

Texas Mid-coast National Wildlife Refuge Complex

*Comprehensive Conservation Plan
and Environmental Assessment*

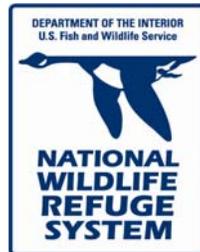


September 2013



U.S. Fish and Wildlife Service Mission Statement

The mission of the U.S. Fish and Wildlife Service is working with others to conserve, protect, and enhance fish, wildlife, plants, and their habitats for the continuing benefit of the American people.



National Wildlife Refuge System Mission Statement

The mission of the National Wildlife Refuge System is to administer a national network of lands and waters for the conservation, management, and, where appropriate, restoration of the fish, wildlife, and plant resources and their habitats within the United States for the benefit of present and future generations of Americans.

-National Wildlife Refuge System Improvement Act of 1997

Comprehensive conservation plans provide long-term guidance for management decisions and set forth goals, objectives, and strategies needed to accomplish refuge purposes and identify the Service's best estimate of future needs. These plans detail program planning levels that are sometimes substantially above current budget allocations and, as such, are primarily for Service strategic planning and program prioritization purposes. The plans do not constitute a commitment for staffing increases, operational and maintenance increases, or funding for future land acquisition.



United States Department of the Interior

FISH AND WILDLIFE SERVICE
P.O. Box 1306
Albuquerque, New Mexico 87103



Dear Reader:

The U.S. Fish and Wildlife Service is pleased to provide you with a copy of the Final Comprehensive Conservation Plan (CCP) and Finding of No Significant Impact (FONSI) for Texas Mid-coast National Wildlife Refuge Complex (Complex) along the Gulf Coast of Texas. This CCP identifies the role that the Complex will play in support of the mission of the U.S. Fish and Wildlife Service and National Wildlife Refuge System. It provides long-term guidance to the refuge's management programs and activities.

The CCP was developed by an interdisciplinary planning team which evaluated three management alternatives and chose Alternative B as the proposed action. The Service believes this management action is a positive step in conserving and managing the refuge's fish and wildlife resources.

The Service would like to thank you for participating in the planning process. Comments you submitted helped us prepare a better plan for the future of the Complex.

Additional copies of this CCP may be obtained by contacting the Texas Mid-coast National Wildlife Refuge Complex, 2547 CR 316, Brazoria, TX 77422. The CCP is also available on the Service's Internet website as follows:

<http://www.fws.gov/southwest/refuges/Plan/planindex.html>

Thank you for your continued support and interest in our fish and wildlife conservation efforts.

Sincerely,



Dr. Benjamin N. Tuggle, Regional Director
U.S. Fish and Wildlife Service, Region 2

SEP 16 2013
Date

[This page intentionally left blank.]

**COMPREHENSIVE CONSERVATION PLAN AND ENVIRONMENTAL
ASSESSMENT**

***TEXAS MID-COAST NATIONAL
WILDLIFE REFUGE COMPLEX***

Brazoria, Fort Bend, Matagorda and Wharton Counties, Texas

**Prepared by:
Texas Mid-coast National Wildlife Refuge Complex
2547 CR 316
Brazoria, TX 77422**

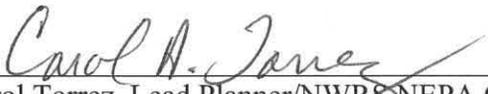
**U.S. Fish and Wildlife Service
National Wildlife Refuge System
Division of Planning
P.O. Box 1306
Albuquerque, New Mexico 87103**

[This page intentionally left blank.]

COMPREHENSIVE CONSERVATION PLAN APPROVAL
For
Texas Mid-coast National Wildlife Refuge Complex,
Brazoria, Fort Bend, Matagorda and Wharton Counties, TX

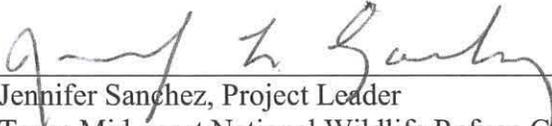
The attached Comprehensive Conservation Plan for the Texas Mid-coast National Wildlife Refuge Complex has been prepared by Regional Office and Refuge staff. The contents and format are found to be in compliance with Service Policy on the preparation of Comprehensive Conservation Plans, and is hereby submitted for approval.

Submitted by:



Carol Torrez, Lead Planner/NWRS NEPA Coordinator
U.S. Fish and Wildlife Service, Region 2

9/10/13
Date



Jennifer Sanchez, Project Leader
Texas Mid-coast National Wildlife Refuge Complex

4-12-2013
Date

Concurrence by:



Kelly McDowell, Refuge Supervisor, TX/OK
U.S. Fish and Wildlife Service, Region 2

9/6/2013
Date



Aaron Archibeque, Regional Chief, NWR System,
U.S. Fish and Wildlife Service, Region 2

9/11/13
Date

Approved by:



Dr. Benjamin N. Tuggle, Regional Director
U.S. Fish and Wildlife Service, Region 2

9/12/13
Date

[This page intentionally left blank.]

Table of Contents

Table of Contents	i
Vision Statement	vii
1.0 INTRODUCTION.....	1-1
1.1 Purpose and Need for the CCP	1-1
1.2 Complex Overview: History of Each Refuge's Establishment, Acquisition and Management	1-3
1.2.1 Establishment of Brazoria National Wildlife Refuge.....	1-5
1.2.2 Establishment of San Bernard National Wildlife Refuge.....	1-5
1.2.3 Establishment of Big Boggy National Wildlife Refuge	1-7
1.2.4 Three Refuges - One Complex	1-8
1.2.5 Refuge Purpose(s)	1-8
1.3 Planning Context.....	1-10
1.3.1 The U.S. Fish and Wildlife Service.....	1-10
1.3.2 The National Wildlife Refuge System	1-11
1.3.2.1 Legal and Policy Guidance	1-12
1.3.3 Setting the Stage for Planning: Identifying the Landscape Context.....	1-15
1.3.3.1 Climate Change.....	1-15
1.3.3.2 Strategic Habitat Conservation and Gulf Coast Prairie Landscape Conservation Cooperative.....	1-16
1.3.3.3 National Conservation Plans and Initiatives	1-17
1.3.3.4 Regional Plans and Initiatives.....	1-22
1.3.3.5 State and Local Plans and Designations.....	1-24
1.3.3.6 Species-specific Plans.....	1-29
1.3.4 Coordination with the State of Texas	1-31
2.0 THE PLANNING PROCESS	2-1
2.1 Preplanning	2-1
2.2 Initiate Public Involvement and Scoping	2-2
2.3 Determine Issues	2-4
2.3.1 Ecoregion Issues.....	2-6
2.3.2 Habitat Management Issues.....	2-8
2.3.3 Wildlife Management Issues	2-11
2.3.4 Public Use Issues.....	2-12
2.3.5 Facilities Issues.....	2-13
2.4 Develop and Analyze Alternatives.....	2-13
2.5 Prepare Draft Plan and EA.....	2-14
2.6 Prepare and Adopt Final Plan	2-14
2.7 Implement Plan, Monitor, and Evaluate	2-14
2.8 Review and Revise Plan.....	2-14
3.0 REFUGE RESOURCES AND CURRENT MANAGEMENT	3-1
3.1 Landscape Setting	3-1
3.1.1 Central Flyway	3-1
3.1.2 Gulf Coast Prairie Landscape Conservation Cooperative	3-3
3.1.3 Ecoregion Setting	3-4

Table of Contents

3.1.3.1	Terrestrial Description	3-5
3.1.3.2	Aquatic Description	3-7
3.1.4	Protected Areas in the Gulf Coast Prairies and Marshes Ecoregion	3-9
3.1.5	Conservation Corridors	3-9
3.1.6	Refuge Location	3-11
3.1.7	Surrounding Land Uses	3-13
3.2	Physical Environment	3-15
3.2.1	Climate	3-15
3.2.2	Air Quality.....	3-17
3.2.3	Water Resources.....	3-19
3.2.4	Geology and Soils	3-21
3.2.5	Mineral Resources.....	3-23
3.2.6	Concerns Regarding the Physical Environment.....	3-30
3.3	Biological Environment	3-33
3.3.1	Habitat Types	3-33
3.3.1.1	Terrestrial Vegetation Classes.....	3-40
3.3.1.2	Aquatic Vegetation Classes.....	3-44
3.3.1.3	Natural Disturbance Processes.....	3-46
3.3.1.4	Historical Habitat Description.....	3-47
3.3.1.5	Estimated Conditions due to Climate Change	3-47
3.3.1.6	Concerns Regarding Refuge Habitat.....	3-49
3.3.2	Wildlife.....	3-52
3.3.2.1	Priority Species	3-52
3.3.2.2	Focal/Representative Species.....	3-67
3.3.2.3	Birds	3-69
3.3.2.4	Mammals.....	3-70
3.3.2.5	Reptiles.....	3-70
3.3.2.6	Amphibians	3-71
3.3.2.7	Fish and Marine Life.....	3-71
3.3.2.8	Invertebrates.....	3-71
3.3.2.9	Concerns Regarding Wildlife Populations.....	3-72
3.4	Socioeconomic Environment	3-73
3.4.1	Population.....	3-73
3.4.2	Economy.....	3-74
3.4.2.1	Regional Economic Profile	3-74
3.4.2.2	Economic Significance of the Refuge.....	3-75
3.4.2.3	Other Economic Uses.....	3-76
3.5	Archeological, Cultural and Historical Resources.....	3-77
3.6	Current Management.....	3-81
3.6.1	Administration.....	3-81
3.6.1.1	Staffing.....	3-81
3.6.1.2	Administrative Facilities	3-84
3.6.1.3	Oil and Gas Operations and Management	3-90

3.6.1.4	Partnerships	3-93
3.6.1.5	Memorandums of Understanding and Other Agreements	3-93
3.6.1.6	Law Enforcement and Resource Protection	3-93
3.6.1.7	Safety	3-94
3.6.2	Habitat Management	3-94
3.6.3	Wildlife Management	3-110
3.6.4	Visitor Services and Infrastructure	3-111
3.6.4.1	Wildlife-Dependent Recreation Opportunities	3-112
3.6.4.2	Other Recreational Opportunities	3-128
3.6.4.3	Public Use Areas	3-129
3.6.4.4	Public Use Access	3-129
3.6.4.5	Public Use Facilities	3-133
3.6.5	Special Management Areas	3-134
3.6.5.1	Wilderness Areas	3-134
3.6.5.2	Research Natural Areas	3-135
3.6.5.3	Other Special Management Areas	3-135
3.6.5.4	Concerns Regarding Special Management Areas	3-137
3.6.6	Land Protection and Acquisition	3-137
3.6.7	Cultural Resource Management	3-140
4.0	MANAGEMENT DIRECTION	4-1
4.1	Ecoregional Goal	4-1
4.2	Habitat Management Goal	4-3
4.3	Wildlife Goal	4-9
4.4	Visitor Services Goal	4-16
4.5	Facilities Goal	4-27
5.0	PLAN IMPLEMENTATION AND MONITORING	5-1
5.1	Personnel and Budget Needs	5-1
5.1.1	Personnel	5-1
5.1.2	Budget	5-3
5.1.2.1	Existing Budget	5-3
5.1.2.2	Additional Budget Needs	5-6
5.2	Appropriate Refuge Uses and Compatibility	5-10
5.2.1	Appropriate Refuge Uses	5-10
5.2.2	Compatibility Determinations	5-10
5.3	Intra-Service Section 7 (Endangered Species Act Consultation)	5-11
5.4	Step-Down Management Plans	5-11
5.4.1	Current Step-Down Plans	5-12
5.4.2	Future Step-Down Plans	5-13
5.5	Refuge Projects	5-14
5.5.1	Existing Projects	5-14
5.5.1.1	Biological Management Projects	5-14
5.5.1.2	Visitor Services Management Projects	5-16
5.5.2	Future Projects	5-18

Table of Contents

5.5.2.1	Biological Management Projects	5-18
5.5.2.2	Visitor Services Projects	5-20
5.5.2.3	Facilities/Infrastructure Management Projects	5-22
5.6	Partnerships	5-23
5.7	Memorandums of Understanding and Other Agreements	5-26
5.8	Monitoring and Evaluation	5-26
5.9	Plan Amendment and Revision	5-26

Terminology

Glossary

Abbreviations and Acronyms

Appendices

Appendix A	Key Legislation and Service Policies
Appendix B	Environmental Assessment and Finding of No Significant Impact (FONSI)
Appendix C	Compatibility Determinations
Appendix D	Ecoregion Table
Appendix E	Species List
Appendix F	Vegetative Alliances
Appendix G	Intra-Service Section 7 Consultation
Appendix H	Wilderness Review
Appendix I	Land Protection Plan
Appendix J	List of Preparers
Appendix K	References
Appendix L	Service Response to Public Comments

Figures

Figure 1-1.	Texas Mid-coast Refuge Complex Vicinity	1-9
Figure 1-2.	National Wildlife Refuge System	1-11
Figure 2-1.	The Planning Process	2-1
Figure 3-1.	Administrative Flyways.	3-1
Figure 3-2.	Gulf Coast Prairie Region Landscape Conservation Cooperative.	3-3
Figure 3-3.	Average Annual Precipitation of Lake Jackson, Texas.....	3-15
Figure 3-4.	Average Annual Temperature of Lake Jackson, Texas.....	3-16
Figure 3-5.	Unhealthy Days in Brazoria, Texas, 2000-2010.	3-18
Figure 3-6.	Designated Critical Habitat for Wintering Piping Plover.	3-56
Figure 3-7.	Annual Population Percent Change from 2000-2008.	3-73
Figure 3-8.	Gulf Coast Region Industrial Employment from 2004-2014.	3-75

Tables

Table 2-1.	Location, Attendance, and Dates of Public Meetings	2-2
Table 2-2.	Concerns Grouped by Category and Listed by Stakeholder.....	2-3
Table 2-3.	Addressing the Issues Raised During Scoping	2-5
Table 3-1.	Agricultural and Cropland Acreages in Brazoria, Fort Bend, Matagorda and Wharton Counties	3-13
Table 3-2.	Ozone and Oxides of Nitrogen Monitoring Data for 2009.....	3-18
Table 3-3.	Management Concerns due to the Physical Environment	3-30

Table 3-4. Listed Endangered and Threatened Species with Potential to Occur on or Adjacent to the Complex and Refuge Species of Concern.	3-53
Table 3-5. Focal Species, Habitats and Limiting Factors	3-68
Table 3-6. Focal Four County Population Changes 2000-2008.....	3-74
Table 3-7. Median Household Income by County.....	3-74
Table 3-8. Pipelines on Brazoria National Wildlife Refuge.....	3-85
Table 3-9. Rights-of-way on San Bernard National Wildlife Refuge.....	3-86
Table 3-10. Treatment Applications for Target Invasive Species	3-96
Table 3-11. Refuge Road Information	3-130
Table 3-12. Summary of Refuge Trail Information.....	3-132
Table 3-13. Tracts Acquired Under the Austin’s Woods Conservation Plan.....	3-139
Table 5-1. Existing Personnel.....	5-1
Table 5-2. Additional Personnel Beyond Current Levels Needed to Implement the CCP	5-3
Table 5-3. 2011 Base Operational Budget for the Complex.....	5-4
Table 5-4. Staffing and Project Needs identified in SAMMS and RONS	5-6
Table 5-5. Biological Inventorizing and Monitoring.....	5-28

Maps

Map 3-1. Landscape Scale Conservation.....	3-2
Map 3-2. Gulf Coast Prairies and Marshes Ecoregion	3-10
Map 3-3. Texas Mid-coast National Wildlife Refuge Complex Location.....	3-12
Map 3-4. Big Boggy National Wildlife Refuge Soils.....	3-24
Map 3-5. Brazoria National Wildlife Refuge Soils	3-25
Map 3-6 San Bernard National Wildlife Refuge Soils, Area A.....	3-26
Map 3-7. San Bernard National Wildlife Refuge Soils, Area B	3-27
Map 3-8. San Bernard National Wildlife Refuge Soils, Area C	3-28
Map 3-9. San Bernard National Wildlife Refuge Soils, Area D.....	3-29
Map 3-10. Big Boggy National Wildlife Refuge Vegetation	3-34
Map 3-11. Brazoria National Wildlife Refuge Vegetation.....	3-35
Map 3-12. San Bernard National Wildlife Refuge Vegetation, Area A	3-36
Map 3-13. San Bernard National Wildlife Refuge Vegetation, Area B	3-37
Map 3-14. San Bernard National Wildlife Refuge Vegetation, Area C	3-38
Map 3-15. San Bernard National Wildlife Refuge Vegetation, Area D	3-39
Map 3-16. Brazoria National Wildlife Refuge Oil and Gas Exploration	3-91
Map 3-17. San Bernard National Wildlife Refuge Oil and Gas Operations	3-92
Map 3-18 Big Boggy National Wildlife Refuge Fire Management.....	3-97
Map 3-19 Brazoria National Wildlife Refuge Fire Management	3-98
Map 3-20 San Bernard National Wildlife Refuge Fire Management	3-99
Map 3-21. Big Boggy National Wildlife Refuge Agricultural Units.....	3-101
Map 3-22. Brazoria National Wildlife Refuge Agricultural Units	3-102
Map 3-23. San Bernard National Wildlife Refuge Agricultural Units	3-103
Map 3-24 Brazoria National Wildlife Refuge Moist Soil Units – Big Slough	3-105
Map 3-25 Brazoria National Wildlife Refuge Moist Soil Units – North Refuge	3-106
Map 3-26 San Bernard National Wildlife Refuge Moist Soil Units	3-107
Map 3-27 Big Boggy National Wildlife Refuge Moist Soil Units	3-108

Table of Contents

Map 3-28. Big Boggy National Wildlife Refuge Public Use	3-114
Map 3-29. Brazoria National Wildlife Refuge Public Use	3-115
Map 3-30. Brazoria National Wildlife Refuge Big Slough Area Public Use	3-116
Map 3-31. San Bernard National Wildlife Refuge Public Use	3-117
Map 3-32. San Bernard National Wildlife Refuge Hudson Woods Unit Public Use	3-118
Map 3-33. Brazoria National Wildlife Refuge Hunt Areas	3-119
Map 3-34. Brazoria National Wildlife Refuge Middle Bayou Hunt Areas	3-120
Map 3-35. San Bernard National Wildlife Refuge Hunt Areas	3-121
Map 3-36. Big Boggy National Wildlife Refuge Hunt Areas	3-122
Map H-1. Wilderness Inventory Units.....	H-7



Osprey approaching take-off. Photo Credit: Dave Sanders

Vision Statement

The Texas Mid-coast National Wildlife Refuge Complex will preserve and protect the wildlife and habitat of the Texas Mid-coast Region. The Complex will protect the diverse habitats typical to the Gulf Coast Prairies and Marshes ecoregion, including the estuaries and salt marshes, the prairies and freshwater wetlands and the Columbia Bottomlands forest ecosystem. The refuges will serve as a resilient source of natural evolving habitats and ecosystem processes even as structure and composition are altered due to climate change and adjacent areas are increasingly fragmented and altered by human development. The Complex will endeavor to protect habitats and the wildlife dependent on them by conserving, enhancing, and restoring a network of public lands and waters. These refuges will provide quality habitat for native plants and wildlife, with emphasis on threatened and endangered species, migratory birds and other species of concern. The Complex will continue to encourage visitors to participate in high quality programs for hunting, fishing, wildlife observation, photography, interpretation and environmental education. The Complex will provide facilities to help connect people to nature while building support for the refuge and enhancing the local community. The Complex will continue to work with partners including land-owners, local and regional organizations, and State and Federal agencies to achieve national and regional conservation goals for the benefit of present and future generations.

[This page intentionally left blank.]

1. Introduction

The Texas Mid-coast National Wildlife Refuge Complex (Complex) is comprised of three refuges: Brazoria National Wildlife Refuge (NWR), San Bernard NWR, and Big Boggy NWR that provides a vital complex of salt and freshwater marshes, sloughs, ponds, coastal prairies, and bottomland hardwood forests that provide habitat for a wide variety of resident and migratory wildlife. This document is a Comprehensive Conservation Plan (CCP) designed to guide management of the Complex for the next 15-years. The CCP provides a description of the desired future conditions and long-range guidance to accomplish the purposes for which each refuge was established. The CCP and accompanying Environmental Assessment (EA) address Service legal mandates, policies, goals, and National Environmental Policy Act (NEPA) compliance. The EA (Appendix B) presents a range of alternatives for habitat and wildlife management, visitor services, and facilities management that consider issues and opportunities on the Complex. It also identifies, describes, and compares the consequences (or impacts) of implementing three management alternatives (including current management) on the physical, biological, and human environments described in the CCP. The final CCP will be developed through modifications made after the public review process and will replace current management direction when it is completed.

The CCP is divided into five chapters. Chapter 1, Introduction, provides information about why the Service is developing this CCP, an overview of the refuges within the Complex, including the history of their establishment and management, authorizing legislation, description of their purposes and information on the National Wildlife Refuge System (Refuge System) and the laws, policies, and guidance that sets the stage for management direction. Chapter 2, The Planning Process, explains the process used to develop the CCP consistent with planning requirements. Chapter 3, Complex Resources and Current Management, explains the landscape setting; physical, biological, and socio-economic environment; and the current management programs on the Complex. Chapter 4, Management Direction, describes the goals, objectives, and strategies for the Service's preferred alternative (Alternative B). Finally, Chapter 5, Plan Implementation and Monitoring, describes the various tools the Complex will use to implement the management direction presented in this CCP.

1.1 Purpose and Need for the CCP

The purpose of comprehensive conservation planning is to provide long-range guidance for the management of national wildlife refuges, as mandated by the National Wildlife Refuge System Improvement Act of 1997 (Improvement Act). This CCP provides a vision for the Complex and offers management direction for conducting scientific research, habitat restoration, and maintenance and management of compatible public uses of refuge resources for the next 15 years.

The CCP will enhance the management of the Complex by:

- providing a clear statement of direction for the future management of the Complex;
- providing long-term continuity in refuge management throughout the Complex;

- communicating the Service’s management priorities for the Complex to their partners, neighbors, visitors, and the general public;
- providing an opportunity for the public to help shape the future management of the Complex;
- ensuring that management programs on the Complex are consistent with the mandates of the Refuge System and the purposes for which the refuges were established;
- ensuring that the management of the Complex is consistent with Federal, State, and local plans; and
- providing a basis for budget requests to support the Complex’s needs for staffing, operations, maintenance, and capital improvements.

The CCP is needed to provide guidance and rationale for management actions and will be used by the Project Leader and refuge staff as a reference document when developing work plans, step-down plans, and making management decisions. Through the development of goals, objectives, and strategies, this CCP describes how the Complex contributes to the overall mission of the Refuge System, fulfills the purposes designated for the refuges, and uses the best available science for adaptive management.

The goals established for the Complex, include the following:

- To contribute to conservation efforts and to foster the ecological integrity of the Gulf Coast Prairies and Marshes Ecoregion through proven and innovative management practices across the Complex.
- To conserve, restore, enhance, and protect Complex habitats by implementing appropriate management programs to benefit native flora and fauna, including threatened and endangered species and other species of concern.
- To protect, maintain, and enhance populations of migratory birds and resident fish and wildlife, including federal and state threatened and endangered species.
- To develop and implement quality wildlife dependent recreation programs that are compatible with each refuge’s purposes and foster enjoyment and understanding of the Complex’s unique wildlife and plant communities.
- To provide administrative and public use facilities needed to carry out each refuge’s purposes and meet management objectives.

By preparing this CCP, documenting our goals and objectives, and involving our partners and the public in the process, we gain a better understanding of the issues—from all sides. Sustaining the nation’s fish and wildlife resources is a task accomplished only through the combined efforts of governments, partners, and private citizens. This CCP will help explain how the Complex fits into the larger landscape and our role in protecting our natural resources for present and future generations. In addition, with sea-level rise (SLR) being one of the most predicted effects of climate change, the CCP will ensure that the Complex continues to conserve fish, wildlife, and ecosystems in the face of climate change and related stressors. Management of the Complex as outlined in the CCP will help to restore biodiversity to the landscape.

1.2 Complex Overview: History of Each Refuge's Establishment, Acquisition and Management

The need for establishing a waterfowl refuge along the upper mid-coast of Texas was recognized by both the Service (formerly the Bureau of Sport Fisheries and Wildlife) and the TPWD (formerly the Texas Game and Fish Commission) as early as the mid-1950s. For many years, the most important wintering area for migratory waterfowl along the upper Gulf Coast of Texas had been the area between the Sabine River on the Louisiana-Texas line southwesterly to Galveston Bay and, from Galveston Bay southwesterly to Port Lavaca. This strip of high and low coastal marsh, coupled with extensive rice farming, had been very attractive to migratory waterfowl. The area between the Galveston Bay and the Sabine River had been the principal wintering area for hundreds of thousands of snow geese as well as large numbers of white-front and Canada geese and large numbers of ducks. The zone between Galveston Bay and Port Lavaca had increased in importance since the late 1940s. There had been a general movement of wintering migratory waterfowl southwest along the Texas coast. By the 1950s, the zone between Galveston Bay and Port Lavaca was wintering a large number of migratory waterfowl. It was thought that a very conservative estimate of a million migratory waterfowl would utilize an established refuge in this region if ample food were provided (USFWS 1956).

Another issue driving the need for a waterfowl refuge was that the land pattern along this section of the Gulf Coast was changing at a very rapid rate. Large areas of wetlands had been drained for farming, grazing, urbanization, industry, and the building of the Gulf Intracoastal Waterway (GIWW). The remaining marshlands along the Gulf Coast that had not been drained or that had been drained for other purposes, then found to be unsatisfactory, were being purchased by large companies or wealthy individuals and turned into private hunting clubs (USFWS 1956).

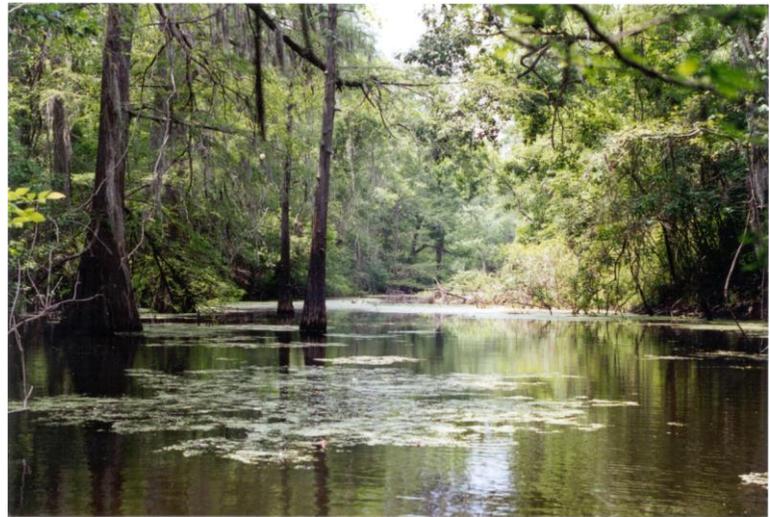
In mid-1956, the Service began to search for areas along the Texas coast that would be large enough to meet the needs of large numbers of wintering waterfowl. With assistance from the U.S. Geological Survey, the area identified that could potentially meet wildlife needs of this magnitude, was the abandoned 40,000-acre Hoskins Mound oil field owned by Texas Oil Company, in Brazoria County. By October, the Service had contacted representatives with Texas Oil Company to inquire about the possibility of purchasing lands owned by them for the purpose of establishing the proposed Hoskins Mound National Wildlife Refuge. While numerous meetings and negotiations between the Service and Texas Oil Company followed, the company decided in the end not to sell the property.

As the Service persisted in its search for suitable lands to acquire, the ever-increasing deterioration and destruction of the remaining marshes on the Texas Gulf Coast continued to remain a concern. The coastal habitat of Texas, so important to the welfare of the Central Flyway waterfowl and vital to many other species of water birds, was dwindling at a rapid pace and creating drastic adverse effects on the value and availability of waterfowl and other wildlife habitat (USFWS 1965). It became evident that in order to preserve and enhance sufficient coastal habitat to accommodate even a portion of the waterfowl population utilizing the Texas Gulf Coast, it would be necessary to establish two areas. The areas would



Brazoria NWR includes the largest contiguous salt marsh and coastal prairie habitats and managed fresh water wetlands on the Complex. Photo Credit: USFWS

San Bernard NWR includes more than 20,000 acres of bottomland hardwood forest in the Brazos and San Bernard River Basins. Photo Credit: USFWS



Although it is the smallest refuge, Big Boggy NWR includes important salt marsh and salty prairie habitat for migratory birds. Photo Credit: USFWS

need to be located between the existing Sabine NWR, located in Louisiana just east of the Texas state line and the Aransas NWR, located to the west along the mid-Gulf Coast. However, this was a challenge not easily met. In several instances when lands of highly valuable waterfowl habitat had been proposed for acquisition, the Service would find that the landowner was unwilling to negotiate. The economic boom on the Texas Gulf Coast had created keen competition in the land market and owners were well aware of the potential value of their lands for industrial and urban development purposes. By the 1960s, approximately 65 percent of the total Central Flyway waterfowl population was utilizing habitat along the Texas Gulf Coast during the winter months.

1.2.1 Establishment of Brazoria National Wildlife Refuge

The Service remained interested in identifying coastal marsh with high waterfowl potential as refuges and contacted landowners near the Texas Oil Co. lands. Several land owners, who grazed cattle on the prairie/marsh lands southwest of Bastrop Bayou became interested in the opportunity. Moving quickly, the Service began the necessary steps of the acquisition process. A biological reconnaissance revealed that the property identified for acquisition was a natural waterfowl area of significance to the resource containing three relatively large brackish lakes totaling approximately 950 acres. These lakes are surrounded by a pothole complex, dubbed the “Slop Bowl” by virtue of its extremely wet condition. To the north of the lakes, the land slopes gently upward to Bastrop Bayou. The north end of this area is bisected by a fresh water slough along which a series of ponds have been developed and contain lush growths of various aquatic plants (USFWS 1965).

On May 4, 1965, Service Director John C. Gatlin approved the proposal for the acquisition of lands suitable for the establishment of a new refuge in Texas to be known as the Brazoria National Wildlife Refuge. An option to purchase the property was accepted and approved by the Migratory Bird Conservation Commission on August 24, 1965. The following day, the newly authorized Brazoria NWR was announced by Secretary of the Interior, Stewart L. Udall. A little over a year later, the refuge was established on October 17, 1966, with the initial acquisition of approximately 6,398 acres in Brazoria County. Over the course of 36 years, additions to the refuge through a combination of fee-title land acquisitions, easements and gift donations, brought the total acreage to 44,413.88 acres. A large portion of this total acreage is from the addition of the approximately 28,655-acre Hoskins Mound Marsh. On December 28, 1990, the Service acquired in fee-title an initial 21,832.26 acres of the property, approximately 34 years after initial interest in the area. The remainder of the property was acquired over the following two years.

1.2.2 Establishment of San Bernard National Wildlife Refuge

In early 1963, in an attempt to preserve additional coastal habitat, the Service began initial investigations into the feasibility of acquiring the Poole Ranch in Brazoria County, for the establishment of another refuge along the Texas Gulf Coast. Originally, the ranch was identified in 1956 as an area that could possibly be used as an alternative refuge site in the event negotiations with Texas Oil Company were unsuccessful. The Service recognized a vital need for a national wildlife refuge along the mid-Texas Gulf Coast area near the mouth

of the San Bernard River in Brazoria County. This section of the Texas coast was situated near the center of the principal snow, blue and to a lesser extent, Canada goose wintering area in the Central Flyway, extending from the Louisiana marshes down the coast to San Antonio Bay and the Lissie Prairie region. In addition to preserving much needed wintering habitat, the refuge would also provide a concentration point for those species enroute to and from ancestral wintering locations further south (USFWS 1963).

In April 1963, the Service contacted the landowners to inquire of their interest to sell the property. With indications of willingness to sell from several family members, the Service initiated efforts to acquire the ranch for the establishment of the proposed San Bernard NWR. A biological reconnaissance revealed that the property was a natural waterfowl area heavily utilized by wintering birds and coastal migrants. Portions of the ranch consisted of isolated ridges of coastal prairie with small intermittent sloughs and coastal marsh. Scattered throughout the ranch were numerous swales and potholes, filled occasionally by rainfall.

On October 22 of the same year, Acting Director Abram V. Tunison approved recommendations for the establishment of the San Bernard NWR in Brazoria and Matagorda Counties, with acquisitions to begin in fiscal years 1967 and 1968 (USFWS 1963). The Migratory Bird Conservation Commission approved funding for land acquisitions on February 27, 1968. The San Bernard NWR was established with the initial purchase of approximately 14,906 acres from the Poole Ranch, on November 7, 1968. Subsequent purchases increased refuge acreage to 52,400 by May 3, 2012. This acreage includes lands acquired within Austin's Woods, which is discussed below.

Austin's Woods (Columbia Bottomlands)

During the 1990s, land acquisition activities began to focus on not only coastal prairie and marsh habitat, but on inland areas comprised of bottomland hardwood forest. The Service became interested in conserving floodplain habitat after a bird study conducted by Dr. Sidney Gauthreaux, a Clemson University scientist, revealed that large numbers of neotropical birds utilized floodplain forests and forested wetlands during their migrations. Using Doppler weather surveillance radar to detect bird migration movement along the northern Gulf Coast, Dr. Gauthreaux discovered that coastal woodlands served as important stopover areas during bad weather, but sites farther inland from the coastline where floodplain forests are present, were even more important. Soon after arriving on the northern Texas coast, most trans-Gulf migrants would land in the forested area of Brazoria County, the first extensive bottomland hardwood forests to the west of Galveston Bay and centered near West Columbia. It became evident early on in the study, that there were clear indications that the forested wetland (now referred to as Columbia Bottomlands or Austin's Woods) served as a major rest area for neotropical migrants.

The Service saw in Dr. Gauthreaux's findings the need to propose the protection of this important habitat through various land acquisition efforts and other conservation means. In mid-1995, the Service released for public review a proposal to establish the Columbia Bottomlands NWR. In an effort to address concerns about the extent of federal acquisition in the Austin's Woods area, a Four-County Task Force (Task Force) comprised of

representatives from Brazoria, Fort Bend, Matagorda and Wharton Counties, was established. At the request of local, state and federal officials, the Service delayed its refuge establishment to allow the Task Force to review the proposal further and consider local efforts in conserving habitat.

After the Task Force reviewed existing information on the wildlife resources of the bottomlands, it was determined that approximately 237 bird species totaling 29 million individuals, migrated through the area every year. They also estimated that 177,000 acres was all that remained of the 700,000 acres once present in Austin's Woods at the beginning of the century. With this information, the Task Force affirmed the natural resource values within the four county area and agreed to the designation of additional protected areas. It was recommended that a community-based conservation effort be implemented for habitat protection. The Service proposed a goal of 70,000 acres of habitat be conserved under the combined efforts of private, local, state and federal entities. This would ensure the protection of at least 10 percent of the original ecosystem. In August 1996, Acting Service Director John G. Rogers approved a Preliminary Project Proposal to expand the San Bernard NWR boundary by 28,000 acres. In 1997, the Service developed the Austin's Woods Conservation Plan, which proposed land acquisitions within the Austin's Woods area (also known as the Columbia Bottomlands) as its part of the combined effort. Lands acquired by the Service became part of the San Bernard NWR as a separate management unit. To date, the Service has acquired more than 24,500 acres of Columbia Bottomlands.

1.2.3 Establishment of Big Boggy National Wildlife Refuge

During the 1970s, land acquisition along the Texas coast was a high priority with the Service's Migratory Bird Habitat Preservation Program. In January 1976, a national priority system for ranking wetlands by their value to the Nation's waterfowl resource was initiated as part of the Migratory Bird Land Acquisition Program. Of the 33 categories identified, the Texas coast ranked eighth on the national scale. To ensure adequate acreage would be available for wintering migratory bird populations, the Service proposed a minimum acquisition of 100,000 acres for the Texas coast (Final EIS 1981).

In February 1980, representatives of 10 landowners of approximately 4,500 acres within Matagorda County approached the Service to inquire if there was still an interest in preserving waterfowl habitat through acquisition. The properties were within an area of interest to the Service known as Big Boggy Marsh, located approximately 20 miles south of Bay City, the county seat of Matagorda County. Big Boggy Marsh contained some of the finest remaining marshlands and was included in a Concept Plan in 1977 that identified a number of wetland areas along the Texas Gulf Coast as candidates for protection. Under this plan, Wetland Preservation Program Category 8 – Texas Coast, the proposed area had a biological ranking of 16 out of 25 key waterfowl areas. The State had identified Big Boggy Marsh as an area of concern. Approximately 80 percent of the proposed acquisition consisted of marsh, while the remainder of the property consisted primarily of coastal prairie (USFWS 1981).

The Service evaluated the proposal and soon met with county commissioners who went on record as supporting the acquisition of lands within Big Boggy Marsh. The Service initiated scoping in 1980 for the development of an Environmental Impact Statement (EIS) for the purchase of lands within Big Boggy Marsh for the establishment of a national wildlife refuge. In February 1981, the Service prepared an EIS for the proposed acquisition of approximately 4,500 acres of privately owned marshland within Matagorda County, for the creation of Big Boggy NWR. The acquisition of these lands for the establishment of a wildlife refuge would enable the Service to continue to meet its mandate under the Migratory Bird Conservation Act of providing and maintaining adequate and vital migration and wintering habitat for migratory waterfowl (USFWS 1981). As a new addition to the Refuge System, the refuge would not only preserve additional habitat for migratory waterfowl and native resident wildlife species dependent on the gulf coastal marshes, but would provide available lands for use by the public for recreational purposes.

The Big Boggy NWR was approved by the Migratory Bird Conservation Commission on October 7, 1981 (USFWS 1981). The refuge was established on July 8, 1983 with the initial acquisition of 1,271.15 acres. In the years that followed, additions to the refuge through a combination of fee-title land acquisitions and conservation easements would increase the acreage to the current total of approximately 4,526 acres.

1.2.4 Three Refuges – One Complex

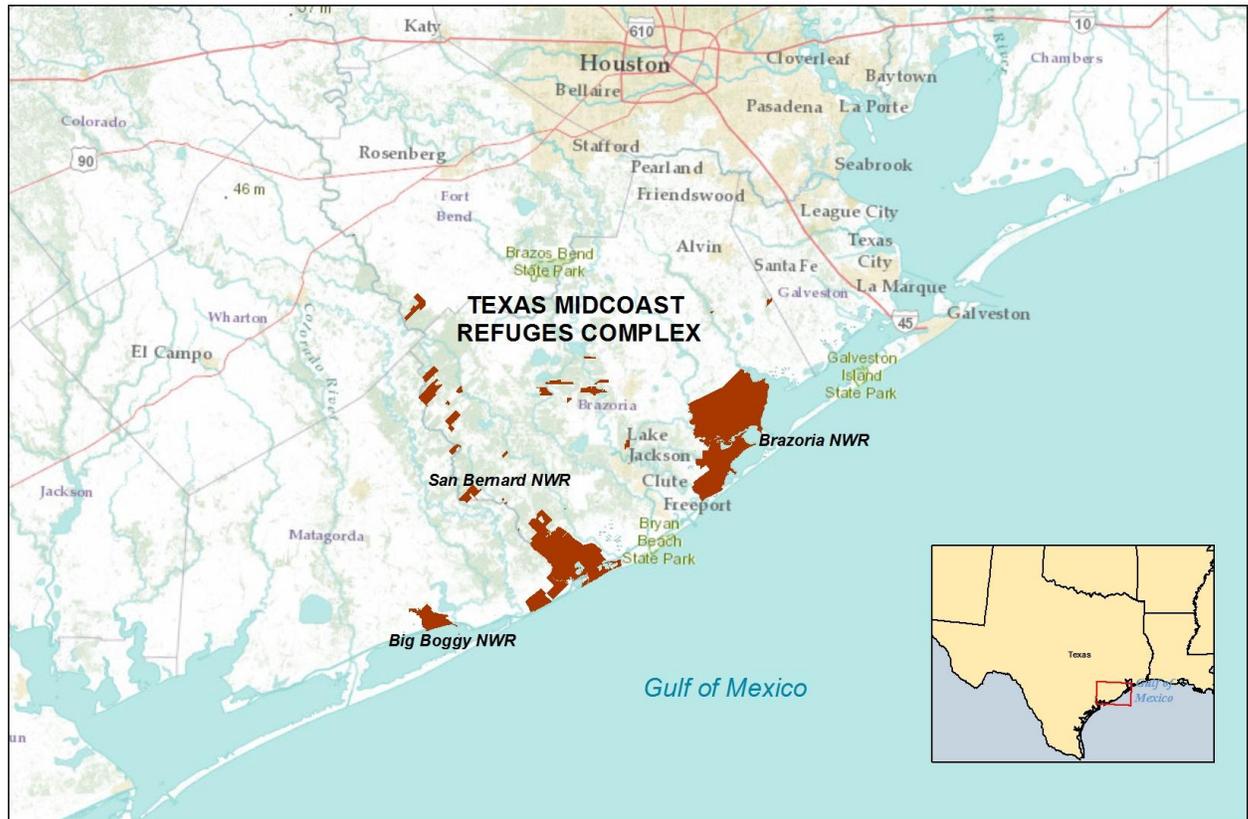
In the early days, there was no base for field operations at Brazoria NWR so all field work and equipment operations were based out of San Bernard NWR, which had some facilities remaining from the Poole Ranch and additional facilities added in 1982. With one project leader (Brazoria NWR manager) overseeing refuge operations on both refuges, Brazoria and San Bernard NWRs became loosely known as the Brazoria National Wildlife Refuge Complex. Big Boggy NWR was added to this complex during its establishment.

In the mid to late 1990s, the Service decided to officially complex the three refuges in an attempt to effectively manage the resources on each refuge. Since the refuges were situated within the Mid-Coast Initiative Area of the Gulf Coast Joint Venture under the North American Waterfowl Management Plan, the official name for the Complex became the Texas Mid-Coast National Wildlife Refuge Complex (Bisbee 2010), which is shown in Figure 1-1.

1.2.5 Refuge Purpose(s)

National wildlife refuges are established under a variety of legislative acts and administrative orders and authorities. These orders and authorities include one or more specific purposes for which the refuge lands are acquired. The purposes are of key importance in refuge planning, and are the foundation for management decisions. The purposes of a refuge are specified in, or derived from the law, proclamation, executive order, agreement, public land order, donation document, or administrative memorandum establishing, authorizing, or expanding a refuge, refuge unit, or refuge subunit.

Figure 1-1 Texas Mid-Coast Refuge Complex Vicinity



Note: This map does not depict all units of the San Bernard NWR acquired after October 1, 2010.

By law, refuges are to be managed to achieve their purposes, and unless otherwise indicated by the establishing document the following rules apply:

- Purposes dealing with the conservation, management, and restoration of fish, wildlife, and plants, and their habitats take precedence over other management and administration purposes.
- When in conflict, the purpose of an individual refuge may supersede the Refuge System mission.
- Where a refuge has multiple purposes related to fish, wildlife, and plant conservation, the more specific purpose will take precedence in instances of conflict.
- When an additional unit is acquired under a different authority than that used to establish the original unit, the addition takes on the purpose(s) of the original unit, but the original unit does not take on the purpose(s) of the addition.

The establishing authorities and related purposes for the Brazoria NWR include:

- ... for use as an inviolate sanctuary, or for any other management purpose, for migratory birds. 16 U.S.C. § 715d (Migratory Bird Conservation Act)
- "... for the development, advancement, management, conservation, and protection of fish and wildlife resources ..." 16 U.S.C. § 742f(a)(4) "... for the benefit of the United States Fish and Wildlife Service, in performing its activities and services. Such

acceptance may be subject to the terms of any restrictive or affirmative covenant, or condition of servitude ..." 16 U.S.C. § 742f(b)(1) (Fish and Wildlife Act of 1956)

- "... suitable for— (1) incidental fish and wildlife-oriented recreational development, (2) the protection of natural resources, (3) the conservation of endangered species or threatened species ..." 16 U.S.C. § 460k-1 "... the Secretary ... may accept and use ... real ... property. Such acceptance may be accomplished under the terms and conditions of restrictive covenants imposed by donors ..." 16 U.S.C. § 460k-2 (Refuge Recreation Act (16 U.S.C. § 460k-460k-4), as amended).

The establishing authorities and related purposes for San Bernard NWR include:

- ... for use as an inviolate sanctuary, or for any other management purpose, for migratory birds. 16 U.S.C. § 715d (Migratory Bird Conservation Act)
- "... suitable for— (1) incidental fish and wildlife-oriented recreational development, (2) the protection of natural resources, (3) the conservation of endangered species or threatened species ..." 16 U.S.C. § 460k-1 "... the Secretary ... may accept and use ... real ... property. Such acceptance may be accomplished under the terms and conditions of restrictive covenants imposed by donors ..." 16 U.S.C. § 460k-2 (Refuge Recreation Act (16 U.S.C. § 460k-460k-4), as amended).
- "... for the development, advancement, management, conservation, and protection of fish and wildlife resources ..." 16 U.S.C. § 742f(a)(4) "... for the benefit of the United States Fish and Wildlife Service, in performing its activities and services. Such acceptance may be subject to the terms of any restrictive or affirmative covenant, or condition of servitude ..." 16 U.S.C. § 742f(b)(1) (Fish and Wildlife Act of 1956)

The establishing authorities and related purposes for Big Boggy NWR include:

- ... for use as an inviolate sanctuary, or for any other management purpose, for migratory birds. 16 U.S.C. § 715d (Migratory Bird Conservation Act)
- "... suitable for— (1) incidental fish and wildlife-oriented recreational development, (2) the protection of natural resources, (3) the conservation of endangered species or threatened species ..." 16 U.S.C. § 460k-1 "... the Secretary ... may accept and use ... real ... property. Such acceptance may be accomplished under the terms and conditions of restrictive covenants imposed by donors ..." 16 U.S.C. § 460k-2 (Refuge Recreation Act (16 U.S.C. § 460k-460k-4), as amended).

1.3 Planning Context

The Complex is part of a national system of more than 551 refuges. The Service manages individual refuges in a manner that reflects each refuge's purpose(s) while supporting the mission of the Refuge System.

1.3.1 The U.S. Fish and Wildlife Service

The Service is the principal federal agency responsible for conserving, protecting, and enhancing fish and wildlife and their habitats for the continuing benefit of the American people. The Service has a primary responsibility to manage and protect Federal trust species, which includes migratory birds, threatened species, endangered species, inter-jurisdictional fish, marine mammals, and other species of concern. In addition to the Refuge System, the

Service also operates national fish hatcheries, fishery and wildlife conservation offices, and Ecological Services field stations. The Service enforces federal wildlife laws, manages migratory bird populations, restores nationally significant fisheries, administers the Endangered Species Act, conserves and restores wildlife habitat such as wetlands, and helps Native American tribal governments and foreign governments with their conservation efforts. It also oversees the Federal Assistance Program, which distributes hundreds of millions of dollars in excise taxes on fishing and hunting equipment to state fish and wildlife agencies.

The mission of the U.S. Fish and Wildlife Service is:

“working with others to conserve, protect and enhance fish, wildlife, and plants and their habitats for the continuing benefit of the American people”

1.3.2 The National Wildlife Refuge System

The Refuge System is the only system of federally-owned lands managed chiefly for the conservation of wildlife. Founded in 1903 by President Theodore Roosevelt with the designation of Pelican Island as a refuge for brown pelicans, the Refuge System consists of over 150 million acres in more than 551 refuges and 38 wetland management districts in all 50 states and U.S. territories (Figure 1-2). National wildlife refuges host a tremendous variety of plants and animals supported by a variety of habitats from arctic tundra and prairie grasslands to subtropical estuaries. Most national wildlife refuges are strategically located along major bird migration corridors ensuring that ducks, geese, and songbirds have rest stops on their annual migrations. Many refuges are integral to the protection and survival of

Figure 1-2. National Wildlife Refuge System.



plant and animal species listed as endangered. The Refuge System is the world's largest collection of lands and waters set aside specifically for the conservation of wildlife and ecosystem protection.

The mission of the Refuge System is:

“...to administer a national network of lands and waters for the conservation, management and, where appropriate, restoration of the fish, wildlife, and plant resources and their habitats within the United States for the benefit of present and future generations of Americans” (National Wildlife Refuge System Improvement Act of 1997, Public Law 105-57).

The goals of the Refuge System are to:

- Conserve a diversity of fish, wildlife, and plants and their habitats, including species that are endangered or threatened with becoming endangered;
- Develop and maintain a network of habitats for migratory birds, anadromous and inter-jurisdictional fish, and marine mammal populations that is strategically distributed and carefully managed to meet important life history needs of these species across their ranges;
- Conserve those ecosystems, plant communities, wetlands of national or international significance, and landscapes and seascapes that are unique, rare, declining, or underrepresented in existing protection efforts;
- Provide and enhance opportunities to participate in compatible wildlife-dependent recreation (hunting, fishing, wildlife observation and photography, and environmental education and interpretation); and
- Foster understanding and instill appreciation of the diversity and interconnectedness of fish, wildlife, and plants and their habitats.

1.3.2.1 Legal and Policy Guidance

Refuge management and administrative activities are dictated, in large part, by the legislation that created the unit and its purposes and goals. However, other laws, regulations, and policies also guide management. The mission and goals of the Refuge System, Service Policy, federal laws and executive orders, and international treaties guide the Complex. Appendix A provides a complete list of the laws, policies, treaties and executive orders that pertain to the conservation and protection of natural and cultural resources. Key laws and policies directly related to comprehensive conservation planning are discussed below.

National Wildlife Refuge System Improvement Act of 1997

The National Wildlife Refuge System Administration Act of 1966, as amended, states that each refuge shall be managed to fulfill both the mission of the Refuge System and the purposes for which the individual refuge was established. It also requires that any use of a refuge be a compatible use—a use that will not materially interfere with nor detract from, in

the sound professional judgment of the refuge manager, fulfillment of the mission of the Refuge System or the purposes of the refuge.

The 1997 amendments to the National Wildlife Refuge System Administration Act of 1966 identified a number of principles to guide management of the Refuge System. They include the following:

- Conserve fish, wildlife, and plants and their habitats within the Refuge System;
- Maintain the biological integrity, diversity, and environmental health of the Refuge System;
- Coordinate, interact, and cooperate with adjacent landowners and state fish and wildlife agencies;
- Maintain adequate water quantity and quality to meet Complex and Refuge System purposes and acquire necessary water rights;
- Maintain hunting, fishing, wildlife observation, wildlife photography, interpretation, and environmental education as the priority general public uses of the Refuge System;
- Provide opportunities for compatible priority wildlife-dependent public uses within the Refuge System;
- Provide enhanced consideration for priority wildlife-dependent public uses over the other general public uses in planning and management;
- Provide increased opportunities for families to experience priority general public uses, especially traditional outdoor activities such as fishing and hunting; and
- Monitor the status and trends of fish, wildlife, and plants in each refuge.

The Improvement Act establishes the responsibilities of the Secretary of the Interior for managing and protecting the Refuge System; requires a CCP for each refuge by the year 2012; and provides guidelines and directives for the administration and management of all areas in the Refuge System, which includes wildlife refuges, areas for the protection and conservation of fish and wildlife threatened with extinction, wildlife ranges, game ranges, wildlife management areas, and waterfowl production areas.

To maintain the health of individual refuges and the Refuge System as a whole, managers must anticipate future conditions. Managers must endeavor to avoid adverse impacts and take positive actions to conserve and protect refuge resources. Effective management also depends on acknowledging resource relationships and acknowledging that refuges are parts of larger ecosystems. Refuge managers work together with partners, including other refuges, federal and state agencies, tribal and other governments, and nongovernmental organizations (NGOs) and groups—to protect, conserve, enhance, or restore all native fish, wildlife (including invertebrates), plants, and their habitats.

Appropriate Use Policy

This policy describes the initial decision process the refuge manager follows when first considering whether to allow a proposed use on a refuge. The refuge manager must find a use appropriate before undertaking a compatibility review of the use. An appropriate use as defined by the Appropriate Use Policy (603 FW 1 of the Service Manual) is a proposed or existing use on a refuge that meets at least one of the following four conditions:

- The use is a wildlife-dependant recreational use as identified in the Improvement Act.
- The use contributes to the fulfilling of the refuge purpose(s), the Refuge System mission, or goals or objectives described in a refuge management plan approved after October 9, 1997, the date the Improvement Act was signed into law.
- The use involves the take of fish and wildlife under State regulations.
- The use has been found to be appropriate as specified in Section 1.11 (603 FW 1 of the Service Manual).

Chapter 5 of this CCP includes additional information on appropriateness of refuge uses.

Compatibility Policy

Lands within the Refuge System are different from other multiple use public lands in that they are closed to all public uses unless specifically and legally opened. The Improvement Act states, "... the Secretary shall not initiate or permit a new use of a refuge or expand, renew, or extend an existing use of a refuge, unless the Secretary has determined that the use is a compatible use and that the use is not inconsistent with public safety."

In accordance with the Improvement Act, the Service has adopted a Compatibility Policy (603 FW 2 of the Service Manual) that includes guidelines for determining if a use proposed on a national wildlife refuge is compatible with the purposes for which the refuge was established. A compatible use is defined in the policy as a proposed or existing wildlife-dependent recreational use or any other use of a national wildlife refuge that, based on sound professional judgment, will not materially interfere with or detract from the fulfillment of the Refuge System mission or the purposes of the refuge. Sound professional judgment is defined as a finding, determination, or decision that is consistent with the principles of sound fish and wildlife management and administration, available science and resources (funding, personnel, facilities, and other infrastructure), and applicable laws.

The Service strives to provide priority public uses when they are compatible. If financial resources are not available to design, operate, and maintain a priority use, the refuge manager will take reasonable steps to obtain outside assistance from the State and other conservation interests. Additional information regarding compatibility determinations (CDs) is provided in Chapter 5, and the CDs prepared in association with this CCP are provided in Appendix C.

Biological Integrity, Diversity, and Environmental Health Policy

The Improvement Act directs the Service to "ensure that the biological integrity, diversity, and environmental health of the Refuge System are maintained for the benefit of present and future generations of Americans..." To implement this directive, the Service has issued the Biological Integrity, Diversity, and Environmental Health Policy (601 FW 3 of the Service Manual), which provides policy for maintaining and restoring, where appropriate, the biological integrity, diversity, and environmental health of the Refuge System. The policy is an additional directive for refuge managers to follow while achieving the refuge purpose(s) and Refuge System mission. It provides for the consideration and protection of the broad spectrum of fish, wildlife, and habitat resources found on refuge and associated ecosystems. Further, it provides refuge managers with an evaluation process to analyze their refuge and

recommend the best management direction to prevent further degradation of environmental conditions and restore lost or severely degraded components where appropriate and in concert with refuge purposes and the Refuge System mission. When evaluating the appropriate management direction for refuges, refuge managers will use sound professional judgment to determine their refuges' contribution to biological integrity, diversity, and environmental health at multiple landscape scales.

1.3.3 Setting the Stage for Planning: Identifying the Landscape Context

1.3.3.1 Climate Change

Department of the Interior Secretarial Order 3226, signed on January 19, 2001, and reinstated on February 22, 2010, by Secretarial Order 3289 Amendment No. 1, states that “there is a consensus in the international community that global climate change is occurring and that it should be addressed in governmental decision making...” This Order ensures that climate change impacts are taken into account in connection with Departmental planning decision making.” Additionally, it calls for the incorporation of climate change into long-term planning documents such as this CCP.

The U.N. Intergovernmental Panel on Climate Change (IPCC) reports that direct temperature measurements at weather stations world-wide suggest that the surface of Earth has warmed, on average, 1.0 °C (1.8 °F) in the last 100 years (IPCC 2007). Data for the Southwest show an increase in temperature between 1.1°C (2 °F) to 1.7°C (3.1 °F) during the past century and project an increase in temperature of 4.5°C (8.1 °F) to 6.1°C (11 °F) in the future (Sprigg and Hinkey 2000). Estimates for the 20th century show that global average sea level rose at a rate of about 1.7 mm per year, which equals 17.0 centimeters (6.7 inches) for those 100 years. The increase of carbon dioxide (CO₂) within the earth's atmosphere has been linked to the gradual rise in surface temperature commonly referred to as global warming. The IPCC also concludes that substantial increases in global average temperatures will cause major changes in ecosystem structure and function, species' ecological interactions, and species' geographical ranges. These projected changes have enormous implications for management of fish, wildlife, and their habitats around the world.

The U.S. Department of Energy's (DOE) “*Carbon Sequestration Research and Development*” (USDE 1999) defines carbon sequestration as “...the capture and secure storage of carbon that would otherwise be emitted to or remain in the atmosphere.” Conserving natural habitat for wildlife is the heart of any long-range plan for national wildlife refuges. The actions proposed in this plan would conserve or restore land and habitat, and would thus retain existing carbon sequestration on the Complex. This, in turn, contributes positively to efforts to mitigate human-induced global climate change. Vegetated land is a tremendous factor in carbon sequestration. Terrestrial biomes of all sorts—grasslands, forests, wetlands, tundra, and desert—are effective both in preventing carbon emission and in acting as a biological “scrubber” of atmospheric CO₂. The DOE report concludes that ecosystem protection is important to carbon sequestration and may reduce or prevent loss of carbon currently stored in the terrestrial biosphere. One Service activity in particular—prescribed burning—releases CO₂ directly into the atmosphere from the biomass consumed during combustion. However, there is actually no net loss of carbon, since new vegetation quickly germinates and sprouts to

replace the burned-up biomass and sequesters or assimilates an approximately equal amount of carbon as was lost to the air (Boutton *et al.* 2006).

Climate change may accelerate and intensify existing stressors (pollution, invasive species, development, habitat fragmentation, loss and degradation, etc.), which could have a number of possible effects on the Complex. An increase in temperature may include: reduced rainfall and surface water supplies; deterioration of water quality; decreased habitat availability for many species; changes in vegetation communities; modification of migratory bird patterns; loss of breeding habitat for migratory forest dwelling land birds and resident wildlife species; loss of some species along with the introduction of new species; and significantly increased energy costs. Possible effects were a substantive consideration in the development of the objectives and strategies in this CCP. Implementation of all the strategies for monitoring and surveys will emphasize identification and analysis of the effects of climate change on the various habitats and species. In addition, implementation of all strategies will emphasize energy conservation and/or use of alternative energy sources when feasible. Chapter 3, Section 3.3.1.5 discusses possible climate change impacts to the Complex.

In September 2010, the Service released a strategic approach to climate change, *Rising to the Urgent Challenge: Strategic Plan for Responding to Accelerating Climate Change*, found in Chapter 1, Section 1.3.3.2, National Plans and Initiatives.

1.3.3.2 Strategic Habitat Conservation and Gulf Coast Prairie Landscape Conservation Cooperative

Strategic Habitat Conservation (SHC) is a way of thinking and doing business that requires the Service to set biological goals for priority species. It allows for making strategic decision, and encourages constant reassessment and improvement of actions. These are critical steps in dealing with a range of landscape-scale resource threats such as urban development, invasive species, and water scarcity—all magnified by accelerating climate change.

SHC incorporates five key principles in an ongoing process that changes and evolves:

- Biological Planning (setting goals)
- Conservation Design (developing a plan to meet the goals)
- Conservation Delivery (implementing the plan)
- Monitoring and Adaptive Management (measuring success and improving results)
- Research (increasing our understanding)

To ensure that science entities are strategically placed, the Service and the U.S. Geological Survey (USGS) have developed a national geographic framework for implementing strategic habitat conservation at landscape scales. The framework provides a platform upon which the Service can work with partners to connect project- and site- specific efforts to larger biological goals and outcomes across the continent.

The framework serves as a base geography for Landscape Conservation Cooperatives (LCCs), which are management-science partnerships between the Service, federal agencies, states, tribes, NGOs universities, and other entities. These partnerships inform and assist integrated resource management actions by addressing climate change and other stressors within and across landscapes. LCCs are fundamental units of planning and science capable of carrying out the functional elements of SHC.

The Complex is located in the Gulf Coast Prairies LCC (see section 3.1.2), which consists of four Bird Conservation Regions (BCR): the Oaks and Prairies, Edwards Plateau, Tamaulipan Brushlands, and Gulf Coastal Prairie. The Complex is located in the Gulf Coastal Prairie BCR (described in Section 1.3.3.3).

1.3.3.3 National Conservation Plans and Initiatives

Rising to the Urgent Challenge: Strategic Plan for Responding to Accelerating Climate Change (2010)

The Service’s climate change strategy establishes a basic framework within which the Service will work as part of the larger conservation community to help ensure the sustainability of fish, wildlife, plants, and habitats in the face of accelerating climate change. It begins with a dynamic action plan that details specific steps the Service will take during the next five years to implement. The plan focuses on three key strategies to addressing climate change: *Adaptation*, *Mitigation*, and *Engagement*. For the Service, adaptations are planned, science-based management actions, including regulatory and policy changes, that we take to help reduce the impacts of climate change on fish, wildlife, and their habitats. *Adaptation* forms the core of the Service’s response to climate change and is the centerpiece of our Strategic Plan (USFWS 2010). *Mitigation* involves reducing our “carbon footprint” by using less energy, consuming fewer materials, and appropriately altering our land management practices. Biological carbon sequestration—the process in which plants take up CO₂ from the atmosphere through photosynthesis and store it as carbon in tree trunks, branches, and roots—achieves mitigation. *Engagement* involves reaching out to Service employees; local, national, and international partners in the public and private sectors; key constituencies and stakeholders; and citizens to join forces and seek solutions to the challenges to fish and wildlife conservation posed by climate change.

Our goal is to achieve carbon neutrality as an organization by 2020 (USFWS 2010). By building knowledge and sharing information in a comprehensive and integrated manner, the Service, its partners, and stakeholders together will gain an understanding of global climate change impacts and with combined expertise, help wildlife resources adapt in a climate-changed world.

North American Landbird Conservation Plan (2004) (Partners in Flight)

The Partners in Flight (PIF) is a cooperative effort involving partnerships among federal, state, and local government agencies, philanthropic foundations, professional organizations, conservation groups, industry, the academic community, and private individuals. PIF was

created in 1990 in response to growing concerns about declining populations of many land bird species and to emphasize the conservation of birds not covered by existing conservation initiatives. Bird conservation plans, are developed in each region to identify species and habitats most in need of conservation, to establish objectives and strategies to provide needed conservation, to establish objectives and strategies to provide needed conservation activities, and to implement and monitor progress on the plans.

The North American Landbird Conservation Plan summarizes the conservation status of landbirds across North America, illustrating broad patterns based on a comprehensive, biologically-based species assessment. It identifies species most in need of attention at the continental scale, recognizing that additional species will need attention in each region and outlines ways in which continental scale issues and objectives relate to regional conservation efforts.

The Complex is within PIF Physiographic Area #6, the Coastal Prairies, which covers approximately 547 miles of coastal shoreline from Atchafalaya Basin, Louisiana to Baffin Bay, Texas, and consists of grasslands, bottomland hardwood forests, cheniers, and scrub-shrub habitats. Marsh vegetation is determined largely by the salt content of the water, with community types ranging from salt marsh to brackish or freshwater marsh. Nearly all grassland habitats have been converted to agriculture use, primarily pasture lands and rice farms. Forested areas occur primarily along major riverine systems and on coastal cheniers (ancient beachfront ridges), mottes and salt domes, and manmade levees and spoil bands. Bottomland hardwood forests along the major river systems that drain the coastal prairies range in composition from cypress-tupelo to hackberry-ash-elm to water oak-willow oak dominated forests. Priority bird populations and habitats in this physiographic area as well as the Complex include: Grasslands – Henslow’s sparrow, short-eared owl, Sprague’s pipit, and



sedge wren; Bottomland hardwood forests – swallow tailed kite, Swainson’s warbler, prothonotary warbler and American woodcock; and Scrub-shrub – painted bunting and Bell’s vireo. These species are indicators of the condition of the natural communities of the coastal prairies. Their populations are identified as a priority for monitoring due to the tremendous alteration within this physiographic area.

The prothonotary warbler, which nests in wet forested habitats, is one of many priority species identified in the North American Landbird Conservation Plan and occurs on the Complex.

Photo Credit: USFWS

North American Waterfowl Management Plan (2012)

The North American Waterfowl Management Plan (NAWMP) is an international plan to conserve waterfowl and migratory birds in North America. It was established in 1986 by Canada and the U.S. Previous plan updates – in 1994 (when Mexico became a signatory), 1998 and 2004 – described abundant waterfowl populations as the plan’s ultimate goal, pursued through large-scale partnership-based habitat conservation. The 2012 plan renewal is termed a Revision to differentiate it from the previous updates because for the first time since its inception, we fundamentally reexamined the NAWMP’s goals. The 2012 NAWMP Revision sets forth three overarching goals for waterfowl conservation: 1) abundant and resilient waterfowl populations to support hunting and other uses without imperiling habitat; 2) wetlands and related habitats sufficient to sustain waterfowl populations at desired levels, while providing places to recreate and ecological services that benefit society; and 3) growing numbers of waterfowl hunters, other conservationists and citizens who enjoy and actively support waterfowl and wetlands conservation. The first two goals have always been part of the NAWMP. The third goal underscores the importance of people to the success of waterfowl and wetlands conservation. The plan identifies continental population objectives and estimates for duck, goose, and swan species. Appendix B of the revised NAWMP identifies areas of greatest continental significance to North American ducks, geese, and swans – the Gulf Coast Region is one of the areas identified. More information about the revised NAWMP can be found at <http://www.nawmprevision.org/>.

The NAWMP committee is developing an action plan for implementing the Revision.



The ability of the refuges to provide habitat for wintering migratory waterfowl is part of evaluating habitat management activities. Photo Credit: Dave Sanders

Regional partnerships, called Joint Ventures (JV), are the implementing mechanisms of the NAWMP. A JV is a collaborative, regional partnership of government agencies, non-profit organizations, corporations, tribes, and individuals that conserves habitat for priority bird species, other wildlife, and people. There are 18 habitat based and three species based JVs in the U.S. today. Cumulatively, they have conserved 17.3 million acres of habitat for waterfowl and migratory birds. Within the Gulf Coast JV are six initiative areas. The Complex occurs in the Texas Mid-coast Initiative Area, which is comprised of sixteen counties from San Patricio County to Harris County and inland. The goal of the Texas Mid-coast Initiative Area is to provide wintering and migration habitat for significant numbers of dabbling ducks, redheads, lesser snow geese, and greater white-fronted geese, and provide year-round habitat for mottled ducks (Wilson and Esslinger 2002).

Waterbird Conservation for the Americas: the North American Waterbird Conservation Plan (2002)

The North American Waterbird Conservation Plan (NAWCP) provides a continental-scale framework for the conservation and management of 210 species (23 families) of waterbirds, including seabirds, coastal waterbirds, wading birds, and marsh birds using aquatic habitats in 29 nations throughout North America, Central America, the islands and pelagic waters of the Caribbean Sea and western Atlantic, the U.S.-associated Pacific Islands, and pelagic waters of the Pacific. Eighty percent of the species identified in the plan are colonial nesters congregating at breeding sites in numbers ranging from many to hundreds of thousands of birds. The NAWCP considers one-third of these species to be at risk of serious population loss. Additional information is available on the NAWCP website at <http://www.waterbirdconservation.org/nawcp.html>.

U.S. Shorebird Conservation Plan (2001)

The U.S. Shorebird Conservation Plan (SCP) seeks to stabilize populations of all shorebirds that are in decline because of factors affecting habitat in the U.S. At a regional level, the plan's goal is to ensure that shorebird habitat is available in adequate quantity and quality to support shorebird populations in each region. Ultimately, the goal of the SCP is to restore and maintain shorebird populations throughout the western hemisphere through an international partnership. The SCP considers 53 species of shorebirds as special concern, of which 34 species occur within the Complex (see Appendix E for a complete list of shorebirds that have been documented on the Complex). More information about the SCP can be found at <http://www.fws.gov/shorebirdplan/USShorebird/PlanDocuments.htm>.



The Complex supports a large number of shorebirds throughout the year on freshwater wetlands, tidal marshes, and flats and beaches. Photo Credit: Dave Sanders

U.S. Ocean Action Plan (2004)

As part of the Oceans Act of 2000 and the U.S. Commission on Ocean Policy, the U.S. Ocean Action Plan (OAP) recognizes the importance of the ocean, coasts, and Great Lakes of the U.S., and promotes responsible use and stewardship of ocean and coastal resources for the benefit of all Americans. The intent of the OAP is to identify immediate, short-term actions that provide direction for ocean policy and to outline additional long-term actions that

provide direction for the future. The Service has established guiding principles (June 21, 2007 Memo) to implement relevant aspects of the plan through an ecosystem-based management approach. This CCP complements these efforts by incorporating relevant priorities including, but not limited to, conserving and restoring coastal habitat, enhancing the conservation of marine mammals and sea turtles, strengthening coordination with other agencies, establishing and maintaining excellent partnerships, and monitoring coastal resources within the management area.

National Marine Protected Areas Center Strategic Plan 2010-2015

The U.S. has more than 1,600 Marine Protected Areas (MPAs) covering approximately 40 percent of U.S. marine waters. MPAs are “any areas of the marine environment established by individual federal, state, territorial, tribal, and local authorities for a wide range of purposes.” However, there was a growing need to ensure that MPAs were coordinated within a larger ecosystem framework to effectively protect the nation’s natural and cultural resources, and represent the diversity of U.S. marine ecosystems. In 2000, the National Marine Protected Areas Center (MPA Center) was established to meet this need. The mission of the MPA Center is “to facilitate the effective use of science, technology, training, and information in the planning, management, and evaluation of the nation’s system of MPAs.” The MPA Center works in partnership with federal, state, tribal, and local governments, tribes, and stakeholders to develop and implement a science-based, comprehensive national system of MPAs. These collaborative efforts are intended to ensure more efficient, effective use of MPAs now and in the future to conserve and sustain the nation's vital marine resources. These efforts have assumed even greater importance as the nation and the world continue planning for the potential effects of climate change. In 2009, portions of all three refuges received MPA designation.

Guidance for MPAs is in the National MPA Center Strategic Plan. In 2009, the plan was revised to more accurately reflect the organization’s evolving structure and priorities, with emphasis on further developing the national system of MPAs and its operational capabilities. Included within the plan are special interest areas of importance to the design and implementation of the national system over the next five years. The ongoing development and implementation of the national system of MPAs is a dynamic process requiring adaptive management. As the national system of MPAs matures, the plan will also evolve in recognition of accomplishments and future requirements (NMPAC 2009). The recently formed Gulf of Mexico MPA Network is beginning to implement coordinated activities. The vision of the Network is: *To improve coordination, cooperation, communication, and collaboration among Gulf Coast MPAs by creating opportunities for; collective response; information sharing and continuity; and collectively developing ideas, leveraging agreements, and conveying a common message.* The Complex will continue to work closely with the Gulf of Mexico MPA Network to implement management strategies and assist in meeting the challenge to build resilience within the Gulf of Mexico for natural and man-made disturbance.

1.3.3.4 Regional Plans and Initiatives*TNC Gulf Coast Prairies and Marshes Ecoregional Conservation Plan (2002)*

The Nature Conservancy (TNC) developed an ecoregional approach to conservation in 1996 that stated biodiversity conservation required working at larger scales and along ecological instead of geopolitical lines. The TNC has historically been very involved in protecting coastal habitats in the Gulf Coast Prairies and Marshes (GCP&M) by means of habitat acquisition (e.g., 13 national wildlife refuges, 5 state wildlife areas, various county, other land trust organization and TNC preserves). However, recent estimates indicate that just a fraction of the biodiversity in the ecoregion has been documented on these managed areas. The development of the GCP&M Ecoregional Conservation Plan (plan) is an effort to identify the most important remaining, viable conservation areas and determine how to achieve lasting conservation results on the landscape. These sites, known as portfolio conservation areas, are a prioritization management tool for conservation action and resources. Portfolio conservation areas are designed to conserve conservation elements, defined as all viable native community types and all viable vulnerable native species. Protecting one population of each element is seldom adequate for the long-term survival of most species, so the goal of the GCP&M plan is to design areas that will conserve multiple, viable or recoverable occurrences of elements. The GCP&M plan contains supporting data for each site, as well as an ecoregional management strategy applicable to each management area. Management areas are prioritized by biodiversity and threats. Results and data may then be used to create site specific conservation plans like the CCP.

North American Bird Conservation Initiative: Bird Conservation Region Descriptions (2000)

The purpose of the North American Bird Conservation Initiative (NABCI) is to ensure the long-term health of North America's native bird populations by increasing the effectiveness of existing and new bird conservation initiatives, enhancing coordination among the initiatives, and fostering greater cooperation among the continent's three national governments and their people. In 1999, the NABCI approved a framework for delineating ecologically-based planning, implementation, and evaluation units for cooperative bird conservation in the U.S. and Canada known as Bird Conservation Regions (BCRs). BCRs are ecologically distinct regions in North America with similar bird communities, habitats, and resource management issues.

The Complex is located within the Gulf Coastal Prairie BCR #37. In this area, flat grasslands and marshes hug the coast of the Gulf of Mexico from northern Tamaulipas across the mouth of the Río Grande, up into the rice country of southeastern Texas and southwestern Louisiana and across the great Louisiana marshlands at the mouth of the Mississippi River. This BCR features one of the greatest concentrations of colonial waterbirds in the world, with breeding reddish egret, roseate spoonbill, brown pelican, and large numbers of herons, egrets, ibises, terns, and skimmers. The region provides critical in-transit habitat for migrating shorebirds, including buffbreasted sandpiper and Hudsonian godwit, and for most of the neotropical migrant forest birds of eastern North America. Mottled duck, fulvous whistling-duck, and purple gallinule also breed in wetlands, and winter numbers of waterfowl are among the

highest on the continent. These include dabbling ducks (especially pintail), gadwall, redhead, lesser scaup, and white-fronted geese from both the Central and the Mississippi flyways. The most important waterfowl habitats of the area are coastal marsh, shallow estuarine bays and lagoons, and wetlands on agricultural lands of the rice prairies. This BCR, as mentioned previously, features one of the greatest concentrations of colonial waterbirds in the world. Loss and degradation of wetland habitats due to subsidenece, SLR, shoreline erosion, freshwater and sediment deprivation, saltwater intrusion, oil and gas canals, and navigation channels and associated maintenance dredging are the most important problems facing the area's wetland wildlife. Find additional information on NABCI at <http://www.nabci-us.org>.

Partners In Flight Landbird Conservation Plan: Gulf Coastal Prairie Bird Conservation Region (2008)

This plan covers the U.S. BCR #37, the Gulf Coastal Prairie. The Service selected four species of concern, and one suite of species, and developed conservation recommendations for each with expectations that actions proposed would benefit a number of species with similar habitat requirements. The selected species are seaside sparrow, northern bobwhite, loggerhead shrike, LeConte's sparrow, and a suite of warblers (cerulean, Swainson's, and goldenwinged) that represent migrants that use the Gulf Coast as stopover habitat.

Gulf Coast Joint Venture: Mottled Duck Conservation Plan (2007)

This plan was developed by the GCJV Management Board to provide mottled duck conservation guidance to partners within the GCJV. This plan focuses on actions to increase nest success and brood survival and the habitat and land management actions necessary to allow for population expansion.



The refuges are striving to increase mottled duck population by providing a mosaic of freshwater wetlands and marsh habitats. Photo Credit Dave Sanders

Gulf Coast Joint Venture: Conservation Planning for the Reddish Egret (2009)

The reddish egret is among the priority species identified for habitat planning, implementation, and evaluation by the GCJV partnership. This plan describes protection and improvement actions to promote populations expansion of the reddish egret. It also describes specific habitat targets within the Texas Mid-Coast Initiative Area, that partners can utilize to promote this species.

More information on Gulf Coast Conservation Plans that are pertinent to the Complex, can be found at <http://www.gcjv.org/documents.php>. In addition to the mottled duck and reddish egret plans mentioned above, this website provides links to the *Gulf Coast Joint Venture: Texas Mid-Coast Initiative (2002)*, the *Gulf Coast Joint Venture Shorebird Plan*, and a number of other plans/reports.

1.3.3.5 State and Local Plans and Designations

In administering the Refuge System, the Service will ensure that the CCP complements state efforts to conserve fish, wildlife and their habitats, and to increase support for the Refuge System and participation from conservation partners and the public. During the development of the CCP, the Service is required to consult and coordinate with affected state conservation agencies, as well as adjoining federal, local, and private landowners. The Service is required to ensure effective coordination, interaction, and cooperation in a timely and effective manner with the state during the course of acquiring and managing refuges. Under the Refuge Administration Act of 1966 and 43 CFR 24, the Director and the Secretary's designee is required to ensure the Refuge System regulations and management plans are to the extent practicable, consistent with state laws, regulations, and management plans.

Texas Comprehensive Wildlife Conservation Strategy (2005)

The Texas Comprehensive Wildlife Conservation Strategy (TCWCS) is required to assess the condition of the state's wildlife and habitats, identify the problems they face, and outline the actions needed for long-term conservation within the state's 10 major ecoregions. The TCWCS identifies a variety of actions aimed at preventing wildlife from declining to the point of becoming endangered. Instead of focusing on single species in isolated areas, the TCWCS focuses on steps needed to protect, restore, and enhance habitat types, in addition to educating the public and private landowners about effective conservation practices.

As part of the State Wildlife Grant Program, the TCWCS was completed by TPWD to assist the agency and its conservation partners with the development of non-game initiatives and goals to address the needs of wildlife and habitats. The document provides detailed species and habitat information on 10 major ecoregion in Texas. The Complex occurs within the GCP&M Ecoregion. The GCP&M Ecoregion ranks as a high terrestrial

conservation priority and is considered to be among the most threatened of the 10 ecoregions (TPWD 2005). Inland prairies, coastal woodlands, and beach habitats are specifically threatened by increased population growth and associated development. Approximately 297 priority species have been identified within this ecoregion, with several species occurring or nesting on the Complex.

Land and Water Resources Conservation and Recreation Plan (2010)

The TPWD developed the Land and Water Resources Conservation and Recreation Plan to aid the agency in conserving the natural and cultural resources of Texas for future generations. The criteria outlined in the plan will provide TPWD with a foundation for decision-making regarding the State's conservation and recreation needs. The following goals are addressed within the plan:

- Practice, encourage and enable science-based stewardship of natural and cultural resources. Various methods are outlined for achieving this goal, which include basing management decisions on best available science, becoming leaders in managing State lands, fostering conservation on private lands, and developing effective conservation partnerships;
- Increase access to and participation in the outdoors. This may be accomplished through actions like encouraging nature and heritage tourism or facilitating access to private and public lands and waters for recreation purposes;
- Educate, inform and engage Texas citizens in support of conservation and recreation; and
- Employ efficient, sustainable and sound business practices. This is accomplished through technology, professionalism, excellent customer service, financial resources, effective communication, and an organized culture.

The goals and objectives are intended to promote stewardship on public and private lands and waters; protect our unique natural and cultural resources; encourage partnerships with all stakeholders; utilize science as the backbone of decision-making; promote participation in the outdoors; instill appreciation of nature in our citizens, young and old; and promote business approach that leverage industry standards and best management practices to support TPWD's mission.

According to the original LWRCRP, "*...the high population growth and associated development along the coast have fragmented land, converted prairies, changed river flows, decreased water quality and increased sediment loads and pollutants on marshes and estuaries. Projections indicate continued high growth and increasing fragmentation in most parts of this ecoregion.*" The LWRCRP recommends, "*...many beach areas and mud flats need additional protection.*" The LWRCRP as well as the Complex incorporate many relevant strategies, such as monitoring species' status and trends, restoring coastal prairie, providing public outreach, protecting cultural and historical resources, maintaining and developing new partnerships, and managing invasive species.

Texas Wetlands Conservation Plan (1997)

The goal of the Texas Wetlands Conservation Plan (TWCP) is consistent with wetland conservation goals of the Complex and is to “...*enhance our wetland resources with respect to function and value through voluntary conservation and restoration of the quality, quantity and diversity of Texas wetlands.*” The TWCP focuses on a non-regulatory, incentive-based approach to wetlands management and conservation aimed mainly at private landowners. TWCP focuses on: 1) enhancing the landowner’s ability to use existing incentive programs and other land use options through outreach and technical assistance; 2) developing and encouraging land management options that provide an economic incentive for conserving existing wetlands or restoring former ones; and, 3) coordinating regional wetlands conservation efforts.

Austin’s Woods Conservation Plan (1997)

The Austin’s Wood Conservation Plan describes the land acquisition and conservation activities by the Service within a four county area known as the Columbia Bottomlands (known locally as Austin’s Woods). The Columbia Bottomlands is a southern floodplain forest formation on the upper Texas Gulf Coast that historically covered approximately 700,000 acres. The rapid destruction of bottomland hardwood forests in this area, and the concerns of conservationists about preserving a sustainable area of this habitat, gave rise to this plan (FWS 1997). An important aspect of the plan is emphasis on cooperation with local conservation partners. Any entity that can provide assistance to the conservation of this unique ecosystem is encouraged to contribute. An aim of the local effort is to give landowners, who might otherwise be forced to clear their lands, other land use options that will conserve the forest. The combined efforts and coordination among these entities could eliminate duplication of effort and optimize the use of financial resources in pursuit of the protection of Columbia Bottomlands. The purpose of Service efforts is to contribute to the protection and enhancement of the ecological integrity of the Columbia Bottomlands. In the 1997 Decision Document, the Service agreed to:

- Be a part of the long-term monitoring effort;
- Assist local agencies and other entities in protection efforts;
- Provide technical assistance and Partners for Wildlife funds;
- Hold conservation easements when other organizations are unable; and
- Acquire fee and easement interests in lands when other organizations are unable.

Under this project, the Service did not designate an all-encompassing “acquisition boundary” which is done with many projects so as not to affect non-refuge lands across the area. This strategy allows for promoting private conservation efforts but does not restrict development or other land uses on private lands adjacent to the refuge (FWS 2008). Therefore, non-Service lands do not receive a “refuge designation.” It is anticipated that the eventual pattern of land acquisition would be characterized as a mosaic of land blocks that together, with conservation projects, protect the ecosystem and maintain essential ecological elements and functions.



The Texas Champion Live Oak, the San Bernard Oak on the McNeal/Stringfellow/Ducroz Unit of San Bernard is a 300 year old monument to the unique and diverse Columbia Bottomlands Ecosystem.
Photo Credit: USFWS

Purchases are from willing sellers only and purchased at fair market value as determined by appraisals prepared by, or under contract with, the Service. Reservation of any surface or subsurface interests may be allowed as long as certain stipulations to protect habitat can be agreed upon. The Service evaluates each landowner's request to sell to the Service based on a number of criteria. These criteria are not in priority order and are used flexibly in relation to each other with an eye to the site's overall contribution to the conservation goal. The criteria are not weighted or ranked when evaluating sites. The criteria are:

1. Exceptional/unique plant communities (e.g., canebrakes, willow swamps, bald cypress swamps, Carolina cherry laurel stands, southern red cedar stands);
2. High quality undisturbed habitat;
3. No minimum size, but large tracts are preferred (recognizing that larger tracts maximize ecological integrity and are necessary for area-sensitive species);
4. Site complements, is adjacent to, or near other protected areas, particularly where natural links exist such as the same hydrologic system or seed dispersal corridors. Acquisition would establish linkage between other protected sites;

5. Expansion capability (will the acquisition of this site add to adjacent acquisitions or other protection strategies to build a larger unit?);
6. Number and kind of Heritage Program database elements contained (the Heritage Program database is maintained by TPWD and addresses element occurrence records, community descriptions/rankings and element rankings) and other known exceptional biological elements that are not currently in the database (an element is an exception biological occurrence such as an active bald eagle nest, a rare plant population, or a heron rookery);
7. Would acquisition maximize maintenance of natural ecological functions and processes (e.g., natural hydrological patterns);
8. Presence of intact natural biological diversity characteristic of healthy bottomland hardwood forest;
9. Degree of human-caused disturbance to the communities (e.g., roads, houses, utility corridors, etc);
10. Proximity to development (threat or vulnerability);
11. Degree of fragmentation of surrounding habitats;
12. Ease of restoration (enough of the basic ecological processes such as a hydrologic regime are present to support restoration so as to not require intensive restoration efforts);
13. Level and kind of current disturbance;
14. Hydrologic/watershed influences; and
15. Degree of structural (plant community and topographic) complexity.

Seagrass Conservation Plan for Texas (1999)

Having state management authority or jurisdiction where seagrasses occur, TPWD, Texas General Land Office, and the Texas Commission of Environmental Quality have taken the lead in development and implementation of this plan. The plan focuses on three separate issues categories: Seagrass Research, Management/Policy, and Education/Outreach, including cross-agency coordination and cooperation with federal agencies. Habitat management activities on the Complex that include protection and maintenance of natural habitats, as compared to increasing development along the Texas coast, indirectly helps maintain and protect the quality of seagrass beds that occur on adjoining state lands. The Complex will promote the value and protection of seagrasses through outreach and environmental education strategies.

Coastal Preserve

Under the Texas Coastal Management Program, coastal preserves are any lands owned by the state that are designated and used as parks, recreation areas, scientific areas, wildlife management areas, wildlife refuges, or historic sites and that are designated by the Texas Parks and Wildlife Department (TPWD) as being coastal in character.

Under the Texas Coastal Preserve Program, the Land Office leases coastal lands to the TPWD, which manages them as preserves. The Coastal Preserve Program is designed to protect unique coastal areas and fragile biological communities, including important colonial bird nesting sites. Currently, there are four coastal preserves.

The Christmas Bay Coastal Preserve (5,660 acres) is located in the southwestern portion of the Galveston Bay system in Brazoria County. The preserve is home to migratory and resident waterfowl and shorebirds. Christmas Bay, a small secondary bay at the southwestern extreme of the Galveston Bay system, is an important finfish and shellfish nursery area. Seagrasses are probably the most valuable and productive habitats in the bay. Four seagrass species occur in the bay; however, only widgeongrass is found elsewhere in the Galveston Bay system. Brazoria National Wildlife Refuge is adjacent to Christmas Bay and has been a major, positive influence on the health and maintenance of the Christmas Bay ecosystem.

1.3.3.6 Species-Specific Plans

Species-specific recovery plans identify site-specific management actions that, if completed, could lead to reclassification of a species to a less critical status or help them recover to the point of removal from Endangered Species Act protection. The Service drafted the following recovery plans for species that could potentially occur on the Complex:

Whooping Crane Recovery Plan (1994)

According to the recovery plan, two primary objectives and measurable criteria will allow species reclassification from “endangered” to “threatened”. The first objective is to establish and maintain wild self-sustaining populations of whooping cranes that are genetically stable and environmentally resilient. This will involve maintaining and allowing for a continued increase of the Aransas-Wood Buffalo Population (AWBP). Specifically, the AWBP will consist of a minimum of 40 productive pairs. In addition, the recovery plan calls for establishing a minimum of 25 productive pairs in separate self-sustaining populations at each of two other discrete locations. Downlisting to threatened status requires attaining or exceeding these breeding pair levels for 10 years. Population targets are 160 in the AWBP, and 100 each in the Florida non-migratory population and the eastern migratory population. An alternative criterion for this objective is as follows: if a second and third wild population cannot become self-sustaining, then the AWBP must be self-sustaining and remain above 1,000 individuals (USFWS 1994) i.e., 250 productive pairs for downlisting to occur. The Conservation of Whooping Cranes Memorandum of Understanding (MOU), approved by Canadian and U.S. officials, recognizes a goal of 1,000 individuals in the AWBP population.

The target of 1,000 is reasonable for downlisting given the historical growth of the AWBP, its low probability of extinction (Mirande *et al.* 1993), and theoretical considerations of minimum population viability (Salwasser *et al.* 1984). The Complex does not currently support a whooping crane population, but may play a future role in whooping crane recovery, particularly if recovery efforts need sufficient Texas Gulf Coast habitat to support 1,000 birds.

Attwater's Prairie Chicken Recovery Plan (Second Revision 2007)

The Attwater's prairie chicken was listed as endangered on March 11, 1967 (32 FR 4001), without critical habitat when approximately 1,070 birds were thought to remain in the wild in 13 Texas counties. Current recovery objectives for downlisting from endangered to threatened call for raising the overall population to at least 3,000 birds maintained annually over a 5-year period. De-listing may be appropriate when there is a minimum overall population of 6,000 breeding adults annually over a 10-year period occupying habitats along a linear distance of no less than 100 miles. The Brazoria NWR is located approximately 35 miles southwest of the Texas City population and 100 miles east of the Attwater Prairie Chicken NWR. The Brazoria NWR could be a possible location for future populations of Attwater's prairie chickens.

Piping Plover

Because of declines in numbers and breeding sites, piping plover populations became federally-listed in 1986 (50 FR 50726-50734). The Service listed piping plovers on the Great Lakes as endangered and Atlantic and Northern Great Plains populations as threatened. Piping plovers on migration and in wintering areas (such as at Matagorda Island) are classified as a threatened species. The Service proposed critical habitat along the Texas coast (74 FR 23476-23600; May 19, 2009), with a final ruling on June 18, 2009, revising designation of critical habitat for the wintering population of the piping plover in 18 specific units in Texas. In total, approximately 139,029 acres fall within the boundaries of the revised critical habitat designation (FWS 2009). Brazoria and Matagorda Counties are included.

Piping plovers winter primarily along beaches, sandflats, and algal flats on the Gulf of Mexico. Plovers mainly occur in and around the Cedar Lakes area on the San Bernard NWR. Some of the actions needed to recover the species include determining current distribution and population trends, and protecting, preserving and enhancing piping plover habitat. Strategies to help implement these recovery actions for the piping plover are included in Chapter 4, Management Direction of the CCP.

Sea Turtle Recovery Plans

Major actions needed to achieve sea turtle recovery involve providing long-term protection to important nesting beaches, ensuring hatching success, determining distribution and seasonal movements for all life stages, minimizing mortality from commercial fisheries, and reducing the threat from marine pollution. On the San Bernard NWR, the Kemp's ridley may nest on

the beach. The Kemp's ridley, loggerhead, hawksbill, green, and leatherback sea turtles occur within the Gulf of Mexico and may occur within bay waters.

The Complex contributes to recovery plan tasks for sea turtles primarily through monitoring nesting and stranding (turtles that wash ashore, dead or alive, or are found floating in shallow water dead or alive), patrolling beaches, protecting nest areas, participating in recovery work groups, and collaborating with sister agencies such as the National Park Service's Padre Island National Seashore. Nest monitoring includes all-terrain vehicle (ATV) beach patrols on the San Bernard NWR beach (4 miles), as well as on 60 miles of non-refuge beach from Matagorda to Quintana. The Complex conducts patrols from April through June, which corresponds with the nesting season of the Kemp's ridley sea turtle. The Complex participates in the Sea Turtle Stranding and Salvage Network, as recommended in the recovery plans. This CCP incorporates habitat and monitoring strategies and other action items beneficial to sea turtles, as they apply to the Complex.



Refuge staff and volunteers monitor more than 80 miles of Texas beaches for sea turtle stranding and nesting. A Kemp's ridley nest on Matagorda Peninsula is excavated and transported to Padre Island for incubation and release. Inset: A baby sea turtle makes its walk to the surf on the Quintana Beach. Photo Credit: USFWS

1.3.4 Coordination with the State of Texas

The Service is required to consult and coordinate with affected state conservation agencies, as well as adjoining federal, local, and private landowners. The Service ensures effective coordination, interaction, and cooperation in a timely and effective manner with the state

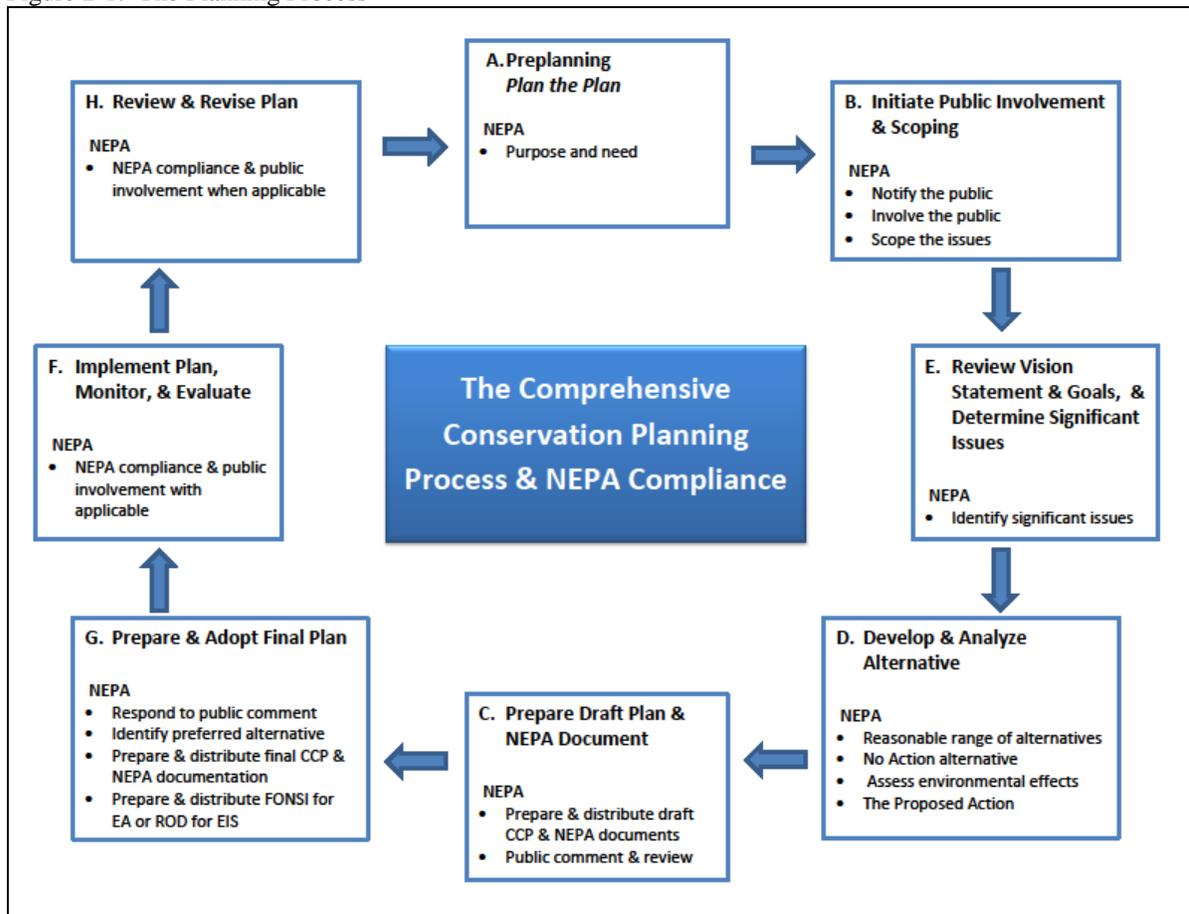
during the course of acquiring and managing refuges. Under the Refuge Administration Act of 1966 and 43 CFR 24, the Director and the Secretary's designee are required to ensure the Refuge System regulations and management plans are to the extent practicable, consistent with state laws, regulations, and management plans. As such, the Service will ensure this CCP complements the State of Texas efforts to conserve fish, wildlife and their habitats, and to increase support for the Refuge System and participation from conservation partners and the public.

This CCP recognizes that both the Service and Texas Parks and Wildlife Department (TPWD) have authorities and responsibilities for management of fish and wildlife species on the Complex. The State's participation and contribution throughout this planning process has provided for ongoing opportunities and open dialogue to improve the ecological conservation of fish and wildlife species and their habitats in Texas. A key part of the planning process is the integration of common objectives, where appropriate.

2.0 The Planning Process

This CCP complies with the requirements of the Improvement Act and NEPA. Refuge planning policy also guided the process and development of the CCP, as outlined in Part 602, Chapters 1, 3, and 4 of the Service Manual. Service policy, the Improvement Act, and NEPA provide specific guidance for the planning process, such as seeking public involvement in the preparation of the EA. The development and analysis of “reasonable” management alternatives within the EA include a “no action” alternative that reflects current conditions and management strategies on the Complex. Figure 2-1 shows the steps in the CCP planning process in a linear cycle. The following sections (2.1-2.8) provide additional detail on individual steps in the planning process.

Figure 2-1. The Planning Process



2.1 Preplanning

The Service completed the following preplanning tasks prior to formally initiating the development of this CCP in order to support planning activities:

- Established an interdisciplinary interagency planning team;
- Identified refuge purposes, history, and establishing authorities;

- Identified all relevant laws, regulations, and policies that would have to be considered during the development of the CCP;
- Identified purpose and need for the CCP to make sure all issues are adequately addressed; and
- Identified planning area and resource data needs.

2.2 Initiate Public Involvement and Scoping

The formal planning process begins with the scoping period, which involves soliciting public involvement and results in a thorough assessment of issues, concerns, opinions, thoughts, ideas, concepts, and visions for the Complex. Formal scoping began with publication of a Notice of Intent to prepare a Comprehensive Conservation Plan and Environmental Assessment, published in the *Federal Register* on June 23, 2009 (Volume 74, Number 119, pp. 29714-29715).

The planning team distributed a Planning Update Newsletter requesting public feedback and informing community members of upcoming public scoping meetings upon publication of the Notice of Intent. The planning team solicited public comments on Complex issues to aid in the CCP development through three open house meetings held the week of September 14, 2009 as shown in Table 2-1. The local newspaper announced meeting dates, times and locations, with the first held at the Lake Jackson Library in Lake Jackson, Texas, the second at the Demi-John Fire Hall in Freeport, Texas, and the third at the Complex Headquarters in Brazoria, Texas.

Table 2-1. Location, Attendance, and Dates of Public Meetings

Lake Jackson, Texas	18	09/15/2009
Freeport, Texas	9	09/16/2009
Brazoria, Texas	14	09/17/2009

The planning team held an ecoregion-wide coordination meeting with partner agencies and organizations at the Complex’s Discovery Center on December 2, 2009, to gain a better understanding of what issues are occurring within the Gulf Coast Prairies and Marshes Ecoregion, and to determine the Complex’s role in addressing issues that impact fish, wildlife, and their habitats within this larger landscape. Seventeen people attended this meeting, representing the following agencies and organizations:

- Attwater Prairie Chicken NWR
- Bosque del Apache NWR
- USFWS Ecological Services
- The Nature Conservancy
- Texas Parks and Wildlife Department
- Texas Chenier Plains NWR Complex
- Trinity River NWR

One additional stakeholder meeting, with representatives from TPWD, was held on February 9, 2010. The meeting enabled the Complex staff to discuss their concerns regarding past management, future management and issues common to both agencies. The feedback received at the conclusion of the public involvement period identified numerous concerns from a variety of stakeholders. Table 2-2 lists the concerns identified by each stakeholder.

Table 2-2. Concerns Grouped by Category and Listed by Stakeholder

Issues/Opportunities	General Public	State of Texas	USFWS
General / Ecoregion			
Climate Change	X		X
Erosion/Salt Water Intrusion	X	X	X
Invasive Flora/Fauna Control	X	X	X
Fire Suppression	X	X	X
Urbanization and Development	X	X	X
Petroleum Development	X	X	X
Habitat Management			
Bottomland Forest Habitat			
Land Acquisition	X		X
Wildfire	X		X
Wetland Restoration	X	X	X
Gulf Coast Prairies and Marshes			
Habitat Management	X	X	X
Fire and Smoke Management	X	X	X
Erosion / Salt Water Intrusion	X	X	X
Water Management	X	X	X
Public Use			
Waterfowl and Other Hunting Opportunities	X	X	X
Fishing Opportunities	X		X
Historical Preservation and Interpretation	X		X
Canoe and Kayak Access	X		X
Education and Outreach	X		X
Entrance Fee for Public	X		X
Wildlife			
Disturbance to Wildlife	X	X	X
T & E Species and Species of Concern	X	X	X
Reintroduction of Species	X	X	X

Issues/Opportunities	General Public	State of Texas	USFWS
Facilities			
Volunteer Facilities	X		X
Administrative Facilities			X
Visitor Center / Orientation Center	X		X
Roads and Trails	X		X

Additional public scoping for the LPP planning process was conducted in January, 2012, with a comment period open from January 15, 2012 until February 5, 2012. Three public (open house) meetings were held to provide information on the proposed expansion and respond to questions and concerns; January 20, 2012, at the Discovery Center on Brazoria NWR near Freeport, Texas; January 24, 2012, at the Complex Office near Brazoria, Texas; and February 2, 2012 at the Hudson Woods Unit of San Bernard near Angleton, Texas. A total of 30 people attended the public meeting, with attendance of 15, 7, and 8 respectively, at each public meeting. A response card indicating support or non-support of the proposal was handed out at each meeting, enabling participants to provide a quick response. In addition, The Facts newspaper printed articles twice during the open comment period which generated 8 email responses. Of the 27 total responses, 22 supported the project expansion and five did not.

2.3 Determine Issues

To determine the planning issues the CCP addresses, the planning team reviewed the concerns identified by the public along with management concerns identified by Service staff, the State of Texas and other governmental agencies.

Refuge planning policy defines an issue as any unsettled matter that requires a management decision: an initiative, opportunity, resource management problem, threat to the Complex’s resources, conflict in uses, public concern, or presence of an undesirable resource condition (602 FW 1.6I). Public responses, obtained through newsletters and three public open house meetings, in addition to management concerns identified by the Complex’s staff and other stakeholders, were used to identify issues addressed in the CCP and EA.

Public responses identified a broad range of concerns, which the planning team grouped and categorized by how they would be address them in the CCP (see Table 2-3). This process helped the planning team identify issues that are addressed in the CCP.

Table 2-3. Addressing the Issues Raised during Scoping –

Category	Concern
Issues that are outside the scope of this Plan.	<p><u>Landscape Level</u></p> <ul style="list-style-type: none"> • Stream Channelization <p><u>Wildlife Management</u></p> <ul style="list-style-type: none"> • Reintroduction of Species
Issues to be addressed in this Plan where no alternatives are presented.	<p><u>Landscape Level</u></p> <ul style="list-style-type: none"> • Petroleum Development • Wildfire Suppression <p><u>Habitat Management (Bottomland Forests)</u></p> <ul style="list-style-type: none"> • Forest Restoration • Wildfire • Wetland Restoration <p><u>Habitat Management (Gulf Coast Prairies and Marshes)</u></p> <ul style="list-style-type: none"> • Fire and Smoke Management <p><u>Public Use Opportunities</u></p> <ul style="list-style-type: none"> • Fishing Opportunities
Issues to be addressed in the Plan where alternative actions are presented.	<p><u>Landscape Level</u></p> <ul style="list-style-type: none"> • Land Conservation • Urbanization and Development • Erosion/Salt Water Intrusion • Flora and Fauna Invasive Species Control • Climate Change <p><u>Habitat Management (Bottomland Forests)</u></p> <ul style="list-style-type: none"> • Habitat Management <p><u>Habitat Management (Gulf Coast Prairies and Marshes)</u></p> <ul style="list-style-type: none"> • Habitat Management (farming, grazing, haying, etc.) • Water Management • Invasive Species (flora) Control • Prairie Restoration <p><u>Wildlife Management</u></p> <ul style="list-style-type: none"> • T & E species and Species of Concern • Waterfowl Management • Species of Management Concern • Invasive Species (fauna) Control <p><u>Public Use Opportunities</u></p> <ul style="list-style-type: none"> • Waterfowl and other hunting opportunities • Historical Preservation and Interpretation • Environmental Education and Outreach • Wildlife Observation • Canoe and Kayak Access • Entrance Fee for public <p><u>Facilities</u></p> <ul style="list-style-type: none"> • Roads and Trails • Volunteer Facilities • Visitor Center/ Orientation Center • Administrative Facilities

Based on issues, concerns and opportunities identified during scoping, the Complex identified five issue categories (ecoregion, habitat, wildlife, public use and facilities) for consideration during planning and development of this CCP. These issues reflect problems, opportunities, or points of discussion that the CCP addresses in a variety of ways. The EA (Appendix B) further discusses how the issues were addressed and displays the potential environmental consequences of the proposed action and its alternatives.

Strong public support or opposition is an important consideration, and the Service considers all comments, when deciding what management actions best meet the purposes of each refuge and the mission of the Refuge System. These comments demonstrate the broad range of approaches and opinions people bring to the issues. The complete set of written and verbal responses received is available from the Service's Regional Office in Albuquerque, New Mexico.

2.3.1 Ecoregion Issues

Documents including TNC's Gulf Coast Prairies and Marshes Ecoregional Assessment, Texas Comprehensive Wildlife Conservation Strategy, and Gulf Coast Joint Venture's Migratory Bird Management Plans and others identify threats and issues for the Gulf Coast Prairies and Marshes Ecoregion. We used the information derived from these documents during the meeting to gain a greater understanding of what other land management agencies and organizations are doing to address identified issues. The Complex used a "larger picture" when considering development of management direction for its CCP.

Members of the public, TPWD, and the planning team expressed concern about what role the Complex plays within the larger landscape. The Complex would like to take a landscape-scale approach to managing the Complex over the life of the CCP. Comments and concerns from our partners and the general public on ecoregion conservation-related issues were addressed according to, but not limited to, major issues such as climate change, fragmentation, commercialization, prairie conversion/habitat conservation, fire suppression, urbanization, and disturbance and are described in detail below.

Climate Change - As habitats change, the wildlife species that utilize those habitats will also change. Although the Complex can do little to resolve this issue, it can realize that such change is occurring, document these changes through data collection, and adapt management to reflect/address changes in hydrology and plant communities. Sea-level rise will have a direct impact on all three of the coastal refuges. Various models are being used to evaluate the loss of coastal marshes. Estimates from some models are showing that nearly 90 percent of the marshes on the Complex today may be converted to open water by 2100. Water, or lack of water, is expected to become a major environmental crisis throughout the state in the near future if conservation measures are not taken seriously. Combined with climate change, this issue has the potential to impact many refuge management activities such as wetland management, farming, habitat restoration, grazing, and fire management. Although climate change and other factors have the potential to alter the distribution of habitat types in this area, the effects of this change on resources across the landscape, including wildlife species, are still unknown.

Fragmentation - Remaining tracts of wetland, marsh, and prairie habitats are being broken up, divided, and impacted from development of roads for commerce, development for housing and businesses, and for agricultural purposes. Fragmentation has a highly detrimental impact on species that are less mobile.

Commercialization - Commercialization activities have negative impacts on both wildlife and habitat within the ecoregion. One of the commercialization activities of concern involves loss of habitat from communities spreading out from the Houston Metropolitan, which is approximately 45 miles north of the Complex. Commercial resale of sand deposits from wetland and riparian areas impacts water quality downstream and in the bays.

Petroleum development, timber cutting, commercial crabbing and oyster harvest, grazing and haying, turf farms, and illegal dumping are major impacts of commercialization affecting the entire ecoregion.

Petroleum Development - The public had concerns of petroleum development and the potential impacts it can have on both Complex habitats and wildlife species. Many members of the public would like to see no petroleum development on refuges and many would like to see special mitigations incorporated to minimize negative impacts to wildlife.

Prairie Conversion, Habitat Conversion - Monocultures and urban environments change habitats through development and draining of wetlands. These projects are directly contributing to a net loss of prairie habitat affecting both flora and fauna prairie-dependent species. This direct loss of habitat is a major concern for the ecoregion.

Wildland Fire Use - The suppression of wildfire has changed local prairie communities and this suppression supports the growth of invasive and exotic species, which compound the need for prairie restoration efforts.

Salt Water Intrusion - Navigation traffic introduces saltwater into freshwater marshes, causes drastic changes in native local plant communities and loss of habitat for many other species. Natural processes such as storms, hurricanes, and sea-level rise all contribute to salt-water intrusion that impacts prairie habitat.

Urbanization - Changing from vegetative environments to those of asphalt and concrete are reducing wildlife species, producing monocultures of grass that do not benefit wildlife and create barriers for many less mobile species. Urbanization is fragmenting native plant communities and resulting in a direct loss of plant diversity. Increasing pesticide and herbicide use around managed lands and an increase in fertilizer use are some of the many contributing factors of urbanization with negative impacts on prairie habitat. Urbanization is also adding additional stressors on a limited amount of public lands in Texas with an increased amount of natural resource users such as boaters, anglers, hunters, and outdoor enthusiasts. Urbanization is a serious issue, since the Complex is approximately 45 miles outside of the 5 million people living in Houston.

Disturbance - The effects of disturbance in some coastal habitats to a number of coastal wildlife species, particularly certain groups of birds (waterfowl, colonial waterbirds, shorebirds), is largely unquantified and merits investigation. Ecoregional partners have identified increased boat use and increased air traffic, as well as oil and gas exploration, as disturbances that affect wildlife in the ecoregion.

Land Conservation - The San Bernard NWR is approaching the 28,000-acre cap originally set by the Service in 1997 in decision documents with the Austin's Woods Conservation Plan Land Protection and Compliance Document. The Plan outlines the need to counter the rapid development and expansion of urban areas within the Columbia Bottomlands and protect a unique ecosystem essential for maintaining populations of migratory birds and resident species. The concerns identified in 1997 are still relevant and to date less than 5 percent of the historic habitat has been conserved. Recent research has continued to support the importance of these habitats for migratory songbirds, while nation-wide populations of songbirds continue to decline. Millions of Nearctic-Neotropical migrants make landfall in the bottomlands during spring and fall migration to rest and feed after and before crossing the Gulf of Mexico, respectively.

Acquisition efforts are a watershed-scale ecosystem type approach; focusing on the conservation of ecosystem integrity, function, heterogeneity, and biologic diversity addressed as a "bioreserve" network. The bottomlands are home to rare plants and several species that are at the edge of their range as well as newly defined species. Where the landscape is flat and unencumbered, the native forests are unique and add to the natural beauty of the area. An updated Land Protection Plan (LPP) (Appendix I) includes a proposal to allow the Service to continue conservation efforts within the Columbia Bottomlands, including raising the 28,000-acre cap to 70,000 acres. During the separate scoping meetings held for the LPP, concerns from the public regarding this expansion included feral hogs, the "thicket" appearance, removing lands from the tax base, acquisition funding, and additional public use opportunities. These issues are addressed in this document, the EA and the LPP.

2.3.2 Habitat Management Issues

Gulf Coast Prairies and Marshes

The Gulf Coast prairies and marshes were once part of an immense ecosystem covering nine million acres, in the states of Texas and Louisiana. Many of the tall grasses typically found in the Midwest prairie region occur on the coastal prairie as well, where bluestems are intermixed with species native to the coastal wetlands. The coastal prairie underwent intensive man-made development starting in the mid-20th century (Allain et al. 1999) and now totals less than 250,000 acres in Texas. Many native plant and animal components have already been lost, but the Service along with partners recognize the need to maintain existing remnants and restore native coastal prairie habitats.

Members of the public, TPWD, other federal agencies, and the planning team expressed concern on how the Complex will manage to ensure the conservation, diversity, and enhancement of the Gulf Coast prairies and marshes. Comments and concerns from our

partners and the general public on issues related to the conservation, diversity, and enhancement of Gulf Coast prairies and marshes were addressed consistent with, but not limited to, major issues such as development, erosion, fragmentation, invasive species, land management and other land use practices, natural occurrence, and pollution and are described in detail below.

Development - The effects of development include construction activity (i.e. building roads, structures, hardscape, oil and gas exploration), urbanization, urban sprawl, utility lines, and right of ways, as well as creation and modification of reservoirs. Direct effects of development in the Gulf Coast prairies and marshes are loss and habitat, and direct mortality of wildlife. Associated affects to development include impacts on water quality due to fertilizers, pesticides, herbicides and sanitary waste systems.

Erosion – Erosion may occur on beaches, along rivers, streams, creeks, shipping channels (including the GIWW), jetties, ditches and other locations. Sea level rise, siltation, beach erosion, and subsidence are also major contributors to erosion.

Fragmentation – Habitat fragmentation results from changes in land use for purposes such as agriculture, land transportation (roads and highways), water transportation (shipping channels), housing, and commercial and industrial development. Ecoregional partners have linked fragmentation to inhibited wildlife dispersal, lack of available habitat and reduced gene flow. Fencing and saltwater intrusion have been linked to fragmentation as well.

Invasive Species (Flora) – Invasive species are a sub-set of non-native species that can aggressively alter an ecosystem. Several invasive species, including Chinese tallow, Macartney rose, deep-rooted sedge, and salt cedar are common on the Complex and are reducing the quality and potential of native prairie and marsh habitats. Invasive species out-compete native vegetation, reduce plant diversity, alter hydrology, change soil characteristics and nutrient cycling and can impact the effectiveness of prescribed fire. Fire is the predominant management tool in the coastal prairies and salt marsh to control brush and invasive species encroachment. The use of herbicides may be employed during habitat restoration to remove invasive species and improve overall habitat conditions to support native wildlife.

Land Management and Other Land Use Practices - Land management practices including, prescribed fire, farming, moist soil management, grazing and haying have a variety of impacts on the Gulf Coast prairies and marshes. Effects of management practices vary but the intent is to provide quality habitat for native wildlife, including non-natural management areas. Water management is the one tool that the refuges do not have control over. Although the refuges do have some water rights, they are not sufficient for even current management needs. In addition, the ability to purchase water in support of farming programs and wildlife wetlands is solely determined by the River Authorities.

Natural Occurrences - Natural occurrences such as drought, floods, and stochastic events such as hurricanes and wildfire have both positive and negative impacts on Gulf Coast

prairies and marshes. Although unpredictable, these events are regularly occurring and impact management decisions.

Pollution - Pollution outside the Complex, but within the Gulf Coast prairies and marshes—such as petroleum/chemical spills, non-point and point source pollutants, contaminated water discharge, airborne sulfates, nitrates, heavy metals, and pesticide use—have lasting negative impacts on both wildlife and habitat.

Bottomland Hardwood Forests

Bottomland hardwood forests are the most diverse Texas ecosystems; they also rank as one of the most endangered ecosystems in the United States (U.S. Department of the Interior 2006). The Columbia bottomlands of east Texas in the Sabine, Trinity, Neches, and Sulfur River flood plains are the predominant Texas bottomlands, which make up about 75 percent of Texas' interior wetlands. Columbia bottomland wetlands are plant communities created because of the actions of creeks, rivers, and floodplains. Trees found in the bottomland hardwood forests include bald cypress, pecan, oaks, elm, cottonwood, and hackberry. These hardwoods, particularly old-growth hardwoods (50 to 100 years old), contribute to the biodiversity of the wetland system and provide food and shelter for wildlife. There has been a steady decline in bottomland forest since the early 19th century. Estimated loss of bottomland forest in Texas is 12% per decade.

The southern most bottomland forest, located south of Houston, is commonly referred to at the Columbia Bottomlands. The Columbia Bottomlands extends from the Gulf Coast in Brazoria and Matagorda County inland approximately 93 miles. Today, less than one quarter of the 700,000 acre historic forest remains intact. The Service along with partner agencies and organizations have conserved approximately 20 percent or 31,000 acres of those remaining forests.

Members of the public, representatives at the ecoregional meeting (TPWD and other agencies) and the planning team are concerned about the conservation of the Columbia Bottomlands. Restoration of wetlands (including flooded forests) are essential to preserving diversity, and controlling flooding down-stream flooding. There is concern that recently restored areas are vulnerable to wildfire ignitions in areas where the tree canopy has not yet shaded out grasses. Concerns were also expressed about how the Complex will manage to ensure the conservation, diversity and enhancement of the bottomland hardwood forests. Comments and concerns from our ecoregional meeting, as well as concerns from partners and the general public, were addressed according to, but not limited to, major issues such as incompatible forestry and livestock production practices, stream channelization, and invasive flora and fauna and are described in detail below.

Incompatible Forestry and Livestock Production Practices - Forestry and livestock production affects the productivity and function of bottomland hardwood forests through efforts such as clear cutting of trees to convert forests to grasslands as well as an increased number of “hobby ranchers.” These types of incompatible practices can eliminate or alter a system drastically enough to change the entire production of flora and provide ideal

conditions for exotic flora establish, decrease soil stability, and change the hydrology of the entire system.

Stream Channelization - As residential areas continue to expand, the natural hydrology of a system becomes difficult to maintain and manage, especially in the constantly flooded hardwood forest. Large developers, as well as municipalities, typically alter hydrological activities on a large-scale in an attempt to minimize damage to newly developed areas.

Invasive Native and Exotic Flora and Fauna - Invasive plants have the potential to take over sites and out-compete less aggressive native vegetation in areas disturbed through livestock production practices, clear-cutting, and development including rights-of-way. Animal pests, such as feral hogs and free roaming cats, have negative impacts on native wildlife in bottomland hardwood forests.

2.3.3 Wildlife Management Issues

The Complex is home to a vast variety of wildlife species that reside year round and others that migrate to, from, and through the Complex. The expanse of marshes, sloughs, ponds, prairies, and forests represent feasting and lodging for more than 400 species of wildlife, including 320 species of birds. The Complex also provides wildlife an opportunity to nest, rest, feed, and winter within the boundaries of the Complex. The Complex is well known for its large variety of migratory birds including waterfowl and other water, grassland and forest dependant species. The Complex supports more than 100,000 shorebirds annually, as well as white-tail deer, bobcat, river otter and alligator populations. The refuges include several rookeries for a large variety of wading birds, terns, gulls, and black skimmers.

Members of the public and planning team commented on the management of both migratory and resident wildlife on the Complex. They identified the need for critical habitat for mottled ducks year round. The Complex provides important habitat for migratory waterfowl, songbirds, and shorebirds during portions of the year, including critical beach habitat for piping plovers.

The public, other state and federal agencies, and the planning team also expressed concern on how the Complex will manage wildlife to ensure the conservation, diversity, and enhancement of trust resources. Wildlife are vulnerable to disturbance and habitat loss as a result of agriculture, development, erosion, fragmentation, human disturbance, invasive species, natural events such as hurricanes, flood events, brood parasitism, direct competition, stochastic events, wildfire, pollution, lack of protection, naturally limited range, and vehicular impacts such as beach compaction and nest disturbance.

Threatened and Endangered Species – Three listed bird species (piping plover, northern aplomado falcon, and interior least tern) have been documented on the Complex. The piping plover is listed as endangered in Brazoria and Matagorda Counties and can be found on refuge beaches and mud flats from late July to May annually. The northern aplomado falcon is listed as endangered in Matagorda County. Irregular sitings of a transient bird have occurred on the San Bernard NWR. The interior least tern is listed as endangered in Wharton

and Fort Bend Counties. These birds are migratory through the area and are usually associated with mudflats along river banks. In addition, the Sprague's pipit, which is a candidate species, has been documented in all four counties, but its current status on the Complex is unknown. It is a migrant species found during migration and winter, generally tied to upland native grasslands and can be found in large numbers in coastal grasslands. The red knot is also a candidate species utilizing beach and tidal flats at San Bernard NWR. All five listed sea-turtles are found in the Gulf or Bays near the refuges. The Kemp's ridley sea turtle will nest on the San Bernard NWR beach. The refuge supports the Kemp's ridley Sea Turtle Recovery Plan by patrolling and responding to turtle stranding and nesting reports.

Two additional species, the Attwater's prairie chicken and the whooping crane, which do not currently occur on the Complex, may have potential recovery habitat on the Complex. In the future, the Service may consider reintroducing the Attwater's prairie-chicken onto refuge prairies and the expansion of whooping crane populations up the coast.

Migratory Bird Species and Species of Special Management Concern – The Texas Gulf Coast is the primary wintering area for most of the Central Flyway. More than 250 bird species use Complex habitats during all or part of the year. The Complex is one of the few areas on the Texas coast where snow geese still feed on native salt marsh grasses rather than on agricultural crops. The mottled duck is a species of management concern which requires an integration of habitats including prairie for nesting and freshwater wetlands for brood rearing and molting.

Species of special management concern and focal species are monitored with the intent that habitat features affecting these species can expect to have similar effects on other species with similar habitat requirements. Species are selected to monitor the effects of landscape scale characteristics that if properly managed will have beneficial effects on species sharing similar conservation needs. Loss of prairie habitat has affected many grassland dependent bird species which are experiencing an alarming rate of decline. Managed wetlands are essential for providing habitats for migratory waterfowl where drought and loss of wetlands have altered the landscape. Preserving old growth forest habitats along the Gulf Coast are essential for maintaining Nearctic-Neotropical migratory bird populations and resident mammal, bird and herpetile populations in this rapidly developing area.

2.3.4 Public Use Issues

Approximately 34,000 visitors visit Brazoria NWR and 34,000 visitors come to San Bernard NWR annually. About a quarter of the visitors, come during the spring season (March–April) to view birds and enjoy the coastal prairie habitat when a variety of flowering plants are blooming. Approximately 5,000 visitors come to Big Boggy NWR for hunting and fishing opportunities. The Brazoria NWR Discovery Center is approximately 1,500 square feet in size and includes a visitor contact center, lab, and office, and can host up to 50 students at a time. It also contains a large screen television and projection screen for interpretive programs and contains a pavilion overlooking Big Slough in the back of the Discovery Center. The Discovery Environmental Education Program (DEEP) has been functioning at the refuge since 1994. DEEP currently serves approximately 3,000 students

and in future years, could expand to 6,000 students as the population of the area increases. The Complex continues to serve as an outdoor education center where graduate students conduct research projects involving waterfowl and other migratory birds, agriculture, moist soil unit production, fish and wildlife, and forestry studies. The Complex is open to the public throughout the year with the exception of Big Boggy NWR, which stays closed to all public uses except for limited hunting and fishing activities.

Individuals expressed multiple concerns regarding public use opportunities on the Complex such as increased opportunities for public use facilities, administrative facilities and increased access. Some individuals would like to see more opportunities for photography and viewing areas with information about refuge habitats. Individuals expressed a desire to expand DEEP into additional school districts. Some individuals would also like to have additional canoe and kayak launch sites available for accessing water bodies adjacent to and within the Complex.

2.3.5 Facilities Issues

The Complex is comprised of three wildlife refuges and a headquarters office Stringfellow Unit of San Bernard NWR outside Brazoria, TX. A Complex manager oversees a number of employees with duties toward all refuges and the individual refuge managers.

Brazoria NWR - The Otter Slough headquarters consists of the refuge's field office, maintenance and equipment storage facilities which is located off FM 2004, Angleton, TX. The office has eight individual offices and supports field operations including management, maintenance, fire, and law enforcement.

San Bernard NWR - The field headquarters of San Bernard NWR is located on CR 306, near Brazoria, TX. The field headquarters include the refuge's office and fire office, maintenance and equipment storage facilities and storage sheds, one quarters, two volunteer recreational vehicle pads, and a communications tower (repeater).

Big Boggy NWR - The primary facility resources on Big Boggy NWR are habitat management and resource protection related. No developed infrastructure occurs on this refuge.

Members of the public and the planning team have concerns about the Complex's facilities. There is a need to repair and update some roads and trails and build greening infrastructures to help mitigate climate change impacts. The Complex desires to upgrade and construct additional facilities to support volunteer program and public use opportunities. The additions of administrative facilities to support various refuge programs would be beneficial.

2.4 *Develop and Analyze Alternatives*

The practice of developing management alternatives as a part of the planning process is derived from NEPA. This act requires federal agencies to consider the impacts of proposed actions and to develop a reasonable range of alternatives to those actions. Alternatives are

“different sets of objectives and strategies or means of achieving refuge purposes and goals, helping to fulfill the Refuge System mission, and resolving issues” (602 FW 1 of the Service Manual). The planning team developed a range of alternatives that respond to the planning issues and eliminated alternatives that did not meet each refuge’s purposes or that were outside the Service’s ability to implement. The effects of the alternatives were analyzed and presented in Chapter 4 of the EA found in Appendix B.

2.5 Prepare Draft CCP and EA

The Draft CCP and EA were prepared concurrently. The Draft CCP and EA were then submitted for internal review, submitted to TPWD for review, then released to the public for a 30-day review period. The Notice of Availability for the Draft CCP and EA was published in the *Federal Register* on August 15, 2012 (Volume 77, Number 158, pp. 49011-49015) and again on August 21, 2012 (Volume 77, Number 162, pp. 50523-50526) because the incorrect comment period end date was published in the first notice. The comment period closed on September 20, 2012.

2.6 Prepare and Adopt Final CCP

During the full public review period, only four comments were received by the Service. A summary of comments and the Service’s response can be found in Appendix L. This Final CCP will replace current management direction after the decision document is signed (see section 1.6, Decision to be Made, of Appendix B, Environmental Assessment).

2.7 Implement Plan, Monitor, and Evaluate

This CCP will guide management of the Complex over the coming 15-year period. It will guide the development of more detailed step-down management plans for specific resource areas and will be the basis for the annual budgeting process for operations and maintenance (Chapter 5). Most importantly, it lays out the general approach to managing habitat, wildlife, and people at the Complex that will direct day-to-day decision-making and actions.

A critical component of management is monitoring and measuring resources and social conditions to make sure that the Complex makes progress towards meeting its goals. Monitoring also detects new problems, issues, or opportunities to address. The Complex is using an adaptive management approach, which means that information gained from monitoring is used to evaluate and, as needed, to modify Complex objectives.

2.8 Review and Revise Plan

Agency policy directs that the Complex review the CCP annually to assess the need for changes. The Complex will revise the CCP when significant new information becomes available, ecological conditions change, or upon identification of the need to do so during the annual review. If major changes are proposed, the Complex may hold public meetings, or new environmental assessments and environmental impact statements may be necessary. Consultation with appropriate state agencies would occur at least every 15 years.

3. Refuge Resources and Current Management

This chapter provides a detailed description of the Complex, its habitats, the species that occur, how habitat and species are managed, and the recreational opportunities it offers. It is divided into six major sections: Landscape Setting; Physical Environment; Biological Environment; Socioeconomic Environment; Archeological, Cultural and Historic Resources; and Current Management.

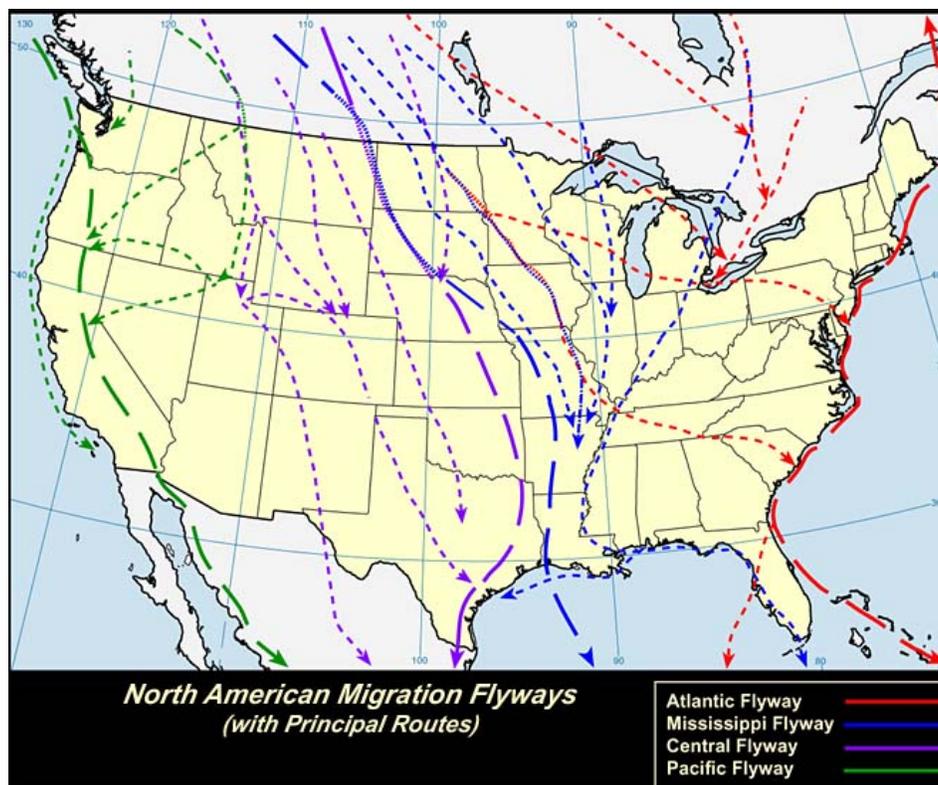
3.1 Landscape Setting

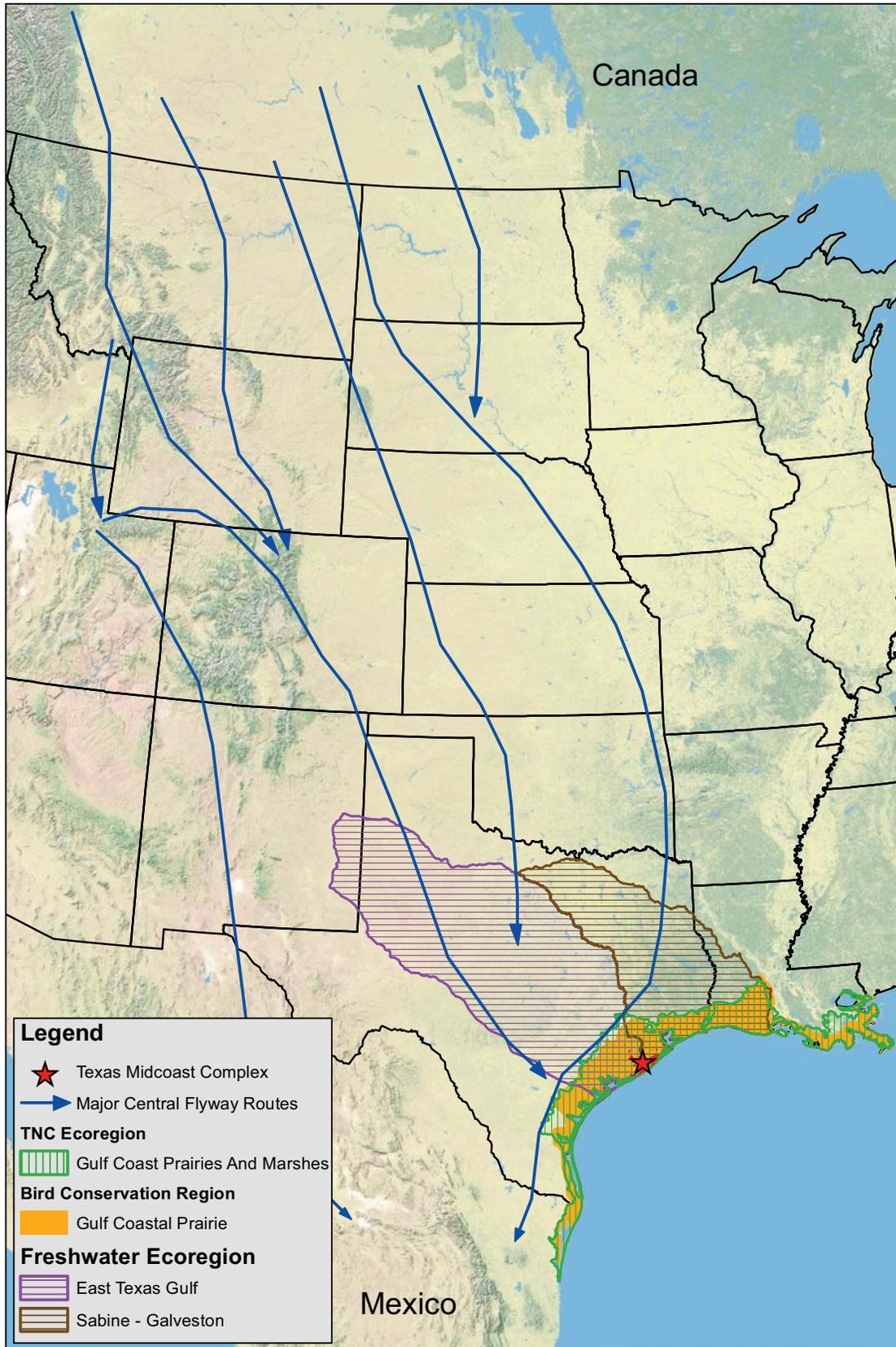
In order to effectively achieve the Refuge System mission of conserving fish, wildlife, plant resources and their habitats, the Complex took a landscape-scale approach identifying resources, issues, and management direction. The Complex is one small portion of land within a larger landscape, and as such, looked beyond its boundaries to determine its role in the larger conservation effort. This section describes the landscape setting where the Complex is located (Map 3-1. Landscape-Scale Conservation).

3.1.1 Central Flyway

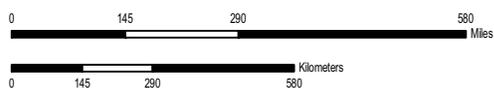
Bird migration is the seasonal movement of birds between summer nesting habitat in Canada and the northern U.S. and wintering habitat in the southern U.S., Central, and South America. These movements generally follow regular routes called flyways. There are four administrative flyways in North America: the Atlantic, Mississippi, Central, and Pacific (Figure 3-1).

Figure 3-1. North American Migration Flyways





PRODUCED IN THE DIVISION OF REFUGE PLANNING
 ALBUQUERQUE, NEW MEXICO
 LAND STATUS CURRENT TO: 5/31/09
 MAP DATE: May 2011
 BASEMAP: N/A
 MERIDIAN: N/A
 FILE: tmc_landscape_scale_5.4.11_shl



It is along these four flyways that tens of millions of migrating birds travel seasonally. The Service established refuges along these flyways to provide resting and nesting habitat for migrating birds. The Complex is located within the Central Flyway, which spans the Canadian Northwest Territory, two Canadian provinces (Alberta and Saskatchewan), ten U.S. states (Montana, North Dakota, South Dakota, Wyoming, Nebraska, Colorado, Kansas, New Mexico, Oklahoma, and Texas), and numerous countries in Central and South America. There are over 100 national wildlife refuges and/or waterfowl management units located in the ten states found within the Central Flyway. The Service's Southwest Region manages 36 of these, in the states of New Mexico, Texas, and Oklahoma. The Complex has three of the 18 refuges located within the state of Texas. All three refuges provide quality winter habitat for migratory birds which is necessary to sustain a healthy condition for spring migration and reproductive success.

3.1.2 Gulf Coast Prairie Landscape Conservation Cooperative (LCC)

The Gulf Coast Prairie region faces many challenges that threaten both nature and wildlife within this diverse landscape. The once extensive grassland system has been impacted by urban and agricultural development. Large rivers struggle to maintain integrity as base flows have declined. Coastal systems suffer from the effects of reduced freshwater inputs. Unprecedented drought, catastrophic wildfires, and climate-related impacts, as well as other threats such as pollution, invasive species, and disease also put a strain on native species and habitats.

From tall grass prairies to forested landscapes, across tidal flats and reef complexes, the Gulf Coast Prairie region boasts a beautiful and incredibly complex landscape. The area encompasses portions of five states (Texas, Oklahoma, Louisiana, Mississippi, and Kansas). The Gulf Coast Prairie region contains several large river systems, including the lower Rio Grande, Guadalupe, Brazos, Trinity, Nueces, Arkansas, Red, San Antonio, and Mississippi Rivers. The Region includes 4 subdivisions or ecoregions; Tamaulipan Brushlands, Oaks and Prairies, Gulf Coastal Prairie and Edwards Plateau (Figure 3-2). Each ecoregion contains a unique mix of habitats and priority populations of fish and wildlife. The Complex lies within the Gulf Coastal Prairie Conservation Region (ecoregion) but includes a unique ecosystem; the Columbia Bottomlands which occurs across the floodplanes of the Brazos, San Bernard and Colorado Rivers.

Figure 3-2. Gulf Coast Prairie Region Landscape Conservation Cooperative.



3.1.3 Ecoregion Setting

Ecoregions denote areas of general similarity in ecosystems and in the type, quality, and quantity of environmental resources. They are designed to serve as a spatial framework for the research, assessment, management, and monitoring of ecosystems and ecosystem components. By recognizing the spatial differences in the capacities and potentials of ecosystems, ecoregions stratify the environment by its probable response to disturbance. Ecoregions are critical for structuring and implementing ecosystem management strategies across federal agencies, state agencies, and nongovernment organizations that are responsible for different types of resources within the same geographical areas (EPA Web site: <http://www.epa.gov/wed/pages/ecoregions.htm>).

The Complex is located within the Gulf Coast Prairies and Marshes (GCP&M) ecoregion as identified by TNC (Gould et al. 1960). The GCP&M Ecoregion is a region of contrasts and commonalities. The region encompasses two countries, two states, 22 primary bays, 19 major rivers, and nearly 600 miles of shoreline. Great biodiversity characterizes the GCP&M, a rich and vast ecoregion consisting of nearly 24 million acres. The number and species of birds in the ecoregion are among the greatest anywhere in the U.S. and Canada. The region is also renowned for its butterfly and reptile diversity. The region's productive bays and estuaries are virtual factories, producing fishes and shellfish upon which the people of the ecoregion depend economically, and that constitute important links in the food chain for many marine organisms. At the same time, the ecological diversity of the GCP&M faces drastic declines, with habitat loss and fragmentation posing some of the most serious threats to the ecoregion's biological health (Ricketts et al. 1999).

Pre-Settlement Landscape

Before European settlement, the GCP&M was composed of a mosaic of tallgrass coastal prairie, riparian bottomland hardwood forests, ephemeral freshwater wetlands, canebrake swamps, extensive coastal forests, chenier woodlands, freshwater tidal wetlands, brush mottes and corridors, barrier islands, estuaries, saltwater marshes, hypersaline lagoons, lomas, and associated Tamaulipan thornscrub habitats. This integrated matrix of habitat types combined to form one of the most productive and biologically rich ecosystems in the world (Smeins et al. 1991).

Humans in the GCP&M

Human inhabitants have always been drawn to the Gulf of Mexico. Nomadic native peoples took advantage of the bounty of food resources such as oysters, shrimp, fish, alligators, and birds available in the nearshore waters and coastal prairies (Ricklis, 1997). Today, industrial development and distribution, business infrastructure, agricultural production, tourism, and the appeal of a coastal lifestyle with associated recreational and aesthetic attributes fuel the attraction.

Although certain areas of the ecoregion are sparsely populated, other areas such as Houston, the fourth largest city in the U.S., and Harris County, the second most populous county in the U.S., locally impact biodiversity. On a somewhat larger scale, the ecoregion supports the world's second largest petrochemical complex and some of the nation's busiest port

facilities. In Texas, more than 1/3 of the state's population lives within 100 miles of the coast.

Alteration of the Landscape

The ecoregion has been transformed dramatically since the early 1900s. Freshwater wetlands have been reduced by 30 percent (Moulton et al. 1997), coastal forests have been cleared and fragmented (USFWS 1997), the chenier woodlands of the upper Texas coast are essentially gone (Gosselink et al. 1979), less than one percent of the tall grass coastal prairie remains (Smeins et al. 1991) and the Gulf Intracoastal Waterway has had significant impacts on coastal marshes. Remaining representative pieces of most habitat types are generally small, fragmented, and degraded in some way (i.e., exotic plants, disrupted hydrology, overgrazing, channelization, etc). Large landholdings are also becoming less common due to inheritance taxes and developmental pressures.

3.1.3.1 Terrestrial Description

Coastal Prairie

The prominent feature of this ecosystem includes the coastal prairies, which in many places contain small depressional wetlands. Coastal prairies once occupied over nine million acres, but today substantially less than one percent of original coastal prairie grasslands remain in relatively pristine condition. Estimates are that as little as 65,000 acres of high quality coastal prairies remain in Texas (Smeins et al. 1991). This ecosystem is now largely fragmented by agricultural, urban development, woody species encroachment resulting from fire suppression, overgrazing, and invading exotic species such as Macartney rose, Chinese tallow, deep-rooted sedge, and red imported fire ants.



A once vast and diverse ecosystem, remnant coastal prairies are being restored and managed across the Complex to provide habitat for resident and migratory wildlife including Henslow's sparrow (inset), a priority species. Photo Credit: USFWS

Tallgrass coastal prairie is found along the coast of Texas and Louisiana and is defined by the presence of little bluestem along with various compositions of numerous other tall grass species including big bluestem, bushy bluestem, brownseed paspalum, Indian grass, eastern gammagrass, switchgrass, longtom, and coastal species including marsh hay cordgrass.

Native coastal prairie grasslands, and their associated wetlands, are biologically the most impacted habitat type within the Gulf Coast Ecosystem (USFWS 1996). Natural forces that shape the system include prevailing southeast winds, tropical weather systems, and rainfall of more than 60 inches/year on the upper Texas coast. Fire and grazing by American bison were, prior to colonization, key factors influencing plant succession, particularly in the grasslands (The Nature Conservancy 2002).

Functional prairies and insects naturally go together. The result is a unique insect diversity including butterflies, dragonflies, and numerous species of bees, wasps, leafhoppers, ants, grasshoppers, beetles, and praying mantis. Many bird species rely upon remnant coastal prairie habitat where more red-tailed hawks, northern harriers, white and white-faced ibises reside than in any other ecoregion of North America (Gosse et al. 2002). There are also abundant numbers of waterfowl, wading birds, and shorebirds.

Many remaining stands of coastal prairie are under constant threat from habitat fragmentation, exotic species, overgrazing, and lack of fire (The Nature Conservancy 2002). The Brazoria NWR has a contiguous expanse of native prairie (16,000 acres) with 5,000 acres of mima mounds and natural potholes intact. The remaining prairie has been restored on old fields and pastures by controlling native brush and invasive species over the past seven years. Smaller acres of prairie are found on San Bernard, where the marsh grades toward bottomland forest in the Brazos and San Bernard river flood plains rather than upland prairie. Two notable additions to San Bernard, the Buffalo Creek Unit and Eagle Nest Lake Unit do contain expanses of former coastal prairie, near Daman, TX. The Service has been restoring 800 acres of coastal prairie from former pasture/field on the Buffalo Creek Unit for the past 5 years. Nearly 1,000 acres of field and pasture lands will be restored on Eagle Nest Lake in cooperation with NRCS over the next several years.

Bottomland Hardwood Forest (Columbia Bottomlands)

The bottomland hardwood forests that occur adjacent to the Brazos, Colorado, and San Bernard rivers of the upper Texas Gulf Coast are known regionally as the Columbia Bottomlands. These bottomland hardwood forests are among the most diverse of Texas ecosystems; they are also ranked as one of the most endangered ecosystems in the U.S. (U.S. Department of the Interior 2006). Bottomland wetlands are plant communities that have been created as a result of the actions of creeks, rivers, and floodplains. The bottomland hardwood forest is a part of a system that starts at a river's headwaters and ends in an estuary at the ocean. These hardwoods, particularly old-growth hardwoods (80+ years old), contribute to the biodiversity of the wetland system and also provide a significant amount of food and shelter for wildlife. Dominant tree species include water oak, green ash, sugar hackberry, live oak, Shumard oak, honey locust, cedar elm, pecan, box elder, black willow, American elm, cottonwood, and sycamore. The understory in undisturbed areas is frequently dense with shrubs, vines, palmetto, and young trees (USFWS 1997).

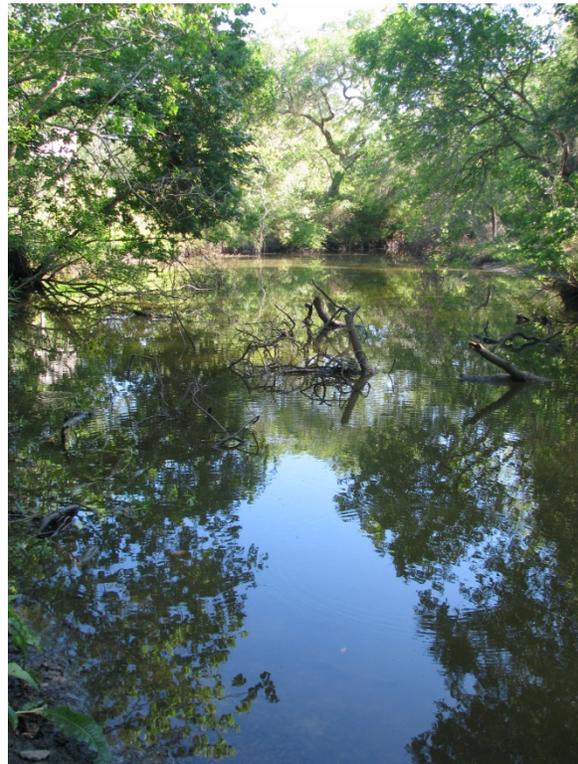
The Columbia Bottomlands (known locally as Austin's Woods), extend from the Texas coast, approximately 93 miles inland, and include parts of seven counties. It has been estimated that the Columbia Bottomlands, comprised over 699,308 acres at the beginning of the last century (USFWS 1997). In 1995 approximately 177,000 acres remained, and these remaining stands are highly fragmented and are threatened by residential and commercial development, agricultural conversion, timber removal, and infestation by non-native plants (USFWS 1997; Barrow & Renne 2001; Barrow et al. 2005). Recent studies utilizing Geographic Information Systems suggested a loss of approximately 17 percent between 1979 and 1995 (Webb 1997). Today it is estimated that only 150,000 acres of forest remain. An estimated 29 million Nearctic-neotropical migrant landbirds represented by 65-70 species migrate through the Columbia Bottomlands annually (USFWS 1997). The bottomlands form a broad corridor from the Gulf of Mexico inland, providing a passageway for migration in a strategic location of the Gulf.

3.1.3.2 Aquatic Description

Within this ecoregion, Texas has approximately 365 miles of open Gulf shoreline and contains approximately 2,361 miles of bay-estuary-lagoon shoreline. This is the most biologically rich and ecologically diverse region in the state and supports more than 601,000 acres of fresh, brackish and salt marshes (TPWD 2005).

Freshwater Wetlands

San Bernard and Big Boggy NWRs are located in the East Texas Gulf freshwater ecoregion of North America. The East Texas Gulf is an ecoregion of the Mississippi Complex located in the Arctic-Atlantic Bioregion. This ecoregion stretches from eastern New Mexico to southeastern Texas, defined by the watersheds of the Brazos and Colorado rivers and their tributaries. Other freshwater habitats in this karst area include caverns and springs (Abell et al. 2000). There are approximately 100 fish species, of which at least two are endemic - the burrhead chub and smalleye shiner (Conner and Suttkus 1986). There are 12 endemic hydrobiid snails, two endemic unionid mussels, and one endemic salamander, the Texas blind salamander (Bowles and Arsuffi 1993). This ecoregion is considered vulnerable, meaning that remaining habitat occurs in blocks or segments and established exotic species may be controllable (Abell et al.



One of several small waterways, Bastrop Bayou carries local runoff from the Columbia Bottomlands north of Lake Jackson, through the Dow Woods Unit of San Bernard NWR. Photo Credit: USFWS

2000). Of these endemic species, the smalleye shiner has been documented on the Complex.

The Brazoria NWR and units of the San Bernard NWR are located in the Sabine-Galveston freshwater ecoregion of North America. The Sabine-Galveston is an ecoregion of the Mississippi Complex located in the Arctic-Atlantic Bioregion. It covers central and southeastern Texas and western Louisiana and includes the watersheds of the Neches, Trinity, San Jacinto, and Calcasieu rivers (Abell et al. 2000). Wetlands dominate the ecoregion, although there has been a 30 percent decline in freshwater wetlands in recent decades. There are no known endemic fish species in this ecoregion (Connor and Suttkus, 1986). This ecoregion is considered vulnerable (Map 3-1. Landscape Scale Conservation).

Marshes

Coastal marshes within this ecoregion and the Complex include: salt marsh, brackish marsh, and fresh marsh. Salt marshes near Texas estuaries are typically dominated by cordgrass, although black mangroves predominate in certain areas. They are subject to intermittent inundation due to tidal action and high levels of freshwater inflow. Fluctuations in temperature, salinity, water depth, and sediment composition can have a limiting effect on the number of plant species found (Armstrong 1987). The brackish-marsh community is a transitional area between salt marshes and fresh marshes. Brackish marshes are the dominant wetland communities in the Galveston Bay system (White and Paine 1992). They are widely distributed along the lower reaches of the Trinity River delta in the inland system west of the Brazos River and along the lower reaches of the Lavaca and Guadalupe River valleys (TPWD 2005). The environments in which fresh marshes occur are generally beyond the effects of saltwater flooding, except perhaps during hurricanes. Freshwater influence from rivers, precipitation, runoff and groundwater is sufficient to maintain a fresher-water vegetation assemblage consisting of such species as cattail and three-square bulrush. Fresh marshes occur on the mainland and barrier islands along river or fluvial systems.

Marine Environments

The northern Gulf of Mexico is a rich and productive subtropical environment that supports extensive wetland and seagrass habitats, oyster reefs, sponge and soft coral, marshes, mangroves, tidal flats, submerged freshwater grasses, and several distinctive species such as dwarf seahorse, Gulf sturgeon, diamondback terrapin, and fringed pipefish. Coastal marine environments in this ecoregion are ecologically inseparable from the terrestrial and freshwater environments. The Complex is located within the western subregion of the northern Gulf of Mexico which extends south from Galveston Bay. This area is characterized by low freshwater input, sandy sediments, and clear waters: ideal conditions for the growth of seagrasses. In general, freshwater input decreases southward, and in the southern portions of this subregion evaporation is greater than freshwater input. The total drainage basin for the northern Gulf of Mexico contains nearly 60 percent of the land area of the continental U.S., including some of the most fertile lands in the world (Lovejoy 1992). This productive drainage makes the Gulf one of the primary producers of finfish and shellfish in the U.S. (TNC 2002). The Gulf of Mexico is a productive environment - ranking as the number one region for seafood harvest in both poundage and monetary value. Much of the productivity of this region is believed to have its origins in the productivity of the nearshore marshes and seagrasses (Duke and Kruczynski 1992), because these habitats serve as

nurseries for juveniles, and/or simply because they are a large source of carbon and nutrients (Deegan 1993).

3.1.4 Protected Areas in the Gulf Coast Prairies and Marshes Ecoregion

The International Union for Conservation of Nature (IUCN) defines a protected area as “a clearly defined geographical space, recognized, dedicated, and managed through legal or other effective means, to achieve the long-term conservation of nature with associated ecosystem services and cultural values” (Dudley 2008). Protected areas serve a variety of purposes for society. They are an expression of our community’s goals to maintain the value of biodiversity and to ensure that we pass these values on to future generations. They represent the diversity of the earth’s history and the current natural processes, and provide many environmental services such as clean air, water, and nutrients. They are treasured landscapes reflecting the inherited cultures of many generations and they hold spiritual values for many societies (IUCN 2005).

Protected areas cover over 13 percent of the earth’s land surface (IUCN 2005). In the U.S., over 10,480 protected areas, including state level protected areas, account for 27 percent of the land area (1,006,619 sq. mi) (UNEP 2008). Within the GCP&M Ecoregion there are approximately 135 conservation and recreation areas set aside by federal (51.3 percent of total acres), State of Texas (5.8 percent of total acres), State of Louisiana (39.3 percent of total acres), or privately owned/managed conservation and recreation units (3.6 percent of total acres). Appendix D identifies conservation and recreation areas within the GCP&M Ecoregion. These protected areas total 1,599,366 million acres (6.6 percent) of the entire GCP&M Ecoregion (Map 3-2. Ecoregion Map).

Within the Texas Mid-coast Complex area there are several protected areas. These include the Nannie M. Stringfellow and Justin Hurst Wildlife Management Area near San Bernard NWR. Further inland, Texas Parks and Wildlife also manages the Brazos Bend State Park which includes riverine and bottomland forest. The Christmas Bay Conservation Preserve, adjacent to the Brazoria NWR are Texas waters leased to Texas Parks and Wildlife Department under the Texas Coastal Preserve Program. The Preserve is designed to protect unique coastal areas and fragile biological communities. In addition to State lands, several non-profit organizations hold fee title or conservation easements on parcels within the Mid-coast area including Gulf Coast Bird Observatory, Galveston Bay Foundation, Houston Audubon, Bayou Land Conservancy and Ducks Unlimited.

3.1.5 Conservation Corridors

Conservation corridors are physical connections between disconnected fragments of plant and animal habitat. Without such connections, some species would be unable to reach necessary resources like food, water, mates, and shelter. The Complex will continue to work with its partners to identify key conservation corridors and crucial habitats necessary to meet the needs of an array of wildlife species.

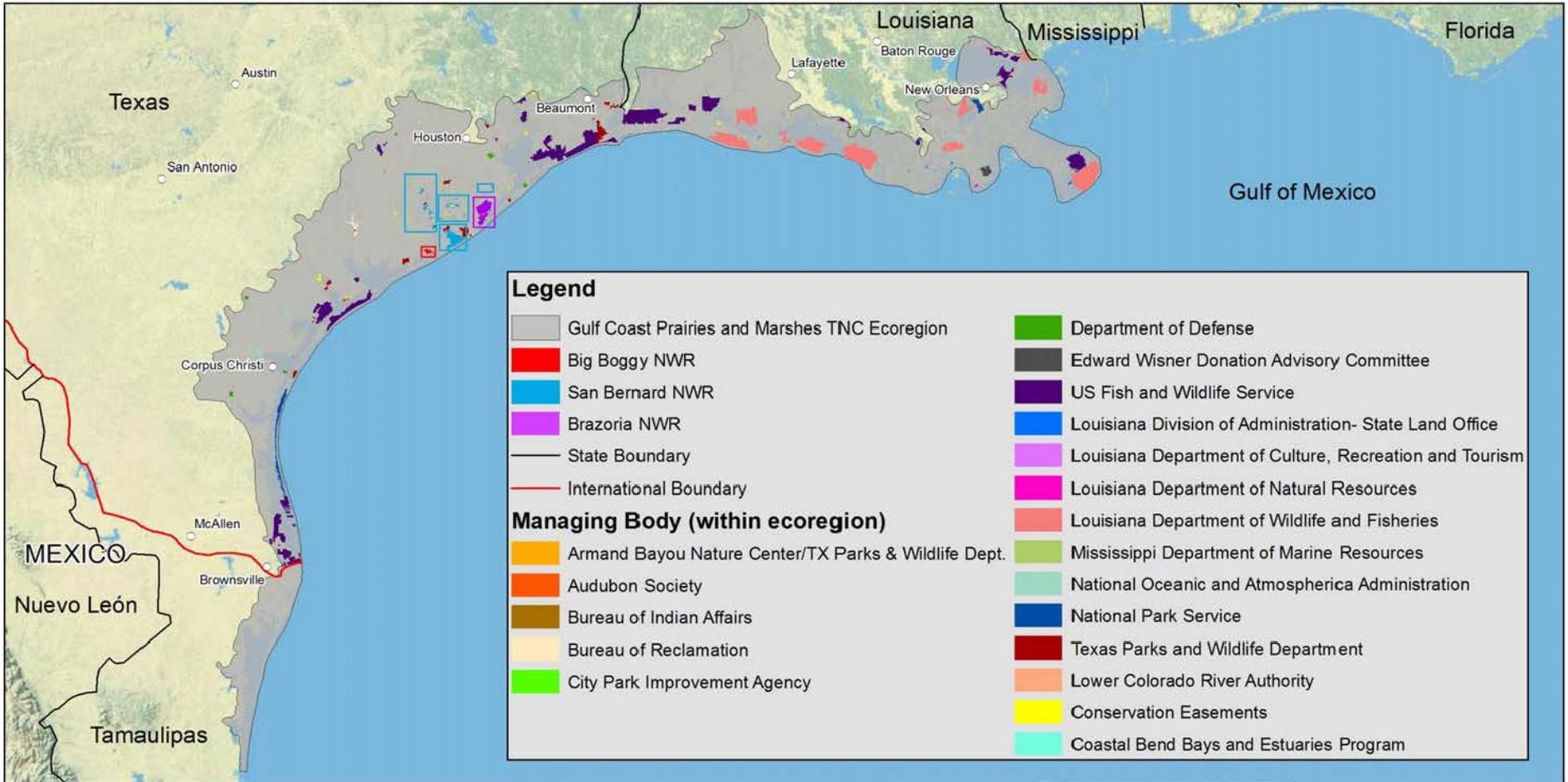


U.S. Fish & Wildlife Service

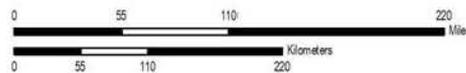
Texas Mid-coast National Wildlife Refuge Complex

Brazoria, Wharton, Fort Bend and Matagorda Counties, Texas

Map 3-2. Ecoregion Map



PRODUCED IN THE DIVISION OF REFUGE PLANNING
 ALBUQUERQUE, NEW MEXICO
 LAND STATUS CURRENT TO: 5/31/09
 MAP DATE: August 2012
 BASEMAP: N/A
 MERIDIAN: N/A
 FILE: tmc_ecoregion8_22_2012sk



The Complex contains a vast expanse of bottomland hardwood forest tracts that serve as intermittent corridors. Woodland corridors can support a large diversity of species, sometimes the highest in the landscape (Stauffer and Best 1980), and can enrich the ecological opportunities for mammals (Jones et. al. 1985) and birds. Songbirds in Canada were twice as likely to move through woodlands than clearings, and the majority of birds selected wooded routes over cutting across a clearing, even though the wooded routes may have been three times as long (Desrochers and Hannon 1997). On the Complex, the Columbia Bottomlands serve as stopover corridors for songbirds during spring and fall migration. The periodic occurrences of excellent stopover habitat where these birds can stop and refuel are definitely beneficial to them on their journey.

The Columbia Bottomlands in association with riparian areas may be very important for migratory bat species as they provide tree roosts, an abundance of insect prey, a constant source of water, landmarks to follow during migration (Cryan and Veilleux 2007), and protection from predators. Less obvious wildlife species such as box turtles and timber rattlesnakes also benefit from the presence of solid corridors in the bottomland system. As they move overland to find mates and denning sites, fragmentation of these corridors by roads and features that expose them to greater mortality risks work against them.

Endangered species such as the whooping crane may also benefit from the riparian and wetland habitats on the Complex. Suitable stopover habitat is necessary for whooping cranes to complete their migration. Yet, wetlands suitable for overnight roost sites may be limited along this route (Stahlecker 1992), further increasing the importance of wetland habitats like those within the Complex that may eventually be part of the whooping crane migration corridor.

In a similar fashion, the Complex expects coastal prairie and salt marsh habitats to serve as part of a migration corridor for a wide range of species of concern. Examples are Henslow's and LeConte's sparrows, yellow rail, and the white-faced ibis.

3.1.6 Refuge Location

Located along the upper Texas Gulf Coast in Brazoria, Matagorda and Fort Bend Counties, the Complex includes Brazoria, San Bernard, and Big Boggy NWRs. The Complex is approximately 50 miles south of Houston (Map 3-3. Texas Mid-Coast Refuge Complex Location).

Brazoria NWR - The Brazoria NWR is located approximately ten miles east of Freeport, Texas, in Brazoria County. The refuge is bordered by FM 2004, a prominent two-lane highway along the north and northwest; by Chocolate Bay along the east; by Bastrop, Christmas, and Drum Bays on the south and southeast; and by private land and Austin Bayou along the west.

San Bernard NWR - The San Bernard NWR is located approximately ten miles southwest of Freeport, Texas, in Brazoria, Matagorda, and Fort Bend Wharton Counties. The Austin Woods Conservation Plan enables the expansion of San Bernard in to part of Wharton

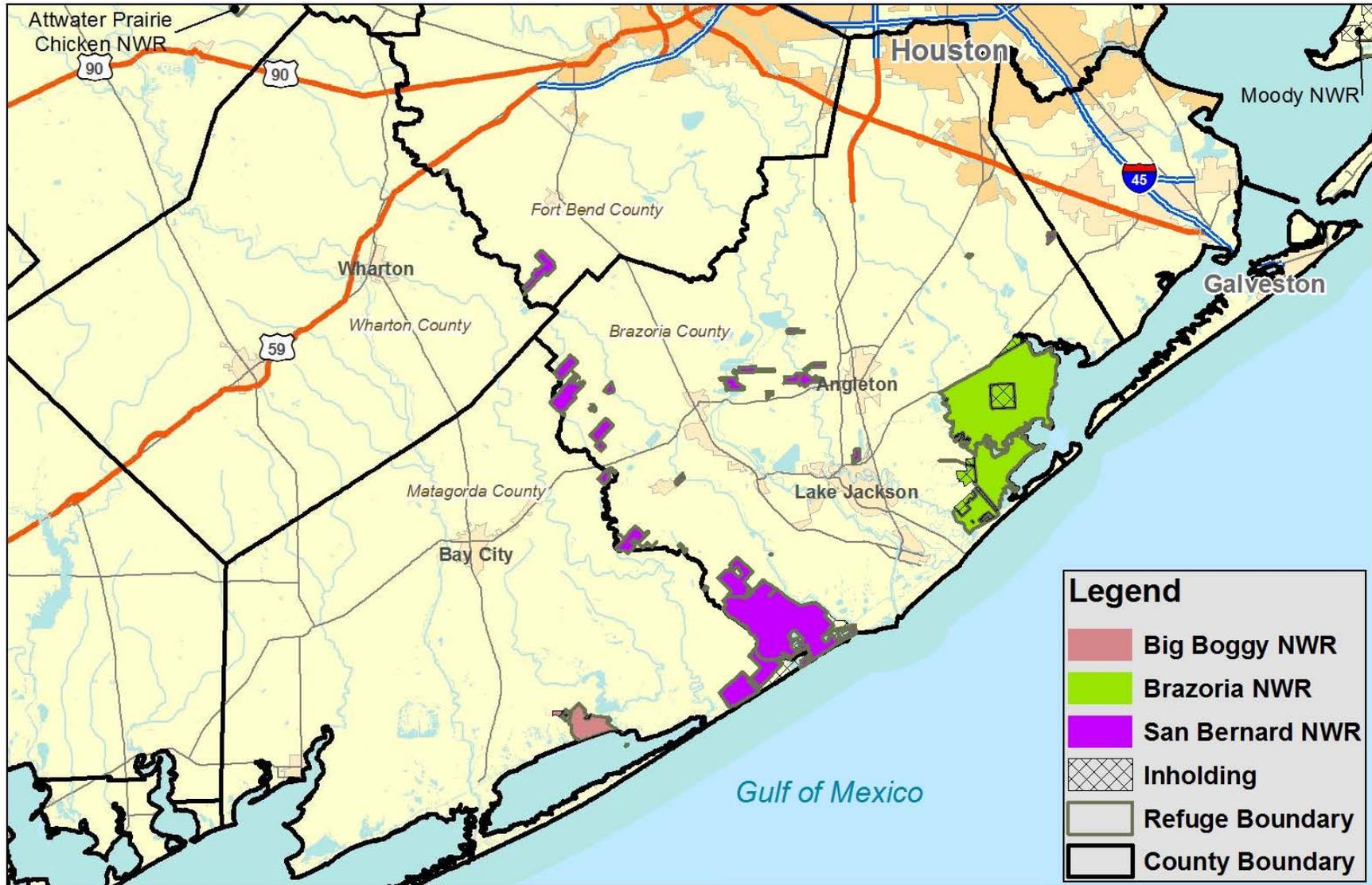


U.S. Fish & Wildlife Service

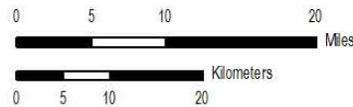
Texas Mid-coast National Wildlife Refuge Complex

Brazoria, Fort Bend, Matagorda and Wharton Counties

Map 3-3 Location



PRODUCED IN THE DIVISION OF REFUGE PLANNING
 ALBUQUERQUE, NEW MEXICO
 LAND STATUS CURRENT TO: 5/31/09
 MAP DATE: May 2012
 BASEMAP: N/A
 MERIDIAN: N/A
 FILE: TMC_location5_17_2012sk



County. The Gulf of Mexico bounds the core of the refuge on the south; on the east by FM 2918; on the north by adjacent private property near CRs 306, 317, and FM 2611; and on the west by Cedar Lake Creek and adjacent private property near CR 457 south of the town of Sargent. The Columbia Bottomland units of the refuge are located primarily along bayous, creeks, and rivers.

Big Boggy NWR - The Big Boggy NWR is located approximately 20 miles south of Bay City, Texas, in Matagorda County. East Matagorda Bay bounds the refuge on the south; on the west the refuge is bounded by Big Boggy Creek; and to the north and east by Chinquapin Road. The refuge also includes Dressing Point Island, approximately one and one-half miles south in east Matagorda Bay, which is a prominent colonial nesting bird rookery on the Texas coast.

3.1.7 Surrounding Land Uses

Land conservation on the Complex is just one of a variety of land uses found across the larger landscape. Industrial and urban development—as well as agricultural and livestock land uses—create an array of threats to fish, wildlife, and their habitats. Additional threats include invasive plants, feral animals, crop monocultures, habitat fragmentation, pathogens, and pollutants.

Rural communities, cattle ranches, and agricultural lands surround the Complex. Historically, much of the mid-Texas coast was contained within large ranches or prospected and developed for oil and gas drilling and extraction. While the oil and gas industry still maintains a strong presence, the trend is more towards the subdivision of large ranches for residential development (small ranch-ettes). Many of the agricultural lands remaining within the region continue to be used for grazing or crop production.

Table 3-1. Agricultural and Cropland Acreages in Brazoria, Matagorda, Fort Bend and Wharton Counties 1992-2007

Brazoria	563,993	221,812	528,957	186,201
Matagorda	562,612	225,372	577,594	234,688
Fort Bend	422,464	191,148	382,740	152,112
Wharton	644,730	396,009	615,851	376,001

Source: AgCensus 2007

In 1992, Brazoria County had 563,993 acres in agricultural lands with total cropland acreage of 221,812 acres. Top crops (in order of most to least acreage), were rice, hay, sorghum, cotton, corn, and soybeans. By 2007, total cropland acreage decreased to 186,201 acres, with forage (hay, etc), sorghum, corn, rice, and cotton being the top crops produced. In 1992, Matagorda County had a total land area in agricultural practices of 562,612 acres, with total cropland acreage of 225,372 acres; top crops were rice, sorghum, cotton, soybeans, hay, and corn. By 2007, total cropland acreage increased to 234,688 acres, with sorghum, rice, forage,

cotton, and corn being the top crops produced. In 1992, Fort Bend County had 422,464 acres in agricultural lands with total cropland acreage of 191,148; cotton, sorghum, hay, rice, corn, soybean, and wheat were the top crops being produced. By 2007, total croplands had decreased to 152,112, with cotton, sorghum, forage, corn, and rice being the top crops produced. In 1992, Wharton County had 644,730 acres in agricultural land with total cropland acreage of 396,009; sorghum, rice, corn, cotton, hay, soybean, and wheat were the top crops being produced. By 2007, cropland acreage decreased to 376,001 with corn, cotton, sorghum, rice and forage being the top crops produced.

The average market value of land and buildings in Brazoria and Matagorda Counties in 2007 was \$2,188/acre and \$1,380/acre, respectively. However, residential development is expanding from Houston and the associated suburbs. Find additional information pertaining to agricultural statistics on the U.S. Census for Agriculture (*AgCensus*) website at <http://www.agcensus.usda.gov/>.

Urbanization continues to expand from Houston, located approximately 50 miles northeast of the Complex and with a population estimated at more than 5 million people in the metropolitan area (Texas Comptroller's Office 2009). Residential and commercial development is concentrated along Interstates 10 and 45, as well as State Highways 288 and 59, with small towns and cities, such as Angleton, populating the corridor. However, both counties still retain a largely rural landscape, despite the expanding urban sprawl and the preponderance of personal incomes from non-agricultural economic sectors.



Development around the refuge has created Wildland Urban Interface (WUI); which must be incorporated in all refuge management issues, including prescribed fire. Photo Credit: USFWS

The Port of Freeport along with oil and gas reserves have enabled the development of oil and gas refining and chemical companies to be established. Freeport/Clute Industrial complex includes multiple large and integrated companies. Additional companies are scattered through the Mid-coast area including the Sweeny Complex and the Chocolate Bayou Complex. These industries provide a large number of jobs and influence local community development through expansions and jobs. Planned expansions at several plants will provide a large number of additional jobs in the near future, which will increase development around the refuges.

3.2 Physical Environment

This section describes the physical environment of the Complex. It includes a description of the climate, air quality, water resources, aquifers and groundwater, geology and soils, oil and gas occurrences, and potential environmental contaminants found at the Complex; and concludes with a short discussion about the Service's concerns pertaining to those physical resources.

3.2.1 Climate

Larkin and Bomar (1983) characterize the climate of the region as having predominant onshore flow of tropical maritime air from the Gulf of Mexico. A lateral decrease in moisture content from east to west across the state and intermittent seasonal intrusions of continental air modify this onshore flow. The Gulf of Mexico is a dominant geographical feature moderating temperatures along the Gulf Coast and, more importantly, providing the major source of moisture for the state. Average annual precipitation recorded at Lake Jackson, centrally located in the vicinity of all three refuges, is 50.66 inches annually (Figure 3-3).

Figure 3-3. Average Annual Precipitation of Lake Jackson, Texas



Temperatures within this region are fairly uniform, with hot, humid summers and mild winters (Figure 3-4). Annual average temperatures range from 70°F to 74°F. However, the Gulf Coast area, from Brownsville northward, can experience severe ocean-borne storms, including destructive hurricanes. The state has two principal seasons, with summer usually extending from approximately April to October, and winter beginning in November and lasting until March (Carr 1967).

