. The park also is home to the “Big Tree”, which is the national champion Live Oak estimated to be around 2000 years old. The park was acquired in 1931-1935 by deeds from private owners and Legislative Act setting aside the state-owned Goose Island as a state park. The earliest park facilities were constructed by the Civilian Conservation Corps (CCC) in the early 1930s.

The Aransas National Wildlife Refuge (ANWR) is comprised of the land on the Black Jack Peninsula (Aransas proper), Tatton Unit (NW of St. Charles Bay) and Matagorda Island. The refuge was established in 1937 to protect the endangered whooping crane and was created through an executive order signed by Franklin D. Roosevelt. Matagorda Island Wildlife Management area and State Park, became part of the ANWR in 1982 and is managed through a memorandum of agreement by Texas Parks and Wildlife Department (TPWD) and U.S. Fish and Wildlife Service (USFWS). The ANWR has a large portion of tidal and deltaic marshes. Upland vegetation is predominately coastal plain grasses interspersed with oak mottes, swales and ponds (Stevenson and Griffith 1946, Allen

1952, Labuda and Butts 1979). Vegetation and wetlands at the refuge support wildlife such as the brown pelican, Attwater's prairie chicken, peregrine falcon, white-tailed deer, javelina, coyote, wild pig, Rio Grande turkey, raccoon, armadillo, and the threatened American alligator (CCBNEP 1996). Further information on the ANWR is in Appendix 23.

Climate

There are several published accounts pertaining to the climate within the proposed NERR site and this section is largely based on a wetland conservation plan done by Smith and Dilworth (1999). The proposed site has a "subhumid-to-semiarid east coast subtropical climate, with extreme variability in precipitation" with generally high humidity and infrequent but significant killing frosts (Fulbright et al. 1990). Generally, the area experiences high temperatures along with deficiencies in moisture. Major climatic influences are temperature, precipitation, evaporation, wind, tropical storms and hurricanes.

Temperatures within the proposed NERR site range from an average winter minimum range of 8.3 - 8.9 ^{o}C to an average summer maximum range of 33.3 - 35.6 ^{o}C. The major impacts of temperature within the proposed site are frosts or freezes. Average annual rainfall ranges from 91.4 cm in the north to 77.4 cm in the south. Annual precipitation values alone are not necessarily significant unless compared with precipitation deficiency caused by evapotranspiration and transpiration from plants (Orton 1996). These deficit values range from 7.6 to 40.6 cm, and coupled with this deficient rainfall budget is the seasonal bimodal distribution of precipitation, with most rainfall occurring in the spring and summer months.

Two principle wind regimes dominate the proposed NERR site: persistent, southeasterly winds from March through September and north-northeasterly winds form October through March (Behrens and Watson 1973, Brown et al. 1976). Sedimentologists stress the importance of winds affecting coastal processes along the Texas coast, noting that it is perhaps the most important agent that influences coastal development. The strongest winds occur during tropical storms and hurricanes generating high velocity currents which move vast quantities of sediment in relatively short periods of time (Morton and McGowen 1980).

Hydrography / Oceanography

There are several published accounts pertaining to the hydrography within the proposed NERR site and this section is largely based on a wetland conservation plan by Smith and Dilworth (1999). Hydrographical conditions in the proposed site are influenced primarily by climatic conditions, freshwater inflow and to a lesser extent tidal exchange. The Mission and Aransas rivers contribute the major freshwater inflows into the proposed site. All drainages of the Mission/Aransas estuary share the major Gulf of Mexico connection at Port Aransas (Aransas Pass). Minimum and maximum annual inflows, median inflows, and mean inflows from surface runoff are compared to those of the central Coastal Bend and south Texas in table 14.

Other hydrological parameters such as precipitation and evaporation, along with inflows, provide a better understanding of the water balance and estuarine salinity levels within the area (Table 15). The Aransas estuary receives most of its inflow from adjacent ungauged areas, with a

net positive input of freshwater. A salinity gradient is normally present, where there is decreasing salinity from the Aransas inlet to the upper bays.

Table 14. Comparison of freshwater inflows in acre-feet per year in three estuaries along the lower Texas coast. Data is the estimated annual flows based on values from 1941 - 1991 (http://hyper20.twdb.state.tx.us/data/bays_estuaries/hydrologypage.html).

Estuary	Minimum Annual Inflow	Maximum Annual Inflow	Median Inflow	Mean Inflow
Aransas	7503	1542142	317720	439486
Nueces	42551	2744260	349945	569198
San Antonio	275082	7696573	2067302	366148

Table 15. Comparison of estuarine hydrology in acre-feet for three estuaries along the lower Texas coast. Data is the estimated annual flows based on values from 1941 - 1991 (http://hyper20.twdb.state.tx.us/data/bays_estuaries/hydrologypage.html).

Estuary	Gauged Inflow	Ungauged Inflow	Evaporation	Precipitation	Inflow Balance
Aransas	135537	317193	584038	366667	215209
Nueces	522430	194855	659314	331996	241881
San Antonio	2009889	435961	642512	435707	2159344

Tidal exchange in the Aransas estuary is driven by astronomical tides, meteorological conditions, and density stratification (Armstrong 1987). Because of shallow bay depths (1 - 4 m at mid-tide) and a relatively small tidal prism, wind exerts a much greater influence on bay circulation than astronomical tides (Morton and McGowen 1980, Armstrong 1987, NOAA 1990a). Substantial exchange of water between the Gulf of Mexico and the Aransas Estuary occurs from wind-generated tides (Ward 1997). Astronomical tides are predominantly diurnal, but also have a semi-diurnal component. The greatest influence on the bay system by astronomical tides is at the tidal inlet. Seasonal high tides occur during the spring and fall, while seasonal lows occur during winter and summer.

This estuarine system has a large salinity gradient, with high salinities in Redfish Bay to lower salinities in Mission Bay. Salinity gradients occur with low salinities at the mouth of the Aransas and Mission Rivers, to higher salinities at the primary bays. Salinity structure within the proposed site is determined by “isolated freshwater pulses that, once introduced are retained within the system” (NOAA 1993). Freshwater pulses tend to lower salinities for long periods of time because of the shallowness of the bay and the restricted inlet connection. Salinity stratification is common following fresh water impulses and usually occurs in Copano Bay (NOAA 1993). Salinity stratification can occur in secondary bays (e.g., Aransas Bay), in summer when winds subside and evaporation causes dense water to sink (Morehead et al. 2002).

Geology

The shorelines of Copano and Aransas Bay are in a state of erosion; whereas the bay side shoreline of San Jose is in a state of equilibrium or accretion (Chandler et al. 1981). The Mission/Aransas estuary system is in an intermediate stage of geological succession with the final stage being the filling of the estuary by riverine deposits. There are three sources of sediment in the proposed site: 1) suspended and bedload material from the Mission and Aransas rivers, 2) Gulf of Mexico deposits from storms and inlets, and 3) dredge spoil from channels (Tunnell et al. 1996). The most common sediment type in the Mission/Aransas estuary is mud, which is comprised of silt and clay (White et al. 1983). Mesquite Bay and St. Charles Bay most common sediment type is sand to sandy silt (White et al. 1989). Aransas, and northern Copano Bay have a higher portion of clay, while the southern portion of Copano Bay has a higher portion of silt. Copano Bay also has areas were the sediments have as high as 75% shell material occurring near oyster reefs. The margins of Copano and Aransas Bay have a higher percentage of sand (White et al. 1983).

Along the southern Texas coast, growth faults occur sub-parallel to the coast. Most faults along the southern Texas coast are down-to-the-basin, but up-to-the-basin are common (McGowen and Morton 1979). These faults belong to the Willamar system (McGowen and Morton 1979, CCGS 1967). Faulting is concentrated outside the proposed boundary on South Padre Island (Rio Grande - Port Mansfield Ship Channel), Mustang Island (Malaquite Beach - Port Aransas), Brazos-Colorado Delta (Colorado River - Bolivar Peninsula), and near Sabine Pass (McGowen and Morton 1979). Faulting is a result of structural activity, and gravity sliding, motile salt beds, or basin subsidence are suspected to be the causes of Gulf coast faults (McGowen and Morton 1979, Link 1982). On the southern Texas coast, most oil and gas reservoirs are hydrocarbon traps associated with down-to-the-basin gravity faults and related closures to their downthrown sides (Brown et al. 1976). On the south Texas coast, the principal accumulations of hydrocarbons are associated with major or concentrated fault zones (CCGS 1967). These hydrocarbon reservoirs are, in general, shallow water sands (CCGS 1967).

Water Quality

Concerns about the quality of the Aransas-Copano-Mission bay system has risen more recently than for the urbanized and industrialized bays on the upper Texas coast. Up to World War II, there were few reports or indications of perceived pollution problems in the area, in contrast to the upper coast. In the last two decades, public attention and concern for the Aransas-Copano Bay system has changed. With accelerating urban development, awareness of the potential impacts on the system has increased, and maintenance of the health of the system has become a major issue (Smith and Dilworth 1999). Nuisance and toxic blooms are observed, but hypoxia is not. Nitrogen and phosphorus concentrations range from low to medium (Table 16) (NOAA 1977). Ambient nutrient concentrations are important factors in determining agricultural pollution via runoff. Nitrogen is the primary limiting nutrient to Texas estuaries and is supplied to the Mission-Aransas estuary by the Aransas and Mission rivers (24%), and precipitation (28%). The final nutrient concentration, however, is determined more by the estuarine processes than by inputs to the system. The processes being geochemical trappings within sediments, regeneration by biological communities, and benthic-pelagic coupling (Tunnell et al. 1996). Sewage treated water from the City

of Rockport is used as irrigation at the Rockport Country Club Golf Course and is released into Tule Creek, which flows into Little Bay.

Table 16. Predicted annual pollutant loads to Copano and Aransas Bay (Smith and Dilworth 1999).

Stream Outlet Point	Total Phosphorus (kg/yr)	Total Nitrogen (kg/yr)	Total Cadmium (kg/yr)	Fecal Coliform (trillion col./yr)
Copano Creek	9320	67152	45.4	941
Medio Creek	60594	369122	173.5	1469
Mission River	57781	239843	76.8	550
Aransas River	60900	213314	56.1	503
Chiltipin Creek	19524	66252	15.3	43
Aransas Sub-Basin*	138205	519409	148.2	1099
Copano Bay*	208119	955683	367	3509

*Note: The Aransas Sub-Basin entry represents a sum of the Aransas River, Chiltipin Creek, and Taft Drainage entries. The Copano Bay entry represents the sum of all five major outlets to the bay.

The Texas Commission on Environmental Quality (TCEQ) tests the water quality of all water bodies on the Texas Coast as required by the Clean Water Act. The TCEQ applies Texas Surface Water Quality Standards to determine which water bodies are impaired. Bodies of water can be designated impaired because of low dissolved oxygen levels, high bacteria concentrations, high mercury concentrations, and many other conditions. Once a body of water is determined impaired a Total Maximum Daily Loads (TMDLs) is scheduled by TCEQ for priority impaired waters. There is one segment in the Mission-Aransas Estuary that is listed as impaired (2002, 303(d) List). The TCEQ segment 2472 entailing Copano Bay, Port Bay, and Mission Bay is impaired by bacteria and does not support oyster use. The locations of impairment include the area along southern shoreline, Port Bay, and the area near the town of Bayside. This segment of the proposed site is listed as a low urgency for a TMDL. Even though there are areas in the proposed site that are impaired by bacteria, the Mission-Aransas estuary has a small area of impairment in comparison to other estuarine systems along the Texas coast (Table 17). There is also impaired waters along the Gulf coast (including Port Aransas area). These waters have shown high concentrations of mercury in king mackerel greater than 43 inches, and this impairment is listed as a high priority of a TMDL (http://www.tnrcc.state.tx.us/water/quality/305_303.html).

Table 17. Number of segments in Texas estuaries listed as impaired by the TCEQ in 2002.

Estuarine System	Number of Segments	Parameters
Trinity-San Jacinto	14	bacteria, dioxin, low DO
Lavaca-Colorado	5	bacteria, low DO, mercury
Guadalupe	1	bacteria
Mission-Aransas	**1**	**bacteria**
Nueces	3	bacteria, low DO, zinc
Laguna Madre	1	low DO

Habitat Types and Descriptions

Along with open-water habitats, the proposed Texas NERR site includes several types of wetlands: freshwater (palustrine), brackish, and salt marshes, and mangrove communities. The wetland and open water habitats also support benthic and nektonic populations, as well as large areas of oyster reefs. Large areas of seagrass are present in southern boundaries of the site, and mangroves are abundant in the northern boundaries. Beach and flat habitats are located along the ocean side of Matagorda Island. Several maritime forests are also located within the proposed NERR site including coastal prairies, oak mottes, and riparian woodlands. All these habitats support endangered and culturally important species, such as shrimp and fish. Further information on habitats, significant species, and archaeological sites within the proposed NERR boundary is given in the following sections.

Coastal Marshes

Coastal marshes are important habitats that support diverse communities of producers, decomposers, and consumers. There are two types of coastal marshes within the proposed NERR site: deltaic and tidal marshes (Figure 8). Deltaic marshes occur where there is riverine freshwater and sediment flows, and are found at the Nueces (Rincon Bayou), Mission and Aransas river delta plains (Brown et al. 1976). Tidal marshes occur on flood-tidal deltas near natural passes and along bay shorelines, and are found on the bay side of Matagorda, St. Joseph, and Harbor Islands (Tunnell et al. 1996). There are also marshes exhibiting both characteristics of a deltaic and tidal marsh that have developed between bay-estuary-lagoon system passes at Harbor Island, Cedar Bayou, Redfish, Aransas, Mission and Copano Bay (Brown et al. 1976). Harbor Island is the largest tidal-deltaic marsh in the proposed NERR site, followed by Cedar Bayou. Wetland plant composition and abundance in deltaic and tidal marshes are controlled by salinity ranges, which break the marsh into three community types: salt, brackish and freshwater marshes. The motility of fish and birds results in the absence of zonation patterns of these organisms within the three marsh types.

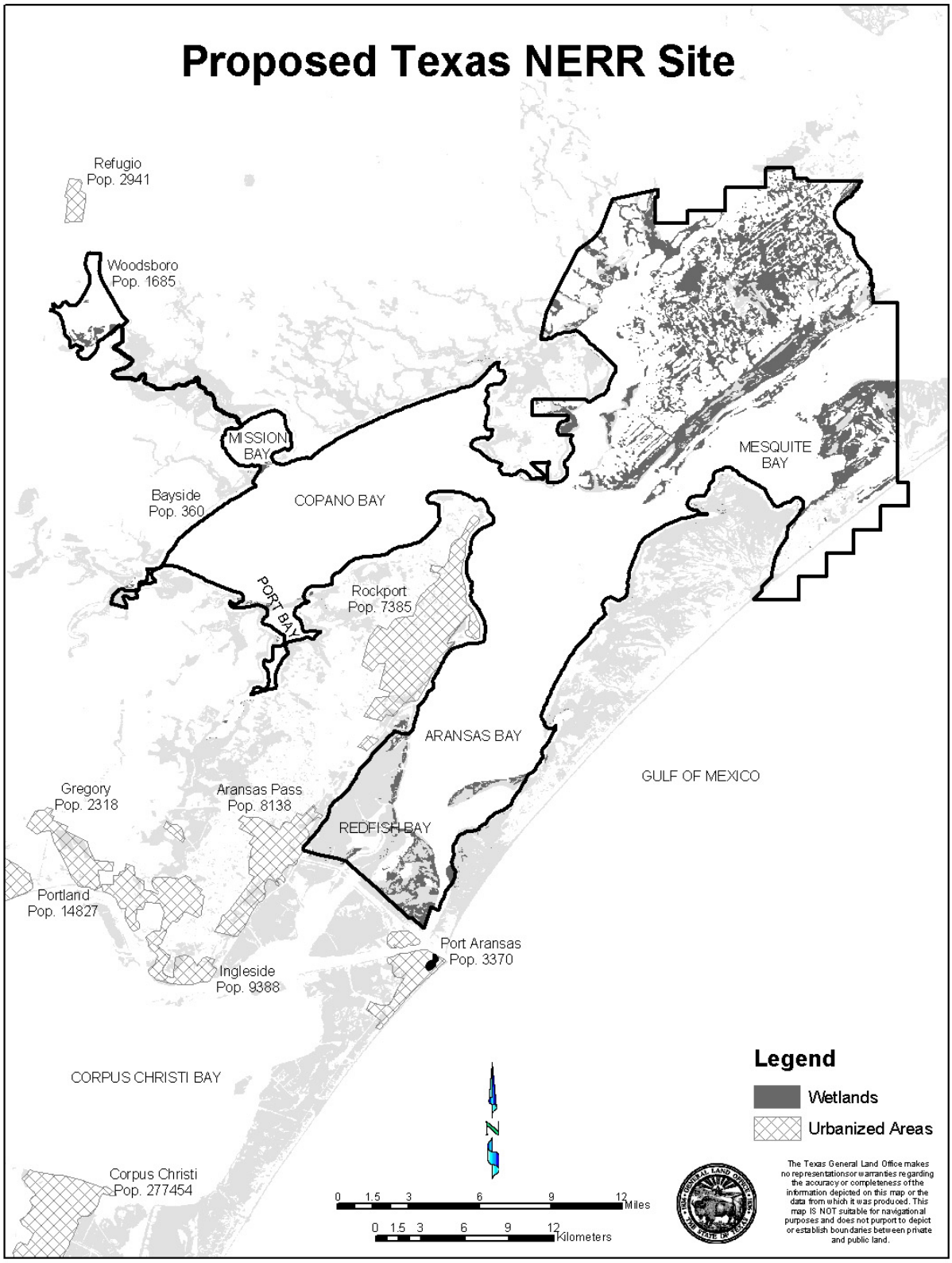
Salt Marsh. Salt marshes receive daily tidal innundation and typically maintain a salinity between 20 and 35 psu (Tunnell et al. 1996). Producers inhabiting low salt marshes, at low elevations, are dominated by monotypic stands of smooth cordgrass (*Spartina alterniflora*) (Brown et al. 1976). In addition to smooth cordgrass in the low marsh, salt marshes along bay margins also have *Batis maritima*, *S. bigelovii*, S. *perennis*, *S. spartinae*, and *Distichlis spicata* at higher

elevations (Brown et al. 1976). In addition to smooth cordgrass in the low marsh, salt marshes along the back side of St. Joseph, and Matagorda Island also have *B. maritima*, *Borrichia* sp., *Monanthochole* sp., *Suaeda* sp., and *Distichlis spicata* at higher elevations (Brown et al. 1976). Among others, consumers typically include the salt-marsh periwinkle (*Littorina irrorata*), fiddler crabs (*Uca pugnax*), and the clapper rail (Stewart 1951, Kerwin 1972, Tunnell et al. 1996).

Brackish Marsh. Brackish marshes receive seasonal tidal innundation, storm surges, and typically maintain a salinity between 5 and 19 psu (Tunnell et al. 1996). Brackish marshes are found in tidal creeks and tributaries of Port Bay. The producers in brackish marshes are usually composed of coastal sacahuista, marshhay cordgrass, big cordgrass, bulrush and cattail (Brown et al. 1976). Among others, consumers typically include the ribbed mussel (*Geukensia demissa*), salt-marsh periwinkle (*Littorina irrorata*), fiddler crabs (*U. minax*), Virginia rail (*Rallas limicola*), and the king rail (*R. elegans*) (Stewart 1951, Kerwin 1972, Tunnell et al. 1996).

Fresh Marsh. Freshwater marshes receive tidal innundation only during extreme storm surges such as hurricane, which increase water levels but may not change salinity levels (0 - 0.5 psu) (Tunnell et al. 1996). Freshwater marshes are found in the Mission Delta, on Fennessey Ranch (Fennessey Flats), and along the Aransas, and Mission Rivers. The producers in freshwater marshes are composed of rushes, bulrush, cattail, and slough grass (Brown et al. 1976). A large 200 acre freshwater lake, McGuill Lake, is also found on the Fennessey Ranch. Among others, consumers found in freshwater marshes typically include *Melampus bidentatus*, Virginia rail (*Rallas limicola*), and the king rail (*R. elegans*) (Stewart 1951, Tunnell et al. 1996).

Figure 8. Coastal marshes in the proposed Texas NERR site. Map provided by GLO.



Open-water Habitats

Benthos. Macrobenthic infauna are organisms that live within the sediment and are composed of organisms such as nematodes, polychaetes, molluscs, and crustaceans. Macrobenthic infauna (> 0.50 mm) are dominated by polychaetes and mollusk assemblages in most estuarine systems. Historical studies indicate that in the Mission-Aransas estuary, the polychaetes *Mediomastus californiensis* and *Streblospio benedicti* are the most abundant macrobenthic organisms (Montagna, unpublished data). Combined together, the abundance of these species has a range of 800 - 2500 *n* m^{-2} in Aransas Bay and 180 - 5000 *n* m^{-2} in Copano Bay (Holland et al. 1975, Armstrong 1987). Historical studies indicate that within Aransas Bay, the polychaete *Praprionospio pinnata* is the most dominant macrobenthic organism, and in Copano Bay the dominant polychaete species are *Glycinde solitaria* and *P. pinnata*. The open bays in the proposed site dominate is small bivalves, which typically represent two-thirds of the molluscan community (Montagna and Kalke 1995). In Copano Bay the dominant epibenthos are *Macoma mitchelli* and *Mulinia lateralis* (molluscs), and *Lepidactylus sp.* (crustacean) (Calnan et al. 1983, Tunnell et al. 1996). The small bivalve *M. lateralis* is a primary food source of the commercially fished black drum (Montagna and Kalke 1995).

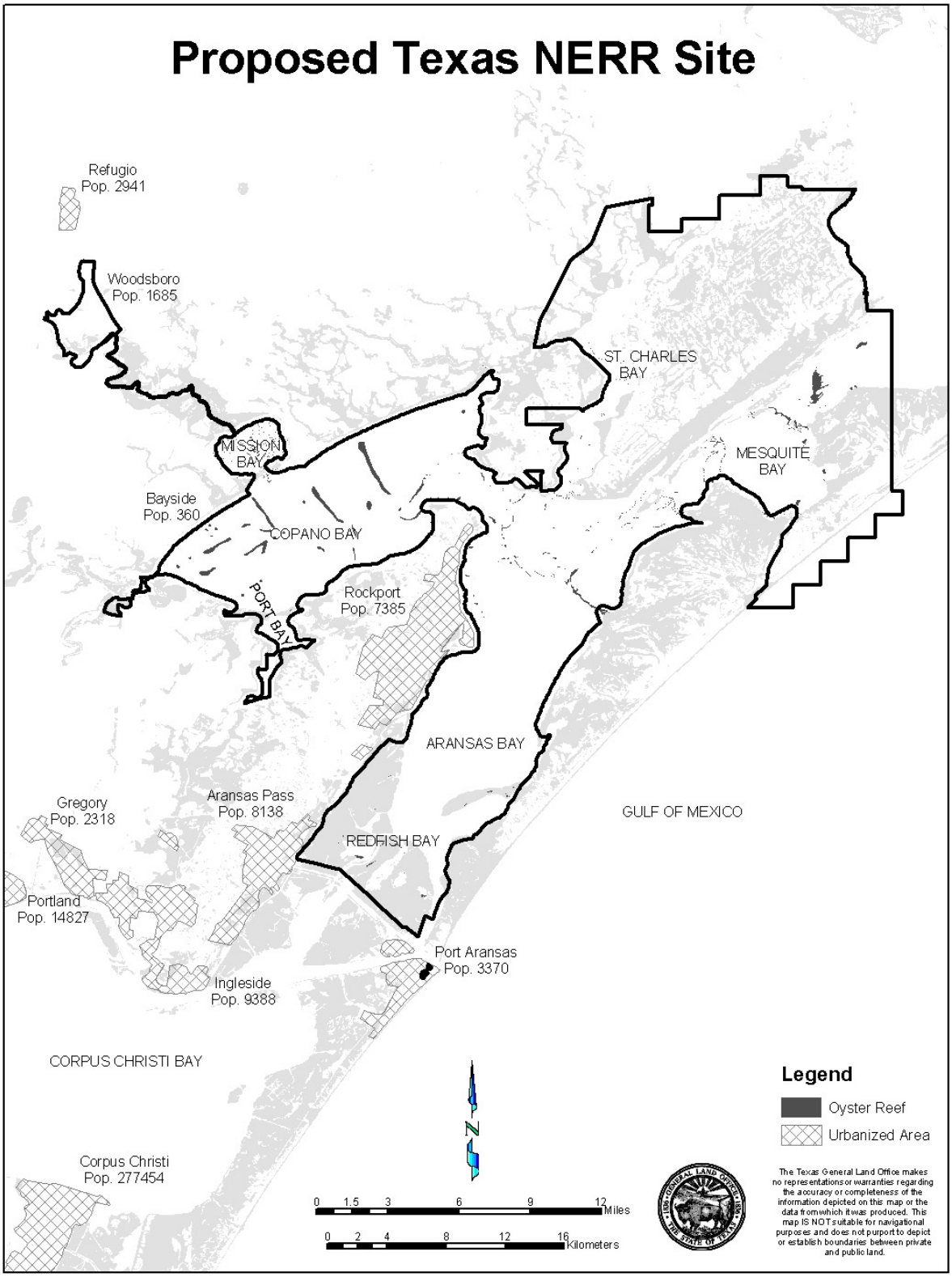
Epibenthos are invertebrates that live on the surface of the sediment and include organisms such as shrimp, crabs, and molluscs. Epifauna densities range from less than 1 to over 100 organisms per square meter (Montagna et al. 1998). They are an important group of organisms because they are a high trophic level, and are the primary consumers of macrobenthic infauna. Molluscan epifauna common to the proposed site include species such as whelks, murexs, quahogs, conchs, and scallops. Epifauna also contains economically important species that are commercially harvested such as shrimp and crabs. The shrimp species in the proposed site that are harvested include the brown, pink, and white shrimp. These species can be found in high abundances throughout the bays and support a large shrimping industry, which is discussed later in under the heading "recreational and commercial fishing." Blue crabs (*Callinectes* sp.) are one of the more abundant brachyuran crabs found in the bays and are most abundant during spring and summer (Hammerschmidt 1985, Britton and Morton 1989). One of the reasons blue crabs are so abundant in the proposed site are because the adults are tolerant of environmental extremes (1-27 ppt, 10-35 ^{o}C), which is typical of Texas bays (Britton and Morton 1989). Blue crabs are active foragers during the day and night, and is also a major predator of estuarine infauna (Britton and Morton 1989).