Figure 3-4. Average Annual Temperature of Lake Jackson, Texas



The sub-tropical climate on the Gulf Coast ranges from average temperatures during the winter months of 55°F to summer average temperatures of 91°F. Humidity drops to low relative humidity values of 16 percent or lower during the winter months, yet the summer often sustains humidity values near 100 percent. These high humidities are generally associated with incoming pressure systems. Prevailing winds are from the southeast unless northern fronts pass through, which usually dominate the wind direction for several days. Annual precipitation can vary dramatically. During years of drought (most recent: 2008) annual precipitation was below 30 inches. During years of heavy rainfall, precipitation

approaches 60 inches. Rain may occur throughout the year and is typically associated with frontal passages during the winter and tropical disturbances during the summer months. The wettest months are typically September (>10 inches avg.) and March (>7 inches avg.). Hurricanes may occur at any time from early June through late November, but are most common in August and September. Rainfall amounts vary at different sites due to coastal influences and variability at individual sites. The remote area weather station (RAWS) records rain levels for the year from near Otter Slough Road on Brazoria NWR and Hunt Road on San Bernard NWR.

3.2.2 Air Quality

Pursuant to the Clean Air Act, as amended in 1977, the Service has an affirmative responsibility to protect air quality related values on national wildlife refuges, with special emphasis on Class I Wilderness Areas (areas in excess of 5,000 acres formally designated as Wilderness prior to August, 1977). Congress gave the Service the responsibility to protect the air quality and natural resources, including visibility of the area from manmade pollution. Polluted air injures wildlife and vegetation, causes acidification of water, degrades habitats, accelerates weathering of buildings and other facilities, and impairs visibility.

Under the Clean Air Act, the U.S. Environmental Protection Agency (EPA) has established primary air quality standards to protect public health. The EPA has also set secondary standards to protect public welfare. Secondary standards relate to protecting ecosystems, including plants and animals, from harm, as well as protecting against decreased visibility and damage to crops, vegetation, and buildings.

The EPA has developed National Ambient Air Quality Standards (NAAQS) for six principal air pollutants (also called “criteria pollutants”). They are ground-level ozone (O₃), particulate matter (PM), nitrogen dioxide (NO₂), sulfur dioxide (SO₂), carbon monoxide (CO), and lead (Pb).

The ambient air quality within the boundaries of the Complex can vary considerably from impacts due to the Freeport/Clute industrial center. Contributing to this region’s air quality is the presence of extensive grasslands, marshes, and bottomland/riparian hardwood forest communities that provide beneficial nutrient cycling and the return of oxygen to the atmosphere.

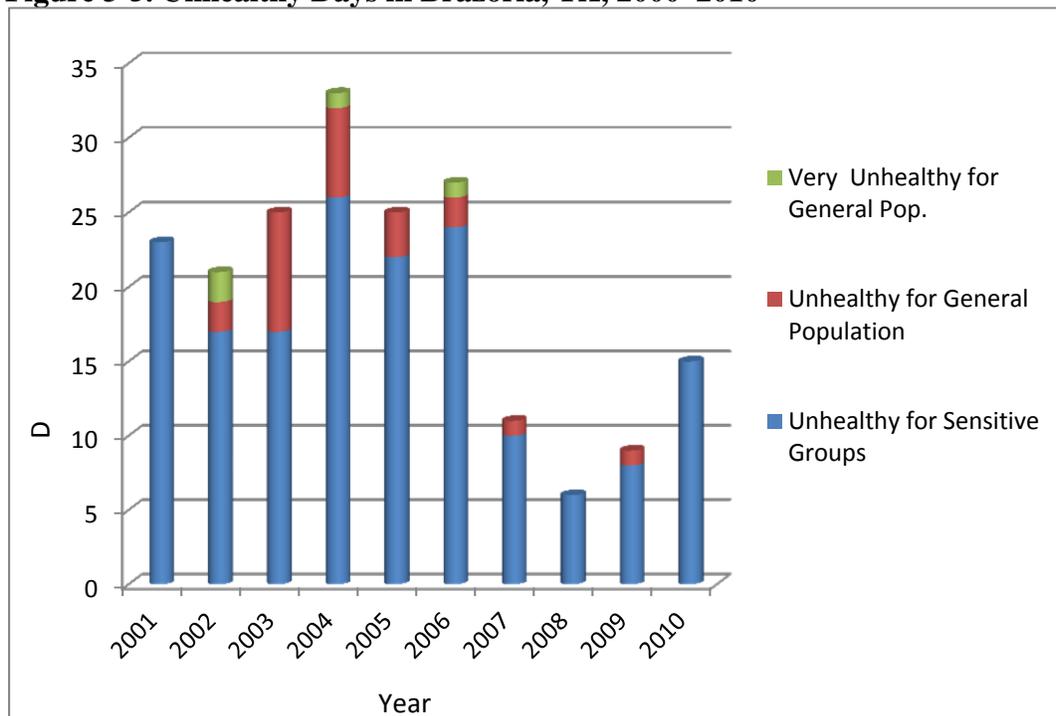
Air quality is monitored in 30 of the 254 counties in Texas, including Brazoria County. The EPA monitors oxides of nitrogen and ozone at four locations in Brazoria County. Three of the monitoring sites are within the Complex area: Lake Jackson, Danciger, and Mustang Bayou. Lake Jackson is located between the Brazoria and San Bernard NWRs; Mustang Bayou is in the vicinity of Liverpool and the Carolyn Davies Conservation Easement. Danciger is in proximity to the Big Pond, Bird Pond, and Dance Bayou Units. Table 3-2 shows ozone and oxides of nitrogen data for 2009 from the three monitoring stations.

Table 3-2. Ozone and oxides of nitrogen monitoring data for 2009

	Max. ozone (Parts per billion)	Avg. ozone (Parts per billion)	Max. Nitrogen Oxides (Parts per billion)	Avg. Nitrogen Oxides (Parts per billion)	Number of days with ozone in moderate concern	Number of days with ozone in health risk to sensitive groups
Danciger	104	25	75.5	3	10	5
Lake Jackson	113	26	95.1	3.8	5	3
Mustang Bayou	99	26	41.2	3.5	7	3

In comparing the 30 Texas counties with EPA registered monitoring stations, Brazoria County ranked 7th during 2008 for the greatest number of days where air quality was greater than the threshold for human health concerns for sensitive groups. However, annual records have shown a marked decrease in days exceeding the threshold since 2006. The following graph depicts the number of unhealthy days from 2000 to 2010 in Brazoria County, for sensitive groups (older adults and children) and the general population (AirCompare Report – www.epa.gov).

Figure 3-5. Unhealthy Days in Brazoria, TX, 2000–2010



Sources: AirCompare Report

3.2.3 Water Resources

Surface Water

The majority of project area is susceptible to at least periodic inundation due to numerous hydrologic resources in the area. Proximity to the Gulf of Mexico presents the threat of occasional Gulf storms, which can produce significant rainfall events. Forested wetlands, and open water areas exist within the project area. The San Bernard River, Brazos and Colorado River are the principle water courses within the project area. The headwaters for the Brazos and Colorado Rivers are in west Texas and along their courses to the Gulf of Mexico support numerous communities, including Austin and the Dallas-Fort Worth Metro Area. Both rivers have been dammed, which affects sediment flows to the Gulf. On the Coastal Plain, smaller bayous and creeks also move surface water across the landscape. These waterways; including Buffalo Creek, Dance Bayou, Linnville Bayou, Oyster Creek, Bastrop Bayou, Caney Creek and Live Oak Bayou, and are significant waterways which are important for draining the project area and surrounding lands following significant storm events. Today's topography was created by the meanderings of these watercourses over time. Oxbow lakes and swales hold significant surface water and are scattered across the landscape, during wet years. However during droughts, these shallow wetlands often dry up and freshwater resources become very limited.

Ground Water

Gulf Coast Aquifer (REPORT 163)

The project area is underlain by the Gulf Coast Aquifer, which forms a wide belt along the Gulf of Mexico from Florida to Mexico. The aquifer provides water to all or parts of 54 counties within the state of Texas. The aquifer extends from the Rio Grande northeastward past the Louisiana-Texas border (Mace, 2006). Municipal and irrigation uses account for 90 percent of the total pumpage from the aquifer. The Greater Houston metropolitan area is the largest municipal user, where well yields average approximately 1,600 gal/min. Earlier investigators in the Gulf Coast region of Texas attempted to delineate aquifer units based on geologic formations, but in the younger Gulf Coast sediments, the aquifers consist of parts of one or more geologic formations (USGS 1973).

The aquifer consists of complex interbedded clays, silts, sands, and gravels of the Cenozoic age that connect hydrologically to form a large, leaky artesian aquifer system. This system comprises four major components consisting of the following generally recognized water-producing formations. The deepest is the Catahoula, which contains ground water near the outcrop in relatively restricted sand layers. Above the Catahoula is the Jasper aquifer, primarily contained within the Oakville Sandstone. The Burkeville confining layer separates the Jasper from the overlying Evangeline aquifer, which is contained within the Fleming and Goliad sands. The Chicot aquifer, or upper component of the Gulf Coast aquifer system, consists of the Lissie, Willis, Bentley, Montgomery, and Beaumont formations, and overlying alluvial deposits. Not all formations are present throughout the system, and nomenclature often differs from one end of the system to the other. Maximum total sand thickness ranges from 700 feet in the south to 1,300 feet in the northern extent.

Water quality is generally good in the shallower portion of the aquifer. The Complex usually encounters ground water containing less than 1.76 oz./qt. dissolved solids to a maximum depth of 3,200 feet in the aquifer from the San Antonio River Basin northeastward to Louisiana. From the San Antonio River Basin southwestward to Mexico, quality deterioration is evident in the form of increased chloride concentration and saltwater encroachment along the Texas Gulf Coast. Little of this ground water is suitable for prolonged irrigation due to either high salinity or alkalinity, or both. In several areas at or near the Texas Gulf Coast, including Galveston Island and the central and southern parts of Orange County, heavy municipal or industrial pumpage had previously caused an updip migration, or saltwater intrusion, of poor-quality water into the aquifer. Recent reductions in pumpage here have resulted in stabilization and, in some cases, even improvement of ground-water quality.

Years of heavy pumpage for municipal and manufacturing use in portions of the aquifer have resulted in areas of significant water-level decline. Some areas of eastern and southeastern Harris and northern Galveston counties measured declines of 200 feet to 300 feet. Other areas of significant water-level declines include the Kingsville area in Kleberg County and portions of Jefferson, Orange, and Wharton counties. Some of these declines have resulted in compaction of dewatered clays and significant land surface subsidence. Subsidence is generally less than 0.5 feet over most of the Texas coast, but has been as much as nine feet in Harris and surrounding counties. As a result, structural damage and flooding have occurred in many low-lying areas along Galveston Bay in Baytown, Texas City, and Houston. Conversion to surface-water use in many of the problem areas has reversed the decline trend.

Evangeline and Chicot Aquifer (REPORT 163)

The Chicot and Evangeline aquifers are part of the Gulf Coast Aquifer system and are important sources of fresh groundwater around the Complex. The Evangeline aquifer is present in the subsurface everywhere in the county except for small areas where the salt domes pierce through the Evangeline and into the overlying Chicot beds.

The Chicot and Evangeline aquifer is the primary, and in some cases only, source of fresh water for many of the small towns and rural areas of the Texas Gulf Coast. The most widespread fresh-water aquifer in Brazoria County, and the only aquifer containing freshwater in much of the southern part of the county, is the upper unit of the Chicot aquifer. The principal source of the fresh ground water in Brazoria County is rainfall on the outcrops of the aquifers. It supplies all water for public supply and domestic use as well as part of the water used by industry in the Brazosport area. Industries and towns in the Sweeny and Old Ocean areas also use it. Because of the large drawdown in the area, the thin section of freshwater sand, and the proximity of water of poorer quality, the aquifer is fully developed and may be overdeveloped in the Brazosport area.

Brazoria and Big Boggy NWRs contain a network of irrigation ditches that connect to Chocolate Bayou Water Company and Lower Colorado River Authority, respectively. These connections allow both refuges to order water when available at a variable price. San Bernard and Brazoria obtain additional water by accessing ground water wells. Water wells at Brazoria NWR have averaged 200-300 feet deep and water wells at San Bernard NWR are

averaging 450 feet deep. In addition, the Wolfweed Complex on San Bernard NWR contains reservoirs that store water accumulated from rainfall, or water (brackish or fresh) pumped from the adjacent Cedar Lake Creek. There are no water wells on Big Boggy NWR.

Water Quality

Water quality is a measure of the suitability of water for a particular use based on physical, chemical, and biological characteristics. Natural water quality varies from place to place, with the seasons, climate, and the types of soils and rocks through which water moves. Human activities including, but not limited to, urban and industrial development, farming, mining, combustion of fossil fuels and stream-channel alteration, also affect water quality (U.S. Geological Survey 2001).

The Clean Water Act of 1977 (CWA) requires states to identify and prioritize waters that do not currently support designated uses. Each state's 303(d) list identifies water bodies that do not meet one or more applicable water quality standards and those that one or more pollutants threaten for a designated use. The 303(d) list includes waters impaired by both point and non-point source pollution. Point source pollution occurs when contaminants enter the waterbody from a distinct localized source, such as a chemical plant or equipment exhaust. Non-point source pollution occurs when contaminants enter the water body from indirect sources, such as residential development or agricultural practices.

The Brazos, San Bernard River and Colorado River Basins are monitored by the Texas Commission on Environmental Quality (TCEQ) for water quality. Significant urban and agriculture development occurs along all waterways in and above the refuges. The San Bernard River Above Tidal, San Bernard Tidal, Cedar Lakes, Caney Creek Above Tidal and Upper Oyster Creek (just above Austin's Woods project area) are all on the Texas 303(d) List by TCEQ as impaired waterways (TCEQ, 2010). The San Bernard River Above Tidal - Segment 1302 of the San Bernard River is primarily rural with adjacent agriculture lands. San Bernard Tidal is primarily rural development with some agriculture. Cedar Lakes are shallow marsh lakes in the San Bernard outfall. Caney Creek Above Tidal - Segment 1305 through much of Wharton County and especially the city of Wharton is not well defined, tremendously disturbed, and essentially non-existent in places. The communities of Sugar Land, Stafford, and Missouri City align the Upper Oyster Creek.

http://www.tceq.state.tx.us/assets/public/compliance/monops/water/08twqi/2008_303d.pdf.

3.2.4 Geology and Soils

In the region, the Lissie Formation consists of varying proportions of sand, silt, clay, and minimal amounts of gravel. Concentrations of calcium carbonate, iron oxide, and iron-manganese oxides are common in the weathered zone. Loamy prairie, sandy prairie, and coarse sand range sites predominate on the Complex, with interspersed claypan and lowland range sites. Geological characteristics of the virgin coastal prairie include small mounds or hills called "mima" or "pimple" mounds. Formation of these mounds is not exactly understood.

Geology

According to the Physiographic Map of Texas (1996), the Complex lies within the Gulf Coastal Plains Physiographic Province (Gulf Coastal Plains). Each province or landscape reflects a unified geological history of deposition and erosion processes and characteristic geologic structure, rock and soil types, vegetation, and climate distinguish each physiographic province. The elevations and shapes of its landforms contrast significantly with those of landforms in adjacent regions. The geologic formations of the Gulf Coastal Plains slope gently toward the Gulf of Mexico and are the direct result of prehistoric alluvium and marine sediment laid down by ancient streams from the western U.S. These materials consist primarily of clay, sandy clay, clay loam, silt, and sand, which originated from a multitude of soils, rocks, and unconsolidated sediment that existed throughout the flood plains of the ancient streams. Three sub-provinces referred to as the Coastal Prairies, the Interior Coastal Plains, and the Blackland Prairies, further divide the Gulf Coastal Plains. The Complex lies within the Coastal Prairies sub-province.

Soils

Deep Non-Saline Soils

Soils within this region of the Texas Gulf Coast are primarily in the Vertisol soil order, with some regional inclusions of Alfisol soils (<http://soils.usda.gov/technical/soilorders/>). Vertisol soils are heavy and expansive clay soils that develop deep, wide cracks during dry periods of the year. Conversely, these soils have incredibly high moisture storage potential and swell tremendously as they become wet. Vertisol soils frequently underlie expansive grassland communities. Engineers know vertisols well because of their unique property limits and engineering uses. Alfisol soils result from weathering processes that leach clay minerals and other constituents out of the surface layer and into the subsoil, where they can hold and supply moisture and nutrients to plants. Alfisols frequently underlie forests or mixed vegetative cover. Additional descriptions of soil series may be found in the soil survey publication for the desired county (NRCS Soil Survey). Approximately 82 percent of the soils in Brazoria County are deep, non-saline soils. The major soils are Aris, Asa, Bernard, Brazoria, Edna, Lake Charles, Norwood, and Pledger series. They are on broad, nearly level areas that are far enough inland that they are not affected by salts from the Gulf of Mexico. With the exception of the Asa and Norwood soils, which are loamy throughout and well drained, all of the soils are somewhat poorly drained and have very slow permeable subsoil (USDA-SCS). Fort Bend County includes the Bernard, Edna, Kaman clay, and Lake Charles soils. The dominant soils in Matagorda County include the Dacosta, Edna, Laewest, Livco, Telferner, and Texana, which formed in the clayey and loamy sediment of the Beaumont Formation. Wharton County soils include Brazoria clay, Norwood silt, Asa silty clay loam, Clemville Norwood complex, Lake Charles and Pledger clay.

Deep Saline

The second soil series is the Harris-Velasco-Placedo. These soils are very poorly drained, nearly level, clayey, saline soils. These soils have weakly convex relief and a water table at or near the surface. Standing ponds of water, small bayous, and small drains break the relief. This soil generally occurs in the coastal marshes and is commonly flooded. Slopes are generally less than 0.5 percent. The natural vegetation consists mainly of low growing, salt-tolerant plants, yet occasionally the surface is barren of vegetation. The Harris, Velasco, and

Placedo soils are very deep with very slow permeability and generally have high clay content. Clayey and loamy sediments underlay these soils, which are poorly suited to uses other than wildlife habitat because of wetness, the hazard of flooding, salinity, and the clayey texture (See Map 3-4 Big Boggy NWR Soils, Map 3-5 Brazoria NWR Soils, Maps 3-6, 3-7, 3-8, and 3-9 San Bernard NWR Soils).

3.2.5 Mineral Resources

The Service does not own the mineral interest underlying most of the lands within the Complex and must provide reasonable access to mineral owners to explore and develop their mineral interests. Oil and gas activities are allowed to take place on refuges for a number of reasons. On the majority of refuges, oil and gas activities occur where private entities, states, or Native corporations, rather than the federal government, own the mineral rights. Owners of these mineral rights have the right to develop, produce, and transport the oil and gas resources located within a refuge (USGAO 2001). However, the Department of the Interior's regulations require, "to the

greatest extent practicable," that "all exploration, development and production operations" be conducted in such a manner as to "prevent damage, erosion, pollution, or contamination to the lands, waters, facilities, and vegetation of the area."

Further, "so far as practicable, such operations must also be conducted without interference with the operation of the refuge or disturbance to the wildlife thereon" (50 C.F.R. Part 29.32).



Oil and gas exploration and operations are common across the landscape and require coordination and monitoring to ensure the protection of refuge resources during all operations.

Photo Credit: USFWS

Under the National Wildlife Refuge System Administration Act of 1966, as amended, the

Service is responsible for regulating all activities on refuges. The Service is required to determine the compatibility of activities with the purposes of the particular refuge and the mission of the Refuge System and not allow those activities deemed incompatible. However, the Service does not apply the compatibility requirement to the exercise of private mineral rights on refuges. Department of the Interior regulations also prohibit leasing Federal minerals underlying refuges outside of Alaska, except in cases where federal minerals are being obtained by operations on property adjacent to a refuge. Nevertheless, the activities of private mineral owners on refuges are subject to a variety of legal restrictions, including Service regulations, Federal laws affect how private mineral rights owners conduct their activities. Also, Service regulations require that oil and gas activities be performed in a way that minimizes the risk of damage to the land and wildlife and the disturbance to the operation of the refuge. The regulations also require that land affected by reclaimed after

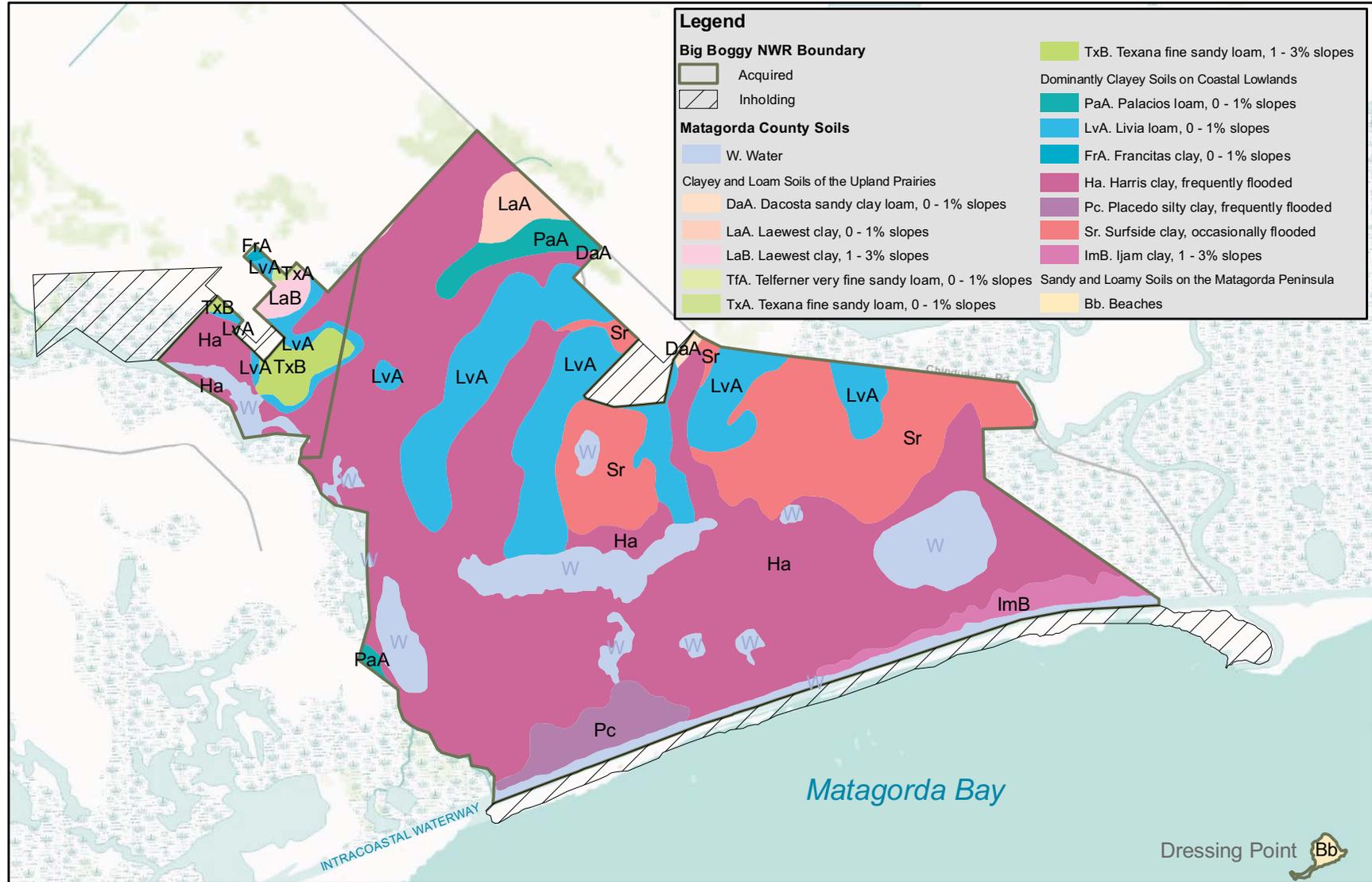


U.S. Fish & Wildlife Service

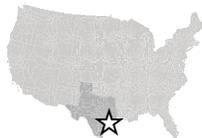
Big Boggy National Wildlife Refuge

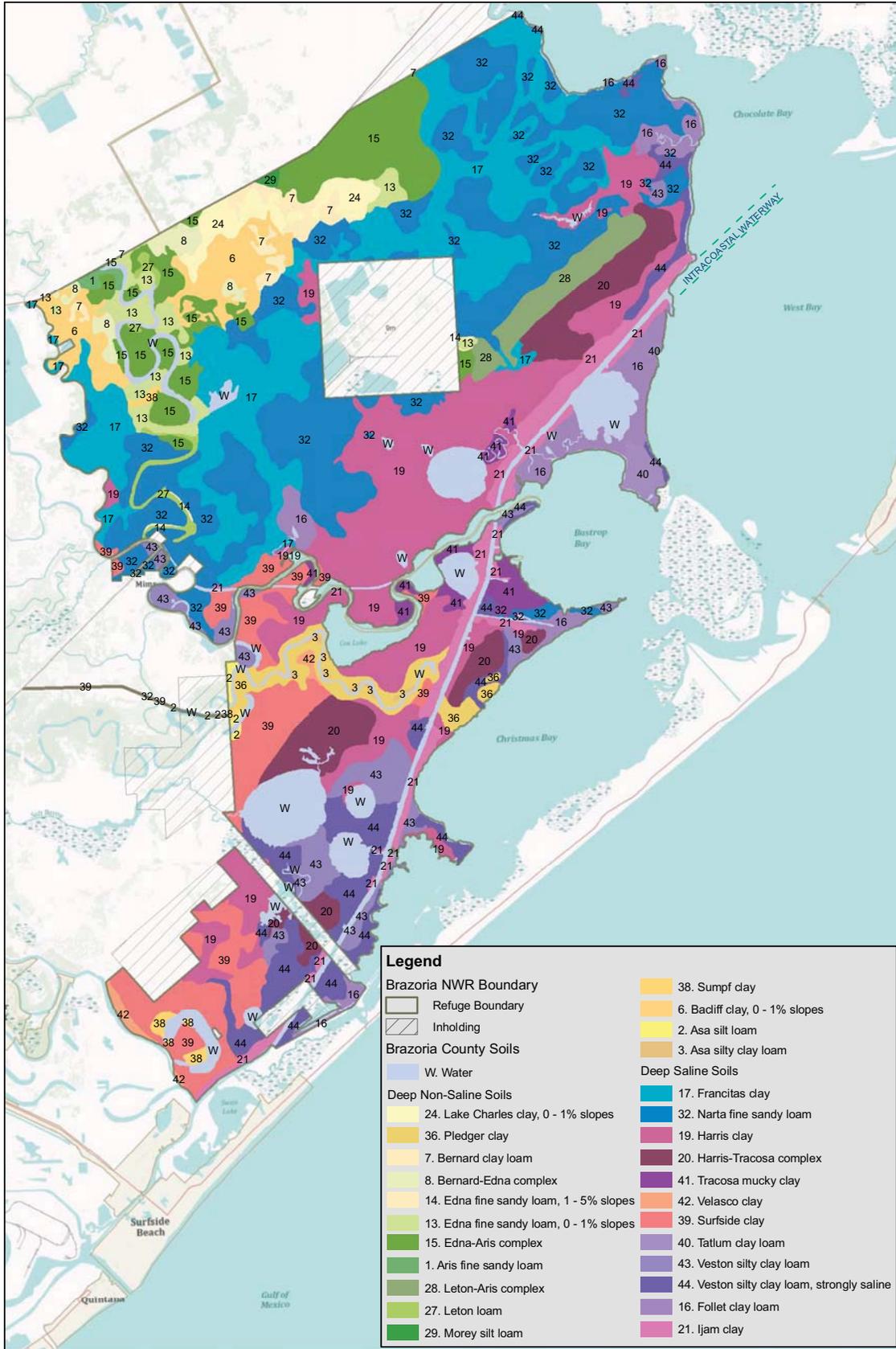
Matagorda County, Texas

Map 3-4. Natural Resource Conservation Service - Soils



PRODUCED IN THE DIVISION OF REFUGE PLANNING
 ALBUQUERQUE, NEW MEXICO
 LAND STATUS CURRENT TO: 5/31/09
 MAP DATE: May, 2011
 BASEMAP: N/A
 MERIDIAN: N/A
 FILE: bbg_soils_8.5by11_5.18.11_shl

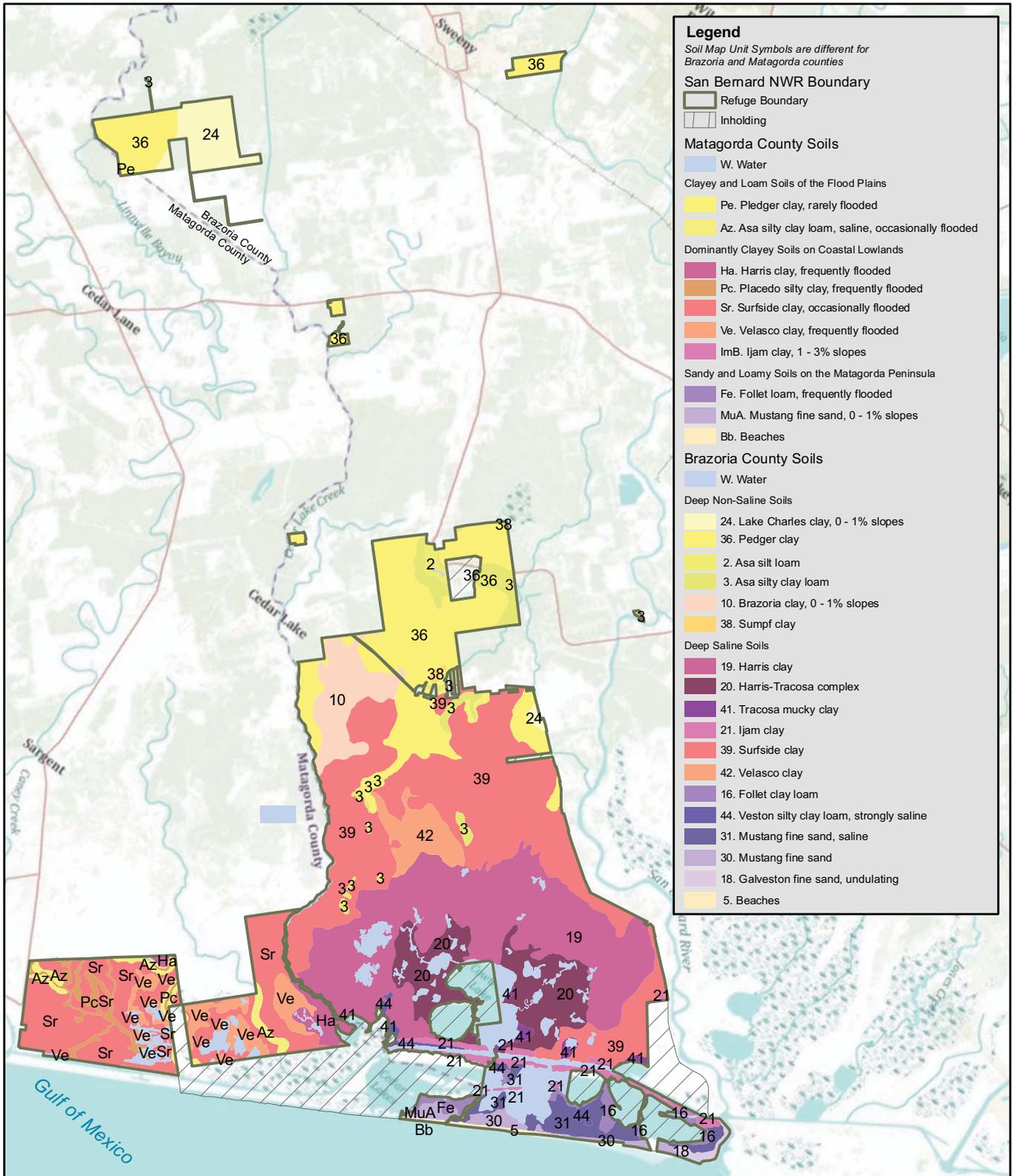




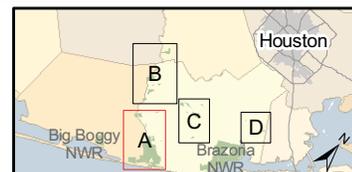
PRODUCED IN THE DIVISION OF REFUGE PLANNING
ALBUQUERQUE, NEW MEXICO
LAND STATUS CURRENT TO: 5/31/09
MAP DATE: May 2011
BASEMAP: N/A
MERIDIAN: N/A
FILE: brz_soils_5.18.11_shl

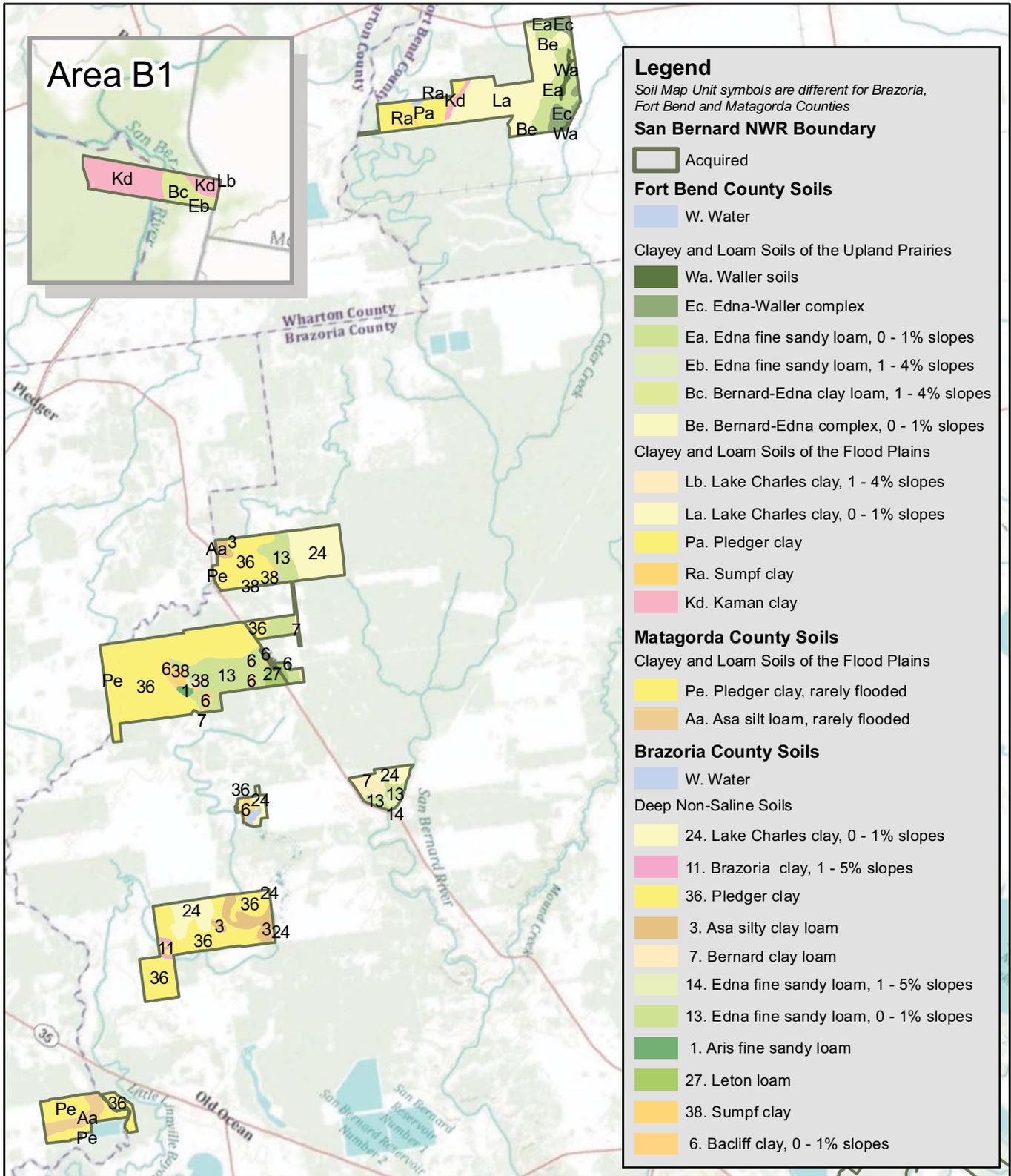


UTM ZONE 15
NAD 83

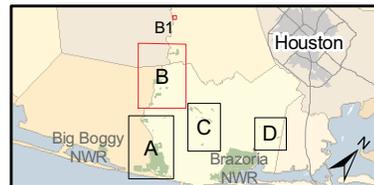
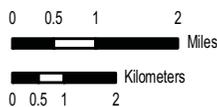


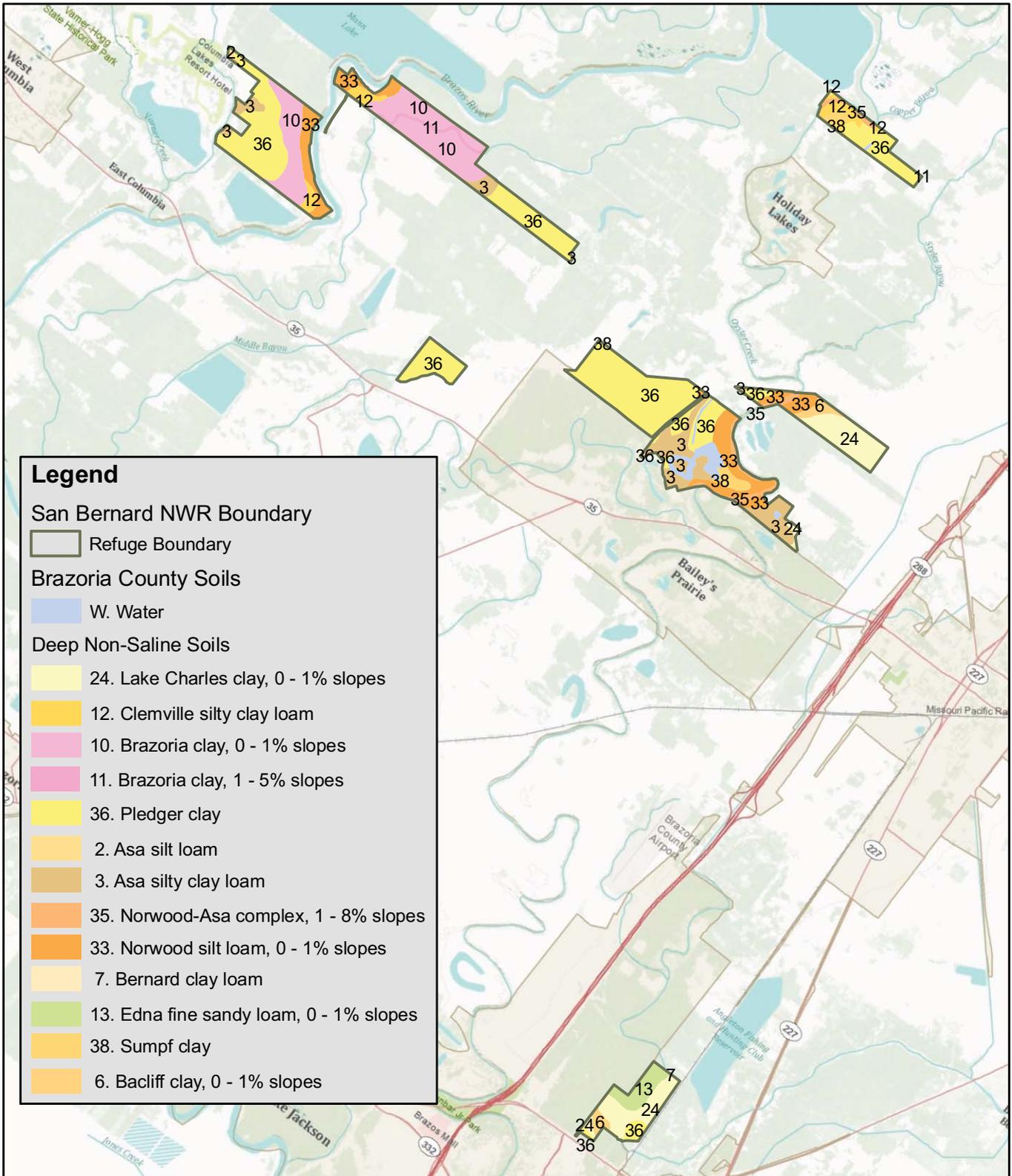
PRODUCED IN THE DIVISION OF REFUGE PLANNING
 ALBUQUERQUE, NEW MEXICO
 LAND STATUS CUR RENT TO: 5/31/09
 MAP DATE: May 2011
 BASEMAP: N/A
 MER IDIAN: N/A
 FILE: snb_soils_A_8.5by11_5.18.11.shl



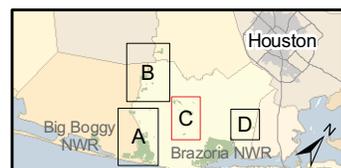
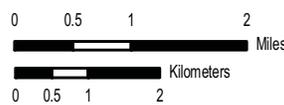


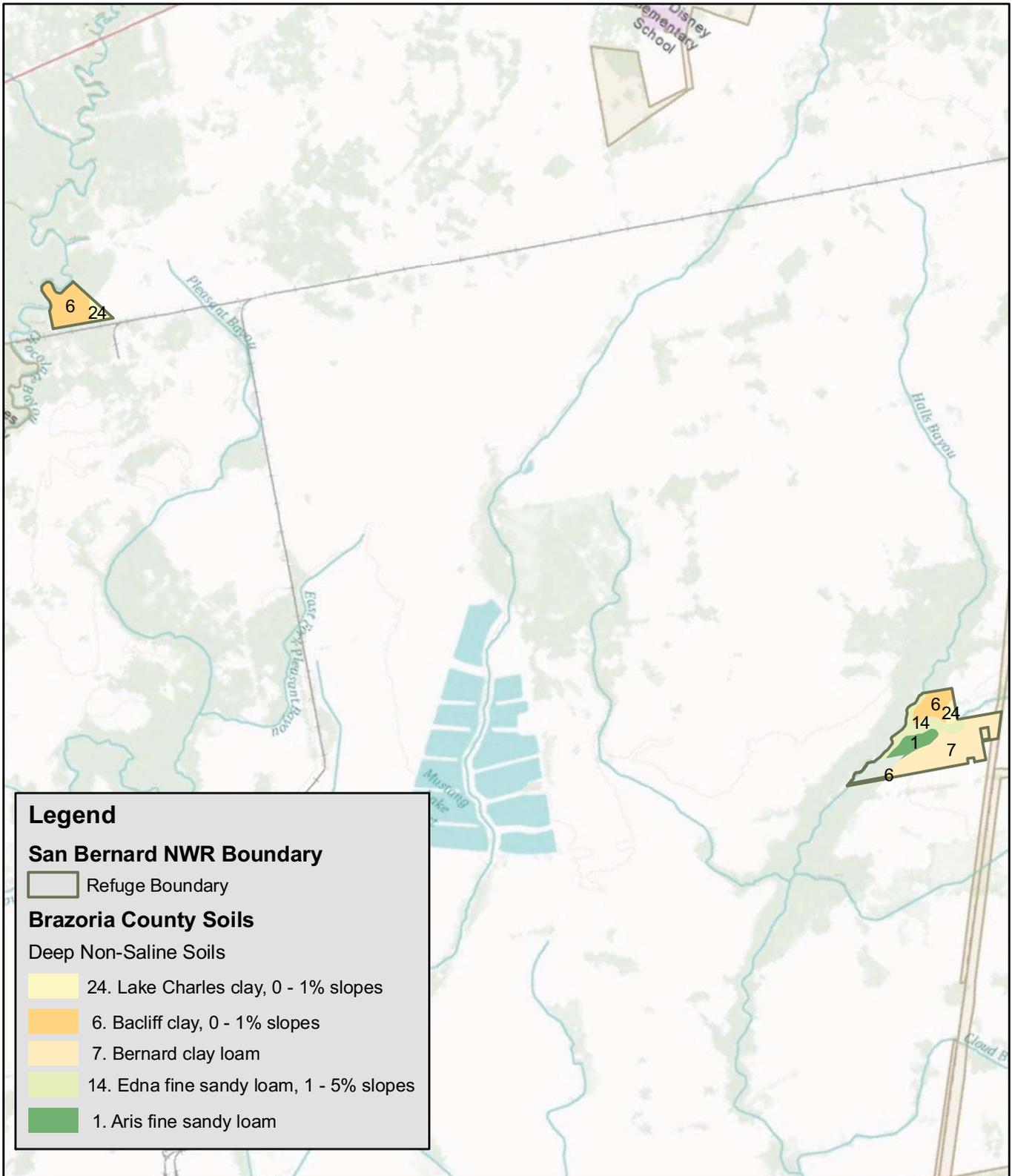
PRODUCED IN THE DIVISION OF REFUGE PLANNING
ALBUQUERQUE, NEW MEXICO
LAND STATUS CURRENT TO: 5/31/09
MAP DATE: May 2011
BASEMAP: N/A
MERIDIAN: N/A
FILE: snb_soils_B_8.5by11_5.18.11_shl





PRODUCED IN THE DIVISION OF REFUGE PLANNING
 ALBUQUERQUE, NEW MEXICO
 LAND STATUS CURRENT TO: 5/31/09
 MAP DATE: May 2011
 BASEMAP: N/A
 MERIDIAN: N/A
 FILE: snb_soils_C_8.5by11_5.18.11_shl





Legend

San Bernard NWR Boundary

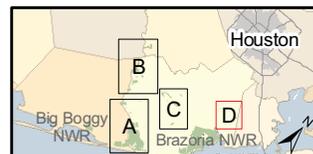
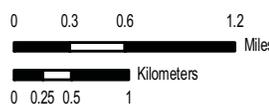
- Refuge Boundary

Brazoria County Soils

Deep Non-Saline Soils

- 24. Lake Charles clay, 0 - 1% slopes
- 6. Bacliff clay, 0 - 1% slopes
- 7. Bernard clay loam
- 14. Edna fine sandy loam, 1 - 5% slopes
- 1. Aris fine sandy loam

PRODUCED IN THE DIVISION OF REFUGE PLANNING
 ALBUQUERQUE, NEW MEXICO
 LAND STATUS CURRENT TO: 5/31/09
 MAP DATE: May 2011
 BASEMAP: N/A
 MERIDIAN: N/A
 FILE: snb_soils_D_8.5by11_5.18.11_shl



operations have ceased. Information about oil and gas operations and management on the Complex can be found in Section 3.6.1.3.

3.2.6 Concerns Regarding the Physical Environment

The availability and quality of water resources is critical to maintaining Complex landscapes. As experienced over the past decade, the refuges are generally near the extremes of the rainfall charts, either suffering extreme drought or excess rains. Rarely does annual rainfall occur near the annual average. Managing the refuges at climatic extremes is difficult. Table 3-3 summarizes management concerns due to the physical environment.

Table 3-3. Management Concerns Due to the Physical Environment

Moist-soil management	<ul style="list-style-type: none"> • Unable to fill ponds in fall for migrating and wintering birds. • Water can be purchased for Big Boggy and Brazoria NWRs to fill limited fields if available from the Gulf Coast Water Authority. However, purchases are often restricted during periods when brood water is needed for target spp. 	<ul style="list-style-type: none"> • Cannot dry ponds out for manipulation resulting in increased vegetation encroachment.
Burning	<ul style="list-style-type: none"> • Generally beneficial and enables burning; however, under extreme conditions, burning is halted due to the potential damage to native vegetation. 	<ul style="list-style-type: none"> • Reduces burnable acreage, and burn opportunities. • Reduces fire intensity; decreasing control of invasive and aggressive species.
Salt marsh management	<ul style="list-style-type: none"> • Salt water inundation (storm surge) of upper salt marsh and salty prairie habitats are not diluted and washed out without adequate rainfall. Hyper-saline conditions are created in swales. • Interrupts life cycles of invertebrates in upper salt marsh, and salty prairie, thereby influencing species that feed on those invertebrates. 	<ul style="list-style-type: none"> • Encroachment of freshwater tolerant invasive species (phragmites, Chinese tallow, etc.) into upper salt marsh habitats occurs.
Bottomland forest	<ul style="list-style-type: none"> • Stresses bottomland trees during extended drought conditions. • Enables fire to ignite and burn through restoration areas. 	<ul style="list-style-type: none"> • Generally beneficial, shallow-rooted trees are susceptible to blow over during storms due to soil saturation.

Environmental Contaminants

The Service assesses existing and potential environmental contaminants found on national wildlife refuges through a Contaminant Assessment Process (CAP) report. A CAP is an information gathering process and initial assessment of a national wildlife refuge in relation to environmental contaminants. Each CAP analyzes particular contaminants of concern to fish, wildlife, and other resources on a refuge. The information summarized through the CAP can provide the basis by which land managers select options to reduce contaminant impacts on the species and lands under their stewardship. The CAP also identifies Service-managed areas located downstream or down-gradient from highways, railways, or navigation channels that may be vulnerable to hazardous substance spills. Such areas may then be targeted for baseline data collection which could support future on-refuge investigations, natural resource damage assessments, or field work. A CAP report for Big Boggy NWR was conducted in 1999. The CAP reports for Brazoria and San Bernard NWRs were updated in 2009.

Management activities for the Complex include monitoring of on/off-land contaminant sites and water sampling of nearby bayous, waterways, and rivers that could carry contaminants onto the refuge. While there are known contaminant sources and suspected contaminant presence within the vicinity of the Complex, to date no contaminant incidents have occurred. On-site sources of contaminants, (pesticides, petroleum products, etc.) are managed and contained according to the Complex's Environmental Management Plan. Absorbant booms and materials are maintained for local spills in accordance with Spill Prevention Plans. In the case of third party spills, the refuge will coordinate with Brazoria County, Texas General Land Office, and the Coast Guard. Approximately 10 staff maintain Hazwopper training for emergency actions.

Brazoria NWR (2009)

Many bays and bayous lie within and around the refuge. West Bay is an impaired body of water that borders the east portion of the refuge, along with Chocolate Bay and the bayous that drain into it. The Christmas Bay, Bastrop Bay, and other small bays border the southern portion of the refuge, where bayous and lakes drain into them. These waters could potentially carry contaminants onto the refuge. North and south winds can carry air pollution onto refuge lands. The GIWW runs from the southwestern corner of the refuge and continues in a northeastern direction through the refuge. It connects with Drum Bay (on the right), Nicks Lake and Salt Lake (on the left), and runs through Bastrop Bayou and Oyster Lake, exiting the refuge at West Bay. A significant amount of barge traffic utilizes this waterway carrying a variety of chemicals and materials. Various sites on the refuge could become contaminated should there be a spill or leak of materials. The industrial sites within the Clute and Freeport areas pose a potential for producing contaminants that could impact refuge resources. These sites include chemical plants, oil and gas storage, and major pipelines. Nearby oil fields located at Stratton Ridge and Hoskins Mound, are potential contaminant sources to the Complex. Multiple pipelines are located on the refuge which have the potential for contaminating refuge lands.

San Bernard NWR (2009)

Several sites in the vicinity of the refuge could pose a threat in the event of a contaminant incident. The sites are primarily industrial areas including Dow Chemical Company, the Freeport Complex, and the cities of Freeport and Lake Jackson, all of which are located east of the refuge. The types of contaminants range from air pollutants to toxins to oil and gas spills. Transport pathways include roads, pipelines, rivers, and bayous. A major pathway for contamination is the GIWW which traverses the southern portion of the refuge for approximately 10 miles carrying a variety of chemicals and materials throughout the length of the refuge. Pollution from numerous nonpoint sources could transport contaminants onto the refuge through the GIWW. Additional pathways include multiple rivers and bayous. The lower San Bernard River and Cedar Lakes (near the outfall) in the southern portion of the refuge are considered impaired bodies of water. Predominant winds carry air pollution from the southeast and northwest. While there are known contaminant sources in the vicinity, no documented contaminant problems or habitat degradation has occurred on the refuge as a result of these sources. Multiple pipelines are located on the core refuge and bottomland units. These pipelines have the potential for contaminating the refuge lands.

Big Boggy NWR (2011)

Aerial drift from nearby agricultural applications of herbicides and pesticides are also possible. Portions of the refuge are subject to periodic inundation during extreme tides, heavy rain events, and major storm surges via Big Boggy Creek. Contaminants from various sources can accumulate in sediments and affect waters within the many ponds and impoundments on the refuge, as well as affected marshlands. Significant surface water pathways such as Big Boggy Creek and irrigation canals are avenues for oil and chemical spills and other contaminants from the GIWW, local agriculture, offshore petrochemical production facilities, and pipelines. Although no oil and gas pipeline corridors transverse the refuge, nearby land and upstream crossings occur and could be an exposure pathway in the event of an accidental discharge.

Other sources

Wildlife can disperse contaminants as well. Mammals are affected through the food chain and can transmit contaminants; wading bird, shorebird, and migratory bird species are affected by spills and can carry pesticides from feeding areas, especially geese that often fly out to the farm fields surrounding the refuge; raptors are affected by pesticides in the food chain and bio-accumulate contaminants; invertebrates are important forage and indicator species sensitive to oil and chemical spills; and resident birds such as mottled ducks and various song birds could be subjected to area contaminants.

Recreational uses, including hunting and special organized group activities, makes possible the disposal of urban waste in public areas and site contamination from the use of toxic shot by indiscriminate hunters. Past use as sugarcane and cotton agricultural land and, more recently, grazing of cattle on what eventually became the refuge, are less significant sources of potential contamination. Remnant windmills and natural gas well sites from the past could present an exposure pathway between surface and groundwater media.

3.3 *Biological Environment*

This section describes the biological environment in which the Complex is found. It includes a description of the historical, present and potential future condition of terrestrial and aquatic habitat types found on the Complex, as well as the natural processes that influence them. It identifies priority wildlife species and focal species used for monitoring purposes, and includes a discussion of various wildlife types found on the Complex. This section also includes a short discussion on concerns pertaining to the biological environment.

3.3.1 **Habitat Types**

The refuges are a haven to a myriad of plant communities, co-evolving with biotic and abiotic organisms, rich bottomland soil, and flat to low topography (0–50 ft. elevation) that form a mosaic of wetlands, grasslands, and forested bottomland habitats. The Complex currently has over 19,000 acres of bottomland hardwood forest and continues to acquire additional lands on the San Bernard NWR under the auspices of the Austin's Woods Conservation Plan. Salt marsh and salty prairies make up the greatest part of the Complex. The salty prairies give way to coastal prairie and bottomland hardwood forest on higher elevations. Gulf Coast prairies total less than 250,000 acres in the state of Texas, of which approximately 12,000 acres are on the Complex.

Prairie habitats are managed predominantly with fire. Where fire cannot be used, haying or shredding may be utilized. Where fire has not been implemented on a regular basis, control of invasive species during restoration may require herbicide application or mechanical removal of brush/trees. On Brazoria NWR, approximately 1,000 acres of former prairie are farmed (primarily rice) and also managed as freshwater wastelands. An additional 500 acres are artificially managed as freshwater wetlands through the maintenance of levees and associated water control structures. These structures are meant to replicate acres of freshwater prairie wetlands that have been lost due to past agricultural practices and provide essential freshwater habitats. San Bernard and Big Boggy NWRs have small fields; 10 and 90 acres respectively, that are planted in rye as browse for geese. The forested habitats are managed as old-growth habitats, limiting management to control of invasive species. The marshes are generally left unmanaged however fire (prescribed and wildland) will occasionally run through the marshes. Restoration of degraded and eroded marshes due to saltwater intrusion require a variety of techniques. More details on these and additional management activities can be found in Section 3.6.

The Complex uses the National Vegetation Classification System (NVCS) to describe habitat types at the ecological system level (Map 3-10 Big Boggy, Map 3-11 Brazoria, and Maps 3-12, 3-13, 3-14, and 3-15 for San Bernard Vegetation Maps). *Note: The National Land Cover Data (NLCD) maps for the Complex has been altered substantially to more accurately reflect the actual vegetation communities present. In addition, location-specific vegetation communities that are not part of the NVCS classification system have been represented on the map and roughly described. NVCS tends to focus on climax communities and many managed, previously altered, and invasive communities are not accurately identified.*

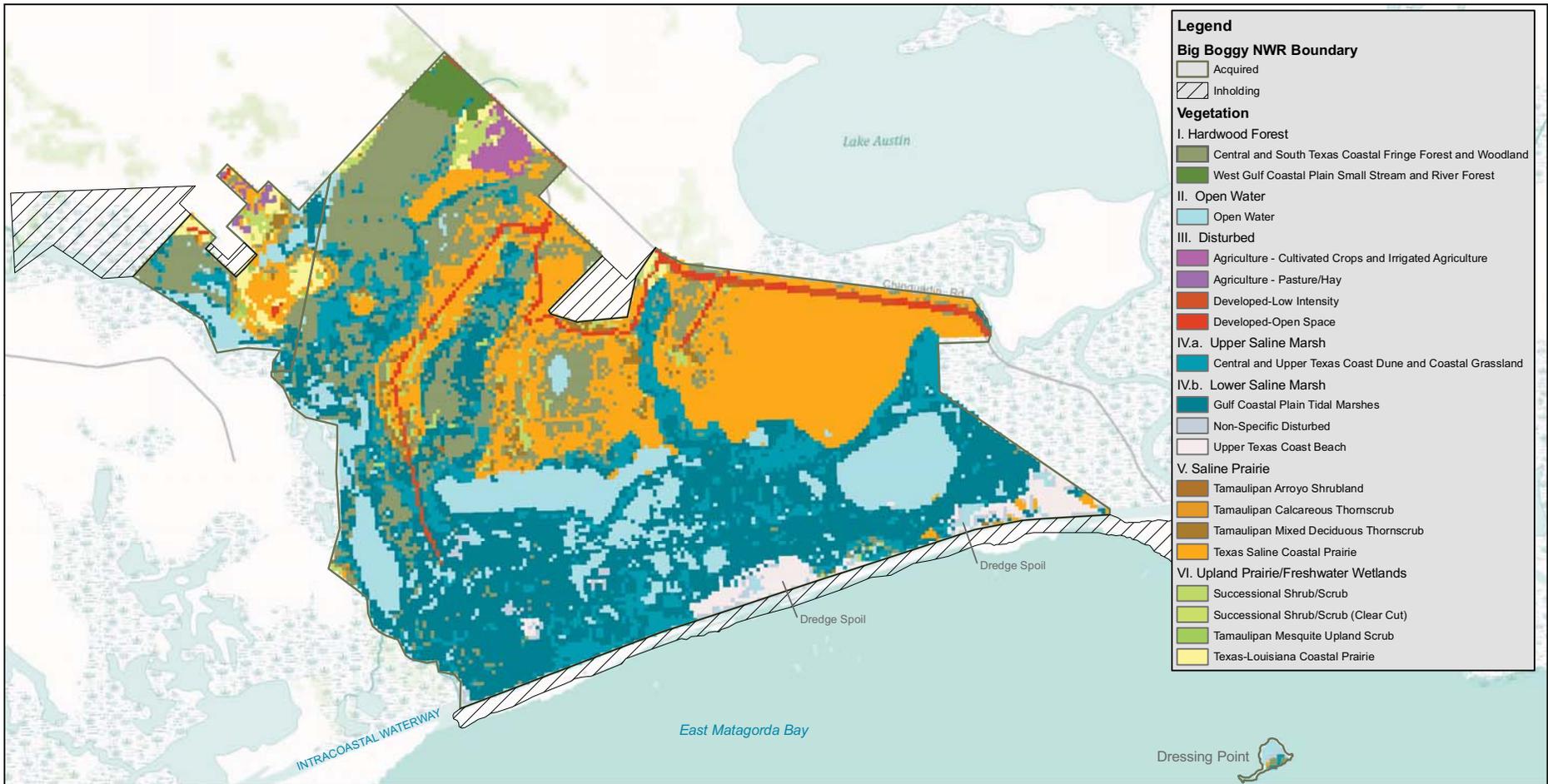


U.S. Fish & Wildlife Service

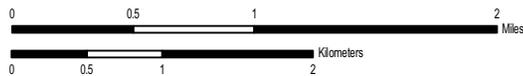
Big Boggy National Wildlife Refuge

Matagorda County, Texas

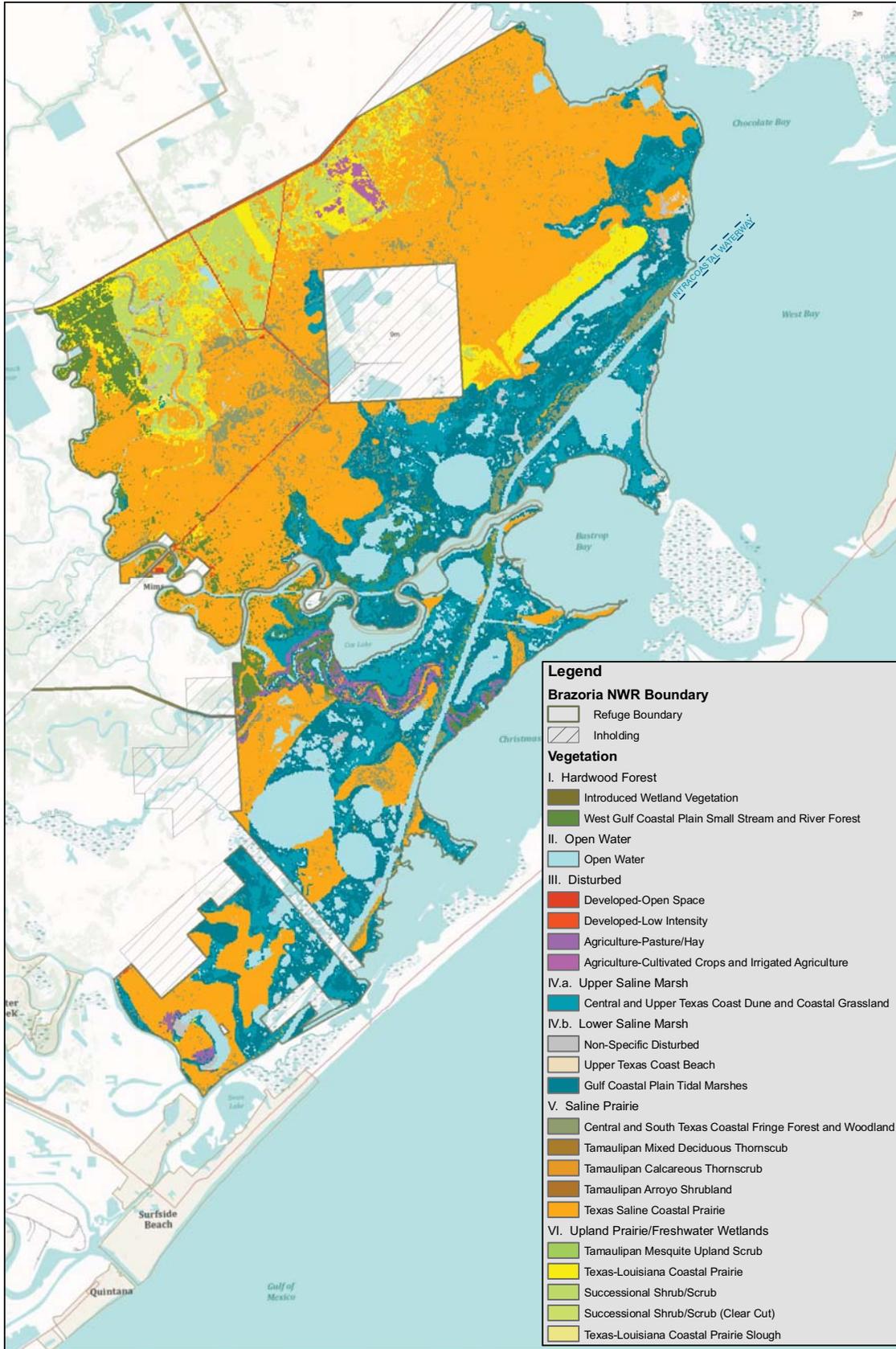
Map 3-10. National Vegetation Classification System - Vegetation



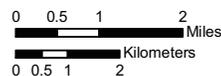
PRODUCED IN THE DIVISION OF REFUGE PLANNING
 ALBUQUERQUE, NEW MEXICO
 LAND STATUS CURRENT TO: 5/31/09
 MAP DATE: May, 2011
 BASEMAP: N/A
 MERIDIAN: N/A
 FILE: bbg_nvcs_5.19.11_shl

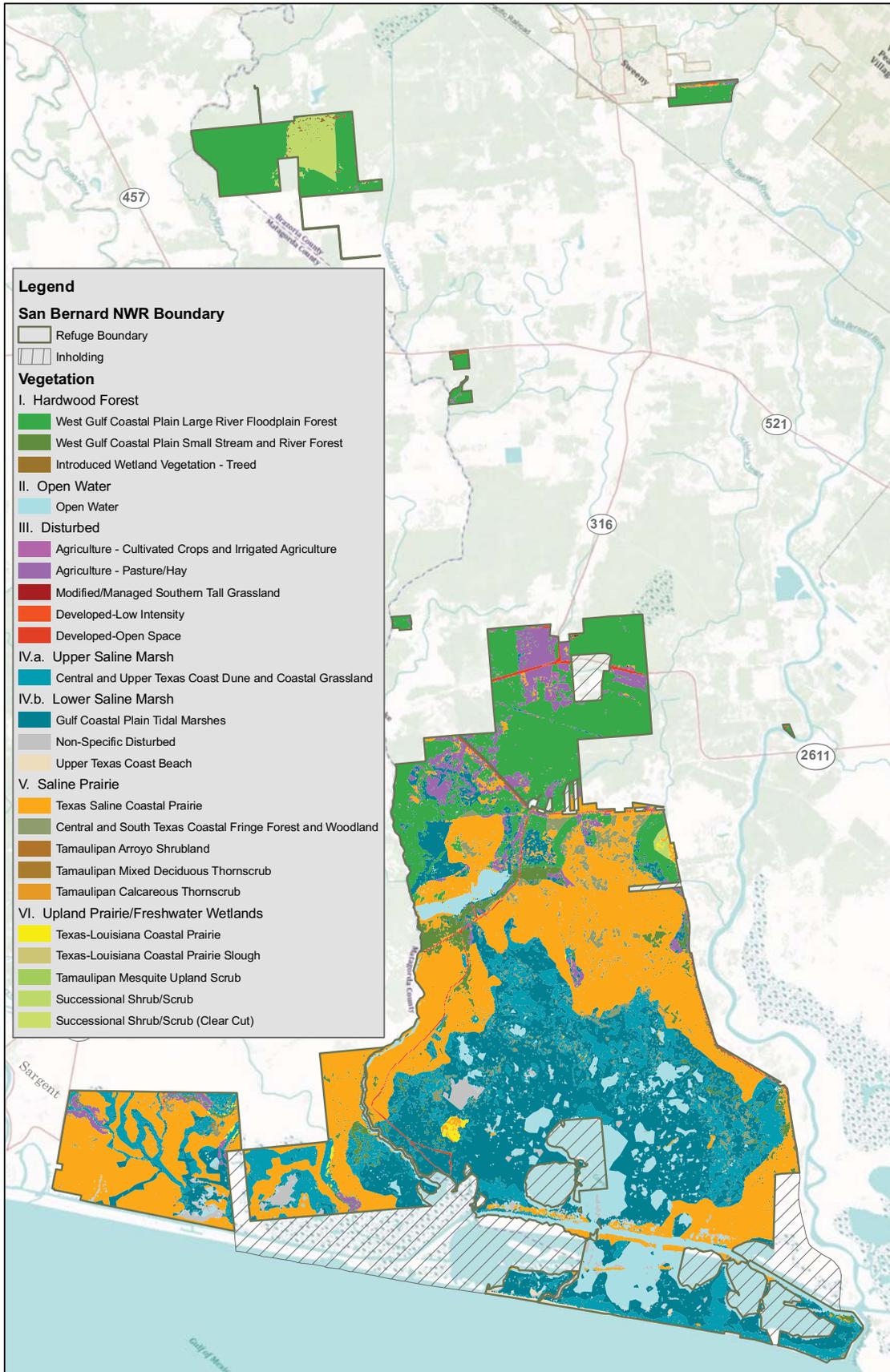


UTM ZONE 15
NAD 83

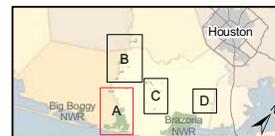
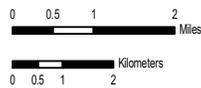


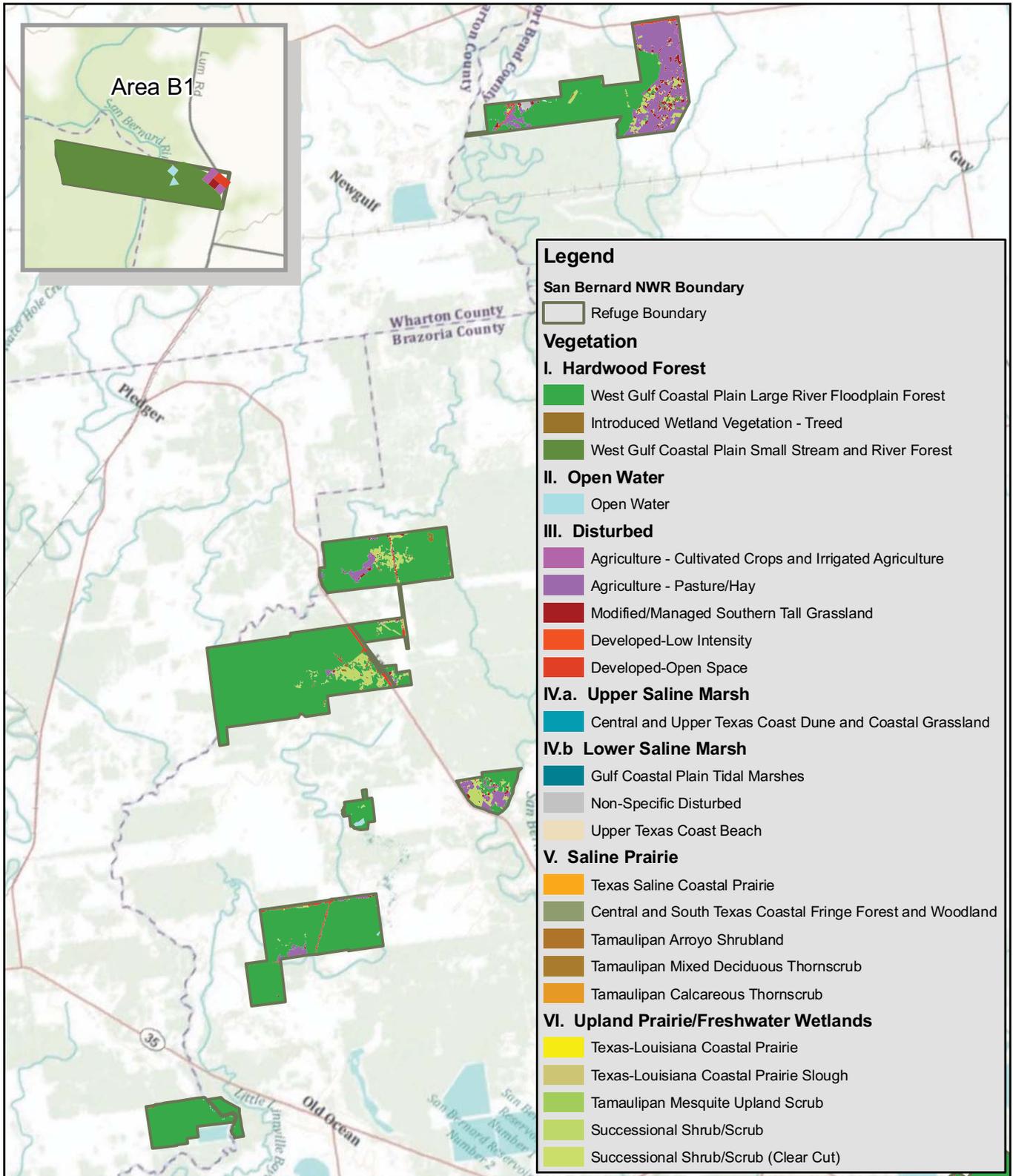
PRODUCED IN THE DIVISION OF PLANNING
ALBUQUERQUE, NEW MEXICO
LAND STATUS CURRENT TO: 5/31/09
MAP DATE: MAY 2011
BASEMAP: N/A
MERIDIAN: N/A
FILE: brz_nvcs_5.19.11_shl



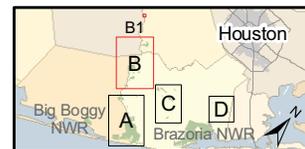
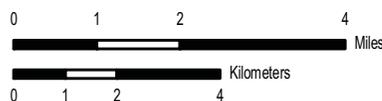


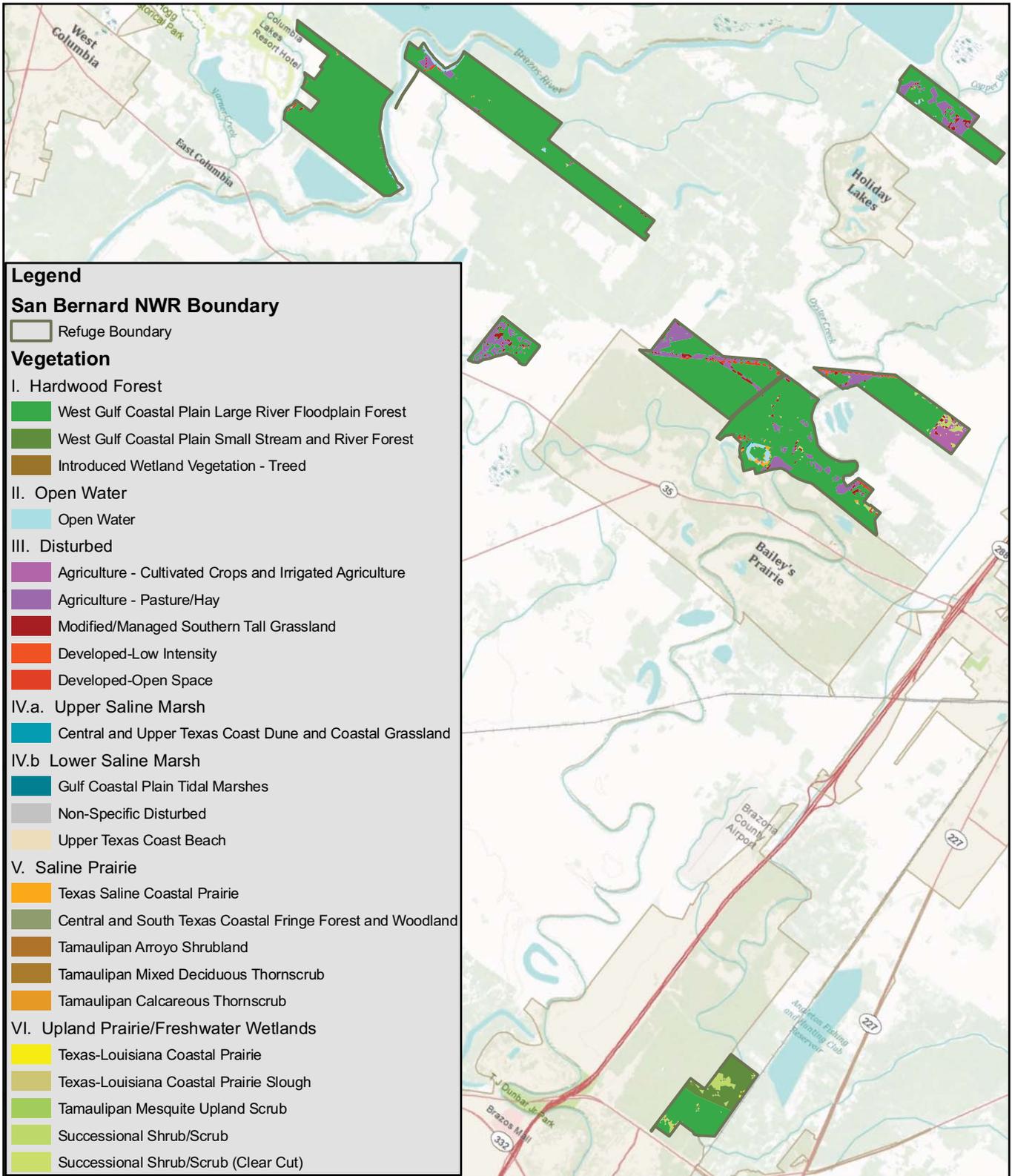
PRODUCED IN THE DIVISION OF PLANNING
 ALBUQUERQUE, NEW MEXICO
 LAND STATUS CURRENT TO: 05/31/09
 MAP DATE: May 2011
 BASEMAP: N/A
 MERIDIAN: N/A
 FILE: snb_NVCS_A_5.20.11_shl





PRODUCED IN THE DIVISION OF PLANNING
 ALBUQUERQUE, NEW MEXICO
 LAND STATUS CURRENT TO: 5/31/09
 MAP DATE: May 2011
 BASEMAP: N/A
 MERIDIAN: N/A
 FILE: snb_NVCS_B_8.5by11.5.20.11_shl





Legend

San Bernard NWR Boundary

- Refuge Boundary

Vegetation

I. Hardwood Forest

- West Gulf Coastal Plain Large River Floodplain Forest
- West Gulf Coastal Plain Small Stream and River Forest
- Introduced Wetland Vegetation - Treed

II. Open Water

- Open Water

III. Disturbed

- Agriculture - Cultivated Crops and Irrigated Agriculture
- Agriculture - Pasture/Hay
- Modified/Managed Southern Tall Grassland
- Developed-Low Intensity
- Developed-Open Space

IV.a. Upper Saline Marsh

- Central and Upper Texas Coast Dune and Coastal Grassland

IV.b Lower Saline Marsh

- Gulf Coastal Plain Tidal Marshes
- Non-Specific Disturbed
- Upper Texas Coast Beach

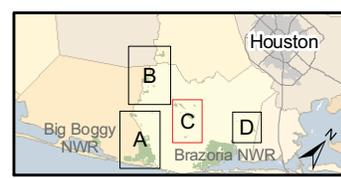
V. Saline Prairie

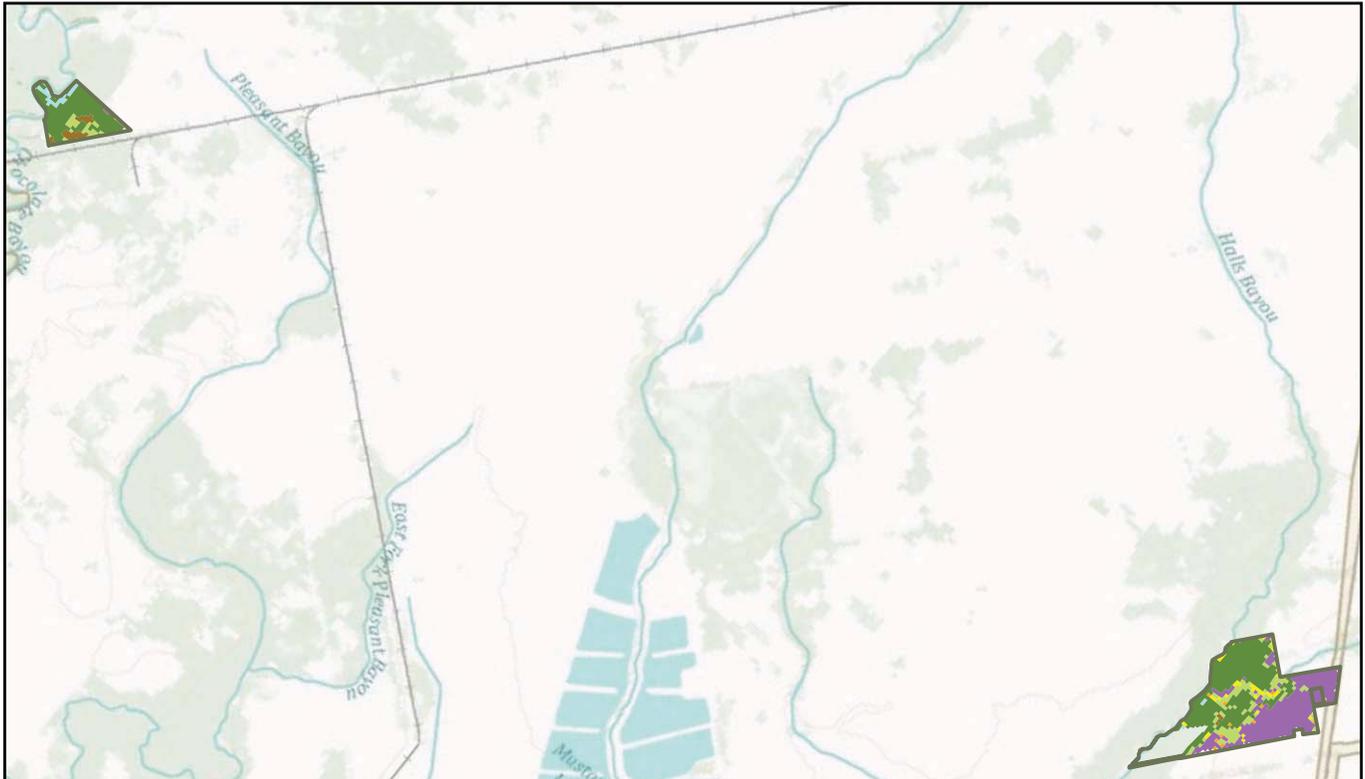
- Texas Saline Coastal Prairie
- Central and South Texas Coastal Fringe Forest and Woodland
- Tamaulipan Arroyo Shrubland
- Tamaulipan Mixed Deciduous Thornscrub
- Tamaulipan Calcareous Thornscrub

VI. Upland Prairie/Freshwater Wetlands

- Texas-Louisiana Coastal Prairie
- Texas-Louisiana Coastal Prairie Slough
- Tamaulipan Mesquite Upland Scrub
- Successional Shrub/Scrub
- Successional Shrub/Scrub (Clear Cut)

PRODUCED IN THE DIVISION OF PLANNING
 ALBUQUERQUE, NEW MEXICO
 LAND STATUS CURRENT TO: 5/31/09
 MAP DATE: May 2011
 BASEMAP: N/A
 MERIDIAN: N/A
 FILE: snb_NVCS_C_8.5by11_5.20.11_shl





Legend

San Bernard NWR Boundary

Refuge Boundary

Vegetation

I. Hardwood Forest

- West Gulf Coastal Plain Large River Floodplain Forest
- West Gulf Coastal Plain Small Stream and River Forest
- Introduced Wetland Vegetation - Treed

II. Open Water

Open Water

III. Disturbed

- Agriculture - Cultivated Crops and Irrigated Agriculture
- Agriculture - Pasture/Hay
- Modified/Managed Southern Tall Grassland
- Developed-Low Intensity
- Developed-Open Space

IV.a. Upper Saline Marsh

Central and Upper Texas Coast Dune and Coastal Grassland

IV.b Lower Saline Marsh

Gulf Coastal Plain Tidal Marshes

Non-Specific Disturbed

Upper Texas Coast Beach

V. Saline Prairie

Texas Saline Coastal Prairie

Central and South Texas Coastal Fringe Forest and Woodland

Tamaulipan Arroyo Shrubland

Tamaulipan Mixed Deciduous Thornscrub

Tamaulipan Calcareous Thornscrub

VI. Upland Prairie/Freshwater Wetlands

Texas-Louisiana Coastal Prairie

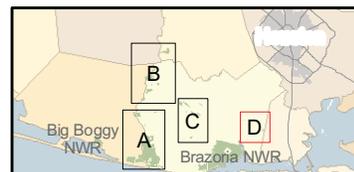
Texas-Louisiana Coastal Prairie Slough

Tamaulipan Mesquite Upland Scrub

Successional Shrub/Scrub

Successional Shrub/Scrub (Clear Cut)

PRODUCED IN THE DIVISION OF REFUGE PLANNING
 ALBUQUERQUE, NEW MEXICO
 LAND STATUS CURRENT TO: 5/31/09
 MAP DATE: May 2011
 BASEMAP: N/A
 MERIDIAN: N/A
 FILE: snb_NVC_S_D_8.5by11_5.20.11_shl



3.3.1.1 Terrestrial Vegetation Classes

The Complex reviewed previous on-the ground mapping efforts along with TNC's National Vegetation Classification System (NVCS), a hierarchical system of standard vegetation types across the landscape of the Complex to define the broad and alliance level categorization of refuge habitats. This compilation was required because the national vegetation classification system focuses on existing vegetation rather than potential natural vegetation, climax vegetation, or physical habitats. Multiple areas categorized as non-specific disturbed were simply areas impacted by natural processes including drought, fire, or salt-water inundation. Temporal and spatial variation in communities is an intrinsic property of the vegetation itself and, therefore, critical to the protection of biodiversity and landscape dynamics. Not restricting the classification to stable vegetation types ensures the units are appropriate for inventory and site description, and provide the level of detail required to build ecological and landscape models. Appendix F further breaks down vegetative alliances.

Bottomland Hardwood Forest

The Complex classifies these forests as two NVCS divisions; West Gulf Coastal Plain Small Stream and River Forest (CES203, 487) and West Gulf Coastal Plain Large River Floodplain Forest (CES203, 488). These descriptions, recognized by the NVCS, are not accurate for the coastal bottomland hardwood forests adjacent to the Brazos, Colorado, and San Bernard Rivers, known as the Columbia Bottomlands. This unique forest once comprised an estimated 700,000 acres at the beginning of the last century. This forested area has been reduced to about 150,000 acres. Bottomland hardwood species and other trees tolerant of flooding dominate vegetation. The Complex defines an array of alliances within the floodplain, generally associated with geomorphic features; including swales, sloughs, oxbows, and meander scrolls.

West Gulf Coastal Plain Small Stream and River Forest

This is a predominantly forested system of the West Gulf Coastal Plain associated with small rivers and creeks. In contrast to West Gulf Coastal Plain Large River Floodplain Forest, examples of this system have fewer major geomorphic floodplain features. Those features that are present tend to be smaller and more closely intermixed with one another, resulting in less obvious vegetational zonation. Bottomland hardwood tree species are typically important and diagnostic, although mesic hardwood species are also present in areas with less inundation, such as upper terraces and possibly second bottoms. As a whole, flooding occurs annually, but the water table usually is well below the soil surface throughout most of the growing season. Some canopy trees in stands of this system include river birch, sugarberry, common persimmon, green ash, honey locust, sweetgum, loblolly pine, American sycamore, and numerous oak species. Shrubs and understory trees may include American hornbeam, common buttonbush, silky dogweed, hophornbeam, parsley hawthorn, American holly, black willow, and black highbush blueberry.

West Gulf Coastal Plain Large River Floodplain Forest

This system represents a geographic subset of Kuchler's (1964) Southern Floodplain forest found west of the Mississippi River. Examples of this habitat type may be found along the Trinity, Neches, and Sabine Rivers. Several distinct plant communities can be recognized within this system that may be related to the array of different geomorphic features present

within the floodplain. Some of the major geomorphic features associated with different community types include natural levees, point bars, meander scrolls, oxbows, and sloughs (Sharitz and Mitsch 1993). Vegetation generally includes forests dominated by bottomland hardwood species and other trees tolerant of flooding, including bald-cypress and water tupelo. However, herbaceous and shrub vegetation may be present in certain areas as well. Vegetation generally includes forests dominated by bottomland hardwood species and other trees tolerant of flooding, including bald cypress and water tupelo. Other trees associated with examples of this system include Drummond's maple, river birch, water hickory sugarberry, green ash, sweetgum, American sycamore, swamp tupelo, loblolly pine, cedar elm, and various species of oak. Smaller areas of herbaceous- and shrub-dominated vegetation may also be present in certain areas. Shrubs and small trees include hazel alder, giant cane, American hornbeam, common buttonbush, coastal sweetpepper bush, stiff dogwood, Virginia sweetpepper, wax myrtle, dwarf palmetto, and Gulf Sebastian-bush.

Open Water

Within the boundaries of the Complex, this classification generally refers to open water associated with marsh ponds, open saltwater lakes like Cowtrap or Salt Lake, the GIWW, and freshwater ponds that management practices do not drain and otherwise disturb. In the salt marsh, widgeon grass and shoal grass with possibly small populations of turtle grass and manatee grass dominate vegetation known as seagrasses. Widgeon grass is by far the most important and will exist further inland in brackish and fresher waters. Seagrasses provide food and shelter to thousands of invertebrate species, including the economically important shrimp, crab, and juvenile game fishes. Freshwater ponds are solely dependent on rainfall and depths will fluctuate.

Disturbed

The Complex categorizes disturbed areas as: 1) continuously disturbed (e.g., roads, spoil sites, moist soil units, etc.); 2) static successional disturbed (e.g., unclassified static successional communities, mud flats, salt pans, etc.); and 3) successional disturbed (e.g., old fields).

Disturbed areas undergo environmental stresses either naturally or culturally and result in a static vegetation or landscape succession. Therefore, they have vegetative or non-vegetative characteristics. If naturally disturbed, as in the case of old fields, the shift in succession to another population may take several years to a decade or more. Salt pannes or mud flats for example are frequently disturbed by tidal action to the point where the soil is hypersaline and pioneering seeds are washed away before they germinate. Mechanical manipulation of moist soil units disrupts invasion by plants such as cattails to keep the area open for waterfowl activity. Other natural conditions may for a time inhibit or promote the occurrence of one dominant species year after year, such as those found occupied by wolfweed.

Saline Marsh

Saline marsh generally includes two NVCS classifications: the Central and Upper Texas Coast Dune and Coastal Grassland (CES203.465) and the Central and Upper Texas Coast Salt and Brackish Tidal Marsh (CES203.473).

Central and Upper Texas Coast Dune and Coastal Grassland

This system consists of wetland and upland herbaceous and shrubland vegetation of barrier islands and near-coastal areas in the northern Gulf of Mexico along the upper Texas coast, at least to Galveston Bay. Plant communities of primary and secondary dunes, interdunal swales and adjacent mainland are included. Salt spray, saltwater overwash, and sand movement are important ecological forces.



Efforts to utilize photo applications to depict vegetation characteristics along with efforts to ground truth data will provide long-term monitoring capability. Photo Credit: USFWS

Central Upper Texas Coast Salt and Brackish Tidal Marsh

This ecological system encompasses the brackish to salt intertidal marshes of the central and upper coast of Texas. These marshes typically occur on the bay side of barrier islands. It also includes extensive irregularly flooded tidal flats and salt pannes, which may or may not be vegetated. This system ranges from Galveston Bay in Chambers County, south to approximately Corpus Christi Bay. Vegetation occurring in this habitat type include succulent herbs such as swampfires, glassworts and turtleweed. Other plants that may be found in this system include sand bluestem sand sagebrush, black mangrove, eastern baccharis, bushy seaside tansy, saltgrass, Jesuit's bark, needlegrass rush, shoregrass, Pacific swampfire, various cordgrasses, seashore dropseed and exotic species of tamarix.

Plants of the saline marsh are adapted to clay soils, salinity, and desiccating winds as well as frequent inundation from the Gulf Coast waters through tidal action and storm surges. These plants have adaptive structures to take in oxygen while their roots are under water. The primary dominant species are smooth cordgrass, saltwort, saltgrass, and saltmarsh bulrush. Two recognizable sub-classifications are Upper Saline Marsh and Lower Saline Marsh. Where lower saline marshes transition toward less saline conditions, there can be an annual shift in species populations depending on the inundation of saltwater. For example, seashore paspalum and olney bulrush populations can dominate acres of freshwater until a storm surge shifts the species composition toward salt tolerant saltgrasses.

Saline Prairie

Saline Prairie is denoted as Texas Saline Coastal Prairie (CES203.543) in the NVCS. This system includes grassland vegetation occurring on saline soils that are often saturated with

rainfall and periodically flooded by saline waters during major storm events. The saline prairie is a transition from the upland prairie toward plants adapted to persistent desiccating winds and saline clay soils due to their near proximity to coastal waters. Plants have fleshy leaves that retain water and have waxy surfaces to delay desiccation. The dominate flora of the saline prairie are gulf cordgrass, sea ox-eye daisy, and shoregrass with scattered populations of glasswort. Fire is an important ecological process needed to maintain this system, though periodic submersion by saltwater during storm events also helps to control the invasion of woody species. The woody eastern bacharris shrub will co-dominate with gulf cordgrass and become a nuisance that requires periodic burning to eradicate or suppress.

Upland Prairie/Freshwater Wetlands

Upland Prairie/Freshwater Wetlands are generally described in the NVCS's Texas-Louisiana Coastal Prairie (CES203.550) and Texas-Louisiana Coastal Prairie Pond Edges (Slough) (CES203.541).

Texas-Louisiana Coastal Prairie

This system is often characterized by a ridge-and-swale or mound-and-intermound microtopography and encompasses both upland and wetland plant communities. Little bluestem, brown-seed paspalum, and switchgrass dominate the upland prairies, in addition to dozens of rush and sedge species. Common wildflowers found here are the prairie coneflower, Texas coneflower, white heath aster, and yellow-puff. Factors that contribute to the establishment and maintenance of prairie are soil type, fire, rainfall, and grazing. Some estimates state that 99 percent of coastal prairie has been lost through conversion to other uses and environmental degradation due to the interruption of important ecological processes, such as fire, needed to maintain this system. In the absence of regular fire, woody shrubs and trees will invade this system. Examples of invading woody species include eastern baccharis, Chinese tallow tree and yaupon as well as native trees. Many prairie species depend on fire for seed production because it removes accumulated plant litter and satisfies seed dormancy needs.

Drought occurs in areas of low rainfall and heavy clay soils hold water making it unavailable to plants. Plants can also experience drought-like stress as a result of root restriction caused by a 8–12 inch deep hard pan layer in some soils that roots cannot penetrate. Water is retained in scattered ponds and ditches throughout the upland prairie. Here the plant species are adapted to having their roots submerged under water for months. Dominant wetland species are *Sagittaria* sp., cattails, rice cutgrass, bulrushes, and floating forbs. Phragmites, although native to the region, are a persistent invader of freshwater wetlands and must be controlled by mechanical, chemical, and prescribed burn treatments.

Texas-Louisiana Coastal Prairie Pond Edges (Slough)

This system includes small to moderately large ponds and wwales in the coastal prairie of southeastern Texas and Louisiana. These wetlands contain surface water during much of the year, desiccating only in the driest summer months. They are often fed by water runoff but result from percolation from adjacent sandy areas. Soils in the basins are finer-textured than surrounding areas and may be underlain by pans that enhance perched water tables in the winter. These wetlands occur within the coastal prairie matrix of southeastern Texas and Louisiana and are wetter than wet prairie dominated by eastern gamagrass and switchgrass.

These wetlands may be dominated by squarestem spikerush. Other species that may be present include nipplebract arrowhead, longbarb arrowhead, gaping grass, haspan flatsedge, green flatsedge, cylindricalfruit primrose-willow, narrowleaf primrose-willow, hairy umbrella-sedge, Richard's yellow-eyed grass, southern cutgrass, erect centella, and eastern annual saltmarsh aster. Open areas in the ponds may contain floating and submersed aquatic vegetation, including sago pondweed, coon's tail, watershield, big floatingheart, yellow pond-lilly, and American lotus.

3.3.1.2 Aquatic Classes

The Complex has a diversity of salt, brackish, and fresh wetlands, including wet prairies, forested wetlands, tidal flats, estuarine bays, bayous, and rivers. The existence and extent of specific plant species within these different wetland types depends on their tolerances to fluctuating salt concentrations and variability in water depth. There is some overlap of species within the different wetland types on the Gulf Coast.

Tidal flats are located in the intertidal zone and are consistently exposed and flooded by tides. Tidal flats, characterized by sand, silt, and clay, have minimal vegetation but are important feeding grounds for coastal shorebirds, fish, and many invertebrates including crabs, oysters, clams, shrimp, and mussels.

Salt marsh, with an average salinity of 18 ppt, it has the greatest tidal fluctuation of all marsh types. Salt marshes contain relatively few plant species and are characterized by smooth cordgrass, a species that depends on water fluctuations. Soils have a lower organic content than fresher inland wetlands.

Brackish marsh communities are transitional between saline and intermediate marshes with an average salinity of 8.2 ppt. They are still subject to daily tidal influence. Marsh soils have a higher organic content than salt marshes, and higher water levels. Brackish marshes contain numerous small bayous and lakes.

Intermediate marshes are somewhat tidally influenced and have greater plant diversity than saline or brackish marshes. The average salinity is 3.3 ppt.

Fresh marshes support the greatest diversity in plant species of all marsh types. They are normally free from tidal influence, exhibit slow drainage, and have the highest soil organic content of coastal wetlands.

Coastal prairie generally extend from the coastal marshes to as much as 75 miles inland. Much of the former tall grass prairies dotted with shallow, ephemeral prairie wetlands (called potholes) and agricultural fields and human development drain and replace meandering bayous, creeks, and rivers.

Forested wetlands consist of bottomland hardwood trees that grow in creek and river floodplains. These wetlands are open productive systems that receive supplement from soil and organic matter upstream. The ebb and flow of floodwater has shaped and reshaped the

forest floor into ridges, swales, and flats. These in turn affect soil saturation and the type and abundance of plants that can grow. Numerous lesser creeks, bayous, and sloughs lie between the major rivers, carrying local rainfall to the coastal marshes, bays, and the Gulf. The waterways are generally forested along their banks and provide riparian habitat for native wildlife and migratory birds.

The Brazos and Colorado Rivers are the primary river basins. The headwaters extend into west Texas and provide water to numerous large and small communities including Austin and the Dallas/Fort Worth Metro Area along the way. Both rivers have numerous dams upstream from the Complex. Several of the bottomland units are adjacent to the Brazos. The San Bernard River follows a former channel of the Brazos and lies between these two major rivers. Its drainage basin extends approximately 100 miles inland. Lesser waterways, including Oyster Creek, Halls Bayou, Chocolate Bayou, and Caney Creek have drainages, which extend beyond 50 miles from the coast. The smallest drainages including Bastrop Bayou, Austin Bayou, Live Oak Bayou, Cedar Lake Creek, Dance Bayou, and Linnville Bayou are slow moving waterways that have drainages within 50 miles of the Gulf Coast. These all carry local rainfall to the coastal marshes, bays, and the gulf.

An extensive amount of rainfall during particularly wet periods drains to the marshes via surface or sheet runoff across the wet prairies; Cocklebur Slough and Rail Pond drainages on San Bernard NWR are good examples. This drainage is particularly important for intermediate and brackish marshes and creates a flushing mechanism. Where the drainage districts have created drainage ditches—particularly at Brazoria NWR, south of FM 2004—this flushing mechanism does not occur to the extent it did historically. The Complex established managed ponds along ditches and natural drainages to capture local rainwater, creating freshwater habits.

Shoreline habitats across the Complex vary from beach habitat at San Bernard NWR to natural marsh edges in the Cedar Lakes and Cow Trap Lakes at San Bernard NWR and Christmas Bay and Bastrop Bayou edges at Brazoria NWR. Shoreline habitat also occurs as both armored and unarmored shorelines along the GIWW. Erosion along the edges of the GIWW has been significant since it was first dredged. In some areas, particularly along spoil sites, the Army Corp of Engineers have armored banks with concrete block. However, acres of marsh are lost annually as vessel wakes, tides, and wind driven wave-action erode fine marsh sediments along exposed shorelines.

Texas coastal wetlands are an important wintering and migration area for North American waterfowl. Numerous birds of special concern, such as the bald eagle, piping plover, and reddish egret all depend on Texas marshes and estuaries, as do otters, alligators, swamp rabbits, furbearers, and amphibians. Texas coastal marshes and estuaries provide productive nursery and spawning areas and habitat for marine species and other marine organisms.

3.3.1.3 Natural Disturbance Processes

The habitats of the Complex have evolved with natural disturbances that continuously shape plant communities, their composition, and structure. In addition, these disturbances, mostly weather generated, maintain an early seral stage, cycle nutrients, and can have dramatic effects on productivity. The primary natural disturbance drivers in these habitats are wildland fire, shifting salinity concentrations (from inflows of freshwater from rainfall, seasonal tidal activity, the passage of frontal boundaries, droughts, and tropical storms), and hurricanes having effects other than changes in salinity.

With the nature of coastal weather in the Gulf of Mexico, wildland fires have generally started from lightning strikes in favorable fuels. A dominant fuel, gulf cordgrass, readily ignites under damp and wet conditions. Showers and thunderstorms generate as seasonal winds (south and southeast) bring gulf moisture over land. They typically form along the coast and move inland. Lightning is a large component of these storms, and is responsible for the majority of wildland fires started on the Complex. In 2010, only three wildland fires were started on San Bernard NWR, but 2009 saw the start of several fires on both San Bernard and Brazoria NWRs due to drier conditions. In 2008, a wildland fire starting from at least three separate lightning strikes and consumed more than 5,000 acres on San Bernard before it was contained. These fires, although in most cases beneficial to the habitat, are controlled or contained to protect life and property both on and off the refuges.

The salinity gradient literally draws the line in the mud for many organisms. There are plants and animals that tolerate a wide range of salinities and there are those with more narrow tolerances of either fresh or saline water, and the Complex distributes both accordingly. The movement of water, both fresh and saline, impacts the salinity gradient. Fresh water enters the Complex via rainfall, run-off, inland waterways, and transport through permeable soils. Saline water comes from the Gulf of Mexico, and seasonal tidal limits impact it daily. The passage of frontal boundaries and winds that can push water inland or out to sea can impact both fresh and saline water, as well as the gradient between them.

Tropical storms and hurricanes impact the refuges. Depending on the severity of the storm (wind classification), size of the storm, and associated factors (storm surge, rainfall, etc.); storms will have varying impacts on the landscape. Storm surges push salt water up onto the marsh, salty prairie, and even into the coastal prairie or forest woodlands. This in itself may or may not be devastating; depending on rainfall and the length of time salt stays inland. Sufficient rainfall will dilute the saltwater, flushing the salts back into the gulf. Without sufficient rainfall, the salt water will pool in shallow wetlands throughout the upper salt marsh, salty prairie, and even coastal prairie, killing vegetation and invertebrate populations that are not capable of sustained high salt conditions. Hurricane Ike was a good example of this drastic condition when the lack of rainfall immediately following the storm, and for months afterward, left rock salt-size crystals lying in dry pond bottoms. The Complex may try to capture and store storm surge water temporarily in freshwater wetlands to control cattail, phragmites, and California bulrush. The primary impact of wind to the natural habitat is to woodlands and bottomland hardwood forests. Even Category 1 force winds like those

of Hurricane Ike can break and blow down smaller trees and may up root larger trees if the soil is saturated.

3.3.1.4 Historical Habitat Description

Bottomlands in the early 1800s were typically composed of mature hardwoods. References also include the description of the forest as the “cane-break forest,” describing the immense stands of native cane growing under the canopy. Many bottomlands have now been cut over and cleared and others have thick under stories resulting from timber cutting or various soil disturbances, or are relatively open due to continuous grazing. According to written accounts from early explorers and settlers in the 1800s, white-tailed deer, wild turkey, bison, black bear, squirrel, mountain lion, and red wolf were once common.

The Coastal Prairie of Texas is a tall-grass prairie similar in many ways to the tall-grass prairie of the Great Plains. The Service estimates that, in pre-settlement times, there were 9 million acres of Coastal Prairie, of which 6.5 million acres were in Texas. Today, less than one percent of the Coastal Prairie remains. Nearly 1,000 plant species were known to once occur in the vast Coastal Prairie, but no one knows how many species have followed the prairie vole and the Louisiana Indian paintbrush to extinction. The Coastal Prairie, historically, was home to herds of bison and pronghorn antelope, and red wolves roamed among the riverine forests that crisscrossed the area. The Coastal Prairie and its adjacent marsh habitat provide immense space for waterfowl and other forms of wildlife. Even in its altered state, Coastal Prairies routinely host more red-tailed hawks, northern harriers, white ibises, and white-faced ibises than any other region in the country.

Factors such as soil type and rainfall contribute to the formation of a prairie but fire is the natural mechanism by which prairie reverts to an early successional stage. Fire prevents woody plants from establishing, stimulates seed germination, replenishes nutrients, and allows light to mar young leaves. Historically, lightning strikes caused prairie fires to occur in the summer, and the fires, along with drought and competition from herbaceous plants, prevented the establishment of woody plants and remained a grass-dominated ecosystem. Across the landscape, much of the historic prairie has been converted to improved pasture for cattle grazing, the farming of rice, sugarcane, forage, and grain crops. Much of the Coastal Prairie that remains in Texas exists because it was used as pastureland for cattle production and never plowed. Overgrazing caused the loss of many herbaceous species. Continued threats to what remains of the Coastal Prairie include conversion to agriculture and development, paving, and now face overgrazing or becoming overgrown with shrubs due to fire suppression. Private ownership accounts for most Coastal Prairie remnants, with only a small percentage preserved by agencies or organizations.

3.3.1.5 Estimated Future Habitat Conditions due to Climate Change

The Service assessed future wetland conditions spatially by modeling sea level inundation rates resulting from predicted SLR from 2010 to 2100. They derived low and high estimates of SLR used in the inundation model by combining two SLR prediction models for the region. Results of the sea level inundation model were stored in a GIS and used to quantify

potential impacts to existing wetlands at decadal intervals from 2010 to 2100. Results of the 1938/44–2008 trends analysis showed a significant increase of inflow through (tidally influenced) wetland acres across the Complex. Results of the future conditions analysis predict that SLR will significantly alter or displace the majority of wetlands across the Complex between 2020 (71.03 percent of current wetland acres) and 2050 (87.10 percent of current wetland acres).

Results of the 1938/44–2008 wetlands trends analysis tend to indicate subsidence and/or SLR had been occurring across the Complex prior to the significant impacts of climate change scientists predict today. The increase in the area of flow through wetland basins from 2872.79 (1938/44) acres to 4593.34 (2008) acres is an indication that the coastal wetlands of the Complex have already been impacted by SLR to some degree. In addition to SLR, many climate change studies predict changes to tropical storm events, precipitation rates, and temperature levels at rates that can impact habitat conditions and distributions along the Gulf Coast. Combined with SLR, it is likely that tropical storm events will accelerate wetland impacts across the Complex by increasing wave action and erosion rates that will compound the conversion of coastal salt marsh to open bays. Changes in precipitation amounts and runoff may also impact wetlands. A decrease in freshwater inputs to coastal wetland systems resulting from reduced rainfall and increased upstream water usage from agriculture, urban, and industrial use may increase salinity rates and reduce sediment inputs to coastal wetland systems. Compounding this likelihood is a predicted temperature increase of $>3^{\circ}$ F (HadCM2) to $>7^{\circ}$ F (CGCM2), which could increase the annual surface water evaporation rates by more than a foot (Fang and Stefan, 1999), further decreasing freshwater inputs and increasing salinity rates.

In response to past episodes in SLR, coastal wetlands have responded by migrating to adjacent uplands or building additional substrate to account for changes in water depth. Following this scenario, it is unlikely that impacts to coastal wetland systems would be significant in a period of accelerated climate change. However, where development of new wetlands does not coincide with current land use practices or urban extent, wetlands development is likely to be impacted (Cahoon et al., 1999). Using the results of the high inundation model, the Complex is predicted to lose 37,926 acres (35.93 percent of total area) to open bay (seawater) conversion by 2100. This will eliminate 89.68 percent of the current wetlands on the Complex. While San Bernard and Brazoria NWRs will still contain a substantial portion of the upland land mass, it is not known if these areas are suitable for future wetland development or if the wetlands developed there would function at a level where productivity would offset predicted losses. The Complex may need to purchase additional lands suitable for inland wetland development to offset predicted wetland loss.

The Complex will use the results of this report and accompanying data as a refuge-scale decision support tool and incorporate them into existing land management actions, habitat protection, and land acquisition planning efforts. The Complex will also apply data to existing ancillary datasets to address additional management questions.

3.3.1.6 Concerns Regarding Refuge Habitat

Invasive Plant Species

Dozens of non-native invasive plant species occur on the Complex, including Chinese tallow tree, macartney rose, water hyacinth, privet (*Ligustrum spp.*), salt cedar, trifoliolate orange, and deep-rooted sedge. Many are very aggressive and have habitat changing characteristics. The Complex's efforts to control these species are discussed in section 3.6.2. Chinese tallow is prevalent in forest, woodland, prairie and freshwater wetlands. This quick growing tree can quickly establish monoculture stands when left unchecked. It quickly establishes itself in disturbed areas, along right-of-ways and fence lines. Much of the restoration activities on the refuge include removal of Chinese tallow. Treatments include aerial spraying on open prairies or monoculture stands, foliar and basal bark spraying in bottomlands. Macartney rose is more isolated to just several problem areas including parts of the Brazoria prairie, Eagle Nest Lake pastures and farm fields, and the Janks tract of Hudson Woods. Treatments include aerial spraying on prairies in association with tallow or individual foliar application. Water hyacinth is can be found in several freshwater wetlands in the bottomlands; including Scobey Lake, Big Pond, and Bird Pond. Irregular (2 to 3 years intervals) herbicide applications seem to keep it in check. Privet is generally scattered in many of the bottomland units, but prevalent population are found on Dance Bayou and Halls Bayou Units and Carolyn Davies Easement. Deep-rooted sedge is a problem on pipeline right of ways in the bottomlands; particularly on Big Pond and Bird Pond and in the Buffalo Creek Unit prairie. Treatments are generally foliar application with a boom or wand sprayer. Salt cedar which had only slowly invaded from the core sites for more than 100 years has become a larger problem in the past five years. It aggressively invades dried ponds such as Wolfweed and Moccasin Pond at San Bernard NWR and Teal Pond at Brazoria NWR. Herbicide and mechanical removal are generally utilized for control salt cedar. Trifoliolate orange can be found in isolated locations on many bottomland units but the largest densities occur on the McNeal, Bludworth and Stringfellow Units.

Loss of Salt Marsh Habitat

The loss of salt marsh habitat on the Complex is occurring due to both natural and man-made causes. Wind driven erosion along shorelines, including Salt Lake, Cow Trap Lake, Dressing Point Island, and Cox Lake are occurring at increasing rates. The GIWW has created the greatest change in coastal habitats over the past 75 years. The GIWW is now three to four times wider than when originally dredged. This equates to a direct loss of marsh habitat as well as opening up channels into once isolated wetlands. Vessel traffic along the GIWW creates wave action that continues to erode marsh habitat along the Texas Gulf Coast.

Native Invasives

Native plant communities have existed in concert with each other on the Complex for thousands of years. Each community benefits by a stable interaction with natural changes that allow them to occupy certain niches. European settlers disrupted this balance by manipulating plant communities through farming and grazing. Two primary disruptions by modern day settlement was the suppression of natural wildfires on the prairies and over-grazing by domestic ungulates. Both actions favored the encroachment of shrubs and trees



Chinese tallow is the most widespread invasive species across the refuges. It is a problem in and around all freshwater wetlands including ditches, wet prairie and bottomlands. Photo Credit: USFWS

Macartney rose is primarily associated with old field habitats that are being restored to native hardwood or prairie habitats. Photo Credit: USFWS



Salt cedar is becoming increasingly a problem to manage in freshwater wetlands, where it had not been seen previously, possibly due to extensive droughts lengthening periods when the wetland is dry. Photo Credit: USFWS

into the prairies. For example, periodic wildfires prevented woody species from expanding into open prairies. Prairie forbs have adapted by hastening their maturation within a growing season, thereby allowing them to disperse their seeds beyond the perimeters of a wildfire or by introduction into a prairie community after a fire has passed through. Historically, a grassland community would not have a large buildup of “fuels” because of periodic fires.

Therefore, the fires would not burn as hot and the grass would survive. The suppression of wildfires allows more buildup of dead grasses, producing more fuels for a hotter burn and increasing the chances that a grass species will not survive, therefore; allowing opportunities for woody species to establish. Similarly, the repeated overgrazing by domestic ungulates removes grass species and allows less palatable woody species to invade and thrive in an overgrazed community.

Presently, woody native species such as eastern baccharis and trees have occupied many niches on the coastal prairie where grasses and forbs once dominated. Reversing their dominance on the prairie requires extensive labor and costs by the Complex. With a consistent and determined plan of control or eradication, the Complex is succeeding in this endeavor through prescribed burning and mechanical and chemical treatments of woody plant species. The result is the reclamation of thousands of acres of coastal prairie.



Prescribed fire can effectively be utilized to control baccharis, but burning in September/early October provides the best opportunity for complete kill. Photo Credit: USFWS

Accelerated Climate Change

The majority of the coastal wetlands on the Complex are at very low elevations adjacent to or in proximity to the Gulf of Mexico and are susceptible to impacts by major storm events and long-term anthropogenic landscape alterations that can alter wetland function and development. Compounding these impacts is an anticipation of SLR resulting from global warming and accelerated climate change. Current estimates of SLR along the mid-Gulf Coast of Texas range between 8.4 inches to 19.2 inches by 2100 with an additional average subsidence rate of 4 inches over that period (Twilley et al., 2001). At present, it is unclear how such events will fully impact future management decisions and wildlife habitat conditions over time.

Anticipated habitat changes due to accelerated climate change include loss of marshes to open water, loss of prairie to marsh habitat, and even a loss of forest to prairie habitats. The same climate stressors that are impacting native habitat will also increase vulnerability to invasive species. Invasive species in general more easily adapt to changing conditions than native species.

Habitat Fragmentation

Habitat fragmentation occurs both on and off the refuges. Roads, utility corridors, development, pipelines, and the GIWW fragment natural habitats. In addition to significantly altering the landscape, these rights-of-way (ROW) enable the transport and introduction of invasive species, direct take of wildlife, and alteration of adjacent habitats increase light reaching the canopy floor and alters species composition. Oil and Gas operations have the potential of adding roads, pipelines and development into pristine areas. The Complex works with companies to reduce this fragmentation while preparing the Environmental Assessment and Operational Plan. Other ROW requests (common carrier pipelines, roads, utility lines) require Appropriate Use and Compatibility Determinations. Due to these policies no new pipeline right-of-ways have been constructed through bottomland habitats that have been acquired by the Service. Other sources of fragmentation include opening new public use areas (trails, roads, and infrastructure). These too, are addressed during planning with NEPA compliance.

Bottomland Conservation

The Service is nearing the 28,000-acre cap originally set in the deciding documents included in the Austin's Woods Conservation Plan. For 15 years, the Service has been working with partners to conserve bottomland forest working toward the 10 percent of historic forest conservation goal. Due to financial constraints, partner agencies and organizations have not been able to conserve as much lands as may have been originally hoped but rather have been able to support Service's acquisition program through donations. At the same time, remaining forests have been opened up and converted to residential development, open right-of-ways, and agriculture. In order to reach the conservation goal for this ecosystem to support migratory birds and resident wildlife, the Service is proposing an increase in the cap through preparation of a new LPP (see Appendix I).

3.3.2 Wildlife

The Complex supports a great diversity of wildlife, which is one of the most noticeable and outstanding features. The Complex is home to large populations of both resident and migratory wildlife, including more than 400 different wildlife species.

The Complex provides habitat for at least 305 breeding bird species, 52 species of mammals, 67 reptilian species, 24 amphibian species, 128 fish species, and countless invertebrates. These bottomland hardwood forests and prairies also support a large number of neotropical migrants during fall and spring migration. Appendix E provides a complete list of species.

3.3.2.1 Priority Species

The Complex provides habitat for a variety of rare and declining species, including listed (endangered or threatened), proposed, and candidate species, and other species of concern (SOC). Declines are often related to loss and fragmentation of suitable habitat, loss of food sources, increased disturbance, increased pollution, or increased predation.

Table 3-4 includes the listed species (state and federal endangered or threatened species) and refuge SOC that are known to occur or have potential habitat on the Complex. Species accounts for Federal and State listed species and Refuge Species of Concern (SOC) are provided below.

Table 3-4. Listed Endangered and Threatened Species with potential to occur on or adjacent to the Complex and Refuge Species of Concern.

American peregrine falcon	<i>Falco peregrinus anatum</i>	DL	T	
Northern aplomado falcon	<i>Falco femoralis septentrionalis</i>	E	E	
Attwater's prairie-chicken	<i>Tympanuchus cupido attwateri</i>	E	E	
Bald eagle	<i>Haliaeetus leucocephalus</i>	DL	T	SOC
Brown pelican	<i>Pelecanus occidentalis</i>	DL	E	SOC
Interior least tern	<i>Sterna antillarum athalassos</i>	E		
Piping plover	<i>Charadrius melodus</i>	E	E	SOC
Reddish egret	<i>Egretta rufescens</i>		T	SOC
White-faced ibis	<i>Plegadis chihi</i>		T	SOC
White-tailed hawk	<i>Buteo albicaudatus</i>		T	SOC
Whooping crane	<i>Grus americana</i>	E	E	
Wood stork	<i>Mycteria americana</i>		T	
Sprague's pipit	<i>Anthus spragueii</i>	C		
Black rail	<i>Rallus jamaicensis</i>			SOC
Yellow rail	<i>Coturnicops noveboracensis</i>			SOC
Henslow's sparrow	<i>Ammodramus henslowii</i>			SOC
Leconte's sparrow	<i>Ammodramus leconteii</i>			SOC
Mottled duck	<i>Anas fulvigula</i>			SOC
Painted bunting	<i>Passerina ciris</i>			SOC
Dickcissel	<i>Spiza americana</i>			SOC
Seaside sparrow	<i>Ammodramus maritimus</i>			SOC
Swainson's warbler	<i>Limnothlypis swainsonii</i>			SOC
Red knot	<i>Calidris canutus</i>	C		SOC
Wilson's plover	<i>Charadrius wilsonia</i>			SOC

Species				
Snowy plover	<i>Charadrius nivosus</i>			SOC
Black skimmer	<i>Rynchops niger</i>			SOC
Loggerhead shrike	<i>Lanius ludovicianus</i>			SOC
Northern bobwhite	<i>Colinus virginianus</i>			SOC
Swallow-tailed kite	<i>Elanoides forficatus</i>			SOC
Sharpnose shiner				
Blue sucker	<i>Cycleptus elongatus</i>		T	
Smalltooth sawfish	<i>Pristis pectinata</i>	E	E	
False spike mussel				
Smooth pimpleback	<i>Quadrula houstonensis</i>		T	
Texas fawnsfoot	<i>Truncilla macrodon</i>		T	
Texas pimpleback	<i>Quadrula petrina</i>		T	
Atlantic hawksbill sea turtle				
Green sea turtle	<i>Chelonia mydas</i>	T	T	
Kemp's ridley sea turtle	<i>Lepidochelys kempii</i>	E	E	
Leatherback sea turtle	<i>Dermochelys coriacea</i>	E	E	
Loggerhead sea turtle	<i>Caretta caretta</i>	T	T	
Texas scarlet snake	<i>Cemophora coccinea lineri</i>		T	
Diamond-backed terrapin	<i>Malaclemys terrapin littoralis</i>			SOC
Timber/Canebrake rattlesnake	<i>Crotalus horridus</i>		T	SOC
Salt marsh snake	<i>Nerodia clarkia</i>			SOC

“DL”=de-listed, “E”=endangered, “T”=threatened, “SOC”=species of concern.

Threatened and Endangered Species

The purpose of the Endangered Species Act is to conserve “the ecosystems upon which endangered and threatened species depend” and to conserve and recover listed species.

Under the law, species may be listed as either “endangered” or “threatened.” Endangered means a species is in danger of extinction throughout all or a significant portion of its range. Threatened means a species is likely to become endangered within the foreseeable future. All species of plants and animals, except pest insects, are eligible for listing as endangered or threatened.

The Complex knows the following federally-listed, endangered/threatened species occur or have potential habitat on the refuge:

Attwater’s Prairie Chicken

Historically, Attwater’s prairie-chickens are found throughout the coastal prairies of Texas; however, only three isolated populations remain. Although not currently occurring on the Complex, several areas have been identified as potential future reintroduction sites. Uniquely situated southwest of the Texas City Prairie population and southeast of the Attwater Prairie Chicken NWR, the Complex may provide an essential link between the populations south of the Houston Metro Area.

Restoration of native prairie is an essential first step in preparing for the reintroduction of Attwater prairie chickens. Although the Attwater Prairie Chicken Recovery Team previously identified Brazoria NWR as a potential reintroduction site, the Complex needs to evaluate current management practices, including rotational burning, lack of grazing, and haying in terms of providing appropriate prairie chicken habitat. The interior prairies associated with bottomland units may be better potential reintroduction locations than Brazoria NWR. These prairies are not as exposed to tropical events and are more similar to the inland prairie at the Attwater Prairie Chicken NWR.

Northern Aplomado Falcon

The northern aplomado falcon is a subspecies of the aplomado falcon that inhabits lowland neotropical savannas, coastal prairies, and higher-elevation grasslands from the southwestern United States south to Tierra del Fuego. The northern subspecies was originally documented in the United States at six general localities in southeastern Arizona, south-central New Mexico, western Texas, and the lower Texas coast. The northern subspecies prefers coastal prairies and desert grasslands with scattered yuccas and mesquites. They also utilize oak woodlands and riparian gallery forests in midst of desert grassland. Aplomado falcons nest in bromeliads or abandoned stick platforms of corvids and other raptors or artificial structures. From 1996 to 1999, northern aplomodo falcons were hacked on Matagorda Island and are continuing to nest and inhabit the Island's prairie habitat. Since then, two documented sightings of aplomado falcons have occurred on San Bernard NWR; the most recent in December 2011. Both sightings appear to be single transient birds. If the population were to increase the refuges may provide future nesting habitats. No directed management actions for this species are planned at this time.

Whooping Crane

Whooping cranes do not regularly occur on the Complex. However, for the cranes to reach recovery status, the Aransas/Wood Buffalo population will need to expand. The tidal marsh areas of the Complex will be required for the cranes to reach recovery status for delisting. Because plans to expand their territory outside the current migration corridor have not been

well defined, the Complex does not yet have management or monitoring plans specific to providing whooping crane habitat at this time. In the mean time, the Complex will manage the native coastal marshes insuring hydrological integrity, native species diversity and protect existing marshes from degradation due to erosion, subsidence, and rising sea-levels.

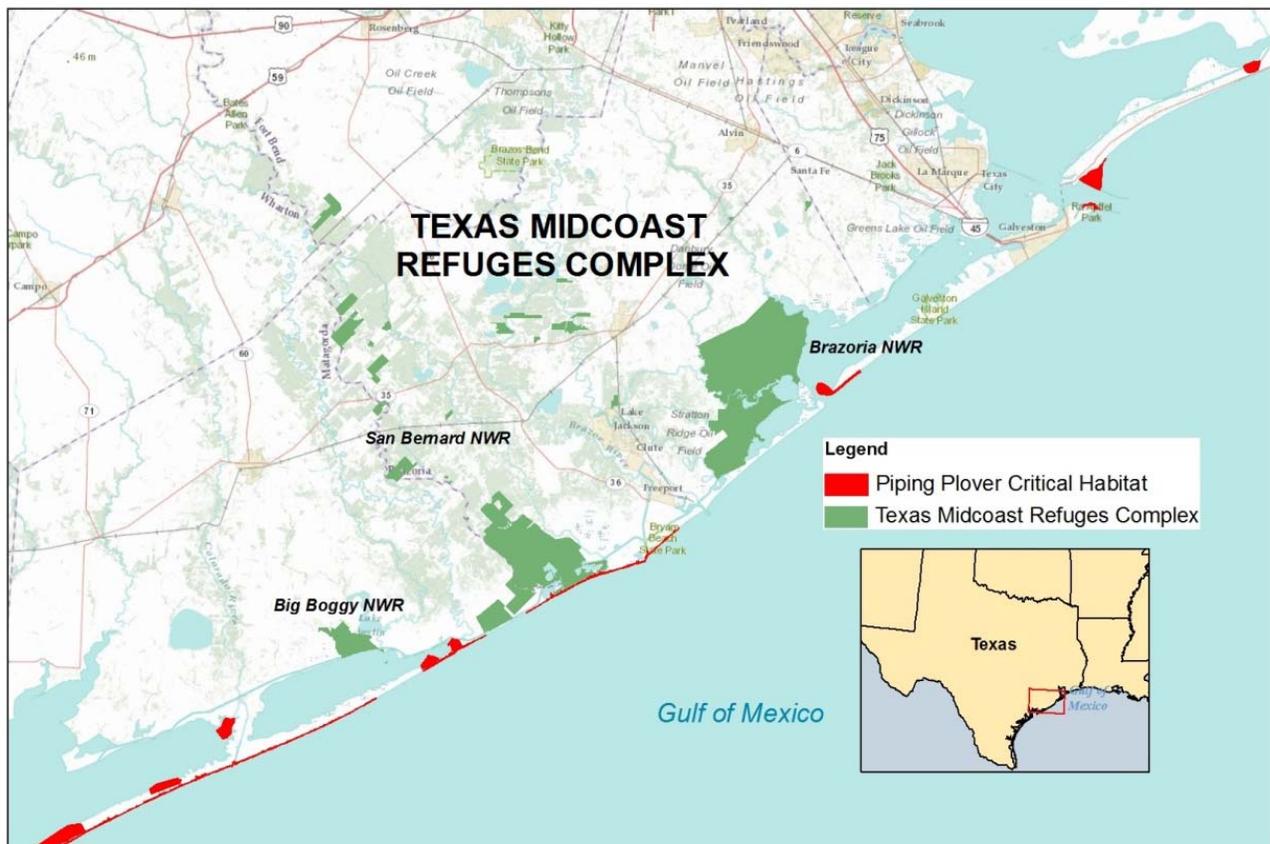
Interior Least Tern

The interior subspecies of least tern is a listed species for Fort Bend and Wharton Counties. This species is distinguished from the coastal subspecies in its location of nesting, along rivers and mudflats on the interior middle North America. For this reason, nesting birds identified more than 50 miles from the coast are considered interior subspecies. These birds cannot be easily distinguished from coastal least terns and overlap migration and wintering areas. No documented nesting occurs in either Fort Bend or Wharton County and birds found are wintering or transient. No directed management actions for this species are planned at this time.

Piping Plover

Breeding piping plovers are not know to occur on the Texas Gulf Coast (Haig and Elliott-Smith 2004); however, our coastal habitat is very valuable as a wintering area. Individuals typically arrive here July through November and most have left for the breeding grounds by mid-May (Haig and Elliott-Smith 2004).

Figure 3-6. Designated Critical Habitat for Wintering Piping



The tidal mudflats on the Complex, especially in the Cedar Lakes area of San Bernard NWR, are extremely valuable to this and other plovers when tides are low. The critical habitat designation does not clearly identify these mudflats, but they are at times more valuable to this species than the nearby beaches. Research shows that they prefer the bayside mudflats to the beaches periodically (Haig and Elliott-Smith 2004). The map below shows critical habitat areas near or adjacent to the Complex. For each area, the Complex considers the beach and adjacent “wind tidal flats” critical habitat.

Smalltooth Sawfish

The U.S. population of smalltooth sawfish is found only in the Atlantic Ocean and Gulf of Mexico. Historically, the U.S. population was common throughout the Gulf of Mexico from Texas to Florida, and along the east coast from Florida to Cape Hatteras. The current range of this species has contracted to peninsular Florida, and smalltooth sawfish are relatively common only in the Everglades region at the southern tip of the state. The loss of juvenile habitat, namely mangroves and other shallow water habitats, is thought to be a primary reason for the species’ decline. Because the species generally requires marine habitats, which are outside of the Complex boundaries, the refuges cannot play a direct role in the species recovery. However, the Complex can assist with outreach and partnering with state and federal entities to encourage habitat protection.

Sea Turtle Species

Five sea turtles—Kemp’s ridley, loggerhead, green, leatherback, and hawksbill—occur in the gulf and bay waters near the Complex. San Bernard NWR, which has a small segment of gulf beach, had one documented Kemp’s ridley nest in 2009. The Complex continues to restrict refuge beaches from vehicular traffic to protect this and other turtle species. The Complex supports all sea turtle recovery efforts by patrolling area beaches for stranding and nests. The Complex excavates and transfers all nests to the incubation site at Padre Island National Seashore, and transfers live turtles to the NOAA recovery facility in Galveston.

Candidate Species

Candidate species are those species for which the Service has enough information to warrant proposing them for listing as threatened or endangered, but these species have not yet been proposed for listing due to other higher priority listing activities. The Service works with States and private partners to carry out conservation actions for candidate species to prevent their further decline and possibly eliminate the need to list them as endangered or threatened.

Sprague’s Pipit

Sprague’s pipit is known to occur in Brazoria, Fort Bend, Matagorda, and Wharton counties. It is associated with native coastal prairie and salty prairie habitats on the Complex similar to the American pipit. It prefers shorter prairie or prairie patches among denser or more mature prairie stands. It does not tolerate brush encroachment in prairie habitats (Robbins et.al. 1999). It can be found in post-burn areas. The species is a wintering migrant, feeding on insects spiders and some seeds, and may be found on the refuges October through March. Prescribed burning to reduce shrub encroachment as well as residual grass cover and reduce or restrict invasion of exotic plants is the preferred method of prairie management. Grazing to reduce residual grass cover, stimulate growth of native plants and prevent or slow invasion

of exotic plants may be employed as well but can be detrimental if not appropriately managed.

Red Knot

The red knot occurs in Brazoria and Matagorda counties mainly September through April. Small numbers overwinter (Eubanks et al. 2006). It mainly rests and forages along beaches, where it is seen eating *Donax* during both spring and fall migration. However, on one occasion during fall migration a small group was observed on tidal mud flats at Cedar Lakes, on the bay side of the dune lines. San Bernard and Sargent Beaches and Cedar Lakes Pass (“the cut”) harbor knots during migration and for the winter. Significant numbers of first-year birds were noted on San Bernard and Sargent Beaches in June 2012 (J Wilson personal observation). It is possible that these non-breeding individuals summered at this location (D. Newstead, personal communication). The habitat types in which this species occurs receive little management. It would benefit from policies that limit vehicle disturbance on beaches and intertidal locations in Cedar Lakes. When its potential habitat is included, it should be considered in reviews of any activities that could impact potential habitat, such as oil and gas operations.



During the summer of 2011, large numbers of red knots were found feeding on the San Bernard beach. Photo Credit: USFWS

Other Species of Concern

The Complex’s SOC list was established based on the TPWD’s Comprehensive Wildlife Conservation Strategy, the state and federal endangered/threatened species list, and consideration of how Complex management activities, or the activities of others, may impact potentially sensitive species that have no state or federal status.

Bald Eagle

There are at least six active bald eagle nests in Brazoria County. These are primarily located on private land, however one historic nest is located on the Eagle Easement. This pair of birds have recently abandoned this historic nest tree and moved to a nearby tree along the forest edge on private land. Nests are generally located in mature trees however, they are often at forest edges or in pastures where canopy and mid-story underbrush have been removed.

It should be noted that over half of nest departures result in the young being tended on the ground until they can fly. This puts them at a disadvantage regarding predators. Thick vegetation on the ground beneath the nest can result in the adults not tending the young. When fledglings are flight-capable, they can remain with the adults for 1–2.5 months. At this time, they begin a roaming period that will last 4 years. These birds normally breed at age 5 years, but can start sooner or later depending on how much competition is present. Lifespan is roughly 30 years (Buehler 2000). At the Eagle Easement, fledglings normally leave the nest site by the end of May.

White-tailed Hawk

White-tailed hawks are year-round residents. Successful nesting territories have 40 percent or less shrub cover (sometimes up to 75 percent) and are interspersed with potential nesting sites, trees, or shrubs that offer nesting substrates approximately 9 feet from the ground (Farquhar 1992).

This raptor is associated with open grasslands with little woody cover, but needs shrubs for nesting substrates. Nesting territories become established in December, and take at least a month to build a nest; the Complex expects nesting activities to continue until at least mid-May. They will not re-nest following nest failures later than the incubation stage and will abandon due to human disturbance. They commonly leave the nest when people come within 547 yards or less. Pesticide applications may be particularly detrimental to this species.

This raptor's status and its narrow nesting range, coupled with the tendency for suitable nesting habitat off the Complex to be overgrazed, are justifications for considering nest sites in land management planning. Pairs are present typically near Mottled Duck Marsh at Brazoria NWR and in the interior of San Bernard NWR off Rail Pond Road.

Gulf Coast Salt Marsh Snake

Gulf coast salt marsh snakes have a very narrow range along the Texas Gulf Coast, extending from the Sabine River to Corpus Christi (Werler and Dixon 2000).

Populations are supported at all three refuges in coastal prairie, salty prairie, and lower salt marsh, as well as in moist soil units and freshwater marsh habitats. This snake has sharply declined in association with habitat loss and degradation, making refuges and other conservation areas its last stronghold.



**Gulf Coast salt marsh snakes have been seen near water in upland prairie and salt marsh habitats.
Photo Credit: Charlie Brower**

Seaside Sparrow

Oberholser (1974) describes a steady loss of habitat for this species on the Texas Gulf Coast beginning with WWII; in 1974 he listed only Chenier Plains, Texas Mid-coast, and Aransas NWRs as offering a stronghold for this species. Nesting occurs on the Texas Gulf Coast any time between early April and late July (Oberholser 1974), so this species benefits from the Complex's current policy of not burning grasslands in this timeframe. At least one full season is needed for this sparrow to return and use burned habitat following prescription. Seaside sparrows exhibit strong nest site fidelity (Post, 1974), have a social monogamous reproductive strategy, and both male and female share parental care. They have a restricted range inhabiting marshes only along the Atlantic and Gulf coasts. Seaside sparrows are habitat specialists, spending their entire life cycle in tidal marshes (Robins 1983). They forage in shallow muddy areas of the marsh along the banks of ponds, and by gleaning prey off of tidal marsh vegetation. Their main prey consists of adult and larval insects, spiders and their egg cases, and amphipods (Post and Greenlaw 2009).

LeConte's Sparrow

Grassland birds are in decline over much of their range in North America. LeConte's sparrow is one of the most secretive grassland birds. Given their secretive behavior, historic changes in their status and distribution are poorly understood. Wetland drainage probably caused declines in some populations, but since this species also breeds in upland grasslands, their overall populations may not have been reduced to the same extent as species restricted wetlands. Additionally, populations are known to experience considerable annual fluctuations in abundance in portions of their range, becoming most numerous during wet years (Stewart 1975). These fluctuations tend to obscure long-term population trends.

LeConte's sparrows are generally recorded in small numbers from Texas and Oklahoma across the southeastern U.S. and northward along the middle Mississippi Valley to southern Illinois. This species has a very narrow wintering and breeding range (Lowther 2005), occurring on the Complex as a wintering migrant; it may appear during early fall migration and be noted as late as March or April. Baldwin (2005) expressed management concerns due to this species' tendency toward within-season site fidelity. Prescribed burns on the Complex are necessary to remove brush cover, thatch, and maintain grassland prairies. However, applying these burns during the dormant season to large blocks of habitat without leaving behind adjacent, similar habitat will leave these birds with no options for the rest of the season (Baldwin 2005). The Complex implements a burn-rotation strategy that produces a mosaic of different-aged grasslands and provide adjacent habitat next to areas burned in late fall and winter. Growing season burns conducted in August and September will eliminate the possibility of evicting winter grassland birds from their home ranges, which is believed to increase mortality (Thatcher et al. 2006). Baldwin (2005) also determined a greater density of this sparrow at Brazoria NWR two years post burn. This age post burn correlates with "relatively medium non-woody vegetation density."

Henslow's Sparrow

The Henslow's sparrow has a very narrow wintering and breeding range. On the Complex this species is a wintering migrant; it may appear during early fall migration (October) and may remain as late as March or April. Interestingly, in 1973, this sparrow was well

documented in Harris County, Texas, as a nesting species, with fledged juveniles resulting (Oberholser 1974). This is the only known account of nesting by this species in the southern United States.

The Henslow's sparrow is considered to be the sparrow most in peril. Like LeConte's sparrow, this species shows within-season site fidelity. Local birders that have followed this species in our vicinity comment that they most frequently observe it wintering in tall grass prairie infiltrated by saplings and baccharis, and it is on the heavy side regarding leaf litter (Ron Weeks, personal communication, December 2010).

Black Rail

The smallest of North America's rail species, it measures six inches in length. Population declines are likely attributable to increasing development in coastal areas that has resulted in habitat loss and degradation of breeding areas. The biggest threat may be yet to come if sea levels rise as a result of climate change. Climate change model predictions suggest that the low-lying habitat of this species will likely be among the first areas inundated (<http://www.dec.ny.gov/animals/>).

The black rail has a very narrow wintering and breeding range. They are present on the Complex year round. Oberholser (1974) relays former Brazoria NWR manager Fleetwood's 1969 and 1970 documentation of nests with eggs for this species at Brazoria NWR. Some of the birds present on the Complex during the wintering months likely leave to breed in more northerly locations (Eddleman et. al. 1994). Black rails nest on the higher ground portions of coastal salt and brackish marshes dominated by rushes, grasses, and sedges. A clutch of 6 to 10 buffy white eggs with brown spots is incubated for 16 to 20 days. Both sexes share incubation and brood rearing duties suggesting a monogamous relationship, but it is unknown whether the pair bond lasts longer than one breeding season.

Little is known about black rails, due to their secretive nature and rareness. Night surveys on the Complex have demonstrated their potential use of any salty prairie unit two years or more after the habitat has been burned. They also occur in coastal prairie habitats. As these birds are cover-dependent, managing in a mosaic of different-aged units will be highly beneficial ensuring that suitable, dense habitat is always available on the Complex. Leaving nearby, similar habitat is also appropriate for this species, as cover is needed for survival and long treks in the open, leaves them vulnerable to predation. Their reluctance to flush from cover and their lack of vertical lift leaves them highly vulnerable to disturbance, including refuge management activities such as burning or mowing. To minimize potential impacts the Complex assumes suitable habitat is occupied and implements management activities accordingly (see section 3.6.2).

Yellow Rail

Yellow rails occur on the Complex as a migratory stopover and wintering species only. Wintering yellow rails have been recorded to arrive as early as September 12 (2006 observation) and stay as late as early May (Given 2005).

These birds are very secretive in nature and will not flush unless forced to do so. Often they escape disturbances by running on the ground. However, they will sometimes “hunker down” in an attempt to let a disturbance event pass them by. Oberholser (1974) reports the death of many yellow rails by hay mowers due to the birds’ hesitation to flush from cover. Similar to black rails, these birds are cover-dependent and are vulnerable to disturbance. Managing the Complex in a mosaic of different-aged units is highly beneficial, ensuring that suitable, dense habitat is always available. Leaving nearby, similar habitat is also appropriate for this species, as cover is needed for survival and long treks in the open, leaves them vulnerable to predation.



Wintering yellow rails along with mottled ducks and black rails are priority species that benefit from managed salty prairie which provides hiding ground cover, invertebrates for food and minimal brush cover. Photo Credit: USFWS

Mottled Duck

The mottled duck is one of only four nesting duck species found on the Texas Gulf Coast. This species does not regularly migrate between a wintering and breeding range; it spends its entire life cycle in the wetlands of the Gulf Coast from Mexico to Florida with the ducks of the western Gulf Coast not documented as breeding with those of the Florida coast (Haukos et. al. 2004). Waterfowl management professionals are concerned over the status of the mottled duck as available long-term data suggest a declining trend in Texas and a stable population trend in Louisiana.

Stutzenbaker (1988) documented a 36 percent decline for this species in Texas and Louisiana from 1971–1983. Between 1986 and 2004, Haukos et. al. (2004) report a decrease in numbers on Texas national wildlife refuges of 88.6 percent. He also reports decreasing female survivorship from 1997–2004 for ducks banded on Texas coastal refuges.

Texas refuges designated this species a priority for CCPs and the GCJV Mottled Duck Conservation Plan calls for conservation planning efforts on public and private lands. Mottled ducks are likely constrained by habitat availability; thus it is vital that we consider the habitat needs of this species in our management planning. Although placed in a variety of salt marsh vegetation (gulf cordgrass, marshhay, *Scirpus*, and mixes of these plants), gulf cordgrass is the most common (Merrit, K., 1981, and FWS 1982). Mottled ducks also use upland bluestem prairie sites. In nesting areas with both heavy and thin vegetation densities, ducks choose the heaviest, highest clumps of vegetation available for situating their nests.

Ideal nest sites are thus in heavy, tall cover within, but not limited to, a little over a mile from water (Stutzenbaker 1988).

As this species is dependent upon relative cover for nesting, managing in a mosaic of different-aged units across the landscape, the Complex ensures that this species has available nesting habitat. In years with heavy rainfall, these ducks can initiate nests as early as late January.

Painted Bunting

The painted bunting is a breeding species found on the Atlantic and western Gulf Coast and the central U.S. This bunting is a nesting species on our Complex, present from March–September.

Habitat loss has thrown populations into sharp decline, prompting the inclusion of this species on the Partners in Flight Watchlist (Lowther et. al. 1999). This bird uses grasslands with light shrub or tree components, including the upper reaches of the Complex’s salt marshes and coastal prairies. It is sensitive to management actions during the nesting season, March–July. Management activities such as prescribed burning and mowing are timed to minimize disturbance during the breeding season. Management actions are also implemented in a manner that produces a mosaic of habitat, which is beneficial to this species.

Dickcissel

The dickcissel is a breeding species found chiefly in the central United States. This bird is a nesting species on our Complex, present from March–September. Habitat loss has thrown populations into sharp decline in the periphery of the dickcissel’s range, including Texas. This bird uses salty prairie or coastal prairie grasslands with light shrub or tree components, a high density of forbs, grass heights of 4.9 feet or more and relatively thick thatch (1.9–5.9 in. deep). This species is sensitive to activities during the nesting season, March–July. Timing burns and mowing activities to maximize reproductive opportunities and distributing these activities in a mosaic fashion will benefit this species.

Diamondback Terrapin

Seven subspecies of diamondback terrapins are known to occur in the U.S. Our diamondback terrapin subspecies is found in coastal brackish waters from Mexico to Louisiana (Hogan 2003). In recent years, visitors observed this terrapin on our Complex at Cedar Lakes (San Bernard NWR) and Wolf Lake (Brazoria NWR). It is likely to occur in other areas. Recently, this species was well documented in Galveston Bay, a short distance from likely terrapin habitat along the east shoreline of Brazoria NWR (Hogan 2003).

The diamondback terrapin is a state species of concern and TPWD proposes it for species of concern status at the federal level (TPWD 2005). Brazoria NWR’s current ban on crabbing in the Salt Lake, Wolf Lake, and Nicks Lake areas is beneficial to this species, as is annual participation in the state’s crab trap removal program. Terrapins would benefit from having additional areas closed to crabbing. Some consider terrapins a delicacy. Presently, there is no harvest limit at all on this species and fishermen can remove all captured in crab traps from refuges if we do not regulate these activities that lead to their capture.

Reddish Egret

Reddish egrets are strictly coastal in habitat choice and have the narrowest distribution of any of the herons found in Texas. The Gulf Coast hosts some individuals for the wintering months, but most migrate to Central America and Mexico (Dyes 1993).

Two thousand pairs nest in the U.S.; 1,500 of those are on the Texas coastline (Lowther and Paul 2002). Dressing Point Island (Big Boggy NWR) is a Gulf Coast Joint Venture priority island for its high concentration of nesting reddish egret (average 19 pairs). Erosion of nesting islands used for rookeries threatens the local population. Several attempts to slow the erosion on Dressing Point Island have occurred over the past 20 years with limited success. The Cedar Lakes rookeries, which were man-made islands, continued to erode as well. Treatment of fire ants as needed and work to reduce acreage loss on these islands will benefit reddish egrets. Also of concern in refuge management activities are West Bay Bird Island and the Drum Bay colonies. Although these colonies are not under refuge ownership, these islands hold noteworthy numbers of reddish egrets which justify efforts for continuing to work toward their protection from human disturbance.

Swainson's Warbler

Swainson's warbler breeds in the coastal plains, alluvial floodplains, and mountains of the southeastern United States (Peters et. al. 2005). Belize, the Caribbean, and the Yucatan Peninsula are its wintering grounds (Brown and Dickson 1994). It's narrow distribution is part of the reason for conservation concerns for this species.

Current management of the bottomland hardwood forests to allow small, naturally forming, early successional tree gaps created by attrition of canopy trees is beneficial for this species. The current practice of prohibiting grazing is also beneficial, as grazing decimates the thick understory favored by this species. Although research indicates that even-aged stands of trees created by clear-cutting are useful for Swainson's warblers (Peters et. al. 2005), refuge units are so small, with high Chinese tallow invasions, that clear-cutting even small patches does not seem a viable management option for this bird. Swainson's warbler is sensitive to changes in hydrologic regime; therefore the Complex avoids projects with the potential to back up water into their habitat during the nesting season.

White-faced Ibis

White-faced ibis in Texas are found nesting near the Coast, where it selects shrubs, trees, and emergent vegetation in flooded freshwater marshes for constructing its platform nest. It also has been documented nesting on the ground in coastal rookeries of Louisiana and Texas, but its occurrence within colonies of this habitat is not annually consistent.

The white-faced ibis has nested on our coastal rookeries in the past, especially Dressing Point Island. Why they discontinued nesting there and so many other areas along the coast is unknown. It is known these birds suffered diminished reproductive success due to DDT exposure in the U.S., and that they still come into contact with DDT when wintering in Mexico (Ryder and Manry 1994). Maintenance of quality nesting habitat at our colony sites for our assemblage of colonial nesters will ensure available habitat for them when they return again. The refuge needs to look at what is missing from area rookeries to support white-faced ibis

populations. This key may involve restoration of islands, vegetation control, or enhancement of appropriate vegetation as well as control of fire ants.

Wilson's Plover

Locally abundant on and adjacent to the complex, only 6,000 Wilson's Plovers are estimated on our continent (Corbat and Bergstrom 2000). It is present March through September with small numbers overwintering (Eubanks et al. 2006). This plover nests on beaches, bay shorelines and both sides of the GIWW. It is found on all local beaches including San Bernard and Sargent beaches. Its groundnesting habits and restriction to areas easily accessible by humans make disturbance and habitat impacts a concern for this species.

Snowy Plover

This plover frequently uses loose sand, sand dunes, and exposed substrates on tidal flats in the beach and bay habitats where it is encountered. It is present July through May, and small numbers may linger through the summer. It is a rare nester on our section of coastline (Eubanks et al. 2006), so summering individuals should be scrutinized for nesting activity. Invasive plants, human disturbance, and habitat loss and degradation are threats facing this plover species. Only 18,000 are estimated to breed in North America (Page et al. 2009).

American Oystercatcher

This large shorebird nests on shell or sand on either islands or mainland habitats of our beaches and bays. Nesting occurs in Chocolate, Bastrop, and Drum Bays at Brazoria NWR, in Cowtrap and Cedar Lakes at San Bernard NWR, and on Dressing Point Island and various shell hash islands in East Matagorda Bay. It is present throughout the year. Only 10,000 remained in North America in 2001. Current threats include sea level rise; habitat loss and degradation due to disturbance and development; food resource compromise due to invasives, pollution, and water quality changes; and increased predation due to human induced predator increases (American Oystercatcher Working Group et al. 2012).



The Service has been assisting Gulf Coast Bird Observatory with locating and monitoring American oystercatchers and their nests on and around the refuges. Photo Credit: USFWS

Black Skimmer

This large tern can be found on shell and sand stretches along bay shores or beaches. Just over 2,000 pairs nested on the Texas coast in 2001 (Eubanks 2006). Accurate estimates of the remaining continental population do not exist, but this species is declining in many locations. Disturbance and habitat loss and degradation are concerns (Gochfeld and Burger 1994), as is sea level rise. Colonies exist or have existed at Chocolate Bay, Bastrop Bay, Wolf Lake, San Luis Pass, Dow Chemical Company, Cedar Lakes, and Dressing Point in and near the Refuges.

Loggerhead Shrike

This bird of open grasslands is in sharp decline nationwide. Known threats include loss and degradation of habitat, changes in land utilization, chemical pest control, and nest site disturbance. Trees and shrubs with ample canopy scattered in large expanses of open area and absence of chemical application are correlated with the presence of this species in some portions of its range (Yosef 1996).

Northern Bobwhite

This species is found on the Complex in the salty prairie habitats and higher elevations. It is typically found in grasslands with both early or late successional cover, but needs overhead cover in the form of grass or hedgerows for concealment. Able to produce 25+ offspring in a successful nesting season, this short-lived species is most productive in Texas in successive years of above normal rainfall. Its populations are in decline throughout most of its range (Brennan 1999).

Swallow-tailed Kite

A coastal plain nester in the southeastern United States and increasingly common in east Texas, this kite is found during the nesting months on the Complex during some years. Two years ago Charlie and Olivia Brower documented recent fledglings at a location near Sweeny; the landowners indicated that Swallow-tailed kites had nested in that area previously. No observations have been made since the drought of 2011, but the recent nesting activity of this imperiled species warrants SOC status. The Swallow-tailed kite is area sensitive and affected by logging activity and human disturbance (Meyer 1995). In some parts of its range this kite uses premigration roost sites; these areas are protected in South Carolina. Complex staff should be on the lookout for roost sites and sightings of individual birds in the 4-county Columbia Bottomlands project area. The habitat protection and acquisition components of this project are highly favorable for this species. When reviewing projects that impact bottomland hardwood forests, Complex staff should consider habitat impacts for this species.

Canebrake (Timber) Rattlesnake

Timber rattlesnakes are forest dwellers native to the eastern United States and Canada. Prior to widespread extermination and habitat degradation, this snake's historical range in Texas included the forested eastern third of the state (TPWD 2005).

These snakes hibernate between early November and late March annually. Appropriate hibernation habitat is 10-30 cm beneath the surface of the ground (TPWD 2005), and includes areas like armadillo burrows, rotting logs and stumps, rotting tree roots that have become channelized, or in the case of our snakes at Big Pond, concrete slabs that have burrows beneath them, which all provide warmth. (Werler and Dixon 2000). The need to move to appropriate hibernacula makes fall a time of travel, the period when this snake is most active. Timber rattlers are genetically programmed to move along the same pathways used to reach a hibernaculum as their ancestors. The increase of roads throughout its range and the presence of roads near its denning sites is a cause for concern for this species. These snakes are vulnerable not only to direct extermination by humans but also indirect extermination via increasing forest fragmentation.



Timber rattlesnake observed at winter denning site on Big Pond Unit of San Bernard NWR. Photo Credit: USFWS

It is important that this site be protected and we continue to search for other den sites. The nearest known den site to the Big Pond location is near the town of Damon, Texas. Timber rattlesnakes have also been located on private property near the town of Iago, Texas, and on Stringfellow WMA.

3.3.2.2 Focal/Representative Species

The Migratory Bird Program Strategic Plan 2004-2014 identified 139 focal species or populations to increase the percent of migratory birds that are at healthy and sustainable levels. Focal species are a subset of priority species and represent larger guilds of species that use habitats in a similar fashion. Selecting priority species and from this a subset of focal species for Strategic Habitat Conservation (SHC) is outlined in the Strategic Habitat Conservation Technical Implementation Guide. As discussed in the Implementation Guide, the selection of a subset of species for full SHC adaptive management should strive to optimize landscape-scale conservation to benefit additional priority species and habitats within the landscape. It is important to consider the full species' range in assessing its landscape potential to extend management and conservation benefits to other priority species. Four basic scales of importance are evaluated in determining these species: 1) ecological significance of the species; 2) management significance of the species; 3) legal/policy mandate for the species; and 4) cost effectiveness and feasibility of managing the species. Focal species and their associated habitats will be included in the CCP's objectives and strategies to emphasize specific management efforts used to promote life history requirements of these species.

Table 3-5 Focal Species, Habitats, and Limiting Factors

Timber (Canebrake) rattlesnake	Bottomland Hardwood Forest	Hibernate between early November and late March 10–30 cm (4-12 inches) beneath the surface of the ground, and includes areas like armadillo burrows, rotting logs and stumps, and rotting tree roots.
Swainson's warbler	Bottomland Hardwood Forest	Nest on or near the ground. Favor small, naturally forming tree gaps created by attrition of canopy trees. Require thick herbaceous understory for nesting and cover.
Black rail	Upper Saline Marsh	Cover needs require ungrazed areas with completely closed grass canopy to shield from avian predators.
Seaside sparrow	Upper Saline Marsh	Require a mosaic of grassland for feeding and cover and combination of tall grasses such as cordgrass and low growing shrubs for nesting.
Reddish egret	Lower Saline Marsh	Healthy estuarine systems for foraging; nest sites free of disturbance and with natural or manmade barriers to prevent predation.
Yellow rail	Saline Prairie	Cover needs require closed grass canopy to shield from avian predators. Forage from the ground on invertebrates and seeds.
LeConte's sparrow	Upland Prairie	Cover and nesting needs require mosaic coastal to ensure stands of grass of various ages and size.
Henslow's sparrow	Upland Prairie	Mosaic coastal prairie with grass of various ages and size for cover and nesting. Wet topographic features with brushy component desirable
Dickcissel	Upland Prairie	Uses grasslands with light shrub or tree components, a high density of forbs, grass heights of 1.5 m (1.6 yards)(or more with thick thatch (5–15cm (2-6 inches)deep) for feeding and nesting. Ground nester.
Loggerhead shrike	Upland Prairie	Uses grassland with light shrub or tree components from which it scans for food from perches.
White-tailed hawk	Upland Prairie	Associated with open grasslands with little woody cover to feed, but needs shrubs for nesting substrates. Avoid grazed areas.
Northern bobwhite	Upland Prairie	Requires early successional habitats that can exist across wide variety of vegetation types. Will use moderately grazed prairie and prairie 1 year post burn.
Mottled duck	Freshwater Wetlands	Low saline marshes (<8 ppt) with <50 percent emergent vegetation to allow nesting, brood rearing and adult flight feather molt. Wetlands with emergent islands preferred for roosting.

3.3.2.3 Birds

Texas Gulf Coast is the primary wintering area for most of the Central Flyway waterfowl; utilizing both freshwater and saline habitats for feeding and shelter. Breeding waterbirds including mottled ducks, secretive marsh birds, and waders utilize coastal wetland and upland habitats as well. In addition, islands and islets provide nesting habitat for a large population of colonial water birds, while thousands of shorebirds use the beach and tidal mud flats. Inland, coastal prairie supports large populations of wintering songbirds and other grassland dependent resident species. Bottomland forests support large numbers of migrating nearctic-neotropical and wintering songbirds. The Complex lists 320 bird species which regularly utilize habitats during parts of their life cycles.

Grassland Dependent Species

Native coastal prairie grasslands on the Complex include a mosaic of upland bluestem dominated prairie, fresh water wet prairie, and coastal marsh (salty prairie). Noteworthy grassland bird species include the northern bobwhite quail, LeConte's sparrow, Henslow's sparrow, seaside sparrow, Sprague's pipit, dickcissel, eastern meadowlark, yellow rail, black rail, clapper rail, king rail, sora, and Virginia rail. Unfortunately, the loss of prairie habitat has affected many of these grassland bird species, making them a guild of birds with one of the fastest rates of decline. About 48 percent of these species are of conservation concern and 55 percent are showing significant declines (NABCI, 2009).

Waterfowl

Waterfowl use on the Complex during the winter months occurs in salt marsh areas, bays adjacent to the Complex, and in actively managed moist-soil units. The Complex provides habitat for approximately 31 species of waterfowl. Brazoria NWR has a rice farming program that results in second-harvest rice fields being re-flooded to provide wintering habitat for waterfowl; mottled ducks, fulvous ducks and black-bellied whistling ducks use these fields heavily for several weeks after the first harvest. Habitat quality varies in the unmanaged natural habitats in accordance with annual rainfall; drought years produce poor habitat across a large-scale for waterfowl. Peak numbers of waterfowl occur in December and January. Some of the more common duck species that use the Complex include green-winged teal, blue-winged teal, gadwall, American widgeon, northern shoveler, ruddy duck, and northern pintail. Fulvous and black-bellied whistling ducks continue to use the Complex during the spring and summer months.

Shorebirds and Waterbirds

The Complex provides habitat for approximately 90 species of shorebirds and waterbirds. The rice farming program and moist-soil units aid shorebird and waterbird use during drier months. These species are also commonly seen using the salt marshes with their regularly exposed muddy substrates, and beaches. Some of the more common shorebirds and waterbirds seen on the Complex include great blue herons, great egrets, snowy egrets, black-necked stilts, greater yellowlegs, lesser yellowlegs, and short-billed dowitchers. Black-necked stilts nest in moist soil units and the salt marsh, and the Complex includes a number of colonial waterbird nesting sites within or adjacent to its boundary. Reddish egret, white

ibis, roseate spoonbill, black skimmer, and brown pelicans can be found throughout the Complex's wetlands.

Raptors

The Complex is also home to 12 species of raptors and owls; including white-tailed hawks, crested caracara, turkey, and black vultures, red-shouldered hawks, red-tailed hawks, and Mississippi kites, and barn, great horned and barred owls. In recent years, visitors commonly observed swallow-tailed kites near the Complex during the nesting months and credible reports exist of swallow-tailed kite fledglings, implying that they are becoming established as a nesting species. Wintering raptors include the northern harrier, American kestrel, peregrine falcon, short-eared owl, and sharp-shinned hawk.

Perching Birds

The Complex provides habitat for approximately 90 species of perching birds. Perching birds are primarily grouped in terms of management into the grassland, bottomland, and marsh bird/perching bird species that use the Complex. They include loggerhead shrikes, yellow-billed cuckoos, common nighthawks, red-bellied woodpeckers, northern mockingbirds, scissor-tailed flycatchers, painted buntings, and numerous warbler and sparrow species.

3.3.2.4 Mammals

The Complex includes habitat suitable for approximately 52 species of mammals (Appendix E). Visitors frequently observe white-tailed deer, bobcat, coyote, raccoon, armadillo, skunk, and opossum. A greater abundance of wildlife may be observed near the heavily wooded areas of the Columbia Bottomlands. Of medium conservation concern status on the state's Comprehensive Action Plan that may be observed on the Complex are the river otter, long-tailed weasel, cougar, and Eastern spotted skunk. Rafinesque's big-eared bat is of high conservation status and is a state-threatened species that occur on the Complex.

Other not-so-welcomed species, like feral hogs, often represent a problem or challenge for the management of the refuge, particularly because uncontrolled rooting behavior destroys important habitat for other species of wildlife are readily observed throughout the Complex.

3.3.2.5 Reptiles

The Complex falls within the ranges of 67 reptilian species associated with coastal tallgrass prairie, marsh, and riparian habitats of the Texas Gulf Coast (Appendix E). Characteristic species of the Texas Gulf Coast include the American alligator, common snapping turtle, box turtle, red-eared slider, soft-shell turtle, water snake, western mud snake, rat snake, cottonmouth, and canebrake rattlesnake. Of high conservation status concern on the state's Conservation Action Plan are both the ornate box turtle and the three-toed box turtle that may be observed on the Complex. Of medium status are the map turtles, Kemp's ridley sea turtle, canebrake rattlesnake, and diamondback terrapin that also occur on the Complex.

3.3.2.6 Amphibians

The Complex lies within the ranges of 24 amphibian species associated with coastal tallgrass prairie, marsh, and riparian habitats of the Texas Gulf Coast (Appendix E). Characteristic species of the Texas Gulf Coast include the Gulf Coast toad, bullfrog, southern leopard frog, and green tree frog. Of medium conservation status on the state's Conservation Action Plan is the Southern crawfish frog that also occurs on the Complex.

3.3.2.7 Fish and Marine Life

The Complex lies within the ranges of 128 fish species associated with wetland areas of the Texas Gulf Coast (Appendix E). Tidal-inlet dependent fish species, including 20 species with commercial and recreational value, use refuge wetland and marshes for spawning, nursery, and rearing habitat. Generally, two categories of fish associated with the coastal marshes of this region include: (1) species directly dependent on coastal marshes and (2) species making opportunistic use of coastal marshes. The first category includes species such as shrimp, oyster, crabs, tidewater silversides, southern flounder, killifish (four species), striped mullet, white mullet, inland silverside, spot, pinfish and redfish, who have a well-established dependence on marsh vegetation. The second category includes near-shore and bay species such as gizzard shad, black drum, spotted seatrout, bay anchovy, silver perch, pigfish, Atlantic croaker, Atlantic and cownose rays, sea catfish, and sheepshead; shown to be seasonally common in coastal marshes as young or adults.

3.3.2.8 Invertebrates

There are a myriad of terrestrial and aquatic invertebrate species that occur throughout the uplands, rivers, creeks, and floodplains within the Complex; however, they are not well documented. Invertebrates serve as food for numerous other invertebrate and vertebrate species already discussed above. Dragonfly and butterfly species lists are included in Appendix E.



Invertebrates, like this Queen on a salt marsh aster, are an integral part of maintaining healthy ecosystems. Photo Credit: USFWS

3.3.2.9 Concerns Regarding Wildlife Populations

Species of Concern

Documented population declines for Complex species of concern, coupled with expected loss of coastal habitats due to climate change necessitates the need for management actions throughout the Complex. Moist-soil units and prescribed fires are managed to provide habitat for many species of concern throughout the Complex.

The Complex's acquisition program is targeted to conserve bottomland hardwood forests, fresh and salt marsh habitats, and coastal prairie to offset population declines, habitat loss and the anticipated effects of climate change.

Invasive, Exotic, and Native Nuisance Species

Feral Hogs – Feral hogs are present in all habitats on the refuge. Dense stands of baccharis and groves of salt cedar or other trees in the main refuges are prime denning sites. An elevated feral hog population can adversely affect habitats and native animal populations by competing for food, transmitting disease, direct mortality, and damaging habitat through rooting. Their rooting of habitat opens the door for invasive plants, negatively impacting the surrounding environment.

Nutria - Nutria are present on the Complex, but not in large numbers. Sudden loss of nutria often correlates with increased use of the area by alligators.

Ants - Originally from South America, red imported fire ants (RIFAs) began to appear on the Texas coastal prairie landscape during the mid-1970s. Research documented the disruptive impacts of RIFA on native insect communities. It is hypothesized that invasive red imported fire ants have negatively impacted native prairie invertebrates, especially leaf hoppers. Studies have also documented negative impacts on a diverse group of bird species including loggerhead shrikes, northern bobwhites, and colonial waterbirds. However, it is also known that woodland habitats (such as the Columbia Bottomlands), typically hold few RIFA, and grasslands with good grass canopy (i.e., ungrazed ones) have fewer ant mounds than those that are managed for short grass height. Scientists will conduct further research to determine the significance of RIFA to the Complex.

Unfortunately, another invasive ant species found east of Houston, could potentially pose a major threat to local wildlife. Some ant experts consider Raspberry crazy ants to be worse than RIFA and have the potential to destroy biodiversity further. Unfortunately, the Complex knows little about their biology. Masses of Raspberry crazy ants affect ground and tree nesting birds and have the potential to cause birds to die of asphyxia by obstructing their nasal passages. Texas A&M University ant experts have documented Raspberry crazy ants consuming carcasses of slow-moving animals such as snakes, but the exact cause of death was not established. The Gulf Coast Bird Observatory recently surveyed the Brazos River Unit of San Bernard NWR. Located within a mile of Brazoria County's largest and highly studied Raspberry crazy ant colony, the Gulf Coast Bird Observatory believes it lies in the path of dispersal and colony expansion. Surveys completed in summer 2010, revealed no evidence of their presence on the Complex.

3.4 Socioeconomic Environment

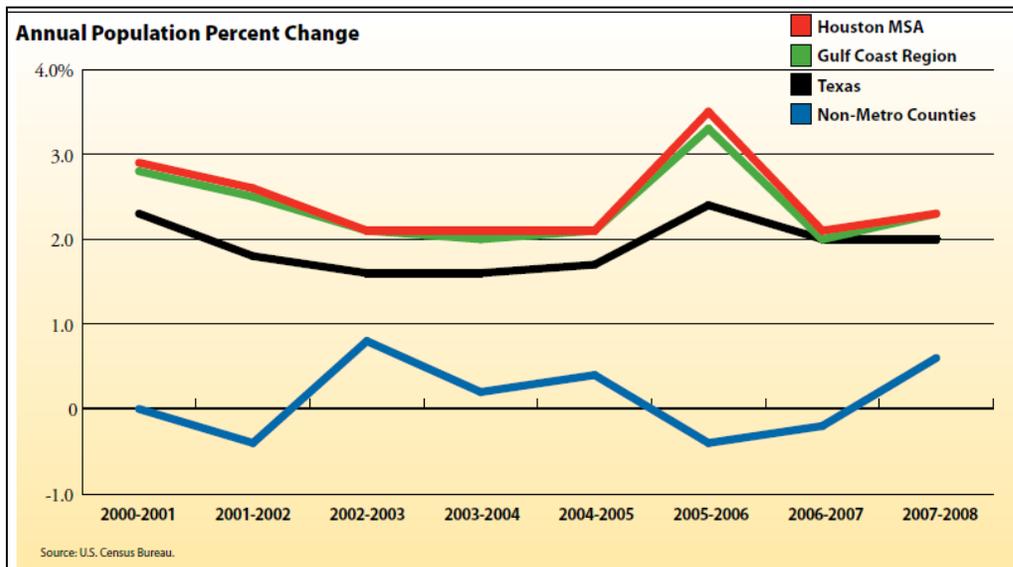
This section describes the socioeconomic environment of the communities surrounding the Complex. It includes a discussion of nearby human populations and economies; the archeological, cultural, and historical resources associated with the Complex; public use opportunities and access; and public use and the Service administrative facilities. It concludes with a short discussion about the Service’s concerns pertaining to the socioeconomic environment.

3.4.1 Population

The Complex is located in the Texas Gulf Coast region, which consists of 13 counties. The counties include Austin, Brazoria, Chambers, Colorado, Fort Bend, Galveston, Harris, Liberty, Matagorda, Montgomery, Walker, Waller, and Wharton. Only four of these counties (Colorado, Matagorda, Walker, and Wharton) are not in the metropolitan statistical area (MSA) of Houston-Sugar Land-Baytown. The Houston-Sugar Land-Baytown MSA is the nation’s fourth-largest metro area and the second largest in Texas with an estimated population of 6.3 million people in 2010. Figure 3-7 indicates the region’s population rose by an estimated 20.8 percent between 2000 and 2008, led by strong growth in Fort Bend, Montgomery, and Brazoria counties (Susan Combs Texas Comptroller of Public Accounts, 2010).

Population change can be an indicator of economic vitality, the types of economic sectors that are likely to be strong, probable development and disturbance impacts on wildlife habitat, and trends in real estate markets. Table 3-6 shows population changes for all four counties between 2000 and 2010. Find additional U.S. Census data at <http://www.census.gov/>.

Figure 3-7. Annual Population Percent Change from 2000–2008



Source: Texas Comptroller of Public Accounts

Table 3-6 Focal Four County Population Changes 2000 to 2010

County	2000	2010	Change	% Change
Brazoria	241,767	313,166	71,399	29.5%
Matagorda	37,957	36,702	-1,255	-3.3%
Fort Bend	354,452	585,375	230,923	65.1%
Wharton	41,188	41,280	92	.2%

Source: Bureau of the Census (2012)

3.4.2 Economy

3.4.2.1 Regional Economic Profile

The median income for all Texas households was \$50,049 in 2008. The ten counties of the Houston-Sugar Land-Baytown MSA have the highest median household incomes in the region, ranging from \$48,374 to \$83,968 (Texas Comptroller of Public Accounts, 2009).

Table 3-7. Median Household Income by County

Brazoria	\$65,607
Matagorda	\$43,205
Fort Bend	\$79,845
Wharton	\$41,148

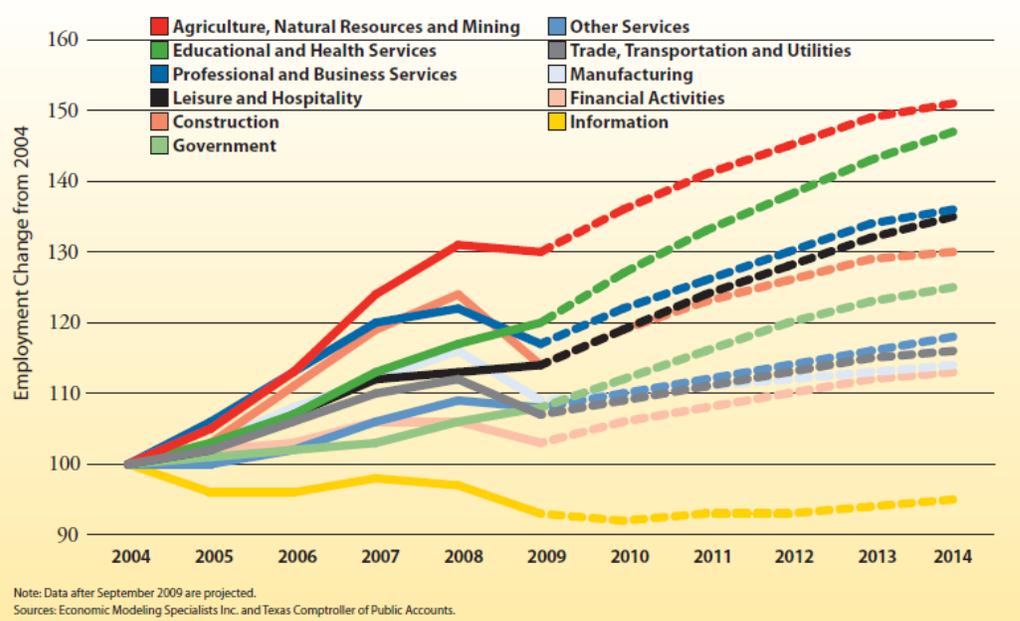
Source:US Census, 2010

The region’s proximity to the Texas Coast makes the area a center for commerce, industry, and recreation. Ship and rail transport facilities support such industries as petroleum refineries, metals fabrication, plastics, and chemical plants. Available natural gas supplies, freshwater, distance from heavily populated areas, and the GIWW originally attracted these industries to the area. In 2009, the Gulf Coast region employers provided a total of 2.6 million jobs, representing nearly a quarter of the jobs in Texas (Texas Comptroller of Public Accounts, 2010). Figure 3-8 provides a picture of projected employment trends in the region. A vast majority of growth is due to new jobs in oil and gas well drilling, oil and gas extraction, and support activities.

Agriculture is a popular industry in this region because of its proximity to the coast. In 2008, the Gulf Coast Region produced crops, livestock, and other agricultural goods worth \$1.69 billion (Texas Comptroller of Public Accounts, 2010). Rice crops in this in this region account for 79 percent of the total rice acreage in Texas. Matagorda County is one of the state’s top three rice-producing counties. Also, Matagorda County produced 45 percent of the state’s catfish sales and 40 percent of the state’s total aquaculture sales (USDA Census of Agriculture, 2007).

Nature tourism rapidly developed as another industry particularly important to the refuge and the region’s economy. Nature tourism is defined as “discretionary travel to natural areas that conserve the environmental, social, and cultural values while generating an economic benefit to the local community”. Nature tourism includes such things as wildlife or bird watching, photography, nature study, hiking, boating, camping, biking, and visiting parks. Nature tourism also provides opportunities for communities to promote their cultural and ethnic diversity.

Figure 3-8. Gulf Coast Region Industrial Employment from 2004–2014.



Source: Texas State Comptroller of Public Accounts

3.4.2.2 Economic Significance of the Refuge

The socioeconomic impact of the Complex consists primarily of the contributions it makes to local retail trade in the form of equipment rental and purchases as well as in the purchase of services. The Complex also contributes to the area’s socioeconomic well being through the salaries of its staff. Annual salaries totaling more than \$2 million are currently paid to refuge employees, many of whom own homes and pay taxes in Matagorda and Brazoria Counties. In addition operational and project funds exceeding \$600,000 also feed into the local economies.

Land acquired by the Service in fee title is removed from the county tax rolls. To help pay for lost tax revenues, the county receives an annual payment in lieu of taxes, as provided by the Refuge Revenue Sharing Act of 1935 (16 U.S.C. 7145:49 Stat. 383, as amended). Revenue funds are generated from all refuge fees and include grazing, haying, farming, special use permits, etc. If not enough generated revenues are available in the fund to make full payments; the Service distributes the funds proportionately nationwide. Congress is authorized to make up the difference. This has been the case since 1975. The 2010 Refuge Revenue Sharing payments were delivered to Brazoria and Matagorda and Fort Bend Counties. A total \$70,683 was delivered to Brazoria County for Brazoria (44,245 acres) and San Bernard (36,844 acres) NWRs. A total of \$5,659 was delivered to Matagorda County for San Bernard (6,566 acres) and Big Boggy (4,216 acres). A total \$3,866 was delivered to Fort Bend County for San Bernard (1,828 acres). These payments were approximately 12 percent lower than the previous year's due to Federal Budget cuts. For 2009, the Complex's payments to Matagorda County was \$8,032 for San Bernard (6,566 acres) and Big Boggy (4,216 acres) NWRs; Brazoria County's payment was \$80,810 for Brazoria (44,245 acres) and San Bernard (36,199 acres) NWRs, and Fort Bend County's payment was \$5,515 for San Bernard NWR (1,828 acres).

In addition, the Complex hosts a Migration Celebration in April every spring to provide an opportunity for visitors to become familiar with management actions and available resources to the general public. Visitors also come from all parts of the world to bird watch and recreate on the Complex, thus providing an economic stimulus to local towns through the use of hotels, gas stations, and restaurants.

3.4.2.3 Other Economic Uses

Cooperative Farming Program

The Cooperative Farming Program is not only an economic use of the Complex, but is also an important habitat management tool. Many cooperative farming programs on refuges grow crops as supplemental food sources for wildlife, such as migratory waterfowl. On Brazoria NWR, the program focuses on providing feeding and resting areas for migratory birds along with moist soil habitat improvements.

Haying

Where and when fire cannot be implemented haying becomes an option for removing fuel loads and promoting forb growth among. Although it does not recycle the nutrients the way fire does, haying can be an effective alternative management tool. Haying rights are provided at market value unimproved or native pasture rates.

3.5 Archeological, Cultural, and Historical Resources

Cultural Resources

Three basic prehistoric periods comprise southeast Texas prehistory: Paleo-Indian, Archaic, and Late Prehistoric. The Paleo-Indian period follows the last ice age in North America during the Pleistocene. The nomadic people who followed the migrations of mega-fauna, such as mammoth and mastodon, characterize this period. Small bands of hunters and gatherers who roamed in search of plants and animals characterize the Archaic period, which follows the extinction of the Pleistocene mega-fauna. During this time, the overall population increased as evident by a greater number of known archaeological sites.

The Texas Gulf Coast was historically home to several Native American nations and early European settlers. This region is also significant for its history in the spread and development of early American ranchers, pioneers, and especially oil prospectors. When Alvar Nunez Cabeza de Vaca shipwrecked along the Texas coast in 1528, he and three surviving shipmates became the first Spaniards to explore the territory that would become Texas (Chipman, 2007). Cabeza de Vaca and his companions lived among the Native Americans for eight years before returning home to what is now Mexico. They took with them tales of cities of gold that caused great excitement. In 1540, Francisco Vasquez de Coronado set off with an army to find the fabled cities of gold. Coronado searched all the way to present day Kansas without ever finding the wealth described by Cabeza de Vaca. Numerous historic sites dot the region such as homes, buildings, cemeteries, farmsteads, and settlements. Researchers consider the banks of many local rivers and bays to have good potential for archaeological sites, as indigenous cultures preferred to locate near sources of water and the Tonkawan, Couthatta, and Karankawa tribes were known to inhabit this area before European settlement.

Historical Resources

There are currently no sites listed on the National Register of Historic Places (NRHP); however, numerous identified archaeological or cultural sites are located within the boundaries of the Complex. The majority of the sites are prehistoric, generally shell middens and campsites located along the banks of bayous, lakes, and oxbow lakes or meander scars. The remaining sites are historic in nature and include cemeteries, shipwrecks, a plantation, canal, cattle dipping vat, and foundations for structures.

Prehistoric Sites

The Texas Archeological Survey recorded prehistoric sites during the Seadock project in 1973. The predominant diagnostic artifacts found at these sites are pottery fragments, which date them to the Late Prehistoric period, probably the Galveston Bay Focus. These sites are composed mainly of oyster and rangia shells and vary in depth from a single shell lens two inches in size, to over a yard in thickness. Some of the shell middens are located beneath spoil piles, while others remain visible on the surface. Brazoria Girl, which dates back to the middle Holocene (5600 B.P.), was located in 1999 by refuge staff constructing reservoir levees for the Wolfweed Wetland Complex at San Bernard NWR. Texas A&M University excavated the skeletal remains in 2003.



In 2003, Brazoria girl, a 5,000 to 6,000 year old skeleton was excavated at San Bernard NWR by researchers at Texas A&M University. Photo Credit: USFWS

Historic Sites

The following historical information was provided by the Texas State Historical Association's website:

Brazoria County

The Brazoria and San Bernard NWRs are located in the center of colonial movement into Mexican Territory. In the early 1820s, Stephen F. Austin brought the first of his colonists to the area where they landed at the mouth of the Brazos River. Known as the "Old Three Hundred," they settled along the alluvial bottomlands of the San Bernard River and Brazos River and along Jones Creek and Oyster Creek. Most of the early settlers relied on cotton and sugarcane to make a living and founded large plantations that relied on slave labor. In the 1840s, there were 29 sugar mills in Brazoria County.

In 1832, the Mexican government organized a separate municipal district, called Brazoria. As a result, Brazoria county became one of the original counties following Texas independence in 1836. The town of West Columbia in west-central Brazoria County is the site of the first capital of Texas and dates to pre-revolutionary days. Prior to Anglo-American settlement, transportation routes were Indian trails and navigable streams and rivers such as the Brazos River, San Bernard River, and Oyster Creek. Early settlers later traveled some of these trails and eventually they became roads. Prior to the Civil War, sugar plantations used Oyster Creek as a transportation route along its banks. Brazoria NWR developed the Maddox home site into a historical interpretive trail. Adjacent to the

Stringfellow unit of San Bernard NWR is the oldest known Anglo-structure in Brazoria County. A small trail across from the office takes visitors up to the cedar cabin where the refuge will display an interpretive sign. When the Service acquired the DuCroz Unit, they agreed to erect a sign identifying the historical use of the property by the DuCroz Family during the mid-1800s.

Wharton County

The land was inhabited as early as the Paleo-Indian period, and a stable occupation pattern lasted through the Late Prehistoric period for as long as 10,000 years. The Karankawa Indians, a Coco band, occupied the area that became Wharton County until the late eighteenth century, using the region for hunting and settlement along the Bernard, Caney, Peach, Mustang, and Colorado waterways as late as 1823. The Tonkawas came into the area on occasions, as their lower range overlapped the upper range of the Karankawas. Skirmishes with white settlers continued as late as 1840, but by 1850 most of the Indians had retreated out of this area into Mexico.

Wharton County is in the section of Texas first explored by Europeans. In 1687 René Robert Cavelier, Sieur de la Salle, traversed the area on the last exploration he made before his death. Alonso De León passed through on his third and fourth trips in search of the La Salle colony in 1688 and 1689, and in 1718 Martín de Alarcón came to inspect East Texas missions after exploring Espiritu Santo Bay. Pedro de Rivera y Villalón crossed the area in 1727, and between 1745 and 1746 Prudencio Orobio y Basterraqv explored the coastal area. Spain controlled the territory until Mexico achieved independence in 1821, and Anglo-American colonization began under a program sponsored by the Mexican government in 1823, when thirty-one of Stephen F. Austin's Old Three Hundred received titles to land in the area of present Wharton County. The main transportation trails across the county originally passed along the Colorado River and Caney and Peach creeks from Matagorda to San Felipe, bisected by a trail across the Colorado near Egypt that connected Richmond with Texanna; the Old Spanish Trail crossed the San Bernard River to East Bernard connecting Richmond with Columbus.

Fort Bend County

The settlement of Fort Bend County began in the early 1820s as part of the Anglo-American colonization of Texas under the auspices of the Spanish government. Authorization to settle 300 families in the valleys of the Brazos and Colorado rivers was initially granted to Moses Austin, but plans were delayed by his death in June 1821 and Mexican independence from Spain. Stephen F. Austin assumed the responsibility of leadership from his father and gained confirmation of the original Spanish grants from the newly established Mexican government in 1823. Following arrangements with Austin, a group of colonists sailed from New Orleans in November 1821 on the schooner *Lively* and anchored near the mouth of the Brazos River on the Texas coast.

In 1822 a small party of men from this group left the ship and traveled inland some ninety miles and, on a bluff near a deep bend in the river, built a two-room cabin. As the settlement grew, the cabin became known as both Fort Settlement and Fort Bend; the latter name, in time, prevailed. In 1824 the Mexican government issued documents officially granting to the colonists their leagues of land. Of the 297 grants, fifty-three were issued to Fort Bend

settlers. The presence of the Karankawa Indians near the new colonial settlements proved to be a comparatively minor problem. The first settlers had a few skirmishes, but as the colonies increased, the Karankawas began moving out of the area and by the 1850s had migrated as far south as Mexico.

Matagorda County

Archeological research has revealed a pattern of relatively dense occupation near inland water sources in the upper Texas coastal region, and projectile points from the early Paleo-Indian period (10,000–6,000 B.C.) have been found thinly scattered along the Texas coastal plain. By the time of European exploration in the early 1500s, the central section of the Texas coast, including Matagorda County, was home to several linguistically related subgroups of the hunter-gatherer Karankawa Indians. By the eighteenth and nineteenth centuries the shifting of tribal territories further north forced other tribes, notably the Tonkawa Indians of Central Texas, toward the coast and into Karankawa territory. Alonso Álvarez de Pineda mapped the Texas coastline in 1519, but the first recorded European expedition into the Texas interior was conducted by Álvar Núñez Cabeza de Vaca, who sometime after 1528 probably passed through what later became Matagorda County. Guido de Lavazares landed at Matagorda Bay in 1558, surveyed the northern Gulf Coast, and claimed the area for King Charles V. In 1690 Manuel José de Cárdenas y Magaña mapped Matagorda Bay as part of the Llanos-Cárdenas expedition, and the Alarcón expedition passed through what is now Matagorda County between 1718 and 1719.

As early as 1820 plans were made to establish a port at the site of the future town of Matagorda, but none developed, since silt deposited in the bay by the Colorado River made a port impractical at that time. Settlement by Anglo-Americans began in 1822, when the schooner *Only Son* landed immigrants for Stephen F. Austin's colony at the mouth of the Colorado. Some of the first white residents of what is now Matagorda County were soldiers sent to protect the new settlers from the Karankawa Indians. Austin gave grants in the area to fifty-two families, principally from New York, and in 1827 received permission to settle 300 more within thirty leagues of the coast in areas where settlement had previously been forbidden by the Mexican government.

The town of Matagorda, at the mouth of the Colorado River, was founded in 1829 after Austin had convinced the Mexican government that a military post was needed to protect incoming settlers. The town quickly flourished, and settlement proceeded inward from the coast, initially along Caney Creek. A custom house established at Matagorda in 1831 was maintained until the Texas Revolution. Steamers and sailing vessels approached within six miles of the town on Matagorda Bay; other county transportation was also largely by water. The municipality of Matagorda, which comprised the southeast corner of the original Austin grants, was established in 1834 while the area remained under Mexican control.

Cemeteries

DuCroz Cemetery is located within the San Bernard NWR near the community of Cedar Lakes. The cemetery was founded in 1907 (Leezer, 2006), and Laurentz and Mary DuCroz were buried there in 1910 and 1911 respectively. There are reports of other family members interred there as well.

3.6 Current Management

3.6.1 Administration

3.6.1.1 Staffing

In fiscal year 2011, the Complex had a staff consisting of 27 permanent full-time employees. They also hired 5 interns, and more than 120 individuals volunteer their time to conduct work each year (Chapter 5, Table 5-1 identifies existing Complex staff). The annual operations and maintenance budget was 3.05 million in 2011.

Volunteer Program

Volunteers play a vital role in daily refuge operations. Volunteers accomplish numerous work projects within all aspects of refuge management, including biological, maintenance, and administrative tasks. The amount of time volunteered varies from full-time to a few hours a week or month, or during a particular season. During 2011, the Complex recorded more than 13,000 volunteer hours.

Volunteers perform a wide variety of tasks. These could include assisting in habitat modification projects such as developing freshwater impoundments, maintenance projects, construction of additional public use facilities, leading tours, providing information and interpretation to the public, helping with environmental education for school groups, performing clerical and administrative duties, and taking part in special projects such as bird banding and sea turtle beach patrol.

The Friends group provides local volunteers to help with biological surveys, construction of public facilities, maintenance, fundraising, and the annual Migration Celebration. The DEEP docents teach students during field trips and are mostly Texas Master Naturalists. Additional parent volunteers help to manage small groups of children during the field trips. San Bernard NWR supports the Kemp's ridley sea turtle recovery plan by monitoring beaches from the mouth of the Colorado River to the mouth of the Brazos River for nests and nesting turtles. Volunteers are an essential part of this program to monitor beaches. A citizen scientist organization called the Forest Bird Study Group has been conducting winter bird banding for the past eleven San Bernard NWR.

Both San Bernard and Brazoria NWRs host RV volunteers, typically during the winter months. Brazoria has an eight-pad volunteer village. San Bernard NWR has two RV sites. The refuges provide the sites to volunteers who donate a minimum of 24 hours per week of work. Many volunteers provide considerably more hours.



Seasonal and local volunteers have assisted with the construction of many public use facilities. Photo Credit: USFWS

The DEEP program relies on local volunteers, many of which are Texas Master Naturalists, to provide the hands-on education opportunities. Photo Credit: USFWS



Specialty projects like tree planting will bring in community support volunteers including honor society students and boy scouts. Photo Credit: USFWS

Youth Conservation Corps Program

The Complex continues to use the Youth Conservation Corps (YCC) Program as a part of operations. Typically, the Complex hires four enrollees and a group leader for the summer months. The group works on habitat and maintenance projects including fence construction, rip-rap of water control structures, clean-up of brush, weeds, and litter at fishing areas, and assists with environmental education programs.

Friends Group

National wildlife refuges have many needs beyond those that can be provided by their traditional funding sources and limited staff. Refuge Friends groups are private, non-profit organizations that partner with their respective refuge to advocate for refuge program needs. The Friends of Brazoria Wildlife Refuges (FBWR) was established in 1994 by local volunteers, is a non-profit organization dedicated to supporting the Brazoria, San Bernard, and Big Boggy NWRs. They provide volunteers for many important refuge activities and raise funds for a variety of refuge projects. Funds are raised through donations, grants, and gifts to help fund refuge projects, educational



A Harris hawk flies over the heads of spectators during Earthquest® presentation at Migration Celebration. Photo Credit: Dave Sanders



Youth enjoy numerous hands-on educational activities during Migration Celebration including crabbing. Photo Credit: USFWS

programs, and other activities. Members of this group are dedicated volunteers who work tirelessly for the benefit of the refuges and the community. Activities provided by the Friends include: construction of public use facilities; environmental education through DEEP and summer programs; clean-up efforts at the refuges; hosting the annual spring Migration Celebration; promoting public awareness of our refuges' habitat and wildlife; fundraising for refuge projects and programs; and participating in data gathering and bird counts.

3.6.1.2 Administrative Facilities

Infrastructure

Brazoria NWR

The Otter Slough field headquarters is located off FM 2004. The office has eight individual offices and supports field operations including management, maintenance, fire, and law enforcement. Adjacent to the office is a 20-foot-by-50-foot metal building, a 40-foot-by-60-foot metal storage building, a 40-foot-by-60-foot metal tractor shed, a 14-foot-by-8-foot pesticide storage building, two fuel tanks, and water quick fill. One water well, a septic system, and numerous wooden power poles provide utilities. The Service maintains a remote automated weather system (RAWS) near Otter Slough as well. The refuge maintains 50-plus miles of barbed wire boundary fence, two automatic entry gates, numerous field gates, approximately 100 water control structures, 27.9 miles of limestone gravel roads, 40.8 miles of earthen levees, and three irrigation wells.

Volunteer village, located near Bastrop Bayou, consists of eight recreational vehicle (RV) pads all supplied with electricity, sewer, and water. A mobile home and one travel trailer are set up for temporary quarters in the village as well. A portable building is used for a common area and wash house. A wooden well house sits across the yard alongside a 100-foot radio tower. A wooden fence and information signs front the yard.

San Bernard NWR

The field headquarters of San Bernard NWR is located on CR 306 and includes the refuge's office and fire office, three maintenance buildings, three storage buildings, two storage sheds, one quarters (three-bedroom), two volunteer pads, and a communications tower (repeater). The refuge maintains 17-plus miles of gravel or shell roads, 16-plus miles of earthen levees, many miles of barbed wire boundary fence, 27 water control structures, four automated entry gates, and a RAWS. There are numerous wells and windmills also located near the headquarters and in the bottomlands. A twelve-inch water well is located at the Sargent Unit, and an eight-inch water well is located at the Wolfweed Wetlands for irrigation. Facilities in the bottomland hardwood forest units include a 600-square-foot cabin with a 320-square-foot deck overlooking the pond located on Hudson Woods. The Complex acquired a small cabin (500 square feet) located on the Buchanan Tract and it is being utilized for temporary quarters. The Complex uses a 35-foot-by-70-foot Quonset hut located on the east side of Hudson Woods for hurricane evacuation.

The Complex headquarters is located at the intersection of FM 2611 and CR 316. Construction was completed on the headquarters in 2008 and supports the administrative, management, biological, acquisition, fire, and public use programs across the Complex.

Big Boggy NWR

The refuge has 6.7 miles of gravel and shell roads, 5.23 miles of earthen levees, several miles of boundary fence (barbed wire), seven gates, 1.36 miles of water delivery canals, several

culverts, and 13 water control structures. There are also three known water wells and three deteriorated windmills on the refuge.

Utilities and Rights-of-Way

Brazoria NWR

Centerpoint Electric has a right-of-way (ROW) for the utility pole along FM 2004 and the Otter Slough Entrance Road which supplies electricity to the field headquarters. Multiple pipeline ROWs occur on the refuge; including a large corridor which contains 23 pipelines (See Table 3-8). Brazoria County drainage district maintains fourteen drainage ditches on the north side of the refuge. The CR 208 ROW is on the refuge crosses the refuge. The CR227 ROW adjoins the refuge property line. An undeveloped ROW for an alternate segment of CR 227 crosses the Bluestem Unit. There are several oil and gas wells in the Slop Bowl unit with associated ROW rights on a field road.

San Bernard NWR

Table 3-9 summarizes the ROWs on San Bernard NWR. Prior to each acquisition the Complex Project Leader reviews the existing ROWs, along with outstanding interests, and confirms that these interests would not adversely impact the Service’s ability to manage the parcel to meet the mission of the Service.

Big Boggy NWR

County Road and the adjoining service line to Chinquapin are the only current ROW’s on Big Boggy.

Table 3-8 Pipelines on Brazoria NWR.

Strategic Petroleum Reserve	Petroleum	AMOCO	LPG
Buckeye Gulf Coast Pipeline	Petroleum	AMOCO	LPG
Exxon	Chem Grade Propylene	AMOCO	LPG
Equistar	Ethylene	AMOCO	LPG
Chevron	Propylene	AMOCO	LPG
Praxair	Hydrogen	Texas Ship Channel LLC	Natural Gas
Dow	Petroleum	Coastal Refining and Marketing	Anhydrous Ammonia
Dow	Petroleum	Air Liquide	Hydrogen Gas
Dow	Petroleum	Air Liquide	Nitrogen Gas
Dow	Petroleum	Air Liquide	Oxygen Gas
Dow	Petroleum	Seminole	LPG

Dow	Petroleum		
Equistar	Ethane Propylene Propylene	Houston Pipeline (2 easements)	Natural Gas

Table 3-9. Rights-of-Way on San Bernard NWR.

San Bernard (core)	Service line along CR 306 Service line to check station	Zinn Petroleum – natural gas Winn Crosby, - Poole gathering line Am. Mid-stream Offshore (2 lines) – both natural gas Brazos Lat. Holding – natural gas Wynn-Crosby - natural gas	CR 306, FM 457, FM 2918
Buchanan	Along CR 321		
Dance Bayou	Service line along FM 524	Exxon Mobil – propylene dilute Kinder Morgan – 2 lines both Nat. Gas Chevron Pipeline -2 lines both ethylene Seadrift Pipeline Co. (3 lines) - (1)propylene, ethane, propane (2)propylene, Ethane, Propane (3) LPG Energy Transfer Co. - natural gas Houston Pipeline - natural gas ConocoPhillips - ethylene	CR 524 CR 781
Big Pond	Service line along FM 1301 Service line along entrance road to	Exxon Mobil – (1) propylene dilute (2) proylene chem. Kinder Morgan – (2	Communications Tower

Bottomland Unit			
	pipeline pump stations and communications tower. CenterPoint Transmission Line	lines) both nat. gas Equi Star – (1)ethylene (2)propylene Panther Gas – nat. gas Houston Pipeline - natural gas (2 lines) Enterprise – crude oil Enterprise - ethane Energy Transfer - natural gas Tx. Petrol. Invest – nat. gas (7 lines) Dow - EP Mix	
Bird Pond		Tx. Petrol. Invest – Nat. Gas (2 lines)	Access Easement along pond levee for adjacent land owners
San Bernard River	Service line along FM 1301		
Buffalo Creek		Energy Transfer - Natural Gas	Drainage Easement across east end
Stringfellow/McNeal/Ducroz	Transmission Line Service line along FM2611, CR 306 and CR 316 Service line to Poole #4 well and toward San Bernard Oak and water wells.	Equi Star - ethylene Equistar - empty Celanese - propylene	CR 306 CR 316 FM 2611
Brazos River Unit		Kinder Morgan - LPG Seadrift Pipeline Co. - ethylene	Access easement to sand pit inholding
Eagle Nest Easement		Gulfmark – crude Houston Pipeline – natural gas ConocoPhillips – crude Chevron – ethylene ConocoPhillips – natural gas Enterprise – natural gas (2 lines)	

Bottomland Unit			
Eagle Nest Lake	Service line along CR 24 & CR24a	Enterprise Crude – crude Enterprise Prod. - nitrogen ConocoPhillips (4 lines)- (1) EP mix (2) gas/distillates/naptha (3) EP mix/propane (4) gas/distillates/naptha	CR 24 and CR 24a CR 25
Dow Woods	Service line along CR 288 Center Point transmission line	Equistar - petrol	County Road 288
Hudson Woods	Service line to cabin Center Point – Transmission Line	Noble Energy Inc. – product line ConocoPhillips – (9 lines) – (1)crude (2) crude (3)crude butadiene (4) EP mix/propane (5) ethylene (6) nat. gas (7) propylene (8) propane (9) empty Chevron – (3 lines) (1) Ethylene (2) EP mix/propane (3) ethylene TX Eastern Trans. LP – natural gas Standard Resources – natural gas Gulfmark Ener - crude	Railroad easement on west side of property (inactive) CR 29
Carolyn Davies Easement		ConocoPhillips (4 lines) – (1) EP mix/propane (2) crude butadiene (3) crude (4) natural gas Chevron (2 lines) – (1) EP mix/propane (2) ethylene Houston Pipeline-	

Bottomland Unit			
		natural gas Enterprise Prod. – natural gas	
Sweeny		Conoco Phillips – 4 corridors (a) Hydrogen Nat. Gas (b) Pentane Butane Mix Ethan/Propane Ethylene Propane Nat. Gas Propylene Propylene Butane Isobutane (c) Crude Oil (d) Gas/oil Raffinate/Naphtha Empty	
Halls Bayou		Monument Pipeline – natural gas Seadrift Pipeline (2 lines) – both propylene/ ethane/ propane	Access easement for two adjacent land owners
Media Luna		Oxea – prolyene Equistar - empty	CR 457
Cedar Lake Creek		Oxea - prolyene Equistar - empty	CR 318

3.6.1.3 Oil and Gas Operations and Management

Oil and gas exploration and production is prevalent in the area. Although the Complex does not own mineral rights and cannot deny access for oil and gas development, various laws, regulations, and administrative procedures must be adhered to before access is granted. Therefore, oil and gas companies contact each refuge to prepare an Operational Plan and Environmental Assessment prior to receiving a Special Use Permit for initiating any exploration or production activities. Complex staff works closely with each operator to carefully consider and mitigate any impacts of oil and gas operations on wildlife species or refuge visitors. Although somewhat unsightly on the prairie landscape, these oil and gas operations can be minimally intrusive and consistent with the purposes of the refuges as long as their activities are properly managed. Operations in the bottomlands require extensive planning and negotiation to ensure the removal of trees are minimized in order for these operations to be compatible with the purpose of the bottomlands, namely the provision of old growth habitat for dependent wildlife. The potential for future oil and gas exploration and production activities on the Complex is possible depending on the economic stability of the industry. The following oil and gas activities occur on the Complex:

Brazoria NWR

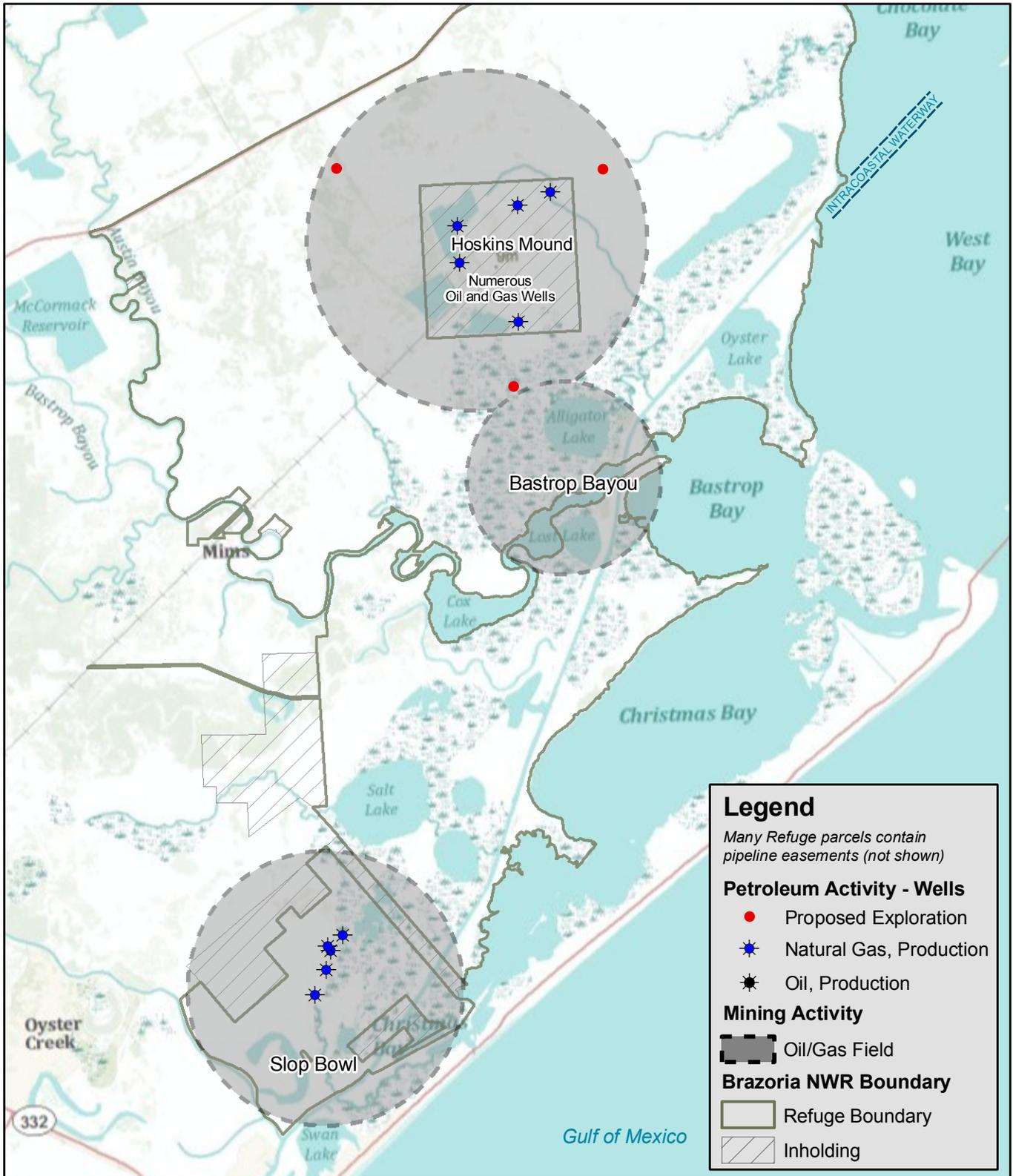
Current oil and gas operations on Brazoria NWR include natural gas wells in the Slop Bowl Unit, operated by Texas Petroleum Investment Co., and a saltwater disposal well. Exploration drilling for natural gas at several locations around the Hoskins Mound inholding, has been proposed by Suemar Inc. They would like to begin the first of these drilling operations in the spring/summer of 2012. The most recent 3-D seismic survey, completed by Seitel Inc., covered the southern part of the Brazoria NWR from Otter Slough through the Slop Bowl Unit during 2008. (Map 3-16 Brazoria National Wildlife Refuge Oil and Gas Operations)

San Bernard NWR

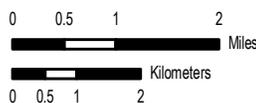
Oil and gas operations on San Bernard NWR include the following: Wynn Crosby Inc. operates three natural gas wells located near the Wolfweed Wetlands; Wynn Crosby operates five natural gas wells and a saltwater disposal well within the Sargent Unit, which is located near the GIWW; Zinn Petroleum and Endeavor Natural Gas each operate a well in Cedar Lakes; and three oil wells located on the Buffalo Creek Unit near the San Bernard River are operated by ZK Petroleum (Map 3-17 San Bernard National Wildlife Refuge Oil and Gas Operations).

Big Boggy NWR

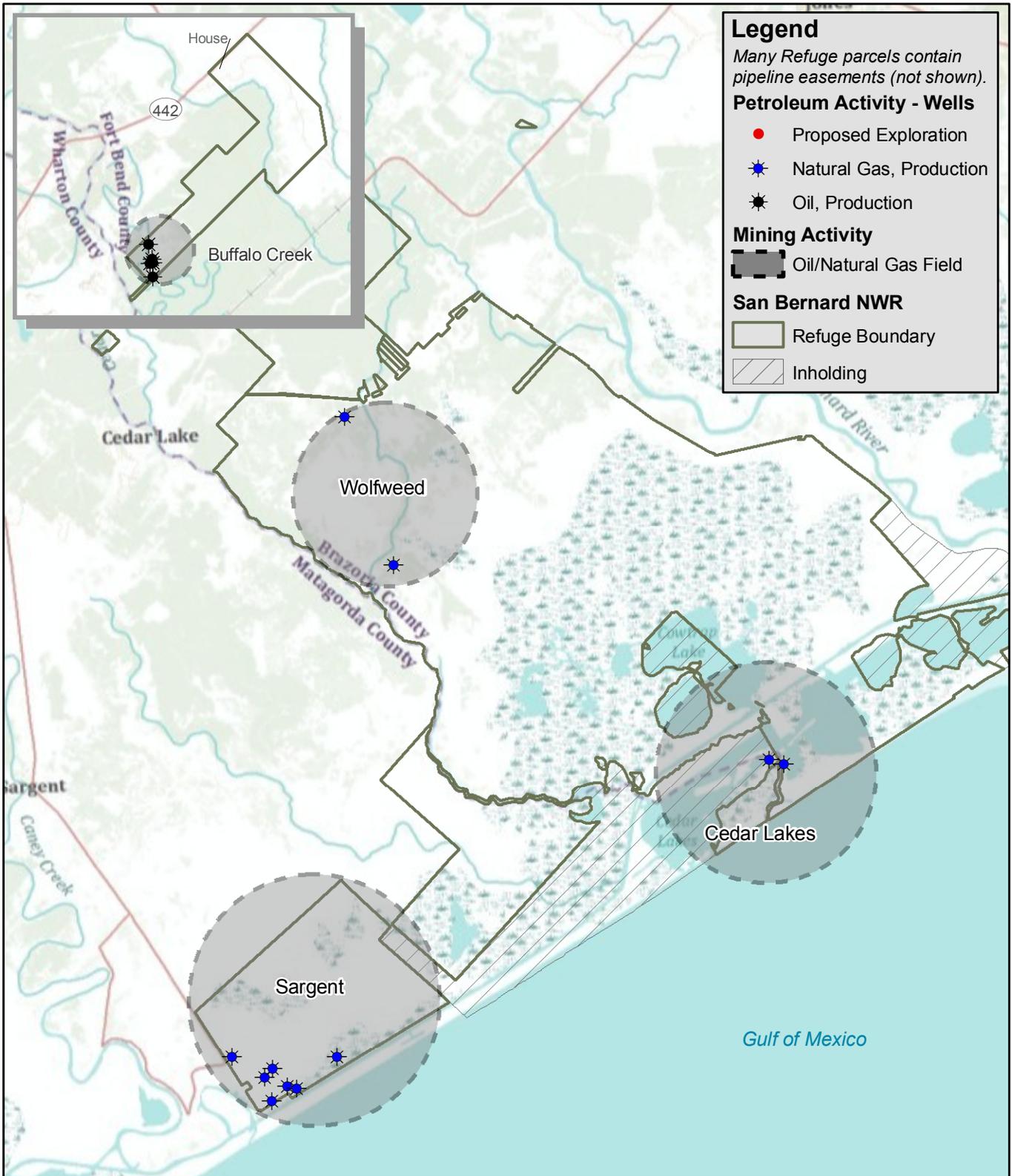
No oil and gas operations occur on the Big Boggy NWR.



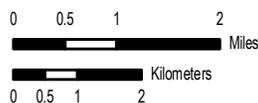
PRODUCED IN THE DIVISION OF REFUGE PLANNING
 ALBUQUERQUE, NEW MEXICO
 LAND STATUS CURRENT TO: 5/31/09
 MAP DATE: May 2011
 BASEMAP: N/A
 MERIDIAN: N/A
 FILE: brz_oil_gas_8.5by11_5.18.11_shl



UTM ZONE 15
 NAD 83



PRODUCED IN THE DIVISION OF PLANNING
 ALBUQUERQUE, NEW MEXICO
 LAND STATUS CURRENT TO: 5/31/09
 MAP DATE: MAY 2011
 BASEMAP: N/A
 MERIDIAN: N/A
 FILE: snb_oil_gas_8.5by11.5.18.11_shl



3.6.1.4 Partnerships

The Complex has a strong history of working with numerous partners to implement Service policy, projects, and Complex goals. These partnerships include biological research, land conservation, community protection, land management, public use opportunities, environmental education, and habitat restoration/improvements. The Complex includes the following organizations and agencies as partners:

- Brazosport Independent School District
- Texas Parks and Wildlife Department
- Texas General Land Office
- U.S. Army Corp of Engineers
- Brazoria County Parks and Recreation
- Natural Resource Conservation Service
- Houston Audubon
- National Fish and Wildlife Foundation
- Gulf Coast Bird Observatory
- Trust for Public Land
- The Conservation Fund
- The Community Foundation
- Brazosport Birders
- The Nature Conservancy
- Galveston Bay Foundation
- Ducks Unlimited
- Bayou Land Conservancy
- Houston Wildlerness
- Cradle of Texas Conservancy
- Texas Master Naturalist
- Friends of Brazoria Wildlife Refuges
- Texas RICE
- Brazoria County
- Matagorda County
- Nat. Oceanic and Atmospheric Administration
- U.S. Geological Service
- Houston Regional Group of the Sierra Club

3.6.1.5 Memorandums of Understanding and Other Agreements

The Complex has a Memorandum of Understanding with Brazoria County's Emergency Management Office. In accordance with the agreement, the Service may assist Brazoria County with Wildland Fire Response and during all-risk (Hurricane) situations. Only the County's Emergency Management Coordinator can make requests for assistance from the refuges.

3.6.1.6 Law Enforcement and Resource Protection

Complex staff recognizes the obligation that has been entrusted to them – the care of valuable natural and cultural resources. Law enforcement on the Complex is used both for protection and for prevention. Used for prevention, law enforcement safeguards the visiting public, staff, facilities, and natural and cultural resources from criminal action, accidents, vandalism, and negligence. Law enforcement inhibits incidents from occurring by providing a law enforcement presence. The Complex has two full-time law enforcement officers and one collateral law enforcement officer.

3.6.1.7 Safety

Safety is important for both staff and visitors. Monthly staff safety meetings are held at the Complex with safety videos and discussions on safety issues. The intent of the safety meetings is to update and train personnel, as well as to resolve any safety concerns that arise. Sample topics include safety awareness, heavy equipment safety, hazardous materials, first aid, and heat stress. Job Hazard Analysis are prepared for all projects and kept on file. Tail gate safety meeting prior to beginning a new or not reoccurring assignment are incorporated in planning.

The Complex has a Safety Plan which is updated annually, that describes the safety program and the responsibilities of the refuge staff and volunteers. All Complex staff are trained annually in CPR and AED operation. All permanent staff maintain current CPR/AED and First Aid Certification.

3.6.2 Habitat Management

Prairie/Grassland Restoration and Management

Active restoration activities occur on Brazoria and San Bernard NWRs. Because much of the prairie habitats were in agriculture prior to establishment, there remains a significant amount of infrastructure in place that interferes with native prairie restoration and management including roads, levees, ditches, and water control structures that all affect the natural hydrology of the prairie.

Many of the species of special management concern have life history requirements (i.e., nesting, wintering habitat, etc.) directly tied to grasslands. The coastal prairies of Texas are important wintering grounds for sparrows and wrens. With nationwide habitat loss of prairies and grasslands, there are fewer places migrating birds can feed, rest, and winter. Direct habitat loss is the biggest concern for prairie-dependent species.

Brazoria and San Bernard NWRs actively restore old fields and coastal prairie through a combination of chemical, mechanical, fire, and planting of native prairie seed. Fire is utilized to maintain the prairie habitat on all three refuges, mimicking historic fire regimes in restored areas.

The Complex collects a small amount of native seed for restoration efforts from native prairie grasslands within its borders. However, this is challenging because production and access to seed harvested is highly dependent on weather conditions. To help overcome this challenge, the Complex has purchased native prairie hay and distributed that hay using a bale spreader to restore native prairie.

Invasive Species Management (Flora)

Of the dozens of non-native invasive plant species on the Complex, management efforts have concentrated on the most aggressive and invasive species with habitat changing characteristics. These are the Chinese tallow tree, Macartney rose, water hyacinth, privet (*Ligustrum* spp.), trifoliate orange, salt cedar and deep-rooted sedge. The Complex uses

herbicide application, mechanical manipulation, and prescribed fire to control and prevent the spread of invasive species. The Complex anticipates the development and implementation of an integrated pest management plan by 2013. Table 3-10 below describes the applications used and invasive species targeted to manage/restore the Complex to a native plant community.

With disturbances initiated through farming, grazing, and development, prairies and grasslands are easily encroached by invasive species like Chinese tallow and restoration efforts have proved to be a challenge on budget and resources. Exotic and invasive species have complicated restoration efforts in prairie habitats since they can quickly become established prior to implementing restoration plans. The Complex initially treats many Chinese tallow-infested tracts with herbicides as well as mechanical manipulation in an attempt to convert it back to a functional prairie habitat.

Brazoria NWR uses mechanical treatment on up to 100 acres of invasive species, including salt cedar and Chinese tallow. Mechanical treatment is the direct removal of trees using a tub grinder on an excavator or grinding using a gyrotrac. Mechanical removal of Chinese tallow trees along drainage ditches has been done in partnership with the Drainage District. Approximately 1,600- 2,500 acres of Chinese tallow are treated with chemical application as part of an annual on-going prairie restoration initiative. The chemicals generally used are Grazon P+D ® and Grazon Next® through aerial application. This process has been extremely successful in reducing Chinese tallow and Macartney rose. Ground application is used for road maintenance and in small problem areas of deep-rooted sedge using a backpack pump or an ATV. The use of herbicides continues to decline as the refuge transitions from a restoration to a maintenance management approach in prairie habitats. Prescribed fire is used as a management tool on approximately 5,000 – 10,000 acres of prairie annually.

San Bernard NWR treats up to 50 acres annually by the same mechanical means as Brazoria NWR designed to remove Chinese tallow. Chemical application (same chemicals as Brazoria NWR) is applied to approximately 100 acres annually and the refuge burns approximately 2,500 – 6,000 acres of coastal and salty prairie habitats to control invasive species annually. Because of the presence of native hardwood trees in the bottomland forests of San Bernard NWR, mechanical and ground applied chemical treatments are used to control invasive species, including Chinese tallow. On average, the refuge annually treats up to 100 acres of bottomlands for invasive species.

At Big Boggy NWR, the refuge primarily utilizes prescribed fire to control invasive species among the coastal and salty prairie habitats. However, mechanical and herbicide application may be utilized when species and density warrant their use. The refuge generally treats less than 100 acres of invasive species annually.

Table 3-10 Treatment Applications for Target Invasive Species

Rodeo and Habitat	Cattails & Phragmites	Boom sprayer & aerial	Create open water for wildlife
Clearcast	Chinese tallow	Aerial	Eradicate invasive flora in bottomland forest
Glyphosate	Various grasses and Deep-rooted sedge	Hand & Backpack sprayer	Manage various grasses in & around facilities for safety & aesthetics
Garlon 4	Chinese tallow & Macartney rose	Hand & Backpack sprayer	Coastal Prairie restoration
Roundup & Arsenal	Various grasses	Hand & Backpack sprayer	Manage various grasses in & around facilities for safety & aesthetics
Grazon P+D & Remedy	Chinese tallow & Macartney rose	Aerial	Coastal Prairie restoration
Grazon Next	Chinese tallow & Macartney rose	Aerial	Coastal Prairie restoration

Fire Management

The Complex uses prescribed fire as a management tool for restoration and maintenance of fire-adapted ecosystems including upper marsh, and prairie habitats. Restoration of coastal prairie may require treatment with prescribed fire annually or once every two years depending on the response of the vegetation and the ability to carry fire. Maintenance of coastal prairie habitats generally requires the application of fire to the unit on a three to four year cycle. The Complex treats 25 to 35 percent of the coastal prairie and salty prairie habitats annually. The Complex uses a helicopter on prescribed fire ignitions on larger burns



More than 12,000 acres of coastal and salty prairie are treated with prescribed fire across the complex. Photo Credit: USFWS

as funding permits, and ground ignition when not feasible. The Complex uses backing fires (against the wind) and flanking fires (parallel with the wind) and limited head fires, with flanking fire preferred due to longer combustion rates. Backing fires are used to reinforce the firebreak. Map 3-18 depicts the fire management units on Big Boggy. Map 3-19 depicts the fire management units on Brazoria and Map 3-20 depicts the fire management units on San Bernard.

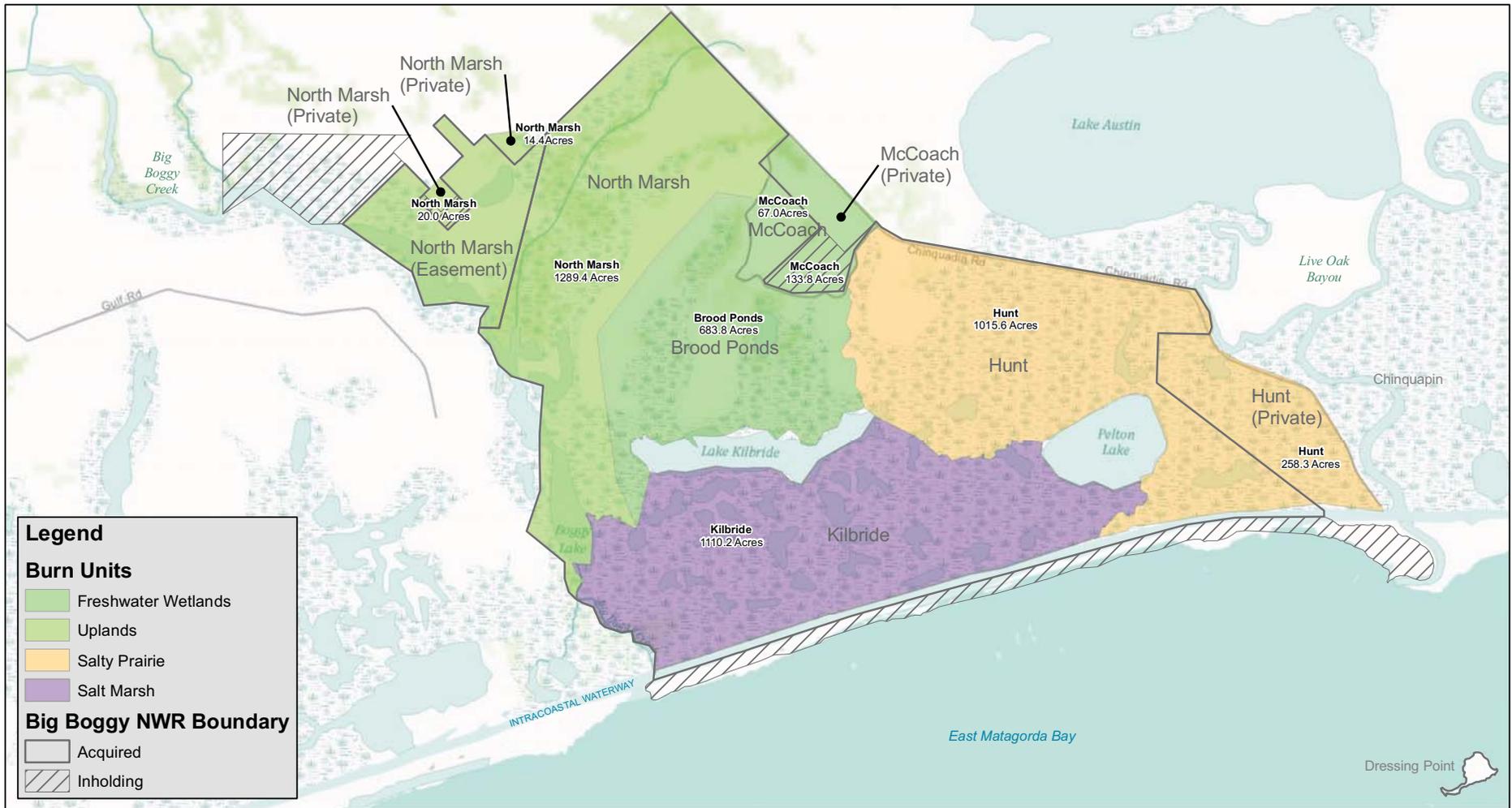


U.S. Fish & Wildlife Service

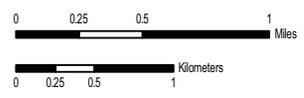
Big Boggy National Wildlife Refuge

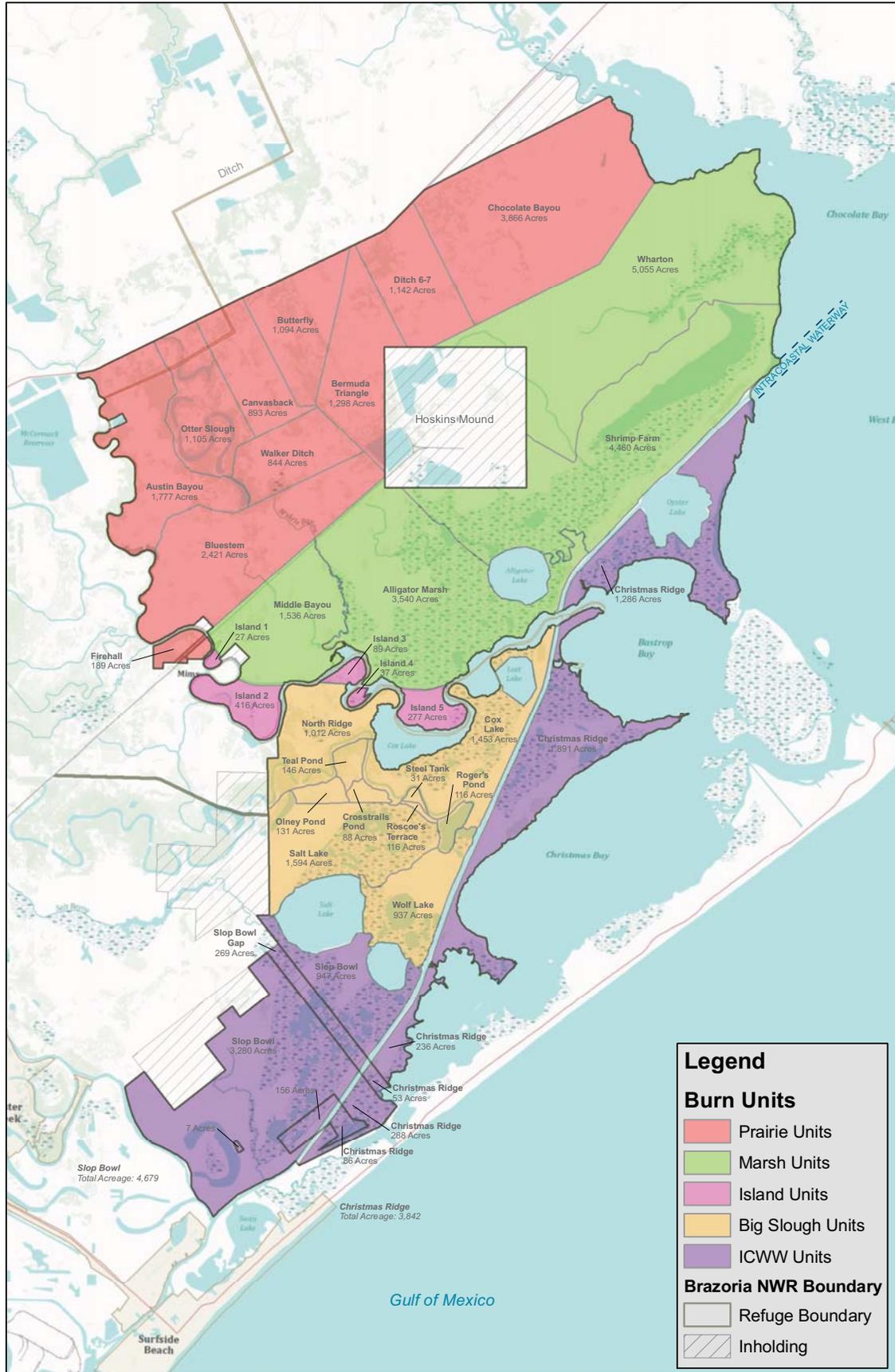
Matagorda County, Texas

Map 3-18. Fire Management

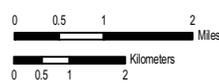


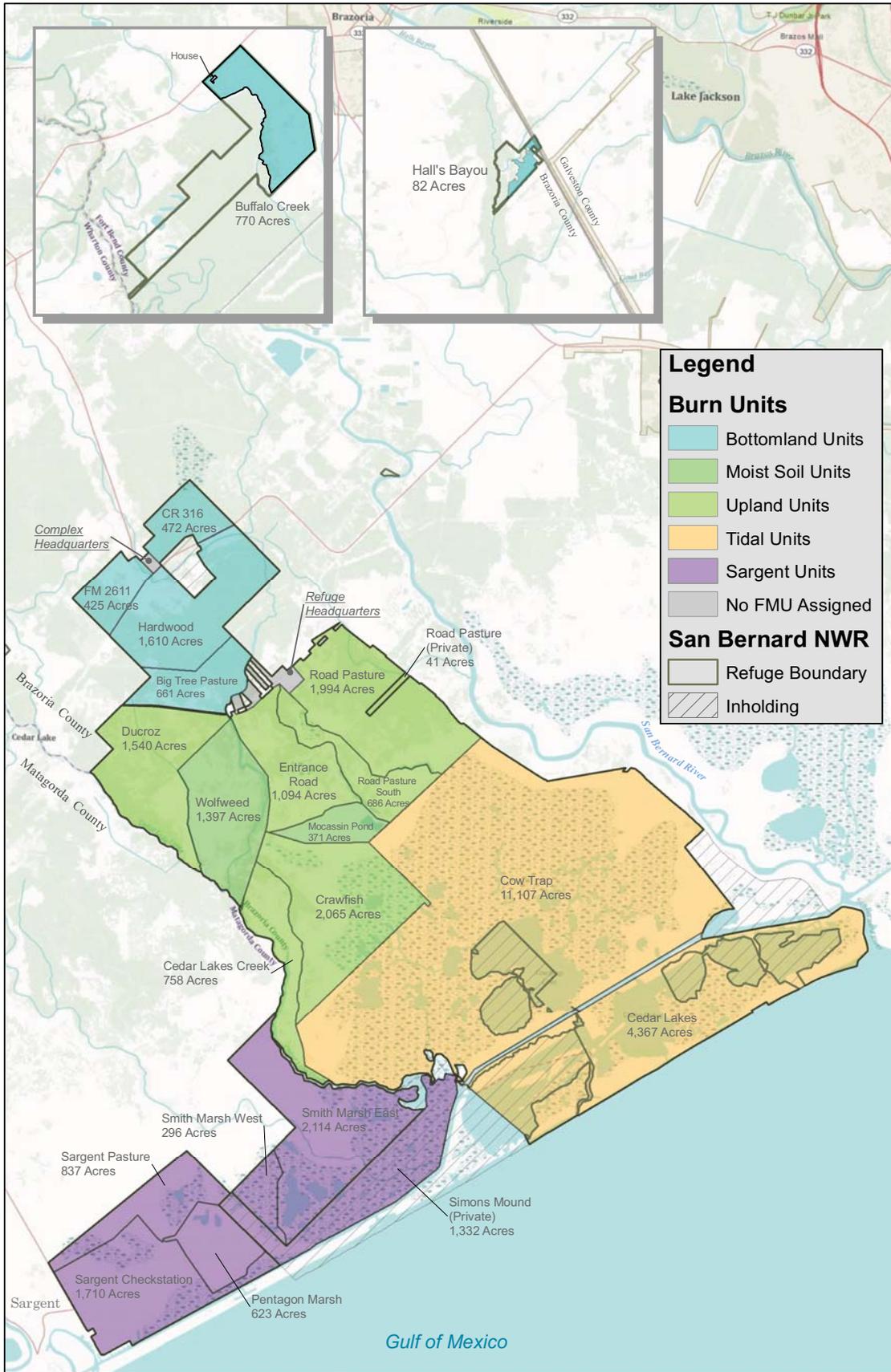
PRODUCED IN THE DIVISION OF REFUGE PLANNING
 ALBUQUERQUE, NEW MEXICO
 LAND STATUS CURRENT TO: 5/31/09
 MAP DATE: May, 2011
 BASEMAP: N/A
 MERIDIAN: N/A
 FILE: bbg_fire_5.24.11_sh





PRODUCED IN THE DIVISION OF REFUGE PLANNING
 ALBUQUERQUE, NEW MEXICO
 LAND STATUS CURRENT TO: 5/31/09
 MAP DATE: May 2011
 BASEMAP: N/A
 MERIDIAN: N/A
 FILE: brz_fire_5.24.11_sh





Legend

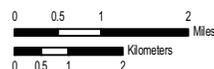
Burn Units

- Bottomland Units
- Moist Soil Units
- Upland Units
- Tidal Units
- Sargent Units
- No FMU Assigned

San Bernard NWR

- Refuge Boundary
- Inholding

PRODUCED IN THE DIVISION OF REFUGE PLANNING
ALBUQUERQUE, NEW MEXICO
LAND STATUS CURRENT TO: 5/31/09
MAP DATE: May 2011
BASEMAP: N/A
MERIDIAN: N/A
FILE:snb_fire_5.24.11_shl



Farming Program

At Big Boggy NWR, a total of 90 acres are farmed through force account at Mathis Field (Map 3-21). The entire 90 acres is planted with rye grass to provide winter browse for waterfowl.

Brazoria NWR uses cooperative farming on 10 farm fields that fall in a three-year rotation and range from 50 to 120 acres for a total of 1,000 acres (Map 3-22). Out of these 1,000 acres, approximately 220-350 acres are farmed on a given year. Three out of ten units (approximately 220-350 acres) are put into production each year with the remaining seven



Rice fields are planted on a 3 year rotation . Photo Credit: USFWS



During fallow years, the fields can be flooded and managed as moist soil units. Photo Credit: USFWS

left fallow. The fallow fields are generally manipulated through discing and flooding during the off cycles of the rotation. The units essentially become a moist soil unit and may be flooded to provide wildlife habitat during non-production years. Rice is the main crop in production with the occasional grain sorghum. The purpose of the cooperative farming program on Brazoria NWR is for habitat benefits from the farming operations. Rent equivalents from farmers may include discing in non-farmed marshes; purchase of herbicide used to spray invasive trees and brush on irrigation laterals and/or track-hoe or excavator work on irrigation laterals. Rent equivalents have also included maintenance of feeder ditches, pipes, and water control structures and water credits purchased by farmer to be used by the refuge as duck or shorebird water following harvest. The farmer ensures

that after final harvest, all cropped fields will be prepared for re-watering. Levees will be made water tight up next to control structures. Discing immediately after harvest will generally not be allowed because of excess rutting of fields and breaching levees. In the event that a second cutting of rice crop occurs, the farmer is required to leave 25 percent of the second harvest uncut to provide forage for waterfowl.

San Bernard NWR farms a 10-acre plot located in the headquarters area (Map 3-23). This minimal field is planted with rye grass during the winter as a source of winter browse and to attract wildlife with emphasis on white-fronted geese to the area for winter wildlife viewing. At other times, the field is basically used for administrative purposes such as testing plastic sphere ignition devices, testing and demonstrating rocket nets or other activities requiring a minimally vegetated area.



U.S. Fish & Wildlife Service

Big Boggy National Wildlife Refuge

Matagorda County, Texas

Map 3-21. Agricultural Units



Legend

- Boat Launch
- Parking Lot
- Agricultural Unit

Refuge Roads and Trails

- Gravel
- Native
- Primitive

Big Boggy NWR Boundary

- Acquired
- Acquisition Boundary

PRODUCED IN THE DIVISION OF REFUGE PLANNING
 ALBUQUERQUE, NEW MEXICO
 LAND STATUS CURRENT TO: 5/31/09
 MAP DATE: May, 2011
 BASEMAP: N/A
 MERIDIAN: N/A
 FILE: bbg_fam_5.24.11.shl



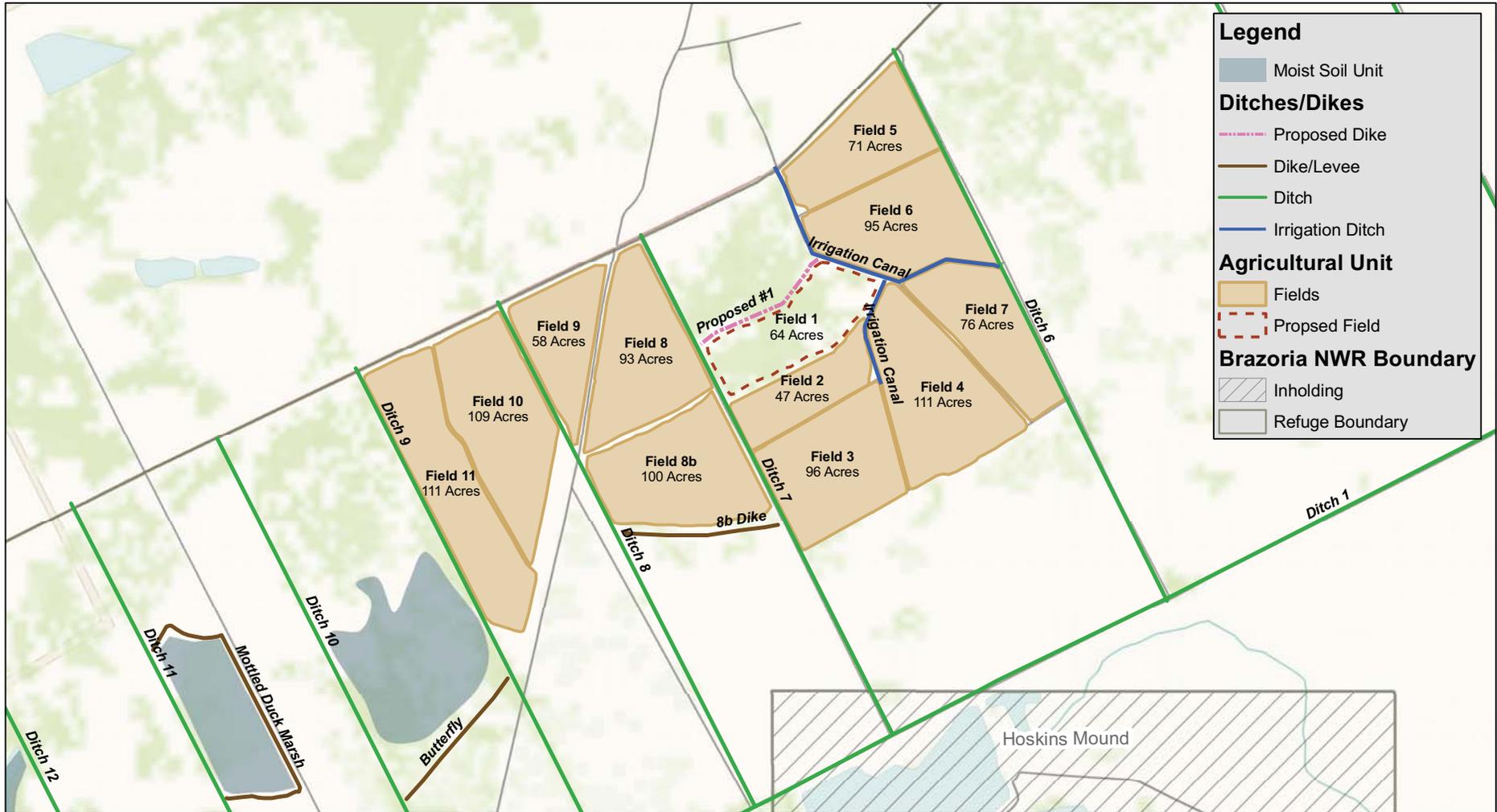
UTM ZONE 15
NAD 83



U.S. Fish & Wildlife Service

Brazoria National Wildlife Refuge
Brazoria County, Texas

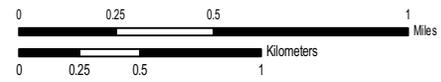
Map 3-22. Agricultural Units



Legend

- Moist Soil Unit
- Ditches/Dikes**
 - Proposed Dike
 - Dike/Levee
 - Ditch
 - Irrigation Ditch
- Agricultural Unit**
 - Fields
 - Proposed Field
- Brazoria NWR Boundary**
 - Inholding
 - Refuge Boundary

PRODUCED IN THE DIVISION OF REFUGE PLANNING
 ALBUQUERQUE, NEW MEXICO
 LAND STATUS CURRENT TO: 5/31/09
 MAP DATE: May, 2011
 BASEMAP: N/A
 MERIDIAN: N/A
 FILE: brz_farm_5.24.11_shl



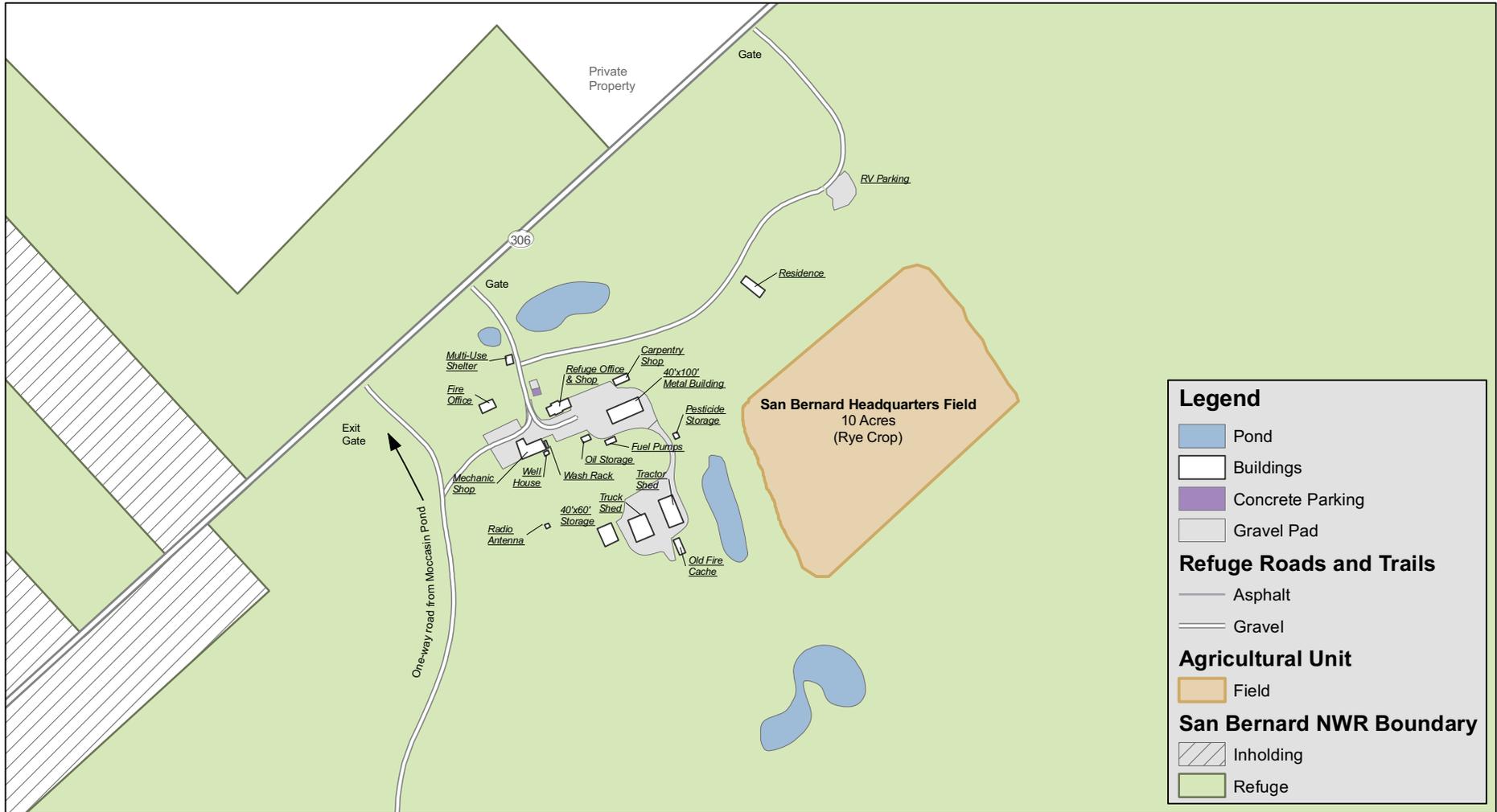
UTM ZONE 15
NAD 83



U.S. Fish & Wildlife Service

San Bernard National Wildlife Refuge Brazoria County, Texas

Map 3-23. Agricultural Units



Legend

- Pond
- Buildings
- Concrete Parking
- Gravel Pad

Refuge Roads and Trails

- Asphalt
- Gravel

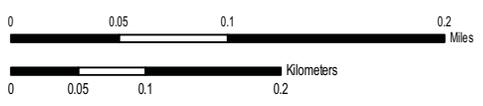
Agricultural Unit

- Field

San Bernard NWR Boundary

- Inholding
- Refuge

PRODUCED IN THE DIVISION OF REFUGE PLANNING
 ALBUQUERQUE, NEW MEXICO
 LAND STATUS CURRENT TO: 5/31/09
 MAP DATE: May, 2011
 BASEMAP: N/A
 MERIDIAN: N/A
 FILE: snb_farm_5.24.11_sh



UTM ZONE 15
NAD 83

Haying

Brazoria NWR is the only refuge in the Complex that administers a cooperative haying program although haying has been utilized on San Bernard NWR in preparation of bottomland hardwood restoration. Cooperative haying of 35 to 50 acres annually on Brazoria NWR establishes wildfire buffer areas for Wildland Urban Interface (WUI) areas at the refuge. A WUI area is the zone where natural areas and development meet. These areas have gained increasing importance as more Americans build homes in rural settings adjacent to public lands. The cooperative haying program is designed to reduce fuel buildup in salty and coastal prairie habitats where prescribed fire cannot be implemented due to an expansion of WUI areas closing in on the refuge boundary. Two units, Halls Bayou near Santa Fe, Texas and Fire Hall Units near Demi John are currently hayed. Cooperative haying is generally conducted in late summer.

Mowing

Mowing is utilized as an alternative to fire when fire cannot be implemented due to habitat or weather conditions. In 2010, mowing was utilized on the Ducroz Unit during a period of extremely high wildfire potential. The County had been under a 6-month burn ban and north wind, which would enable the smoke to blow off-shore rather than inland toward inhabited areas, failed to develop. The cost of mowing is high but this cost is weighted by the potential of not completing an essential restoration project.

Water Management

Whenever possible, the Complex restores drained wetlands through plugging ditches or installing water control structures. Brazoria NWR restores the wetland component of wet prairie mostly by reshaping and building-up ditch borrows material. Water control structures are installed to manipulate water levels in the prairie, recreating a mosaic of freshwater wetlands and wet prairie. In addition, water delivery canals, and levees around farm field/moist soil units, are rebuilt to improve water management and movement capability across the units. Moist-soil Units are depicted on Maps 3-24 and 3-25 for Brazoria NWR, 3-26 for San Bernard NWR, and 3-27 for Big Boggy NWR.

Ponds, Reservoirs, and Moist Soil Units

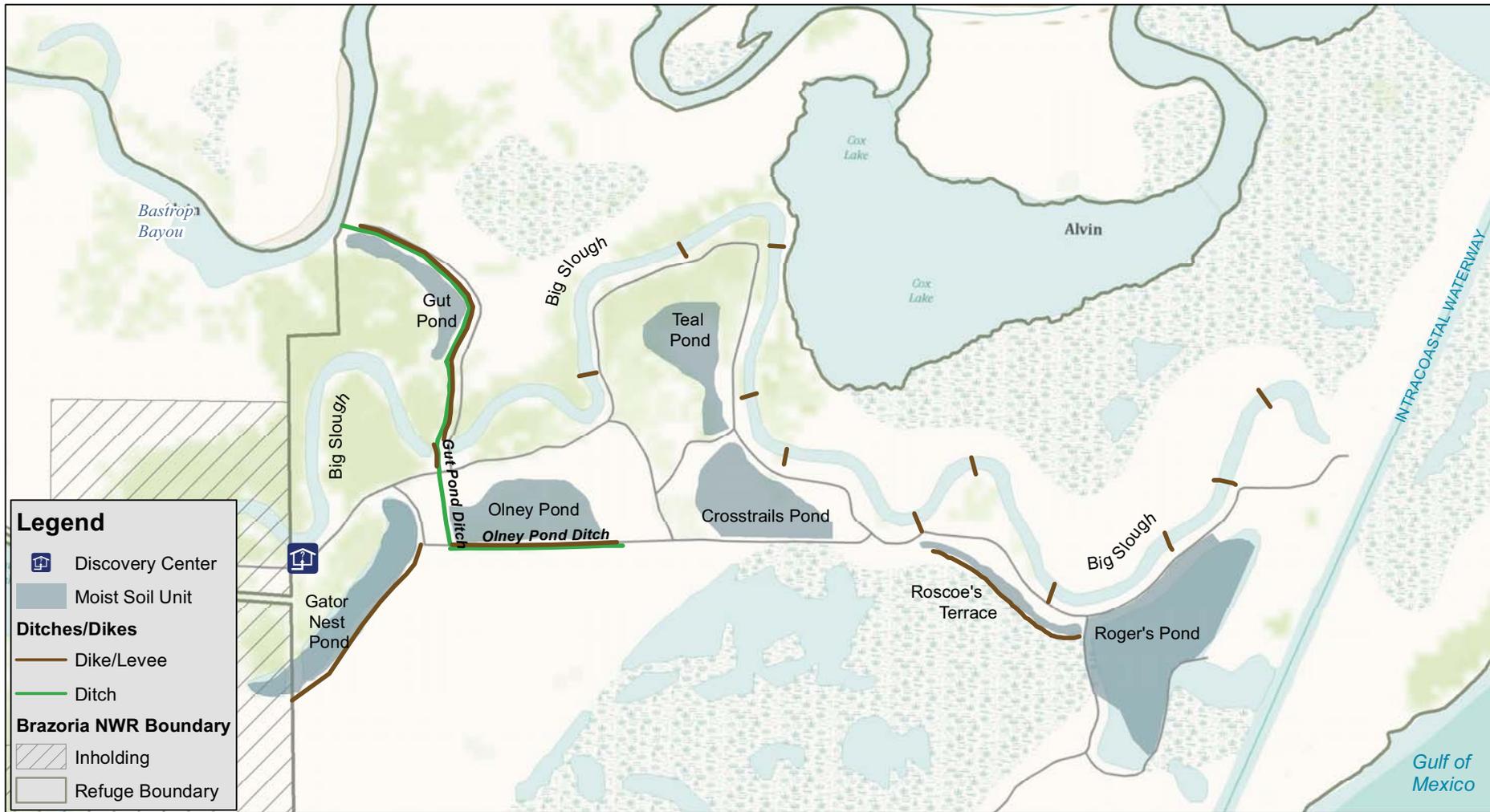
All refuges on the Complex manage moist soil units and fields with a combination of draining and summer discing, utilizing a stubble roller while flooded, and where opportunity exist, flood units with saltwater to control vegetation. Brazoria NWR manages 23 fields/ponds for moist-soil and freshwater habitats. San Bernard NWR manages two reservoirs along with four moist soil units and two ponds near Cocklebur Slough and five moist-soil units on near Sargent. The 2,000 acre Eagle Nest Lake will be restored to an emergent marsh in partnership with NRCS. Hudson Woods includes two natural oxbow lakes, one of which can be artificially managed with a large flashboard structure. A total of five moist-soil units have been constructed at Big Boggy NWR. Freshwater habitats can be extremely limiting during extended droughts, as seen in 2009 – 2011. The refuges continue to look for opportunities to provide freshwater resources. Potential expansion of the



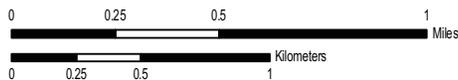
U.S. Fish & Wildlife Service

Brazoria National Wildlife Refuge
Brazoria County, Texas

Map 3-24. Moist Soil Units - Big Slough



PRODUCED IN THE DIVISION OF REFUGE PLANNING
ALBUQUERQUE, NEW MEXICO
LAND STATUS CURRENT TO: 5/31/09
MAP DATE: May, 2011
BASEMAP: N/A
MERIDIAN: N/A
FILE: brz_big_slough_MSU_5.25.11_shl



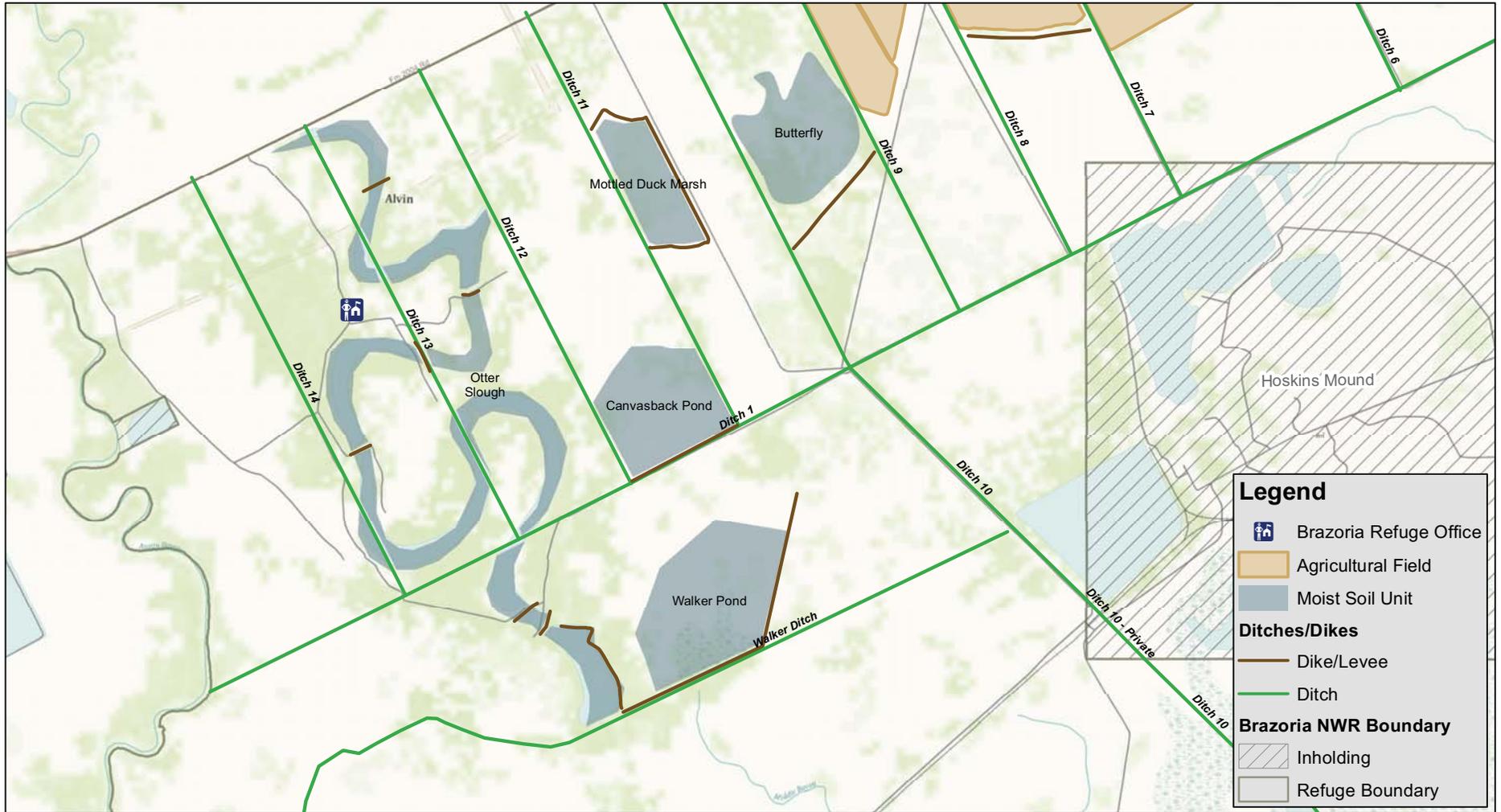
UTM Zone 15
NAD 83



U.S. Fish & Wildlife Service

Brazoria National Wildlife Refuge
Brazoria County, Texas

Map 3-25. Moist Soil Units - North Refuge



PRODUCED IN THE DIVISION OF REFUGE PLANNING
ALBUQUERQUE, NEW MEXICO
LAND STATUS CURRENT TO: 5/31/09
MAP DATE: May, 2011
BASEMAP: N/A
MERIDIAN: N/A
FILE: brz_north_MSU_5.25.11_shl



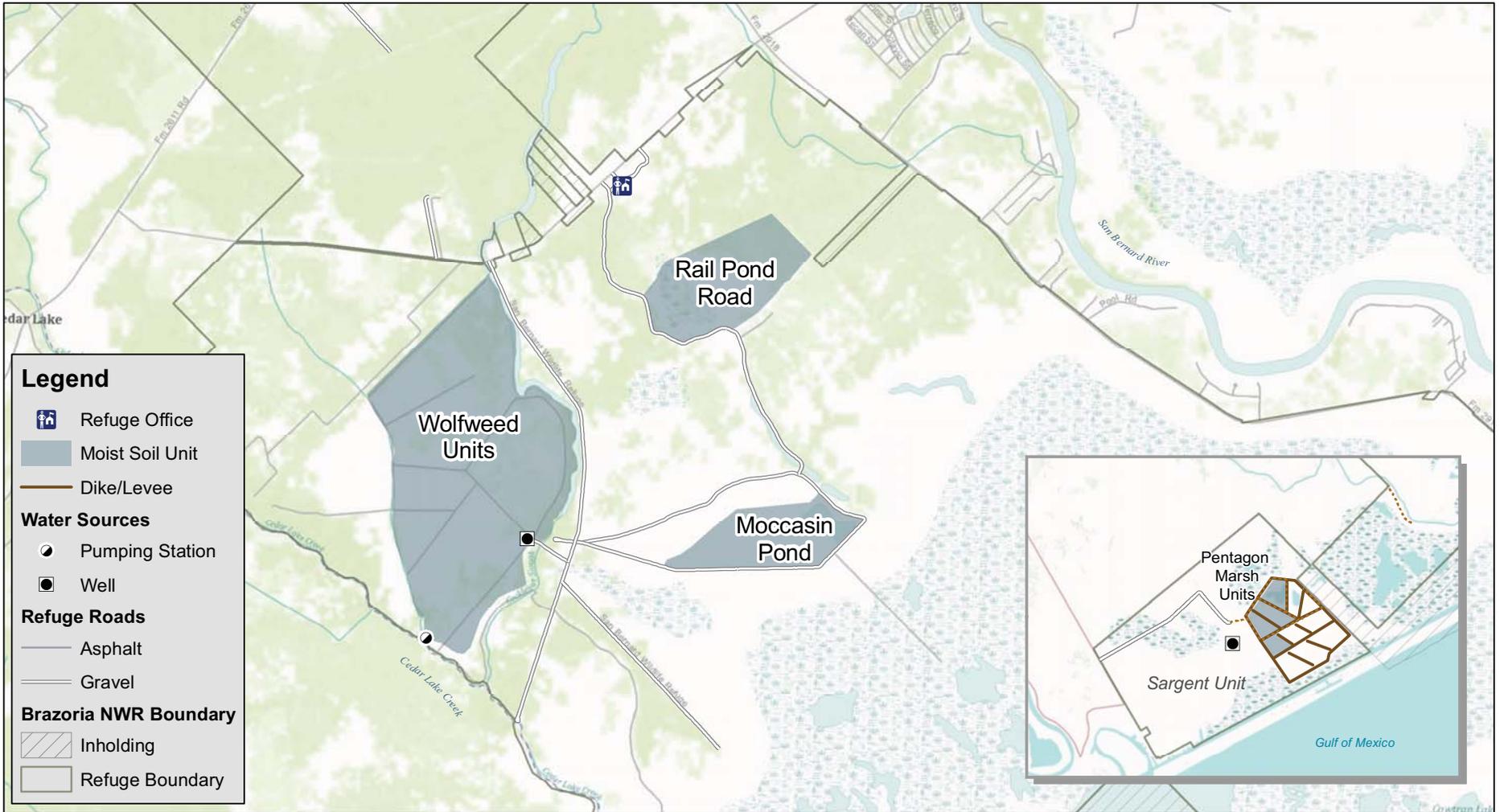
UTM Zone 15
NAD 83



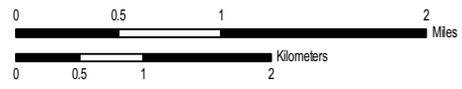
U.S. Fish & Wildlife Service

San Bernard National Wildlife Refuge
Brazoria and Matagorda Counties, Texas

Map 3-26. Moist Soil Units



PRODUCED IN THE DIVISION OF REFUGE PLANNING
ALBUQUERQUE, NEW MEXICO
LAND STATUS CURRENT TO: 5/31/09
MAP DATE: May, 2011
BASEMAP: N/A
MERIDIAN: N/A
FILE: snb_MSU_5.25.11_shl

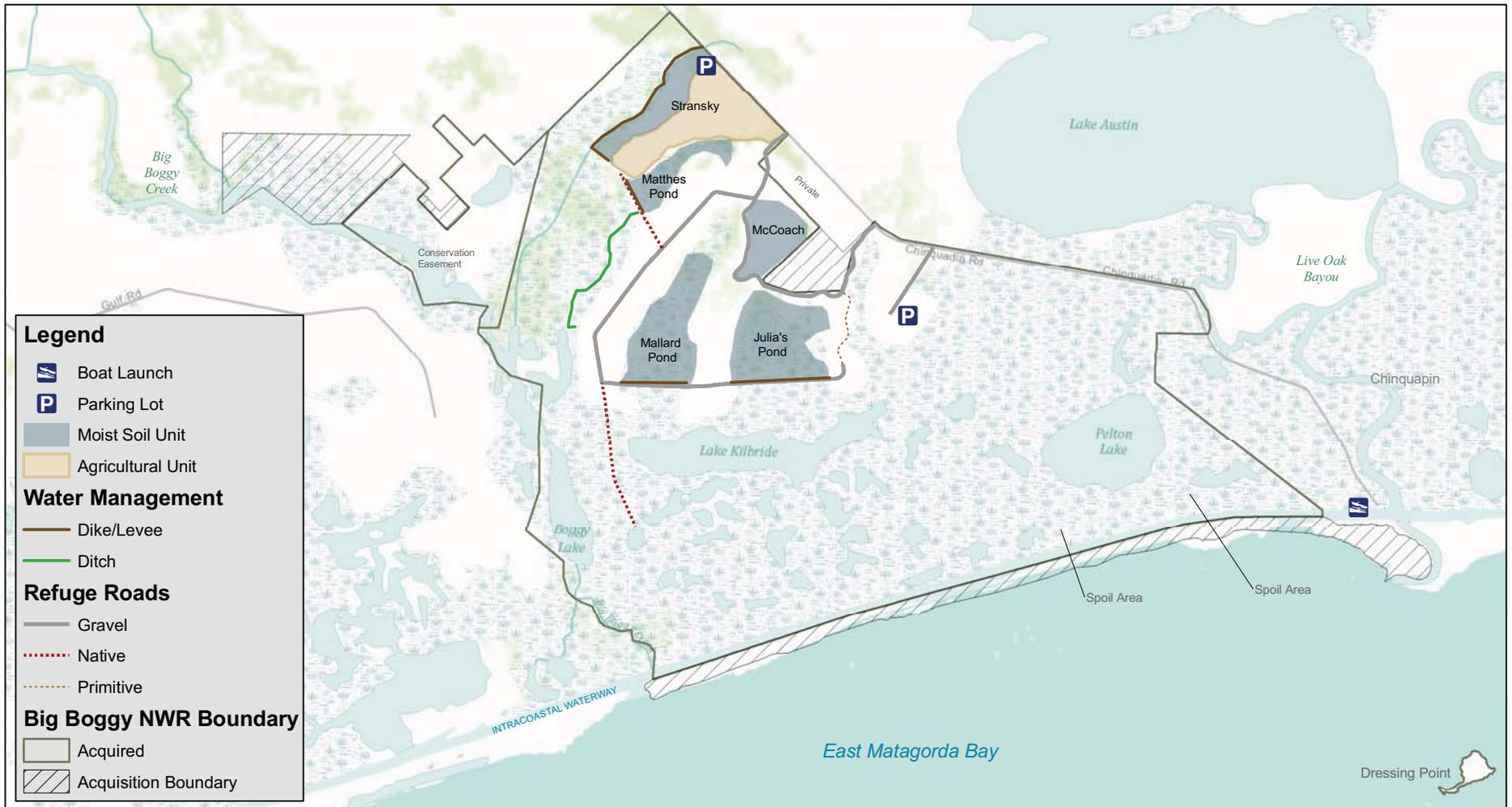




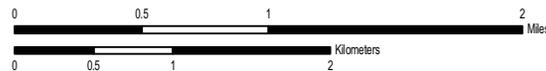
U.S. Fish & Wildlife Service

Big Boggy National Wildlife Refuge Matagorda County, Texas

Map 3-27. Moist Soil Units



PRODUCED IN THE DIVISION OF REFUGE PLANNING
 ALBUQUERQUE, NEW MEXICO
 LAND STATUS CURRENT TO: 5/31/09
 MAP DATE: May, 2011
 BASEMAP: N/A
 MERIDIAN: N/A
 FILE: bbg_MSU_5.25.11_shl



Wolfweed Wetlands on San Bernard and reestablishment of natural wetlands on future acquisitions near the Sargent Unit are being evaluated.

Water Delivery Canals

Brazoria NWR and Big Boggy NWR maintain irrigation canals on the refuges for water delivery and movement. The drainage district generally maintains ditches 1-14 on the Brazoria NWR, which includes Chinese tallow control, mowing and digging-out ditches. Several of the ditches are utilized for water delivery as well. There are no irrigation canals on San Bernard NWR.

Water Purchases

Brazoria NWR and Big Boggy NWR have the ability to purchase and receive water. Brazoria NWR may purchase water from the Gulf Coast Water Authority and Big Boggy NWR from Lower Colorado River Authority. Water purchase is dependent on rainy seasons and may not be an option in extreme drought years. During droughts, water is extremely limited and may not be purchased for agricultural use. Water purchases are determined on an annual basis and highly dependent on funding. Freshwater from rice fields is captured and can provide wetland habitat below the rice fields. Brazoria NWR purchased approximately \$15,000 and \$18,000 worth of water in 2008 and 2009, respectively. Big Boggy NWR purchased approximately \$5,000 worth of water for the 2008 and 2009 fall/winter seasons. In 2011, Brazoria spent \$30,000 to purchase water during the drought and provide a limited freshwater source. San Bernard NWR does not purchase water due to lack of infrastructure in place to support this operation.

Irrigation Wells

Brazoria NWR manages three irrigation wells but regularly uses only the two 4-inch wells at Teal Pond. During drought situations, these small pumps may provide the only freshwater in the Big Slough area. Water from this pump can be diverted to Teal, Olney, or Crosstrails Ponds. San Bernard NWR regularly utilizes two large irrigation wells. The 8-inch well at Wolfweed is a backup to the Cedar Lake Creek diversion pump and is used when Cedar Lake Creek is salty. A 12-inch pump at Sargent is utilized to provide fresh water in the moist-soil units in the Pentagon Marsh. This pump is essential to providing freshwater in this salt marsh habitat. There are no wells on Big Boggy NWR.

Bottomland Hardwood Forest

The bottomland hardwood forests are both a mix of old growth, sustainable habitats and newly regenerative habitats. The old growth forest habitat of the San Bernard NWR (parts of Dance Bayou, Bird Pond, Big Pond, McNeil, Wilson, and other units) largely require no direct management to maintain dynamic ecological processes. Many units previously cleared for tree harvesting and cattle grazing are susceptible to non-native species invasion. Invasive species control coupled with a propensity for regeneration has allowed many units to overcome extensive habitat damage. The San Bernard NWR has over 24,000 acres of bottomland hardwoods and associated habitats with continuing accrual of additional habitat and all the wildlife it harbors, under the auspices of the Austin's Woods Conservation Plan.

Dune and Beach

San Bernard NWR has approximately four miles of beach habitat between the mouth of the San Bernard River and Cedar Lakes Cut. Due to re-dredging of the San Bernard River in January 2010, the Cedar Lakes Cut has since silted-in, enabling vehicle access to the San Bernard Beach from the Sargent Beach during lower tides. To access the Cedar Lakes cut, vehicles traverse above the vegetation line due to the erosion of Sargent Beach. Prior to the silting-in of the Cedar Lakes Cut, the San Bernard Beach had been accessible only by boat for the past 12 years. The Complex is extremely concerned about the beach resources, where unlimited access is contrary to refuge purposes. San Bernard NWR is currently working with the Texas General Land Office to further protect the San Bernard Beach. Bollards were installed in 2011 to notify the public that the upper beach is part of Refuge and limit access. The Service needs to continue to educate the public on the importance of beach resources.

3.6.3 Wildlife Management

Threatened and Endangered Species

There are three birds (Attwater's prairie-chicken, piping plover, and whooping crane), one fish, (smalltooth sawfish), and five reptiles (Atlantic hawksbill, green, Kemp's ridley, leatherback, and loggerhead sea turtles) that are all listed under the Endangered Species Act, which potential habitat in or adjacent to the Complex. The Service identifies the Complex as having potential re-introduction areas for both the Attwater's prairie-chicken and the whooping crane. Biological staff conducts coordination and studies to determine the best potential management direction to maximize success if reintroductions occur on the Complex. The Service identified portions of the Complex as critical habitat for the piping plover. With current and proposed management actions, habitat restoration efforts are providing larger tracts of functional native habitat that have the potential to eventually provide suitable habitat for other listed species that have been historically documented in the vicinity of the Complex.

San Bernard NWR assists with the implementation of the Kemp's Ridley Sea Turtle Recovery Plan. This includes beach sea turtle surveys during nesting season (May–July), flipper tagging, excavating sea turtle nests and transporting them to the incubation facility at Padre Island National Seashore. The refuge monitors and responds to calls regarding sea turtles on Gulf Coast beaches between the mouth of the Colorado River and Quintana Beach.

Management of Invasive Species (Fauna)

Invasive species such as feral hog, nutria, red imported fire ants, and Raspberry crazy ants have negative effects to both wildlife and wildlife habitat. In addition, areas disturbed by feral hogs become prone to the establishment of exotic plant species. Nutria are rare, but are present in Complex water impoundments. Alligators generally hold their population in check. Red imported fire ants throughout the southeastern U.S. have seriously impacted numerous ground-dwelling species such as northern bobwhite quail. Researchers in the academia and land management arenas are evaluating their impact on mottled ducks and black rails. Populations of Raspberry crazy ants have not yet been located on the Complex. Impacts to tree and ground nesting birds, and reptile nests could be devastating if they move into refuge habitats.

Feral Hog

The Complex continues to issue special use permits for feral hog hunting with the aid of hounds or trapping in accordance with the Feral Hog Management Plan (2004). Permits are issued on a 6-month or 1-year time frame for a specific area on the Complex, including bottomland units. Hunters and trappers must provide harvest reports on a monthly basis to the appropriate refuge manager.

Brazoria and San Bernard NWRs partner with the Texas Youth Hunting Association and hold a youth feral hog hunt on two weekends per year. The refuges hold the hunt in February at San Bernard NWR and in March at Brazoria NWR. Through special use permits and youth hunting, approximately 150 hogs are removed from Brazoria NWR and over 500 removed from San Bernard NWR annually. In December 2011, a contract aerial hunting service was employed to remove hogs on Brazoria and San Bernard. The contractor removed 83 hogs on Brazoria during eight hours of flight and 305 off San Bernard in about eight hours of flight. A follow up flight in March 2012 removed in additional 125 hogs on San Bernard NWR.

The U.S. Department of Agriculture Wildlife Service continues to include Big Boggy NWR in their aerial hunting to control feral hogs in Matagorda County. Aerial hunting removes less than five hogs annually from the refuge.

Red Imported Fire Ants and Raspberry Crazy Ants

Throughout the Complex, staff treat rookery areas for red imported fire ants using methoprene (insect growth regulator) bait like Extinguish®. Treatments occur before nesting season in October-November when moisture starts and ants begin surfacing. At Brazoria NWR, staff treat Wolf Lake Skimmer Lot rookery with the same chemicals. San Bernard NWR staff treat Cedar Lakes rookery. At Big Boggy NWR, staff treat Dressing Point Island rookery.

The Complex is monitoring the Raspberry crazy ant, a recently discovered invasive species, for presence and wildlife impacts on the Brazos River Unit of San Bernard NWR. The ants are in a nearby hayfield, but have not been located on the Complex. Currently, no field treatment has been developed for these ants. As research and treatments become available, the Complex will use the best available science to control them. The Service partnered with the Gulf Coast Bird Observatory in 2010 to conduct initial monitoring of the Brazos River Unit for Raspberry crazy ants. A follow-up monitoring is scheduled in 2012.

3.6.4 Visitor Service and Infrastructure

Providing recreational opportunities, environmental education, and interpreting the unique natural resources of the Complex for visitors are important elements of the Service's mission and the goals and objectives of the Refuge System. As stated in the Refuge Improvement Act of 1997, six wildlife-dependent recreational uses were determined to be priority public uses on national wildlife refuges. These are hunting, fishing, wildlife observation and wildlife photography, environmental education and interpretation. These six uses, when compatible with each refuge purposes, are the focus of the Complex's public use activities.

The Complex may consider other public uses compatible if they are found to be supportive of the six wildlife-dependent recreational activities. The following describes public use opportunities on the Complex. Map 3-28 depicts the public use areas for Big Boggy National Wildlife Refuge. Maps 3-29 and 3-30 depict the public use areas for Brazoria National Wildlife Refuge. Maps 3-31 and 3-32 depicts the public use areas for San Bernard National Wildlife Refuge

Brazoria and San Bernard NWRs each receive approximately 35,000 visitors annually. About a quarter of the visitors come during the spring season (March–April) to view birds and enjoy the coastal prairie habitat when a variety of flowering plants are blooming. Approximately 5,000 visitors come to Big Boggy NWR for hunting and fishing opportunities.

3.6.4.1 Wildlife-Dependent Recreation Opportunities

Hunting

In 1966, and again in 1997, Congress recognized the legitimacy of hunting on national wildlife refuges. The Service is dedicated to providing opportunities for hunting as well as other compatible wildlife-dependent recreation. Hunting is an important wildlife management tool used to control populations of some species that might otherwise exceed the carrying capacity of their habitat and threaten the well-being of other wildlife species, and in some instances, that of human health and safety. The guiding principles that the Refuge System uses to manage quality hunting on refuges are: 1) to manage wildlife populations consistent with approved management plans; 2) to promote visitor understanding of and increase visitor appreciation for America’s natural resources; 3) to provide opportunities for quality recreational and educational experiences; and, 4) to minimize conflicts with visitors participating in other compatible wildlife-dependent recreational activities.

The Complex strives to provide safe and high quality waterfowl hunting opportunities. Waterfowl hunting is a traditional, and still very popular, outdoor recreational activities in the region. Refuges and other public lands along the Texas Gulf Coast play a key role in providing hunting opportunities to the public.

Brazoria NWR

Brazoria NWR has two public waterfowl hunting areas. The Christmas Point Public Waterfowl Hunting Area lies southeast of the GIWW and encompasses approximately 4,000 acres. Access is by boat only. The Middle Bayou Public Waterfowl Hunting Area encompasses approximately 1,500 acres and allows boat or walk-in access to this site. The hunting of coots, ducks, geese, and mergansers is permitted in these designated areas, but pits and permanent blinds are prohibited (50 C.F.R. § 32.63). Hunters are required to use non-toxic shot. Hunting areas are open during the early teal season (September) and regular waterfowl season, which runs from late October through mid-January. Hunting Areas are open for hunting in accordance to state regulations during the Conservation Order Light Goose Season, following regular waterfowl season (Map 3-33 Brazoria National Wildlife Refuge Hunt Areas and Map 3-34 Brazoria National Wildlife Refuge Middle Bayou Hunt Areas).

San Bernard NWR

San Bernard NWR has three designated public waterfowl hunting areas and one permit hunting area. All of the public hunting areas are accessible by boat only, and open for the pursuit of coots, ducks, geese, and mergansers. They include the Cedar Lakes Public Waterfowl Hunting Area (2,400 acres) south of the GIWW and the Smith Marsh Public Waterfowl Hunting Area (1,400 acres) on the west side of Cedar Lakes Creek. Salt Bayou Public Waterfowl Hunting Area encompasses 3,600 acres and is accessible from Cedar Lake Creek, the GIWW, or through the shallow Cowtrap Lakes system. The Sargent Permit Waterfowl Hunt also offers a controlled walk-in and boat access hunting opportunity on 4,000 acres.

The public waterfowl hunting areas are open during the early teal season (September) and regular waterfowl season, which runs from late October through mid-January. The public waterfowl Hunting Areas are open for hunting in accordance to state regulations during the Snow Goose Conservation Hunt following regular waterfowl season (Map 3-35 San Bernard National Wildlife Refuge Hunt Areas).

Big Boggy NWR

Big Boggy NWR has two public hunting areas: the Pelton Lake Public Hunting Area, encompassing 1,100 acres on the east end of the refuge, which is accessible from Chinquapin Road or by boat, and the Matthes Field Public Waterfowl Hunting Area located at the north end of the refuge along Chinquapin Road. The Complex maintains this 200-acre area primarily for goose hunting, but both areas are open for the hunting of ducks, mergansers, geese, and coots. The public waterfowl hunting areas are open during the early teal season (September) and regular waterfowl season, which runs from late October through mid-January, and are open for hunting in accordance to state regulations during the Conservation Order Light Goose Season, following regular waterfowl season (Map 3-36 Big Boggy National Wildlife Refuge Hunt Areas).

Youth Hunts

In cooperation with TPWD and the Nannie M. Stringfellow WMA, San Bernard NWR permits TPWD to use the McNiel/Ducroz/Stringfellow Units during their youth hunts, held three weekends per year. The refuge provides this opportunity to youth hunters enabling standby hunters in excess of available blinds on the Stringfellow WMA to hunt. The Complex allows no baiting in association with the hunt. The refuge maintains nine hunt blinds on Service property for this cooperative hunt.

The Complex partners with the Texas Youth Hunting Program (TYHP) to provide up to two additional weekends of hunting opportunities for feral hogs at San Bernard and Brazoria NWRs. At San Bernard NWR, TYHP uses the same blinds as used by TPWD during their youth hunts. A special use permit issued to TYHP enables them access to the blinds, and for baiting during the hunt. At Brazoria NWR, TYHP erects portable blinds within Otter Slough and along ditches. The hunt has been successful over the past three years in removing an average of 35 feral hogs per year from the Complex.

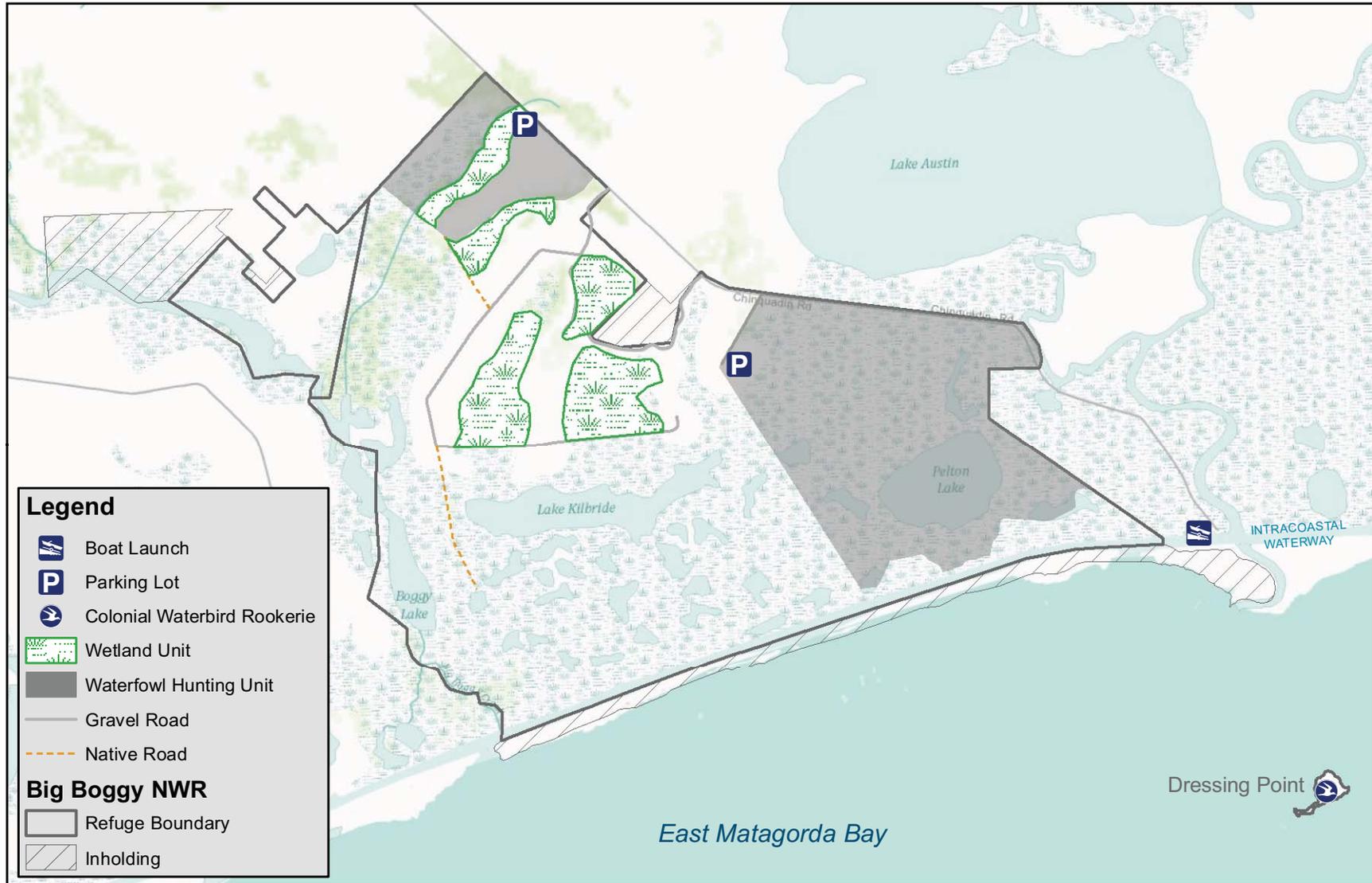


U.S. Fish & Wildlife Service

Big Boggy National Wildlife Refuge

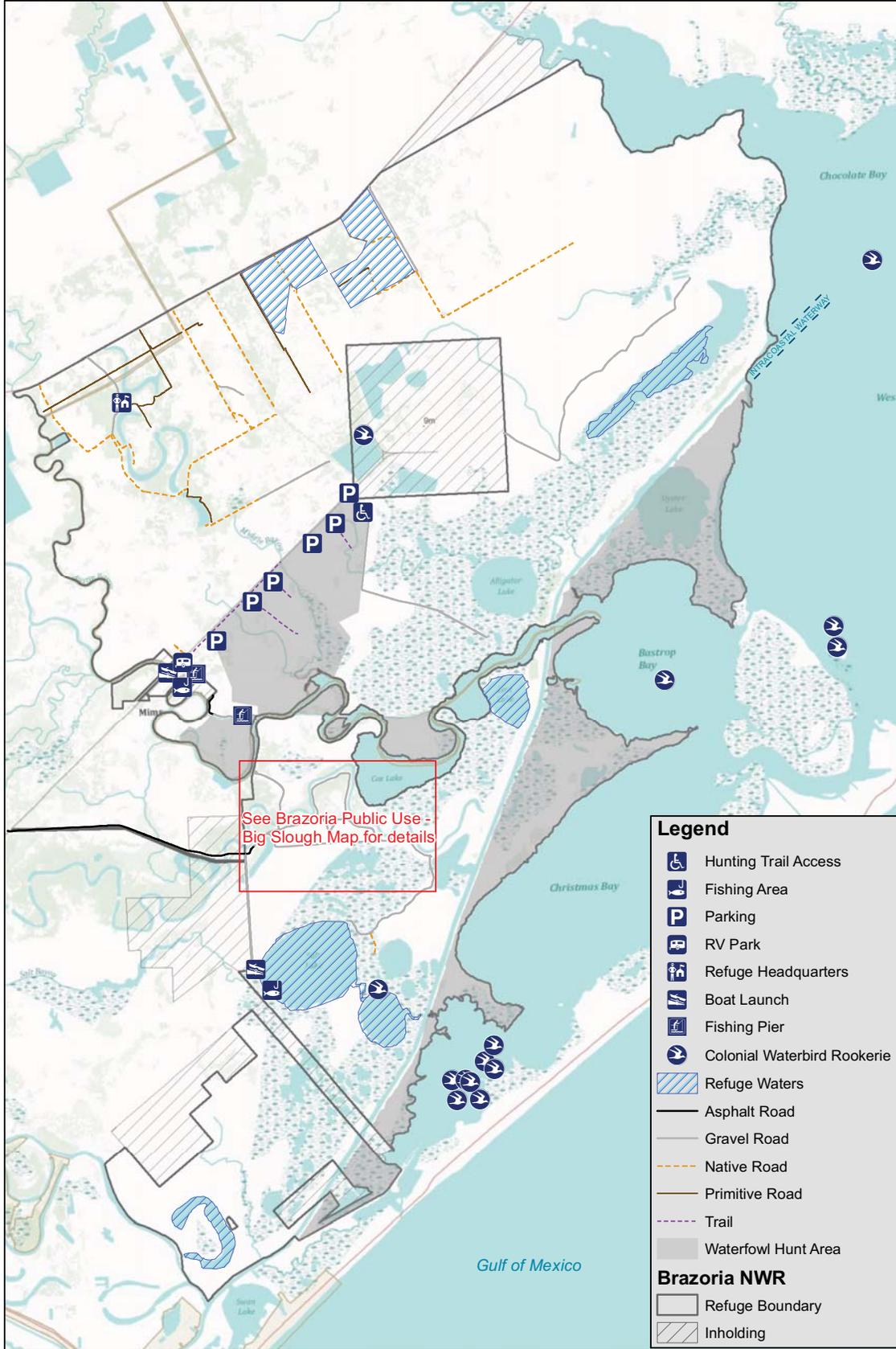
Matagorda County, Texas

Map 3-28. Public Use



PRODUCED IN THE DIVISION OF REFUGE PLANNING
 ALBUQUERQUE, NEW MEXICO
 LAND STATUS CURRENT TO: 5/31/09
 MAP DATE: May, 2011
 BASEMAP: N/A
 MERIDIAN: N/A
 FILE: bbg_public_use_8.5by11_5.19.11_shl





PRODUCED IN THE DIVISION OF REFUGE PLANNING
 ALBUQUERQUE, NEW MEXICO
 LAND STATUS CURRENT TO: 5/31/09
 MAP DATE: May 2011
 BASEMAP: N/A
 MERIDIAN: N/A
 FILE: brz_public_use_5.19.11_shl





U.S. Fish & Wildlife Service

Brazoria National Wildlife Refuge

Brazoria County, Texas

Map 3-30. Public Use - Big Slough Area



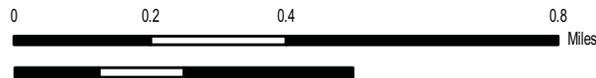
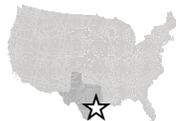
Legend

- Discovery Center
- Maddox Monument
- Observation Platform
- Parking
- Picnic Shelter
- Restroom
- Shelter
- Auto Tour Route
- Trail
- Asphalt Road
- Gravel Road
- Wetland Unit

Brazoria NWR

- Inholding
- Refuge Boundary

PRODUCED IN THE DIVISION OF REFUGE PLANNING
 ALBUQUERQUE, NEW MEXICO
 LAND STATUS CURRENT TO: 5/31/09
 MAP DATE: May, 2011
 BASEMAP: N/A
 MERIDIAN: N/A
 FILE: brz_big_slough_pub_use_8.5by11_5.19.11_shl

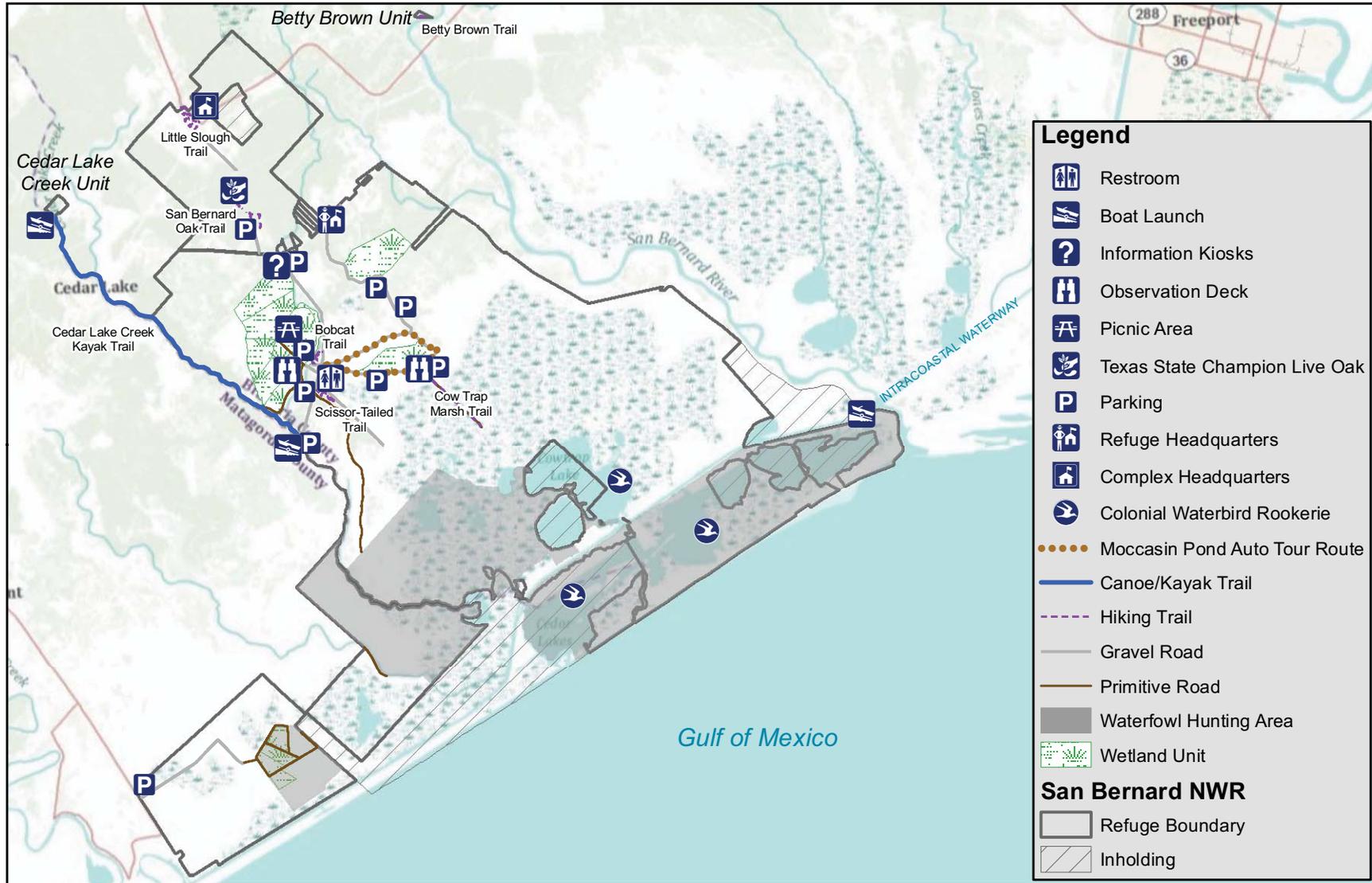


UTM ZONE 15
 NAD 83



U.S. Fish & Wildlife Service
San Bernard National Wildlife Refuge
 Brazoria and Matagorda Counties, Texas

Map 3-31. Public Use



PRODUCED IN THE DIVISION OF REFUGE PLANNING
 ALBUQUERQUE, NEW MEXICO
 LAND STATUS CURRENT TO: 5/31/09
 MAP DATE: May, 2011
 BASEMAP: N/A
 MERIDIAN: N/A
 FILE: snb_public_use_8.5by11_5.20.11_sht



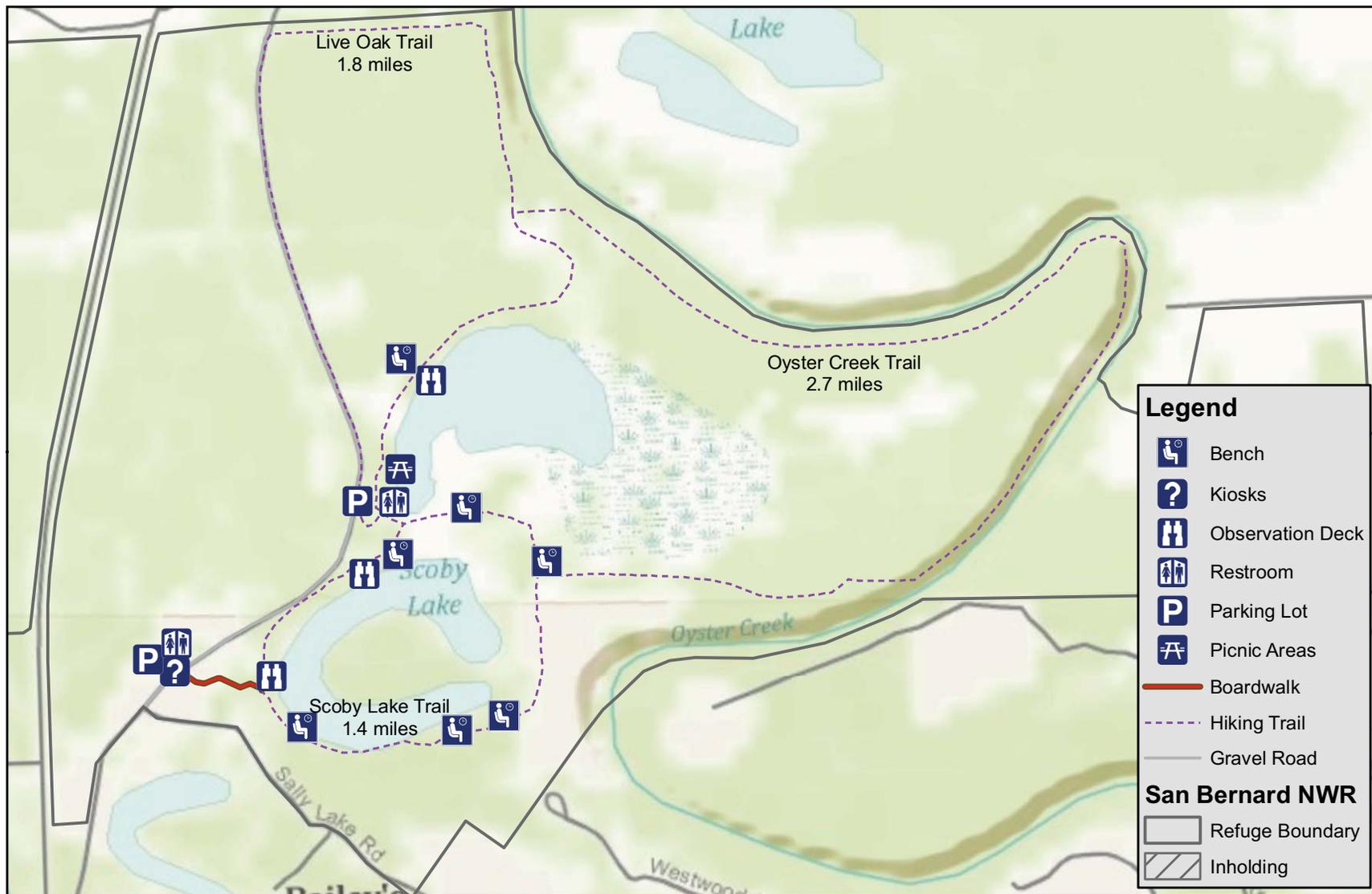


U.S. Fish & Wildlife Service

San Bernard National Wildlife Refuge

Brazoria and Matagorda Counties, Texas

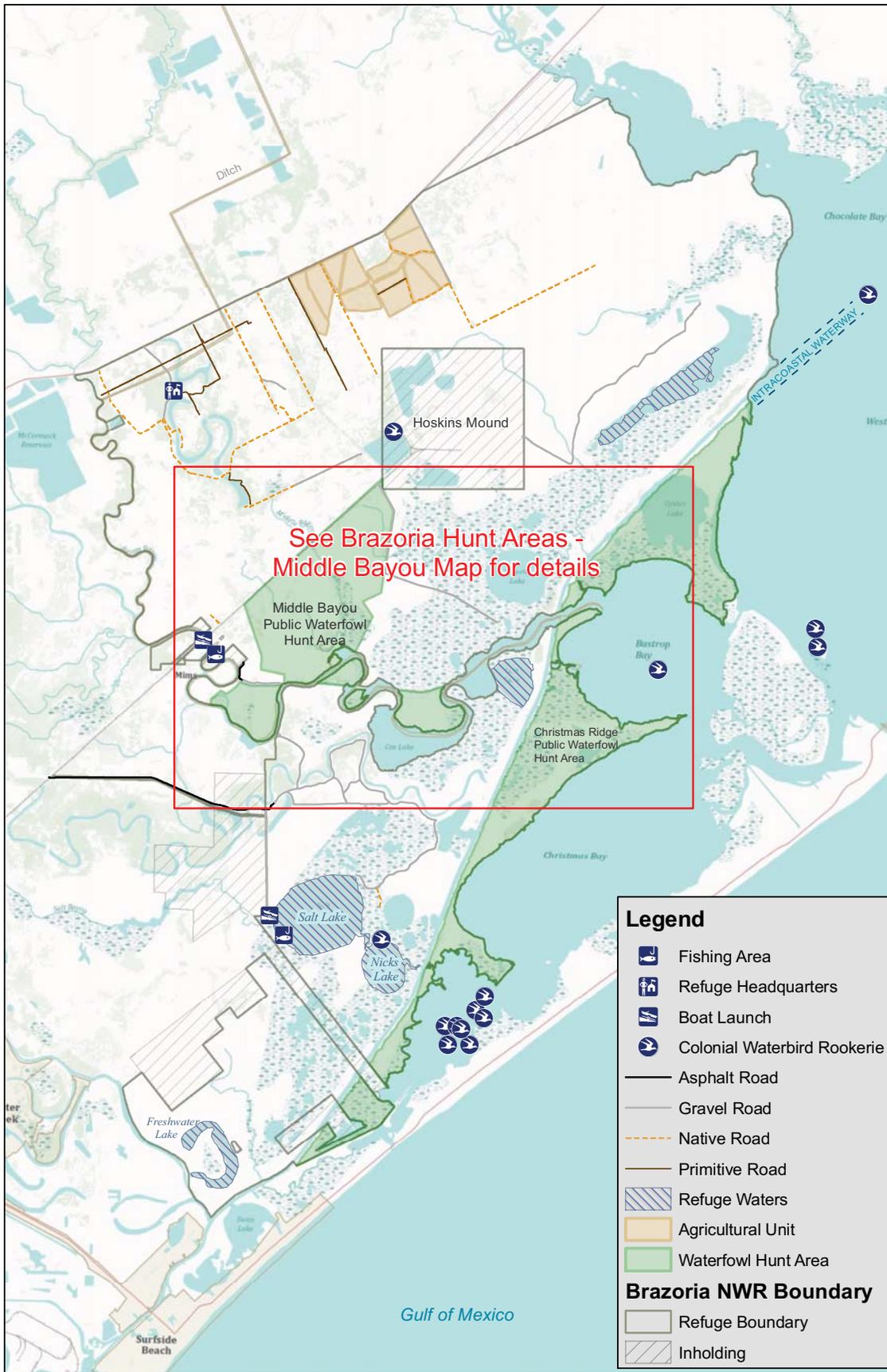
Map 3-32. Public Use - Hudson Woods Unit



PRODUCED IN THE DIVISION OF REFUGE PLANNING
 ALBUQUERQUE, NEW MEXICO
 LAND STATUS CURRENT TO: 5/31/09
 MAP DATE: May, 2011
 BASEMAP: N/A
 MERIDIAN: N/A
 FILE: snb_hudson_wood_pub_use_8.5by11_5.20.11_shl



UTM ZONE 15
 NAD 83



Legend

- Fishing Area
- Refuge Headquarters
- Boat Launch
- Colonial Waterbird Rookerie
- Asphalt Road
- Gravel Road
- Native Road
- Primitive Road
- Refuge Waters
- Agricultural Unit
- Waterfowl Hunt Area

Brazoria NWR Boundary

- Refuge Boundary
- Inholding

PRODUCED IN THE DIVISION OF REFUGE PLANNING
 ALBUQUERQUE, NEW MEXICO
 LAND STATUS CURRENT TO: 5/31/09
 MAP DATE: May, 2011
 BASEMAP: N/A
 MERIDIAN: N/A
 FILE: brz_hunt_5.24.11_shl





U.S. Fish & Wildlife Service

Brazoria National Wildlife Refuge

Brazoria County, Texas

Map 3-34. Hunt Areas - Middle Bayou



Legend

- Discovery Center
- Hunting Trail Access
- Fishing Area
- Parking
- Boat Launch
- Fishing Pier
- Colonial Waterbird Rookerie
- Trail
- Refuge Waters
- Waterfowl Hunt Area

Refuge Roads

- Asphalt
- Gravel
- Primitive

Brazoria NWR Boundary

- Inholding
- Refuge Boundary

PRODUCED IN THE DIVISION OF REFUGE PLANNING
 ALBUQUERQUE, NEW MEXICO
 LAND STATUS CURRENT TO: 5/31/09
 MAP DATE: May, 2011
 BASEMAP: N/A
 MERIDIAN: N/A
 FILE: brz_middlebayou_hunt_5.24.11_sht



UTM ZONE 15
NAD 83



U.S. Fish & Wildlife Service

San Bernard National Wildlife Refuge

Brazoria and Matagorda Counties, Texas

Map 3-35. Hunt Areas



PRODUCED IN THE DIVISION OF REFUGE PLANNING
 ALBUQUERQUE, NEW MEXICO
 LAND STATUS CURRENT TO: 5/31/09
 MAP DATE: May, 2011
 BASEMAP: N/A
 MERIDIAN: N/A
 FILE: snb_hunt_524.11_sfl



UTM ZONE 15
 NAD 83

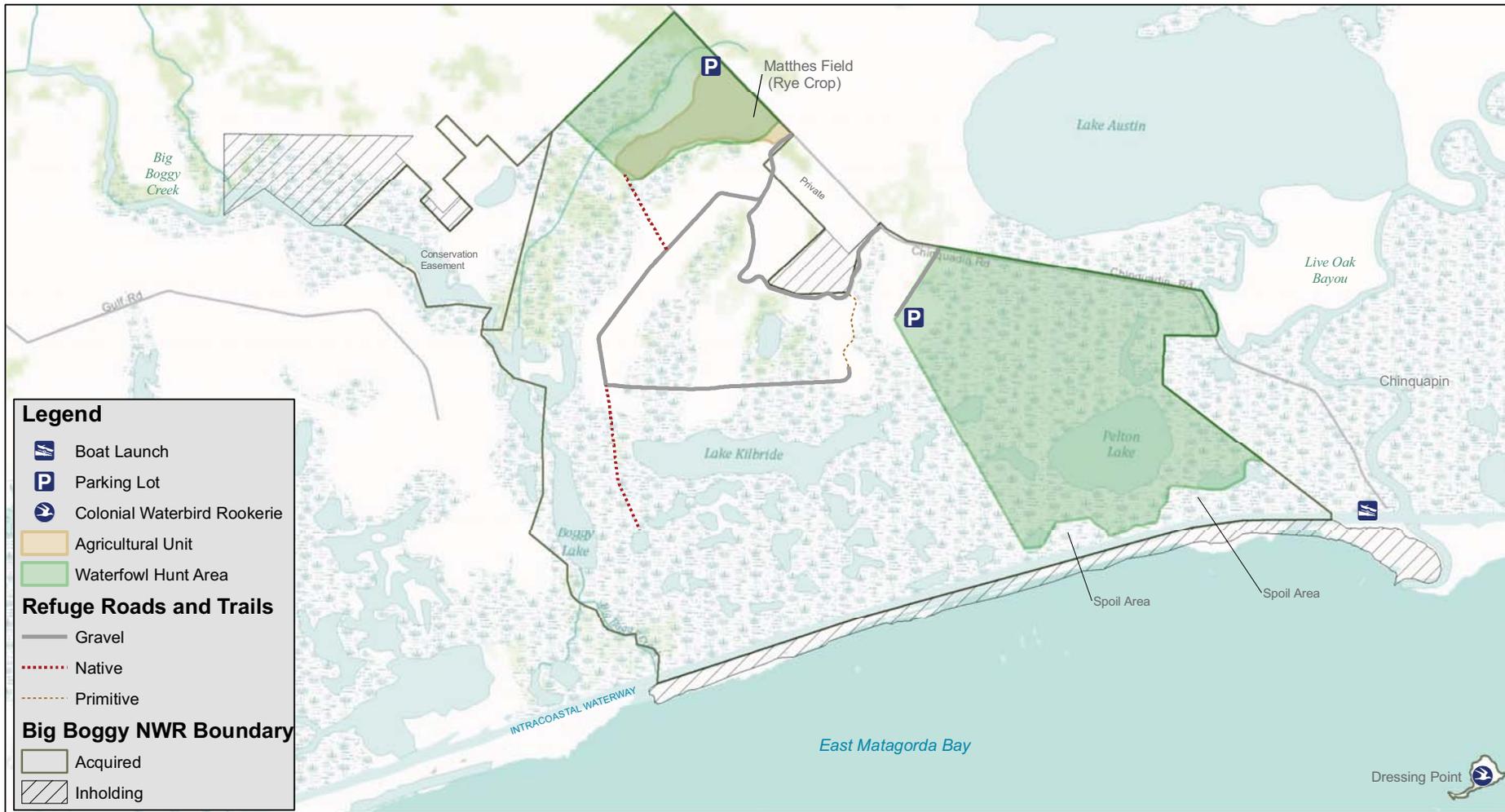


U.S. Fish & Wildlife Service

Big Boggy National Wildlife Refuge

Matagorda County, Texas

Map 3-36. Hunt Areas



Legend

- Boat Launch
- Parking Lot
- Colonial Waterbird Rookerie
- Agricultural Unit
- Waterfowl Hunt Area

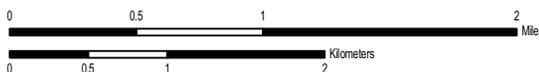
Refuge Roads and Trails

- Gravel
- Native
- Primitive

Big Boggy NWR Boundary

- Acquired
- Inholding

PRODUCED IN THE DIVISION OF REFUGE PLANNING
 ALBUQUERQUE, NEW MEXICO
 LAND STATUS CURRENT TO: 5/31/09
 MAP DATE: May, 2011
 BASEMAP: N/A
 MERIDIAN: N/A
 FILE: bbg_hunt_5.24.11.shl



UTM ZONE 15
NAD 83

Fishing

The Complex offers exceptional recreational fishing and crabbing opportunities in a saltwater environment. Due to increasing populations in the Houston Metropolitan Area, the Complex expects demand for fishing opportunities to increase over the life of the CCP.

Forty percent of the visitation on the Complex is for salt-water fishing where anglers can saltwater fish on refuge waters throughout the year. Anglers are treated to some of the best fishing for redfish, spotted sea trout, black drum, sheepshead, and flounder in Texas. Refuge law enforcement officers have stepped up patrol to prevent littering and illegal taking of fish, while educational efforts such as visitor contacts and kiosks have been increased to encourage anglers to collect and discard excess and old fishing line, hooks, and sinkers, since wildlife are known to die after ingesting this debris.

Brazoria NWR

The refuge has three public fishing areas that allow land access to salt-water fishing. Bastrop Bayou Public Fishing Area is accessible and offers a 200-foot pier with fish attracting lights, five paved bank fishing pull-offs, an accessible toilet, paved parking, and night-lights. This area is open 24 hours a day; however, the refuge does not permit overnight camping.

Excellent crabbing is also available from the pier. The Clay Banks Public Fishing Area offers bank fishing along a one-mile segment of Bastrop Bayou and is open daily from sunrise to sunset. The Salt Lake Fishing Area offers bank fishing and a non-motorized boat ramp and is open daily from sunrise to sunset. The Complex permits canoes, kayaks, and boats on Nicks, Salt, and Lost Lakes and two county boat ramps are available. One boat ramp is located on the west bank of Bastrop Bayou, off CR 227, and another ramp is located off CR 257 on the refuge's southwestern boundary.

San Bernard NWR

Public fishing is allowed in two areas. The Cedar Lake Public Fishing Area offers an accessible fishing pier, a fishing trail that offers bank fishing, and a public boat ramp that gives visitors access to Cedar Lake Creek. The San Bernard Beach is open for surf fishing. The Complex permits canoes, kayaks, and boats on Cedar and Cow Trap Lakes, and on Cedar Lake Creek. Saltwater fishing and crabbing are allowed in designated areas in accordance with applicable state and federal regulations. The refuge plans a second canoe/kayak launch north of CR 318 on Cedar Lake Creek.

Big Boggy NWR

Public fishing is limited to navigable waters of Boggy Creek and Lake and the portion of the refuge bordering the GIWW.

Wildlife Observation

The Complex strives to provide safe, enjoyable, high quality, and accessible wildlife observation opportunities while promoting visitor understanding for America's natural resources. Almost half of all visitors hike a trail, drive the auto tour, or spend a few moments at a wildlife overlook. The Complex provides a wide range of wildlife observation opportunities, supporting a rapidly growing nature tourism industry in Texas.

Bird watching continues to be the most popular form of wildlife observation. Most people prefer to visit during the cooler months of November through March when large concentrations of waterfowl are present. The spring and fall bird migrations are also popular for viewing neo-tropical songbirds. There are many interesting resident bird species here in the summer such as the roseate spoonbill, but the extremely hot and muggy weather deters many people. The refuges are known for their easily observed population of alligators. This one species brings more visitors to the Complex than any other. Mammals such as raccoons, armadillos, coyotes, and bobcats are observed on a fairly regular basis. Butterfly, dragonfly, and wildflower identification is starting to become popular with visitors.

Brazoria NWR

Brazoria NWR offers a 7.5-mile gravel auto tour loop through the Big Slough Recreation Area, wrapping around Olney and Teal ponds, and accessing Big Slough and Rogers Pond. The tour loop includes boardwalks, observation platforms, vehicle pullouts, trails, and butterfly gardens for wildlife observation. The three-mile, paved entrance road from County Rd. 227 (which passes through private lands) also provides wildlife viewing. The auto-tour is open daily from sunrise to sunset accommodating vehicle and bicycle traffic.

Several viewing areas outside the Big Slough Public Use Area are available to the public. The Middle Bayou trail allows visitors to hike or bike along a two-mile trail that follows the abandoned Missouri Pacific Railway line. The elevated trail starts at the Bastrop Bayou Public Fishing Area and offers views across the rare bluestem coastal prairie. Mottled Duck Marsh, off CR 208 on the refuge's northern edge, rewards visitors on the lookout for views of waterfowl, wading birds, and shorebirds. The farm fields along CR 227 and FM 2004 offers wildlife-viewing opportunities from the public roadway.

San Bernard NWR

San Bernard NWR offers wildlife observation and hiking at several locations, which are open from sunrise to sunset. The San Bernard NWR auto tour and Moccasin Pond auto tour loop provide 9.4 miles of gravel roads with observation platforms, vehicle pull-offs, trails, boardwalks, and a butterfly garden. The Cocklebur Slough Road provides opportunities to see wading birds, raptors, and passerines, as well as resident wildlife, in a light forest and grassland habitat. Moccasin Pond loop is at the edge where the salty prairie meets the high marsh. From the loop road, a variety of fresh and saltwater, marsh and grassland habitats support an array of migratory and resident wildlife. Bicyclists are welcome on all refuge roads that are open to public vehicles. The San Bernard Oak trail, which is located .5 mile north of the public use area, provides a .6 mile trail through a mature bottomland hardwood forest to the largest live oak in Texas. The trail crosses a slough before reaching the tree, which provides excellent opportunity for viewing wildlife including wood ducks, reptiles, and songbirds.

Hudson Woods, located five miles west of Angleton, on SH 521 provides 5.9 miles of walking trails in early and mid-succession stage bottomland hardwood forest. Walking the trails provides excellent opportunities for viewing winter and migratory songbirds. Two oxbow lakes provide opportunities for viewing waterbirds including anhinga, waterfowl, and

egrets. An observation deck at Scoby Lake and the deck on the front of the Discovery Outpost provide excellent opportunities to view wetland wildlife species.

Betty Brown, the smallest unit on the refuge, has a 3/8 mile loop trail that takes visitors to the shore of the San Bernard River. This mature-growth forest provides excellent opportunities to see migratory songbirds as they move inland from the Gulf of Mexico.

Dow Woods is the most recent bottomland hardwood forest unit opened to the public for wildlife observation opportunities. The unit is located on the north side of the City of Lake Jackson. Currently, 2.8 miles of trail are available for wildlife observation through a recently protected forest that is being allowed to develop into an old growth forest and along the shore of Bastrop Bayou. Native wildlife, including deer, armadillos, and raccoons, are commonly seen along with migratory songbirds, woodpeckers, and owls.

Big Boggy NWR

Big Boggy NWR only provides wildlife observation opportunities from the county road. Matthes Field and Wetland provide opportunities for viewing winter waterfowl.

Wildlife Photography

The Complex provides opportunities for wildlife photography in conjunction with wildlife observation. Photographing wildlife in a natural or managed environment fosters a connection between visitors and natural resources. A photo contest in conjunction with the annual spring Migration Celebration has attracted many new photographers to the Complex. The Complex provides local, regional, national, and international visitors with a wide range of photography opportunities, supporting a rapidly growing nature tourism industry in Texas.

Brazoria NWR

At Brazoria NWR a nature photography activity has been added to the DEEP. The DEEP educational program helps children develop an interest in the natural world at a young age. The Friends Group funded cameras for structured and unstructured exploration of nature. Interpretive programs also use these cameras.

San Bernard NWR

The San Bernard NWR has a photo blind at the Hudson Woods Unit. This blind has enhanced the visitor's opportunity for a quality wildlife experience and limits wildlife disturbance with a protected walkway and blind.

Environmental Education

The environmental education program provides safe, accessible, and high quality opportunities for both children and adults to learn about the refuge and habitats of the Texas Gulf Coast. Educational programs improve the quality of the visitor's experience and provide them with a better understanding of the benefits, issues, and challenges of natural resource conservation in the coastal ecosystem. The programs meet local and State of Texas education standards, allowing professional development for teachers, provides community-based service organization programs, meets youth group merit badge requirements, and instills a sense of stewardship and understanding of conservation issues.

Education programs typically involve groups of students of varying ages participating in on-site activities led by teachers or docents about the geological, biological, or ecological importance. This program could potentially serve up to 7 additional school districts, with limited expansion dependent upon the number of available docents as well as the carrying capacity of the environment. In addition to the activities of the docents, the Friends has a fundraising campaign to direct the generosity of individuals, corporations, and foundations that wish to participate in this program. The Friends Group has made use of grants to provide the equipment and supplies required for a high quality field experience. These include seines and other nets to collect specimens, testing equipment to study water chemistry, stereomicroscopes, a video microscope projector, and binoculars, as well as high quality displays and an aquarium.

Students are naturally curious and enjoy being outdoors, and this program taps into their enthusiasm and directs it into a science learning experience. Texas Department of Education mandates that a significant percentage of science education be in the form of lab and field investigations. This program makes a perfect fit. The experience provided at the Discovery Center influence the lives of students, and helps them appreciate the gift of living on the Texas Gulf Coast.

In 2011, the Complex initiated the Refuge Junior Naturalist Program. This program takes 15-18 youth in the 5th and 6th grade and provides them a variety of opportunities to not only learn but participate in refuge activities. The youth are welcomed in to the program at the beginning of the summer and then have the opportunity to participate in 14 different programs over the next seven months. These programs including learning how to excavate sea turtle nests, band birds, identify and treat invasive species, produce a video interpretive trail stop and capture and band raptors. The youth will maintain a nature journal during the program and complete two projects.

Brazoria NWR

The Discovery Center at Brazoria NWR has been in service since 2005, serving as a meeting site for refuge staff and the Friends Group, as well as a visitor contact station. However, its primary function has been as the focus for the Complex's active environmental education program. The Discovery Center has received high praise from visitors and the classroom/lab, outfitted with stereomicroscopes and a video microscope projector, has become a highlight for visiting students and adults. During the fall and spring, visitors may encounter groups of students as they learn about the natural world.

DEEP has been functioning on the refuge since 1994. DEEP currently serves approximately 3,000 students and in future years may expand to 6,000 students as the population of the area increases. The expansion of this program and the increasing number of students served may necessitate the use of additional areas. While there are small numbers of organisms, like aquatic insects, that the program temporarily removes from the habitat for observation, they return these organisms and students are taught the ethic of leaving the refuge in an undisturbed state, including prohibitions on picking wildflowers or removal of bird feathers.

DEEP teaches students the importance of good wildlife observation techniques, including moving slowly and quietly to produce the least possible disruption to the environment. At some sites, students have been involved with habitat restoration.

A partnership exists between the Friends Group and area school districts to help with the financial impacts of the program expansion. The Complex has a Memorandum of Understanding (MOU) with the Brazosport Independent School District for this program and expects additional MOUs with other school districts. To help accommodate increases in demand for the program, workshops will be available to train teachers to lead their students through a high quality outdoor experience.



Students learn about freshwater ecosystems and the invertebrates they support through hands-on learning. Photo Credit: USFWS

San Bernard NWR

DEEP has been functioning at the San Bernard NWR since 2003. DEEP currently serves approximately 500 students, and in future years, may expand to 1,000 students as the population of the area increases. The expansion of this program and the increasing number of students served may necessitate the use of additional areas. Activities occur primarily at the Hudson Woods Unit, making use of a small building (Discovery Outpost), the entrance road, and various trails. The involved habitats are bottomland hardwood forest and freshwater marsh.

Interpretation

The refuge communicates fish, wildlife, habitat, and other resource issues to visitors of all ages and abilities through effective interpretation. The refuge tailors messages and delivery methods to specific audiences and presents them at the Discovery Center and other locations. Interpretation enhances opportunities for a quality visitor experience. It also promotes visitor understanding for America's natural resources by providing safe, enjoyable, and accessible interpretive opportunities. Interpretation at the Complex provide opportunities for visitors to make their own connection with the resource through talks, publications, brochures, fact sheets, species lists, signs, interpretive panels, and exhibits. Exhibits are easy to read, understand, and are accessible. They contain audio and tactile elements that can benefit everyone through multiple paths to learning.

The Complex has recently upgraded interpretive materials including fact sheets, brochures, wayside exhibits, and trail signs.

Brazoria NWR

Brazoria NWR has a self-guided auto tour CD. Interpretive services include Discovery Center programs, group presentations, guided talks and tours, and special events. Open houses are used to provide unique educational opportunities to families, groups, and individuals. Activities include live reptile displays, animal track casting, seining for aquatic insects, and viewing the micro world. Hunting and fishing information kiosks are located at Bastrop Bayou Fishing Area.

The Big Slough Trail has a corresponding interpretive trail guide. Teal Pond observation platform has three interpretive panels providing information on migratory waterfowl. The information pavilion near the Discovery Center has four interpretive panels on recreational opportunities and wildlife specific information and identification.

San Bernard NWR

San Bernard NWR has five interpretive kiosks located at Bobcat Woods, Auto Loop entrance, San Bernard Oak Trail, Hudson Woods, and Dow Woods. Hunting and fishing information kiosks are located at Cedar Lake Creek, Sargent Unit, and Big Boggy NWR. San Bernard Oak trail has a corresponding interpretive guide and trail brochure. Bobcat Woods, Hudson Woods, and Dow Woods units have interpretive panels along each trail. Cedar Lake Creek Paddling Trail has an interpretive trail guide. San Bernard Office and screened shelter provide interpretive panels to welcome and orient visitors and introduce them to refuge resources.

3.6.4.2 Other Recreational Opportunities

Outreach

Outreach efforts consist of staff and volunteers participating in many community activities throughout the area. The Complex provides programs on a per-request basis to schools and local conservation and civic groups. Refuge staff attend Chamber of Commerce meetings and serve on conservation committees. The refuge staff and Friends members manned a Complex exhibit at the Brazos Bend State Park Earth Day Celebration in the summer of 2011 for about 2,800 people. The Friends Group manned an exhibit at the Feather Fest in Galveston, seen by 400 people. In addition, the Friends Group presented the Birds of Prey program at local schools to over 10,000 students and teachers. In the summer of 2011, refuge volunteers and staff presented reptile programs for the county library system for approximately 650 people. In past years, the refuge staff manned a booth at the Texas Expo in Austin, and participated in Coastal Expo in Freeport and other outreach events.

Picnicking

Picnic tables are available at multiple locations across the Complex for refuge visitor use in conjunction with other wildlife-oriented public use opportunities. Organized group picnicking, events, or parties are prohibited.

Bicycling

The Complex allows bicycling along all tour roads, Dow Woods Trails, and Middle Bayou Trail.

Canoeing/Kayaking

The Complex allows canoeing and kayaking on all navigable waters and in Salt Lake.

Special Events

The Friends Group host the Migration Celebration (speakers, seminars, trade show, field trips, and other activities) at San Bernard NWR. The event occurs in April each year. Over 1,000 visitors regularly participate in the annual event.

Cooperative Programs

The objective for community outreach and partnerships is to promote conservation of natural resources by working effectively with partners in support of the Services management programs on the Complex, including habitat management and restoration, fish and wildlife population management, and providing public recreational and educational opportunities. The Complex has a partnership with the Friends Group and Brazosport Independent School District.

3.6.4.3 Public Use Areas

The following public use areas are available on the Complex:

- Cedar Lakes Public Hunting Area, 2,400 acres.
- Smith Marsh/Salt Bayou Public Waterfowl Hunting Area, 5,000-acres.
- Sargent Permit Waterfowl Hunting Area, 2,900 acres.
- Middle Bayou Public Waterfowl Hunting Area, 3,300-acres.
- Christmas Point Public Waterfowl Hunting Area, 4,600 acres.
- Big Boggy NWR Public Hunting Areas
- San Bernard NWR Public Use Areas. An expansion of public uses in Hudson Woods occurred in October 2004 and Dow Woods in 2010.
- Brazoria Public Use Area; originally opened only one weekend a month, public use opportunities were expanded to daily use in 1993.
- San Bernard NWR Beach, between Cedar Lakes Cut and the San Bernard River is open for fishing, wildlife observation, and beach combing. In order to protect sensitive habitat and wildlife, the beach is closed to motorized vehicles above high tide. Boats can anchor on the refuge at the San Bernard River and Cedar Lakes to access the beach.

3.6.4.4 Public Use Access***Roads*****Brazoria NWR**

Big Slough Entrance road is a three-mile asphalt surfaced road that starts at CR 227 and ends at the Discovery Center parking lot (daily public use). Big Slough tour loop consists of 7.5 miles of limestone roads that begin and end at the Discovery Center parking lot (daily public use). Salt Lake road consists of 1.5 miles of limestone gravel that begins at the Discovery Center and ends at Salt Lake fishing area (daily public use). Otter Slough road is a one-mile

limestone road that starts at FM 2004 and ends at the Refuge Headquarters (public use during office hours). Clay Banks road is a one-quarter mile asphalt and three-quarter mile limestone road that starts at CR 476 and ends at turn around point (daily public use). Bastrop Bayou public fishing pier has a 4,000 square foot asphalt parking lot with five additional asphalt pull-offs and is located off CR 476 (24-hour public use). The refuge maintains and owns the roads described above, which are used by the public.

San Bernard NWR

Cocklebur Slough Entrance Road is a three-mile gravel road welcoming visitors from County Road 306, and leading them to the refuge’s public use area and associated facilities. Off of Cocklebur Slough Road, Moccasin Pond Loop is a 3.8-mile gravel road that guides visitors around and through some of the best wildlife viewing opportunities on the refuge. The gravel, 2.5-mile Rail Pond Road is a one-way exit from the Moccasin Pond Loop. An abandoned county road traverses Hudson Woods (east of SH521). Although generally closed to vehicle access beyond the parking lot, the road provides access to the Discovery Outpost during special events. Sargent Road provides hunters access to the Sargent Permit Waterfowl Hunting Area. A short .8-mile road provides visitors to the San Bernard Oak Trail Head. Hunters can access the gate entering this road by registering with the San Bernard NWR Office. The Complex keeps all remaining roads on the core refuge and on bottomland hardwood forest units are closed to the public.

Table 3-11. Refuge Roads Information

Big Slough Entrance Road	3 miles	Paved
Big Slough AutoTour Loop	7.5 miles	Limestone
Otter Slough Road	1 mile	Limestone
Clay Banks	1.5 miles	Paved/limestone
Salt Lake Road	1.5 miles	Gravel
Cocklebur Slough	3 miles	Gravel
Moccasin Pond Loop	3.8 miles	Gravel
Rail Pond Road	2.5 miles	Gravel
Hudson Woods	1.3 miles	Gravel
Sargent	3.0 miles	Gravel
San Bernard Oak	.8 miles	Gravel
Hunter Access Road	0.3 mile	Gravel
Remaining Refuge Roads	6.2 miles	Gravel/shell/unimproved

Big Boggy NWR

Big Boggy NWR has one road seasonally opened to the public. The Hunter Access Road is a 0.3-mile gravel road providing walk-in access to the Pelton Lake Hunt Area. The remaining refuge roads, 6.2 miles, are a mix of gravel, shell, and unimproved service roads used for management purposes.

Trails

San Bernard NWR

San Bernard NWR has a total of twelve hiking trails and one paddling trail. Bobcat Woods Trail (1.5 miles) offers an accessible boardwalk winding through shady woods along Cocklebur Slough. A hot spot for spring migrant birds, the trees also shelter year-round residents like barred owls. The boardwalk leads to an accessible platform that overlooks the reservoir and moist-soil units of the Wolfweed Wetland Project. At the trailhead are restrooms, interpretive displays, tables, and a demonstration native garden for hummingbirds and butterflies.

Other trails along the San Bernard Auto Tour include the Cowtrap Marsh Trail, which provides an opportunity to hike from the high marsh through intermediate to low marsh habitat along a 1.5-mile long man-made levee. The trail crosses a huge marsh and prairie dotted with small potholes. Scissor-tail Trail (0.8 miles) provides an opportunity to stroll through a brush habitat that attracts numerous passerines. The Cedar Lake Creek Trail is a .20-mile trail following the creek for fishing or hiking opportunities. The 8-mile Cedar Lake Creek Paddling Trail starts at the boat ramp and goes up the creek through the shady bottomland hardwood forests. The terrain along the creek is flat, with fast water only after a hard rain. The Complex developed a trail guide brochure with 10 interpretive stops for the paddling trail.

Refuge trails in the bottomland hardwood forest units include: the .45-mile Little Slough Trail, which is next to the Complex office. The Betty Brown Trail is a .36-mile trail that passes through the bottomland hardwood forest, crosses a slough, and meanders to an overlook point on the San Bernard River. At San Bernard Oak Trail, visitors will experience the natural beauty of the wetlands and bottomland forests along this 0.7-mile trail. The Hudson Woods Unit has three hiking trails. Scoby Lake Trail is a 1.4 miles long loop, circles Scoby Lake. An accessible 800-foot boardwalk begins at the parking lot and winds through the woods to Scoby Lake with a small observation deck on the lake. The Live Oak Trail, 1.8 miles long, circles the north end of the property and follows Oyster Creek. The Oyster Creek Trail is a 2.7-mile trail following Oyster Creek.

Dow Woods includes Tveten trail, a 0.9-mile concrete loop, and Bayou Loop (1.9 miles) gravel trail.

Brazoria NWR

The Big Slough Boardwalk and Trail crosses over, and along the edges of a major slough. The gravel trail meanders through low forests of yaupon and hackberry trees and small clearings to an observation platform. The main loop is 0.6 mile long; other loops run 0.1, 0.25, and 0.5 miles. The trail begins and ends at the visitor Information Pavilion.

The .58-mile Cox Lake grass trail starts at Big Slough and meanders through salt cedars to the Maddox monument. This monument is the 1890 home site of Koger Thomas Maddox. From here, the trail wander over a salt grass prairie to Cox Lake then follows cedars back to the parking lot.

At the Middle Bayou Trail visitors can hike or bike along a two-mile gravel trail that follows the abandoned Missouri Pacific Railway line. The elevated trail starts and ends at the Bastrop Bayou Public Fishing Area.

Table 3-12. Summary of Refuge Trail Information

Big Slough	0.6 miles with additional loops	Boardwalk/Grass
Cox Lake	0.58 miles	Limestone
Middle Bayou	2 miles	Gravel
Clay Banks	1.5 miles	Paved/limestone
Bobcat Woods	1.5 miles	Boardwalk
Cowtrap Marsh	1.5 miles	Man-made levee
Scissor-tail	0.8 miles	Grass
Cedar Lake Creek	0.2 miles	Dirt
Cedar Lake Creek	8 miles	Water
Paddling Trail		
Little Slough	0.45 miles	Dirt
Betty Brown	0.36 miles	Dirt
San Bernard Oak	0.7 miles	Dirt
Scoby Lake	1.4 mile loop	800 Ft Boardwalk/Grass
Live Oak	1.8 miles	Dirt
Oyster Creek	2.7 miles	Dirt
Tveten Trail	0.9 miles	Concrete Loop
Bayou Loop Trail	1.8 miles	Crushed granite
No Trails on Big Boggy		

Waterways

Brazoria NWR

Public waterways surrounding the refuge include Basrop Bayou, Austin Bayou, GIWW, Chocolate Bay, West Galveston Bay, Bastrop Bay, Christmas Bay, Drum Bay, and Oyster Creek. Public waterways within the refuge boundary include Salt Lake, Nicks Lake, Cox Lake, Lost Lake, Alligator Lake, Oyster Lake, Essex Bayou, and Middle Bayou. Non-motorized boat launches exist at Salt Lake and Clay Banks fishing areas.

San Bernard NWR

Units of the San Bernard NWR adjoin the San Bernard River, Brazos River, GIWW, Cedar Lake Creek, Bastrop Bayou, Oyster Creek, and Linville Bayou, which are all public

waterways. The Cedar Lakes and Cowtrap Lakes are navigable estuaries within the boundaries of the refuge. In addition, several prominent sloughs, creeks, and wetlands are located within or adjacent to bottomland hardwood forest units. A boat launch is available at Cedar Lake Creek.

Big Boggy NWR

The GIWW and East Matagorda Bay border the refuge on the south and Boggy Creek on the west.

3.6.4.5 Public Use Facilities

Public Use Facilities

Access to the Complex is provided primarily to facilitate the six priority public uses of the Refuge System (hunting, fishing, wildlife observation, photography, and environmental education and interpretation). The Complex allows public access in designated areas and along designated routes of travel (e.g., roads, trails, waterways, and other routes). Designated routes of travel can be public roadways (e.g., state or county roads) and waterways or refuge roads, trails, and waterways. Various funding sources provide the maintenance, improvements, and additions to refuge routes of travel and access, with one of the main sources being the Refuge Roads Program (RRP).

Environmental Education Center

The Discovery Center is approximately 1,500 square feet and includes a visitor contact area, lab, and office. It supports up to 50 students at a time. It consists of interpretive displays and live animal exhibits and dioramas. It contains a large screen television and projection screen for interpretive programs. An open pavilion that overlooks Big Slough is behind the Discovery Center.

Interpretive Signs / Kiosks

The Complex provides 32 interpretive exhibits, 18 trailhead signs, and six orientation wayside exhibits. The Complex primarily uses directional signs, trail and tour loop stops, facility signs, refuge signs, and refuge unit signs constructed of recycled plastic to reduce climatic wear and tear.

Parking/Viewing Locations

Brazoria NWR has seven viewing locations. There are viewing locations at Crosstrails Pond, Teal Pond and Rogers Pond. The Big Slough Recreation Area has a viewing area at the Big Slough Pavilion. There are also viewing areas at Bastrop Bayou



Cedar Lake Creek enables kayakers a great opportunity to view wildlife and natural forested habitats along an inland waterway between two refuge launch areas.

Photo Credit: USFWS

fishing pier and at Salt Lake. Viewing shelters include three at Crosstrails three at Big Slough, and Maddox Monument. San Bernard NWR has eight viewing platforms; Cedar Lake Creek boat ramp, Wolfweed Reservoir, Moccasin Pond, San Bernard Oak Trail, Scoby Lake, two at Bobcat Woods, and one at Dow Woods.

Photography Blinds

The Complex constructed one photography blind at Hudson Woods on the Live Oak Trail.

Visitor Contact Station

An information pavilion is available at Big Slough when the Discovery Center is closed. During business hours, all offices (San Bernard and Brazoria NWRs, and the Complex office) provide visitor information.

Fishing Piers

The Bastrop Bayou Fishing Pier at Brazoria NWR is a 200-foot lighted pier, open 24 hours a day. In addition, five pull-offs are available for fisherman to pull up to the bank of the Bayou. A 20-foot-by-10-foot fishing pier is available at the Cedar Lake Creek boat launch for fishing and wildlife observation.

Restroom Facilities

Self-contained restroom facilities are available at Hudson Woods Cabin, Hudson Woods Parking area, Dow Woods, and Bobcat Woods. Port-a-can facilities are located at Bastrop Bayou and Salt Lake fishing areas and Crosstrails on the Big Slough Tour Loop. Restroom facilities are adjacent to the Discovery Center.

3.6.5 Special Management Areas

This section identifies special management areas designated within the Complex. The “special” status of lands within individual refuges may be recognized by additional designations (i.e., legislative or administrative). Special designations may also occur through the actions of other agencies or organizations. The influence that special designations may have on the management of lands and waters within refuges may vary considerably.

3.6.5.1 Wilderness Areas

The 1964 Wilderness Act (WA) recognized wilderness as a resource in and of itself and established a mechanism for preserving that resource in a national system of lands and waters. The definition of wilderness found in the WA provides a framework for identifying and describing wilderness values. According to the WA, the fundamental qualities of wilderness are: undeveloped, untrammeled, natural, and outstanding opportunities for solitude, or a primitive and unconfined type of recreation. In addition, the WA states that wilderness “may also contain ecological, geological, or other features of scientific, educational, scenic, or historical value.”

There are no designated wilderness areas on the Complex. Refuge planning policy 610 FW 4 requires a Wilderness Review as part of the comprehensive conservation planning process.

After completing the inventory phase of the Wilderness Review, the team determined that the Complex does not have any inventory units that meet the minimum criteria for a Wilderness Study Area. Therefore, the team does not recommend any land areas as designated Wilderness. The Complex's Wilderness Review is provided in Appendix H.

3.6.5.2 Research Natural Areas

The Service recognizes the importance of preserving plant and animal communities in a natural state for research purposes. Research Natural Areas (RNAs) on national wildlife refuges are part of a national network of research areas under various ownerships. This network is the result of a designation system recognized by other federal land administering agencies and the Federal Committee on Ecological Reserves. RNAs are intended to represent the full array of North American ecosystems; biological communities, habitats, and phenomena; and geological and hydrological formation and conditions. RNAs are areas where the Complex allows natural processes to dominate without human intervention. However, under certain circumstances, we use deliberate manipulation to maintain unique features that the RNA was established to protect.

The National Wildlife Refuge System Administration Act of 1966 delegates designation and management of RNAs to the Director of the Service. The Service administers 210 RNAs on refuges nationwide comprising a total of 1,955,762 acres. The Service's Southwest Region administers 27 RNAs totaling 59,940 acres on 14 national wildlife refuges. The Complex contains one RNA, Christmas Point Research Natural Area, totaling 175 acres.

General Management of RNAs

Service policy 8 RM 10.8 states that "RNAs must be reasonably protected from any influence that could alter or disrupt the characteristic phenomena for which the area was established." Activities on RNAs are limited to research, study, observation, monitoring, and educational activities that are non-destructive, non-manipulative, and maintain unmodified conditions. Policy encourages scientific use by scientists and educators, providing their activities do not impair or threaten the features of the areas; the refuge should discontinue public uses that contribute to modification of the areas or expressly prohibit them if such uses threaten serious impairment of research or education values. A natural area management plan should govern use of RNAs by what is compatible with established refuge objectives.

3.6.5.3 Other Special Management Areas

Western Hemisphere Shorebird Reserve Network (WHSRN)

WHSRN is an international strategy for saving shorebirds and their habitats. This strategy follows the simple idea that to sustain healthy populations of shorebirds, we must maintain the ecological integrity of key sites, those specific locations that provide the habitats and nourishment needs for survival (www.whsrn.org).

There are three designations recognized by WHSRN that include:

1. Sites/Landscapes of Hemispheric Proportions—Receives at least 500,00 shorebirds annually or at least 30 percent of a species bio-geographic population
2. Site of International Importance—Receives at least 100,000 shorebirds annually or at least 10 percent of a species bio-geographic population
3. Site of Regional Importance—Receives at least 20,000 shorebirds annually or at least 1 percent of a species bio-geographic population

In order to incorporate an area into one of these three designations, a partner or landowner nominates the area for one of these three categories of designation by the WHSRN hemispheric Council. Additionally, to qualify for a WHSRN designation, the sites landowner(s) must agree to:

1. Make shorebird conservation a priority
2. Protect and manage shorebird habitat
3. Keep WHSRN informed of any changes at the site

The Service recognizes the Complex as a Site of International Importance because it annually supports more than 100,000 shorebirds. The refuges include a myriad of habitat types, including tidal mud flats, shell beaches, fresh, brackish, and salt marshes, impoundments, rice fields, and moist-soil areas. Several thousand acres of both salty prairie and coastal prairie are also present.

The Complex hosts at least 30 shorebird species. Most common winter residents include: American avocet, willet, dunlin, dowitcher spp., long-billed curlew, and western sandpiper. Some piping plovers are always present on the San Bernard NWR Christmas Bird count. During spring migration, lesser yellowlegs, dowitcher spp., dunlins, and semi-palmated and western Sandpipers are most numerous. Stilt, least, and pectoral sandpipers, and black-necked stilts are also present in substantial numbers. Black-necked stilts and willets are most noticeable shorebirds that nest in the Complex; however, a few other species also nest in the area.



The freshwater wetlands, mudflats and beaches support more than 100,000 shorebirds of 30 species annually, giving the Complex a Site of International Importance designation by WHSRN. Photo Credit Dave Sanders

Marine Protected Areas

In 2010, all three refuges received designation as Marine Protected Areas under National Oceanic and Atmospheric Administration. Current efforts to create a Gulf of Mexico MPA

Network will aid in collaboration on issues associated with man-made and natural disasters, climate change, and outreach and education.

3.6.5.4 Concerns Regarding Special Management Areas

Natural and man-made disasters as well as threats from exotic flora and fauna threaten the diversity of the refuges and Special Management Areas. The additional challenges of climate change and the anticipated impacts of SLR also threaten the dynamics of these highly productive shorebird areas. Through multiple collaborative, research, and monitoring efforts, the refuges will need to proactively manage and protect resources.

3.6.6 Land Protection and Acquisition

Land interests are acquired only from willing sellers/donors and are subject to the availability of funding. The presence of a national wildlife refuge would not mean increased regulation of adjacent private land uses. The Service acquires lands and interests in lands, such as easements, and management rights in lands through leases or cooperative agreements, consistent with legislation or other congressional guidelines and executive orders, for the conservation of fish and wildlife and to provide wildlife-dependent public use for recreational and educational purposes. When land is needed to achieve those objectives, the Service seeks to acquire the minimum interest necessary to reach those objectives. If fee title is required, the Service gives full consideration to extended use reservations, exchanges, or other alternatives that will lessen the impact on the owner and the community. Donations of desired lands or interests are accepted. In all fee title acquisition cases, the Service is required by the Uniform Relocation Assistance and Real Property Acquisition Policies Act of 1970 (Public Law 91-646) to offer 100 percent of the property's appraised market value, as set out in an approved appraisal that meets professional standards and federal requirements.

We only propose fee acquisition when adequate land protection is not assured under other ownerships, active land management is required, or we determine the current landowner would be unwilling to sell a partial interest such as a conservation easement. Conservation easements leave the parcel in private ownership, while allowing the Service involvement in land management decisions in a way that enables us to meet our conservation goals, as well as being able to provide some assistance to the landowner with stewardship and management of their lands. Easements are a property right, and typically are perpetual. If a landowner later sells the property, the easement continues as part of the title. The structure of such easements would provide permanent protection of existing wildlife habitats while also allowing habitat management or improvements and access to sensitive habitats, such as for endangered species or migratory birds. These determinations are on a case-by-case basis, and negotiated with each landowner, the extent of the rights we would be interested in buying. Those may vary, depending on the configuration and location of the parcel, the nature of wildlife activities in the immediate vicinity, the needs of the landowner, and other considerations. In general, easement acquisition would maintain the land in its current configuration with no further subdivision or development.

Properties subject to easements generally remain on the tax rolls and taxes are still paid by the landowner. The Service does not pay refuge revenue sharing (i.e., funds the Service pays to counties in lieu of taxes) on easement rights. Easements generally work best when:

- only minimal management of the resource is needed, but there is a desire to ensure the continuation of current undeveloped uses and to prevent fragmentation over the long term;
- a landowner is interested in maintaining ownership of the land, does not want it to be substantially altered, and would like to realize the benefits of selling development rights;
- current land use regulations do not limit the potential for adverse management practices;
- the protection strategy calls for the creation and maintenance of a conservation area that can be accommodated with passive management; or
- only a portion of the parcel contains lands of interest to the Service.

On easement lands the opportunities for wildlife-dependent public uses, partnerships, or scientific research would be at the discretion of the landowner. These uses would be generally only considered on lands owned in fee by the Service.

While land owned by the U.S. Government is not taxable by state or local authorities, the federal government has a program in place to compensate local governments for foregone tax revenues. The Refuge Revenue Sharing Act of June 15, 1935, as amended (16 U.S.C. 715s) requires the Service to make payments to local taxing authorities, typically counties, to offset the loss of local tax revenues as a result of federal acquisition of private property. The Service makes annual payments to local taxing authorities, based on the estimated values of lands that the Service owns located in those jurisdictions. The actual refuge Revenue Sharing payment does vary from year to year because Congress may or may not appropriate sufficient funds to make full payment.

Land Acquisition – San Bernard NWR

Land acquisition activities are very active on San Bernard NWR. Land acquisition efforts focus on bottomland hardwood forests as described in the approved 1997 Austin's Woods Conservation Plan. Under the plan, 10 percent of the historical 700,000-acre bottomland forest habitat that existed at the beginning of the last century would be conserved through a community-based effort. As stated in the 1997 Decision Document, the Service may acquire up to 28,000 acres as its contribution to the effort. At the present time, the Service is approaching the 28,000-acre land base cap. It is estimated that by the end of 2012, approximately 33,000 acres will be conserved through the combined efforts of governmental and non-governmental entities, with approximately 28,000 acres of this total acreage protected as refuge lands. While this is a noteworthy endeavor, it is short of the original 10 percent, or 70,000 acres, goal. This necessitates the Service to continue its land acquisition efforts, if the goal is to be reached. In April 2011, a Preliminary Project Proposal was approved by Acting Service Director Dan Ashe to increase the Service's land base acreage from 28,000 acres to a total of 70,000 acres within the Columbia Bottomlands project area. The Service has prepared an LPP, which is included in Appendix I.

Opportunities continue to exist in working with private landowners and willing sellers within the approved project area. The real estate market for the project area has slowed considerably and there appears to be an increased interest and support from a variety of partners and landowners. The Service has identified numerous tracts of land, from willing sellers, that meet the biological qualifications for acquisition.

Funding for land acquisitions on the Complex come primarily from two sources, the Migratory Bird Conservation Fund (MBCF) and Land and Water Conservation Fund (LWCF). The MBCF derives its funds mainly from the sale of migratory bird hunting stamps, also known as “duck stamps”. The LWCF derives its funds from the sales of offshore mineral leases. These funds are appropriated annually on a project by project basis, with the approval of Congressional budget. Other funding sources used to a lesser extent are donated funds from private sources and matching grants. Table 3-13 lists the tracts acquired under the Austin’s Woods Conservation Plan

Table 3-13. Tracts Acquired Under the Austin’s Woods Conservation Plan through 6/1/2012.