Salinity is the primary factor in determining distribution of benthos. There are three zones defined in the south Texas estuarine systems: freshwater zone, and estuarine zone and a marine zone (Kalke and Montagna 1984). The freshwater zone resides in the upper portion of the estuary that receives the most freshwater inflow. The estuarine zone occurs when the freshwater inflow and saltwater are mixed, creating intermediate salinities. The marine zone resides near the outlets of an estuary, where salinities approach those of an open ocean.

Oyster Reefs. Oyster reefs within the proposed NERR site are concentrated in Copano, Aransas and Mesquite Bay (Figure 9). The reef structure is usually long and narrow orientating perpendicular to prevailing water currents or parallel to channels, and has a tendency to grow out at a right angle from shore in order to maximize feeding and waste removal (Price 1954). Oyster reef development is dependent on hydrological variables such as salinity, water temperature, current flow, dissolved oxygen levels, and sedimentation. *Crassostrea virginica* is the primary species creating

the oyster reefs in the proposed NERR site and is found in bays with a salinity range of 10 - 30 psu. Mean salinities for Aransas Bay range from 10 - 20 psu and 10 - 15 psu in Copano Bay (White et al. 1989). A thin algal film usually forms on the surfaces of oyster reefs and provides an additional source of primary production to consumers that live in the reef habitat (Bahr and Lanier 1981). Invertebrates are the most abundant consumers associated with oyster reef habitats. Of these invertebrates, arthropods, such as amphipods, brachyuran crabs, and caridean shrimp are the most abundant. Molluscs, aside from *C. virginica*, also inhibit the reefs with the dominant species are *Odostomia impressa* and *Ischadium recurvum* (Calnan et al. 1983). Oyster reefs are also one of the substrates that is most frequented by the commercially viable fished redfish *Sciaenops ocellatus* (Miles 1950). Birds are also primary consumers of oyster reefs (A. Drumright, unpubl. data), and feral hogs have also been reported using oyster reefs as crossings during low tides and they appear to forage as they cross (McAlister and McAlister 1993).

Figure 9. Oyster reefs in the proposed Texas NERR site. Map provided by GLO.



Plankton. Open-water habitats of the estuaries are subtidal and unvegetated, in which case primary production is dominated by phytoplankton. The phytoplankton community in the northern portion of the Mission-Aransas estuary is dominated by blue-green and green algae, while the southern portion of the estuary is dominated by diatoms (Holland et al. 1975, Tunnell et al. 1996). In Aransas Bay, *Coscinodiscus sp.* is the dominant genera (Freese 1952). Average chlorophyll concentrations for the Mission-Aransas estuary are 3.1 μg/L (Powell and Green 1992). High chlorophyll concentrations are found near Aransas Pass and Cedar Bayou gulf exchanges which may be caused by nutrient additions from adjacent estuaries (Powell and Green 1992). In Aransas Bay, the minimum abundance during summer is 6 cells/mL and the maximum abundance during the winter is 381 cells/mL (Armstrong 1987).

As principal consumers of primary production, zooplankton are abundant in open-water habitats. The dominant zooplankter in Mission-Aransas estuary is the calanoid copepod *Acartia tonsa*, with 40 - 60% of total zooplankton abundance (Holland et al. 1975, Tunnell et al. 1996). Freshwater inflows have a large positive effect on zooplankton abundances in the Mission-Aransas and Nueces estuaries because these estuaries receive little inflow in terms of bay volumes (Powell and Green 1992).

Nekton. Fish are the dominant secondary consumers and constituents of the nektonic community (Table 18). The dominant nekton species of Aransas Bay, based on a seven year study, are Atlantic croaker (*Micropogonias undulatus*), spot (*Leiostomus xanthurus*), bay anchovy (*Anchoa mitchilli*), hardhead catfish (*Arius felis*), pinfish (*Lagodon rhomboides*), and sand seatrout (*Cynoscion arenarius*) (Moore 1978). The TPWD has had a continuous monthly monitoring programs in place since 1977. Thus, an enormous amount of data is available for nekton.

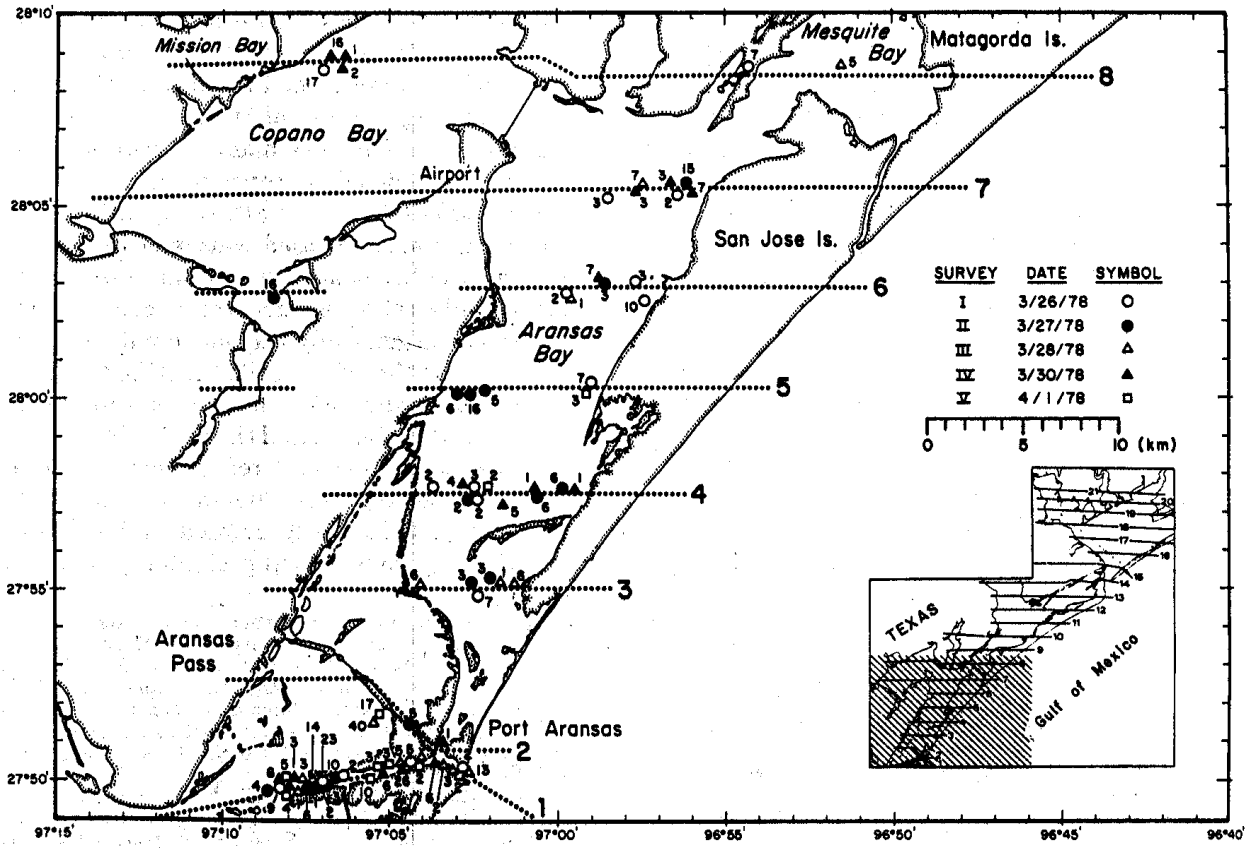
Birds. Birds are high level consumers of open-water habitats. Waders such as the great blue heron (*Ardea herodias*), reddish egret (*Egretta rufescens*), great egret (*Casmerodius albus*) and the tricolor heron (*E. tricolor*) frequent the peripheral areas of the bays. Floating and diving birds such as cormorants, loons, gulls, terns, and grebes feed on fish in the bays, while ducks such as the lesser scaup (*Aythya affinis*), redhead (*A. americana*), and ruddy duck (*Oxyura jamaicensis*) feed on benthic fauna and submerged vegetation (Tunnell et al. 1996). A common bird of prey to the Mission-Aransas area is the osprey (*Pandion haliaetus*), which nests along the shorelines and feed off fish from the open-water habitats (Armstrong 1987).

Mammals. The only resident mammal in the open-water habitat within the estuaries is the Atlantic bottlenose dolphin (*Tursiops truncatus*). This species is most frequently found in the Aransas Pass, shallow areas inside barrier islands and near shorelines (Barham et al. 1979) (Figure 10). The winter populations in the area are often twice the size of the summer populations and are known to move against ebb and flood tides (Shane 1980).

Table 18. Abundance of estuarine species in Aransas and Corpus Christi Bay. Values are relative abundance of adults or juveniles in any salinity zone, in any month (Nelson et al. 1992).

Species	Aransas Bay	Corpus Christi Bay
Bay scallop	rare	rare
American oyster	low	low
Common rangia	rare	rare
Hard clam	low	low
Bay squid	low	low
Brown shrimp	high	high
Pink shrimp	low	low
White shrimp	medium	medium
Grass shrimp	medium	high
Blue crab	high	high
Gulf stone crab	low	low
Bull shark	low	low
Tarpon	rare	rare
Gulf menhaden	medium	medium
Gizzard shad	rare	low
Bay anchovy	high	high
Hardhead catfish	medium	medium
Sheepshead minnow	medium	medium
Gulf killifish	medium	low
Silversides	medium	medium
Snook	rare	rare
Bluefish	rare	rare
Crevalle jack	low	low
Florida pompano	low	low
Gray snapper	rare	rare
Sheepshead minnow	low	low
Pinfish	medium	medium
Silver perch	low	low
Sand seatrout	low	medium
Spotted seatrout	low	low
Spot	medium	medium
Atlantic croaker	medium	medium
Black drum	low	low
Red drum	low	low
Striped mullet	medium	medium
Code goby	low	low
Spanish mackerel	rare	rare
Gulf flounder	rare	rare
Southern flounder	low	low

Figure 10. Distribution of bottlenose dolphin herd and their estimated numbers from Aransas Pass to Mesquite Bay, Texas. Figure courtesy of: Barham et al. 1979. Fishery Bulletin 77:585-595.



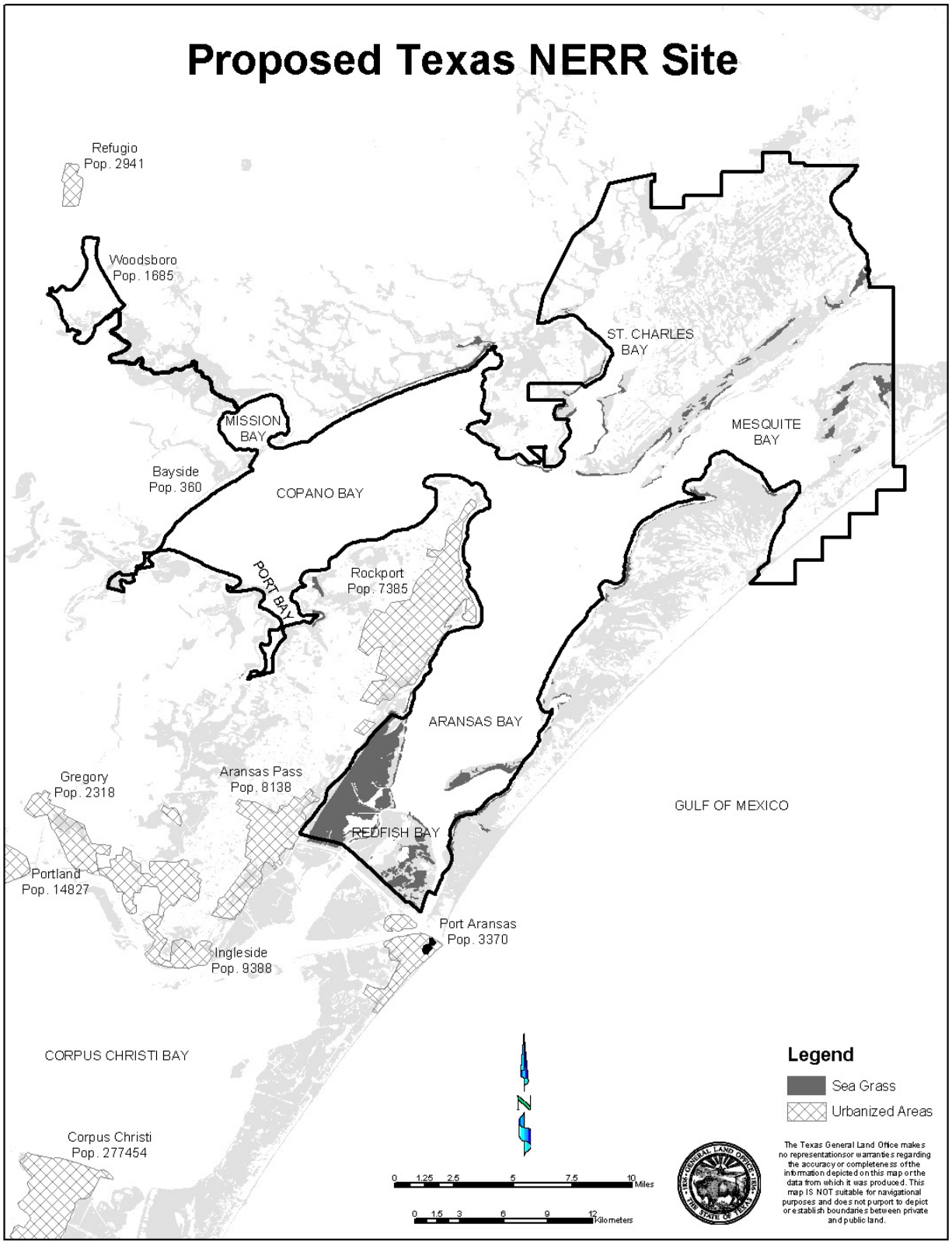
Seagrass. Seagrass beds are critical coastal nursery habitat for estuarine fisheries and wildlife. They are also direct food sources for fish, waterfowl, and sea turtles, as well as major contributors of organic matter to estuarine and marine food web. Seagrass beds can act as stabilizing agents for coastal sedimentation and erosion, and also biological indicators of water quality and ecosystem health. Harbor Island and Redfish Bay contain the one of the most extensive area of pristine seagrass beds and comprises 6% abundance of all Texas seagrass (57 km^2) (Table 19) (Pulich et al. 1997; 1999) (Figure 11). The TPWD currently operates a Seagrass Conservation Management Plan. Redfish Bay was established as a scientific area under this conservation management plan (Appendix 24).

Table 19. Current status and trends in seagrass at proposed site (Pulich et al. 1999).

Bay System	Current Acreage	Percent of Coastwide	Species*	Trends
Copano	8000	3.4	Hd, Rup	
St. Charles			Hd, Rup	
Aransas			All five	
Nueces	24600	11.2	Hd, Rup	Fluctuates with inflow
Corpus Christi			All five	Acreage stable, some bed fragmentation
Redfish			All five	

*Hd - Halodule, Rup = Ruppia, Hph = Halophile, Th = Thalassia, Syr = Syringodium

Figure 11. Seagrasses in the proposed Texas NERR site. Map provided by GLO.



Terrestrial Habitats

Terrestrial habitats within the proposed NERR site include coastal prairies, oak mottes, spoil islands, riparian woodlands, tidal flats, and mangroves. All of these habitats provide shelter and food for many significant flora and fauna.

Coastal Prairies. There are four types of coastal prairies in the proposed site: 1) cordgrass prairie with gulf cordgrass (*Spartina spartinae*) and marshhay cordgrass (*Spartina patens*); 2) sand mid-grass prairie with seacoast bluestem and panamerican balsalmscale (*Elyonurus tripsacoides*); 3) clay mid-grass prairie with little bluestem (*Schizachyrium scoparium*) and trichloris (*Chloris pluriflora*); and 4) short-grass prairie with sliver bluestem (*Bothriochloa saccharoides*), buffalograss (*Buchloe dactyloides*), and trichloris as dominants. Usually clumps of mesquite (*Prosopis glandulosa*), oak (*Quercus* sp.), huisache (*Acacia farnesiana*), and prickly pear cactus (*Opuntia lindheimeri*) are found in any these coastal prairies (McLendon 1991, Chaney et al. 1996).

Tidal Flats. Wind-tidal flats are found along the bay sides of San Jose Island, deltas of the Mission and Aransas Rivers, and scattered along the bay margins of Copano and Redfish Bay (Withers and Tunnell Jr. 1998, Brown et al. 1976, Morton and McGowen 1980) (Figure 12). Wind-tidal flats are halophilic ecosystems generally inundated by wind and storm tides and are found at elevations between mean sea level (MSL) and 1 m above MSL. Wind-tidal flats major primary producers are mats of filamentous blue-green algae that support a large array of consumers of the blue-green algae. These flats are one of the most significant feeding areas for aquatic bird life on the Gulf coast. Tidal flats also act as flood basins which protect vegetation in adjacent bay habitats (Withers and Tunnell Jr. 1998).

Mangroves. The black mangrove (*Avicennia germinans*) is the primary mangrove found in the Coastal Bend (Figure 13). Dense stands of black mangrove are found on Harbor Island in Redfish Bay and dominants approximately 600 hectares on this island. Black mangroves are also found in scattered stands on bay margins and islands in Redfish and Aransas Bay as well as along Matagorda and St. Joseph Island (Sherrod 1980). Black mangrove stands are usually interspersed with *Spartina* spp., *Salicornia* spp., and *Batis* spp. (Sherrod and McMillian 1981). Seasonal freezes are the largest threat to black mangroves. A large freeze in 1989, decreased abundance of black mangrove stands, but since then populations have recovered (Everitt et al. 1996).

Figure 12. Tidal flats in the proposed Texas NERR site. Map provided by GLO.

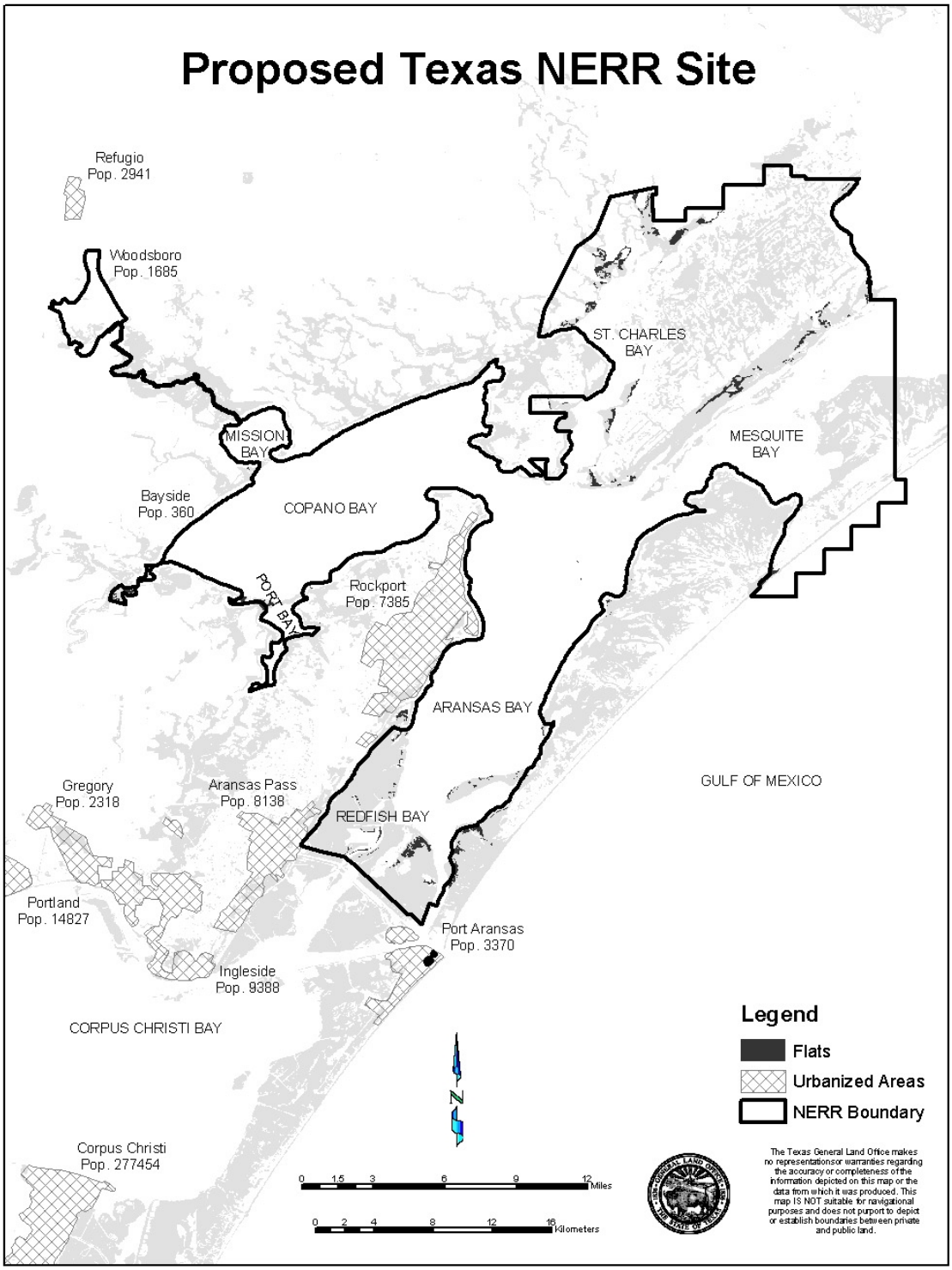
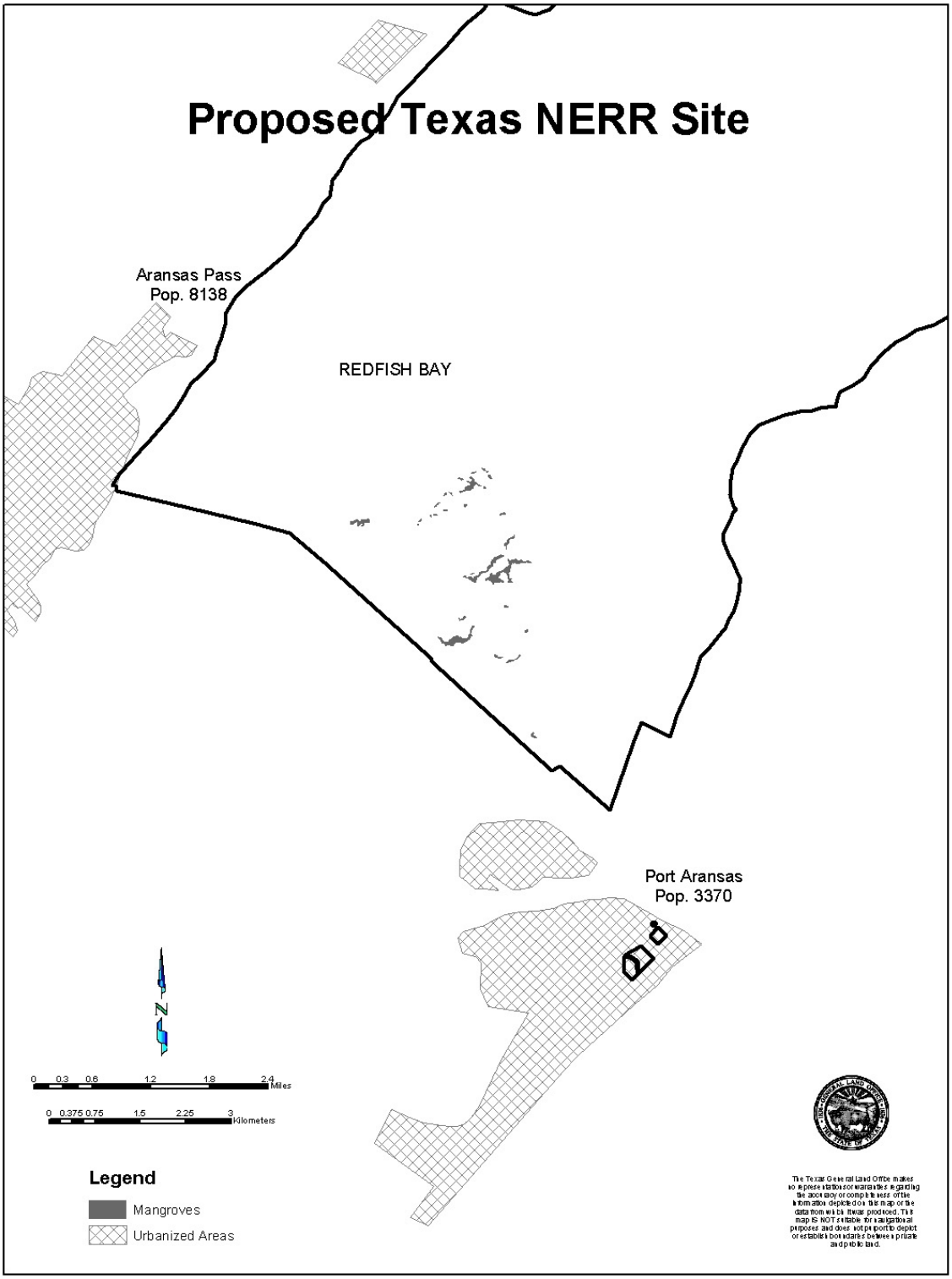


Figure 13. Mangroves in the proposed Texas NERR site. Map provided by GLO.