Palm Tract	7-31-96	23	Phillips additions	3-31-05	128.628
Dance Bayou	4-4-97	657	Cameron	10-25-05	86.281
Eagle Easement	7-22-97	137	Cannan	12-6-05	740
Big Pond	3-29-99	2,378.591	Spears (easement)	12-30-05	249.74
McNeill	1-12-01	1,276.421	Munson	4-4-06	196.776
Bird Pond	12-19-01	100	Giese	5-24-06	1806.408
Phillips Petroleum	12-27-01	404	Muhm	9-18-06	10.0
Hudson Woods	8-24-02	1,093	Sturm	5-15-07	50.03
Swaggart I	12-23-02	608.786	Sebok	5-18-07	46.295
Gunn (Palm Tract)	1-24-03	23	Chapman (easement)	12-27-07	48.49
Bludworth	4-28-03	738	Griffith	3-19-08	516.972
Wilson	7-18-03	1,344.902	Theodore Smith	6-4-08	35.941
Swaggart II	4-15-04	101.72	Moore	9-18-08	49.73
Audubon Easement	5-20-04	63.06	Shepherd	10-31-08	94.447
Peterson	7-19-04	95.8	Sudderth	11-25-08	56.439
Parker	8-3-04	203.26	Dow Chemical Co.	12-30-08	329.911
GCBO tract	12-16-04	22.174	McGinnes	5-29-09	766.77
CLT	12-17-04	730.5881	Otto	9-14-09	1,116.284
Stringfellow Trust	1-18-05	933.260	Jenks	11-13-09	330.02
Wisch	9-07-10	119	Roy	12-15-09	36
Buchanan	10-20-10	174	Waterstone (easement)	12-15-11	110
Ted Smith	3-11-11	1.8	Palaez	5-4-11	1,315.334
Burke	6-2-11	56.439	Vickery	9-19-11	47.267
Eagle Nest Lake	2-15-12	4,471.01	Brothers (BRI)	5-4-12	498
TOTAL			24,552		

3.6.7 Cultural Resource Management

Cultural resources (archaeological sites, historic structures, and Native American traditional cultural properties) are important parts of the nation's heritage. The Service strives to preserve evidence of these human occupations, which can provide valuable information regarding not only human interactions with each other, but also with the natural environment. Protection of cultural resources is accomplished in conjunction with the Service's mandate to protect fish, wildlife, and plant resources.

The Service is charged with the responsibility under Section 106 of the National Historic Preservation Act of 1966 (NHPA), of identifying historic properties (cultural resources that are potentially eligible for listing on the National Register of Historic Places) that may be affected by our actions. The Service is also required to coordinate these actions with the State Historic Preservation Office, Native American tribal governments, local governments, and other interested parties. Cultural resource management in the Service is the responsibility of the Regional Director and is not delegated for the Section 106 process when historic properties could be affected by Service undertakings, for issuing archaeological permits, and for Indian tribal involvement.

The Archaeological Resources Protection Act of 1970 (ARPA) Section 14 requires plans to survey lands and a schedule for surveying lands with "the most scientifically valuable archaeological resource." This act also affords protection to all archaeological and historic sites more than 100 years old (not just sites meeting the criteria for the National Register) on Federal land and requires archaeological investigations on Federal land be performed in the public interest by qualified persons.

The Regional Historic Preservation Officer (RHPO) advises the Regional Director about procedures, compliance, and implementation of these and other cultural resource laws. The actual determinations relating to cultural resources are to be made by the RHPO for undertakings on Service fee title lands and for undertakings funded in whole or in part under the direct or indirect jurisdiction of the Service, including those carried out by or on behalf of the Service; those carried out with Federal financial assistance; and those requiring a Federal permit, license or approval.

The responsibility of the refuge manager is to identify undertakings that could affect cultural resources and coordinate the subsequent review process as early as possible with the RHPO and State, tribal, and local officials. Also, the refuge manager assists the RHPO by protecting archaeological sites and historic properties on Service managed and administered lands, by monitoring archaeological investigations by contractors and permittees, and by reporting ARPA violations.

4. Management Direction: Goals, Objectives, and Strategies

The Service manages fish and wildlife habitats considering the needs of all resources in decision-making. The following goals, objectives, and strategies are the Service's response to the issues and concerns expressed by the planning team, the public and our partners; unless otherwise noted in the text, they are expected to be implemented throughout the 15-year term of this CCP. Goals and objectives are the unifying elements of successful refuge management. They identify and focus management priorities, provide a context for resolving issues, guide specific projects, provide rationale for decisions, and offer a defensible link among management actions, refuge purpose(s), Service policy, and the National Wildlife Refuge System mission. Goals define general targets in support of the vision, followed by objectives that direct effort into incremental and measurable steps toward achieving those goals. Finally, strategies identify specific tools or actions to accomplish objectives. The Service organized the goals into five broad categories of ecoregional, habitat, wildlife, visitor services, and facilities.

Even though the objectives and strategies in this Chapter are intended to guide future management, the Service acknowledges that the future remains uncertain. Understanding interactions on the Complex, anticipating effects of changing climate, recognizing that there are gaps in available data, and anticipating changes in funding make future management planning difficult and complex. For this reason, the Complex will use this chapter as a guide to stay on track with its overall goals and with the intent to achieve current objectives; however, the most effective approach to resource management over the long-term is an adaptive one. Adaptive management is a management style in which the effectiveness of management actions is frequently monitored and evaluated, and future management is modified as needed based on the results of this evaluation or other relevant information as it becomes available. The Complex will use adaptive management and implement strategic habitat conservation on a landscape-level throughout the lifetime of this CCP.

4.1 Ecoregional Goal

To implement conservation efforts and foster the ecological integrity of the Gulf Coast Prairies and Marshes Ecoregion (including the Columbia Bottomlands) through proven and innovative restoration, enhancement and management practices across the Complex to preserve essential habitats for migratory birds and resident wildlife.

Objective 1 - Managing Landscapes

To increase knowledge through research and collaboration to evaluate the impacts and trends of accelerated climate change on refuge habitats and wildlife populations including site-specific sea-level rise with corresponding sediment accretion, invasive species and habitat shifts, to implement best management practices to adapt and mitigate the impacts of a changing climate, and the anticipated effects, over the life of the CCP on native flora and fauna.

Rationale:

The Refuge Complex within the Gulf Coast Prairies and Marshes Ecoregion recognizes the critical nature of conserving and managing remaining wildlife and habitat within a fragmented landscape with multiple anthropogenic threats. Regional modeling of how long-term global warming patterns might emerge in the U.S. suggests that future climates along the Texas Gulf Coast could be very different than those of the past. Climate researchers used unique, state-of-the-art, high resolution nested



Eagle Nest Lake , acquired in 2012, is a natural freshwater wetland which will be restored to an emergent marsh. More than 1,000 acres of adjacent pasture and farm fields will be restored to native coastal prairie habitats through control of invasive species and planting. Photo Credit: USFWS

climate simulation models to explore the importance of fine scale processes in determining climate change hotspots in the continental United States and Mexico (Texas Climate Initiative). In addition to sea-level rise, many climate change studies predict changes to tropical storm events, precipitation rates, and temperature levels at rates that can affect habitat conditions and species distributions along the Gulf Coast (USFWS, 2009). In order to accomplish our goals, the Complex must continue to work with partners. Current partners include TPWD, U.S. Army Corps of Engineers, Texas General Land Office, Texas Commission on Environmental Quality, as well as other national wildlife refuges, The Texas Nature Conservancy, Houston Audubon, Texas RICE, The Conservation Fund, Trust for Public Land, Houston Wilderness, Houston Regional Group of the Sierra Club, other Marine Protected Areas, and Scenic Galveston.

Strategies:

1. Participate in the Mid-coast Initiative of the Gulf Coast Joint Venture, bringing project proposals and success stories to share.
2. Monitor sea level rise and accretion of sediments in the coastal marshes to further evaluate impact of rising sea-level in Mid-coast marshes.
3. Map freshwater resources on an annual basis.
4. Monitor native and non-native species range shift (i.e., black mangrove in estuaries) to compensate for changes in floristic composition.
5. Exercise best management practices based on results of monitoring sea level rise, fresh water shifts, and species range shifts.
6. Continue to partner with state and federal agencies as well as nonprofit organizations and private land owners to share biological information including species trends, habitat management techniques, and land conservation strategies.
7. Support research from partners that would contribute to scientific information benefiting the ecoregion.

8. Support land conservation efforts of partners through coordination of opportunities and resources.
9. Assist sister agencies and organizations with the implementation of prescribed fire to benefit native habitats through established agreements.
10. Within three years, initiate modeling of the Columbia Bottomlands in response to a changing climate.

Objective 2 - Conservation of Columbia Bottomlands Ecosystem

Conserve approximately 1,000-2,500 acres annually through Service acquisition authorities, while working with partners to conserve an overall minimum of 10 percent of the historic Columbia Bottomlands forest.

Rationale:

The Columbia Bottomlands is a unique forested hardwood species ecosystem within the Gulf Cost Prairies and Marshes Ecoregion which extends to within 4 miles of the Gulf of Mexico. This ecosystem, recognized for its importance for migratory songbirds, is threatened by agricultural and commercial development and encroachment of invasive species. Plant and animal diversity is tied to topography, differences in soil, hydrology, and succession stages across the larger landscape. Thereby conservation of tracts spread across the historic ecosystem is required to ensure diversity and functionality of this already fragmented forest is maintained.

The bottomland forests are critical for migratory songbirds and native wildlife (Barrow, W. et.al. 2000). The bottomland forests store large amounts of carbon in their foliage, roots and soil (195.7 tons of carbon/hectare average total found on Dance Bayou Unit), and offers opportunities for carbon-offsets with local industry (Delaney, M. et. al. 2002). Natural bottomland forests buffer flooding related to heavy rainfall common on the Texas coast, protecting human communities.

Strategies:

1. Acquire fee title from will sellers of high priority lands as outlined in the LPP through the use of Migratory Bird Conservation Funds, Land and Water Conservation Funds, grant funding, mitigation for loss of natural habitats and/or wildlife, and donation.
2. Acquire conservation easements on high priority lands as outlined in the LP through donation, grants, and mitigation opportunities
3. Work with partner agencies and organizations to conserve, protect and manage Columbia Bottomlands to promote the integrity of the ecosystem.

4.2 Habitat Management Goal

To conserve, restore, enhance, and protect refuge habitats by implementing appropriate management programs to benefit native flora and fauna, including threatened and endangered species and other species of concern.

Objective 1 – Bottomland Hardwood Forests

Manage all bottomland forests to promote natural succession toward old growth stages (80+ year old forest) which increases diversity and reduces the impacts of catastrophic events, including; droughts, wildfire, invasive species and flooding and high winds on species diversity and populations.

Rationale :

Agricultural, commercial development, and the encroachment of invasive species continually threaten the Columbia Bottomlands, a regionally limited ecosystem. Plant and animal diversity is tied to topography, differences in soil, hydrology, and



Linville Bayou unit is a naturally aging bottomland forest providing maximum benefit to resident and migratory wildlife. Photo Credit: USFWS

successional stages across the larger ecosystem rather than to individual tracts. Therefore, conservation of tracts spread across the ecosystem is preferred rather than one large unit.

The 649-acre Dance Bayou Unit is a structured, diverse, and well-functioning representative of what the Complex is striving to achieve in managing toward old growth bottomland hardwood forests. An inventory conducted from 2002 to 2005 on the Dance Bayou Unit produced 356 species of trees and shrubs, vines, grasses, and herbaceous plants (Rosen, D.; Miller M., 2005). The Dance Bayou Unit also self-manages hardwoods 100-plus years old, characterized by frequent tree falls followed by gap succession, large vines, and abundant epiphytic growth. This is the type of understory, mid-story, and canopy diversity the Complex is striving to achieve on all larger tracts. The Complex also manages smaller hardwood tracts, although limited by size, toward an older stage forest, but may not have the luxury of such species diversity although management will still strive to achieve a multi-layer diverse older forest.

The bottomland forests are critical for migratory songbirds and native wildlife (Barrow, W. et. al. 2000). The bottomland forests store large amounts of carbon in their foliage, roots, and soil (195.7 t C/ha average total found on Dance Bayou Unit), and offers opportunities for carbon-offsets with local industry (Delaney, M. et. al. 2002). Natural bottomland forests buffer flooding related to heavy rainfall common on the Texas coast, protecting human communities.

Strategies:

1. Where appropriate, restore degraded habitats through removal of grazing pressure, mowing, and human encroachment, allow natural regeneration of hardwood species and where necessary, plant hardwood species to encourage succession and or diversity.
2. Eradicate invasive plant species within the bottomland habitats.
3. Control invasive fauna populations by means approved in management plan that minimize environmental damage of habitat and native wildlife resources.

4. Where appropriate, restore natural hydrological processes, including storage basins and waterways.
5. Continue outreach efforts to local communities, explaining the benefits of natural bottomland forests.
6. Explore opportunities to partner with industry to protect and restore bottomland forests through the exchange of carbon credits.
7. Monitor rare and endemic populations occurring within the Columbia Bottomlands and focus strategies, including acquisition, toward protecting remaining populations.
8. Continue research collaboration with state and federal agencies, universities, and NGOs.
9. Immediately suppress all wildfires in bottomland hardwood forests throughout the Complex.
10. Within two years, complete a Habitat Management Plan.

Objective 2 – Coastal Prairie

Throughout the life of this CCP, protect, restore and manage 19,000 acres of coastal prairie habitat toward a climax prairie community, while promoting rare endemic species such as prairie coneflower and sharp gay feather through planting or seed dispersal (of refuge produced seed) on 100 acres annually.

Rationale:

Once part of an immense ecosystem covering 9 million acres from Mexico through Texas and into Louisiana, the coastal prairie underwent intensive manmade development starting in the mid-20th century (Allain et. al. 1999) and now totals approximately 250,000 acres in Texas, which includes areas that contain natives prairies species that have been managed and/or restored. Less than 1 percent of (unaltered) natural coastal prairies remain in existence and remaining prairie are continually threatened by agricultural and commercial development, invasive species, and suppression of wildfire (Grace et. al. 2000). The once wide-spread prairies were extremely diverse, including nearly 1,000 floral species (Allain L. et. al. 1999). Today, these highly fragmented and degraded prairies support a lower population and decreased diversity of plant and animal species. As more species continually disappear from a prairie, the entire health of the ecosystem declines as well, compounding the challenges of managing a functional community well represented by both native flora and fauna.

Long-lived perennials that form a dense mat of intertwined roots should dominate coastal prairie. Due to a variety disturbances (drought, flooding, fire, haying, mowing and/or grazing), the prairie should exhibit structural heterogeneity across the landscape. Annuals are less than 25 percent of



Multiple lightning strikes ignited a wildfire near the mouth of Cedar Lake Creek in June 2008, which burned more than 4,500 acres of salty prairie, marsh and coastal prairie habitats.

Photo Credit: USFWS

total species and woody species such as eastern baccharis and wax myrtle should make up no more than 10 percent of cover, with optimal being below 5 percent. Multiple species should co-dominate, including little bluestem, bushy bluestem, fall switchgrass, rattlesnake master, goldenrod, and Jamaican sawgrass with beak sedges and freshwater needle rush in the swales.

Although the focus of the acquisition program is bottomland forests, the Complex acquired adjacent prairie habitat in conjunction with the forest on several units; all of which require restoration. Restoration of native coastal prairie generally involves: 1) preparation by herbicide, solarization, or tillage; 2) planting by haying, seeding, sodding, or transplanting; or 3) management by mowing irrigation, grazing, and fire (nwrc.usgs.gov/prairie/tcpr.htm).

Restoration of prairies presents a variety of challenges including the constant assault of non-native vegetation and their ability to out-compete native flora and introducing a seed source to encourage diversity. As conversion from farmlands to prairies progresses, the Complex moves into a transitional mode from restoration to management and continues to successfully rehabilitate disturbed areas into functional, diverse, and productive prairies; producing a native seed source used to continue the restoration process on newly acquired lands.

Strategies:

1. Within 3 years, have an approved Preliminary Project Proposal (PPP) for Brazoria NWR, focusing on conservation of coastal prairie habitats for reclamation and restoration of prairie species.
2. Monitor and inventory shifts in species composition within prairie habitats due to a changing climate and/or other influences, e.g. contaminants, catastrophic event, and disease.
3. Mimic historic fire regimes through application of prescribed fire across prairie habitats, promoting a diversity of seral stages across the refuges.
4. Maintain diversity across the refuge prairies by promoting hydrological and topographical differences.
5. Prepare a grazing management plan, to add grazing as a management option to be utilized in conjunction with fire to promote structural heterogeneity and species diversity.
6. Continue research collaboration with state and federal agencies, universities, and NGOs
7. Eradicate invasive plant species across the prairie through mechanical, herbicide, and fire applications.
8. Control invasive fauna populations by means approved in management plans that minimize environmental damage of habitat and native wildlife resources.
9. Encourage native species diversity through reseeding and transplanting native grasses and forbs.
10. Promote prairie restoration off-refuge through provision of seed and assistance in prescribed burning for partners.
11. Protect communities through control of fuel loading in WUI areas through haying and application of prescribed fire and maintenance of fire breaks.
12. Within 2 years, complete a Habitat Management Plan.
13. Acquire prairie and former prairie habitat associated with Columbia Bottomland Forest Ecosystem.

14. Restore fallow fields and non-native pasture to native prairie habitat.

Objective 3 – Wetlands

Throughout the life of the CCP, protect and manage 59,000 acres of wetlands, including 9,500 acres of open water across the Complex, promoting a diversity of wetland types, including saline marshes, Gulf cordgrass dominated saline prairie, freshwater ponds moist-soil units, and natural waterways.

Rationale:

Natural wetland functions across the region have been altered by drainage, commerce, pollution, erosion, subsidence, agriculture, and grazing activities. Preservation of remaining wetland habitats are essential to maintaining plant and wildlife diversity, including nursery grounds for shell and fin fish, buffering storm surges, and filtering pollutants. The impacts of preserving refuge wetlands extend beyond refuge boundaries by supporting large populations of migratory birds and sustainable commercial and recreational fisheries. The primary cause of loss of marsh (conversion to open water) appears to be subsidence and faulting. Subsidence and sea-level rise are natural processes that contribute to marsh deterioration and loss, but in some cases, humans exacerbate them. The Slop Bowl on Brazoria NWR is severely degraded due to influences from oil and gas (including pipelines) developments physically manipulating the marsh.



Freshwater wetlands are the most essential habitat the refuges provide, especially during extended droughts. A brood of mottled ducks makes their way to freshwater. Photo Credit: USFWS

The Complex supports a vast variety of both fresh and salt water wetlands that make it a destination for thousands of migratory birds. The Complex has a diversity of salt, brackish, and fresh water wetlands including wet prairies, forested wetlands, tidal flats, salt marsh, intermediate marsh, coastal prairie, ephemeral ponds, estuarine bays, bayous, and rivers. The existence and extent of specific plant species within these different wetland types depends on their tolerances to fluctuating salt concentrations and variability in water depth attracting specific species of wildlife.

Saline marsh management objectives throughout the Complex include 75 percent vegetated and 25 percent open water or mudflats. Gulf cord grass dominated saline prairie is managed for less than 25 percent woody plants with 50 percent hydrophytes such as rushes and sedges and fresh water ponds are managed for no more than a 50:50 ratio of vegetation and water.

Strategies:

1. Maintain or enhance natural hydrological functions of marshes through restoration, erosion control, and reduction of saltwater intrusion into brackish and freshwater wetlands.
2. Seek opportunities to protect wetlands from shoreline erosion through partnerships with state and federal agencies and NGOs.
3. Protect refuge shorelines and dunes from human disturbance to maintain the natural function of these areas by restricting vehicle traffic above high tide lines.
4. Work with GLO to limit access to San Bernard Beach.
5. Provide freshwater habitat through maintenance of existing and additional freshwater impoundments, across the Complex.
6. Restore degraded salt marsh habitat in the Slop Bowl and Salt Lake areas using multiple approaches, including planting smooth cord grass, dredge placement, and blocking channels that lead to salt water intrusion.
7. Within 5 years, have an approved PPP for lands surrounding Big Boggy NWR through an independent PPP or included in the Aransas NWR PPP, protecting additional wetlands in Matagorda County.
8. Control native and non-native invasive species and maintain managed wetlands in an early seral stage through herbicide, mechanical, water level manipulation, fire, and biological control.
9. Supplement rainfall in managed wetlands by trapping runoff, groundwater and channel pumping, and purchase of irrigation water, particularly in drought conditions.
10. Continue research collaboration with state and federal agencies, universities, and NGOs.
11. Encourage natural flow of surface water, including protection of riparian vegetation along waterways and natural sheet-flow to the marshes.
12. Within 2 years, complete a Habitat Management Plan.



The refuges will utilize a variety of wetland management options including roller chopping. Photo Credit: USFWS

4.3 Wildlife Goal

To protect, maintain, and enhance populations of migratory birds and resident fish and wildlife, including federal and state threatened and endangered species.

Objective 1 – Waterfowl

Increase annual winter waterfowl use across the Complex five percent over the term of this CCP by providing quality nesting, resting, feeding, and molting habitats including 2,000 acres of seasonally flooded freshwater habitats, such as coastal prairie swales, ponds, impoundments and flooded farm fields for wintering and migrating waterfowl. Increase annual mottled duck production on the Complex 10 percent over the life of this CCP by providing 600 acres of freshwater with adjacent prairie habitat (less than two miles away) during the late spring and summer months.

Rationale:

Coastal wetlands of Texas (including the Complex) are the primary wintering site for ducks using the Central Flyway, wintering more than half of the Central Flyway waterfowl population (Wilson et al. 2002). Many species including resident mottled duck populations have declined from historic populations (Stutzenbaker, C.E. 1988). The census numbers reflect these declines across the refuges for the past 20 years (Haukos. et al. 2004). Resident mottled ducks are present year round on the Complex and depend on freshwater marsh and prairie habitat to meet their annual cycle needs. Fresh marsh provides feeding and resting sites to many species of ducks and geese and USFWS considers it the most valuable marsh type to waterfowl (Wilson et al. 2002).



The Complex plans on managing a variety of freshwater habitats to benefit wintering waterfowl. Photo Credit: Dave Sanders

Fresh marsh provides feeding and resting sites to many species of ducks and geese and USFWS considers it the most valuable marsh type to waterfowl (Wilson et al. 2002).

Strategies:

1. Provide freshwater habitats throughout the year; through water management activities including purchase, pumping, and holding of freshwater in impoundments.
2. Manipulate freshwater impoundments using disking, shredding, roller-chopping, fire, and or herbicide to disturb perennial vegetation, control exotic vegetation, and encourage production of wetland annual plants.
3. For mottled ducks, provide nesting (prairie) and 600 acres of brood habitats (freshwater with less than 5ppt salinity content) in proximity of each other (less than two miles) to encourage nesting and increase nesting success.

4. Increase managed wetlands at San Bernard NWR by expanding the Wolfweed and Sargent wetland complexes an additional 400 acres.
5. Manage the farmland/wetlands at Brazoria NWR in such a manner as to provide a combination of high-energy foods, cover, and resting areas, and natural wetland food resources during the fall and winter season.
6. Manage Eagle Nest Lake at a lower water level to create a palustrine marsh and create additional waterfowl habitat.
7. Continue research programs on mottled ducks including brood and molter banding programs.

Objective 2 – Forest birds

Throughout the life of the CCP, protect and manage existing mature forest and restore units requiring restoration due to cattle grazing, clearing, logging, etc, to provide floral diversity and high stem density at all canopy layers to provide habitat for 80 percent of the following indicator forest breeding bird species (Swainson’s, prothonotary and hooded warblers, yellow-breasted chat, acadian flycatcher, barred owl, downy woodpecker, yellow-throated vireo, northern parula, and summer tanager).

Rationale:

The Austin Woods Conservation Plan identifies the need to protect forested habitats in the Columbia Bottomlands for the preservation of migratory birds. For the past ten years, a variety of research and monitoring projects occurred in the bottomlands. These projects generally focus on continuing to gather information on species’ habitat associations to aid management in decision making concerning priorities for conservation and restoration of existing units. During migration, bottomland hardwood forest are particularly valuable to a large variety of warblers, vireos, thrushes, tanagers, buntings, goatsuckers, and other forest birds that seek out forest resources after a long flight to recuperate and refuel. In Mississippi, research has demonstrated that neotropical migrants using coastal forests are found in increasing abundance with increasing density of forest trees and increasing numbers of insects in forest understories (Buler et. al. 2007).

Conservation and restoration of bottomland habitats will result in a mosaic of microhabitat types that support a variety of forest birds. For example, Swainson’s warblers require high stem densities and nest in association with heavy concentrations of small trees such as rhododendron (Lanham and Miller 2006) or switchcane or beneath vine tangles with a non-vegetated leaf litter below (Graves 2002). Prothonotary warblers are cavity nesters that select snags in flooded areas and frequently forage in the forest mid-story (Petit 1999). Unlogged forests with all layers intact provide the greatest densities of Acadian flycatchers (Twedt and Somershoe 2009). For migrating songbirds, it appears that birds probably settle in response to gross habitat features such as vegetation density or stratification and then search for resources based on other factors (Moore and Aborn 2000).

Our objective to establish canopy layers to provide habitat for 80 percent of the indicator forest breeding bird species (Swainson’s, prothonotary and hooded warblers, yellow-breasted chat, acadian flycatcher, barred owl, downy woodpecker, yellow-throated vireo, northern parula, summer tanager) will be measured through point count surveys in designated tracts on

an annual basis. If our studies indicate the presence of eight of these ten species, then we will be meeting our habitat management objectives of 80 percent forest breeding bird species throughout the Complex.

Strategies:

1. Within two years, publish information gathered by the Forest Bird Study Group on the site fidelity of some wintering songbirds in the bottomland habitats.
2. Within five years, evaluate the potential of reestablishing turkeys into bottomland habitats through partnering with TPWD and other organizations.
3. Continue to acquire a variety of bottomland habitats that provide corridors for wildlife movement including the migration of large numbers of songbirds along waterways.
4. Locate nesting territories of bald eagles and swallow-tailed kites. Consider these locations a priority in conservation activities.
5. Within one year, develop and implement a forest bird habitat monitoring protocol such as a modified James and Schugart vegetation sample.

Objective 3 – Grassland and Secretive Marsh Birds

Manage prairie and upper marsh habitats, which will support and maintain existing populations of LeConte’s sparrows and loggerhead shrikes, seaside sparrows, black rails and yellow rails (as indicator species), and increase populations of northern bobwhite quail 30 percent over the life of the CCP through continued application of habitat disturbance and treatment of invasive species across 15,000 acres of prairie and marsh habitat annually. Continue to restore old field and pasture land to coastal prairie, enabling the acreage to support grassland dependent species.

Rationale:

Degradation and loss of habitat has occurred throughout the prairies and salt marshes along the Texas coast. Coastal marshes are expected to change in the future in conjunction with sea-level rise and climatic change, affecting species in these habitats even further (Rush et. al. 2009). The birds associated with these habitats have documented declining populations (Igl and Ballard 1999). Texas’ northern bobwhite population has declined approximately 5.6 percent per year since 1980 (Brennan et. al. 2005). The refuges and other managed and conserved areas along the Gulf Coast offer a remnant of high quality habitat, essential for continued survival.

In order to provide quality habitat for the array of grassland and prairie birds, prairies and marshes will require regular disturbance. Northern bobwhites use early successional habitat in a variety of landscape settings, including prairies (Brennan 1999). LeConte’s sparrows prefer tall grass, sparse to moderate litter, and little woody vegetation (Baldwin 2005). Gabrey and Afton (2000) found that abundance of male seaside sparrows decreased in burned plots during the first breeding season post-burn, but was higher than that of unburned plots during the second breeding season post-burn. The preferred habitat of loggerhead shrike in breeding season and winter is open country with scattered bushes, including pastures with hedgerows, orchards, and roadway edges (Yosef 1996).

Continue research on wintering grassland birds on two select sites annually during the management cycle (i.e. fire rotation) to ensure management practices are continuing to provide habitat for select species of concern (Henslow's and LeConte's sparrows, northern bobwhite and yellow rails). Continue black and yellow rail research annually, to aid in determining habitat requirements, impacts of management techniques, food availability, and through collaboration with other researchers, determine populations for both species across the wintering range.

Strategies:

1. Continue to acquire a variety of prairie and marsh habitats that provide corridors for wildlife movement.
2. Throughout the life of this CCP, protect coastal and saline prairie, salt marsh, and associated wetlands for resident and migratory birds including Henslow's and LeConte's sparrows, white-tailed hawk, northern bobwhite, and dickcissels in prairie; and yellow and black rails and seaside sparrow in marsh habitats.
3. Conduct habitat management activities (prescribed burning, haying, grazing etc.) in rotations to provide structural heterogeneity and promote a mosaic of habitat conditions for grassland birds, considering food and cover requirements during planning and implementation.
4. Conduct prescribed burns in such a manner as to minimize bird mortality, including using backing and flanking fires rather than head fires, burn units adjacent to quality habitat to allow movement of displaced wildlife.
5. Continue black and yellow rail research in salt marshes and expanding research within three years into the coastal prairie to evaluate secretive marsh bird habitat requirements.
6. Within two years, establish a grassland bird food and cover monitoring protocol.
7. Coordinate with Attwater Prairie Chicken NWR to monitor and evaluate habitat suitability for Attwater's prairie-chickens.
8. Monitor populations and evaluate how refuge management would better benefit northern bobwhite quail.
9. Locate and document nesting sites of white-tailed hawks.

Objective 4 – Colonial Waterbird Colonies

Maintain eight existing colonies of waterbirds and where opportunities lie, create three additional colonies (Bastrop Bayou, Cowtrap, Salt Lake) through terracing or dredge placement and improve four existing colonies through dredge placement, erosion control, predator barrier, or other means to encourage additional nesting birds. Within the term of this CCP, double the population of nesting reddish egrets in and around the Complex.



A permanent solution for erosion and growth of Dressing Point Island at Big Boggy NWR is needed to maintain this important nesting colony. Photo Credit: USFWS

Rationale:

Colonial waterbird nesting sites across the Texas Gulf coast have diminished due to development, erosion, and disturbance. Nesting sites are now at a premium and determine population levels for several species of concern. (Glass 1994). The reddish egret is among the priority species identified for habitat planning, implementation, and evaluation by the Gulf Coast Joint Venture (GCJV) partnership. Because of its relatively specialized habitat needs, this species was probably never as abundant as other egret species; however, it is believed that the population was greatly impacted by plume hunters in the early 20th century, as well as high pesticide levels, and possibly military training on nesting islands (Paul 1991). Today, major threats to the species include habitat loss and disturbance by humans (Lowther and Paul 2002). Current nesting population of reddish egrets in and around the Complex is approximately 18. The Complex needs to work with partners to expand/improve existing colonies and work with the Army Corps of Engineers on beneficial dredge projects that would establish additional nesting locations.

Strategies:

1. Continue to protect from disturbance all refuge locations and advocate protection of other local colonies.
2. Within five years, partner with other agencies (including Army Corps of Engineers) and organizations to protect the Dressing Point Island from erosion and ultimately find a means to increase the acres of the island and establish new nesting islets using dredge material.
3. In partnership with the Texas General Land Office, seek a means to protect area rookeries that are not on the Complex.
4. When necessary, control predator populations near rookeries that could have detrimental effects on the nesting success of colonial waterbirds.
5. When feasible, establish predator-proof enclosures around rookeries to protect nesting birds from predators.
6. Control invasive fauna (primarily fire ants) in accordance with approved management plans.
7. In association with terracing projects to protect eroding shorelines in Salt and Cowtrap Lakes, establish new islets for nesting birds.
8. Continue monitoring populations of birds on local rookeries through colonial waterbird count and other established censuses.

Objective 5 – Shorebirds

Provide a combination of quality habitats including 1,400 acres of shorebird foraging habitat during spring migration (April–May) and 900 acres during fall (August–September) among managed wetlands and farm fields by providing water ranging from a fraction of an inch to several inches deep.

Rationale:

Because of the geographic location of the Gulf Coastal Prairies region, and the diversity of habitats provided by rice fields, beaches, coastal marshes, and lagoons, large numbers of shorebirds migrate, winter, and breed on the Gulf Coast, making this is one of the most important regions in the U.S. for this group of birds. However, habitat along the Texas coast

has degraded and been lost due to erosion, disturbance, and development (Wilson and Esslinger 2002). The Western Hemisphere Shorebird Reserve Network recognize the refuges as a Western Hemisphere Shorebird Reserve Network site and host large populations of shorebirds. Habitats for shorebirds using maritime and estuarine habitats can be generally defined as submerged to emergent lands between seagrass beds and upland grasslands on bay sides of barrier islands and the mainland, and as the area between the low intertidal zone (forebeach) and backshore (backbeach) on Gulf of Mexico beaches (Elliot and McKnight 2000). The Complex has minimal management capability over much of this area; however, the refuges protect the habitats from disturbance and degradation. The Complex characterizes non-maritime habitats as those occurring inland from the upland grasslands on bay sides of barrier islands and the mainland, and from the backbeach inland. These habitats include coastal marsh (saline to fresh), prairie, agricultural lands (rice, crawfish), and inland ponds (including waterfowl impoundments) and depressions (Elliot and McKnight 2000). Additional shorebird habitat includes shallow wetlands, salt marsh, tidal flats, and beach. The Complex manages more than 4,000 acres of impoundments and farm fields/wetlands that it can manipulate to enhance the naturally occurring wetlands and provide feeding areas for shorebirds.

Strategies:

1. Ensure available prey for shorebirds by slowly drawing down wetlands in the spring or allowing ponds/reservoirs to dry through evaporation.
2. Begin flooding managed wetlands early August to enable feeding areas for fall migrating shorebirds.
3. Provide foraging and nesting areas associated with estuary and managed wetlands throughout the year.
4. Continue shorebird monitoring protocol that was established in 2011.
5. Continue to monitor snowy and piping plovers every five years with the International Piping Plover Survey.
6. Protect four miles of beach habitat of San Bernard NWR by restricting vehicle access above mean high tide, establishing education programs and regular law enforcement patrols.

Objective 6 – Reptiles and Amphibians

Maintain current populations by providing quality habitat for a variety of reptiles and amphibians, and where opportunities arise, increase populations of threatened, endangered, and species of concern such as sea turtles, timber rattlesnake, diamond-backed terrapin, Gulf saltmarsh snake, ornate box turtles, and Texas horned lizard through adaptive management and protection of habitat throughout the life of the CCP.

Rationale:

Reptile and amphibian populations across the refuges are not well documented; however, many populations of reptile and amphibians have declined due to habitat loss and exploitation of species throughout their range (TPWD 2005). However, the refuges provide conserved habitat, safe from specimen collection. Despite favorable habitats, some species, including the Texas horned lizards, are not recently documented. Because development is increasingly isolating the refuge units, determining reptile and amphibian populations' status

and trends will aid in establishing priorities for conservation of minimal unit size and corridors between units to sustain existing populations.

Strategies:

1. Protect four miles of San Bernard NWR beach habitat by restricting vehicular travel above mean high tide to protect nesting sea turtles and nests.
2. Within five years of the CCP's approval, develop an inventory and monitoring protocol for reptiles and amphibians across Complex habitats.
3. Locate and protect den sites for timber rattlesnakes in the bottomlands.
4. Continue sea turtle stranding and nest monitoring on area beaches, both on and off refuge.
5. Continue to support research on herptile populations in association with education and non-profit organizations.
6. Within five years, implement a monitoring protocol on American alligators across the Complex.

Objective 7 – Mammals

Maintain current populations of 45 mammal species by providing bottomlands, prairies, freshwater wetlands, and salt-marsh habitats across the Complex. Within three years of the CCP's approval, conduct baseline monitoring for river otter, deer in bottomlands, and small mammals, in an attempt to determine population trends in three to five year intervals, and assess the need to initiate adaptive management practices if trends show declining populations or overpopulations.

Rationale:

Mammal populations are difficult to monitor; therefore, populations are unknown across the ecoregion. The Complex provides habitat not found in abundance outside of each refuge due to protection and management. Monitoring the mammal populations on the refuge is essential in determining the status of populations throughout the area. River otters wander a great deal through their habitats, making them scarce and rarely seen in most localities (TPWD-WFS 2011). In order to protect refuge populations, information on population status on and around the refuges is required. White-tailed deer populations on and around the refuges are stable; approximately one deer per eight to ten acres, with a one to three buck to doe ratio (Pilchek 2011). However, development in Brazoria County continues at a high rate may push deer into less than ideal habitats (dense bottomland forests). The refuges need to begin monitoring deer populations, and/or habitat



Populations of bobcats along with other mammals will be monitored in the future to ensure management activities are not adversely affecting populations. Photo Credit: Janie Mason

conditions (browse lines), in both bottomland and prairie habitats where increases in the deer population have been observed recently. In these prairie habitats, carrying capacity should be about one deer to 15 acres (Pilchek, 2011). The refuge may manage populations through controlled hunts in the future in order to maintain healthy deer populations and habitat. The Complex has no information on small mammals. Because development increasingly isolated the refuge units, determining small mammal populations will aid in establishing priorities for conservation of minimal unit size and corridors between units to sustain existing populations. Small mammal surveys will include live trapping on various habitat types throughout the Complex. These live trapping surveys will initiate baseline data on species diversity, abundance, and eventually trend. Initial inventory and monitoring of mammals will determine the need for future best management practices.

Strategies:

1. Locate and monitor river otter populations on core refuges and along waterways adjoining the refuge units.
2. Within three years, set up an inventory and monitoring program for small mammals.
3. Control feral hog populations across the Complex in accordance with Feral Hog Management Plan to protect habitat and native wildlife populations.
4. Seek opportunities to reduce impacts of red-imported fire ants by reducing populations through biological control and pesticides in accordance with an Integrated Pest Management Plan.
5. Coordinate with education and other organizations to conduct research and monitoring of specific species.
6. Within three years, implement a deer-monitoring program in select bottomland and prairie units to ensure healthy populations.
7. Partner with other organizations to monitor bat habitat use across the Complex.
8. Work with our partners and adjacent landowners to help conserve habitat for the river otter.

4.4 Visitor Services Goal

To develop and implement quality wildlife-dependent recreation programs, which are compatible with Refuge purposes, and foster enjoyment and understanding of the Refuge’s unique wildlife and plant communities.

Objective 1 – Visitation

Throughout the term of this CCP, increase annual visitation by 25 percent (current numbers are 75,000) while striving to maintain a positive and memorable experience on the refuge. The visitors’ experience should be that



**The Complex will strive to provide public use opportunities which will connect people with nature.
Photo Credit: USFWS**

they would desire to return to the Complex, recognizing it as a national treasure and a premier destination for wildlife-dependent recreational activities.

Rationale:

Because the Complex is located close to Houston, Texas, the sixth largest metropolitan area with the largest growth (26.11 percent) over the past ten years of the top 10 metropolitan areas in the country, (2010 Census), it will likely see increased visitation during the life of this CCP. Although refuge visitation has been irregular over the past 10 years, we believe in part due to a poor economy, the refuge must continually garner public support by increasing outreach as well as providing the highest quality experiences available.

Strategies:

1. Within five years of completing of this CCP, develop a Visitor Services Plan that evaluates existing public use facilities, identifies additional facilities needed to provide high-quality compatible wildlife-dependent recreation, and identify sources of funding for development and maintenance of facilities.
2. Use advertising and marketing strategies, including publishing web and news/magazine articles with information about refuge activities.
3. Within two years, increase signage on incoming highways and county roads to identify public use areas.
4. Continue to offer quality public programs including the interpretive programs at the annual Migration Celebration.
5. Within two years, develop monthly interpretive programs at various refuge locations during the winter months.
6. Maintain and update the refuge web site as needed; provide relative and up-to-date information on a continuous basis.
7. Utilize the Visitor Estimation Handbook to collect visitor use information and track visitation trends on an annual or biannual basis.
8. Partner with local chambers of commerce; gaining support for refuge programs and promoting the Complex as a Great Texas Coastal Birding Trail designated site.
9. Incorporate higher customer service standards by providing periodic training for staff and volunteers ensuring compliance with Service customer service standards.
10. Increase Visitor Services personnel to accomplish priority visitor services needs. Add one full-time staff member to assist with keeping the Discovery Center open in fall, winter, and spring season. Explore innovative volunteer options such as recruitment through the Refuge Volunteer Program, SCA, interns, grants, and work study programs.
11. When funds are available, establish a Visitor Contact Station at the San Bernard NWR. This would facilitate increased awareness and understanding of the natural value of the bottomland units, and would likely attract additional volunteers from local communities.

Objective 2 – Wildlife Observation

Over the term of this CCP, provide visitors with quality wildlife observation opportunities by maintaining existing viewing areas and infrastructure across the Complex, while expanding opportunities on existing and new tracts as opportunities for development allow and are able to be maintained in a safe and operational manner with limited resources for maintenance.

Rationale:

Most visitors come to the Complex to view wildlife and enjoy nature. Approximately 32,000 visitors annually visit the refuges for wildlife observation. The refuges have received requests to expand wildlife-viewing opportunities. The Complex will balance wildlife observation opportunities with the conservation and protection of habitats and species. Most newly acquired units will not be open for wildlife observation. This ensures that the conservation of lands is meeting the purpose for which the Complex conserved them, namely migratory birds. The Complex may open units that are near communities and provide unique opportunities that enhance public awareness for conserving natural resources to the public.

Strategies:

1. Within five years of the completing of this CCP, develop a Visitor Services Plan that evaluates existing public use facilities, identifies additional facilities needed to provide high-quality compatible wildlife-dependent recreation, and identify sources of funding for development and maintenance of facilities.
2. Maintain all viewing areas on the Complex to including the auto tour loops, San Bernard beach, walking trails, viewing areas, decks, boardwalks, and observation platforms in a safe and usable condition. The Complex may remove facilities from service for public safety.
3. Establish scheduled programs for wildlife viewing such as the interpretive van tours and guided bird and wildflower walks.
4. Continue to evaluate existing facilities for accessibility requirements every three years and make necessary improvements to these facilities as resources allow.
5. Within five years of this CCP, expand trail system to the west side of Bastrop Bayou at the Dow Woods Unit.
6. Continue to work in partnership with local chambers of commerce, Gulf Coast Bird Observatory, Sea Center Texas, Brazosport Center for the Arts, Houston Zoo, State Parks, and TPWD's Texas Wildlife Expo. Participate in selected nature-related community events.
7. Provide social media outlets, including maintaining the refuge web sites and working with the Friends Group to provide the latest information to ensure the site has the latest information on wildlife observation opportunities such as bird sightings, optimal viewing times, and links to other important wildlife observation websites.
8. Provide a one-mile trail and boardwalk across from the Brazoria Field Office to enhance wildlife observation opportunities.

Objective 3 – Wildlife Photography

The Complex will provide safe and high quality opportunities on the Complex by maintaining existing photo blinds and viewing areas and develop new opportunities where appropriate to achieve a 10 percent annual increase in wildlife photography participants throughout the Complex.

Rationale:

The refuges are destinations for both professional and novice wildlife and nature photographers. Wildlife photography is a means of exploring and sharing the natural world. Photographers come to the refuges to get an opportunity to capture a unique expression of the

environment and nature around us, take that image home, and continuously reflect upon it promoting both wildlife and wildlife dependent recreational opportunities provided by national wildlife refuges throughout the country.

The annual Migration Celebration, sponsored by the Friends of Brazoria Wildlife Refuges and hosted on San Bernard NWR, includes an annual photography contest for both youth and adults, in an attempt to encourage wildlife photography opportunities. Ten youth and thirty-six adults participated in the 2010 Migration Celebration photography contest, entering forty-nine and 194 photos respectively. Many participating photographers come back to the Complex throughout the year to continuously pursue wildlife photography opportunities. The Complex has used the amount of annual contestants as a method to determine trends and even numbers of visitors taking advantage of wildlife photography opportunities and is striving to continuously expand this opportunity by 10 percent on an annual basis throughout the life of the CCP.

In 2009, the DEEP program added a nature photography session. This mini-course educational activity allows youth to use digital cameras and capture natural images. Youth provide all images to the teacher. Expansion of this opportunity beyond the DEEP program and photography workshops will further expand photography among youth.

Recreational wildlife photography programs will promote understanding and appreciation of natural resources and their management on all lands and waters in the Refuge System (General Guidelines for Wildlife Dependent Recreation 605 FW 1).

Strategies:

1. Within five years of completing the CCP, develop a Visitor Services Plan that evaluates existing public use facilities, identifies additional facilities needed to provide high-quality compatible wildlife-dependent recreation, and identify sources of funding for development and maintenance of facilities.
2. Host children's refuge photography contests and display winning photos in the refuge Complex office or other outreach opportunities including the Brazos Mall.
3. Facilitate nature photography on the refuge in partnership with local schools or other organizations for children and adults by making cameras and portable photo blinds available for loan to the visiting public.
4. Construct two additional photo blinds on the Complex; one at Dow Woods and one on Otter Slough at Brazoria NWR.
5. Incorporate photography into the Refuge Junior Naturalist Program.



The photo blind at Hudson Woods was constructed to provide photography opportunities at the oxbow lake. Photo Credit: USFWS

Objective 4 – Interpretation

Over the life of the CCP, the Complex will increase the effectiveness of all interpretive activities by 25 percent above current levels.

Rationale:

Surveys will measure the increasing the effectiveness of the interpretive program above current levels in annual increments with the 2010/2011 National Wildlife Refuge Visitor Surveys as the baseline. Surveys will attempt to capture a better understanding of three primary concepts: 1) the value and unique purposes of Complex, including conservation of species and habitats; 2) the Complex as a component of a national network of refuges, and; 3) the significance and mission of the Refuge System.

Many visitors do not realize the distinction between a national wildlife refuge and a park or federal or state agency lands managed for different purposes. Increased efforts are needed to help people better understand the role of national wildlife refuges, the Service mission, and to have a heightened awareness of conservation and stewardship concepts.

Strategies:

1. Within five years of the signing of the CCP, develop a Visitor Services Plan that evaluates existing public use facilities, identifies additional facilities needed to provide high-quality compatible wildlife-dependent recreation, and identify sources of funding for development and maintenance of facilities.
2. Improve existing kiosk exhibits and add at least one new informational kiosk to be located off FM 2004 by Brazoria NWR field office.
3. Complete the interpretive trails at Dow Woods.
4. Develop and schedule high-quality interpretive programs to hold monthly during fall, winter, and spring.
5. Recruit, enlist, and train naturalists for interpretative and environmental education programs across refuge habitats.
6. Continue to offer popular, audience-specific, interpretive programs both on- and off-site, and at special events such as the Brazoria County Library Series, “Migration Celebration,” and “Wildlife Expo,” which includes activities such as interpretive van tours, guided bird and wildflower walks, and programs for school groups, libraries, and scouts.
7. Within three years, develop and interpret the San Bernard NWR Auto Tour.
8. Update all informational and interpretive materials to improve accuracy, consistency, quality, and availability. Revise and make some brochures available to local visitors in Spanish.
9. Throughout the life of this CCP, maintain and update or replace damaged and obsolete interpretive and informational panels on refuges; including entrance signs, roadway signs, wayside exhibits, trails, and viewing areas.
10. Within two years, install identification markers for native plants at the Discovery Center, Bobcat Woods, and Complex gardens.
11. Within two years of the CCP, develop an annual visitor use survey for the Complex to evaluate services and determine needs.

Objective 5 – Hunting

Over the life of the CCP, the Complex will continue to work through partnerships to increase youth hunting opportunities by 20 percent and while maintaining existing waterfowl hunts at current use levels, increase opportunities by opening additional area(s).

Rationale:

The refuges work to foster public understanding and appreciation of the natural world through wildlife-oriented recreation. This includes hunting. Hunters have supported the conservation of our nation's wildlife resources, including the Mid-coast Refuges, through the purchase of the Federal Duck Stamp. The refuges provide hunting opportunities where appropriate and compatible with refuge purposes. Although Texas has one of the largest hunting populations; estimated at 16 percent in 2001 (TPWD 2001); similar to national trends, it is declining. Comparing 1991 to 2006 estimates, the number of all hunters declined by 11 percent nationwide (USFWS 2006). This decline in overall users poses a challenge for the Complex to maintain current levels. The Complex will continue to provide opportunities for waterfowl hunting, and strive to maintain hunt use at 3,400, providing compatible, safe, accessible, quality recreational hunting opportunities on the Complex while minimizing conflicts with other non-hunting visitors.



The refuge will continue to offer migratory bird hunting opportunities and expand opportunities in the future. Photo Credit: USFWS

Strategies:

1. Within five years of completing the CCP, develop a Visitor Services Plan that evaluates existing public use facilities, identifies additional facilities needed to provide high-quality compatible wildlife-dependent recreation, and identify sources of funding for development and maintenance of facilities.
2. Provide waterfowl hunting opportunities within designated Public Waterfowl Hunting Areas in accordance with regulation set forth by the State of Texas.
3. In cooperation with TPWD, provide additional waterfowl hunting opportunities that foster an appreciation of refuge resources and are appropriate and compatible following appropriate NEPA processes (i.e. Eagle Nest Lake).
4. Continue to partner with TPWD and Texas Youth Hunting Program, to offer opportunities for youth deer and feral hog hunting.
5. Encourage hunting participation of under-represented segments of the public such as disadvantaged youth, persons with disabilities, and women, through various outreach.

6. Promote hunter compliance with federal and state regulations and encourage good sportsmanship, ethical hunting behavior, and understanding of the refuge and its purposes through law enforcement visibility and effective wording within informational brochures with high quality maps, signs, and posts on the refuge web site.

Objective 6 – Fishing

Over the life of the CCP, provide for a 55 percent increase of compatible, safe, accessible, and quality recreational fishing experience while minimizing conflicts with other non-fishing visitors.

Rationale:

Fishing is a traditional use of the area’s salt water bays and lakes that adjoin and are within the refuges. In 2001, TPWD estimated 38 percent of Texans participate in fishing as a recreational activity. With the expected continued growth in the Houston Metropolitan Area, the number of fishing visits is likely to increase. The Complex is currently providing fishing opportunities for up to 30,000 fishing visits (70 percent accessed by boats) and with the anticipated increase, the refuges can still provide quality experience while minimizing conflicts with other Complex users. The Complex expects the anticipated increase to primarily occur from boat access fishing, rather than land access fishing in the Public Fishing Areas. Fishing provides opportunities to connect many people, particularly children, with nature. By providing safe and accessibly opportunities from designated refuge lands and access to some refuge waters, the Complex will continue to meet the need while protecting resources.

Strategies:

1. Within five years of completing the CCP, develop a Visitor Services Plan that evaluates existing public use facilities, identifies additional facilities needed to provide high-quality compatible wildlife-dependent recreation, and identify sources of funding for development and maintenance of facilities.
2. Continue to provide a variety of fishing opportunities including bank fishing, canoe/kayak, and motorboat access areas.
3. Maintain facilities at the Public Fishing Areas including the accessible fishing piers.
4. Revise all brochures and fishing maps to include the San Bernard beach as a public fishing area, allowing non-motorized access along the beach to the San Bernard River.
5. Continue to encourage fishing among youth by offering fishing oriented educational activities in DEEP and at Migration Celebration.
6. Encourage fishing participation by under-represented segments of the public such as disadvantaged youth, persons with disabilities, and women, through outreach to various organizations.
7. Within three years, provide at least one educational fishing event for local youth with an emphasis on disadvantaged and minorities.
8. Throughout the life of this CCP, promote angler compliance with federal and state regulations and encourage good sportsmanship, conservation practices, and understanding of the refuge and its purposes through law enforcement visibility and effective wording within informational brochures with high quality maps, signs, and on the refuge web site.

9. Conduct all fishing activities in accordance with State of Texas regulations.

Objective 7 – Environmental Education

Over the term of the CCP, increase both on- and off-refuge structured, curriculum-based environmental education opportunities (DEEP) by 25 percent.

Rationale:

Environmental education is a critical first step in providing visitors with an awareness of the Complex and the Refuge System and will ultimately translate into support for the refuges and the Refuge System mission. Environmental education provides a way for people to connect with nature through a “hands on” approach, and provides educational experiences not easily gained in a classroom. The population of Brazoria County has grown nearly 30 percent over the past 10 years (US Census) with more than 30 percent of the population under the age of 18. In order to maintain the current opportunities to provide hands-on environmental education for area schools, DEEP will need to continue expanding from the current 3,000 students per year.

All environmental education activities both on and off refuge, will comply with Service policy (605 FW 6), which are aligned with state and national environmental educational criteria.

Strategies:

1. Within five years of the completing the CCP, develop a Visitor Services Plan that evaluates existing public use facilities, identifies additional facilities needed to provide high-quality compatible wildlife-dependent recreation, and identify sources of funding for development and maintenance of facilities.
2. Offer hands-on environmental education programs both on- and off-site, such as field trips, special educational events, and special-interest group programs.
3. Conduct annual on-site environmental education workshops that orient educators to the refuge resources and, in turn, encourage them to incorporate this into their curriculum, both in the classroom and during field trips.
4. Maintain existing and build additional partnerships with local, state, and federal agencies, nonprofit organizations, businesses, and individuals during the Migration Celebration to improve the Refuge EE Program.
5. Promote the learning trunks and resource materials for the Environmental Education Program to use on-site and take off-site for programs. These trunks include materials for topics as wetlands, wildlife, plants, conservation, endangered species, and fishing.
6. Within two years, develop and maintain a multi-faceted environmental education resource library comprised of books, videos, posters, environmental education field trip guides, specific topic packets, and pertinent written materials. These will be available for use in refuge educational programs and by educators.
7. Within 10 years, in cooperation with partners and Friends group, explore the development of environmental education areas at San Bernard NWR (including Dow Woods). At Dow Woods, construct an environmental education laboratory addition next to the pavilion, with seating and study/lab equipment for up to 50 students and teachers for the various schools, including Brazosport College.

8. Annually review and maintain the “Educator’s Guide to Texas Mid-coast National Wildlife Refuge Complex” that provides orientation, guidelines, grade-level, and state learning standards information, maps, and site-specific activities that focus on one or more refuge themes.
9. Seek funding sources such as grants for refuge environmental education programs that promote understanding and appreciation of the refuge’s natural and cultural resources and their management consistent with Service policy.
10. Promote the Discovery Environmental Education Program through news releases, the refuge web site, informational fliers, and other social media.

Objective 8 – Outreach

Increase refuge awareness in the local community by annually providing opportunities for approximately 15,000 people to participate in off-refuge programs and exhibits. These activities will also help recruit an additional 5 percent annually of volunteers for the Complex, and help build membership an additional 5 percent annually for the Friends of Brazoria Wildlife Refuges.

Rationale:

Accomplishing the Service's mission depends on our ability to build relationships and communicate with the American public. Strategic outreach efforts facilitate the communications and relationship building required for achieving conservation goals. It is critical to the mission of the Complex that the neighbors and citizens in the surrounding communities know about the Complex and support it as a valuable and contributing part of the community. Although currently recognized for its aesthetic and biological value by current users, by preserving wilderness (or natural environments such as refuges) and avoiding the irreversible decision of development, we may be creating and capturing option, existence, and bequest values (Manning, 1989).

Strategies:

1. Within two years, complete an Outreach Plan that will better identify the need, target audience, and means for future outreach.
2. Coordinate with partners and Friends group, continue to work off-site to promote and support refuge events like the Migration Celebration. Sponsor special on-site annual events such as Refuge Week, International Migratory Bird Day, and National Fishing and Boating Week that engage the public in wildlife-dependent activities, and increase people’s knowledge and understanding of wildlife conservation and related issues.
3. Within five years, develop portable interpretive displays that highlight the Refuge System mission, refuge purposes, management, themes, and natural resource highlights to use on-site as needed for programs or special events, and for off-site displays at festivals, special events, and malls as part of the Visitors Services Plan.
4. Maintain an active volunteer program that includes recruitment and training of volunteers for assistance in all refuge programs.
5. Within eight years, develop at least two outreach tools such as posters or brochures to promote public involvement or participation in support of the refuge purposes and vision.

6. Increase outreach efforts to local schools, organizations, agencies, neighbors, and the public to enhance awareness, understanding, and support for the Complex and Refuge System.
7. Partner with local hunting and fishing organizations to develop outreach opportunities specific to those uses.
8. Support and help promote the Texas Junior Duck Stamp Program including featuring artwork in the Brazos Mall.
9. Coordinate with local chambers of commerce, birding organizations, local attractions, and other public venues such as motels to display and provide refuge information to the public.
10. Ensure consistency of media and public communication information among staff and volunteers during all outreach functions, as an important element of the Visitor Services Plan. This involves maintaining and regularly updating the Refuge and Friends web site as a “single source” for this outreach information.
11. Within eight years, develop outreach plans for important resource issues in the local area for distribution in the Discovery Center, Complex, and field offices.

Objective 9 – Law Enforcement and Visitor Safety

Throughout the life of the CCP, the Complex will double its law enforcement presence in and around the Complex by increasing cooperation with other local, county, and state public safety officers by formalizing cooperative agreements through Memorandums of Understandings (MOUs).

Rationale:

Currently, the Complex is limited to two full-time and one dual-function law enforcement officer to cover more than 100,000 acres spread out over 27 units in three counties. Building strong partnerships and liaisons with federal, state, and local law enforcement agencies improves our ability to provide a 24/7 presence or access to all parts of the Complex. The Complex currently has MOUs with Brazoria County and TPWD and one formal agreement with one city near the refuges. With populations in and around the refuges continuing to grow, Brazoria County is reporting a 20 percent increase in call outs over the past five years (Sheriff’s Office, personal communication). The Complex will continue to work collaboratively to provide law enforcement coverage to protect natural resources, facilities, and people, and provide visitor safety and emergency response by building and maintaining partnerships with local law enforcement agencies over the term of this CCP.

Strategies:

1. Continue to build strong partnerships to increase law enforcement coverage, enhance visitor safety, and emergency response. Continue to work cooperatively, developing good relations and radio communications with local law enforcement offices of TPWD Law Enforcement; Brazoria, Matagorda County Sheriff’s Departments; Texas Department of Public Safety; and the Service’s Law Enforcement Office in Houston to enforce federal, state, and refuge-specific hunting and fishing regulations.
2. Provide for visitor safety, protect resources, and ensure compliance with federal, state, and refuge-specific regulations through law enforcement.

3. Maintain a good working relationship with Emergency Medical Services of Brazoria and Matagorda counties and local volunteer fire departments to provide immediate emergency response as needed.
4. Within three years, develop a Law Enforcement and Emergency Services Management Plan.
5. Annually review and revise refuge-specific visitor regulations for consistency and compatibility.
6. Maintain current law enforcement and emergency equipment and provide as necessary, including any patrol vehicles to meet applicable federal and state emergency vehicle standards.
7. Increase the public's knowledge of refuge regulations and the boundaries on refuge lands. Update Web pages and improve Complex signs, kiosks, and facilities to better advise the public on refuge regulations, boundaries, and safety issues.

Objective 10 – Partnerships

Continue to maintain existing partnerships (eight) with agencies, groups, neighboring landowners, and other interested parties to help achieve the vision, goals, objectives, and strategies outlined in this CCP.

Rationale:

Partnerships are an essential element in fulfilling the vision as stated in this CCP. Partners bring new and different ideas and resources to the table that supports conservation management, biological research, and a variety of public use programs.

Strategies:

1. Within two years of completing the CCP, develop and revise the “Volunteer Manual” to ensure consistency in our message to the public to include the Service mission, Refuge System mission, refuge purpose, and difference between state and federal areas.
2. Continue to partner with local schools, state and federal agencies, and local organizations to promote the refuges and conservation of habitat throughout the mid-coast area of Texas.
3. Within three years, in cooperation with Friends of the Brazoria Wildlife Refuges, offer educational materials for sale at the Discovery Center and Complex with proceeds benefitting the education and interpretation programs.
4. Coordinate with and support the Friends of Brazoria Wildlife Refuges, continuing to develop new opportunities that support the vision of this CCP.
5. Continue to coordinate with Area Leaders for Christmas Bird Counts on both San Bernard and Brazoria NWR, which are in the San Bernard, Freeport, and Brazoria Count Circles.

Objective 11 – Cultural Resources

Maintain existing interpretive, cultural, historical, and archeological resources (two) on refuge lands and interpret additional sites as new opportunities arise.

Rationale:

The Service is required to protect all cultural resources on refuge lands as mandated by federal law and Service policies and mandates. Interpretation of the history of the area is an important aspect of highlighting the refuge resources and people's connections with the land. Although people are more removed from the environment today than in times past, they are nonetheless a part of it.

Strategies:

1. Within five years, complete a step-down Cultural Resources Management Plan to fulfill requirements of the Archaeological Resources Protection Act for surveying lands and the National Historic Preservation Act for a preservation program.
2. Throughout the life of this CCP, preserve known cultural resources in place through non-disturbance. The most abundant type of cultural resource on the Complex is the numerous "shell middens" left by Karankawa Indians.
3. Continue to consult with the State Historic Preservation Office prior to all proposed construction actions.
4. Work with community and county museums to document more of the human history across what are now refuge lands, collecting historic photographs and integrating this information into refuge programs.
5. Within 10 years, develop exhibits to inform and interpret the historical connection between people and the land.

4.5 Facilities Goal

To provide administrative and public use facilities needed to carry out the Refuges' purposes and meet management objectives.

Objective 1 – Public Use Facilities

Maintain current public use facilities in a safe and accessible manner and construct additional (25 percent) facilities (i.e. trails, classrooms, hunting blinds, and wildlife observation facilities) over the life of the CCP that support a diversity of compatible wildlife-oriented public use opportunities.

Rationale:

Quality public use facilities enhance visitor experiences and encourage visitor's to return to the refuges, building a connection between the visitor and nature. However, the Complex's ability to maintain existing facilities is paramount to adding additional facilities. It is often easier through grants and partnerships to develop facilities, but much more difficult to ensure resources (time, staff (including LE), and equipment) are available for maintaining those facilities over time. The Complex will add facilities only as funds for construction and resources to maintain additional facilities become available.

Strategies:

1. Within three years, expand the trail system at Dow Woods Unit of San Bernard NWR to the west side of the Bayou; providing additional access and interpretive opportunities.

2. Within ten years and through a partnership with the Friends group, construct an educational facility at San Bernard NWR to support school and group environmental education activities, including Migration Celebration.
3. Develop accessible waterfowl hunting facilities at the Sargent Permit Hunt Area on San Bernard NWR.
4. Expand RV volunteer site at San Bernard NWR from two to five campsites.
5. Maintain all roads, trails, wildlife observation facilities, fishing piers, and other public use facilities in a safe and operable condition.

Objective 2 – Administrative, Maintenance, and Storage Facilities

Provide safe, accessible administrative facilities that support the administrative, refuge management, biological, maintenance, and law enforcement programs across the Complex and foster productive environments for staff and volunteers.

Rationale:

Throughout the refuges' history, facilities have slowly grown and today, two field headquarters—including offices, maintenance and storage facilities, and one Complex office—provide the primary infrastructure supporting administrative, maintenance, biological, and management programs. Most recently, the construction of the Brazoria Field Headquarters in 2006–2011 and the Complex Headquarters (2008) has enabled the refuge to move out of GSA leased space. Refuge administrative, maintenance, and storage facilities are critical for protecting government-owned equipment and staff essential to completing the refuges' mission.

Strategies:

1. Replace the refuge office at San Bernard NWR with an accessible facility; providing office space for 11 staff and volunteers as funds allow.
2. Replace the Quonset hut at Hudson Woods Unit with a facility at Buffalo Creek to provide storage for equipment used on the unit and during hurricanes.
3. Replace the wash station at San Bernard NWR and construct a wash station at Brazoria NWR, using “green” technology that will enable the refuges to maintain equipment in this harsh environment.
4. Construct one additional storage shop facility at Brazoria NWR for the secure storage of vehicles and equipment.
5. Construct on additional storage facility supporting the Refuge Law Enforcement Program at a central location.

Objective 3 – Habitat Management Facilities

Throughout the life of the CCP, maintain all habitat management facilities including levees, ditches, water-control structures, freshwater wells, and fire lines to effectively manage habitat across the Complex.

Rationale:

A variety of ditches, levees, and water control structures support the water management capabilities across the Complex. Staff must keep these facilities in good working condition to effectively use rainfall, run-off, and purchased water to support resident and migratory

birds. Freshwater wells may become a lifeline during extended droughts, providing a minimum amount of freshwater in some ponds. Boundary fire breaks must be maintained in order to manage effectively wildland fire and prescribed burning on refuges and protect adjacent private property.

Strategies:

1. Maintain all levees, ditches, and water control structures and pumps in serviceable condition ensuring that the Complex can move and store water to provide the optimal support of management programs.
2. Maintain freshwater wells at Sargent, Wolfweed, and Big Slough Tour Loop to provide freshwater during drought periods for wildlife.
3. Regularly maintain fire breaks on the refuges, to control the spread of wildland fires and conduct prescribed burning .

Objective 4. Oil and Gas Facilities. Continue to work closely with companies who have oil and gas interests under refuge lands and ensure that exploration and development of those interests are conducted in the most environmentally-sensitive manner possible.

Rationale:

There are currently four active oil and/or gas operations (Slop Bowl, Sargent, Cocklebur Slough and Buffalo Creek) across on the Complex. A number of active pipelines cross the core refuges and many of the bottomland units as well. The refuges do not own the minerals below the surface (with the exception of a partial interest on Swaggert Tract). The refuge must allow for their exploration and development through reasonable means. Except for Dance Bayou tract there are generally no deed restrictions for O&G development. Refuge personnel work closely with those oil and gas companies during all phases of operations through the preparation of an EA and Operation Plan for seismic, and drilling activities to ensure the surface is minimally impacted to the extent possible by these operations. Although issues are rare, occasional spills and worn or abandoned equipment must be cleaned-up and removed.

Strategies:

1. Coordinate with oil and gas interests on all exploration and development activities on the refuge, and administer such activities under Service policy and regulations through issuance of Special Use Permits
2. Coordinate with Regional Oil and Gas Specialist to ensure oil and gas operations are in compliance with Service regulations and policy.
3. Work with Environmental Protection Agency and Texas Railroad Commission to ensure operators are within State compliance. Require each operator to operate under current local, state and federal regulations and policies.
4. Require each operator to prevent, to the maximum extent possible, releases of hazardous materials and substances, crude oil, and produced water.
5. Ensure that each operator has a current *Oil Discharge Prevention and Contingency Plan* outlining procedure for accidental releases.

6. On a case-by-case basis, the refuge may request that wells, roads, pipelines, and associated infrastructure and facilities not needed to support operations be removed and the sites restored to the satisfaction of the Refuge Manager.

5. Plan Implementation and Monitoring

The CCP will serve as the primary management reference document for refuge planning, operations, and management for the next 15 years or until it is formally revised or amended within that period. The effectiveness of any management plan is dependent on a multitude of factors that change over time. This chapter describes a number of these factors in further detail, including the funding, staff, projects, compliance requirements, partnerships, monitoring, and additional planning associated with CCP implementation. Adaptive management will also be necessary to meet new, unforeseen challenges, and to take advantage of new opportunities.

As noted in the inside cover of this document, this plan does not constitute a commitment for additional staffing or increases in operational and maintenance resources. These decisions are at the discretion of Congress in overall appropriations, and in budget allocation decisions made at the national and regional levels of the Service.

5.1 Personnel and Budget Needs

Table 5-1 and 5-2 show the existing and additional staff needed to implement the projects identified later in this chapter.

5.1.1 Personnel

In fiscal year 2011, Complex had a permanent staff consisting of 27 employees, including 26 permanent full-time and one permanent part-time. In addition, we had six temporary positions, four Youth Conservation Corpsmen (YCC) and 128 volunteers contributed over 12,000 hours (See Table 5-1).

Table 5-1. Existing Personnel

Texas Mid-coast NWR Complex				
Management/Supervision	Refuge Manager	0485	GS-14	FT Permanent
Biology	Wildlife Biologist	0486	GS-13	FT Permanent
Biology	Wildlife Biologist	0486	GS-11	FT Permanent
Biology	Botanist/Ecologist	0430	GS-11	FT Permanent
Biology	Biological Technician	0404	GS-4	FT Temporary
Law Enforcement	Park Ranger/LE (2)	0025	GS-9	FT Permanent
Public Use	Outdoor	0023	GS-11	FT

Function / Program				
	Recreation Specialist			Permanent
Public Use	Training Technician	NA	GS-07	PT Permanent
Administration	Administrative Officer	0303	GS-09	FT Permanent
Administration	Fire Program Technician	0303	GS-07	FT Permanent
Administration	Administrative Assistant	0303	GS-03	PT Temporary
Fire Management	Fire Management Officer	0401	GS-12	FT Permanent
Fire Management	Prescribed Fire Specialist	0401	GS-11	FT Permanent
Fire Management	Station Manager (2)	0462	GS-7	FT Permanent
Fire Management	Fire Fighter (4)	0462	GS-5	FT Permanent
San Bernard National Wildlife Refuge				
Management/Supervision	Refuge Manager	0485	GS-12	FT Permanent
Management/Supervision	Wildlife Refuge Specialist	0485	GS-11	FT Permanent
Biology	Biological Technician	0404	GS-4	FT Temporary
Maintenance	Engineering Equipment Operator	5716	WG-10	FT Permanent
Maintenance	Maintenance Mechanic	4749	WG-09	FT Permanent
Maintenance	Laborer (2)	3502	WG-02	FT Temporary
Big Boggy National Wildlife Refuge				
Maintenance	Maintenance Mechanic	4749	WG-09	FT Permanent
Brazoria National Wildlife Refuge				
Management/Supervision	Refuge Manager	0485	GS-12	FT Permanent
Management/Supervision	Wildlife Refuge Specialist	0485	GS-09	FT Permanent
Facilities	Facilities		GS-09	FT

Function / Program				
	Operation Specialist			Permanent
Maintenance	Maintenance Mechanic	4749	WG-09	FT Permanent
Youth Program	YCC Enrollee (4)			

Table 5-2. Additional Personnel Needs beyond Current Levels

San Bernard National Wildlife Refuge				
Biology	Invasive Sp. Biologist	0404	GS-9/11	FT Permanent
Maintenance	Maintenance Worker	4749	WG-8	FT Permanent
Visitor Services	Outdoor Recreational Planner	0025	GS-7/9	FT Permanent
Biology	Biological Technician	0404	GS-5/7	FT Permanent
Brazoria National Wildlife Refuge				
Administration	Administrative Assistant (Clerk)	0303	GS-4	FT Permanent
Biology	Invasive Sp. Biological Technician	0404	G-7/9	FT Permanent
Maintenance	Maintenance Worker	4749	WG-8	FT Permanent

5.1.2 Budget

5.1.2.1 Existing Budget

Table 5-3 details the each refuge's base operational and maintenance budget in fiscal year 2011 of \$3,053,687. The Complex received additional project-specific funds totaling \$320,929 during 2011. The Complex used project funds to rehabilitate a 130-acre bottomland unit that had a wildfire in 2008, develop the Refuge Jr. Naturalist Program, treat invasive species, and fund a Youth Conservation Corp program among others.

Table 5-3 reflects the funds needed to maintain current levels based on FY 2011 dollars. The planning team calculated projections for staff costs as salary plus 25 percent. Long-term adjustments to the base operational budget reflect not only short-term adjustments, but also implementation of projects currently identified in the Refuge Operational Needs System (RONS) and Service Asset Maintenance Management (SAMMS) databases.

Table 5-3. 2011 Base Operational Budget for Complex

Refuge Base Operational Budget (includes administrative, maintenance, and biological staff and program costs)	\$848,934	\$339,262	\$82,607	\$263,184	\$1,523,987
Full Implementation Projected		\$702,543		\$530,959	\$2,165,043
Annual Maintenance	\$15,678	\$73,748	\$15,364	\$92,185	\$196,975
Public Use (includes volunteer and public use staff and program costs)	\$228,760	\$74,463		\$60,072	\$363,295
Full Implementation Projected		\$209,712			\$504,439
Law Enforcement (includes staff and program costs)	\$218,780				\$218,780
Fire Program (includes staff, program, and Rx project costs; Complex-wide)	\$740,650				\$740,650

Special Project Funding

Vehicle Replacement	\$64,406	\$56,500
Rental Funds (Complex-wide)	\$9,000	\$15,000
Burned Area Rehabilitation Project	\$19,150	
Invasive Species Projects (Complex-wide)	\$24,500	\$25,000
Youth Conservation Corp	\$22,410	\$21,400
Equipment Replacement (tractor)	\$22,384	\$75,000

Type 6 Fire Engine Replacement	\$128,579	
BP – Emergency Restoratation – Sea turtle recovery	\$23,000	\$20,000
Youth Initiative (Refuge Jr. Naturalist)	\$5,000	\$5,000
Mottled Duck Banding	\$2,500	\$2,500

Refuge Operational Needs System

The Refuge Operational Needs System (RONS) is the mechanism that the refuges use to justify needed funds and personnel for new programs and projects necessary to meet legal mandates, refuge plans, and Departmental and Service directives. All refuges use this database to compete for dollars needed to adequately fund programs. Staffing levels are set through a separate mechanism and only applies to the refuges rather than the Complex office for non-law enforcement staff. RONS allocated 10 positions for Brazoria NWR, and they currently have four positions on the existing organization chart. Brazoria NWR needs three additional positions identified in the table above to fully implement this CCP. However, this Plan identifies an additional three positions, as allowed in RONS, below. In addition to the six positions, Brazoria NWR has two habitat projects for a total RONS list totaling \$572,196. San Bernard NWR is allocated eight staff in RONS and currently has four staff members. San Bernard NWR has three positions (note: the fourth position is identified as a reality specialist to support Region-wide needs) and seven habitat/wildlife projects in the current RONS database for a total cost of \$1,879,831. Two additional positions are identified in the approved PPP for expanding the approved acreage of the Austin Woods Conservation Project from 28,000 acres to 70,000 acres are identified below, bringing the total to \$2,068,531. RONS allocated three staff to Big Boggy NWR, which currently has only one staff member. These two additional positions and two projects to control erosion bring the Big Boggy NWR RONS database total to \$1,658,495. Although the staff is a recurring need, many of the habitat projects do not have recurring needs. Due to budget tightening, the availability of fire funds for prescribed burning has declined. In FY 2011, the Complex used \$25,000 from the main operational account to supplement fire project funds and complete the required habitat burning. For this reason, Big Boggy NWR entered RONS projects into the system to support prescribed burning across the Complex. The section on Complex-wide needs compiles and lists all of these. See Table 5-4 for summary.

Service Asset Maintenance Management System

The Service Asset Maintenance Management System (SAMMS) is a database the refuges uses to document and justify significant maintenance projects and equipment replacement. The Brazoria NWR SAMMS database currently lists seven deferred maintenance and five capital improvement projects; totaling \$1,828,984. The San Bernard NWR SAMMS project list currently has 10 deferred projects and six capital improvement projects identified for a total of \$1,410,060. Big Boggy NWR has two deferred and two capital improvement projects for a total of \$291,429. See Table 5-4 for summary.

5.1.2.2 Additional Budget Needs

Table 5-4 identifies budget needs, beyond current levels, as identified in the RONS and SAMMS databases as well as the Austin’s Woods PPP.

Table 5-4. Staffing and Project Needs identified in SAMMS and RONS.

Brazoria National Wildlife Refuge				
Maintain and Enhance Refuge Habitats (Maintenance Worker)	FT Staff	77,650	-	77,650
Enhance Biological Monitoring (Biological Technician)	FT Staff	72,806	-	110,300
Improve Refuge Administration and Efficiency (Clerk)	FT Staff	57,962	-	57,962
Maintain wetland levees, water conveyance structure, facilities, and roads (Engineering Equipment Operator)	FT Staff	88,133		88,133
Park Ranger	FT Staff	90,184		90,184
Monitor wetland restoration efforts. (Biologist)	FT Staff	133,461		133,461
Replace Boundary and Hunt Area Signs (WO-2007735961)	Deferred Maintenance		15,000	
Rehabilitate Clay Banks Access Road (WO-2010135586)	Deferred Maintenance		15,135	
Rehabilitate Salt Lake Road (WO-2006480033)	Deferred Maintenance		172,000	
Replace culverts and water control structures on Big Slough (WO-2010122944)	Deferred Maintenance		40,000	
Widen and upgrade Otter Slough Road (WO-2010123044)	Capital Improvement		325,000	
Convert Electric Lights at Fishing Pier to Solar Voltaic (WO-2010122813)	Capital Improvement		50,000	
Drill high capacity ground water well at Moist Soil Units. (WO-2010122946)	Capital Improvement		250,000	

Project				
Replace battery room at Discovery Center with stand alone, explosion proof building	Capital Improvement		85,000	
Construct wash rack with water recovery system at Brazoria Field Office	Capital Improvement		160,000	
Plug abandoned waterwells (WO-05139591)	Deferred Maintenance		55,000	
Replace deteriorated wood/metal storage building (WO-05139587)	Deferred Maintenance		644,749	
Replace and update interpretive panels across Brazoria NWR (WO-2007735939)	Deferred Maintenance		17,100	
Maintain clear water movement capabilities to improve drainage	Habitat Management	83,000		10,000
Restore water holding capability and management on Otter Slough	Habitat Management	19,000		6,000
San Bernard National Wildlife Refuge				
Manage invasive species and increase partnerships.	FT Staff	133,461		133,461
Conduct biological monitoring and implement habitat management program.	FT Staff	90,184		90,184
Outdoor Recreation Planner (RONS and PPP)	FT Staff	110,311		110,311
Manage Austin Woods Units (identified in PPP for expansion of Austin's Woods Project to 70,000 acres)	FT Staff	120,300		120,300
Maintenance Worker (identified in PPP for expansion of Austin's Woods Project to 70,000 acres)	FT Staff	68,400		68,400
Shoreline Protection of Sargent Unit Marsh	Habitat Protection	741,875		4,000

Chapter 5: Plan Implementation and Monitoring

Project				
Enhance hydrological management opportunities in Moccasin and Rail Ponds	Habitat Management	25,000		10,000
Wolfweed wetland expansion project	Habitat Management	21,000		
Terrace project for shoreline protection along eroding banks of Cowtrap marsh	Habitat Protection	145,800		
Sea Turtle Recovery Program	Wildlife Enhancement	9,000		3,000
Three-toed Box Turtle Survey	Wildlife Enhancement	1,700		
Restore eroding banks of Cow Trap Marsh	Habitat Protection	601,500		
Replace deteriorated tractor shed with structure that meet today's building standards for hurricane wind loads.	Deferred Maintenance		40,000	
Road Projects Rehabilitate Public Use Roads (WO-04135421) Rehabilitate Big Pond Road (WO-04135458) Rehabilitate Cow Trap Marsh Road (WO-97108019)	Deferred Maintenance		386,000 39,060 42,500	
Demolition of apartment on Hudson Woods East (WO-2008803825)	Deferred Maintenance		10,000	
Replace Quonset hut used for hurricane response on Hudson Woods East	Capital Improvement		125,000	
Install 10 KW photovoltaic system at San Bernard HQ (WO-210121764)	Capital Improvement		150,000	
Rehabilitate domestic water supply well and install filtration system (WO-2010121765)	Capital Improvement		85,000	
Expand RV volunteer pad sites (WO-2010125775)	Capital Improvement		30,000	

Project				
Rehabilitate field irrigation wells Sargent (WO-2010121777)	Deferred Maintenance		60,000	
Wolfweed (WO-2010121778)			50,000	
Repaint metal storage, and shop buildings (3).	Deferred Maintenance		45,000	
Replace overhead doors on mechanic shop	Deferred Maintenance		7,500	
Add crushed limestone base to the tops of the Wolfweed levees.	Capital Improvement		150,000	
Replace Boardwalk surface at Bobcat Woods with recycled plastic lumber (WO-2010121779)	Deferred Maintenance	-	30,000	
Construct equipment wash facility with recovery system (WO-2010121766)	Capital Improvement	-	160,000	
Big Boggy National Wildlife Refuge				
Facilitate Habitat Management	FT-Staff	90,184		90,184
Develop and direct habitat mgmt, public use, easement acquisition and enforcement, facility maintenance, and community relations.	FT-Staff	110,311		110,311
Preserve and restore Dressing Point Island Rookery	Habitat Protection/Wildlife Enhancement	745,000		
Shoreline Protection and Restoration along the Gulf Intracoastal Waterway	Habitat Protection	713,000		
Replace deteriorated boundary posts and signs (WO-2007736003)	Deferred Maintenance		12,848	
Rehabilitate sac-create wave-barrier on Dressing Point Island (WO-05139643)	Deferred Maintenance		49,081	

Project				
Rehabilitate Roads	Capital Improvement		170,000	
Re-surface 2 miles dirt access roads (WO-2010121772)				
Resurface Hunter Access Road (WO-2010121774)			59,500	
Texas Mid-coast Complex-wide				
Average Annual Equipment Replacement Needs	Equipment Replacement-Complex	-	75,000	75,000
Support of Fire Program Projects	Habitat Management/Restoration-Complex	63,000		63,000

5.2 Appropriate Refuge Uses and Compatibility

5.2.1 Appropriate Refuge Uses

All uses of a national wildlife refuge over which the Service has jurisdiction must be determined to be appropriate under the Appropriate Refuge Uses policy (603 FW 1). If an existing use is not appropriate, the refuge manager will deny the use without determining compatibility (see Section 5.2.2). An appropriate use of a national wildlife refuge is a proposed or existing use that meets at least one of the four following conditions:

1. The use is a wildlife-dependent recreational use as identified in the Refuge System Improvement Act (i.e., hunting, fishing, wildlife observation and photography, and environmental education and interpretation);
2. The use contributes to fulfilling the refuge purposes, the Refuge System mission, or goals or objectives described in a refuge management plan approved after October 9, 1997, the date the Refuge Improvement Act was signed into law;
3. The use involves the take of fish and wildlife under state regulations;
4. The refuge manager has evaluated the use following guidelines in the Service Manual 603 FW 1.11 and found it appropriate.

5.2.2 Compatibility

In accordance with the Refuge Improvement Act of 1997, no uses for which the Service has authority to regulate may be allowed on a unit of the National Wildlife Refuge System unless it is determined to be compatible. A compatible use is a proposed or existing wildlife-dependent recreation use, or any other use of a national wildlife refuge that, in the sound professional judgment of the refuge manager, will not materially interfere with or detract from the fulfillment of the National Wildlife Refuge System mission or the purposes of the national wildlife refuge.

Compatibility determinations are not required for refuge management activities except economic activities. Examples of refuge management activities that do not require a compatibility determination include: invasive species control; prescribed burning; water level management; routine scientific monitoring, studies, surveys, and censuses; historic preservation activities; law enforcement activities; and maintenance of existing refuge facilities, structures, and improvements. Economic uses (i.e., farming, haying, grazing) of a natural resource must contribute to achieving refuge purposes and the Refuge System mission. They are also not required where statute directs mandatory approval of the activity, as in the case of facilities for national defense (603 FW 2, section 2.10).

The Service re-evaluates compatibility determinations for existing hunting, fishing, wildlife observation and photography, and environmental education and interpretation with the preparation or revision of a CCP or at least every 15 years. The Service must re-evaluate compatibility determinations for all other uses every 10 years or earlier if conditions change or significant new information relative to the use and its effects becomes available. Refuge managers must complete a written compatibility determination for each use, or collection of like-uses, signed by the manager and the Regional Refuge Chief. If the Service finds a use to be incompatible, the refuge will follow normal administrative procedures for stopping the action.

Appendix D contains 13 compatibility determinations drafted as part of this comprehensive conservation planning effort, including:

- Hunting
- Fishing
- Wildlife Observation – Brazoria
- Wildlife Observation – San Bernard
- Wildlife Photography
- Environmental Education
- Interpretation
- Cooperative Farming
- Boating including launch sites
- Hiking
- Bicycling
- Mosquito control
- Livestock Grazing

5.3 Intra-Service Section 7 (Endangered Species Act Consultation)

The Complex conducted an Intra-Service Section 7 consultation for the implementation of CCP objectives and strategies with the Clear Lake Ecological Services Field Office (see Appendix G).

5.4 Step-Down Management Plans

The Complex will accomplish the implementation of this CCP, in part, through various step-down management plans (see sections 5.3.1 and 5.3.2). Each step-down plan has its own program focus, identifying, and directing the implementation of strategies (i.e., actions, techniques, and tools) designed to achieve programmatic objectives outlined in the CCP.

5.4.1 Current Step-Down Plans

Current step-down management plans for the Complex include the following:

Biological Management Step-Down Plans

Hog Management Plan

The Complex completed the Feral Hog Management Plan in 2004. The plan addresses the need to control feral hogs on the refuges. Uncontrolled, hogs damage native vegetation, compete with native species, and enable the spread of invasive plants. The plan outlines procedures and conditions associated with issuing special use permits for trapping and hunting with the aid of hounds and opportunity for public hunting. In addition, the plan provides for aerial hunting or take by authorized staff.

Fire Management Plan

The Complex signed the Fire Management Plan in 2001. A new plan is currently awaiting review and signature. The plan outlines goals, objectives, and strategies of the fire management program on the Complex. This plan is scheduled to be completed in June 2012.

Visitor Services Step-Down Management Plans

Refuge Exhibit Plan

The Refuge Exhibit plan is prepared for individual public use areas. Only one Refuge Exhibit Plan has been prepared to date and signed in 2009. This plan details exhibit concepts for interpretation at the Discovery Center. Refuge Exhibit Plans will be addressed in the new Visitors Services Plan.

Facilities/Infrastructure Step-Down Management Plans

Hurricane Preparedness and Response Plan

The Complex reviews and approves a Hurricane Preparedness and Response Plan annually. The plan identifies preparedness throughout hurricane season and actions and responsibilities if the potential of a strike occurs. The Complex will not place protection of Service assets above the safety of Service personnel.

Safety Plan

The Complex updates the Safety Plan, a working document that requires annual review, updated every three years. The refuge updated the plan in March 2012.

Aviation Plan

The Aviation Plan outlines the use of aircraft on the Complex. The Complex signed the original plan in 2002 and an updated plan in December 2011.

Spill Prevention and Counter Measure Contingencies

San Bernard NWR is the only station with a Spill Prevention Plan. The minimum criterion for the requirement of this plan is storage of 1,600 gallons of fuel. San Bernard NWR signed the plan, which outlines the presence of storage facilities, spill prevention guidelines, and

post spill management, in 2007. With the new Otter Slough Headquarters at Brazoria NWR, a request for a Spill Plan was made through the Environmental Management Officer in 2011.

Environmental Management Plan

The Environmental Management Plan outlines all environmental issues including water quality, hazardous material, training, and greening opportunities. The Complex updates the plan annually.

5.4.2 Future Step-Down Plans

The Complex will draft the following list of step-down management plans to guide management of specific refuge programs:

Biological Management Step-Down Plans

Hunt Management Plan

The Complex will revise and update the existing Hunt Management Plan to include the Public Waterfowl Hunting Areas, permit waterfowl hunts, the youth deer hunt in partnership with TPWD, and the Youth Hog Hunt in partnership with Texas Youth Hunting Program. This plan is scheduled for completion in 2015.

Integrated Pest Management Plan

An integrated Pest Management Plan will describe the use of mechanical, fire and herbicide applications for the control and eradication of invasive species. This plan has been initiated is scheduled for completion in 2015.

Fisheries Management Plan

A Fisheries Management Plan will describe fishery resources and aid in the management of fish resources across refuge waters. This plan is scheduled for completion in 2017.

Habitat Management Plan

The Complex drafted the Habitat Management Plan in 2007 and scheduled finalization of this plan for 2013.

Hydrologic and Water Resources Plan

The Complex will implement a Hydrologic and Water Resources Plan, which will describe various types of water projects, to support management objectives. Water projects will encompass areas including water quantity, water quality, water rights, water infrastructure, climate change, sedimentation, and erosion. The primary goal of these projects will be to provide hydrologic information to guide management decisions related to maintenance, restoration, and enhancement of refuge habitats. This plan is scheduled for completion in 2015.

Visitor Services Step- Down Management Plans

Visitor Services Plan

The Service completed a Visitors Services review for the Complex in April of 2010. Using information from that review, the Complex will develop a Visitors Service Plan that describes how Texas Mid-coast NWR Complex will provide recreational opportunities. The plan will describe public access points, hunting, fishing, and wildlife observation opportunities that are provided by Complex, as well as descriptions of those public uses that are prohibited, such as camping.

Interpretive Plan

The Interpretive Plan describes in detail all of the areas of the refuges where interpretation may occur. The areas described include the Discovery Center, Big Slough Recreation Area, Otter Slough, Cocklebur Slough Recreation Area, San Bernard Oak, Dow Woods, and Hudson Woods. The new interpretive plan will be included in the Visitors Services Plan.

Sign Management Plan

The Sign Management Plan identifies the need and use of appropriate signage for information and law enforcement needs. This plan is scheduled for completion in 2015.

Facilities/Infrastructure Step-Down Management Plans

Oil and Gas Management Plan

The Oil and Gas Management Plan will define management objectives and ensure protection of refuge habitats and wildlife during oil and gas operations. This plan is scheduled for completion in 2015.

Law Enforcement Plan

A Law Enforcement Plan will describe the need and ensure the consistence of application for the protection of refuge resources and the safety of the public. This plan is scheduled for completion in 2015.

5.5 Refuge Projects

The planning team identified the following list of projects are needed to fulfill the goals and objectives identified in Chapter 4, Management Direction.

5.5.1 Existing Projects

5.5.1.1 Biological Management Projects

Prairie Management and Restoration

With less than 1 percent of the native coastal prairie habitats still in existence, the Complex will restore coastal prairie habitats, including their hydrological component, where applicable, and manage prairie habitats in order to enhance species diversity among both plants and animals. Current targeted areas include Brazoria NWR, northeast corner of San Bernard NWR, Buffalo Creek Unit, and Halls Bayou Unit. Management actions include

implementation of prescribed fire, control of invasive species, restoration of the hydrological component, and spreading seed or direct planting to encourage diversity. Associated research and monitoring include grassland birds, effectiveness of herbicide treatments, species diversity, fire intensity and effects, yellow and black rail use, and stable isotope analysis.

This project supports achievement of the Ecoregional Goal (4.1), Coastal Prairie Objective (Obj. 2) under Habitat Management (Goal 4.2), and the Waterfowl (Obj. 1) and Grassland and Secretive Marsh Birds (Obj. 3) Objectives under Wildlife (Goal 4.3) as identified in Chapter 4, Management Direction.

Bottomland Management and Restoration

Although the primary focus of the Austin Woods Conservation Program is the conservation of high quality bottomland forests, restoration activities may be required. Where the hydrology has been altered to reduce holding capacity or increase surface flow water, the Service will install water control structures or fill ditches to restore water holding capacity. Rest from disturbance and allowing natural succession of hardwood species is the primary means for restoring forests. However, where haying, mowing, or agriculture repeatedly disturb the land and an over-story no longer exists, planting bare-root seedlings or young trees to encourage regrowth of hardwood species or add diversity will be completed. In addition, the refuge may apply herbicide via a ground sprayer to control invasive species in these restoration areas. Research and monitoring associated with this project include wintering forest songbird banding, spring migratory songbird banding, Swainson's and prothonotary warbler nesting, bird call point counts in late winter and spring, and flora inventory.

This project supports achievement of Objective 2 Conservation of Columbia Bottomlands Ecosystem under the Ecoregional (Goal 4.1), the Bottomland Hardwood Forest Objective (Obj. 1) under Habitat Management (Goal 4.2) and the Forest Birds Objective (Obj. 2) under the Wildlife (Goal 4.3) as identified in Chapter 4, Management Direction.

Moist-soil Management

Fresh water is extremely limiting, particularly during droughts on the coastal plain. All three refuges developed moist-soil units to provide fresh water habitat. Dual management of the rice fields gains additional moist-soil units at Brazoria NWR. Providing fresh water habitat involves management of the ponds including disking, rolling vegetation, water manipulation, herbicide application, and supplementing rainfall. Supplemental water may be obtained through purchase of water from water authorities, ground pumping through operation of wells, or diversion from natural flow. Research and monitoring associated with this project include monthly aerial winter waterfowl counts, mottled duck nesting survey, summer waterfowl banding, and shorebird counts.

This project supports achievement of the Wetlands Objective (Obj. 3) under Habitat Management (Goal 4.2) and the Waterfowl (Obj. 1) and Shorebird (Obj. 5) Objectives under the Wildlife Goal (4.3) as identified in Chapter 4, Management Direction.

Manage Colonial Waterbird Colonies

Several colonial waterbird colonies are located on or near refuge lands that require regular maintenance to protect from predators (raccoons), invasive species (red-imported fire ants), and disturbance in order to maintain productivity. The refuge completes an annual count on all refuge colonies and adjacent colonies (Hoskin’s Mound and General Land Officer (GLO) islets) and hopes to partner with both Chevron-Texaco and GLO on the protection and enhancement of these colonies.

This project supports achievement of the Ecoregional Goal (4. 1) and Colonial Waterbird Colonies Objective (Obj. 4) under the Wildlife Goal (4.3) as identified in Chapter 4: Management Direction.

Manage and Protect Beach Resources

The Gulf beach of the San Bernard NWR provides a unique wildlife resource. In order to protect wildlife habitat, the refuge restricts the use of the beach to non-motorized access. Visitors may walk or bicycle along the beach, which protects the beach and dunes. The beach is accessible by boat and from Sargent Beach when the Cedar Lakes cut fills in. Posts and signs mark the no vehicle access at the cut. Monitoring associated with this project includes annual shorebird counts and 5-year plover counts.

This project support achievement of the Shorebird (Obj. 5) and Reptiles (Obj. 6) under the Wildlife Goal (4.3) as identified in Chapter 4, Management Direction.

Protection of Marsh Habitats

The refuge protects the salt marsh habitat and has conducted small restoration or erosion projects in the past. These habitats are particularly fragile to repetitive encroachment including the use of rubber-tired or tracked vehicles, cattle and feral hog trails and goose eat outs. The refuge completes small restoration projects including the planting of smooth cord grass, shoreline riprap, and plugging small, eroded channels with bags of secrete or hay bales. Protection of this habitat during oil and gas exploration activities, pipeline construction, or other encroachment is critical to enabling natural accretion and minimizing loss of marsh habitats to sea level rise. Research and monitoring associated with this project includes black and yellow rail research, monthly winter waterfowl counts, and colonial waterbird counts.

This project supports achievement of the Wetlands Objective (Obj. 3) under Habitat Management (Goal 4.2) and the Waterfowl (Obj. 1), Grassland and Secretive Marsh Birds (Obj. 3), Colonial Waterbirds (Obj. 4) and Shorebird (Obj. 5) Objectives under the Wildlife Goal (4.3) as identified in Chapter 4, Management Direction.

5.5.1.2 Visitor Services Management Projects

Provide Public Use Opportunities and Maintain Facilities Associated with Public Use Areas

Maintain the Big Slough and Cacklebur Slough auto-tour loops and associated roads, pull-offs, parking areas, observation platforms, trails, and etc. at Brazoria NWR and San Bernard

NWR as the primary public use areas offering wildlife observation, photography, interpretation, fishing, and environmental education opportunities. Maintain secondary public use areas, including Dow Woods, Hudson Woods, Betty Brown, and San Bernard Oak Trail at San Bernard NWR and Bastrop Bayou fishing pier at Brazoria NWR, along with associated trails, parking areas, piers, and interpretive signs that offer wildlife observation, photography, interpretation, and fishing opportunities.

This project supports achievement of the Visitation, Wildlife Observation, Photography, Interpretation, Fishing, Environmental Education, Law Enforcement, and Cultural Resources Objectives (Obj. 1, 2, 3, 4, 6, 7, and 10) under the Recreation Goal (4.4) and Public Use Facilities (Obj. 1) under the Facilities Goal (4.5) as identified in Chapter 4, Management Direction.

Hunting Programs

The waterfowl hunting program on the refuges provide wildlife-dependent public use opportunities. Waterfowl hunting within the Public Waterfowl Hunting Areas will continue and may expand as new compatible opportunities arise through acquisition of additional lands. The San Bernard will continue to partner with TPWD's, Stringfellow Wildlife Management Area, providing the opportunity for youth to participate in the three deer and hog hunt weekends. San Bernard and Brazoria NWRs will continue to partner with the Texas Youth Hunting Program, providing a hog hunting opportunity for youth as an introduction to hunting.

This project supports achievement of the Hunting Objective (Obj. 5) under the Public Use Goal (4.4) as identified in Chapter 4, Management Direction.

Discovery Environmental Education Program (DEEP)

Provide quality, hands-on environmental education programs through the DEEP at Brazoria NWR, Hudson Woods Unit, and San Bernard NWR, in partnership with the Texas Master Naturalist. Maintain all DEEP facilities, providing a safe and enjoyable learning environment.

This project supports achievement of the Environmental Education (Obj. 7) under the Recreation Goal (4.4) as identified in Chapter 4, Management Direction.

Volunteer Program

Volunteers contribute over 12,000 hours annually to the Complex. Public Use Programs, including Environmental Education and Outreach, extensively rely on volunteers. In addition, volunteers are an essential component in conducting research and biological censuses. RV volunteers maintain the public use areas through mowing roadways, trails and maintaining the observation decks, and other facilities.

Maintaining Volunteer Programs supports achievement of the Environmental Education (Obj. 7), Interpretation (Obj. 4), Outreach (Obj. 8), and Partnerships (Obj. 10) under the Recreation Goal (4.4) and Public Use Facilities (Obj. 1) and Administrative, Maintenance,

and Storage Facilities (Obj. 2) under the Facilities Goal (4.5) as identified in Chapter 4, Management Direction.

5.5.2 Future Projects

5.5.2.1 Biological Management Projects

Slop Bowl Marsh Restoration

Drainage, commerce, pollution, erosion, subsidence, agricultural and grazing activities alter natural wetland functions across the region. Preservation and restoration of the remaining wetland habitats is essential to maintaining plant and wildlife diversity. These areas serve a major role by providing nursery grounds for shell and fin fish, buffering storm surges, and filtering pollutants. The Complex can influence those outside the boundaries by preserving refuge wetlands, which support large populations of migratory birds, and sustainable commercial and recreational fisheries. Current targeted areas for restoration include the Slop Bowl unit located on the southern portion of Brazoria NWR. The Slop bowl marsh has degraded due to subsidence and saltwater intrusion. Management actions include implementation of prescribed fire, control invasive species, eliminate trespass grazing, restore hydrological component, reduce saltwater intrusion, and spreading seed or direct planting to encourage diversity.

This project supports achievement of the Wetlands Objective (Obj. 3) under Habitat Management (Goal 4.2) and Ecoregional (Goal 4.1), and the Waterfowl (Obj. 1) and Grassland and Secretive Marsh Birds (Obj. 3) Objectives under Wildlife (Goal 4.3) as identified in Chapter 4, Management Direction.

Treatment of Invasive species in Bottomlands, Prairies, and Wetlands

Invasive plant species spread rapidly and quickly displace native plants, degrading habitat value for wildlife. The Complex will work with partners to identify the most effective and environmentally conscious treatment methods to address existing populations specifically targeting avenues of dispersal (Rights-of-way, waterways, restoration areas, etc.) to control invasive plant species on refuge lands. Current threats to native species include Chinese tallow, deep-rooted sedge, trifoliolate orange, McCartney rose, water hyacinth and others. The refuge will carefully monitor all individual treatments to assess efficacy, non-target effects, and the need or frequency of follow-up treatments.

This project supports achievement of the Bottomland Hardwood Forest (Obj. 1), Coastal Prairie Obj. 2), and Wetland (Obj. 3) Objectives under Habitat Management Goal (Goal 4.2) as identified in Chapter 4: Management Direction.

Restoration of Eagle Nest Lake Prairies

The acquisition of the Eagle Nest Lake Property brought not only quality bottomland hardwood habitat and associated wetlands, but also retired agricultural lands. The Complex will actively restore these converted prairies to native coastal prairie through a variety of techniques using local plant and seed sources, and working with partner prairie restoration organizations and experts to re-create this vanishing habitat type. Techniques may include,

but are not limited to, re-seeding, sprigging, transplanting, spreading native prairie hay for seed and mulch, prescribed fire, and treatment of invasive species. All work, including management actions will be coordinated with the NRCS office, which has a Conservation Easement on the property.

This project supports achievement of the Coastal Prairie Objective (Obj. 2) under Habitat Management Goal (Goal 4.2), and Waterfowl (Obj. 1) and Grassland and Secretive Marsh Birds (Obj. 3) Objectives under Wildlife Goal (Goal 4.3) as identified in Chapter 4, Management Direction.

Restoration of Salty Prairie and Coastal Prairie on Sargent-North

The acquisition of the McCormick/Williamson property north of the original Sargent Unit requires restoration of salty prairie and coastal prairie habitats. The Complex will actively restore these degraded prairies to native prairie through a variety of techniques using local plant and seed sources, and working with partner prairie restoration organizations and experts to re-create this vanishing habitat type. Techniques may include, but are not limited to re-seeding, sprigging, transplanting, spreading native prairie hay for seed and mulch, prescribed fire, and treatment of invasive species. In addition, small shallow water impoundments will be constructed by installing water control structures to impound freshwater for waterbirds and waterfowl. Mottled ducks and black rails will be the indicator species for prairie conditions. All work, including management actions will be coordinated with the NRCS office, which has a Conservation Easement on the property.

Erosion Control and Bank Stabilization to Protect Wetlands and Marshes

Several critical marshes, wetlands, riparian banks and islands on the Complex are currently threatened by eroding soil conditions. This erosion can lead to increased salinity and turbidity, loss of freshwater habitat, loss of nesting habitat for colonial waterbirds, and loss or degradation of submergent and emergent aquatic vegetation. Primary causes of erosion on the Complex are the GIWW and associated wakes from barges, and wind-driven waves. The Complex will employ a variety of proven techniques including geo-tubes, breakwater structures, terracing, weirs, gabions, reef domes, beneficial dredge use, and others to address specific cases of habitat loss due to erosion. We will work with partners in the conservation community to seek funding sources for priority projects.

This project supports achievement of the Wetlands Objective (Obj. 3) under the Habitat Management Goal (Goal 4.2), and the Waterfowl (Obj. 1) and Colonial Waterbird Colonies (Obj. 4) Objectives under the Wildlife Goal (Goal 4.3) as identified in Chapter 4, Management Direction.

Turkey Reintroduction in the Columbia Bottomlands

As the Austin's Woods Partnership continues to grow and its footprint expands, the Complex will explore opportunities to release transplanted wild turkeys into suitably sized and appropriately conserved habitats within our influence. The counties within our acquisition boundary are home to very few remnant populations of the eastern subspecies of wild turkey. We will reach out to TPWD game bird biologists and other conservation organizations, such as the National Wild Turkey Federation to tap into their knowledge and expertise regarding

habitat requirements, suitability, and source populations, ensuring that these efforts have the support and guidance needed to be successful.

This project supports achievement of the Bottomland Hardwood Forest Objective (Obj. 1) under the Habitat Management Goal (Goal 4.2), and the Forest Birds Objective (Obj. 2) under the Wildlife Goal (Goal 4.3) as identified in Chapter 4, Management Direction.

Development of Artificial Rookery Structures

Several important colonial waterbird rookeries exist on the Complex. As suitable habitat continues to be lost, these sites will become even more critical to nesting birds of the area. We will research, design, test, and implement artificial rookery structures to supplement these sites, allow for increased bird use, and replace deteriorating natural structures. Possible sites for this project include the Wolfweed Wetland complex, Cedar Lakes islands, and Dressing Point Island, and Otter Slough.

This project supports achievement of the Wetlands Objective (Obj. 3) under the Habitat Management Goal (Goal 4.2) and the Colonial Waterbird Colonies (Obj. 4) and Shorebirds Objectives (Obj. 5) under the Wildlife Goal (Goal 4.3) as identified in Chapter 4, Management Direction.

5.5.2.2 Visitor Services Projects

Monthly Interpretive Programs

Expand current interpretive activities to include monthly interpretive programs across the Complex. Staff, volunteers, and other partners will provide these programs to enhance opportunities for the public to experience the Mid-coast refuges. The primary goals are to increase visitation to the refuge and improve community support for the refuges.

This project supports achievement of the Visitation (Obj. 1) and Interpretation (Obj. 4) Objectives under the Recreation Goal (4.4) as identified in Chapter 4, Management Direction.

Develop Cultural Resource Interpretive Program

Existing public use facilities will interpret original Native Americans and the spread and development of Native Americans, pioneers, oil prospectors, and ranchers to the area. The purpose of these displays will be to show how people have shaped the natural environment in the past and how they continue to impact the environment today. Examples include: interpreting how the agriculture and cattle influenced development in Brazoria County or how Native Americans and settlers used the plants and animals to survive on the Gulf Coast.

This project supports achievement Cultural Resources Objective (Obj. 11) under the Recreation Goal (4.4) as identified in Chapter 4, Management Direction.

Expansion of Discovery Environmental Education Program

San Bernard NWR will expand the Discovery Environment Educational Program (DEEP) to include the school districts of Brazoria, West Columbia, Sweeny, Bay City, and Van Vleck.

There is a demand for more field trips to serve the southern portion of the county, but expansion of the program will require additional volunteers. The Complex will seek opportunities to partner with school districts, colleges, Friends, and Texas Master Naturalists to expand DEEP.

This project supports achievement of the Environmental Education Objective (Obj. 7) of the Recreation Goal (4.4) as identified in Chapter 4, Management Direction.

Otter Slough Kiosk and Trail

Quality public use facilities enhance visitor experiences and encourage visitor's to return to the refuges; building a connection between the visitor and nature. The current trails are located on the southern half of the refuge and provide a salty prairie and woodlot habitat experience. The current targeted area includes the Otter Slough unit of Brazoria NWR, which is located on the northern boundary of the refuge leading visitors through a native coastal prairie ecosystem. Management actions will include construction and maintenance of a kiosk and hiking trail near the Brazoria NWR field office to provide a quality outdoor experience to visitors during office hours.

This project supports achievement of the Public Use Facilities Objective (Obj. 1) under Facilities (Goal 4.5), and the Visitation (Obj. 1), Wildlife Observation (Obj. 2), Photography (Obj. 3), and Interpretation (Obj. 4) Objectives under Recreation (Goal 4.4) as identified in Chapter 4, Management Direction.

Expansion of Interpretive Materials

The Complex will increase interpretation through the development of an interpretive guide for the San Bernard Auto Tour Loop, Spanish translation of interpretive brochures and development of portable interpretive displays. Portable interpretive displays will be suitable for use at outreach events as well as a static display. Translation of the general brochures and Big Slough Auto Tour into Spanish will enable the refuge to reach a wider audience.

This project supports achievement of the Visitation (Obj. 1) and Interpretation (Obj. 4) and Outreach (Obj. 8) Objectives under the Recreation Goal (4.4) as identified in Chapter 4, Management Direction.

Accessible Hunting Blind at Sargent Unit

The Complex currently offers no accessible waterfowl hunting locations on any of the refuges. The Sargent Unit of San Bernard NWR offers our most feasible opportunity to offer a quality waterfowl hunting experience for our mobility challenged users. The unit has all-weather access roads, fresh water and is currently open to limited permit hunting for ducks and geese. Working with possible partners in the sporting and conservation communities, we will design and construct an accessible blind and associated access on a managed wetland near the Pentagon Marsh. Construction of the managed wetland through installation of water control structures and limited earth-moving will also be necessary.

This project supports achievement of the Wetlands Objective (Obj. 3) under the Habitat Management Goal (Goal 4.2), the Hunting (Obj. 5) and Outreach Objectives (Obj. 8) under

the Recreation Goal (Goal 4.4), and the Public Use Facilities Objective (Obj. 1) under the Facilities Goal (Goal 4.5) as identified in Chapter 4, Management Direction.

Provide Educational Youth Fishing Event

In an effort to promote the Complex, fishing and outdoor recreation among area youth, we will develop an event highlighting beginning fishing tactics, equipment, and fisheries conservation. Potential freshwater venues could include Scoby Lake on the Hudson Woods Unit, and Eagle Nest Lake. By working with local conservation partners, State agencies, and sporting organizations we could deliver an opportunity for local and area youth to learn about and enjoy the sport of fishing.

This project supports the achievement of the Fishing (Obj. 6) and Environmental Education (Obj. 7), and Outreach Objectives (Obj. 8) under the Recreation Goal (Goal 4.1.4) as identified in Chapter 4, Management Direction.

5.5.2.3 Facilities/Infrastructure Management Projects

Shop and Equipment Storage Building

Throughout the refuges' history, facilities have slowly grown, and today, two field headquarters—including offices, maintenance, and storage facilities—and one Complex office provide the primary infrastructure supporting administrative, maintenance, biological, and management programs. The Brazoria NWR Field Office completed construction in January 2011 and was fully functional by the middle of February 2011, which has enabled the refuge to get out of GSA-leased space. Refuge administrative, maintenance, and storage facilities are critical for protecting government-owned equipment and staff essential to completing the refuges' mission. The proposed building will be located next to the Brazoria NWR Field Office. Management actions include construction and maintenance of a working shop and storage facility to provide support for all refuge programs.

This project supports achievement of the Administration, Maintenance, and Storage Facilities Objective (Obj. 2) under Facilities (Goal 4.1.5) as identified in Chapter 4, Management Direction.

Replacement of San Bernard NWR Field Office

The current field office at San Bernard NWR has served the Complex well, but it is in need of replacement. The mid-1980s concrete block design is inefficient to heat and cool, and the design is not visitor friendly. In addition, current and predicted staffing levels have outgrown our current office space. We seek to combine office space with the fire staff, also at San Bernard NWR, into one facility with more modern features and design elements that will create a more user and visitor friendly space that is energy efficient and accommodates anticipated staffing loads.

This project supports the achievement of the Public Use Facilities (Obj. 1) and Administrative, Maintenance, and Storage Facilities Objectives (Obj. 2) under the Facilities Goal (Goal 4.1.5) as identified in Chapter 4, Management Direction.

Replacement of Quonset Hut with Hurricane Evacuation Staging Area on San Bernard NWR

The Complex currently owns a Quonset hut building located on an inland tract used for staging emergency response equipment (boats, heavy equipment, marsh buggies, generators, etc.) during hurricane evacuations. It is our most protected storage facility, but is in dire need of replacement. We plan to erect a new facility on refuge property that is further inland and closer to a state highway for better access. The current building resides along a tree-lined county road that could be difficult to access following a large storm event. The Complex needs a facility that is accessible and structurally sound located far enough inland to be safe from major storms, but close enough for quick response when needed to secure property, provide access, and save lives following catastrophic events.

This project supports the achievement of the Law Enforcement Objective (Obj. 9) under the Recreation Goal (Goal 4.1.4), and the Administrative, Maintenance, and Storage Facilities Objective (Obj. 2) under the Facilities Goal (Goal 4.1.5) as identified in Chapter 4, Management Direction.

5.6 Partnerships

Because the refuge exists within a dynamic ecosystem and many of its resources are of national and international importance, members of the public, organizations, and other government agencies have interests in the refuge and the work the Service does. Successful implementation of many refuge programs requires active community participation, support, and assistance. Partnerships are among the best ways for the refuge to accomplish its work and fulfill its mission, and it seeks opportunities with others to do that work, including but not limited to the following stakeholders:

- Texas Parks and Wildlife Department
- Texas General Land Office
- U.S. Army Corp of Engineers
- Brazoria County Parks
- Natural Resource Conservation Service
- Houston Audubon
- National Fish and Wildlife Foundation
- Gulf Coast Bird Observatory
- Trust for Public Land
- The Conservation Fund
- Texas Master Naturalist
- Friends of Brazoria Wildlife Refuges
- Texas RICE

5.6.1 Existing Partnerships

5.6.1.1 Prairie Restoration and Wetland Improvement

Since 2008, the Complex has been working with Texas RICE on restoring prairie habitats and improving wetland management capability. Texas RICE has secured grant funding for herbicide application on invasive species, installation of new and replacement of deteriorated water control structures, and construction of levees to hold water on prairie habitats. The

Complex treated over 6,000 acres of Chinese tallow with back-to-back herbicide applications since 2008. In addition, management improved capabilities on 450 acres of existing wetlands and captured water on 540 acres of coastal prairie.

This project supports achievement of the Ecoregional Goal (4.1), Coastal Prairie Objective (Obj. 2) under Habitat Management (Goal 4.2), and the Waterfowl (Obj. 1) and Grassland and Secretive Marsh Birds (Obj. 3) Objectives under Wildlife (Goal 4.3) as identified in Chapter 4, Management Direction.

5.6.1.2 Austin Woods Conservation Project: A Partnership Project

The Austin Woods Conservation Project involves numerous partners who are working to conserve forested habitat in the Columbia Bottomlands. Primary Partners include National Fish and Wildlife Foundation, Natural Resource Conservation Service, TPWD, The Conservation Fund, Trust for Public Land, Houston Audubon, Gulf Coast Bird Observatory, and The Nature Conservancy. By the end of 2011, the refuge will conserve an estimated 35,000 acres of bottomland forest and adjacent coastal prairie.

This project supports achievement of Objective 2 Conservation of Columbia Bottomlands Ecosystem under the Ecoregional (Goal 4.1), Bottomland Hardwood Forest Objective (Obj. 1) under Habitat Management (Goal 4.2) and the Forest Birds Objective (Obj. 2) under the Wildlife (Goal 4.3) as identified in Chapter 4, Management Direction.

5.6.1.3 Kemp's Ridley Sea Turtle Recovery

The San Bernard NWR is a partner in the Kemp's ridley sea turtle recovery program. Refuge staff are the listed contacts for the upper Texas mid-coast from the Brazos River to the Colorado River. We respond to all stranding reports within the zone as well as assist adjacent zones when requested. San Bernard NWR takes all live sea turtle strandings to the National Oceanic and Atmospheric Agency facilities in Galveston. San Bernard NWR organizes and trains staff and volunteers to conduct nesting sea-turtle patrols on zone beaches. Refuge staff excavate all nests and transport them to National Park Service facilities on Padre Island.

In coordination with the National Park Service and National Oceanic and Atmospheric Association, this project supports achievement of the Ecoregional Goal (4.1) and the Reptile (Obj. 6) under the Wildlife Goal (4.3).

5.6.1.4 Texas Master Naturalist (Cradle of Texas Chapter)

The Cradle of Texas Chapter of the Texas Master Naturalists (TMN) is a vital component of the DEEP program, providing most of the volunteers needed to conduct hands-on environmental education activities on the refuges. The TMN volunteers come to us well-trained and highly motivated, and both adults and children are inspired by the programs developed and presented by these docents. Texas Master Naturalists provide an estimated 1,200 volunteer hours supporting DEEP annually.

Maintaining partnership with the Cradle of Texas Chapter of the Texas Master Naturalist supports achievement of the Environmental Education (Obj. 7) and Partnerships (Obj. 10) under the Recreation Goal (4.4).

5.6.1.5 Friends of Brazoria Wildlife Refuges

The Friends of Brazoria Wildlife Refuges started in 1992. The organization supports the Complex through outreach, environmental education, development of public use opportunities, and habitat restoration or improvement. Outreach, including the annual Migration Celebration and taking the Birds of Prey program to local schools, is the largest project. However, they have recently assisted with the development of public use opportunities in the Dow Woods Unit of San Bernard NWR and habitat restoration with Texas RICE.

Maintaining Friends Programs supports achievement of the Environmental Education (Obj. 7), Outreach (Obj. 8), and Partnerships (Obj. 10) under the Recreation Goal (4.4)

5.6.1.6 Wildlife Research Partnerships

The Complex partners with educational institutions on multiple research projects, which benefits the management of the refuges. Recent partnerships include the population and habitat use by diamond-back terrapins, phorid fly dispersal for the control of red-imported fire ants, carbon gas storage in the soils of bottomland forests, carbon storage in saltmarsh habitats, stable isotope analysis on black and yellow rail feathers, and benthic invertebrate sampling. The Complex will continue to partner with institutions where populations are not adversely impacted and the information gathered would benefit management decisions in the future.

This project supports achievement of the Ecoregional (4.1), Habitat Management (4.2), and Wildlife (4.3) Goals as identified in Chapter 4, Management Direction.

5.6.1.7 Gulf Coast Bird Observatory

The Complex regularly partners with the Gulf Coast Bird Observatory (GCBO) to conduct research and bird censuses both on and off refuges, and assist in outreach opportunities. Recently, Special Use Permits have been issued for conducting Raspberry crazy ant research on one of the bottomland units, capture and banding loggerhead shrikes, shorebird surveys, and capture and banding oyster catchers.

This partnership and the projects support achievement of the Ecoregional (4.1) Goal and Bird Objectives (1, 2, 3, 4 & 5) under the Wildlife (4.3) Goal as identified in Chapter 4, Management Direction.

5.6.1.8 Forest Bird Study Group

For the past 10 years, the Forest Bird Study Group, a group of experienced bird banders and volunteers with ties to the local birding club, Friends Group, and GCBO, have partnered with

the Complex conducting monthly winter songbird banding at the Big Pond Unit. The project, initiated by United States Geological Surveys, has carried on for 10 years, collecting data on wintering forest songbirds. In addition, the group assists in the annual Migration Celebration by catching and banding songbirds during the two-day event.

This partnership project supports achievement of the Ecoregional (4.1) Goal, the Forest Bird Objective (2) under the Wildlife (4.3) Goal, and the Outreach (Obj. 8) under the Public Use Goal (4.4) as identified in Chapter 4, Management Direction.

5.7 Memorandums of Understanding and Other Agreements

5.7.1 Brazoria County

A Memorandum of Agreement exists between Brazoria County and the Complex. In accordance with the agreement, the Service may assist Brazoria County with Wildland Fire Response and during all-risk (Hurricane) situations. Only the Counties Emergency Management Coordinator can make requests for assistance from the refuges.

5.7.2 Local Landowners

The Complex has Memorandums of Agreement with four adjacent landowners for management purposes. The agreements enable the Service the ability to burn across private lands during regularly scheduled prescribed burns. These agreements are essential for in-holdings and increase the opportunity to provide quality wildlife habitat on adjacent lands.

5.8 Monitoring and Evaluation

Monitoring helps the Complex track the progress of implementing the CCP. The results of monitoring show how the refuges achieve objectives and measures progress toward accomplishing goals. Table 5-5 displays proposed inventory and monitoring projects for fish, wildlife, and their habitats. Table 5-6 displays proposed monitoring indicators for public use. These proposed monitoring plans will be refined as various step-down management plans are drafted or revised.

5.9 Plan Amendment and Revision

Periodic review and change of this CCP will be necessary. As knowledge of refuge resources, user groups, and use evolves, the Complex may identify changes in management. Fish and wildlife populations, user groups, adjacent land users, and other management considerations change with time—often in unforeseen ways. The Complex may encounter challenges in trying to implement some portions of the CCP. Plan revision is a necessary part of the adaptive management approach used by the Service. This means that the Complex can adjust objectives and strategies identified to reach goals.

Service policy calls for an annual review of the CCP and revision when significant events or new information necessitate change in order to achieve the refuge purposes, vision, and goals

(602 FW 3). Refuge staff will informally review this CCP while preparing annual work plans, and may review it during routine inspections or programmatic evaluations. Results of the reviews may indicate a need to modify the CCP. The monitoring of objectives is an integral part of the CCP, and the Complex may modify management activities if they do not achieve desired results. If minor changes are required, the project leader will determine the level of public involvement and associated NEPA documentation that will be prepared. The Complex will formally revise this CCP at least every 15 years.

Table 5-5. Biological Inventorying and Monitoring Plan

Attwater's Prairie Chicken Habitat Pre-Assessment	Five years following the CCP's approval, complete a preliminary assessment of potential Attwater's Prairie Chicken Habitat	What is the quality of potential Attwater's prairie chicken habitat? What is needed to improve habitat? What other species of concern occupy it?	Vegetation density and diversity and invertebrate size characterization; winter and breeding grassland bird surveys; small mammal surveys	Records from APCNWR	Repeat on 5-year interval	Possible changes in habitat management and restoration techniques
Yellow Rail Habitat Assessment	Within three years following the CCP's approval, complete an assessment on wintering habitat for yellow rails	What are the key habitat variables affecting wintering yellow rail distribution?	Vegetation density and diversity and invertebrate size characterization in relation to burn unit age	Burn Unit Age	Measure vegetation, physical attributes and collect invertebrates at sampling points	Possible change in management actions including burn cycles

Project						
Black Rail Habitat Assessment	Within three years following the CCP's approval, complete an assessment on wintering and breeding habitat for black rails	What are the key habitat variables affecting black rail distribution during the breeding and non-breeding seasons?	Vegetation density and diversity and invertebrate size characterization in relation to burn unit age	Burn Unit Age	Measure vegetation, physical attributes, and collect invertebrates at sampling points	Possible change in management actions including burn cycles
Reptile and Amphibian Survey	Within five years following the CCP's approval, complete an inventory of reptiles and amphibians across all major habitat types on the Complex	What species are present? Are they associated with different management treatments?	Species diversity and density relative to burn unit age, moist soil unit treatment, forest stand age	Burn unit age; msu treatment; forest stand age	Repeat on 10 year interval	Possible change in management actions

Project						
Small Mammal Survey	Within five years following the CCP's approval, complete an inventory of small mammals across all major habitat types on the Complex	What species are present? Are they associated with different management treatments?	Species diversity and density relative to burn unit age, moist soil unit treatment, forest stand age	Burn unit age; msu treatment; forest stand age	Repeat on 10 year interval	Possible change in management actions
Secretive Marsh Bird Survey	Within three years following the CCP's approval, complete an inventory of breeding and wintering secretive marsh birds across fresh and salt marsh habitats	What species are present? Are they associated with different management treatments?	Species diversity and density relative to burn unit age, moist soil unit treatment	Burn unit age; msu treatment	Repeat on 3 year interval	Possible change in management actions
Bobwhite quail surveys across coastal prairie habitats	Within two years, initiate a bobwhite quail survey across coastal prairie habitats	Evaluate impact prairie restoration projects a having on the population of quail	Point Call Counts on prairies across the Complex.	Measure, year post burn and shrub component along with calls heard	Repeat annually for five years	Possible change in management actions including burn cycles or grazing

Project						
Raptor nest monitoring for white-tailed hawks and other hawks.	Within three years, initiate a raptor nest monitoring program on Refuge lands	Evaluate site selection, population levels, and nest success of raptors	Maintain an inventory of raptor nests identifying GPS location	Identify nest tree and surrounding vegetation. Identify management measures	Ongoing process, adding and deleting nest sites from database	Possible change in management actions
Alligator Survey	Within two years, initiate an alligator survey	Evaluate size and number of alligators across refuges	Population numbers	Survey transect lines, either aerial or by vehicle to estimate population.	Repeat every second year.	Identify population status and the need to reduce populations on refuges.
River Otter Survey	Within two years initiate a monitoring protocol to evaluate populations of river otters on the Complex	Evaluate population sustainability of river otters on the Complex	Population numbers	Survey transect lines, either aerial or by vehicle to estimate population.	Repeat annually.	Possible change in management actions to maintain populations.

Project						
White-tail deer Survey	Within 5 years initiate a monitoring protocol to evaluate populations of white-tailed deer on specific bottomland units	Evaluate population stability and growth across the larger bottomland units	Population estimates	Survey transect lines through bottomland habitats.	Repeat biannually	Possible change in management actions, including the development of a hunting program.
Bat inventory	Within 5 years, conduct an inventory on species of bats using refuges	Evaluate bat use of refuges	Survey a variety of areas using frequency recording device	Survey a variety of habitats to evaluate bat use.	Conduct for two years. Repeat every five years.	Possible change in management actions to maintain populations.
Complex Prescribed Burn Monitoring Plan	Within two months following the CCP's approval, implement the prescribed burn monitoring protocol	Evaluate impact of burns on invasive species, aggressive species, and diversity of prairie species	Fire intensity, weather, and habitat conditions; Vegetation response to burning	Historical records	Ongoing process to evaluate impact of fire program.	Possible change in management actions including burn cycles.

Project						
Complex Non-native plant species inventory and monitoring	Within two years of the CCP's approval, compile list of non-native plant species on the complex.	How many species of non-native plants are residing within the complex boundaries	Population densities and avenues of infestation	U.S. Park Service I&M plan. Historical records.	Repeat on 2-year interval	Change in monitoring protocols
Complex Invasive Plant Control	Within six months following the CCP's approval, implement invasive plant control protocols.	What is the efficacy success rate of herbicide, mechanical and prescribe burn treatments	Response to treatments	Historical record, application rate guidelines	Ongoing process to evaluate impact on invasive plants	Reevaluate application rates. Reevaluate time and date of application and weather conditions
Complex Vegetation Community Mapping of Bottomland Hardwood Units	Within 5 years of the CCP's approval, identify and map all dominant vegetation communities in the bottomland hardwood forests of all units	How many dominate vegetation communities reside in the bottomland hardwood units of the Complex	Recognition of vegetation communities with ground and map observations.	Historical records. NVCS vegetation classification system	Ongoing process as bottomland hardwood property is acquired	Increase monitoring personnel. Provide for training to recognize plant species.

Project						
Complex Prairie Restoration	Within one year of CCP's approval, map timeline of Chinese tallow tree eradication on the Brazoria NWR	How many acres of Chinese tallow trees have been removed during the timeline of 2009–2011	Landsat photographs depicting tell-tale absence of foliage following mortality of Chinese tallow trees	Landsat photographs from period of 2009–2011	Ongoing process as tracts within the Brazoria NWR are treated for Chinese tallow trees	Increase monitoring of herbicide efficacy at other time and dates herbicide is applied
Fire Atlas	Within one year of CCP's approval, produce an atlas depicting individual burn coverage of Rx burns	How many acres of land were actually burned for all documented prescribed burn and wildfires over the past ten years. Using Landsat photography, determines fire intensity across unit	Landsat photographs depicting pre- and post-burn condition of burn units	Data analysis of Landsat photographs	Ongoing process to evaluate all prescribed burn operations and tropical events	Verify with ground truth. Review Landsat analysis process

Table 5-6. Visitor Services Inventorying and Monitoring Plan

Public Use Opportunities	Within five years of the CCP's approval, initiate a program to assess the numbers and types of activities visitors partake in while visiting the refuges	What is annual visitation across the Complex and are facilities meeting the needs of the public?	Total visitation and survey of attitudes toward public use opportunities across the Complex	Contact a sample of visitors at all Public Use Areas to assess their use of facilities to enjoy nature	Repeat on every five years	Develop additional public use opportunities (primarily in bottomlands) or close opportunities not being used to save money.
Visitor Use Counters	Accurately evaluate public use numbers	How many visitors use trail and roads for visiting the refuges?	Total visitation and individual users	Complete installation of trail and vehicle recorders	Ongoing	Develop additional public use opportunities (primarily in bottomlands) or close opportunities not being used to save money.

[This page intentionally left blank.]

GLOSSARY

Accessible Facilities: Structures accessible for most people with disabilities without assistance; facilities that meet Uniform Federal Accessibility Standards (UFAS); Americans with Disabilities Act (ADA)-accessible.

Adaptive Management: The rigorous application of management, research, and monitoring to gain information and experience necessary to assess and modify management activities. A process that uses feedback from research, monitoring and evaluation of management actions to support or modify objectives and strategies at all planning levels.

Agricultural Land: Non-forested land (now or recently pastures or crops).

Alternatives: Different sets of objectives and strategies or means of achieving refuge purposes and goals, helping fulfill the Refuge System mission, and resolving issues. A reasonable way to fix an identified problem or satisfy a stated need [40 CFR 1500.2 (cf. “management alternative”)].

Appropriate Use: A proposed or existing use on a refuge that is a wildlife-dependent recreational use as identified in the 1997 Refuge System Improvement Act (hunting, fishing, wildlife observation and photography, and environmental education and interpretation) or a use that contributes to the fulfillment of refuge purpose(s), the Refuge System mission, or goals or objectives described in a refuge management plan approved after October 9, 1997.

Approved Acquisition Boundary: A project boundary that the Director of the U.S. Fish and Wildlife Service approves upon completion of the planning and environmental compliance process. An approved acquisition boundary only designates those lands which the Service has authority to acquire or manage through various agreements. The approval of an acquisition boundary does not grant the Service jurisdiction or control over lands within the approved boundary. Lands do not become part of the National Wildlife Refuge System until the Service buys them or they are placed under an agreement that provides for their management as part of the System.

Aquatic: Growing in, living in, or dependent upon water.

Best Management Practices: Land management practices that produce desired results [e.g., best management practices for herbicide application, grazing etc.].

Biological Diversity or Biodiversity: The variety of life and its processes, including the variety of living organisms, the genetic differences among them and communities and ecosystems in which they occur.

Biological Integrity: Biotic composition, structure and functioning at genetic, organism and community levels comparable with historic conditions, including the natural biological processes that shape genomes, organisms and communities.

Biotic Community: A set of plants, animals and microorganisms occupying an area interacting directly or indirectly with each other and their physical environment.

Breeding habitat: Habitat used by animals during the breeding season.

Candidate species: Species for which we have sufficient information on file about their biological vulnerability and threats to propose listing them.

Categorical Exclusion (CE, CX, CATEX, CATX): Pursuant to the National Environmental Policy Act (NEPA), a category of Federal agency actions that do not individually or cumulatively have a significant effect on the human environment [40 CFR 1508:4].

CFR: The Code of Federal Regulations.

Community: An assemblage of plants occurring together at any point in time.

Compatible Use: A wildlife-dependent recreational use, or any other proposed or existing use on a refuge that will not materially interfere with or detract from the purposes of the refuge or the National Wildlife Refuge System mission.

Compatibility Determination: A required determination for wildlife-dependent recreational uses or any other public uses of a refuge.

Comprehensive Conservation Plan: A document that describes the desired future conditions of a refuge or planning unit and provides long-range guidance and management direction to achieve the purposes of the refuge; helps fulfill the mission of the Refuge System; maintains and, where appropriate, restores the ecological integrity of each refuge and the Refuge System; helps achieve the goals of the National Wilderness Preservation System; and meets other mandates.

Concern: “*see issue*”

Connectivity: Community occurrences and reserves that have permeable boundaries and thus are subject to inflows and outflows from the surrounding landscape. Connectivity in the selection and design of nature reserves relates to the ability of species to move across the landscape to meet basic habitat requirements. Natural connecting features within the ecoregion may include river channels, habitat corridors, ridgelines, or migratory pathways.

Conservation: Managing natural resources to prevent loss or waste [Management actions may include preservation, restoration, and enhancement.].

Conservation easement: A non-possessory interest in real property owned by another imposing limitations or affirmative obligations with the purpose of returning or protecting the property’s conservation values.

Conservation status: Assessment of the status of ecological processes and of the viability of species or populations in an ecoregion.

Cooperative agreement: A legal instrument reflecting a relationship between the Federal Government and a recipient when the principle purpose is to fund a project to support or stimulate activities that are not for the direct benefit or use of the Federal government but instead for a public purpose that the government participates substantially in.

Critical Habitat: According to U.S. Federal law, the ecosystems upon which endangered and threatened species depend.

Cultural Resources: The remains of sites, structures, or objects used by people in the past.

Cultural Resource Overview: A comprehensive document prepared for a field office that discusses, among other things, project prehistory and cultural history, the nature and extent of known cultural resources, previous research, management objectives, resource management conflicts or issues, and a general statement of how program objective should be met and conflicts resolved. [An overview should reference or incorporate information from a field office's background or literature search described in section VIII of the Cultural Resource Management Handbook (cf. FWS Manual 614 FW 1.7).]

Degradation: the loss of native species and processes due to human activities such that only certain components of the original biodiversity persist, often including significantly altered natural communities.

Designated Wilderness Area: An area designated by Congress as part of the National Wilderness Preservation System [FWS Manual 610 FW 1.5 9 draft]

Desired future condition: The qualities of an ecosystem or its components that an organization seeks to develop through its decisions and actions.

Disturbance: Any relatively discrete event in time that disrupts ecosystem, community, or population structure and changes resources, substrate availability, or the physical environment.

Donation: A citizen or group may wish to give land or interests in land to the Service for the benefit of wildlife. Aside from the cost factor, these acquisitions are no different than any other means of land acquisition. Gifts and donations have the same planning requirements as purchases.

Easement: An agreement by which landowners give up or sell one of the rights on their property (e.g. landowners may donate rights-of-way across their properties to allow community members access to a river). See "*conservation easement*."

Ecological Integrity: The relative intactness of biotic and abiotic components and their interrelated structure and function within a given ecosystem.

Ecological Processes: a complex mix of interactions among animals, plants, and their environment that ensures maintenance of an ecosystem's full range of biodiversity. Examples include population and predator-prey dynamics, pollination and seed dispersal, nutrient cycling, migration, and dispersal.

Ecoregion: A territory defined by a combination of biological, social, and geographic criteria, rather than geopolitical considerations; generally, a system of related, interconnected ecosystems.

Ecosystem: Dynamic and interrelating complex of plant and animal communities and their associated non-living environment.

Terminology

Ecosystem Approach: A strategy or plan to protect and/or restore the natural function, structure and species composition of an ecosystem, recognizing that all components are interrelated.

Ecosystem Management: Management of an ecosystem that includes all ecological, social, and economic components, which make up and/or that affect the whole of the system.

Ecotourism: Visits to an area that maintains and preserves natural resources as a basis for promoting its economic growth and development.

Emergent Wetland: wetlands dominated by erect, rooted, herbaceous plants.

Endangered Species: A plant or animal species listed under the Endangered Species Act that is in danger of extinction throughout all or a significant portion of its range.

Environmental Assessment: A systematic analysis to determine if proposed Federal actions would result in a “significant effect on the quality of the human environment” thereby requiring either the preparation of an environmental impact statement (EIS) or a determination of a “Finding of No Significant Impact.”

Environmental Education: Curriculum-based education aimed at producing a citizenry that is knowledgeable about the biophysical environment and its associated problems, aware of how to help solve those problems, and motivated to work toward solving them.

Environmental Health: The composition, structure, and functioning of soil, water, air, and other abiotic features comparable with historic conditions, including the natural abiotic processes that shape the environment.

Exotic Species: A non-native plant or animal species introduced intentionally or unintentionally to the ecosystem under consideration.

Extinction: The termination of any lineage of organisms, from subspecies to species and higher taxonomic categories from genera to phyla. Extinction can be local, in which one or more populations of a species or other unit vanish but others survive elsewhere, or total (global), in which all the populations vanish (Wilson 1992).

Fauna: All animal life associated with a given habitat, country, area or period.

Federal land: Public land owned by the Federal Government, including national forests, national parks, and national wildlife refuges.

Federally-listed Species: A species listed either as endangered, threatened, or a species at risk (formerly, a “candidate species”) under the Endangered Species Act of 1973, as amended.

Federal Trust Species: Important fish and wildlife resources that the U.S. Fish and Wildlife Service is specifically mandated to protect including migratory birds, threatened species, endangered species, inter-jurisdictional fish, marine mammals, and other species of concern.

Fee-title Acquisition: The acquisition of most or all of the rights to a tract of land; a total transfer of property rights with the formal conveyance of a title. While a fee-title acquisition involves most rights to a property, certain rights may be reserved or not purchased, including water rights, mineral rights, or use reservation (e.g., the ability to continue using the land for a specified time period, such as the remainder of the owner's life).

Finding of No Significant Impact (FONSI): Supported by an environmental assessment, a document that briefly presents why a Federal action will have no significant effect on the human environment, and for which an environmental impact statement, therefore, will not be prepared [40 CFR 1508.13].

Fire regime: The characteristic frequency, intensity, and spatial distribution of natural fires within a given ecoregion or habitat.

Floodplain: Flat or nearly flat land that may be submerged by floodwaters; a plain built up or in the process of being built up by stream deposition.

Flora: All the plants found in a particular place.

Flyway: Any one of several established migration routes of birds.

Focal species: A species that is indicative of particular conditions in a system (ranging from natural to degraded) and used as a surrogate measure for other species of particular conditions. An element of biodiversity selected as a focus for conservation planning or action. The two principal types of targets in planning projects are species and ecological communities.

Forested Land: Land dominated by trees. For impacts analysis in CCPs, we assume all forested land has the potential for occasional harvesting; we assume forested land owned by timber companies is harvested on a more intensive, regular schedule.

Fragmentation: The disruption of extensive habitats into isolated and small patches. Fragmentation has two negative components for biota: the loss of total habitat area; and, the creation of smaller, more isolated patches of habitat.

Geographic Information System (GIS): A computerized system to compile, store, analyze and display geographically referenced information [e.g., GIS can overlay multiple sets of information on the distribution of a variety of biological and physical features.].

Goal: Descriptive, open-ended, and often broad statement of desired future conditions that conveys a purpose but does not defined measurable units.

Grassland: A habitat type with landscapes dominated by grasses and with bio-diversity characterized by species with wide distributions, communities being relatively resilient to short-term disturbances but not to prolonged, intensive burning or grazing. In such systems, larger vertebrates, birds, and invertebrates display extensive movement to track seasonal or patchy resources.

Groundwater: Water in the ground that is in the zone of saturation, from which wells and springs and groundwater runoff are supplied.

Guild or Species Guild: An aggregation or group of species that tend to use the same kinds of resources for feeding or reproduction in a similar manner. Species guilds are useful in helping to focus wildlife and habitat management efforts or in environmental impact studies.

Habitat: The place or type of site where species and species assemblages are typically found and/or successfully reproduce. [An organism's habitat must provide all of the basic requirements for life, and should be free of harmful contaminants.].

Habitat Conservation: Protecting an animal or plant habitat to ensure that the use of that habitat by the animal or plant is not altered or reduced.

Habitat Fragmentation: The breaking up of a specific habitat into smaller, unconnected areas

Historic Conditions: The composition, structure and functioning of ecosystems resulting from natural processes that we believe, based on sound professional judgment, were present prior to substantial human-related changes to the landscape.

Hydrologic or Flow Regime: Characteristic fluctuations in river flows.

Hydrology: The science of waters of the earth: their occurrences, distributions, and circulations; their physical and chemical properties; and their reactions with the environment, including living beings.

Impoundment: A body of water, such as a pond, confined by a dam, dike, floodgate, or other barrier, which is used to collect and store water for future use.

Interpretive Facilities: Structures that provide information about an event, place, or thing by a variety of means, including printed, audiovisual, or multimedia materials [e.g., kiosks that offer printed materials and audiovisuals, signs, and trail heads.].

Interpretive Materials: Any tool used to provide or clarify information, explain events or things, or increase awareness and understanding of the events or things [e.g., printed materials like brochures, maps or curriculum materials; audio/visual materials like video and audio tapes, films, or slides; and, interactive multimedia materials, CD-ROM or other computer technology.].

Invasive Species: A non-indigenous species whose introduction causes or is likely to cause economic or environmental harm or harm to human health. Invasive species generally reduce the diversity of ecosystems when they become dominant.

Invertebrate: Any animal lacking a backbone or bony segment that encloses the central nerve cord.

Issue: Any unsettled matter that requires management decision, e.g., an initiative, opportunity, resource management problem, threat to the resources of the unit, conflict in uses, public concern, or the presence of an undesirable resource condition.

Land Protection Plan (LPP): A document that identifies and prioritizes lands for potential Service acquisition from willing sellers, and describes other methods of providing protection.

Land Trusts: Organizations dedicated to conserving land by purchase, donation, or conservation easement from landowners.

Landscape: An aggregate of land forms, together with its biological communities.

Limiting Factor: An environmental limitation that prevents further population growth.

Management Alternative: A set of objectives and the strategies needed to accomplish each objective [FWS Manual 602 FW 1.4].

Management Concern: see “*issue*”.

Management Opportunity: see “*issue*”.

Management Plan: A plan that guides future land management practices on a tract. [N.b. In the context of an environmental impact statement, management plans may be designed to produce additional wildlife habitat along with primary products like timber or agricultural crops (see “*cooperative agreement*”).]

Management Strategy: A general approach to meeting unit objectives [N.b. A strategy may be broad, or it may be detailed enough to guide implementation through specific actions, tasks, a projects (FWS Manual 602 FW 1.4)].

Mesic soil: Sandy-to-clay loams containing moisture-retentive organic matter, well-drained (no standing water).

Mima Mound: A term used for low, flattened, circular to oval, domelike, natural mounds. Mima mounds also occur within landscapes where a permanent water table impedes drainage, creating waterlogged soil conditions for prolonged periods.

Mission statement: A succinct statement of the purpose for which the unit was established; its reason for being.

Mitigation: Actions to compensate for the negative effects of a particular project [e.g., wetland mitigation usually restores or enhances a previously damaged wetland or creates a new wetland.].

National Environmental Policy Act of 1969 (NEPA): Requires all Federal agencies to examine the environmental impacts of their actions, incorporate environmental information, and use public participation in planning and implementing environmental actions [Federal agencies must integrate NEPA with other planning requirements, and prepare appropriate NEPA documents to facilitate better environmental decision-making (cf. 40 CFR 1500).].

National Wildlife Refuge: A designated area of land or water or an interest in land or water within the Refuge System, such as refuges, wildlife management areas, waterfowl production areas and other areas under Service jurisdiction for the protection and conservation of fish and wildlife and plant resources. A complete listing of all units of the Refuge System may be found in the current “Annual Report of Lands under Control of the U.S. Fish and Wildlife Service.”

National Wildlife Refuge System: All lands, waters and interests therein administered by the U.S. Fish and Wildlife Service as wildlife refuges, wildlife ranges, wildlife management areas, waterfowl production areas and other areas for the protection and conservation of fish, wildlife and plant resources.

Native: A species that historically occurred in a particular ecosystem.

Native plant: A plant that has grown in the region since the last glaciation, and occurred before European settlement.

Natural disturbance event: Any natural event that significantly alters the structure, composition, or dynamics of a natural community: e.g., floods, fires, and storms.

Non-consumptive, Wildlife-oriented Recreation: Wildlife observation and photography and environmental education and interpretation.

Non-point Source Pollution: A diffuse form of water quality degradation in which wastes are not released at one specific, identifiable point but from diffuse sources or a number of points or that are spread out and difficult to identify and control.

Non-forested Wetlands: Wetlands dominated by shrubs or emergent vegetation.

Notice of Availability: An announcement we publish in the Federal Register that we have prepared an environmental impact statement or an environmental assessment and that it is available for public review and comment.

Notice of Intent (NOI): An announcement we publish in the Federal Register that we will prepare and review an environmental impact statement [40 CFR 1508.22].

Objective: A concise statement of what we want to achieve, how much we want to achieve, when and where we want to achieve it, and who is responsible for the work. Objectives derive from goals and provide the basis for determining strategies, monitoring refuge accomplishments, and evaluating the success of strategies. Objectives should be attainable, time-specific, and measureable.

Old Fields: Areas formerly cultivated or grazed, where woody vegetation has begun to invade. [N.b. if left undisturbed, old fields will eventually succeed into forest. Many occur at sites marginally suitable for crops or pasture].

Outdoor Education: Educational activities that take place in an outdoor setting.

Partnership: A contract or agreement among two or more individuals, groups of individuals, organizations, or agencies, in which each agrees to furnish a part of the capital or some service in kind (e.g., labor) for a mutually beneficial enterprise.

Payment in Lieu of Taxes: cf. Revenue Sharing Act of 1935, Chapter One, Legal Context.

Point Source: A source of pollution that involves discharge of waste from an identifiable point, such as a sewage-treatment plant outfall pipe.

Population: An interbreeding group of plants or animals. Also refers to the entire group of organisms of one species.

Population Monitoring: Assessing the characteristics of populations to ascertain their status and establish trends on their abundance, condition, distribution, or other characteristics.

Prairie: An extensive area of flat or rolling grassland.

Prescribed Fire: The application of fire to wildland fuels, either by natural or intentional ignition, to achieve identified land use objectives [FWS Manual 621 FW 1.7].

Priority Public Use: Wildlife-dependent recreational uses involving hunting, fishing wildlife observation and photography, and environmental education and interpretation which receive priority consideration in refuge planning and management. Priority Public Uses were designated by the Refuge System Administration Act, as amended.

Priority Species: Wildlife or plant species that include Federal trust species such as migratory birds, threatened species, endangered species, inter-jurisdictional fish, marine mammals, and other species of concern. Priority species also include rare, declining, or species of management concern that are on lists maintained by natural heritage programs, State wildlife agencies, other Federal agencies, or professional, academic, and scientific societies, and those mentioned in landscape-level or other conservation plans.

Private Land: Land owned by a private individual, group or non-government organization.

Private Organization: Any non-government organization.

Protection: Mechanisms like fee title acquisition, conservation easements, or binding agreements with landowners that ensure land use and land management practices will remain compatible with maintaining species populations at a site.

Public: Individuals, organizations, and non-government groups; officials of Federal, State, and local government agencies; Native American tribes, and foreign nations – includes anyone outside the core planning team, those who may or may not have indicated an interest in the issues, and those who do or do not realize that our decisions may affect them.

Public Involvement: Offering an opportunity to interested individuals and organizations potentially affected by actions or policies to become informed and provide input. Public input is thoroughly studied and given thoughtful consideration in shaping decisions about managing refuges.

Public Land: Land owned by the local, State, or Federal Government.

Public Uses: Normally refers to the six priority public uses (hunting, fishing, wildlife observation and photography, and environmental education and interpretation), but may include other permitted special uses.

Purposes of the Refuge: “The purposes specified in or derived from the law, proclamation, executive order, agreement, public land order, donation document, or administrative memorandum establishing, authorizing, or expanding a refuge, refuge unit, or refuge subunit.” (601 FW 1)

Ranchette: a small-scale ranch, typically of only a few acres.

Rare Species: Species identified for special management emphasis because of their uncommon occurrence within a watershed.

Rare Community Types: Plant community types classified as rare by any State program; includes exemplary community types.

Refuge Goals: According to “Writing Refuge Management Goals and Objectives: A Handbook, refuge goals are “...descriptive, open-ended, and often broad statements of desired future conditions that convey a purpose but do not define measureable units.”

Refuge lands: Lands in which the Service holds full interest in fee title or partial interest like an easement.

Refuge Operating Needs System (RONS): A national database that contains the unfunded operational needs of each refuge. Projects are required to implement approved plans and meet goals, objectives, and legal mandates.

Refuge Purposes: According to the National Wildlife Refuge System Improvement Act of 1997, “The terms ‘purposes of the refuge’ and ‘purposes of each refuge’ mean that purposes specified in or derived from the law, proclamation, executive order, agreement, public land order, donation document, or administrative memorandum establishing, authorizing, or expanding a refuge, refuge unit, or refuge subunit.”

Restoration: Management of a disturbed or degraded habitat that results in the recovery of its original state [e.g., restoration may involve planting native grasses and forbs, removing shrubs, prescribed burning, or reestablishing habitat for native plants and animals on degraded grassland.].

Riparian: Of or relating to land lying immediately adjacent to a water body and having specific characteristics of that area, such as riparian vegetation. A stream bank is an example of a riparian area.

Riparian Habitat: Habitat along the banks of a stream or river.

Riverine: Within the active channel of a river or stream.

Runoff: Water from rain, melted snow, or agricultural or landscape irrigation that flows over a land surface into a water body.

Scoping: A process for identifying the “scope of issues” to be addressed in planning refuge activities. Involved in the scoping process are Federal, State, local agencies, private organizations, and individuals.

Service Presence: Service programs and facilities that it directs or shares with other organizations; public awareness of the Service as a sole or cooperative provider of programs and facilities.

Shrublands: Habitats dominated by various species of shrubs, often with many grasses and forbs.

Sound Professional Judgment: A finding, determination, or decision that is consistent with principles of sound fish and wildlife management and administration, available science and resources, and adherence to the requirements of the Refuge Administration Act and other appropriate laws.

Species: The basic category of biological classification intended to designate a single kind of animal or plant. Any variation among the individuals may be regarded as not affecting the essential sameness which distinguishes them from all other organisms.

Species of Concern: Species not federally listed as threatened or endangered, but about which we or our partners are concerned.

Species Diversity: Usually synonymous with “species richness,” but may also include the proportional distribution of species.

Species Richness: A simple measure of species diversity calculated as the total number of species in a habitat or community.

Stakeholders: Those agencies, organizations, groups and individuals of the public, having an interest or stake in an organization’s program and that may be affected by its implementation.

State agencies: Natural resource agencies of State governments.

State land: State-owned public land.

State-listed species: see “Federal-listed species.”

Step-down Management Plan: A plan that provides specific guidance on management subjects (e.g. habitat, public use, fire, safety) or groups of related subjects. It describes strategies and implementation schedules for meeting CCP goals and objectives.

Stranding: Marine animals that wash ashore, dead or alive, or are found floating dead or alive (generally in a weakened condition).

Strategy: A specific action, tool, technique, or combination of actions, tools, and techniques used to meet unit objectives.

Succession: The natural, sequential change of species composition of a community in a given area.

Surface Water: All waters whose surface is naturally exposed to the atmosphere, or wells or other collectors directly influenced by surface water.

Sustainable Development: The attempts to meet economic objectives in ways that do not degrade the underlying environmental support system. Note that there is considerable debated over the

meaning of this term...we define it as “human activities conducted in a manner that respects the intrinsic value of the natural world, the role of the natural world in human well-being, and the need for humans to live on the income from nature’s capital itself.”

Terrestrial: Living on land.

Threatened Species: A plant or animal species listed under the Endangered Species Act that is likely to become endangered within the foreseeable future.

Tributary: A stream or river that flows into a larger stream, river, or lake, feeding it water.

Trust Resource: A resource that the Government holds in trust for the people through law or administrative act. [N.b. A federal trust resource is one for which responsibility is given wholly or in part to the Federal Government by law or administrative act. Generally, federal trust resources are nationally or internationally important no matter where they occur, like endangered species or migratory birds and fish that regularly move across state lines. They also include cultural resources protected by Federal historic preservation laws, and nationally important or threatened habitats, notable wetlands, navigable waters, and public lands like national wildlife refuges.]

Trust Species: (*See Federal Trust Species*).

Unfragmented Habitat: Large, unbroken blocks of a particular type of habitat.

Upland: Dry ground (i.e., other than wetlands).

Urban Runoff: Water from rain, melted snow, or landscape irrigation flowing from city streets and domestic or commercial properties that may carry pollutants into a sewer system or water body.

Vision Statement: A concise statement of what the planning unit should be, or what is planned to be accomplished, based primarily upon the Refuge System mission and specific refuge purposes, and other mandates. The vision statement for the refuge should be linked to the mission of the Refuge System; the purpose(s) of the refuge; the maintenance or restoration of the ecological integrity of each refuge and the Refuge System; and other mandates.

Wetland: Areas such as lakes, marshes, ponds, swamps, or streams that are inundated by surface or groundwater long enough to support plants and animals that require saturated or seasonally saturated soils.

Wilderness Study Areas: Lands and waters identified by inventory as meeting the definition of wilderness and being evaluated for a recommendation they be included in the National Wilderness Preservation System.

Wilderness: See “designated wilderness area.”

Wildfire: Unplanned ignition of a wildland fire (such as a fire caused by lightning, volcanoes, unauthorized and accidental human-caused fires) and escaped prescribed fires.

Wildland fire: Every wildland fire is either a wildfire or a prescribed fire [FWS Manual 621 FW 1.3]. A general term describing any non-structure fire that occurs in the wildland.

Wildlife-dependent Recreational Use: “A use of a refuge involving hunting, fishing, wildlife observation and photography, or environmental education and interpretation.” (605 FW 1) These are the six priority public uses of the Refuge System Administration Act, as amended. Wildlife-dependent recreational uses, other than the six priority public uses, are those that depend on the presence of wildlife. Other uses are also considered in the preparation of refuge CCPs; however, the six priority public uses always will take precedence.

Wildlife management: Manipulating wildlife populations, either directly by regulating the numbers, ages, and sex ratios harvested, or indirectly by manipulating habitat conditions. Wildlife management is not always to increase populations (e.g., wildlife damage control).

ABBREVIATIONS AND ACRONYMS

ADA	Americans with Disabilities Act
<hr/>	
BCR	Bird Conservation Region
<hr/>	
CCP	Comprehensive Conservation Plan
<hr/>	
CPCI	Coastal Prairie Conservation Initiative
<hr/>	
DEEP	Discovery Environmental Education Program
<hr/>	
EE	Environmental Education
<hr/>	
EPA	Environmental Protection Agency
<hr/>	
EO	Executive Order
<hr/>	
FM	Farm-to-Market (State secondary road)
<hr/>	
FR	Federal Register
<hr/>	
FTE	Full-time equivalent
<hr/>	
GCP&M	Gulf Coast Prairies and Marshes
<hr/>	
GS	General Schedule (pay rate schedule for certain Federal positions)
<hr/>	
IUCN	International Union for Conservation of Nature
<hr/>	
lbs.	Pounds

LCC	Landscape Conservation Cooperative
LCRA	Lower Colorado River Authority
LEED	Leadership in Energy and Environmental Design
MOU	Memorandum of Understanding (Agreements)
MPA	Marine Protected Areas
MSA	Metropolitan Statistical Area
N	Nitrogen
NAAQS	National Ambient Air Quality Standards
NABCI	North American Bird Conservation Initiative
NADP	National Atmospheric Deposition Program
NAWMP	North American Waterfowl Management Plan
NEPA	National Environmental Policy Act
NGOs	Non-governmental Organizations
NNL	National Natural Landmark
NO₂	Nitrogen dioxide
NRCS	Natural Resources Conservation Service (U.S. Department of Agriculture)
NVCS	National Vegetation Classification System
NWR	National Wildlife Refuge
NWRS, Refuge System	National Wildlife Refuge System
O&M	Operation & Maintenance
PIF	Partners in Flight
RIFA	Red Imported Fire Ant
RNA	Research Natural Area
RONs	Refuge Operating Needs System
RRP	Refuge Roads Program
SAMMS	Service Asset Maintenance Management System
SHC	Strategic Habitat Conservation
SUP	Special Use Permit
T&E	Threatened and Endangered Species
TCEQ	Texas Commission on Environmental Quality
TCPP	Texas City Prairie Preserve

Terminology

TNC	The Nature Conservancy
TPWD	Texas Parks and Wildlife Department
UNESCO	United National Educational, Scientific and Cultural Organization
USDA	United States Department of Agriculture
USGS	United States Geological Survey
USFWS, FWS, Service	United States Fish and Wildlife Service
WG	Wage Grade Schedule (pay rate schedule for certain Federal positions)
WWF	World Wildlife Fund

A. Key Legislation and Service Policies

Administrative Procedure Act (1966; 5 U.S.C. 551-559, 701-706 and 801-808, as amended): Contains procedures that Federal agencies must follow, including public information, open meetings, and privacy of information requirements, and provisions for hearings, adjudications, rule making, and judicial and congressional review of Federal agency actions.

Agricultural Credit Act of 1987 (7 U.S.C. 5104; P.L. 100-233): Authorizes the Farmer's Home Administration (FmHA) to transfer land to any Federal or State agency for conservation purposes (e.g., the FmHA can transfer fee-title or assign interests in real estate to the U.S. Fish and Wildlife Service for the protection of floodplains, wetlands, and surrounding uplands).

American Indian Religious Freedom Act (1978): Directs agencies to consult with native traditional religious leaders to determine appropriate policy changes necessary to protect and preserve Native American religious cultural rights and practices.

Americans with Disabilities Act (1992): The Americans with Disabilities Act is the most comprehensive Federal civil-rights statute that prohibits discrimination on the basis of disability in employment, State and local government, public accommodations, commercial facilities, transportation, and telecommunications.

Antiquities Act of 1906 (16 U.S.C. 431-433): First United States law to provide general protection of cultural or natural resources. This act authorizes the scientific investigation of antiquities on Federal land and provides penalties for unauthorized removal of objects taken or collected without a permit.

Archaeological and Historic Preservation Act (1974): Requires that Federal agencies provide for "*...the preservation of historical and archeological data (including relics and specimens) which might otherwise be irreparably lost or destroyed as the result of...any alteration of the terrain caused as a result of any Federal construction project of Federally-licensed activity or program.*"

Archaeological Resources Protection Act of 1979, as amended (16 U.S.C. 470aa-470mm): The Archaeological Resources Protection Act (ARPA) was enacted "*...to secure, for the present and future benefit of the American people, the protection of archaeological resources and sites which are on public lands and Indian lands, and to foster increased cooperation and exchange of information between governmental authorities, the professional archaeological community, and private individuals.*" The main focus of ARPA is on regulation of legitimate archeological investigation on public lands and the enforcement of penalties against looting or vandalism of these resources. Protects materials of archaeological interest from unauthorized removal or destruction and requires Federal managers to develop plans and schedules to locate archaeological resources.

Appropriate Uses Policy (2006) 603 FW1: Describes procedures for refuge managers to follow when deciding if uses are appropriate on a refuge. Appropriate uses are either proposed or existing uses on a refuge that meet at least one of the following four conditions: 1) the use is a wildlife-dependent recreational use as identified in the 1997 Improvement Act; 2) the use contributes to fulfilling the refuge purpose(s), the Refuge System mission, or goals or objectives described in a refuge management plan approved after October 9, 1997, the date the Improvement Act was signed into law; 3) the use involves the take of fish and wildlife under State regulations; or 4) the use has been found to be appropriate as described further in the Appropriate Refuge Uses policy. This policy applies to all proposed and existing uses in the Refuge System only where the Service has jurisdiction over the use. The policy does not apply in: 1) situations where reserved rights or legal mandates provide that the Service must allow the use, and 2) refuge management activities (e.g., fish and wildlife population or habitat management actions including, but not limited to: prescribed burns, water level management, invasive species control, routine scientific monitoring, law enforcement activities, and maintenance of existing refuge facilities).

Architectural Barriers Act (1968): Requires Federally-owned, leased, or funded buildings and facilities to be accessible to persons with disabilities.

Bald and Golden Eagles Protection of 1940 (16 U.S.C. 668-668d; 54 Statute 250), as amended: Provides for the protection of the bald eagle (the national emblem) and the golden eagle by prohibiting, except under certain specified conditions, the taking, possession and commerce of such birds.

Biological Integrity, Diversity, and Environmental Health (2001) 601 FW 3: As part of the comprehensive conservation planning process, this policy provides for the consideration and protection of the broad spectrum of fish, wildlife, and habitat resources found on refuges and associated ecosystems. It provides refuge managers with an evaluation process to analyze their refuge and recommend the best management direction to prevent further degradation of environmental conditions; and where appropriate and in concert with refuge purposes and Refuge System mission, restore lost or severely degraded components.

Clean Air Act (1970; 42 U.S.C. 7401 et seq.), as amended: A comprehensive Federal law that regulates air emissions from area, stationary, and mobile sources. This law authorizes the U.S. Environmental Protection Agency to establish National Ambient Air Quality Standards to protect public health and the environment.

Clean Water Act (1977); Federal Water Pollution Control Act: This is the principal law that governs pollution of the Nation's surface waters. The Clean Water Act employs several regulatory and non-regulatory tools to sharply reduce direct pollutant discharges into waterways, finance municipal wastewater treatment facilities, and manage polluted runoff. Section 404 of the Clean Water Act requires permits (issued by the U.S. Army Corps of Engineers) for the discharge of dredged or fill material into waters of the United States, including wetlands.

Coastal Barrier Resources Act (1982; 16 U.S.C. 3501 et seq.), as amended: This Act (CBRA) designated various undeveloped coastal barrier islands, depicted by specific maps, for inclusion in the Coastal Barrier Resources System. Areas so designated were made ineligible for direct or indirect Federal financial assistance that might support development, including flood insurance, except for emergency life-saving activities. Exceptions for certain activities, such as fish and wildlife research, are provided, and National Wildlife Refuges and other, otherwise protected areas are excluded from the System.

Compatibility Policy (2000) 603 FW 2: Incorporates the compatibility provisions of the National Wildlife Refuge System Improvement Act of 1997, that amends the National Wildlife Refuge System Administration Act of 1966. The Compatibility Policy is for determining whether proposed and existing uses, which the Service has jurisdiction over and are occurring on national wildlife refuges, are compatible (i.e., will not detract from or materially interfere) with the purpose(s) of the refuge or with the Refuge System's mission. The policy is to ensure that we (the Service) administer proposed and existing national wildlife refuge uses according to laws, regulations, and policies concerning compatibility, and provides procedures for documentation and periodic review of existing refuge uses.

Comprehensive Conservation Plans (2000) 602 FW 3: As required by the National Wildlife Refuge System Improvement Act of 1997, Comprehensive Conservation Plans (CCPs) describe the desired future conditions of a refuge and provide long-range guidance and management direction to achieve refuge purposes; help fulfill the Refuge System mission; maintain and, where appropriate, restore the ecological integrity; as well as to meet other mandates. The purpose of developing the CCP is to provide the refuge manager with a 15-year management plan for the conservation of fish, wildlife, and plant resources and their related habitats, while providing opportunities for compatible wildlife-dependent recreational uses.

Convention Between the United States of America and the Mexican States for the Protection of Migratory Birds and Game Mammals, 1936 (50 Statute 1311).

Convention of Nature Protection and Wildlife Preservation in the Western Hemisphere, 1940 (56 Statute 1354).

Convention Between the United States and Great Britain (for Canada for the Protection of Migratory Birds). (39 Statute 1702; TS 628), as amended.

Convention on Wetlands of International Importance, Especially as Waterfowl Habitats (I.L.M. 11:963-976, September 1972, Ramsar Convention).

Cooperative Research and Training Units Act (1960; 16 U.S.C. 753a-753b), as amended: Authorizes the Secretary of the Interior to enter into cooperative agreements with colleges and universities, State fish and game agencies, and nonprofit organizations for the purpose of developing adequate, coordinated, cooperative research and training programs for fish and wildlife resources.

Criminal Code Provisions of 1940 (18 U.S.C. 41), as amended: Provides for fines and penalties for the unlawful taking, disturbing, hunting, trapping, capturing of *“...any bird, fish, or wild animal of any kind whatever, or takes or destroys the eggs or nest of any such bird or fish, on any lands or waters which are set apart or reserved as sanctuaries, refuges or breeding grounds for such birds, fish, or animals under any law of the United States or willfully injures, molests, or destroys any property of the United States on any such lands or waters...”*

Disaster Relief Act of 1974 (42 U.S.C. 5121 et seq.), as amended: Provides authority for Federal agencies to assist State and local governments during Presidentially-declared emergencies.

Economy Act (1932; 31 U.S.C. 1535): Provides authority for Federal agencies to order goods and services from other Federal agencies and to pay the actual costs of those goods and services. The Act was passed to obtain economies of scale and eliminate overlapping activities of the Federal government.

Emergency Wetlands Resources Act of 1986 (16 U.S.C. 3901-3932, as amended): The purpose of this act is to promote wetlands conservation for the public benefit and to help fulfill international obligations in various migratory bird treaties and conventions. The Act authorizes the purchase of wetlands from Land and Water Conservation Fund monies. The Act also requires the Secretary of the Interior to establish a National Wetlands Priority Conservation Plan, requires the States to include wetlands in their Comprehensive Outdoor Recreation Plans, and transfers funds from import duties on arms and ammunition to the Migratory Bird Conservation Fund.

Endangered Species Act of 1973, as amended: The main purposes of the Endangered Species Act are to: 1) provide a means whereby ecosystems of threatened and endangered species may be conserved; and 2) provide a program for the conservation of threatened and endangered species. The provisions of the Endangered Species Act include, but are limited to, land acquisition, cooperative programs with the States, and interagency cooperation (Section 7). Section 7(a)(1) directs Federal agencies to carry out programs for the conservation of threatened and endangered species.

Environmental Education Act of 1990 (20 U.S.C. 5501-5510): Established the Office of Environmental Education within the Environmental Protection Agency, to develop and administer a Federal environmental education program. The Office is required to develop and support environmental programs in consultation with other Federal natural resource management agencies, including the Fish and Wildlife Service.

Environmental Education Policy (2006) 605 FW 6: Provides the Service’s policy governing the management of environmental education programs on units of the Refuge System. Environmental education is a priority, appropriate use of the Refuge System when compatible. The policy encourages refuge managers to provide quality environmental education programs that can promote understanding and appreciation of natural and cultural resources and their management on all lands and waters in the Refuge System. The policy

also emphasizes that refuge staff develop and take full advantage of opportunities to work with volunteers and partners who have an interest in conducting quality environmental education programs on refuges.

Executive Order 11514; Protection and Enhancement of Environmental Quality (1970):

This directs that the “...*Federal Government shall provide leadership in protecting and enhancing the quality of the Nation's environment to sustain and enrich human life. Federal agencies shall initiate measures needed to direct their policies, plans, and programs so as to meet national environmental goals...*”

Executive Order 11644; Use of off-road vehicles on the public lands (1972): Requires that the Service designate areas as open or closed to off-highway vehicles in order to protect refuge resources, promote safety, and minimize conflict among the various refuge users; monitor the effects of these uses once they are allowed; and amend or rescind any area designation as necessary based on the information gathered.

Executive Order 11987; Exotic organisms (1977): Executive agencies shall, to the extent permitted by law, restrict the introduction of exotic species into the natural ecosystems on lands and waters which they own, lease, or hold for purposes of administration; and, shall encourage the States, local governments, and private citizens to prevent the introduction of exotic species into natural ecosystems of the United States.

Executive Order 11988; Floodplain Management (1977): This directs that each Federal agency “...*shall provide leadership and take action to reduce the risk of flood loss, to minimize the impact of floods on human safety, health and welfare, and to restore and preserve the natural and beneficial values served by floodplains...*,” in carrying out its responsibilities.

Executive Order 11989; Off-Road Vehicles on Public Lands (1977): Requires the Service to close areas to off-highway vehicles when we determine that the use cause or will cause considerable adverse effects on the soil, vegetation, wildlife, habitat, or cultural or historic resources.

Executive Order 11990; Protection of Wetlands (1977): This directs that each Federal agency “...*shall provide leadership and shall take action to minimize the destruction, loss or degradation of wetlands, and to preserve and enhance the natural and beneficial values of wetlands in carrying out the agency's responsibilities...*”

Executive Order 12996; Management and General Public Use of the National Wildlife Refuge System (1996): This spells out the mission of the Refuge System along with establishing guiding principles to help insure the long-term enjoyment of the Refuge System for present and future generations. The order directs the Secretary of the Interior to recognize compatible wildlife-dependent recreational activities involving hunting, fishing, wildlife observation and photography, and environmental education and interpretation as priority general public uses on the Refuge System (i.e., the big six).

Executive Order 13007; Indian Sacred Sites (1996): Directs Federal land management agencies to accommodate access to and ceremonial use of Indian sacred sites by Indian religious practitioners, avoid adversely affecting the physical integrity of such sacred sites and where appropriate, maintain the confidentiality of sacred sites.

Executive Order 13112; Invasive Species (1999): This order was established to address the growing ecological and economic damage caused by invasive species. Executive Order 13112 requires Federal agencies to: 1) identify actions that might impact the status of invasive species and prevent introductions of invasive species; 2) not authorize, fund, or carry out actions likely to cause the introduction or spread of invasive species; 3) detect and respond rapidly to control invasive species populations; 4) monitor and conduct research on invasive species; 5) restore native species and habitat conditions in ecosystems that have been invaded; and 6) promote public education on invasive species.

Executive Order 13158; Marine Protected Areas (2000): directs protection of the significant natural and cultural resources within the marine environment for the benefit of present and future generations by strengthening and expanding the Nation's system of marine protected areas (MPAs). An MPA is any area of the marine environment that has been reserved by Federal, State, territorial, tribal, or local laws or regulations to provide lasting protection for part or all of the natural and cultural resources therein. The EO directs Federal agencies to work together with states, territories, tribes and non-governmental partners to develop and maintain an effective national system of MPAs in the United States and to accomplish a variety of related tasks working with public and private partners. The "marine environment" is defined as those areas of ocean and coastal waters, the Great Lakes and their connecting waters, and submerged lands thereunder, over which the United States exercises jurisdiction, consistent with international law.

Executive Order 13186; Responsibilities of Federal agencies to protect migratory birds (2001): Provides guidance for Service programs relative to the management and conservation of migratory birds. Its purpose is to minimize the potential adverse effects of migratory bird take, with the goal of striving to eliminate take, while implementing our mission. This guidance includes, but is not limited to: 1) integrating migratory bird conservation measures into our activities; 2) restoring and enhancing the habitat of migratory birds; 3) ensuring our actions/plans promote migratory bird conservation; 4) promoting inventory, monitoring, research, management studies and information exchange related to migratory birds; 5) promoting education and outreach related to migratory birds; 6) identifying special migratory bird habitats; and 7) strengthening non-Federal partnerships to further bird conservation.

Executive Order 13443; Facilitation of Hunting Heritage and Wildlife Conservation (2007): Directs Federal agencies that have programs and activities that have a measurable effect on public land management, outdoor recreation, and wildlife management, including the Department of the Interior and the Department of Agriculture, to facilitate the expansion and enhancement of hunting opportunities and the management of game species and their habitat.

Farmland Protection Policy Act (7 U.S.C. 4201 et seq.): Requires Federal agencies to identify and take into account the adverse effects of their programs on the preservation of farmlands.