Other Terrestrial Habitats. Oak mottes are isolated groves of live oaks (*Quercus virginiana*) that exist as remnants of oak forests that occurred on sand sheets and barrier islands. These mottes are interspersed with little bluestem, yaupon (*Ilex vomitoria*), beautyberry (*Callicarpa americana*), greenbriar (*Similax* sp.), mustang grape (*Vitis mustangensis*), and muscadine (*Vitis rotundifolia*) (Chaney et al. 1996).

Natural and dredged spoil islands are also present in the proposed NERR site. These islands are ideal nesting for several species of birds and usually contain plant communities of mesquite, salt cedar (*Tamarix* spp.), popinac (*Leucaena leucocephala*), granjeno (*Celtis laevigata*), and oleander (*Oleander* spp.) (Chaney et al. 1996).

Riparian woodlands are found along rivers and streams and are important stopovers for migrating birds. These woodlands are communities of tall trees with a dense to sparse understory. The understory is usually dwarf palmetto (*Sabal minor*) and common trees are: anaqua (*Ehretia anacua*), cedar elm (*Ulmus crassifolia*), live oak, sugar hackberry (*Celtis laevigata*), net-leaf hackberry (*Celtis retuculata*), Mexican ash (*Fraxinus berlandieriana*), and black willow (*Salix nigra*) (Chaney et al. 1996).

Significant Fauna and Flora

Endangered Species

Several estuarine dependent species in the proposed are listed as endangered or threatened (Table 20).

Table 20. Listed endangered, threatened and candidate species within the proposed NERR site. USFWS[1] = US Fish and Wildlife Service, TPWD[2] = Texas Parks and Wildlife Department, TNHP[3] = Texas Natural Heritage Program, TOES[4] = Texas Organization of Endangered species (Tunnell et al. 1996).

Scientific Name	Common Name	USFW	TPWD	TNHP	TOES
Plants					
Eleocharis brachycarpa	Short-fruited spikerush	C2		G1SH	
Anthericum chandleri	Lila de los llanos	C2		G3S3	
Grindelia oolepis	Plains gumweed	3C		G2S2	WL
Ambrosia cheiranthifolia	South Texas ragweed	C1		G1S1	
Echinocereus rechenbachii albertii	Black lace catus	E	E	G4T1S1	E
Allium elmendorfii	Elmendorf's onion			G2S2	
Chloris texensis	Texas windmill grass	C2		G2S2	
Hoffmannesggia tenella	Slender rush-pea	E	E	G1S1	E
Sesuvium trianthemoides	Roughseed sea-purslane	C2		G1S1	E
Sensitive Plant Communities					
Blackbrush series				G5S5	
Cane bluestem-false rhodesgrass series				G3S3	

Scientific Name	Common Name	USFW	TPWD	TNHP	TOES
Coastal live oak- redbay series				G3S3	
Glasswort-saltwort series				G4S4	
Gulf cordgrass series				G4S4	
Mesquite-granjeno series				G5S5	
Mesquite-huisache series				G5S5	
Seacoast bluestem-gulfdune paspalum series				G4S3	
Sea oats-bitter panicum series				G4S3	
Fish					
Oostethus brachyurus	Opossum pipe fish		T	G5S1	
Syngnathus affinis	Texas pipe fish			G5S1	
Amphibians					
Hypopachus variolosus	Sheep frog		T	G5S2	T
Notophthalmus meridionalis	Black-spotted newt	C2	E	G1S1	E
Siren intermedia texana	Rio grande lesser siren	C2	E	G5T2S2	E
Reptiles					
Lepidochelys kempii	Kemp's ridley sea turtle	E	E	G1S1	E
Caretta caretta	Loggerhead sea turtle	T	E	G3S2	T
Chelonia mydas	Green sea turtle	T	T	G3S1	T
Dermochelys coriacea	Leatherback sea turtle	E	E	G3S1	E
Eretmochelys imbricata	Hawksbill sea turtle	E/CH		G3S1	E
Gopherus berlandieri	Texas tortoise		T	G4S3	T
Alligator mississipiensis	American alligator	T/SA			WL
Holbrookia lacerata subcaudalis	Southern earless lizard			G3S3	
Holbrookia p. propinqua	Keeled earless lizard			G3S3	
Phrynosoma cornutum	Texas horned lizard	C2	T	G5S4	T
Cemophora coccinea lineri	Texas scarlet snake		T	G5S4	T
Drymarchon corais erebennus	Texas indigo snake		T	G5T5S2	WL
Drymobius margaritiferus	Speckled racer		E	G5S1	WL
Lampropeltis triangulum	Mexican milk snake				WL
Leptodeira septentrionalis	Northern cat-eyed snake		E	G5T5S2	T
Nerodia clarki	Gulf saltmarsh snake	C2		G4QS4	
Birds					
Pelecanus occidentalis	Brown pelican	E	E	G5S1	E
Egretta rufescens	Reddish egret	C2	T	G4S22	T
Plegadis chihi	White-faced ibis	C2	T	G5S2	T
Mycteria americana	Wood stork		T	G5S3N	T

Scientific Name	Common Name	USFW	TPWD	TNHP	TOES
Grus americana	Whooping crane	E	E	G1S1	E
Dendrocygna bicolor	Fulvous whistling duck	C2		G5S4	T
Oxyura dominica	Masked duck			G5S4	WL
Elanoides forficatus	American swallow-tailed kite	3C	T	G5S2	T
Haliaeetus leucocephalus	Bald eagle	E	E	G3S2	E
Buteo albicaudatua	White-tailed kite		T	G5S2	T
Buteo albonotatus	Zone-tailed hawk		T	G5S3	T
Falco femoralis septentrionalis	Aplomado falcon	E	E	G4T2S1	E
Falco peregrinus anatum	American peregrine falcon	E	E	G3T2S1	E
Falco peregrinus tundrius	Arctic peregrine falcon	T	T	G3T1S1	T
Jacana spinosa	Northern jacana				T
Charadrius melodus	Piping plover	T	T	G2S2	T
Charadrius montanus	Mountain plover	C2		G3S2	
Charadrius alexandrinus nivosus	Western snowy plover	C2		G4TU	
Numenius borealis	Eskimo curlew	E	E	G1S1	E
Numenius americanus	Long-billed curlew	C2		G5S5	
Sterna antillarum antillarum	Coastal least tern				T
Sterna antillarum athalassos	Interior least tern	E	E	G4T2S1	E
Sterna fuscata	Sooty tern		T	G5S2	WL
Rhynchops niger	Black skimmer				T
Ceryle torquata	Ringed kingfisher				WL
Camptostoma imberbe	Northern beardless tyrannulet		T	G5S3	WL
Pachyramphus algaiae	Rose-throated becard		T	G4G5S2	WL
Lanius ludovicianus migrans	Loggerhead shrike	C2		G5T2?	
Aimophila botteri texana	Texas botteri's sparrow	C2	T	G4TUS3	T
Mammals					
Felis pardalis	Ocelot	E	E	G2?S1	E
Felis yagouaroundi	Jaguarundi	E	E	G4S1	E
Conepatus leuconotus texensis	Gulf coast hog-nosed skunk	C1		G5T?S?	
Tursiops truncatus	Bottle-nosed dolphin			G?S2	
Stenella plagiodon	Atlantic spotted dolphin		T	G?S1	T
Steno bredanensis	Rough-toothed dolphin		T	G?S1	

1 US Fish and Wildlife Service: E- Endangered; T- Threatened; T/SA- Threatened due to similarity of appearance. Because similarity of appearance of the Texas American alligator hides and parts are protected crocodilians, it is necessary to restrict commercial activities involving alligator specimens taken in Texas to ensure the conservation of the alligator populations, as well as other crocodilians that are threatened or endangered. USFWS, 12 October 1983. Fed. Reg. 48 (198):46332-46337. C1- candidate, category 1. USFWS has substantial information on biological vulnerability threats to support proposing to list as endangered or threatened. Data is

being gathered on habitat needs and for critical designations. C2- candidate, category 2. Information indicates that proposing to list as endangered or threatened is possible appropriate; substantial data on biological vulnerability and threats are not currently known to support the immediate preparation of the rules. Further biological research field study will be necessary to ascertain the status and/or taxonomic validity of the taxa in category 2. 3A- former candidate, rejected because presumed extinct and/or habitats destroyed. 3B- former candidate, rejected because not a recognized taxon; i.e. synonym or hybrid. 3C- former candidate, rejected because more common, widespread, or adequately protected.

2 Texas Parks and Wildlife Department, Endangered/Threatened Species Data File: (TNHP 1994). E- endangered; T- threatened.

3 Texas Natural Heritage Program, Special Species and Natural Community Status (1994). G1- critically imperiled globally, extremely rare, 5 or fewer occurrences. G2- imperiled globally, very rare, 6 to 20 occurrences. G3- Very rare and local throughout range or found locally in restricted range, 21 to 100 occurrences. G4- Apparently secure globally. G5Demonstrably secure, globally S1-5 state rankings of the same categories as those listed globally. U- denotes uncertain rank (G2?), or range (G1G2). Q- designates questionable rank or taxonomic assignment. H- denotes historical occurrence. T- subrank of species or variety.

4 Texas Organization for Endangered Species; Endangered, Threatened and watch lists of plants and vertebrates of Texas (March 1987 - plants and January 1988 - vertebrates). E- State endangered species - any species which is in danger of extinction in Texas or in addition to federal status. T - State threatened species - any species which is likely to become a state endangered species within the foreseeable future. WL- TOES watch list - any species which at present has either low population or restricted range in Texas and is not declining or being restricted in its range but requires attention to insure that the species does not become endangered or threatened (State of Texas).

One of the most well known endangered species that inhabits the proposed NERR site is the whooping crane. This species winters along the south Texas coast at the Aransas National Wildlife Refuge (ANWR). Historically the winter range of the whooping crane extended from Mexico up to Louisiana. Extremely low populations of this species were first noticed in the late 1930's. The ANWR was established in 1937 and the whooping crane is making a comeback from a low of 15 birds in 1941 to individuals 185 in 2003 (Tom Stehn, personnel communication).

The brown pelican is also a well known endangered bird species that is present within the proposed site. Brown pelican populations began declining in the 1930's and numbers dropped dramatically between 1952 and 1957 (Tunnell et al. 1996). Less than 100 individuals were believed to be present on the Texas coast from 1967 to 1974 (King et al. 1977). The drastic decline in numbers were due to hurricanes, disease and pesticides. Populations have been increasing since the 1970's and the increase is correlated with the discontinued use of DDT in 1972, along with conservation efforts. The primary nesting sites for brown pelicans are located on the outskirts of the proposed site at Sundown Island in Galveston Bay and at Pelican Island in Corpus Christi Bay (Tunnell et al. 1996).

Archaeological Sites

Karankawa, Tamaulipecan, and Coahuiltecan Indians are the first known inhabitants of the proposed site (Martin 1972, Hester 1980) (Table 21). It is estimated that they lived here for at least 20,000 years and disappeared by the mid-1800's. The Karankawan tribe and those within their linguistic family had the highest population within the proposed site with their core range extending from Matagorda to Corpus Christi Bay (Hester 1980). There are several locations of archaeological sites from these tribes surrounding and within the proposed boundary (Hester 1980, Ricklis 1996) (Figure 14, Table 22). Analysis of these sites determined that tribes inhabited the large shoreline fishing camps from March to August and then moved inland to the smaller prairie-riverine hunting

camps from September to March. Estuarine fauna, such as *Rangia* clams and fish, made up the bulk the diet at the shoreline camps, and large game, such as deer, made up the bulk of the diet at the inland camps (Ricklis 1996). Analysis of these archaeological sites have also determined that there have been three major periods of prehistoric fishery use: 1) about 7,500-7,000 YBP shellfish harvest, 2) Mid-Holocene about 5,900-4,200 YBP shellfish harvest and limited finfish harvest, and 3) Late Holocene after about 3,000 YBP heavy shellfish and finfish harvest (Ricklis 1993). The Corpus Christi Bay area was first discovered by Europeans in 1519, due to the efforts of Spanish Explorer Alonzo de Pineda (CCBNEP 1996). The decline of indigenous populations correlates with arrival of Spanish settlers when the first trading posts were established during the 1700's. Development and industrialism continued in the region resulting in the present day society (Appendix 25).

Sites of historical interest are also present in the proposed site. The Aransas Pass Lighthouse was established as a lighthouse in 1855, and is listed in the National Historical Registry. The lighthouse is located in the Lydia Ann Channel. It was seriously damaged during a Confederate attack in December 1862, in which the top twenty feet of the tower was destroyed. It was rebuilt in 1867 and was decommissioned in 1952 (Holland 1972). The current private owner had the light re-commissioned in 1988. The banks of the Cedar Bayou inlet also have remains of 19th century brickyards. At this site, large complexes of brick kilns, huge open cisterns, and associated brick foundations are present to account for relics of the industrial age (Fox 1983).

Figure 14. Locations of known large shoreline fishing camps (Group 1 sites) and smaller prairie-riverine camps (Group 2 sites) in Corpus Christi and Copano Bay. From *"The Karankawa Indians of Texas: an Ecological Study of Cultural Tradition and Change"* by Robert A. Ricklis, Copyright 1996. Courtesy of the University of Texas Press.

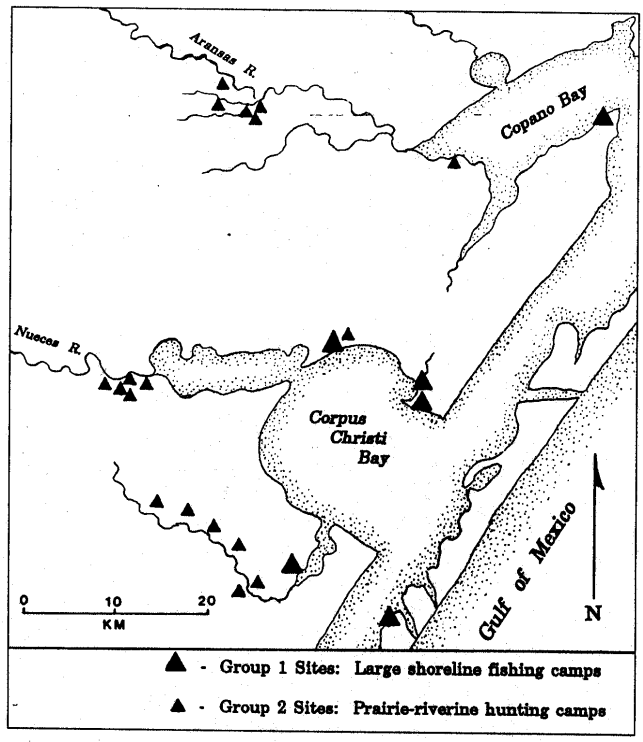


Table 21. Indian tribes of the South Texas coast.

Linguistic Family	Tribe	Range
Karankawan	Copane	Mission River, San Jose Island
Karankawan	Coapite	Goliad; San Antonio River
Karankawan	Coco	Nueces River to Brazos River
Karankawan	Cujan	Aransas and Copano Bays; San Jose Islands
Tamaulipecan	Malaguite	Nueces to Baffin Bay
Tamaulipecan	Araname	San Antonio River
Tamaulipecan	Lipan	Nueces to Baffin Bay
Coahuiltecan	Pajalache	San Antonio River, Gulf coast
Coahuiltecan	Piguique	Nueces River and coast
Coahuiltecan	Atanaguaypacam	Gulf Coast Bays
Coahuiltecan	Cacaxtle	South bend of Nueces River
Coahuiltecan	Chayopin	East of Nueces River, near coast
Coahuiltecan	Pajaseque	Near Corpus Christi Bay
Coahuiltecan	Pamoque	Mouth of Nueces River; Nueces and Corpus Christi Bays
Coahuiltecan	Papanac	Nueces River
Coahuiltecan	Pastaloca	Nueces River valley

Table 22. Archaeological sites presently known in the proposed Texas NERR site.

Site	Location	Site Type	Camp Type	Items Found
41CL3	Mustang Lake (ANWR)	Midden	Large shoreline fishing and hunting camp	Shells, fish bones, pot shards, animal bones, perforated oysters, shell tools, chert flakes
41CL84	North of Mustang Lake (ANWR)	Midden	Prairie-riverine hunting camp	Shells, fish bones, pot shards, animal bones, perforated oysters, shell tools, chert flakes
41CL48	South of Mustang Lake (ANWR)	Midden	Prairie-riverine hunting camp	Shells, fish bones, pot shards, animal bones, perforated oysters, shell tools, chert flakes
41SP159	Aransas River Mouth	Midden	Large shoreline fishing camps	Arrow points, small unifacial end scrappers, prismatic blades, pottery, Rangia clams, fish and animal bones
41SP160 thru 41SP171	Moody Creek (Aransas R.) flood plain	Midden	Prairie-riverine hunting camps	Cultural debris, Rangia clams, fish and animal bones

EXISTING AND POTENTIAL USES

Oil and Gas Activities

The Western Gulf of Mexico Biogeographic Subregion is blessed with abundant hydrocarbon deposits, making this region the most economically advantaged in the nation in terms of mineral wealth. No part of the region is without oil or gas wells and pipelines, including all wetland and open water habitats (Warner 1939). In fact, the Texas Constitution requires that State owned lands including coastal submerged lands, be utilized to produce income to benefit the Public School Fund. Typically this entails the leasing of, exploration for, and production of geologic resources, mainly crude oil and natural gas, on State Lands including State Submerged Lands. Although much of the past production in the proposed site has been depleted, recent drilling has been successful at deeper depths (10,000 to 15,000 feet) and it is likely that further exploration and drilling will be conducted in the area. In addition, technology is improving and interest is beginning to be seen that indicates even deeper depths (20,000 + feet) will be explored in the near future. Exactly where this deeper exploration will be focused is impossible to determine at this time. Offshore, the presence of oil and gas platforms can be environmentally beneficial because they create reef habitats (Montagna et al. 2002). The effects of inshore activities on fish habitat are not well known, thus presenting a great opportunity for NERR studies.

Future oil and gas activities will be addressed in the management plan. The management plan will include specific protections for the right to explore for and develop oil, gas, and other minerals from state-owned or controlled lands within the boundaries of the TxNERR. Regulations at 15 CFR §921.13(a)(10) provide that the management plan shall include, if applicable, a resource manipulation plan describing those portions of the Reserve buffer in which long-term pre-existing manipulation for reasons not related to research or restoration is occurring. The Reserve buffer zone is distinguished from the core area in NOAA regulations. The "core area" is comprised of those ecological units of a natural estuarine system (key land and water areas) which preserve, for research purposes, a full range of significant physical, chemical and biological factors contributing to the diversity of fauna, flora and natural processes occurring within the estuary. The basic principle to follow in deciding upon key land and water areas, according to NOAA regulations, is that they should encompass resources representative of the total ecosystem, and which if compromised could endanger the research objective of the Reserve (15 CFR § 921.4(c)(3)). In determining the core and buffer areas, it will be critical to designate both current and future drill sites no further than 3,000 feet from state-owned tracts to insure access to oil and gas through directional drilling, together with pipeline routes to those sites. However, it may be necessary to provide in the management plan that seismic exploration must be allowed with appropriate restrictions even in the core areas.

Texas Regulations and Policy

Since the state of Texas became independent in 1836, public lands have been given to settlers, soldiers, veterans, and railroads as recompense for service, but more importantly, 52 million acres of public lands were reserved for education, therein creating the Permanent School Fund (PSF). Since the initial donation, most of the school lands have been sold due to poor management and improper classification, but Texas still retains a mineral estate of more than 12 million acres. The Texas

General Land Office (GLO) is directly responsible for the management of this land, which is dedicated to the PSF. The growth of the oil industry in the 20th century helped change the state's land policy from an emphasis on income through the sale of land to an emphasis on income through resource development. The GLO leases rights for oil and gas production on state lands, producing revenue and royalties that are funneled into the state's PSF. In 1939, the Texas legislature created the School Land Board (SLB) to help manage mineral lease awards on school lands, and the lands dedicated to the PSF. The legislature dedicated the mineral income from riverbeds, bays and submerged lands to the PSF. Although non-submerged school land can be sold today under the authority of the SLB, this is rarely done. Instead, the land is leased for resource development and the revenues earned are deposited in the PSF, which stands today at over $7 billion. The interest earned on the PSF investments is deposited in the Available School Fund each year and distributed by the State Board of Education to every school district in Texas on a per-pupil basis. The land office also deposits in that fund fines on unpaid or late royalties, and commercial leasing revenues. Since the Permanent School Fund was established in 1854, the GLO has deposited more than $6.8 billion, mostly from oil and gas leases and real estate trades and sales.

In 1991, the Texas Legislature passed the Coastal Coordination Act, which directed the GLO to develop a long-range, comprehensive plan for the coast in cooperation with state agencies, local governments, and coastal citizens. The act prompted GLO to establish the Coastal Coordination Council (CCC), with the goal to oversee the development of the state's coastal management plan, adopt coast wide management policies, and to implement the plan and designate the physical boundaries for the coastal area. The GLO and CCC effort's resulted in the Coastal Management Plan (CMP), which is a networked program that links the regulations, programs, and expertise of state, federal, and local entities that manage various aspects of coastal resources (Coastal Management Program Guide).

In Texas, there are two primary state agencies that regulate the oil and gas industry. The GLO regulates the leasing, exploration, and development of oil and gas on state submerged lands by means of the provisions of the GLO oil and gas leases issued. The Texas Railroad Commission (RRC) regulates oil and gas production. Both the GLO and RRC have regulations which state that exploration, leasing and production of oil and gas must comply with the policies of the CMP. The CMP sets policies for oil and gas activities that occur within Coastal Natural Resource Areas (CNRAs). The proposed area for the Texas reserve encompasses numerouse CNRAs within its boundaries, including tidal waters, submerged lands, coastal wetlands, submerged aquatic vegetation, oyster reefs, and coastal barriers (Table 23). The CMP states that oil and gas operations in or near "critical areas" are to be conducted in such a manner as to avoid and otherwise minimize adverse effects. The majority of habitats in the proposed NERR site are critical areas, which are defined as coastal wetlands, oyster reefs, hard substrate reefs, submerged aquatic vegetation, tidal sand flats, and mud sand flats. The CMP has already established explicit permit authority to which detailed guidelines apply for the operations of oil and gas that protect the natural resources within the proposed NERR site.

Table 23. Coastal natural resource areas as designated by the Coastal Coordination Act as the focus of the CMP (Coastal Management Program Guide).

CNRAs	Definition
Coastal barrier	An undeveloped area on a barrier island, peninsula, or other protected area, as designated by USFWS.
Coastal historical area	A site that is specifically identified in rules adopted bu the Texas Historical Commission as being coastal in character and that is on the national register of historic places or a state archaeological landmark.
Coastal preserve	Any land that is owned by the state and subject to Parks and Wildlife Code, because it is a park, recreation area, scientific area, wildlife refuge, or historic site.
Coastal shore area	An area within 100 feet landward of the high water mark on submerged land.
Coastal wetlands	A wetland located seaward of the Coastal Facility Designation Line, within rivers and streams to the extent of tidal influence, or within one mile of the mean high tide line of rivers and streams.
Critical dune area	A protected sand dune complex on the Gulf shoreline within 1,000 feet of mean high tide.
Critical erosion area	An area designated by the Land Commissioner
Gulf beach	A beach bordering the Gulf of Mexico that is located inland from the mean low tide line to the natural line of vegetation bordering the seaward shore, or an area of public access.
Hard substrate reef	A naturally occurring hard substrate formation, including a rock outcrop or serpulid worm reef, living or dead, in an intertidal or subtidal area.
Oyster reef	A natural or artificial formation that is composed of oyster shell, live oysters, and other living or dead organisms; discrete, contiguous, and clearly distinguishable from scattered oyster shell or oysters; and located in an intertidal or subtidal area.
Special hazard area	An area having special flood, mudslide or mudflow, or flood-related erosion hazards.

Exploration and Leasing

The Texas General Land Office (GLO) and the School Land Board (SLB) regulates the oil and gas exploration and leases in the proposed NERR site. The GLO and SLB must also comply with the policies of the CMP when approving oil, gas, and other mineral lease plans of operation and granting surface leases, easements, and permits and adopting rules under the Texas Natural Resources Code, Chapters 32, 33 and 51-53, governing oil and gas exploration and production on submerged lands (Texas Administrative Code (TAC), Title 31, Part 16, Ch 501, Rule §501.4).

Aside from the regulations of the CMP, the GLO also has its own regulations in reference to pollution, and other impacts to natural resources (TAC, Title 31, Part 1, Ch 9, Rule §9.11). The GLO states that exploration and leasing of state oil and gas shall be governed by these guidelines:

- All geophysical and geochemical exploration shall be conducted in compliance with all applicable state and federal statutes and regulations relating to pollution of land and water;
- Any physical modification of the surface including, but not limited to, mounding, cratering, or vehicle tracks shall be remedied upon completion of the work and coordinated with and approved by GLO.
- Persons using wheeled or tracked vehicles on state-owned lands shall use reasonable efforts to avoid impact to the area;

- No person operating a vessel, vehicle, or equipment operating under permit shall discharge solid waste (which includes, but is not limited to, non-biodegradable containers, rubbish, or refuse or garbage) into state waters or state-owned lands.
- No geophysical surveying or shooting shall be performed within 1,000 feet of a known bird rookery island, as depicted on maps maintained by GLO, between February 15th and September 1st.
- In accordance with Texas Parks and Wildlife Code, §12.301, a permittee or contractor is liable to the state for the value of fish or wildlife taken, killed, or inured by work under a permit.
- Staging areas must be approved by the GLO, and shall not be established in vegetated areas of tidal sand or mud flats, submerged aquatic vegetation, or coastal wetlands, as those terms are defined in §16.1 of this title (relating to Definitions and Scope), or vegetated dune areas.
- Shot holes shall be at least 120 feet below the mudline on submerged lands, unless otherwise authorized in writing by the commissioner.
- No high velocity energy source shall be discharged within 500 feet of any oyster reef, marked oyster lease, marked artificial reef, or marked red snapper bank, or within 500 feet of any dredged channel, dock, pier, causeway, or other structure. Assistance in locating oyster reefs and leases is available from TPWD.
- No shot in excess of 20 pounds shall be discharged within one mile of any pass, jetty, mouth of a river, or other entrance to the Gulf of Mexico from inland waters.

The GLO ensures compliance with the above guideline through permit conditions designed to: avoid adverse impacts to natural resources, minimize unavoidable impacts, and to compensate for those significant and adverse impacts that may occur during the permitted activity (TAC, Title 31, Part 1, Ch 9, Rule §9.11). The GLO and the SLB shall not take a major action that is inconsistent with the following goals or the policies of the TAC coastal protection chapter:

- to protect, preserve, restore, and enhance the diversity, quality, quantity, functions, and values of Coastal Natural Resource Areas (CNRAs);
- to ensure sound management of all coastal resources by allowing for compatible economic development and multiple human uses of the coastal zone;
- to balance the benefits from economic development and multiple human uses of the coastal zone, the benefits from protecting, preserving, restoring, and enhancing CNRAs, the benefits from minimizing loss of human life and property, and the benefits from public access to and enjoyment of the coastal zone.

In addition, the GLO and the SLB shall avoid and otherwise minimize the cumulative adverse effects to CNRAs of each of its major actions relating to the activity (TAC, Title 31, Part 1, Ch 16, Rule §16.2).

The GLO and SLB have thresholds for referral for actions of exploration and leases. Any action that exceeds these threshold levels will be referred to the Coastal Coordination Council (CCC) for consistency review to the CMP. The approval of a mineral lease exceeds the threshold for potential referral if the authorized activities would adversely affect CNRA acreage greater than the following in the Mission-Aransas Estuary (lower coast): one-half acre of oyster reef, 40 acres of submerged aquatic vegetation, five acres of coastal wetland, 20 acres of algal flat, 20 acres of tidal mud flat, 40 acres of tidal sand flat, 40 acres of waters in the open Gulf of Mexico, 40 acres of open bay waters under tidal influence, or 40 acres of upland area fitting the definition of coastal barrier,

coastal shore area, gulf beach, critical dune area, special hazard area, critical erosion area, coastal historic area, or coastal park, wildlife management area, or preserve. The issuance of a geophysical permit for exploration for oil, gas, or other minerals on state-owned lands also exceeds the threshold if the permit authorizes one of the following: a shot in excess of 40 pounds of dynamite equivalent (upland areas), a shot in excess of 20 pounds of dynamite equivalent (submerged areas), a shot hole less than 120 feet below the mud line (submerged areas). In addition, any action described in §16.1 of this title that may adversely affect a CNRA that has not been specifically addressed in this section, exceeds the threshold if the action would adversely affect greater than 40 acres of any such CNRA. (TAC, Title 31, Part 1, Ch 16, Rule §16.4).

Production

The RRC regulates the oil and gas production in the proposed NERR site. In regard to access of property within the proposed site; the commission or its representatives has access to come upon any lease or property operated or controlled by an operator, producer, or transporter of oil, gas, or geothermal resources, and to inspect any and all leases, properties, and wells and all records of said leases, properties, and wells. Designated agents of the commission are authorized to make any tests on any well at any time necessary to conservation regulation, and the owner of such well is hereby directed to do all things that may be required of him by the commission's agent to make such tests in a proper manner (TAC, Title 16, Part 1, Ch 3, Rule §3.2).

Activities by the RRC of oil, gas, or geothermal resources in the coastal zone must be consistent with the Texas Coastal Management Program (CMP). Activities that must be consistent with the CMP include disposal of oil and gas waste in a pit, discharge of oil and gas wastes to surface waters, compliance with applicable water quality requirements for federal permits for development (including pipelines) in critical areas, dredging, and dredged material disposal. Aside from the regulations of the CMP, the RRC also has their own regulations in reference to pollution prevention. These regulations state that the operator of oil, gas, or geothermal resources shall not pollute the waters of the Texas offshore and adjacent estuarine zones (saltwater bearing bays, inlets, and estuaries) or damage the aquatic life therein. Particularly, the disposal of liquid waste material into the Texas offshore and adjacent estuarine zones shall be limited to saltwater and other materials which have been treated, when necessary, for the removal of constituents which may be harmful to aquatic life or injurious to life or property. The Texas Commission of Environmental Quality (TCEQ) also requires that there be no discharge of oil and gas waste to surface waters which may cause a violation of the Texas Surface Water Quality Standards, codified at TAC, Title 30, Ch 307.

TCEQ standards state that no discharge of oil, grease, or related residue is allowed that will produce a visible film of oil or globules of grease on the surface or coat the banks or bottoms of the watercourse; or cause toxicity to man, aquatic life, or terrestrial life. In reference to brine discharge, salinity gradients in estuaries shall be maintained to support attainable estuarine dependent aquatic life uses (TAC, Title 30, Ch 307, Rule §307.4). In addition, no oil or other hydrocarbons (including deck wash, and oil based drilling muds) in any form or combination with other materials or constituent shall be disposed of into the Texas offshore and adjacent estuarine zones. Immediate corrective action shall be taken in all cases where pollution has occurred. An operator responsible for the pollution shall remove immediately such oil, oil field waste, or other pollution materials from

the waters and the shoreline where it is found. Such removal operations will be at the expense of the responsible operator (TAC, Title 16, Part 1, Ch 3, Rule §3.8).

Coastal Management Plan

The Coastal Management Program (CMP) was created by has several pertinent policies for construction, operation, and maintenance of oil and gas exploration and production facilities in Coastal Natural Resource Areas (CNRAs). CNRAs are located using several methods, depending on the resource: photointerpretation of aerial photography, along with field verification (seagrasses, coastal wetlands, tidal flats and other CNRAs); side-scan sonar (oyster reefs); field surveys (all CNRAs); or a combination of methods. One of the first steps applicants for permits, leases, or easements must take is to locate CNRAs (if any) within the area of the proposed action. If CNRAs are found, applicants must take steps to avoid, minimize, restore, enhance, protect, or mitigate for any impacts.

The goals of the Texas Coastal Management Program (CMP) are:

1. to protect, preserve, restore, and enhance the diversity, quality, quantity, functions, and values of CNRAs;
2. to ensure sound management of all coastal resources by allowing for compatible economic development and multiple human uses of the coastal zone;
3. to minimize loss of human life and property due to the impairment and loss of protective features of CNRAs;
4. to ensure and enhance planned public access to and enjoyment of the coastal zone in a manner that is compatible with private property rights and other uses of the coastal zone;
5. to balance the benefits from economic development and multiple human uses of the coastal zone, the benefits from protecting, preserving, restoring, and enhancing CNRAs, the benefits from minimizing loss of human life and property, and the benefits from public access to and enjoyment of the coastal zone;
6. to coordinate agency and subdivision decision-making affecting CNRAs by establishing clear, objective policies for the management of CNRAs;
7. to make agency and subdivision decision-making affecting CNRAs efficient by identifying and addressing duplication and conflicts among local, state, and federal regulatory and other programs for the management of CNRAs.
8. to make agency and subdivision decision-making affecting CNRAs more effective by employing the most comprehensive, accurate, and reliable information and scientific data available and by developing, distributing for public comment, and maintaining a coordinated, publicly accessible geographic information system of maps of the coastal zone and CNRAs at the earliest possible date;
9. to make coastal management processes visible, coherent, accessible, and accountable to the people of Texas by providing for public participation in the ongoing development and implementation of the Texas CMP; and
10. to educate the public about the principal coastal problems of state concern and technology available for the protection and improved management of CNRAs.

Oil and gas exploration and production on submerged lands shall also comply with the CMP, including the following policies. In or near critical areas, facilities shall be located and operated and geophysical and other operations shall be located and conducted in such a manner as to avoid and otherwise minimize adverse effects, including those from the disposal of solid waste and disturbance resulting from the operation of vessels and wheeled or tracked vehicles, whether on areas under lease, easement, or permit or on or across access routes thereto. Where practicable, buffer zones for critical areas shall be established and directional drilling or other methods to avoid disturbance, such as pooling or unitization, shall be employed. In addition, lessees, easement holders, and permittees shall construct facilities in a manner that avoids impoundment or draining of coastal wetlands, if practicable, and shall mitigate any adverse effects on coastal wetlands impounded or drained in accordance with the sequencing requirements in this subsection. Upon completion or cessation of operations, lessees, easement holders, and permittees shall also remove facilities and restore any significantly degraded areas to pre-project conditions as closely as practicable, unless facilities can be used for maintenance or enhancement of CNRAs or unless restoration activities would further degrade CNRAs (TAC, Title 31, Part 16, Ch 501, Rule §501.14).

In reference to discharges of wastewater and waste disposal from oil and gas exploration and production activities, the CMP dictates the following regulations. No new commercial oil and gas waste disposal pit shall be located in any CNRA. Oil and gas waste disposal pits shall be designed to prevent releases of pollutants that adversely affect coastal waters or critical areas. All discharges shall comply with all provisions of surface water quality standards established by the TCEQ. To the greatest extent practicable, new wastewater outfalls shall be located where the discharge will not adversely affect critical areas. Existing wastewater outfalls that adversely affect critical areas shall be either discontinued or relocated so as not to adversely affect critical areas within two years of the June 15, 1995 (TAC, Title 31, Part 16, Ch 501, Rule §501.14).

The CMP also states that GLO regulations governing prevention of, response to and remediation of coastal oil spills shall provide for measures to prevent coastal oil spills and to ensure adequate response and removal actions. The GLO regulations for certification of vessels and facilities that handle oil shall be designed to ensure that vessels and facilities are capable of prompt response and adequate removal of unauthorized discharges of oil. The GLO regulations adopted pursuant to the Oil Spill Prevention and Response Act (OSPRA), Texas Natural Resources Code, Chapter 40, shall be consistent with the State Coastal Discharge Contingency Plan adopted pursuant to OSPRA; and the National Contingency Plan adopted pursuant to the Federal Water Pollution Control Act, 33 United States Code Annotated, Chapter 26. GLO also rules under OSPRA governing the assessment of damages to natural resources injured as the result of an unauthorized discharge of oil into coastal waters shall provide for reasonable and rational procedures for assessing damages and shall take into account the unique circumstances of the spill incident. The costs of assessing the damages shall not be disproportionate to the value of the injured resources. Plans for the restoration, rehabilitation, replacement or acquisition of equivalent resources shall provide for participation by the public and shall be designed to promote the restoration of the injured resources with all deliberate speed.

The GLO rules must be consistent with other state rules and policies and with the CMP goals and policies (TAC, Title 31, Part 16, Ch 501, Rule §501.14). Consistency review is often required

to ensure that all agencies (local, state, and federal) comply with CMP goals and policies. The process for conducting consistency reviews addresses four questions:

Is the proposed project within the CMP boundary?
Will the proposed project adversely affect CNRAs?
Is the proposed project subject to review?
Is the proposed project consistent with the goals and policies of the CMP?

Local consistency review includes coastal cities and counties with authority under Texas Open Beaches Act (TEX. NAT. RES. CODE ANN. Ch. 61), Dune Protection Act (TEX. NAT. RES. CODE ANN. Ch. 63), and Land Office's beach/dune rules (31 TAC Ch. 15). These coastal cities and counties are responsible for permitting and issuing certificates in the beach/dune system and must ensure that CNRAs will not be adversely affected by a proposed action. These actions are limited to construction in the beach/dune, coastal shore protection, and closure, relocation, or reduction in public beach access. State consistency review includes the networked state agencies and subdivisions. Each state agency proposing an action subject to the CMP must ensure that the action is consistent in writing, such as an order, permit, or other document approving or authorizing the document. Federal consistency review includes actions undertaken, licensed, permitted, or funded by a federal agency. The following listed actions are subject to consistency review: federal actions - licenses or permits issued by federal agencies, federal activities and development projects - functions performed by or for a federal agency, and federal assistance - state and local government applications for federal assistance.

Resources management codes assist potential users of state-owned submerged lands with their project planning efforts. State and federal resource agencies assign codes to state-owned tracts in Texas bays and estuaries and Gulf of Mexico waters, representing development guidelines for activities within the tracts. The codes provide recommendations for minimizing adverse impacts to sensitive natural resources from mineral exploration and development activities.

Oil and Gas Permits

Oil and gas operations are regulated by the GLO and RRC, but before any operation can begin, permit(s) must be obtained from the U.S. Army Corps of Engineers (http://www.swg.usace.army.mil/reg/permits.asp). The Nationwide Permits (NWP) required for oil and gas operations in bays and estuaries include NWP 6 for seismic activities and NWP 44 for mining activities. The NWPs have several general conditions relevant to environmental protection. Some of these conditions include compliance with laws regarding water quality, coastal zone management, endangered species, historic properties, shellfish beds, mitigation, waterfowl breeding areas, and designated critical resource waters. The water quality and endangered species laws are two laws that more readily hold up permit approval. In Texas, mining permit activities must be authorized by TCEQ, which sets the state water quality standards for discharges. These standards are based on the Clean Water Act and require discharges to be consistent with the Coastal Management Plan (CMP). The Endangered Species Act of 1973 requires any seismic or mining permit that may allow adverse impacts to threatened or endangered species or their corresponding critical habitats to be approved by the U.S. Fish and Wildlife Service (USFWS) before the permit is authorized. General conditions of NWP designate a NERR site as a critical resource water. Because NERR sites are designated as

critical resource waters, no discharges of dredged or fill material are allowed within the site unless it is authorized by the USFWS for compliance with threatened or endangered species. In addition compliance with the Coastal Zone Management Act through the CMP is required for seismic and mining permit approval (33 CFR 330.4(d)). A general permit is also required for directional drilling (permit 14114). A directional drilling permit is also bound by laws regarding endangered species, historic properties, mitigation, and waterfowl breeding areas. Further information on Corps of Engineers permits required for activities in the proposed site can be found at http://www.swg.usace.army.mil/reg/permits.asp.

Specific Land Owner Policies

Aransas National Wildlife Refuge. Economic uses of the Aransas National Wildlife Refuge (including Matagorda Island) (ANWR) are primarily cattle grazing, and oil and gas development. Grazing is permitted on 6,000 acres of the Aransas Proper, 7,000 acres on the Tatton Unit and approximately 17,000 acres on Matagorda Island (Figure 15). Grazing is permitted not for economic returns, but as a management tool. With the exception of a few scattered tracts, mineral rights on the Aransas and Matagorda Island are still outstanding. Approximately 40 producing wells exist on the Aransas tract, along with the necessary pipelines, storage, and processing facilities (Figure 16 and 17). Regulations for mineral operations on the ANWR are bound to the GLO and RRC regulations. In addition, the mineral recovery operations on the ANWR shall be conducted so as to minimize impact. Several years ago, State and Federal biologists got together, at the request of the GLO, and compiled a list of restrictions for each tract on the refuge. There are now drilling restrictions in many parts of the refuge, including St. Charles Bay, during October 15th through April 15th (Figure 18). There is no seismic exploration allowed on whooping crane management units between October 15th and April 15th, or no activity on the Tatton Unit during Attwater's prairie chicken booming and nesting periods (March - July). Restrictions on the tracts surrounding the refuge are such that development of oil and gas resources is almost impossible from within the tracts. Oil companies bidding on these tracts are well aware of the restrictions, but hope that the US Fish and Wildlife Service (USFWS) will permit certain activities on refuge lands. By law, no Federal agency may authorize any action that may jeopardize an endangered species or adversely modify critical habitat or habitat that may in the future be critical to the survival and recovery of an endangered species. It is believed by the USFWS that the zoning and special restrictions of the refuge imposed on the operator will protect endangered species utilizing the refuge (ANWR 1986).

Figure 15. Designated units of Aransas National Wildlife Refuge.

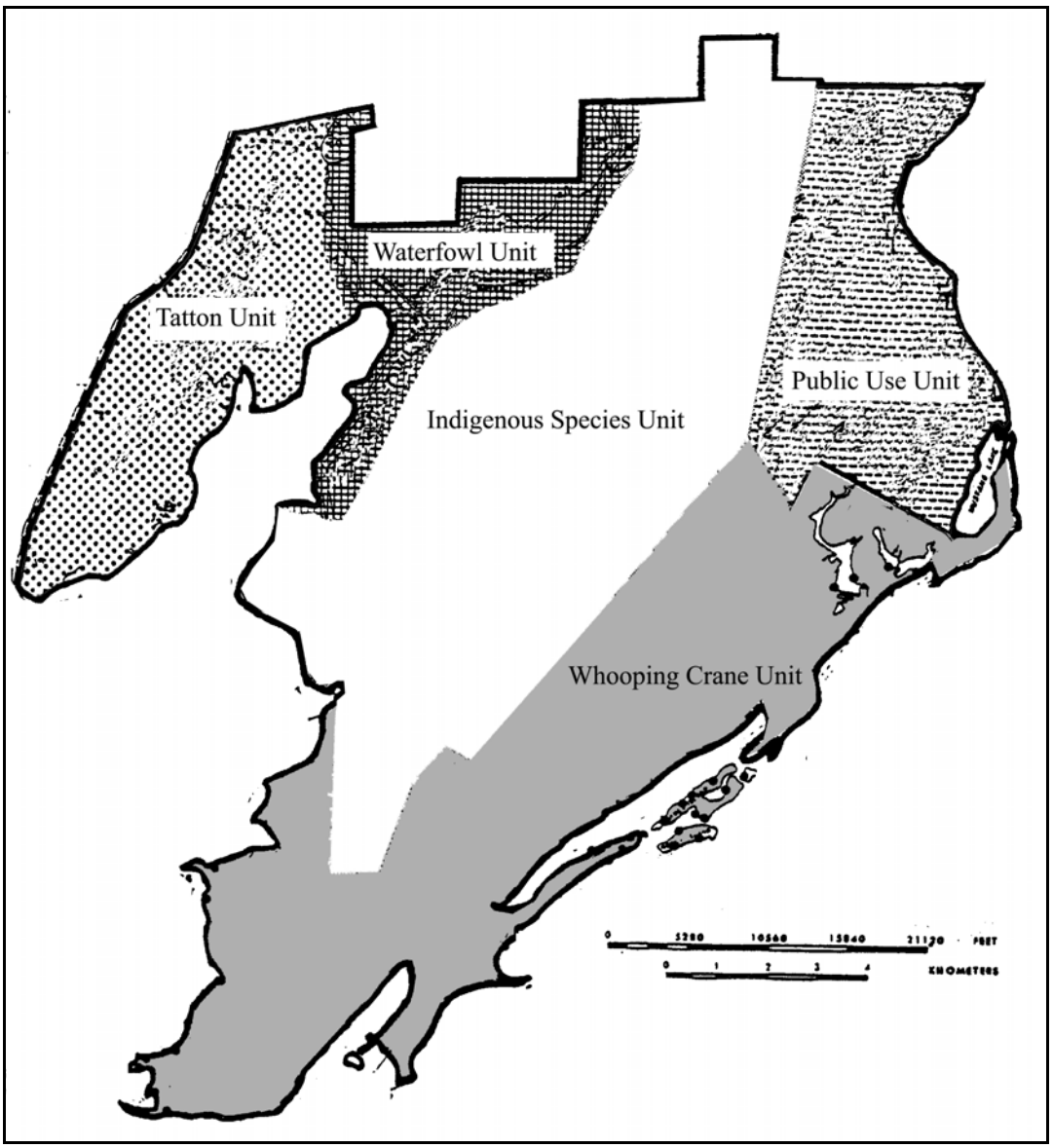


Figure 16. Historical and current gas and oil wells on the Aransas National Wildlife Refuge. Map provided by ANWR.

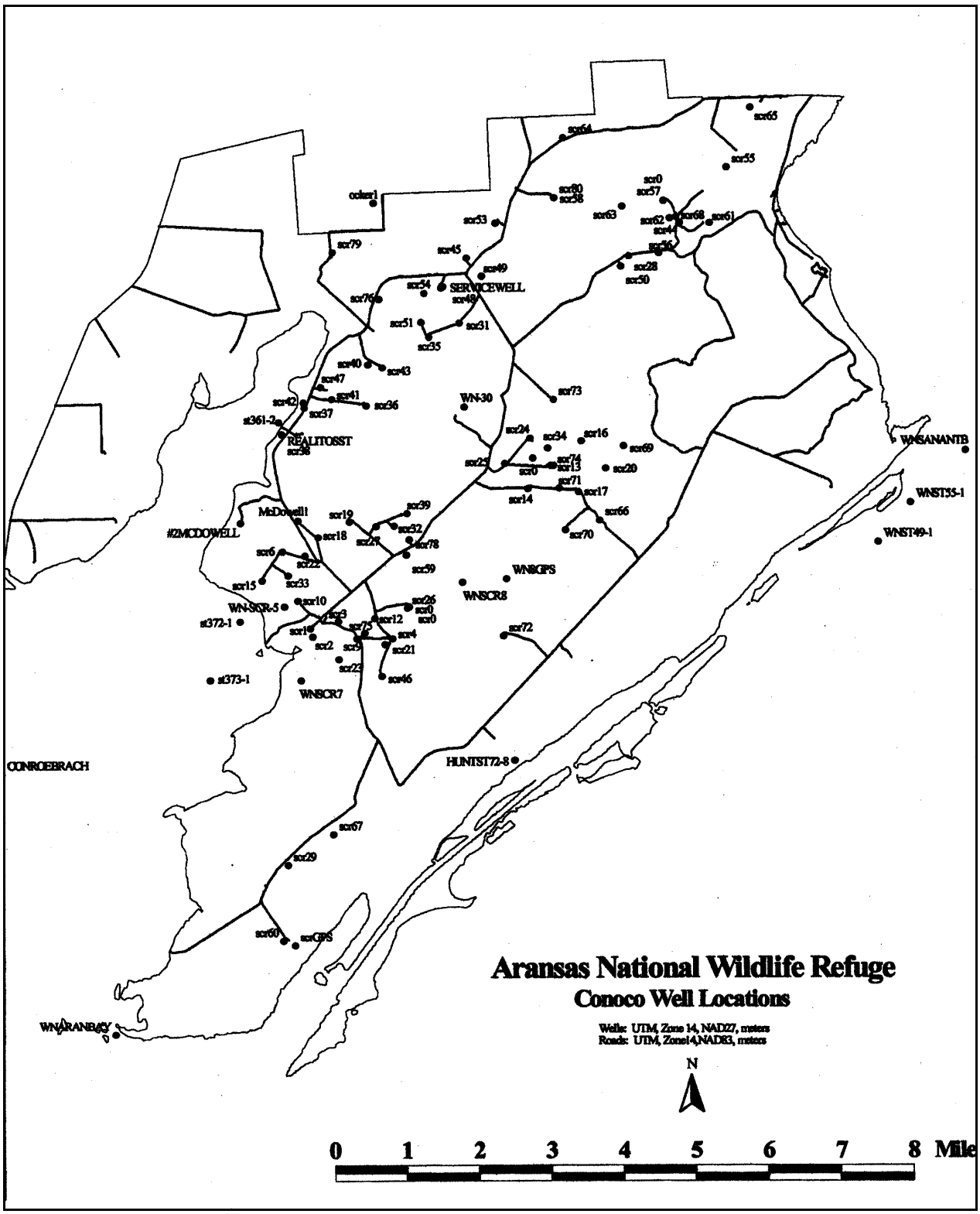


Figure 17. Historical and current gas and oil pipelines on the Aransas National Wildlife Refuge. Map provided by ANWR.