Federal Aid in Sport Fish Restoration Act (1950; 16 U.S.C. 777-777k), as amended: Commonly called the Dingell-Johnson Act or Wallop-Breaux Act, this provides Federal aid to the States for management and restoration of fish having "...*material value in connection with sport or recreation in the marine and/or fresh waters of the United States.*" In addition, amendments to the Act provide funds to the States for aquatic education, wetlands restoration, boat safety, and clean vessel sanitation devices (pumpouts), and a non-trailerable boat program. Funds are derived from a 10-percent excise tax on certain items of sport fishing tackle, a 3-percent excise tax on fish finders and electric trolling motors, import duties on fishing tackle, yachts and pleasure craft, interest on the account, and a portion of motorboat fuel tax revenues and small engine fuel taxes. To participate in the Federal Aid in Sport Fish Restoration program, States are required to agree to this law and pass laws for the conservation of fish, which include a prohibition against the diversion of license fees for any other purpose than the administration of the State fish department.

Federal Aid in Wildlife Restoration Act (1937; 16 U.S.C. 669-669i), as amended: Commonly called the "Pittman-Robertson Act," this provides Federal aid to States for management and restoration of wildlife. Funds from an 11-percent excise tax on sporting arms and ammunition are appropriated to the Secretary of the Interior and apportioned to States on a formula basis for paying up to 75 percent of the cost-approved projects. Project activities include acquisition and improvement of wildlife habitat, introduction of wildlife into suitable habitat, research into wildlife problems, surveys and inventories of wildlife problems, acquisition and development of access facilities for public use, and hunter education programs, including construction and operation of public target ranges.

Federal Environmental Pesticide Control Act of 1972 (7 USC 136-136y), as amended: This established, under the Administrator of the EPA, a program for controlling the sale, distribution, and application of pesticides through an administrative registration process. The amendments provided for classifying pesticides for "general" or "restricted" use. "Restricted" pesticides may only be applied by or under the direct supervision of a certified applicator. Amendments to this Act also authorized experimental use permits and provided for administrative review of registered pesticides and for penalties for violations of the statute. States were authorized to regulate the sale or use of any pesticide within a State, provided that such regulation does not permit any sale or use prohibited by the Act. The Federal Environmental Pesticide Control Act of 1972 amended the **1947 Federal Insecticide, Fungicide, and Rodenticide Act (FIFRA)**. The 1947 statute (FIFRA), prohibited the sale or distribution of "*economic poisons*," provided for the registration of such materials, and authorized penalties for violation of the Act. The Endangered Species Act later amended FIFRA to define imminent hazard to include situations involving *unreasonable hazard to the survival of a species declared by the Secretary of the Interior to be endangered or threatened*.

Federal Fire Prevention and Control Act of 1974 (15 U.S.C. 2201 et seq.), as amended:

This authorizes reimbursement to State and local fire services for costs incurred in firefighting on Federal property.

Federal Noxious Weed Act (1990): Requires the use of integrated management systems to control or contain undesirable plant species, and an interdisciplinary approach with the cooperation of other Federal and State agencies.

Federal Property and Administrative Services Act of 1949 (40 U.S.C. 471-535), as amended: Sets forth requirements for the management and disposal of government property, including excess property (property under the control of any Federal agency, but which it no longer needs) and surplus property (excess property not required for the needs of any Federal agency).

Fish and Wildlife Act of 1956 (16 U.S.C. 742a-742j, not including 742 d-l), as amended: This established a comprehensive national fish and wildlife policy and broadened the authority for acquisition and development of refuges. The policy emphasizes the commercial fishing industry but also with a direction to administer the Act with regard to the inherent right of every citizen and resident to fish for pleasure, enjoyment, and betterment, and to maintain and increase public opportunities for recreational use of fish and wildlife resources. Among other things, the Act directs a program of continuing research, extension, and information services on fish and wildlife matters, both domestically and internationally. A 1974 amendment to the Fish and Wildlife Act of 1956 abolished the “Bureau of Sport Fisheries and Wildlife” and re-designated it as the “United States Fish and Wildlife Service”(Public Law 93-271). In 1978, the Fish and Wildlife Act was amended to allow the Service to accept donations of both real and personal property. In 1998, the Fish and Wildlife Act of 1956 was further amended to promote volunteer programs and community partnerships for the benefit of national wildlife refuges. This also required the Secretary of the Interior to develop refuge education programs to provide outdoor classroom opportunities for students to promote understanding of the Refuge System and to improve scientific literacy in conjunction with both formal and informal education programs.

Fish and Wildlife Conservation Act of 1980 (“Nongame Act”)(16 U.S.C. 2901-2911), as amended: Authorizes financial and technical assistance to the States for the development, revision, and implementation of conservation plans and programs for nongame fish and wildlife. A 1988 amendment requires the Service to monitor and assess migratory nongame birds, determine the effects of environmental changes and human activities, identify those likely to be candidates for endangered species listing, identify appropriate actions, and report to Congress one year from enactment. It also requires the Service to report at 5 year intervals on actions taken.

Fish and Wildlife Coordination Act (1934), as amended: Authorizes the Secretary of the Interior to assist Federal, State, and other agencies in development, protection, rearing and stocking fish and wildlife on Federal lands and to study effects of pollution on fish and wildlife. The Act also requires consultation with the U.S. Fish and Wildlife Service and the wildlife agency of any State wherein the waters of any stream or other water body are

proposed to be impounded, diverted, channelized or otherwise controlled or modified by any Federal agency, or any private agency under Federal permit or license; with a view to preventing loss of, or damage to, wildlife resources in connection with such water resource projects. The Act further authorizes Federal water resource agencies to acquire lands or interests in connection with water use projects specifically for mitigation and enhancement of fish and wildlife.

Fish and Wildlife Improvement Act of 1978 (16 U.S.C. 7421; 92 Stat. 3110), as amended: Authorizes the Secretaries of the Interior and Commerce to establish, conduct, and assist with National training programs for State fish and wildlife law enforcement personnel. It also authorized funding for research and development of new or improved methods to support fish and wildlife law enforcement. The law provides authority to the Secretaries to enter into law enforcement cooperative agreements with State or other Federal agencies, and authorizes the disposal of abandoned or forfeited items under the fish, wildlife, and plant jurisdictions of these Secretaries. It strengthens the law enforcement operational capability of the Service by authorizing the disbursement and use of funds to facilitate various types of investigative efforts.

Flood Control Act of 1944, as amended: This act, supplemented by other flood control acts and river and harbor acts, authorizes various Corps of Engineers water development projects. The Flood Control Act expressed Congressional intent to limit the authorization and construction of navigation, flood control, and other water projects to those having significant benefits for navigation and which could be operated consistent with other river uses. This authorized the construction of numerous dams and modifications to previously existing dams. Several provisions of this act impact the responsibilities of the Service under the **Fish and Wildlife Coordination Act**.

Food Security Act of 1985 “Farm Bill” (99 Stat. 1354), as amended by the Food, Agriculture, Conservation, and Trade Act of 1990: This contains several provisions that contribute to wetland conservation. The “Swampbuster” provisions stated that farmers who produce an agricultural commodity on wetlands converted after enactment are ineligible for most farmer program subsidies. Administration of the program in the Department of Agriculture (USDA), which is required to consult with the U.S. Fish and Wildlife Service on matters relating to wetland identification, determination of exemptions to the wetland conservation provisions, issuance of implementing regulations, mitigation, and restoration of values and functions on converted wetlands. This Act also authorized the Secretary of Agriculture to grant or sell conservation easements, which may include wetlands, to State or local governments or private non-profit organizations for conservation purposes. In addition, the 1985 Act also established a Conservation Reserve program, providing incentives to private landowners (e.g., farmers) to return farmland to permanent vegetative cover and for applying soil conservation prescriptions such as wildlife habitat development. The program was expanded in 1988 by regulation to make cropped wetlands eligible for the program, with the intended result of wetland restoration (i.e., The Wetland Reserve Program).

Freedom of Information Act (1966; 5 U.S.C. 552): Requires all Federal agencies to make available to the public for inspection and copying administrative staff manuals and staff

instructions, official, published and unpublished policy statements, final orders deciding case adjudication, and other documents. Special exemptions have been reserved for nine categories of privileged material, including but not limited to confidential matters relating to National defense or foreign policy, law enforcement records, and trade or commercial secrets. The Act requires the party seeking the information to pay reasonable search and duplication costs.

Historic Sites, Buildings and Antiquities Act (16 U.S.C. 461-462, 464-467), as amended.

Also known as the Historic Sites Act, this declared it a national policy to preserve historic sites and objects of national significance, including those located on refuges. It provided procedures for designation, acquisition, administration, and protection of such sites. Among other things, National Historic and Natural Landmarks are designated under authority of this Act. As of January, 1989, 31 national wildlife refuges contained such sites.

Lacey Act of 1900 (16 U.S.C. 701), as amended: Makes it unlawful to import, export, sell, acquire, or purchase fish, wildlife or plants taken, possessed, transported, or sold: 1) in violation of U.S. or Indian law, or 2) in interstate or foreign commerce involving any fish, wildlife, or plants taken possessed or sold in violation of State or foreign law. The Lacey Act covers all fish and wildlife and their parts or products, and plants protected by the Convention on International Trade in Endangered Species and those protected by State law. Commercial guiding and outfitting are considered to be a sale under the provisions of the Act. The Act also includes prohibitions on the importation of wild vertebrates and other animals listed in the Act or declared by the Secretary of the Interior to be injurious to man or agriculture, wildlife resources, or otherwise, except under certain circumstances and pursuant to regulations. The Lacey Act includes penalties and fines for violations involving imports or exports or violations of a commercial nature.

Land and Water Conservation Fund Act (1965): Authorizes the use of the receipts from the sale of surplus Federal land, outer continental shelf oil and gas sales, and other sources for land acquisition. Section 7(a)(1) of this Act provides authority to use Land and Water Conservation Fund money for acquisition of refuge areas under paragraph (5) of section 7(a) of the Fish and Wildlife Act of 1956.

Marine Mammal Protection Act (1972): The Marine Mammal Protection Act (MMPA) was enacted on October 21, 1972. All marine mammals are protected under the MMPA. The MMPA prohibits, with certain exceptions, the "take" of marine mammals in U.S. waters and by U.S. citizens on the high seas, and the importation of marine mammals and marine mammal products into the U.S.

Migratory Bird Conservation Act (1929; 16 U.S.C. 715-715d, 715e, 715f-715r), as amended: This established a Migratory Bird Conservation Commission to approve areas recommended by the Secretary of the Interior for acquisition with Migratory Bird Conservation Funds.

Migratory Bird Treaty Act of 1918 (16 U.S.C. 703-712), as amended: The Migratory Bird Treaty Act (MBTA) is one of the earliest Federal wildlife management laws enacted to

protect migratory birds, which were rapidly declining from unregulated sport and commercial hunting. Specific provisions in the MBTA include the establishment of a Federal prohibition, unless permitted by regulations, to "*...pursue, hunt, take, capture, kill, attempt to take, capture or kill, possess, offer for sale, sell, offer to purchase, purchase, deliver for shipment, ship, cause to be shipped, deliver for transportation, transport, cause to be transported, carry, or cause to be carried by any means whatever, receive for shipment, transportation or carriage, or export, at any time, or in any manner, any migratory bird, included in the terms of this Convention ...for the protection of migratory birds...or any part, nest, or egg of any such bird.*"

Migratory Bird Hunting and Conservation Stamp Act (1934; 16 U.S.C. 718-718j), as amended: Known as the "Duck Stamp Act," this requires each waterfowl hunter 16 years of age or older to possess a valid Federal hunting stamp. Receipts from the sale of the stamp are deposited in a special Treasury account known as the Migratory Bird Conservation Fund and are not subject to appropriations. Funds appropriated under the Wetlands Loan Act (16 U.S.C. 715k-3 - 715k-5), as amended, are merged with duck stamp receipts and provided to the Secretary of the Interior for the acquisition of migratory bird refuges under provisions of the Migratory Bird Conservation Act (16 U.S.C. 715 et seq), as amended, and since August 1, 1958, for acquisition of "Waterfowl Production Areas."

National Environmental Policy Act of 1969 (42 U.S.C. 4321-4347), as amended: The National Environmental Policy Act (NEPA) requires that all Federal agencies prepare detailed environmental impact statements for "every recommendation or report on proposals for legislation and other major Federal actions significantly affecting the quality of the human environment. NEPA stipulates factors to be considered in environmental impact statements, and requires that Federal agencies employ an interdisciplinary approach in related decision-making and develop means to ensure that un-quantified environmental values are given appropriate consideration, along with economic and technical considerations.

National Historic Preservation Act of 1966 (16 U.S.C. 470-470b, 470c-470n), as amended: Provides for preservation of significant historical features (buildings, objects, and sites) through a grant-in-aid program to the States. It established a National Register of Historic Places and a program of matching grants under the existing National Trust for Historic Preservation (16 U.S.C. 468-468d). The Act established an Advisory Council on Historic Preservation, which was made a permanent independent agency in 1976. That Act also created the Historic Preservation Fund. Federal agencies are directed to take into account the effects of their actions on items or sites listed or eligible for listing in the National Register. As of January, 1989, 91 historic sites on national wildlife refuges have been placed on the National Register, including Aransas NWR (Matagorda Island Lighthouse).

National Wilderness Preservation System (1964): Also known as the "Wilderness Act of 1964"; the purpose was to preserve and protect wild lands in their natural condition "*...to secure for the American people of present and future generations the benefits of an enduring resource of wilderness.*" This act directed Federal agencies such as the U.S. Fish and Wildlife Service to survey their roadless lands for possible wilderness designation. Wilderness areas are protected from development and the operation of motorized equipment.

A Wilderness Area is defined as an area with at least 5,000 acres of undisturbed, undeveloped land affected by the forces of nature and may also contain ecological, geological, or other features of scientific, educational, scenic, or historical value.

National Wildlife Refuge System Administration Act of 1966 as amended by the National Wildlife Refuge System Improvement Act of 1997, 16 U.S.C. 668dd-668ee.

(Refuge Administration Act): Defines the National Wildlife Refuge System and authorizes the Secretary to permit any use of a refuge provided such use is compatible with the purposes for which the refuge was established. The Refuge Improvement Act clearly defines a unifying mission for the Refuge System; establishes the legitimacy and appropriateness of the six priority public uses (hunting, fishing, wildlife observation and photography, and environmental education and interpretation); establishes a formal process for determining compatibility; established the responsibilities of the Secretary of Interior for managing and protecting the System; and requires a comprehensive conservation plan for each refuge by 2012. This Act amended portions of the Refuge Recreation Act and National Wildlife Refuge System Administration Act of 1966.

National Wildlife Refuge System Improvement Act (1997): Sets the mission and administrative policy for all refuges in the National Wildlife Refuge System. Clearly defines a unifying mission for the Refuge System; establishes the legitimacy and appropriateness of the six priority public uses (hunting, fishing, wildlife observation and photography, and environmental education and interpretation); establishes the responsibilities of the Secretary of the Interior for managing and protecting the system; and requires a comprehensive conservation plan for each refuge by the year 2012. This Act amended portions of the Refuge Recreation Act and National Wildlife Refuge System Administration Act of 1966.

Native American Graves Protection and Repatriation Act (1990): Requires Federal agencies and museums to inventory, determine ownership of, and repatriate cultural items under their control or possession.

North American Wetlands Conservation Act (1989; 16 U.S.C. 4401-4412), as amended: Provides funding and administrative direction for implementation of the North American Waterfowl Management Plan and the Tripartite Agreement on wetlands between Canada, U.S. and Mexico.

Protection Act (1922; 16 U.S.C. 594): Provides for the Secretary of the Interior to protect and preserve, from fire, disease, or the ravages of beetles or other insects, timber on the public lands owned by the United States.

Reciprocal Fire Protection Act of 1955 (42 U.S.C. 1856), as amended by the Wildfire Suppression Assistance Act of 1989 (102 Stat. 1615): Provides authority for Federal agencies to enter into mutual assistance agreements with foreign, State, and local governments for combating wildfires, and to provide emergency assistance when no agreement exists.

Refuge Recreation Act of 1962 (16 U.S.C. 460k-460k-4), as amended: Authorizes the Secretary of the Interior to administer refuges, hatcheries, and other conservation areas for recreational use, when such uses do not interfere with the area's primary purposes. The Act provides for public use fees and permits, and penalties for violation of regulations. It also authorizes the acceptance of donations of funds and real and personal property to assist in carrying out its purposes. Amendments to the Act authorize acquisition of lands and interests suitable for: 1) fish and wildlife-oriented recreation, 2) protection of natural resources, 3) conservation of endangered or threatened species, or 4) carrying out two or more of the above. Such lands were required to be adjacent to or within an existing conservation area. Acquisition was not permitted with "duck stamp" receipts for these purposes.

Refuge Revenue Sharing Act of 1935 (16 U.S.C. 715s), as amended: Provides for payments to county governments in lieu of taxes, using revenues derived from the sale of products from refuges. Revenues received from refuge products, such as animals, timber and minerals, or from leases or other privileges, are required to be deposited in a special Treasury account and net receipts distributed to counties. Remaining monies are required to be transferred to the Migratory Bird Conservation Fund for land acquisition under provisions of the Migratory Bird Conservation Act. The Act was later amended to expand the revenue sharing system to include National Fish Hatcheries and Service research stations. It also included in the Refuge Revenue Sharing Fund receipts from the sale of salmonid carcasses. Payments to counties were established as: 1) on acquired land, the greatest amount calculated on the basis of 75 cents per acre, three-fourths of one percent of the appraised value, or 25 percent of the net receipts produced from the land, and 2) on land withdrawn from the public domain, 25 percent of net receipts and basic payment, in lieu of taxes on public lands. Amendments to the Act authorized appropriations to make up any difference between the amount in the Revenue Sharing Fund and the amount scheduled for payment in any year. Counties are also required to pass payments along to other units of local government within the county which suffer losses in revenues due to the establishment of Service areas.

Refuge Trespass Act of 1948 (18 U.S.C. 41): This consolidated penalty provisions of various acts from 1905 through 1934, establishing and protecting fish and wildlife areas, and restated the intent of Congress to protect all wildlife within Federal sanctuaries, refuges, fish hatcheries and breeding grounds.

Rehabilitation Act (1973): Requires programmatic accessibility in addition to physical accessibility for all facilities and programs funded by the Federal government to ensure that anybody can participate in any program.

Rivers and Harbors Act (1899; 33 U.S.C. 403): Section 10 of this Act requires the authorization by the U.S. Army Corps of Engineers prior to any work in, on, over, or under a navigable water of the United States.

Secretarial Order No. 3226; Evaluating Climate Change Impacts in Management Planning (2001): The Department of the Interior Secretarial Order 3226 states that "there is a consensus in the international community that global climate change is occurring and that it should be addressed in governmental decision making... This Order ensures that climate

change impacts are taken into account in connection with Departmental planning and decision making.” Additionally, it calls for the incorporation of climate change into long-term planning documents such as the CCP.

Transfer of Certain Real Property for Wildlife Conservation Purposes Act of 1948 (16 U.S.C. 667b-d), as amended: This Act provides that, upon a determination by the Administrator of the General Services Administration, real property no longer needed by a Federal agency can be transferred without reimbursement to the Secretary of the Interior if the land has particular value for migratory birds, or to a State agency for other wildlife conservation purposes.

Uniform Relocation Assistance and Real Property Acquisition Policies Act of 1970 (42 U.S.C. 4601 et seq.), as amended: Establishes uniform land acquisition policies for all Federal agencies, and establishes requirements for the uniform and equitable treatment of persons displaced from their homes, businesses or farms by Federal or Federally-assisted programs, including land acquisition.

Volunteer and Partnership Enhancement Act (1998): This amended the Fish and Wildlife Act of 1956 to promote volunteer programs and community partnerships for the benefit of national wildlife refuges, and for other purposes.

Waterfowl Depredations Prevention Act (1956; 7 U.S.C. 442-445), as amended: This Act authorizes the Secretary of the Interior to use surplus grain owned by Commodity Credit Corporation in feeding waterfowl to prevent crop damage. Findings regarding possible crop damage are to be made by the Secretary of the Interior and grain is to be used to lure waterfowl away from crops while not exposing them to shooting over areas to which they have been lured. Such grain may be made available to Federal, State or local governments or private organizations or individuals. Appropriations are authorized to reimburse the Corporation for packaging and transporting such grain.

Water Resources Planning Act (1965), as amended: This established a Water Resources Council to be composed of Cabinet representatives, including the Secretary of the Interior. The Council was empowered to maintain a continuing assessment of the adequacy of water supplies in each region of the U.S. In addition, the Council was mandated to establish principles and standards for Federal participants in the preparation of river basin plans and in evaluating Federal water projects. Upon receipt of a river basin plan, the Council was required to review the plan with respect to agricultural, urban, energy, industrial, recreational, and fish and wildlife needs. This also established a grant program to assist States in participating in the development of related comprehensive water and land use plans.

Wetlands Reserve Program: The Wetlands Reserve Program (WRP) is a voluntary program. It provides technical and financial assistance to eligible landowners to address wetland, wildlife habitat, soil, water, and related natural resource concerns on private lands in an environmentally beneficial and cost-effective manner. The program provides an opportunity for landowners to receive financial incentives to restore, protect, and enhance wetlands in exchange for retiring marginal land from agriculture. There are three enrollment

options for landowners: 1) permanent easement, 2) 30-year easement, and 3) a restoration cost-share agreement. The WRP was re-authorized in the Farm Security and Rural Investment Act of 2002 (Farm Bill). The Natural Resources Conservation Service administers the program (*See Also: Food Security Act of 1985*).

Wilderness Act of 1964 (16 U.S.C. 1131): This Act directed the Secretary of the Interior to review every roadless area of 5,000 or more acres and every roadless island (regardless of size) within National Wildlife Refuge and National Park Systems and to recommend to the President the suitability of each such area or island for inclusion in the National Wilderness Preservation System, with final decisions made by Congress. The Act provides criteria for determining suitability and establishes restrictions on activities that can be undertaken on a designated area. It authorizes the acceptance of gifts, bequests, and contributions in furtherance of the purposes of the Act and requires an annual report at the opening of each session of Congress on the status of the wilderness system.

[This page intentionally left blank.]

Appendix B. Environmental Assessment and Finding of No Significant Impact (FONSI)

1.0 PURPOSE OF AND NEED FOR PROPOSED ACTION

1.1 Introduction

The United States Fish and Wildlife Service (Service) proposes to implement a Comprehensive Conservation Plan (CCP) for the Texas Mid-coast National Wildlife Refuge Complex (Complex), which would guide management on the Brazoria, San Bernard and Big Boggy National Wildlife Refuges for the next 15 years. This Environmental Assessment (EA) is being prepared to evaluate the effects associated with this proposal and it complies with the National Environmental Policy Act (NEPA) in accordance with Council on Environmental Quality regulations (40 CFR 1500-1509) and Department of the Interior (516 DM 8) and Service (550 FW 3) policies (see Section 1.7 for a list of additional regulations with which this EA complies). NEPA requires examination of the effects of proposed actions on the natural and human environment. In the following chapters, we describe three alternatives for future refuge management, the environmental consequences of each alternative, and our preferred management direction. Each alternative includes a reasonable mix of fish and wildlife habitat prescriptions and wildlife-dependent recreational opportunities consistent with the Refuge System Improvement Act and specific refuge purposes.

The environmental consequences of each alternative are described and form the basis for selection of the proposed action. This EA covers the environmental consequences for future management actions and current facilities on the Complex. However, some future actions such as the construction of major facilities will require further environmental documentation.

1.2 Location

The Complex is located in Brazoria, Fort Bend, Matagorda, and Wharton Counties, Texas. The Refuge is approximately 45 miles south of Houston, and approximately 45 miles southwest of Galveston, Texas (See Figure EA 1-1 or Map 3-3. Texas Mid-coast National Wildlife Refuge Complex Location in the CCP).

1.3 Background

The Complex includes the Brazoria, San Bernard, and Big Boggy National Wildlife Refuges (NWR), comprising a total of 105,000 acres along the Texas Gulf Coast. Brazoria NWR and most of the San Bernard NWR occur in Brazoria County with satellite units of San Bernard NWR in Matagorda, Fort Bend and Wharton Counties. Big Boggy NWR is entirely in Matagorda County. Figure 1 shows the location of the core refuges. Brazoria NWR is the oldest refuge of the Complex (1966) followed by San Bernard (1969) and Big Boggy (1983). The Service established the refuges to provide quality habitat for wintering migratory waterfowl and other wildlife.

The Complex supports a myriad of plant communities, co-evolving with biotic and abiotic systems, soil and flat to low topography (0 - 50 ft. elevation) to form an ecosystem of marshes, prairies and bottomland hardwood forests that are increasingly disappearing from the coastal landscape. Further influencing the preponderance of plant communities is the varied marine type

climatic conditions that result from the flow of warm gulf air modified by surges of continental air, resulting in a humid subtropical climate with hot summers and mild winters (Hatch et al. 1999).

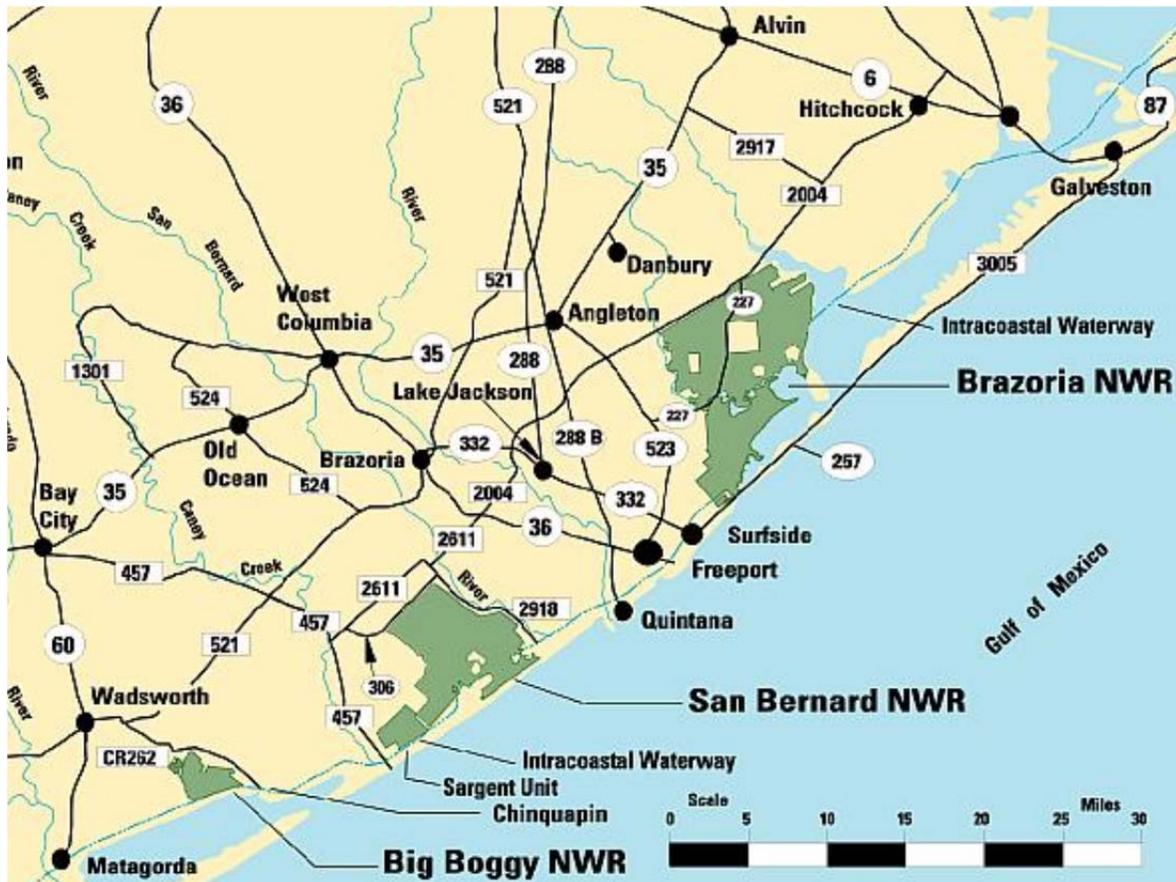


Figure EA 1-1. Refuges of the Texas Mid-coast National Wildlife Refuge Complex (U.S. Government Printing Office. 2003).

The Complex is home to thousands of wintering snow geese and recognized as an internationally significant shorebird site. Scattered woodlots in the refuges, as well as the remaining portions of the Columbia Bottomlands forest in the San Bernard NWR, are vital stopover points for neotropical migrants.

The wide variety of habitats include saline and non-saline prairie, mudflats, fresh and salt marsh, fresh and saltwater lakes, bottomland hardwood forest, and two intermittent freshwater streams. A 5,000-acre tract of native bluestem prairie on Brazoria NWR represents one of the last coastal prairies in Texas.

The Complex is one of the principal wintering areas in North America for snow geese as well as hundreds of thousands of shorebirds that use the mudflats during spring and fall migration. Over 230 species of neo-tropical passerine migrants have been recorded in the Complex.

Ongoing management is necessary to maintain these important and varied habitats. Water management projects help to maintain the shallow, freshwater ponds used by many birds, especially during times of drought. Controlled burning of grasslands recycles nutrients and helps control the spread of invasive species. A multitude of coordinated efforts related to preservation of the remaining Columbia Bottomland forests continue throughout the Complex to benefit the wildlife and habitat encompassing the entire Complex.

1.4 Purpose

The purpose of the proposed action is to specify a management direction for the Complex over the next 15 years. The selected management direction for the Complex achieves each Refuge's purposes, vision and goals; contributes to the mission of the National Wildlife Refuge System (NWRS or Refuge System); is consistent with principles of sound fish and wildlife management; and address relevant mandates and major issues during scoping. The proposed management direction is described in detail through a set of goals, objectives, and strategies in the CCP. The purpose of this EA is to assess the impacts of proposed management actions.

1.5 Need for Action

The action is needed because a long-term management plan does not currently exist for the Complex. Management is guided by various general policies and short-term plans that do not reflect current conditions or recent scientific knowledge. The action is also needed to address current management issues and to satisfy the legislative mandates of the National Wildlife Refuge System Improvement Act of 1997, which requires the preparation of a CCP for all national wildlife refuges in the United States.

1.6 Decision to be Made

The Regional Director for the Southwest Region (Region 2 of the Service) will make two decisions based on this EA: (1) select which alternative the Refuge will implement, and (2) determine if the selected alternative is a major federal action significantly affecting the quality of the human environment, thus requiring preparation of an Environmental Impact Statement (EIS), or whether the Proposed Action alternative can proceed.

The Complex's proposed action is Alternative B. Assuming no significant impact is found, the final CCP will include a Finding of No Significant Impact (FONSI), a statement explaining why the selected alternative will not have a significant effect on the quality of the human environment. This determination takes into consideration the Service and Refuge System mission, the purpose(s) for which the refuges were established, and other legal mandates. Once the FONSI is signed, the CCP will be implemented, monitored annually, and revised when necessary.

1.7 Regulatory Compliance

National Wildlife Refuges are guided by the mission and goals of the National Wildlife Refuge System (NWRS), the purpose(s) of an individual refuge, Service policy, and laws and international treaties. Relevant guidance includes the National Wildlife Refuge System Administration Act of 1966, as amended by the National Wildlife Refuge System Improvement Act of 1997 (Improvement Act), Refuge Recreation Act of 1962, and selected portions of the Code of Federal Regulations and Fish and Wildlife Service Manual.

The CCP's overriding consideration is to carry out the purposes for which the refuges were established. The laws used to establish the refuges and provide the funds for acquisition, state the refuge purposes. Fish and wildlife management is the first priority in refuge management, and the Service allows and encourages public use (wildlife-dependent recreation) as long as it is compatible with, or does not detract from, refuge purposes.

The Service prepared this EA and represents compliance with applicable federal statutes, regulations, Executive Orders, and other compliance documents. Appendix A contains a list of the key laws, orders, and regulations that provide a framework for the proposed action. Further, this EA reflects compliance with applicable State of Texas and local regulations, statutes, policies, and standards for conserving the environment and environmental resources such as water and air quality, endangered plants and animals, and cultural resources. The Complex will complete an Endangered Species Act Section 7 Consultation for inclusion in the CCP (Appendix G).

Comprehensive Conservation Plans include a review of the appropriateness and compatibility of existing Refuge uses and of any planned future public uses. If a use is determined to be an 'Appropriate Refuge Use' by a refuge manager, it then goes through the 'Compatibility Determination' process. For more information on Appropriate Refuge Uses and Compatibility Determinations, including a list of currently approved CDs, see Chapter 5, Section 2 of the CCP.

1.8 Scoping/Public Involvement and Issues Identified

Formal scoping began with publication of a notice of intent to prepare a CCP and EA in the *Federal Register* on June 23, 2009. Planning Update #1 was released to the public in August of 2009, announcing the beginning of the planning process and asking the public for help identifying the issues that need to be addressed in the CCP.

The Complex held three public open house meetings during the June 23rd to September 21st, 2009 comment period. The Complex held all three meetings the week of September 14, 2009. The first meeting was held at the Lake Jackson Library in Lake Jackson, Texas from 6–8 p.m. with 18 in attendance, the second at Demi-John Fire Hall in Freeport, Texas from 6–8 p.m. with 9 in attendance, and the last at the Complex Headquarters in Brazoria, Texas from 10 a.m.–3 p.m. with 14 people attending.

The Planning Team held an ecoregional coordination meeting at Brazoria NWR on December 9, 2009, to coordinate with other conservation agencies and organizations in an attempt to gain a

greater understanding of issues occurring at the landscape-scale, and what management actions are taking place to address those issues. This joint effort helped gain a better understanding of the management actions occurring within the Gulf Coast Prairies and Marshes Ecoregion and attempted to highlight areas that each agency, including the Texas Mid-coast NWR Complex, can focus management efforts in addressing issues impacting fish, wildlife, and their habitats within the larger landscape. Table EA 1-1 lists agencies and organizations that attended the ecoregion coordination meeting.

Table EA 1-1 Agencies and Organizations attending Ecoregional Coordination Meeting

Texas Parks Wildlife Department	Attwater Prairie Chicken NWR
Texas Chenier Plains NWR	The Nature Conservancy
Gulf Coast Joint Venture	Trinity River NWR
FWS Ecological Services	Texas Mid-coast NWR Complex

In addition to three open house public meetings and the ecoregional coordination meeting, the Complex hosted a government-to-government meeting and invited Texas Parks and Wildlife Department (TPWD) on February 9, 2010. The Complex held the meeting at its Headquarters and provided a forum for sharing ideas, concerns, and issues regarding management and outcomes on the Complex to benefit the development of the CCP. This interagency meeting proved to be a great asset with the State of Texas and helped the Complex form many of its wildlife related alternatives and management consideration of multiple species such as quail, turkey, and deer.

The Complex released Planning Update # 2 in March of 2010, to offer an opportunity to the public to review and comment on the issues identified during the public scoping process and announced the draft goal statements as well as the preliminary range of management alternatives developed by the planning team.

Additional public scoping for the Land Protection Plan (LPP) planning process was conducted in January, 2012, with a comment period open from January 15, 2012 until February 5, 2012. Three public (open house) meetings were held to provide information on the proposed expansion and respond to questions and concerns; January 20, 2012, at the Discovery Center on Brazoria NWR near Freeport, Texas; January 24, 2012, at the Complex Office near Brazoria, Texas; and February 2, 2012 at the Hudson Woods Unit of San Bernard NWR near Angleton, Texas. A total of 30 people attended the public meeting, with attendance of 15, 7, and 8 respectively, at each public meeting. A response card indicating support or non-support of the proposal was handed out at each meeting, enabling participants to provide a quick response. In addition, The Facts newspaper printed articles twice during the open comment period, which generated 8 email responses. Of the 27 total responses, 22 supported the project expansion and five did not.

The feedback received at the conclusion of the public scoping period and throughout the planning process identified concerns from a variety of stakeholders. The issues and concerns provided the basis for developing the Complex’s management direction and played a role in determining desired conditions for each refuge. The issues are divided into five categories: ecoregion-related management, habitat management, wildlife management, public use

opportunities, and facilities/infrastructure management as described below. All the following issues are Refuge management concerns unless otherwise specified.

The planning team identified the following issues after reviewing The Nature Conservancy's Gulf Coast Prairies and Marshes Ecoregional Assessment, Texas Comprehensive Wildlife Conservation Strategy, and other supporting documents to identify threats and issues for the Gulf Coast Prairies and Marshes Ecoregion. In addition to these documents, conservation and research organizations; local, state, and federal government agencies; and the public also identified issues during our scoping process and open house meetings. These issues helped us further our outreach efforts, gain a better understanding of what is occurring on the landscape surrounding the Complex, and determine the role of the refuges in conserving wildlife and their habitats within the larger landscape. Although these issues are outside the scope of the CCP they were used when considering development of management direction.

1.8.1 Ecoregion Issues

The Complex is taking a landscape-scale approach to management over the life of the CCP. Comments and concerns from our partners, the general public, and our ecoregional meeting were addressed according to; but not limited to, major issues/threats such as the effects of climate change, erosion/saltwater intrusion, wildland fire use, petroleum development, and land conservation and are described in detail below.

Fragmentation

Remaining tracts of wetland, marsh, and prairie habitats are being broken up, divided, and impacted from development of roads for commerce, development for housing, and businesses, and for agricultural purposes throughout the ecoregion. Fragmentation of the landscape has also been identified as having a highly detrimental impact on species that are less mobile (Fahrig 2003).

Commercialization

Commercialization activities are having negative impacts on both wildlife and habitat within the ecoregion, which is encompassing expanding human encroachment from the Houston Metropolitan approximately 45 miles north of the Complex. One of the biggest challenges is the sale of sand deposits developed throughout the ecoregion for commercial resale out of wetland and riparian areas that affect water quality downstream as well as in the bays.

Petroleum development, timber cutting, commercial crabbing and oyster harvest, livestock grazing and haying, turf farms, pollution from fertilizer and pesticides, and illegal dumping have all been identified as major impacts of commercialization affecting the entire ecoregion.

Urbanization

Changing from vegetative environments to those of asphalt and concrete reduces wildlife species, produces monocultures of grass that do not benefit wildlife, and creates barriers for many less mobile species. Urbanization is fragmenting native plant communities and resulting in a direct loss of plant diversity. Increasing pesticide and herbicide use around managed lands and an increase in fertilizer use are some of the many contributing factors of urbanization with negative impacts on prairie habitat. Urbanization also adds additional stressors on a limited

amount of public lands in Texas with an increased amount of natural resource users such as boaters, anglers, hunters, and outdoor enthusiasts. Urbanization is a serious issue since the Complex is just about 45 miles of the 3.9 million people living in and around Houston.

Disturbance

The effects of disturbance in some coastal habitats to a number of coastal wildlife species, particularly certain groups of birds, (waterfowl, colonial waterbirds, shorebirds) is largely unquantified and merits investigation. The Complex identified increased boat use and increased air traffic as well as oil and gas exploration as disturbances that could affect wildlife in the ecoregion.

Prairie Conversion, Habitat Conversion

Habitats are being converted into monocultures and are changing to urban environments through development and draining of wetlands. These projects are directly contributing to a net loss of prairie habitat affecting both flora and fauna prairie-dependent species. This direct loss of habitat is a major concern for the ecoregion.

Climate Change

As habitats change, the wildlife species that utilize those habitats will also change. Although the Complex can do little to resolve this issue, it can realize that such change is occurring, document these changes through data collection, and adapt management to reflect/address changes in hydrology and plant communities. Sea-level rise will have a direct impact on all three of the coastal refuges. Various models are being used to evaluate the loss of coastal marshes. Estimates from some models are showing that nearly 90 percent of the marshes on the Complex today may be converted to open water by 2100. Water, or lack of water, is expected to become a major environmental crisis throughout the state in the near future if conservation measures are not taken seriously. Combined with climate change, this issue has the potential to impact many refuge management activities such as wetland management, farming, habitat restoration, grazing, and fire management. Although climate change and other factors have the potential to alter the distribution of habitat types in this area, the effects of this change on resources across the landscape, including wildlife species, are still unknown.

Erosion/Saltwater Intrusion

Concerns on the impacts of navigation traffic that introduces saltwater into freshwater marshes and causes drastic changes in native local plant communities and a loss of habitat for many other species was expressed by the planning team as well as in the ecoregional meeting. Natural processes such as storms, hurricanes, and SLR all contribute to saltwater intrusion that affects prairie habitat.

Wildland Fire Use

The suppression of wildfire has changed local prairie communities and this suppression supports the growth of invasive and exotic species, which compound prairie restoration efforts. The planning team expressed concerns on the use of wildland fire from suppression tactics to the negative impacts of smoke in local communities surrounding the Complex.

Petroleum Development

The public had concerns of petroleum development and the potential impacts it can have on both Complex habitats and wildlife species. Many members of the public would like to see no petroleum development on refuges and many would like to see special mitigations incorporated to minimize negative impacts to wildlife.

Land Conservation

The expected effects of climate change, urban encroachment, development of small ranchettes with a few livestock and horses, as well as fragmentation, continue to expand near the Complex highlighting the importance of land conservation and continued expansion of Refuge-managed lands. Stakeholders expressed a desire to continue the acquisition process and promoted the management activities occurring throughout the Complex promoting land conservation.

The San Bernard NWR is approaching the 28,000-acre cap originally set by the Service in 1997 in decision documents with the Austin's Woods Conservation Plan Land Protection and Compliance Document. The Plan outlines the need to counter the rapid development and expansion of urban areas within the Columbia Bottomlands and protect a unique ecosystem essential for maintaining populations of migratory birds and resident species. The concerns identified in 1997 are still relevant and to date less than 5 percent of the historic habitat has been conserved. Recent research has continued to support the importance of these habitats for migratory songbirds, while nation-wide populations of songbirds continue to decline. Millions of Nearctic-Neotropical migrants make landfall in the bottomlands during spring and fall migration to rest and feed after and before crossing the Gulf of Mexico, respectively.

Acquisition efforts are a watershed-scale ecosystem type approach; focusing on the conservation of ecosystem integrity, function, heterogeneity, and biologic diversity addressed as a "bioreserve" network. The bottomlands are home to rare plants and several species that are at the edge of their range as well as newly defined species. Where the landscape is flat and unencumbered, the native forests are unique and add to the natural beauty of the area. An updated Land Protection Plan (LPP) (Appendix I) includes a proposal to allow the Service to continue conservation efforts within the Columbia Bottomlands, including raising the 28,000-acre cap to 70,000 acres. During the separate scoping meetings held for the LPP, concerns from the public regarding this expansion included feral hogs, the "thicket" appearance, removing lands from the tax base, acquisition funding, and additional public use opportunities. These issues are addressed in this document, the EA and the LPP.

1.8.2 Habitat Management Issues

Gulf Coast Prairies and Marshes

The Gulf Coast prairies and marshes were once part of an immense ecosystem covering nine million acres, in the states of Texas and Louisiana. Many of the tall grasses typically found in the Midwest prairie region occur on the coastal prairie as well, where bluestems are intermixed with species native to the coastal wetlands. The coastal prairie underwent intensive man-made development starting in the mid-20th century (Allain et al. 1999) and now totals less than 250,000 acres in Texas. Many native plant and animal components have

already been lost, but the Service along with partners recognize the need to maintain existing remnants and restore native coastal prairie habitats.

Members of the public, TPWD, other federal agencies, and the planning team expressed concern on how the Complex will manage to ensure the conservation, diversity, and enhancement of the Gulf Coast prairies and marshes. Comments and concerns from our partners and the general public on issues related to the conservation, diversity, and enhancement of Gulf Coast prairies and marshes were addressed consistent with, but not limited to, major issues such as development, erosion, fragmentation, invasive species, land management and other land use practices, natural occurrence, and pollution and are described in detail below.

Development - The effects of development include construction activity (i.e. building roads, structures, hardscape, oil and gas exploration), urbanization, urban sprawl, utility lines, and right of ways, as well as creation and modification of reservoirs. Direct effects of development in the Gulf Coast prairies and marshes are loss and habitat, and direct mortality of wildlife. Associated effects to development include impacts on water quality due to fertilizers, pesticides, herbicides and sanitary waste systems.

Erosion – Erosion may occur on beaches, along rivers, streams, creeks, shipping channels, jetties, ditches and other locations. Sea level rise, siltation, beach erosion, and subsidence are also major contributors to erosion.

Fragmentation – Habitat fragmentation results from changes in land use for purposes such as agriculture, land transportation (roads and highways), water transportation (shipping channels), housing, and commercial and industrial development. Ecoregional partners have linked fragmentation to inhibited wildlife dispersal, lack of available habitat and reduced gene flow. Fencing and saltwater intrusion have been linked to fragmentation as well.

Invasive Species (Flora) – Invasive species are a sub-set of non-native species that can aggressively alter an ecosystem. Several invasive species, including Chinese tallow, Macartney rose, deep-rooted sedge, and salt cedar are common on the Complex and are reducing the quality and potential of native prairie and marsh habitats. Invasive species out-compete native vegetation, reduce plant diversity, alter hydrology, change soil characteristics and nutrient cycling and can impact the effectiveness of prescribed fire. Fire is the predominant management tool in the coastal prairies and salt marsh to control brush and invasive species encroachment. The use of herbicides may be employed during habitat restoration to remove invasive species and improve overall habitat conditions to support native wildlife.

Land Management and Other Land Use Practices - Land management practices including, prescribed fire, farming, moist soil management, grazing and haying have a variety of impacts on the Gulf Coast prairies and marshes. Effects of management practices vary but the intent is to provide quality habitat for native wildlife, including non-natural management areas. Water management is the one tool that the refuges do not have control over. Although the refuges do have some water rights, they are not sufficient for even current management needs. In addition, the ability to purchase water in support of farming programs and wildlife wetlands is solely determined by the Water Development Boards.

Natural Occurrences - Natural occurrences such as drought, floods, and stochastic events such as hurricanes and wildfire have both positive and negative impacts on Gulf Coast prairies and marshes. Although unpredictable, these events are regularly occurring and impact management decisions.

Pollution - Pollution outside the Complex, but within the Gulf Coast prairies and marshes—such as petroleum/chemical spills, non-point and point source pollutants, contaminated water discharge, airborne sulfates, nitrates, heavy metals, and pesticide use—have lasting negative impacts on both wildlife and habitat.

Bottomland Hardwood Forest

Comments and concerns from our ecoregional meeting, as well as concerns from partners and the general public, were expressed according to, but not limited to, major issues such as residential development, incompatible forestry and livestock production practices, and stream channelization, and are each described in detail below.

Residential Development - Residential development in the bottomland hardwood forests and floodplain is affected by habitat being converted for residential use and the associated effects of development such as the impacts on water quality with septic systems outside city limits, use of fertilizers, as well as pesticide and herbicide run-off into river systems. The development of subdivisions usually alters the entire hydrological system of a given area.

Incompatible Forestry and Livestock Production Practice - Forestry and livestock production also affects the productivity and function of bottomland hardwood forests through efforts such as clear cutting of trees to convert forests to grasslands as well as an increased number of “hobby ranchers.” These types of incompatible practices can eliminate or alter a system drastically enough to change the entire production of flora and provide ideal conditions for exotic flora to become established, decrease soil stability, and change the hydrology of the entire system.

Stream Channelization - As residential areas continue to expand as well as increased livestock production and forestry practices the natural hydrology of a system becomes difficult to maintain and manage, especially in the constantly flooded hardwood forest. Large developers as well as municipalities, typically alter hydrological activities on a large scale in an attempt to minimize flooding damage to newly developed areas.

Forest Restoration - The Complex allows some areas in the bottomland hardwood forests to grow and regenerate and in some areas, supplemental plantings are necessary to provide an additional seed source to help areas develop into mature stands.

Water Management - Alterations to associated wetlands in bottomland hardwood forests are to the extent that management efforts need to be initiated to restore wetlands. The Complex will continue to collaborate with natural resource partners to maximize wetlands for the benefit of waterfowl and all other wildlife dependent on bottomland hardwood forests.

Dune and Beach

San Bernard NWR has approximately four miles of beach habitat between the mouth of the San Bernard River and Cedar Lakes Cut. Due to re-dredging of the San Bernard River in January 2010, the Cedar Lakes Cut has since silted in enabling vehicle access to the San Bernard Beach from the Sargent Beach during lower tides. To access the Cedar Lakes cut, vehicles need to traverse above the vegetation line due to the erosion of the Sargent Beach. Prior to the silting in of the Cedar Lakes Cut the San Bernard Beach has been accessible only by boat for the past 12 years. The Refuge is extremely concerned about the beach resources, where unlimited access is contrary to the Refuges purposes.

1.8.3 Wildlife Management

Threatened and Endangered Species

Three listed bird species (piping plover, northern aplomado falcon, and interior least tern) have been documented on the Complex. The piping plover is listed as endangered in Brazoria and Matagorda Counties and can be found on refuge beaches and mud flats from late July to May annually. The northern aplomado falcon is listed as endangered in Matagorda County. Irregular sightings of a transient bird have occurred on the San Bernard NWR. The interior least tern is listed as endangered in Wharton and Fort Bend Counties. These birds are migratory through the area and are usually associated with mudflats along river banks. In addition, the Sprague's pipit, which is a candidate species, has been documented in all four counties, but its current status on the Complex is unknown. It is a migrant species found during migration and winter, generally tied to upland native grasslands and can be found in large numbers in coastal grasslands. The red know is also a candidate species utilizing beach and tidal flats at San Bernard NWR. All five listed sea-turtles are found in the Gulf or Bays near the refuges. The Kemp's ridley sea turtle will nest on the San Bernard NWR beach. The refuge supports the Kemp's ridley Sea Turtle Recovery Plan by patrolling and responding to turtle stranding and nesting reports.

Two additional species, the Attwater's prairie chicken and the whooping crane, which do not currently occur on the Complex, may have potential recovery habitat on the Complex. In the future, the Service may consider reintroducing the Attwater's prairie-chicken onto refuge prairies and the expansion of whooping crane populations up the coast.

Migratory Bird Species and Species of Special Management Concern

Loss of prairie habitat has affected many grassland dependent bird species and is experiencing an alarming rate of decline. Waterfowl wintering throughout the Complex are dependent upon the wetlands provided by the Complex and are faced with additional challenges during periods of drought. Shorebirds and waterbirds are also dependent on moist soil management to get them through extended drought periods.

Monitoring the effects of management actions includes monitoring species of special management concern and focal species. These species are good representatives for a host of other species, with similar habitat requirements. The management staff selects focal species to monitor the effects of landscape scale characteristics that if properly managed will have beneficial effects on species sharing similar conservation needs.

Management of Invasive Species (Fauna)

Invasive fauna pose a biological threat to the entire Complex with their ability to displace native plant species, degrade wetlands and other natural communities, alter fire regimes, reduce natural diversity and habitat values. Once established, eliminating these plants is very expensive and labor intensive and continue to cause major economic and biological impacts throughout the entire ecoregion.

1.8.4 Visitor Services

Public Use Opportunities

The public has expressed concerns in growing each of the big six wildlife dependent recreational opportunities provided throughout the Complex including hunting, fishing, wildlife observation, wildlife photography, interpretation, and environmental education. Some members of the public felt that the Complex needs to expand public outreach as well as expand opportunities for the public to volunteer on the refuges.

Preservation of Historical Sites

The Complex is situated in an area recognized within a rich archeological and historical setting. The Complex will continue to incorporate historical interpretation into the public use areas.

Entrance Fees

Members of the public split, with some opposed and some in favor of implementing an entrance fee throughout the Complex.

1.8.5 Facilities/Infrastructure Management

The Complex identified the need to improve and expand upon visitor use and administrative infrastructure.

Visitor Use Infrastructure

Members of the public would like to see additional hiking and paddling trails, non-motorized boat launches, and signs and exhibits throughout the Complex.

Roadways - The public use roads are generally maintained gravel roads in good condition. The Complex paved the 3-mile entrance road to the Discovery Center over the past 7 years. Temporary road closures may occur during and after storm events. Large amounts of rainfall will result in tour road closures at San Bernard NWR as surface run-off may flood the road in several locations. Cedar Lake Creek periodically floods following heavy rainfall. The end of the tour loop at San Bernard may close until floodwaters recede and the turn-around is dry. Storm tides occurring at Brazoria often push debris and water across the public use area. The refuge may close the Big Slough Tour Road until floodwaters recede, debris is removed from the roadway, and washouts repaired. The Complex identified the need to maintain vehicular access on existing roads with some opportunities to provide additional pullouts in strategic locations to provide additional wildlife observation opportunities.

Administrative Infrastructure - The Brazoria NWR identified the need for additions and improvements in volunteer facilities, and relocating facilities to higher grounds.

1.8.6 Addressing Issues in the CCP and EA

While the Complex is influenced by all of the landscape-level issues discussed above, development outside Complex boundaries is beyond the control of the Service. These stressors on wildlife and habitat help focus the importance of the Complex. These issues help the Complex to further its outreach efforts, gain a better understanding of what is occurring on the landscape surrounding refuge lands, and determine the role of the Complex in conserving wildlife and their habitats within the larger landscape.

- Fragmentation
- Commercialization
- Urbanization
- Disturbance
- Prairie / Habitat Conversion
- Residential Development
- Incompatible Forestry and Livestock Production Practices
- Stream Channelization

These issues, which impact resources outside refuge boundaries, are considered outside the scope of the CCP: however, they were considered while developing the refuge management direction. These stressors can also occur within refuge lands and are addressed with the remaining issues (in sections 1.8.1 through 1.8.5) in the CCP (Chapter 4: Management Direct) and EA (as shown in Table EA 2-3).

2.0 ALTERNATIVES

2.1 Formulation of Alternative

Alternatives are different approaches or combinations of management actions designed to achieve a refuge's purposes and vision, the goals identified in the CCP, the goals of the Refuge System, and the mission of the Service. Based on the issues, concerns, and opportunities heard during the scoping process, the Planning Team developed three alternative management scenarios that represent a reasonable range of alternatives, which the Complex may use.

The EA considered three alternatives. In addition, the planning team considered two other alternatives but eliminated them from detailed analysis for the reasons listed below (see section 2.2). These alternatives represent different approaches or management scenarios for the future protection, restoration, and management of the refuge fish, wildlife, plants, habitats, and other resources, as well as compatible wildlife-dependent recreation. Refuge staff assessed the biological conditions of refuge habitats and analyzed the external relationships affecting each refuge unit. This information contributed to the development of refuge goals and, in turn, helped formulate the alternatives, summarized in Table 2-4. The Complex will examine alternatives in five broad issue categories:

Ecoregion Management: How will the Complex contribute to addressing Gulf Coast Prairies and Marshes ecoregion conservation related issues?

Habitat Management: How will the Complex manage habitats to ensure the conservation, diversity, and enhancement of the Gulf Coast Prairies and Marshes? How will the Complex manage habitats to ensure the conservation, diversity, and enhancement of bottomland hardwood forests?

Wildlife Management: How will the Complex manage wildlife to ensure the protection of trust resources?

Visitor Services: How will the Complex manage public use opportunities while ensuring the protection of fish, wildlife, and their habitats?

Facilities/Infrastructure Management: How will the Complex provide for infrastructure and related developments while ensuring the protection of trust resources?

2.2 Alternatives Considered but Dismissed from Detailed Analysis:

NEPA and the Improvement Act designed the alternatives development process to allow the planning team to consider the widest possible range of issues and develop feasible management solutions that respond to these issues. The Refuge then incorporates these management solutions into one or more alternatives evaluated in the EA process and considered for inclusion in the CCP.

The Complex does not usually consider actions and alternatives that are not feasible or may cause substantial harm to the environment in an EA. Similarly, an action (and therefore, an alternative containing that action) should generally not receive further consideration if:

- It is illegal (unless it is the No Action Alternative, which must be considered to provide a baseline for evaluation of other alternatives, even though it may not be capable of legal implementation).
- It does not fulfill the mission of the Refuge System.
- It does not relate to or help achieve one of the goals of the refuge.
- Its environmental impacts have already been evaluated in a previously approved NEPA document.

However, if such actions or alternatives address a controversial issue or an issue on which the Planning Team received many public comments, they may consider these in detail in a NEPA document to demonstrate clearly, why they are not feasible or would cause substantial harm to the environment.

During the alternatives development process, the planning team considered a wide variety of potential actions on the Complex. The planning team ultimately rejected and excluded the

following actions from the alternatives proposed here because they did not achieve refuge purposes or were incompatible with one or more goals.

The Complex considered eliminating the farming program at Brazoria NWR. They considered this alternative infeasible because it does not contribute to the objectives and goals outlined in the plan. The farm fields/wetlands provide valuable habitats as both wetlands and farm fields for large population of wintering waterfowl. Without active management of these areas, the refuge could not support the waterfowl, shorebird and sandhill crane population it currently supports. Abandoning this program will involve habitat restoration to combat invasive species encroachment. Areas currently farmed were previously disturbed before establishment of the Refuge. Farming is limited in scope and provides both “hot foods,” natural foods, as well as freshwater and cover for migratory birds and resident wildlife in both the fields and secondary water catchment basins. The Complex uses farming as a wildlife management tool, where wildlife directly benefit from crops left in the field, but equally benefit from the presence of fresh water associated with rice farming.

The public made a request to concentrate efforts on buying existing mineral rights on the refuge so that no more drilling will occur, initiating in sensitive areas of the Refuge and slowly expanding until the refuge owns all the mineral rights. The Complex considers this infeasible because, oftentimes, mineral rights have been withheld prior to the current landowner’s title policy and, therefore, do not transfer to the refuge upon acquisition. Acquiring mineral rights is unfeasible with current staff and budget.

2.3 Features and Management Common to All Alternatives

Although the alternatives differ in many ways, there are similarities among them; several elements of refuge management are common to all alternatives. We list these common management activities below to reduce the length and redundancy of the individual alternative descriptions.

2.3.1 Ecoregion Management

Climate Change

The Complex would continue to monitor prairie habitat and condition to determine the effects of climate change on refuge resources by conducting groundwater modeling, water quality/water quantity analyses to fully understand the refuge’s water resources, and use the best available science to minimize the impacts associated with climate change. The refuges would use green infrastructure and related technologies when opportunities and funding permit to reduce its carbon footprint and contribution to climate change.

Wildland Fire Use

The Complex will suppress all wildland fires. Suppression strategies range from monitoring the fire while allowing it to burn itself out (as in the case where no life, property, or resources are threatened and/or smoke management is not an issue of concern), to full suppression (if life, property, and resources are threatened and/or smoke management is an issue of concern).

The Complex will use a decision support process to guide and document wildfire management decisions. The process will provide situational assessment, analyze hazards and risk, define implementation actions, and document decisions and rationale for all decisions. The Complex will continue to manage wildland fires for multiple objectives, acknowledging that objectives can change as the fire progresses across the landscape.

Petroleum Development

Oil and gas exploration is occurring on four locations on the Complex (see Map 3-13. Brazoria National Wildlife Refuge Oil and Gas Exploration and 3-14. San Bernard National Wildlife Refuge Oil and Gas Operations in the CCP). Service policy 612 FW 2 states: “the objectives of oil and gas management on Service lands are to protect wildlife populations, habitats and other resources; and provide for the exercise of non-federal oil and gas rights while protecting Service resources to the maximum extent possible.” In accordance with 50 CFR 29.32, persons holding mineral rights shall to the greatest extent practicable, conduct all exploration, development, and production operations in such a manner as to prevent the damage, erosion, pollution, or contamination to the lands, waters, facilities, and vegetation of the area. They must also conduct such operations without interference with the operation of the Refuge or disturbance to wildlife, and would be subject to prior approval by the Service. All operations would be required to operate under current local, state, and federal regulations and policies. Each operator is required to provide the Refuge Manager with an annual Development and Operations Plan for review and approval.

Operators would be required to prevent, to the maximum extent possible, releases of hazardous materials and substances, crude oil, and produced water. Each operator and/or facility operator would have a current Oil Discharge Prevention and Contingency Plan outlining procedures for accidental releases. Sampling, remediation, and restoration of contaminated sites would be the responsibility of the operator and/or facility operator and would occur in consultation with the Service and the appropriate state agency. All sites no longer being used by industry would be sampled for contaminants at the operator’s expense to ensure proper disposal of material and that refuge staff and/or the visiting public are not exposed to contaminants.

Based on Service policy, the Complex requires that wells, roads, pipelines, and associated infrastructure and facilities not needed to support ongoing operations be removed and the sites restored to the satisfaction of the Refuge Manager.

Reasonable restrictions include restriction on time of year (October 15–March 15) for operations designed to minimize wildlife disturbance during the winter months; restriction on equipment to include low-pressure terra-tired vehicles or tracked equipment in the marshes and small “Bumble Bee” drillers in the bottomlands; and restrict ATV use in marsh habitats. The Refuge Manager will negotiate seismograph operations, pad placement, pipeline right-of-way, access roads, and all associated activities to reduce impacts on Refuge resources and management programs. The Refuge Manager will negotiate locations of production lines prior to drilling. Operators will generally place such lines along roadways and are directionally drill under wetlands or other sensitive environments. The refuge only permits closed-loop drilling operations. All seismic operations must hire an environmental monitor, selected by the Refuge Manager, who reports to the Refuge Manager, to monitor all seismic operations and ensure minimal habitat damage. In

Texas, the refuges may accept payment for restoration work required after the seismic operations. The refuges will then conduct restoration and monitoring efforts using those funds.

2.3.2 Habitat Management

Gulf Cost Prairies and Marshes

Prescribed Fire

The Complex would continue to use prescribed fire as a management tool used for restoration and maintenance of fire-adapted ecosystems and integrate the natural fire regime into bottomland hardwood forests, marsh, and prairie habitats. Restoration of coastal prairie may require treatment with prescribed fire annually or once every two years depending on the response of the vegetation and the ability to carry fire.

Maintenance of coastal prairie habitats generally requires the application of fire to the unit on a three to four year cycle. The Complex would continue to treat 25 to 35 percent of the coastal prairie and salty prairie habitats annually. The Complex uses a helicopter on prescribed fire ignitions on larger burns and as funding permits, and ground ignition when feasible. The Complex uses backing fires (against the wind) and flanking fires (parallel with the wind) and limited head fires, with flanking fire preferred due to longer combustion rates. The Complex uses backing fires to reinforce the firebreak.

Prescribed fire will be used on a two to six year rotation on 25 to 35 percent of burnable acres within the Complex’s coastal marshes (as environmental conditions allow) to mimic the historic fire regime of this ecosystem.

Regularly scheduled prescribed burning best mimics the historic natural fire regimes within the Gulf Coast Prairie Ecoregion. Table EA 2-1 identifies burnable acres that the Complex can best manage by applying fire along with acreages and desired management rotation and season. (See Map EA 2-1. Big Boggy National Wildlife Refuge Fire Management, Map EA 2-2. Brazoria National Wildlife Refuge Fire Management and Map EA 2-3. San Bernard National Wildlife Refuge Fire Management).

Table EA 2-1. Prescribed Fire Schedule for Texas Mid-coast NWR Complex

Table EA 2-1. Prescribed Fire Schedule for Texas Mid-coast NWR Complex				
Big Slough Units (5,725 acres)	Cox Lake	1834	3 - 4 years	L. Summer – Winter
	Cross Trail Pond	85		
	North Ridge	1002		
	Olney Pond	134		
	Salt Lake	1576		
	Teal Pond	147		
	Wolf Lake	947		
Marsh Unit (14,593 acres)	Alligator Marsh	3857	4 - 5 years	L. Summer – Fall
	Middle Bayou	1457		

Appendix B: Environmental Assessment

	Shrimp Farm	4828		
	Wharton Bayou	4451		
ICWW (Salt Marsh) Units (8,253 acres)	Christmas Ridge	5808	4 - 5 years	L. Summer – Fall
	Freshwater Lake	3421	5 - 6 years	
	Slop Bowl	946	5 - 6 years	
Island Units (841 acres)	Island 1	26	3 – 4 years	L. Summer – Winter
	Island 2	420		
	Island 3	88		
	Island 4	38		
	Island 5	269		
Prairie Units (13,338 acres)	Austin Bayou	1524	3 – 4 years	L. Summer – Winter
	Bermuda Triangle	1129		
	Bluestem	2441		
	Butterfly	755		
	Chocolate Bayou	3831		
	Ditch 6 to 7	578		
	Canvasback	937		
	Firehall	183		
	Otter Slough	555		
	Walker Ditch	861		
2004 Crossroads	544			
Sargent Units (4 subunits) (5620 acres)	Pentagon Marsh	618	4 years	Summer
	Sargent Check	1719		L. Summer
	Station	835		L. Summer
	Sargent Pasture	2448		Summer – Fall
	Smith Marsh			
Upland Units (7 subunits) (8,201 acres)	Cedar Lake Creek	739	3- 4 years	Summer – Fall
	Storm Pasture	599	3- 4 years	Fall – Winter
	Crawfish	2092	3- 4 years	Fall – Winter
	Ducroz	1551	3- 4 years	Summer – Fall
	Entrance Road	1096	3- 4 years	L. Summer
	Rail Pond Road	1011	3 years	Fall – Winter
	Road Pasture	1113	3 years	L. Summer – Fall
Tidal Units—2 subunits (15,611)	Cedar Lakes	4475	4 – 5 years	L. Summer – Fall
	Cowtrap Marsh	11,136		L. Summer – Winter
Moist Soil Units- 2 subunits (1767)	Moccasin Pond	368	2 – 3 years	L. Summer – Fall
	Wolfweed	1399		
	Wetlands			
Bottomland Units—3 subunits (1123)	Big Tree Pasture	205	4 - 5 years	L. Summer – Fall
	Buffalo Creek	850	3 - 4 years	L. Summer – Winter
	Halls Bayou	68	4 - 5 years	L. Summer – Winter
Freshwater Wetlands	Mallard and Julia’s Pond	675	3-4 years	Summer – Fall

(742 acres)	McCoach	67		
Uplands and Salty Prairie (2195 acres)	North Marsh Hunter	1209 986	3 years	L. Summer – Winter
Salt Marsh	Kilbride	1107	5 years	L. Summer

Bottomland Hardwood Forests

Forest Restoration

Although the focus of the Austin’s Woods Conservation Plan is acquiring old growth hardwood forest, some tracts acquired have a combination of old growth and restoring forests. Often, the Refuge allows natural regeneration to occur and supplemental planting are not required to achieve the desired conditions. However if immediate seed sources are not available, the Refuge will complete supplemental plantings, generally with slower growing species (live oaks). These plantings are necessary to provide an additional plant resource to help areas develop into diverse mature stands. In addition, direct planting has occurred following illegal clearing, at the expense of the culprit.

Water Management

The San Bernard NWR, where appropriate, would restore historic hydrology by filling ditches, installing water control structures, or constructing levees in areas that have been hydraulically altered with drainage ditches prior to acquisition. The Complex acquired Hudson Woods (and possibly future tracts) and restored natural hydrology, in partnership with the Natural Resource Conservation Service (NRCS). NRCS purchased a conservation easement from the landowner with Wetland Reserve Program funds prior to the Service acquiring the remaining land (fee title) from the landowner. In collaborating with NRCS, the Service must adhere to any stipulations identified in the conservation agreement. The NRCS designed and paid for the water control structure installed at Hudson Woods to restore Willow Oxbow.

2.3.3 Wildlife Management

Migratory Bird Species and Species of Special Concern

Over 320 bird species use Complex habitats during parts of their lifecycles and the Texas Gulf Coast is the primary wintering area for most of the Central Flyway waterfowl. Additionally, these coastal salt marshes are the ancestral wintering grounds of the lesser snow goose, which are highly dependent upon native marsh plants produced on the Complex. The Complex is one of the few areas on the Texas coast where large numbers of snow geese still feed on the native salt marsh grasses rather than on agricultural crops. In addition, rookeries at the Complex provide nesting habitat for a large population of colonial water birds, while thousands of shorebirds use the tidal mud flats on the Complex.

Neotropical migratory birds nest in the understory and mid-story layers of un-grazed bottomland hardwood forests. Newly acquired, under-brushed tracts are allowed to naturally re-vegetate, which supports species of concern such as acadian flycatcher, prothonotary warbler, and yellow-

billed cuckoo. During migration, a large variety of warblers, vireos, thrushes, tanagers, buntings, and goatsuckers take cover and refuel on insects and soft berries in these lush, multi-layered forests.

Coastal prairies and marshes provide nesting habitat for a variety of songbirds including Henslow's sparrow, LeConte's sparrow, sedge wren, and other species of concern overwinter in our coastal prairies. These wintering sparrows and wrens vary in cover requirements, so the wide range of species benefit greatly from the prescribed burn program's mosaic of different-aged prairie units. Painted bunting and dickcissel nest in these grasslands during the summer, using the cover for nest site concealment and feeding on seeds and insects provided by the variety of prairie plants that exist in non-grazed grasslands. Species benefit from our burn timing; which targets woody species and allows nesting birds' time to complete nesting attempts.

Yellow rails, black rails, and mottled ducks all use the heavy salty prairie grasses present in our 3–6 year burn rotations. Mottled ducks need these places to conceal their nests, and further benefit from their presence near brood water. However, they need these tracts in large acreages, as mammalian predators like raccoons search areas adjacent to water bodies. The larger grassland offers better concealment for this duck. Overlapping in nesting requirements is the black rail, a highly secretive species of concern. Present year-round, the Complex overlooks this bird due to its highly secretive nature and its unwillingness to emerge from beneath its canopy of grass cover. Similar to the black rails is the wintering yellow rails. Some estimates place the number of remaining North American yellow rails at less than 20,000. Both species of rails have very little "vertical lift," making it possible to enclose them when using ring fire ignition patterns. Our current practice of using low-mortality ignition tactics benefits both rails and more vulnerable herptiles, such as the Gulf Salt Marsh Snake, another high-level species of concern. All refuges on the Complex will provide habitat for mottled ducks. Mottled ducks are a priority species for management and the Complex will continue to provide nesting habitat in conjunction with freshwater wetlands that provide habitat for rearing young and cover for molting birds. Flooding impoundments will coincide with the nesting season. The Complex will also manage prairie for grassland wintering birds through three-year rotational burning. We will manage upper marsh habitat for black and yellow rails.

A variety of research and monitoring surveys in conjunction with these species and their habitat is occurring on a seasonal (winter) basis. Coordination with other agencies and other academic institutions would continue. Monitoring and banding will continue to monitor changes in vegetation, population trends and species diversity in response to habitat changes. Annual surveys would continue including the Christmas Bird Count, Mottled Duck Surveys (aerial), and Colonial Waterbird Counts. The Complex would continue to conduct diamondback terrapin surveys, annual breeding songbird census, feeding behavior study at Dance Bayou Unit, black and yellow rail banding, summer mottled duck banding, winter and migratory bottomland songbird banding, and grassland songbird banding. Special use permits would be issued to researchers and other cooperators for banding raptors, shrikes, bottomland migratory songbirds at the Brazos River Unit, bottomland wintering songbirds at Big Pond Unit, grassland songbirds, and diamond-back terrapins.

Rare and Protected Species (Flora)

Four plant species listed as both federal and state Species of Concern are Texas windmill grass, Coastal Gay-feather, three-flower broomweed, and Texas yucca. The Complex's prairie restoration efforts would benefit these and future rare and protected species should they become present on any of the refuges. The Complex would continue to collect data on species present on its land and monitor any occurrence of rare or protected species.

Feral Hog Management

The Complex would continue to manage feral hog populations in accordance with the current Feral Hog Management Plan (2004), which identifies multiple options including; issuing Special Use Permits for trapping and use of hounds, public hunts and aerial shooting to control populations. All of these actions are needed to manage refuge habitats for native wildlife. It is estimated that only 20 percent of the population of feral hogs in Texas are removed annually. This is far below the recommended rate of 50 – 60 percent removal needed to maintain current numbers. Without control, feral hog populations will continue to grow, increasing impacts on soil, water, vegetation, habitat diversity and wildlife populations both on and off refuge lands.

Currently, Special Use Permits (SUPs) are issued so that hogs can be trapped or hunted with the aid of hounds. SUPs are issued on a 6-month or 1-year basis, for a specific area of the refuge. This is the principle method for feral hog management within the bottomland units. Hunters and trappers must provide harvest reports on a monthly basis to the appropriate refuge manager. These SUPs require that hogs be killed quickly and removed from the refuge. Approximately 120 hogs are removed from Brazoria NWR and 450 hogs removed from San Bernard NWR annually thru the issuance of Special Use Permits.

The Service would contract with U.S. Department of Agriculture Wildlife Services or a private contractor to aerial hunt and control feral hog populations within marsh and prairie habitats (excluding bottomland units of San Bernard NWR) at Brazoria, San Bernard and Big Boggy NWRs. For aerial control, a professional sharpshooter would conduct shooting from a helicopter. Hogs would be humanely killed by accurate shots taken from the lowest safe altitude at which the helicopter can operate. Eighteen hours of flight time in December 2011 removed nearly 400 hogs across the Complex.

Brazoria NWR and San Bernard NWR collaborate with the Texas Youth Hunting Association and hold a youth feral hog hunt on two weekends per year. The Refuges hold the hunt in February at San Bernard NWR and in March at Brazoria NWR. Approximately 20 hogs at Brazoria NWR and 30 hogs at San Bernard NWR are removed annually by youth hunts. Other than the special youth hunts, public hunting is not currently allowed; however, the Complex intends to complete a Hunt Plan and Hunt Open Package for white-tailed deer and feral hogs in selected units in the future. Additional NEPA assessment will be conducted at that time.

2.3.4 Visitor Services

Fishing

The Complex provides four public fishing areas, offering a variety of saltwater fishing and crabbing opportunities. Fishing occurs on all navigable waters throughout the Complex from

designated locations and the Gulf Intracoastal Waterway (GIWW). State regulations determine all fishing restrictions with specific restrictions listed in 50 CFR. Navigable waters open to fishing are by boat access only and users must remain within the tidal margins.

The Complex allows fishing year-round in the designated areas in accordance with applicable state and federal regulations. All public fishing areas are available for use during daylight hours only, with the exception of Bastrop Bayou Public Fishing Area. This particular area is open 24 hours a day, but permits no overnight camping. All fishing must occur in accordance with state fishing regulations, and fishermen are required to have appropriate state fishing licenses.

Brazoria NWR has three public fishing areas that allow land access to saltwater fishing: Bastrop Bayou, Clay Banks, and Salt Lake Public Fishing Areas. Bastrop Bayou Public Fishing Area is universally accessible and offers a 200-foot pier with fish attracting lights, five paved bank fishing pull-offs, a universally accessible toilet, paved parking, and night-lights. The Clay Banks Public Fishing Area offers bank fishing along a one-mile segment of Bastrop Bayou. The Salt Lake Fishing Area offers 1.4 mile of bank fishing and a non-motorized boat ramp.

Navigable waters within the boundaries of the refuge open to fishing are Salt Lake, Nicks Lake, and Lost Lake. State waters including Cox Lake, Alligator Lake, Bastrop Bayou, and bays adjacent to the *Brazoria NWR* are open to fishing as well.

San Bernard NWR has one public fishing area that allows land access to Cedar Lake Creek. The Cedar Lake Public Fishing Area offers an accessible 20 foot by 10 foot fishing pier, a fishing trail that offers .4 miles of bank fishing, and a small public boat ramp that gives visitors access to Cedar Lake Creek. Fishing is permitted in navigable waters including Cedar Lake Creek, Cedar Lakes, and Cow Trap Lakes within and adjacent to the boundary of the refuge. The refuge permits fishing from the San Bernard Beach also.

Big Boggy NWR allows public fishing on the navigable waters of Boggy Creek and adjacent state waters.

Fishing is a traditional use of the area's saltwater bays and lakes that adjoin and are within the refuges. With the expected continued growth in the Houston Metropolitan Area, the number of fishing visits is likely to increase. The Complex is currently providing fishing opportunities for up to 30,000 fishing visits, and with the anticipated increase of 55 percent over the life of the CCP, the Complex can still provide quality experience while minimizing conflicts with other Complex users.

Preservation of Historic Sites

The Complex would continue to identify, protect, and manage all significant cultural resources in a spirit of stewardship for the benefit of future generations. The Refuge would administer, preserve, and protect these resources in such a manner that sites, buildings, structures, and other objects of cultural value are preserved and maintained for scientific study and public appreciation and use. The Complex would ensure that during the appropriate stages of decision-making affecting these resources such as construction, land use or resource planning, and land acquisition or disposal, it will give full consideration to cultural resources and remains in compliance with the state historic preservation act.

A monument and a historical interpretation panel identify the former Maddox home site on Brazoria NWR. The area is open to the public and a short trail enables visitors to access the former home site along the tour loop.

There are no historic sites preserved or interpreted on San Bernard NWR and Big Boggy NWR.

2.3.5 Facilities/Infrastructure Management

Visitor Use Infrastructure

Roadways

Vehicle access is allowed on designated refuge roads. Section 3.4.5.1 of the CCP provides a list of public use roads. Other roads throughout the Complex are for Service personnel only. Maintenance of these roads is highly dependent on weather, but generally graded two to three times a year. Major storm events may require additional maintenance.

2.3.6 Coordination between Government Agencies and Private Interests

Coordination with governmental agencies and private interests is essential in carrying out the objectives of the Complex. The Complex would continue to work with state and federal agencies, academia, conservation organizations, interested entities, and private landowners to provide positive results in areas of conservation of lands, habitat management, science, and public outreach. The Complex will continue cooperation with Padre Island National Seashore and U.S. Geological Survey (USGS) sea turtle lab regarding the sea turtle stranding and nest collection from area beaches.

2.4 Alternatives Analyzed in Detail

The Complex developed the following alternatives to comply with NEPA and to provide ways to represent a number of issues, concerns, and opportunities identified during the public and internal scoping process. Though the alternatives may have different emphases, habitat maintenance, restoration, and preservation are common elements of each alternative. The Complex intends for the alternatives to provide a range of public uses and access and respond to issues or concerns identified during the planning process as discussed below.

2.4.1 Alternative A—No Action Alternative (Current Management):

2.4.1.1 Ecoregion Management

Climate Change

San Bernard NWR would continue to implement limited carbon sequestration projects. These projects include natural forest restoration and supplemental planting totaling approximately 36 acres. The Refuge would continue to market the opportunity for carbon sequestration projects.

Brazoria NWR and San Bernard NWR would continue to incorporate climate change into their environmental education programs. Photovoltaic technology powers the Discovery Center located on Brazoria NWR and it uses green building products when feasible.

Big Boggy NWR would not conduct any climate change projects.

Erosion/ Saltwater Intrusion

The Complex will continue to engage in management activities and maintain facilities that reduce erosion and prevent saltwater intrusion on all three refuges.

At Brazoria NWR, projects include: bank armoring by use of concrete block/mats from Bastrop Bayou to Alligator Lake (approximately 2 miles) along the GIWW and shoreline rip-rap along 2,000 feet of Cox Lake and 100 feet at Salt Lake.

At San Bernard NWR projects include: large concrete slabs placed as rip-rap along the south end to protect 1500 feet of levee from wind driven wave action; as funds and time allow, the refuge plants smooth cordgrass in “goose eat-outs” (barren mudflats) to encourage sedimentation of the marsh and plugging small tidal channels.

Big Boggy NWR would continue to implement projects to slow down erosion including rip-rap projects that occur on Dressing Point Island. The rip-rap does not prevent erosion but significantly reduces the rate.

Land Conservation

Under Alternative A the San Bernard NWR would complete the existing Austin’s Woods Conservation Plan. The expected effects of climate change, urban encroachment, development of small ranchettes, as well as habitat fragmentation near the Complex highlight the importance of land conservation and expansion of refuge managed lands. Acquisition efforts are a watershed scale ecosystem type approach; focusing on the conservation of ecosystem integrity, function, heterogeneity, and biological diversity addressed as a “bioreserve” network.

Conservation with this approach requires a conservation design establishing an integrated network of individual tracts that provide representative samples of the regional landscape, or what is referred to as a “bioreserve” network. Reflecting the concept of a bioreserve network, the Columbia Bottomlands Conservation Partnership will have conserved 33,000 acres with its governmental and non-governmental partners by the end of fiscal year 2012, with 28,000 acres protected as refuge lands.

Currently, the emphasis of land acquisition focuses on bottomland hardwood forest and associated wetlands and prairie habitats. The bottomland forests of the ecosystem have high wildlife and wetland values. This ecosystem is the only expanse of forested wetlands adjacent to the Gulf of Mexico in Texas and originally covered 700,000 acres. In 1995, a Columbia Bottomlands Task Force (Task Force) estimated that only 177,000 acres of forest remained. This ecosystem is especially important for Nearctic-Neotropical migratory birds because of its proximity to the Gulf of Mexico. Millions of Nearctic-Neotropical migrants make landfall in the bottomlands during spring migration and use the area during fall migration. Migrating birds

depend on the remaining forest tracts for rest and feeding both before and after crossing the Gulf. The Task Force found that 237 species of birds, totaling at least 29 million individuals, migrate through the forest every year. Dr. Sidney Gauthreaux, Jr., (2002) using Doppler radar, documented that the Columbia Bottomlands is a major stopover area for these migrants. The area is located within the Texas Mid-coast Initiative Area of the Gulf Coast Joint Venture of the North American Waterfowl Management Plan.

Since 1997, the Complex has been working with partners conserving forested habitat, with the Service acquiring fee title and conservation easements to approximately 24,500 acres from willing sellers and donors. Under the approved Austin's Woods Conservation Plan the Service can only acquire 28,000 acres. With this cap reached in 2012, the Service would stop acquiring bottomland forest tracts.

2.4.1.2 Habitat Management

Gulf Coast Prairies and Marshes

Prairie/Grassland Restoration

Because much of the Complex was working livestock ranch or farm prior to refuge establishment, there infrastructure remains in place that interfere with native prairie restoration and management including roads, levees, ditches, and water control structures that all affect the natural hydrology of the prairie.

With disturbances initiated through farming, grazing, and development, prairies and grasslands are often the first areas encroached by exotic species such as Chinese tallow and restoration efforts have proved to be a challenge on budget and resources. Exotic and invasive species have complicated restoration efforts in prairie habitats since they can quickly become established prior to implementing restoration plans. The Complex initially treats many tallow-infested tracts with herbicides as well as mechanical manipulation in an attempt to convert it back to a functional prairie habitat.

Many of the species of special management concern have life history requirements (i.e., nesting, wintering habitat, etc.) directly tied to grasslands. The coastal prairies of Texas are important wintering grounds for sparrows and wrens. With nationwide habitat loss of prairies and grasslands, there are fewer places migrating birds can feed, rest, and winter. Direct habitat loss is the biggest concern for prairie-dependent species.

As a management tool, the Refuge Complex is actively collecting native seed for restoration efforts from native prairie grasslands within its boundaries. However, this is challenging because production and access to seed harvested is highly dependent on weather conditions. To help overcome this challenge, the Complex has purchased native prairie hay and distributed that hay using a bale spreader to restore native prairie. The Refuge will use areas restored as healthy functioning prairie habitat to collect seed to aid in the restoration of other prairie habitats.

Cooperative Haying

Brazoria NWR is the only refuge in the Complex that administers a cooperative haying program. Cooperative haying of 35 to 50 acres annually would continue to maintain wildfire buffer areas for Wildland Urban Interface (WUI) areas at Brazoria NWR. The cooperative haying program reduces fuel buildup in salty and coastal prairie habitats where prescribed fire cannot be implemented due to an expansion of WUI areas closing in on the Refuge boundary. The Complex generally conducts cooperative haying in late summer.

Restoration

Active restoration activities would occur on Brazoria and San Bernard NWRs. These refuges would actively restore old fields and coastal prairie through a combination of chemical, mechanical, fire, and planting of native prairie seed. Once restored, the refuges will use fire to maintain the habitat mimicking historic fire regimes.

Management of Invasive Species (Flora)

The Complex would continue not consider grazing as a management tool on all three refuges.

The Complex would continue to use mechanical, chemical, and prescribed fire treatments to control salt cedar, Chinese tallow, deep-rooted sedge, trifoliolate orange and Japanese honeysuckle, and any additional species on an as-needed basis. Table EA 2-2 describes the chemicals used to target high profile invasive species throughout the Complex.

Table EA 2-2 Chemical Treatments on the TMC NWR Complex

Rodeo	Cattails & Phragmites	Boom sprayer & aerial	Create open water for wildlife
Clearcast	Chinese tallow	Aerial	Eradicate invasive flora in bottomland forest
Glyphosate	Various grasses and Deep-rooted sedge	Hand & Backpack sprayer	Manage various grasses in & around facilities for safety & esthetics
Garlon 4	Chinese tallow & Macartney rose	Hand & Backpack sprayer	Coastal Prairie restoration
Roundup & Arsenal	Various grasses	Hand & Backpack sprayer	Manage various grasses in & around facilities for safety & esthetics
Grazon P+D & Remedy	Chinese tallow & Macartney rose	Aerial	Coastal Prairie restoration
Grazon Next	Chinese tallow & Macartney rose	Aerial	Coastal Prairie restoration
Habitat	Cattails & Phragmites	Boom sprayer & aerial	Create open water for wildlife
Pasture Guard	Yaupon	Aerial	Coastal Prairie restoration

Brazoria NWR would continue to use mechanical treatment on up to 100 acres of invasive species, including salt cedar and Chinese tallow. Mechanical treatment is the direct removal of trees using a tub grinder on an excavator or grinding using a gyrotrac or hydroax. Mechanical removal of Chinese tallow trees along drainage ditches would continue to be done in partnership with the drainage district. Approximately 1,600- 2,500 acres of Chinese tallow will be treated with chemical application as part of an annual on-going prairie restoration initiative. The chemicals generally used are Grazon P+D ® and Grazon Next® through aerial application. The Complex utilizes drift retardant to minimize drift; spraying is only conducted in areas where there are no sensitive resources (i.e., species that could be adversely impacted) and where private lands would not be impacted. Ground application would continue to be used for road maintenance and in small problem areas of deep-rooted sedge using a backpack pump or an ATV. The use of herbicides will continue to decline as the refuge transitions from a restoration to a maintenance management approach in prairie habitats. All herbicide application are evaluated through the Pesticide Use Permit (PUP) process (see section 4.2 for further detail). Prescribed fire would be used as a management tool on approximately 2,500 - 3,000 acres of prairie annually. Prescribed fire techniques and schedule are discussed above in the Features and Management Common across Alternatives section under Fire Management.

San Bernard NWR would continue to treat up to 50 acres annually by the same mechanical means as Brazoria NWR designed to remove Chinese tallow. Chemical application (same chemicals as Brazoria NWR) would be applied to approximately 100 acres annually and the Refuge would burn approximately 600 acres of coastal and salty prairie habitats to control Chinese tallow. Because of the presence of native hardwood trees in the bottomland forests of San Bernard NWR, mechanical and ground applied chemical treatments would be used to control invasive species, including Chinese tallow. On average, the refuge would annually treat up to 100 acres of bottomlands for invasive species.

At Big Boggy NWR, the refuge would primarily utilize prescribed fire to control invasive species among the coastal and salty prairie habitats. However, mechanical and herbicide application will be utilized when species and density warrant their use. The refuge generally treats less than 100 acres of invasive species annually.

Farming Program

Brazoria NWR would continue to use cooperative farming on 10 farm fields that fall in a three-year rotation and range from 50 to 120 acres for a total of 1,000 acres. Out of these 1,000 acres, approximately 220-350 acres are farmed on a given year. Three out of ten units (approximately 220-350 acres) are put into production each year with the remaining seven left fallow. The fallow fields are generally manipulated through discing and flooding during the off cycles of the rotation. The units essentially become a moist soil unit and may be flooded to provide wildlife habitat during non-production years. Rice is the main crop in production with the occasional grain sorghum. The purpose of the cooperative farming program on Brazoria NWR is for habitat benefits from the farming operations. A Cooperative Farming Agreement is prepared annually and identifies field and crops planted as well as compensation to the government, which could include direct payment, crops left in field, or rent equivalents. Rent equivalents may include discing in non-farmed marshes; purchase of herbicide used to spray invasive trees and brush on

irrigation laterals and/or track-hoe or excavator work on irrigation laterals. Additional rent equivalents include maintenance of feeder ditches, pipes, and water control structures and water credits purchased by farmer to be used by the refuge as duck or shorebird water following harvest. The farmer ensures that after final harvest, all cropped fields will be prepared for re-watering. Levees would be made water tight next to control structures. Discing immediately after harvest is not allowed unless unusual conditions warrant ground disturbance because of excess rutting of fields and breaching levees. In the event that a second cutting of rice crop occurs, the farmer is required to leave 25 percent of second harvest uncut to provide forage for waterfowl.

San Bernard NWR would continue to farm a 10-acre plot located in the headquarters area. This field is planted with rye grass during the winter as a source of winter browse and to attract wildlife with emphasis on white-fronted geese to the area for winter wildlife viewing. At other times, the field is used for administrative purposes such as testing plastic sphere ignition devices, testing and demonstrating rocket nets or other activities requiring a minimally vegetated area.

At Big Boggy NWR, a total of 90 acres would be farmed through force account at Mathis Field. The entire 90 acres would continue to be planted with rye grass to provide winter browse for waterfowl.

Water Management

Whenever possible, the Complex would continue to restore drained wetlands through plugging ditches or installing water control structures.

Brazoria NWR would continue to restore the wetland component of wet prairie mostly by reshaping and building up ditch borrows material. Water control structures are installed to manipulate water levels in the prairie. In addition, water delivery canals, and levees around farm field/moist soil units are rebuilt to improve water management and movement capability across the units.

Water Delivery Canals

Brazoria NWR and Big Boggy NWR would continue to maintain irrigation canals on the refuges for water delivery and movement. The drainage district general maintains ditches 1-14 on the Brazoria NWR, which includes Chinese tallow control, mowing and digging out ditches. Several of the ditches are utilized for water delivery as well.

San Bernard NWR - There are no irrigation canals on the refuge.

Water Purchases

Brazoria NWR and Big Boggy NWR have the ability to purchase and receive water. Brazoria NWR may purchase water from the Gulf Coast Water Authority and Big Boggy NWR from Lower Colorado River Authority. Water purchase is dependent on rainy seasons and may not be an option in extreme drought years. During droughts, water is extremely limited and may not be purchased for agricultural use. Water purchases will be determined on an annual basis and highly dependent on funding and availability. Freshwater from rice fields is captured and can provide wetland habitat below the rice fields. Brazoria NWR purchased approximately \$15,000

and \$18,000 worth of water in 2008 and 2009 respectively. Big Boggy purchased approximately \$5,000 worth of water for the 2008 and 2009 fall/winters. At San Bernard NWR, no purchases are made because there is no infrastructure in place to support this operation.

Irrigation Wells

Brazoria NWR will continue to manage three irrigation wells but regularly uses only the 4-inch well at Teal Pond. During drought situations, this small pump may provide the only freshwater in the Big Slough area. Water from this pump can be diverted to Teal, Olney, or Crosstrails Ponds. San Bernard NWR will continue to utilize two large irrigation wells. The 8-inch well at Wolfweed is a backup to the Cedar Lake Creek diversion pump and is used when Cedar Lake Creek is salty. A 10-inch pump at Sargent is utilized to provide fresh water in the moist-soil units in the Pentagon Marsh. This pump is essential to providing freshwater in this salt marsh habitat.

Big Boggy NWR has no wells.

Ponds, Reservoirs, and Moist Soil Units

All refuges on the Complex would continue to manage moist soil units and fields with a combination of draining and summer discing, utilizing a stubble roller while flooded, and where opportunity exists, flood units with saltwater to control vegetation. The reservoirs are generally self-sustaining but may be drained and refilled with saltwater to control encroaching vegetation.

Brazoria NWR would continue to manage 23 fields/ponds for freshwater habitats (See Map EA 2-4. Brazoria National Wildlife Refuge Moist Soil Units – Big Slough and Map EA 2-5. Brazoria National Wildlife Refuge Moist Soil Units – North Refuge).

San Bernard NWR would continue to maintain two reservoirs, eight moist soil units, and two ponds (See Map EA 2-6. San Bernard National Wildlife Refuge Moist Soil Units).

Big Boggy NWR will continue to manage four moist soil units (See Map EA 2-7. Brazoria National Wildlife Refuge Moist Soil Units).

Bottomland Hardwood Forest

The bottomland hardwood forests are both a mix of old growth, sustainable habitats and newly regenerative habitats. The old growth forest habitat of the San Bernard NWR (parts of Dance Bayou, Bird Pond, Big Pond, McNeil, Wilson, and other units) largely require no direct management to maintain dynamic ecological processes. Many units previously cleared for tree harvesting and cattle grazing are susceptible to non-native species invasion. Invasive species control coupled with a propensity for regeneration has allowed many units to overcome extensive habitat damage. Herbicide applications are generally by hand due to the need to limit drift.

Today, the San Bernard NWR has over 24,500 acres of bottomland hardwoods with continuing accrual of additional habitats under the auspices of the Austin's Woods Conservation Plan. Its objective is to conserve and restore these mature forests and protect this dynamic climax ecosystem and all the wildlife it harbors.

Across the Texas Gulf Coast marshes, prairies, and bottomland hardwood forests, the focus of restoration efforts is on converting previously disturbed areas back to native habitat to be fully utilized by native wildlife species.

Dune and Beach

San Bernard NWR has approximately four miles of beach habitat between the mouth of the San Bernard River and Cedar Lakes Cut. Due to re-dredging of the San Bernard River in January 2010, the Cedar Lakes Cut has since silted in enabling vehicle access to the San Bernard Beach from the Sargent Beach during lower tides. To access the Cedar Lakes cut, vehicles need to traverse above the vegetation line due to the erosion of the Sargent Beach. Prior to the silting in of the Cedar Lakes Cut, the San Bernard Beach has been accessible only by boat for the past 12 years. The refuge is extremely concerned about the beach resources, where unlimited access is contrary to the refuges purposes.

2.4.1.3 Wildlife Management

Threatened and Endangered Species

A total of five bird species (piping plover, northern aplomado falcon, interior least tern, Attwater's prairie-chicken, and whooping), one fish, (the smalltooth sawfish); and five reptiles (the Atlantic hawksbill, green, Kemp's ridley, leatherback, and the loggerhead sea turtles) are all protected under the Endangered Species Act and have potential habitat in or adjacent to the Complex. The piping plover is listed as endangered in Brazoria and Matagorda Counties and can be found on refuge beaches and mud flats from late July to May annually. The Service identifies portions of the Complex as critical habitat for the piping plover. The northern aplomado falcon is listed as endangered in Matagorda County. Irregular sittings of a transient bird have occurred on the San Bernard NWR. The interior least tern is listed as endangered in Wharton and Fort Bend Counties. These birds are migratory through the area and are usually associated with mudflats along river banks. The Attwater's prairie chicken and the whooping crane do not currently occur on the Complex; however, the Service identifies the Complex as potential re-introduction areas for both of these species with potential reintroduction of Attwater's prairie chickens onto refuge prairies and the expansion of whooping crane populations up the coast. Management staff will conduct coordination and studies to determine best potential management direction to maximize success if reintroductions occur on the Complex. With current and proposed management actions, habitat restoration efforts are providing larger tracts of functional native habitat that have the potential to eventually provide suitable habitat for other listed species that have been historically documented in the vicinity of the Complex.

In addition, the Sprague's pipit, which is a candidate species, has been documented in all four counties, but its current status on the Complex is unknown. It is a migrant species found during migration and winter, generally tied to upland native grasslands and can be found in large numbers in coastal grasslands. All five listed sea-turtles are found in the Gulf or Bays near the refuges. The Kemp's ridley sea turtle will nest on the San Bernard NWR beach. The refuge supports the Kemp's ridley Sea Turtle Recovery Plan by patrolling and responding to turtle stranding and nesting reports.

The Complex supports and assists with the implementation of the Kemp's Ridley Sea Turtle Recovery Plan. This includes beach sea turtle surveys during nesting season (May–July), flipper tagging, excavating sea turtle nests and transporting them to the incubation facility at Padre Island National Seashore. The Refuge monitors and responds to calls regarding sea turtles on Gulf coast beaches between the mouth of the Colorado River and Quintana Beach.

Management of Invasive Species (Fauna)

Invasive species such as feral hog, nutria, red imported fire ants, and Raspberry crazy ants have negative effects to both wildlife and wildlife habitat. In addition, areas disturbed by feral hogs become prone to the establishment of exotic plant species. Feral Hog Management is discussed in section 2.3.3 of this document. Nutria are rare but are present in Complex water impoundments. Alligators generally hold their population in check. Red imported fire ants throughout the southeastern United States have seriously impacted numerous ground-dwelling species such as Northern bobwhite quail. Researchers in the academia and land management arenas are evaluating their impact on mottled ducks and black rails. Populations of Raspberry crazy ants have not been located on the Complex yet. However, impacts to tree and ground nesting birds, and reptile nests could be devastating if they move into the Complex.

Red Imported Fire Ants and Raspberry Crazy Ants

Throughout the Complex, staff would treat rookery areas for red imported fire ants using methoprene (insect growth regulator) bait like Extinguish®. Treatments will occur before nesting season in October-November when moisture starts and ants began surfacing.

At Brazoria NWR, staff would treat Wolf Lake Skimmer Lot rookery with the same chemicals. At San Bernard NWR, staff would treat Cedar Lakes rookery.

The Complex is monitoring the Raspberry Crazy Ant, a recently discovered invasive species, for presence and wildlife impacts on the Brazos River Unit of San Bernard NWR. The ants are in a nearby hayfield, but have not been located on the Complex. Currently, no field treatment has been developed for Raspberry Crazy Ants. As research and treatments become available, the Complex will use the best available science to control Raspberry crazy ants.

At Big Boggy NWR, staff would treat Dressing Point Island rookery.

2.4.1.4 Visitor Services

Approximately 35,000 visitors visit Brazoria NWR and 35,000 visitors come to San Bernard NWR annually. About a quarter of the visitors come during the spring season (March–April) to view birds and enjoy the coastal prairie habitat when a variety of flowering plants are blooming. Approximately 5,000 visitors come to Big Boggy NWR for hunting and fishing opportunities. The Brazoria Discovery Center is approximately 1,500 square feet and includes a visitor contact center, lab, and office, and can host up to 50 students at a time. It also contains a large screen television and projection screen for interpretive programs and contains a pavilion overlooking Big Slough in the back of the Discovery Center. The Discovery Environmental Education Program (DEEP) has been functioning at Brazoria NWR since 1994. DEEP currently serves

approximately 3,000 students and in future years may expand to 6,000 students as the population of the area increases.

The Complex continues to serve as an outdoor education center where graduate students conduct research projects involving waterfowl and other migratory birds, agriculture and moist soil unit production, fish and wildlife, as well as forestry studies. Brazoria NWR and San Bernard NWR are open to the public throughout the year during daylight hours. Big Boggy NWR is closed with the exception of limited hunting and fishing opportunities.

San Bernard NWR maintains six areas that provide wildlife observation, interpretation, and photography opportunities. Cocklebur Slough Public Use Area provides an auto tour while the Hudson Woods, Dow Woods, Betty Brown, San Bernard Oak, and Little Slough are walking trails. Visitors can find interpretation of Refuge resources along all trails and the auto tour. Expansion of the environmental education programs at Brazoria NWR occurs at San Bernard NWR proper, as well as at the bottomland units.

Boating is allowed in all navigable waters throughout the Complex in support of hunting, fishing, and wildlife observation.

Hunting

The Complex will continue to provide the current level of hunting opportunities. All three refuges in the Complex allow waterfowl hunting. In addition to waterfowl hunting opportunities, the Service cooperates with TPWD and the Stringfellow Wildlife Management Area (WMA) and Texas Youth Hunting Program (TYHP) to provide white-tailed deer/feral hog youth hunts on San Bernard NWR and feral hog hunts on San Bernard and Brazoria NWR's respectively.

Brazoria NWR has two public waterfowl hunting areas: Christmas Point and Middle Bayou Public Waterfowl Hunt Areas (see Brazoria NWR Hunt Area Map 3-30 and 3-31). The Christmas Point Public Waterfowl Hunt Area lies southeast of the GIWW and encompasses approximately 4,000 acres. Access is by boat only. The Middle Bayou Public Waterfowl Hunt Area encompasses approximately 1,500 acres and access to this site is by boat or by walk-in from CR227. On these units, the Refuge permits hunting of ducks, geese, and coots. It prohibits pits and permanent blinds.

During the youth feral hog hunts, in partnership with TYHP, youth hunt from temporary blinds located off FM2004, in the Otter Slough Area.

San Bernard NWR has three designated public hunting areas (Cedar Lakes, Smith Marsh, and Salt Bayou Public Waterfowl Hunt Areas) and one permit hunting area (Sargent Permit Waterfowl Hunt Area), illustrated on the San Bernard NWR Hunt Area Map 3-32 of the CCP. All of these public hunting areas are accessible by boat only, and are open for the pursuit of ducks, geese, and coots. The Cedar Lakes Public Waterfowl Hunt Area (2,400 acres) lies south of the GIWW, and the Smith Marsh Public Waterfowl Hunt Area (1,400 acres) is on the west side of Cedar Lakes Creek. Salt Bayou Public Waterfowl Hunt Area encompasses 3,600 acres accessible from Cedar Lakes Creek, the Gulf Intracoastal Waterway, or through the shallow

Cowtrap Lakes system. The Sargent Permit Waterfowl Hunt offers a limited hunting opportunity on 4,000 acres with walk-in or boat access.

For the TPWD youth deer/feral hog hunts and the TYHP feral hog hunts, all hunting opportunities are limited to stationary blinds. There are a total of nine stationary blinds in the McNiel/Ducroz/Stringfellow Unit. This bottomland unit is contiguous with the Nannie M. Stringfellow WMA.

Big Boggy NWR has two public hunting areas: the Pelton Lake Public Waterfowl Hunt Area and Matthes Field Public Waterfowl Hunt Area. Pelton Lake encompasses 1,100 acres on the east end of the refuge, whereas the Matthes Field Public Waterfowl Hunt Area is located at the north end of the refuge along Chinquapin Road (see Big Boggy NWR Hunt Area Map 3-33). The Complex primarily maintains this 200-acre area for goose hunting, but both areas are open for the hunting of ducks, geese, and coots.

On the Complex, the Public Waterfowl Hunt Areas are open during the State Waterfowl seasons. Teal season is generally scheduled for 9 to 16 days beginning mid-September. Regular season generally begins late October through mid-January with one two-week mid-season closure. In addition, the Public Waterfowl Hunt Areas across the Complex are open during the Conservation Order Light Goose Season, following regular waterfowl season. The Complex holds youth hunts on the McNiel/Ducroz/Stringfellow Unit of San Bernard NWR three weekends per year; two in October and one in December. Youth hunts led by the Texas Youth Hunting Program (TYHP) occur at San Bernard and Brazoria NWRs two weekends per year (February/March) at each location.

All refuges on the Complex provide hunting opportunities. Issue 1, Management of Invasive Species (Fauna) discusses feral hog hunting opportunities. Public Waterfowl Hunting Areas are open access on a first come, first serve basis. Waterfowl hunting areas are open during the teal and general waterfowl seasons in accordance with state seasons. The Complex allows hunting from a half hour before sunrise to sunset.

Wildlife Observation

Existing Wildlife observation opportunities would continue to be available at San Bernard and Brazoria NWRs. The Complex estimates annual visitation at 70,000 with approximately 32,000 visitors coming to the refuges for wildlife observation opportunities. General public access to observe wildlife and refuge habitats including the means of access such as automobile, hiking, bicycling, boating, canoeing and kayaking. Bird watching continues to be the most popular form of wildlife observation on the refuge, where visitors can see large concentrations of waterfowl, wading birds, and neo-tropical songbirds. Big Boggy NWR would remain closed to public use other than special tours.

San Bernard NWR offers wildlife observation and hiking at several locations. The San Bernard auto tour and Moccasin Pond loop provide 9.4 miles of gravel roads with observation platforms, vehicle pullouts, trails, boardwalks, and a butterfly garden. The Cacklebur Slough Road provides opportunities to see wading birds, raptors, and passerines as well as resident wildlife in light forest and grassland habitats. Moccasin Pond loop is at the edge where the salty prairie

meets the high marsh. From the loop road a variety of fresh and saltwater, open water, marsh, and grassland habitats support an array of migratory and resident wildlife. Bicyclists are welcome on all Refuge roads that are open to public vehicles. The San Bernard Oak trail, which is located .5 mile north of the Refuge entrance, along CR 306, provides a .6 mile trail through a mature bottomland forest to the largest live oak in Texas. The trail crosses a slough before reaching the tree, which provides excellent opportunity for viewing bottomland wildlife including wood ducks, reptiles, and songbirds.

Hudson Woods, located five miles west of Angleton, Texas, on SH 521 provides 5.9 miles of walking trails through early and mid-succession stage bottomland forest. Walking the trails provides excellent opportunities for viewing winter and migratory songbirds. Two oxbow lakes provide opportunities for viewing waterbirds including anhinga, waterfowl, and wading birds. An observation deck at Scoby Lake, the deck on the front of the Discovery Outpost and the photo blind provide excellent opportunities to view wetland wildlife.

Dow Woods is the most recent bottomland forest unit opened to provide wildlife observation opportunities. The unit is located on the north side of the City of Lake Jackson. Currently 2.7 miles of trail are available for wildlife observation through a restoring forest and along the shore of Bastrop Bayou. Visitors commonly see native wildlife including deer, armadillos, and raccoons along with migratory songbirds, woodpeckers, and owls.

Betty Brown, the smallest unit on San Bernard NWR, has a 3/8 mile loop trail that takes visitors to the shore of the San Bernard River. This mature growth forest provides excellent opportunities to see migratory songbirds as they move inland from the Gulf of Mexico.

Brazoria NWR will continue to emphasize wildlife observation and highlight these opportunities in a variety of strategic locations including: the Big Slough Public Use Area, Otter Slough, Bastrop Bayou, and Middle Bayou Trail. On Brazoria NWR, the 7.5-mile gravel auto tour route meanders through the Big Slough Public Use Area, wrapping around Olney and Teal Ponds and accessing Big Slough and Rogers Pond. The tour loop, accessible by foot, bicycle, or automobile, includes boardwalks, observation platforms, vehicle pull-offs, trails, and butterfly gardens, each of which is associated with offering opportunities for wildlife observation. In addition, a remote bird-viewing camera is set up at Gator Nest Pond to broadcast video of wildlife to the Discovery Center. The 3-mile paved entrance road from County Road 227 also provides wildlife observation opportunities.

Brazoria NWR also has viewing areas outside the Big Slough Public Use Area. Mottled Duck Marsh, off County Road 208 on the refuge's northern edge, rewards visitors on the lookout for views of waterfowl, wading birds, and shorebirds. The farm fields along County Road 227 and FM 2004 also offer wildlife-viewing opportunities from the public roadway. The Refuge is proposing to work with Brazoria County and develop pull-offs along the county roads for visitors to safely view wildlife without hampering traffic flow.

Wildlife Photography

In addition to the opportunities provided above for wildlife observation, San Bernard NWR would continue to provide a photo blind at Hudson Woods, which presents opportunity for photographing wildlife.

Brazoria and Big Boggy NWRs would provide no additional facilities for wildlife photography.

Environmental Education

The Complex would continue to provide environmental education through their Discovery Environmental Education Program (DEEP).

The Discovery Center at Brazoria NWR would continue to host the majority of the DEEP programs. However, the Discovery Outpost at Hudson Woods and the Wolfweed Wetlands at San Bernard NWR may continue to host field trips as well. The Discovery Center would continue to offer environmental education year round. Activities would include staff-led field trips and issuance of Special Use Permit for after hours or closed area access.

Picnicking may occur as an incidental use supportive of the environmental education program. Picnic tables are located outside of the Discovery Center and visitors may use them in conjunction with environmental education activities.

Interpretation

The Complex would continue to coordinate with the Friends of Brazoria Wildlife Refuges to host the annual Migration Celebration at San Bernard NWR, a weekend event held in April. The event hosted at the refuge features van and marsh buggy tours, numerous children hands-on learning activities, and presentations, including Birds of Prey and Reptiles. Over 1,800 visitors and volunteers attended the 2012 event.

Opportunities for interpretation occur throughout the Complex. People may encounter interpretive opportunities within any public use areas and administrative offices throughout the Complex.

Entrance Fee

Currently, there is no entrance fee required.

2.4.1.5 Facilities/Infrastructure Management

The Complex has three administrative sites. The Complex Office is located on San Bernard at the intersection of FM2611 and CR316. The facility provides office space for Complex management, administrative, biological, law enforcement, and fire program management. The field office for San Bernard NWR is located along CR306 and includes office facilities for refuge management, maintenance, and fire crew as well as maintenance and equipment storage facilities. The Brazoria NWR field office is located off FM2004 and south of CR208. The facility provides office space for refuge management, maintenance, law enforcement, and fire crew as well as maintenance and equipment storage facilities.

The Otter Slough headquarters of Brazoria NWR consists of the Refuge's field headquarters that is located off FM 2004. The office has eight individual offices and supports field operations including management, maintenance, fire, and law enforcement.

The field headquarters of San Bernard NWR is located on CR 306. The field headquarters include the Refuge's office and fire office, maintenance and storage buildings and storage sheds, quarters, two volunteer pads and a communications tower (repeater).

The primary facility resources on Big Boggy NWR are habitat management and resource protection related. No developed infrastructure occurs on this refuge.

Visitor Use Infrastructure

Visitor Orientation Facilities

The Discovery Center at Brazoria NWR is the only facility constructed specifically for visitor orientation in the Complex. However, visitors will continue to find printed information, interpretive map panels, and a helpful staff member at the Complex Headquarters and Refuge Field Offices.

Trails

Both San Bernard NWR and Brazoria NWR would continue to provide trails for Refuge visitors. Big Boggy NWR does not have any trails. Please refer to Section 3.4.5.2 of the CCP for a full list of trails provided at each Refuge.

San Bernard NWR offers 12 miles of walking/hiking trails at four different locations; Hudson Woods, Betty Brown Unit, San Bernard Oak, and the Cacklebur Slough public use area.

Brazoria NWR offers 5 miles of walking/hiking trails at two different locations; Middle Bayou and Big Slough Public Use Area.

Non-motorized Boat Launches

The Complex would continue to provide four access points to use for launching canoes and kayaks at Brazoria and San Bernard NWRs. There are no access points on Big Boggy NWR.

Brazoria NWR has two non-motorized boat launches at Salt Lake and Bastrop Bayou. San Bernard NWR has a boat ramp on Cedar Lake Creek that visitors could use for canoes and kayaks.

Signs/Exhibits

Exhibit and information panels at observation decks, kiosks, and trailheads would consist of photo panels.

Administrative Infrastructure

Volunteer Facilities

The Complex would continue to provide recreational vehicle pads at Brazoria NWR and San Bernard NWR. There would not be any volunteer facilities provided at Big Boggy NWR. The RV village at Brazoria NWR supports eight RV pads. San Bernard NWR has RV facilities to support two volunteer RVs.

Administrative Facilities

The Complex would continue to maintain a variety of facilities to support Refuge operations and programs including administrative, maintenance, and fire facilities. Find a full list of facilities and their descriptions in Section 3.4.6.2 of the CCP.

2.4.2 Alternative B—(Proposed Action):

2.4.2.1 Ecoregion Management

Climate Change

Management would be the same as Alternative A; however, the Complex would also consider monitoring prairies and marshes carbon sequestration. The Complex would implement a baseline monitoring program for all species that occur on the Complex and would monitor population shifts. The visitor services program would consider expanding the climate change curriculum provided by their DEEP program as new information on climate change becomes available. The Complex would expand its use of green products where feasible. The Complex would add photovoltaics to old offices and new facilities and expand existing systems when opportunities arise.

San Bernard NWR would restore 10 percent of bottomland forests requiring restoration through native planting of oak using carbon sequestration funding. San Bernard NWR may also use exchange of carbon credits for restoration and would implement a habitat-modeling program to predict shifts in bottomland composition. San Bernard NWR would incorporate climate change into their Refuge displays and replace existing refuge displays with recycled products.

Erosion/Saltwater Intrusion

Management to address erosion and saltwater intrusion would be the same as Alternative A; however, there would be an increase in the types and amounts of structural and restoration techniques used and discussed below.

Brazoria NWR would rehab the Salt Lake weir, and increase cooperation with the Army Corps of Engineers (ACOE) to establish up to seven additional beneficial dredge projects, shoreline protection projects and approximately 10 miles of bank armoring along the GIWW. Reef domes will be installed along the bank of Oyster Lake and West Bay to prevent the breaching of Oyster Lake due to ongoing erosion. Brazoria NWR would also explore the option of planting smooth cordgrass to reduce erosion.

San Bernard NWR will also increase cooperation with the ACOE to identify and implement two beneficial dredge sites and approximately 6 miles of bank armoring or installation of breakwaters along the GIWW with breakwaters preferred.

Big Boggy NWR would install reef domes and/or geotubes to stabilize erosion of Dressing Point Island.

Land Conservation

Under Alternative B, the Service proposes to increase the 28,000 acre cap by an additional 42,000 acres (to a total of 70,000 acres); continuing conservation efforts in the Columbia Bottomlands and associated habitats, as described in the Land Protection Plan provide CCP Appendix I. This expansion would remain within the approved project geographical boundary in Brazoria, Matagorda, Fort Bend, and Wharton counties in Texas and would continue the conservation efforts within the Austin's Woods Conservation Project. The original Conservation Plan, approved in 1997, was intended to counter the rapid destruction of prime old growth bottomland hardwood forests in the Columbia Bottomlands ecosystem. That plan responded to concerns shared by the Service, the Texas Parks and Wildlife Department, local government agencies, conservation organizations and landowners over preserving a sustainable portion of this internationally significant ecosystem. The original overall goal shared by all of the project partners was to protect approximately 10 percent of the estimated original 700,000-acre ecosystem to sustain plant and animal populations and maintain the ecosystem's diversity. The Service would continue to utilize a variety of funding mechanisms for purchasing fee title or conservation easements within the Columbia Bottomland Ecosystem; work with partners finding conservation solutions; and take a lead role in the conservation of additional forested habitats, identifying federal and non-federal funding sources in cooperation with private landowners, federal, state and local governments and non-profit organizations.

2.4.2.2 Habitat Management

Gulf Coast Prairies and Marshes

Cooperative Haying

Brazoria NWR would increase the cooperative haying program up to 75 total acres to increase the wildland urban interface (WUI) buffer area where it cannot implement prescribed fire due to the presence of houses adjacent to the Refuge boundary.

Restoration

Management would be the same as Alternative A; however, *Brazoria NWR* would establish partnerships for native prairie seed harvest. It would collect seed from refuge prairies and use it to restore other coastal prairie habitats on the refuge. The refuge would restore approximately 600–800 acres annually.

Management of Invasive Species (Flora)

The Complex would continue to use mechanical, chemical, and prescribed fire treatments as described in Alternative A, with the additional treatments as described below. This management alternative would incorporate limited livestock grazing throughout the Complex as a

management tool for specific issues like invasive species management, pond management, or to control aggressive native plants. Livestock grazing would be seasonal with AUM (animal unit month) and acreage to be grazed determined annually. It would be a winter grazing program, short duration incorporating a rotation system in this time frame. Although the Refuge would maintain existing fences, the use of electric wires would be the primary method of keeping the livestock within the specific unit. An example may be to use grazing to control phragmites re-growth following a fall burn.

Brazoria NWR would increase the number of acres treated mechanically every year to approximately 200 acres. The Refuge would reduce chemical application to approximately 800–1200 acres annually as it restores areas. The Refuge would increase prescribed fire to approximately 5,000 acres annually. Brazoria NWR would also implement monitoring and control of phragmites stands and they would implement an early detection program to identify new invasive species.

San Bernard NWR (prairie and marsh habitats) would increase mechanical treatment to approximately 100 acres annually and increase use of prescribed fire to approximately 1,000 acres per year. Chemical application would continue to be the same as Alternative A.

San Bernard NWR (bottomland forest) would implement the same management as Alternative A, plus they would contract approximately 50 acres per year for mechanical and chemical treatments. The refuge would increase mapping of invasive and prevent the spread of invasive species along right-of-ways through monitoring and education.

Big Boggy NWR would implement the same management as Alternative A; however, it would treat Chinese tallow along fence lines, roads, and water delivery canals (approximately 20 acres) through chemical application.

Farming Program

Management would be the same as Alternative A; however, Brazoria NWR would increase farming acres to approximately 1,200–1,500 to include additional moist soil units into the crop rotation. The cooperative farmer would still only plant 350–400 acres annually. The acreage that would be included is already in moist soil production.

San Bernard NWR would explore potential for habitat restoration and protection partnerships with Texas RICE, Ducks Unlimited, and the Coastal Program. San Bernard NWR would also implement monitoring on prairie restoration areas listed in Alternative A.

Water Management

Management would be the same as Alternative A; however, there would be drilling of additional wells and development of new/rehabilitation of existing water control structures as outlined below.

Water Delivery Canals

Brazoria NWR would construct water diversions along ditches and canals to capture more runoff water. Lift pumps and check dams would be installed in drainage ditches.

Big Boggy NWR would clean out existing water delivery canals and drainage ditches to increase freshwater availability.

Water Purchases

Water will continued to be purchased, on an as needed basis, as described in Alternative A.

Irrigation Wells

Brazoria NWR would drill an additional well in farm fields.

San Bernard NWR would rehabilitate two existing irrigation wells. Rehabilitation of these wells would involve clearing out well and determining the reason for low water flow. The refuge would add one additional well for Moccasin and Rail Pond.

Big Boggy NWR would add an irrigation well at McCoach Unit.

Ponds, Reservoirs, Moist Soil Units

Big Boggy NWR would rehabilitate levee and water control structures at Matthes Pond and Mallard Pond.

San Bernard NWR would rehabilitate levees and level the west and middle units of Wolfweed Wetlands to improve management capability. The refuge would explore expansion of Wolfweed Wetlands and increase management capabilities at Sargent Pentagon Marsh by establishing two additional moist-soil units totally 120 acres and water canals.

Bottomland Hardwood Forest

Management would be the same as Alternative A.

Dune and Beach Management

San Bernard NWR would protect the San Bernard beach habitat and wildlife through limiting vehicle access above the tidal zone. Beach resources, including the debris that help to stabilize the dunes, are extremely critical to maintaining this habitat for a variety of native wildlife and protection of the adjacent marsh. Unintentional fires could have detrimental effects on marsh and dune habitats. The Service will restrict campfires and fireworks on the beach habitat.

2.4.2.3 Wildlife Management

Threatened and Endangered Species

In addition to the Alternative A, the Complex would begin monitoring for the potential reintroduction of APC and whooping crane. The Service lists the refuge as a potential reintroduction site for whooping crane, but given the fact that the refuge is outside of the whooping crane flyaway means the refuge will play a much smaller role in this recovery effort. Monitoring would include baseline data on freshwater availability and blue crab populations.

In preparation for a potential APC reintroduction, the refuge would monitor habitat conditions; conduct research on burning regimes, grazing, and cooperative haying; and collect baseline data

on insect populations. If the Complex reintroduced APC, it would implement the APC Recovery Plan.

Management of Invasive Species (Fauna)

Feral Hog

Management of feral hogs would be the same as Alternative A.

Red Imported Fire Ants and Raspberry Crazy Ants

Management of invasive ants would be the same as Alternative A; however, the Complex would enable the release of Phorid flies as a natural predator to control red imported fire ants.

2.4.2.4 Visitor Services

Hunting

The Complex will continue to manage hunting as it is under Alternative A, but Brazoria NWR would provide a youth waterfowl hunting permit area, which would increase youth hunting opportunities by 20 percent over the life of the CCP. San Bernard and Big Boggy NWRs would provide hunting only until 1 p.m. Additional areas will be open to waterfowl hunting in Eagles Nest Lake after completion of a hunt plan and associated environmental compliance. The Complex may consider future deer hunts if populations and/or habitat conditions would benefit from enacting a white-tailed deer hunt program following environmental compliance.

Wildlife Observation

Wildlife observation would continue to be managed as it is under Alternative A; however, the Complex would increase opportunities by constructing new wildlife observation facilities. Brazoria NWR would provide a viewing area on Otter Slough (possibly a boardwalk across the slough) and establish pull-off points along FM2004, at the farm fields, and on CR 227.

Wildlife Photography

The Complex would continue to manage wildlife photography as it is under Alternative A, plus San Bernard NWR would add photo blinds at Dow Woods area. Brazoria NWR would add photo blinds to the Big Slough area.

Environmental Education

Environmental education would continue as it is under Alternative A and the Complex would increase the education program. Brazoria NWR and San Bernard NWR would expand outreach by contacting local media outlets, radio, and Web sites to provide information on the DEEP program, events, and refuge purposes. Provide a one-weekday camp focused on the “at-risk” group of youth (Boys and Girls Club, etc.).

The DEEP program at Brazoria NWR would expand to include an additional school district. The DEEP program at San Bernard NWR would expand to include seven additional school districts including: West Columbia, Sweeny, Bay City, Van Vleck, Angleton, Pearland, and Alvin schools. San Bernard NWR would also like to develop a partnership with Brazosport College at the Dow Woods Unit, enabling them to use the Unit as an outdoor classroom.

Interpretation

Management of interpretation would continue as in Alternative A, but organized interpretative programs would be expanded to include a variety of venues on a monthly basis. Interpretive activities would include day and night naturalist walks and audio/visual presentations conducted by staff and volunteers. Brazoria NWR would also construct an information kiosk along FM2004.

Entrance Fee

In this management alternative, the Complex would make the current voluntary moneybox visible and more secure. Brazoria NWR would add a donation box at the fishing pier and San Bernard NWR would add donation boxes to public use areas.

2.4.2.5 Facilities/Infrastructure Management**Visitor Services Facilities*****Visitor Orientation Facilities***

Management of these facilities would be the same as Alternative A; however, San Bernard NWR would develop a stand-alone, unmanned visitor orientation facility for after-hour and weekend visitors.

Trails

Management would be the same as Alternative A, except Brazoria NWR would remove the Middle Bayou Trail at Brazoria NWR and provide a new trail at Otter Slough. San Bernard NWR would provide bicycle opportunities in the bottomland forest public use area at Dow Woods and Hudson Woods.

Non-motorized Boat Launches

Management would be the same as Alternative A; however, San Bernard NWR would provide a second launch and pullout location at the end of CR 318 that provides access to Cedar Lake Creek to provide additional opportunities for canoes and kayaks and establish a paddling trail.

Signs/Exhibits

Management would be the same as Alternative A, but this alternative would require construction of eight new exhibits and signs replacing signs in existing kiosks. The Complex will place new information signs at Cedar Lake Creek's kayak access and Dow Woods Unit. The refuge will also replace existing signs to improve the quality and content.

Administrative Facilities***Volunteer Facilities***

Under this alternative, Brazoria NWR would develop a new RV facility near the new field headquarters at Otter Slough. This facility would replace the existing facility and would move it out of the immediate storm surge zone where it currently occurs. San Bernard NWR would

expand volunteer facilities to five total volunteer pads and would construct a laundry/community building.

Administrative Facilities

San Bernard NWR would construct an equipment storage facility to use for staging equipment and supplies prior to landfall of a hurricane at Buffalo Creek Unit.

2.4.3 Alternative C

2.4.3.1 Ecoregion Management

Climate Change

Management would be the same as Alternative B; however, San Bernard NWR would increase restoration efforts to 25 percent.

Erosion/Saltwater Intrusion

Management would be the same as Alternative B; however, additional shoreline protection projects would occur.

Brazoria NWR would construct breakwater structures (rip-rap, reef domes, or geotubes) to Lost Lake to increase sedimentation behind the structure and prevent further erosion. The refuge would do these projects in partnership with the ACOE and through grants and other funds available.

San Bernard NWR would increase bank armoring or installation of breakwaters along the Intracoastal Waterway to 10 miles of shoreline protected.

Big Boggy NWR would expand Dressing Point Island using geotubes, beneficial dredges, and breakwaters, and also work with ACOE to implement two beneficial dredge sites off-refuge on the opposite side of the GIWW and install approximately two miles of bank armoring or installation of breakwater with breakwaters being preferred.

Land Conservation

Land Conservation within the Columbia Bottomlands will be the same as Alternative B.

2.4.3.2 Habitat Management

Gulf Coast Prairies and Marshes

Cooperative Haying

Management would be the same as Alternative B.

Restoration

Management would be the same as Alternative B; however, Brazoria NWR would develop a seed bank on 500 acres of native prairie to collect and distribute native prairie seed to increase restoration efforts across the ecosystem to include off-refuge locations.

Management of Invasive Species (Flora)

This management alternative would be the same as Alternative B, but Brazoria NWR would allow limited bison grazing instead of livestock as a management tool for specific issues such as invasive species control or reducing the progression of aggressive natives. Grazing with bison would be managed on a year-round basis across the larger coastal prairies rather than seasonal like livestock. Bison may be moved into a small part of a larger pasture using an electric fence to obtain the desired habitat outcome, for instance in moist soil unit to control phragmites. Brazoria NWR would decrease the number of acres treated mechanically every year to approximately 100. Chemical application would be reduced to approximately 200 acres annually and only occur where the refuge cannot use fire as the primary management tool (i.e. levees). The refuge would continue to increase its use of prescribed fire to burn approximately 8,000 acres annually. Reduction in mechanical and chemical treatments is due to conversion from active restoration to maintenance.

San Bernard NWR (prairie and marshes) would decrease both mechanical and chemical treatments to approximately 50 acres annually where it cannot employ fire as the primary management tool. There would be an increase in prescribed fire to burn approximately 4,200 acres annually.

Farming

Under Alternative C, the Refuge would reduce the cooperative farming program at Brazoria NWR to 500 acres, and only farm 150–200 annually. The Complex would eliminate farming at San Bernard and Big Boggy NWRs.

Water Management

Water management would be the same as Alternative B.

Water Delivery Canals

Management would be the same as Alternative B.

Water Purchases

Management would be the same as alternative B; however, Brazoria NWR would explore the options to purchase water rights so that we would not have to rely heavily on purchases and decrease water purchase from Gulf Coast Water Authority to approximately \$10,000 annually. Brazoria NWR would also increase partnerships with Ducks Unlimited and Velasco Drainage District to increase freshwater availability.

Irrigation Wells

Management would be the same as Alternative B.

Ponds, Reservoirs, Moist Soil Units

Management would be the same as Alternative B.

Bottomland Hardwood Forest

Management would be the same as Alternative A.

Dune and Beach

Management would be the same as Alternative B.

2.4.3.3 Wildlife Management

Threatened and Endangered Species

Management would be the same as Alternative B.

Management of Invasive Species (Fauna)

Feral Hog

Management would be the same as Alternative A; however, the Brazoria and San Bernard NWRs would open refuges to general feral hog hunt. Portions of both refuges (including bottomland units) would be open on three weekends during the late winter/early spring. An estimated 210 hunter days would occur annually.

Red Imported Fire Ants and Raspberry Crazy Ants

Under this alternative, the Complex would implement broad scale treatment using methoprene (insect growth regulator) bait like Extinguish®.

2.4.3.4 Visitor Services

Hunting

Management of hunting would be the same as Alternative B; however, San Bernard NWR would offer a deer hunt to reduce populations once population data is available.

Wildlife Observation

Management of these activities would be the same as Alternative B.

Wildlife Photography

Management of these activities would be the same as Alternative B.

Environmental Education

Management of these activities would be the same as Alternative B.

Interpretation

Management of these activities would be the same as Alternative B.

Entrance Fee

Management of these activities would be the same as Alternative B.

2.4.3.5 Facilities/Infrastructure Management

Visitor Use Infrastructure

Visitor Orientation Facilities

Management under this alternative would establish a standalone and manned visitor contact station at San Bernard NWR Headquarters.

Trails

Management of trails would be the same as Alternative B.

Non-motorized Boat Launches

Management of these launches would be the same as Alternative B; however, San Bernard NWR would work with partners to establish additional launch sites, one on Brazos River, one on Oyster Creek, and one on the San Bernard River.

Signs/Exhibits

Management of signs and exhibits would be the same as Alternative B.

Administrative Infrastructure

Volunteer Facilities

Under this alternative Brazoria NWR would keep the same facilities outlined in Alternative A, but the refuge would construct a larger laundry/community building to support volunteers. Management of these facilities for San Bernard NWR would be the same as Alternative B.

Administrative Facilities

Management of these facilities would be the same as Alternative B.

2.5 Comparison of Alternatives

Table EA 2-3. Comparison of Alternatives

Issue	Alternative A: Current Management (No Action)	Alternative B	Alternative C
Ecoregion Management			
Climate Change	Supplement natural forest regeneration with restoration efforts; monitor carbon sequestration; conduct education programs; and use “green” technologies and building products on all new construction	Same as Alternative A plus increase restoration efforts; utilize exchange of carbon credits; gather baseline data on habitat composition/wildlife diversity; update refuge displays; and	Same as Alternative B plus increase restoration efforts above described levels

		increase use of “green” technologies	
Erosion / Saltwater Intrusion	Construct/Use a variety of structural and some restoration techniques at various locations	Same as Alternative A plus increase the types and amounts of structural and restoration techniques used	Same as Alternative B but diversify the types of structural and restorative techniques used
Wildland Fire Use	Follow direction of current FMP	Same as Alternative A	Same as Alternative A
Petroleum Development	Work cooperatively with companies to minimize impacts to refuge resources	Same as Alternative A	Same as Alternative A
Land Conservation	The Complex will continue to acquire lands under the 1997 Austin’s Woods Conservation Plan until the 28,000 cap is reached	The Complex will acquire lands under the new (see Appendix) Land Protection Plan up to 70,000 acres	Same as Alternative B
Habitat Management			
Gulf Coast Prairies and Marshes			
Prairie/Grassland Restoration and Management	Cooperative haying conducted; wetland and farmland rehabilitation. Native prairie restoration	Same as Alternative A, plus increase acreage of haying, and increase number of rehabilitation projects. Increase prairie restoration	Same as Alternative B plus develop seed bank on prairie restoration areas.
Management of Invasive Species (Flora)	Mechanical, chemical, and prescribed fire use allowed; grazing not allowed	Same as Alternative A plus increase the types and amounts of management prescriptions used including limited livestock grazing	Same as Alternative B but diversity the types of management prescriptions used including bison grazing
Prescribed Fire Use	Allowed Complex-wide to improve habitats and reduce hazardous fuels	Same as Alternative A	Same as Alternative A
Farming Program	Cooperative farming and force account farming occur on all three refuges	Same as A, plus incorporate additional moist soil units into farming rotation at Brazoria NWR	Reduce cooperative farming acres at Brazoria NWR and eliminate farming at Big Boggy and San

			Bernard NWRs
Water Management	Restore prairie pothole hydrology as opportunity arises; use established wells to provide freshwater to moist soil units during drought periods; and purchase water from various water authorities annually	Same as Alternative A plus drill additional wells, and develop new / rehabilitate existing water control structures	Same as Alternative B plus increase water availability through the development of partnerships and purchase of water rights; expand wetlands; and rehabilitate marshes
Bottomland Hardwood Forest			
Forest Restoration	Allow natural regeneration, where appropriate add supplemental planting of hardwood species; treat invasive species	Same as Alternative A	Same as Alternative A
Water Management	Restore previously drained wetlands	Same as Alternative A	Same as Alternative A
Dune and Beach			
	Management of beach resources have not been clearly defined due to recent silting in of Cedar Lakes Cut and trespass across upland vegetation on private land to access the Cut.	Cooperatively work with County and General Land Office (GLO) to provide additional protection on San Bernard Beach restricting type of access and activities by visitors that would be compatible with Refuge Purpose.	Same as Alternative B
Wildlife Management			
Threatened and Endangered Species	Implement the Sea Turtle Recovery Plan	Same as A, plus if reintroduction of APC and whooping crane occur, implement APC and whooping crane recovery plans	Same as Alternative B
Migratory Bird Species and Species of Special Management Concern	Manage a variety of habitats for resting, feeding, and reproductive purposes	Same as Alternative A	Same as Alternative A
Management of Invasive Species	Baiting and broad scale treatments to control	Same as Alternative A plus release natural	Same as Alternative A but diversify the

(Fauna)	ants	predators to control ants	types of management prescriptions used for each invasive
Visitor Services			
Hunting	Allowed in designated areas for waterfowl, youth deer/feral hog hunt on San Bernard NWR, and a youth feral hog hunt One permit area and ATV use allowed in designated area for disable hunters	Same as Alternative A plus provide a youth waterfowl hunt; and revise the hunting schedule at two locations	Same as Alternative B plus provide a population reduction deer hunt
Fishing	Allowed on all navigable waters and from designated locations	Same as Alternative A	Same as Alternative A
Wildlife Observation	Brazoria and San Bernard NWRs open to wildlife observation; visitors directed to designated public use areas	Same as Alternative A plus construct additional photo blinds, new trails, a boardwalk, and road pull-offs to provide for additional opportunity	Same as Alternative B
Wildlife Photography	Photo blind at Hudson Woods	Same as Alternative A plus develop additional photography opportunities	Same as Alternative B
Environmental Education	Various programs and events conducted	Same as Alternative A plus increase number of programs conducted and expand programs into additional school districts at San Bernard NWR	Same as Alternative B
Interpretation	One annual 3-day event	Same as Alternative A plus expand organized interpretive programs at a variety of Refuge venues on a monthly basis.	Same as Alternative B

Preservation of Historic Sites	Historical sites are identified and interpreted in public use areas when appropriate	Same as Alternative A	Same as Alternative A
Entrance Fee	No entrance fee required	Provide donation boxes at various public use areas	Same as Alternative B
Facilities/ Infrastructure Management			
Visitor Use Infrastructure:			
Visitor Orientation Facilities	Visitor contact station located at Brazoria NWR Discovery Center	Same as Alternative A plus additional Visitor Contact Station at San Bernard NWR	Same as Alternative A plus construct stand-alone Visitor Center at San Bernard NWR Field Office.
Trails	Hiking trail provided at Brazoria and San Bernard NWRs	Same as Alternative A plus construct a new trail at Brazoria NWR Field Office; provide bicycle access at Dow Woods Unit.	Same as Alternative B
Non-Motorized Boat Launches	Canoe / Kayak launches provided at San Bernard and Brazoria NWRs	Same as Alternative A plus construct one additional launch	Same as Alternative B plus construct two additional launches
Signs/Exhibits	Signs and exhibits at Brazoria and San Bernard NWRs	Construct new exhibits and signs and improve quality and content of existing exhibits and signs	Same as Alternative B
Roadways	Vehicular access allowed on designated refuge roads	Same as Alternative A	Same as Alternative A
Administrative Infrastructure:			
Volunteer Facilities	Recreation vehicle pads provided at Brazoria and San Bernard NWRs	Construct new recreation vehicle site at Brazoria NWR, and expand recreation vehicle sites at San Bernard NWR; include additional facilities at both locations	Same as A, plus construct additional facilities at Brazoria NWR
Administrative Facilities	A variety of administrative /	Construct new administrative /	Same as Alternative B

	maintenance facilities available at various Refuges	maintenance facilities at various refuges	
Budget	Base Funding: \$2.9M Fire Funding: \$788,000 Other: \$ 410,000 (Project Specific Funding)	In addition to Alt. A: \$1.7M Project Funding: \$213,000 Staff Salaries: \$200,000	Addition to Alt. A: \$1.7M Project Funding: \$220,000. Staff Salaries: \$200,000.
Staff	26 FTEs	In addition to Alt A: 7 FTEs	In addition to Alt. A: 7 FTEs

Table EA 2-4. Mitigation Measures and Monitoring

Mitigation Measure and Monitoring Description	Alternatives
General	
Gather updated resource baseline data to form a current analytical base from which to judge future management impacts and effects.	A, B, & C
Develop and implement an extensive and ongoing monitoring program to judge management action effectiveness and provide alternative solutions that would decrease any short-term or long-term negative impacts on fish and wildlife resources and other environmental elements.	A, B, & C
Regulate management actions to address any potential impacts. For example, activities would be conducted during times of the year and in areas where breeding and nesting activities are at a minimum.	A, B, & C
Prohibit or restrict activities in areas where listed species occur. The potential effects of CCP implementation on federally-listed species has been reviewed per an Intra-Service Section 7 Consultation (See Appendix F).	A, B, & C
Seek public input in future planning for any management actions that are considered major federal actions, as per NEPA requirements.	A, B, & C
Air Quality	
For prescribed burning the following precautions would be in place: habitat management involving prescribed burning will occur only under ideal weather conditions and smoke management practices will be implemented during all burning events; an approved Prescribed Burn Plan, favorable weather conditions, and adequate firefighting resources all work together to prevent pervasive air pollution or from affecting air quality.	A, B, & C
Water Management and Quality	
Avoids spraying during or immediately before a rainfall event to reduce the chances of run-off and herbicide delivery to water resources.	A, B, & C
Agency-approved application practices and guidelines will be implemented during all prescription events and under an approved plan to prevent or minimize effects to water quality.	A, B, & C
Conduct water sampling on all potable waters on the Complex. Multiple water quality sampling and analysis occurs in the surface waters on and around the Complex.	A, B, & C

Mitigation Measure and Monitoring Description	Alternatives
Soils	
Erosion fences will be established on construction sites when erosion is a concern. If heavy sediment deposits occur in water, maintenance workers will use excavators to pull sediment and move it back into place.	A, B, & C
Habitats	
Take a proactive approach to working with information provided through biological surveys, inventories, and monitoring including monitoring of invasive species and prescribed burning to determine changing conditions and vegetation associated with climate change or other potential impacts.	A, B, & C
Wildlife	
The Complex will coordinate with Coastal Prairie Conservation Initiative and others to maximize outcomes and success of prairie restoration efforts.	A,B, & C
The Complex will continue to monitor area beaches for nesting sea turtles in coordination with Padre Island National Seashore.	A, B, & C
The refuge management methods would not result in direct take of any species of conservation concern and vegetation clearing activities would not occur during general bird nesting season, March through August.	A, B, & C
Oil and Gas Activities	
Each refuge will work with oil and gas companies to ensure that to the greatest extent practicable, all exploration, development, and production operations are conducted in such a manner as to prevent the damage, erosion, pollution, or contamination to the lands, waters, facilities, and vegetation of the area.	A, B, & C
The Complex will continue restoring marshland by planting smooth cordgrass in areas impacted by oil and gas activities.	A, B, & C

3.0 AFFECTED ENVIRONMENT

Refer to Chapter 3 of the Comprehensive Conservation Plan.

4.0 ENVIRONMENTAL CONSEQUENCES

This section analyzes and discusses the potential environmental effects or consequences reasonably expected by the implementation of each of the three alternatives described in Chapter 2 of this EA. The 15-year life of the CCP will portray each alternative and the expected outcomes.

This chapter identifies, describes, and compares the impacts of implementing the three alternatives proposed in this EA on the Complex's physical, biological, and socio-economic environment. Current management (Alternative A, the No Action Alternative) provides the basis for comparing the effects of the action alternatives (Alternatives B and C). This chapter analyzes the direct, indirect, and cumulative effects of each alternative as defined below in section 4.1.

The Complex conducted an analysis of the effects of management actions on the physical environment for air quality, water quality/quantity, and soils. It also conducted an analysis of the

effects of management actions on the biological environment for vegetation/habitat, wildlife, and species of special concern (e.g., threatened and endangered species). Although all plant, animal, and fish species on the Complex are important, many species are not expected to experience any change—or at most, a negligible one—as a result of implementing any of the alternatives. For that reason, this chapter does not discuss all Refuge species.

An analysis of the effects of management actions on the socio-economic environment has been conducted for local populations and economy, recreational uses and facilities, scenery, oil and gas activities, natural and cultural prehistoric and historic resources, and land acquisition. This chapter describes potential impacts in terms of type, duration, intensity, and context (scale). General definitions are as follows:

4.1 Definition of Terms

Effects

Direct effects are the impacts that would be caused by the alternative at the same time and place as the action.

Indirect effects are impacts that occur later in time or distance from the triggering action.

Cumulative effects are incremental impacts resulting from other past, present, and reasonably foreseeable future actions, including those taken by federal and non-federal agencies, as well as undertaken by private individuals. Cumulative impacts may result from singularly minor but collectively significant actions taking place over a period of time.

Impact Type

Beneficial impacts are those resulting from management actions that maintain or enhance the quality and/or quantity of identified refuge resources or recreational opportunities.

Adverse impacts are those resulting from management actions that degrade the quality and/or quantity of identified refuge resources or recreational opportunities.

Duration of Impacts

Short-term impacts affect identified refuge resources or recreational opportunities; they occur during implementation of the management action but last no longer.

Medium-term impacts affect identified refuge resources or recreational opportunities that occur during implementation of the management action; they are expected to persist for some time into the future though not throughout the life of the CCP.

Long-term impacts affect identified refuge resources or recreation opportunities; they occur during implementation of the management action and are expected to persist throughout the life of the CCP and possibly longer.

Intensity of Impact

Negligible impacts result from management actions that cannot be reasonably expected to alter identified refuge resources or recreational opportunities at the identified scale; impacts are so small that they would not be measurable.

Minor impacts result from a specified management action that can be reasonably expected to have detectable though limited effect on identified refuge resources or recreation opportunities at the identified scale; impacts are detectable but would affect a small area.

Moderate impacts result from a specified management action that can be reasonably expected to have apparent and detectable effects on identified refuge resources or recreation opportunities at the identified scale; effects would be readily apparent and would occur over a relatively large area but are not extreme or excessive.

Major impacts result from a specified management action that can be reasonably expected to have readily apparent and substantial effects on identified refuge resources and recreation opportunities at the identified scale; effects would be readily apparent and would substantially change the characteristics of the resource.

Scale of Impact

Site-specific effects are those impacts that occur solely within the project area (i.e., construction site or treatment area).

Localized impacts are those that would occur within and immediately surrounding the project area.

Refuge/Complex-wide impacts are those that would occur across the entire Refuge/Complex landscape.

Widespread impacts are those that would occur beyond the Complex landscape.

4.2 Effects Common to all Alternatives

Several potential effects will be very similar under each alternative, and they are summarized in this section.

Climate Change

The Complex considers carbon sequestration, a climate-related phenomenon, in planning. Vegetated land is a tremendous factor in carbon sequestration. Terrestrial biomes of all sorts—grasslands, forests, wetlands, tundra, and desert—are effective in both preventing carbon emission and acting as biological “scrubber” of atmospheric CO₂.

In terms of climate change, conserving natural habitat for the Complex is the primary management focus for the CCP. The actions proposed in this CCP would conserve or restore land and habitat, and would thus retain existing carbon sequestration on the Complex. Additional conserved lands would ensure that development and loss of current carbon sequestration ability does not occur in the future. This in turn contributes positively to efforts to mitigate human-induced global climate change.

One Complex activity in particular, prescribed burning, releases CO₂ directly into the atmosphere from the biomass consumed during combustion. However, there is actually no net loss of carbon, since new vegetation quickly germinates and sprouts to replace the burned-up biomass and over time sequesters or assimilates an approximately equal amount of carbon as was lost to the air (Dai et al. 2006). The use of green technology and products as specified in the CCP would reduce the Complex's carbon footprint. The differences in the amount of carbon sequestration expected from each alternative is further discussed in section 4.3.1.

Regional modeling of how long-term global warming patterns might emerge in the U.S. suggests that future climates along the Texas Gulf Coast could be very different from those of the past. Climate researchers used unique state-of-the-art high resolution nested climate simulation models to explore the importance of fine scale processes in determining climate change hotspots in the continental U.S. and Mexico (Texas Climate Initiative).

The occurrence of climate change hotspots in the U.S. was generally persistent in the southwestern U.S., including Texas. Northern Mexico was also a region of persistent, intense climate changes. Interestingly, the observed pattern of responsiveness was largely consistent between low and high-end emissions scenarios and throughout the 21st century. The persistence of the hotspot patterns observed in these regional climate modeling experiments suggest that the broad patterns of responsiveness observed may be robust to climate system variability. Changes in inter-annual variability, particularly of precipitation, were the primary drivers of peak climate changes in these modeling studies (Texas Climate Initiative).

The Service undertook an investigation of wetland trends and future conditions in response to a changing climate across three coastal units of the Complex.

The Complex assessed future wetland conditions spatially by modeling sea level inundation rates resulting from predicted sSLR from 2010 to 2100. Researchers derived low and high estimates of SLR used in the inundation model by combining two SLR prediction models for the region. Results of the sea level inundation model were stored in a GIS database and used to quantify potential impacts to existing wetlands at decadal intervals from 2010 to 2100. Results of the 1938/44–2008 trends analysis showed a significant increase of in-flow through (tidally influenced) wetland acres across the Complex. Results of the future conditions analysis predict that sea level rise will significantly alter or displace the majority of wetlands across the Complex between 2020 (71.03 percent of current wetland acres) and 2050 (87.10 percent of current wetland acres) (USFWS 2009). This will occur equally under all three proposed management alternatives evaluated in this EA.

Results of the 1938/44 to 2008 wetlands trends analysis tends to indicate subsidence and/or SLR

had been occurring across the Complex prior to the significant impacts of climate change predicted today. The increase in the area of flow through wetland basins from 2872.79 (1938/44) acres to 4593.34 (2008) acres is an indication that the coastal wetlands of TMC have already been impacted by SLR to some degree. In addition to SLR, many climate change studies predict changes to tropical storm events, precipitation rates, and temperature levels at rates that can affect habitat conditions and distributions along the Gulf Coast. Combined with SLR, it is likely that tropical storm events will accelerate wetland impacts across the Complex by increasing wave action and erosion rates that will compound the conversion of coastal salt marsh to open bays. Changes in precipitation amounts and runoff may also impact wetlands. A decrease in freshwater inputs to coastal wetland systems resulting from reduced rainfall and increased upstream water usage from agriculture, urban, and industrial use may increase salinity rates and reduce sediment inputs to coastal wetland systems. Compounding this likelihood is a predicted temperature increase of $>3^{\circ}\text{F}$ (HadCM2) to $>7^{\circ}\text{F}$ (CGCM2), which could increase the annual surface water evaporation rates by more than a foot (Fang and Stefan 1999), further decreasing freshwater inputs and increasing salinity rates.

In response to past episodes of SLR, coastal wetlands have responded by migrating to adjacent uplands or building additional substrate to account for changes in water depth. Were this to happen, it is unlikely that impacts to coastal wetland systems would be significant in a period of accelerated climate change. However, where migration of wetlands to higher ground is not possible because of existing human developments and land uses, coastal wetlands are likely to be diminished in extent or eliminated (Cahoon et al. 1998). Using the results of the high inundation model, the Complex is predicted to lose 37,926 acres (36 percent of its total area) to open bay (seawater) conversion by 2100. This will eliminate 90 percent of the current wetlands on the Complex. While San Bernard and Brazoria NWRs will still contain a substantial portion of the upland land mass, it is not known if these areas are suitable for future wetland migration and formation or if the wetlands formed there would function at a level 24 of long-term productivity to offset predicted losses. The Complex may need to purchase additional lands suitable for inland wetland development to offset predicted wetland loss.

Again, these predicted long-term, climate-change-related impacts would occur regardless of which of the management alternatives under consideration here the Service ultimately selects. Over the 15-year life of the CCP, impacts associated with climate change are likely to be adverse, minor to moderate, and widespread.

Herbicide Application

Chemical herbicides are one of the methods the Service uses to control invasive plants on national wildlife refuges. Herbicides can efficiently and effectively suppress or kill unwanted plants and the Service uses them in such a manner as to minimize adverse effects on non-target resources. An herbicide suppresses or kills plants by decreasing their growth, seed production, and competitiveness (USFWS 2009b).

The Complex must weigh the benefits of herbicides in controlling invasive plants against the potential for exposure and impacts to human health, non-target organisms, and the environment. The federal and state governments regulate herbicides to ensure that they do not pose unreasonable risks. The EPA requires extensive test data from herbicide producers prior to

licensing and determining restriction on use. EPA scientists and analysts carefully review these data to determine whether to register (license) an herbicide and whether certain restrictions on use are needed (USFWS 2009b).

EPA evaluates both exposure and toxicity to determine the risk associated with use of a given herbicide. Applications and subsequent movement may expose people, non-target flora and fauna, water, and soil directly or indirectly to herbicides; the refuge can minimize or avoid this exposure by following proper instructions and labels. For wildlife and humans, herbicides may enter the body through the skin, by swallowing, and by breathing. Once the refuge applies herbicides, the many biotic (living) and abiotic (non-living) processes that affect the fate of herbicides in the environment further influence the potential for exposure.

Herbicide use on national wildlife refuges must comply with the Federal Insecticide, Fungicide, and Rodenticide Act (FIFRA) and other federal laws and authorities. The use of herbicides and other pesticides on refuges is governed by the U.S. Department of Interior Integrated Pest Management Policy (517 DM 1), the Service Pest Management Policy and Responsibilities (30 AM 12), and the Service Refuge Manual (7 RM 14).

The Service policies and Refuge Manual state that we will use herbicides only after full consideration of management alternatives including chemical, biological, physical, and no action. If after considering all of these factors managers determine that we must use herbicides to meet invasive plant management objectives, then we will use the least hazardous, most effective herbicides to meet those objectives (USFWS 2009b).

Refuge staff must complete a Pesticide Use Proposal (PUP) whenever we use a pesticide or herbicide on a refuge, including applications by staff, volunteers, contractors, or in association with a right-of-way easement or Special Use Permit. Individuals with duties related to plant management and knowledge and experience with herbicides typically complete and submit the PUP. An online PUPs database enables staff to complete and submit PUPs electronically at <https://systems.fws.gov/PUPS/>. Depending on the pesticide and other conditions listed in the PUP, the PUP may need Regional Office review and approval, and under some circumstances, the Regional Office may need to submit the PUP for Washington Office review and approval. PUPS that are part of an approved integrated pest management plan may receive five-year approvals. The Director periodically issues specific guidance that includes details about PUP approval authority and which herbicides and application scenarios require review beyond the field station.

Refuge managers or the project leader ensures that:

- Pest management decisions are consistent with all applicable policies, laws, and regulations.
- Anyone applying pesticides, releasing biological control agents, and conducting other Integrated Pest Management activities has the appropriate training and equipment necessary to protect their safety and health.
- We apply pesticides only after the appropriate reviewer approves the PUP.
- We establish threshold levels of damage or pest populations according to Service or refuge goals and objectives and applicable laws.

- Staff store, handle, and dispose of pesticides and pesticide containers in accordance with the label and in a manner that safeguards human, fish, and wildlife health and prevents soil and water contamination.
- Submit annual reports documenting pesticide use and efficacy into the online PUPs database (USFWS 2009b).

Each of the alternatives would follow the above procedures and each would use the same herbicides and have approximately similar rates of application. Environmental impact associated with herbicide use on the Complex would be both adverse and beneficial. Adverse impacts may occur from localized toxicity of non-target organisms (plant and animal), and would be short-term to long-term (short-term for any given application, but long-term if the applications are repeated regularly). Herbicides would also have negligible, short-term adverse impacts on water quality. They may potentially leach into and pollute groundwater and may flush into surface water if improperly applied. However, proper application under conditions specified on product labels and the use of best management practices minimizes movement of herbicides from their intended targets.

Beneficial impacts from herbicide application would also occur under each alternative. Benefits would result from control of invasive plants that threaten to infest large areas, displacing native species of flora and fauna; these beneficial effects would be long-term, Complex-wide, and of moderate intensity.

Petroleum Development Impacts

As noted in Section 2.3 of this EA, oil and gas exploration is occurring on four locations on the Complex. Operators are required to prevent, to the maximum extent possible, releases of hazardous materials and substances, crude oil, and produced water. All oil and gas facilities are required to have berms or secondary containment systems to prevent contamination of land and water resources. Each operator and/or facility operator must have a current Oil Discharge Prevention and Contingency Plan outlining procedures for accidental releases. Sampling, remediation, and restoration of contaminated sites would be the responsibility of the operator and/or facility operator and would occur in consultation with the Service and the appropriate state agency. All sites no longer in use must be sampled for contaminants at the operator's expense to ensure proper disposal of material and that refuge staff and/or the visiting public are not exposed to contaminants. The Service may request that wells, roads, pipelines, and associated infrastructure and facilities not needed to support ongoing operations be removed and the sites restored to the satisfaction of the Refuge Manager.

Reasonable restrictions include restriction on time of year (October 15–March 15) for operations designed to minimize wildlife disturbance during the winter months; restriction on equipment to include low-pressure terra-tired vehicles or tracked equipment in the marshes and small “Bumble Bee” drillers in the bottomlands; and restriction of ATV use in marsh habitats. The Refuge Manager will negotiate the locations of production lines prior to drilling. Operators will generally place such lines along roadways, and directionally drill under wetlands or other sensitive environments. The Complex only permits closed loop drilling operations. All seismic operations must hire an environmental monitor, who is selected by the Refuge Manager and who reports to the Refuge Manager, to monitor all seismic operations and ensure minimal habitat

damage. In Texas, the refuges may accept payment for restoration work required after the seismic operations. The refuges will then conduct restoration and monitoring efforts using those funds.

Petroleum exploration and extraction activities and facilities would impact each alternative equally. In summary, these impacts would be adverse, long-term, site-specific, and of negligible to minor intensity.

Cultural Resources

The Service is responsible for managing archeological and historic sites found on national wildlife refuges. Undertakings accomplished on the Complex have the potential to impact cultural resources. The consequences for cultural resources would be the same under each management alternative.

Although the presence of cultural resources, including historic properties, cannot stop a federal undertaking, the undertakings are subject to Section 106 of the National Historic Preservation Act. Thus, Refuge Managers and the Project Leader, during early planning, provide the Regional Historic Preservation Officer (RHPO) with: 1) a description and location of all projects, activities, routine maintenance and operations that affect ground and structures; 2) requests for permitted uses; and 3) alternatives being considered. The RHPO analyzes these undertakings for potential to affect historic properties and enters into consultation with the State Historic Preservation Officer (SHPO) and other parties as appropriate. The Refuge Manager and/or Project Leader ask the public and local government officials to identify concerns about impacts caused by the undertaking in a notification that is at least equal to, and preferably with, the public notification carried out for NEPA and compatibility.

Impacts on cultural resources associated with each alternative would at most be negligible to minor, site-specific, and long-term.

Environmental Justice

Executive Order 12898, "Federal Actions to Address Environmental Justice in Minority Populations and Low-Income Populations" was signed by President Clinton on February 11, 1994, to focus federal attention on the environmental and human health conditions of minority and low-income populations, with the goal of achieving environmental protection for all communities. The Order directs federal agencies to develop environmental justice strategies to aid in identifying and addressing disproportionately high and adverse human health or environmental effects of their programs, policies, and activities on minority and low-income populations. Another intent of the Order is to promote nondiscrimination in federal programs substantially affecting human health and the environment, and to provide minority and low-income communities with access to public information and opportunities for participation in matters relating to human health or the environment.

None of the three management alternatives described in this EA would disproportionately place any adverse environmental, economic, social, or health impacts on minority and low-income populations. The Complex anticipates that implementation of any alternative that includes

public use and environmental education will provide a benefit to the residents residing in the surrounding communities.

Feral Hog Management

The detrimental impacts of feral hogs are well documented (West et. al. 2009). They damage native habitat by rooting and trampling. These activities result in compaction of soils, which influence plant regeneration, community structure, soil properties, nutrient cycling, and water infiltration. Feral hogs induce the spread of invasive plant species because invasive exotics typically favor disturbed areas and colonize more quickly than many native plants. Feral hogs compete with native wildlife for resources and cause direct wildlife mortality through nest predation and opportunistic consumption of birds, reptiles and amphibians. Feral hogs also vector many diseases that can be contracted by other animal species. Any increase in population would lead to adverse impacts on other wildlife species. Feral hogs increase the overall harvest yield losses incurred by farmers both on and off the refuges. Additionally, feral hogs cause damage to roads, levees, and public use areas by means of rooting, thus leading to equipment and vehicle damage used to maintain and travel these areas. They also pose health and safety risks due to disease and potential for vehicle accidents.

The management activities conducted on the Complex, (as described in the Feral Hog Management Plan), are necessary to reduce the impacts mentioned above. Activities that require use of vehicles or equipment may increase impacts to air quality due to emission. Impacts to soils and vegetation would be expected from foot and vehicular traffic. However, these direct impacts to air, soil and vegetation would be negligible and short-term impacts. No impacts to water quality or quantity are expected from the proposed management activities. There would likely be some short-term impacts to non-target wildlife species (short-term disturbance and displacement) as a result of the activities involving vehicles, foot traffic and aerial shooting. These impacts, however, would be short-term, only lasting through the duration of the management activity.

Hogs that are killed by staff (i.e., law enforcement officers or professional sharpshooters) are quickly and humanely killed by an accurate shot to the neck/shoulder area. Special Use Permits and staff removal are outside of public view. Coyotes, vultures, and other wildlife, normally consume carcasses that are left where shot in remote areas, within one to two days. Carcasses near public use facilities are removed from public view.

The indirectly long-term impacts of feral hog management are expected to be beneficial to soil, water, vegetation, and wildlife as feral hog numbers are reduced. In addition, many predators and scavengers would benefit from the carcasses left in the field.

Fishing

Forty percent of the visitation on the Refuge Complex is for saltwater fishing. Visiting anglers enjoy some of the best fishing for redfish, spotted sea trout, black drum, sheepshead, and flounder in Texas. Brazoria NWR has three public fishing areas that allow land access to saltwater fishing. One boat ramp is located on the west bank of Bastrop Bayou, off CR 227, and another ramp is located off CR 257 on the refuge's southwestern boundary. San Bernard NWR has one fishing area—Cedar Lake Public Fishing Area offers an accessible fishing pier, a fishing

trail that offers bank fishing and a public boat ramp that gives visitors access to Cedar Lake Creek. The Refuge allows saltwater fishing and crabbing in designated areas in accordance with applicable state and federal regulations. At Big Boggy NWR, public fishing is limited to the navigable waters of Boggy Creek and Lake and the portion of the Refuge bordering the GIWW.

Under each of the alternatives, the refuge would continue to allow fishing on all navigable waters from designated locations. The effects of each alternative would be identical. The effects of fishing and associated boating activities on migratory and shore birds include noise, harassment, and displacement. Compaction of vegetation may occur along the shores and along creeks from fisherman accessing fishing points. With the stipulations outlined below disturbances caused by fishing, including associated boating activities is not having an adverse impact on wildlife resources. Refuge staff monitor shorelines for erosion. Trash is the single greatest impact on the refuges associated with this use. Trash left from fishing activities can be harmful to wildlife. Monofilament line can entangle wildlife or be ingested. Ingested lead sinkers can cause lead poisoning and food scraps are not healthy for wildlife. In an effort to control trash, the refuge has installed monofilament recycling containers at fishing areas. Trash is removed from fishing areas on a weekly basis. Fishing areas are shut down if trash gets out of hand.

Under each, the impacts on Complex fishing opportunities would be beneficial, long-term, widespread, and of moderate intensity.

Refuge Revenue Sharing

Annual Refuge revenue-sharing payments to Brazoria, Matagorda, and Fort Bend counties, Texas, would continue at similar rates under each alternative. If the Complex acquires and adds lands to the refuges, the payments would increase accordingly.

Indian Trust Assets

The Complex has identified no Indian Trust Assets on its lands. There are no reservations or ceded lands present. Because the Complex does not believe resources are present, it does not anticipate impacts to result from implementation of either alternative described in the EA.

Other Common Effects

None of the alternatives would have more than negligible or at most minor effects on geology, topography, noise levels, transportation, waste management, or human health and safety.

4.3 Physical Environment

4.3.1 Impacts on Air Quality

Each of the alternatives would implement the following mitigation measure to protect air quality: For prescribed burning, the following precautions would be in place: habitat management involving prescribed burning will occur only under ideal weather conditions and smoke management practices will be implemented during all burning events; an approved prescribed burn plan, favorable weather conditions, and adequate firefighting resources all work together to prevent pervasive air pollution or unnecessary effects on air quality.

The analysis below assumes implementation of this mitigation measure to protect air quality.

Alternative A—No Action Alternative (Current Management)

Existing conserved lands provide important beneficial impacts on regional air quality by providing open space and vegetated habitats. The forests, wetlands and prairies serve as air filters, filtering out particulates, aerosols, and other pollutants, thus improving air quality in the region. Mature bottomland forests sequester carbon in the leaves, stems, trunks and roots of woody plants. It has been estimated that an acre of maturing Columbia Bottomland forest will sequester 131 tons of carbon (Delaney et al. 2002). So, within the current boundaries of the refuge (which has included acquisition of 28,000 of bottomland hardwood habitat to date) up to 3,668,000 tons of carbon could potential be sequestered.. Conservation of existing refuge units is beneficial, long-term, minor to moderate, and widespread.

Management actions and activities associated with Alternative A that could potentially affect air quality include prescribed fire, farming operations, equipment and vehicle operation, and landscape conservation.

Refuge staff would use prescribed fire Complex-wide to manage, enhance, or restore habitats and reduce hazardous fuels. Table 2-1 shows the prescribed fire schedule for the Complex. Annually, Brazoria NWR would burn on average about 10,600 acres, San Bernard NWR about 8,200 acres, and Big Boggy NWR about 1,900 acres. Prescribed fire would have generally minor, sometimes moderate, adverse impacts that are short-term in duration at the local to widespread scales due to smoke emitted from burning vegetation. Smoke consists of particulate matter, aerosols, soot, and a variety of gases, all of which degrade air quality when they are present. In brush and grass vegetation types, smoke would dissipate rapidly and smoke should disappear shortly after the fire burns down; long-lasting smoldering would not be a problem. Generally, whenever weather conditions allow for prescribed burns, air masses are not stagnant, and smoke will rise and disperse, minimizing impacts on ground level air quality, visibility, and human health.

Brazoria NWR would continue to use cooperative farming on 10 farm fields comprising 1,000 acres; of these 1,000 acres, the Refuge farms three fields of approximately 220–350 acres in a given year with the remaining seven units left fallow. San Bernard NWR would continue to farm a single 10-acre plot. Big Boggy NWR would farm a total of 90 acres of rye grass for winter browse for waterfowl through force account at Mathis Field. Exhaust from farm equipment and fugitive dust produced by the use of agricultural machinery (e.g., tractors and plows) during discing and harvest may both produce negative short-term direct effects to air quality. These farming operations would continue to result in some negligible short-term negative impacts on air quality at the local scale since the refuge only farms up to 350 acres and the total Complex is approximately 44,044 acres. In preparation and harvest of all farming operations, the use of two tractors for less than two months out of the year will have negligible impact on air quality within the Complex.

Dust and emissions produced by equipment and vehicle operation associated with construction such as road maintenance would be minor and localized. Performing work during times of low to no wind would abate blowing dust. Furthermore, most construction occurs as maintenance to already existing facilities or infrastructure that is small scale and localized. During extremely

dry periods, the Complex would water down heavily used unpaved roads to reduce fugitive dust emissions.

Herbicides are an important management tool used to gain an upper hand on the war against the many aggressive non-native flora. Table 2-2 identifies chemicals and target species. Brazoria NWR would continue to treat 1,600–2,500 acres with Grazon P+D and Grazon Next Generation through aerial application. San Bernard NWR would use the same chemicals as Brazoria NWR and treat approximately 100 acres annually. The Complex conducted no chemical treatments on Big Boggy NWR, but the option to use them if deemed necessary would still be available in the event of a Chinese tallow outbreak. The majority of these treatments would be aerial application, but the Complex may use hand, backpack, and boom sprayers on a variety of target species. Performing work during times of low wind would abate non-target species and maximize chemical efficiency. Spraying chemicals to treat target fauna may produce negative short-term direct effects to air quality.

The Complex does not anticipate any other Refuge management activities or public uses to adversely affect air quality to any appreciable degree.

Important beneficial impacts from Alternative A on regional air quality would accrue from the Complex's continuing management of tens of thousands of acres of open space and vegetated habitats. The forests, fields, and marshes on these conservation lands serve as air filters, filtering out particulates, aerosols, and other pollutants, thus improving air quality in the region. In summary, Alternative A would entail both adverse and beneficial impacts on air quality on the Complex. Impacts from prescribed fire would be adverse, short-term, minor to moderate, and localized to widespread. Impacts from farming and vehicular operation would be adverse, short-term, negligible to minor, and localized. Overall impacts from habitat conservation and management would be beneficial, long-term, minor to moderate, and widespread.

Alternative B—Proposed Action

Alternative B would conserve and restore additional habitat acreage, with a focus on bottomland hardwood forests and prairies. By conserving additional habitat and filtering foliage, this alternative would be more beneficial for air quality than Alternative A. Carbon sequestration in the bottomland hardwood habitats would be expected to be up to ___ with potential acquisition of 42,000 additional acres. These benefits would be long-term, moderate, and widespread.

Alternative B would have the same amount of prescribed fire but would have a slightly higher (from 1,000 acres to 1,200 acres) use of herbicides that would have short-term, localized air quality impacts. Although these adverse impacts would be slightly greater (from 1,000 acres to 1,200 acres) than Alternative A, they would still be considered adverse, short-term, minor to moderate, and localized to widespread.

Alternative B would conserve and restore additional habitat acreage, with a focus on bottomland hardwood forests and prairies. By conserving more habitats and filtering foliage, this alternative would be slightly more beneficial for air quality than Alternative A.

Alternative C

This alternative would keep prescribed fire use the same and reduce farming, leading to lower air emissions from exhaust and fugitive dust. Overall, adverse impacts of Alternative C on air quality from the same actions and activities would still be approximately the same as Alternative B.

The beneficial impacts on air quality from habitat conservation (including carbon sequestration), management, and restoration would be the same as Alternative B. These benefits would be long-term, moderate, and widespread.

4.3.2 Impacts on Water Resources

Each of the alternatives benefits water resources, both in terms of quality and quantity, simply by maintaining and conserving large areas of healthy, vegetated habitats that protect soils and waters. These vegetated habitats filter out contaminants, minimize erosion, turbidity, and sedimentation, and regulate water flows by serving as “sponges” that soak up rainfall and slowly release moisture over the following days and weeks.

Each of the alternatives would implement the following mitigation measures to protect water quality:

- Avoid spraying during or immediately before a rainfall event to reduce the chances of run-off and herbicide delivery to water resources.
- Implement agency-approved application practices and guidelines during all prescription events and under an approved plan to prevent or minimize effects to water quality.
- Conduct water sampling on all potable waters on the Complex. Multiple water quality sampling and analysis occurs in the surface waters on and around the Complex.

The analysis below assumes implementation of these mitigation measures to protect water quality.

Alternative A—No Action Alternative

The following activities would continue under Alternative A and could potentially have impacts on water quality: erosion prevention measures, farming, invasive species control, herbicide use, and oil and gas operations. Section 4.2 discussed herbicide use and oil and gas operations above in “Effects Common to All Alternatives.”

The Complex would continue to engage in management activities and maintain facilities that reduce erosion and prevent saltwater intrusion on all three refuges. Such facilities would include bank armoring by use of concrete block/mats and large concrete slabs used as riprap.

The Complex would construct and use a variety of structural and some restoration techniques at various locations. Brazoria NWR projects include two miles of bank armoring by use of concrete block/mats along the GIWW and shoreline riprap along 2,000 feet of Cox Lake and 100 feet at Salt Lake. San Bernard NWR projects include large concrete slabs serving as riprap along the south end to protect 1,500 feet of levee from wind-driven wave action and to encourage sedimentation of the marsh and plugging small tidal channels. Big Boggy NWR would continue to install riprap to slow down erosion at Dressing Point Island. These activities would result in

increased sedimentation and turbidity during construction, but these impacts would be minor and short-term; long-term benefits would outweigh these short-term adverse impacts. These efforts would help protect freshwater quality, prevent saltwater intrusion, and reduce erosion and sedimentation, and would thus represent a long-term, localized beneficial effect on the Complex's hydrology.

The cooperative farming operation and moist soil units on Brazoria NWR would continue to maintain 1,000 acres of farmland, of which only 220 to 350 acres would be farmed annually. This operation has the potential to cause short-term, negligible to minor, localized (only within and around specific farm units) to widespread adverse impacts to water quality. Ground-disturbing farming operations such as crop planting and discing using tractors may churn and expose bare soils to direct rainfall; they have the potential to increase erosion, thereby resulting in higher levels of sediments reaching area water bodies. This siltation could adversely affect water quality of these water bodies locally and downstream during and after storm events; however, the area's virtually flat topography reduces erosive potential, and the amount of soil matter reaching watercourses as suspended sediments is likely to be relatively small.

Overall, these adverse impacts on water quality from Alternative A are likely to be negligible to minor, localized, and short-term. The Complex's habitat conservation efforts and erosion control measures would have beneficial, moderate, long-term, and widespread effects on water quality (extending beyond the boundaries of individual refuges).

Alternative B—Proposed Action

Under Alternative B, there would be greater efforts to address erosion and saltwater intrusion than with Alternative A. Brazoria NWR would rehabilitate the Salt Lake weir and increase cooperation with ACOE to establish up to seven additional beneficial dredge projects and approximately 10 miles of bank armoring along the GIWW. This refuge would also explore the option of planting smooth cordgrass to reduce erosion. San Bernard NWR would also increase cooperation with ACOE to identify and implement two beneficial dredge sites and approximately six miles of bank armoring or installation of breakwaters along the GIWW with breakwaters preferred. Big Boggy NWR would install reef domes and/or geotubes to stabilize erosion of Dressing Point Island. There would be minor short-term adverse impacts (increased sedimentation and turbidity) during project construction; however, these actions would expand water resource benefits provided by Alternative A.