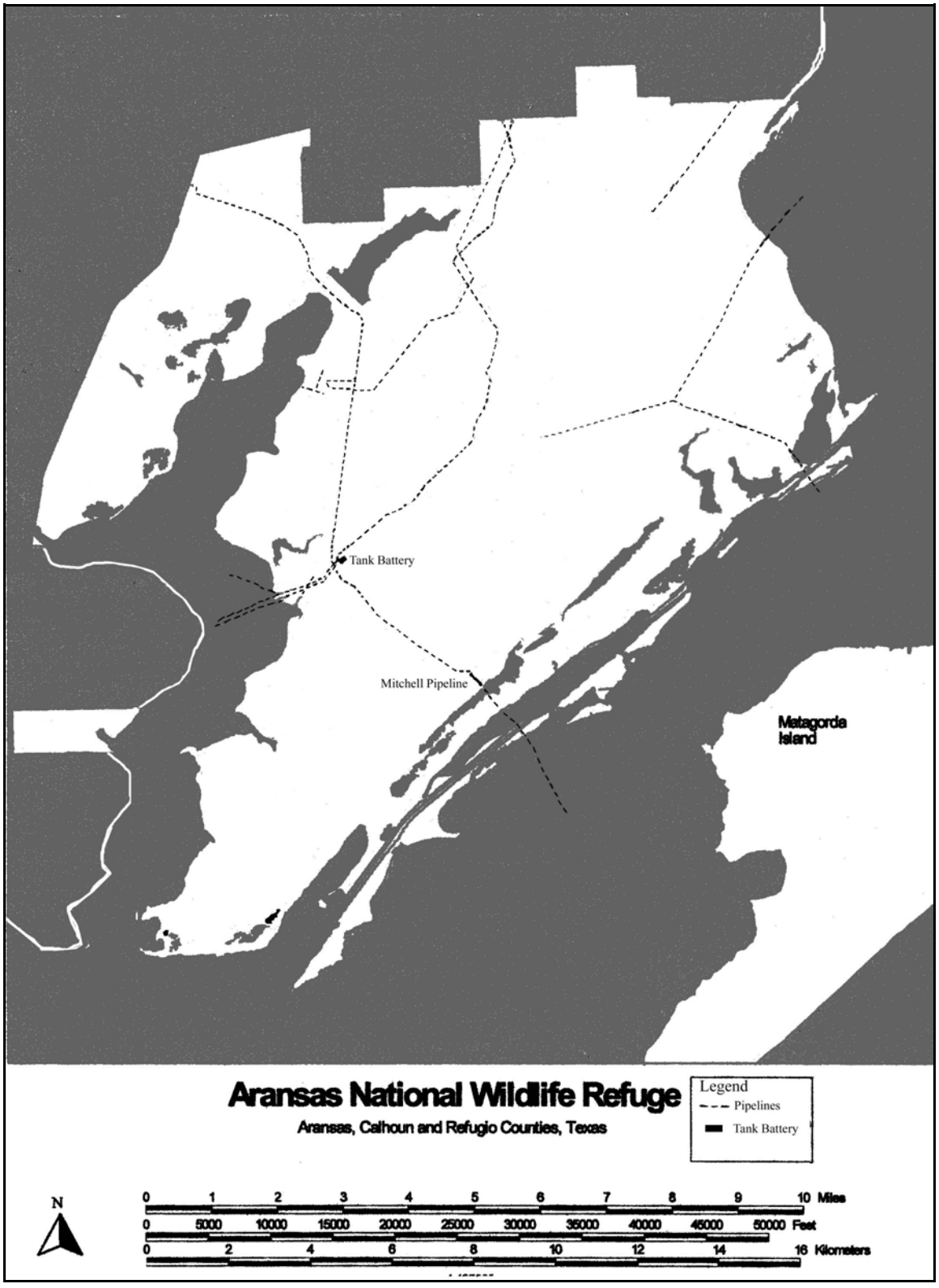
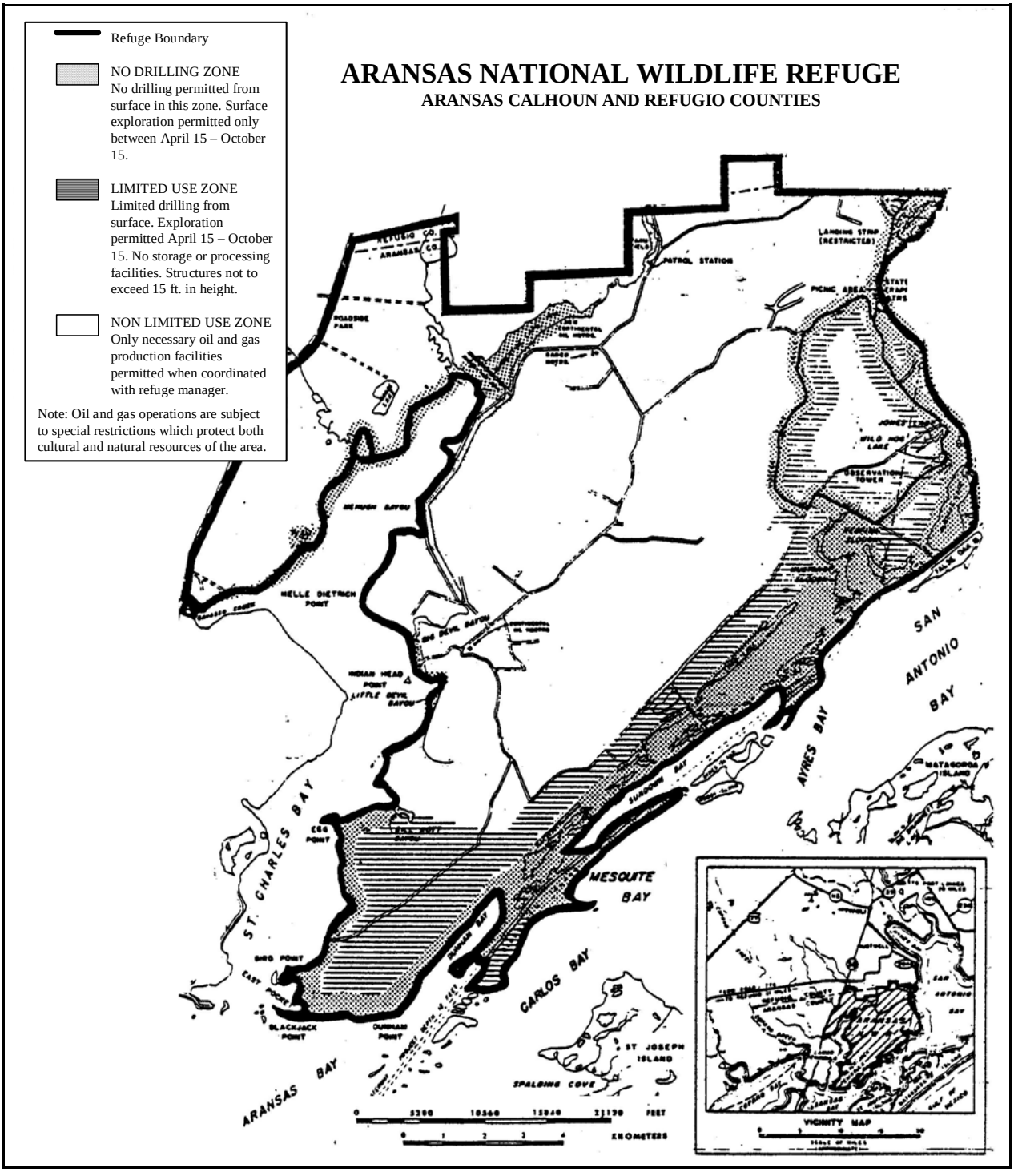


Figure 18. ANWR zones designated by the Oil and Gas Plan (ANWR 1986).



Texas Parks and Wildlife Department. Goose Island State Park and the Johnson Ranch (Nature Conservancy) are managed by the Texas Parks and Wildlife Department (TPWD). Regulations for mineral operations on TPWD managed lands are bound to the goals and policies of the CMP and RRC regulations. In addition, the staff guidelines for mineral recovery operations on TPWD lands state that operations shall be conducted so as to minimize impact and shall be approved by the land manager. Under general provisions, the guidelines state that TPWD retains the right to make special provisions to protect sensitive resources or to minimize potentially adverse impacts (TPWD staff guidelines gen. provisions *p*). The general provisions also state that reasonable precautions, including consultation with the land manager, shall be taken to avoid disturbance of fish, wildlife or critical plant resources during mineral recovery operations (TPWD staff guidelines gen. provisions *q*). Mineral operations may also be prohibited during nesting, breeding or migration activities of specific species identified by the land manager (TPWD staff guidelines gen. provisions *r*). Restoration of activity sites to preconstruction condition is also required on TPWD managed lands.

Texas Coastal Preserves. The Texas Coastal Preserve System was created from the Coastal Public Lands Act, Section 33.001 which charges GLO with the responsibility to preserve the natural resources of the surface estate in coastal public land. The coastal preserves are a form of integrated management, in which GLO leases coastal public land to TPWD for management. There are currently four leases in the Texas Coastal Preserve system (Appendix 26). In all the coastal preserves, GLO may lease land within the preserve for mineral exploration and development, but a plan of operations is required for reviewed by TPWD for consistency with the coastal management plan. A memorandum of understanding between GLO and TPWD is listed in appendix 26.

Oil Spills

The Oil Spill Prevention and Response Act of 1991 (OSPRA) designated the Texas General Land Office as the lead state agency for preventing and responding to oil spills in the marine environment. In a typical year, the agency's Oil Spill Prevention and Response Program (OSPR) responds to between 850 and 1,000 reported oil spills. A two-cent-per-barrel fee on crude oil loaded or off-loaded in Texas ports funds the OSPR program, which deposits fee proceeds in the Coastal Protection Fund Account. As indicated in its name, the OSPR program emphasizes both the prevention of and response to oil spills. The program maintains an active outreach education effort, visiting schools, associations, and interest groups, teaching that many small, chronic spills can be as detrimental as one large spill. As another prevention step, the OSPR program has completed construction of four oily bilge water reception facilities along the coast. The Oily Bilge Water Reception Facility Program provides operators of pleasure and commercial boats with places to dispose of oily water. To date, over 200,000 gallons of used engine oil have been recycled. Further prevention efforts include increased boat and harbor patrols, which have heightened the Texas General Land Office's presence on the waterfront. The OSPR program maintains a comprehensive, unannounced oil spill drill and audit program designed to measure the readiness level of all sectors of the oil handling community: deep draft vessels, pipelines, and shore-based facilities. Facilities and vessel operators are required to address prevention issues, such as leak detection systems, maintenance, and testing and inspection schedules in Oil Spill Prevention and Response plans, the specifics of which are outlined in regulations developed by the program. The second focus of the OSPR program highlights spill response resources directed at stopping, containing, and cleaning oil

spills. The program has compiled a massive spills databank that is used to determine resource allocation, preparedness levels, spill profiles, and corrective activities. In preparation for spills, the program has pre-staged response equipment in sensitive and geographically advantageous locations. The program also maintains a substantial inventory of response equipment including mobile command posts, husbandry and wildlife rehabilitation trailers, fire boom, skimmers, vehicles and vessels. The OSPR program also focuses on research and development, Texas automated buoy system (TABS), clean gulf conference and exhibition, on-line vessel database, regulation review, oil spill prevention task, and the Texas oil spill planning and response toolkit (http://www.glo.state.tx.us/oilspill/).

Regulations of the Oil Spill Prevention and Response Act of 1991 is found in the Natural Resource Code Ch. 40; Texas Administrative Code 31 Ch. 19. It is the policy of the state to protect these natural resources and to restore, rehabilitate, replace, and/or acquire the equivalent of these natural resources with all deliberate speed when they have been damaged. It is the intent of the legislature that natural resource damage assessment methodologies be developed for the purpose of reasonably valuing the natural resources of the State of Texas in the event of an oil spill and that the state recover monetary damages or have actions commenced by the spiller as early as possible to expedite the restoration, rehabilitation, and/or replacement of injured natural resources. The OSPRA contains statutes regarding the following:

§ 40.001. Short Title
§ 40.002. Policy
§ 40.003. Definitions
§ 40.004. Administration of Oil Spill Response and Cleanup
§ 40.005. Administration of Hazardous Substance Spill Response and
§ 40.006. Interagency Council
§ 40.007. General Powers and Duties
§ 40.008. Railroad Commission Authority
§ 40.051. Notification
§ 40.052. Hazardous Substances Discharges
§ 40.053. State Coastal Discharge Contingency Plan
§ 40.101. Notification and Response
§ 40.102. Response Coordination
§ 40.103. Assistance and Compensation
§ 40.104. Qualified Immunity for Response Actions
§ 40.105. Equipment and Personnel
§ 40.106. Refusal to Cooperate
§ 40.107. Natural Resources Damages
§ 40.108. Derelict Vessels and Structures
§ 40.109. Registration of Terminal Facilities
§ 40.110. General Terms
§ 40.111. Information
§ 40.112. Issuance
§ 40.113. Suspension
§ 40.114. Contingency Plans for Vessels
§ 40.115. Entry into Port
§ 40.116. Audits, Inspections, and Drills
§ 40.117. Regulations
§ 40.151. Coastal Protection Fund
§ 40.152. Use of Fund
§ 40.153. Reimbursement of Fund
§ 40.154. Coastal Protection Fee; Administrative Costs
§ 40.155. Determination of Fee
§ 40.156. Administration of Fee
§ 40.157. Liability of the Fund
§ 40.158. Exceptions to Liability
§ 40.159. Claims From Discharges of Oil
§ 40.160. Payment of Awards
§ 40.161. Reimbursement of Fund
§ 40.162. Awards Exceeding Fund
§ 40.201. Financial Responsibility
§ 40.202. Response Costs and Damages Liability
§ 40.203. Liability for Natural Resources Damages
§ 40.204. Defenses
§ 40.205. Third Parties
§ 40.251. Penalties
§ 40.252. Administrative Penalties
§ 40.253. Cumulative Enforcement
§ 40.254. Orders and Hearings
§ 40.255. Actions
§ 40.256. Individual Cause of Action
§ 40.257. Venue
§ 40.258. Federal Law
§ 40.301. Interstate Compacts
§ 40.302. Institutions of Higher Education
§ 40.303. Oil Spill Oversight Council
§ 40.304. Small Spill Education Program

Oil and Gas Effects on the Marine Environment

Oil and gas activities can affect the marine and terrestrial environment. Disturbances can be caused by drill cuttings, drilling muds, produced water, physical disturbance, and oil spills. Drill cuttings are crustal materials brought to the surface during drilling, and can contain heavy metals. Drilling muds have two purposes, 1) to carry small bits of rock (cuttings) from the drilling process to the surface so they can be removed, and 2) to equalize pressure and prevent water or other fluids in underground formations from flowing into the wellbore during drilling. Water-based drilling mud is composed primarily of clay, water, and small amounts of chemical additives to address particular subsurface conditions that may be encountered. In deep wells, oil-based drilling mud is used because water-based mud cannot stand up to the higher temperatures and conditions encountered. The petroleum industry has developed technologies to minimize the environmental effects of the drilling fluids it uses, recycling as much as possible (Society of Petroleum Engineers, http://www.spe.org). The disposal oil-based drilling muds in Texas estuarine or offshore zones has been banned since 1969 (TAC, Title 16, Part 1, Ch 3, Rule §3.8(e)). Water-based drill muds have been shown to be relatively benign (Peterson et al. 1996).

Produced water is formation water that is brought to the surface during oil and gas production, and these waters usually contain elevated concentrations of salts and hydrocarbons (NRC 2003). The ratio of produced water to oil normally increases with the age of the well (D'unger et al. 1996). The effects of produced water in estuarine ecosystems is dependent upon the ecosystem. Shallow, turbid, confined systems with a high percentage of clay sediment such as Trinity Bay, Texas are more likely to have decreased diversity and species abundance near produced water outfalls (Armstrong et al. 1979). In a confined stream-like estuary at New Bayou, Texas, a depressed zone of macrobenthic populations extended from the produced water outfall 107 m downstream and 46 m upstream (Nance 1991). Sublethal effects from polyaromatic hydrocarbons (PAHs) were not found for sedimentary microbial and meiofaunal communities when exposed to high (sublethal) doses of PAHs from produced water (Carman et al. 1995). The amount of impact produced water has on estuarine ecosystems is dependent upon the ecosystem's characteristics. Produced water discharges can be toxic to organisms and decrease species abundance, however, current regulations in Texas state that produced waters must meet surface water quality standards adopted by the TCEQ prior to disposal. The amount of oil content in produced water has decreased in Texas and throughout the world (Table 24). The majority of studies that have shown a decrease in diversity and species abundance from produced waters occurred before the present day regulations were initiated.

Table 24. Estimates of oil discharges to the marine environment from produced water discharges (NCR 2003).

	Produced Water (1,000 bbl/yr)		Oil and Grease Discharge (tonnes/yr)	
Country	1979	1990	1979	1990
USA	311300	745000	2228	2500
Gulf of Mexico Offshore		473000		1700
Louisiana Territorial Seas		186000		600
Texas Territorial Seas		4300		4.5
UK	57400	1620000	486	5700
Norway		450000		2000
Netherlands		74200		230

Physical disturbance is another potential impact created by oil and gas activities. Physical disturbance can be caused by pipeline, access road, and platform construction. Backfilling from pipeline construction is a remediation method and in salt marshes recovery of cordgrass can be rapid, but full recovery of marsh macrofauna is slow and may take longer than four years (Knott et al. 1997). A study conducted on the Padre Island National Seashore documented vegetation recovery was incomplete after extraction operations (Carls et al. 1990). The slow recovery was primarily due to hard surfacing of sites (with oyster and caliche) and the alteration of site elevation. Drilling activities adjacent to Pelican Island in Galveston Bay caused a decrease in bird abundance during drilling 1983 - 1985, but abundance increased in the next breeding season after drilling activities ceased (Mueller and Glass 1988).

Oil spills are another disturbance that can occur with the presence of wells and pipelines. From 1990-1999 forty-eight spills were recorded in the U.S. from coastal pipelines transporting refined products (NRC 2003). Crude oil induced spills had minimal to no effect on marsh macrophytes, macrofauna and meiofauna in Louisiana (Fleeger and Chandler 1983, DeLaune et al. 1984). Diesel fuel induced spills can cause reduced meiofaunal grazing and increased microalgal biomass, which was due to the reduced grazing (Carman et al. 1997). In the event of an oil spill, the GLO has adopted regulations pursuant to the Oil Spill Prevention and Response Act (OSPRA). Since 1998 a total of 55.35 barrels of oil have been spilled in the waters of Aransas County (Table 25), and 74% of those spills were under 0.1 barrels. A relevantly large spill of 28.57 barrels occurred in Redfish Bay during 2002 from a vessel from Brown Water Towing. Although the majority of the spill sources are unknown, 31% of the spills in Aransas County were from vessels, and 5% were from facilities (mostly fishing related). Oil spill statistics for Aransas County were obtain from Ms. Peggy Spies at the GLO.

Table 25. Total amount of oil spilled per water body in Aransas County from 1998 through 2003.

Water Body	Oil (Bbl)
Aransas Bay	19.74
Copano Bay	0.72
Gulf of Mexico	0.13
Harbor Island	0.1
Little Bay	0.06
Redfish Bay	34.6
Total in Aransas County	55.35

There is an existing network of pipelines that transport oil and natural gas from wells to onshore facilities. There are two types of pipelines used in this transport. Gathering pipelines from individual wells feed into larger, main pipelines, which then transport the oil and natural gas to onshore collection sites. The onshore collection sites then distribute or store the oil and gas. Future activity of oil and gas may increase the number of pipelines to the existing network; however it is practice that whenever possible existing pipelines are used to prevent disturbance and minimize cost.

The overall effects of oil and gas on the marine and terrestrial environment appear to be minimal. Disturbance from produced water, drill muds, and drill cuttings are not significant factors because of present day regulations that prohibit and restrict these activities. Research offshore has shown that pollution due to current practices is so low that it is only detectable within 100-200 m of a platform (Montagna and Harper 1996, Kennicutt et al. 1996). The pollutant effects are indistinguishable from artificial reef effects (Montagna et al. 2002). The impacts of oil and gas on the terrestrial ecosystem are restricted to physical disturbance, especially to the beach ecosystem. Remediation of all physical disturbance from oil and gas activities is required by the CMP and can be achieved by methods such as backfilling, revegetation, fertilization, and construction of nesting sites. The OSPRA and the other regulations in place for the Texas Coast ensure that the effects of oil and gas on the marine environment will continue to be minimal.

Current Activities in Texas Bays

Estuaries along the Gulf of Mexico, including Texas, are rich in oil and gas deposits. Every estuary in the Western Gulf of Mexico Biogeographic Sub-region has oil and gas wells and pipelines. Much of the past production in the Mission-Aransas Estuary has been depleted. However, recent testing indicates that there is interest in deeper exploration and drilling in the area. As drilling technology continues to improves, deeper and deeper depths become prospective. Exactly where deeper drilling would be focused is impossible to tell before additional seismic data is obtained. In addition, the Texas coast has seen “waves” of seismic exploration. It is likely that there will be additional activity (seismic surveying, drilling, and production) in the future. Seismic operations are conducted in an area, and at a later date, when technology has improved the area is investigated with the new technology. There is no reason to believe that the future of seismic exploration will be any

different from the past in terms of repeated " waves" of investigation. If so, the proposed site will most likely be investigated again.

Currently, the Mission-Aransas Estuary has a low number of current leases (Figure 19, Table 26) and little production in comparison to all other estuaries along the Texas coast (Table 27). In fact, the Mission-Aransas estuary has the second lowest number of leases, and Aransas county has the second lowest production rates in comparison to all Texas coastal counties. The low activity of oil and gas in the Mission-Aransas Estuary, along with the representativeness and minimal human populations, makes this estuary an ideal NERR site for the Western Gulf of Mexico Biogeographic Sub-region.

Figure 19. Current state tracts that are leased within the proposed boundary.