Increasing cooperative farming and moist soil acreage at Brazoria NWR to 350-400 acres annually has the potential to increase short-term, localized to widespread adverse impacts to water quality from increased erosion, turbidity (suspended sediments), and sedimentation. However, as noted above, the area's flat topography tends to minimize erosion and sedimentation; therefore, the intensity of these impacts would still be negligible to minor. Since Alternative B would eventually protect more riparian lands and conserve their bottomland hardwood forests which filter surface and ground water, than Alternative A, its long-term beneficial impacts on water quality and resources would be greater than Alternative A's.

Overall, Alternative B, like Alternative A, would cause both adverse and beneficial impacts. Its adverse impacts would be greater than Alternative A's. Its beneficial impacts would be greater than Alternative A's.

Alternative C

Alternative C would maintain and develop structures like Alternative B, but would diversify the types of structural and restorative techniques used. Brazoria NWR would construct a breakwater structure made of riprap, reef domes, or geotubes) to Lost Lake to increase sedimentation behind the structure and prevent further erosion. San Bernard NWR would increase bank armoring or installation of breakwaters along the GIWW to 10 miles of shoreline protected.

Big Boggy NWR would expand Dressing Point Island using geotubes, beneficial dredges, and breakwaters, as well as working with ACOE to implement two beneficial dredge sites off-refuge on the opposite side of the GIWW and install approximately two miles of bank armoring or breakwater. There would be adverse, short-term direct impacts during construction. However, the long-term effects would be beneficial for water resources and quality, as engineers design these structures to restore and protect areas from further erosion.

Under Alternative C, Brazoria NWR would reduce the cooperative farming program to 500 acres, and only farm 150–200 acres annually, restoring the remaining acres to coastal prairie. San Bernard and Big Boggy NWRs would eliminate agricultural activities altogether. These actions could potentially further reduce the erosion and localized water pollution from siltation and turbidity associated with agriculture in this flat area.

Overall, Alternative C would have fewer adverse impacts on water quality than Alternative B due to reduced farming. Adverse impacts would be negligible to minor, localized, and short-term. Alternative C's beneficial impacts on water quality would be greater than Alternative A and B's due to the increased land conservation (Alt. B & C) and a greater level of effort to reduce erosion and saltwater intrusion.

4.3.3 Impacts on Soils

Each of the alternatives would implement the following mitigation measure to protect soils:

- Establish erosion fences on construction sites when erosion is a concern. If heavy sediment deposits occur during construction in water, maintenance workers will use excavators to pull sediment and move it back into place.

The analysis below assumes implementation of this mitigation measure to protect soils.

Alternative A—No Action Alternative

Habitat conservation (of bottomland hardwood forest and other habitat) has beneficial effect on soils. Vegetation catches rainfall before it strikes the ground and roots hold the soils in place. Impacts from conserving natural habitats, which protect the soil surface and prevents erosion, would be largely beneficial, long-term, minor to moderate, and widespread. Over considerable time, conserving the protective cover provided by vegetation gives soils a chance to develop, improving both fertility and depth.

The following management activities, which would continue under Alternative A, could potentially have impacts on the Complex's soils: construction activities, road maintenance, prescribed fire and fire suppression, farming, public use facilities, wildlife foraging such as geese eat-outs and feral hog foraging, and habitat conservation. All but the last of these activities would have adverse effects on soils; the final (habitat conservation) would have a beneficial effect.

Construction activities (including excavation), road maintenance, farming, as well as some fire suppression and prescribed fire activities all have the potential to disturb, compact, or disrupt and move soils. This can happen by means of bulldozer blades, front-end loader buckets, tractor discs, or by means of treads or tires. These activities expose soils to potential wind and water erosion; however, the flat topography of the three refuges minimizes the risk of erosion and soil loss.

Geese eat-outs and feral hog foraging can disturb soils as well. Geese eat-outs happen when a large flock of wintering geese eats most or all of the vegetation in a confined area, exposing the soils beneath. A secondary factor is that their fecal matter would fertilize these same soils, and if not over-fertilized or "burned," this could assist in the recovery of vegetation on the site. The high feral hog population foraging across the refuges in many habitats causes widespread soil disturbance due to their particular feeding habits, namely their aggressive rooting behavior, which rips up extensive areas. While this is certainly damaging to vegetation and native plants, the amount of damage it causes to soils proper is unclear, because once more, the area's flat topography does not facilitate soils erosion and transport offsite. The Complex's ongoing efforts to control feral hog populations helps keep this potential damage in check.

Impacts from conserving Complex habitats and ground cover, which protects the soil surface and prevents erosion, would be largely beneficial, long-term, minor to moderate, and widespread. Over considerable time, conserving the protective cover provided by vegetation gives soils a chance to develop, improving in both fertility and depth.

Overall, Alternative A would lead to both adverse and beneficial effects on the Refuges' soils. Adverse effects would tend to be negligible to minor, localized to Complex-wide, and mostly short-term. Beneficial effects would be minor to moderate, Complex-wide, and long-term.

Alternative B—Proposed Action

Under this alternative, a larger amount of land would be conserved, which would result in beneficial impacts to soils over a larger area.

Impacts that result from implementing refuge management activities would be similar those discussed under Alternative A; the type of impacts would be the same with varying degrees of soil disturbance depending on the amount and location of management actions. Overall, the impacts would be adverse and beneficial, negligible to minor, localized, and short term.

Alternative C

Impacts from implementing Alternative C would be similar but not identical to Alternatives A and B. The reduction in farming acreage at Brazoria NWR and elimination of farming at San

Bernard and Big Boggy NWRs would reduce the amount of soils subjected to the repeated stresses of discing, disturbance, exposure, fertilizers, and herbicide. Over time, subjecting soils to intensive agriculture tends to degrade them by reducing fertility, nutrient availability, and depth, and increasing compaction and possible contamination. The farming acreage is a small fraction of the total acreage of soils on the three refuges, but this would still constitute a reduced adverse impact on soils from the other two alternatives.

In general, under Alternative C, adverse effects (from reducing in farming acreage) would be less than Alternatives A and B, and beneficial effects (from habitat conservation) would be about the same. In summary, Alternative C is more beneficial than Alternatives A and B.

4.4 Biological Environment:

4.4.1 Impacts on Prairie Habitats

Alternative A—No Action Alternative

Under Alternative A, impacts on prairie habitats would result from the use of habitat management and restoration techniques (including prescribed fire and cooperative haying), mechanical and chemical treatments of invasive species, feral hog control, visitor and facilities use and management, and oil and gas development. Section 4.2 above describes impacts of oil and gas development.

The Complex would continue to prohibit grazing on all three refuges. The Complex would also continue to use mechanical, chemical, and prescribed fire treatments to control salt cedar, Chinese tallow, deep-rooted sedge, trifoliolate orange and Japanese honeysuckle, and any additional invasive species on an as-needed basis. The Complex would conduct cooperative haying. Native prairie restoration activities would occur on Brazoria and San Bernard NWRs. These refuges would actively restore old fields and coastal prairie through a combination of chemical, mechanical, fire, and planting of native prairie seed. Once restored, they would use fire to maintain the habitat, mimicking natural fire regimes. Regular fires every few years can prevent the encroachment of woody plants that could eventually take over a prairie and replace it with scrub or woodland. The Complex would continue to control feral hogs through a variety of means including issue special use permits for feral hog hunting with the aid of hounds or trapping, collaborative youth hunts and aerial shooting. While this would not be enough to eradicate feral hogs from the Complex, it would help control their numbers and thus adverse impacts to native prairie habitats from the hogs' rooting behavior, which damages and destroys native prairie fauna.

Existing visitor use facilities and management/administrative infrastructure, including buildings, parking lots, trails, and over 50 miles of roads occupy land surface area. These developed lands represent a small fraction of the total area of the three refuges. Fragmentation and loss of coastal prairie habitat due to development is an issue in and around the refuges. The Complex addresses this issue through its acquisition and restoration programs, which provides unfragmented habitat for wildlife.

Overall effects from Alternative A on prairie habitats at the Complex would be both adverse and beneficial. However, the beneficial effects greatly exceed the adverse effects. Adverse effects would be minor, long-term, and localized to refuge-wide. Beneficial effects would be moderate, long-term, and refuge-wide.

Alternative B—Proposed Action

Under Alternative B, impacts on prairie habitat would result from the same actions and activities listed under Alternative A. However, Alternative B would be more beneficial than Alternative A as described below.

This management alternative would incorporate limited livestock grazing throughout the Complex as a management tool for specific issues, such as invasive species management (of both exotic species and aggressive native plants). San Bernard NWR would increase mechanical treatment to approximately 100 acres annually and increase use of prescribed fire to approximately 1,000 acres per year. Chemical application would continue to be the same as Alternative A. Feral hog management would continue as described in Alternative A. Brazoria NWR would increase the cooperative haying program up to 75 total acres to increase the wildland urban interface buffer area where it cannot implement prescribed fire due to the presence of houses adjacent to the refuge boundary.

The Complex would establish a one-mile long trail across from the Brazoria NWR Field Office to support other wildlife dependent recreational activities and would result in direct loss of less than an acre of prairie habitat. Other prairie restoration activities would be the same as Alternative A; however, Brazoria NWR would establish partnerships for native prairie seed harvest. Seeds would be collected from refuge prairies and used to restore other coastal prairie habitats on the refuge; approximately 600–800 acres of prairie annually.

San Bernard NWR would also implement monitoring on prairie restoration areas listed in Alternative A.

Overall, Alternative B would be more beneficial for prairie habitat than Alternative A.

Alternative C

Under Alternative C, impacts on prairie habitat would result from the same actions and activities listed under Alternatives A and B. However, Alternative C would be more beneficial for native prairies than either Alternative A or Alternative B, as described below.

The refuge would manage invasive species under Alternative C the same as Alternative B, but Brazoria NWR would allow limited bison grazing under Alternative C instead of livestock as a management tool for specific issues, such as invasive species or controlling aggressive natives. The refuge would manage grazing with bison on a year-round basis across the larger coastal prairies rather than seasonally as with livestock. Bison may be moved into a small part of a larger pasture using an electric fence to obtain the desired habitat outcome, for instance in a moist soil unit to control phragmites. Management of feral hogs would be the same as Alternative A; however, Brazoria and San Bernard NWRs would open refuges to a general feral hog hunt. Cooperative haying and prairie restoration would be the same as Alternative B.

However, Brazoria NWR would develop a seed bank on 500 acres of native prairie to collect and distribute native prairie seed to increase restoration efforts across the ecosystem to include off-refuge locations.

Overall, Alternative C would be more beneficial for prairie habitat than either Alternative A or Alternative B.

4.4.2 Impacts on Wetland and Aquatic Habitats

Alternative A—No Action Alternative

Many ongoing refuge management activities that would continue under Alternative A—including prescribed fire, restoration, management of invasive species, and provision of additional water—have beneficial and adverse impacts on wetland and aquatic habitats as described below.

The Complex would continue to use mechanical, chemical, and prescribed fire treatments to control salt cedar, Chinese tallow, deep-rooted sedge, and any additional species on an as needed basis. The Complex would continue to control feral hogs with various means, particularly aerial shooting in marsh and prairie habitats in and around wetlands. Brazoria NWR would continue to restore the wetland component of wet prairie mostly by reshaping and building up ditch borrows material. The refuge would install water control structures to manipulate water levels in the prairie. In addition, it would rebuild water delivery canals and levees around farm field/moist soil units to improve water management and movement capability across the units.

Brazoria and Big Boggy NWRs would continue to maintain irrigation canals on the refuges for water delivery and movement. They would capture freshwater from rice fields and provide wetland habitat below the rice fields. Brazoria NWR would continue to manage three irrigation wells. During drought situations, the small 4-inch pump at Teal Pond may provide the only freshwater in the Big Slough area. The Complex can also divert water from this pump to Teal, Olney, or Crosstrails Ponds. San Bernard NWR would continue to use two large irrigation wells regularly. The 8-inch well at Wolfweed is a backup to the Cedar Lake Creek diversion pump and the Refuge would use it when Cedar Lake Creek is salty. The refuge would use a 10-inch pump at Sargent to provide fresh water in the moist-soil units in the Pentagon Marsh, which is essential to providing freshwater in this salt marsh habitat.

All refuges on the Complex would continue to manage moist soil units and fields with a combination of draining and summer discing, using a stubble roller while flooded. The reservoirs are generally self-sustaining but may be drained and refilled with saltwater to control encroaching vegetation. Brazoria NWR would continue to manage 23 fields/ponds for freshwater habitats. San Bernard NWR would continue to maintain two reservoirs, eight moist soil units, and two ponds. Big Boggy NWR would continue to manage four moist soil units.

Existing administrative and public use roads and trails occupy a small fraction of the total area of wetlands across the three refuges. The Complex conserves additional wetlands and aquatic habitats through the acquisition program in addition to forested habitat.

Overall, Alternative A would result in both adverse and beneficial impacts on wetland and aquatic habitats. Adverse effects would be minor, long-term, and localized to refuge-wide. Beneficial effects from the actions described above would be moderate, long-term, and refuge-wide to widespread.

Alternative B—Proposed Action

Under Alternative B, both adverse and beneficial impacts on wetland and aquatic habitats would occur from the same actions and activities as under Alternative A. However, Alternative B would be more beneficial for wetlands and aquatic habitats than Alternative A due to the additional actions described below.

San Bernard NWR would increase mechanical treatment in salty prairie from 50 to approximately 100 acres annually and increase use of prescribed fire from 400 acres to approximately 1,000 acres per year. Chemical application would continue to be the same as Alternative A, which is less than 200 acres annually. Feral hog management would be the same as Alternative A. Water management would be the same as Alternative A; however, there would be drilling of additional wells and development of new/rehabilitated existing water control structures. The Complex would continue to purchase water on an as-needed basis, as described in Alternative A. Brazoria NWR would drill an additional well in Farm Fields. San Bernard NWR would rehabilitate two existing irrigation wells. Rehabilitation of these wells would involve clearing out the well and determining the reason for low water flow. The refuge would add one additional well for Mocassin and Rail Pond while Big Boggy NWR would add an irrigation well at McCoach Unit.

Big Boggy NWR would rehabilitate levee and water control structures at Matthes Pond and Mallard Pond. San Bernard NWR would rehabilitate levees and level the west and middle units of Wolfweed Wetlands to improve management capability. San Bernard NWR would explore expansion of Wolfweed Wetlands and increase management capabilities at Sargent Pentagon Marsh by establishing two additional moist-soil units totaling 120 acres and water canals. Brazoria NWR would construct water diversions along ditches and canals to capture more runoff water. The refuge would install lift pumps and check dams in drainage ditches. Big Boggy NWR would clean out existing water delivery canals and drainage ditches to increase freshwater availability.

Land conservation would benefit wetland and aquatic habitats. Many conserved tracts include conservation of waterways, and seasonally flooded swales. Bottomland forests filter surface and ground water, which improves water quality in waterways and basins, including the Bays and estuaries.

Impacts to wetlands and aquatic habitats would also include construction of a 600-foot boardwalk across from Brazoria NWR Field Office. Overall, Alternative B would be more beneficial for wetlands and aquatic habitats than Alternative A.

Alternative C

Alternative C includes the same management actions and activities that may affect wetlands and aquatic habitats both adversely and beneficially as Alternatives A and B.

Under Alternative C, management of water purchases, irrigation wells, ponds, reservoirs, moist soil units, and water delivery canals would be the same as Alternative B; however, Brazoria NWR would explore the option of purchasing water rights so that we would not have to rely heavily on annual water purchases from the water authority to flood seasonal wetlands. Brazoria NWR would also increase partnerships with Ducks Unlimited and Velasco Drainage District to increase freshwater availability through canal improvements. This will improve the Refuge's ability to manage wetlands for the benefits of waterfowl.

Overall, Alternative C would be more beneficial for wetlands and aquatic habitats than Alternatives A and B.

4.4.3 Impacts on Bottomland Hardwood Forests

Alternative A—No Action Alternative

Under Alternative A, the current levels and type of management activities for bottomland hardwood forests would continue. Current management includes restoring hydrology, planting of native hardwood species, allowing natural regeneration, and controlling invasive species. Restoring hydrology would ensure that bottomland hardwood forests have the levels of standing, flowing, and groundwater they need, and during the right seasons. Planting of native hardwood species would emphasize native species that offer benefits to wildlife, such as oaks. The Complex would continue to allow natural regeneration in those instances where staff judge that native species will predominate. Staff would also control invasive species to prevent them from displacing and outcompeting natives. Trail maintenance supporting public use (hunting, wildlife observation, wildlife photography, hiking) through bottomland hardwood forests result in minor, site-specific impacts.

The Complex maintains thousands of acres of bottomland hardwood forests, a disappearing habitat on the Texas Gulf Coast due to extensive urban, suburban, industrial, and agricultural development. Existing visitor use facilities and management/administrative infrastructure, including buildings, parking lots, and trails occupy land surface area. These developed lands represent a small fraction of the total area of bottomland forest.

Currently, emphasis in land acquisition focuses on bottomland hardwood forest and associated wetlands and prairie habitats. The Complex is currently working on updating the LPP to expand the acreage within the acquisition boundary from 28,000 to 70,000 acres. These additional acres would have a long-term beneficial impact to the bottomland hardwood ecosystem.

Overall, Alternative A's effects on bottomland hardwood forests would include both adverse and beneficial impacts, though the latter would far outweigh the former. Adverse impacts would be minor, long-term, and localized to refuge-wide. Beneficial impacts would be moderate, long-term, and widespread.

Alternative B—Proposed Action

Under Alternative B, the acreage of conserved bottomland forest would increase and therefore ensure that natural diversity is sustained across the ecoregion. The overall benefit of conserving additional bottomland habitat will ensure its preservation into the future. The hydrology is

preserved to the extent possible insuring future diversity of plants and animals. Overall, Alternative B's effects on bottomland hardwood forests would include both adverse and beneficial impacts, though again the latter would far outweigh the former. Overall, the net benefits for migratory birds associated with Alternative B would greatly exceed those of Alternative A.

The same management actions and activities that occur on existing bottomland hardwood forests under Alternative A would likely occur under Alternative B. Due to the costs and personnel required to maintain public use programs, these programs are limited to only a few tracts, where the use is at such a level that the benefit to the public to have trails, and other opportunities. Invasive species management is required to some level on all bottomland tracts. Nearly all tracts are intersected by pipeline, road, electrical line and other right-of-way easements. These are all conduits for invasive species and non-native species that threaten natural bottomland diversity.

Overall, Alternative B would be more beneficial, moderate, long-term and widespread than Alternative A.

Alternative C

Same as Alternative B.

4.4.4 Impacts on Migratory Birds

Alternative A—No Action Alternative

Alternative A would manage a variety of habitats for resting, feeding, and reproductive purposes for the benefit of migratory birds. Tools and techniques used on behalf of migratory birds would include prescribed fire, moist soil management, farming, research (primarily on mottled ducks, yellow and black rails, wintering and migratory songbirds), water management, and rookery management. These habitat management activities result in short-term adverse impacts (temporary disturbance and displacement) to resident wildlife; however, these impacts would be of short duration and the benefits of the resulting habitat improvements would outweigh these adverse impacts. Each of these management tools/techniques would be used explicitly to maintain and restore habitats that would benefit migratory waterfowl, neotropical migrants, and other migratory birds. Prescribed fire would maintain open habitats and encourage vigorous growth that foraging birds use. The Complex manages moist soil management and farming specifically to provide carbohydrate and protein-rich foods for wild birds, which are important in helping them gain weight and strength while they are wintering on the Complex. Water management provides water to habitats and makes them more beneficial to migratory birds, both as sources of food and places to loaf, rest, and breed. Research helps generate knowledge and information that would lead to better resource management and decision-making on behalf of migratory birds. Rookery management protects known and active rookery sites for colonial nesting water birds from disturbance during the nesting season.

Under this alternative, there would also be certain adverse impacts from disturbance associated with public use programs, including hunting. The presence of hunters and other humans may agitate and disturb flocks of birds, placing them under energetic and psychological stress. Hunting will remove waterfowl from the population both directly through take and indirectly

through wounding. Even wildlife watchers may inadvertently scare off large flocks of wintering geese, ducks, and other water-associated birds, causing them to use energy unnecessarily when they need to be feeding, resting, adding weight, and strengthening themselves for their long journeys northward to breeding grounds. These adverse impacts would be short-term to long-term, negligible to minor, localized but also potentially widespread throughout the central flyway.

Overall, Alternative A would have both beneficial and adverse effects. The beneficial effects from many different management efforts and actions would be moderate, long-term, and widespread. The adverse effects would be short-term to long-term, negligible to minor, localized but also potentially widespread.

Alternative B—Proposed Action

Like Alternative A, Alternative B would also manage a variety of habitats for resting, feeding, and reproductive purposes for the benefit of migratory birds, using the same tools and techniques discussed above.

Alternative B would also carry out additional actions that would affect migratory birds beneficially including the conservation of additional lands. To reduce erosion and saltwater intrusion, Alternative B would increase the types and amounts of structural and restoration techniques used. This alternative would increase the acreage of haying, increase the number of rehabilitation projects, and increase prairie restoration. It would incorporate additional moist soil units into the farming rotation at Brazoria NWR. Alternative B would drill additional wells on the Complex; these would provide additional water for irrigation and increase water management capacity on moist units and wetlands. This alternative would also develop new and rehabilitate existing water control structures. In order to manage invasive flora, it would increase the types and amounts of management prescriptions used, including limited and targeted livestock grazing. These combined habitat conservation, management, and restoration actions would have short-term adverse impacts (disturbance and displacement) during project implementation, but would generally benefit a wide variety of migratory birds, from waterfowl to shorebirds and wading birds in the long-term.

Adverse impacts from hunting and other public uses would be the same as Alternative A: short-term to long-term, negligible to minor, localized but also potentially widespread.

Overall, the net benefits for migratory birds associated with Alternative B would exceed those of Alternative A.

Alternative C

As Alternatives A and B, Alternative C would also manage a variety of habitats for resting, feeding, and reproductive purposes, are benefiting migratory birds. Alternative C would use the same tools and techniques as the other two alternatives. However, it reduces the acreage dedicated to farming from 1,000 to 500 acres. Alternative C converts the reduction of 500 acres in farming back to prairie habitat, which would in turn reduce the amount of food and forage production for migratory and wintering waterfowl, and thus, the ability of the Complex to

support the same large waterfowl numbers for extended periods. This would represent a minor to moderate, long-term, widespread adverse impact for migratory birds.

Overall, Alternative C would generate both adverse and beneficial impacts on migratory birds. Adverse impacts would result from both public use disturbance as well as a reduction in farming acreage and would be minor to moderate, long-term, and widespread. Beneficial impacts would result from prescribed fire, moist soil management, some farming, research, water management, and rookery management. These benefits, like those of Alternatives A and B, would be moderate, long-term, and widespread.

4.4.4 Impacts on Resident, Native Wildlife

Alternative A—No Action Alternative

Existing habitat management practices that support current populations and diversity of resident native wildlife would continue under Alternative A. These management practices include: constructing and using a variety of structural and some restoration techniques at various locations to decrease erosion and saltwater intrusion; controlling invasive plant species with mechanical, chemical, and prescribed fire treatments; hunting and trapping to control feral hogs; baiting and broad scale treatments to control non-native fire ants; rehabilitating wetlands and farm lands; restoring native prairie habitat; haying and farming (both cooperative and force account); restoring prairie pothole hydrology as opportunity arises; using established wells to provide freshwater to moist soil units during drought periods; purchasing water from various water authorities annually; and restoring previously drained wetlands. Since all of these actions would continue under this alternative, current levels of wildlife diversity and abundance should also continue through the life of the CCP.

Implementation of these management actions can result in minor short-term adverse impacts such as temporary disturbance and displacement of native wildlife; however, management specifically designed these actions to improve habitat conditions for the benefit of wildlife. Reducing erosion and saltwater intrusion would protect freshwater areas and marshes from conversion to brackish and salt marshes. A variety of vertebrates and invertebrates depend on the maintenance of fresh water areas. Controlling invasive flora and fauna precludes or minimizes the displacement of native species. Cooperative haying helps maintain grasslands and stimulates growth of edible, nutritious shoots. Many native species forage on the Complex's farmlands. Restoring pothole hydrology would provide water and valuable edge habitat for a number of prairie and wetlands species. Irrigating moist soil units during drought periods would maintain their usefulness as important foraging grounds for many species of waterfowl, wading birds, marsh birds, and shorebirds.

Under Alternative A, no appreciable changes in populations or species diversity are expected. Wildlife population and habitat management on the Complex already renders considerable benefits for resident, indigenous wildlife, and these benefits would continue under this alternative. The adverse impacts from disturbance associated with public use programs such as wildlife observation, wildlife photography, and hunting (including direct mortality of white-tailed deer), all of which bring people into relatively close proximity to wildlife, which would be negligible to minor, short-term to long-term, localized to widespread.

Overall net impacts on resident, native wildlife from Complex management under Alternative A would continue to be moderate beneficial, long-term, and widespread.

Alternative B—Proposed Action

Under Alternative B, the Complex would implement the same management activities as those described under Alternative A, except at different levels and intensities. Additional conservation of lands, increased habitat management and restoration efforts would result in greater short-term adverse impacts (disturbance and displacement during project implementation). However, by increasing invasive species control, reducing erosion, restoring habitat, and improving hydrology on the Complex, it would tend to provide for greater benefits to resident, native wildlife than those of Alternative A. Adverse impacts from public use-related disturbance would be negligible to minor, short-term to long-term, localized to widespread, as they are with Alternative A.

Overall, Alternative B's net impacts on resident, native wildlife would be more beneficial than Alternative A's.

Alternative C

Under Alternative C, management of invasive species would use more diverse strategies and perhaps be more effective, to the benefit of native wildlife. In this alternative, increasing water availability through the development of partnerships and purchase of water rights, expanding wetlands, restoration of 500 acres of fields to native prairies, and rehabilitating marshes would all tend to benefit wildlife more than in Alternative B. Adverse impacts from disturbance associated with public use would be negligible to minor, short-term to long-term, localized to widespread, as they are with Alternative A.

Overall, Alternative C's net effects on resident, native wildlife would be more beneficial than Alternative B. These impacts would be moderate, beneficial, long-term, and widespread.

4.4.5 Impacts on Threatened and Endangered Species

Alternative A—No Action Alternative

Table 3-8 in Chapter 3 of the CCP is a list of federal and state threatened and endangered species, as well as species of concern, that are expected to occur within Brazoria, Matagorda, Fort Bend, and Wharton Counties. Within the Complex, the only federally listed species known to occur are the piping plovers, green sea turtle, and Kemp's ridley sea turtle. In addition, the Complex has found loggerhead, hawksbill, and leatherback-stranded sea turtles on area beaches. The Complex would continue to implement the Sea Turtle Recovery Plan and would support all sea turtle recovery efforts by patrolling area beaches for stranding and nests. The Complex would continue to restrict refuge beaches from vehicular traffic to protect these species. The Complex will continue to excavate all nests and transfer them to the incubation site at Padre Island National Seashore, and live turtles would be transferred to the NOAA recovery facility in Galveston.

The San Bernard beach is designated critical habitat for piping plovers. The Complex will continue to conduct plover surveys on area beaches and protect designated critical habitat.

The Complex provides potential habitat for Attwater's prairie chicken and the whooping crane, but do not currently occur in the Complex. All the federally listed species would continue to be protected under the Endangered Species Act and any projects that could potentially impact listed species would undergo Section 7 Consultation prior to any ground disturbing activities.

Overall, the effects of Alternative A on federally threatened and endangered species would be beneficial, moderate to major, long-term, and widespread.

Alternative B—Proposed Action

Each of the actions and impacts for listed species anticipated for Alternative A would also occur with Alternative B. In addition, under Alternative B, there would be potential benefits to the federally endangered whooping crane and the APC, if these species re-establish populations on the Complex. Both of these species occur on refuges nearby and are the focus of major sustained federal recovery programs. If these reintroductions occur, the Complex would then implement APC and whooping crane recovery plans.

The Complex would begin monitoring for the potential reintroduction of APC and whooping crane. In preparation for a potential APC reintroduction, the Complex would monitor habitat conditions; conduct research on burning regimes, grazing, and cooperative haying; and collect baseline data on insect populations. The Complex is listed a potential reintroduction site for whooping crane, but since the Complex is outside of the whooping crane flyway, the Complex would play only a small role in this recovery effort. Monitoring would include baseline data on freshwater availability and blue crab populations.

Overall, the effects of Alternative B on federally threatened and endangered species would also be beneficial, moderate to major, long-term, and widespread. With additional efforts on behalf of two other endangered species—the APC and the whooping crane—this alternative would be more beneficial than Alternative A.

Alternative C

Alternative C's actions and effects on threatened and endangered species would be the slightly more than Alternative B: beneficial, moderate to major, long-term, and widespread.

4.5 Human Environment

4.5.1 Impacts on Local Population and/or Economy

Alternative A—No Action Alternative

The Complex would continue to implement current management programs and no change in refuge staff would be required. The economic and social condition of the area would remain the same. The presence and operation of the refuges provides economic benefits to the surrounding communities within a 30-mile radius in several ways. The Complex attracts local, national, and some international visitors and by attracting visitors to the area, the refuges generates revenue for the local economy. Much of the Complex's annual budget is recycled into local businesses through Complex staff salaries and purchases of equipment and supplies, as well as contracts for local labor to accomplish refuge projects. The annual Complex budget is roughly 2.8 million dollars. The Complex provides full-time employment for 28 individuals and up to 12 temporary

or part-time staff (primarily high school and college students), that live in nearby communities. Special project funds for restoration through grants, private and corporate donations add an additional \$500,000 to the economy annually as projects to restore and enhance refuge habitats are implemented by the refuge and partners on refuge lands.

Although the refuge does not pay taxes to the counties, Revenue Sharing does provide some offset for the loss of taxes. These represent important contributions to the coffers of local governments. As such, expenditures and profits associated with these programs are important inputs to the economy of the local community.

Spending by approximately 75,000 annual visitors to the Complex generates economic activity throughout the local economy in terms of income, jobs, and tax revenue (Carver and Caudill, 2007). Extrapolating from economic studies conducted for other Region 2 national wildlife refuges, total expenditures related to Complex visitation could reach some two million dollars annually, with up to several dozen jobs generated by and dependent on these expenditures. This is a positive and important contribution to the local economy, but it is quite small in comparison with the total annual income, employment, and tax bases of Brazoria, Matagorda, and Fort Bend counties, in which the three refuges of the Complex are located.

Under Alternative A, the economic benefits would continue at current levels. The impact of Complex operation and visitation on the local economy would be beneficial, minor, long-term, and widespread.

Alternative B—Proposed Action

Economic impacts of Alternative B would be greater than Alternative A, commensurate with the proposed increase in Complex programs, actions, staffing, budget, and spending under this alternative. In addition, the populations of the Texas Gulf Coast and Houston metro areas are projected to continue growing for the near future. This would likely result in an increase in visitation to the Complex and associated visitor spending, which is a stimulus for the local economy, contributing jobs, income, and tax revenues. Relative to the enormous local economy, these socioeconomic benefits would be small, but still tangible and appreciated.

The loss in tax revenue to the counties would occur with additional land acquisition. Prior to 2010, the counties on average received 43 percent of what the maximum payment could be through the Refuge Revenue Sharing Program. This percentage decreased significantly in 2010 due to the decision not to supplement revenue funds with general tax revenue funds by Congress, through their efforts to reduce the Federal Budget. The Service's land acquisition benefits the economy by sustaining land values at current and rising levels. In addition, funds generated from land sales are available for other economic benefits to the landowner.

Under Alternative B, the impact of Complex operations and visitation on the local economy would be beneficial, minor, long-term, and widespread.

Alternative C

Economic impacts of Alternative C would also be beneficial, and exceed those of Alternative A, due to the increased staffing, budget, and visitation at the Complex. The elimination of

cooperative farming would reduce economic benefits to one individual farmer but impacts to the local economy from this reduction would be negligible. The Complex expects the proposed addition of grazing to offset this effect. In addition, under this alternative the Complex would have greater short-term expenditures on larger projects to reduce erosion and saltwater intrusion. Like Alternative A and B, the net effect of Alternative C on the local economy would be would be beneficial, minor, long-term, and widespread under this alternative as well.

4.5.2 Impacts on Aesthetic and Visual Resources

Alternative A—No Action Alternative

Habitat management actions that remove vegetation, disturb soils, and use heavy equipment (prescribed burning, invasive species control, habitat restoration, etc.) can be visually unattractive in the short-term (during project implementation); however, in the long-term these actions restore and improve habitat quality and should result in a more aesthetically pleasing landscape. Existing erosion control structures, including revetment geotubes and oyster domes, can detract from aesthetics.

Under Alternative A, the Complex would continue to protect tens of thousands of acres of open space, including scenic habitats such as bottomland hardwood forests, coastal marshes, prairies, and farmland. In an area of the state and the Gulf Coast that is developing rapidly and that already has substantial industrial, commercial, and residential footprints, the maintenance of this aesthetically pleasing open space is a great benefit of the Complex.

Proposed maintenance (no new construction planned) of infrastructure under Alternative A is on a small scale and would not have more than negligible, short-term, localized adverse effects on visual resources within the Complex. Long-term impacts will depend on the design, location, and context of the new facilities. Overall, the Complex expects the impacts of its facilities, operations, and visitation on aesthetic and visual resources to be beneficial, moderate, long-term, and widespread.

Alternative B—Proposed Action

Under Alternative B, the same actions that take place under Alternative A would also occur, but to different extents. There would be an increase in prairie restoration and management activities such as mechanical treatments and prescribed fire, as well as construction of one new trail, a new office at San Bernard NWR, and construction of new maintenance and storage buildings at Brazoria and San Bernard NWRs. Increased erosion control would further detract from aesthetics along the GIWW. Short-term impacts would be the same as Alternative A, but overall long-term impacts would be more beneficial than Alternative A due to increased restoration and management and the augmented effort to acquire and protect more riparian corridors and bottomland hardwood forest.

Alternative C

Under Alternative C, the San Bernard will construct an office and visitor center instead of the office/visitor contact station proposed under Alternative B on San Bernard NWR. The impacts will be the same (same location and project footprint) as described under Alternative B.

4.5.3 Impacts on Public Use Opportunities

Alternative A—No Action Alternative

Under Alternative A, current opportunities for hunting, fishing, wildlife observation and photography, environmental education and interpretation on the Complex would all remain the same. The Complex identified these six wildlife-dependent activities as priority public uses of national wildlife refuge in accordance with the Improvement Act.

Section 4.2 discusses fishing; each of the alternatives would have the same effect on fishing opportunities on the Complex.

Alternative A would maintain existing hunting opportunities, including waterfowl and feral hog and white-tailed deer. The Complex would allow waterfowl hunting in designated areas of all three refuges. One permit area and ATV use is allowed for disabled hunters at the Sargent Unit of San Bernard NWR. There would also be a youth-only hunt allowed for feral hogs on Brazoria and San Bernard NWRs in cooperation with TYHP. Feral hogs/white-tailed deer hunting opportunities for youth will continue at San Bernard NWR in cooperation with TPWD-Stringfellow WMA. Maintaining existing public hunting opportunities on the Complex would continue to be a benefit to the public. The impact of Alternative A on hunting opportunities would be beneficial, moderate, long-term, and localized.

Alternative A would maintain current wildlife observation and photography opportunities and facilities. Brazoria and San Bernard NWRs would remain open to wildlife observation; visitors would be directed to designated public use areas. Bird watching is the most popular form of wildlife observation and would likely remain so in the future. Most birders visit during the cooler months of November through March when large concentrations of waterfowl are present and readily observable. The spring and fall bird migrations are also popular for viewing neotropical songbirds. Brazoria NWR would maintain its auto-tour route through the Big Slough Recreation Area, which contains a number of wildlife viewing areas and stations as well as a couple of nature trails. San Bernard NWR would also maintain its wildlife drive, trails, and observation platforms, which offer outstanding views of geese, ducks, shorebirds, marsh birds, and wading birds. San Bernard NWR would also maintain a photo blind at Hudson Woods. Wildlife observation and photography are two of the big six wildlife-dependent public uses identified in the Improvement Act as being generally compatible with the purposes of national wildlife refuges. Alternative A would maintain existing wildlife observation and photography opportunities on the Complex, which would be a benefit. Thus, impacts of Alternative A on wildlife observation and photography would be beneficial, moderate, long-term, and widespread.

Under Alternative A, the environmental program on the Complex would continue to provide opportunities for both children and adults to learn about the Complex and natural habitats of the Texas Gulf Coast. The education programs improve the quality of the visitor's experience and provide them with a better understanding of the benefits, issues, and challenges of natural resource conservation in the coastal ecosystem. The program meets local and State of Texas education standards, allows professional development for teachers, provides community-based service organization programs, meets youth group merit badge requirements, and instills a sense of stewardship and understanding of conservation issues.

The Discovery Center at Brazoria NWR is the focus of the Complex's active environmental education program. Its classroom/lab, outfitted with stereomicroscopes and a video microscope projector, is a highlight for visiting students and adults. The DEEP currently serves approximately 3,000 students annually. A partnership exists between the Friends of Brazoria NWR and area school districts to help with the financial impacts of the program expansion. The Complex has an MOU with the Brazosport Independent School District for this program. To help accommodate increases in demand for the program, workshops would be available to train teachers to lead their students through a high quality outdoor experience.

At San Bernard NWR, DEEP currently serves approximately 500 students, and this alternative would maintain this level. Activities would continue to occur primarily at the Hudson Woods Unit, making use of a small building (Discovery Outpost), the entrance road, and various trails. Habitats studied are bottomland hardwood forest and freshwater marsh.

Alternative A would maintain existing opportunities for interpretation on the Complex. The Complex would continue to hold one annual 3-day event (Migration Celebration). Other interpretive opportunities are present and would continue along wildlife drives, at observation points, and at the Brazoria NWR visitor contact station.

The Complex would continue to tailor messages and delivery methods to specific audiences and present them at the Discovery Center and other locations. Interpretation enhances opportunities for a quality visitor experience on the refuges and promotes visitor understanding for America's natural resources. Visitors would continue to make their own connection with natural resources through talks, publications, brochures, fact sheets, species lists, signs, interpretive panels, and exhibits. Exhibits would continue to be easy to read, understand, and accessible.

Current levels of wildlife observation, photography, environmental education, and interpretation would continue and the Complex would maintain facilities that support these activities. The impacts of continuing these activities throughout the Complex would be beneficial, moderate, long-term, and widespread.

Alternative B—Proposed Action

In general, under Alternative B, the Complex would augment wildlife-dependent recreation opportunities.

Alternative B would provide a new youth waterfowl hunt and revise the schedule at two locations. Potentially opening Eagle Nest Lake on San Bernard NWR to waterfowl hunting would be an additional benefit. Alternative B would offer more hunting opportunities than Alternative A. Overall benefits of Alternative B for hunting would be moderate, long-term, and localized.

Under this alternative, the Complex would increase wildlife observation opportunities by constructing new wildlife observation facilities. Brazoria NWR would provide a viewing area on Otter Slough (possibly a boardwalk across the slough) and establish pull off points along FM2004, at the Farm Fields, and on CR 227. San Bernard NWR would add photo blinds at the Dow Woods Unit and Brazoria NWR would add photo blinds to the Big Slough area. Because

of these new facilities for both wildlife observation and photography, Alternative B would be more beneficial than Alternative A, but overall impacts would be basically the same (moderate, long-term, and widespread).

Alternative B would allow bicycles on the trails at Hudson Woods. This would increase opportunities for visitors to access remote areas along Oyster Creek. Based on current levels of bicycle use on other areas of the refuge conflicts between users are not anticipated.

Alternative B would expand the environmental education program into additional school districts. Brazoria NWR and San Bernard NWR would expand outreach by contacting local media outlets, radio, and Web sites to provide information on the DEEP program, events, and refuge purposes. We would provide a one week day camp focused on the “at-risk” group of kids (Boys and Girls Club, etc.). The DEEP program at Brazoria NWR would expand to include one additional school district (Angleton/Danbury school district).

The DEEP program at San Bernard NWR would expand to include two additional school districts (Van Vleck/Bay City and Columbia). San Bernard NWR would also like to develop a partnership with Brazosport College at the Dow Woods Unit, enabling them to use the area as an outdoor classroom. Overall then, with respect to environmental education, Alternative B would be more beneficial than Alternative A, but overall impacts would be basically the same (moderate, long-term, and widespread).

Alternative B would expand the interpretive program at a variety of refuge venues on a monthly basis. Across the Complex, interpretive activities would include day and night naturalist walks and audio/visual presentations conducted by staff and volunteers. Brazoria NWR would also construct an information kiosk along FM2004. Due to this expanded program, Alternative B would be more beneficial than Alternative A, but overall impacts on interpretation would be the same (moderate, long-term, and widespread).

Alternative C

In general, public uses under Alternative C tend to be similar to or more expansive than those of Alternative B.

Alternative C proposes a new hunt for white-tailed deer on bottomland units (San Bernard NWR). This alternative would also change the Sargent Unit waterfowl lottery hunt to an open, walk-in hunt and modify the timing of the hunt by decreasing the hours of allowed hunting (morning hunt instead of all-day hunt). Overall effects of Alternative C with respect to hunting opportunities on the Complex would be more beneficial than those of Alternative B. Alternative C would be beneficial, moderate, long-term, and localized.

Proposed facilities and opportunities for wildlife observation and photography, as well as expansion of environmental education, under Alternative C would be the same as Alternative B. Therefore, the effects on these activities would be the same as well (beneficial, moderate, long-term, and widespread).

Under Alternative C, interpretation would be the same as in Alternative B. The effects would also be very similar: beneficial, moderate, long-term, and widespread.

4.5.4 Impacts on Visitor Use Facilities:

Alternative A—No Action Alternative

All visitor use facilities and related infrastructure, including roads, kiosks, trails, boardwalks, observation decks, and visitor centers/contact stations would be maintained. The impact of Alternative A on visitor use facilities would be moderate, beneficial, long-term, and widespread.

Alternative B—Proposed Action

There would be additional benefits under Alternative B from expanded visitor use facilities such as signs, trails, a visitor contact station, and a new kayak and canoe launch on Cedar Lake Creek at San Bernard NWR, additional photo blinds, trails, and a boardwalk on Brazoria NWR. Allowing bicycle use of the dirt trails at Hudson Woods may cause rutting which could require additional maintenance to make the trail safe and accessible to all visitors.

Alternative C

There would be even more additional benefits from those of Alternative B due to a new visitor center at San Bernard NWR and a new kayak and canoe launch.

4.6 Assessment of Cumulative Impacts:

A cumulative impact is defined as an impact on the environment that results from the incremental impact of the [proposed] action when added to other past, present, and reasonably foreseeable future action regardless of what agency (federal or nonfederal) or person undertakes such other actions. Cumulative impacts can result from individually minor but collectively significant actions taking place over a period of time (40 CFR 1508.7).

Cumulative impacts are the overall, net effects on a resource that arise from multiple actions. Impacts can “accumulate” spatially, when different actions affect different areas of the same resource. They can also accumulate over the course of time, from actions in the past, the present, and the future. Occasionally, different actions counterbalance one another, partially cancelling out each other’s effects on a resource. But more typically, multiple effects add up, with each additional action contributing an incremental impact on the resource. Accurately summarizing cumulative effects is difficult in that while one action increases or improves a resource in an area, other unrelated actions may decrease or degrade that resource in another area.

As stated in the Service Manual (550 FW 1 and 2), in an EA, a cumulative impact assessment should be conducted if it is determined necessary through scoping to make a determination of significance of the proposed action. When a cumulative effects analysis is included in an EA, the analysis need only be sufficient for the decision maker to reach a conclusion on the significance of the impact in order to determine if the preparation of an EIS is required.

This section addresses the potential cumulative effects for all the alternatives and is intended to consider the activities on the Complex in the context of other actions on a larger spatial and temporal scale. The current resource conditions (Affected Environment) reflect the impacts of

past and present actions that have taken place on the Complex as described in Chapter 3 of the CCP. Earlier parts of this EA discuss the impacts of proposed future actions (for all alternatives). The adverse direct and indirect effects of current refuge management and the proposed actions (all alternatives) on air, water, soil, habitat, wildlife, the local economy and population, and aesthetic/visual resources are expected to be mostly negligible to moderate and short-term to long-term. The benefits to habitat, wildlife, and public use that the proposed action would achieve greatly outweigh any of the adverse impacts discussed in this document. The Service also considered past, present, and future planned actions on other state, federal, and private lands surrounding the Complex. The section below provides an analysis area for potential cumulative effects on each resource and a summary of those potential impacts.

Cumulative Impacts on Physical Resources

Air Quality

A substantial amount of heavy industrial activity is present within the multi-county region south of Houston. Both permitted and unpermitted releases of a wide variety of pollutants and contaminants have a substantial impact on air quality in the region. These organic and inorganic chemicals would have an adverse impact on air quality and ecosystems within the Complex, but these precise effects have not been extensively studied or documented. Barge and boat traffic along the GIWW, pipelines, Houston airports, and the traffic of millions of residents in the metropolitan area all have substantial negative impacts on air quality. While the Complex's implementation of periodic prescribed fires during times when this is permitted would temporarily add smoke to the regional air shed; overall, the presence of the Complex's nearly 100,000 acres of natural habitat would help serve to ameliorate adverse effects on air quality of hundreds of other human activities and processes in the region.

Air quality is always a concern on the Complex, which is located within 60 miles of one of the most industrialized and populated areas in the United States. Hundreds of refineries and chemical plants occur in surrounding counties as well as the Freeport/Clute industrial center. Approximately 60 natural gas and coal power plants, some of the nation's largest shipping ports, two major airports several regional airports, and one military base also surround the Complex. The Houston area has nearly 5 million inhabitants as well as a sprawling urban commuter population in one of the largest industrial complexes in the country.

Projects on the refuge that affect air quality would be consistent with the minimal effects produced in the past (as described in section 4.3.1 of this EA). When compared to the magnitude of industrialization occurring in areas surrounding the Complex, the effects of refuge management actions are negligible. In all alternatives, the prescribed burning program, construction, and maintenance activities and increased visitor use would essentially have the same adverse effects to refuge air quality, while the preservation of native bottomland hardwood habitat would have long-term benefits to air quality by limiting local development and increasing carbon sequestration. These adverse and beneficial impacts, however, would not be cumulatively significant.

Water Management and Quality

Increasing population in the region, along with greater urban, commercial, and industrial development would all tend to increase the extent of adverse effects on water quality in and

around the Complex by increasing discharges from point and non-point sources of water pollutants and contaminants.

As the area has grown and developed, the increasing diversion and drainage of water from shallow channels and bayous upstream of the Complex have occurred as flood control measures. This has cumulatively reduced the amount of water flowing into the Complex refuges and is a long-term threat to both aquatic and wetland habitats.

The GIWW is a major source of erosion, leading to saltwater intrusion and the subsequent degradation of freshwater marshes. This project affects all three refuges in the Complex.

E. coli (fecal coliform bacteria) from untreated wastewater, whether from an increase in ranching activity or improperly controlled septic system releases, affects both primary (contact) and secondary recreational activities involving contact with the water. This affects both the Brazoria and San Bernard NWRs. It has led to periodic closures of both boating and fishing activities along the San Bernard River.

All of the above activities, actions, and trends have had adverse implications for water quality and quantity in the area. These large detrimental influences work against and offset the refuges' largely beneficial impacts on water quality and quantity, from conserving more than 100,000 acres of marsh, prairie, riparian, and bottomland hardwood forest. In view of these increasing adverse pressures on water quality and quantity, which are likely to continue to increase in the near future, the Complex's positive effects on water resources become even more important. However, the net cumulative effect on water resources in the coming decades would probably be more negative than positive. At the end of the 15-year planning period, the overall condition of water resources on the Complex as a result of cumulative effects is likely to be less than at present, with less water and lower water quality. These impacts, however, would not be cumulatively significant.

Soils

Rapid population growth and associated development in the multi-county region cause the development and covering of soils in the greater Houston area and Texas Gulf Coast at a rapid rate. As the population of an area grows, it converts soils that formerly supported agriculture and natural habitats to roads and streets, residential, commercial, institutional, and industrial areas. Instead of supporting biologically productive ecosystems, the soils beneath all these developments support buildings and structures. In this regional context, the soils of the Complex have an even greater importance.

Past, present, and reasonably foreseeable future impacts to soils on the Complex would stem mostly from activities on the Complex itself, rather than from activities occurring outside of the three refuges. Refuge management activities would result in effects on soils as discussed in earlier parts of this EA, including ground disturbance from crop cultivation, prescribed fires and wildlife suppression, and construction, which can result in erosion and sedimentation. Over years of farming a site, its soils are also subject to nutrient loss and declining soil fertility, which the Complex can compensate for to some extent by extensive application of nitrogen and phosphate fertilizers (See Table 3-7, Applications for Invasive Target Species Applications).

While there would be some application of herbicides, both to agricultural soils and other sites, currently, herbicides tend not to be persistent or accumulate in the environment. However, continuous use of these chemical compounds would mean that residues of a number of herbicides would continue to occur in soils throughout the lifetime of the CCP.

Effects from other ground disturbance activities off-refuge are likely to remain at roughly the same level as they are currently. The Complex implements farming under organic practices, which allow for maintaining soil nutrients without the use of fertilizers, pesticides, herbicides, and constant crop propagation and harvesting. Alternatives A, B, and C, which propose similar amounts of construction and other management activities, would have similar effects to soils. Oil and gas operations vary seasonally depending on the industry. The refuge has some facilities on the south unit and there are a number of facilities and pipelines outside the refuge boundaries. The refuge does not own the mineral rights; therefore, the potential for additional oil and gas operations is always possible. There could be potential cumulative impacts on soil quality if oil and gas operations increase in the future.

Overall, cumulative effects on soils (from all alternatives) would be a mix of minor adverse and minor to moderate, beneficial. Adverse cumulative effects would probably occur to those soils that are regularly or continually subjected to some form of disturbance. The Complex does not anticipate these adverse effects to be major. Minor to moderate, beneficial effects on soils would be expected to occur at those sites constituting the great majority of the area of the refuges, whereupon undisturbed soils would continue to develop (slowly increasing in depth as well as fertility) as a result of nearly continuous vegetative cover. These adverse and beneficial impacts, however, would not be cumulatively significant.

Cumulative Impacts on Biological Resources

In general, the area considered for the cumulative impacts on biological resources is the Gulf Coast Prairies and Marshes Ecoregion, unless otherwise specified below. Chapter one of this EA discussed ecoregion issues such as fragmentation, commercialization, urbanization, disturbance, and habitat conversion, which influence, impact, and threaten biological resources on the Complex.

Prairie Habitats

Impacts on prairie habitats from the management actions under all three alternatives would be generally beneficial, long-term, moderate, and widespread. There would also be some adverse impacts from implementation of refuge management activities, construction and maintenance of refuge infrastructure, and visitor use, but these adverse impacts would be minor in comparison to the beneficial effects.

Other private and public prairie conservation and restoration efforts in the region contribute to long-term beneficial cumulative impacts on prairie habitats. The Katy Prairie Conservancy (KPC) was established in 1992 to conserve Katy Prairie west of Houston. This prairie encompasses more than 1,000 square miles and is bordered by the Brazos River on the southwest, pine-hardwood forest on the north, and Houston on the east. Historically, Katy Prairie was a poorly drained tall-grass prairie subject to periodic fires; it also included a substantial area

of wetlands. The aim of the KPC is to protect between 30,000–60,000 acres of Katy Prairie both in its current agricultural state, with portions enhanced as wetlands and restored prairie habitat.

The Nature Conservancy owns Nash Prairie, north of West Columbia; this will be the Complex's biggest partner in prairie conservation and restoration. Nash Prairie is a 300-acre parcel of native Texas Coastal Prairie. Nash Prairie has never been grazed or farmed. Except for the encroachment of invasive species (notably Chinese tallow), it represents the Texas Coastal Prairie as it existed centuries ago at the time of European contact. To date, the Service has identified almost 300 plant species at Nash Prairie, with 14 considered rare.

There is also the Pierce Ranch west of Wharton, partnering with Texas RICE, restoring and constructing wetlands and prairies. TPWD has a prairie initiative as well; its action plan calls for identifying critical habitats of Texas Coastal Prairie.

In combination, these and other initiatives will have a generally beneficial, cumulative effect on restoration of prairie habitats in the wider region. The Complex would be contributing to these positive impacts. When compared to the magnitude of impacts on prairie habitats occurring outside of the Complex, these beneficial impacts would not be cumulatively significant.

Wetland and Aquatic Habitats

Continuing development in and around the refuges will continue to adversely affect the Complex's wetland and aquatic habitats through alteration of the hydrologic regime. In general, there will be less water flow to the refuges in the future, which could subject wetland and aquatic habitats to moisture stress.

Long-term cumulative impacts from the Complex's proposed management actions on wetlands and aquatic habitats would be moderate, beneficial, and widespread across the Complex. Adverse cumulative impacts from habitat fragmentation due to visitor use and management infrastructure would be minor and localized to widespread. When compared to the magnitude of impacts on wetland and aquatic habitats occurring outside of the Complex, the impacts from proposed management activities (all alternatives) would not be cumulatively significant.

Bottomland Hardwood Forests

The Complex partners with the NRCS on conservation easements that include management, conservation, and restoration of bottomland hardwood forests, as part of the Wetlands Reserve Program. The TPWD is acquiring bottomland hardwood forest in these counties as well. In addition, there are two WMAs and one state park in Complex counties and one state park, Columbia Bottomlands. In combination, all of these joint efforts will increase the acreage and quality of protected bottomland forests along the Texas mid-coast. Against these positive conservation trends is the general population growth and residential, commercial, and industrial development occurring in the wider region between the Gulf Coast and Houston.

The Complex maintains thousands of acres of bottomland hardwood forests, which is disappearing due to extensive urban, suburban, industrial, and agricultural development. The impacts from management of bottomland hardwood forests (under all alternatives) would be both beneficial (due to land acquisition and protection) and adverse (due to development, use, and

maintenance of visitor use and administrative infrastructure) as described in section 4.4.3. These impacts, however, when compared to impacts on bottomland hardwood forest outside of the Complex, would not be cumulatively significant.

Migratory Birds

Under each of the alternatives, effects on migratory birds from proposed management actions would be beneficial, long-term, moderate to major, and widespread. Under this alternative, there would also be certain adverse impacts from disturbance associated with public use programs, including hunting. Adverse impacts from the disturbance of visitor use activities would be short-term to long-term, negligible to minor, localized but also potentially widespread. None of these impacts would be cumulatively significant.

These actions on the Complex are a small part of a number of integrated efforts to manage migratory birds on the flyway, continental, and hemispheric scales, as described in Chapter 1 of the CCP. The Complex contributes to and collaborates with waterfowl management efforts by the Service and a number of states and Canadian provinces in the Central Flyway. The North American Waterfowl Management Plan (NAWMP) seeks to restore waterfowl populations in Canada, the United States, and Mexico to levels recorded in the 1970s. This international partnership has worked to identify priority habitats for waterfowl and has established goals and objectives for waterfowl populations and habitats. Regional partnerships, called joint ventures, are the implementing mechanisms of the NAWMP. The Texas Mid-coast Complex is situated within the Gulf Coast Joint Venture.

The North American Bird Conservation Initiative (NABCI) seeks to ensure the long-term health of North America's native bird populations by increasing the effectiveness of existing and new bird conservation initiatives, enhancing coordination among the initiatives, and fostering greater cooperation among the continent's three national governments and their people. In 1999, the U.S. NABCI approved a framework for delineating ecologically-based planning, implementation, and evaluation units for cooperative bird conservation in the U.S. and Canada known as Bird Conservation Regions (BCRs). BCRs are ecologically distinct regions in North America with similar bird communities, habitats, and resource management issues.

Partners in Flight (PIF) is a cooperative effort involving partnerships among numerous governments and NGOs concerned about neotropical migrants and other birds. Partners in Flight was created in 1990 in response to growing concerns about declining populations of many land bird species and to emphasize the conservation of birds not covered by existing conservation initiatives. Bird conservation plans, are developed in each region to identify species and habitats most in need of conservation, to establish objectives and strategies to provide needed conservation, to establish objectives and strategies to provide needed conservation activities, and to implement and monitor progress on the plans. This North American Landbird Conservation Plan summarizes the conservation status of landbirds across North America, illustrating broad patterns based on a comprehensive, biologically-based species assessment. The Texas Mid-coast NWR is within PIF Physiographic Area #6, the Coastal Prairies.

PIF Landbird Conservation Plan-Gulf Coastal Prairie (2008) covers the BCR #37, the Gulf Coastal Prairie. This plan selected and developed conservation recommendations for four

species of concern, and one suite of species, with expectations that actions proposed would benefit a number of species with similar habitat requirements. The selected species are seaside sparrow, northern bobwhite, loggerhead shrike, Le Conte's sparrow, and a suite of warblers (Cerulean, Swainson's, and goldenwinged) which represent neotropical migrants that use Gulf Coast stopover habitat.

The U. S. Shorebird Conservation Plan, adopted in 2001, seeks to stabilize populations of all shorebirds that are in decline because of factors affecting habitat in the United States. At a regional level, the plan's goal is to ensure that shorebird habitat is available in adequate quantity and quality to support shorebird populations in each region. This plan considers 53 species of shorebirds. Twenty of these species at risk listed in this plan occur on the Complex.

In addition to these continent-wide and international plans, Texas has a number of initiatives. At the state level, there are a number of initiatives in Texas that have positive cumulative consequences for migratory birds, including the Texas Comprehensive Wildlife Conservation Strategy (2005), Land and Water Resources Conservation and Recreation Plan (2005), Texas Wetlands Conservation Plan (1997), Austin's Woods Conservation Plan (1997), and Seagrass Conservation Plan for Texas (1999). While these do not focus primarily on migratory birds, their implementation would still provide long-term, cumulative benefits for them.

Finally, the Complex is located within the Service-designated Gulf Coast Prairies and Marshes Ecoregion, which is the subject of intra-Service collaborative conservation efforts.

In combination, all of the foregoing efforts should improve the prospects for many migratory birds species at all scales, from local to hemispheric. However, these efforts confront a wide variety of threats to migratory birds at all scales. Most of these are threats to habitats where the birds breed in the spring and summer months (in more northerly areas) and where they winter (in more southerly areas), as well as crucial stopover habitats that migratory birds need when they are in transit between summer and winter ranges. Habitat conversion, degradation, and fragmentation from diverse human activities, including urbanization, agriculture, logging and forestry, mining, and hydroelectric development, all on a vast scale, threaten populations of migratory birds species. Whether long-term cumulative impacts trend negative or positive varies by species, and there are hundreds of migratory bird species in question.

Resident, Native Wildlife

Regionally, the Complex anticipates increased habitat loss and fragmentation to occur in the coming 15 years from the general, long-term increase in population and development within the central Gulf Coast region of Texas. In general, such habitat loss and fragmentation would be detrimental to populations of most, but not all, species of resident, native wildlife. Reduced populations of wildlife outside of the Complex may or may not affect the size and viability of populations on the Complex.

Under all alternatives, there would be long-term benefits to resident native wildlife due to the habitat protection provided by the Complex. Overall, cumulative impacts on resident, native wildlife from Complex management under the three alternatives would be moderate, beneficial, long-term, and widespread. There would also be adverse impacts from disturbance associated with public use programs, but these impacts would be negligible to minor, short-term to long-

term, localized to widespread. None of these impacts, however, would be cumulatively significant.

Threatened and Endangered Species

The protection of habitat provided by the Complex would result in a benefit to long-term conservation of threatened and endangered species. All alternatives would beneficially impact federally threatened and endangered species known to occur on Complex (piping plovers, green sea turtle, and Kemps ridley sea turtle) due to habitat protection, species surveys, and monitoring. These beneficial impacts would be moderate to major, long-term, and widespread. Alternatives B and C would provide greater benefits to additional species than Alternative A, with the potential reintroduction of the whooping crane and the APC. These impacts, however, would not be cumulatively significant.

Recent years have witnessed a slow trend toward the overall recovery of populations of both piping plovers and sea turtles. The Complex expects this cumulative trend to continue over the coming 15 years, and the Complex will continue contributing to the recovery of these species. Neither the APC nor the whooping crane now occur on the Complex, but if generally positive trends continue with regard to their recovery, they may possibly occur, or relocation efforts may be focused inside the boundaries of the Complex, within the timeframe of this CCP. With regard to the whooping crane, the Complex would therefore participate in continuing efforts to re-establish other flocks, migratory and non-migratory, of this highly endangered bird.

Cumulative Impacts on the Human Environment

Based on the analysis presented earlier in this chapter, the Service has concluded that there would be no significant cumulative impacts on the human environment from proposed refuge management actions, when considered in context with other state, federal, and private actions (as summarized below), all management alternatives have similar impacts and conclusions.

Local Population and/or Economy

As a result of projected population and economic growth in the region over the coming 15 years, overall cumulative economic impacts would continue to be beneficial. The Complex would continue to contribute positive, if relatively minor, economic effects on the region.

Aesthetic and Visual Resources

Aesthetic and visual resources in the region surrounding the Complex are rapidly diminishing due to residential development, urbanization, and other ecoregional issues. The Complex has an overall beneficial effect on aesthetic and visual resource in this area where open space and natural beauty are diminishing.

Hunting

As in most states, there is a long-term, generalized decline in hunting participation in Texas, even as the state's population (and thus the number of potential hunters) continues to grow very rapidly. While a number of factors undoubtedly contribute to this, the rising cost of hunting on private land may be growing prohibitively expensive for much of the public, decreasing its ability to actually participate in hunting, if not the desire or demand to hunt. Under these circumstances, the importance of public lands and wildlife habitat to hunters, such as those available on the Complex, cannot be understated. However, if hunting demand or participation

on the Complex were to increase greatly, as a result of declining opportunities elsewhere, this excessive competition could eventually decrease the quality of the hunting experience available on the Complex.

Wildlife Observation and Wildlife Photography

There are a growing number of other formal and informal opportunities for wildlife observation in the region. The City of Freeport is developing wildlife observation areas in marsh habitats alongside Hwy 36. Two county parks offer additional opportunities for both observation and photography. The Gulf Coast Bird Observatory, outside of Lake Jackson and Quintana, encourages wildlife observation. TPWD has established the Coastal Birding Trail. Brazos Bend State Park, west of Rosharon, covers roughly 5,000 acres, with an eastern boundary fronting on the Brazos River. Visitors may view and photograph wildlife from a nature trail and hike bike/foot trails. The City of Lake Jackson has a wilderness park. The Complex will contribute to these long-term, cumulatively beneficial effects related to wildlife observation opportunities in the region. However, even as these formal facilities and opportunities increase, an expected decrease in the amount of overall wildlife habitat present due to the area's continuing growth and development (and associated habitat conversion) may reduce the amount of wildlife actually available for viewing and photography.

Environmental Education

Environmental Education (EE) is also taking place at other sites in the region, so that the Complex contributes to a beneficial cumulative effect from all of these combined efforts. The Texas Master Naturalists Chapter does EE programs out of the INEOS facility, east of Brazoria NWR; it focuses on marsh ecology. The Chevron/Phillips plant provides EE opportunities at Flag Pond, north of Sweeney. TPWD does EE focused on fisheries at Sea Center Texas, located in Lake Jackson.

Interpretation

Within the larger region, each of the sites mentioned above under "Wildlife Observation and Wildlife Photography" also offers interpretive opportunities. Thus, the Complex would be playing an integral role in growing opportunities for nature and wildlife interpretation around the region.

Visitor Use Facilities

No outside forces or factors would cause or contribute to cumulative effects on these facilities.

4.7 Short-Term Uses versus Long-Term Productivity

The Complex dedicates the habitat protection and management actions under the proposed alternative to maintaining the long-term productivity of refuge habitats. The benefits of this plan for long-term productivity far outweigh any impacts from short-term actions, such as the construction of observation towers and a visitor center, or creation of new trails. While these activities would cause short-term negative impacts, the educational values and associated public support gained from the improved visitor experience would produce long-term benefits for the ecosystem.

Inventory and monitoring refuge resources is an essential part of ensuring long-term productivity. Resources are impacted by a variety of natural influences, including climate and storm events. Adding additional stressors through public use opportunities, oil and gas development, and short-term construction activities can have detrimental effects if coupled with other stressors. The Refuges ability to manage habitats, control short-term disturbance and buffer uncontrollable events will enable population sustainability. Within the limited public use areas at each refuge, it is expected that repetitive disturbance and infrastructure does impact populations. However, by limiting the area of impact, the refuge hopes to obtain a balance between providing opportunities for visitors and meeting the needs of wildlife. Therefore, implementing the proposed alternative would lead to long-term benefits for wildlife protection and land conservation that far outweigh any short-term impacts.

4.8 Unavoidable Adverse Effects and Mitigation Measures

All action alternatives may have some unavoidable adverse impacts. The Complex expects the impacts described below to be minor and/or short-term in duration. The Complex would attempt to minimize these impacts wherever possible. The following sections describe the measures the Complex would employ to mitigate and minimize the potential impacts that could result from implementation of the proposed action.

Water Quality from Soil Disturbance and Use of Herbicides

The Complex expects foot traffic on new foot trails to have a negligible impact on soil erosion. To minimize the impacts from public use, the Complex would include informational signs that request trail users to remain on the trails, in order to avoid causing potential erosion problems.

Long-term herbicide use for exotic plant control could result in a slight decrease in water quality in areas prone to exotic plant infestation. Through the proper application of herbicides, however, the Complex expects this to have a minor impact on the environment, with the benefit of reducing or eliminating exotic plant infestations.

Wildlife Disturbance

Disturbance to wildlife is an unavoidable consequence of any public use program, regardless of the activity involved. The Complex would design all of the public use activities proposed under the proposed alternative to minimize levels of impact.

Vegetation Disturbance

Negative impacts could result from the creation and maintenance of trails that require the clearing of non-sensitive vegetation along their length. The Complex expects this to be a minor short-term impact. The Complex would minimize this impact by installing informational signs that request users to stay on the trails.

Other Unavoidable and Adverse Impacts

Potential development of the Complex's buildings, trails, and other improvements could lead to minor short-term negative impacts on vegetation, soils, and some wildlife species. When building the administrative facilities, the Complex would make efforts to use recycled products

and environmentally sensitive products and would build the facility in the same footprint as the current administrative offices. Projects to remove man-made impoundments and other infrastructure would be done using best management practices and areas would be restored through planting of native prairie grasses. All construction activities would comply with the requirements of Section 404 of the Clean Water Act; the National Historic Preservation Act; Executive Order 11988, Floodplain Management; and other applicable regulatory requirements.

4.9 Irreversible and Irretrievable Commitment of Resources:

Irreversible and irretrievable resource commitments are related to the use of nonrenewable resources and the effects that this use could have on future generations. Irreversible effects primarily result from the use or destruction of specific resources that cannot be replaced within a reasonable period, such as energy or minerals. Irretrievable resource commitments involve the loss in value of an affected resource that cannot be restored as a result of the action, such as extinction of a threatened or endangered species or the disturbance of a cultural resource. None of the alternatives would result in a large commitment of nonrenewable resources. Project implementation would require the irretrievable commitment of fossil fuels (diesel and gasoline), oils, and lubricants used by heavy equipment and vehicles. In addition, management actions in this document will require a commitment of funds that would then be unavailable for use on any other Service projects. At some point, commitment of funds to these projects would be irreversible, and once used, these funds would be irretrievable. The Service would implement best management practices to minimize potential impacts.

Table EA 4-2. Summary of Environmental Effects by Alternative

Environmental Resource	Alternative A: Current Management/ No Action Alternative	Alternative B: Proposed Action Alternative	Alternative C
Impacts on Air Quality	<ul style="list-style-type: none"> • Impacts from prescribed fire would be adverse, short-term, minor to moderate, and localized to widespread • Impacts from farming and vehicular operation would be adverse, short-term, negligible to minor, and localized • Impacts from habitat conservation and management would be beneficial, long-term, minor to moderate, and widespread. 	<ul style="list-style-type: none"> • Adverse impacts greater than Alternative A, but still considered adverse, short-term, minor to moderate, and localized to widespread. • Impacts from additional habitat conservation and management would be more beneficial than Alternative A, long-term, moderate, and widespread. 	<ul style="list-style-type: none"> • Adverse impacts from the same actions are approximately the same as Alternative B. • Impacts from additional habitat conservation and management would be greater than Alternative A & B, long term, moderate, and widespread

<p>Impacts on Water Resources</p>	<ul style="list-style-type: none"> • Adverse impacts on water quality from farming and invasive control using herbicides are likely to be negligible to minor, localized, and short-term. • Habitat conservation efforts and erosion control measures would be beneficial, moderate, long-term, and widespread. 	<ul style="list-style-type: none"> • Adverse impacts greater than Alternative A's, negligible to minor, localized and short-term. • Beneficial impacts would be greater than Alternative A's, due to increased habitat conservation. 	<ul style="list-style-type: none"> • Fewer adverse impacts on water quality than Alternative B due to reduced farming. • Overall adverse impacts would be negligible to minor, localized, and short-term. • Beneficial impacts would be greater than Alternative A's due to the habitat conservation and a greater level of effort to reduce erosion and saltwater intrusion.
<p>Impacts on Soils</p>	<ul style="list-style-type: none"> • Both adverse and beneficial effects. • Adverse effects would tend to be negligible to minor, localized to Refuge-wide, and mostly short-term. • Beneficial effects would be minor to moderate, Refuge-wide, and long-term. 	<ul style="list-style-type: none"> • Same as Alternative A. 	<ul style="list-style-type: none"> • Better than Alternatives A and B due to reduced impacts on soils from farming.
<p>Impacts on Prairie Habitats</p>	<ul style="list-style-type: none"> • Both adverse and beneficial effects but beneficial effects exceed adverse. • Adverse effects would be minor, long-term, and localized to Refuge-wide. • Beneficial effects would be moderate, long-term, and Refuge-wide. 	<ul style="list-style-type: none"> • More beneficial than Alternative A. 	<ul style="list-style-type: none"> • More beneficial than Alternatives A and B.
<p>Impacts on Wetland and Aquatic Habitats</p>	<ul style="list-style-type: none"> • Both adverse and beneficial impacts on wetland and aquatic habitats. • Adverse effects would be minor, long-term, and localized to Refuge-wide. • Beneficial effects from the actions described 	<ul style="list-style-type: none"> • More beneficial than Alternative A. 	<ul style="list-style-type: none"> • More beneficial than Alternative A and probably more beneficial than Alternative B.

	above would be moderate, long-term, and Refuge-wide to widespread.		
Impacts on Bottomland Hardwood Forests	<ul style="list-style-type: none"> • Effects would be both adverse and beneficial with beneficial impacts outweigh the adverse impacts. • Adverse impacts would be minor, long-term and localized to Refuge-wide. • Beneficial impacts would be moderate, long-term, and widespread. 	<ul style="list-style-type: none"> • Same as Alternative A. 	<ul style="list-style-type: none"> • Same as Alternative A.
Impacts on Migratory Birds	<ul style="list-style-type: none"> • Both beneficial and adverse effects. • Beneficial effects from many different management efforts and actions would be moderate, long-term, and widespread. • Adverse effects would be short-term to long-term, negligible to minor, localized but also potentially widespread. 	<ul style="list-style-type: none"> • More beneficial than Alternative A. 	<ul style="list-style-type: none"> • Both adverse and beneficial impacts. • Adverse impacts would result both from public use disturbance as well as a reduction in farming acreage and would be minor to moderate, long-term, and widespread. • Beneficial impacts would result from prescribed fire, moist soil management, some farming, research, water management, and rookery management and would be moderate, long-term, an widespread.
Impacts on Resident, Native Wildlife	<ul style="list-style-type: none"> • Net impacts would be beneficial, moderate, long-term, and widespread. 	<ul style="list-style-type: none"> • Net impacts would be more beneficial than Alternative A's. 	<ul style="list-style-type: none"> • Net effects would be more beneficial than Alternative B. • These impacts would be moderate, beneficial, long-term, and widespread.
Impacts on Threatened and Endangered Species	<ul style="list-style-type: none"> • Net impacts would be beneficial, moderate to major, long-term, and widespread. 	<ul style="list-style-type: none"> • More beneficial than Alternative A. 	<ul style="list-style-type: none"> • Same as Alternative B.

Impacts on Cultural Resources	<ul style="list-style-type: none"> • Continue to protect cultural resources under NHPA and Section 106 consultations with TX SHPO. • Impacts would be beneficial, minor to moderate, long-term and localized to widespread. 	<ul style="list-style-type: none"> • Same as Alternative A. 	<ul style="list-style-type: none"> • Same as Alternative A.
Socioeconomic Impacts	<ul style="list-style-type: none"> • Impact of Complex operations and visitation on the local economy would be beneficial, negligible to minor, long-term, and widespread. 	<ul style="list-style-type: none"> • Likely greater than Alternative A. 	<ul style="list-style-type: none"> • Likely greater than Alternative B.
Impacts on Aesthetic and Visual Resources	<ul style="list-style-type: none"> • Impacts would be moderate, beneficial, long-term, and widespread. 	<ul style="list-style-type: none"> • Short-term impacts would be the same as Alternative A • Long-term impacts would be more beneficial than Alternative A due to stepped-up restoration and management and the augmented effort to acquire and protect more riparian corridors and bottomland hardwood forest. 	<ul style="list-style-type: none"> • The impacts will be the same (same location and project footprint) as described under Alternative B.
Impacts on Hunting	<ul style="list-style-type: none"> • Impact would be beneficial, moderate, long-term, and localized. 	<ul style="list-style-type: none"> • More beneficial than Alternative A. 	<ul style="list-style-type: none"> • Overall benefits same as Alternative B. • New hunt for white-tailed deer on bottomland units (San Bernard NWR) would increase public benefits of this alternative. • Change Sargent Unit waterfowl lottery hunt to open, walk-in hunt and modify timing.
Impacts on Fishing	<ul style="list-style-type: none"> • Impact would be moderate, beneficial, long-term, and widespread. 	<ul style="list-style-type: none"> • Same as Alternative A. 	<ul style="list-style-type: none"> • Same as Alternative A.
Impacts on Wildlife	<ul style="list-style-type: none"> • Impact would be 	<ul style="list-style-type: none"> • Slightly more beneficial 	<ul style="list-style-type: none"> • Same as Alternative B.

Observation	beneficial, moderate, long-term, and widespread	than Alternative A because of new facilities development.	
Impacts on Wildlife Photography	<ul style="list-style-type: none"> • Impact would be moderate, beneficial, long-term, and widespread. 	<ul style="list-style-type: none"> • Slightly more beneficial than Alternative A because of new photography opportunities (e.g., photo blinds). 	<ul style="list-style-type: none"> • Same as Alternative B.
Impacts on Environmental Education	<ul style="list-style-type: none"> • Impact would be moderate, beneficial, long-term, and widespread. 	<ul style="list-style-type: none"> • More beneficial than Alternative A due to expansion into additional school districts. 	<ul style="list-style-type: none"> • Same as Alternative B.
Impacts on Interpretation	<ul style="list-style-type: none"> • Impact would be moderate, beneficial, long-term, and widespread. 	<ul style="list-style-type: none"> • More beneficial than Alternative A due to expanded program. 	<ul style="list-style-type: none"> • Same as Alternative B.
Impacts on Visitor Use Facilities	<ul style="list-style-type: none"> • Impact would be moderate, beneficial, long-term, and widespread. 	<ul style="list-style-type: none"> • Additional benefits from expanded visitor use facilities such as signs, trails, visitor contact station, and boat launches. 	<ul style="list-style-type: none"> • Additional benefits from those of Alternative B from new visitor center at San Bernard NWR and boat launches.

5.0 CONSULTATION, COORDINATION, AND DOCUMENT PREPARATION

5.1 Document prepared by:

Please refer to Appendix I in the Plan

5.2 References

Allain L., Malcolm V, Johnston S, Patton D, Stewart Sr. RE, Milam N. Brochure. 1999. Paradise Lost? The Coastal Prairie of Louisiana and Texas. U.S. Government Printing Office. Plamplet. 732 North Capitol St. NW • Washington, DC. 2003. 39 pp

Cahoon, D.R., J. W. Day and D. J. Reed. 1999. The influence of surface and shallow subsurface soil processes on wetland elevation, a synthesis. *Current Topics in Wetland Biogeochemistry* 3: 72-88.

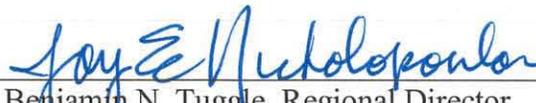
Carver, Erin and James Caudill 2007. *Banking on Nature 2006: The Economic Benefits to Local Communities of National Wildlife Refuge Visitation*. Division of Economics, U.S. Fish and Wildlife Service, Washington, DC. September.

- Collins, S., Collins S.L. 1990. Fire in North American Tallgrass Prairies. University of Oklahoma Press. 82-98 pp.
- Cowardin, L. M., V. Carter, F. C. Golet, E. T. LaRoe. 1979. Classification of wetlands and deepwater habitats of the United States. U.S. Department of the Interior, Fish and Wildlife Service, Washington, D.C. Jamestown, ND: Northern Prairie Wildlife Research Center Online. <http://www.npwrc.usgs.gov/resource/1998/classwet/classwet.htm> (Version 04DEC98).
- Dai, X.; Boutton, T.W.; Hailemichael, M. 2006. Soil carbon and nitrogen storage in response to fire in a temperate mixed-grass savanna. *Journal of Environmental Quality* 35: 1620-8pp.
- Fang, X., and H.G. Stefan. 1998. "Temperature Variability in the Lake Sediments ." *Water Resources Research*, 34(4), 717-729.
- Fahrig, L. 2003 Effects of habitat fragmentation on biodiversity. *Annu. Rev. Ecol. Evol. Stm.* 34:487-515.
- Gauthreaux, Dr. S.A. 2002. Radar Ornithology and the Conservation of Migratory Birds. Clemson University. 6pp.
- Hatch SL, Schuster JL, and Drawe DL. 1999. Grasses of the Texas Gulf Prairies and Marshes. 1st ed. College Station (TX). Texas A&M University Press. 1999. 355 pp.
- Schuman, G.E., J. D. Reeder, J. T. Manley, R. H. Hart and W. A. Manley. 1999. Impact of Grazing Management on the Carbon and Nitrogen Balance of a Mixed-grass Rangeland. *Ecological Applications* 9 (1)- 65-71 pp.
- Texas Climate Initiative. 2011. <http://texasclimate.org/>. Accessed February 14, 2011.
- U.S. Fish and Wildlife Service. 2009. Texas Mid-coast Refuge Complex: Trends and Predicted Sea Level Rise Impacts to Coastal Wetlands. Southwest Region, Albuquerque, NM. 37 pp.
- U.S. Fish and Wildlife Service. 2009 b. U.S. Fish and Wildlife Service, National Wildlife Refuge System. Managing Invasive Plants: Concepts, Principles and Practices. Available online at: <http://www.fws.gov/invasives/staffTrainingModule/methods/chemical/practice.html>.
- West, B. C., A. L. Cooper, and J. B. Armstrong. 2009. Managing wild pigs: A technical guide. *Human-Wildlife Interactions Monograph* 1:1–55.

[This page intentionally left blank.]

United States Fish and Wildlife Service
Environmental Action Statement

Within the spirit and intent of the Council on Environmental Quality's regulations for implementing the National Environmental Policy Act (NEPA), and other statutes, orders, and policies that protect fish and wildlife resources, I have established the following administrative record and determined that the action of implementing the Texas Mid-coast National Wildlife Refuge Complex Comprehensive Conservation Plan is found not to have significant environmental effects as determined by the attached *Finding of No Significant Impact* (following) and the *Comprehensive Conservation Plan and Environmental Assessment*.


Dr. Benjamin N. Tuggle, Regional Director
U.S. Fish and Wildlife Service, Region 2

9/12/13
Date


Jennifer Sanchez, Project Leader
Texas Mid-coast National Wildlife Refuge Complex

4-12-2013
Date


Aaron Archibeque, Regional Chief
NWR System, Region 2

9/11/13
Date


Carol Torrez, NEPA Coordinator
Division of Planning, Region 2

9/10/13
Date

[This page intentionally left blank.]

FINDING OF NO SIGNIFICANT IMPACT

ENVIRONMENTAL ASSESSMENT FOR THE TEXAS MID-COAST NATIONAL WILDLIFE REFUGE COMPLEX COMPREHENSIVE CONSERVATION PLAN U.S. FISH AND WILDLIFE SERVICE

The U.S. Fish and Wildlife Service (Service) has developed a Comprehensive Conservation Plan (CCP) and Environmental Assessment (EA) for the Texas Mid-coast National Wildlife Refuge Complex (Complex) located in Brazoria, Matagorda, Fort Bend and Wharton Counties, Texas. The CCP provides management direction for present and future refuge managers of the Brazoria, Big Boggy and San Bernard National Wildlife Refuges (NWRs) for the next 15 years. The Complex took a landscape-scale approach in preparing the CCP, identifying issues and threats to the ecosystem including climate change, erosion/saltwater intrusion, fragmentation, urbanization and development, and loss of natural processes such as fire in maintaining natural habitats. The CCP describes management activities that occur on the refuges and provides management goals, measurable objectives, and strategies designed to enhance and protect existing habitats for the benefit of wildlife. The goals and objectives shall guide management toward the Complex's vision or the ecologically desirable outcome across the refuges. The CCP also identifies wildlife observation, interpretation, photography, and other wildlife-dependent recreation opportunities; development of compatible facilities; habitat and wildlife management; and implementation of related programs.

An EA was completed to fulfill the requirements of the National Environmental Policy Act (NEPA) of 1969 and to inform the public of the possible environmental consequences of implementing the CCP for the Complex. Three alternatives were evaluated and analyzed for potential impacts on the natural and human environment. The EA was prepared to provide decision-making framework that 1) explores a reasonable range of alternatives to meet project objectives, 2) evaluates potential issues and impacts to the refuge, resources and values, and 3) identifies mitigation measures to minimize the degree or extent of these impacts.

ALTERNATIVES CONSIDERED AND ANALYZED

Alternative A: Current Management (No Action Alternative)

This alternative is the baseline for comparison with the action alternatives because it does not involve change from current management programs and emphases. It represents biological management, land conservation and public use activities presently occurring and those that have occurred on the Brazoria, Big Boggy and San Bernard NWR during the last 10 or so years. Activities such as prescribed fire, wildlife management, cooperative farming, wetland management, photography, interpretation, environmental education, hunting, and fishing would continue without any major changes.

Under Alternative A, the Complex would continue land conservation only under the existing Austin's Woods Conservation Plan, which limits acquisition to 28,000 acres. The Service currently has one pending acquisition which when acquired will complete the authorization limit. No further acquisition would occur within the scope of the Austin's Woods Conservation Plan.

The coastal prairie and salty prairie habitats across the Complex will be managed with prescribed burning and haying on a limited scale. The Brazoria NWR would continue Cooperative Farming on about 1,000 acres and moist-soil management on nearly 1800 acres. The San Bernard NWR would continue to provide a 10 acre rye field near the headquarters and moist-soil management on about 1,200 acres including the Pentagon Marsh and Wolfweed Wetlands. Big Boggy NWR would continue to manage about 300 acres of moist-soil managed wetlands and maintain the 90 acre rye field. Native prairies would be restored across the Complex, treating invasive species with herbicide, burning, and dispersing seed.

Forests would be allowed to restore naturally and could be supplemented with seedling planting. Drained wetlands within the bottomlands would be restored. Forested habitats on the refuge will be protected from additional fragmentation.

Dune and beaches will be managed within the Open beaches act, limiting vehicle access above the high-tide line.

Wildlife management activities; including the implementation of the Sea Turtle Recovery Plan will continue. The Complex will manage all habitats to benefit a diversity of native and migratory wildlife providing for resting feeding, and reproductive needs. Feral hog control will continue as outlined in the 2004 Plan allowing issuance of Special Use Permits, aerial shooting and public hunts to control local populations. Treatment of local populations of red-imported fire ants will occur within the rookeries. Treatment of mosquito populations on the refuges are prohibited.

Recreational opportunities would continue with the six wildlife-dependent recreation uses that include hunting, fishing, wildlife observation, photography, interpretation, and environmental education throughout its Public Use Areas. The refuge would also continue to provide opportunities for some recreational uses that are supportive of the six uses mentioned above. These uses include hiking, bicycling, and boating. No entrance fee is currently charged.

Alternative B: Proposed Action

This alternative would provide for a proactive approach to making concerted strategic decisions, through the consideration and analysis of the best available science, based on the goals for management of the Complex. This alternative was developed based on input received from the public, Texas Parks and Wildlife Department (TPWD), ecoregion partners, Service staff, Service biological and visitor services reviews, and the professional judgment of the planning team. This alternative is based on successful pre-existing management strategies and has incorporated ecological principles that apply to the Coastal Prairie and Marshes Ecoregion.

This is the alternative that would best achieve refuge purposes, vision, and goals and would best contribute to the National Wildlife Refuge System mission. Alternative B, with associated goals, objectives, and strategies, comprises the CCP for the Texas Mid-coast National Wildlife Refuge Complex. This alternative would also stress the use of adaptive resource management based on observation and the most current scientific research.

Under Alternative B the San Bernard NWR would acquire and conserve lands in accordance with the 2012 Land Protection Plan (Appendix I in CCP) of up to 70,000 acres within the Columbia Bottomland Ecosystem. Conserved lands may include bottomland forest, riparian, open water and coastal prairie habitats within the original Austin's Woods Conservation Project Area Boundary. The Service will continue to work with conservation partners, working toward maintaining the integrity of this isolated and threatened ecosystem.

The Service will include grazing by domestic cattle as a management tool to promote the fire-grazing interaction that historically occurred and increase diversity and health in the prairie environment. Additional acreage would be incorporated under the haying program. The cooperative farm fields/moist soil units would be increase 200 acres for a total of 1200, of which 400 acres would be planted annually. Water wells would be drilled to provide ground water to supplement rainfall, and purchased water and provide freshwater wetlands.

Forests will be managed as in Alternative A but the Service would work cooperatively with the Texas General Land Office to provide additional protection on the San Bernard Beach.

The Complex would implement inventory and monitoring programs to evaluate habitat for the potential reintroduction of both the Attwater's Prairie Chicken and the Whooping Crane. Phorid flies which are a natural predator of the red-imported fire ant could be released on the Complex.

Recreational opportunities would improve its six priority public uses through increased information, signage, and facilitation by refuge staff. The Complex would also improve the uses that are supportive of the six priority public uses in a similar manner. Consideration of charging an entrance fee was withdrawn from this alternative; no entrance fee will be charged.

Alternative C

Alternative C is based on input received from the public, TPWD, ecoregion partners, Service staff, and biological and visitor services reviews. This alternative responds to the issues of habitat management for greater public access throughout the refuge. Alternative C is generally a "more of" alternative than Alternative B. Alternative C departs from Alternative B by allowing for bison grazing rather than domestic cattle grazing in the management of the prairie grasslands.

In addition Alternative C would reduce the cooperative farming acreage from 1000 to 500 acres, allowing 500 of former field to be restored to native coastal prairie. Alternative C would allow for the Service to manage a portion of the prairie as a seed bank for prairie restoration projects off the refuge.

DECISION: THE SELECTED ALTERNATIVE

Alternative B was selected over the other alternatives because it best meets the Complex's vision for the future, the purposes for which the refuge was established, and the habitat, wildlife, and visitor services goals identified in the CCP. This alternative is the basis for the Comprehensive Conservation Plan and describes how habitat objectives will be accomplished through a combination of management activities to encourage ecological integrity, improve or maintain habitats for native and migratory wildlife and provide for recreational opportunities. Future

management actions will have a neutral or positive impact on the local economy and the recommendations in the CCP will ensure that refuge management is consistent with the mission of the National Wildlife Refuge System and U.S. Fish and Wildlife Service.

SUMMARY OF EFFECTS

Implementation of the Service's decision would be expected to result in environmental, social and economic effects as outlined in the CCP/EA and summarized here. The CCP describes habitat management, wildlife management, and land conservation objectives that would result in improved habitat conditions. The proposed recreational opportunities would result in enhanced experiences for refuge visitors.

The San Bernard NWR would continue to expand in accordance with the 2012 Land Protection Plan. Lands may be acquired if a willing seller or donor becomes available and acquired through fee title acquisition or conservation easement. Conservation would allow beneficial minor to moderate and long-term effects to air, water, soil and habitats and wildlife.

Refuge management activities (prescribed burning, farming, moist-soil management, invasive species control, new construction, etc.) would result in short- and long-term negligible to moderate, both adverse and beneficial impacts to soils, air, water, habitat, and wildlife as described in the EA; however, the long-term impacts are expected to be beneficial. These habitat management activities would mimic heterogeneous conditions created by the historic fire-grazing interaction and healthy landscape conditions. Alternative B would benefit and improve habitat quality on the refuge's prairie grasslands.

The refuge would increase some public uses and facilities in this alternative. However, any additions to public use opportunities would be small and produce only a minor effect on habitats. New facilities would remain within the already developed footprint so as to prevent habitat loss. Short-term wildlife and habitat disturbance may occur during construction of additional facilities. The public use management actions and associated facilities improvements might have a negative though minor negative impact on habitat at the local scale but would also have a beneficial effect to public use opportunities on the widespread scale. All public use actions help the Complex and the National Wildlife Refuge System meet habitat and wildlife related outreach and education goals at a local to widespread scale. Public use improvements will allow for increased public use due to the growing metropolitan area and improve the quality and management of those opportunities. The increased opportunities for wildlife-related recreational opportunities on the refuge would also have beneficial impacts on the local economy through increased visitation and revenue.

Disturbance to wildlife at some level is an unavoidable consequence of any public use program, regardless of the activity involved. Obviously, some activities innately have the potential to be more disturbing than others. The management actions to be implemented have been carefully planned to avoid high levels of impact. As currently proposed, the known and anticipated levels of disturbance associated with management actions are considered minimal and well within the tolerance levels of known wildlife species and populations present in the area.

Implementing the Service's management action is not expected to have any significant adverse effects on wetlands and floodplains, pursuant to Executive Order 11990 and 11988, because there would be no development of refuge facilities within wetland or floodplain areas. There would be no adverse effect on threatened, endangered, proposed or candidate species and/or critical habitat, as documented in the intra-service Section 7 (Endangered Species) Consultation completed with the Clear Lake Ecological Services Field Office and signed on September 21, 2012. In addition, archeological and/or historical resources would not be impacted.

The Complex considered other past, present, or reasonably foreseeable future planned actions and no significant cumulative impacts would result from the addition of the proposed refuge management actions, as outlined in Alternative B.

PUBLIC OUTREACH, REVIEW AND COMMENT

Development of the Texas Mid-coast NWR Complex CCP has been coordinated with all interested and/or affected parties.

Formal scoping began with publication of a Notice of Intent to prepare a CCP and EA, which was published in the *Federal Register* on June 23, 2009 (Volume 74, Number 119, pp. 29714-29715). When the Notice of Intent was published, the team distributed a Planning Update requesting public feedback and informing community members of upcoming public scoping meetings. The planning team solicited public comments on rRefuge issues to aid in CCP development through three open house meetings held the week of September 14, 2009. Forty-one participants attended these meetings.

The Planning Team held an ecoregion-wide coordination meeting at the Brazoria NWR Discovery Center December 2, 2009, to gain a better understanding of the issues within the Gulf Coast Prairie and Marshes Ecoregion, where the Complex is located, and to determine the Complex's role in addressing issues impacting fish, wildlife, and their habitats within the larger landscape. Seventeen participants attended this meeting.

The Complex also met with the State (TPWD) on February 9, 2010 to solicit feedback on past, present and future management concerns across the Complex.

In preparation for developing a Land Protection Plan for the Austin's Woods Conservation Project, three public meetings were held in January and February, 2012. A total of 30 people attended the public meeting. In addition the local newspaper published two articles about the meetings and comment period. A total of 27 comments were received, 22 supporting the project expansion and five did not.

Comments were solicited on the draft CCP and the EA for the Complex from August 15, 2012 to September 20, 2012. The public was notified of the release of the draft CCP and the EA through the Notice of Availability on August 15, 2012 (77 FR 158, pp. 49011-49015) and again on August 21, 2012 (77, FR 162, pp. 50523-50524), through local media outlets, and public notices were posted at all refuge offices. The draft CCP and EA were made available online, at the Regional Office in Albuquerque, at the Complex headquarters, and at three public libraries in surrounding communities. An open house public meeting was held on August 29, 2012.

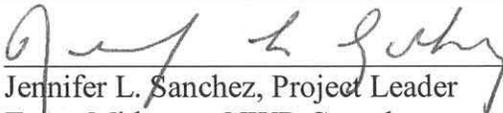
Approximately 10 participants attended that meeting. The Service received four comments (three via emails and one letter). All comments were considered and addressed in Appendix L (Response to Comments) of the CCP.

FINDINGS

Based on the analysis documented in the environmental assessment and with due consideration given to comments from the public and through consultation with the State of Texas, it is my determination that the proposed action does not constitute a major Federal action that will have a significant effect on the quality of the human environment under the meaning of Section 102 (2) (C) of the National Environmental Policy Act of 1969 (as amended). As such, it is my conclusion that an environmental impact statement is not required for this plan and the selected alternative may be implemented as soon as practicable. This determination is based on the following factors (40 C.F.R. 1508.27), as addressed in the attached Environmental Assessment, which is attached.

1. Both beneficial and adverse effects have been considered and this action will not have a significant effect on the environment (Environmental Assessment, pages B-53 – B-98).
2. The actions will not have a significant effect on public health and safety (Environmental Assessment, pages B-78 – B-98).
3. The project will not significantly affect any unique characteristics of the geographic area such as proximity to historical or cultural resources, wild and scenic rivers, or ecologically critical areas (Environmental Assessment, pages B-93 – B-98).
4. The effects on the quality of the human environment are not likely to be highly controversial (Environmental Assessment, pages B-78 – B-98).
5. The actions do not involve highly uncertain, unique, or unknown environmental risks to the human environment (Environmental Assessment, pages B-78 – B-98).
6. The actions do not establish a precedent for future actions with significant effects nor do they represent a decision in principle about a future consideration (Appendix B, Environmental Assessment).
7. There will be no cumulatively significant impacts on the environment. Cumulative impacts have been analyzed with consideration of other similar activities on adjacent lands, in past action, and in foreseeable future actions (Environmental Assessment, pages B-84 – B-92).
8. The actions will not significantly affect any site listed in, or eligible for listing in, the National Register of Historic Places, nor will they cause loss or destruction of significant scientific, cultural, or historic resources (Environmental Assessment, pages B-97).

9. The actions are not likely to adversely affect threatened or endangered species, or their habitats (Environmental Assessment, pages B76 – B-97); Appendix G: Intra-Service Section 7 Consultation).
10. The actions will not lead to a violation of federal, state, or local laws imposed for the protection of the environment (Environmental Assessment, pages B-4 – B-5).

Recommended:  4-12-2013
Jennifer L. Sanchez, Project Leader Date
Texas Mid-coast NWR Complex

Approved:  9/12/13
Dr. Benjamin N. Tuggle, Regional Director Date
U.S. Fish and Wildlife Service, Region 2

SUPPORTING REFERENCES

Fish and Wildlife Service, 2012. Draft Comprehensive Conservation Plan and Environmental Assessment for the Texas Mid-coast National Wildlife Refuge Complex, Brazoria, Fort Bend, Matagorda and Wharton Counties, Texas. U.S. Department of the Interior, Fish and Wildlife Service, Southwest Region.

Fish and Wildlife Service, 2013. Draft Comprehensive Conservation Plan and Environmental Assessment for the Texas Mid-coast National Wildlife Refuge Complex, Brazoria, Fort Bend, Matagorda and Wharton Counties, Texas. U.S. Department of the Interior, Fish and Wildlife Service, Southwest Region.

[This page intentionally left blank.]

Appendix C. Compatibility Determinations

Compatibility determinations are included in this appendix. The following uses were found to be appropriate and evaluated to determine their compatibility with the mission of the Refuge System and the purposes of refuges within the Complex:

- Hunting
- Fishing
- Wildlife Observation
- Wildlife Photograph
- Environmental Education
- Interpretation
- Boating
- Bicycling
- Hiking
- Cooperative Farming
- Cooperative Grazing
- Pesticide Application to Control Mosquito Populations

[This page intentionally left blank]

COMPATIBILITY DETERMINATION

USE: Hunting

REFUGE NAME: Texas Mid-coast National Wildlife Refuge Complex

ESTABLISHING AND ACQUISITION AUTHORITIES:

Texas Mid-coast National Wildlife Refuge Complex (Complex) is comprised of Brazoria, San Bernard, and Big Boggy National Wildlife Refuges (NWRs). Brazoria NWR was established on October 20, 1966, San Bernard NWR was established next on November 7, 1968, and Big Boggy NWR was established on July 8, 1983. All three refuges were created and managed under provisions of the Migratory Bird Conservation Act (16 U.S.C. 712d) and the Refuge Recreation Act (16 U.S.C. 460k-1 and 16 U.S.C. 460k-2). Brazoria and San Bernard NWRs were also established under the Fish and Wildlife Act of 1956 (16 U.S.C. 742(a)(4) and 16 U.S.C. 742(b)(1)).

REFUGE PURPOSE(S):

1. "...for use as an inviolate sanctuary,... for any other management purposes,... for migratory birds." (Migratory Bird Conservation Act [16 U.S.C. 712d])
2. "...for the development, advancement, management, conservation, and protection of fish and wildlife resources..." [16 U.S.C. 742f(a)(4)] and "...for the benefit of the United States Fish and Wildlife Service, in performing its activities and services. Such acceptance may be subject to the terms of any restrictive or affirmative covenant, or condition of servitude..." [16 U.S.C. 742f(b)(1)] (Fish and Wildlife Act of 1956)
3. "...suitable for-(1) incidental fish and wildlife-oriented recreational development, (2) the protection of natural resources, (3) the conservation of endangered species or threatened species..." [16 U.S.C. 460k-1]; "...the Secretary... may accept and use... real... property. Such acceptance may be accomplished under the terms and conditions of restrictive covenants imposed by donor..." [16 U.S.C. 460k-2] (Refuge Recreation Act, as amended [16 U.S.C. 460k – 460k-4]).

NATIONAL WILDLIFE REFUGE SYSTEM MISSION:

The mission of the National Wildlife Refuge System (Refuge System) is to administer a national network of lands and waters for the conservation, management, and where appropriate, restoration of the fish, wildlife, and plant resources and their habitats within the United States for the benefit of present and future generations of Americans.

Description of Use:

(a) What is the use?

Currently, waterfowl hunting is allowed on all three refuges in the Complex. In addition to waterfowl hunting opportunities, the Service cooperates with Texas Parks and Wildlife Department (TPWD) and the Nannie M. Stringfellow Wildlife Management Area (WMA) to provide white-tailed deer/feral hog youth hunts on San Bernard NWR. For these youth hunts, TPWD issues youth hunting permits through a

lottery system, and assigns hunt blinds on the day of the hunt. Permitted hunters and standby hunters are given the opportunity to utilize up to 9 blinds (one youth hunter per blind with one adult) on the refuge, adjacent to the WMA, so that all standby hunters are accommodated and a youth has the opportunity to hunt. TPWD administers the hunt almost completely, with the exception of the Service providing the land base and providing a higher level of regulations regarding hunting methods (e.g., baiting is not allowed). The Service also partners with Texas Youth Hunting Program (TYHP) to provide feral hog hunting opportunities at San Bernard and Brazoria NWRs. Feral Hog hunts normally provide opportunities for 10 youth hunters a weekend, on 4 weekend hunts (2 weekends at each refuge).

(b) Where is the use conducted?

Brazoria NWR has two public waterfowl hunting areas: Christmas Point and Middle Bayou Public Waterfowl Hunt Areas - see Brazoria NWR Hunt Area Map 3-30 of the Comprehensive Conservation Plan (CCP). The Christmas Point Public Waterfowl Hunt Area lies southeast of the Gulf Intracoastal Waterway and encompasses approximately 4,000 acres. Access is by boat only. The Middle Bayou Public Waterfowl Hunt Area encompasses approximately 1,500 acres and access to this site is also by boat or by walk-in from CR227. On these units, hunting of ducks, geese and coots is permitted. Pits and permanent blinds are prohibited.

During the youth feral hog hunts, in partnership with TYHP, youth hunt from temporary blinds located off FM2004, in the Otter Slough Area.

San Bernard NWR has three designated public hunting areas (Cedar Lakes, Smith Marsh, and Salt Bayou Public Waterfowl Hunt Areas) and one permit hunting area (Sargent Permit Waterfowl Hunt Area), illustrated on the San Bernard NWR Hunt Area Map 3-32 of the CCP. All of these public hunting areas are accessible by boat only, and are open for the pursuit of ducks, geese and coots. The Cedar Lakes Public Waterfowl Hunt Area (2,400 acres) lies south of the Gulf Intracoastal Waterway, and the Smith Marsh Public Waterfowl Hunt Area (1,400 acres) is on the west side of Cedar Lakes Creek. Salt Bayou Public Waterfowl Hunt Area encompasses 3,600 acres accessible from Cedar Lakes Creek, the Gulf Intracoastal Waterway, or through the shallow Cowtrap Lakes system. The Sargent Permit Waterfowl Hunt offers a limited hunting opportunity on 4,000 acres with walk-in or boat access.

For the TPWD youth deer/feral hog hunts and the TYHP feral hog hunts, all hunting opportunities are limited to stationary blinds. There are a total of nine stationary blinds in the McNiel/Ducroz/Stringfellow Unit. This bottomland unit is contiguous with the Nannie M. Stringfellow WMA.

Big Boggy NWR has two public hunting areas: the Pelton Lake Public Waterfowl Hunt Area and Matthes Field Public Waterfowl Hunt Area. Pelton Lake encompasses 1,100 acres on the east end of the refuge, whereas the Matthes Field Public Waterfowl Hunt Area is located at the north end of the refuge along Chinquapin Road (see Big

Boggy NWR Hunt Area Map 3-33 of the CCP). This 200-acre area is primarily maintained for goose hunting, but both areas are open for the hunting of ducks, geese, and coots.

(c) When is the use conducted?

On the Complex, the Public Waterfowl Hunt Areas are open during the State Waterfowl seasons. Teal Season is generally scheduled for 9 to 16 days beginning mid September. Regular season generally begins late October through mid-January with one two-week mid-season closure. In addition the Public Waterfowl Hunt Areas across the Complex are open during the Conservation Order Light Goose Season, following regular waterfowl season. Youth hunts on the McNiel/Ducroz/Stringfellow Unit of San Bernard NWR are held three weekends per year; two in October and one in December. Youth hunts led by the TYHP occur at San Bernard and Brazoria NWRs two weekends per year (February/March) at each location.

(d) How is the use conducted?

Hunting on these Public Waterfowl Hunt Areas is managed in accordance with regulation set forth by the State of Texas. Hunters are required to use non-toxic shot. As stated in Goal 4, Strategy 5 under Objective 5 of the CCP, the refuge will promote hunter compliance with Federal and State regulations and encourage good sportsmanship, ethical hunting behavior, and understanding of the refuge and its purposes through law enforcement visibility and effective wording within informational brochures with high-quality maps, signs, and website updates. The refuge will continue to encourage hunting participation of under-represented segments of the public such as disadvantaged youth, persons with disabilities, and women, through various organizations.

In addition, San Bernard NWR permits TPWD to utilize the McNiel/Ducroz/Stringfellow Unit during their youth deer/feral hog hunts three weekends per year. The refuge provides this opportunity to youth hunters enabling standby hunters an additional area to hunt if needed due to standby hunters in excess of permits available on the Stringfellow WMA. No baiting is allowed in association with the hunt on refuge lands. The Service maintains nine hunt blinds on Service property for this cooperative hunt.

As stated above, the Service also partners with TYHP to provide feral hog hunting opportunities at San Bernard and Brazoria NWRs. At San Bernard NWR, TYHP utilizes the same blinds as utilized by TPWD during their youth hunts. A special use permit is issued to TYHP to enable them access to the blinds and for baiting prior to the hunt and during the hunt. At Brazoria NWR, TYHP erects portable blinds within Otter Slough and along ditches on the north side of the refuge. The hunt has been successful over the past three years in removing an average of 35 feral hogs per year from the refuges.

(e) Why is this use being proposed?

Hunting is an existing wildlife-dependent public use occurring on all three refuges within the Complex. Hunting, one of the six priority public uses of national wildlife refuges, is an important wildlife management tool used to control populations of some species that might otherwise exceed the carrying capacity of their habitat and threaten the well-being of other wildlife species or, in some instances, human health and safety. The objective for hunting is to provide safe and high quality hunting opportunities on the Complex. Waterfowl hunting is a traditional use and still very popular outdoor recreational pursuit in the region. Refuges and other public lands along the Texas Gulf Coast play a key role in providing hunting opportunities to the public.

Big game hunting is one management tool used to enhance healthier populations of deer, and decrease feral hog populations, however, throughout the Complex; impacts to the overall populations of these species are minimal.

The guiding principles that the Refuge System uses to manage quality hunting on refuges are: 1) to manage wildlife populations consistent with approved management plans; 2) to promote visitor understanding of and increase visitor appreciation for America's natural resources; 3) to provide opportunities for quality recreational and education experiences; and, 4) to minimize conflicts with visitors participating in other compatible wildlife-dependent recreational activities.

AVAILABILITY OF RESOURCES:

With the exception of the Sargent Permit Hunt, waterfowl hunting is open in accordance with state seasons. The Complex has two full-time Refuge Officers and one dual function officer, who monitor the use for adherence to regulations. Permits for the Sargent Permit Hunt are issued out of the Complex office in October each year. These permits require about 40 hours to process. Although blinds have been maintained in the past, the refuge changed the permit hunt to allow hunters to set up temporary blinds within the hunt zone. The estimated cost for managing waterfowl hunts is \$22,000.

In preparation for the TPWD deer/feral hog hunts, the refuge maintains the access to the nine blinds. During the TPWD deer/feral hog hunts and the TYHP feral hog hunts, the Service provides one individual during orientation to provide information on the refuge and Refuge System. One staff will also be available during the hunt for any issues that arise. Both of these hunts are managed by the partner agency/organization. In addition to the hunting opportunity, youth receive a variety of other opportunities tied to hunting such as learning how to follow a blood trail, making hog sausage, and learning about the refuge and its purpose. The San Bernard NWR provides nine hunt blinds for both of these hunts. Temporary blinds and feeders are provided by the TYHP. The estimated cost for partnering with these organizations and providing youth hunting opportunities is \$3,800.

ANTICIPATED IMPACTS OF THE USE:

Short-term impacts: Providing carefully planned and managed hunting opportunities with restrictions that limit access to specific refuge locations will generally minimize disturbance to wildlife populations, the environment, and non-consumptive users. Direct mortality to hunted species (deer, feral hogs,) would, of course, occur. Some wounding of animals may occur as well. The presence and activity of hunters may cause temporary disturbance to other wildlife in the area, but there are no foreseeable detrimental impacts to these species.

Concerns are primarily centered on the possibility of impacting non-target species that are sensitive to disturbance. Visitor and hunter safety and law enforcement issues are the priority when designing and planning all hunting activities on refuges. Vehicle traffic will increase slightly during the hunting events, and the sound of gun shots will temporarily reduce the serenity for the non-hunting public. Loss of plants from foot traffic is minor, or temporary. Soil and plant disturbance may occur in ingress and egress routes, but will be minor and temporary because of the limited and controlled use associated with the managed hunts.

Long-term impacts: No detrimental long-term impacts from hunting are anticipated as long as wildlife populations are monitored through the refuge biological program or by state officials. When deer populations become over-abundant they can have profound negative impacts on their environment through herbivory thereby directly and indirectly affecting other native plants and wildlife species.

Cumulative Impacts:

There are no anticipated cumulative impacts. Harvest on the refuge would be limited and would fall within the state's population management goals, which are based on the best available science.

All hunts would follow all applicable laws, regulations and policies; including title 50 of the Code of Federal Regulations, the Refuge System Manual, the mission and goals of the Refuge System, and the purposes, goals, and objectives of the Complex. Operating this activity does not hinder the refuge's ability to meet habitat goals, provides for the safety of the area's citizens, and supports several of the primary objectives of the refuge. The EA for the Draft CCP contains a more detailed discussion of the anticipated impacts of hunting on the Complex.

PUBLIC REVIEW AND COMMENT:

This compatibility determination was published and available for public review and comment concurrent with the Draft CCP and EA; the comment period opened August 15 and closed on September 20, 2012. Public notification included a notice in the Federal Register, media announcements, public notices posted throughout the local communities, and a public meeting. One comment specific to hunting was received. The comment suggested that displacement of users by hunting is a long-term and cumulative impact that should be stated and discussed. Displacement of users is not discussed as a long-term or cumulative impact because hunting areas on the Complex are separate from other public use areas. Under the existing hunt program, there is no user conflict. See CCP Appendix L for more information on the Complex's Response to Comments.

DETERMINATION (CHECK ONE BELOW):

Use is Not Compatible

Use is Compatible with Following Stipulations

Stipulations Necessary to Ensure Compatibility:

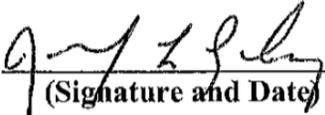
In order to ensure that hunting remains a compatible use on the Complex, the following stipulations are necessary:

1. Big Boggy NWR, Sargent Permit Public Waterfowl Hunt Area on San Bernard NWR, and Middle Bayou Public Waterfowl Hunting Area on Brazoria NWR prohibit the shooting or hunting of all animals except ducks, geese, and coots.
2. Hunters are prohibited from the use of or possession of lead shot, target shooting, target practice, dog training (with or without the use of firearms), and hunting within 500 feet of houses.
3. Hunters utilizing temporary blinds are required to remove decoys and portable blinds daily upon cessation of hunting.
4. Shotguns must be unloaded and cased or broken down when transported in vehicles.
5. Hunters must use nontoxic shot and maintain a safe and courteous distance from other parties.
6. Hunters must carry out their empty shells and trash.
7. The Complex prohibits the use or possession of alcoholic beverages while on refuge lands or waters.
8. In order to protect fragile habitats and wildlife, the Complex prohibits off-road vehicle travel and ATV use on refuge lands.

JUSTIFICATION:

As defined by the National Wildlife Refuge System Improvement Act of 1997, wildlife-dependent recreational uses may be authorized on a refuge when they are compatible and not inconsistent with public safety. Hunting is included as one of these six wildlife-dependent recreational opportunities, which are to receive enhanced and priority consideration in refuge planning and management. Continued hunting opportunities on the Complex will not conflict with any of the other priority public uses, adversely impact biological resources, or detract from refuge goals, objectives, and management activities described in the CCP. Through the compatibility determination process, the Complex has determined that hunting, in accordance with the stipulations provided above, will not materially interfere with or detract from the fulfillment of the Refuge System mission or the purposes of each refuge.

SIGNATURE: Refuge Manager

 4-12-2013
(Signature and Date)

CONCURRENCE: Regional Chief

 9/4/13
(Signature and Date)

MANDATORY 15-YEAR RE-EVALUATION DATE:

2028

COMPATIBILITY DETERMINATION

USE: Fishing

REFUGE NAME: Texas Mid-coast National Wildlife Refuge Complex

ESTABLISHING AND ACQUISITION AUTHORITIES:

Texas Mid-coast National Wildlife Refuge Complex (Complex) is comprised of Brazoria, San Bernard, and Big Boggy National Wildlife Refuges (NWRs). Brazoria NWR was established on October 20, 1966, San Bernard NWR was established next on November 7, 1968, and Big Boggy NWR was established on July 8, 1983. All three refuges were created and managed under provisions of the Migratory Bird Conservation Act (16 U.S.C. 712d) and the Refuge Recreation Act (16 U.S.C. 460k-1 and 16 U.S.C. 460k-2). Brazoria and San Bernard NWRs were also established under the Fish and Wildlife Act of 1956 (16 U.S.C. 742(a)(4) and 16 U.S.C. 742(b)(1)).

REFUGE PURPOSE(S):

1. "...for use as an inviolate sanctuary,... for any other management purposes,... for migratory birds." (Migratory Bird Conservation Act [16 U.S.C. 712d])
2. "...for the development, advancement, management, conservation, and protection of fish and wildlife resources..." [16 U.S.C. 742f(a)(4)] and "...for the benefit of the United States Fish and Wildlife Service, in performing its activities and services. Such acceptance may be subject to the terms of any restrictive or affirmative covenant, or condition of servitude..." [16 U.S.C. 742f(b)(1)] (Fish and Wildlife Act of 1956)
3. "...suitable for- (1) incidental fish and wildlife-oriented recreational development, (2) the protection of natural resources, (3) the conservation of endangered species or threatened species..." [16 U.S.C. 460k-1]; "...the Secretary... may accept and use... real... property. Such acceptance may be accomplished under the terms and conditions of restrictive covenants imposed by donor..." [16 U.S.C. 460k-2] (Refuge Recreation Act, as amended [16 U.S.C. 460k – 460k-4]).

NATIONAL WILDLIFE REFUGE SYSTEM MISSION:

The mission of the National Wildlife Refuge System (Refuge System) is to administer a national network of lands and waters for the conservation, management, and where appropriate, restoration of the fish, wildlife, and plant resources and their habitats within the United States for the benefit of present and future generations of Americans.

DESCRIPTION OF USE:

(a) What is the use?

Fishing is an existing wildlife-dependent public use occurring on all three refuges within the Complex. Fishing is one of the six priority public uses of national wildlife refuges, as specified in the National Wildlife Refuge Improvement Act of 1997. Approximately 35,000 of the 78,000 annual visitors come to the Complex to fish allowing the Complex to provide traditional outdoor activities for families to participate in wildlife recreational opportunities. Anglers are treated to some of the best fishing for redfish, spotted sea

trout, black drum, sheepshead, and flounder in the state of Texas. No commercial fishing or crabbing is allowed on the Complex.

(b) Where is the use conducted?

The Complex provides four public fishing areas, offering a variety of saltwater fishing and crabbing opportunities. All shoreline areas open to fishing are designated by “Public Fishing Area” signs and are shown on public use maps of the Comprehensive Conservation Plan (CCP). Navigable waters open to fishing are by boat access only and users must remain within the tidal margins.

Bastrop Bayou Public Fishing Area and Pier	Cedar Lake Creek Public Fishing Area and Pier	Navigable waters within refuge boundaries
Clay Banks Public Fishing Area	Navigable waters within refuge boundaries	
Salt Lake Public Fishing Area		
Navigable waters within Refuge Boundaries		

Brazoria NWR has three public fishing areas that allow land access to salt water fishing: Bastrop Bayou, Clay Banks, and Salt Lake Public Fishing Areas. Bastrop Bayou Public Fishing Area is universally accessible and offers a 200-foot pier with fish attracting lights, five paved bank fishing pull-offs, a universally accessible toilet, paved parking, and night-lights. The Clay Banks Public Fishing Area offers bank fishing along a one-mile segment of Bastrop Bayou. The Salt Lake Fishing Area offers 1.4 mile of bank fishing and a non-motorized boat ramp.

Navigable waters within the boundaries of the refuge open to fishing are Salt Lake, Nicks Lake, and Lost Lake. State waters including Cox Lake, Alligator Lake, Bastrop Bayou, and bays, adjacent to the Brazoria NWR are open to fishing as well.

San Bernard NWR has one public fishing area that allows land access to Cedar Lake Creek. The Cedar Lake Public Fishing Area offers an accessible 20 foot by 10 foot fishing pier, a fishing trail that offers .4 miles of bank fishing, and a small public boat ramp that gives visitors access to Cedar Lake Creek. Fishing is permitted in navigable waters including Cedar Lake Creek, Cedar Lakes and Cow Trap Lakes within and adjacent to the boundary of the refuge.

On Big Boggy NWR, public fishing is allowed on the navigable waters of Boggy Creek and adjacent State waters.

(c) When is the use conducted?

Fishing is allowed year-round in the designated areas in accordance with applicable State and federal regulations. All public fishing areas are available for use during daylight hours only, with the exception of Bastrop Bayou Public Fishing Area. This particular area is open 24 hours a day, but no overnight camping is permitted.

(d) How is the use conducted?

All fishing must occur in accordance with state fishing regulations, and fishermen are required to have appropriate State fishing licenses. Refuge law enforcement officers patrol Public Fishing Areas to prevent littering and illegal take of fish, while educational efforts have been increased to encourage anglers to collect and discard excess and old fishing line, hooks, and sinkers, since wildlife are known to die after ingesting this debris. The refuge allows the use of cast nets for collecting bait for personal use at public fishing areas. The Brazoria NWR also has picnic tables at the Bastrop Bayou Fishing Area and Salt Lake Fishing Area. Refuge visitors are welcome to use these tables for picnicking, which typically occurs in conjunction with the primary use of fishing.

(e) Why is this use being proposed?

The objective for the fishing program is to provide safe and high-quality fishing opportunities on the Complex, which offers exceptional recreational fishing and crabbing opportunities in a saltwater environment.

Fishing programs promote understanding and appreciation of natural resources and their management on all lands and waters in the Refuge System.

AVAILABILITY OF RESOURCES:

The public fishing areas require routine maintenance in terms of mowing, maintenance or repairs to piers, and replacement of lights at Bastrop Bayou. At Brazoria NWR, trash is collected from trash receptacles on a weekly basis. Port-a can service is required at the Bastrop Bayou Fishing Pier and Salt Lake Public Fishing Area. The majority of routine maintenance is performed by volunteers and youth program hires in the summer. The estimated cost of maintaining these areas is \$5,000. Two full-time and one dual function law enforcement officers patrol the public fishing areas and assist TPWD Game Wardens patrolling navigable waters, ensuring that regulations are being followed and resources protected. Checking fishing areas and users is the single greatest LE activity occurring on the refuges. Approximately, \$55,000 is needed for law enforcement associated with this use. The Complex can sustain the current fishing program at current funding levels.

ANTICIPATED IMPACTS OF THE USED:

Short and Long-term Impacts:

Fishing is consistent with the refuge purpose and mission by providing traditional outdoor pastime that is deeply rooted in America's natural heritage. Fishing on the refuge will have a beneficial effect on goals and objectives identified in the Complex's CCP by providing opportunities for families to participate in a wildlife dependent recreational use.

The affects of fishing and associated boating activities on migratory and shore birds include noise, harassment and displacement. Compaction of vegetation may occur along the shores and along creeks from fisherman accessing fishing points. With the existing mitigation measures disturbances caused by fishing, including associated boating activities is not having an adverse impact on wildlife resources. Shorelines are monitored for erosion. Trash is the single greatest impact on the refuges associated with this use.

Cumulative Impacts:

Fishing on the Complex is not anticipated to have any cumulative negative impacts that will affect life history requirements of any wildlife species. Fish and crab harvest on the refuges would be limited and would fall within the state's population management goals which are based on the best available science. Shoreline fishing is permitted at only four locations (identified above) which limits conflict with other users, habitat degradation and wildlife disturbance. Fish gear, including lead sinkers and monofilament line discarded by fishermen creates trash and can injure or kill wildlife. Law enforcement patrol of fishing area would help to minimize this effect.

All fishing is within all applicable laws, regulations and policies; including title 50 of the Code of Federal Regulations, the Refuge System Manual, the mission and goals of the Refuge System, and the purposes, goals, and objectives of the Complex. Operating this activity does not hinder the refuge's ability to meet habitat goals, provides for the safety of the area's citizens, and supports several of the primary objectives of the refuges.

PUBLIC REVIEW AND COMMENT:

This compatibility determination was published and available for public review and comment concurrent with the Draft CCP and EA; the comment period opened August 15 and closed on September 20, 2012. Public notification included a notice in the Federal Register, media announcements, public notices posted throughout the local communities, and a public meeting. One comment specific to fishing was received. The comment states there are no long-term and cumulative impacts but lead sinkers and monofilament line discarded by fishing creates trash and kills wildlife and are long-term and cumulative impacts that should be stated and discussed. The CD was edited for clarification. See CCP Appendix L for more information on the Complex's Response to Comments.

DETERMINATION (CHECK ONE BELOW):

- Use is Not Compatible
 Use is Compatible with Following Stipulations

STIPULATIONS NECESSARY TO ENSURE COMPATIBILITY:

The following stipulations are required to ensure that fishing remains a compatible use on the Complex:

1. Vehicles may be parked only in designated areas.
2. Access to the three designated Public Fishing Areas where bank fishing is allowed is by foot only.
3. The Complex prohibits off-road vehicle travel and parking.
4. Mud boats use on refuge waters is prohibited to protect fragile habitats and wildlife.

[This page intentionally left blank.]

COMPATIBILITY DETERMINATION

USE: Wildlife Observation

REFUGE NAME: Brazoria National Wildlife Refuge

ESTABLISHING AND ACQUISITION AUTHORITIES:

Brazoria NWR was established next on October 20, 1966, under provisions of the Migratory Bird Conservation Act (16 U.S.C. 712d), the R Recreation Act (16 U.S.C. 460k-1 and 16 U.S.C. 460k-2), and the Fish and Wildlife Act of 1956 (16 U.S.C. 742(a)(4) and 16 U.S.C. 742(b)(1)).

REFUGE PURPOSE(S):

1. "...for use as an inviolate sanctuary,... for any other management purposes,... for migratory birds." (Migratory Bird Conservation Act [16 U.S.C. 712d])
2. "...for the development, advancement, management, conservation, and protection of fish and wildlife resources..." [16 U.S.C. 742f(a)(4)] and "...for the benefit of the United States Fish and Wildlife Service, in performing its activities and services. Such acceptance may be subject to the terms of any restrictive or affirmative covenant, or condition of servitude..." [16 U.S.C. 742f(b)(1)] (Fish and Wildlife Act of 1956)
3. "...suitable for- (1) incidental fish and wildlife-oriented recreational development, (2) the protection of natural resources, (3) the conservation of endangered species or threatened species..." [16 U.S.C. 460k-1]; "...the Secretary... may accept and use... real... property. Such acceptance may be accomplished under the terms and conditions of restrictive covenants imposed by donor..." [16 U.S.C. 460k-2] (Refuge Recreation Act, as amended [16 U.S.C. 460k – 460k-4]).

NATIONAL WILDLIFE REFUGE SYSTEM MISSION:

The mission of the National Wildlife Refuge System (Refuge System) is to administer a national network of lands and waters for the conservation, management, and where appropriate, restoration of the fish, wildlife, and plant resources and their habitats within the United States for the benefit of present and future generations of Americans.

DESCRIPTION OF USE:

(a) What is the use?

Wildlife observation is an existing wildlife-dependent recreational use available on Brazoria NWR. The refuge estimates annual visitation at 35,000 with approximately 16,000 visitors coming to the refuge for wildlife observation opportunities. General public access to observe wildlife and refuge habitats including the means of access such as automobile, hiking, bicycling, boating, canoeing and kayaking. Bird watching continues to be the most popular form of wildlife observation on the refuge, where visitors can see large concentrations of waterfowl, wading birds and neo-tropical songbirds. Other wildlife observation opportunities allow the public to view alligators, raccoons, armadillos, coyotes, bobcats, butterflies, and dragonflies, as well as wildflowers.

(b) Where is the use conducted?

The refuge will continue to emphasize wildlife observation and highlight these opportunities in a variety of strategic locations including: the Big Slough Public Use Area, Otter Slough, Bastrop Bayou and Middle Bayou Trail. On Brazoria NWR, the 7.5-mile gravel auto tour route meanders through the Big Slough Public Use Area, wrapping around Olney and Teal Ponds and accessing Big Slough and Rogers Pond. The tour loop, accessible by foot, bicycle, or automobile, includes boardwalks, observation platforms, vehicle pull-offs, trails, and butterfly gardens, each of which is associated with offering opportunities for wildlife observation. In addition, a remote bird viewing camera is set up at Gator Nest Pond to broadcast video of wildlife to the Discovery Center. The 3-mile paved entrance road from County Road 227 also provides wildlife observation opportunities.

Brazoria NWR also has viewing areas outside the Big Slough Public Use Area. Mottled Duck Marsh, off County Road 208 on the refuge's northern edge, rewards visitors on the lookout for views of waterfowl, wading birds, and shorebirds. The farm fields along County Road 227 and FM 2004 also offer wildlife viewing opportunities from the public roadway. The refuge is proposing to work with Brazoria County and develop pull-offs along the County Roads for visitors to safely view wildlife safely without hampering traffic flow.

(c) When is the use conducted?

Visitors can observe wildlife on Brazoria NWR year-round during daylight hours. As bird watching is the most popular form of wildlife observation across the refuge, most people prefer to visit during the cooler months of November through March when large concentrations of migratory waterfowl are present. The spring and fall bird migrations are also popular for viewing neo-tropical songbirds and shorebirds. The refuge is also known for its easily observed population of alligators, which brings visitors to the refuge throughout the year.

(d) How is the use conducted?

Wildlife observation is conducted with the Service's mission and the refuge's purposes, goals, and objectives as the guiding principles. Visitors are allowed to utilize any of the public use areas for wildlife observation purposes. Occasionally, refuge visitors observing wildlife utilize picnic tables scattered across the refuge. Picnicking, therefore, is an incidental use that supports wildlife observation. Wildlife observation may occur through a variety of modes, including from vehicles and bicycles on refuge public access roads as well as on foot along designated trails and boardwalks.

(e) Why is this use being proposed?

Wildlife observation is an existing priority public use of the Refuge System as identified in the Refuge System Improvement Act of 1997, and receives enhanced consideration over non-priority uses. Wildlife observation activities on Brazoria NWR are designed to promote the purpose of the refuge and support the mission, promote understanding and appreciation of natural and cultural resources, and their management on all lands and waters in the Refuge System.

The objective for wildlife observation is to provide safe, enjoyable, high quality, and accessible opportunities to view wildlife on the refuge. In addition, the program aims to promote visitor understanding for America's natural resources while minimizing conflicts with visitors participating in other compatible wildlife-dependent activities. Almost half of all visitors to the refuges hike a trail, drive the auto tour, or spend a few moments at a wildlife overlook. The refuge provides local, regional, national and international visitors with a wide range of wildlife observation opportunities, supporting a rapidly growing nature tourism industry in coastal Texas.

AVAILABILITY OF RESOURCES:

The refuge only has one full-time public-use staff (Outdoor Recreation Planner). The majority of maintenance in public use areas is completed by volunteers, youth program hires and maintenance staff. Roadways, trails and the yard around the Discovery Center require mowing and weed-eating throughout the growing season. Gravel roads require grading and all observation decks, platforms and shelters require annual maintenance and repairs. Much of the public use area is below 8 feet in elevation and even tropical storms may wash debris up on to the roads, scour gravel, damage piers and platforms and blow down signs. The estimated cost for providing facilities for wildlife observation at Brazoria NWR is \$22,000 annually. To date, annual requirements in time, materials, and supplies needed to manage and ensure the success of this area have been within existing refuge resources.

Public use areas are patrolled regularly by law enforcement staff (2 –FTEs) ensuring protection of refuge resources and public safety.

ANTICIPATED IMPACTS OF THE USE:

Short and Long-term Impacts:

Wildlife observation of one of several wildlife oriented public use opportunities being provided primarily within the Big Slough Public Use Area. Although there is some temporary disturbance to wildlife due to human activity on the land, these short-term impacts are minimal. The most likely impacts will be during migration when wildlife may be easily disturbed because they have not become accustomed to recurring traffic. Visitor access is typically by individuals or small groups for short durations. Destruction or negative impacts to habitat and associated vegetation are minimal because public use is confined to trails, and to state, county, and refuge roads.

These short-term, temporary effects are countered by the opportunity to connect with nature while observing wildlife, which results in stronger environmental stewardship. This is a long-term benefit that impacts the landscape as a whole. The long-term impacts of the public use facilities are minimal, because the facilities are confined to county roads and the Public Use Areas which are utilized for biological monitoring and habitat management as well.

The activities follow all applicable laws, regulations and policies, including: Migratory Bird Conservation Act, Title 50 Code of Federal Regulations, Refuge System Manual, Refuge System goals and objectives, and refuge goals and objectives.

These activities are compliant with the purpose of the refuge and the Refuge System mission. Wildlife observation has a beneficial effect on refuge goals and objectives by striving to enhance

opportunities and quality of visitor experiences on the refuge while instilling an appreciation for the value of and the need for fish and wildlife habitat conservation. Crucial

Cumulative Impacts:

Providing an opportunity for people to observe wildlife and nature is a beneficial long-term environmental impact. Because of the limited opportunity beyond the refuges that provide wildlife observation in a natural setting, cumulative impacts are considered beneficial. Because facilities are utilized by visitors conducting multiple priority recreation uses, the cumulative impacts are minimal. Since impacts are anticipated to be minimal, there will be no negative impacts to the extent that will affect life history requirements of any wildlife species. Wildlife impacts will be carefully monitored in an attempt to identify changes in wildlife behavior and habitat response near observation areas. If impacts are detected, adaptive strategies will be developed to reduce or eliminate impacts to wildlife.

PUBLIC REVIEW AND COMMENT:

This compatibility determination was published and available for public review and comment concurrent with the Draft CCP and EA; the comment period opened August 15 and closed on September 20, 2012. Public notification included a notice in the Federal Register, media announcements, public notices posted throughout the local communities, and a public meeting. No comments specific to this determination were received.

DETERMINATION (CHECK ONE BELOW):

Use is Not Compatible

Use is Compatible with Following Stipulations

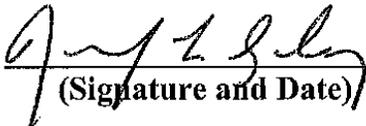
STIPULATIONS NECESSARY TO ENSURE COMPATIBILITY:

To ensure compatibility with Refuge System and Brazoria NWR goals and objectives the activity can only occur under the following stipulations:

1. Use is confined to daylight hours.
2. Camping and campfires are prohibited.
3. To protect fragile habitat and wildlife, the refuge prohibits off-road vehicle travel and parking is not permitted. Wandering off-trail is also prohibited.
4. Harassment of wildlife or excessive damage to vegetation is prohibited.

JUSTIFICATION:

As defined by the National Wildlife Refuge System Improvement Act of 1997, wildlife-dependent recreational uses may be authorized on a refuge when they are compatible and not inconsistent with public safety. Wildlife observation is included as one of these six wildlife-dependent recreational opportunities, which are to receive enhanced and priority consideration in refuge planning and management. Continued wildlife observation on the refuge will not conflict with any of the other priority public uses, adversely impact biological resources, or detract from refuge goals, objectives, and management activities described in the CCP. Through the compatibility determination process, Brazoria NWR has determined that wildlife observation, in accordance with the stipulations provided above, will not materially interfere with or detract from the fulfillment of the Refuge System mission or the purposes of the refuge.

SIGNATURE: Refuge Manager  4-12-2013
(Signature and Date)

CONCURRENCE: Regional Chief  9/4/13
(Signature and Date)

MANDATORY 15-YEAR RE-EVALUATION DATE: 2028

(This page intentionally left blank.)

COMPATIBILITY DETERMINATION

USE: Wildlife Observation

REFUGE NAME: San Bernard National Wildlife Refuge

ESTABLISHING AND ACQUISITION AUTHORITIES:

San Bernard NWR was established next on November 7, 1968, under provisions of the Migratory Bird Conservation Act (16 U.S.C. 712d), the Refuge Recreation Act (16 U.S.C. 460k-1 and 16 U.S.C. 460k-2), and the Fish and Wildlife Act of 1956 (16 U.S.C. 742(a)(4) and 16 U.S.C. 742(b)(1)).

REFUGE PURPOSE(S):

1. "...for use as an inviolate sanctuary,... for any other management purposes,... for migratory birds." (Migratory Bird Conservation Act [16 U.S.C. 712d])
2. "...for the development, advancement, management, conservation, and protection of fish and wildlife resources..." [16 U.S.C. 742f(a)(4)] and "...for the benefit of the United States Fish and Wildlife Service, in performing its activities and services. Such acceptance may be subject to the terms of any restrictive or affirmative covenant, or condition of servitude..." [16 U.S.C. 742f(b)(1)] (Fish and Wildlife Act of 1956)
3. "...suitable for- (1) incidental fish and wildlife-oriented recreational development, (2) the protection of natural resources, (3) the conservation of endangered species or threatened species..." [16 U.S.C. 460k-1]; "...the Secretary... may accept and use... real... property. Such acceptance may be accomplished under the terms and conditions of restrictive covenants imposed by donor..." [16 U.S.C. 460k-2] (Refuge Recreation Act, as amended [16 U.S.C. 460k – 460k-4]).

NATIONAL WILDLIFE REFUGE SYSTEM MISSION:

The mission of the National Wildlife Refuge System (Refuge System) is to administer a national network of lands and waters for the conservation, management, and where appropriate, restoration of the fish, wildlife, and plant resources and their habitats within the United States for the benefit of present and future generations of Americans.

DESCRIPTION OF USE:

(a) What is the use?

Wildlife observation is an existing wildlife-dependent recreational use available on San Bernard NWR. The refuge estimates annual visitation at 35,000 with approximately 16,000 visitors coming to the refuge for wildlife observation opportunities. General public access to observe wildlife and refuge habitats including the means of access such as automobile, hiking, bicycling, boating, canoeing and kayaking. Bird watching continues to be the most popular form of wildlife observation on the refuge, where visitors can see large concentrations of waterfowl and neo-tropical songbirds. Other wildlife observation opportunities allow the public to view alligators, raccoons, armadillos, coyotes, bobcats, butterflies, and dragonflies, as well as wildflowers.

(b) Where is the use conducted?

San Bernard NWR offers wildlife observation and hiking at several locations. The San Bernard auto tour and Moccasin Pond loop provide 9.4 miles of gravel roads with observation platforms, vehicle pullouts, trails, boardwalks, and a butterfly garden. The Cocklebur Slough Road provides opportunities to see wading birds, raptors and passerines as well as resident wildlife in light forest and grassland habitats. Moccasin Pond loop is at the edge where the salty prairie meets the high marsh. From the loop road a variety of fresh and saltwater, open water, marsh and grassland habitats support an array of migratory and resident wildlife. Bicyclists are welcome on all refuge roads that are open to public vehicles. The San Bernard Oak trail which is located .5 mile north of the refuge entrance, along CR 306, provides a .6 mile trail through a mature bottomland forest to the largest live oak in Texas. The trail crosses a slough before reaching the tree which provides excellent opportunity for viewing bottomland wildlife including wood ducks, reptiles and songbirds.

Hudson Woods, located 5 miles west of Angleton, Texas on SH 521 provides 5.9 miles of walking trails through early and mid-succession stage bottomland forest. Walking the trails provides excellent opportunities for viewing winter and migratory songbirds. Two oxbow lakes provide opportunities for viewing waterbirds including anhinga, waterfowl and wading birds. An observation deck at Scoby Lake, the deck on the front of the Discovery Outpost and the photo blind provide excellent opportunities to view wetland wildlife.

Dow Woods is the most recent bottomland forest unit opened to provide wildlife observation opportunities. The unit is located on the north side of the City of Lake Jackson. Currently 2.7 miles of trail are available for wildlife observation through a restoring forest and along the shore of Bastrop Bayou. Native wildlife including deer, armadillo's and raccoons are commonly seen along with migratory songbirds, woodpeckers and owls.

Betty Brown, the smallest unit on San Bernard NWR, has a 3/8 mile loop trail which takes visitors to the shore of the San Bernard River. This mature growth forest provides excellent opportunities to see migratory songbirds as they move inland from the Gulf of Mexico.

(c) When is the use conducted?

Visitors can observe wildlife on San Bernard NWR year-round during daylight hours. As bird watching is the most popular form of wildlife observation across the Complex, most people prefer to visit during the cooler months of November through March when large concentrations of waterfowl are present. The spring and fall bird migrations are also popular for viewing neo-tropical songbirds. The refuge is also known for their easily observed population of alligators.

(d) How is the use conducted?

Wildlife observation is conducted with the Service's mission and the refuges' purposes, goals, and objectives as the guiding principles. Visitors are allowed to utilize any of the

public use areas for wildlife observation purposes. Occasionally, refuge visitors observing wildlife utilize picnic tables at the headquarters, Bobcat Woods or at Hudson Woods. Picnicking, therefore, is an incidental use that supports wildlife observation. Wildlife observation may occur through a variety of modes, including vehicles and bicycles on refuge public access roads as well as on foot at designated trails and boardwalks.

(e) Why is this use being proposed?

Wildlife observation is an existing priority public use of the Refuge System as identified in the Refuge System Improvement Act of 1997, and receives enhanced consideration over non-priority uses. Wildlife observation activities on San Bernard NWR are designed to promote the purpose of the refuge and support the mission, promote understanding and appreciation of natural and cultural resources, and their management on all lands and waters in the Refuge System.

The objective for wildlife observation is to provide safe, enjoyable, high quality, and accessible opportunities on the refuge. In addition, the program aims to promote visitor understanding for America's natural resources while minimizing conflicts with visitors participating in other compatible wildlife-dependent activities. Almost half of all visitors to the refuges hike a trail, drive the auto tour, or spend a few moments at a wildlife overlook. The refuge provides local, regional, national and international visitors with a wide range of wildlife observation opportunities, supporting a rapidly growing nature tourism industry in Texas.

AVAILABILITY OF RESOURCES:

The Complex only has one full-time public-use staff (Outdoor Recreation Planner). The majority of the maintenance of the public use areas is completed by volunteers, youth program hires and maintenance staff. Facilities at Hudson Woods are maintained via a contract. Roadways, trails and the yard around the Discovery Outpost at Hudson Woods all require mowing and weed-eating throughout the growing season. Gravel roads require grading and all observation decks, platforms and shelters require annual maintenance and repairs. Current staff is stretched with trying to maintain all trails and parking areas. For this reason, a contract is issued for work at Hudson Woods, which is 23 miles away from the field headquarters. A contract may be added for maintaining Dow Woods in the future. The estimated cost for providing facilities for wildlife observation at San Bernard NWR is \$35,000 annually. To date, annual requirements in time, materials, and supplies needed to manage and ensure the success of this area have been within existing refuge resources. Trail counters are being installed on trails to better evaluate the use of trails. A sign-in record is being maintained at Hudson Woods.

Public use areas are patrolled regularly by law enforcement staff (2 –FTEs) ensuring protection of refuge resources and public safety.

ANTICIPATED IMPACTS OF THE USE:

Short and Long-term Impacts:

Wildlife observation of one of several wildlife oriented public use opportunities being provided at several public use locations on San Bernard NWR. Although there is some temporary disturbance to wildlife due to human activity on the land, these short-term impacts are minimal. The most likely impacts will be during migration when wildlife may be easily disturbed because they have not become accustomed to repetitive traffic. Visitor access is typically by individuals or small groups for short durations. Destruction or negative impacts to habitat and associated vegetation are minimal because public use is confined to trails, and to state, county, and refuge roads.

These short-term, temporary effects are countered by the opportunity to connect with nature while observing wildlife, which results in stronger environmental stewardship. This is a long-term benefit that impacts the landscape as a whole. The long-term impacts of the public use facilities are minimal, because the facilities are confined to county roads and the Public Use Area which are utilized for biological monitoring and habitat management as well.

The activities follow all applicable laws, regulations and policies, including: Migratory Bird Conservation Act, Title 50 Code of Federal Regulations, Refuge System Manual, Refuge System goals and objectives, and refuge goals and objectives.

These activities are compliant with the purpose of the refuge and the National Wildlife Refuge System Mission. Wildlife observation has a beneficial effect on refuge goals and objectives by striving to enhance opportunities and quality of visitor experiences on the refuge while instilling an appreciation for the value of and the need for fish and wildlife habitat conservation.

Cumulative Impacts:

Providing an opportunity for people to observe wildlife and nature is a beneficial long-term environmental impact. Because of the limited opportunity beyond the refuges that provide wildlife observation in a natural setting, cumulative impacts are considered beneficial. Because facilities are utilized by visitors conducting multiple priority recreation uses, the cumulative impacts are minimal. Since impacts are anticipated to be minimal, there will be no negative impacts to the extent that will affect life history requirements of any wildlife species. Wildlife impacts will be carefully monitored in an attempt to identify changes in wildlife behavior and habitat response near observation areas. If impacts are detected, adaptive strategies will be developed to reduce or eliminate impacts to wildlife.

PUBLIC REVIEW AND COMMENT:

This compatibility determination was published and available for public review and comment concurrent with the Draft CCP and EA; the comment period opened August 15 and closed on September 20, 2012. Public notification included a notice in the Federal Register, media announcements, public notices posted throughout the local communities, and a public meeting. No comments specific to this determination were received.

DETERMINATION (CHECK ONE BELOW):

Use is Not Compatible

Use is Compatible with Following Stipulations

STIPULATIONS NECESSARY TO ENSURE COMPATIBILITY:

To ensure compatibility with National Wildlife Refuge System and San Bernard NWR goals and objectives the activity can only occur under the following stipulations:

1. Use is confined to daylight hours.
2. Camping and campfires are prohibited.
3. To protect fragile habitat and wildlife, the refuge prohibits off-road vehicle travel and parking is not permitted. Wandering off-trail is also prohibited.
4. Harassment of wildlife or excessive damage to vegetation is prohibited.

JUSTIFICATION:

As defined by the National Wildlife Refuge System Improvement Act of 1997, wildlife-dependent recreational uses may be authorized on a refuge when they are compatible and not inconsistent with public safety. Wildlife observation is included as one of these six wildlife-dependent recreational opportunities, which are to receive enhanced and priority consideration in refuge planning and management. Continued wildlife observation on the refuge will not conflict with any of the other priority public uses, adversely impact biological resources, or detract from refuge goals, objectives, and management activities described in the CCP. Through the compatibility determination process, San Bernard NWR has determined that wildlife observation, in accordance with the stipulations provided above, will not materially interfere with or detract from the fulfillment of the Refuge System mission or the purposes of the refuge.

SIGNATURE: Refuge Manager  4-12-2013
(Signature and Date)

CONCURRENCE: Regional Chief  9/4/13
(Signature and Date)

MANDATORY 15-YEAR RE-EVALUATION DATE: 2028

(This page intentionally left blank.)

COMPATIBILITY DETERMINATION

USE: Wildlife Photography

REFUGE NAME: Texas Mid-coast National Wildlife Refuge Complex

ESTABLISHING AND ACQUISITION AUTHORITIES:

Texas Mid-coast National Wildlife Refuge Complex (Complex) is comprised of Brazoria, San Bernard, and Big Boggy National Wildlife Refuges (NWRs). Brazoria NWR was established on October 20, 1966, San Bernard NWR was established next on November 7, 1968, and Big Boggy NWR was established on July 8, 1983. All three refuges were created and managed under provisions of the Migratory Bird Conservation Act (16 U.S.C. 712d) and the Refuge Recreation Act (16 U.S.C. 460k-1 and 16 U.S.C. 460k-2). Brazoria and San Bernard NWRs were also established under the Fish and Wildlife Act of 1956 (16 U.S.C. 742(a)(4) and 16 U.S.C. 742(b)(1)).

REFUGE PURPOSE(S):

1. "...for use as an inviolate sanctuary,... for any other management purposes,... for migratory birds." (Migratory Bird Conservation Act [16 U.S.C. 712d])
2. "...for the development, advancement, management, conservation, and protection of fish and wildlife resources..." [16 U.S.C. 742f(a)(4)] and "...for the benefit of the United States Fish and Wildlife Service, in performing its activities and services. Such acceptance may be subject to the terms of any restrictive or affirmative covenant, or condition of servitude..." [16 U.S.C. 742f(b)(1)] (Fish and Wildlife Act of 1956)
3. "...suitable for- (1) incidental fish and wildlife-oriented recreational development, (2) the protection of natural resources, (3) the conservation of endangered species or threatened species..." [16 U.S.C. 460k-1]; "...the Secretary... may accept and use... real... property. Such acceptance may be accomplished under the terms and conditions of restrictive covenants imposed by donor..." [16 U.S.C. 460k-2] (Refuge Recreation Act, as amended [16 U.S.C. 460k – 460k-4]).

NATIONAL WILDLIFE REFUGE SYSTEM MISSION:

The mission of the National Wildlife Refuge System (Refuge System) is to administer a national network of lands and waters for the conservation, management, and where appropriate, restoration of the fish, wildlife, and plant resources and their habitats within the United States for the benefit of present and future generations of Americans.

DESCRIPTION OF USE:

(a) What is the use?

Wildlife photography is one of the six existing wildlife-dependent recreational uses occurring on Brazoria and San Bernard NWR. Many visitors come to the Complex to observe a variety of wildlife and landscapes that they would not be able to observe without the Complex's presence. Photography is closely linked to wildlife observation as the refuge offers visitors a chance to photograph wildlife in their native habitat. The

Complex estimates annual visitation at 78,000 with approximately 30,000 visitors coming to the Complex for wildlife observation and photography opportunities.

(b) Where is the use conducted?

All Complex public roads will be open to the public for wildlife photography unless specifically closed by the refuge manager. Wildlife photography is primarily facilitated by wildlife observation points across the general public use areas throughout the Complex. These include auto-tour routes, boardwalks, observation platforms, vehicle pullouts, trails, butterfly gardens, access roads, and farm fields. In addition, San Bernard NWR has constructed a photo blind at the Hudson Woods Unit that has enhanced the visitor’s opportunity for a quality wildlife experience while limiting wildlife disturbance with a protected walkway and blind. An additional photo blind is planned for Dow Woods and at Brazoria NWR.

The Complex will continue to emphasize wildlife photography and highlight these opportunities in a variety of locations including:

Brazoria Auto Tour	Middle Bayou Trail
Field Headquarters Entrance Road /Otter Slough	Bastrop Bayou Fishing Areas
Farm Fields	Mottled Duck Marsh
San Bernard Auto Tour and Moccasin Pond	
San Bernard Oak Trail	Hudson Woods Unit
Little Slough Trail (across from Complex Office)	Dow Woods Unit
Betty Brown Unit	

(c) When is the use conducted?

Visitors are welcome to participate in photography opportunities during daylight hours year-round.

(d) How is the use conducted?

The Complex provides local, regional, national, and international visitors with a wide range of photography opportunities, supporting a rapidly growing nature-tourism industry in Texas. Photography of birds, wildlife, wildflowers, and scenery are each very popular. Most of the photography takes place from the window of the visitor’s vehicle, trails, and observation platforms at the Brazoria and San Bernard NWR. A photo contest in conjunction with the Migration Celebration has attracted many new photographers to the refuge Complex.

In addition, Brazoria NWR has added a nature photography activity to the Discovery Environmental Education Program (DEEP). The Friends group funded eleven cameras to

be used for structured and unstructured exploration of nature occurring there. These cameras will also be used for interpretive programs at Migration Celebration.

Through the strategies listed under Objective 3 of the Comprehensive Conservation Plan, the refuge has established a bird feeding station at Discovery Center and manage this station as dynamic exhibits that promote photography among other public uses. In addition, the Complex plans to host children refuge photography contests and display the winning photos in the Complex office or Brazos Mall. Lastly, the Complex will continue to facilitate photography by making cameras and portable photo blinds available for loan to the visiting public.

(e) Why is this use being proposed?

The objective for this use is to provide safe and high quality opportunities for photography on the Complex. Visitors of all ages and abilities have an opportunity to photograph wildlife and habitat resources on the refuges. Photographing wildlife in natural or managed environments fosters a connection between visitors and natural resources. Wildlife photography on the Complex provides opportunities for wildlife enjoyment not commonly available on adjacent private land.

AVAILABILITY OF RESOURCES:

Because photography utilizes the same facilities as wildlife observation, there is no identified additional cost of maintaining these facilities for photography beyond that described under the wildlife observation compatibility determination. Photography was added to the mini-course schedule for DEEP in 2010. Although the majority of the costs of starting the program were handled by the Friends Group, an estimated \$1,000 is required annually for maintaining the program; replacing cameras, flash drives and portable blinds. Costs generally come out of the Public Use Operational budget for the Complex. Expansion of photography opportunities through providing cameras and blinds on loan through special interpretation programs will require additional staff or volunteers to manage this use. The estimated cost for this expansion is \$2500.00 annually. The photography contest, held in association with Migration Celebration, is managed by a Friends Group Member and self sustaining through the entry fees required for the contest. Costs associated with matting and the display of the photographs in the Complex office is paid by the refuge. An estimated \$500.00 is required annually to mount and display quality photographs. To date, the photography mini-course has been well received by students and teachers. The Complex will continue to monitor the success of this and other DEEP courses through teacher feedback. No formal monitoring of photography users is planned.

ANTICIPATED IMPACTS OF THE USE:

Short and Long-term Impacts:

The measurable environmental impacts for photography are expected to be short-term. There is some temporary disturbance to wildlife due to human activity on the land. The most likely impacts will be during spring and early summer when many animals are nesting and brood rearing, and during spring and fall migration. Visitor access is typically by individuals or small groups for short durations. Destruction or negative impacts to habitat and associated vegetation are minimal because public use is confined to trails, and to state, county, and refuge roads.

Reducing the size of the impacted area, combined with sporadic, limited use by the public should prevent unacceptable impacts. Winter activities pose little to no impact on vegetation, and winter disturbance to resident wildlife is temporary and minor.

These short-term, temporary effects are countered by the opportunity photography allows, which results in stronger environmental stewardship long-term which benefits the landscape as a whole.

The activities follow all applicable laws, regulations and policies, including: Migratory Bird Conservation Act, Title 50 Code of Federal Regulations, Refuge System Manual, Refuge System goals and objectives, and refuge goals and objectives.

These activities are compliant with the purposes of the refuges and the Refuge System Mission. Operating this activity does not alter the refuges' ability to meet habitat goals and it helps support several of the primary objectives of the refuges.

Cumulative Impacts:

Wildlife photography opportunities are not anticipated to have any cumulative negative impacts to the extent that will affect life history requirements of any wildlife species. Other public uses such as wildlife observation occur at the same sites used for wildlife photography. Wildlife photography opportunities may increase over time, but it is not anticipated to be significant enough to cause any cumulative impacts. Wildlife impacts will be carefully monitored in an attempt to identify changes in wildlife behavior and habitat response near photography areas. If impacts are detected, adaptive strategies will be developed to reduce or eliminate the impacts on wildlife.

Providing an opportunity for people to photograph wildlife and nature is a beneficial long-term environmental impact. Because of the limited opportunity beyond the refuges that provide photography in a natural setting, cumulative impacts are considered beneficial. Because photographers also participate in other approved recreation uses, the cumulative impacts will be minimal.

PUBLIC REVIEW AND COMMENT:

This compatibility determination was published and available for public review and comment concurrent with the Draft CCP and EA; the comment period opened August 15 and closed on September 20, 2012. Public notification included a notice in the Federal Register, media announcements, public notices posted throughout the local communities, and a public meeting. No comments specific to this determination were received.

DETERMINATION (CHECK ONE BELOW):

Use is Not Compatible

Use is Compatible with Following Stipulations

STIPULATIONS NECESSARY TO ENSURE COMPATIBILITY:

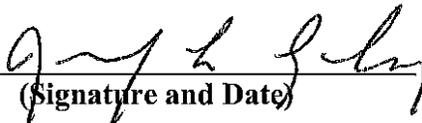
To ensure compatibility with the Refuge System and Complex goals and objectives, photography can only occur under the following stipulations:

1. Use is confined to daylight hours only.

2. Camping and fires are prohibited.
3. No temporary photo blinds may be left on the overnight.
4. Harassment of wildlife or excessive damage to vegetation is prohibited.
5. Photography is restricted to designated public access points and established blinds. To protect fragile habitats and wildlife, off-road vehicle travel and parking is not permitted.
6. Wildlife impacts will be carefully monitored. If impacts are detected, adaptive strategies will be developed, such as temporary closures and limit number o photographers in a given area to reduce wildlife disturbance.

JUSTIFICATION:

As defined by the National Wildlife Refuge System Improvement Act of 1997, wildlife-dependent recreational uses may be authorized on a refuge when they are compatible and not inconsistent with public safety. Photography is included as one of these six wildlife-dependent recreational opportunities, which are to receive enhanced and priority consideration in refuge planning and management. Continued photography opportunities on the Complex will not conflict with any of the other priority public uses, adversely impact biological resources, or detract from refuge goals, objectives, and management activities described in the National Wildlife Refuge System Improvement Act of 1997. Through the compatibility determination process, the Complex has determined that photography, in accordance with the stipulations provided above, will not materially interfere with or detract from the fulfillment of the Refuge System mission or the purposes of the refuges.

SIGNATURE: Refuge Manager  4-12-2013
 (Signature and Date)

CONCURRENCE: Regional Chief  9/4/13
 (Signature and Date)

MANDATORY 15-YEAR RE-EVALUATION DATE: 2028

(This page intentionally left blank.)

COMPATIBILITY DETERMINATION

USE: Environmental Education

REFUGE NAME: Texas Mid-coast National Wildlife Refuge Complex

ESTABLISHING AND ACQUISITION AUTHORITIES:

Texas Mid-coast National Wildlife Refuge Complex (Complex) is comprised of Brazoria, San Bernard, and Big Boggy National Wildlife Refuges (NWRs). Brazoria NWR was established on October 20, 1966, San Bernard NWR was established next on November 7, 1968, and Big Boggy NWR was established on July 8, 1983. All three refuges were created and managed under provisions of the Migratory Bird Conservation Act (16 U.S.C. 712d) and the Refuge Recreation Act (16 U.S.C. 460k-1 and 16 U.S.C. 460k-2). Brazoria and San Bernard NWRs were also established under the Fish and Wildlife Act of 1956 (16 U.S.C. 742(a)(4) and 16 U.S.C. 742(b)(1)).

REFUGE PURPOSE(S):

1. "...for use as an inviolate sanctuary,... for any other management purposes,... for migratory birds." (Migratory Bird Conservation Act [16 U.S.C. 712d])
2. "...for the development, advancement, management, conservation, and protection of fish and wildlife resources..." [16 U.S.C. 742f(a)(4)] and "...for the benefit of the United States Fish and Wildlife Service, in performing its activities and services. Such acceptance may be subject to the terms of any restrictive or affirmative covenant, or condition of servitude..." [16 U.S.C. 742f(b)(1)] (Fish and Wildlife Act of 1956)
3. "...suitable for- (1) incidental fish and wildlife-oriented recreational development, (2) the protection of natural resources, (3) the conservation of endangered species or threatened species..." [16 U.S.C. 460k-1]; "...the Secretary... may accept and use... real... property. Such acceptance may be accomplished under the terms and conditions of restrictive covenants imposed by donor..." [16 U.S.C. 460k-2] (Refuge Recreation Act, as amended [16 U.S.C. 460k – 460k-4]).

NATIONAL WILDLIFE REFUGE SYSTEM MISSION:

The mission of the National Wildlife Refuge System (Refuge System) is to administer a national network of lands and waters for the conservation, management, and where appropriate, restoration of the fish, wildlife, and plant resources and their habitats within the United States for the benefit of present and future generations of Americans.

DESCRIPTION OF USE:

(a) What is the use?

Environmental education is an existing wildlife-dependent recreational use occurring on Brazoria and San Bernard NWRs. The environmental education (EE) program provides safe, accessible, and high quality opportunities for children and adults to learn about the refuge and habitats of the Texas Gulf Coast.

Environmental education at the Complex incorporates on-site, hands-on activities and programs that address the audience's course of study, refuge purpose(s), physical attributes, ecosystem dynamics, conservation strategies, and the Refuge System mission. These programs are conducted on refuge lands by Service staff, volunteers and partner organizations.

The Complex currently provides on-site environmental education programs for local schools ranging from elementary to high school in the surrounding areas and activities for approximately 41 groups per year with a total yearly visitation of approximately 3,200 students to these programs.

On Brazoria NWR, the refuge has been conducting the Discovery Environmental Education Program (DEEP) since 1994. The program there currently serves approximately 3,000 students but the refuge would like to increase the program's capabilities in other school districts.

DEEP has also been functioning at the San Bernard NWR since 2003, serving approximately 500 students with expectations to expand service to 1,000 students.

(b) Where is the use conducted?

On Brazoria NWR, the Discovery Center has been the center of the Complex's active environmental education program since 2005, serving also as a meeting site for refuge staff and the Friends of the Brazoria NWR and a visitor contact station. The building has received high praise from visitors and the classroom/lab, outfitted with stereomicroscopes and a video microscope projector, has become a highlight for visiting students and adults. In addition to the Discovery Center Environmental education programs are conducted at the following refuge trails and facilities:

- Big Slough Trail
- Big Slough Auto Tour
- Crosstrails Kiosk

The San Bernard NWR activities occur primarily at the Hudson Woods Unit, making use of a small cabin (Discovery Outpost), the entrance road, and various trails including:

- Soby Lake
- Live Oak Trail

At Hudson Woods environmental education focuses primarily on freshwater wetlands and bottomland forest ecosystems and wildlife. On average, a single field trip is hosted at the San Bernard Wolfweed Wetland Complex annually. This trip focuses on freshwater marsh, riparian habitat and blue crab ecology. The Comprehensive Conservation Plan includes opportunities to expand the program at San Bernard NWR's Wolfweed Wetlands area and at Dow Woods.

(c) When is the use conducted?

The use is conducted during the school year with on-site activities occurring primarily throughout the spring and fall. The refuge provides winter and summer programs as needed.

(d) How is the use conducted?

Structured, curriculum-based environmental education activities comply with Service policy (605 FW 6), which are aligned with State and national environmental education criteria. Environmental education programs typically involve groups of students of varying ages participating in on-site activities led by staff or docents about the geological, biological, or ecological topics regarding the site. A variety of mini-courses are available that are generally taught outside of the classroom. Standard mini-courses include:

- Bug sweeping in a freshwater wetland
- Microscope lab in the classroom
- Fishing basics
- Reptiles and amphibians
- Wildlife track casting
- Trail Walks
- Refuge tours
- Water and it's characteristics
- Seining in brackish wetlands
- Bats: facts and superstitions
- Wings: how birds fly
- Terrestrial insect sweeping and ID
- blue crab ecology
- nature photography and
- tree identification and growth.

At some sites, students have even been involved with habitat restoration activities.

A partnership exists between the Friends of Brazoria NWR and area school districts to help with the financial impacts of the program expansion. The Complex has a Memorandum of Understanding (MOU) with the Brazosport Independent School District for this program and additional MOUs are expected with other school districts. To help accommodate increases in demand for the program, workshops will be available to train teachers to lead their students through a high quality outdoor experience.

Both refuges also participate in the Wilderness Passport program, and each child receives a passport sticker for two of the eight area ecosystems, included in the passport, they visit on the Complex. This program was developed by Houston Wilderness, a community conservation and outdoor education organization.

Picnicking may occur as an incidental use supportive of the environmental education program. Picnic tables are located outside of the Discovery Center and may be utilized in conjunction with environmental education activities.

(e) Why is this use being proposed?

Environmental education provides a way for people to connect with nature through a hands-on approach and provides educational experiences that are not easily gained in a classroom setting. Texas mandates that a significant percentage of science education be in the form of lab and field investigations, and the refuge program is a perfect fit for these types of field-based experiences. The program meets local and State of Texas education standards, allows professional development for teachers, provides community-based service organization programs, meets youth group merit badge requirements, and instills a sense of stewardship and understanding of conservation issues. The EE program also improves the quality of the visitor's experience and provides them with a better understanding of the benefits, issues, and challenges of natural resource conservation in the coastal ecosystem. The program expansion is proposed to serve additional students, though the expansion is limited by the number of available docents as well as the carrying capacity of the environment. The experiences provided at the Discovery Complex influence the lives of the children and help them to fully appreciate the gift of living on the Texas Coast.

AVAILABILITY OF RESOURCES:

The Complex currently has one part-time employee (1/2 FTE) to manage the environmental education program. The program relies heavily on volunteers, many of which are trained Texas Master Naturalists, for docents and to conduct the actual classes. Other Complex staff assists throughout the year during various field trips when volunteers are not available or providing specialty topics such as fire management. Operation of DEEP requires replacement of EE supplies, including; petri dishes, sweep nets, cameras, flash drives, food for live reptiles, etc. and operation of the Discovery Center. Being off the electrical grid, operations costs are generally associated with replacement of batteries, propane fuel for the back-up generator and facility cleaning and maintenance (including staff salary). Annual expenditures to maintain the current DEEP are estimated at \$65,000. Based on a review of the refuge budget allocated for these activities, there is currently sufficient funding to ensure compatibility and to administer and manage the existing use. Strategies to expand DEEP have been identified and would require hiring a full-time FTE to replace the current part-time position. Expansion of DEEP to additional School Districts including the use of additional venues and full-time FTE will increase the annual costs to \$110,000.

The Complex has an MOU with the Brazosport Independent School District for this program and additional MOUs are expected with other school districts.

The activities follow all applicable laws, regulations and policies, including: Migratory Bird Conservation Act, Title 50 Code of Federal Regulations, Refuge System Manual, Refuge System goals and objectives, and refuge goals and objectives.

These activities are compliant with the purpose of the refuge and the Refuge System Mission. Operating this activity does not alter the refuge's ability to meet habitat goals and it helps support several of the primary objectives of the refuge.

ANTICIPATED IMPACTS OF THE USE:

Short and Long-term Impacts:

Environmental education has a beneficial effect on refuge purposes as well as the mission of the NWRS by developing a refuge based curriculum to meet national and/or State educational standards for 4th and 7th grades. The Complex serves as an information resource and outdoor classroom for post secondary schools throughout the area.

Environmental education has a beneficial effect on refuge goals and objectives by striving to enhance opportunities and the quality of the visitor's experience, allowing program participants to demonstrate learning through refuge-specific stewardship tasks and projects. Environmental education activities strive to promote understanding and appreciation of natural and cultural resource management throughout the Complex.

Most interpretation activities will occur at, or be directed to, existing and future facilities in strategic locations, providing quality opportunities while limiting wildlife and habitat disturbance. These activities are usually predictable in timing (such as daylight hours) and in a given geographical location (such as on a trail). School buses and personal vehicles would utilize developed roads and parking areas to access trails which are already in place. Self-guided interpretation would be sporadic, by small groups of people, and at established trails and kiosks. This may cause short term disturbance as well, but would have minimal impact. In addition, the refuge teaches students the prohibitions on picking wildflowers and removing bird feathers. Students are taught the importance of good wildlife observation techniques, including moving slowly and quietly to produce the least possible disruption to the environment

Potential impacts to wildlife and the environment include short-term disturbance, minor soil compaction on existing trails and vegetative impacts in the immediate vicinity of the activity. During on-site activities, a small number of organisms, like aquatic insects, may be temporarily removed from their habitat for observation, but these organisms are returned and the students are taught the ethic of leaving the refuge in an undisturbed state. Disturbance is typically short-term and will only temporarily displace wildlife. Adequate habitat is usually available for wildlife nearby. Anticipated long-term impacts are beneficial to the refuge, as these activities promote a conservation ethic in the local community. This use would increase in the future the DEEP program expanded to additional school districts with a full-time position with visitor services responsibilities added as proposed in the CCP.

Cumulative Impacts:

Environmental education on the Complex is not anticipated to have any cumulative negative impacts to the extent that will affect life history requirements of any wildlife species. Other public uses such as wildlife observation and photography at the same sites used for environmental education and interpretation may increase over time, but it is not anticipated to be significant enough to cause cumulative impacts. The cumulative impacts of educating the public about conservation issues would be beneficial to meeting the Service mission and refuges purposes. Wildlife impacts will be carefully monitored in an attempt to identify changes in

behavior and habit response near congregation areas. If impacts are detected, adaptive strategies will be developed to reduce or eliminate the impacts to wildlife.

PUBLIC REVIEW AND COMMENT:

This compatibility determination was published and available for public review and comment concurrent with the Draft CCP and EA; the comment period opened August 15 and closed on September 20, 2012. Public notification included a notice in the Federal Register, media announcements, public notices posted throughout the local communities, and a public meeting. No comments specific to this determination were received.

DETERMINATION (CHECK ONE BELOW):

Use is Not Compatible

Use is Compatible with Following Stipulations

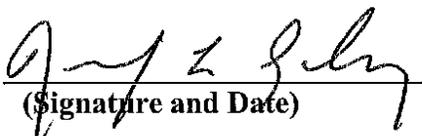
STIPULATIONS NECESSARY TO ENSURE COMPATIBILITY:

The refuges are always involved in facilitating environmental education programs on the Complex in order to ensure compatibility. Special requests for environmental education use of the Complex after-hours must be reviewed by the Refuge Manager.

1. Other than Service programs, any other environmental education activity or program conducted on Service lands will be required to obtain a Special Use Permit. These permits will contain conditions to ensure that impacts are minimized to ensure compatibility. As part of the special use permit application and renewal process, annual evaluations will be conducted to assess if objectives are being met and that the natural resources are not being adversely affected. The refuge will modify or eliminate any use that results in unacceptable impacts to wildlife or any other resources.
2. Environmental education programs will avoid sensitive sites and vulnerable wildlife populations and will be held at or near established facilities so that impacts may be minimized.
3. Evaluations of sites and programs will be conducted periodically to assess if objectives are being met and that natural resources are not being adversely impacted.
4. Wildlife impacts will be carefully monitored. If impacts are detected, adaptive strategies will be developed, such as the creation of approach-zones, or moving program locations and times to reduce wildlife disturbance.

JUSTIFICATION:

Environmental education is an existing priority public use of the Refuge System as identified in the Refuge System Improvement Act of 1997, and receives enhanced consideration over non-priority uses. Environmental education activities on the Complex are designed to promote the purpose of the Refuge and support its mission, promoting understanding and appreciation of natural and cultural resources and their management on all lands and water in the Refuge System. Environmental education programs conducted on the Complex are in accordance with the stipulations above, will not “materially detract from or interfere with” the purposes for which the refuges were established or conflict with any of the other priority public uses. The program also will not adversely impact other biological resources or detract from refuge goals, objectives, and management activities.

SIGNATURE: Refuge Manager  4-12-2013
(Signature and Date)

CONCURRENCE: Regional Chief  9/4/12
(Signature and Date)

MANDATORY 15-YEAR RE-EVALUATION DATE: 2028

(This page intentionally left blank.)

COMPATIBILITY DETERMINATION

USE: Interpretation

REFUGE NAME: Texas Mid-coast National Wildlife Refuge Complex

ESTABLISHING AND ACQUISITION AUTHORITIES:

Texas Mid-coast National Wildlife Refuge Complex (Complex) is comprised of Brazoria, San Bernard, and Big Boggy National Wildlife Refuges (NWRs). Brazoria NWR was established on October 20, 1966, San Bernard NWR was established next on November 7, 1968, and Big Boggy NWR was established on July 8, 1983. All three refuges were created and managed under provisions of the Migratory Bird Conservation Act (16 U.S.C. 712d) and the Refuge Recreation Act (16 U.S.C. 460k-1 and 16 U.S.C. 460k-2). Brazoria and San Bernard NWRs were also established under the Fish and Wildlife Act of 1956 (16 U.S.C. 742(a)(4) and 16 U.S.C. 742(b)(1)).

REFUGE PURPOSE(S):

1. "...for use as an inviolate sanctuary,... for any other management purposes,... for migratory birds." (Migratory Bird Conservation Act [16 U.S.C. 712d])
2. "...for the development, advancement, management, conservation, and protection of fish and wildlife resources..." [16 U.S.C. 742f(a)(4)] and "...for the benefit of the United States Fish and Wildlife Service, in performing its activities and services. Such acceptance may be subject to the terms of any restrictive or affirmative covenant, or condition of servitude..." [16 U.S.C. 742f(b)(1)] (Fish and Wildlife Act of 1956)
3. "...suitable for- (1) incidental fish and wildlife-oriented recreational development, (2) the protection of natural resources, (3) the conservation of endangered species or threatened species..." [16 U.S.C. 460k-1]; "...the Secretary... may accept and use... real... property. Such acceptance may be accomplished under the terms and conditions of restrictive covenants imposed by donor..." [16 U.S.C. 460k-2] (Refuge Recreation Act, as amended [16 U.S.C. 460k – 460k-4]).

NATIONAL AND WILDLIFE REFUGE SYSTEM MISSION:

The mission of the National Wildlife Refuge System (Refuge System) is to administer a national network of lands and waters for the conservation, management, and where appropriate, restoration of the fish, wildlife, and plant resources and their habitats within the United States for the benefit of present and future generations of Americans.

DESCRIPTION OF USE:

(a) What is the use?

Interpretation is an existing wildlife-dependent recreational opportunity occurring on Brazoria and San Bernard NWRs. The refuge communicates the most important fish, wildlife, habitat, and resource issues to visitors of all ages and abilities through effective interpretation. In accordance with Objective 4 of the Comprehensive Conservation Plan, the Complex is proposing to increase the overall effectiveness of the interpretive program

above current levels to ensure that all visitors gain a better understanding of three primary concepts:

1. The value of protecting natural landscapes and the unique purposes of the Complex;
2. The Complex as a component of a national network of refuges, protecting wildlife and habitat resources; and
3. The significance and mission of the Refuge System.

(b) Where is the use conducted?

Opportunities for interpretation occur throughout the Complex. People may encounter interpretive opportunities within any public use areas provided on the Complex including but not limited to the following areas:

On Brazoria NWR, interpretation is conducted at the following locations: the self-guided auto tour route, Discovery Center and associated information pavilion, Bastrop Bayou Fishing Area, Big Slough Trail, and the Teal Pond observation platform. Personal interpretive services include the Discovery Center programs, group presentations, guided talks and tours, and special events. The refuge utilizes open houses to provide unique interpretive opportunities to groups, families, and individuals, through live reptile displays, animal track casting, seining for aquatic insects, and viewing the microscopic world. Hunting and fishing information kiosks are located at the Bastrop Bayou Fishing Area. The Big Slough Trail has a corresponding interpretive trail guide. Teal Pond observation platform has three interpretive panels providing information on migratory waterfowl. The Discovery Center has static and interactive interpretive displays and dioramas. The information pavilion near the Discovery Center has four interpretive panels on recreational opportunities and wildlife specific information and identification. The Brazoria Field Office, located off FM 2004 near Otter Slough, provides a brief welcome and introduction to the refuge via interpretive panels in the lobby.