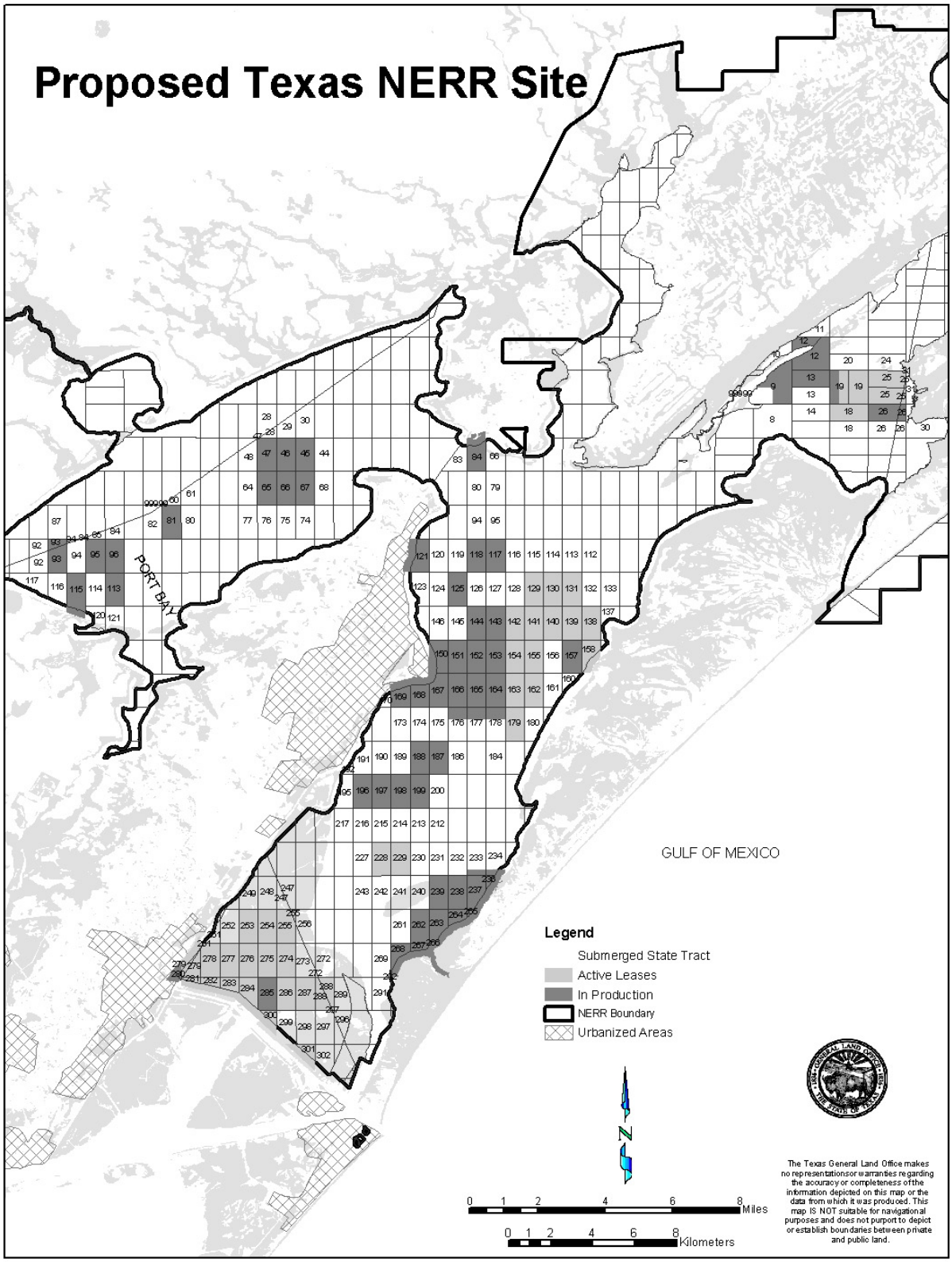
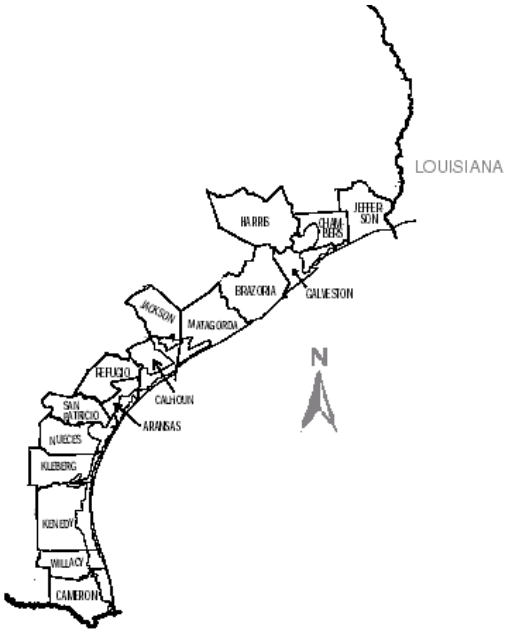


Table 26. Active and producing leases for estuaries along Texas Coast, listed northeast to southwest (http://www.glo.state.tx.us/energy/ellis/data/rpt_SLDBays.pdf).

Estuary	Number of Leases	Total Acreage of Leases
Trinity - San Jacinto	164	54343
Lavaca - Colorado	152	53218
Guadalupe	28	11477
Mission - Aransas	**51**	**13107**
Nueces	120	42247
Laguna Madre	141	56527

Table 27. Production for onshore oil and gas wells in coastal Texas counties (northeast to southwest) for 2003 January through March. Abbreviations: Bbl = barrel (42 U.S. gallons), and Mcf = thousand cubic feet (http://www.rrc.state.tx.us/interactive_data.html) (http://www.lib.utexas.edu/maps/texas.html).



County	Oil (Bbl)	Gas (Mcf)
Jefferson	320,054	4,979,071
Chambers	437,111	6,382,929
Harris	470,044	7,385,619
Galveston	401,796	4,115,603
Brazoria	664,753	10,369,609
Matagorda	490,838	7,794,979
Calhoun	128,533	1,841,479
Aransas	**82,947**	**1,797,844**
San Patricio	187,063	3,255,544
Nueces	454,073	16,184,647
Kleberg	421,811	11,325,294
Kenedy	132,702	12,624,768
Willacy	149,362	3,839,373
Cameron	148	270232

Past and Present Trends

The Texas coast stretches nearly 370 miles along the Gulf of Mexico. Along the coastline and far out into the waters of the Gulf of Mexico, geological formations produce oil and gas that have been continually surveyed by exploration companies. Despite a low record of offshore oil and gas production from areas along the Texas coast in the 1940s and 1950s, companies continued to conduct

exploratory drilling throughout the 1960s. In 1966, sixty-nine offshore wells were drilled in Texas, though only one produced oil and one gas. Oil and gas production in Texas and Aransas county has been on a steady decline, although the number of wells seem to be increasing (Figures 20 - 22). Subsequently, economic, social, and political life in the state changed greatly. The petroleum industry, more than one-quarter of the state's economy in 1981, fell to half that level ten years later. One-third of oil and gas employment was lost between 1982 and 1994. State and local governments found that lower income from production and property taxes necessitated austere budgets, and affected communities launched searches for new revenue and increased efforts to diversify their economies. The proportion of state government revenue from the petroleum industry declined to 7 percent in 1993, one-quarter of its level ten years earlier. In the final decade of the twentieth century, a great industry and the aspects of Texas life that were related to it were downsizing. In 1994, Jebco Seismic, Incorporated, and Petroleum Geo-Services contracted with various oil companies to conduct the first 3-D seismic survey within Texas coastal waters in search of gas and oil deposits (http://www.tsha.utexas.edu/handbook/online/articles/view/OO/doogz.html).

The first well drilled in the proposed site was in 1940. To date, there have been 649 oil and gas wells drilled in the proposed site. Of these wells drilled, only 315 have produced oil or gas and there are currently 40 active producing wells within the proposed site (Figure 23). Data was provided by Dr. Peter Boone, GLO.

Figure 20. Texas oil and gas production from 1972 through 2002. Abbreviations: Mbbl = million barrels (1 barrel = 42 U.S. gallons), and Mcf = thousand cubic feet (http://www.rrc.state.tx.us/divisions/og/information-data/oginfo.html).

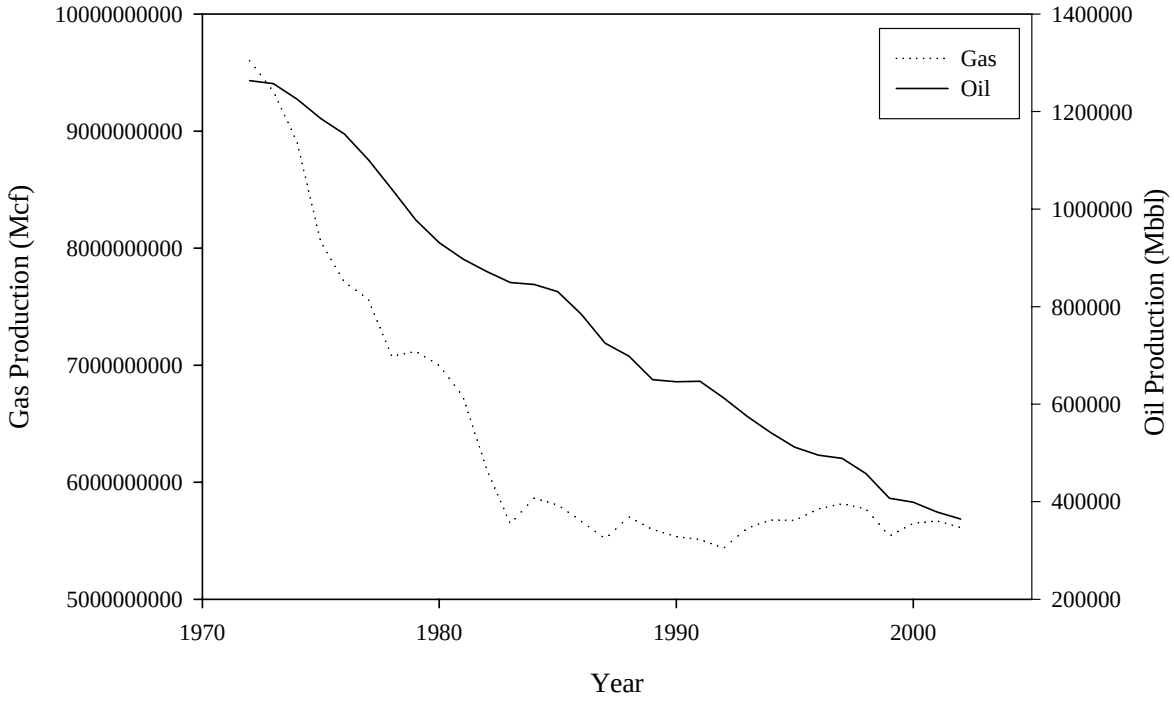


Figure 21. Aransas oil and gas production from 1993 through 2002 (http://www.rrc.state.tx.us/interactive_data.html).

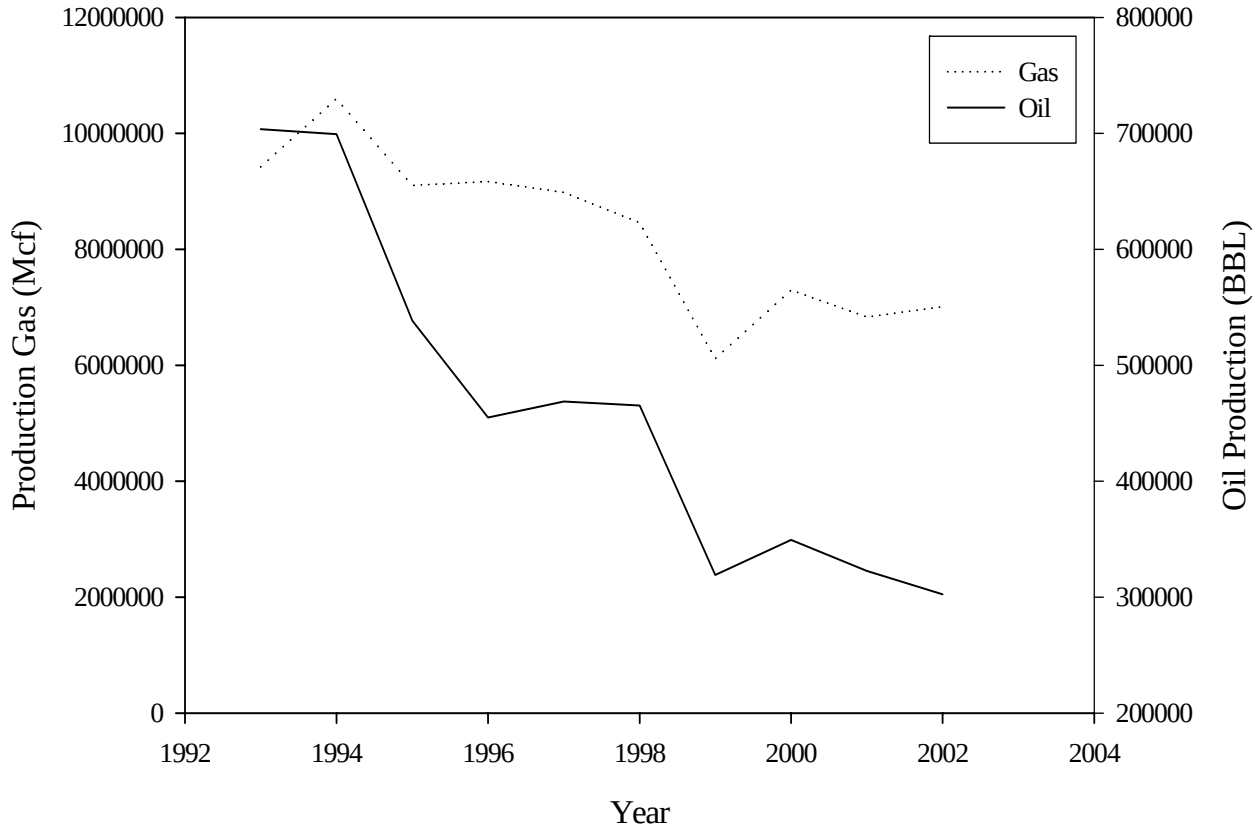


Figure 22. Number of wells drilled and produced per year in the proposed site.

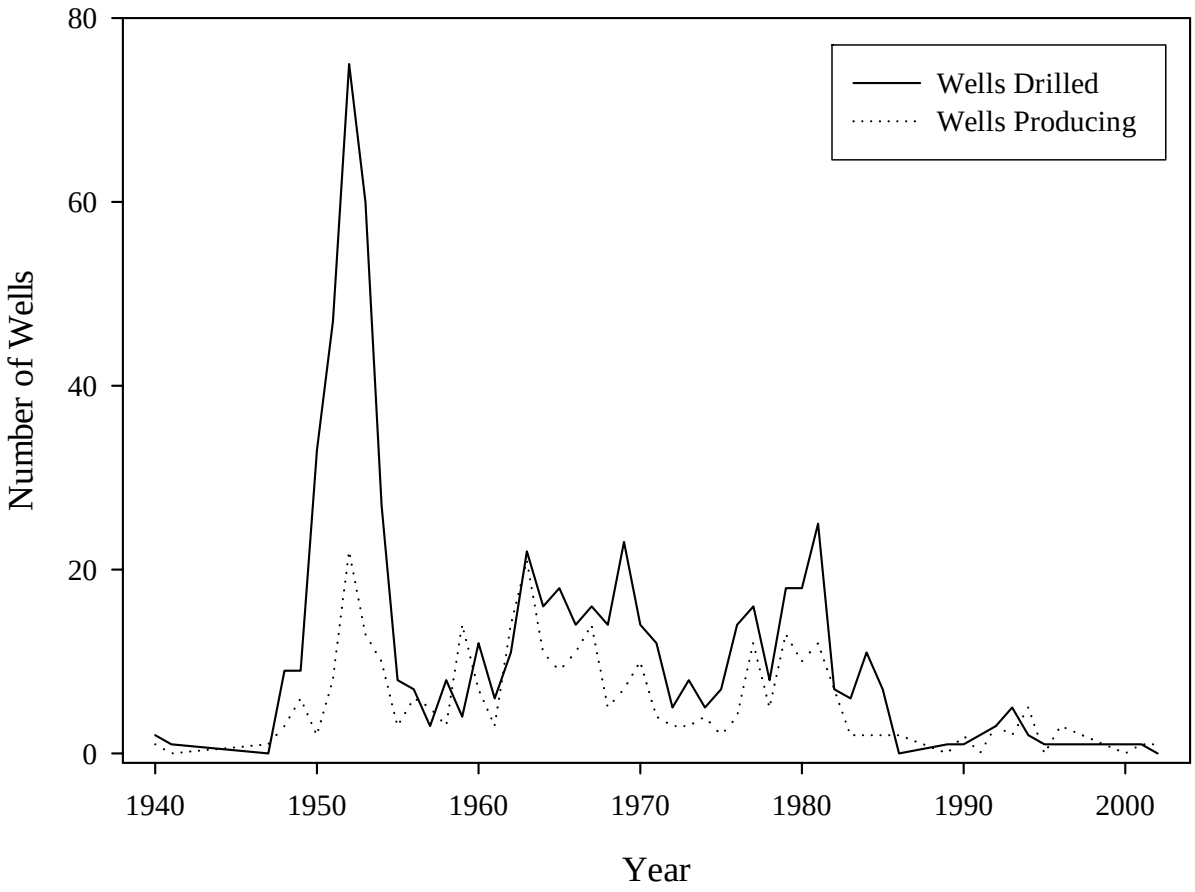
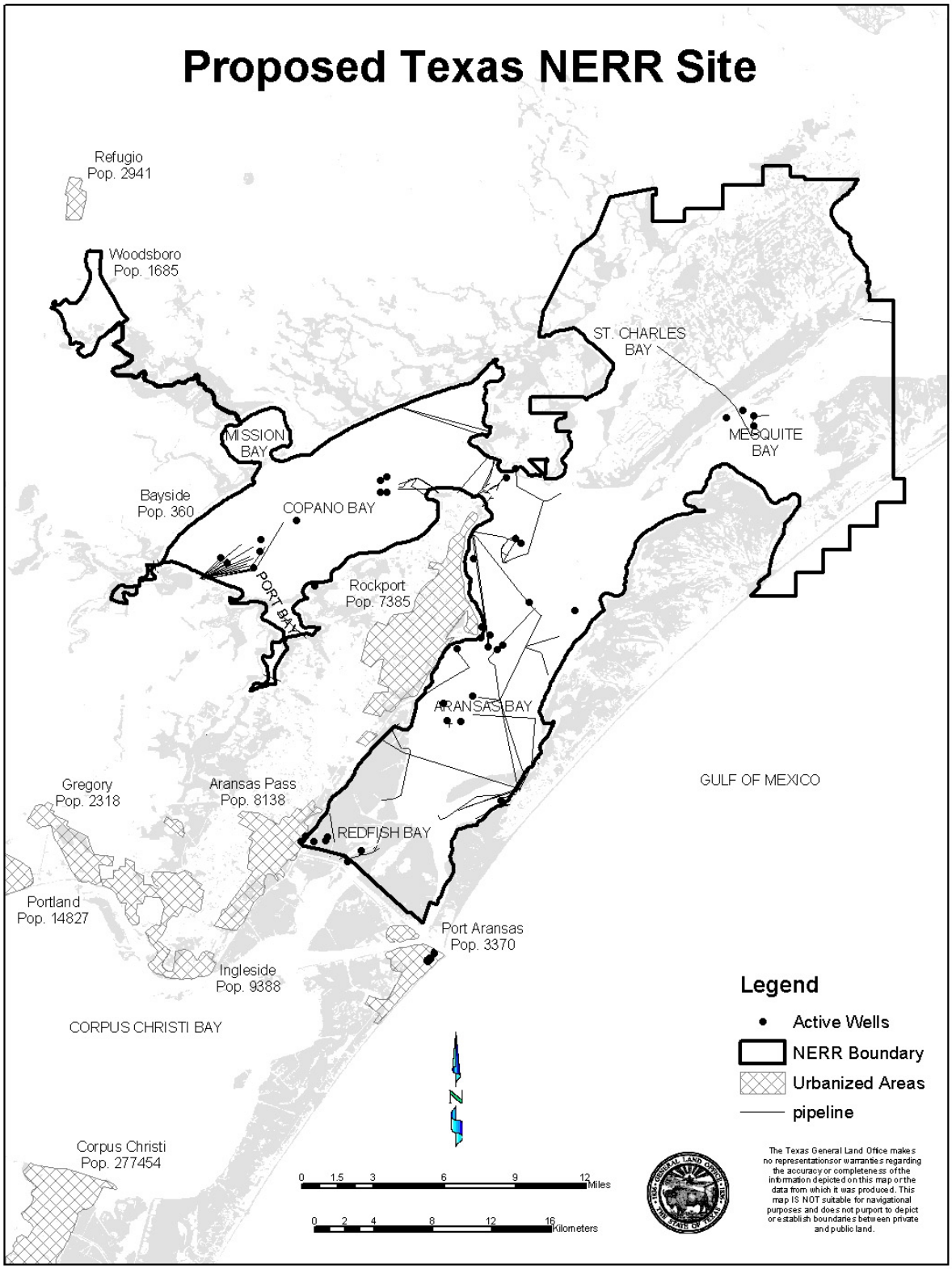


Figure 23. Pipelines and estimated active oil and gas wells in the proposed site. Map provided by GLO.



Recreational and Commercial Fishing

The habitats in the proposed NERR site support both commercial and recreational fisheries, including shrimp, crabs, oysters, and fin fish resources (Table 28). The life history strategies of these organisms are dependent upon estuarine-based life cycles. The estuary systems are nursery grounds for many of the commercially viable species, such as penaeid shrimp, in the Mission-Aransas estuary. It has been estimated that up to 97.5% of the commercial fisheries in the Gulf of Mexico rely on estuaries for a portion of their life histories (Gunter 1967).

Commercial landings of finfish, shrimp, and shellfish appear to be on an upward trend in the Mission-Aransas estuary (Figure 24). Abundance of finfish, shrimp, and blue crab harvests were nearly equal to each other from 1972 - 1976. After 1976, the percentage of finfish harvests began to decrease in relation to shrimp and blue crab harvests. After 1981, and up to the present time, shrimp harvests increased in relation to finfish and blue crab harvests, and are now the major fishery for the Mission/Aransas estuary (Robinson et al. 1994).

Commercial shrimping was a minor activity in the 1920's, but since then this fishery has grown rapidly. Brown shrimp (*Farfantepenaeus aztecus*), white shrimp (*Litopenaeus setiferus),* and pink shrimp (*Farfantepenaeus duorarum*), each are estuarine dependent species and usually concentrate in estuarine waters less than three feet deep where there is attached vegetation and or abundant detritus. For the shrimp fishery, a limited entry and buyback (license) management plan was established in 1995. Since implementation of the buyback plan TPWD had purchased and retired 815 commercial shrimp boat licenses (Cook 2002). Trawling can cause disturbance to benthic communities. The amount of disturbance is dependent on two factors: (1) time spent trawling (i.e. effort) and (2) the area covered per unit time (i.e. net size multiplied by towing speed) (Montagna et al. 1998). Schubel et al. (1979) reported high levels of suspended sediment concentrations behind shrimp trawls and found levels comparable to that caused by dredge disposal activities. Some possible impacts of trawling include increased mortality, predation, bioavailability of toxic contaminants, reduction of food, changes in community structure, and stimulation of phytoplankton production (Messeih et al. 1991).

In addition, recreational fishing is also pressure for the fisheries in the proposed NERR site. Annual coastal wide private-boat fishing pressure in the Mission-Aransas estuary has been increasing. Aransas Bay accounts for about 23% of the coastwide landings and pressure of party-boat fishing (Warren et al. 1994). Disturbance to seagrass beds from propellers, known as “prop scarring,” can also result from boating in shallow seagrass habitats. Twenty-three percent of the area in Redfish Bay has moderate to severe scarring (Montagna et al. 1998). Prop scarring can lead to loss of critical sea grass habitat.

Management regulations have become increasingly restrictive over time in an attempt to offset the commercial and recreational fishing pressures. In an attempt to increase species abundance, several fish species were designated as a game species and then banned against sale (Table 29). Other restrictions, such as time, area and gear type have also been enforced within the proposed NERR site (Table 30). Some areas of Redfish Bay are also designated as a Texas Scientific Area, which is regulated by the Texas Parks and Wildlife Department. Redfish Bay has three separate areas of voluntary no prop zones, which are set to deter high speed power boats, and

facilitate seagrass recovery as well as provide enhanced fishing opportunities in areas free of high speed motor boat traffic (Appendix 24). It is important to note that although recreational and commercial fishing exert pressures on the fisheries there are sufficient rules and regulations by state agencies to maintain a sustainable yield and manage the fisheries present in the proposed site. In most cases, stocks and catches are higher today than they were prior to 1975 (Figure 24).

Figure 24. Commercial fishing trends in Mission-Aransas Estuary from 1974 through 1998. Data obtained from TPWD.