San Bernard NWR has five interpretive kiosks located at Bobcat Woods, Auto Loop entrance, San Bernard Oak Trail, Hudson Woods, and Dow Woods. Hunting and fishing information kiosks are located at Cedar Lake Creek, Sargent, and Big Boggy NWR. San Bernard NWR Oak Trail and the Tveten Trail at Dow Woods has a corresponding interpretive guide and trail brochure. Bobcat Woods, Hudson Woods, and Dow Woods have interpretive panels along each trail. Cedar lake Creek Paddling Trail also has an interpretive trail guide. San Bernard NWR Office and Screened Shelter both contain interpretive panels to welcome and orient visitors and introduce them to refuge resources.

(c) When is the use conducted?

Visitors are welcome to participate in interpretive programs during daylight hours throughout the year. Interpretive opportunities are available in the form of self-guided tours and interpretive signs along historical structures and trails. Interpretive guided programs are also available throughout the year or as requested by organized groups such as school groups, Boy Scouts, Girl Scouts, etc.

(d) How is the use conducted?

The Complex contains multiple means for refuge visitors to experience the interpretative program through publications, including: brochures, fact sheets, and species lists; signs, interpretive panels, exhibits, guided walks and presentations. Exhibits are accessible and easy to read and understand. They contain audio and tactile elements that can benefit everyone through appealing to multiple paths of learning. The Complex plans to enhance the interpretation program through partnerships with the Texas Master Naturalists and the Friends Group providing additional lectures and guided walks at both Brazoria and San Bernard NWRs.

(e) Why is this use being proposed?

Interpretation enhances opportunities for a high quality visitor experience on each of the three refuges. It also promotes visitor understanding for America's natural resources by providing safe, enjoyable, and accessible interpretive opportunities, products, and facilities. Many visitors do not realize the distinction between national wildlife refuges and a park or Federal or State agency lands that are managed for different purposes. Increased efforts are needed to help people better understand the role of national wildlife refuges, the Service mission, and to have a heightened awareness of conservation and stewardship concepts. Interpretation at the Complex provides opportunities for visitors to make their own connection with refuge resources through talks, publications, brochures, fact sheets, species lists, signs, interpretive panels, and exhibits.

AVAILABILITY OF RESOURCES:

Currently, the primary interpretation is primarily through panels and publications. Over the past three years, many of the brochures and panels were updated and replaced through the efforts of a seasonal intern (.25 FTE) and the outdoor recreation specialist. Approximately 0.5 FTE is required to administer and manage these activities adequately. In addition, maintenance and improvement of refuge interpretive signs, trails, and visitor center displays will periodically be required. The total estimated cost per year is estimated at \$65,000. Based on a review of the refuge budget allocated for these activities, there is currently sufficient funding to ensure compatibility and to administer and manage the existing use. Strategies to expand the interpretive program with additional interpretive activities will require hiring another FTE to capture the potential for this area.

The CCP recommends additional staffing and facilities to expand interpretation. Greater numbers of people would learn about, and benefit from, the refuge with additional staff and interpretative materials. Additional staff would be able to provide additional interpretation programs and develop new or replace existing panels and literature.

ANTICIPATED IMPACTS OF THE USE:

Short and Long-term Impacts:

The overall impacts to the refuges and their associated wildlife populations from interpretation would be minimal. Most interpretive activities will occur at, or be directed to, existing and future facilities in strategic locations, providing quality opportunities while limiting wildlife and habit disturbance. These activities are usually predictable in timing (such as daylight hours) and in a given geographical location (such as on a trail). Potential impacts to wildlife and the environment include short-term disturbance, minor soil compaction on existing trails and vegetative impacts in the immediate vicinity of the activity. Disturbance is typically short-term and should only temporarily displace wildlife. Adequate habitat is usually available for wildlife nearby. Personal vehicles would utilize developed roads and parking areas to access trails that are already in place. Self-guided interpretation would be sporadic, by small groups of people, and at established trails and kiosks. This may cause short-term disturbance as well, but would have minimal impact.

Cumulative Impacts: No cumulative or indirect effects are anticipated to occur as a result of the refuge interpretation program. Evaluations of sites and programs will be conducted periodically to assess if objectives are being met and that natural resources are not being adversely impacted.

Interpretation occurs in conjunction with other wildlife-dependent activities including; wildlife observation, environmental education and photography. Providing an opportunity for people to learn among natural habitats and view native wildlife provides wide-scale beneficial environmental impacts. Although interpretation and associated wildlife-dependent uses may increase over time, it is not anticipated to be significant enough to cause cumulative impacts. The cumulative impacts of educating the public about conservation issues would be beneficial to meeting the Service mission and the refuges purposes.

As the demand for interpretation changes, refuge management will adjust the frequency, time and locations of the programs to minimize impact on wildlife and other resources affected by these programs. Interpretive programs will avoid sensitive sites and vulnerable wildlife populations and will be held at or near established facilities so that impacts may be minimized. Potential wildlife impacts will be carefully monitored. If impacts are detected, adaptive strategies will be developed, such as the creation of approach-zones, or moving program locations and times to reduce wildlife disturbance.

PUBLIC REVIEW AND COMMENT:

This compatibility determination was published and available for public review and comment concurrent with the Draft CCP and EA; the comment period opened August 15 and closed on September 20, 2012. Public notification included a notice in the Federal Register, media announcements, public notices posted throughout the local communities, and a public meeting. No comments specific to this determination were received.

DETERMINATION (CHECK ONE BELOW):

Use is Not Compatible

Use is Compatible with Following Stipulations

STIPULATIONS NECESSARY TO ENSURE COMPATIBILITY:

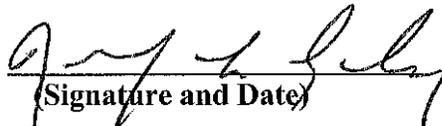
To ensure compatibility with the Refuge System and Complex goals and objectives, photography can only occur under the following stipulations:

1. Use is confined to daylight hours only.
2. Camping and campfires are prohibited.
3. To protect fragile habitat and wildlife, the refuge prohibits off-road vehicle travel and parking is not permitted.
4. Harassment of wildlife or excessive damage to vegetation is prohibited.

JUSTIFICATION:

As defined by the National Wildlife Refuge System Improvement Act of 1997, wildlife-dependent recreational uses may be authorized on a refuge when they are compatible and not inconsistent with public safety. Interpretation is included as one of these six wildlife-dependent recreational opportunities, which are to receive enhanced and priority consideration in refuge planning and management. The continued interpretation program on the Complex will not conflict with any of the other priority public uses, adversely impact biological resources, or detract from goals, objectives, and management activities described in the National Wildlife Refuge System Improvement Act of 1997. In fact, this wildlife-dependent recreational use will serve to enhance visitors' understanding of refuge resources and the role the refuges serve within the Refuge System. Through the compatibility determination process, the Complex has determined that interpretation, in accordance with the stipulations provided above, will not materially interfere with or detract from the fulfillment of the Refuge System mission or the purposes of the refuges.

SIGNATURE: Refuge Manager


(Signature and Date)

4-12-2013

CONCURRENCE: Regional Chief


(Signature and Date)

9/4/13

MANDATORY 15-YEAR RE-EVALUATION DATE: 2028

(This page intentionally left blank.)

COMPATIBILITY DETERMINATION

USE: Boating (Use of small motor boats, canoes, kayaks, and air boats)

REFUGE NAME: Texas Mid-coast National Wildlife Refuge Complex

ESTABLISHING AND ACQUISITION AUTHORITIES:

Texas Mid-coast National Wildlife Refuge Complex (Complex) is comprised of Brazoria, San Bernard, and Big Boggy National Wildlife Refuges (NWRs). Brazoria NWR was established on October 20, 1966, San Bernard NWR was established next on November 7, 1968, and Big Boggy NWR was established on July 8, 1983. All three refuges were created and managed under provisions of the Migratory Bird Conservation Act (16 U.S.C. 712d) and the Refuge Recreation Act (16 U.S.C. 460k-1 and 16 U.S.C. 460k-2). Brazoria and San Bernard NWRs were also established under the Fish and Wildlife Act of 1956 (16 U.S.C. 742(a)(4) and 16 U.S.C. 742(b)(1)).

REFUGE PURPOSE(S):

1. "...for use as an inviolate sanctuary,... for any other management purposes,... for migratory birds." (Migratory Bird Conservation Act [16 U.S.C. 712d])
2. "...for the development, advancement, management, conservation, and protection of fish and wildlife resources..." [16 U.S.C. 742f(a)(4)] and "...for the benefit of the United States Fish and Wildlife Service, in performing its activities and services. Such acceptance may be subject to the terms of any restrictive or affirmative covenant, or condition of servitude..." [16 U.S.C. 742f(b)(1)] (Fish and Wildlife Act of 1956)
3. "...suitable for- (1) incidental fish and wildlife-oriented recreational development, (2) the protection of natural resources, (3) the conservation of endangered species or threatened species..." [16 U.S.C. 460k-1]; "...the Secretary... may accept and use... real... property. Such acceptance may be accomplished under the terms and conditions of restrictive covenants imposed by donor..." [16 U.S.C. 460k-2] (Refuge Recreation Act, as amended [16 U.S.C. 460k – 460k-4]).

NATIONAL WILDLIFE REFUGE SYSTEM MISSION:

The mission of the National Wildlife Refuge System (Refuge System) is to administer a national network of lands and waters for the conservation, management, and where appropriate, restoration of the fish, wildlife, and plant resources and their habitats within the United States for the benefit of present and future generations of Americans.

DESCRIPTION OF USE:

(a) What is the use?

Boating is an existing recreational use occurring on Brazoria, San Bernard, and Big Boggy NWRs. Boating opportunities on the Complex include use of canoes, kayaks, small motor boats, and airboats. Although boating is not identified as one of the six wildlife-dependent recreational uses in the National Wildlife Refuge System Improvement Act of 1997, this activity is directly tied to fishing and hunting and supports wildlife observation, photography, and interpretation. The Complex is proposing to

continue to provide boating opportunities specifically in support of fishing, hunting and wildlife observation. The Complex estimates annual visitation at 78,000 with approximately 32,000 visitors accessing the Complex through boats for wildlife observation, hunting and fishing.

(b) Where is the use conducted?

On Brazoria NWR, boats are permitted on Nicks, Salt, and Lost Lakes by way of the Gulf Intracoastal Waterway (GIWW) or Bastrop Bayou. Brazoria NWR has one non-motorized boat launch for canoes and kayaks at Salt Lake and one at Clay Banks for access into Bastrop Bayou. Other boat launches are located off-refuge, and individuals may access refuge waters through the adjacent bayous, bays, and the Intracoastal Waterway.

At San Bernard NWR, a boat ramp is located on Cedar Lake Creek to provide access for canoes, kayaks, and small motor boats. A second non-motorized boat launch is available further up Cedar Lake Creek, just off CR 318 to encourage wildlife observation from non-motorized boats on Cedar Lake Creek. Navigable waters of Cedar Lakes, Cow Traps, and Salt Bayou are open to boat access. Again, boats may gain access to refuge waters from adjacent bayous, bays, and the GIWW. Boats are allowed on all navigable waters across the Complex.

Navigable waters of Boggy Creek are open for boating on Big Boggy NWR. Access is gained via the Intracoastal Waterway.

(c) When is the use conducted?

Boat launches on Brazoria and San Bernard NWRs are open to the public each day from dawn to dusk. Boating may occur year-round within that time range. As the majority of this use occurs in association with fishing and hunting, boating use is heaviest in the spring and fall during prime fishing seasons.

(d) How is the use conducted?

Refuge visitors are allowed to access waters via refuge boat ramps and by access from adjacent bays, bayous, and the GIWW. The refuges boating opportunities is designed as a means of enabling additional opportunities for wildlife dependent priority public uses such as hunting and fishing (in accordance with state regulations) and wildlife observation and photography. These opportunities enable visitors to fish and observe wildlife, which can instill an appreciation for the value of and need for fish and wildlife habitat conservation.

(e) Why is this use being proposed?

Boating on Brazoria and San Bernard NWRs facilitates fishing, hunting, wildlife observation, photography, and interpretation, each of which is one of the six wildlife-dependent recreational uses described in the National Wildlife Refuge System Improvement Act of 1997. This supportive recreational opportunity will help to establish an enhanced appreciation of the outdoor experience and encourage families and future generations to continue to pursue outdoor recreation

AVAILABILITY OF RESOURCES:

Boating serves primarily as a mode of transportation for Complex visitors to experience hunting, fishing and wildlife observation opportunities. Existing refuge visitor services and law enforcement staff and budget are adequate to administer this use. The Service will not have to provide special equipment or require a significant increase in staff expenditure to continue this use but will need to maintain the current staffing levels. The needed staff, time, and equipment is already largely committed. Approximately \$10,000 is required annually to maintain this use.

ANTICIPATED IMPACTS OF THE USE:

Short and Long-term Impacts:

Boating supports the fishing, hunting and wildlife observation which are all consistent with the refuges' purposes and the mission of the Service, by providing traditional outdoor pastime that is deeply rooted in America's natural heritage. Boating on the refuge will have a beneficial effect on Refuge goals and objectives identified in the Complex's Comprehensive Conservation Plan by providing opportunities for families to participate in the wildlife dependent recreational uses.

The affects of boating activities on migratory and shore birds include noise, harassment and displacement. Within current regulations including the restrictions to navigable waters and closed marsh, boating activities are not anticipated to have an adverse impact on wildlife resources.

Cumulative Impacts:

There are no anticipated cumulative impacts anticipated from the use of boats for fishing, hunting and wildlife observation to the extent that will affect life history requirements of any wildlife species. Any potential wildlife impacts will be carefully monitored in an attempt to reduce or eliminate these impacts on all wildlife.

All wildlife-dependant uses and boating are within all applicable laws, regulations and policies; including title 50 of the Code of Federal Regulations, the Refuge System Manual, the mission and goals of the Refuge System, and the purposes, goals, and objectives of the Complex. Operating this activity does not hinder the refuges' ability to meet habitat goals, provides for the safety of the area's citizens, and supports several of the primary objectives of the refuges.

PUBLIC REVIEW AND COMMENT:

This compatibility determination was published and available for public review and comment concurrent with the Draft CCP and EA; the comment period opened August 15 and closed on September 20, 2012. Public notification included a notice in the Federal Register, media announcements, public notices posted throughout the local communities, and a public meeting. One comment specific to boating was received. The comment states there are no cumulative impacts but noise and visual presence by boating creates disturbance and is a long-term and cumulative impact that should be stated and discussed. FWS lumps airboats with other craft that are much less intrusive and cause less disturbance. Airboats have much greater impacts and should be analyzed separately than small motor boats (which are not defined but should be defined), canoes, and kayaks. Known impacts were discussed and future monitoring will be conducted. The CD was not changed as result of the comment. See CCP

Appendix L for more information on the Complex's Response to Comments.

DETERMINATION (CHECK ONE BELOW):

Use is Not Compatible

Use is Compatible with Following Stipulations

STIPULATIONS NECESSARY TO ENSURE COMPATIBILITY:

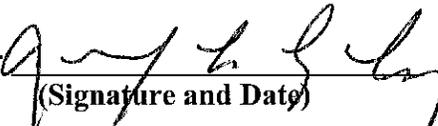
To ensure that boating remains a compatible use, the Complex has developed the following stipulations:

1. Use is confined to daylight hours only.
2. Camping and campfires are prohibited.
3. Boat launching is permitted at designated areas only.
4. The use of mud boats outside of navigable waters is prohibited to protect fragile habitat and wildlife.

JUSTIFICATION:

As defined by the National Wildlife Refuge System Improvement Act of 1997, wildlife-dependent recreational uses are to receive enhanced and priority consideration in refuge planning and management. Boating is consistent with the refuges purposes and the mission of the Refuge System by providing alternative means of transportation to allow the public to enjoy wildlife dependent recreational opportunities such as hunting, fishing, wildlife observation, wildlife photography and interpretation.

Boating will not conflict with any of the other priority public uses, adversely impact biological resources, or detract from refuge goals, objectives, and management activities described in the CCP. Boating in accordance with the above stipulations will enhance the Complex's ability to attract refuge visitors and teach them about the purposes of the refuges and their role in the Refuge System. Through the compatibility determination process, the Complex has determined that boating, as described above, will not materially interfere with or detract from the fulfillment of the Refuge System mission or the purposes of the refuges.

SIGNATURE: Refuge Manager  4-12-2013
(Signature and Date)

CONCURRENCE: Regional Chief  9/4/13
(Signature and Date)

MANDATORY 10-YEAR RE-EVALUATION DATE: 2023

COMPATIBILITY DETERMINATION

USE: Bicycling

REFUGE NAME: Texas Mid-coast National Wildlife Refuge Complex

ESTABLISHING AND ACQUISITION AUTHORITIES:

Texas Mid-coast National Wildlife Refuge Complex (Complex) is comprised of Brazoria, San Bernard, and Big Boggy National Wildlife Refuges (NWRs). Brazoria NWR was established on October 20, 1966, San Bernard NWR was established next on November 7, 1968, and Big Boggy NWR was established on July 8, 1983. All three refuges were created and managed under provisions of the Migratory Bird Conservation Act (16 U.S.C. 712d) and the Refuge Recreation Act (16 U.S.C. 460k-1 and 16 U.S.C. 460k-2). Brazoria and San Bernard NWRs were also established under the Fish and Wildlife Act of 1956 (16 U.S.C. 742(a)(4) and 16 U.S.C. 742(b)(1)).

REFUGE PURPOSE(S):

1. "...for use as an inviolate sanctuary,... for any other management purposes,... for migratory birds." (Migratory Bird Conservation Act [16 U.S.C. 712d])
2. "...for the development, advancement, management, conservation, and protection of fish and wildlife resources..." [16 U.S.C. 742f(a)(4)] and "...for the benefit of the United States Fish and Wildlife Service, in performing its activities and services. Such acceptance may be subject to the terms of any restrictive or affirmative covenant, or condition of servitude..." [16 U.S.C. 742f(b)(1)] (Fish and Wildlife Act of 1956)
3. "...suitable for- (1) incidental fish and wildlife-oriented recreational development, (2) the protection of natural resources, (3) the conservation of endangered species or threatened species..." [16 U.S.C. 460k-1]; "...the Secretary... may accept and use... real... property. Such acceptance may be accomplished under the terms and conditions of restrictive covenants imposed by donor..." [16 U.S.C. 460k-2] (Refuge Recreation Act, as amended [16 U.S.C. 460k – 460k-4]).

NATIONAL WILDLIFE REFUGE SYSTEM MISSION:

The mission of the National Wildlife Refuge System (Refuge System) is to administer a national network of lands and waters for the conservation, management, and where appropriate, restoration of the fish, wildlife, and plant resources and their habitats within the United States for the benefit of present and future generations of Americans.

DESCRIPTION OF USE:

(a) What is the use?

Bicycling is an existing recreational use occurring on all established gravel tour roads, Middle Bayou Trail on Brazoria NWR and trails at the Dow Woods Unit of San Bernard NWR. Although bicycling is not identified as one of the six wildlife-dependent recreational uses in the National Wildlife Refuge System Improvement Act of 1997, this activity serves as a supplemental recreational opportunity that enhances the Complex's offerings for wildlife observation, photography, and interpretation.

(b) Where is the use conducted?

On San Bernard NWR, bicyclists are welcome on the Auto Tour Loop, along with vehicles, within the Public Use Area.

On Dow Woods, a unit of San Bernard NWR, bicycling is permitted on both the Tveten Trail and the Bayou Loop.

On Brazoria NWR, bicycling is permitted on gravel roads, open to vehicles, within the Big Slough Auto Tour. In addition, bicycling is allowed on the Middle Bayou Trail, located near the Fishing Pier on Bastrop Bayou.

(c) When is the use conducted?

Both Brazoria and San Bernard NWRs are open to the public each day from sunrise to sunset. Bicycling may occur during those daytime hours.

(d) How is the use conducted?

Bicyclists are allowed to ride solely along designated refuge trails and public access roads. This use primarily facilitates other wildlife-dependent recreational uses such as wildlife observation, photography and interpretation.

(e) Why is this use being proposed?

Bicycling on Brazoria and San Bernard NWRs facilitates/or generates additional opportunities for wildlife observation, photography, and interpretation, each of which is one of the six wildlife-dependent recreational uses described in the National Wildlife Refuge System Improvement Act of 1997. This supportive recreational opportunity helps to establish an enhanced appreciation of the outdoor experience and encourage families and future generations to continue to pursue outdoor recreation and appreciate the value of wildlife and habitat conservation.

AVAILABILITY OF RESOURCES:

For the management and maintenance of this use in association with the public use roads at San Bernard and Brazoria NWRs, there is no additional cost. Roads are graded and roadways are mowed for all traffic. No additional mowing or maintenance is required for the Middle Bayou Trail at Brazoria NWR. The trail is mowed two to three times annually for all users. The costs associated with bicycling on the Dow Woods Trails, has not been determined. This is a new use on a new type of trail base (recycled granite over crushed concrete laid between garden edging). Additional maintenance may be required on the Bayou Loop, for the first couple of years as the concrete and granite compact. The estimated cost of maintaining the Dow Woods Trails is \$1,200 annually for the first several years and less than \$500 after that.

Additional law enforcement is required at Dow Woods to monitor all public uses, including bicycling to ensure that use is in accordance to published regulations and habitat and wildlife disturbance is minimized. Based on a review of the refuge budget allocated for these activities, there is currently sufficient funding to ensure compatibility and to administer and manage the existing use.

ANTICIPATED IMPACTS OF THE USE:

Short and Long-term Impacts:

Short-term negative impacts from bicycling are similar to those associated with vehicular traffic on roads and hiking along trails, namely associated with disturbance of wildlife. Wildlife disturbances may include flushing, as well as altering wildlife behavior to avoid human presence. The most likely impacts will be during spring and early summer when public use is greatest. Visitor access is typically by individuals or small groups for short durations. The use of the trails and roadways are generally irregular; minimizing impacts to temporarily displaced wildlife.

The long-term negative impacts are the modification of natural habitat to provide public use opportunities. This loss of natural habitat may be minimal, for dirt paths or mowed vegetation paths to moderate; for boardwalks or concrete trails and gravel roads.

Bicycling also has a beneficial effect on refuge goals and objectives by striving to enhance and diversify opportunities and quality of visitor experiences on the refuge. Bicycling can also promote visitor understanding of, and increase appreciation for, America's natural and cultural resources and conservation history. Bicycling provides an opportunity for people to bicycle among natural habitats and view native wildlife, which is a beneficial long-term environmental impact as people are able to connect with nature. This connection fosters environmental stewardship.

The activity follows all applicable laws, regulations and policies, including: Migratory Bird Conservation Act, Title 50 Code of Federal Regulations, National Wildlife Refuge System Manual, National Wildlife Refuge System goals and objectives, and Refuge goals and objectives.

This activity is compliant with the purposes of the refuges and the Refuge System mission. Operating this activity does not alter the refuges' ability to meet habitat goals and it helps support several of the primary objectives of the refuges.

Cumulative Impacts: Bicycling on the Complex is not anticipated to have any cumulative negative impacts to the extent that will affect life history requirements of any wildlife species. Bicycling is a mode for visitors to obtain access to the refuges while participating in other wildlife-dependent activities including; wildlife observation, interpretation, environmental education and photography. Providing an opportunity for people to bicycle among natural habitats and view native wildlife provides wide-scale beneficial environmental impacts as well. Although bicycling and associated wildlife-dependent uses may increase over time, it is not anticipated to be significant enough to cause cumulative impacts. The Complex will regularly evaluate bicycling to assess if objectives are being met and that natural resources are not being adversely impacted by these opportunities. If negative impacts are determined, mitigation measures may include seasonal or short term closures to protect both wildlife and trails.

PUBLIC REVIEW AND COMMENT:

This compatibility determination was published and available for public review and comment concurrent with the Draft CCP and EA; the comment period opened August 15 and closed on September 20, 2012. Public notification included a notice in the Federal Register, media announcements, public notices posted throughout the local communities, and a public meeting.

One comment specific to bicycling was received. The comment states there are no cumulative impacts but rutting, safety, illegal trails, and wildlife disturbance by mountain bikes are long-term and cumulative impacts that should be stated and discussed. Based on the historical light use these potential impacts are not expected to be a concern. This activity could result in some deterioration of the trails from rutting, but regular maintenance will be conducted to ensure that needed repairs are made and the trails are safe for all visitors. As stated above, the Complex will regularly evaluate bicycling to assess if objectives are being met and that natural resources are not being adversely impacted by these opportunities. As stated above, if negative impacts are determined, mitigation measures may include seasonal or short-term closures to protect both wildlife and trails. See CCP Appendix L for more information on the Complex's Response to Comments.

DETERMINATION (CHECK ONE BELOW):

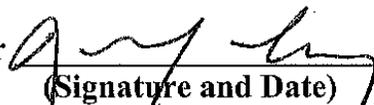
- Use is Not Compatible
 Use is Compatible with Following Stipulations

STIPULATIONS NECESSARY TO ENSURE COMPATIBILITY:

To protect fragile habitats and wildlife, off-road vehicle travel and parking is not permitted. For the same reason, bicycles are allowed only on public access roads and designated trails.

JUSTIFICATION:

As defined by the National Wildlife Refuge System Improvement Act of 1997, wildlife-dependent recreational uses are to receive enhanced and priority consideration in refuge planning and management. The continuation of bicycling at the Complex supports these priority public uses offered on the refuges as this activity supports wildlife observation, photography, and interpretation. This use will not conflict with any of the other priority public uses, adversely impact biological resources, or detract from refuge goals, objectives, and management activities described in the CCP. In fact, bicycling in accordance with the above stipulations will enhance the Complex's ability to attract refuge visitors and teach them about the purpose of the Complex and its role in the National Wildlife Refuge System. Through the compatibility determination process, the Complex has determined that bicycling, as described above, will not materially interfere with or detract from the fulfillment of the Refuge System mission or the purposes of the refuges.

SIGNATURE: Refuge Manager  4-12-2013
(Signature and Date)

CONCURRENCE: Regional Chief  4/4/13
(Signature and Date)

MANDATORY 10-YEAR RE-EVALUATION DATE: 2023

COMPATIBILITY DETERMINATION

USE: Hiking

REFUGE NAME: Texas Mid-coast National Wildlife Refuge Complex

ESTABLISHING AND ACQUISITION AUTHORITIES:

Texas Mid-coast National Wildlife Refuge Complex (Complex) is comprised of Brazoria, San Bernard, and Big Boggy National Wildlife Refuges (NWRs). Brazoria NWR was established on October 20, 1966, San Bernard NWR was established next on November 7, 1968, and Big Boggy NWR was established on July 8, 1983. All three refuges were created and managed under provisions of the Migratory Bird Conservation Act (16 U.S.C. 712d) and the Refuge Recreation Act (16 U.S.C. 460k-1 and 16 U.S.C. 460k-2). Brazoria and San Bernard NWRs were also established under the Fish and Wildlife Act of 1956 (16 U.S.C. 742(a)(4) and 16 U.S.C. 742(b)(1)).

REFUGE PURPOSE(S):

1. "...for use as an inviolate sanctuary,... for any other management purposes,... for migratory birds." (Migratory Bird Conservation Act [16 U.S.C. 712d])
2. "...for the development, advancement, management, conservation, and protection of fish and wildlife resources..." [16 U.S.C. 742f(a)(4)] and "...for the benefit of the United States Fish and Wildlife Service, in performing its activities and services. Such acceptance may be subject to the terms of any restrictive or affirmative covenant, or condition of servitude..." [16 U.S.C. 742f(b)(1)] (Fish and Wildlife Act of 1956)
3. "...suitable for- (1) incidental fish and wildlife-oriented recreational development, (2) the protection of natural resources, (3) the conservation of endangered species or threatened species..." [16 U.S.C. 460k-1]; "...the Secretary... may accept and use... real... property. Such acceptance may be accomplished under the terms and conditions of restrictive covenants imposed by donor..." [16 U.S.C. 460k-2] (Refuge Recreation Act, as amended [16 U.S.C. 460k – 460k-4]).

NATIONAL WILDLIFE REFUGE SYSTEM MISSION:

The mission of the National Wildlife Refuge System (Refuge System) is to administer a national network of lands and waters for the conservation, management, and where appropriate, restoration of the fish, wildlife, and plant resources and their habitats within the United States for the benefit of present and future generations of Americans.

DESCRIPTION OF USE:

(a) What is the use?

Hiking is an existing recreational use occurring at Brazoria and San Bernard NWRs. Hiking serves as a supportive recreational use that enhances the Complex's wildlife-dependent recreation offerings, especially wildlife observation, photography, and interpretation. The refuge estimates annual visitation at 78,000 with approximately 30,000 visitors coming to the refuge for wildlife observation and photography

opportunities with an additional 3,500 attending interpretational and environmental educational opportunities; with many of these activities accessed through hiking.

(b) Where is the use conducted?

Brazoria NWR provides three trails for hikers to use in a variety of settings, leading to a wide variety of habitat experiences. The Big Slough Boardwalk and Trail (0.6 miles) over the slough that provides a close encounter with a marsh crowned with spiky cattail and bulrush. The Big Slough Trail winds through low forests of yaupon and small clearings to an observation platform. The Cox Lake Trail is a short (.5 miles) is located within the Big Slough Public Use Area and takes visitors to the Maddox homesite and the shore of Cox Lake. The Middle Bayou Trail (2 miles) is located along the old abandoned Union Pacific Railroad. The trail traverses salty and coastal prairie habitats.

San Bernard NWR has a total of twelve hiking trails. Cow Trap Marsh Trail (1.2 miles) is a levee trail that traverses high, intermediate, and low marsh zones. Bobcat Woods Trails (1.5 miles) provides an accessible boardwalk and trail that provides exciting wildlife observation opportunities. At the trailhead are restrooms, interpretive displays, tables, and demonstration native garden for hummingbirds and butterflies. The San Bernard Oak Trail (0.7 miles) allows refuge visitors to wander through an old growth stand of live oak, pecan, hackberry, and ash. The Scissortail Trail (0.8 miles) is a loop following forested and brushy habitat along Cocklebur Slough. Cedar Lake Creek Trail is a .20 mile trail following the creek for fishing or hiking opportunities. Little Slough Trail (1.2 miles) located across from the Complex Office offers an opportunity for visitors to walk along a seasonally flooded slough.

Three bottomland units provide hiking opportunities away from the core refuges. Betty Brown Unit, located just north of FM 2611 offers a 3/8th mile loop trail that takes visitors to the shore of the San Bernard River. Hudson Woods Unit, located 5 miles west of Angleton, Texas, on State Highway 521, has three additional hiking trails in early and mid-succession stage bottomland forest. These include the Scoby Lake Trail (1.4 mile loop along Scoby Lake), the Live Oak Trail (1.8 miles that circles the north end of the property), and the Oyster Creek Trail (2.7 mile trail following the Oyster Creek). Dow Woods Unit, located just north of Lake Jackson, Texas, includes the accessible Tveten Trail (0.9 concrete loop) and Bayou Loop (2.3 mile gravel trail).

(c) When is the use conducted?

Public use areas, including the trails on Brazoria and San Bernard NWRs, are open each day from dawn to dusk. Hiking may occur during daytime hours with no seasonal closures, though this use occurs primarily in the spring with some use in the fall and winter.

(d) How is the use conducted?

All manner of pathways are available, from a concrete trail to boardwalks to woodland and bayou mowed trails. None of the trails are especially long, and all are on relatively flat terrain. Wandering off-trail is prohibited, due to habitat disturbance and dangerous wildlife such as alligators and venomous snakes reside in thicker vegetation.

(e) Why is this use being proposed?

Hiking on Brazoria and San Bernard NWRs facilitates fishing, wildlife observation, photography, and interpretation, each of which is one of the six wildlife-dependent recreational uses described in the National Wildlife Refuge System Improvement Act of 1997. The trails provide excellent opportunities for visitors to view waterfowl, wading birds, migratory songbirds, deer, alligators, and other resident and migratory wildlife, while also experiencing the unique coastal ecosystems across the Complex. This supportive recreational opportunity will help to establish an enhanced appreciation of the outdoor experience and encourage families and future generations to continue to pursue outdoor recreation. Additional self-guided brochures or interpretive trails will be developed to expand hiking opportunities as they support wildlife dependent recreational activities. Hiking is usually the preferred method of wildlife observation and increases the potential of observing more elusive bird species not commonly observed on roads.

AVAILABILITY OF RESOURCES:

Trails, including the bottomland trails, require monthly mowing during the growing season. In addition, trimming limbs and picking up fallen limbs is required twice a year. The trails are maintained through a variety of means; contract, volunteers, summer youth programs and maintenance staff. Approximately \$6,000 for San Bernard NWR and \$1,200 for Brazoria NWR are required for annual maintenance of trails and associated parking areas. An estimated 1400 hours, by staff, contractor and volunteers, are spent on trail maintenance across the Complex.

ANTICIPATED IMPACTS OF THE USE:

Short and Long-term Impacts:

Potential impacts to hiking activities include short-term disturbance to wildlife, minor soil compaction on existing trails and vegetative impacts in the immediate vicinity of the activity. Most hiking activities will occur at, or be directed to, existing and future trails and roads in strategic locations, providing quality opportunities while limiting wildlife and habit disturbance. Disturbance is typically short-term and should only temporarily displace wildlife. Adequate habitat and escape cover is usually available for wildlife nearby.

Impacts will be greatest during spring and early summer when use of the trails is greatest. Visitor access is typically by individuals or small groups for short durations. The use of the trails is generally irregular; minimizing impacts to temporarily displaced wildlife.

The long-term negative impacts are the modification of natural habitat to provide public use opportunities. This loss of natural habitat may be minimal, for dirt paths or mowed vegetation paths to moderate; for boardwalks or concrete trails. Hiking has a beneficial effect on refuge goals and objectives by striving to enhance and diversify opportunities and quality of visitor experiences on the refuge, promoting visitor understanding of, and increase appreciation for, America's natural and cultural resources and conservation history by providing safe, informative, enjoyable, and accessible areas of the refuge that would not otherwise be observed or appreciated. Providing an opportunity for people to hike among natural habitats and view native wildlife connects people with nature and fosters environmental stewardship.

The activities follow all applicable laws, regulations and policies, including: Migratory Bird Conservation Act, Title 50 Code of Federal Regulations, Refuge System Manual, National Wildlife Refuge System goals and objectives, and Refuge goals and objectives.

These activities are compliant with the purposes of the refuges and the National Wildlife Refuge System mission. Operating this activity does not alter the refuge's ability to meet habitat goals and it helps support several of the primary objectives of the refuges.

Cumulative Impacts:

There are no anticipated cumulative impacts. Hiking is a mode for visitors to obtain access to the refuges while participating in other wildlife-dependent activities including; wildlife observation, interpretation, environmental education and photography. Providing an opportunity for people to hike among natural habitats and view native wildlife provides wide-scale beneficial environmental impacts as well. Because of the limited opportunity beyond the refuges that provide hiking in a natural setting, the cumulative impacts of the hiking program are beneficial. Although hiking and associated wildlife-dependent uses may increase over time, it is not anticipated to be significant enough to cause cumulative impacts. Evaluations of sites and programs will be conducted periodically to assess if objectives are being met and that natural resources are not being adversely impacted by hiking. The cumulative impacts of educating the public about conservation issues would be beneficial to meeting the Service mission and the refuges purposes.

PUBLIC REVIEW AND COMMENT:

This compatibility determination was published and available for public review and comment concurrent with the Draft CCP and EA; the comment period opened August 15 and closed on September 20, 2012. Public notification included a notice in the Federal Register, media announcements, public notices posted throughout the local communities, and a public meeting. No comments specific to this determination were received.

DETERMINATION (CHECK ONE BELOW):

Use is Not Compatible

Use is Compatible with Following Stipulations

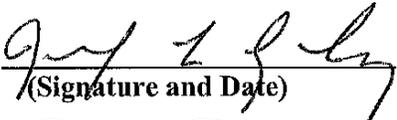
STIPULATIONS NECESSARY TO ENSURE COMPATIBILITY:

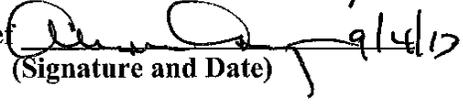
To ensure that hiking remains a compatible use, the Complex has developed the following stipulations:

1. Camping is prohibited.
2. To protect fragile habitats and wildlife, off-road vehicle travel and parking is not permitted. No motorized vehicles are allowed on trails.
3. Wandering off trails is prohibited.
4. Littering is prohibited; hiking is allowed on a "pack it in, pack it out" basis.

JUSTIFICATION:

As defined by the National Wildlife Refuge System Improvement Act of 1997, wildlife-dependent recreational uses are to receive enhanced and priority consideration in refuge planning and management. The continuation of hiking at the Complex supports these priority public uses offered on the refuges as this activity supports wildlife observation, photography, fishing, and interpretation. This use will not conflict with any of the other priority public uses, adversely impact biological resources, or detract from refuge goals, objectives, and management activities described in the Refuge System Improvement Act of 1997. In fact, hiking in accordance with the above stipulations will enhance the Complex’s ability to attract refuge visitors and teach them about the purpose of the Complex and its role in the Refuge System. Through the compatibility determination process, the Complex has determined that hiking, as described above, will not materially interfere with or detract from the fulfillment of the Refuge System mission or the purposes of the refuges.

SIGNATURE: Refuge Manager  4-12-2013
(Signature and Date)

CONCURRENCE: Regional Chief  9/4/13
(Signature and Date)

MANDATORY 10-YEAR RE-EVALUATION DATE: 2023

(This page intentionally left blank.)

COMPATIBILITY DETERMINATION

USE: Cooperative Farming

REFUGE NAME: Brazoria National Wildlife Refuge

ESTABLISHING AND ACQUISITION AUTHORITIES:

Brazoria NWR was established next on October 20, 1966, under provisions of the Migratory Bird Conservation Act (16 U.S.C. 712d), the Refuge Recreation Act (16 U.S.C. 460k-1 and 16 U.S.C. 460k-2), and the Fish and Wildlife Act of 1956 (16 U.S.C. 742(a)(4) and 16 U.S.C. 742(b)(1)).

REFUGE PURPOSE(S):

1. "...for use as an inviolate sanctuary,... for any other management purposes,... for migratory birds." (Migratory Bird Conservation Act [16 U.S.C. 712d])
2. "...for the development, advancement, management, conservation, and protection of fish and wildlife resources..." [16 U.S.C. 742f(a)(4)] and "...for the benefit of the United States Fish and Wildlife Service, in performing its activities and services. Such acceptance may be subject to the terms of any restrictive or affirmative covenant, or condition of servitude..." [16 U.S.C. 742f(b)(1)] (Fish and Wildlife Act of 1956)
3. "...suitable for- (1) incidental fish and wildlife-oriented recreational development, (2) the protection of natural resources, (3) the conservation of endangered species or threatened species..." [16 U.S.C. 460k-1]; "...the Secretary... may accept and use... real... property. Such acceptance may be accomplished under the terms and conditions of restrictive covenants imposed by donor..." [16 U.S.C. 460k-2] (Refuge Recreation Act, as amended [16 U.S.C. 460k – 460k-4]).

NATIONAL WILDLIFE REFUGE SYSTEM MISSION:

The mission of the National Wildlife Refuge System (Refuge System) is to administer a national network of lands and waters for the conservation, management, and where appropriate, restoration of the fish, wildlife, and plant resources and their habitats within the United States for the benefit of present and future generations of Americans.

DESCRIPTION OF USE:

(a) What is the use?

Cooperative farming is an economic use on the Brazoria NWR which is utilized as a management tool to provide habitat for resident and migratory wildlife. The cooperative farming, primarily rice farming occurs on a 3-year rotational basis across up to 1200 acres. Only approximately 1/3 of the total acreage is in production each year, enabling the other acreage to be flooded for moist soil management purposes. Payments by the cooperator may be in the form of water purchase for moist soil units, in-kind services such as mowing or disking fields, or direct payment in addition to a portion of the crop is left in the field for wildlife use.

(b) Where is the use conducted?

The farming acreage is located on the north side of the refuge between Ditch 6 and CR 208, just south of FM2004. The acreage is former coastal prairie that has been in crop production for many years prior to becoming part of the refuge. The area is traversed by several drainage ditches managed by the Brazoria County Drainage District #8. These ditches, along with FM2004, have altered the hydrology throughout this area. Where historically there was sheet surface flow, excess rainfall has been channelized. Although the ditches have altered the natural habitat, the refuge can take advantage of the same ditches by flooding croplands and moist-soil units. Surrounding acreage is managed as coastal prairie where prescribed fire is utilized. Water holding capability has been enhanced where ditch run-off water and excess water from farming is captured creating wet prairies.

(c) When is the use conducted?

Initial entry into the farm units occurs late winter to begin draining flooded units, followed by disking and ground preparation, with planting in March. The units are flooded throughout the growing season (April – June) and drained for harvest in July. Following harvest, the units are re-flooded for a second crop which is harvested in late September/early October. The Service’s portion of the crop, generally comes from this second harvest which can be flooded for a third time, allowing winter waterfowl and waterbirds to utilize the field for food and cover.

(d) How is the use conducted?

A cooperative farming agreement is prepared annually. The agreement identifies which units are to be planted in a given year. Total acreage planted annually is 350 – 400 acres, with fields rotated every three years. In addition, payment including in-lieu services is identified and scheduled.

(e) Why is this use being proposed?

As it has been implemented, cooperative farming is a management tool utilized to provide high energy food for wildlife during the late fall and early winter months. In addition through rotation, fallow units are flooded, providing freshwater wetland habitats during the winter or during periods of severe drought when freshwater resources are critical. One additional benefit of the farming program is the capture of excess water onto the prairies below the farm fields.

AVAILABILITY OF RESOURCES:

Adequate funding and staff are available to manage the cooperative farming program. The cooperative farming program is overseen by the assistant refuge manager. Following preparation of the annual agreement, the assistant manager must stay in contact with the farmer throughout the year ensuring that the agreement is adhered to. On average, less than 2 percent of their time is required to manage the cooperative farming program. Estimated cost for managing the program is \$3500 annually.

ANTICIPATED IMPACTS OF THE USE:

Short and Long-term Impacts:

Farming and associate moist-soil management activities on the refuge are directly related to and support the purposes for which the refuge was established. Cooperative farming results in short-term disturbances and long-term benefits to both resident and migratory wildlife using the refuge. Short-term impacts will include disturbance and displacement of wildlife that is typical of any heavy equipment operation. Positive long-term benefits result in providing food/habitat for migratory and resident wildlife. In 2010, the crops grown on the refuge provide food for a peak population of 800+ mottled ducks, 3,000 snow geese, 10,000+ winter waterfowl, 3000 sandhill cranes, 4000+ shorebirds and 1,000 wading birds.

The activities follow all applicable laws, regulations and policies, including: Migratory Bird Conservation Act, Title 50 Code of Federal Regulations, National Wildlife Refuge System Manual, National Wildlife Refuge System goals and objectives, and Refuge goals and objectives.

These activities are compliant with the purpose of the refuge and the Refuge System mission. Operating this activity does not alter the refuge's ability to meet habitat goals and it helps support several of the primary objectives of the refuge.

Cumulative Impacts:

Farming only occurs on lands that have been previously farmed. The impacts described above are minimal and short-term. The proposed action is not expected to incrementally add to any other state, private, or federal actions that are proposed or currently occurring in the area. The proposal benefits numerous wildlife species and supports hunting, wildlife observation, wildlife photography, environmental education, and interpretation. This activity does not significantly impact other refuge activities or wildlife populations locally or nationwide.

PUBLIC REVIEW AND COMMENT:

This compatibility determination was published and available for public review and comment concurrent with the Draft CCP and EA; the comment period opened August 15 and closed on September 20, 2012. Public notification included a notice in the Federal Register, media announcements, public notices posted throughout the local communities, and a public meeting. One comment specific to farming was received. The comment states that cumulative impacts of farming should be stated and discussed; by farming it not only keeps hundreds of acres from being restored to natural ecosystems but also creates a water pollution problem with fertilizer and pesticide use and costs money which could be used elsewhere to manage natural ecosystems. As stated above, we maintain that there are no cumulative impacts from our small farming program, which only utilized previously farmed areas. The determination was edited to address potential pollution from fertilizer application. See CCP Appendix L for more information on the Complex's Response to Comments.

DETERMINATION (CHECK ONE BELOW):

Use is Not Compatible

Use is Compatible with Following Stipulations

STIPULATIONS NECESSARY TO ENSURE COMPATIBILITY:

Brazoria NWR management will continue periodic monitoring of the vegetative conditions and wildlife populations within the farm field/moist soil units and be aware of changing climatic (e.g. drought, flood) or other conditions which might necessitate changes to the number of farmed acres. If changes should occur, the permittee will be contacted and adjustments to the permit will be made, pursuant to the terms and conditions of the Special Use Permit.

JUSTIFICATION:

The farming program supports the refuge purposes by providing forage and cover for wildlife and by contributing to a diversity of habitat types. The acreage farmed by cooperators greatly reduces the budgetary and manpower requirements that would be needed if the refuge staff farmed all of the cropland independently. Farming, as a management tool to achieve certain vegetative and water level conditions, is recognized in the Service Manual as approved management practices so long as the refuge has control over season and area of use, and the location and extent of farming operations. Cooperative farming on the refuge is consistent with local practices and is accomplished only on land suitable for such management. Refuge croplands supplement natural food sources on the refuge and provide undisturbed areas where wintering waterfowl can forage. The refuge farming program minimizes crop depredation on area lands, thus preventing economic loss to private landowners. Additionally, wildlife viewing opportunities are enhanced through concentrating birds.

SIGNATURE: Refuge Manager *J. L. Goble* 4-12-2013
(Signature and Date)

CONCURRENCE: Regional Chief *[Signature]* 4/14/13
(Signature and Date)

MANDATORY 10-YEAR RE-EVALUATION DATE: 2023

COMPATIBILITY DETERMINATION

USE: Cooperative Grazing Program

REFUGE NAME: Texas Mid-coast National Wildlife Refuge Complex

ESTABLISHING AND ACQUISITION AUTHORITIES:

Texas Mid-coast National Wildlife Refuge Complex (Complex) is comprised of Brazoria, San Bernard, and Big Boggy National Wildlife Refuges (NWRs). Brazoria NWR was established on October 20, 1966, San Bernard NWR was established next on November 7, 1968, and Big Boggy NWR was established on July 8, 1983. All three refuges were created and managed under provisions of the Migratory Bird Conservation Act (16 U.S.C. 712d) and the Refuge Recreation Act (16 U.S.C. 460k-1 and 16 U.S.C. 460k-2). Brazoria and San Bernard NWRs were also established under the Fish and Wildlife Act of 1956 (16 U.S.C. 742(a)(4) and 16 U.S.C. 742(b)(1)).

REFUGE PURPOSE(S):

1. "...for use as an inviolate sanctuary,... for any other management purposes,... for migratory birds." (Migratory Bird Conservation Act [16 U.S.C. 712d])
2. "...for the development, advancement, management, conservation, and protection of fish and wildlife resources..." [16 U.S.C. 742f(a)(4)] and "...for the benefit of the United States Fish and Wildlife Service, in performing its activities and services. Such acceptance may be subject to the terms of any restrictive or affirmative covenant, or condition of servitude..." [16 U.S.C. 742f(b)(1)] (Fish and Wildlife Act of 1956)
3. "...suitable for- (1) incidental fish and wildlife-oriented recreational development, (2) the protection of natural resources, (3) the conservation of endangered species or threatened species..." [16 U.S.C. 460k-1]; "...the Secretary... may accept and use... real... property. Such acceptance may be accomplished under the terms and conditions of restrictive covenants imposed by donor..." [16 U.S.C. 460k-2] (Refuge Recreation Act, as amended [16 U.S.C. 460k – 460k-4]).

NATIONAL WILDLIFE REFUGE SYSTEM MISSION:

The mission of the National Wildlife Refuge System (Refuge System) is to administer a national network of lands and waters for the conservation, management, and where appropriate, restoration of the fish, wildlife, and plant resources and their habitats within the United States for the benefit of present and future generations of Americans.

DESCRIPTION OF USE:

(a) What is the use?

This Compatibility Determination evaluates the use of domestic livestock grazing on selected units of Brazoria and San Bernard NWR as a management tool in order to maintain vital components of waterfowl, endangered species, and other wildlife habitat. Livestock grazing is proposed by the Service under Alternative B (proposed action) of the Draft Comprehensive Conservation Plan (CCP) as an additional management tool that, in conjunction with fire, herbicide and mechanical manipulation, would be utilized

to achieve desired coastal prairie and freshwater management unit conditions to benefit grassland-dependant wildlife.

(b) Where is the use conducted?

A comprehensive livestock management plan will be developed to determine strategic locations to graze livestock, however, grazing may be employed as a management tool in coastal prairie habitats and fresh-water impoundments which would benefit native wildlife including: 1) maintaining of mottled duck nesting habitat; 2) control of invasive species; and 3) manage prairie habitats for Attwater's prairie chicken. Potential locations for implementation include; on Brazoria NWR moist-soil units, farm fields and restored prairie units between Austin Bayou and Ditch 6 and north of Walker Ditch and Haskins Mound, on San Bernard NWR restored prairie units associated with the historic Damon Prairie (Buffalo Creek and Eagle Nest Lake Units).

(c) When is the use conducted?

Timing of grazing will be determined on the development of the livestock management plan that will address season, timing, intensity and duration of each grazing season to meet the management needs of grassland dependent wildlife species throughout the Complex.

(d) How is the use conducted?

Livestock grazing will be conducted based seasonal rotation systems that best meet the habitat management considerations for endangered species, grassland dependent wildlife species, and waterfowl. Stocking rates, season, timing, intensity and duration of all livestock grazing occurring on the Complex will be designed to meet the needs of wildlife. The refuge would administer livestock grazing through issuance of a Special Use Permit (SUP) to a cooperative livestock permittee(s). The SUP would specify the details of the use, including any restrictions.

(e) Why is this use being proposed?

The objective of the livestock grazing program is to provide a management tool to help meet the desirable habitat characteristics (reduce vegetative cover, encourage forbs) that benefit grassland dependent wildlife species that prefer early seral stages. This type of management could make certain areas more attractive to waterfowl, shorebirds, other migratory birds and resident species, including the Attwater's prairie chicken, for which the Complex has been identified as a potential re-introduction site. Grazing on the Complex will be strictly incorporated as a wildlife management tool and no consideration will be given on the basis of economic significance to the Complex or surrounding communities.

Light to moderate grazing, often in combination with prescribed fire, is a generally accepted tool in prairie chicken management for preventing creation of an overly-dense, matted grassland cover situation (Lehmann 1941; Hamerstrom et al. 1957; Chamrad and Dodd 1972; Cogar et al. 1977; Kessler 1978a,b; Jurries 1979; U.S. Fish and Wildlife Service 2010).

AVAILABILITY OF RESOURCES:

Through the issuance of refuge SUPs, this use is a cooperative, commercial program whereby the permittee is leased the grazing rights and the refuge dictates the number of cattle to meet objectives. Direct annual costs to administer this program and facilities are primarily in the form of staff time. It is anticipated that refuge staff will collectively spend approximately 0.25 FTE's (divided between botanist, biologist and manager) and \$25,000 in salary, materials and supplies annually to administer a grazing program. Regular communication with the permittees, rotation and rest planning, boundary and interior fence inspection, vegetation monitoring and wildlife use monitoring are all necessary to gather information and make informed decisions to use this tool.

ANTICIPATED IMPACTS OF THE USE:

Short and Long-Term Impacts:

The refuge does not anticipate short-term or long-term adverse impacts to wildlife species or other resources from the grazing operations as this activity is a management tool which will specifically benefit early succession dependent species. In general, light to moderate grazing results in an increased species richness of both plants and animals (Kantrud and Kologiski 1982, Archer and Smeins 1991). It must be noted however, that while grazing is a viable tool for managing wildlife habitat (Lehmann 1941; Kessler 1978a,b; Ryder 1980; Bryant et al. 1982; Kantrud and Kologiski 1982), not all wildlife species have the same habitat requirements. Therefore, not all species respond similarly to grazing (Phillips 1936, Ryder 1980, Kantrud and Kologiski 1982, Hanley and Page 1982, Clark et al. 1989). Grazing will be implemented in accordance with an approved management plan which will strive to balance the needs of wildlife dependent on more mature prairie grasslands with the needs of early successional grasslands. Grazing, along with fire, will be utilized to proportionally manage for the latter.

Grazing has the potential of producing negative impacts on watershed hydrologic parameters including infiltration, run-off, temperature increase and sedimentation. With light stocking rates and short-term grazing cycles, these potential negative impacts will be minimized through appropriate planning and monitoring.

No adverse socioeconomic impacts are anticipated.

Cumulative Impacts:

There are no anticipated cumulative impacts. Grazing, when implemented would occur in conjunction with other prairie management and restoration techniques. Managing prairie grasslands to provide a diversity species and prairie conditions will benefit a wider array of wildlife and plants. Should grazing be implemented on the Complex as a management tool, the cumulative impacts will be beneficial based on improving habitat characteristics for selective species of wildlife.

PUBLIC REVIEW AND COMMENT:

This compatibility determination was published and available for public review and comment concurrent with the Draft CCP and EA; the comment period opened August 15 and closed on September 20, 2012. Public notification included a notice in the Federal Register, media announcements, public notices posted throughout the local communities, and a public meeting. One comment specific to farming was received. The comment states that cumulative impacts of

grazing should be stated and discussed; livestock grazing results in trampling of vegetation, rutting of soil, and uses up important food sources that could instead be used by wildlife. In addition, the huge amount of organic manure causes water pollution problems. In addition, cattle like to rest in wet or riparian areas, which causes wildlife habitat problems and the potential spread of non-native invasive plant species. The Sierra Club opposes the reintroduction of livestock cattle into the Complex because it is not needed and has not been justified. The Service maintains that sufficient analysis and justification was provided to determine compatibility. Under careful implementation that will include an annual inventory and monitoring of prairie conditions, grazing can be beneficial, increasing diversity, and providing habitat for some species that cannot be sustained in a fire alone management approach. Prior to implementing a grazing program that would utilize only cool season pasture grazing and/or high intensity – short duration grazing to target invasive species, a grazing management plan will be prepared. This plan will identify the goals and objectives for grazing as well as implementation strategies and the specific impacts of this implementation as well as a monitoring program to ensure habitat and wildlife benefits are occurring from this management activity. See CCP Appendix L for more information on the Complex’s Response to Comments.

DETERMINATION (CHECK ONE BELOW):

- Use is Not Compatible
 Use is Compatible with Following Stipulations

STIPULATIONS NECESSARY TO ENSURE COMPATIBILITY:

The following stipulations are required to ensure that grazing remains a compatible use on the Complex:

1. A step down Livestock Management Plan will be developed to determine how grazing will accomplish management objectives on the Complex
2. Grazing activities are strictly used as a management tool to benefit grassland dependent wildlife species, threatened and endangered species and grassland dependent species.
3. The refuges will conduct annual utilization and monitoring techniques to determine if wildlife objectives are being met by the livestock management plan.
4. The Refuge Manager reserves the right to modify all aspects of the livestock management plan to insure wildlife objectives are being met by grazing livestock on the refuge.

JUSTIFICATION:

With the potential of reintroduction of Attwater’s prairie chickens to the mid-coast prairies, grazing should be considered at a viable management tool. Numerous research studies have documented the beneficial impacts of carefully managed grazing on prairie chicken habitat. The approved Attwater’s Prairie Chicken Recovery Plan also reflects the importance of grazing as a tool for management of Attwater’s prairie chicken habitat. Properly managed, grazing provides an alternative prairie management tool that can be beneficial to early seral grassland dependent wildlife species, including mottled ducks, bobwhite quail and some grassland songbirds by prolonging early seral conditions either after habitat manipulating activities or just through active grazing.

The Complex has determined that grazing, in accordance with the stipulations provided above, will not materially interfere with or detract from the fulfillment of the Refuge System mission or the purposes of the refuge. The refuge will continue to monitor this use and adjust the program as necessary to protect and enhance refuge resources. The benefits of the grazing program are expected to outweigh associated impacts.

SIGNATURE: Refuge Manager  4-12-2013
(Signature and Date)

CONCURRENCE: Regional Chief  4/10
(Signature and Date)

MANDATORY 10-YEAR RE-EVALUATION DATE: 2023

(This page intentionally left blank.)

COMPATIBILITY DETERMINATION

USE: Pesticide application to control mosquito populations

REFUGE NAME: Texas Mid-coast National Wildlife Refuge Complex

ESTABLISHING AND ACQUISITION AUTHORITIES:

Texas Mid-coast National Wildlife Refuge Complex (Complex) is comprised of Brazoria, San Bernard, and Big Boggy National Wildlife Refuges (NWRs). Brazoria NWR was established on October 20, 1966, San Bernard NWR was established next on November 7, 1968, and Big Boggy NWR was established on July 8, 1983. All three refuges were created and managed under provisions of the Migratory Bird Conservation Act (16 U.S.C. 712d) and the Refuge Recreation Act (16 U.S.C. 460k-1 and 16 U.S.C. 460k-2). Brazoria and San Bernard NWRs were also established under the Fish and Wildlife Act of 1956 (16 U.S.C. 742(a)(4) and 16 U.S.C. 742(b)(1)).

REFUGE PURPOSE(S):

1. "...for use as an inviolate sanctuary,... for any other management purposes,... for migratory birds." (Migratory Bird Conservation Act [16 U.S.C. 712d])
2. "...for the development, advancement, management, conservation, and protection of fish and wildlife resources..." [16 U.S.C. 742f(a)(4)] and "...for the benefit of the United States Fish and Wildlife Service, in performing its activities and services. Such acceptance may be subject to the terms of any restrictive or affirmative covenant, or condition of servitude..." [16 U.S.C. 742f(b)(1)] (Fish and Wildlife Act of 1956)
3. "...suitable for- (1) incidental fish and wildlife-oriented recreational development, (2) the protection of natural resources, (3) the conservation of endangered species or threatened species..." [16 U.S.C. 460k-1]; "...the Secretary... may accept and use... real... property. Such acceptance may be accomplished under the terms and conditions of restrictive covenants imposed by donor..." [16 U.S.C. 460k-2] (Refuge Recreation Act, as amended [16 U.S.C. 460k – 460k-4].

NATIONAL WILDLIFE REFUGE SYSTEM MISSION:

The mission of the National Wildlife Refuge System (Refuge System) is to administer a national network of lands and waters for the conservation, management, and where appropriate, restoration of the fish, wildlife, and plant resources and their habitats within the United States for the benefit of present and future generations of Americans.

DESCRIPTION OF USE:

(a) What is the use?

In accordance with Service policy, enable Mosquito Control District(s) to apply pesticides for the control of adult mosquitoes over specified areas of the refuges that are adjacent to human populations. Mosquitoes breed in the high salt marsh and migrate inland to brush or forest cover. Spraying is in the public interest, mostly to alleviate severe nuisance to the citizens of Brazoria County but these have the potential of carrying diseases which can infect both human and wildlife populations.

The following mosquito species can be found breeding in the saltmarsh environment on the refuges; the first two of which are the main pests:

Aedes sollicitans – a vector of eastern equine encephalitis and the primary pest, receiving more than half of the control effort. (Note: western equine encephalitis occurs in Texas in western portions)

A. taeniorhynchus – primarily a pest to people.

A. albopictus – a vector of dengue fever (relatively new in the United States)

Psorophora columbiae – primarily a pest to people

West Nile Virus was confirmed in Texas in July 2002. That year, Harris County had several hundred confirmed cases of West Nile in humans. In 2010, although Brazoria County did not have any documented cases of West Nile Virus, Houston and surrounding counties documented 28 cases among the human population and 269 infected mosquitoes (diseasemaps.USGS.gov/wnv). The primary carrier of West Nile has been identified as *Culex spp.* These species breed in fresh water ponds and potholes which can be found on in the wet prairie during periods of high rainfall. These mosquitos are single egg layers, found in generally low numbers and should not be a driving force in implementing a mosquito control program on the refuges.

In Texas, cases of Saint Louis encephalitis (SLE) have averaged about 17 per year, and statewide, SLE caused 27 deaths in 1964, two in 1980 and six in 1986. The local history in State Health Department records indicated four past human cases of SLE from Brazoria County: in 1980, one case each in Freeport and Brazoria; in 1982 one in Freeport. No cases were reported in 2010.

In 2010, six out of 19 documented cases of imported dengue fever in Texas occurred in the Greater Houston area.

Species *A. sollicitans* and *A. taeniorhynchus* are the primary nuisance mosquitos. They lay their eggs in large groups and their eggs may lay in the salt marsh for months without hatching until conditions are right.

(b) Where is the use conducted?

Specific locations would be identified in the Mosquito Control Plan. Locations would generally be areas of the refuge in proximity of human populations including the DemiJohn area, lower San Bernard River (River's End). In the past, the spray areas totaled 996 acres, which comprises only a relatively small portion of the refuges – about two percent. About four percent of the uplands are sprayed: on Brazoria NWR 593 acres are sprayed out of 14,051 acres of upland and on San Bernard NWR 403 acres are sprayed out of 2,220 acres of upland. Malathion nor Dibrom may not be sprayed over water.

The Complex will coordinate with the Mosquito Control district to ensure they are aware of Service lands (bottomlands) near inland communities and restrain from spraying these area unless a serious health concern is identified.

(c) When is the use conducted?

The need for daily spraying is determined through the use of “Landing Rate Counts” by the District; an observer counts the number of mosquitoes landing per minute on the observer’s thigh and on those sites which had a “threshold” count of 5 or more spraying is then completed. Although spraying could occur at any time during the year, it is most likely to occur during late spring and fall when high tides have brought water up and into the upper salt marshes. Spraying is generally conducted during morning hours when the winds are light.

(d) How is the use conducted?

Spraying would be conducted the Mosquito Control District through aerial application. This compatibility review is on ultra-low volume (ULV) aeriially-applied Malathion or Dibrom for use on selected small upland portions of the refuges for control of adult mosquitoes.

(e) Why is this use being proposed?

The Service allows pesticide treatments for mosquito population control on Refuge System lands when local, current mosquito population monitoring data have been collected and indicate that refuge-based mosquito populations are contributing to a human or wildlife health threat. The data from New Jersey Traps at locations near DemiJohn and the San Bernard NWR headquarters show periods of time where within 24 hours, collections in excess of 500 occurred regularly throughout the year.

AVAILABILITY OF RESOURCES:

Adequate staff and funding are available to manage this program, which involves issuance of a Special Use Permit (SUP) to the Mosquito District for mosquito control. The cost is minimal. Primary cost associated with this permit will be annual review of permitted and conditions which warrant control, preparation and reporting on Pesticide Use Proposal and field monitoring. Direct annual costs to administer this program, including staff time is less than \$5,000 annually.

ANTICIPATED IMPACTS OF THE USE:

Short and Long-Term Impacts:

An Environmental Assessment completed in 1994 on this proposed activity discusses the effects of spraying Malathion on refuge lands. In addition the Services’ Report, Environmental Effects of Mosquito Control, discusses the ecological role of mosquitoes and the effects of various control agents of mosquitoes and non-target species.

Malathion and Dibrom are organophosphate adulticides. Several pyrethroids including, permethrin, resmethrin and sumithrin. The pyrethroids are usually combined with the synergist piperonyl butoxide, which interferes with an insect’s detoxifying mechanisms. None of these pesticides is persistent in the environment. Currently, Dibrom is being used to spray over communities and lands surrounding the refuges by the Mosquito Control District.

All adulticides are very highly toxic to aquatic invertebrates in concentration < 1 ppb (Milam al. 2000). However unlike other adulticides, Malathion and Dibrom application over water is restricted by the label and is not proposed by the refuges.

Like other aquatic insects with terrestrial adult stages, mosquitoes provide a link between aquatic and terrestrial ecosystems as they convert detritus and aquatic microbial biomass into flying insect biomass. Most adult mosquitoes are relatively short-lived. The probability of daily survival for adult mosquitoes, an important factor in disease transmission varies among species and habitats. Daily survival probabilities usually range from 0.6-0.9, with much of the mortality coming from predation (USFWS 1993). Mosquitoes are fed upon by a variety of invertebrates predators, including spiders (Strickman et al. 1997; Fox 1998) and odonates (Sukhacheva 1996), although there are no known specialist predators that prey exclusively on mosquitoes. Vertebrate predators include insectivorous birds and bats (Zinn and Humphrey 1981), although mosquitoes often account for only a small percentage of the total biomass consumed. Consumption of mosquitoes by the Indiana bat (*Myotis sodalist*), for example, accounted for up to 6.6 percent of the total diet (Kurta and Whitaker 1998). The apparent absence of any specialized predator-prey relationships among adult mosquitoes and predators however, does not necessarily discount the contribution of mosquitoes to the diet of a wide variety of generalized predators.

The impact of reducing the density of mosquitoes in aquatic and terrestrial systems has not been studied. General predators probably switch to alternate prey, which in turn may be impacted by the increased predation. The few specialist predators of mosquito larvae may be impacted the greatest due to the lack of alternate prey and/or the inability of such predators to uncouple from a closely evolved predator-prey relationship.

None of the adulticides identified above are known to directly impact birds. Nesting birds are not expected to be impacted. The black-shouldered and swallow-tailed kites, white-tailed hawk and northern harrier infrequently nest on the refuges. The American kestrel occurs in migration. Although some insect prey of some bird species will be affected, only a small percentage of the habitat will be impacted and alternate feeding sites are available. No significant impacts are expected

Threatened and endangered species that occur on the refuge (piping plover) and Category 2 species including black rail, Henslow's sparrow, and southeastern snowy plover), and State-listed species (wood stork, swallow-tailed kite, reddish egret and white-tailed hawk) that occur, are not expected to be within spray areas. A Section 7 consultation, dated 1994, has been completed.

Most passerine birds such as warblers are insectivorous. Nesting occurs from March to August. Found nesting in the salty prairie grassland community are eastern meadowlarks, red-winged blackbirds, boat-tailed grackles and sea-side sparrows. The coastal prairie is used during the winter by migrant mourning doves, painted buntings, dickcissels, eastern meadowlarks eastern kingbirds and scissor-tailed flycatchers. Bobwhite quail and great-tailed grackles are nesters.

No significant impacts are expected on these species because alternate sites to the small portions of sprayed habitat are available.

The Service places special emphasis on protection of neo-tropical migratory bird species such as the orioles, tanagers, hummingbirds, wood warblers, vireos, flycatchers, etc., several of which are insectivorous. These birds “fall out” of northward migration during passage of cold fronts along the Gulf coast in May, using coastal woodlands. These sites are not sprayed.

The principle purpose for the refuges is waterfowl maintenance. Common waterfowl species on the refuges include the snow goose, American wigeon, green-winged and blue-winged teal, gadwall, northern pintail and northern shoveler. The mottled duck is a year round resident and a nesting species. With their increased nutritional requirements, breeding female ducks and mottled duck broods are extremely dependent on invertebrate foods. Since wetlands should not receive spray, the waterfowl invertebrate foods, broods and breeding pairs should not be impacted.

Impacts on fish are not expected since spraying over water is not permitted. Maintaining buffer zones should help avoid water. Strict control will be needed on the part of the pilot to avoid drift over tidal water. Impacts on amphibians and reptiles have been poorly studied. One study found no observable response. No significant impacts should occur.

Mammalian toxicity is relatively low for all adulticides.

Cumulative Impacts:

No adverse cumulative impacts are anticipated by the proposed mosquito control techniques. This use will be closely monitored for any adverse impacts throughout the year.

PUBLIC REVIEW AND COMMENT:

This compatibility determination was published and available for public review and comment concurrent with the Draft CCP and EA; the comment period opened August 15 and closed on September 20, 2012. Public notification included a notice in the Federal Register, media announcements, public notices posted throughout the local communities, and a public meeting. One comment specific to this determination (pesticide application to control mosquito populations) was received. The comment states that cumulative impacts of pesticide application for mosquito control should be stated and discussed; mosquito control causes pesticide drift, kills wildlife, kills wildlife foods, and poisons ecosystems. The Sierra Club opposes mosquito control which is not compatible as wildlife management on the Complex and has not been justified. The Service maintains that sufficient analysis and justification were provided to determine compatibility, given the scope of the proposed activity. This determination does not provide for unlimited use of pesticides across the refuges. The scope of this activity is very limited and only conducted when mosquito populations are at levels that jeopardize human and wildlife health. See CCP Appendix L for more information on the Complex’s Response to Comments.

DETERMINATION (CHECK ONE BELOW):

Use is Not Compatible

Use is Compatible with Following Stipulations

STIPULATIONS NECESSARY TO ENSURE COMPATIBILITY:

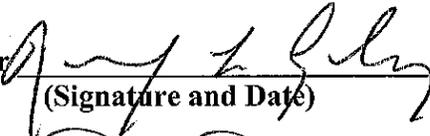
The following stipulations are required to ensure that fishing remains a compatible use on the Complex:

1. A step-down Mosquito Management Plan will be developed to determine how pesticide applications will accomplish management and human health objectives on the Complex.

JUSTIFICATION:

The Complex has a large number of communities near refuge lands. Arthropods such as mosquitoes pose an annoyance to humans and worldwide can have consequences such as mosquito-borne infections. Service Policy allows mosquito control on refuge lands when it is necessary to protect the health and safety of the public or a wildlife or domestic animal population. We will allow management of mosquito populations on refuge lands using effective means that pose the lowest risk to wildlife and habitats.

SIGNATURE: Refuge Manager


(Signature and Date)

4-12-2013

CONCURRENCE: Regional Chief


(Signature and Date)

4/4/13

MANDATORY 10-YEAR RE-EVALUATION DATE: 2023

Appendix D: Conservation and Recreation Areas within the Gulf Coast Prairies and Marshes Ecoregion

Davis Pond Freshwater Diversion Project	Army Corps of Engineers	30.3
Coushatta Reservation	Bureau of Indian Affairs	559.6
Lake Texana	Bureau of Reclamation	13738.1
Mission-Aransas National Estuarine Research Reserve	National Oceanic and Atmospheric Administration	5182.1
Big Thicket National Preserve*	National Park Service	1351.4
Jean Lafitte National Historical Park and Preserve	National Park Service	17010.7
Padre Island National Seashore	National Park Service	55307.8
Anahuac National Wildlife Refuge	US Fish and Wildlife Service	34392.7
Aransas National Wildlife Refuge	US Fish and Wildlife Service	114657.1
Attwater Prairie Chicken National Wildlife Refuge	US Fish and Wildlife Service	10538.0
Bayou Sauvage National Wildlife Refuge	US Fish and Wildlife Service	24292.9
Bayou Teche National Wildlife Refuge*	US Fish and Wildlife Service	4865.5
Big Branch Marsh National Wildlife Refuge	US Fish and Wildlife Service	17584.8
Cameron Prairie National Wildlife Refuge	US Fish and Wildlife Service	9613.4
Delta National Wildlife Refuge	US Fish and Wildlife Service	48799.1
Lacassine National Wildlife Refuge	US Fish and Wildlife Service	34366.3
Laguna Atascosa National Wildlife Refuge	US Fish and Wildlife Service	89398.1
Lower Rio Grande Valley National Wildlife Refuge*	US Fish and Wildlife Service	26799.3
Mandalay National Wildlife Refuge	US Fish and Wildlife Service	3303.0
McFaddin National Wildlife Refuge	US Fish and Wildlife Service	58861.4
Moody National Wildlife Refuge	US Fish and Wildlife Service	3516.9
Sabine National Wildlife Refuge	US Fish and Wildlife Service	125790.1
Texas Point National Wildlife Refuge	US Fish and Wildlife Service	8952.0
Trinity River National Wildlife Refuge*	US Fish and Wildlife Service	9133.8

Gulf Coast Prairies and Marshes Ecoregion Federally, State, and Privately Managed Lands

Atkinson Island Wildlife Management Area	Texas Parks and Wildlife Department	179.4
Battleship Texas (BB-35) State Historic Site	Texas Parks and Wildlife Department	1.0
Boca Chica State Park	Texas Parks and Wildlife Department	1686.8
Brazos Bend State Park	Texas Parks and Wildlife Department	4980.6
Candy Cain Abshier Wildlife Management Area	Texas Parks and Wildlife Department	223.0
CCA/CPL Marine Development Center State Fish Hatchery	Texas Parks and Wildlife Department	115.5
Christmas Bay	Texas Parks and Wildlife Department	218.3
D.R. Wintermann Wildlife Management Area	Texas Parks and Wildlife Department	249.8
Fannin Battleground State Historic Site	Texas Parks and Wildlife Department	13.6
Fulton Mansion State Historic Site	Texas Parks and Wildlife Department	3.6
Galveston Island State Park	Texas Parks and Wildlife Department	2004.5
Goose Island State Park	Texas Parks and Wildlife Department	265.9
Guadalupe Delta Wildlife Management Area	Texas Parks and Wildlife Department	7239.0
J.D. Murphree Wildlife Management Area	Texas Parks and Wildlife Department	24949.9
Justin Hurst Wildlife Management Area	Texas Parks and Wildlife Department	15627.2
Lake Texana State Park	Texas Parks and Wildlife Department	648.9
Levi Jordan Plantation State Historic Site	Texas Parks and Wildlife Department	97.0
Lipantitlan State Historic Site	Texas Parks and Wildlife Department	6.6
Lower Neches Wildlife Management Area	Texas Parks and Wildlife Department	7677.0
Mad Island Wildlife Management Area	Texas Parks and Wildlife Department	7280.9
Mustang Island State Park	Texas Parks and Wildlife Department	4528.8
Nannie M. Stringfellow Wildlife Management Area	Texas Parks and Wildlife Department	4905.6
Perry R. Bass Marine Fisheries Research Center	Texas Parks and Wildlife Department	31.2
Port Isabel Lighthouse State Historic Site	Texas Parks and Wildlife Department	1.6
Redhead Pond Wildlife Management Area	Texas Parks and Wildlife Department	44.7
San Jacinto Battleground State Historic Site	Texas Parks and Wildlife Department	1243.6
San Jacinto Monument	Texas Parks and Wildlife Department	10.4

Gulf Coast Prairies and Marshes Ecoregion Federally, State, and Privately Managed Lands

Sea Center Texas Fish Hatchery	Texas Parks and Wildlife Department	78.2
Sea Rim State Park	Texas Parks and Wildlife Department	4034.8
Sheldon Lake State Park	Texas Parks and Wildlife Department	2655.4
Stephen F. Austin State Park	Texas Parks and Wildlife Department	503.2
Welder Flats Wildlife Management Area	Texas Parks and Wildlife Department	1488.5
Sabine Pass Battleground State Park and Historic Site	Texas Historical Commission	61.5
Varner-Hogg Plantation State Historic Site	Texas Historical Commission	69.8
Bayou Segnette State Park	Louisiana Department of Culture, Recreation and Tourism	86.9
Fairview-Riverside State Park	Louisiana Department of Culture, Recreation and Tourism	96.2
Fontainebleau State Park	Louisiana Department of Culture, Recreation and Tourism	2583.3
Fort Pike State Historic Site	Louisiana Department of Culture, Recreation and Tourism	95.3
Grand Isle State Park	Louisiana Department of Culture, Recreation and Tourism	38.7
Palmetto Island State Park	Louisiana Department of Culture, Recreation and Tourism	1290.0
Saint Bernard State Park	Louisiana Department of Culture, Recreation and Tourism	2.5
Sam Houston Jones State Park*	Louisiana Department of Culture, Recreation and Tourism	1816.7
West Belle Pass	Louisiana Department of Natural Resources	1695.7
Atchafalaya Delta Wildlife Management Area	Louisiana Department of Wildlife and Fisheries	141000.0
Bashman Bayou Natural and Scenic River	Louisiana Department of Wildlife and Fisheries	19.4
Bayou Bienvenue Natural and Scenic River	Louisiana Department of Wildlife and Fisheries	1.1
Bayou Cane Natural and Scenic River	Louisiana Department of Wildlife and Fisheries	3.4
Bayou Chinchuba Natural and Scenic River	Louisiana Department of Wildlife and Fisheries	3.7
Bayou Des Allemands Natural and Scenic River	Louisiana Department of Wildlife and Fisheries	2590.7

Gulf Coast Prairies and Marshes Ecoregion Federally, State, and Privately Managed Lands

Bayou Dupre Natural and Scenic River	Louisiana Department of Wildlife and Fisheries	16.2
Bayou LaCombe Natural and Scenic River	Louisiana Department of Wildlife and Fisheries	222.5
Bayou Saint John Natural and Scenic River	Louisiana Department of Wildlife and Fisheries	118.7
Biloxi Wildlife Management Area	Louisiana Department of Wildlife and Fisheries	40752.5
Huey P Long Fish Hatchery	Louisiana Department of Wildlife and Fisheries	10.5
Isles Dernieres Barrier Islands Refuge	Louisiana Department of Wildlife and Fisheries	17.0
Lake Boeuf Wildlife Management Area	Louisiana Department of Wildlife and Fisheries	780.2
Lake Borgne Canal Natural and Scenic River	Louisiana Department of Wildlife and Fisheries	3.9
Marsh Island Wildlife Refuge	Louisiana Department of Wildlife and Fisheries	70772.7
Pass A Loutre Wildlife Management Area	Louisiana Department of Wildlife and Fisheries	111534.8
Pearl River Wildlife Management Area	Louisiana Department of Wildlife and Fisheries	11776.1
Pirogue Bayou Natural and Scenic River	Louisiana Department of Wildlife and Fisheries	20.5
Pointe Aux Chenes Wildlife Management Area	Louisiana Department of Wildlife and Fisheries	35200.9
Rockefeller Wildlife Refuge	Louisiana Department of Wildlife and Fisheries	85812.7
Salvador Wildlife Management Area	Louisiana Department of Wildlife and Fisheries	30143.1
Sister Lake Camp	Louisiana Department of Wildlife and Fisheries	156.4
St Tammany Wildlife Refuge	Louisiana Department of Wildlife and Fisheries	19.9
State Wildlife Refuge	Louisiana Department of Wildlife and Fisheries	14813.9
Tangipahoa River Natural and Scenic River	Louisiana Department of Wildlife and Fisheries	24.9
Tchefuncte River And Its Tributaries Natural and Scenic River	Louisiana Department of Wildlife and Fisheries	629.6
Terre Beau Bayou Natural and Scenic River	Louisiana Department of Wildlife and Fisheries	17.3
Timken Wildlife Management Area	Louisiana Department of Wildlife and Fisheries	2864.6
West Pearl River Natural and Scenic River	Louisiana Department of Wildlife and Fisheries	268.9
White Lake Wetlands Conservation Area	Louisiana Department of Wildlife and Fisheries	71602.4
LSU Research Station	Louisiana State University	1056.4

Gulf Coast Prairies and Marshes Ecoregion Federally, State, and Privately Managed Lands

Armand Bayou Coastal Preserve & Nature Center	Armand Bayou Nature Center and Texas Parks and Wildlife Department	319.3
Bolivar Flats	Audubon Society	491.3
Deadman Island	Audubon Society	9.6
Dunham Point	Audubon Society	175.6
Green Island	Audubon Society	68.8
Little Pelican Island	Audubon Society	91.1
Lydia Ann Island	Audubon Society	146.2
North Deer Island	Audubon Society	163.3
Pelican Island	Audubon Society	275.8
Rattlesnake Island, Ayres Island, And Roddy Island	Audubon Society	355.0
Sabal Palm Grove Sanctuary	Audubon Society	101.4
Second Chain Of Islands	Audubon Society	9.9
Smith Point Spoil	Audubon Society	10.0
Snake Island	Audubon Society	21.7
Sundown Island	Audubon Society	28.9
Sydney Island	Audubon Society	42.4
Three Islands	Audubon Society	228.7
Vingt-et-un Islands	Audubon Society	12.0
West Bay Bird Island	Audubon Society	121.3
Wisner Wildlife Management Area	Edward Wisner Donation Advisory Committee	16817.9
Houston Audubon Sanctuaries	Houston Audubon	3362.0
Katy Prairie	Katy Prairie Conservancy	13000.0
Pass Manchac Lighthouse	Lake Maurepas Society	8.0
Beason's Park	Lower Colorado River Authority	23.9
FM 521 Park	Lower Colorado River Authority	13.4
Hollywood Bottom	Lower Colorado River Authority	36.1
Matagorda Bay Nature Park	Lower Colorado River Authority	1761.3
Hancock County Marsh Coastal Reserve	Mississippi Department of Marine Resources	7641.4

Gulf Coast Prairies and Marshes Ecoregion Federally, State, and Privately Managed Lands

Clive Runnells Family Mad Island Marsh Preserve	The Nature Conservancy	7063.3
Francine Cohn Preserve	The Nature Conservancy	300.0
Nash Prairie	The Nature Conservancy	403.0
Pierce Marsh Preserve	The Nature Conservancy	1361.0
Shamrock Island Preserve	The Nature Conservancy	110.0
Texas City Prairie Preserve	The Nature Conservancy	2300.0

Data from: U.S. Fish and Wildlife Service (2009), USGS Gap Analysis Program (2010), ESRI (2009), Texas Parks and Wildlife Department (2004), and U.S. National Atlas et al. (2006)

Note: Not all of Lower Rio Grande Valley NWR, Trinity River NWR, Bayou Teche NWR, Sam Houston Jones State Park, and Big Thicket National Preserve fall in Gulf Coast Prairies and Marshes Ecoregion

E. Species List

This appendix contains a list of over 1,600 species identified on Texas Mid-coast National Wildlife Refuge Complex.

E.1. Mammals

ORDER DIDELPHIMORPHA — Marsupials

FAMILY DIDELPHIDAE

Virginia Opossum (*Didelphis virginiana*)

ORDER XENARTHRA — Edentates

FAMILY DASYPODIDAE

Nine-banded Armadillo (*Dasyus novemcinctus*)

ORDER INSECTIVORA — Insectivores

FAMILY SORICIDAE

Short-tailed Shrew (*Blarina brevicauda*)

Least Shrew (*Cryptotis parva*)

FAMILY TALPIDAE

Eastern Mole (*Scalopus aquaticus*)

ORDER CHIROPTERA — Bats

FAMILY VESPERTILIONIDAE

Big Brown Bat (*Estesicus fuscus*)

Eastern Pipistrelle (*Pipistrellus subflavus*)

Eastern Red Bat (*Lasiurus borealis*)

Evening Bat (*Nycticeius humeralis*)

Hoary Bat (*Lasiurus cinereus*)

Brazilian Free-tailed Bat (*Tadarida brasiliensis*)

Northern Yellow Bat (*Lasiurus intermedius*)

Refinesque's Big-eared Bat (*Plecotus rafinesquii*)

Seminole Bat (*Lasiurus seminolus*)

Silver-haired Bat (*Lasionycteris noctivagans*)

ORDER CARNIVORA — Carnivores

FAMILY CANIDAE

Coyote (*Canis latrans*)

Gray Fox (*Urocyon cinereoargenteus*)

Red Fox (*Vulpes vulpes*)

FAMILY PROCYONIDAE

Raccoon (*Procyon lotor*)

Ringtail (*Bassariscus astutus*)

FAMILY MUSTELIDAE

Long-tailed Weasel (*Mustela frenata*)
 American Mink (*Mustela vison*)
 Northern River Otter (*Lutra canadensis*)

Spotted Skunk (*Spilogale putorius*)
 Striped Skunk (*Mephitis mephitis*)

FAMILY FELIDAE

Bobcat (*Felis rufus*)

Cougar (*Felis concolor*)

ORDER ARTIODACTYLA — Ungulates

FAMILY SUIDAE

Pig (*Sus scrofa*)

FAMILY CERVIDAE

White-tailed Deer (*Odocoileus virginianus*)

ORDER RODENTIA — Rodents

FAMILY SCIURIDAE

Eastern Gray Squirrel (*Sciurus carolinensis*)

Southern Flying Squirrel (*Glaucomys volans*)
 Eastern Fox Squirrel (*Sciurus niger*)

FAMILY GEOMYIDAE

Attwater's Pocket Gopher (*Geomys attwateri*)
 Baird's Pocket Gopher (*Geomys breviceps*)

FAMILY CASTORIDAE

American Beaver (*Castor canadensis*)

FAMILY MURIDAE

Deer Mouse (*Peromyscus leucopus*)
 Eastern Woodrat (*Neotoma floridana*)
 Eastern Harvest Mouse (*Reithrodontomys humulis*)
 Fulvous Harvest Mouse (*Reithrodontomys fulvescens*)
 Hispid Pocket Mouse (*Chaetodipus hispidus*)

House Mouse (*Mus musculus*)
 Roof Rat (*Rattus rattus*)
 Hispid Cotton Rat (*Sigmodon hispidus*)
 Marsh Rice Rat (*Oryzomys palustris*)
 Northern Pygmy Mouse (*Baiomys taylori*)
 Norway Rat (*Rattus norvegicus*)
 White-footed Mouse (*Peromyscus leucopus*)

FAMILY CRICETIDAE

Muskrat (*Ondatra zibethicus*)

FAMILY MYOCASTORIDAE

Nutria (*Myocastor coypus*)

ORDER LAGOMORPHA — Lagomorphs**FAMILY LEPORIDAE**Eastern Cottontail (*Sylvilagus floridanus*)California Jackrabbit (*Lepus californicus*)Swamp Rabbit (*Sylvilagus aquaticus*)**E.2. Birds****ORDER PODICIPEDIFORMES****FAMILY GAVIIDAE - Loons**Common Loon (*Gavia immer*)**FAMILY PODICIPEDIDAE – Grebes**Eared Grebe (*Podiceps nigricollis*)Pied-billed Grebe (*Podilymbus podiceps*)Horned Grebe (*Podiceps auritus*)Western Grebe (*Aechmophorus*Least Grebe (*Tachybaptus dominicus*)*occidentalis*)**ORDER PELECANIFORMES****FAMILY PELECANIDAE – Pelicans**American White Pelican (*Pelecanus erythrorhynchos*)Brown Pelican (*Pelecanus occidentalis*)**FAMILY PHALACROCORACIDAE – Cormorants**Neotropic Cormorant (*Phalacrocorax brasilianus*)Double-crested Cormorant (*Phalacrocorax auritus*)**FAMILY ANHINGIDAE – Anhingas**Anhinga (*Anhinga anhinga*)**FAMILY FREGATIDAE - Frigatebirds**Magnificent Frigatebird (*Fregata magnificens*)**ORDER CICONIFORMES****FAMILY ARDEIDAE – Bitterns, Herons, Egrets**American Bittern (*Botaurus lentiginosus*)Reddish Egret (*Egretta rufescens*)Least Bittern (*Ixobrychus exilis*)Cattle Egret (*Bubulcus ibis*)Great Blue Heron (*Ardea herodias*)Green Heron (*Butorides virescens*)Great Egret (*Ardea alba*)Black-crowned Night Heron (*Nycticorax*Snowy Egret (*Egretta thula*)*nycticorax*)Little Blue Heron (*Egretta caerulea*)

Yellow-crowned Night-Heron

Tri-colored Heron (*Egretta tricolor*)(*Nyctanassa violacea*)

FAMILY THRESKIORNITHIDAE – Ibises and Spoonbills

White Ibis (<i>Eudocimus albus</i>)	White-faced Ibis (<i>Plegadis chihi</i>)
Glossy Ibis (<i>Plegadis falcinuis</i>)	Roseate Spoonbill (<i>Platalea ajaja</i>)

FAMILY CICONIIDAE - Storks

Wood Stork (*Mycteria americana*)

ORDER ANSERIFORMES

FAMILY ANATIDAE – Waterfowl

Black-bellied Whistling Duck (<i>Dendrocygna autumnalis</i>)	Gadwall (<i>Anas strepera</i>)
Fulvous Whistling Duck (<i>Dendrocygna bicolor</i>)	American Wigeon (<i>Anas americana</i>)
Greater White-fronted Goose (<i>Anser albifrons</i>)	Canvasback (<i>Aythya valisineria</i>)
Snow Goose (<i>Chen caerulescens</i>)	Redhead (<i>Aythya americana</i>)
Ross' Goose (<i>Chen rossii</i>)	Ring-necked Duck (<i>Aythya collaris</i>)
Canada Goose (<i>Branta canadensis</i>)	Lesser Scaup (<i>Aythya affinis</i>)
Wood Duck (<i>Aix sponsa</i>)	Greater Scaup (<i>Aythya marila</i>)
Green-winged Teal (<i>Anas crecca</i>)	Surf Scoter (<i>Melanitta perspicillata</i>)
Mallard (<i>Anas platyrhynchos</i>)	White-winged Scoter (<i>Melanitta fusca</i>)
Mottled Duck (<i>Anas fulvigula</i>)	Common Goldeneye (<i>Bucephala clangula</i>)
Blue-winged Teal (<i>Anas discors</i>)	Bufflehead (<i>Bucephala albeola</i>)
Cinnamon Teal (<i>Anas cyanoptera</i>)	Hooded Merganser (<i>Lophodytes cucullatus</i>)
Green-winged Teal (<i>Anas crecca</i>)	Common Merganser (<i>Mergus merganser</i>)
Northern Shoveler (<i>Anas clypeata</i>)	Red-breasted Merganser (<i>Mergus serrator</i>)
Northern Pintail (<i>Anas acuta</i>)	Masked Duck (<i>Nomonyx dominicus</i>)
	Ruddy Duck (<i>Oxyura jamaicensis</i>)

ORDER FALCONIFORMES

FAMILY CATHARTIDAE – Vultures

Black Vulture (<i>Coragyps atratus</i>)	Turkey Vulture (<i>Cathartes aura</i>)
---	--

FAMILY ACCIPITRIDAE – Hawks

Osprey (<i>Pandion haliaetus</i>)	Sharp-shinned Hawk (<i>Accipiter striatus</i>)
Swallow-tailed Kite (<i>Elanoides forficatus</i>)	Cooper's Hawk (<i>Accipiter cooperii</i>)
White-tailed Kite (<i>Elanus leucurus</i>)	Red-shouldered Hawk (<i>Buteo lineatus</i>)
Mississippi Kite (<i>Ictinia mississippiensis</i>)	Broad-winged Hawk (<i>Buteo platypterus</i>)
Bald Eagle (<i>Haliaeetus leucocephalus</i>)	Red-tailed Hawk (<i>Buteo jamaicensis</i>)
Northern Harrier (<i>Circus cyaneus</i>)	Swainson's Hawk (<i>Buteo swainsoni</i>)

FAMILY FALCONIDAE – Falcons

Crested Caracara (<i>Caracara cheriway</i>)	Merlin (<i>Falco columbarius</i>)
American Kestrel (<i>Falco sparverius</i>)	Peregrine Falcon (<i>Falco peregrinus</i>)

FAMILY PHASIANIDAE & ODONTOPHORIDAE – Turkey & Quail

Wild Turkey (<i>Meleagris gallopavo</i>)	Attwater's Greater Prairie Chicken
Northern Bobwhite (<i>Colinus virginianus</i>)	(<i>Tympanuchus cupido attwateri</i>) (<i>extirpated</i>)

ORDER GRUIFORMES**FAMILY RALLIDAE – Rails**

Yellow Rail (<i>Coturnicops noveboracensis</i>)	Sora (<i>Porzana carolina</i>)
Black Rail (<i>Laterallus jamaicensis</i>)	Purple Gallinule (<i>Porphyrio porphyrio</i>)
Clapper Rail (<i>Rallus longirostris</i>)	Common Moorhen (<i>Gallinula chloropus</i>)
King Rail (<i>Rallus elegans</i>)	American Coot (<i>Fulica americana</i>)
Virginia Rail (<i>Rallus limicola</i>)	

ORDER CHARADRIIFORMES**FAMILY CHARADRIIDAE – Plovers**

Black-bellied Plover (<i>Pluvialis squatarola</i>)	Wilson's Plover (<i>Charadrius wilsonia</i>)
American Golden Plover (<i>Pluvialis dominica</i>)	Semipalmated Plover (<i>Charadrius semipalmatus</i>)
Snowy Plover (<i>Charadrius alexandrinus</i>)	Piping Plover (<i>Charadrius melodus</i>)
	Killdeer (<i>Charadrius vociferous</i>)

FAMILY HAEMATOPODIDAE - Oystercatchers

American Oystercatcher (<i>Haematopus palliatus</i>)
--

FAMILY RECURVIROSTRIDAE - Stilts and Avocets

Black-necked Stilt (<i>Himantopus mexicanus</i>)	American Avocet (<i>Recurvirostra americana</i>)
--	--

FAMILY SCOLOPACIDAE – Sandpipers

Greater Yellowlegs (<i>Tringa melanoleuca</i>)	Dunlin (<i>Calidris alpina</i>)
Lesser Yellowlegs (<i>Tringa flavipes</i>)	Semipalmated Sandpiper (<i>Calidris pusilla</i>)
Solitary Sandpiper (<i>Tringa solitaria</i>)	Western Sandpiper (<i>Calidris mauri</i>)
Spotted Sandpiper (<i>Actitis macularia</i>)	Least Sandpiper (<i>Calidris minutilla</i>)
Willet (<i>Catoptrophorus semipalmatus</i>)	Pectoral Sandpiper (<i>Calidris melanotos</i>)
Hudsonian Godwit (<i>Limosa haemastica</i>)	White-rumped Sandpiper (<i>Calidris fuscicollis</i>)
Marbled Godwit (<i>Limosa fedoa</i>)	Baird's Sandpiper (<i>Calidris bairdii</i>)
Whimbrel (<i>Numenius phaeopus</i>)	Stilt Sandpiper (<i>Calidris himantopus</i>)
Long-billed Curlew (<i>Numenius americanus</i>)	Buff-breasted Sandpiper (<i>Tryngites subruficollis</i>)
Upland sandpiper (<i>Bartramia longicauda</i>)	Short-billed Dowitcher (<i>Limnodromus griseus</i>)
Ruddy Turnstone (<i>Arenaria interpres</i>)	
Red Knot (<i>Calidris canutus</i>)	
Sanderling (<i>Calidris alba</i>)	

Long-billed Dowitcher (*Limnodromus scolopaceus*)
Wilson's Snipe (*Gallinago delicata*)

American Woodcock (*Scolopax minor*)
Wilson's Phalarope (*Phalaropus tricolor*)

FAMILY LARIDAE – Gulls, Terns and Skimmers

Laughing Gull (*Larus atricilla*)
Ring-billed Gull (*Larus delawarensis*)
Franklin's Gull (*Larus pipixcan*)
Bonaparte's Gull (*Larus philadelphia*)
Herring Gull (*Larus argentatus*)
Lesser Black-backed Gull (*Larus fuscus*)
Greater Black-backed Gull (*Larus marinus*)
Gull-billed Tern (*Sterna nilotica*)

Caspian Tern (*Sterna caspia*)
Royal Tern (*Sterna maxima*)
Sandwich Tern (*Sterna sandvicensis*)
Common Tern (*Sterna hirundo*)
Forster's Tern (*Sterna forsteri*)
Least Tern (*Sterna antillarum*)
Black Tern (*Chlidonias niger*)
Black Skimmer (*Rhynchops niger*)

ORDER COLUMBIFORMES

FAMILY COLUMBIDAE – Pigeons

White-winged Dove (*Zenaida asiatica*)
Mourning Dove (*Zenaida macroura*)
Inca Dove (*Columbina inca*)

Common Ground Dove (*Columbina passerina*)

ORDER CUCULIFORMES

FAMILY CUCULIDAE – Cuckoos

Black-billed Cuckoo (*Coccyzus erythrophthalmus*)
Yellow-billed Cuckoo (*Coccyzus americanus*)

Groove-billed Ani (*Crotophaga sulcirostris*)

ORDER STRIGIFORMES

FAMILY TYTONIDAE - Barn Owls

Barn Owl (*Tyto alba*)

FAMILY STRIGIDAE – Typical Owls

Eastern Screech-Owl (*Otus asio*)
Great Horned Owl (*Bubo virginianus*)
Barred Owl (*Strix varia*)

Burrowing Owl (*Athene cunicularia*)
Short-eared Owl (*Asio flammeus*)

ORDER CAPRIMULGIFORMES

FAMILY CAPRIMULGIDAE – Goatsuckers

Common Nighthawk (*Chordeiles minor*)
Chuck-will's-widow (*Caprimulgus carolinensis*)

Whip-poor-will (*Caprimulgus vociferous*)

ORDER APODIFORMES
FAMILY APODIDAE – SwiftsChimney Swift (*Chaetura pelagica*)**FAMILY TROCHILIDAE – Hummingbirds**Ruby-throated Hummingbird (*Archilochus colubris*)

ORDER CORACIIFORMES
FAMILY ALCEDINIDAE – KingfishersBelted Kingfisher (*Ceryle alcyon*)

ORDER PICIFORMES
FAMILY PICIDAE – WoodpeckersRed-headed Woodpecker (*Melanerpes erythrocephalus*)Red-bellied Woodpecker (*Melanerpes carolinus*)Yellow-bellied Sapsucker (*Sphyrapicus varius*)Downy Woodpecker (*Picoides pubescens*)Northern Flicker (*Colaptes auratus*)Pileated Woodpecker (*Dryocopus pileatus*)

ORDER PASSERIFORMES
FAMILY TYRANNIDAE - FlycatchersOlive-sided Flycatcher (*Contopus cooperi*)Eastern Wood-pewee (*Contopus virens*)Yellow-bellied Flycatcher (*Empidonax flaviventris*)Acadian Flycatcher (*Empidonax virescens*)Willow Flycatcher (*Empidonax trailli*)Alder Flycatcher (*Empidonax alnorum*)Least Flycatcher (*Empidonax minimus*)Eastern Phoebe (*Sayornis phoebe*)Say's Phoebe (*Sayornis saya*)Vermilion Flycatcher (*Pyrocephalus rubinus*)Ash-throated Flycatcher (*Myiarchus cinerascens*)Great Crested Flycatcher (*Myiarchus crinitus*)Brown-crested Flycatcher (*Myiarchus tyrannulus*)Western Kingbird (*Tyrannus verticalis*)Eastern Kingbird (*Tyrannus tyrannus*)Couch's Kingbird (*Tyrannus couchii*)Tropical Kingbird (*Tyrannus melancholicus*)Scissor-tailed Flycatcher (*Tyrannus forficatus*)**FAMILY HIRUNDINIDAE – Swallows**Purple Martin (*Progne subis*)Tree Swallow (*Tachycineta bicolor*)

Northern Rough-winged Swallow

(*Stelgidopteryx serripennis*)

Bank Swallow (*Riparia riparia*)

Cliff Swallow (*Petrochelidon pyrrhonota*)

Cave Swallow (*Petrochelidon fulva*)

Barn Swallow (*Hirundo rustica*)

FAMILY CORVIDAE – Jays/Crows

Blue Jay (*Cyanocitta cristata*)

American Crow (*Corvus brachyrhynchos*)

FAMILY PARIDAE – Chickadees/Titmice

Carolina Chickadee (*Poecile carolinensis*)

Tufted Titmouse (*Baeolophus bicolor*)

FAMILY CERTHIIDAE – Creepers

Brown Creeper (*Certhia americana*)

FAMILY TROGLODYTIDAE – Wrens

Carolina Wren (*Thryothorus ludovicianus*)

Winter Wren (*Troglodytes troglodytes*)

Bewick's Wren (*Thryomanes bewickii*)

Sedge Wren (*Cistothorus platensis*)

House Wren (*Troglodytes aedon*)

Marsh Wren (*Cistothorus palustris*)

FAMILY MUSCICAPIDAE – Kinglets/Gnatcatchers/Thrushes

Golden-crowned Kinglet (*Regulus satrapa*)

Veery (*Catharus fuscescens*)

Ruby-crowned Kinglet (*Regulus calendula*)

Gray-cheeked Thrush (*Catharus minimus*)

Blue-gray Gnatcatcher (*Polioptila caerulea*)

Swainson's Thrush (*Catharus ustulatus*)

Hermit Thrush (*Catharus guttatus*)

Wood Thrush (*Catharus mustelinus*)

Eastern Bluebird (*Sialia sialis*)

American Robin (*Turdus migratorius*)

FAMILY MIMIDAE – Mockingbirds/Thrashers

Gray Catbird (*Dumetella carolinensis*)

Brown Thrasher (*Toxostoma rufum*)

Northern Mockingbird (*Mimus polyglottos*)

FAMILY BOMBYCILLIDAE – Waxwings

Cedar Waxwing (*Bombycilla cedrorum*)

FAMILY LANIIDAE – SHRIKES

Loggerhead Shrike (*Lanius ludovicianus*)

FAMILY STURNIDAE – Starlings

European Starling (*Sturnus vulgaris*)

FAMILY VIREONIDAE - Vireos

White-eyed Vireo (*Vireo griseus*)

Philadelphia Vireo (*Vireo philadelphicus*)

Bell's Vireo (*Vireo bellii*)

Blue-headed Vireo (*Vireo solitarius*)

Yellow-throated Vireo (*Vireo flavifrons*)

Red-eyed Vireo (*Vireo olivaceus*)

Warbling Vireo (*Vireo gilvus*)

FAMILY EMBERIZIDAE – Warblers, etc

Tennessee Warbler (<i>Vermivora peregrina</i>)	Palm Warbler (<i>Dendroica palmarum</i>)
Golden-winged Warbler (<i>Vermivora chrysoptera</i>)	Bay-breasted Warbler (<i>Dendroica castanea</i>)
Blue-winged Warbler (<i>Vermivora pinus</i>)	Blackpoll Warbler (<i>Dendroica striata</i>)
Orange-crowned Warbler (<i>Vermivora celata</i>)	Black-and-white Warbler (<i>Mniotilta varia</i>)
Nashville Warbler (<i>Vermivora ruficapilla</i>)	American Redstart (<i>Setophaga ruticilla</i>)
Northern Parula (<i>Parula americana</i>)	Prothonotary Warbler (<i>Protonotaria citrea</i>)
Yellow Warbler (<i>Dendroica petechia</i>)	Worm-eating Warbler (<i>Helmitheros vermivorus</i>)
Chestnut-sided Warbler (<i>Dendroica pensylvanica</i>)	Swainson's Warbler (<i>Limnithlypis swainsonii</i>)
Magnolia Warbler (<i>Dendroica magnolia</i>)	Ovenbird (<i>Seiurus aurocapillus</i>)
Yellow-rumped Warbler (<i>Dendroica coronata</i>)	Northern Waterthrush (<i>Seiurus noveboracensis</i>)
Black-throated Blue Warbler (<i>Dendroica caerulescens</i>)	Louisiana Waterthrush (<i>Seiurus motacilla</i>)
Black-throated Green Warbler (<i>Dendroica virens</i>)	Kentucky Warbler (<i>Oporornis formosus</i>)
Cerulean Warbler (<i>Dendroica cerulea</i>)	Mourning Warbler (<i>Oporornis philadelphia</i>)
Blackburnian Warbler (<i>Dendroica fusca</i>)	Common Yellowthroat (<i>Geothlypis trichas</i>)
Yellow-throated Warbler (<i>Dendroica dominica</i>)	Hooded Warbler (<i>Wilsonia citrina</i>)
Pine Warbler (<i>Dendroica pinus</i>)	Wilson's Warbler (<i>Wilsonia pusilla</i>)
Prairie Warbler (<i>Dendroica discolor</i>)	Yellow-breasted Chat (<i>Icteria virens</i>)

TANAGERS

Summer Tanager (<i>Piranga rubra</i>)	Western Tanager (<i>Piranga ludoviciana</i>)
Scarlet Tanager (<i>Piranga olivacea</i>)	

CARDINALS, GROSBEAKS & BUNTINGS

Northern Cardinal (<i>Cardinalis cardinalis</i>)	Indigo Bunting (<i>Passerina cyanea</i>)
Rose-breasted Grosbeak (<i>Pheucticus ludovicianus</i>)	Painted Bunting (<i>Passerina ciris</i>)
Blue Grosbeak (<i>Guiraca caerulea</i>)	Dickcissel (<i>Spiza americana</i>)

SPARROWS, TOWHEES & ALLIES

Green-tailed Towhee (<i>Pipilo chlorurus</i>)	Grasshopper Sparrow (<i>Ammodramus savannarum</i>)
Spotted Towhee (<i>Pipilo maculatus</i>)	Henslow's Sparrow (<i>Ammodramus henslowii</i>)
Chipping Sparrow (<i>Spizella passerina</i>)	Le Conte's Sparrow (<i>Ammodramus leconteii</i>)
Clay-colored Sparrow (<i>Spizella pallida</i>)	Nelson's Sharp-tailed Sparrow (<i>Ammodramus nelsonii</i>)
Field Sparrow (<i>Spizella pusilla</i>)	
Lark Sparrow (<i>Chondestes grammacus</i>)	
Savannah Sparrow (<i>Passerculus sandwichensis</i>)	

Seaside Sparrow (*Ammodramus maritimus*)
Fox Sparrow (*Passerella iliaca*)
Song Sparrow (*Melospiza melodia*)
Lincoln's Sparrow (*Melospiza lincolni*)
Swamp Sparrow (*Melospiza georgiana*)

White-throated Sparrow (*Zonotrichia albicollis*)
White-crowned Sparrow (*Zonotrichia leucophrys*)
Dark-eyed Junco (*Junco hyemalis*)

BLACKBIRDS & ORIOLES

Red-winged Blackbird (*Agelaius phoeniceus*)
Eastern Meadowlark (*Sturnella magna*)
Western Meadowlark (*Sturnella neglecta*)
Yellow-headed Blackbird (*Xanthocephalus xanthocephalus*)
Rusty Blackbird (*Euphagus carolinus*)
Brewer's Blackbird (*Euphagus carolinus*)

Great-tailed Grackle (*Quiscalus mexicanus*)
Boat-tailed Grackle (*Quiscalus major*)
Common Grackle (*Quiscalus quiscula*)
Brown-headed Cowbird (*Molothrus ater*)
Bronzed Cowbird (*Molothrus aeneus*)
Orchard Oriole (*Icterus spurius*)
Bullock's Oriole (*Icterus bullockii*)
Baltimore Oriole (*Icterus galbula*)

FAMILY FRINGILLIDAE – Finches

Pine Siskin (*Carduelis pinus*)
American Goldfinch (*Carduelis tristis*)

E.3. Amphibians

ORDER CAUDATA – Salamanders

FAMILY SIRENIDAE

Western Lesser Siren (*Siren intermedia nettingi*)

FAMILY SALAMANDRIDAE

Central Newt (*Notophthalmus viridescens louisianensis*)

FAMILY PROTEIDAE

Red River Mudpuppy (*Necturus maculosus louisianensis*)

FAMILY AMBYSTOMATIDAE

Marbled Salamander (*Ambystoma opacum*)
Small-mouthed Salamander (*Ambystoma texanum*)

ORDER ANURA – Frogs & Toads

FAMILY SCAPHIOPODIDAE

Hurters Spadefoot (*Scaphiopus holbrookii hurteri*)

FAMILY BUFONIDAE

Dwarf American Toad (*Bufo americanus charlesmithi*)
Woodhouse's Toad (*Bufo w. woodhouseii*)
Gulf Coast Toad (*Bufo valliceps*)

FAMILY HYLIDAE

Blanchard's Cricket Frog (*Acris crepitans blanchardi*)
 Cope's Gray Treefrog (*Hyla chrysoscelis*)
 Green Treefrog (*Hyla cinerea*)
 Northern Spring Peeper (*Psuedacris c. crucifer*)
 Eastern Gray Treefrog (*Hyla versicolor*)

Squirrel Treefrog (*Hyla squirella*)
 Spotted Chorus Frog (*Psuedacris clarki*)
 Strecker's Chorus Frog (*Psuedacris streckeri*)
 Upland Chorus Frog (*Pseudacris triseriata feriarum*)

FAMILY MICROHYLIDAE

E. Narrow-mouthed Toad (*Gastrophryne carolinensis*)

Great Plains Narrow-mouth Toad (*Gastrophryne olivacea*)

FAMILY RANIDAE

S. Crawfish Frog (*Rana a. areolata*)
 Bullfrog (*Rana catesbeiana*)
 Bronze Frog (*Rana clamitans clamitans*)

Southern Leopard Frog (*Rana sphenoccephala*)

E.4. Reptiles**ORDER TESTUDINES – Tortoises and turtles****FAMILY KINOSTERNIDAE**

Mississippi Mud Turtle (*Kinosternon subrubrum hippocrepis*)
 Yellow Mud Turtle (*Kinosternon flavivens flavivens*)

Common Musk Turtle (*Sternotherus odoratus*)

FAMILY CHELYDRIDAE

Snapping Turtle (*Chelydra serpentina*)

FAMILY EMYDIDAE

Mississippi Map Turtle (*Graptemys kohnii*)
 Ornate Box Turtle (*Terrapene ornate ornate*)
 Red-eared Slider (*Trachemys scripta elegans*)
 Texas Diamondback Terrapin (*Malaclemys terrapin littoralis*)

Texas River Cooter (*Pseudemys texana*)
 Three-toed Box Turtle (*Terrapene carolina triunguis*)
 Western Chicken Turtle (*Deirochelys reticularia miaria*)

FAMILY TESTUDINIDAE

Texas Tortoise (*Gopherus berlandieri*)

FAMILY TRIONYCHIDAE

Midland Smooth Softshell (*Apalone m. muticus*)

Pallid Spiny Softshell (*Apalone spiniferus pallidus*)

FAMILY CHELONIIDAE – Sea turtles

Loggerhead (<i>Caretta caretta</i>)	Atlantic Hawksbill (<i>Eretmochelys imbricata</i>)
Green Turtle (<i>Chelonia mydas</i>)	Atlantic Ridley (<i>Lepidochelys kempfi</i>)

FAMILY DERMOCHELIDAE - Leatherbacks

Leatherback (*Dermochelys coriacea*)

ORDER SQUAMATA –Snakes and Lizards

FAMILY IGUANIDAE – American arboreal lizards

Green Anole (*Anolis carolinensis*)

FAMILY PHRYNOSOMATIDAE – North American spiny lizards and allies

Northern Fence Lizard (<i>Sceloporus undulates hyacinthinus</i>)	Texas Horned Lizard (<i>Phrynosoma cornutum</i>)
	Texas Spiny Lizard (<i>Sceloporus olivaceus</i>)

FAMILY TEIIDAE - Tegus

Six-lined Racerunner (<i>Cnemidophorus sexlineatus</i>)	Texas Spotted Whiptail (<i>Cnemidophorus sixlineatus sixlineatus</i>)
---	---

FAMILY SCINCIDAE - Skinks

Southern Prairie Skink (<i>Eumeces septentrionalis oitusirastrus</i>)	Broadhead Skink (<i>Eumeces laticeps</i>)
Five-lined Skink (<i>Eumeces fasciatus</i>)	Ground Skink (<i>Scincella lateralis</i>)

FAMILY ANGUIDAE – Lateral Fold Lizards

W. Slender Glass Lizard (*Ophisaurus attenuates attenuates*)

FAMILY COLUBRIDAE – Colubrid Snakes - Advanced

Mississippi Ring-necked Snake (<i>Diadophis punctatus strictogenys</i>)	Prairie Kingsnake (<i>Lampropeltis callisgaster callisgaster</i>)
Texas Rat Snake (<i>Elaphe obsoleta lindheimeri</i>)	Louisiana Milk Snake (<i>Lampropeltis triangulum amaura</i>)
Southwestern Rat Snake (<i>Elaphe guttata meahllmorum</i>)	Western Coachwhip (<i>Masticophis flagellum testaceus</i>)
Western Mud Snake (<i>Farancia abacura reinwardtii</i>)	Rough Green Snake (<i>Opheodrys aestivus</i>)
Eastern Hog-nosed Snake (<i>Heterodon p. platirhinos</i>)	Marsh Brown Snake (<i>Storeria dekayi limnetes</i>)
Dusty Hog-nosed Snake (<i>Heterodon nasicus gloydi</i>)	Blotched Water Snake (<i>Nerodia erythrogaster transversa</i>)
Speckled Kingsnake (<i>Lampropeltis getulua holbrooki</i>)	Broad-banded Water Snake (<i>Nerodia fasciata confluens</i>)
	Gulf Salt Marsh Snake (<i>Nerodia clarki clarki</i>)

Diamond-backed Water Snake (*Nerodia rhombifer*)

Graham's Crayfish Snake (*Regina grahamii*)

Gulf Crawfish Snake (*Regina rigida sinicola*)

Flat-headed Snake (*Tantilla gracilis*)

Gulf Coast Ribbon Snake (*Thamnophis proximus orarulus*)

Checkered Garter Snake (*Thamnophis m. marcianus*)

Rough Earth Snake (*Virginia striatula*)

Eastern Garter Snake (*Thamnophis s. sirtalis*)

Plains Blind Snake (*Leptotyphlops dulcis dulcis*)

Texas Night Snake (*Hypsiglena torquatajani*)

Western Smooth Green Snake (*Liochlorophis vernalis blanchardi*)

Eastern Yellow-bellied Racer (*Coluber constrictor flaviventris*)

Texas Glossy Snake (*Arizona elegans arenicola*)

Texas Scarlet Snake (*Cemophora coccinea lineri*)

FAMILY ELAPIDAE – Cobras, Kraits, Mambas and Coral Snakes

Texas Coral Snake (*Micrurus fulvius tenere*)

FAMILY VIPERIDAE – Pitviper Snakes

Southern Copperhead (*Agkistrodon c. contortrix*)

Western Cottonmouth (*Agkistrodon piscivorus leucostoma*)

Canebrake Rattlesnake (*Crotalus horridus atricaudatus*)

Western Pigmy Rattlesnake (*Sistrurus miliarius streckeri*)

Western Massasauga (*Sistrurus catenatus tergeminus*)

Western Diamondback (*Crotalus atrox*)

ORDER CROCODYLIDAE – True Crocodiles

FAMILY CROCODYLIDAE

American Alligator (*Alligator mississippiensis*)

E.5. Fish

ORDER LEPISOSTEIFORMES - Gars

FAMILY LEPISOSTEIDAE

Spotted Gar (*Lepisosteus oculatus*)

Longnose Gar (*Lepisosteus osseus*)

Alligator Gar (*Atractosteus spatula*)

ORDER ANGUILLIFORMES - True Eels

FAMILY ANGUILLIDAE

American Eel (*Anguilla rostrata*)

ORDER AULOPIFORMES – Grinners and Lizardfish

FAMILY SYNODONTINAE

Inshore Lizard Fish (*Synodus foetens*)

ORDER TETRAODONTIFORMES – Triggerfish, Pufferfish and Boxfish

FAMILY TETRAODONTIDAE

Least Puffer (*Sphoeroides parvus*)

ORDER AMIIFORMES - Bowfins

FAMILY AMIIDAE

Bowfin (*Amia calva*)

ORDER CLUPEIFORMES – Ray-finned fish

FAMILY CLUPEIDAE - Herrings & Shads

Skipjack Herring (<i>Alosa chrysochloris</i>)	Gulf Menhaden (<i>Brevoortia patronus</i>)
Gizzard Shad (<i>Dorosoma cepedianum</i>)	Threadfin Shad (<i>Dorosoma petense</i>)

FAMILY ENGRAULIDAE - Anchovies

Bay Anchovy (*Anchoa mitchilli*)

ORDER OSTEOGLOSSIFORMES

FAMILY HIODONTIDAE - Mooneyes

Goldeye (*Hiodon alosoides*)

ORDER SALMONIFORMES

FAMILY ESOCIDAE - Pikes

Grass Pickerel (*Esox americanus*)

ORDER CYPRINIDAE

FAMILY CYPRINIDAE- Minnows or carps

Central Stoneroller (<i>Campostoma anomalum</i>)	Mississippi Silvery Minnow (<i>Hybognathus nuchalis</i>)
Grass Carp (<i>Ctenopharyngodon idella</i>)	Plains Minnow (<i>Hybognathus placitus</i>)
Goldfish (<i>Carassius auritus</i>)	Ribbon Shiner (<i>Lythrurus fumeus</i>)
Red Shiner (<i>Cyprinella lutrensis</i>)	Shoal Chub (<i>Macrohybopsis hyostoma</i>)
Blacktail Shiner (<i>Cyprinella venusta</i>)	Silver Chub (<i>Macrohybopsis storeriana</i>)
Common Carp (<i>Cyprinus carpio</i>)	Golden Shiner (<i>Notemigonus crysoleucas</i>)

Blackspot Shiner (*Notropis atrocaudalis*)
 Smalleye Shiner (*Notropis buccula*)
 Ghost Shiner (*Notropis buchanani*)
 Sharpnose Shiner (*Notropis oxyrhynchus*)
 Chub Shiner (*Notropis potteri*)
 Silverband Shiner (*Notropis shumardi*)
 Sand Shiner (*Notropis stramineus*)

Mimic Shiner (*Notropis volucellus*)
 Pugnose Minnow (*Opsopoeodus emiliae*)
 Suckermouth Minnow (*Phenacobius mirabilis*)
 Fathead Minnow (*Pimephales promelas*)
 Bullhead Minnow (*Pimephales vigilax*)
 Creek Chub (*Semotilus atromaculatus*)

FAMILY CATOSTOMIDAE- Suckers

River Carpsucker (*Carpionodes carpio*)
 Blue Sucker (*Cycleptus elongates*)
 Lake Chubsucker (*Erimyzon sucetta*)
 Smallmouth Buffalo (*Ictiobus bubalus*)

Black Buffalo (*Ictiobus niger*)
 Spotted Sucker (*Minytrema melanops*)
 Gray Redhorse (*Moxostoma congestum*)

FAMILY MUGILIDAE - Mullet

Striped Mullet (*Mugil cephalus*)

White Mullet (*Mugil curema*)

ORDER ELOPIFORMES

FAMILY ELOPIDAE - Ladyfish

Lady Fish (*Elops saurus*)

ORDER GASTEROSTEIFORMES

FAMILY SYNGNATHIDAE - Pipefishes

Gulf Pipefish (*Syngnathus scovelli*)
 Chain Pipefish (*Syngnathus louisianae*)

ORDER SILURIFORMES

FAMILY ICTALURIDAE - Bullhead Catfishes

Black Bullhead (*Ameiurus melas*)
 Yellow Bullhead (*Ameiurus natalis*)
 Blue Catfish (*Ictalurus furcatus*)
 Channel Catfish (*Ictalurus punctatus*)

Tadpole Madtom (*Noturus gyrinus*)
 Freckled Madtom (*Noturus nocturnus*)
 Flathead Catfish (*Pylodictis olivaris*)

FAMILY ARIIDAE - Sea catfishes

Hardhead Catfish (*Arius felis*)

Gafftopsail Catfish (*Bagre marinus*)

ORDER BATRACHOIDIFORMES

FAMILY BATRACHOIDIDAE - Toadfishes

Gulf Toadfish (*Opsanus beta*)

Atlantic Midshipman (*Porichthys porosissimus*)

ORDER PERCOPSIFORMES

FAMILY APHREDODERIDAE - Pirate Perches

Pirate Perch (*Aphredoderus sayanus*)

ORDER ATHERINIFORMES

FAMILY ATHERINIDAE - Silversides

Brook Silverside (*Labidesthes sicculus*)

Inland Silverside (*Menidia beryllina*)

FAMILY BELONIDAE - Needlefish

Atlantic Needlefish (*Strongylura marina*)

FAMILY POECILIIDAE - Livebearers

Western Mosquitofish (*Gambusia affinis*)

Sailfin Molly (*Poecilia latipenna*)

FAMILY FUNDULIDAE - Topminnows

Western Starhead Topminnow (*Fundulus blairae*)

Bayou Topminnow (*Fundulus pulverous*)

Longnose Killifish (*Fundulus similis*)

Golden Topminnow (*Fundulus chrysotus*)

Plains Killifish (*Fundulus zebrinus*)

Gulf Killifish (*Fundulus grandis*)

Rainwater Killifish (*Lucania parva*)

Diamond Killifish *Adinia xenica*

Sheepshead Minnow (*Cyprinodon*

notatus)

variegatta)

ORDER PERCIFORMES

FAMILY MORONIDAE - Temperate Basses

White Bass (*Morone chrysops*)

FAMILY CARANGIDAE - Jacks

Crevalle Jack (*Caranx hippos*)

FAMILY CENTRARCHIDAE - Sunfish

Flier (*Centrarchus macropterus*)

Longear Sunfish (*Lepomis megalotis*)

Redbreast Sunfish (*Lepomis auritus*)

Redear Sunfish (*Lepomis microlophus*)

Green Sunfish (*Lepomis cyanellus*)

Spotted Sunfish (*Lepomis punctatus*)

Warmouth (*Lepomis gulosus*)

Bantam Sunfish (*Lepomis symmetricus*)

Orangespotted Sunfish (*Lepomis humilis*)

Spotted Bass (*Micropterus punctulatus*)

Bluegill (*Lepomis macrochirus*)

Largemouth Bass (*Micropterus salmoides*)

Dollar Sunfish (*Lepomis marginatus*)

White Crappie (*Pomoxis annularis*)

Black Crappie (*Pomoxis nigromaculatus*)

FAMILY ELASSOMATIDAE

Banded Pygmy Sunfish (*Elassoma zonatum*)

FAMILY PERCIDAE - Perches

Western Sand Darter (*Ammocrypta clara*)

Scaly Sand Darter (*Ammocrypta vivax*)

Slough Darter (*Etheostoma gracile*)

Dusky Darter (*Percina sciera*)

FAMILY GERREIDAE - Mojarra

Spotfin Mojarra (*Eucinostomus argenteus*)

Silver Jenny (*Eucinostomus gula*)

Tidewater Mojarra (*Eucinostomus*

harengulus)

Flagfin Mojarra (*Eucinostomus currani*)

FAMILY HAEMULIDAE

Pigfish (*Orthopristis chrysoptera*)

FAMILY SCIAENIDAE - Drums

Freshwater Drum (*Aplodinotus grunniens*)

Black Drum (*Pogonias cromas*)

Red Drum (*Sciaenops ocellata*)

Gulf Kingfish (*Menticirrhus littoralis*)

Sand Seatrout (*Cynoscion arenarius*)

Silver Seatrout (*Cynoscion nothus*)

Spotted Seatrout (*Cynoscion nebulosa*)

Spot (*Leiostomus xanthurus*)

Atlantic Croaker (*Micropogon undulates*)

Silver Perch (*Bairdiella chrysura*)

FAMILY SPARIDAE - Porgies

Sheepshead (*Archosargus*

probatocephalus)

Pinfish (*Lagodon rhomboids*)

ORDER PLEURONECTIFORMES – Flounders and Soles

FAMILY PARALICHTHYIDAE - Flounders

Southern Flounder (*Paralichthys*
lethostigma)

Fringed Flounder (*Etropus crossotus*)

Bay Whiff (*Citharichthys spilopterus*)

FAMILY SOLEIDAE - Soles

Hogchoker (*Trinectes maculates*)

Lined Sole (*Achirus lineatus*)

FAMILY CYNOGLOSSIDAE - Tonguefishes

Blackcheek Tonguefish (*Symphurus plagiusa*)

ORDER RAJIFORMES

FAMILY DASYPATIDAE - Stingrays

Southern Stingray (*Dasyatis americana*)

Atlantic Stingray (*Dasyatis Sabina*)

FAMILY GOBIIDAE - Gobies

Naked Goby (*Gobiosoma bosci*)

Darter Goby (*Gobionellus boleosoma*)

Clown Goby (*Microgobius golosus*)

E.6. Butterflies

ORDER LEPIDOPTERA

FAMILY PAPILIONIDAE - Swallowtails

Pipe-Vine Swallowtail (*Battus philenor*)

Tiger Swallowtail (*Papilio glaucus*)

Black Swallowtail (*Papilio polyxenes*)

Spicebush Swallowtail (*Papilio troilus*)

Giant Swallowtail (*Heraclides cresphontes*)

Palamedes Swallowtail (*Papilio palamedes*)

FAMILY PIERIDAE - Whites and Sulphurs

Checkered White (*Pontia protodice*)

Cloudless Sulphur (*Phoebis sennae*)

Cabbage White (*Pieris rapae*)

Orange-Barred Sulphur (*Phoebis philea*)

Great Southern White (*Ascia monuste*)

Large Orange Sulphur (*Phoebis agarithe*)

Falcate Orangetip (*Paramidea midea*)

Little Yellow (*Eurema lisa*)

Orange Sulphur (*Colias eurytheme*)

Mexican Yellow (*Eurema mexicanum*)

White Angled Sulphur (*Anteos clorinde*)

Sleepy Orange (*Eurema nicippe*)

Yellow Angled Sulphur (*Anteos maerula*)

Dainty Sulphur (*Nathalis iole*)

Dog Face (*Colias cesonia*)

FAMILY LYCAENIDAE - Gossamer-winged

Harvester (*Feniseca tarquinius*)

Great Purple Hairstreak (*Atlides halesus*)

Soapberry Hairstreak (*Phaeostrymon alcestis*)

Eastern Pine Elfin (*Incisalia niphon*)

Banded Hairstreak (*Satyrium calanus*)

White-M Hairstreak (*Parrhasius m-album*)

Striped Hairstreak (*Satyrium liparops*)

Gray Hairstreak (*Strymon melinus*)

Northern Hairstreak (*Fixsenia ontario*)

Western Pigmy Blue (*Brephidium exile*)

Red Banded Hairstreak (*Calycopis cecrops*)

Cassius Blue (*Leptotes cassius*)

Dusky-blue Hairstreak (*Calycopis isobeon*)

Marine Blue (*Leptotes marina*)

Olive Hairstreak (*Mitoura gyrnea*)

Ceraunus Blue (*Hemiargus ceraunus*)

Henry's Elfin (*Incisalia henrici*)

Reakit's Blue (*Hemiargus isola*)

Eastern Tailed Blue (*Everes comyntas*)

Spring Azure (*Celastrina argiolus*)

FAMILY LIBYTHEIDAE - Snout Butterflies

Snout Butterfly (*Libytheana bachmanii*)

FAMILY HELICONIIDAE - Longwings

Gulf Fritillary (*Agraulis vanilla*)

Julia (*Dryas iulia*)

Zebra (*Heliconius charitonius*)

FAMILY NYMPHALIDAE - Nymphalids

Variegated Fritillary (<i>Euptoieta claudia</i>)	American Painted Lady (<i>Vanessa virginiensis</i>)
Bordered Patch (<i>Chlosyne lacinia</i>)	Painted Lady (<i>Vanessa cardui</i>)
Silvery Checkerspot (<i>Charidryas nycetis</i>)	Buckeye (<i>Junonia coenia</i>)
Texan Crescent (<i>Anthanassa texana</i>)	Red-Spotted Purple (<i>Limenitis arthemis astyanax</i>)
Phaon Crescent (<i>Phyciodes phaon</i>)	Viceroy (<i>Limenitis archippus</i>)
Pearl Crescent (<i>Phyciodes tharos</i>)	Common Mestra (<i>Mestra amymone</i>)
Question Mark (<i>Polygonia interrogationis</i>)	Goatweed Leafwing (<i>Anaea andria</i>)
Mourning Cloak (<i>Nymphalis antiopa</i>)	Hackberry Emperor (<i>Asterocampa celtis</i>)
Red Admiral (<i>Vanessa atalanta</i>)	Tawny Emperor (<i>Asterocampa clyton</i>)

FAMILY SATYRIDAE – Satyrs and Wood Nymphs

Southern Pearly Eye (<i>Enodia portlandia</i>)	Little Wood Satyr (<i>Megisto cymela</i>)
Gemmed Satyr (<i>Cyllopsis gemma</i>)	Common Wood Nymph (<i>Cercyonis pegala</i>)
Carolina Satyr (<i>Hermeuptychia sosybius</i>)	

FAMILY DANAIDAE - Milkweed Butterflies

Monarch (<i>Danaus plexippus</i>)	Queen (<i>Danaus gilippus</i>)
-------------------------------------	----------------------------------

FAMILY HESPERIIDAE - Skippers

Silver-spotted Skipper (<i>Epargyreus clarus</i>)	Tropical Checkered Skipper (<i>Pyrgus oileus</i>)
White-striped Longtail (<i>Chioides catillus</i>)	Turk's Cap Skipper (<i>Heliopetes macaira</i>)
Long-tailed Skipper (<i>Urbanus proteus</i>)	Hayhurst's Scallopwing (<i>Staphylus hayhurstii</i>)
Dorantes Longtail (<i>Urbanus dorantes</i>)	Mazans Scallopwing (<i>Staphylus mazans</i>)
Northern Cloudywing (<i>Thorybes pylades</i>)	Common Sootywing (<i>Pholisora catullus</i>)
Southern Cloudywing (<i>Thorybes bathyllus</i>)	Swarthy Skipper (<i>Nastra lherminier</i>)
Confused Cloudywing (<i>Thorybes confuses</i>)	Neamathla Skipper (<i>Nastra neamathla</i>)
Southern Scalloped Sootywing (<i>Staphylus mazans</i>)	Julia's Skipper (<i>Nastra julia</i>)
Sickle-winged Skipper (<i>Achlyodes mithridates</i>)	Clouded Skipper (<i>Lerema accius</i>)
Sleepy Duskywing (<i>Erynnis brizo</i>)	Least Skipper (<i>Ancyloxypha numitor</i>)
Juvenal's Duskywing (<i>Erynnis juvenalis</i>)	Orange Skipperling (<i>Copaeodes aurantiacus</i>)
Horace's Duskywing (<i>Erynnis horatius</i>)	Southern Skipperling (<i>Copaeodes minimus</i>)
Funereal Duskywing (<i>Erynnis funeralis</i>)	Fiery Skipper (<i>Hylephila phyleus</i>)
Wild Indigo Duskywing (<i>Erynnis baptisiae</i>)	Meske's Skipper (<i>Hesperia meskei</i>)
Common Checkered Skipper (<i>Pyrgus communis</i>)	Whirlabout (<i>Polites vibex</i>)
	Southern Broken Dash (<i>Wallengrenia otho</i>)

Northern Broken Dash (*Wallengrenia egeremet*)
 Little Glassywing (*Pompeius verna*)
 Sachem (*Atalopedes campestris*)
 Broad-winged Skipper (*Poanes viator*)
 Yehl Skipper (*Poanes yehl*)
 Dun Skipper (*Euphyes vestries*)
 Lace-winged Roadside Skipper (*Amblyscirtes aesculapius*)
 Celia's Roadside Skipper (*Amblyscirtes celia*)
 Common Roadside Skipper (*Amblyscirtes vialis*)

Eufala Skipper (*Lerodea eufala*)
 Twin-spot Skipper (*Oligoria maculate*)
 Brazilian Skipper (*Calpodetes ethlius*)
 Salt Marsh Skipper (*Panoquina panoquin*)
 Obscure Skipper (*Panoquina panoquinoides*)
 Ocola Skipper (*Panoquina ocola*)
 Polydamas Swallowtail (*Battus polydamas*)
 Mexican Silverspot (*Dione moneta*)
 White Peacock (*Anaea andria*)

E.7. Dragonflies

ORDER ODONATA

FAMILY AESHNIDAE - Darner

Common Green Darner (*Anax junius*)
 Comet Darner (*Anax longipes*)
 Regal Darner (*Coryphaeschna ingens*)
 Swamp Darner (*Epiaeschna heros*)

FAMILY GOMPHIDAE - Clubtails

Clubtail spp. (*Gomphidae spp.*)

FAMILY MACROMIIDAE - Cruisers

Royal River Cruiser (*Macromiidae taeniolata*)

FAMILY CORDULIIDAE - Emeralds

Common Baskettail (*Epiptera cynosura*)
 Prince Baskettail (*Epiptera princeps*)

FAMILY LIBELLUIDAE - Skimmers

Four-spotted Pennant (*Brachymesia gravida*)
 Halloween Pennant (*Celithemis eponina*)
 Banded Pennant (*Celithemis fasciata*)
 Calico Pennant (*Celithemis elisa*)
 Eastern Pondhawk (*Erythemis simplicicollis*)
 Great Pondhawk (*Erythemis vesiculosa*)
 Band-winged Dragonlet (*Erythrodiplax umbrata*)
 Seaside Dragonlet (*Erythrodiplax bertenice*)
 Slaty Skimmer (*Libellula incesta*)
 Common Whitetail (*Libellula lydia*)
 Needham's Skimmer (*Libellula needhami*)
 Great Blue Skimmer (*Libellula vibrans*)
 Window Skimmer (*Libellula luctuosa*)
 Greater Hyacinth Glider (*Miathyria marcella*)
 Roseate Skimmer (*Orthemis ferruginea*)
 Blue Dasher (*Pachydiplax longipennis*)
 Wandering Glider (*Pantala flavescens*)
 Spot-winged Glider (*Pantala hymenaea*)
 Eastern Amberwing (*Perithemis tenera*)
 Carolina Saddle Bags (*Tramea Carolina*)
 Black-mantled Glider (*Tramea lacerata*)
 Red-mantled Glider (*Tramea onusta*)

E.8. Vascular Plants

CLASS		POLYPODIOPSIDA - Ferns and Fern Allies
FAMILY	ASPLENIACEAE	
		Ebony Spleenwort (<i>Asplenium platyneuron</i>)
FAMILY	AZOLLACEAD	
		Mosquito Fern (<i>Azolla caroliniana</i>)
FAMILY	OPHIOGLOSSACEAE	
		Southern Grape Fern (<i>Botrychium biternatum</i>)
FAMILY	POLYPODIACEAE	
		Resurrection Fern (<i>Polypodium polypodioides</i> var. <i>Michauxianum</i>)
FAMILY	RICCIACEA	
		Riccia Liverwort (<i>Riccia fluitans</i>)
		Ricciacarpus (<i>Ricciacarpus natans</i>)
FAMILY	SALVINIACEAE	
		Mosquito Fern (<i>Azolla caroliniana</i>)
FAMILY	THELYPTERIDACEAE	
		Wide-spread Maiden Fern (<i>Thelypteris kunthii</i>)
CLASS		PINOPSIDA - Gymnosperms
FAMILY	CUPRESSACEAE	
		Eastern Red Cedar (<i>Juniperus virginiana</i> var. <i>silicicola</i>)
FAMILY	PINACEAE	
		Loblolly Pine (<i>Pinus taeda</i>)
CLASS		LILIOPSIDA - Monocots
FAMILY	AGAVACEAE	
		Datil Yucca (<i>Yucca baccata</i>)
		Yucca (<i>Yucca freemanii</i>)
		Louisiana Yucca (<i>Yucca louisianensis</i>)
		Spanish Dagger Yucca (<i>Yucca treculeana</i>)
FAMILY	ALISMATACEAE	
		Beaked Burhead (<i>Echinodorus beteroi</i>)
		Burhead (<i>Echinodorus cordifolius</i>)
		Burhead (<i>Echinodorus rostratus</i>)
		Burhead (<i>Echinodorus tenellus</i>)
		Grassy Arrowhead (<i>Sagittaria graminea</i>)

Longlobe Arrowhead (*Sagittaria longiloba*)

Nipplebract Arrowhead (*Sagittaria papillosa*)
Delta Arrowhead (*Sagittaria platyphylla*)

FAMILY ALLIACEAE

Canada Meadow Onion (*Allium canadense*)

Meadow garlic (*Allium canadense* var. *mobiliense*)
Crow-poison (*Nothoscordum bivalve*)

FAMILY ARACEAE

Green Dragon (*Arisaema dracontium*)
Water Lettuce (*Pistia Stratiotes*)

FAMILY ARECACEAE

Dwarf Palmetto (*Sabal minor*)

FAMILY BROMELIACEAE

Small Ball Moss (*Tillandsia recurvata*)

Spanish Moss (*Tillandsia usneoides*)

FAMILY CANNACEAE

Bannana of the Everglades (*Canna flacida*)

Indian-shot (*Canna glauca*)

FAMILY COMMELINACEAE

Erect Dayflower (*Commelina erecta*)
Narrow-leaf Dayflower (*Commelina erecta* var. *angustifolia*)

Ohio Spiderwort (*Tradescantia ohioensis*)
Spreading Day-flower (*Commelina diffusa*)

FAMILY CYPERACEAE

Broadwing Sedge (*Carex alata*)
Greenish-White Sedge (*Carex albolutescens*)
Amphibious Sedge (*Carex amphibola*)
Bicknell's Sedge (*Carex bicknellii*)
Carolina Sedge (*Carex caroliniana*)
Woodbank Sedge (*Carex cephalophora*)
Cherokee Caric-sedge (*Carex cherokeenses*)
Basal-fruit Caric-sedge (*Carex basiantha*)
Charming Caric-sedge (*Carex blanda*)
Crowfoot Caric-sedge (*Carex crus-corvi*)
Flaccid-fruit Caric-sedge (*Carex flaccosperma*)
Frank's Caric-sedge (*Carex frankii*)
Hyaline-scale Caric-sedge (*Carex hyalinolepis*)

Leavenworth's Caric-sedge (*Carex leavenworthii*)
Long's Sedge (*Carex longii*)
Louisiana Caric-sedge (*Carex louisianica*)
Hop-like Caric-sedge (*Carex lupuliformis*)
Hop caric-sedge (*Carex lupulina*)
Mead's Sedge (*Carex meadii*)
Sharp-scale Caric-sedge (*Carex oxylepis*)
Reflexed fruit Caric-sedge (*Carex retroflexa*)
Four-angled Caric-sedge (*Carex tetrastachya*)
Eastern Foxsedge (*Carex triangularis*)
Sangamon Caltrop Caric-sedge (*Carex tribuloides*)
Fox Sedge (*Carex vulpinoidea*)

- Taperleaf Flat-sedge (*Cyperus acuminatus*)
 Jointed Flat-sedge (*Cyperus articulatus*)
 Slender Flatsedge (*Cyperus bipartitus*)
 Buttonbush Flatsedge (*Cyperus cephalanthus*)
 Poorland Flatsedge (*Cyperus compressus*)
 Baldwin's Flat-sedge (*Cyperus croceus*)
 Globe Flatsedge (*Cyperus echinatus*)
 Yellow Nutgrass (*Cyperus esculentus*)
 Sheathed Flatsedge (*Cyperus haspan*)
 Ricefield flat-sedge (*Cyperus iria*)
 Pond Flat-sedge (*Cyperus ochraceus*)
 Sharp-scale Flatsedge (*Cyperus oxylepis*)
 Marsh Flat-sedge (*Cyperus pseudovegetus*)
 Purple Nutsedge (*Cyperus rotundus*)
 False-nutgrass (*Cyperus strigosus*)
 Coastal Plain Flat-sedge (*Cyperus thyrsiflorus*)
 Oneflower Flatsedge (*Cyperus uniflorus*)
 Green Flatsedge (*Cyperus virens*)
 Deeprooted Sedge (*Cyperus entrerianus*)*
 Needle Spikesedge (*Eleocharis acicularis*)
 White Spikerush (*Eleocharis albida*)
 Gulfcoast Spikesedge (*Eleocharis cellulosa*)
 Small Spikerush (*Eleocharis minima*)
 Sand Spikesedge (*Eleocharis montevidensis*)
 Dwarf Spikesedge (*Eleocharis pavrula*)
 Sparestem Spikesedge (*Eleocharis quadrangulata*)
 Fimbry (*Fimbristylis castanea*)
 Fimbry (*Fimbristylis thermalis*)
 Grasslike Fimbry (*Fimbristylis miliacea*)
 Vahl's Hairy Fimbry (*Fimbristylis puberula*)
- Fimbry (*Fimbristylis spadicea*)
 Woolly Fimbry (*Fimbristylis tomentosa*)
 Vahl fimbry (*Fimbristylis vahlii*)
 Keeled Bulrus (*Isolepis carinata*)
 Short-leaf Spike-sedge (*Kyllinga brevifolia*)
 American Snoutbean (*Rhynchosia americana*)
 Snoutbean (*Rhynchosia minima*)
 Texas Snoutbean (*Rhynchosia senna*)
 Anglestem Beakrush (*Rhynchospora caduca*)
 Whitetop Starrush (*Rhynchospora colorata*)
 Soft-bristle Horned Beakrush (*Rhynchospora corniculata*)
 Elliot's Beakrush (*Rhynchospora elliotii*)
 Globe Beakrush (*Rhynchospora globularis*)
 Clustered Beakrush (*Rhynchospora glomerata*)
 Shortbeak Beaksedge (*Rhynchospora nitens*)
 Olney Bulrush (*Schoenoplectus americanus*)
 California Bulrush (*Schoenoplectus californicus*)
 Threesquare Blurush (*Schoenoplectus pungens*)
 Salt-Marsh Bulrush (*Schoenoplectus robustus*)
 Softstem Bulrush (*Schoenoplectus tabernaemontani*)
 Baldwin's Nutrush (*Scleria baldwinii*)
 Fringed Nutrush (*Scleria ciliate*)
 Slenderfruit Nutrush (*Scleria georgiana*)
 Small-head nutrush (*Scleria oligantha*)
 Carolina Whipgrass (*Scleria pauciflora*)

FAMILY HYDROCHARITACEAECommon Frogbit (*Limnobium spongia*)**FAMILY IRIDACEAE**

Purple Pleat-leaf (*Eustylis pupurea*) or
 (*Alophia drummondii*)
 South Texas Herbertia (*Herbertia lahue*)

Prairienymph (*Herbertia lahue* ssp.
caerula)
 Southern Blue-flag (*Iris virginica*)

Narrowleaf Blue-eyed Grass (*Sisyrinchium angustifolium*)

Yellow Blue-eyed Grass (*Sisyrinchium exile*)

FAMILY JUNCACEAE

Taper-tip (knotleaf) Rush (*Juncus acuminatus*)

White-Root Rush (*Juncus brachycarpus*)

Toad Rush (*Juncus bufonius*)

Forked Rush (*Juncus dichotomus*)

Soft Rush (*Juncus effuses*)

Common Rush (*Juncus effuses* var. *solutes*)

FAMILY LEMNACEAE

Duckweed (*Lemna aequinoctialis*)

Swollen Duckweed (*Lemna gibba*)

Little Duckweed (*Lemna obscura*)

Duckweed (*Lemna trinervis*)

Duckmeat (*Spirodela polyrhiza*)

Brazilian Water-meal (*Wolffia brasiliensis*)

FAMILY LILIACEAE

Yellow Colic-root (*Alteris aurea*)

Drummond Rain Lily (*Cooperia drummondii*)

FAMILY MARANTACEAE

Powdered Thalia (*Thalia dealbata*)

FAMILY NAJADACEAE

Southern Naiad (*Najas guadalupensis*)

FAMILY ORCHIDACEAE

Water Spider Orchid (*Habenaria repens*)

Nodding Ladies' tresses (*Spiranthes cernua*)

Texas Ladies' tresses (*Spiranthes gracilis* var. *brevilabris*)

FAMILY POACEAE

Winter Bentgrass (*Agrostis hyemalis*)

Upland Bentgrass (*Agrostis perennans*)

Rough Bentgrass (*Agrostis scabra*)

Dotted (Roadside) blue-eyed grass (*Sisyrinchium langloisii*)

Least Blue-eyed Grass (*Sisyrinchium minus*)

Bog Rush (*Juncus elliotti*)

Inland rush (*Juncus interior*)

Grass-leaf Rush (*Juncus marginatus*)

Many-Head Rush (*Juncus polycephalus*)

Needlegrass (black) Rush, (*Juncus roemerianus*)

Slender Rush (*Juncus tenuis*)

Roundhead Rush (*Juncus validus*)

Columbia Wolffia (*Wolffia columbiana*)

Water-meal (*Wolffia papulifera*)

Bogmat (*Wolffiella gladiata*)

Mid-midget (Bogmat) (*Wolffiella lingulata*)

Rain-lily (*Cooperia traubii*)

Spider Lily (*Hymenocallis liriosme*)

Spiny Naiad (*Najas marina*)

Oval Ladies' tresses (*Spiranthes cernua*)

Spring Ladies' tresses (*Spiranthes vernalis*)

Carolinia Foxtail (*Alopecurus carolineanus*)

- Bushy Beardgrass (*Andropogon glomeratus*)
 Spritbeard Bluestem (*Andropogon ternaries*)
 Broom-sedge Bluestem (*Andropogon virginicus*)
 Purple Silky-Scale (*Anthaenantia rufa*)
 Slimspike (Prairie) Three-awn (*Aristida longespica*)
 Oldfield Three-awn (*Aristida oligantha*)
 Giant Cane (*Arundinaria gigantea*)
 Giant Reed (*Arundo donax*)
 Southern Carpet Grass (*Axonopus fissifolius*)
 Awnless Bluestem (*Bothriochloa exaristata*)
 King Ranch Bluestem (*Bothriochloa ischaemum* var. *ischaemum*)*
 Long-spike Silver Bluestem (*Bothriochloa longipaniculata*)
 Silver Bluestem (*Bothriochloa laguroides* ssp. *torreyana*)
 Little Quaking Grass (*Briza minor*)*
 Rescuegrass (*Bromus catharticus*)
 Buffalo Grass (*Buchloe dactyloides*)
 Southern Sandbur (*Cenchrus echinatus*)
 Coastal Sandbur (*Cenchrus spinifex*) *
 Broad-leaf Woodoats (*Chasmanthium latifolium*)
 Hairy-collar Woodoats (*Chasmanthium laxum*)
 Paraguay Windmill Grass (*Chloris canterae*)*
 Texas Windmill Grass (*Chloris texensis*)
 Tumble Windmill Grass (*Chloris verticillata*)
 Pitted Jointgrass (*Coelorachis cylindrical*)
 Bermuda grass (*Cynodon dactylon*)*
 Egyptian Crow's-foot (*Dactyloctenium aegyptium*)*
 Tapered Rosette-Grass (*Dichanthelium acuminatum* var. *acuminatum*)
 Cypress Panic Grass (*Dichanthelium dichotomum* var. *dichotomum*)
 Heller's Panic Grass (*Dichanthelium oligosanthos* var. *oligosanthos*)
 Scribner's Rosette-Grass (*Dichanthelium oligosanthos* var. *scribnerianum*)
 Woolly Panicum (*Dichanthelium scabriusculum*)
 Velvet-Panic-Grass (*Dichanthelium scoparium*)
 Roundseed Panicum (*Dichanthelium sphaerocarpon*)
 Roundseed Panicum (*Dichanthelium sphaerocarpon* var. *isophyllum*)
 Roundseed Panicum (*Dichanthelium sphaerocarpon* var. *sphaerocarpon*)
 Angleton Bluestem (*Dichanthium aristatum*)
 Needleleaf Rosette-Grass (*Dichanthelium aciculare*)
 Western Panicgrass (*Dichanthelium acuminatum* var. *fasciculatum*)
 Southern Crab-grass (*Digitaria ciliaris*)
 Fall Witch-Grass (*Digitaria cognate*)
 Fall Witchgrass (*Digitaria cognatum* var. *cognatum*)
 Smooth Crabgrass (*Digitaria ischaemum*)
 Hairy Crabgrass (*Digitaria sanguinalis*)
 Dune Crabgrass (*Digitaria texana*)
 Seashore Saltgrass (*Distichlis spicata*)
 Jungle Rice (*Echinochloa colona*) *
 Barnyard Grass (*Echinochloa crus-galli*)
 Gulf Cockspur Grass (*Echiochloa crus-pavonis*)
 Barnyard Grass (*Echiochloa crus-pavonis* var. *macera*)
 Goosefoot-grass (*Eleusine indica*)
 Canada Wildrye (*Elymus canadensis*)
 Quackgrass (*Elymus repens*)
 Virginia Wildrye (*Elymus virginicus*)
 Lacegrass (*Eragrostis capillaries*)
 Bigtop Lovegrass (*Eragrostis hirsuta*)
 Mourning Lovegrass (*Eragrostis lugens*)
 Field lovegrass (*Eragrostis refracta*)
 Red Lovegrass (*Eragrostis secundiflora*)
 Purple Lovegrass (*Eragrostis spectabilis*)
 Wichita Lovegrass (Lacegrass) (*Eragrostis secundiflora* ssp. *oxylepis*)
 Prairie Cupgrass (*Eriochloa contracta*)
 Louisiana cupgrass (*Eriochloa punctata*)

Stiff-leaf Windmill Grass (<i>Eustachys petraea</i>)	Woodland Paspalum (<i>Paspalum langei</i>)
Stiffleaf Choloris (<i>Eustachys petraea</i>)	Longtom (<i>Paspalum lividum</i>)
Little Barley (<i>Hordeum pusillum</i>)	Mat Paspalum (<i>Paspalum minus</i>)
Junegrass (<i>Rostraria cristata</i>)	Bahia grass (<i>Paspalum notatum</i>)*
Catchfly grass (<i>Leersia lenticularis</i>)	Brownseed Paspalum (<i>Paspalum plicatulum</i>)
Bunch cut-grass (<i>Leersia monandra</i>)	Hairyseed Paspalum (<i>Paspalum pubiflorum</i>)
Virginia Cut-grass (<i>Leersia virginica</i>)	Thin Paspalum (<i>Paspalum setaceum</i>)
Nealley Sprangletop (<i>Leptochloa nealleyi</i>)	Vasey-grass (<i>paspalum urvillei</i>)
Branching Spangletop (<i>Leptochloa panacea</i>)	Seashore paspalum (<i>Paspalum vaginatum</i>)
Mexican Sprangletop (<i>Leptochloa fusca</i> ssp. <i>uninervia</i>)	Yellow Bristlegrass (<i>Pennisetum glaucum</i>)
Ozarkgrass (<i>Limnodea arkansana</i>)	Timothy Canary-grass (<i>Phalaris angusta</i>)
Cane-like Rye-grass (Reed fescue) (<i>Lolium arundinaceum</i>)*	Carolina Canary grass (<i>Phalaris caroliniana</i>)
Perennial Rye-grass (<i>Lolium perenne</i>)*	Savannah Panicum (<i>Phanopyrum gymnocarpon</i>)
Two-flower Melic (<i>Melica mutica</i>)	Common Reed (<i>Phragmites australis</i>)
Shoregrass (<i>Monanthochloe littoralis</i>)	Annual Bluegrass (<i>Poa annua</i>)
Gulf Muhly (<i>Muhlenbergia capillaries</i>)	Autumn Bluegrass (<i>Poa autumnalis</i>)
Nimbleweed (<i>Muhlenbergia schreberi</i>)	Rabbit-foot Grass (<i>Polypogon monspeliensis</i>)
Texas Winter Grass (<i>Nassella leucotricha</i>)	Junegrass (<i>Rostraria cristata</i>)
Creeping Lovegrass (<i>Neeragrostis reptans</i>)	Tumblegrass (<i>Schedonnardus paniculatus</i>)
Basket-grass (<i>Oplismenus hirtellus</i>)*	Little Bluestem (<i>Schizachyrium scoparium</i>)
Bitter Panicum (<i>Panicum amarum</i>)	Slender Bluestem (<i>Schizachyrium tenerum</i>)
Beaked Panicum (<i>Panicum anceps</i>)	Yellow Foxtail (<i>Setaria glauca</i>)
Witchgrass (<i>Panicum capillare</i>)	Giant Bristlegrass (<i>Setaria magna</i>)
Fall Spreading Witchgrass (<i>Panicum dichotomiflorum</i>)	Knotroot Bristlegrass (<i>Setaria parviflora</i>)
Filly Panicum (<i>Panicum halli</i> var. <i>filipes</i>)	Bristlegrass (<i>Setaria pumila</i>)*
Woolly Panicum (<i>Panicum lanuginosum</i>)	Indian grass (<i>Sorghastrum avenaceum</i>)
Vine-mesquite (<i>Panicum obtusum</i>)	Yellow Indiangrass (<i>Sorghastrum nutans</i>)
Red-top panic-grass (<i>Panicum rigidulum</i>)	Johnson grass (<i>Sorghum halepense</i>)
Switchgrass (<i>Panicum virgatum</i>)	Smooth Cordgrass (<i>Spartina alterniflora</i>)
Egyptian Panicgrass (<i>Paspalidium germinatum</i> var. <i>germinatum</i>)	Marshhay Cordgrass (<i>Spartina patens</i>)
Water Panicum (<i>Paspalidium germinatum</i> var. <i>paludivagum</i>)	Prairie Cordgrass (<i>Spartina pectinata</i>)
Pitchfork Paspalum (<i>Paspalum bifidum</i>)	Gulf Cordgrass (<i>Spartina spartinae</i>)
Sour Paspalum (<i>Paspalum conjugatum</i>)	Slender Wedgescale (<i>Sphenopholis intermedia</i>)
Dallis grass (<i>Paspalum dilatatum</i>)*	Prairie Wedgegrass (<i>Sphenopholis obtusata</i>)
Knotgrass (<i>Paspalum distichum</i>)	Tall Dropseed (<i>sporobolus asper</i>)
Florida Paspalum (<i>Paspalum floridanum</i>)	Dropseed (<i>Sporobolus composites</i> var. <i>composites</i>)
Creeping Water Paspalum (<i>Paspalum fluitans</i>)	

Whorled Dropseed (<i>Sporobolus coromandelianus</i>)	Eastern Gamagrass (<i>Tripsacum dactyloides</i>)
Rattail Smutgrass (<i>Sporobolus indicus</i>)	Prairie Trisetum (<i>Trisetum interruptum</i>)
Padre Island Dropseed (<i>Sporobolus Tharpii</i>)	Sea-oats (<i>Uniola paniculata</i>)
Seashore Dropseed (<i>Sporobolus virginicus</i>)	Broad-leaf Liver-seed grass (signalgrass) (<i>Urochloa platyphylla</i>)
Gaping Panicum (<i>Steinchisma hians</i>)	Creeping Liver-seed grass (Sprawling signal grass) (<i>Urochloa reptans</i>) *
St. Augustine grass (<i>Stenotaphrum secundatum</i>)*	Six-weeks Fescue (Common sixweeksgrass) (<i>Vulpia octoflora</i>)
Texas Wintergrass (<i>Stipa leucotricha</i>)	Texas Willkommia (<i>Willkommia texana</i>)
Purple-top Tridens (<i>Tridens flavus</i>)	Marsh Millet (<i>Zizaniopsis miliacea</i>)
Longspike Tridens (<i>Tridens strictus</i>)	

FAMILY PONTEDERIACEAE

Blue Mudplantain (<i>Heteranthera limosa</i>)	Mudplantain (<i>Heteranthera reniformis</i>)
---	--

FAMILY POTAMOGETONACEAE

Waterthread Pondweed (<i>Potamogeton diversifolius</i>)	Longleaf Pondweed (<i>Potamogeton nodosus</i>)
	Widgeon-grass (<i>Ruppia maritime</i>)

FAMILY SMILACEACEAE

Saw Greenbrier (<i>Smilax bona-nox</i>)	Small's Greengrier (<i>Smilax smallii</i>)
Common Greenbrier (<i>Smilax rotundifolia</i>)	

FAMILY TYPHACIAE

Narrow-leaved Cattail (<i>Typha angustifolia</i>)	Gulf Coast Cattail (<i>Typha domingensis</i>)
	Common Cattail (<i>Typha latifolia</i>)

CLASS MAGNOLIOPSIDA - Dicots**FAMILY ACANTHACEAE**

Branched Fold-wing (<i>Dicliptera brachiata</i>)	Low Ruellia (Prairie petunia) (<i>Ruellia humilis</i>)
Gulf Swampweed (<i>Hygrophila lacustris</i>)	Western Wild Petunia (<i>Ruellia nudiflora</i> var. <i>occidentalis</i>)
Lance-leaf Water-willow (<i>Justicia ovata</i> var. <i>lanceolata</i>)	Runyon's Wild Petunia (<i>Ruellia nudiflora</i> var. <i>runyonii</i>)
Water-willow (<i>Justicia runyonii</i>)	Smooth Wild Petunia (<i>Ruellia strepens</i>)

FAMILY ACERACEAE

Box-elder (<i>Acer negundo</i>)	
-----------------------------------	--

FAMILY AIZOACEAE

Coast Sea Purslane (<i>Sesuvium maritimum</i>)	Sea Purslane (<i>Sesuvium portulacastrum</i>)
--	---

Desert Horse Purslane (*Trianthema*

portulacastrum)

FAMILY AMARANTHACEAE

Alligator Weed (*Alternanthera philoxeroides*)
 Sessile Joyweed (*Alternanthera sessilis*)
 Berlandier Amaranth (*Amaranthus berlandieri*)
 Gregg Amaranth (*Amaranthus greggii*)
 Water Hemp (*Amaranthus tamariscinus*)
 Tropical Green Pigweed (Green amaranth) (*Amaranthus viridis*)

Water Hemp (*Amaranthus rudis*)
 Lanceleaf Cottonflower (*Buileminea lanuginosa* var. *tenuiflora*)
 Common Cottonweed (*Froelichia gracilis*)
 Lanceleaf Cottonflower (*Gossypianthus lanuginosus*)
 Woolly Tidestromia (*Tidestromia laniginosa*)

FAMILY ANACARDIACEAE

Winged Sumac (*Rhus copallina*)
 Poison Ivy (*Toxicodendron radicans*)

FAMILY APIACEAE

Butler Sand-parsley (*Ammoselinum butleri*)
 Sea Rocket (*Cakile geniculata*)
 Spade Leaf (*Centella erecta*)
 Hairy-fruit Chervil (*Chaerophyllum tainturieri*)*
 Water Hemlock (*Cicuta maculate*)
 Slim-lobe Celery (*Cyclosporum leptophyllum*)
 Finger Dogshade (*Cynosciadium digitatum*)
 Hooker's Eryngo (*Eryngium hookeri*)
 Blue-flower Coyote-thistle (*Eryngium integrifolium*)

Rattlesnake-master (*Eryngium yuccifolium*)
 Pennywort (*Hydrocotyle bonariensis*)
 Marsh Pennywort (*Hydrocotyle umbellate*)
 Water-pennywort (*Hydrocotyle verticillata*)
 Texas Parsley (*Polytaenia texana*)
 Mock Bishop-Weed (*Ptilimnium capillaceum*)
 Canadian Sanicle (*Sanicula candensis*)
 Black Snakeroot (*Sanicula odorata*)
 Bristly Scaleseed (*Spermolepis echinata*)
 Knotted Hedge-parsley (*Torilis nodosa*)*
 Texas Tauschia (*Tauschia texana*)
 White Nymph (*Trepocarpus aethusae*)

FAMILY APOCYNACEAE

Blue-Star (*Amsonia illustris*)

Eastern Blue-Star (*Amsonia tabernaemontana*)

FAMILY AQUIFOLIACEAE

Possumhaw (*Ilex dicidua*)
 American Holly (*Ilex opaca*)

Yaupon Holly (*Ilex vomitoria*)

FAMILY ASCLEPIADACEAE

Fewflower Milkweed (*Asclepias lanceolata*)
 Slim Milkweed (*Asclepias linearis*)

Shore Milkweed (*Asclepias perennis*)
 Red Milkweed (*Asclepias rubra*)

Antelope-horn (Green) Milkweed
(*Asclepias viridis*)
Gulf Coast Swallowwort (*Cynanchum angustifolium*)

FAMILY ASTERACEAE

Creeping Spotflower (*Acmella opposifolia* var. *repens*)
Common Ragweed (*Ambrosia artemisiifolia*)
Western Ragweed (*Ambrosia psilostachya*)
Giant Ragweed (*Ambrosia trifida*)
Blood Ragweed (*Ambrosia trifida* var. *texana*)
Lazy Daisy (*Aphanostephus skirrhobasis*)
Coast Dozedaisy (*Aphanostephus skirrhobasis* var. *thalassius*)
Common Broomweed (*Amphiachris dracunculoides*)
Indian Plantain (*Arnoglossum ovatum*)
Easter Baccharis (*Baccharis halimifolia*)
Six Spanish Needles (*Bidens bipinnata*)
Smallhead Doll's Daisy (*Boltonia diffusa*)
Sea Ox-eye Daisy (*Borrichia frutescens*)
Straggler Daisy (*Calyptocarpus vialis*)
American Basketflower (*Centaurea americana*)
Common Least Daisy (*Chaetopappa aseroides*)
Spiny Aster (Wolfweed) (*Chlorantha spinosa*)
Hairy Goldenaster (*Chrysopsis pilosa*)
Mauchia (*Chrysopsis texana*)
Yellow Thistle (*Cirsium horridulum*)
Texas Thistle (*Cirsium texanum*)
Blue Mistflower (*Conoclinium coelestinum*)
Canadian Horseweed (*Conyza canadensis*)
Goldmane Coreopsis (*Coreopsis basalis*)
Lance-leaf Tickseed (*Coreopsis lanceolata*)
Plains Coreopsis (Tickseed) (*Coreopsis tinctoria*)
Cardamine Coreopsis (*Coreopsis tinctoria* var. *tinctoria*)

Five –angle Shiney-pod Milkvine
(*Matelea gonocarpos*)

Yerba de Tajo (*Eclipta alba*)
Yerba de Tajo (*Eclipta prostrata*)
Elephant's-foot (*Elephantopus carolinianus*)
Geiser's (Basin) Fleabane (*Erigeron geiseri*)
Fireweed (*Erechtites hieracifolia*)
Canadian Horseweed (*Erigeron canadensis*)
Philadelphia Fleabane (*Erigeron philadelphicus*)
Corpus Christi Fleabane (*Erigeron procumbens*)
Prairie Fleabane (*Erigeron strigosus*)
Dog Fennel (*Eupatorium capillifolium*)
Mist-flower (*Eupatorium coelestinum*)
Yankee Weed (*Eupatorium compositifolium*)
Narrowleaf Boneset (*Eupatorium hyssolifolium*)
Small-flower Boneset (*Eupatorium lancifolium*)
Saw-leaf Throughwort (Fall boneset) (*Eupatorium serotinum*)
Texas Goldentop (*Euthamia gymnospermoides*)
Bushy (Flat-topped) Goldentop (*Euthamia leptcephala*)
Flat-topped Goldentop (*Euthamia tenuifolia*)
Fleischmann's Thrououghwort (*Fleischmannia incarnata*)
Yellow Indian-blanket (*Gaillardia aestivalis*)
Indian Blanket (*Gaillardia pulchella*)
Purple Cudweed (*Gamochaeta americana*)
Sneezeweed (*Helenium amarum*)
Swamp (Narrow-leaf) Sunflower (*Helianthus angustifolius*)
Annual Sunflower (*Helianthus annuus*)

- Maximillian Sunflower (*Helianthus maximilarii*)
 White-flowered Cat's-ear (*Hypochaeris microcephala*)*
 Narrowleaf Sumpweed (*Iva angustifolia*)
 Annual Seacoast Sumpweed (*Iva annua*)
 Bigleaf Sumpweed (*Iva frutescens*)
 Weedy Dwarf Dandelion (*Krigia caespitosa*)
 Tall Yellow Lettuce (*Lactuca canadensis*)
 Woodland Lettuce (*Lactuca floridana*)
 Slender Gayfeather (*Liatris acidota*)
 Bracted Gayfeather (*Liatris bracteata*)
 Kansas Gayfeather (*Liatris pycnostachya*)
 Malva de Caballo (*Malachra capitata*)
 Climbing Hempweed (*Mikania scandens*)
 Yellowtop (*Packera glabella*)
 Thread-leaf Groundsel (*Packera tampicana*)
 Rosy Palafoxia (*Palafoxia rosea*)
 Texas Palafoxia (*Palafoxia texana*)
 False Ragweed (*Parthenium hysterophorus*)
 Salt-marsh Camphorweed (*Pluchea camphorata*)
 Marsh Fleabane (*Pluchea foetida*)
 Sweetscent (*Pluchea carolinensis*)
 Rosy Camphor-weed (*Pluchea rosea*)
 Purple Pluchea (*Pluchea odorata* var. *odorata*)
 Fragrant Cudweed (*Pseudognaphalium helleri*)
 Fragrant Cudweed (*Pseudognaphalium obtusilolium* ssp. *obtusifolium*)
 Wand Black Root (*Pterocaulon virgatum*)
 Carolina False Dandelion (*Pyrrhopappus carolinianus*)
 Small-flowered False Dandelion (*Pyrrhopappus pauciflorus*)
 Mexican Hat (*Ratibia columnifera*)
 Naked Prairie Coneflower (*Ratibida peduncularis* var. *peduncularis*)
 Pinnate Prairie Coneflower (*Ratibida pinnata*)
 Camphor Daisy (*Rayjacksonia phyllocephala*)
 Brown-eyed Susan (*Rudbeckia hirta*)
 Texas Brown-Eyed Susan (*Rudbeckia texana*)
 Slender Rosinweed (*Silphium gracile*)
 Bears-foot Leafcup (*Smallanthus unvedalia*)
 Canada Goldenrod (*Solidago canadense* var. *scabra*)
 Dyersweed Goldenrod (*Solidago nemarolis*)
 Seaside Goldenrod (*Solidago sempervirens*)
 Twistedleaf Goldenrod (*Solidago tortifolia*)
 Lawn Burweed (*Soliva sessilis*)
 Prickly Sow-thistle (*Sonchus asper*)
 Common Sow-thistle (*Sonchus oleraceus*)*
 Bushy Aster (*Symphyotrichum dumosum*)
 Calico Aster (*Symphyotrichum lateriflorum*)
 Heath Aster (*Symphyotrichum ericoides*)
 Meadow Aster (*Symphyotrichum pratense*)
 Southeastern Annual Salt Marsh Aster (*Symphyotrichum squamatum*)
 Eastern Annual Salt Marsh Aster (*Symphyotrichum subulatum*)
 Saline Aster (*Symphyotrichum tenuifolium*)
 Bush Raceme Aster (*Symphyotrichum racemosum*)
 Dandelion (*Taraxacum officinale*)
 Green-thread (*Thelesperma filifolium*)
 Three-flower Snakeweed (*Thurovia triflora*)
 Virginia Frostweed (*Verbesin virginica*)
 Woolly Ironweed (*Vernonia lindheimeri*)
 Missouri Ironweed (*Vernonia missurica*)
 Japanese Hawkweed (*Youngia japonica*)*
 Cocklebur (*Xanthium strumarium*)

FAMILY BATACEAEMaritime Saltwort (*Batis maritima*)**FAMILY BIGNONIACEAE**Common Trumpet Creeper (*Campsis radicans*)**FAMILY BORAGINACEAE**Seaside Heliotrope (*Heliotropium curassavicum*)Indian Heliotrope (*Heliotropium indicum*)Four-spike Heliotrope (*Heliotropium procumbens*)Carolina Puccoon (*Lithospermum caroliniense*)Narrowleaf Groomwell (*Lithospermum incisum*)Spring forget-me-not (*Myosotis macrosperma*)**FAMILY BRASSICACEAE**Sea Rocket (*Cakile geniculata*)Shepard's Purse (*Capsella bursa-pastoris*)Weak Bittercress (*Cardamine debilis**)Bitterweed, Sneezeweed (*Helenium amarum*)Fringed Sneezeweed (*Helenium drummondii*)Purple-head Sneezeweed (*Helenium flexuosum*)Virginia Pepperwort (*Lepidium virginicum*)Bog Marsh-cress (*Rorippa barbareaifolia*)Yellowcress (*Rorippa palustris*)Tansyleaf Yellowcress (*Rorippa teres*)Virginia Sibara (*Sibara virginica*)**FAMILY BUDDLEJACEAE**Juniper-leaf (*Polypremum procumbens*)**FAMILY CACTACEAE**Texas Prickly Pear (*Opuntia engelmannii* var. *lindheimeri*)Plains Prickly Pear (*Opuntia macrorhiza*)**FAMILY CALLITRICHACEAE**Larger Waterwort (*Callitriche heterophylla*)Water-starwort (*Callitriche terrestris*)**FAMILY CAMPANULACEAE**Cardinal Flower (*Lobelia cardinalis*)Foldear Lobelia (*Lobelia flaccidifolia*)Downy Lobelia (*Lobelia puberula*)Chicken Spike (*Sphenoclea zeylanica*)Small Venus Looking-glass (*Triodanis biflora*)Prairie Venus looking-glass (*Triodanis lamprosperma*)Venus' Looking glass (*Triodanis perfoliata*)**FAMILY CAPPARIDACEAE**Roughseed Clammy-weed (*Polanisia dodecandra*)

FAMILY CAPRIFOLIACEAE

Japanese Honeysuckle (*Lonicera japonica*)*
 Trumpet Honeysuckle (*Lonicera sempervirens*)
 Common Elderberry (*Sambucus niger* var. *canadensis*)

Coralberry (Indian-current)
 (*Symphoricarpos orbiculatus*)
 Arrow-wood (*Viburnum dentatum*)
 Rusty Blackhaw (*Viburnum rufidulum*)

FAMILY CARYOPHYLLACEAE

Sticky Mouse-ear Chickweed (*Cerastium glomeratum*)
 Sleepy Catchfly (*Silene antirrhina*)
 Bristleseed Sand-spurry (*Spergularia echinosperma*)

Marsh Sand-spurry (*Spergularia salina*)
 Common Chickweed (*Stellaria media*)
 Prostrate Starwort (*Stellaria prostrate*)

FAMILY CHENOPODIACEAE

Crested Saltbush (*Atriplex cristata*)
 Matamoros Saltbush (*Atriplex matamorensis*)
 Lamb's-quarter (*Chenopodium album*)
 Wormseed Goosefoot (*Chenopodium amrosioides*)

Berlandier's Goosefoot (*Chenopodium berlandieri*)*
 Bigalow Glasswort (*Salicornia bigelovii*)
 Virginia Glasswort (*Salicornia virginica*)
 Annual Seepweed (Sea blite) (*Suaeda linearis*)
 Sea-blight (*Suaeda maritime*)

FAMILY CISTACEAE

Rosemary Sunrose (*Helianthemum rosmarinifolium*)

Hairy Pinweed (*Lechea mucronata*)
 San Saba Pinweed (*Lechea san-sabeana*)

FAMILY CONVULVULACEAE

Silky Cressa (*Cressa truxillensis*)
 Cusp Dodder (*Cuscuta cuspidate*)
 Carolina Ponyfoot (*Dichondra carolinensis*)
 Silky Evolvulus (*Evolvulus sericeus*)
 Sharppod Morning Glory (Tie-vine)
 (*Ipomoea cordatotriloba*)

White-star Morning Glory (*Ipomoea lacunose*)
 Soilbind Morning Glory (*Ipomoea pes-caprae*)
 Saltmarsh Morning Glory (*Ipomoea sagittata*)
 Sharppod Morning Glory (*Ipomoea cordatotriloba* var. *cordatotriloba*)

FAMILY CORNACEAE

Rough-leaf Dogwood (*Cornus drummondii*)

FAMILY CRASSULACEAE

Drummond Crassula (*Crassula drummondii*)
 Ditch Stonecrop (*Penthorum sedoides*)

FAMILY CUCURBITACEAESmell Melon (*Cucumis melo*)Deerapple (Balsam gourd) (*Ibervillea lindheimeri*)Drooping Melonette (Guadeloupe cucumber) (*Melothria pendula*)**FAMILY CUSCUTACEAE**Cusp Dodder (*Cuscuta cuspidata*)Dodder (*Cuscuta pentagona*)Scaleflower Dodder (*Cuscuta squamata*)**FAMILY DROSERACEAE**Annual Dundew (*Drosera annua*)**FAMILY EBENACEAE**Common Persimmon (*Diospyros virginiana*)**FAMILY ELAEAGNACEAE**Cardinal Autumn Olive (*Elaeagnus umbellata*)**FAMILY EUPHORBIACEAE**Slender Three-seeded Mercury (*Acalypha gracilens*)Rhombic-leaf Three-seed Mercury (*Acalypha rhomboidea*)Virginia Three-seeded Mercury (*Acalypha virginica*)Low Wild Mercury (*Argythamnia humilis*)Marsh False-croton (*Caperonia palustris*)Spotted Sand-mat (*Chamaesyce maculata*)Eyebane Sand-mat (*Chamaesyce nutans*)Matted Sand-mat (*Chamaesyce serpens*)Jamaica Sawgrass (*Cladium jamaicense*)Lindheimer's Hogwort Croton (*Croton capitatus* var. *lindheimeri*)Wooly Croton (*Croton capitatus*)Tropic Croton (*Croton glandulosus*)One-seed Croton (Prairie tea) (*Croton monanthogynus*)Gulf Croton (*Croton punctatus*)Snow-on-the-prairie (*Euphorbia bicolor*)Wild Poinsettia (*Euphorbia cyanthophora*)Tramp's Spurge (*Euphorbia corollata*)Toothed Spurge (*Euphorbia dentate*)Warty Spurge (*euphorbia spathulata*)Bird-seed Leafflower (*Phyllanthus pudens*)Chinese Tallow Tree (*Triadica sebifera*)*Nettle-leaf Noseburn (*Tragia urticifolia*)**FAMILY FABACEAE**Huisache (*Acacia farnesiana*)Indian Joint Vetch (*Aeschynomene indica*)Mimosa (*Albizia julibrissin*)*False Indigobush (*Amorpha fruticosa*)American Hogpeanut (*Amphicarpaea bracteata*)Nodding Wild Indigo (*Baptisia bracteata* (*leucophea*))Yellow Wild Indigo (*Baptisia sphaerocarpa*)Green Wild Indigo (*Baptisia viridis*)Prairie Senna (*Cassia fasciculate* var. *faciculata*)Butterfly Pea (*Centrosema virginianum*)Partridge Pea (*Chamaecrista fasciculata*)White Prairie-clover (*Dalea candida*)Oklahoma Prairie Clover (*Dalea compacta* var. *compacta*)Bigtop Dalea (*Dalea enneandra*)

Swarf Bundleflower (*Desmanthus brevipes*)
 Hoary Ticktrefoil (*Desmodium canescens*)
 Illinois Bundleflower (*Desmanthus illinoensis*)
 Sharoppod Bundleflower (*Desmanthus virgatus* var. *acuminatus*)
 Bundleflower (*Demanthus virgatus* var. *depressus*)
 Ticktrefoil (*Desmodium glabellum*)
 Coralbean (*Erythrina herbacea*)
 Downey Milkpea (*Galactia volubilis*)
 Bagbod (*Glottidium vesicarium*)
 Coast Indigo (*Indigofera miniata*)
 Anil Indigo (*Indigofera suffruticosa*)
 Low Pea-vine (*Lathyrus pusillus*)
 Arabian Medick (*Medicago arabica*)*
 Black Medick (*Medicago lupulina*)*
 Burclover (*Medicago polymorpha*)*
 Indian Sweetclover (*Melilotus indicus*)*
 Yellow Sweetclover (*Melilotus officinalis*)*
 Sensitive Brier; Mimosa (*Mimosa microphylla*)
 Pink Sensitivebrier (*Mimosa strigillosa*)

FAMILY FAGACEAE

White Oak (*Quercus alba*)
 Bur Oak (*Quercus macrocarpa*)
 Drummond's Oak (*Quercus margarettiae*)
 Swamp chestnut Oak (*Quercus michauxii*)
 Water Oak (*Quercus nigra*)

FAMILY GENTIANACEAE

Coastal Century (*Centaurium breviflorum*)
 Texas Centaury (*Centaurium claycosum*)
 Muhlenberg's Centaury (*Centaurium muhlenbergii*)

FAMILY GERANIACEAE

Carolina Crane's-bill (*Geranium carolinanum*)

FAMILY HALORAGACEAE

Green Oarrot's Feather (*Myriophyllum pinnatum*)
 Marsh Mermaid-weed (*Proserpinaca palustris*)

Yellow-puff (*Neptunia lutea*)
 Tropical Puff (Prairie neptunia) (*Neptunia pubescens*)
 Retama (*Parkinsonia aculeata*)
 Honey Mesquite (*Prosopis glandulosa*)
 Least Snoutbean (*Rhynchosia minima*)
 Texas Snoutbean (*Rhynchosia senna* var. *texana*)
 Littleleaf Sensitive Briar (*Schrankia microphylla*)
 Sickle-pod (*Senna obtusifolia*)
 Western Senna (*Senna occidentalis*)*
 Drummond's Rattlebush (*Sesbania drummondii*)
 Coffee Bean (*Sesbania herbacae*)
 Sidbeak Pencil-flower (*Stylosanthes biflora*)
 Carolina Clover (*Trifolium carolinianum*)
 Hop Clover (*Trifolium campestre*)
 Peanut Clover (*Trifolium polymorphum*)
 White Clover (*Trifolium repens*)
 Persian Clover (*Trifolium resupinatum*)
 Deer-pea Vetch (*Vicia ludoviciana*)
 Cowpea (*Vigna luteola*)

Shumard Oak (*Quercus shumardii*)
 Bastard Oak (*Quercus sunuata* var. *sinuata*)
 Texas Oak (*Quercus buckleyi*)
 Live Oak (*Quercus virginiana*)

Branching Centaury (*Centaurium pulchellum*)
 Tall Prairie Gentian (*Eustoma exaltatum*)
 Rosepink (*Sabtia angularis*)
 Prairie Rose-gentian (*Sabtia campestris*)

FAMILY HYDROPHYLLACEAEBlue Waterleaf (*Hydrolea ovata*)**FAMILY JUGLANDACEAE**Water Hickory (*Carya aquatica*)Sweet Pecan (*Carya illinoensis*)Eastern Black Walnut (*Juglans nigra*)**FAMILY KRAMERIACEAE**Range Ratany (*Krameria lanceolata*)**FAMILY LAMIACEAE**Browne's Safory (*Clinopodium brownie*)Rough Hedeoma (*Hedeoma hispidum*)Virginia Water Horehound (*Lycopus virginicus*)Lemon Beebalm (*Monarda citriodora*)Spotted Beebalm (*Monarda punctata*)Lionsheart (*Physostegia angustifolia*)Slender False Dragonhead (*Physostegia intermedia*)Showy False Dragonhead (*Physostegia pulchella*)Selfheal (*Prunella vulgaris*)Blue Sage (*Salvia azurea* var. *grandiflora*)Tropical Sage (*Salvia coccinea*)Lyre-leaf Sage (*Salvia lyrata*)Drummond Skullcap (*Scutellaria drummondii*)Egg-leaf Skullcap (*Scutellaria ovate*)Mouse-ear Betony (*Stachys crenata*)Pink Mint (*Stachys drummondii*)Canadian Germander (*Teucrium canadense*)Costal Germander (*Teucrium cubense*)Prairie Germander (*Teucrium lancinatum*)**FAMILY LENTIBULARIACEAE**Conespur (*Utricularia gibba*)Purple Bladderwort (*Utricularia purpurea*)**FAMILY LINACEAE**Winged Flax (*Linum alatum*)Stiff Yellow Flax (*Linum medium* var. *texanum*)Berlandier's Flax (*Linum rigidum* var. *berlandieri*)**FAMILY LOGANIACEAE**Lax Hornpod (*Mitreola petiolata*)Juniperleaf (*Polypremum procumbens*)Texas Pinkroot (*Spigelia loganioides*)**FAMILY LYTHRACEAE**Purple Ammannia (Toothcup) (*Ammannia coccinea*)Sticky Waxweed (*Cuphea glutinosa*)Lance-leaf Loosestrife (*Lythrum alatum* var. *lanceolatum*)California Lythrum (*Lythrum californicum*)Rotala Tooth-cup (*Rotala ramosior*)**FAMILY MALVACEAE**

Tall Poppy-mallow (*Callirhoe leiocarpa*)
 Woods Wine Cups (*Callirhoe papaver*)
 Scarlet Hibiscus (*Hibiscus coccineus*)
 Halberdleaf Rosemallow (*Hibiscus laevis*)
 Woolly Crimson-eyed rosemallow
 (*Hibiscus moscheutos subsp. Lasiocarpos*)
 Virginia Salt-marsh-mallow (*Kosteletzkya virginica*)
 Malva de Caballo (*Malachra capitata*)
 Three-lobed False-mallow (*Malvastrum coromandelianum*)

Turks Cap Hibiscus (*Malvaviscus arboreus*)
 Turk's Cap (*Malvastrum arboreus* var. *drummondii*)
 Carolina Bristlymallow (*Modiola caroliniana*)
 Showy Sida (*Sida Lindheimeri*)
 Arrow-leaf Fanpetals (*Sida rhombifolia*)
 Prickly Sida (*Sida spinosa*)

FAMILY MARANTACEAE
 Powdered Thalia (*Thalia dealbata*)

FAMILY MELASTOMATACEAE
 Maryland Meadow Beauty (*Rhexia mariana*)

FAMILY MELIACEAE
 Chinaberry (China-ball) (*Melia acedarach*)

FAMILY MENISPERMACEAE
 Carolina Smailseed (*Cocculus carolinus*)
 Orientvine (*Cocculus diversifolius*)

FAMILY MOLLUGINACEAE
 Spreading Sweetjuice (*Glinus radiates*)
 Green Carpet-Weed (*Mollugo verticillata*)

FAMILY MORACEAE
 Osage-orange (*Maclura pomifera*)
 Red Mulberry (*Morus rubra*)

FAMILY MYRICACEAE
 Southern Wax-myrtle (*Morella cerifera*)

FAMILY NYMPHAECEAE
 Senorita (Blue) Waterlily (*Nymphaea elegans*)

FAMILY OLEACEAE
 Eastern Swamp-privet (*Forestiera acuminata*)
 Upland Forestiera (*Forestiera ligustrina*)
 Green Ash (*Fraxinus pennsylvanica*)

Japanese Privet (*Ligustrum japonica*)
 Wax leaf Privet (*Ligustrum lucidum*)
 Chinese Privet (*Ligustrum sinense*)

FAMILY ONAGRACEAE

Plains Gaura (*Gaura brachycarpa*)
 Lindheimer's Beeblossom (*Gaura lindheimeri*)
 Large Flowered Beeblossom (*Gaura longiflora*)
 Small Flowered Beeblossom (*Gaura mollis*)
 Cylindric-fruit Seedbox (*Ludwigia glandulosa*)
 Narrow-leaf Seedbox (*Ludwigia linearis*)
 Water-primrose (*Ludwigia octovalis*)
 Marsh Seedbox (*Ludwigia palustris*)

Verdolaga de Agua (*Ludwigia peploides*)
 Creeping Primrose-willow (*Ludwigia repens*)
 Uruguay Water Primrose (*Ludwigia uruguayensis*)*
 Beach Evening-primrose (*Oenothera laciniata*)
 Cutleaf Evening-primrose (*Oenothera laciniata*)
 Pink (Showey) Evening-primrose (*Oenothera speciosa*)

FAMILY OXALIDACEAE

Pink Woodsorrel (*Oxalis debilis*)*
 Yellow Wood-sorrel (*Oxalis stricta*)

Violet woodsorrel (*Oxalis violacea*)

FAMILY PASSIFLORACEAE

Purple Passion Flower (Maypop) (*Passiflora incarnata*)
 Yellow Passion Flower (*Passiflora lutea*)

FAMILY PHYTOLACCACEAE

Pokeweed (*Phytolacca americana*)
 Bloodberry Pigeonberry (*Rivina humilis*)

FAMILY PLANTAGINACEAE

Slender Plantain (*Plantago elongate*)
 Hybrid Plantain (*Plantago heterophylla*)

Red-seed Plantain (*Plantago rhodosperma*)
 Pale-seed Plantain (*Plantago virginica*)

FAMILY PLUMBAGINACEAE

Carolina Sea-lavender (*Limonium nashii*)

FAMILY POLYGALACEAE

Pink Milkwort (*Polygala incarnata*)
 Whorled Milkwort (*Polygala verticillata*)

FAMILY POLYGONACEAE

American Buckwheat-vine (*Brunnichia ovata*)
 Smartweed (*Polygonum amphibium*)
 Smartweed (*Polygonum amphibium* var. *emersum*)
 Prostrate Knotweed (*Polygonum aviculare*)

Swamp Smartweed (*Polygonum hydropiperoides*)
 Pennsylvania Smartweed (*Polygonum punctatum*)
 Bushy Smartweed (*Polygonum ramosissimum*)
 Bristly Smartweed (*Polygonum setaceum*)

Virginia Jumpseed (*Polygonum virginianum*)
Golden Fruited-dock (*Rumex chrysocarpus*)

Curley Dock (*Rumex crispus*)
Fiddle Dock (*Rumex pulcher*)*
Swamp Dock (*Rumex verticillatus*)

FAMILY PONTEDERIACEAE

Blue Mudplantain (*Heteranthera limosa*)
Mudplantain (*Heteranthera reniformis*)

FAMILY PORTULACACEAE

Common Purslane (*Portulaca oleracea*)
Shaggy Portulaca (*Portulac pilosa*)

Wingpod Purslane (*Portulaca umbraticola*)

FAMILY PRIMULACEAE

Scarlet Pimpernel (*Anagallis arvensis*)
Small Pimpernel (*Anagallis minima*)
Chaffweed (*Centunculus minimus*)
Bractless (Coast) Brookweed (*Samolus ebracteatus*)

Limewater Brookweed (*Samolus ebracteatus* var. *alyssoides*)
Valerand's Small-flowered Brookweed (*Samolus valerandi* subsp. *parviflorus*)

FAMILY RANUNCULACEAE

Ten-petal Anemone (Windflower) (*Anemone berlandieri*)
Tuber Anemone (*Anemone heterophylla*)
Swamp Clematis (Blue jasmine) (*Clematis crispa*)
Texas virgin's Bower (*Clematis drummondii*)
Pitchers Virgin's Bower (*Clematis pitcherii*)
Blue Larkspur (*Delphinium carolinianum*)

Tiny Mousetail (*Myosurus minimus*)
Glowing Bristly Buttercup (*Ranunculus hispidus*)
Spiny-seed (fruit) Buttercup (*Ranunculus muricatus*)
Prairie Buttercup (*Ranunculus platensis*)
Low Buttercup (*Ranunculus pusillus*)
Creeping Buttercup (*Ranunculus repens*)
Hairy Buttercup (*Ranunculus sardous*)

FAMILY RHAMNACEAE

Rattan Vine (Alabama supplejack) (*Berchemia scandens*)
Carolina Buckthorn (*Frangula caroliniana*)

FAMILY ROSACEAE

Reverchon Hawthorne (*Crataegus reverchonii*)
Little-hip Hawthorn (*Crataegus spathulata*)
Hawthorn (*Crataegus viridis* var. *viridis*)
Green Hawthorn (*Crataegus viridis*)

White Avens (*Gum canadense*)
Carolina Cherry-laurel (*Prunus caroliniana*)
Macartney Rose (*Rosa bracteata*)
Highbush Blackberry (*Rubus argutus*)
Southern Dewberry (*Rubus trivialis*)

FAMILY RUBIACEAE

Buttonbush (*Cephalanthus occidentalis*)

Rough Buttonweed (Poorjoe) (*Diodia teres*)
 Virginia Buttonweed (*Diodia virginiana*)
 Catchweed Bedstraw (*Galium aparine*)
 Stiff Marsh Bedstraw (*Galium labradoricum*)
 Dry Bedstraw (*Galium tinctorium*)*
 Bedstraw (*Galium uniflorum*)

Rough Falsepennyroyal (*Hedeoma hispida*)
 Prairie Bluetets (*Hedyotis nigricans*)
 Bluets (*Oldenlandia boscii*)
 Clustered Mille Graines (*Oldenlandia uniflora*)
 Pink Spurwort (*Sherardia arvensis*)*
 Smooth False Buttonweed (*spermacoce glabra*)

FAMILY RUTACEAE

Chapatillo (*Amyris texana*)
 Water Ash (*Ptelea trifoliata*)

Hercules' Club (*Zanthoxylum clavaherculis*)

FAMILY SALICACEAE

Black Willow (*Salix nigra*)

FAMILY SAPINDACEAE

Balloon-vine (*Cardiospermum halicacabum*)
 Heartseed (*Cardiospermum microcarpum*)

Drummond's Western Soapberry (*Sapindus saponaria* var. *drummondii*)

FAMILY SAPOTACEA

Gum Bumelia (*Sideroxylon lanuginosum* ssp. *lanuginosum*)

FAMILY SAXIFRAGACEAE

Petiteplant (*Lepuropetalon spathulatum*)

FAMILY SCROPHULARIACEAE

Beach False-foxglove (*Agalinis fasciculata*)
 Prairied False-foxglove (*Agalinis heterophylla*)
 Seaside Gerardia (*Agalinis maritima*)
 Ridge Stem False-foxglove (*Agalinis oligophylla*)
 Saltmarsh Gerardia (*Agalinis purpurea*)
 Water-hyssop (*Bacopa monnieri*)
 Texas Paintbrush (*Castilleja indivisa*)
 Browne's Savory (*Clinopodium brownie*)
 Virginia Hedge-hyssop (*Gratiola virginiana*)

Texas Toad-flax (*Linaria texana*)
 False Pimpernel (*Lindernia dubia*)
 Axilflower (*Mecardonia acuminata*)
 Yellow Flowered Mecardonia (Pagesia) (*Mecardonia procumbens*)
 Pagesia (*Mecardonia vandellioides*)
 Texas Toadflax (*Nuttallanthus texanus*)
 Nodding Beardtounge (*Pentstemon laxiflorus*)
 Gulf Coast penstemon (*Penstemon tenuis*)
 Purslane speedwell (*Veronica peregrine*)
 Wayside Speedwell (*Veronica polita*)

FAMILY SOLANACEAE

Seaside Petunia (*Calibrachoa parviflora*)
 Carolina Worfberry (*Lycium carolinianum* var. *guadrifidum*)

Cut-leaf Groundcherry (*Physalis angulata* var. *lanceifolia*)

Downy Groundcherry (*Physalis pubescens*)

Texas Groundcherry (*Physalis virginiana* var. *texana*)

American Black Nightshade (*Solanum amercanum*)

Carolina Nightshade (*Solanum carolinense*)

Siverleaf Nightshade (*Solanum elaeagnifolium*)

Nightshade (*Solanum nodiflorum*)

Buffalo Bur (*Solanum rostratum*)

Texas Nightshade (Tomatillo) (*Solanum triquetrum*)

FAMILY SPHENOCLEACEAE

Chicken Spike (*Sphenoclea zeylanica*)

FAMILY STERCULIACEAE

Broom-weed (Chocolate weed) (*Melochia corchorifolia*)

Angle-pod Broomweed (*Melochia pyramidata*)

FAMILY TAMERACEAE

Saltcedar Tamarisk (*Tamarix gallica*)

FAMILY TILIACEAE

Smooth Orinoco Jute (*Corchorus hirtus* var. *glabellus*)

FAMILY ULMACEAE

Sugar Hackberry (*Ceeltis laevigata* var. *laevigata*)

American Elm (*Ulmus americana*)

Cedar Elm (*Ulmus crassifolia*)

Slippery Elm (*Ulmus rubra*)

FAMILY URTICACEAE

False-nettle (*Boehmeria cylindrical*)

Florida Pellitory (*Parietaria floridana*)

Brush Noseburn (*Tragia glanduligera*)

Pennsylvania Pellitory (*Parietaria pennsylvanica*)

Heart-leaf Stinging-nettle (*Urtica chamaedryoides*)

Dog Nettle (*Utica urens*)

FAMILY VALERIANACEAE

Woods' Cornsalad (*Valerianella woodsiana*)

FAMILY VERBENACEAE

American Beautyberry (*Callicarpa americana*)

West Indies Lantana (*Lantana camara*)

Common Lantana (*Lantana horrida*)

Texas Lantana (*Lantana utricoides*)

Lance-leaf Frogfruit (*Phyla lanceolata*)

Turkey-tangle (*Phyla nodiflora*)

Diamond-leaf Frogfruit (*Phyla strigulosa*)

Brazilian Vervain (*Verbena brasiliensis*)

South American Vervain (*Verbena bonariensis*)*

Texas Vervain (*Verbena halei*)

Brazilian Vervain (*Verbena litoralis*)*

Nettle-leaf Vervain (*Verbena urticifolia*)

Virginia Frostweed (*Verbena xutha*)

Chastetree (*Vitex agnus-castu*)

FAMILY VIOLACEAE

Missouri Bayou Violet (*Viola sororia*)

FAMILY VISCACEAE

Christmas Mistletoe (*Phoradendron tomentosum*)

FAMILY VITACEAE

Pepper-vine (*Ampelopsis arborea*)

Raccoon Grape (*Ampelopsis cordata*)

Ivy Treebine (*Cissus trifoliata*)

Virginia Creeper (*Parthenocissus
quinquefolia*)

Summer Grape (*Vitis aestivalis*)

Sweet Winter Grape (*Vitis cinerea*)

Mustang Grape (*Vitis mustangensis*)

Catbird Grape (*Vitis palmate*)

(This page intentionally left blank.)