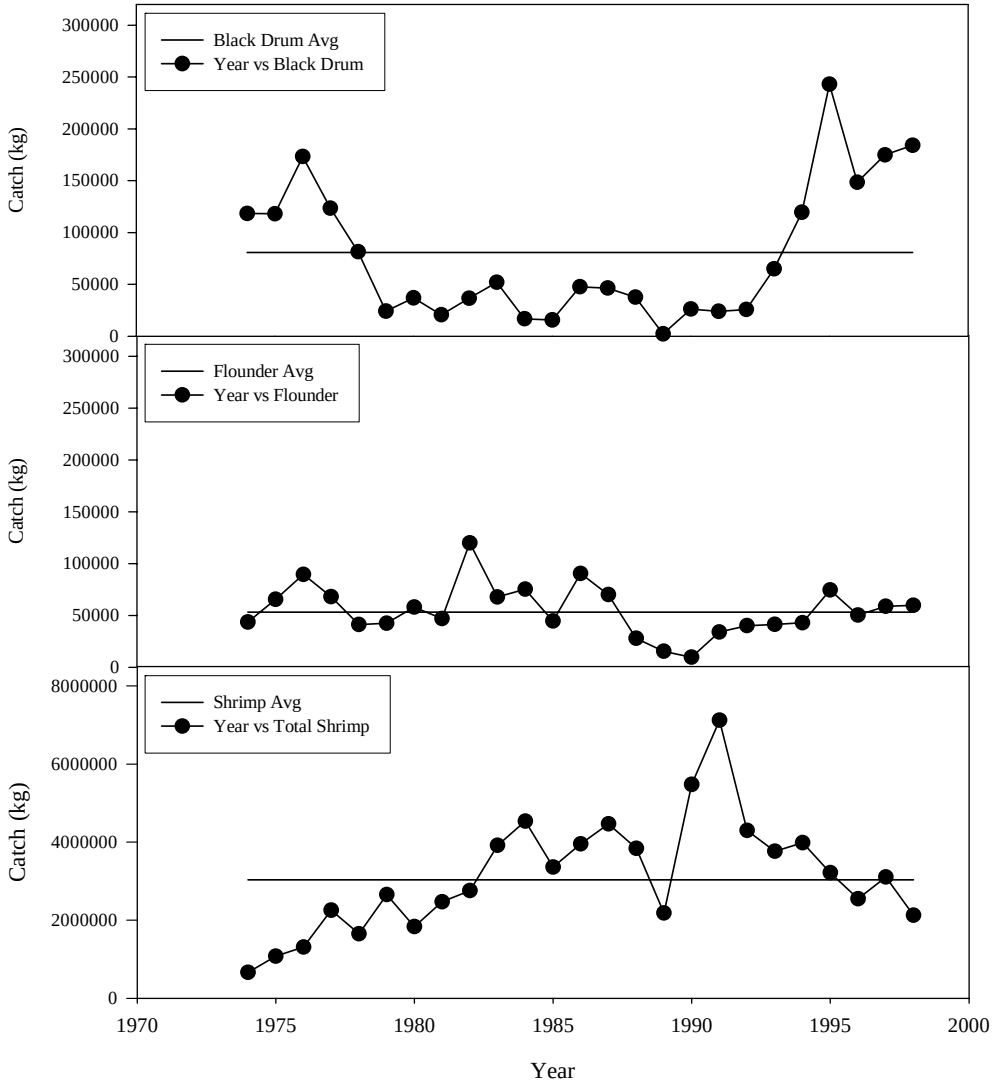


Table 28. Mean catch rates and mean total lengths (mm) of selected fishes and blue crab caught in bay system during 1992 for commercial use. Mean catch rates are No./h for seasonal gill nets, trawls and dredge; annual bag seines are in No./ha. ND indicates no measurement taken. Table is adapted from Boyd et al. (1995).

		Aransas		Coast wide	
Species	Gear	Mean catch	Length	Mean catch	Length
Total Finfish	gill net (spring)	7.1	412	7	414
Total Finfish	gill net (fall)	6.2	419	5.4	389
Total Finfish	18.3m bag seine	2622	57	4188	54
Total Finfish	6.1m trawl	443	97	281	111
Blue Crab	gill net (spring)	0.1	142	0.1	147
Blue Crab	gill net (fall)	0.1	140	0.1	144
Blue Crab	18.3m bag seine	140	34	103	37
Blue Crab	6.1m trawl	38	56	24	65
Brown Shrimp	18.3m bag seine	455	62	565	57
Brown Shrimp	6.1m trawl	64	81	37	84
Pink Shrimp	18.3m bag seine	32	53	38	57
Pink Shrimp	6.1m trawl	7	77	3	89
White Shrimp	18.3m bag seine	211	71	383	58
White Shrimp	6.1m trawl	53	93	36	94
Market Oyster	46 cm dredge	40	83	384	87

Table 29. Size restrictions for commercial finfish fishery in the proposed NERR site, listed as minimum, maximum sizes in inches (*no limit) (Tunnell et al. 1996).

Species	1970	1980	1981[1]	1988
Red Drum	14, 35	Game Fish	No Sale	
Spotted Seatrout	12, *	Game Fish	No Sale	
Flounder	12, *			
Sheepshead	9, *			12, *
Gafftopsail catfish	11, *			
Black Drum				14, 30
Snook		Game Fish	No Sale	
Tarpon		Game Fish	No Sale	

[1] Sale banned as of May 1981.

Table 30. Time, area and gear restrictions on commercial harvest of finfish in the proposed NERR site. Table is adapted from Tunnell et al. (1996).

Effective Date	Regulation
11/1977	Nets and trotlines prohibited on weekends (1 pm Fridays to 1 pm Sundays)
12/1979	Fish taken incidental to shrimp harvest may be retained EXCEPT red drum and spotted seatrout caught in inside waters with a trawl between 16 Dec. and 28 Feb.
7/1980	Monofilament nets banned
9/1980	Gill nets banned in state waters of Gulf
10/1980	Trammel nets, gill nets and drag seines prohibited in waters of Port Bay, St. Charles Bay, and Aransas County portions of Copano and Redfish Bays. All remaining waters of Aransas County closed to gill nets.
5/1981	Commercial sale of red drum and spotted sea trout prohibited
9/1982	Illegal to keep red drum or spotted seatrout caught in any net except a dip net
9/1982	Illegal to retain red drum or spotted seatrout caught in trotline other than a sail line
9/1988	Gill nets, trammel nets and bag seines banned in Texas coastal waters
3/1991	Summer trotline ban is repealed

Water Uses and Freshwater Inflow

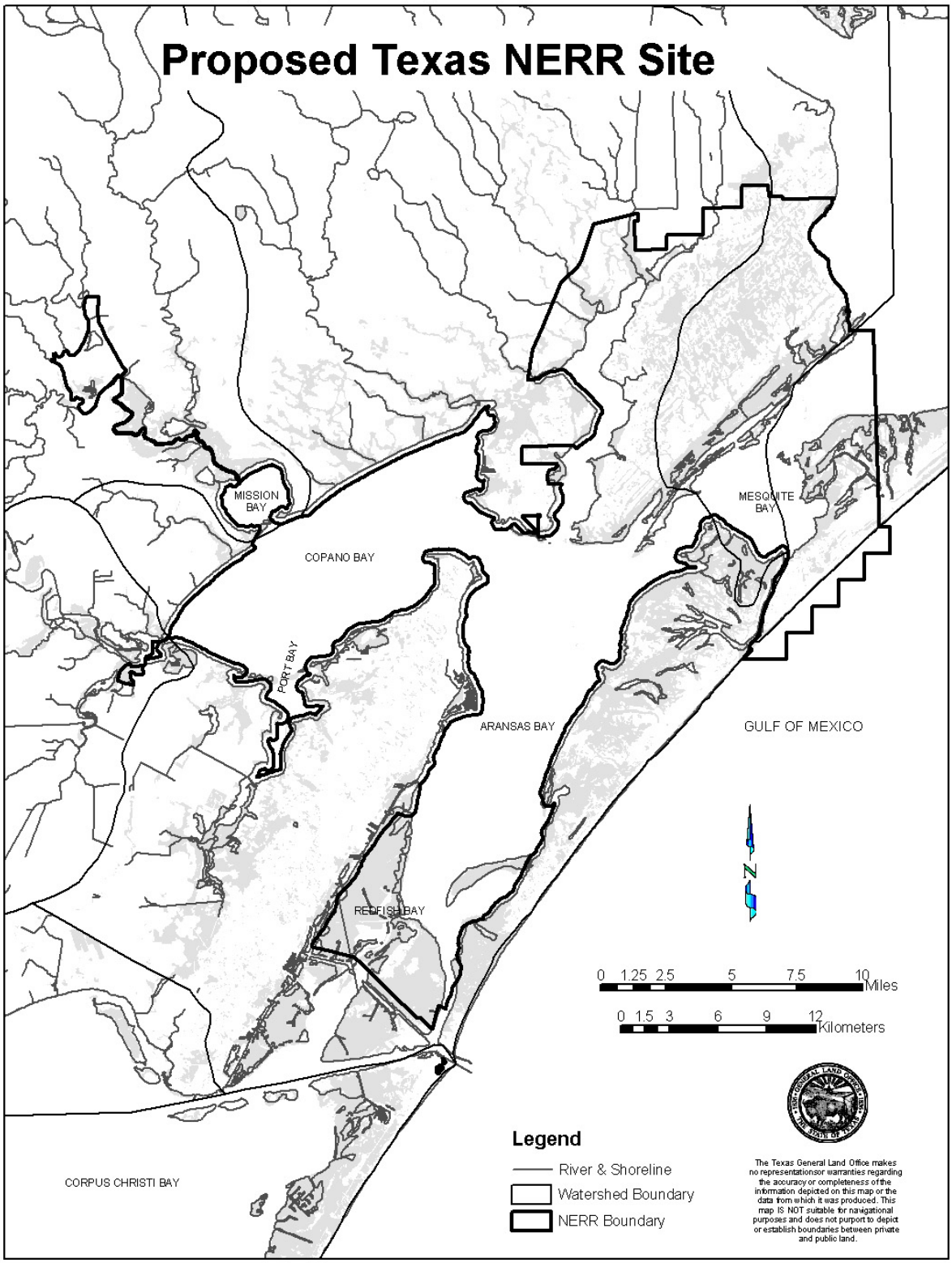
There are several small watersheds in the proposed NERR site (Figure 25). Most of these watersheds drain into Copano Bay, but one drains into Port Bay and one drains into St. Charles Bay. The Mission and Aransas Rivers are small and primarily coastal compared to other rivers in Texas. Texas law (first passed in 1957) ensures that sufficient flows are maintained for "receiving bay and estuary system that is necessary for the maintenance of productivity of economically important and ecologically characteristic sport or commercial fish and shellfish species and estuarine life upon which such fish and shellfish are dependent" (Texas Water Code, § 11.147).

About 40% of all the water used in Texas is supplied by surface water structures. The cities and towns in the region of the Mission-Aransas Estuary are largely served by the City of Corpus Christi and ground water (well-water) systems. The City operates two dams on the Nueces River, and is the major water wholesaler to municipal and county water resellers. Neither the Mission River nor the Aransas River has dams, or is used as water supplies for cities in the region. In fact, all the other major rivers in Texas have dams or other surface water supply structures. For this reason, the Mission-Aransas Estuary is an ideal location for the proposed Texas NERR.

Groundwater supplies 60% of the water used in Texas, but 81% of that use is for irrigation. The watersheds lie above the vast Gulf Coast Aquifer, which stretches the length of the entire coastal plain of Texas. The Gulf Coast Aquifer represents 15% of the groundwater in Texas and is the second largest aquifer after the Ogallala. Groundwater conservation districts are just in the beginning phases of operation in this region.

The proposed NERR site is in water planning district N, the Coastal Bend Region (TWDB 2002). There are no new reservoirs planned for this region through 2050, but several small desalination projects are planned. Groundwater development will be controlled through the operation of the groundwater conservation districts.

Figure 25. Watersheds of proposed NERR site. Map provided by GLO.



Transportation

Marine Navigation

The Gulf Intracoastal Waterway is a major industrial water transportation canal that bisects Aransas Bay within the proposed site. The waterway was first dredged in 1905 and is approximately 125 feet wide by 12 feet deep and links seaports along the Northern Gulf of Mexico. The easement for the waterway is 300 feet and there is additionally 2000 feet of easement within the NERR site for dredge material disposal (Texas Governmental Code, Sec. 2204.601). The waterway serves many uses, such as a commercial trade link, national defense, and protective passage for recreational and working vessels (TxDOT 1996). It is economically imperative to the Texas Coast because it facilitates transporting petrochemicals and agricultural as well as industrial products that would otherwise be too costly or impossible transport by road. In 1994, over 78 million short tons were moved on the Texas waterway, which values up to twenty-two billion in revenue (TxDOT 1996). The US Army Corps of Engineers must annually dredge 8 million cubic yards of shoaled material to maintain the waterway (TxDOT 1996).

Maintaining the navigation channels through Texas' shallow bays systems plus vessel use creates localized impacts to the ecosystem, within 1000 feet of the channel (Scot Sullivan TxDOT, personnel communication). In areas with hard-bottom substrate, dredging has been shown to have detrimental effects to the benthos. However, a five year study conducted in soft-bottomed Corpus Christi Bay concluded that the present benthic communities have a high resilience to disturbance by dredging and trawling (Flint and Younk 1983). This resilience is likely because of a large source of colonist species.

Natural and dredged spoil islands are present in the proposed NERR site. The majority of the dredged spoil islands run along the west of the intracoastal, about 600 yards out, excluding Lydia Ann Channel. The section of the intracoastal waterway that extends along the ANWR shoreline contains the Dunham spoil island and levee to the east of the waterway. This spoil island was created to the east of the waterway so as not to impede upon whooping crane habitat. In November 1995, in a section 216 feasibility study, the Corps of Engineers addressed the 30 mile reach of the waterway that is adjacent to the ANWR. In this study, the following items were addressed: 1) evaluation of possible realignment of the waterway, 2) identified beneficial uses of dredged material, and 3) generated a plan for reducing the bank erosion along the ANWR (TxDOT 1996). Although habitat loss is caused by dredge spoil islands, these islands are also ideal nesting for several species of birds and usually contain plant communities of mesquite, salt cedar (*Tamarix* spp.), popinac (*Leucaena leucocephala*), granjeno (*Celtis laevigata*), and oleander (*Oleander* spp.) (Chaney et al. 1996). Besides the dredging of the intracoastal waterway additional dredging may occur from time to time to maintain the navigation channel to Goose Island State Park or to maintain other channels within the proposed NERR site (Mary Perez and Scot Sullivan TxDOT, personnel communication).

Although there are no future plans for dredging Cedar Bayou Pass, there is some local support for dredging Cedar Bayou Pass. This natural pass was dredged in September 1987 and closed around 1999. The dredging of Cedar Bayou was initiated by TPWD in effort to increase water flow, fish, shrimp and crab abundances, as well as increase the public utilization of the bayou as a recreational fishing area (Heffernan 1985).

Bridges and Runway Protection Zone

There are numerous state roadways throughout the NERR boundary. These roadways include state highways, farm to market roads, and park roads. Periodic maintenance of these facilities will be occurring (Table 31). In addition, a parcel of land (~ 2500'x1750') west of the Rockport/Fulton Airport that extends out into Copano Bay is designated as a runway protection zone. A map of the airport and protection zones are provided in Appendix 27.

Table 31. Future maintenance on state roadways within proposed boundary.

State Roadways	Future projects
State Highway 35 Copano Bay Causeway	Scheduled for replacement, some dredging may be required during construction
State Highway 35 parallel to the ANWR	Bridge replacement scheduled at Copano and Salt Creek Bridges
Farm Road 136 Bridge at Copano Bay	No projects scheduled
Farm Road 2678 Mission River Bridge	No projects scheduled
State Highway 188 Copano Bay Bridge	Long term plans call for the bridge to be widened

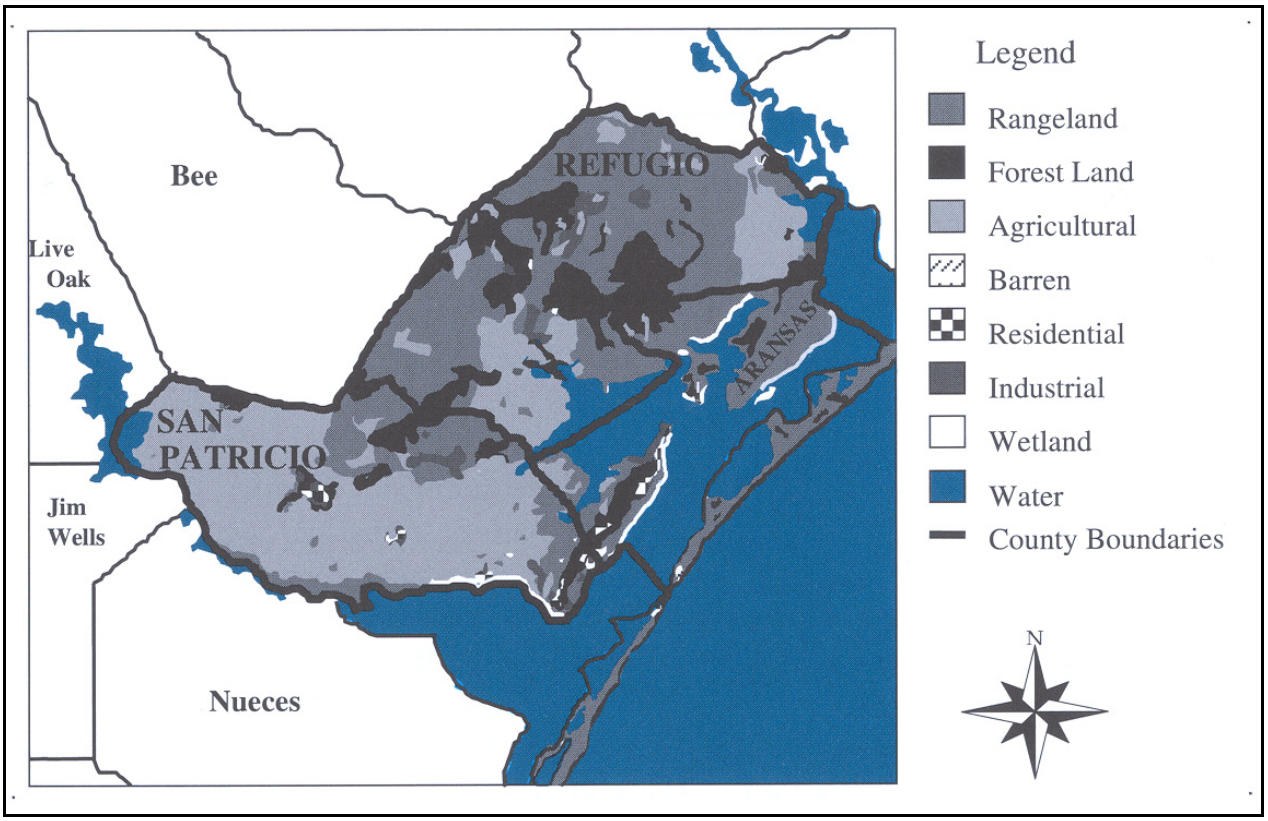
Adjacent Land Uses

Description of land use adjacent to the proposed NERR site is largely based on a wetland conservation plan by Smith and Dilworth (1999). The majority of the land surrounding the proposed site is used for agriculture and rangeland for cattle (Figure 26). Land use around the Mission-Aransas Estuary is divided into six categories: developed lands, cultivated lands, grasslands, woodlands, shrublands, and bare lands.

San Patricio County, which encompasses a very small portion of the site including Buccaneer Cove Preserve and the southern tip of Port Bay, has the highest percentage of cultivated lands followed by Refugio and Aransas County, respectively (Figure 27). The Aransas River watershed includes Chiltipin Creek and other unnamed tributaries which drain approximately two-thirds of San Patricio County including the cities of Sinton, Odem,and Taft. This drainage includes more than 250,000 acres of intensely managed cotton and grain sorghum row crop farms. Much of the Aransas River watershed lies within the land holdings of the Welder Wildlife Foundation (7,800 acres), whose primary purpose is wildlife management and conservation.

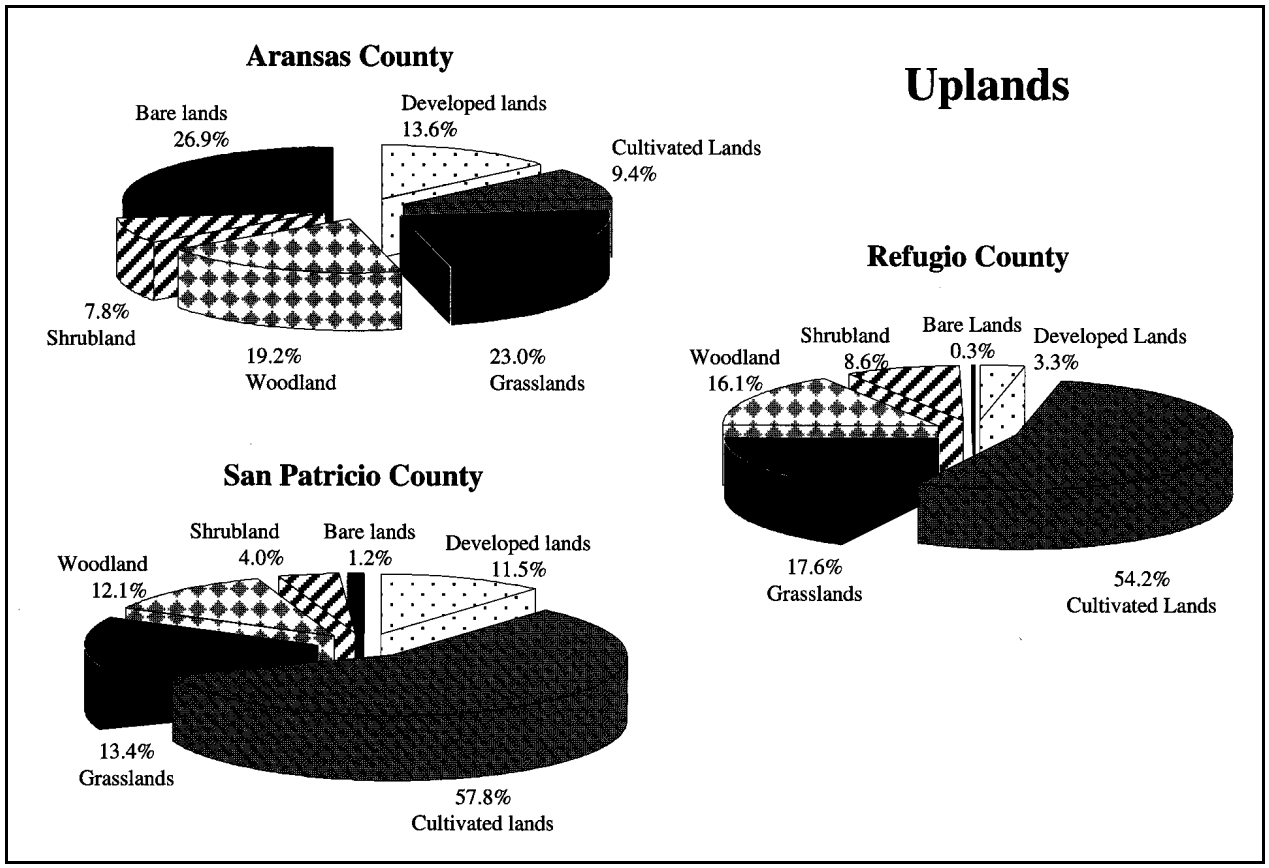
In contrast, Aransas County has the highest percentage of both bare lands and developed lands. Most bare lands in this area are delineated as bay shoreline beaches, creating a significant tourism focus in the county and extensive urban development. Refugio has the most rural land use of the three counties, with the majority of the land identified as agriculture or ranching: limited urban development is centered around the towns of Refugio, Woodsboro, Bayside, Tivoli, and Austwell.

Figure 26. Land uses adjacent to the proposed NERR site.



The city of Corpus Christi with a population of over 250,000 is the largest city in the area and as a result, the Nueces Estuary generally has more anthropogenic activities than the Mission-Aransas or Baffin Bay-Laguna Madre Estuary (Montagna et al. 1998). The Port of Corpus Christi is the sixth largest port in the United States, making marine transportation a dominant industry in the area. The Port of Corpus Christi houses several facilities including: liquid bulk docks, cargo terminals, Rincon Industrial Park, Ortiz Center, and a cold storage terminal. All ship traffic enters through the Aransas Pass, which lies just south of the proposed site.

Figure 27. Land uses of Aransas, Refugio and San Patricio Counties.



CORE AND BUFFER AREAS

A core area is comprised of key land and water areas that contains a full range of significant physical, chemical and biological factors contributing to the diversity of fauna, flora, and natural processes occurring within the estuary. A buffer area is within the NERR boundary and is currently or expected to have human use that may cause alteration to the habitat. These buffer zones will protect the core area and provide additional protection for estuarine dependent species. The finite boundaries of core and buffer areas will be addressed in the management plan. The core areas will be those areas with anticipated minimal human impacts, existing uses, and future uses. Any activities that might occur in core areas will not compromise or endanger the research objective of the reserve.

In general, it is anticipated that the core areas within the proposed site will include the submerged land key habitats for ecological functioning within Mission Bay, Carlos Bay, Ayers Bay, Gulf of Mexico, Mesquite Bay, St. Charles Bay (north of Indian Head Pt.), Aransas Bay (portion due north of Long Reef), Redfish Bay and Harbor Island marsh (east of Corpus Christi Bayou), Buccaneer Cove Preserve wetlands, and the area between San Jose Island and Mud Island (Figure 28). These areas will likely have minimal use by oil and gas activities (Table 32). The management plan will not contain any additional restrictions, only existing rules and regulations will be enforced. Existing rules are sufficient to protect potential core areas for the reserve objectives. Terrestrial and

marsh key habitats will likely include the Aransas National Wildlife Refuge, Matagorda National Wildlife Refuge, Johnson Ranch, Goose Island State Park, McGuill Lake and the freshwater wetlands within the Fennessey Ranch. These anticipated key habitats would be ideal core locations for ongoing research because not only are they sites of minimal impact, but the anticipated areas together contain all of the habitats which represent the western biogeographical region including: open bay water, salt marshes (Figure 8), brackish marshes, freshwater marshes, open water (Figure 7), oyster reefs (Figure 9), seagrass (Figure 11), coastal prairies, tidal flats (Figure 12), and mangroves (Figure 13). These habitats are essential to the functioning of the system.

The buffer areas will include areas within the NERR boundary that surround core areas. Buffer areas will have more human uses such as oil and gas activities or dredging, but these buffer areas will provide additional protection for the core areas.

The Gulf Intracoastal Waterway will be excluded from the boundary, because it will be dredged for maintenance in the future. The 2000 foot easement for disposal of dredge material will likely be included in the buffer area (Texas Governmental Code, Sec. 2204.601).

There are five fishing cabins that are currently leased and will be excluded from the boundary because they are in-holdings (Figure 29). Other areas that may be designated as buffers because of anticipated maintenance include the state roadways listed in table 31 and the runway protection zone (Appendix 27).

Figure 28. Names and locations of points of interest within the proposed NERR site. Map provided by GLO.

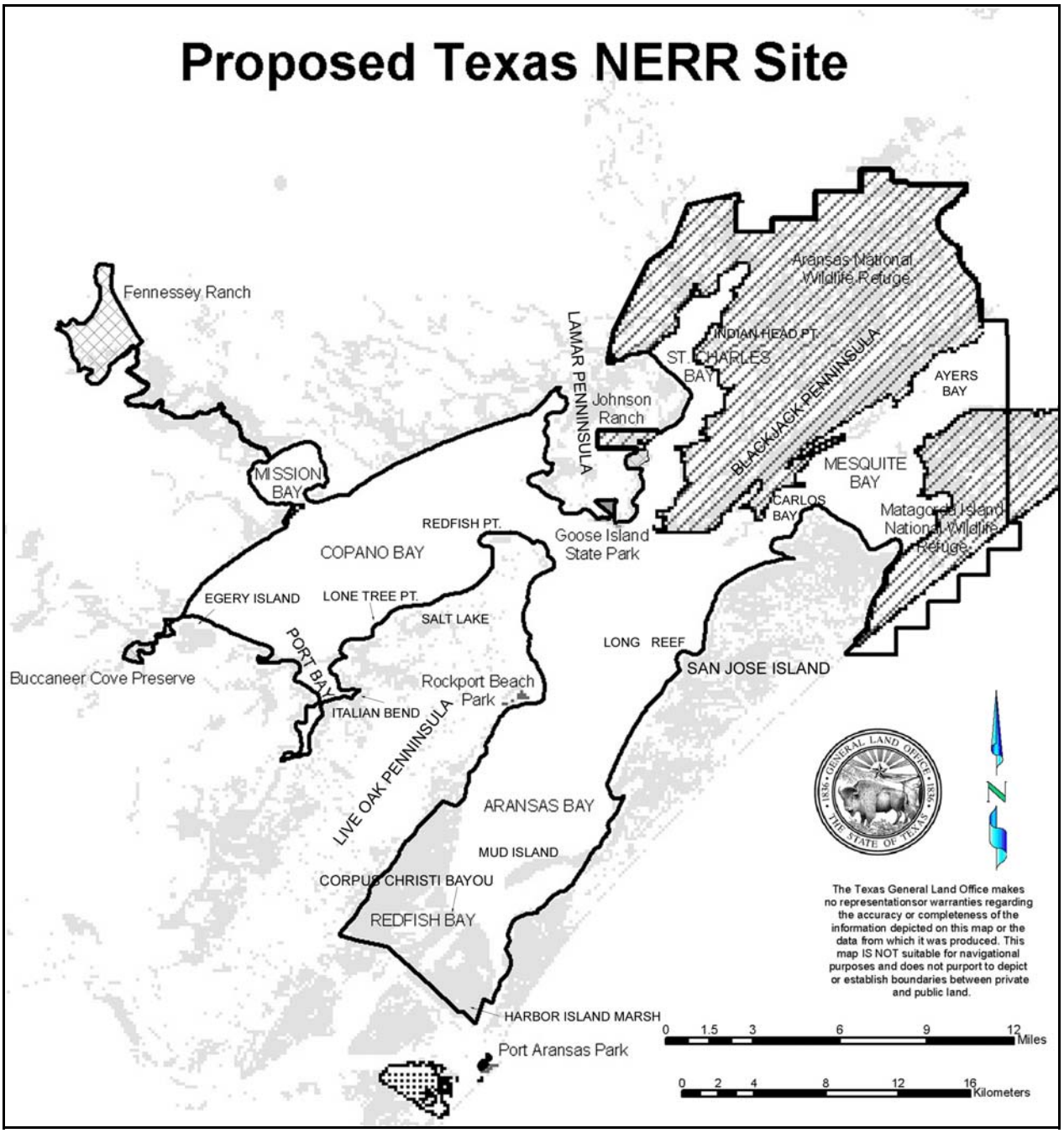
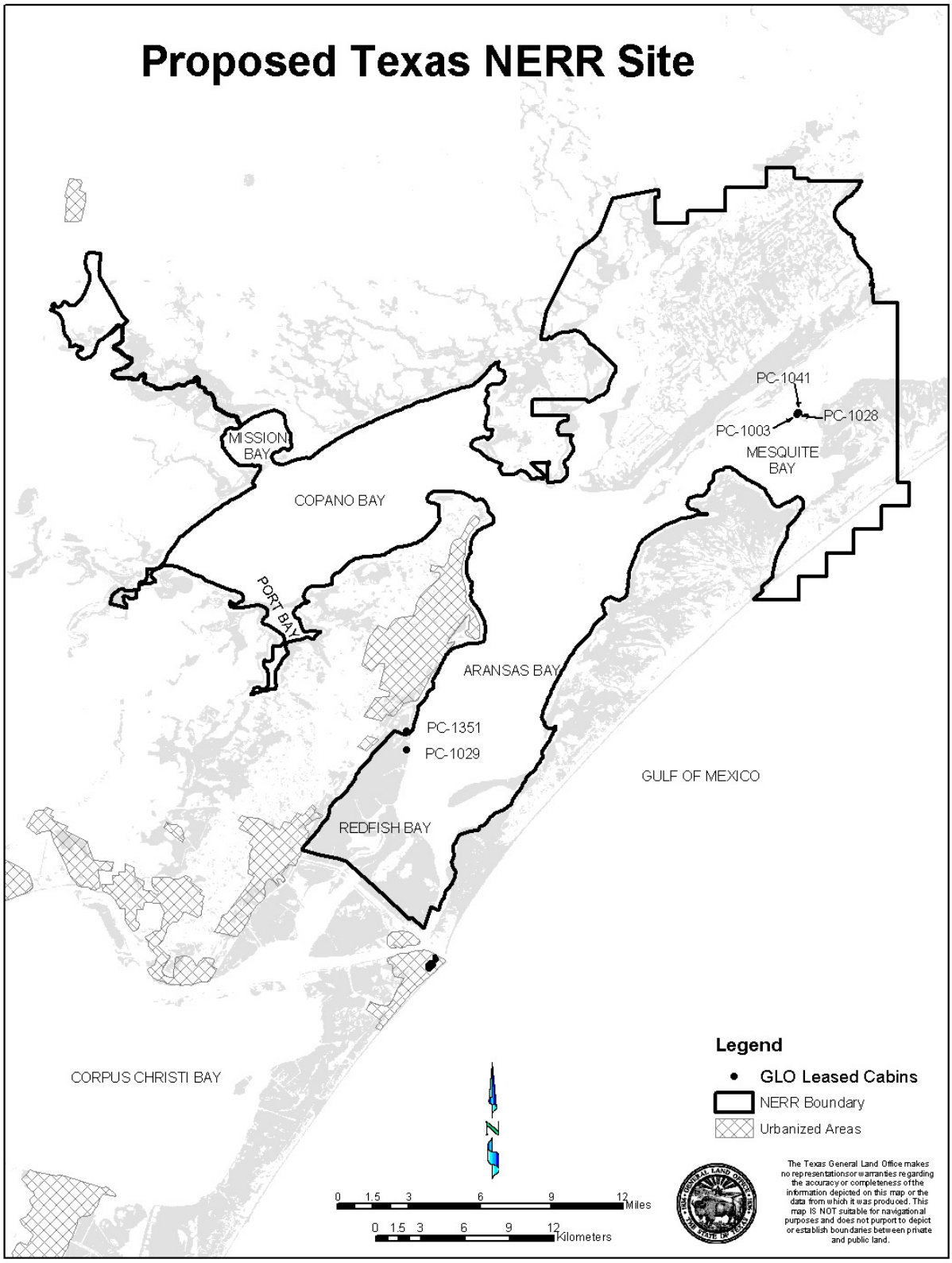


Table 32. Estimated status of oil and gas wells in anticipated core areas. Abbreviations: ACT= active oil or gas well, GAS= non active gas well, OIL= non active oil well, AGW= abandoned gas well, D&A= dry and abandoned well, INJ= injected well, T&A= temporarily abandoned. Data obtained from GLO.

Core Area	Tracts	ACT	GAS	OIL	AGW	D&A	INJ	T&A
Mission Bay	37627	0	0	0	0	0	0	0
Ayers Bay	22, 23, 32-35, 48-54	0	1	0	0	6	0	0
Gulf of Mexico	750, 751, 761-763, 775	0	0	0	0	0	0	0
Mesquite Bay	14-18, 25-31	0	1	0	0	3	0	0
St. Charles Bay	354-388	0	4	3	0	19	0	1
Port Bay	1-4, 126-129	0	0	0	1	3	0	0
Aransas Bay (N of Long Reef)	6, 85-89, 103-111, 132-137	0	0	0	0	0	0	0
Aransas Bay (San Jose - Mud Island)	236-243, 259-269	2	5	0	1	7	0	0
Harbor Island Marsh	270-273, 287-305	0	0	0	0	1	0	0
Redfish Bay	193-196, 217-220, 222-226, 245-257, 271-277	0	4	0	0	16	1	0
Buccaneer Cove Preserve	119	0	0	0	0	0	0	0
Total		2	15	3	2	55	1	1

Figure 29. Fishing cabins leased within the proposed boundary. Map provided by GLO.



CONFORMITY OF PROPOSED SITE WITH NERR PROGRAM GUIDING PRINCIPLES

Throughout the site selection process consideration was given to how each of the candidate sites would conform to the guiding principles for the NERR program, as described in 15 CFR 921.11(c) (Appendix 29). Many of these considerations are reflected in the site selection criteria developed for this effort. It seems important, however, to highlight how the final candidate site conforms to these guiding principles and, therefore, ultimately contributes to the national NERRS. Brief discussions of how the Texas site meets each of these principles are given below.

Site's Contribution to the Biogeographical and Typological Balance of the NERRS

As previously noted at the beginning of the final site selection criteria, any Texas NERR site would fall within a biogeographic subregion (Western Gulf of Mexico) that is not currently represented in the NERR program. This ecological representativeness factor is, therefore, automatically of high value to the National Program. Also as noted in the previous section, the Texas site constitutes a relatively intact and minimally disturbed watershed as well as being an excellent representative estuarine area with a high diversity of habitat types. The Mission-Aransas Estuary is the only site that is representative of the biogeographic subregion. This site is representative because it is the only area along the Texas coast that includes a primary bay, secondary bay, river, pass to the Gulf of Mexico, mangroves, mudflats, seagrasses, oysters, beaches, and coastal prairies. The latitude of the proposed site is particularly important to the representativeness because it encompasses the temperate range of mangroves in the north and seagrasses in the south of the proposed site. Thus, the Mission-Aransas Estuary is the only Texas estuary with all representative habitats contained in an ecologically contiguous unit.

Site's Ecological Characteristics and Degree of Human Influence

The Texas site's ecological characteristics include a high degree of estuarine habitat, diversity (along broad gradients of salinity and elevation), and unique geologic and hydrological features that make it a site that will attractive a broad range of research interests from multiple scientific disciplines. The Texas site has great potential for addressing both pure and applied (i.e., coastal management) research issues, despite a minimal amount of previous research.

The Texas site is and will be minimally affected by human activity or influence. Potential water quality impacts from the area are minimal, due to the low population and minimal industrial development. The population density is small from 0 to 49 persons per square mile around Aransas Bay (NOAA 1990). Population density in the 2000 census was 22,497 for Aransas County and 7,828 for Refugio County. This represents a 1% decline in the population of Refugio County since 1990, and a 26% increase in Aransas County. Industrial land use is characterized by agricultural and ranching activities with only minor areas of irrigated crops (Armstrong 1987).

Adequacy of Site's Boundaries and Control Over Human Activities

The site's boundaries (Figure 5) encompass a relatively large portion of two national wildlife refuges that include both estuarine and adjacent non-estuarine areas. As such the site's size will ensure an adequate level of conservation and management. Because of the relatively rural nature of the site, it will also be possible to maintain adequate levels of control over human access and activities within its borders.

Although preliminary, it is anticipated that the division of the site into key land and water areas (or "core areas") and buffer zones will be made based upon major habitat types and use patterns. The key estuarine intertidal, shallow open-water, and coastal plain portions of the site will make up the bulk of the core area, and as such, will include the full range of estuarine habitats and terrestrial habitats.

Site's Suitability for Long-Term Estuarine Research

The abundance of previous research along with the high diversity and quality of estuarine and non-estuarine habitats and resources found in the proposed boundary make this site and excellent location for the establishment of long-term estuarine research in a number of disciplines. Many of the estuarine habitat types are of high quality and have been minimally impacted by human activities, making them prime candidates as local and regional reference sites. The presence of such a large number of estuarine habitat types falling along gradients of salinity adds to the attractiveness of the site for the establishment of long-term research projects. The protection and control of sites within the reserve would add to the site's value for both long and short-term research. The site is also within easy access from numerous local and regional research and educational institutions. As part of the national NERRS, the site would also be attractive as part of cross-regional comparative studies and as a destination for educational groups from throughout the country.

Site's Compatibility With Existing and Potential Land and Water Uses

The rural nature of the Texas site and the relatively minimal and compatible nature of the adjacent land and water use patterns adds to its value as a proposed NERR. As previously mentioned, the agricultural and ranching activities adjacent to the site pose minimal potential direct or indirect impacts. Historical and current uses of water resources, including the commercial and recreational harvest of shellfish and fish are compatible with likely allowable activities and management strategies of a future NERR. Although past oil and gas exploration was intense, the production has declined since 1970. Research is showing that there is little to no impacts due to current oil and gas activities, which indicate that existing rules and regulations on the oil and gas industry are protecting the environment. This protection ensures a stable platform for future NERR research and education activities. All of the current commercial, industrial, and recreational activities within the site are compatible with the existing Texas Coastal Management Plan. The objectives of the Aransas and Matagorda Island National Wildlife Refuges overlap those of the NERR's and are fully compatible.

Site's Importance to Education and Interpretation

The Texas site will provide excellent opportunities for educational and interpretive activities. The large diversity of habitat types, presence of key archaeological sites, and relatively close proximity of the site to both local public schools and institutions of higher learning make the site an attractive destination for both short and long-term educational visits. Easy access to public estuarine ecosystems has been cited as an important need by many of these programs. The education/outreach program to educate the public about the natural resources and their uses needs to be an integral part of the NERRs program. Education/outreach programs should incorporate oil and gas exploration and production, the petroleum industry and the contribution to the permanent school fund, ecotourism, fishing, and all other uses in the coastal environment that contribute to coastal economies. The proposed site should attract a broad range of educational interests. Currently, there exist a variety of science based education programs along the Texas coast, including some that target selected groups such as students (K-12), winter Texans, tourists, teachers, landowners, and the general public. The UTMSI already operates a model program in marine education and public outreach. Additional programs designed for local decision-makers would also logically benefit from the site.

TEXAS NERR PARTNERSHIPS, ADVISORS, CONTRIBUTORS/USERS

Proposed Management and Operational Partners

The UTMSI is the lead site selection agency and is the preferred management agency. Oversight of the land and water resources comprising the Texas NERR will be undertaken jointly by Texas agencies (GLO and TPWD), the federal government (USFWS), and private landowning partners. The State of Texas owns submerged lands covered by bay and estuarine waters. The Aransas National Wildlife Refuge (ANWR) and Matagorda Island National Wildlife Refuge (MNWR) are owned and operated by the USFWS. Private landholding partners include: Coastal Bend Land Trust (CBLT), The Nature Conservancy (TNC), Coastal Bend Bays and Estuary Program (CBBEP), and the Fennessey Ranch. All lands managed by GLO and SLB for the PSF will continue to be managed by GLO. State agencies with significant interest or management responsibility include the Texas Department of Transportation (TxDOT), Texas Water Development Board (TWDB), and the Texas Commission on Environmental Quality (TCEQ). Management of the Texas NERR will be provided by UTMSI with oversight from NOAA. A draft Memorandum of Understanding (MOU) between UTMSI and NOAA is provided in Appendix 30. Management roles will be fully explored and defined during development of the Draft Management Plan. It is anticipated that UTMSI will provide education, research, and stewardship coordination. In addition, local administrative partners include representatives of the Aransas County and the City of Rockport.

The issue of title holding will be addressed in the management plan. In general, it is anticipated that an MOU will be created between UTMSI and the Aransas and Matagorda Island National Refuges. It is also anticipated that a coastal lease for scientific purposes, which is authorized under the Texas Natural Resource Code (Ch 33.105(4)), will be created between UTMSI and GLO for the state submerged lands (open bays and estuaries) within the proposed site. This scientific lease will be for research and education purposes. Additionally, a conservation easement is anticipated between the CBLT, TNC, and the Fennessey Ranch and UTMSI for the corresponding property within the proposed site.

Advisory Board

The overall policies, activities, and programs of the NERR will be developed with input from an Advisory Board that will include representatives from each of the land owning and operational partners. The landowning members include a representative from USFWS, GLO, TPWD, CBBEP. CBLT, TNC, and Fennessey Ranch. In addition, a local government representative from Aransas County will be added to the Advisory Board. Details about membership on the Advisory Board (e.g., member groups, length of service, etc.) will be determined as part of the development of the Management Plan for the NERR. Input concerning the research and educational components of the NERR program may also be provided through either subcommittees of the advisory board or through separate advisory committees for each program.

Contributors/Users of the NERR

A wide range of potential contributors and users of the NERR were included in the membership of the SSC and SES and will benefit by the establishment of the NERR. Many of these groups may contribute to the establishment and operation of the site in any number of ways, some of which include: financial contributions, donations of materials and manpower, and loans of equipment. Some of these relationships may be established in a more formal way, perhaps through designations as "Friends of NERR" or through sponsor-specific programs (e.g., through local, regional, or national industry sponsors). A number of environmental groups, such as the Audubon Society, CBBEP, CBLT, or TNC may also choose to concentrate some of their efforts at the site, and in doing so contribute to some of the educational and monitoring programs at the NERR. Local schools and regional colleges and universities will be encouraged to use the site either on an occasional basis or through a more detailed cooperative relationship, that may include financial or in-kind contributions. A formal relationship between NERR and local school districts will be pursued. The program can include sharing resources and personnel in a similar fashion that occurs at other NERR sites. Such a relationship already exists at UTMSI with the Flour Bluff and Port Aransas Independent School Districts and is sponsored by the National Science Foundation.

Support for the Texas NERR Nomination

As a means of demonstrating the range and depth of support for the nomination of a Texas NERR, a request for letters of support for this nomination was distributed and resulted in the receipt of letters and resolutions (Appendix 31).

Environmental Impact Statement / Management Plan

Pursuant to the National Environmental Policy Act (NEPA) of 1969 (42 U.S.C. 4321 et seq.), an environmental impact statement (EIS) is required for the Texas NERR project. A management Plan (MP) is required by NOAA for operation of the NERR.

The draft Environmental Impact Statement (DEIS) and draft Management Plan (DMP) for the proposed Texas National Estuarine Research Reserve(TxNERR) program will be written as one combined document and called the draft Environmental Impact Statement and draft Management Plan (DEIS/DMP). Prior to writing the document a scoping meeting will be held to identify alternatives and issues to be included in the DEIS/DMP (Table 33).

After a public meeting and a 45-day comment period, a final EIS and final MP will be written that incorporates public input. The final EIS/MP is then submitted for final review and comment. Not less than 30 days after the publication of the U.S. Environmental Protection Agency's Notice of Availability of the final EISs, NOAA may issue a Record of Decision (ROD) documenting its decision concerning the proposed NERR.

The Texas General Land Office administers the Coastal Management Program in Texas and will provide oversight to ensure federal consistency requirements are met by the University of Texas.

The University will work closely with GLO because all or a portion of the site will more than likely reside on State lands administered by the GLO.

Table 33. The proposed time line for the DEIS/DMP.

Date	Activity
Jan 2004	Site Nomination Document Approved by NOAA
Feb 2004	Scoping meeting for DEIS/DMP
Jun 2004	Preliminary draft of DEIS/DMP complete
Aug 2004	NOAA review of preliminary DEIS/DMP
Sep 2004	Public distribution of DEIS/DMP. Notice of availability of DEIS/DMP
Nov 2004	45 day comment period for DEIS/DMP
Nov 2004	Public hearing on DEIS/DMP (30-45 days after Notice of availability)
Jan 2005	Final draft of DEIS/DMP incorporating responses to public comment
Feb 2005	NOAA review of final DEIS/DMP
Apr 2005	DEIS/DMP final, Start FEIS/FMP

DRAFT ENVIRONMENTAL IMPACT STATEMENT AND DRAFT MANAGEMENT PLAN OUTLINE

(Standard Outline Approved for Use by NOAA's Estuarine and Reserves Division)

The outline below provides a starting point for discussions on what issues and items should or should not be addressed in the DEIS/DMP. The sections that meet DEIS requirements are noted as "DEIS," and the sections which meet DMP requirements are noted as "DMP."

Cover Sheet (DEIS)

Summary
Table of Contents

1.0 Introduction (DMP)
- 1.1 The National Estuarine Research Reserve System
- 1.2 Proposed mission and goals of the Reserve

2.0 Purpose of and Need for Action (DEIS)
- 2.1 Explain who wants to do what; where how and when they want to do it; and why.
- 2.2 Explain any other documents that influence the scope of this EIS.
- 2.3 Explain the decision to be made and identify any other agencies involved in this analysis.
- 2.4 Summarize the scoping and explain the significant issues.
- 2.5 List Federal permits, licenses, and entitlements necessary to implement the project.
- 2.6 Preview the remaining chapters of your DEIS/DMP.

3.0 Alternatives Including the Proposed Action (DEIS)
- 3.1 Explain that this chapter describes the alternatives (potential actions) and summarizes the environmental consequences of the alternatives.
- 3.2 Describe the alternatives, including the proposed action and no action.
- 3.3 Explain how these alternatives represent a range of reasonable alternatives.
- 3.4 Compare the alternatives by summarizing their environmental consequences.
- 3.5 Identify the preferred alternative. (DEIS)
  - 3.5.1 Administration plan (DMP)
  - 3.5.2 Existing resource protection (DMP)
  - 3.5.3 Boundaries/acquisition plan (if applicable) (DMP)
  - 3.5.4 Stewardship plan (DMP)
  - 3.5.5 Restoration/Resource manipulation plan (DMP)
  - 3.5.6 Public access plan (DMP)
  - 3.5.7 Facilities/construction plan (DMP)
  - 3.5.8 Research and monitoring plan (DMP)
  - 3.5.9 Education/interpretation/outreach plan (DMP)
  - 3.5.10 Volunteer plan (DMP)

4.0 The Affected Environment. Describes the current resources. This is the baseline environment for analytical purposes. (DEIS)
- 4.1 Biogeographic region analysis.
- 4.2 Physical aspects.

4.3 Geology.
4.4 Biology and habitats (ecology).
4.5 Human environment/impact.
4.6 Cultural aspects.

Note: Resources include all physical, biological, social, and economic features of the human environment.

Note: Significant issues (resources) should receive more extensive discussion than non-significant issues.

5.0 Environmental Consequences (DEIS)

5.1 General impacts. (DEIS)
5.2 Specific impacts. (DEIS)
5.3 Unavoidable adverse environmental or socioeconomic impacts. (DEIS)
5.4 Relationship between the proposed action on the environment and the maintenance and enhancement of long-term productivity. (DEIS)
5.5 Irreversible and irretrievable commitment of resources. (DEIS)
5.6 Possible conflicts between the proposed action and the objectives of Federal, State, regional, local, and native land use plans, policies and controls for the areas concerned. (DEIS)

6.0 List of Preparers (DEIS)
7.0 References
Appendices

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