F. Vegetative Alliances of the Texas Mid-coast National Wildlife Refuge Complex

I. BOTTOMLAND HARDWOOD FOREST

I.A.1 *CARYA ILLINOINENSIS - CELTIS LAEVIGATA TEMPORARILY FLOODED FOREST ALLIANCE*

Pecan – Sugarberry Temporarily Flooded Forest Alliance

I.A.2 *CELTIS LAEVIGATA – ULMUS CRASSIFOLIA TEMPORARILY FLOODED FOREST ALLIANCE*

Sugarberry – Cedar Elm Temporarily Flooded Forest Alliance

- a. Cedar Elm – Pecan – Sugarberry/Longleaf Spikegrass – Cherokee Sedge Forest (*Ulmus crassifolia* - *Carya illinoensis* - *Celtis laevigata* / *Chasmanthium sessiliflorum* - *Carex cherokeensis*)*Ulmus crassifolia* - *Carya illinoensis* - *Celtis laevigata* / *Chasmanthium sessiliflorum* - *Carex cherokeensis* Forest

Cedar Elm - Pecan - Sugarberry / Longleaf Spikegrass - Cherokee Sedge Forest Association

I.A.3 *FRAXINUS PENNSYLVANICA - ULMUS AMERICANA - CELTIS LAEVIGATA TEMPORARILY FLOODED FOREST ALLIANCE*

Green Ash - American Elm - Sugarberry Temporarily Flooded Forest Alliance

- a. *Fraxinus pennsylvanica* - *Ulmus americana* - *Celtis laevigata* / *Ilex decidua* Forest Green Ash - American Elm - Sugarberry / Possum-haw Forest

I.A.4 *QUERCUS VIRGINIANA TEMPORARILY FLOODED FOREST ALLIANCE*

Live Oak Temporarily Flooded Forest Alliance

- a. Live Oak / Yaupon - Dwarf Palmetto / Cherokee Sedge - Texas Mallow Forest (*Quercus virginiana* / *Ilex vomitoria* - *Sabal minor* / *Carex cherokeensis* - *Malvaviscus arboreus* var. *drummondii*)

I.A.5 *QUERCUS VIRGINIANA - CARYA ILLINOINENSIS ALLIANCE*

Live Oak – Pecan Alliance

I.A.6 *QUERCUS VIRGINIANA - CELTIS LAEVIGATA FOREST ALLIANCE*

Live Oak – Sugarberry Forest Alliance

- a. Live Oak - Sugarberry / Dwarf Palmetto Forest (*Quercus virginiana* - *Celtis laevigata* / *Sabal minor*)

I.A.7 TRIADICA SEBIFERA FOREST ALLIANCE

Chinese Tallow Tree Forest Alliance

I.A.8 QUERCUS NIGRA FOREST ALLIANCE

Water Oak Forest Alliance

- a. Water Oak / Yaupon / Longleaf Spikegrass Forest (*Quercus nigra* / *Ilex vomitoria* / *Chasmanthium sessiliflorum*)

II. OPEN WATER

II.A.1 HALODULE WRIGHTII PERMANENTLY FLOODED - TIDAL HERBACEOUS ALLIANCE

Shoal-grass Permanently Flooded - Tidal Herbaceous Alliance

III. DISTURBED

Disturbed areas can be categorized as 1) continuously disturbed (e.g., roads, spoil sites, moist soil units, etc), 2) static successional disturbed (e.g., unclassified static successional communities, mud flats, salt pans, etc), and 3) successional disturbed (e.g. old fields). Disturbed areas undergo environmental stresses either naturally or culturally and result in a static vegetation or landscape succession. Therefore they have vegetative or non-vegetative characteristics. If naturally disturbed, as in the case of old fields, the shift in succession to another population may take several years to a decade or more. Salt pans or mud flats for example are frequently disturbed by tidal action to the point where the soil is hypersaline and pioneering seeds are washed away before they germinate. Moist soil units are mechanically manipulated to disrupt invasion by plants such as cattails to keep the area open for waterfowl activity. Other natural conditions may for a time inhibit or promote the occurrence of one dominant species year after year such as those found occupied by wolfweed (*Chloracantha spinosus*).

IV. SALINE MARSH

A. UPPER SALINE MARSH

BACCHARIS HALIMIFOLIA - IVA FRUTESCENS TIDAL SHRUBLAND ALLIANCE

Groundsel-tree - Maritime Marsh-elder Tidal Shrubland Alliance

- a. *Baccharis halimifolia* - *Iva frutescens* - *Morella cerifera* - (*Ilex vomitoria*) Shrubland
Groundsel-tree - Maritime Marsh-elder - Wax-myrtle - (Yaupon) Shrubland
- b. *Iva frutescens* ssp. *frutescens* / *Spartina spartinae* Shrubland

Southern Maritime Marsh-elder / Gulf Cordgrass Shrubland

BORRICHIA FRUTESCENS TIDAL SHRUBLAND ALLIANCE

Seaside Oxeye Tidal Shrubland Alliance

- a. Seaside Oxeye / Saltmeadow Cordgrass - (Black Needlerush) Shrubland Association
Borrichia frutescens / Spartina patens - (Juncus roemerianus) Shrubland
Upper marsh edges and flats strongly dominated by Borrichia frutescens, ranging in size from narrow bands to flats in excess of 500 ha, often just below Iva frutescens or Baccharis halimifolia, often just above marshes dominated by Juncus roemerianus or Spartina alterniflora. Other characteristic species include Spartina patens, Iva frutescens, and Limonium carolinianum.
- b. Seaside Oxeye / Gulf Cordgrass Shrubland Borrichia frutescens / Spartina spartinae) Irregularly tidally flooded shrubland. Other species can include Sarcocornia perennis, Lycium carolinianum, and Batis maritima.

DISTICHLIS SPICATA TIDAL HERBACEOUS ALLIANCE

Saltgrass Tidal Herbaceous Alliance

- a. Saltgrass – (Saltmarsh Dropseed) Herbaceous Vegetation (Distichlis spicata - (Sporobolus virginicus)

This association occurs in upper tidal areas (coastal prairies) and is dominated by Distichlis spicata, often mixed with other halophytic grasses and succulents such as Sporobolus virginicus, Sarcocornia perennis, Batis maritima, Lycium carolinianum, Heliotropium curassavicum, and others.

SPARTINA PATENS - (DISTICHLIS SPICATA) TIDAL HERBACEOUS ALLIANCE

Saltmeadow Cordgrass - (Saltgrass) Tidal Herbaceous Alliance

- a. Saltmarsh cordgrass – Saltgrass – Saltmeadow Cordgrass Mesohaline Tidal Herbaceous Vegetation (Spartina alterniflora - Distichlis spicata - Spartina patens)
- b. Gulf Cordgrass - Saltmarsh Dropseed Tidal Herbaceous Vegetation Association (Spartina spartinae – Sporobolus virginicus)
- c. Paspalum vaginatum - Spartina patens Oligohaline Herbaceous Vegetation Seashore
Crowngrass - Saltmeadow Cordgrass Oligohaline Herbaceous Vegetation
- d. Spartina alterniflora - Distichlis spicata - Spartina patens Mesohaline Tidal Herbaceous Vegetation
Saltmarsh Cordgrass - Saltgrass - Saltmeadow Cordgrass Mesohaline Tidal Herbaceous Vegetation
- e. Spartina patens - Schoenoplectus (americanus, pungens) - (Distichlis spicata) Herbaceous Vegetation

Saltmeadow Cordgrass - (Chairmaker's Bulrush, Threesquare) - (Saltgrass) Herbaceous Vegetation

F.1.1. PHRAGMITES AUSTRALIS TEMPORARILY FLOODED HERBACEOUS ALLIANCE

Common Reed Temporarily Flooded Herbaceous Alliance

RUPPIA MARITIMA PERMANENTLY FLOODED - TIDAL TEMPERATE HERBACEOUS ALLIANCE

Beaked Ditch-grass Permanently Flooded - Tidal Temperate Herbaceous Alliance

SPARTINA PATENS - (DISTICHLIS SPICATA) TIDAL HERBACEOUS ALLIANCE

Saltmeadow Cordgrass - (Saltgrass) Tidal Herbaceous Alliance

SPARTINA PATENS - (SCHOENOPLECTUS PUNGENS) HERBACEOUS ALLIANCE

Saltmeadow Cordgrass - (Threesquare) Herbaceous Alliance

B. LOWER SALINE MARSH

BACCHARIS HALIMIFOLIA - IVA FRUTESCENS TIDAL SHRUBLAND ALLIANCE

Groundsel-tree - Maritime Marsh-elder Tidal Shrubland Alliance

- a. Baccharis halimifolia - Iva frutescens - Morella cerifera - (Ilex vomitoria) Shrubland
Groundsel-tree - Maritime Marsh-elder - Wax-myrtle - (Yaupon) Shrubland

This community is usually best developed at the upper limit of non-storm tidal inundation, on natural levees deposited by above-normal tides. The most common species are typically Baccharis halimifolia, Morella cerifera, Iva frutescens ssp. frutescens, Lycium carolinianum, Baccharis angustifolia, and Ilex vomitoria. Other species which may be present include Borrchia frutescens, Fimbristylis castanea, Limonium carolinianum, and Solidago sempervirens.

Iva frutescens ssp. frutescens / Spartina spartinae Shrubland

- b. Iva frutescens ssp. frutescens / Spartina spartinae Shrubland
Southern Maritime Marsh-elder / Gulf Cordgrass Shrubland

SARCOCORNIA PERENNIS - (DISTICHLIS SPICATA, SPARTINA ALTERNIFLORA) TIDAL DWARF-SHRUBLAND ALLIANCE

Woody Glasswort - (Saltgrass, Saltmarsh Cordgrass) Tidal Dwarf-shrubland Alliance

- a. Sarcocornia perennis - Batis maritima - Distichlis spicata Dwarf-shrubland Woody Glasswort - Saltwort - Saltgrass Dwarf-shrubland

BORRICHIA FRUTESCENS TIDAL SHRUBLAND ALLIANCE

Seaside Oxeye Tidal Shrubland Alliance

- a. Seaside Oxeye / Saltmeadow Cordgrass - (Black Needlerush) Shrubland
- b. *Borrichia frutescens* / *Spartina patens* - (*Juncus roemerianus*) Shrubland
- c. Seaside Oxeye/Gulf Cordgrass Shrubland
- d. *Borrichia frutescens* / *Spartina spartinae* Shrubland

BATIS MARITIMA TIDAL DWARF-SHRUBLAND ALLIANCE

Saltwort Tidal Dwarf-shrubland Alliance; Planta de Sal Dwarf-shrubland Alliance

- a. Saltwort – Woody Glasswort Dwarf-shrubland Association (*Batis maritima* - *Sarcocornia perennis*, *S. virginica*)

JUNCUS ROEMERIANUS TIDAL HERBACEOUS ALLIANCE

Black Needlerush Tidal Herbaceous Alliance

- a. *Juncus roemerianus* Herbaceous Vegetation Black Needlerush Herbaceous Vegetation

SCHIZACHYRIUM LITTORALE SHRUB HERBACEOUS ALLIANCE

Seaside Little Bluestem Shrub Herbaceous Alliance

SPARTINA ALTERNIFLORA TIDAL HERBACEOUS ALLIANCE

Saltmarsh Cordgrass Tidal Herbaceous Alliance

- a. *Spartina alterniflora* - *Juncus roemerianus* - *Distichlis spicata* Herbaceous Vegetation
- b. Saltmarsh Cordgrass - Black Needlerush - Saltgrass Herbaceous Vegetation

V. SALINE PRAIRIE*BACCHARIS HALIMIFOLIA SATURATED SHRUBLAND ALLIANCE*

Groundsel-tree Saturated Shrubland Alliance

BACCHARIS HALIMIFOLIA - IVA FRUTESCENS TIDAL SHRUBLAND ALLIANCE

Groundsel-tree - Maritime Marsh-elder Tidal Shrubland Alliance

- a. *Iva frutescens* ssp. *frutescens* / *Spartina spartinae* Shrubland
Southern Maritime Marsh-elder / Gulf Cordgrass Shrubland

BORRICHIA FRUTESCENS TIDAL SHRUBLAND ALLIANCE

Seaside Oxeye Tidal Shrubland Alliance

- a. *Borrichia frutescens* / *Spartina patens* - (*Juncus roemerianus*) Shrubland Seaside Oxeye /
Saltmeadow Cordgrass - (Black Needlerush) Shrubland

- b. *Borrichia frutescens* / *Spartina spartinae* ShrublandSeaside Oxeye / Gulf Cordgrass Shrubland
Irregularly tidally flooded shrubland. Other species can include *Sarcocornia perennis*, *Lycium carolinianum* var. *quadrifidum*, and *Batis maritima*.

MONANTHOCHLOE LITTORALIS TIDAL HERBACEOUS ALLIANCE

Shoregrass Tidal Herbaceous Alliance

PROSOPIS GLANDULOSA SHRUBLAND ALLIANCE

Honey Mesquite Shrubland Alliance

On the complex it is considered to be the northernmost occurrence of its historic range on the Texas Gulf Coast.

- a. *Prosopis glandulosa* var. *glandulosa* - *Opuntia engelmannii* var. *lindheimeri* - *Borrichia frutescens* ShrublandHoney Mesquite - Texas Prickly-pear - Seaside Oxeye Shrubland

SPARTINA PATENS - (DISTICHLIS SPICATA) TIDAL HERBACEOUS ALLIANCE

Saltmeadow Cordgrass - (Saltgrass) Tidal Herbaceous Alliance

- a. Saltmeadow Cordgrass - (Chairmaker's Bulrush, Threesquare) - (Saltgrass) Herbaceous Vegetation Association (*Spartina patens* – *Schoenoplectus* (*Americanus*, *Pungens*) – (*Distichlis spicata*)

b.

SPARTINA SPARTINAE SATURATED HERBACEOUS ALLIANCE

Gulf Cordgrass Saturated Herbaceous Alliance

- a. Gulf Cordgrass – Little Bluestem Herbaceous Vegetation
Spartina spartinae - *Schizachyrium scoparium* Vegetation

VI. UPLAND PRAIRIE/FRESHWATER WETLANDS

ANDROPOGON GLOMERATUS TEMPORARILY FLOODED HERBACEOUS ALLIANCE

Bushy Broomsedge Temporarily Flooded Herbaceous Alliance

SAGITTARIA LATIFOLIA SEMIPERMANENTLY FLOODED HERBACEOUS ALLIANCE

Broadleaf Arrowhead Semipermanently Flooded Herbaceous Alliance

TRIADICA SEBIFERA FOREST ALLIANCE

Chinese Tallow-tree Forest Alliance

SCHOENOPLECTUS AMERICANUS SEMIPERMANENTLY FLOODED HERBACEOUS ALLIANCE

Chairmaker's Bulrush Semipermanently Flooded Herbaceous Alliance

SCHOENOPLECTUS CALIFORNICUS SEMIPERMANENTLY FLOODED HERBACEOUS ALLIANCE

Giant Bulrush Semipermanently Flooded Herbaceous Alliance

- a. Schoenoplectus californicus Herbaceous Vegetation
Giant Bulrush Herbaceous Vegetation

PHRAGMITES AUSTRALIS SEMIPERMANENTLY FLOODED HERBACEOUS ALLIANCE

Common Reed Semipermanently Flooded Herbaceous Alliance

LUDWIGIA PEPLOIDES SEMIPERMANENTLY FLOODED HERBACEOUS ALLIANCE

Floating Water-primrose Semipermanently Flooded Herbaceous Alliance

BACCHARIS HALIMIFOLIA SATURATED SHRUBLAND ALLIANCE
Groundsel-tree Saturated Shrubland Alliance

SAGITTARIA LANCIFOLIA SEMIPERMANENTLY FLOODED HERBACEOUS ALLIANCE

Lanceleaf Arrowhead Semipermanently Flooded Herbaceous Alliance

SCHIZACHYRIUM SCOPARIUM - PASPALUM PLICATULUM HERBACEOUS ALLIANCE
Little Bluestem - Brownseed Crowngrass Herbaceous Alliance

- a. Little Bluestem - Brownseed Crowngrass - Yellow Indiangrass - Few-flower Witchgrass - Slender Crowngrass - Western Silvery Aster Alfisol Herbaceous Vegetation Association (Schizachyrium scoparium - Paspalum plicatum - Sorghastrum nutans - Dichanthelium oligosanthes - Paspalum setaceum - Symphyotrichum pratense)
- b. Schizachyrium scoparium - Paspalum plicatum - Sorghastrum nutans - Dichanthelium oligosanthes - Paspalum setaceum - Symphyotrichum pratense Alfisol Herbaceous Vegetation
Little Bluestem - Brownseed Crowngrass - Yellow Indiangrass - Few-flower Witchgrass - Slender Crowngrass - Western Silvery Aster Alfisol Herbaceous Vegetation.
- c. Schizachyrium scoparium - Sorghastrum nutans - Paspalum plicatum - Carex microdonta - Neptunia lutea Herbaceous Vegetation
Little Bluestem - Yellow Indiangrass - Brownseed Crowngrass - Little-tooth Sedge - Yellow-puff Herbaceous Vegetation

TYPHA (ANGUSTIFOLIA, LATIFOLIA) - (SCHOENOPLECTUS SPP.) SEMIPERMANENTLY FLOODED HERBACEOUS ALLIANCE

(Narrowleaf Cattail, Broadleaf Cattail) - (Bulrush species) Semipermanently Flooded Herbaceous Alliance

- a. Typha (angustifolia, domingensis, latifolia) - Schoenoplectus americanus Herbaceous Vegetation
(Narrowleaf Cattail, Southern Cattail, Broadleaf Cattail) - Chairmaker's Bulrush Herbaceous Vegetation

POTAMOGETON SPP. - CERATOPHYLLUM SPP. - ELODEA SPP. PERMANENTLY FLOODED HERBACEOUS ALLIANCE

Pondweed species - Coontail species - Waterweed species Permanently Flooded Herbaceous Alliance

SPARTINA PATENS SEASONALLY FLOODED HERBACEOUS ALLIANCE

Saltmeadow Cordgrass Seasonally Flooded Herbaceous Alliance

- a. Bushy Goldentop - Swamp Sunflower - White Doll's Daisy - Saltmeadow Cordgrass Herbaceous Vegetation
Euthamia leptoccephala - Helianthus angustifolius - Boltonia asteroides - Spartina patens Vegetation
- b. Saltmeadow Cordgrass - (Tufted Fimbry, Chestnut Fimbry) - (Gulfdune Crowngrass) Herbaceous Vegetation
Spartina patens - Fimbristylis (caroliniana, castanea) - (Paspalum monostachyum) Herbaceous Vegetation

PANICUM VIRGATUM - TRIPSACUM DACTYLOIDES HERBACEOUS ALLIANCE

Switchgrass - Eastern Gammagrass Herbaceous Alliance

NELUMBO LUTEA PERMANENTLY FLOODED TEMPERATE HERBACEOUS ALLIANCE

American Lotus Permanently Flooded Temperate Herbaceous Alliance

PASPALUM VAGINATUM TEMPORARILY FLOODED HERBACEOUS ALLIANCE

Seashore Crowngrass Temporarily Flooded Herbaceous Alliance

POLYGONUM SPP. SEASONALLY FLOODED HERBACEOUS ALLIANCE

Smartweed species Seasonally Flooded Herbaceous Alliance

Pennsylvania Smartweed - Pale Smartweed Herbaceous Vegetation Association (Polygonum pensylvanicum – Polygonum lapathifolium)

ELEOCHARIS QUADRANGULATA - SAGITTARIA SPP. SEASONALLY FLOODED HERBACEOUS ALLIANCE

Squarestem Spikerush - Arrowhead species Seasonally Flooded Herbaceous Alliance

PANICUM VIRGATUM - TRIPSACUM DACTYLOIDES HERBACEOUS ALLIANCE

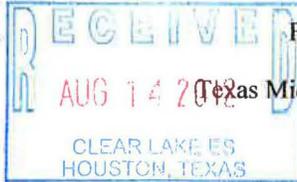
Switchgrass - Eastern Gammagrass Herbaceous Alliance

- a. Switchgrass - Eastern Gammagrass - (Maidencane) Herbaceous Vegetation (Panicum virgatum - Tripsacum dactyloides - (Panicum hemitomom)

[This page intentionally left blank.]



United States Department of the Interior



FISH AND WILDLIFE SERVICE

Texas Mid-coast National Wildlife Refuge Complex

In Reply Refer To:
R2/NWRS-PLN

Memorandum

To: Field Supervisor, Clear Lake Ecological Services Field Office, Region 2, Houston, TX

From: Project Leader, Texas Mid-coast NWR Complex, Region 2 

Subject: Review Copy, Draft Comprehensive Conservation Plan and Environmental Assessment (CCP/EA) for Texas Mid-coast NWR Complex and Intra-Service Section 7 Consultation

Please review the attached copy of the Intra-Service Section 7 Consultation and draft CCP/EA for the Texas Mid-coast NWR Complex. We have determined that implementation of the proposed CCP may affect, but is not likely to adversely affect the Attwater's prairie chicken, whooping crane, piping plover or its designated critical habitat, Atlantic hawksbill sea turtle, green sea turtle, Kemp's ridley sea turtle, leatherback sea turtle, loggerhead sea turtle; will have no effect on northern aplomado falcon, interior least tern, smalltooth sawfish; and is not likely to jeopardize Sprague's pipit and Red Knot. Your comments on the draft CCP/EA and concurrence with our findings would be greatly appreciated.

If you have any questions, please contact me at (979) 964-4011. Thank you for your timely review of this CCP/EA and Intra-Service Section 7 Consultation.

Attachment

cc: Chief, Division of Planning, NWRS, Region 2

[This page intentionally left blank.]

G. INTRA-SERVICE SECTION 7 BIOLOGICAL EVALUATION FORM

Originating Person: Jennifer Sanchez

Telephone Number: (979) 964-4011

Date: June 15, 2012

I. Region: Southwest

II. Service Activity (Program):

Refuges: Texas Mid-coast National Wildlife Refuge Complex (TMCNWR)

III. Pertinent Species and Habitat:

A. Listed species and/or their critical habitat within the action area:

Attwater's prairie-chicken (*Tympanuchus cupido attwateri*) (APC)

Whooping crane (*Grus americana*)

Northern aplomado falcon (*Falco femoralis septentrionalis*)

Interior Least Tern (*Sterna antillarum athalassos*)

Piping plover (*Charadrius melodus*)

Smalltooth sawfish (*Pristis pectinata*)

Atlantic hawksbill sea turtle (*Eretmochelys imbricate*)

Green sea turtle (*Chelonia mydas*)

Kemp's Ridley sea turtle (*Lepidochelys kempii*)

Leatherback sea turtle (*Dermochelys coriacea*)

Loggerhead sea turtle (*Caretta caretta*)

Critical Habitat:

Piping Plover, *Charadrius melodus*

B. Proposed species and/or proposed critical habitat within the action area:

None

C. Candidate species within the action area:

Sprague's pipit (*Anthus spragueii*)

Red Knot (*Calidris canutus*)

IV. Geographic area or station name and action:

The proposed action is to implement a Comprehensive Conservation Plan for Texas Mid-coast NWR Complex located in Brazoria, Matagorda and Ft. Bend and Wharton Counties.

V. **Location:**

A. **Ecoregion Number and Name:**

Gulf Coast Prairies and Marshes Ecoregion

B. **County and State:**

Brazoria, Matagorda, Fort Bend, and Wharton Counties, Texas

C. **Section, township, and range (or latitude and longitude):**

31° 42' N 96° 14' W

D. **Distance (miles) and direction to nearest town:**

Primary parcels approximately 10 miles east and 10 miles west of Freeport, TX

E. **Species/habitat occurrence:**

- *Attwater prairie Chicken*- The Complex has no Attwater prairie chickens at this time but has been identified as a potential future re-introduction site.
- *Whooping crane* - Whooping Cranes do not regularly occur on the Complex but for the cranes to reach recovery status, the Aransas/Wood Buffalo population will need to expand. Mid-coast Refuges (with Big Boggy first) will probably be required for the cranes to reach recovery status, due to the territorial nature of the birds. Plans to expand the range outside the current migration corridor are not established and the Mid-coast refuges do not have plans specific to providing whooping crane habitat at this time.
- *Northern aplomado falcon* - From 1996 to 1999, Northern aplomado falcons were hacked on Matagorda Island and are continuing to nest and inhabit the Island's prairie habitat. Since then, two documented sightings of aplomado falcons have occurred on San Bernard NWR; the most recent in December 2011. Both sightings appear to be single transient birds. If the population were to increase the refuges may provide future nesting habitats. No directed management actions for this species are planned at this time.
- *Interior least tern* - The interior subspecies of least tern is a listed species for Fort Bend and **Wharton** Counties. This subspecies is distinguished from the coastal subspecies in its location of nesting, along rivers and mudflats on the interior middle N. America. For this reason nesting birds identified more than 50 miles from the coast are considered interior subspecies. These birds cannot be easily distinguished from coastal least terns and overlap migration and wintering areas. No documented nesting occurs in either Fort Bend or Wharton County and birds found are wintering or transient. No directed management actions for this species are planned at this time.

- *Piping plover*- The Texas Gulf Coast provides valuable wintering habitat for the piping plover. A portion of the Complex has been designated as critical habitat for the piping plover. The tidal mudflats on our refuges, especially in the Cedar Lakes area of San Bernard NWR, are extremely valuable to this and other plovers. These mudflats are not clearly identified in the critical habitat designation, but they are at times more valuable to this species than the nearby beaches.
- *Sprague's pipit* - Sprague's pipit is known to occur in Brazoria, Fort Bend, Matagorda, and Wharton counties, but its current status on the Complex is unknown. It is a migrant species found during migration and winter, generally tied to upland native grasslands and can be found in large numbers in coastal grasslands. It is associated with native coastal prairie and salty prairie habitats on the Complex similar to the American pipit. It prefers shorter prairie or prairie patches among denser or more mature prairie stands. It does not tolerate brush encroachment in prairie habitats (Robbins et.al. 1999). It can be found in post-burn areas. The species is a wintering migrant, feeding on insects spiders and some seeds, and may be found on the refuges October through March.
- *Red Knot* – Populations of red knots occur in Brazoria and Matagorda counties mainly September through April. Small numbers overwinter (Eubanks et al. 2006). It mainly rests and forages along beaches, where it is seen eating *Donax* during both spring and fall migration. However, on one occasion during fall migration a small group was observed on tidal mud flats at Cedar Lakes, on the bay side of the dune lines. San Bernard and Sargent Beaches and Cedar Lakes Pass (“the cut”) harbor knots during migration and for the winter.
- *Smalltooth sawfish*- The U.S. population of smalltooth sawfish is found only in the Atlantic Ocean and Gulf of Mexico. Historically, the U.S. population was common throughout the Gulf of Mexico from Texas to Florida, and along the east coast from Florida to Cape Hatteras. This species generally requires marine habitats which are outside of the refuge boundaries, (primarily the Everglades region).
- *Sea Turtles*- Five sea turtles; *Kemp's ridley*, *loggerhead*, *green*, *leatherback* and *hawksbill*, occur in the Gulf and bay waters near the refuges. San Bernard, which has a small segment of Gulf beach has had two documented Kemp's ridley nest in 2009 and 2012. The refuge needs to continue to protect refuge beaches, including restricted vehicular traffic to protect this and other species. The Complex supports all sea turtle recovery efforts by patrolling area beaches for stranding and nests. All nests are excavated and transferred to the incubation site at Padre Island National Seashore. Live turtles are transferred to the NOAA recovery facility in Galveston.

VI. Description of proposed action (attach additional pages as needed):

The proposed action is to implement the Comprehensive Conservation Plan for the Texas Mid-coast NWR Complex over the next 15 years.

The Plan is divided into a series of goals, objectives, and strategies that will be implemented throughout the 15-year term of this Plan. Specific goals associated with the CCP are:

1. To contribute to conservation efforts and to foster the ecological integrity of the Gulf Coast Prairies and Marshes Ecoregion through proven and innovative management practices across the Complex.
2. To conserve and restore, enhance, and protect refuge habitats by implementing appropriate management programs to benefit native flora and fauna, including threatened and endangered species and other species of concern.
3. To protect, maintain, and enhance populations of migratory birds and resident fish and wildlife, including federal and state threatened and endangered species.
4. To develop and implement quality wildlife-dependent recreation programs, which are compatible with refuge purposes, and foster enjoyment and understanding of the Refuge's unique wildlife and plant communities.
5. To provide administrative and public use facilities needed to carry out the refuge's purposes and meet management objectives.

The overall management of the Complex will focus on protecting and restoring native habitats to promote wildlife, while enhancing opportunities for public use, such as hunting, fishing, wildlife observation, wildlife photography, environmental education, and interpretation as well as to increase understanding and support for the Complex and the Refuge system. For detailed descriptions of goals, objectives, and strategies for the Plan, please refer to Chapter 4 of the attached Draft Plan.

VII. Determination of effects:

A. Explanation of effects of the action on species and critical habitats in items III. A, B, and C:

Habitat and Wildlife Management

Restoration and maintenance of bottomland hardwood forests and prairie habitat using management tools such as prescribed fire, invasive species management, planting and harvesting native prairie seed will not have any negative impacts on any of the listed species in and around the Complex boundaries

Public Use

The proposed increase in public use opportunities such as additional hunting opportunities, new trails, boardwalks and photo blinds promoting wildlife observation and wildlife photography as well as additional programs to increase environmental education and interpretation will not have any negative impacts on any listed species. Increased opportunities in all public use programs will be designed to avoid any potential impacts to any listed species.

Facilities/Infrastructure

The proposed increase in infrastructure such as new trails, additional bicycle access, new signs and exhibits, and additional canoe and kayak launches as well as new recreational vehicle sites, new administrative and maintenance facilities and a new visitor contact station will not have any negative impacts on any listed species. Additional opportunities in facilities and infrastructure will be designed to avoid any potential impacts to any listed species.

Overall, no significant adverse impacts to Federally-listed T&E species are expected to occur due to the management direction proposed in the Comprehensive Conservation Plan. Species-specific effects are further discussed below:

Attwater's prairie-chicken

The Attwater's prairie chicken are found only on the coastal prairies of Texas. Although not currently occurring on the Complex, several areas have been identified as potential future reintroduction sites.

Management staff will conduct coordination and studies to determine best potential management direction to maximize success if reintroductions occur on the Complex. Should APC be reintroduced on the Complex, restoration and maintenance of prairie habitat using management tools such as invasive species control, prescribed fire, and grazing should have beneficial impacts on APC recovery efforts.

Whooping Crane

Whooping Cranes do not regularly occur on Mid-coast Refuges. However, for the cranes to reach recovery status, the Aransas/Wood Buffalo population will need to expand. Mid-coast Refuges (with Big Boggy first) will probably be required for the cranes to reach recovery status. Implementing management actions identified in the CCP will not impact whooping cranes at this time.

Northern aplomado falcon

The northern aplomado falcons that have been documented on the Complex are transient visitors and the management direction proposed in the CCP is expected to have no effect on this species.

Interior least tern

While this subspecies of least tern may occur on the Complex, ongoing and proposed management actions are not expected to have any impact on it.

Piping Plover

The Complex serves as wintering habitat and the Service has designated portion of the Complex has been designated as critical habitat for the piping plover. Most of the management action that occur on the Complex will have no effect on the piping plover. The Complex will continue to conduct plover surveys on area beaches and protect designated critical habitat. Efforts to protect San Bernard beach through

limiting vehicle access above the tidal zone, should be beneficial to wintering piping plovers.

Sprague's Pipit

Management of prairie habitats (including prescribed burning, brush control, invasive species control, and grazing) as described in the CCP, can be beneficial to Sprague's pipit conservation.

Red Knot

The habitat types in which this species occurs receive little management. It would benefit from policies that limit vehicle disturbance on beaches and intertidal locations in Cedar Lakes. When its potential habitat is included, it should be considered in reviews of any activities that could impact potential habitat, such as oil and gas operations.

Smalltooth Sawfish

Because the species generally requires marine habitats, which are outside of the Complex boundaries, the refuges cannot play a direct role in the species recovery. However, the Complex can assist with outreach and partnering with state and federal entities to encourage habitat protection. Management actions proposed in the CCP will have no effect on this species.

Sea turtles

Five sea turtles; Kemp's ridley, loggerhead, green, leatherback and hawksbill, occur in the Gulf and bay waters near the refuges. San Bernard, which has a small segment of Gulf beach has had one documented Kemp's ridley nest in 2009. The refuge needs to continue to restrict refuge beaches from vehicular traffic to protect this and other species. The Complex supports and assist with all sea turtle recovery efforts. This includes beach sea turtle surveys during nesting season (May–July), flipper tagging, excavating sea turtle nests and transporting them to the incubation facility at Padre Island National Seashore. The Refuge monitors and responds to calls regarding sea turtles on Gulf coast beaches between the mouth of the Colorado River and Quintana Beach. Live turtles are transferred to the NOAA recovery facility in Galveston.

B. Explanation of actions to be implemented to reduce adverse effects:

The Complex will prohibit or restrict activities in areas where listed species occur. If additional listed species are found, the Complex will change/alter management actions so as not to disturb or impact the species, or consult with the Clear Lake Ecological Services Field Office prior (ESFO) to undertaking such actions to determine the appropriate course of action in order to adequately address any listed species concerns. With respect to public use activities, such as hunting, fishing and wildlife observation, these activities will only be allowed in established pre-designated area, seasons, and times.

As a working document, modification to the objectives and strategies are anticipated. If modifications result in changes to the effects analysis, or include actions that are

Appendix G: Intra-Service Section 7 Biological Evaluation Form

adversely modify proposed critical habitat
(species/unit: n/a)

C. Candidate species:

Determination

Response requested

no effect

(species: none)

___*Concurrence

is not likely to jeopardize candidate species/

(species: Sprague's pipit
Red Knot)

X Concurrence

is likely to jeopardize candidate species

(species: none)

___Conference

Signature

date

Complex Manager, TMC NWR Complex

IX. Reviewing ESO Evaluation:

A. Concurrence Nonconcurrency

B. Formal consultation required

C. Conference required

D. Informal conference required

F. Remarks (attach additional pages as needed):

Signature

Title:

Date

H. Wilderness Review Texas Mid-coast NWR Complex

H.1. Introduction

Wilderness Reviews (Reviews) are a required element of CCPs, and each refuge must follow the Review process outlined in 602 FW 1-3 and 610 FW 1-4. The process includes interagency and tribal coordination, public involvement, and NEPA compliance (610 FW 4.4 A). The purpose of the Review is to identify lands and waters that merit inclusion in the National Wilderness Preservation System (NWPS) and recommend suitable lands for Congressional designation (610 FW 4.4 A).

There are three phases to the Review process: (1) inventory; (2) study; and (3) recommendation. During the inventory phase, we identify lands and waters that meet the minimum criteria for wilderness designation (610 FW 4.4 B). Lands and waters that meet the minimum criteria for designation are called Wilderness Study Areas (WSAs). In the study phase, we assess a range of management alternatives to determine if a WSA is suitable for wilderness designation and corresponding management or if management under an alternate set of goals and objectives is more appropriate (610 FW 4.12 A). The findings of the study phase determine whether we will recommend a WSA for designation in the Final CCP. If we determine that the Complex contains lands and/or waters that are suitable for wilderness designation, we report the recommendation from the Director through the Secretary and the President to Congress in a subsequent Wilderness Study Report (610 FW 4.4). The following team performed the Wilderness Review for the Complex.

Table H-1. Wilderness Review Team

Jennifer Sanchez	Complex Manager	Jennifer_sanchez@fws.gov
Shane Kasson	Refuge Manager	Shane_kasson@fws.gov
Cody Dingee	Refuge Manager	James_dingee@fws.gov
Joseph Lujan	Biologist/Natural Resource Planner	Joseph_lujan@fws.gov

H.2. Wilderness Inventory

Section 2 (c) of the Wilderness Act of 1964 states that wilderness is an area that is “untrammeled by man, where man himself is a visitor who does not remain.” The Act identifies the minimum criteria that an area must meet to be eligible for wilderness. Service policy states that we use the Act’s minimum criteria to identify potential wilderness areas. These criteria include size, apparent naturalness, and outstanding opportunities for solitude or primitive recreation. Supplemental values are evaluated and documented but are not required for a WSA. The Complex Wilderness Review Team (team) met on January 12, 2011 to perform the inventory phase of the review.

Identification of Lands that Meet the Size Criteria

First, the team reviewed each refuge for any lands that meet the size criteria outlined by 610 FW 4.8 and described below:

- An area with more than 5,000 contiguous acres. State and private lands are not included in making this acreage determination.
- A roadless island of any size. A roadless island is defined as an area surrounded by permanent waters or that is markedly distinguished from the surrounding lands by topographical or ecological features (610 FW 1.5 Z).
- An area of less than 5,000 contiguous acres that is of sufficient size as to make practicable its preservation and use in an unimpaired condition, and of a size suitable for wilderness management.
- An area of less than 5,000 contiguous Federal acres that is contiguous with a designated wilderness, recommended wilderness, or area under wilderness review by another Federal agency that manages wilderness, such as the Forest Service, National Park Service, or Bureau of Land Management.

Lands that meet any of these four size criteria are identified as inventory units during the review process. Brazoria NWR contains four and San Bernard NWR contains three inventory units that meet the criteria listed above. These areas are identified in the following map (Figure H-1), and unit is evaluated for wilderness criteria in Table H-2. On Brazoria NWR, these were large areas (>5,000 acres) with minimal roads and are minimally managed. On San Bernard NWR, four bottomland areas that are either near the 5,000 acres or considered to be intact old-growth forest with significant acreage (>1,000) were proposed for evaluation. Two marsh units similar to the criteria for selecting areas on Brazoria NWR were also selected on San Bernard NWR for consideration. Big Boggy NWR was not selected for further evaluation because the total acreage is less than 5,000 acres and this further gets reduced as we remove managed areas, conservation easement areas and buffer areas with regular disturbance. The area for consideration becomes quite small and does not provide an area suitable for wilderness management.

Evaluation of the Naturalness Criteria

Section 2 (c) of the Wilderness Act defines wilderness as an area that "...generally appears to have been affected primarily by the forces of nature with the imprint of man's work substantially unnoticeable." In addition to the size criteria, Service policy states that an inventory unit must meet the naturalness criteria to qualify as a WSA. Although the area must appear natural to the average visitor, policy does not require that the land is in a pristine historic state (610 FW 4.9 A).

During the inventory phase, the team evaluated each inventory unit for the naturalness criteria. The following things were taken into consideration when determining naturalness: roads, navigable waters, the GIWW, oil and gas developments, aggressive fire program, and the fact that the area is within one of the most industrialized areas of the Nation. Findings for each inventory unit are noted in Table H-2.

Evaluation of Outstanding Opportunities for Solitude or Primitive and Unconfined Recreation

In addition to meeting the size and naturalness criteria, an inventory unit must provide outstanding opportunities for solitude or primitive recreation to qualify as a WSA. The Wilderness Act does not define what was intended by solitude or a primitive and unconfined type of recreation. The Service, however, defines solitude as “a state of mind, a mental freedom that emerges from settings where visitors experience nature essentially free of the reminds of society, its inventions, and conventions; privacy and isolation are important components, but solitude is enhanced by the absence of distractions, such as large groups, mechanization, unnatural noise and light, unnecessary managerial presence (such as signs), and other modern artifacts (610 FW 1.5 AA).” The Service defines primitive and unconfined recreation as “activities that provide dispersed, undeveloped recreation and do not generally require permanent facilities (610 FW 1.5 R).” According to 610 FW 4.10, an area does not need to have outstanding opportunities for both solitude and primitive recreation nor does the area need to have outstanding opportunities on every acre.

During the inventory process, the team found that none of the units within the Complex qualified for opportunities for solitude or primitive and unconfined recreation. The results of the inventory are also displayed in Table H-2.

Supplemental Values

Although the presence of supplemental values is not required for an inventory unit to qualify as a WSA, 610 FW 4.11 recommends that the team document their presence if they exist. Supplemental values may include any ecological, geological, or other features of scientific, educational, scenic, or historic value. Since there were not any inventory units that met the “has an outstanding opportunity for solitude or primitive and unconfined recreation” criteria, supplemental values within each inventory unit were not documented.

H.3. Wilderness Inventory Summary

After completing the inventory phase of the Wilderness Review, the team did not find any lands that meet the minimum criteria for a Wilderness Study Area. Therefore, the team does not recommend that the Wilderness Study portion of the Review be performed. This concludes the Wilderness Review process at this time. The process will be replicated in accordance with policy at the time of the next CCP revision.

Table H-2. Minimum Criteria Inventory

Inventory Unit		Minimum Criteria for Wilderness				
Name	Size	(1) has at least 5,000 acres of land or is of sufficient size to make practicable its preservation and use in an unconfined condition or is a roadless island;	(2) generally appears to have been affected primarily by the forces of nature, with the imprint of man's work substantially unnoticeable;	(3) has outstanding opportunities for solitude or primitive and unconfined recreation;	(4) contains ecological, geological, or other features of scientific, educational, scenic, or historical value;	Parcel qualifies as a Wilderness Study Area (Meets criteria 1, 2, and 3)
Brazoria Wharton/Shrimp Farm/Chocolate Bayou	12,000 acres.	Yes. It is greater than 5,000 acres.	Yes.	No. Primarily marsh habitat bounded by state waters on the north and east. Although remote, impact from motorboats on these adjacent waters would preclude its sense of solitude.	N/A	No.

Brazoria Slope Bowl	Approximately 5,000 acres.	Yes. It is greater than 5,000 acres.	No. Oil and gas development has lead to facilities and created subsidence. This will require significant restoration over the next several years.	N/A	N/A	No.
Brazoria Alligator Marsh/Middle Bayou	7,200 acres.	Yes. It is greater than 5,000 acres.	No. Previous oil and gas activities may have created subsidence and abandoned roads impact water movement. The area requires repetitive treatment of invasive species.	N/A	N/A	No.
Brazoria Austin/Walker	10,000 acres	Yes. It is greater than 5,000 acres.	No. Although parts (2,000 plus acres) are natural. These parts are fragmented by man-made ditches, levees and roads. The area requires repetitive treatments of invasive species.	N/A	N/A	No

Appendix H: Wilderness Review

San Bernard Cow Trap Marsh/Cedar Lakes	9,500 acres	Yes. It is greater than 5,000 acres.	Yes. Unbroken saline marsh includes saline lakes and appears natural except for the GIWW.	No. Navigable waters are nearby and within the unit including the GIWW.	N/A	No
San Bernard Smith Marsh/Cedar Lake Creek	6,200 acres	Yes. It is greater than 5,000 acres.	Yes. Unbroken saline marsh includes saline lakes and appears natural.	No. Navigable waters are nearby and within the unit including the GIWW, which would preclude a sense of solitude.	N/A	No
San Bernard Austin's Woods Unit: Big Pond Unit	Unit is composed of three contiguous parcels, which total nearly 5,000 acres.	No. Contiguous acres are less than 5,000 acres. However the unit has unique habitat characteristics which is worthy for consideration.	Yes. The Big Pond Unit tracts of forested habitat are part of the largest remaining forested area within the Columbia Bottomlands.	No. The unit is traversed by six primary pipeline corridors that are maintained as open per Texas Railroad Commission requirements. Pipelines are continuous conduits of invasive species invasion, requiring repetitive control.	N/A	No.

<p>San Bernard Austin’s Woods Unit: Dance Bayou Unit</p>	<p>Two tracts totaling 1,300 contiguous acres.</p>	<p>No. Contiguous acres are less than 5,000 acres, however the unique bottomland habitat characteristics’ are worthy for consideration.</p>	<p>Yes. This unit is recognized for its old growth bottomland forest and utilized extensively for research.</p>	<p>No. The unit is traversed by five primary pipeline corridors that are maintained as open per Texas Railroad Commission Requirements. Pipelines are continuous conduits of invasive species invasion, requiring repetitive control.</p>	<p>N/A</p>	<p>No.</p>
<p>San Bernard Austin’s Woods Unit: Linville Bayou Unit</p>	<p>Three contiguous tracts totaling 1,700 acres.</p>	<p>No. Contiguous acres are less than 5,000 acres, however the unique mature bottomland forest habitat is worthy for consideration.</p>	<p>Yes. The unit has a high percentage of quality unbroken mature bottomland forest.</p>	<p>No. Although Linville Bayou Unit requires minimal invasive species treatments, with a heavy occurrence of Chinese tallow around the boundary, regular treatments to ensure encroachment does not occur.</p>	<p>N/A</p>	<p>No.</p>

Appendix H: Wilderness Review

<p>San Bernard Austin's Woods Unit: Eagle Nest Lake.</p>	<p>One tract totaling 4,500 acres.</p>	<p>No. Contiguous acres are less than 5,000 acres, however the unique wetland habitat is worthy for consideration</p>	<p>Yes. The Eagle Nest Unit includes a 2,000-acre lake/emergent marsh that is unusual and unique in this area.</p>	<p>No. The unit is traversed by two pipeline corridors and two County roads and includes more than 1,000 acres of prairie and forest that require restoration including invasive species treatments. Restoration and treatment will need to be reoccurring.</p>	<p>N/A</p>	<p>No.</p>
--	--	---	--	---	------------	------------

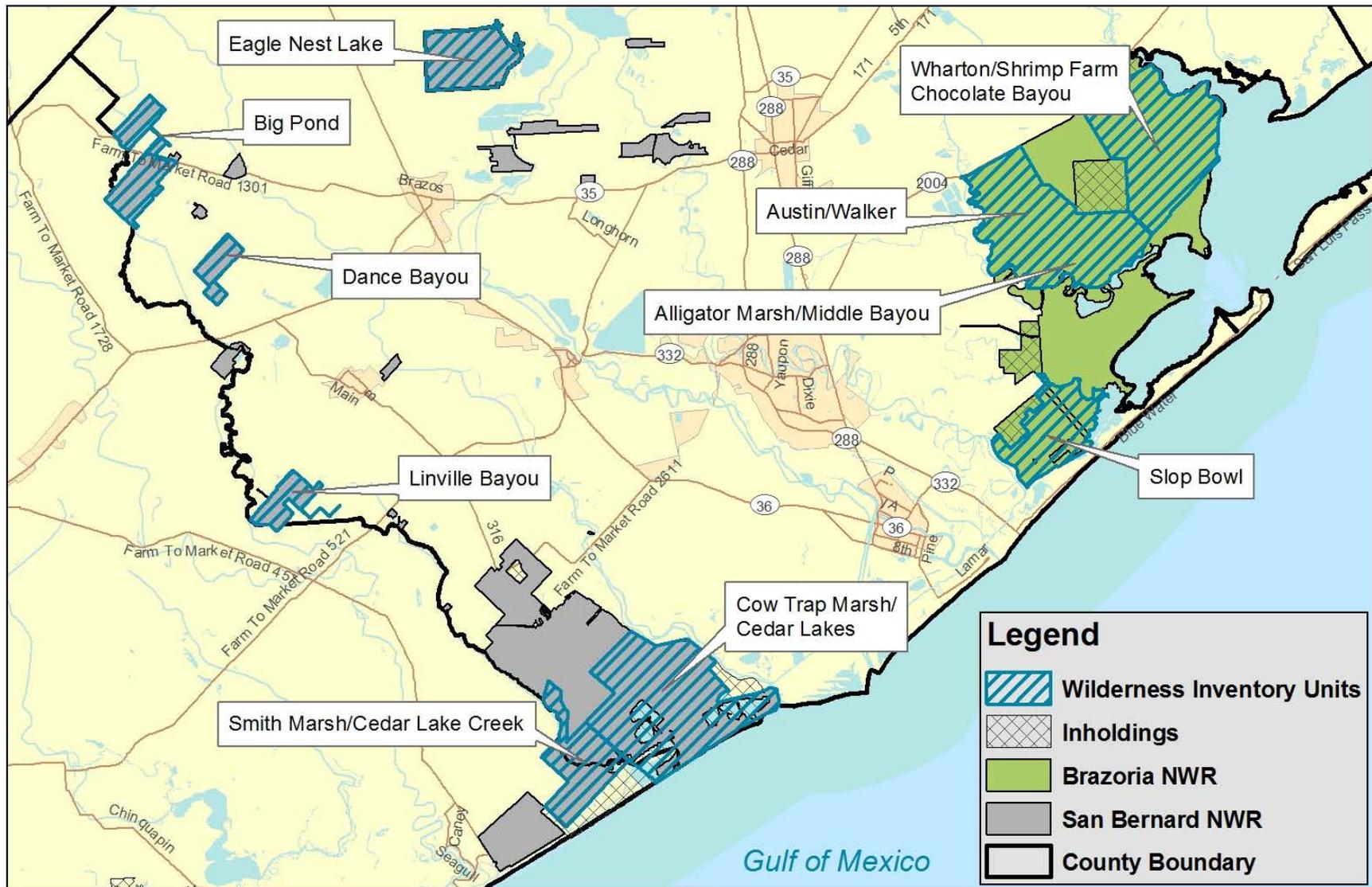


U.S. Fish & Wildlife Service

Texas Mid-coast National Wildlife Refuge Complex

Brazoria, Fort Bend, Matagorda and Wharton Counties

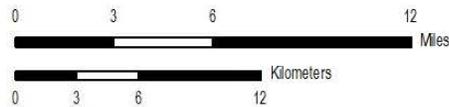
Map H-1. Wilderness Inventory Units



Legend

- Wilderness Inventory Units
- Inholdings
- Brazoria NWR
- San Bernard NWR
- County Boundary

PRODUCED IN THE DIVISION OF REFUGE PLANNING
 ALBUQUERQUE, NEW MEXICO
 LAND STATUS CURRENT TO: 5/31/09
 MAP DATE: June 2012
 BASEMAP: N/A
 MERIDIAN: N/A
 FILE: TMC_wilderness_units_6_4_2012sk



[This page intentionally left blank.]

Land Protection Plan

*Austin's Woods
San Bernard National Wildlife Refuge
Brazoria, Fort Bend, Matagorda and Wharton Counties*

Texas



Bald cypress along Linville Bayou in the Columbia Bottomlands, San Bernard NWR



United States Department of the Interior

FISH AND WILDLIFE SERVICE
Washington, D.C. 20240



JUN 25 2013

In Reply Refer To:
FWS/ANRS /047649

Memorandum

To: Regional Director, Region 2

From: Director

Subject: Approval to Proceed with Publication and Distribution of the Final Planning Documents for the Expansion of the Austin's Woods Units on San Bernard National Wildlife Refuge, Brazoria, Fort Bend, Matagorda, and Wharton Counties, Texas

I approve your request dated March 1, 2013, to increase the current acquisition cap from 28,000 to 70,000 acres within the already established acquisition boundary for the Austin's Woods Units of San Bernard National Wildlife Refuge to meet the protection goal identified in the 1997 Austin's Woods Conservation Plan.

This request is based on the preferred alternative (Alternative B) in the draft Comprehensive Conservation Plan that was initiated for the Texas Mid-coast National Wildlife Refuge Complex, including San Bernard National Wildlife Refuge. Federal, State, and local conservation organizations have supported and continue to support the Service's protection and stewardship of the Austin's Woods conservation effort as described in the plan.

The Decision Package you submitted for my review included an Environmental Assessment, Land Protection Plan, and other related documents indicative of detailed planning. These documents comply with the requirements of the Director's land acquisition planning procedures memo dated August 11, 2000.

The lands targeted for protection will assist the refuge in addressing two priority conservation objectives: implementing the North American Waterfowl Management Plan and conserving migratory birds in decline. Ensure that subsequent funding requests related to this project are accompanied by specific biological objectives. Additionally, requests should include a commitment of additional funding sources, when applicable.

1. Introduction and Project Description

The Southwest Region of the U.S. Fish and Wildlife Service (Service) currently has approval to acquire up to 28,000 acres of bottomland hardwoods as part of the San Bernard National Wildlife Refuge (NWR) in accordance with the Austin's Woods Conservation Plan (Plan). The 1997 Decision Document for the Austin's Woods Conservation Plan authorized "...the acquisition of fee and easement interests of no more than 28,000 acres from willing sellers and donors in Brazoria, Fort Bend, Matagorda and Wharton Counties, Texas." With the strong support and assistance of local government, local businesses, the National Fish and Wildlife Foundation (NFWF), and other conservation organizations, the Service has successfully conserved lands which are now a part of the National Wildlife Refuge System. A lack of funding opportunities, exacerbated by the economic recession has impeded conservation by state, county, and private partners. Partners have been less able to contribute towards the 70,000-acre protection goal. However, partners have been extremely valuable assisting with the Service's acquisition by contributing donated funds as partial matches and applying for and receiving grants toward the Service's acquisition efforts. The Service proposes to increase the 28,000 acre cap by an additional 42,000 acres (to a total of 70,000 acres); continuing conservation efforts in the Columbia Bottomlands and associated habitats. This expansion would remain within the approved project geographical boundary in Brazoria, Matagorda, Fort Bend, and Wharton counties in Texas.

This Land Protection Plan (LPP) has been prepared to support continued conservation efforts within the Austin's Woods Conservation Project. The original Conservation Plan, approved in 1997 was intended to counter the rapid destruction of prime, old-growth bottomland hardwood forests in the Columbia Bottomlands ecosystem. That Plan responded to concerns shared by the Service, the Texas Parks and Wildlife Department (TPWD), local government agencies, conservation organizations and landowners over preserving a sustainable portion of this internationally-significant ecosystem. The original overall goal shared by all of the project partners was to protect approximately 10 percent of the estimated original 700,000-acre ecosystem to sustain plant and animal populations and maintain the ecosystem's diversity.

The Columbia Bottomlands are an important link to the history of Texas. Stephen F. Austin chose this area for the location of his First Colony of 300 in 1828. The first capital of Texas was located in the center of the bottomlands in East Columbia. From this history both names: Austin's Woods and Columbia Bottomlands were derived and are essentially interchangeable. The Service generally refers to the project as Austin's Woods but the habitat and ecosystem as the Columbia Bottomlands.



1.1 Project Description

Region 2 proposes this 42,000-acre expansion of the San Bernard NWR in order to achieve the project goals of the Austin's Woods Conservation Partnership; to conserve at least 10 percent of the historic bottomland forest. Since 1995, the Service has been working with other Federal and State agencies, non-profit organizations and private landowners to conserve, through fee title acquisition and conservation easements this unique and internationally important wetland forest ecosystem.

The project is located in the broad combined floodplains of the lower Brazos, San Bernard and Colorado Rivers and smaller creeks and bayous. This forested habitat is the southern-most bottomland forest on the Gulf of Mexico and lies within the Coastal Prairies and Marshes Ecoregion. The Columbia Bottomlands are the only significant expanse of forest adjacent to the Gulf of Mexico along the western side. Its southern edge extends to within 6 miles of the Gulf of Mexico and forms a passageway that reaches 50 miles inland (Figure. 1).

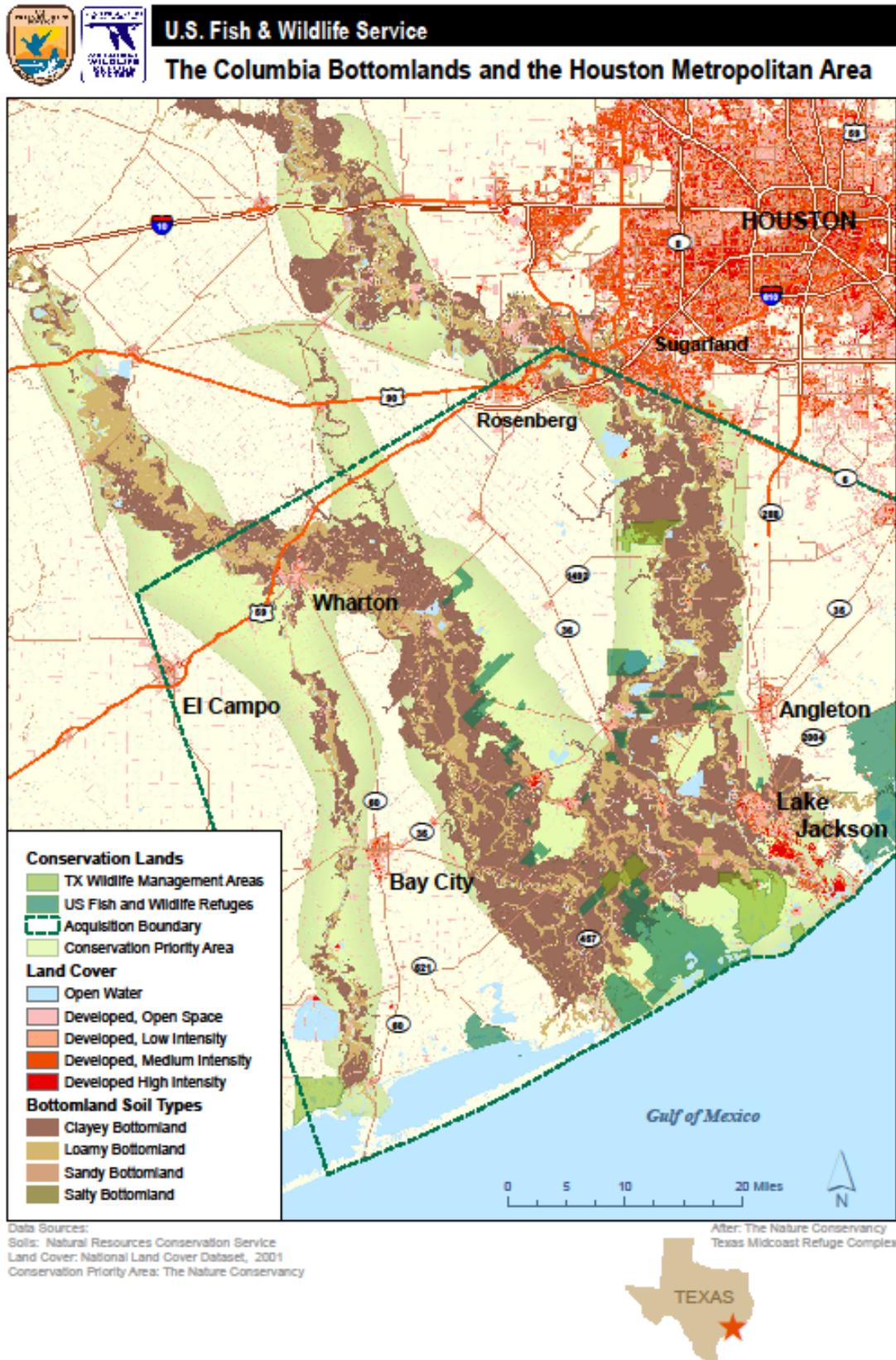
Bottomland hardwood forests are extremely diverse and productive habitats. In addition to neo-tropical migrants, the forested areas are important resting, breeding, feeding, and escape habitats for a great number of other birds. Waterfowl winter in the bottomlands and associated wetlands and prairie wetlands. A significant population of bald eagles are year-round residents, building large nests and raising their young throughout the area.

The Austin's Woods Conservation Plan was approved by the Service in April 1997, to conserve parts of the Columbia Bottomlands ecosystem, a critically important area for millions of migrating birds that use it as a staging area between wintering habitats in the Caribbean and South America and breeding habitats in North America. In the 1997 Decision Document, the Service agreed to:

1. Be a part of the long-term monitoring effort;
2. Assist local agencies and other entities in protection efforts;
3. Provide technical assistance and Partners for Wildlife funds;
4. Hold conservation easements when other organizations are unable; and
5. Acquire fee and easement interests in lands when other organizations are unable.

Although the primary goal is conservation of bottomland forests, coastal prairie, and open water habitats have been acquired when offered along with the forested habitats. These adjacent habitats are integral parts of the ecosystem in that they can often provide transition habitats which support additional wildlife species. Coastal prairies are the primary habitat which has been acquired. Three units with nearly 2,000 acres of former prairie habitat have been acquired. These habitats generally require restoration, but when restored, are representatives of a once vast ecosystem where today only 1-2 percent of the historic prairie remains intact.

Figure 1.



Reflecting the concept of a bio-reserve network, the Austin's Woods Conservation Plan is an active land acquisition and conservation program administered by the Service along with its governmental and non-governmental partners. In response to local concerns about maintaining land use options for private landowners, an important aspect of the plan is the emphasis on cooperation with local conservation partners. The Service has not designated an all-encompassing "acquisition boundary" that would impact non-Service lands across the Columbia Bottomlands area. This strategy allows for promoting private conservation efforts (e.g., conservation easements and habitat management cooperatives) but does not restrict development or other land uses on private lands adjacent to refuge units. The Service acquires lands from willing sellers and donors, particularly where local conservation initiatives are not feasible. The outcome is a mosaic of land blocks that collectively protect the regional ecosystem and maintain essential ecological functions.

Through this LPP, the Service proposes to continue conservation efforts up to 70,000 acres within the Columbia Bottomlands as outlined in the 1997 Austin's Woods Conservation Plan, Land Protection Compliance Document and Conceptual Management Plan. Specifically the Service will

1. Cooperate and assist other agencies and organizations in conserving a network of lands within the Columbia Bottomlands ecosystem for migratory birds, native fish, resident wildlife, and plants and their habitats, including species that are endangered or threatened with becoming endangered.
2. Promote scientific research and participate in long-term monitoring to ensure biological integrity within the Columbia Bottomlands;
3. Work with partners and where applicable, restore fish, wildlife, and their habitats within the Columbia Bottomlands;
4. Provide and enhance opportunities for the public to participate in compatible wildlife-dependent recreation (hunting, fishing, wildlife observation, photography, environmental education and interpretation);
5. Foster understanding and instill appreciation of the diversity and interconnectedness of fish, wildlife, and plants within the Columbia Bottomlands; and
6. Acquire fee and easement interests in lands when other organizations are unable.

1.2 Authorizing Legislation and Refuge Purposes

The project will continue under the same acquisition authorities approved in the 1997 land protection plan. Those authorities are the Migratory Bird Conservation Act of 1929, the Fish and Wildlife Act of 1956, and the Refuge Recreation Act of 1962.

The purposes of Austin's Woods units in the San Bernard NWR are as follows:

"...for use as an inviolate sanctuary, ... for any other management purposes, ... for migratory birds." Migratory Bird Conservation Act (16 U.S.C. 715d).

"...for the development, advancement, management, conservation, and protection of fish and wildlife resources . . ." 16 U.S.C. 742(a)(4) and *" . . . for the benefit of the United States Fish*

and Wildlife Service, in performing its activities and services. Such acceptance may be subject to the terms of any restrictive or affirmative covenant, or condition of servitude . . .” 16 U.S.C. 742(b)(1) (Fish and Wildlife Act of 1956).

“...suitable for— (1) incidental fish and wildlife-oriented recreational development, (2) the protection of natural resources, (3) the conservation of endangered species or threatened species...” 16 U.S.C. 460k-1 “...the Secretary ... may accept and use ... real ... property. Such acceptance may be accomplished under the terms and conditions of restrictive covenants imposed by donor ...” 16 U.S.C. 460k-2 (Refuge Recreation Act (16 U.S.C. 460K-460k-4), as amended).

1.3 Related Actions and Activities

Migratory Bird Conservation Plans - The project directly addresses the objectives of migratory bird conservation plans including the Texas Mid-coast Initiative of the Gulf Coast Joint Venture of the North American Waterfowl Management Plan, the Texas Wildlife Action Plan, and the Land Bird Protection Plan. Associated with the bottomland forest are green ash swamps, slow moving bayous, fresh and tidally influenced creeks and rivers. In addition, adjacent to the forest are several natural lakes and wet prairies. Conservation of these wetlands helps sustain waterfowl and water bird populations by protecting winter, migratory and breeding habitats for waterfowl. Securing acreage along the Gulf Coast is a priority in conservation plans for this region. Prairie bird populations, including bobwhite quail, sparrows and raptors are some of the fastest declining populations in the nation. The proposal targets acreage in the Gulf Coast Prairie (BCR 37), an area of continental significance for North American ducks, geese, and swans. In line with the Gulf Coast Joint Venture’s implementation plan for the Texas Mid-coast region, the project prevents additional loss and degradation of wetlands in a highly threatened area.

National Wildlife Refuge System – Within the project area are Brazoria NWR, located 6 miles northeast of Freeport, Texas and Big Boggy NWR, located 15 miles northeast of Matagorda, Texas. Brazoria NWR, established in 1966, includes more than 44,400 acres of salt marsh, open water, and coastal prairie habitats. Big Boggy NWR, established in 1982 includes more than 4,500 acres of salt marsh habitat. The San Bernard NWR was established on November 7, 1968, with the acquisition of 14,906 acres. Since that date, 38,572 acres have been added to the Refuge through fee title purchases and fee title and conservation easement donations, bringing the total to 53,478 acres as of May 4, 2012. Since 1997, the Service has acquired more than 24,500 acres of bottomland, prairie and wetland habitats under the Austin’s Woods Conservation Plan. All of the above refuges are displayed on Figure 2. Raising the cap on the Service’s contribution to the overall protection goal an additional 42,000 acres will enable the Service to continue to work with partners, and eventually fulfill the overall conservation goal established in 1997. Working with multiple partners and utilizing a variety of funding sources has been the key to past success in the Austin’s Woods Project. The Service will continue to work with these partners, seek out new partners and utilize a variety of funding mechanisms to facilitate conservation.



Eagle Nest Lake Unit was acquired as a partnership with the Natural Resource Conservation Service. The 2000-acre lake will be restored to its original function as an emergent marsh. The Service is planning on providing public use opportunities around this natural wetland.

Table 1 outlines previous acquisition means and acreage acquired. To date, there have been a total of 45 acquisitions. Approximately 30 percent of the acreage conserved by the Service was acquired through direct donations and grants. Many parcels acquired in the past utilize a combination of funding sources. For instance, private donations through a non-profit organization are combined with a grant and Migratory Bird Conservation Act funds.

Table 1. Previous Austin’s Wood Projects

Funding source	Projects	Value of land or donation funds
Donation of easement	5	\$665,000
Donation of fee title	4	\$2,365,000
Donation of funds used toward fee title purchase	12	\$856,000
Wetland Mitigation Funds	4	\$1,725,000
Clean Air or Water Act Violations	3	\$1,290,039
Grants (NAWCA, CIAP) used for fee title purchase	9	\$3,427,360
Federal Acquisition Funds (MBCF, LWCF)	22	\$20,070,533
	Total	\$30,453,932

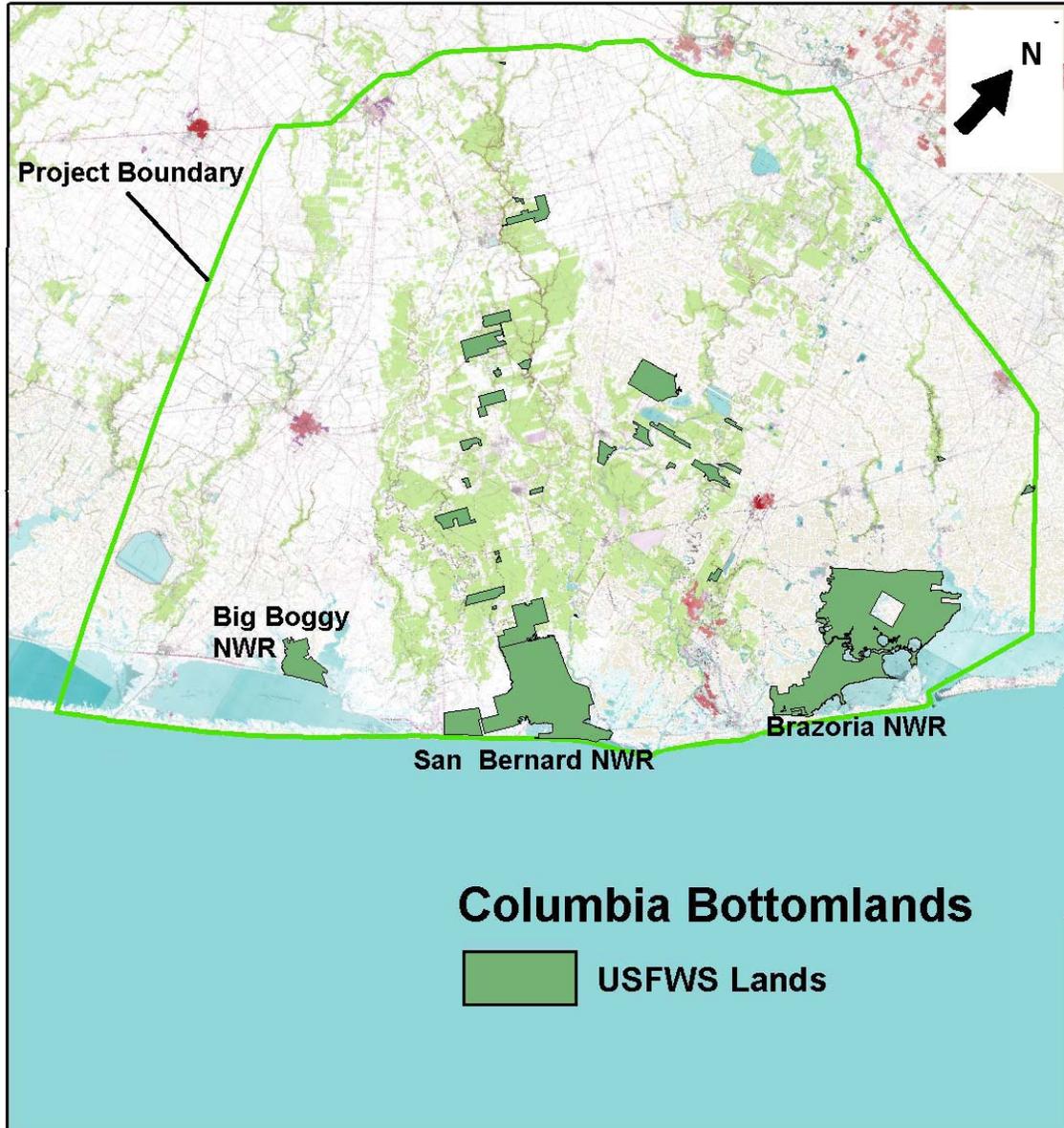


Figure 2, U.S. Fish and Wildlife Service lands within the Austin Woods Conservation Plan Boundary.

Other Conservation Programs

- Conservation Easements held by non-profit organizations – Several non-profit organizations, including: Cradle of Texas Conservancy, Bayou Land Conservancy, Texas Land Conservancy, and Ducks Unlimited hold donated conservation easements within the Columbia Bottomlands. All are active partners in the Austin’s Woods Conservation Project and the Service provides information on these options to land owners interested in Conservation. The majority of these donations are mitigation for development. Two mitigation banks have been recently established within the Project area. One of these areas is located adjacent to the Dance

Bayou Unit and the other adjacent to the Hudson Woods Unit. Both of the projects involve extensive forest restoration and some wetland restoration.

- Texas Parks and Wildlife – Two Wildlife Management Areas (WMA) and one state park are within the Austin’s Woods Conservation Project. Justin Hurst WMA is located less than five miles south of Freeport Texas. Although the WMA is primarily marsh, the upper edge includes forested wetlands. The Nannie M. Stringfellow WMA shares a boundary with the Stringfellow/McNiel Unit of the Refuge. The WMA was acquired by the Texas Department of Transportation as mitigation for road expansion through the bottomlands. The Brazos Bend State Park is a popular destination on the Brazos River west of Rosharon, Texas. The Service notifies TPWD when contacted by a landowner that is near or adjacent to existing State areas and the land owner is interested in conservation opportunities so TPWD can consider the opportunity to participate. In addition, TPWD can assist private landowners with advice on wildlife enhancement and management on private lands.
- Natural Resource Conservation Service (NRCS) – Department of Agriculture, NRCS works extensively with private lands owners within a variety of agricultural and conservation programs. Utilizing the Wetland Reserve Program, NRCS has purchased conservation easements on six properties within the Austin’s Woods Project Area. All but one of these easements is held in perpetuity. In addition to purchasing the easement, NRCS will provide funding for on-the-ground restoration; including invasive species control, planting, and restoring natural drainage on these easements.
- Partners for Fish and Wildlife – This program is administered by the Service and provides financial and technical assistance, and works cooperatively with landowners to voluntarily restore and enhance wildlife habitat on private land. There are several past projects within the project area.
- Gulf Coast Bird Observatory (GCBO) – GCBO is a non-profit organization that promotes the conservation of lands and wildlife, sound science and environmental education. Their headquarters is located in the Columbia Bottomlands and they have partnered with the Service on research as well as assisted with the donation of funds toward acquisition through the Texas Birding Classic, a state-wide birding competition.

2. Resources to be Protected and Their Status

2.1 Habitat

The ecosystem protected under this plan encompasses bottomland hardwood wetland forest and associated wetlands and prairie habitats. The bottomland forests of the ecosystem, which often appear to be like tropical rainforests, have high wildlife and wetland values. This ecosystem is the only expanse of forested wetlands adjacent to the Gulf of Mexico in Texas.

The bottomland forests of what is now Brazoria, Fort Bend, Matagorda and Wharton Counties were known to the settlers of the mid 1800s as the “canebrake forest” due to the understory of

native bamboo. In 1838, the extent of the forest in the project area was described by an early settler as “a district of canebrake and forest, forty miles wide and sixty miles in length.” In 1900, the forest still occupied nearly 700,000 acres, an area of over 1,000 square miles of bottomland hardwood forest adjacent to the Gulf of Mexico. In 1995 a Columbia Bottomlands (Four County) Task Force estimated that only 177,000 acres of forest remained. Today, much more of the forest has been cleared, drained or altered, and it is estimated that only 150,000 acres remain. In addition to the bottomland forest, the floodplain ecosystem also has a variety of other wetland habitats, including bayous, sloughs, marshes, ponds, lakes, along with areas of native prairie.

Because the timber in the Columbia Bottomlands was not of high commercial value, tracts of old-growth forest remain, even today. Instead of selling timber, settlers cleared the land for grazing and other agriculture uses. Those practices continue to the present. Today, many acres are cleared for housing development as well as roads and pipeline rights-of-way. The forest is increasingly fragmented as Houston and local cities and towns expand. Although many landowners and cities have promoted the conservation of trees, even in suburban communities, these open forests and parks do not have the multiple canopy layers and undergrowth needed to support a diversity of migratory birds.

The project mitigates threats to the natural community by conserving some of the remaining forests, and restoring forest and prairie habitats. The Columbia Bottomlands ecosystem continues to lose thousands of acres of forested habitat each year. Remaining bottomland tracts are threatened with urbanization, logging, drainage and clearing for agriculture. Levee districts are being created where thousands of acres are cleared and removed from the floodplain for development. Since recent court decisions, many very valuable wetlands are no longer considered jurisdictional by the Army Corps of Engineers (ACOE); this has resulted in the acceleration of habitat loss. Other threats include pipeline construction, road building, and power line construction - a swath of trees is cut for every corridor, further fragmenting the forest. The economic forces driving the destruction of forest habitat are very difficult to counter. Few landowners can afford to keep the land as forest and garner a higher value through agriculture. The project alleviates the threats through a system-based protection initiative that serves to avoid conflicts with industry: rather than being in a position of



Natural pot-hole prairie wetlands on the Buffalo Creek Unit provide habitat for waterfowl, rails and waterbirds 45 miles inland from the Gulf of Mexico. Since acquired in 2007, the Service has been working to restore native prairie diversity and control invasive species on this 800-acre prairie.

opposing individual activities, the initiative offers landowners economic alternatives to habitat destruction. Having this system-based project area allows flexibility in protecting properties, as long as the protection objective is met. The flexibility and willing-seller aspect of the initiative means conflicts over individual tracts are avoided or minimized.

Several remnant prairies have been acquired along with adjacent bottomland forest. Although native coastal prairie once stretched from Louisiana across the coastal plains to south Texas, less than one percent of the historic prairie exists in a natural state. Easily cleared for agricultural and development, coastal prairie is recognized as an endangered habitat. More than 1,000 plant species created a diverse ecosystem; much of this diversity is forever lost. However, where prairies have been acquired by the Service, these prairies are being restored to provide native habitat for prairie wildlife. To date, approximately 1,800 acres of former prairie have been conserved by the Service as well as the adjacent bottomland forest. Invasive species treatment, seeding and shredding native hay across the field, and fire are being used to restore native prairie habitats. It is hoped that larger prairies near Damon, Texas may one day allow for the future reintroduction of Attwater's prairie-chickens.

2.2 Wildlife

The Columbia Bottomlands habitat supports a great diversity of wildlife. The bottomlands are home to large populations of both resident and migratory wildlife, including more than 400 different wildlife species. The refuge, as part of the Texas Coastal Plain, annually provides critical habitat for numerous neotropical migrants which pass through the area during fall and spring migration. The freshwater fishery within the Columbia Bottomlands consists primarily of marshes, creeks, sloughs, bayous, the San Bernard River, Brazos, and Colorado Rivers. Oxbow lakes such as Soby and Sally Lakes are scattered across the landscape. These lakes can support native and non-native fisheries. The forests are diverse with localized populations of uncommon species. The wildlife that this project provides habitat for includes waterfowl and waterbirds, Nearctic-Neotropical migrant birds, as well as resident reptiles, amphibians and mammals.



Prothonotary Warbler

This ecosystem is especially important for Nearctic-Neotropical migratory birds because of its proximity to the Gulf of Mexico. Millions of Nearctic-Neotropical migrants make landfall in the bottomlands during spring migration and also use the area during fall migration. Migrating birds depend on bottomland forests for rest and feeding before and after crossing the Gulf of Mexico on fall and spring migration, respectively. In 1997, the Columbia Bottomlands Task Force found that 237 species of birds, totaling at least 29 million individuals, migrate through the forest every year. This is the chief

spatially explicit rationale for proposing additional protection for this project area. The bottomlands provide habitat to more than 30 species of warblers, including the Swainson's warbler and Prothonotary warbler. The Swainson's warbler nests in the project area in thick understory, specifically cherry-laurel thickets. The Prothonotary warbler is unique because they nest in low cavities of bald cypress, willows, and sweet gum. The cavities may be in trees near or over standing water and usually created by woodpeckers (Cornell 2012). Other migrant passerines include many species of sparrows, vireos, tanagers, thrushes, orioles, wrens, swallows, grosbeaks, and buntings. Dr. Sidney Gauthreaux, Jr., using Doppler radar (Figure 3), documented that the Columbia Bottomlands is a major stopover area for these migrants.

2.3 Climate Change Management Adaptation and Mitigation

Department of Interior Secretarial Orders 3226 and 3289 direct the Service to "...consider and analyze potential climate change impacts when undertaking long-range planning exercises...and/or when making major decisions regarding the potential utilization of resources under the Department's purview," and to "coordinate an effective response to its impacts on ...the land, water, ocean, fish and wildlife, and cultural heritage resources..." A rapidly changing climate presents challenges to habitat conservation nation-wide. In the Texas Mid-coast area the coastal San Bernard NWR may be impacted by sea-level rise, increased drought, more erratic weather events, overall warming of habitats, and changes in plant and animal phenology (timing of life events like budding, migration, and nesting) for species occurring on the refuge. The Service's strategic response to climate change involves three core strategies: adaptation, migration and engagement (USFWS 2011). The Austin's Woods Conservation Plan provides the elements necessary to minimize the impact on wildlife: resilience, redundancy, adaptation potential, habitat connectivity, drought-tolerant plant communities, natural hydrology, and large and connected ecosystem segments.

Through adaptation, the impacts of climate change on wildlife can be reduced by conserving habitats expected to be resilient. Intact ecosystems are more able to react and adapt to climate change and still support a variety of wildlife than damaged ecosystems with low species diversity. This was evident during the recent drought cycle. A census by the Texas Forest Service showed that the loss of trees, primarily water oaks in the Columbia Bottomlands, were prevalent along edges rather than in the intact forest (Merritt 2012). Further, the Refuge Columbia Bottomland units withstood the drought much better than the other forests surrounding the greater Houston communities, where millions of trees died.

The expansion of the refuge inland is essential to adapt to the anticipated impacts on the refuge coming as a result of climate change without losing critically important habitat for coastal bird species and fisheries resources on the Texas Gulf Coast. The project is essential in adding a buffer of higher elevation lands (20 to 50 feet above sea-level) to the lower marshes and salt

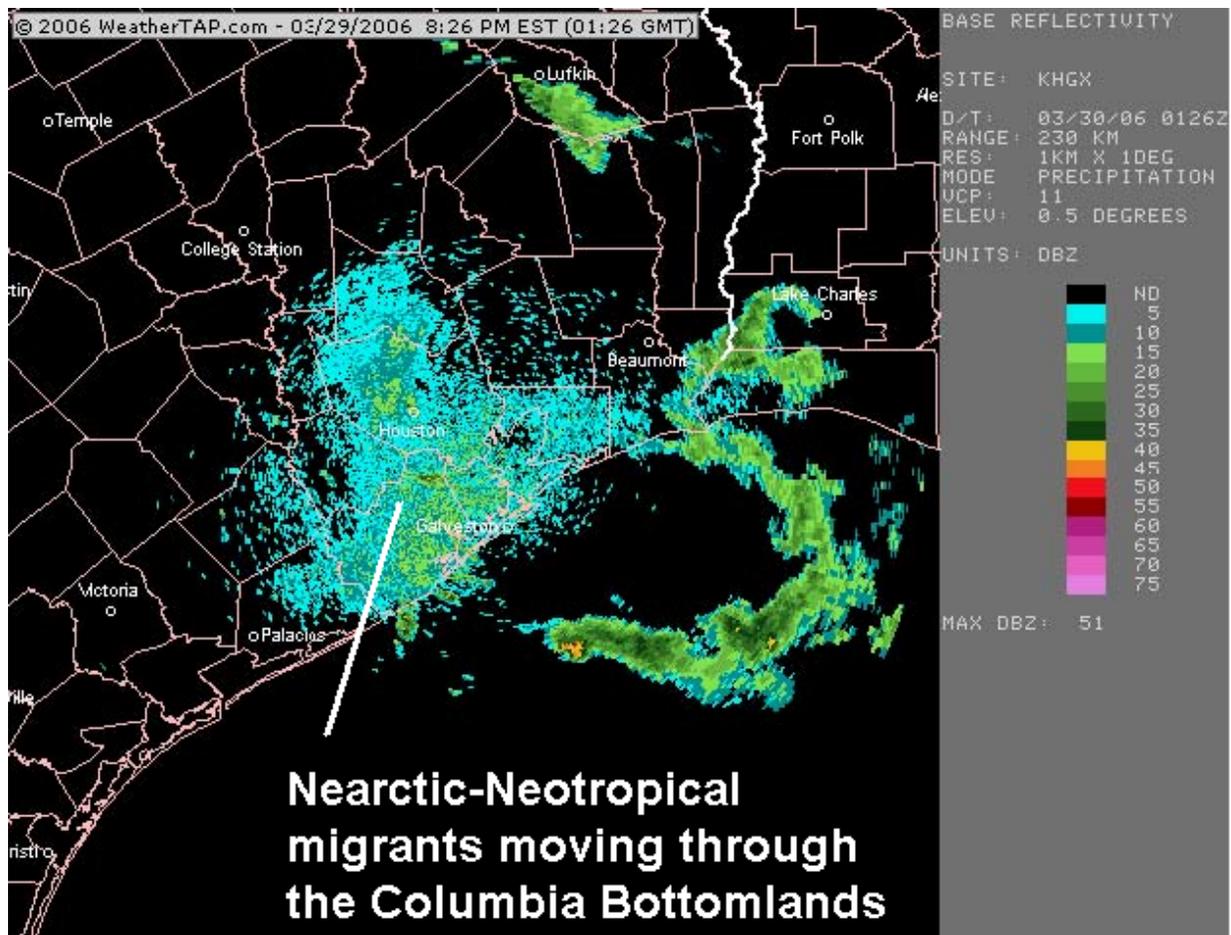


Figure 3. Doppler radar showing movement of Nearctic-Neotropical migrants moving through the Columbia Bottomlands.

marshes of the San Bernard NWR. The adjacent bottomlands help facilitate and allow the movement of coastal species inland as sea level rises in the coming decades. Located inland from the coastal marshes along the Gulf of Mexico, tracts in the Columbia Bottomlands sit at a sufficiently high elevation that they would not be inundated by sea-level rise (based on current worst-case predictions). However, the tracts will provide a buffer to lower-lying lands which may be inundated by rising sea levels due to climate change. The tracts will provide a species reservoir and habitat for a variety of species which may need to move along corridors as changes in climate occur. Future plant and animal species composition may shift with climate change, but the land will still provide quality habitat for forest, and prairie dependent species.

The Refuge may also manage its resources to help mitigate climate change impacts. In November, 2002, the NFWF contracted with Winrock International to provide the Service and the project partners with a detailed baseline study of carbon sequestration potentials of the Columbia Bottomlands. Based on the study specific to the forest biomass of the Columbia Bottomlands, the conservation of forested wetlands will prevent the release of over 78 metric tons of carbon per acre into the atmosphere. If the lands are not conserved, they are likely to be deforested, resulting in the release of carbon.

3. Project Implementation

3.1 Protection Alternatives Considered

No Action

Under the No Action Alternative, continuation of current management, the Service would be limited to 28,000 acres of land acquisitions (fee title and conservation easement) in accordance with the Austin's Woods Conservation Plan of 1997. The plan set a goal for the Austin's Woods Conservation Partnership to conserve 10 percent of the historic bottomlands forest (70,000 acres). To date, the Service has been very successful in working with other Federal and State agencies, non-profit organizations and private landowners to conserve parts of the Columbia bottomland as part of the National Wildlife Refuge System and has nearly met its 28,000 acre acquisition cap. However, a lack of funding exacerbated by the economic recession has impeded conservation by state, county, and private partners. Partners have been less able to contribute towards the 70,000-acre protection goal. This alternative would hamper the Service's ability to continue its conservation efforts in the Columbia Bottomlands. Under this alternative, the Service would not acquire additional fee title and conservation easements (over 28,000 acres), severely diminishing the potential of ever meeting the recommendation of the 1995 task force; that conservation of 10 percent of the original ecosystem was needed in order to sustain this unique ecosystem. Without the Service's funding mechanisms, leadership, ability to leverage partner contributions, and position as the primary contact for landowners interested in finding ways to conserve their lands, future conservation will be limited. The future of the Columbia Bottomlands would be subject to the discretion of the landowners whether the land would stay in an undeveloped setting or be converted to other uses in the long-term, which may include eventual development. The current quantity of land in conservation status is not adequate to protect either the ecosystem or dependent wildlife species. If the Service stops land acquisition now, less than five percent of the historical ecosystem will be conserved. By preserving less than ten percent, the ecosystem may not be able to sustain its botanical diversity on which substantial populations of migratory wildlife species depend. We could lose populations, or even species, of plants with subsequent consequences to resident and migratory wildlife.

Acquisition and/or Management by Others

The alternative was thoroughly considered in the 1997 Austin's Woods Conservation Plan, and was found not be practical in and of itself. This alternative is an ongoing and important part of current management (the no action alternative). In addition to acquisition, the Service has facilitated contacts between landowners and the Department of Agriculture, NRCS to conserve lands through the Wetland Reserve Program. NRCS has purchased permanent conservation easements on 7,700 acres in the Columbia Bottomlands. However, most landowners are not interested in holding conservation lands and the fee title is later purchased by the Service. This is primarily due to the fact that most land owners do not wish to continue to pay taxes on lands where income from the land is curtailed due to conservation and wetland restoration actions. However, in partnering with NRCS the Service accepts the constraints of their conservation easements, works with NRCS on wetland restoration and restores and manages other habitat values including controlling invasive species and restoring native coastal prairie on agricultural lands. In an area that has heavy development pressure due to the proximity of the Houston

Metropolitan Area, this partnership may have been the only means by which these acres could have been conserved.

The TPWD manages one state park, one state historical site, and two WMAs within the project boundary. The Stringfellow WMA which shares a common boundary with San Bernard NWR enabled the conservation of the largest block of forest and a migratory corridor reaching from the coast nine miles inland. The Service will continue to share information about potential projects within the vicinity of existing State areas with TPWD as funding opportunities may arise in the future.

The Service has facilitated the conservation of smaller tracts through donations of conservation easements to area land trusts where the location or size of the property was not suitable for acquisition by the Service. The Service will continue to seek opportunities, working with partners to help all landowners interested in conservation of natural forested habitats. Private land trusts have conserved approximately 1,800 acres.

The TPWD and a host of conservation groups continue to advocate for this preservation effort. However, because of the current slow economic recovery, these entities do not have the necessary resources to acquire, and manage the habitat. Therefore, the land acquisition functions in the Austin's Woods Conservation Plan largely fall to the Service.

Acquisition in Fee and Conservation Easement

Purchase of fee title has been the primary means through which acquisition has occurred in the past. Although funding through the traditional refuge funding mechanisms, Migratory Bird Conservation Act Fund and Land and Water Conservation Fund, has been the primary source, the Service has received substantial assistance from other sources. Working with non-profit organizations, private funds have been raised, and wetland mitigation funds have been held for use in future acquisitions. Both the Trust for Public Land and The Conservation Fund have purchased and held lands as the Service completes due diligence and secures funding for acquisition. The National Fish and Wildlife Foundation has been instrumental in nearly all acquisitions, providing guidance, assisting with landowner negotiations, buying and holding tracts until the Service could obtain the funds, and purchasing appraisals. Under this plan, the Service would continue to be opportunistic and utilize a variety of funding avenues for fee title acquisition.

The purchase of conservation easements has not been readily employed in the past due to the desires of several landowners. Since the purpose of this program is the conservation of forested landscapes, residual rights would preclude the ability to use the land for agriculture (including grazing). Although landowners can reduce their taxes by showing a reduction in their owned value, without an income from the land, few landowners are interested in this approach. Landowners interested in easement opportunities are generally conservation-oriented, where they enjoy the natural landscape and generally own small (<100 acres) tracts.

3.2 U.S. Fish and Wildlife Service Land Acquisition Policy

Land interests are acquired only from willing sellers/donors and are subject to the availability of funding. The presence of a national wildlife refuge would not mean increased regulation of adjacent private land uses. The Service acquires lands and interests in lands, such as easements, and management rights in lands through leases or cooperative agreements, consistent with legislation or other congressional guidelines and executive orders, for the conservation of fish and wildlife and to provide wildlife-dependent public use for recreational and educational purposes. When land is needed to achieve those objectives, the Service seeks to acquire the minimum interest necessary to reach those objectives. If fee title is required, the Service gives full consideration to extended use reservations, exchanges, or other alternatives that will lessen the impact on the owner and the community. Donations of desired lands or interests are accepted. In all fee title acquisition cases, the Service is required by the Uniform Relocation Assistance and Real Property Acquisition Policies Act of 1970 (Public Law 91-646) to offer 100 percent of the property's appraised market value, as set out in an approved appraisal that meets professional standards and federal requirements.

We only propose fee acquisition when adequate land protection is not assured under other ownerships, active land management is required, or we determine the current landowner would be unwilling to sell a partial interest such as a conservation easement. Generally, the lands we would acquire in fee require more than passive management to meet the wildlife conservation goals.

Conservation easements leave the parcel in private ownership, while allowing the Service involvement in land management decisions in a way that enables us to meet our conservation goals, as well as being able to provide some assistance to the landowner with stewardship and management of their lands. Easements are a property right, and typically are perpetual. If a landowner later sells the property, the easement continues as part of the title. The structure of such easements would provide permanent protection of existing wildlife habitats while also allowing habitat management or improvements and access to sensitive habitats, such as for endangered species or migratory birds. We would determine, on a case-by-case basis, and negotiate with each landowner, the extent of the rights we would be interested in buying. Those may vary depending on the configuration and location of the parcel, the nature of wildlife activities in the immediate vicinity, the needs of the landowner, and other considerations. In general, easement acquisition would maintain the land in its current configuration with no further subdivision or development.

Properties subject to easements generally remain on the tax rolls and taxes are still paid by the landowner. The Service does not pay refuge revenue sharing (i.e., funds the Service pays to counties in lieu of taxes) on easement rights. Easements generally work best when:

- only minimal management of the resource is needed, but there is a desire to ensure the continuation of current undeveloped uses and to prevent fragmentation over the long term;
- a landowner is interested in maintaining ownership of the land, does not want it to be substantially altered, and would like to realize the benefits of selling development rights;
- current land use regulations do not limit the potential for adverse management practices;

- the protection strategy calls for the creation and maintenance of a conservation area that can be accommodated with passive management; or
- only a portion of the parcel contains lands of interest to the Service.

On easement lands the opportunities for wildlife-dependent public uses, partnerships, or scientific research would be at the discretion of the landowner. These uses would be considered on lands owned in fee title by the Service.

While land owned by the U.S. Government is not taxable by state or local authorities, the Service has a program in place to compensate local governments for foregone tax revenues. The Refuge Revenue Sharing Act of June 15, 1935, as amended (16 U.S.C. 715s) requires the Service to make payments to local taxing authorities, typically counties, to at least partially offset the loss of local tax revenues as a result of federal acquisition of private property. The Service makes annual payments to local taxing authorities, based on the estimated values of lands that the Service owns located in those jurisdictions. The actual Refuge Revenue Sharing payment does vary from year to year because Congress may or may not appropriate sufficient funds to make full payment.

3.3 Priority Species and Protection Priorities

In 1997, the project was focused on protection of a rapidly declining Columbia Bottomlands ecosystem. Since the project is to ensure conservation of a once 700,000-acre ecosystem, it is important the elements of strategic habitat conservation be incorporated to ensure effective conservation. Biological planning requires the identification of priority species, development of population objectives, and identification of landscape-scale threats. The need to conserve the Columbia Bottomlands ecosystem is identified in the following plans and initiatives reviewed by the planning team:

- Texas Conservation Action Plan
- Gulf Coast Joint Venture Mid-coast Initiative Area
- North American Waterfowl Management Plan
- Mottled Duck Conservation Plan
- North American Landbird Conservation Plan
- Partners in Flight- Gulf Coastal Prairie (BCR 37)

In the Texas Conservation Action Plan, four forest types found within the Columbia Bottomlands are listed in the Rare Communities database as vulnerable or imperiled. These are Columbia Bottomlands Ash Flats, Columbia Bottomlands Bald-cypress forest, Upper Texas Coast Live Oak Forest and Water Oak – Live Oak Forest. In addition, Alfisol Coastal Prairie, which is listed as imperiled/critically imperiled is the principle adjacent habitat to the forest and also conserved by the Austin’s Woods Conservation Plan. Among the Species of Greatest Conservation Needs, with the Action Plan, 38 species birds, eight species of mammals and 12 species of reptiles and amphibians are found within the Columbia Bottomlands. These include the following vulnerable (V) and imperiled (I) species: Rafinesque’s big-eared bat (V), Southeaster myotis (V), mountain lion (I), swallow-tailed kite (I), Bald Eagle (V), northern harrier (V), American woodcock (I), chuck-will’s-widow (V), prothonatary warbler (V), worm-

eating warbler (V), Swainson's warbler (V), Louisiana waterthrush (V), grasshopper sparrow (V), Henslow's sparrow (I), eastern box turtle (V), and ornate box turtle (V).

The Gulf Coast Joint Venture has identified population goals for waterfowl. Mallards, wood ducks and hooded mergansers are the primary species that benefit from the forested wetlands of the Columbia Bottomlands. The flooded bayou's, sloughs and swamps within the Columbia Bottomlands provides habitat to meet the 72,819 goal set for mallards in the Mid-coast initiative area. Inland Freshwater lakes and prairie potholes associated with the Columbia Bottomlands provide significant inland freshwater resources for wintering waterfowl. In 2011, following a two-year drought, biologists estimated more than 75,000 ducks on Eagle Nest Lake. The Mottled duck Conservation Plan, identifies "former coastal prairie dominated by active agriculture, idle fields, grazing pastures, seasonal wetlands, and more intensively managed water, delivery" as one of two priority habitats for mottled ducks (Wilson, 2007). These agricultural areas, associated with the Columbia bottomland ecosystem can provide seasonal, semi-permanent, and permanent natural wetlands.

Partners in Flight has determined a list of bird species of high conservation concern for each Bird Conservation Region (BCR). For the Gulf Coastal Prairie (BCR 37), 16 of the 33 species are associated with the Columbia Bottomlands and adjacent prairie habitats. Some species including painted bunting, yellow-billed cuckoo, and acadian flycatchers nest across the bottomlands, whereas prothonotary warbler, Swainson's warbler and summer tanager have a much narrow niche within the bottomlands that are suitable for nesting. The Landbird Working Group for the Gulf Coast Joint Venture selected a subset of the BCR 37 species for which to build a habitat model as a focal species. All three grassland species, northern bobwhite quail, loggerhead shrike and Le Conte's sparrow occur on the bottomland associated prairies. Winter songbird surveys on restored prairies adjacent to the Columbia Bottomlands have shown a significant increase in Le Conte's sparrows over a two-year period, post restoration (USFWS, unpublished data). Nearly 75% of Loggerhead shrikes detected on breeding bird surveys in BCR 37 were in the Texas Mid-coast initiative area.

Bird Conservation Region 37's riverine bottomland hardwood forests are key migration corridors due to their generally rich avian food resources and proximity to the Gulf of Mexico (Vermillion et al. 2008). The Landbird Working Group selected three warbler species to cover the stratification of coastal landbird migration habitat including canopy species (Cerulean), mid-story (golden-winged) and understory species (Swainson's). Specific migration habitat characteristics is difficult to determine, however several generalizations have been made: 1) the more complex habitats support increased bird species richness (Moore et al. 1990); 2) long-term patterns of migrant use along the Gulf of Mexico indicate that the vicinity of Longitude 95 degrees West receives consistent, high use annually (Barrow et al. 2005); and 3) migrating birds exhibit selective use of some habitats over others (Petit 2000). The working group identifies the protection of large (> 10,000 acres) parcels of forested habitats less than 6 miles from the Gulf of Mexico as the number one priority, followed by protection of large parcels beyond 6 miles from the Gulf of Mexico. Conservation of the bottomland forests adjacent to the Gulf of Mexico as stopover and staging habitat for Nearctic-Neotropical migrant landbirds is critical for the conservation of these species (Barrow et al. 2005). Mature forests with old growth trees and well developed mid and under stories are the priority habitat. These tracts provide significant edge

habitats from natural openings and gap succession among the intact forest as well as edges created by right of ways and property lines. Secondary to intact forests are those that can restore quickly as previous management has left much of the canopy in place and mid and lower stories can regenerate themselves.

This project is a critical component of the Texas Mid-coast National Wildlife Refuge Complex Comprehensive Conservation Plan (Chapter 4). Specifically it accomplishes the following objectives:

Objective 2 (Ecoregional Goal) - Conservation of Columbia Bottomlands Ecosystem

Conserve approximately 1,000-2,500 acres annually through Service acquisition authorities, while working with partners to conserve an overall minimum of 10 percent of the historic Columbia Bottomlands forest.

The Columbia Bottomlands is a unique forested hardwood species ecosystem within the Gulf Coast Prairies and Marshes Ecoregion which extends to within 4 miles of the Gulf of Mexico. This ecosystem, recognized for its importance for migratory songbirds, is threatened by agricultural and commercial development and encroachment of invasive species. Plant and animal diversity is tied to topography, differences in soil, hydrology, and succession stages across the larger landscape. Thereby conservation of tracts spread across the historic ecosystem is required to ensure diversity and functionality of this already fragmented forest is maintained.

Objective 1 (Habitat Management Goal) – Bottomland Hardwood Forests

Manage all bottomland forests to promote natural succession toward old growth stages (80+ year old forest) which increases diversity and reduces the impacts of catastrophic events, including; droughts, wildfire, invasive species and flooding and high winds on species diversity and populations.

Agricultural and commercial development and the encroachment of invasive species continually threaten the Columbia Bottomlands, which is a regionally limited ecosystem. Plant and animal diversity is tied to topography, differences in soil, hydrology, and successional stages across the larger ecosystem rather than to individual tracts. Therefore, conservation of tracts spread across the ecosystem is preferred rather than one large unit. The bottomland forests are critical for migratory songbirds and native wildlife (Barrow, W. et. al. 2000). In addition, the bottomland forests store large amounts of carbon in their foliage, roots, and soil, and offer opportunities for carbon-offsets with local industry (Delaney, M. et. al. 2002). Natural bottomland forests also buffer flooding related to heavy rainfall common on the Texas coast, protecting human communities.

Objective 2 (Habitat Management Goal)– Coastal Prairie

Throughout the life of this CCP, protect, restore and manage 19,000 acres of coastal prairie habitat toward a climax prairie community, while promoting rare endemic species such as prairie coneflower and sharp gay feather through planting or seed dispersal (of refuge produced seed) on 100 acres annually.

Once part of an immense ecosystem covering 9 million acres from Mexico through Texas and into Louisiana, the coastal prairie underwent intensive manmade development starting in the mid-20th century (Allain et. al. 2003) and now totals approximately 250,000 acres in Texas, which includes areas that contain natives prairies species that have been managed and/or restored. Less than 1 percent of (unaltered) natural coastal prairies remain in existence and remaining prairie are continually threatened by agricultural and commercial development, invasive species, and suppression of wildfire (Grace et. al. 2000).

Although the focus of the acquisition program is bottomland forests, the Complex has acquired adjacent prairie habitat in conjunction with the forest on several units; all of which have required restoration. Restoration of prairies presents a variety of challenges including the constant assault of non-native vegetation and their ability to out-compete native flora and introducing a seed source to encourage diversity. The Complex has been successful at rehabilitating disturbed areas into functional, diverse, and productive prairies and producing a native seed source used to continue the restoration process on newly acquired lands.

Objective 2 (Wildlife Goal) – Forest birds

Throughout the life of the CCP, protect and manage existing mature forest and restore units requiring restoration due to cattle grazing, clearing, logging, etc, to provide floral diversity and high stem density at all canopy layers to provide habitat for 80 percent of the following indicator forest breeding bird species (Swainson’s, prothonotary and hooded warblers, yellow-breasted chat, acadian flycatcher, barred owl, downy woodpecker, yellow-throated vireo, northern parula, and summer tanager).

The Austin Woods Conservation Plan identifies the need to protect forested habitats in the Columbia Bottomlands for the preservation of migratory birds. For the past ten years, a variety of research and monitoring projects occurred in the bottomlands. These projects generally focus on continuing to gather information on species’ habitat associations to aid management in decision making concerning priorities for conservation and restoration of existing units. During migration, bottomland hardwood forest are particularly valuable to a large variety of warblers, vireos, thrushes, tanagers, buntings, goatsuckers, and other forest birds that seek out forest resources after a long flight to recuperate and refuel. In Mississippi, research has demonstrated that neotropical migrants using coastal forests are found in increasing abundance with increasing density of forest trees and increasing numbers of insects in forest understories (Buler et. al. 2007).

Accomplishment of these habitat management objectives are a key focus of management on the Complex and will contribute to the population goals discussed below.

Priority Species

Based on the above plans, the Refuge has selected six priority species to represent a larger group of wildlife species with similar needs in the Columbia Bottomlands and associated habitats; prothonotary warbler, Swainson’s warbler, acadian flycatcher, painted bunting, loggerhead shrike, and Le Conte’s sparrow. With the exception of the Le Conte’s sparrow (wintering

species), Partners in Flight has identified that management actions, including conservation and restoration of habitats, would have an impact on stabilizing or reversing populations decline.

Prothonotary warbler, Swainson's warbler, and Acadian flycatcher

Mature forested bottomlands are the priority habitat. They provide structural complexity to support breeding as well as wintering and transient species. The presence of nesting Swainson's is an indicator of the quality of understory habitat, which is severely impacted by brush-hogging, and cattle grazing within the bottomlands. The presence and number of prothonotary warblers is an indication of the hydrological component on each tract, as they will only nest in the wetter areas. Swainson's warblers require high stem densities and nest in association with heavy concentrations of small trees such as rhododendron (Lanham and Miller 2006) or switchcane or beneath vine tangles with a non-vegetated leaf litter below (Graves 2002). Prothonotary warblers are cavity nesters that select snags in flooded areas and frequently forage in the forest mid-story (Petit 2000).

Unlogged forests with all layers intact provide the greatest densities of Acadian flycatchers (Twedt and Somershoe 2009). For migrating songbirds, it appears that birds probably settle in response to gross habitat features such as vegetation density or stratification and then search for resources based on other factors (Moore and Aborn 2000).

Painted bunting, Loggerhead shrike, and LeConte's sparrow

Degradation and loss of habitat has occurred throughout the prairies along the Texas coast. The San Bernard NWR is part of a small network of conservation lands along the Gulf Coast which offer a remnant of high quality habitat, essential for continued survival. Forest edges as well as the transition zone between forest and prairie provide habitat for loggerhead shrikes and painted buntings to catch food but also nesting habitat along the denser forested edges which provide nest protection. Although originally considered to be a "bonus", bottomland tracts with a prairie component are now a high priority. Although the prairies have been impacted by past agricultural practices, through restoration efforts, we can provide habitat for wintering grassland species, as well as loggerhead shrikes, mottled ducks and hopefully in the future Attwater's prairie-chickens.

Painted bunting nest in the grasslands during the summer, using the cover for nest site concealment and feeding on seeds and insects provided by the variety of prairie plants that exist in non-grazed grasslands. This species benefits from burn timing; which targets woody species and allows nesting birds' time to complete nesting attempts. Loggerhead shrike uses grassland with light scrub or tree components from which it scans for food from perches. Trees and shrubs with ample canopy scattered in large expanses of open area and absence of chemical application are correlated with the presence of this species in some portions of its range (Yosef 1996). LeConte's sparrow overwinter in the coastal prairies associated with the bottomlands. LeConte's sparrows prefer tall grass, sparse to moderate litter, and little woody vegetation (Baldwin 2005).

Together these species represent a mosaic of coastal prairie and grassland habitat associated with the bottomland forest ecosystem to support habitat needs for a number of migrants.

Population Goals

Very limited information is available to set habitat goals for forest breeding birds. Work in the Mississippi Alluvial Valley identified patch sizes required to support 500 nesting pairs of forest breeding birds. These ranged from 4,446 acres for red-eyed vireo to 21,000 acres for white-breasted nuthatches. Although we have not determined patch requirements for the Columbia bottomlands, occurrence data from point counts on a mature bottomland forest show similar trends. Acadian flycatchers, Northern parula, and yellow-billed cuckoo are the most common encountered on point counts on two separate bottomland units. Among breeding birds, Swainson's warbler, hooded warbler, painted bunting, and yellow-throated vireo are encountered less, however, their presence is an indicator of the development of structural diversity. The population goal identified in the CCP is to provide habitat for 80 percent of the indicator forest breeding bird species (Swainson's, prothonotary and hooded warblers, yellow-breasted chat, Acadian flycatcher, barred owl, downy woodpecker, yellow-throated vireo, northern parula, and summer tanager) on a bottomland unit. Dance Bayou (original acquisition 640 acres) has long been considered an excellent representative of old growth habitat from the time of acquisition. Over the past 14 years, point counts have been conducted on the unit.

During drought years, prothonotary warblers and other water associated species are not encountered. However, over time, the species counts have stayed consistent. The McNeal Unit (1,276 acres), prior to being acquired was grazed and under-brushed. Initial point counts for two years on this unit showed that a number of the more rare species (including Swainson's warbler, summer tanager, yellow-throated vireo and prothonotary warbler) were for the most part nonexistent; painted buntings were the only rare species encountered during the first year. In 2012, an updated count was completed. Initial analysis indicates a significant increase in species presence and diversity over a 10-year period. Species present include prothonotary warbler, hooded warbler, and summer tanager. A second year of point counts and further analysis will be completed this year.

Point counts at Dance Bayou indicate that in the best habitat, all indicator species including priority species can be found in mature bottomland forests across 400 acres of a 1,300-acre contiguous forest. Ninety percent of the forest outside the boundaries of the unit have been cleared and are utilized as open pasture creating an isolated forest. Although separated from other forest, the unit appears capable of maintain breeding populations of all forest indicator and priority species identified for the bottomlands.

Partners in Flight population goals for loggerhead shrike are to double the current Texas population by providing habitat for 81,386 pairs in the Mid-coast Initiative Area. The Columbia Bottomlands goal is to provide habitat for 500 pairs, totaling 10,000 acres of suitable habitat including forest/grassland transition areas. From previous research on Brazoria NWR, LeConte's sparrow densities are 2 birds per acre on lands managed for wildlife. Within the Columbia Bottomlands, on suitable habitat, the refuges goal is to maintain this same population density.

Monitoring

For the past ten years, a variety of research and monitoring projects occurred in the bottomlands. These projects generally focus on continuing to gather information on species' habitat associations to aid management in decision making concerning priorities for conservation and restoration of existing units. During migration, bottomland hardwood forest are particularly valuable to a large variety of warblers, vireos, thrushes, tanagers, buntings, goatsuckers, and other forest birds that seek out forest resources after a long flight to recuperate and refuel. In Mississippi, research has demonstrated that neotropical migrants using coastal forests are found in increasing abundance with increasing density of forest trees and increasing numbers of insects in forest understories (Buler et. al. 2007). Research and monitoring associated with this project include wintering forest songbird banding, spring migratory songbird banding, Swainson's and prothonotary warbler nesting, bird call point counts in late winter and spring, and flora inventory.

Protection Priorities

Micro-topography, a result of the movement of historic waterways across the landscape, plays a role in the diversity within the bottomlands. The once vast 700,000-acre forest along the Brazos, San Bernard and Colorado Rivers is a series of patches with varying degrees of diversity today. The larger units are able to encompass more of this topographical diversity and hence provides for a greater suite of bird species. Whenever the opportunity arises to add tracts adjacent to already conserved lands, these are given a priority in order to build larger contiguous units. The existing Service units form corridors along three primary waterways, the Brazos River, the San Bernard River, and the Oyster Creek/Bastrop Bayou drainage. Waterways provide migration corridors for nearctic-neotropical birds as they move inland. Having units arrayed along these drainages provides the best possible means of protecting the floral diversity across the landscape as well as provide a series of migratory stopover sites along these waterways.

The Austin's Woods Conservation Plan, approved in 1997, addressed the need for biological integrity of each individual acquired tract as well as the contribution that each tract makes to the integrity of the overall project area. In the Plan, the Service identified 15 criteria for evaluating each proposed new satellite addition to the San Bernard NWR. Although these criteria provided guidance on a macro level for the initial project, additional information on how they impact indicator species has been added. In addition, the criteria have been rewritten as a question and ranked into primary and secondary priorities. In evaluating a parcel, secondary priority criteria will be considered if not all of the primary criteria are met.

Primary Priorities

1. Does the unit provide high quality old growth undisturbed habitat?

Discussion: Northern parula, and acadian flycatcher are associated with mature trees and utilize the canopy for nesting there. Downy woodpecker is expected in forests of sufficient age to contain rotten limbs and trunks for cavity excavation.

2. Does the unit include exceptional/unique plant communities (e.g., canebrakes, willow swamps, bald cypress swamps, Carolina cherry laurel, (also known as wild peach) stands, rare Brazoria palm stands, and southern red cedar stands, and coastal prairie?

Discussion: Swainson's Warbler and Hooded Warbler utilize areas with thick groundcover to conceal their nests, located on or near the ground-canebrakes, high densities of cherry laurel, and palm or palmetto stands can be utilized by these species. Prothonotary warbler is strongly associated with water bodies and tends to select nesting cavities in flooded habitats- tracts that contain bayous, ponds, and ash or willow swamps will be most likely to host this species. Southern Red Cedar is an attractive cover plant because of its thick and evergreen nature- when found on forest edges and associated prairies it is a great nest host for Loggerhead Shrike and likely appeals to midstory nesters that utilize trees in edges and gaps, such as yellow-billed cuckoo.



Brazoria Palms are found only in the south central part of the project area near Sweeney, TX

3. Is the size of tract greater than 1,200 acres or does it have the potential to have adjacent lands conserved that would meet this criteria?

Discussion: Larger parcels ensure the presence of greater diversity. However smaller parcels should not be overlooked especially if they have high biological value and are in proximity to other conserved areas, migration corridors or possess an important biological component for species of concern. The project goal is the protection of a connected landscape of large parcels (10,000 acres) of forested habitats less than 6 miles inland and forests along the primary rivers/creeks, which are utilized as migration corridors, followed by protection of large parcels beyond 6 miles from the Gulf of Mexico.

4. Does the tract compliment, is adjacent to, or near other protected areas, particularly where natural links exist such as the same hydrologic system or seed dispersal corridors?

Discussion: Acquisition would establish linkage between other protected sites.

private conservation areas enables the protection of lands to establish more than

5. Would acquisition maximize maintenance of natural ecological functions and processes (e.g., natural hydrological patterns)?

Discussion: Prothonotary Warbler is associated with waterbodies (see above). Manipulations to influence watersheds should be evaluated beforehand for conflicts with existing wildlife communities that could be impacted- examples are Swainson's Warbler and Hooded Warbler. Elimination of Swainson's Warbler habitat by human-induced flooding is documented in scientific literature.

6. Does the unit have a high degree of structural (plant community and topographic) complexity?

Discussion: Even canopy-associated species such as Northern Parula Warbler and Acadian Flycatcher may benefit from the higher arthropod biomass and soft mast available in a forest with an understory and midstory present. Further, these layers host other species not typically associated with the canopy, such as Hooded Warbler, Swainson's Warbler, and Painted Bunting (all can be treefall gap nesters within the forest). Other species of concern that can utilize two or more layers, such as Yellow-billed Cuckoo, are expected to benefit from the higher food availability and higher nest site availability of mature forests that contain both a midstory and understory. These layers can regenerate over time with rest, on units that have been acquired after underbrushing and some degree of logging activity.

7. Does the unit have great restoration potential with basic ecological processes; natural hydrological components, species presence intact and minimal invasive species?

Discussion: The majority of the previous acquired parcels have been intact forests. However where restoration has been required, natural revegetation is the primary means by which restoration occurs. Invasive species is the principle issue during restoration and management of existing units.

8. Does the unit influence hydrologic or watershed patterns?

Discussion: Manipulations to influence watersheds should be evaluated beforehand for conflicts with existing wildlife communities that could be impacted- examples are Swainson's warbler and hooded warbler. Elimination of Swainson's warbler habitat by human-induced flooding is documented in scientific literature.

Secondary Priorities

1. No minimum size, if the majority of criteria are met.

2. Expansion capability

Discussion: Will acquisition of this site add to adjacent acquisitions or other protection strategies to build a larger unit?

3. Are there other known exceptional biological elements?
Discussion: An element is an exceptional biological occurrence such as an active bald eagle nest, a rare plant population, or a heron rookery.
4. Human-caused disturbance to the communities (e.g., roads, houses, utility corridors, etc.) present but minimized presence of intact natural biological diversity characteristics of healthy bottomland hardwood forests?
5. Is the unit in proximity to existing developments and threatened with irreversible loss; is there a high potential for public use opportunities?
Discussion: A good example is the Dow Woods Unit which is within the City Limits of Lake Jackson. The unit was donated to the Service and in cooperation with our Friends group, the Service provides nearly three miles of accessible walking trails where people can still see deer, armadillo and wood ducks and experience nature.
6. Is fragmentation of surrounding habitats minimal?
Discussion: Even for smaller units (<1500 acres) or units that receive a high degree of human disturbance, factors that could increase ranking for acquisition include: location along a perceived migration corridor such as a river or stream; location adjacent to other desirable forest regardless of ownership; inclusion of unique plant resources such as Florida corkwood and uncommon tree species such as White Oak, Nuttall Oak, or Willow Oak; uncommon wildlife species such as three-toed box turtles, timber rattlesnake, Swallow-tailed Kite; and highly unique wildlife microhabitats such as timber rattlesnake den sites.
7. Does the parcel have good restoration potential with most basic ecological processes; natural hydrological components, species presence intact and invasive species controllable without impacting other components?
Discussion: Restoration should be primarily by natural succession with species nearby to lend toward diversity. Areas requiring planting or seeding must be minimal.
8. Can the level and kind of current disturbance be minimized through management actions?
Discussion: Even though nearly all of the bottomland tract have existing pipelines, the Service has been successful in working with companies to minimize the impact of maintenance through, timing maintenance when vulnerable species would be present or requiring engineering controls to minimize disturbance.

3.4 Acquisition Funding Alternatives

Under the San Bernard NWR's legislative authorities, the Service can acquire lands to be added to the National Wildlife Refuge System from willing sellers and donors through purchase or donation of either fee title or a conservation easement. This project has demonstrated the use of more innovative protection scenarios and accessed more funding sources than perhaps any other

refuge protection project in the nation (see Table 1, page I-8). Funding sources used to date, and which may be used in the future, include the Migratory Bird Conservation Act Fund, the Land and Water Conservation Fund, the National Fish and Wildlife Foundation, the North American Wetlands Conservation Act, the Coastal Impact Assistance Program of the Texas State General Land Office; donations and loans from the Houston Audubon Society, Houston Sierra Club, Gulf Coast Bird Observatory, The Conservation Fund, The Nature Conservancy, Trust for Public Land, Dow Chemical Company, ConocoPhillips Petroleum Company, The John O'Quinn Foundation, and numerous private landowners (plus project partner donations). The Service will continue to work with multiple partners, utilizing a variety of funding mechanisms to facilitate conservation.

3.5 Coordination

Since 1997 when the acquisition began, the Service has developed and nurtured strong partnerships in the area with landowners, public entities, and conservation organizations. The process of identifying, evaluating, and selecting tracts for refuge acquisition involves staff from the Service, TPWD, NFWF, NRCS, ACOE, Texas Commission on Environmental Quality (TCEQ), and county officials. Other partner organizations such as the Trust for Public Land, The Conservation Fund, The Nature Conservancy, as well as local organizations such as the Houston Audubon Society, Houston Sierra Club, Houston Wilderness, the Community Foundation of Brazoria County, and the Gulf Coast Bird Observatory have been essential to the success of this project. Communication with these organizations began with NEPA compliance and collaboration has continued on a regular basis since 1997. As key conservation tracts were added to the Refuge, partners have provided additional support. Their contributions include: funds toward tract acquisitions, providing land consultation services, and holding title to tracts until funding is secured. Of particular importance, in 1999, NFWF established a special fund for the Austin's Woods Conservation Project and provides expert land consultation. Since that initial agreement, NFWF has held in trust and provided several million dollars to the project from private sources and helped administer key public grants. The ACOE and Environmental Protection Agency have provided mitigation funds to NFWF for acquisition. Several local companies including the Dow Chemical Company, Shintech Corporation and ConocoPhillips have donated land to the Service for conservation. Because of the project's and partnerships' successes, opportunities for future collaborations are increasing and will continue to provide non-Service funding. Public support has continued to grow throughout the project's history, as the Service engaged local governments and provided public use opportunities on units near communities.

This LPP being completed as part of The Texas Mid-coast National Wildlife Refuge Complex (Complex) Draft Comprehensive Conservation Plan (CCP), which will be available for public review and comment in the summer of 2012. All comments will be addressed prior to the final decision.

3.6 Sociocultural Impacts

Impacts on Local Population and/or Economy

Refuge lands require very little in the way of services and infrastructure from local governments and often generate tax revenues from tourism. Nature tourism trends will continue to increase as the economy recovers. The refuge's location near Houston has encouraged visitors who want to experience natural areas instead of developed urban environments. Refuge visitors contribute to the local economy through their retail services purchases. Visitors from outside the local area bring an influx of new money to the local economy which stimulates growth and circulation to other economic sectors, such as construction, in the local economy.

The potential exists for some decline in tax revenue to local governments (as lands come under Service ownership). However, this decline may or may not occur, since those lost tax revenues would be at least partially offset by the Service through the Refuge Revenue Sharing Act. The actual Refuge Revenue Sharing payment varies from year to year because Congress may or may not appropriate sufficient funds to make full payment. San Bernard NWR Refuge Revenue Sharing payments for 2010 were \$53,891 total to Brazoria, Fort Bend, and Matagorda Counties.

Impacts on Aesthetic and Visual Resources

Expanding population and increasing urban development spreading out from the metropolitan area of Houston, the fourth largest city in the Nation, are causing changes to the former rural nature of the four-county project area. Many city dwellers like the prospect of living in the rural and forested areas of the project area, along with the appeal of less expensive lands than those closer to Houston. Ironically, the urban expansion tends to diminish the rural qualities that attract people in the first place. One result of the refuge is the saving of open spaces that will continue to contribute to the positive perceptions of open spaces of residents and visitors in the project area.

Impacts on Public Use Opportunities

Because the Refuge is located close to Houston, Texas, the fourth largest city in the country, the Service would like to provide public use opportunities at some of the bottomland units. Most visitors come to the Refuge to view wildlife and enjoy nature. The Service will continue to offer public hunting, fishing, wildlife observation and wildlife photography, interpretation and environmental education opportunities as it has on other Austin's Woods units owned by the San Bernard Refuge. Demand for outdoor recreation is high in the greater Houston metropolitan area; however, public use opportunities are limited by a relative lack of public lands (only about 5% of Texas lands are held in federal, state, or



Visitors kayaking on Cedar Lake Creek.

local government ownership-(*LandWatch.com*). Where the Refuge only has a conservation easement, the public is not allowed on the property, unless the landowner approves. Additional lands acquired in fee will offer more public use opportunities than what the Refuge offers now. As it has in the past, the acquisition units selected for public use development are done so only after evaluating the cost/benefit of doing so. These units are generally located near population centers and provide unique observation opportunities.

The refuge must balance wildlife observation opportunities with the conservation and protection of habitats and species. Most newly acquired units will not be open for wildlife observation in order to ensure that the conservation of lands is meeting the purpose for which they were conserved, primarily migratory birds.

Environmental education is a critical first step in providing visitors with an awareness of the refuge and the Refuge System and will ultimately translate into support for the refuge and the Refuge System mission. Environmental education provides a way for people to connect with nature through a “hands on” approach, and provides educational experiences that are not easily gained in a classroom. An environmental education center has been developed at the Hudson’s Woods Unit. This has become a popular venue for classes to teach place-based environmental education about the unique habitats of the Columbia Bottomlands. College students have used several of the tracts for research that also benefits the refuge in learning more about the resources and providing impetus for adaptive management of the refuge. Environmental education will continue to be an important public use. The addition of new units will allow for the use of new outdoor “laboratories” for students of all ages.



The Discovery Outpost (right) provides environmental education opportunities for school children and Refuge Junior Naturalists (left) at Hudson Woods Woods Unit.

Currently the refuge provides 6 miles of trails on four of the existing bottomland units. Associated observation decks, restrooms are provided at two sites. The development of these facilities has been partially funded through grants and donations. Most recently, the Dow Woods Unit, near Lake Jackson provides 2.5 miles of accessible walking trails and was funded with more than \$250,000 in grants and donations to the Refuge's Friends Group. New opportunities in the bottomlands, including hunting for deer and feral hogs are being planned through the CCP for the Complex and will be opened following appropriate documentation and NEPA assessment.

References

- Allain, L., V. Malcolm, S. Johnston, D. Patton, R.E. Stewart Sr. and N. Milam. 2003. *Paradise Lost? The Coastal Prairie of Louisiana and Texas*. U.S. Government Printing Office. Pamphlet: Washington, D.C. 39 pp.
- Baldwin, H.Q. 2005. *Effects of fire on home range size, site fidelity, and habitat associations of grassland birds overwintering in southeast Texas*. M.S. thesis. Louisiana State University, 76 pp.
- Barrow, W. C., L. A. Johnson-Randall, M. S. Woodrey, J. Cox, E. Ruelas I., C. M. Riley, R. B. Hamilton, and C. Eberly. 2005. *Coastal forests of the Gulf of Mexico: a description and thoughts on their conservation*. *Bird Conservation Implementation and Integration in the Americas: Proceedings of the Third International Partners in Flight Conference*, C. J. Ralph and T. D. Rich, editors pp. 450-464.
- Buler, J., F. Moore and S. Woltmann. 2007. *A Multi-Scale Examination of Stopover Habitat Use by Birds*. *Ecology* 88 (7):1789-1802.
- Cornell Laboratory 2012. *All about Birds Website* (www.allaboutbirds.org/prothonotary_warbler), accessed February 2012
- Graves, G.R. 2002. *Habitat characteristics in the core breeding range of the Swainson's warbler*. *Wilson Bulletin* 114(2):210-220.
- Delaney M., S. Brown and D. Shoch. 2002. *The Carbon content of Austin Woods/Columbia bottomland hardwood forests*, Winrock International, Arlington VA.
- Grace, J.B., L. Allain and C. Allen. 2000. *Vegetation Associations in a Rare Community Type- Coastal Tallgrass Prairie*. *Plant Ecology* 147:105-115.
- Lanham, J. and S. Miller. 2006. *Monotypic Nest Site Selection by Swainson's Warbler in the Mountains of South Carolina*. *Southeastern Naturalist* 5(2):289-294.
- Merritt, M. 2012. *Personal Communication, Texas Forest Service, January 2012*
- Moore, F.R., P. Kerlinger, and T.R. Simons. 1990 *Stopover on a Gulf coast barrier island by*

- spring trans-Gulf migrants. *Wilson Bulletin* 102:487-500
- Moore, F.R. and D.A. Aborn. 2000. Mechanisms of en route habitat selection: how do migrants make habitat decisions during stopover? *Studies in Avian Biology* 20:34-42.
- Petit D.R. 2000. Habitat use by landbirds along nearctic-neotropical migration routes: implication for conservation of stopover habitats. *Studies in Avian Biology* 20:15-33
- Twedt, D., and S. Somershoe. 2009. Bird Response to Prescribed Silvicultural Treatments in Bottomland Hardwood Forests. *Journal of Wildlife Management* 73(7):1140–1150.
- Vermillion, W., J. William Eley, B. Wilson, S. Heath, and M. Parr, 2008 *Partners in Flight, Bird Conservation Plan, Gulf Coastal Prairie Bird Conservation Region (BCR 37)*, Gulf Coast Joint Venture, Gulf Coast Bird Observatory, 78pp.
- Wilson, B.C. 2007. North American Waterfowl Management Plan, Gulf Coast Joint Venture: Mottled Duck Conservation Plan. North American Waterfowl Management Plan, Albuquerque, NM. 27 pp. + appendixes.
- USFWS 2010. *Rising to the Urgent Challenge: Strategic Plan for Responding to Accelerating Climate Change*, U.S. Fish and Wildlife Service, Department of Interior.
- Yosef, R. 1996. Loggerhead Shrike (*Lanius ludovicianus*). In *The Birds of North America*, No. 231 (A. Poole and F. Gill, eds.). The Birds of North America, Inc., Philadelphia, PA.

Appendix J: CCP Preparation and Planning Team

U.S. Fish and Wildlife Service Employees

Project Leaders:

Jennifer Sanchez, Project Lead, Texas Mid-Coast Refuge Complex
Joseph Lujan, Biologist/Natural Resource Planner, Regional Office
Monica Kimbrough, Natural Resource Planner, Regional Office
Carol Torrez, Lead Planner and NEPA Coordinator, Regional Office

Contributors:

Shane Kasson, Refuge Manager, San Bernard and Big Boggy NWRs
Cody Dingee, Refuge Manager, Brazoria NWR
Jennifer Wilson, Wildlife Biologist, Texas Mid-Coast Refuge Complex
Thomas Adams, Botanist, Texas Mid-Coast Refuge Complex
Michael Lange, Wildlife Biologist, Texas Mid-coast Refuge Complex
Tom Schneider, Outdoor Recreation Planner, Texas Mid-Coast Refuge Complex
Sarah McCabe, Refuge Cartographer Technician
David Chisolm, Fire Management Officer, Texas Mid-Coast Refuge Complex
Steve Kettler, Land Protection Planner, GIS Support, Regional Office
Sarah Ledford, former STEP/GIS/Assistant Natural Resource Planner Intern, Regional Office
Katie Boyer, former STEP/Assistant Natural Resource Planner Intern, Regional Office
Art Needleman, Visual Information Specialist, Regional Office
Jeannie Wagner-Greven, Land Protection Planner, Regional Office
Yvette Truitt-Ortiz, Realty Specialist, Regional Office

Contract Consultants:

Leon Kolankiewicz, Senior Environmental Manager, Mangi Environmental Group, Lean, VA

[This page intentionally left blank.]

Appendix K: References

- Abell, R.A., D.M. Olson, E. Dinerstein, P.T. Hurley, et al. 2000. Freshwater ecoregions of North America: A Conservation Assessment. Washington, D.C.: Island Press. 368 pp.
- Allain, L., V. Malcolm, S. Johnston, D. Patton, R.E. Stewart Sr. and N. Milam. 2003. Paradise Lost? The Coastal Prairie of Louisiana and Texas. U.S. Government Printing Office. Pamphlet: Washington, D.C. 39 pp.
- American Oystercatcher Working Group, Erica Nol and Robert C. Humphrey. 2012. American Oystercatcher (*Haematopus palliatus*), The Birds of North America Online (A. Poole, Ed.). Ithaca: Cornell Lab of Ornithology; Retrieved from the Birds of North America Online: <http://bna.birds.cornell.edu/bna/species/082>
doi:10.2173/bna.82
- Armstrong, Neal E. 1987. The ecology of open-bay bottoms of Texas: a community profile. U.S. Fish and Wildlife Service Biological Report 85(7.12). 104 pp.
- Austin, J.E., and A.L. Richert. 2001. A comprehensive review of the observational and site evaluation data of migrant whooping cranes in the United States, 1943-99. U.S. Geological Survey, Northern Prairie Wildlife Research Center, Jamestown, North Dakota, and State Museum, University of Nebraska, Lincoln, Nebraska. 157 pp.
- Bailey, V. 1905. Biological survey of Texas. North American Fauna. 25:1-222.
- Baldwin, H.Q. 2005. Effects of fire on home range size, site fidelity, and habitat associations of grassland birds overwintering in southeast Texas. M.S. thesis. Louisiana State University, 76 pp.
- Barrow, W.C., and I. Renne. 2001. Interactions between migrant landbirds and an invasive exotic plant: the Chinese tallow tree. Flyway 8:11.
- Barrow, W.C., L.A. Johnson Randall, M.S. Woodrey, J. Cox, E. Ruelas Inzunza, C.M. Riley, R.B. Hamilton, and C. Eberly. 2005. Coastal forests of the Gulf of Mexico: a description and some thoughts on their conservation. General Technical report PSW-GTR-191, U.S. Department of Agriculture, Forest Service, Washington, D.C.
- Behler, J.A., and F.W. King. 1996. Field Guide to North American Reptiles and Amphibians. National Audubon Society. Alfred A. Knopf, New York. 743 pp.
- Bisbee, Ron. 2010. Some Recollections on the History of the Texas Mid-Coast Refuge Complex and the Friends of Brazoria Wildlife Refuges. Presented at Partnerships Advanced Training, Texas Master Naturalists – Cradle of Texas Chapter, June 9, 2010.

- Bookhout, T.A. 1995. Yellow Rail (*Coturnicops noveboracensis*). In *The Birds of North America*, No. 139 (A. Poole and F. Gill, eds.). The Academy of Natural Sciences, Philadelphia, and The American Ornithologists' Union, Washington, D.C.
- Boutton, T.W., X. Dai, M. Hailemichael, R.J. Ansley and K.E. Jessup. 2006. Soil carbon and nitrogen storage in response to fire in a temperate mixed-grass savanna. *Journal of Environmental Quality* 35:1620–8.
- Bowles D.E. and T.L. Arsuffi. 1993. Karst aquatic ecosystems of the Edwards Plateau region of central Texas, USA: A consideration of their importance, threats to their existence, and efforts for their conservation. *Aquatic Conservation: Marine and Freshwater Ecosystems*, 3:317-329.
- Brennan, L.A. 1999. Northern Bobwhite (*Colinus virginianus*). In *The Birds of North America*, No. 397 (A. Poole and F. Gill, eds.). The Birds of North America, Inc., Philadelphia, PA.
- Brennan, L., S. DeMaso, F. Guthery, J. Hardin, C. Kowaleski, S. Lerich, R. Perez, M. Porter, D. Rollins, M. Sams, T. Trail, and D. Wilhelm. 2005. Where have all the quail gone? The Texas quail conservation initiative: a proactive approach to restoring quail populations by improving wildlife habitats. Texas Parks and Wildlife Publication PWD RP W7000-1025.
- Brown, R.E., and J.G. Dickson. 1994. Swainson's Warbler (*Limnothlypis swainsonii*). In *The Birds of North America*, No. 126 (A. Poole and F. Gill, eds.). The Birds of North America, Inc., Philadelphia, PA.
- Brown, S., C. Hickey, and Harrington, eds. 2001. *The U.S. Shorebird Conservation Plan*, 2nd ed. Manomet Center for Conservation Sciences: Manomet, MA.
- Buehler, D.A. 2000. Bald Eagle (*Haliaeetus leucocephalus*). In *The Birds of North America*, No. 506 (A. Poole and F. Gill, eds.). The Birds of North America, Inc., Philadelphia, PA.
- Buler, J., F. Moore and S. Woltmann. 2007. A Multi-Scale Examination of Stopover Habitat Use by Birds. *Ecology* 88 (7):1789-1802.
- Butler, J.A., C. Broadhurst, M. Green, and Z. Mullin. 2004. Nesting, nest predation and hatchling emergence of the Carolina diamondback terrapin, *Malaclemys terrapin centrata*, in northeastern Florida. *American Midland Naturalist* 152(1):145-155.
- Cahoon, D.R., J.W. Day and D.J. Reed. 1999. The influence of surface and shallow subsurface soil processes on wetland elevation, a synthesis. *Current Topics in Wetland Biogeochemistry* 3:72-88.

- Carr Jr., J.T. 1967. The climate and physiography of Texas: Austin, Texas Water Development Board Report 53. 27 pp.
- Chipman D. E., "CABEZA DE VACA, ALVAR NUNEZ," *Handbook of Texas Online* (<http://www.tshaonline.org/handbook/online/articles/fca06>), accessed June 13, 2011. Published by the Texas State Historical Association.
- Conner J.V. and R.D. Suttkus. 1986. Zoogeography of freshwater fishes of the western Gulf slope. In Hocutt C.H. and E.O. Wiley (Ed.). The zoogeography of North American freshwater fishes (pp. 413-456). New York, NY: John Wiley & Sons.
- Corbat, Carol A. and Peter W. Bergstrom. 2000. Wilson's Plover (*Charadrius wilsonia*), The Birds of North America Online (A. Poole, Ed.). Ithaca: Cornell Lab of Ornithology; Retrieved from the Birds of North America Online: <http://bna.birds.cornell.edu/bna/species/516> doi:10.2173/bna.516
- Cryan, P.M., and J.P. Veilleux. 2007. Migration and the use of autumn, winter, and spring roosts by tree bats, pp. 153-175. In Bats in Forests: Conservation and Management (M. J. Lacki, J. P. Hayes, and A. Kurta, eds.). The Johns Hopkins University Press, Baltimore, MD.
- Deegan, L. A. 1993. Nutrient and energy transport between estuaries and coastal marine ecosystems by fish migration. Canadian Journal of Fisheries and Aquatic Sciences. 50:74-79.
- Delaney M., S. Brown and D. Shoch. 2002. The Carbon content of Austin Woods/Columbia bottomland hardwood forests, Winrock International, Arlington VA.
- Desrochers, A., and S.J. Hannon. 1997. Gap crossing decisions by forest songbirds during the post-fledging period. Conservation Biology 11:1204-1210.
- Draud, M., M. Bossert and S. Zimnavoda. 2004. Predation on hatchling and juvenile diamondback terrapins (*Malaclemys terrapin*) by the Norway rat (*Rattus norvegicus*).
- Dyes, J.C. 1993. Nesting birds of the coastal islands: a naturalist's year on Galveston Bay. Austin, TX: University of Texas Press. 137 pp.
- Duke, T. and W. L. Kruczynski. 1992. Report on the status and trends of emergent and submerged vegetated habitats of Gulf of Mexico coastal waters. EPA 800-R-92-003.
- Dudley, N. (Editor). 2008. Guidelines for Applying Protected Areas Management Categories. Gland, Switzerland: IUCN. 85 pp.
- Eddleman, W.R., R.E. Flores, and M.L. Legare. 1994. Black Rail (*Laterallus jamaicensis*).

Appendix K: References

- In The Birds of North America*, No. 123 (A. Poole and F. Gill, eds.). Philadelphia: The Academy of Natural Sciences; Washington, D.C.: The American Ornithologists' Union.
- Elliot, L. and K. McKnight. 2000. U.S. Shorebird Conservation Plan, Lower Mississippi/Western Gulf Coast Shorebird Plan, Gulf Coastal Prairie Working Group Mississippi Alluvial Valley/West Gulf Coastal Plain, Lafayette, LA. 64 pp.
- Fang, X., and H.G. Stefan. 1998. "Temperature Variability in the Lake Sediments." *Water Resources Research*, 34(4):717-729.
- Farquhar, C.C. 1992. White-tailed Hawk. *In The Birds of North America*, No. 30 (Poole, P. Stettenheim, and F. Gill, eds.). Philadelphia: The Academy of Natural Sciences; Washington, D.C.: The American Ornithologists' Union.
- Feinberg, J.A., and R.L. Burke. 2003. Nesting ecology and predation of diamondback terrapins, *Malaclemys terrapin*, at Gateway National Recreation Area, New York. *Journal of Herpetology* 37(3):517-526.
- Gabry, S.W. and A.D. Afton. 2000. Effects of winter marsh burning on abundance and nesting activity of Louisiana seaside sparrows in the gulf coast chenier plain. *Wilson Bulletin* 112(3):365-372.
- Gauthreaux, Jr. Sidney A. 2002. Radar Ornithology and Bird Conservation. Available at: <http://www.gcbo.org/>. Accessed March 27, 2012.
- Given, A.M. 2005. Movements and habitat use of wintering yellow rails wintering at the Texas Mid-Coast National Wildlife Refuge Complex in Southeast Texas. M.S. thesis. Cape Girardeau, MO. Southeastern Missouri State University. 80 pp.
- Glass, P. 1994. An analysis of the advisability and need of creating new colonial waterbird nesting islands in Galveston Bay, Texas. Appendix to: Fish and Wildlife Coordination Report Houston-Galveston Navigation Channels, Texas Project. Clear Lake: Texas. 32 pp.
- Gochfeld, Michael and Joanna Burger. 1994. Black Skimmer (*Rynchops niger*), *The Birds of North America Online* (A. Poole, Ed.). Ithaca: Cornell Lab of Ornithology; Retrieved from the *Birds of North America Online*: <http://bna.birds.cornell.edu/bna/species/108> doi:10.2173/bna.108
- Gosse, D., R. McDowell and R. Evans. 2002. Upper West Gulf Coastal Plan Ecoregional Plan. The Nature Conservancy.
- Gosselink, J.G., C. L. Cordes, J. W. Parsons. 1979. An ecological characterization study of the Chenier Plain coastal ecosystem of Louisiana and Texas, Vol. 1-3. U.S. Fish and Wildlife Service, Office of Biological Services, Washington, D.C.

- Gould, F.W., G.O. Hoffman, and C.A. Rechenhain. 1960. Vegetational areas of Texas. Texas Agric. Exp. Sta., Leaflet 492:1-4.
- Grace, J.B., L. Allain and C. Allen. 2000. Vegetation Associations in a Rare Community Type- Coastal Tallgrass Prairie. *Plant Ecology* 147:105-115.
- Grand, J.B. 1988. Habitat selection and social structure of mottled ducks in a Texas coastal marsh [dissertation]. College Station (TX): Texas A&M University. 79 pp.
- Graves, G.R. 2001. Factors governing the distribution of Swainson's warbler along a hydrological gradient in Great Dismal Swamp. *Auk* 118(3):650-664.
- Graves, G.R. 2002. Habitat characteristics in the core breeding range of the Swainson's warbler. *Wilson Bulletin* 114(2):210-220.
- Haig, S.M., and E. Elliott-Smith. 2004. Piping Plover. The Birds of North America Online. (A. Poole, Ed.) Ithaca: Cornell Laboratory of Ornithology; Retrieved from The Birds of North American Online database:
http://bna.birds.cornell.edu/BNA/account/Piping_Plover/.
- Harrington, B.A. 2001. Red Knot (*Calidris canutus*). In The Birds of North America, No. 563 (A. Poole and F. Gill, eds.). The Birds of North America, Inc., Philadelphia, PA.
- Haukos, D., P. Walther and J. Neaville. 2004. Status of the Mottled Duck in Louisiana, Texas and Mexico. Report to Region 2 Regional Office, U.S. Fish and Wildlife Service. Albuquerque, NM.
- Haukos, D.A. and L.M. Smith. 2004. Plant communities of playa wetlands in the Southern Great Plains. Special Publications, No. 47. Museum of Texas Tech University, Lubbock, TX. 66 pp.
- Herkert, J.R., P.D. Vickery and D.E. Kroodsma. 2002. Henslow's Sparrow (*Ammodramus henslowii*). In The Birds of North America, No. 672 (A. Poole and F. Gill, eds.). The Academy of Natural Sciences: Philadelphia, PA and The American Ornithologists' Union: Washington, D.C.
- Hogan, J.L. 2003. Occurrence of the diamondback terrapin (*Malaclemys terrapin littoralis*) at South Deer Island in Galveston Bay, Texas, April 2001-May 2002. U. S. Geological Survey Open-File Report 03-022. 24 pp.
- Howe, M.A. 1989. Migration of radio-marked whooping cranes from the Aransas-Wood Buffalo population: Patterns of habitat use, behavior, and survival. USFWS, Fish Wildl. Tech. Rpt 21. 33 pp.
- Igl, L., and B. Ballard. 1999. Habitat Associations of Migrating and Overwintering Grassland Birds in Southern Texas. *Condor* 101 (4):771-782.

- IPCC. 2007. Climate Change 2007: Synthesis Report. Contribution of Working Groups I, II and III to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change. Core Writing Team: R.K Pachauri and A. Reisinger, eds. IPCC: Geneva, Switzerland. 104 pp.
- IUCN. 2005. World Commission on Protected Areas Strategic Plan.
- James, F.C, and H.H. Shugart. 1970. A quantitative method of habitat description. *Am. Birds* 24:721-736.
- Johnson, K.A. and S.A. Temple. 1980. The migration ecology of the whooping crane. Unpublished report prepared under contract 14-16-0009-78-034 to USFWS. U. of Wisconsin, Madison, Wisconsin. 87 pp.
- Jones, Jr., J.K., Armstrong, D.M., and J.R. Choate. 1985. Guide to mammals of the plains states. University of Nebraska Press, Lincoln, Nebraska.
- Knopf, F.L. 1994. Avian assemblages on altered grasslands. *Stud. Avian Biol.* 15:247-257.
- Kushlan, J.A., M. J. Steinkamp, K. C. Parsons, J. C. Martin, A. Cruz, M. Coulter, I. Davidson, L. Dickson, N. Edelson, R. Elliot, R. M. Erwin, S. Hatch, S. Kress, R. Milko, S. Miller, K. Mills, R. Paul, R. Phillips, J. E. Saliva, B. Sydeman, J. Trapp, J. Wheeler, and K. Wohl. 2002. Waterbird Conservation for the Americas: The North American Waterbird Conservation Plan, Version 1. Waterbird Conservation for the Americas: Washington, D.C. 78 pp.
- Kuyt, E. 1992. Aerial radio-tracking of whooping cranes migrating between Wood Buffalo National Park and Aransas National Wildlife Refuge, 1981-84. *Occas. Pap.* 74, Canadian Wildl. Service. 53 pp.
- Lanham, J. and S. Miller. 2006. Monotypic Nest Site Selection by Swainson's Warbler in the Mountains of South Carolina. *Southeastern Naturalist* 5(2):289-294.
- Larkin, T.J. and G.W. Bomar. 1983. Climatic atlas of Texas. Tex. Dep. Water Resources, Austin, TX.
- Leezer, C. and C. Britt Bousman. 2006. Archaeological Investigations at the Levi Jordan State Historic Site, Brazoria County, Texas, by Carole Leezer. Principal Investigators: Texas Antiquities Permit No. 3800.
- Lockhart, M.L. and B. Freeman. 2004. *The Texas Ornithological Society Handbook of Texas Birds*. Texas A&M University Press. College Station, TX. 261 pp.
- Lovejoy, S.B. 1992. Sources and quantities of nutrients entering the Gulf of Mexico from surface waters of the United States. EPA 800-R-92-002.

- Lowther, P.E., and R.T. Paul. 2002. Reddish Egret (*Egretta rufescens*). In *The Birds of North America*, No. 633 (A. Poole and F. Gill, eds.). The Birds of North America, Inc., Philadelphia, PA.
- Lowther, P.E. 2005. Le Conte's Sparrow (*Ammodramus leconteii*). *The Birds of North America Online* (A. Poole, ed.). Ithaca: Cornell Lab of Ornithology; Retrieved from the Birds of North America Online: <http://bna.birds.cornell.edu/bna/species/224doi:10.2173/bna.224>.
- Manlove, C.A., B.C. Wilson and C.G. Esslinger. 2002. North American Waterfowl Management Plan, Gulf Coast Joint Venture: Coastal Mississippi Wetlands Initiative. North American Waterfowl Management Plan. Albuquerque, N.M. 28 pp.
- Manning, R.E. 1989. Social research in wilderness. In *Wilderness Benchmark 1988*. Proceedings of the National Wilderness Colloquium. Asheville, North Carolina: Southeastern Forest Experiment Station.
- McMahon, G., S.M. Gregonis, S.W. Waltman, J.M. Omernik, T.D. Thorson, J.A. Freeouf, A.H. Rorick, and J.E. Keys. 2001. Developing a spatial framework of common ecological regions for the conterminous United States. *Environmental Management* 28(3):293-316.
- Merritt, K. 1981. Mottled duck pair counts. San Bernard National Wildlife Refuge. 6 pp.
- Meyer, K.D. 1995. Swallow-tailed Kite (*Elanoides forficatus*), *The Birds of North America Online* (A. Poole, Ed.). Ithaca: Cornell Lab of Ornithology; Retrieved from the Birds of North America Online: <http://bna.birds.cornell.edu/bna/species/138> doi:10.2173/bna.138
- Miller, S.M. 2003. First report of a double-brooded Swainson's warbler. *Wilson Bulletin* 115(1):94-95.
- Mirande, C., R. Lacy and U. Seal. 1993. Whooping Crane (*Grus americana*) conservation viability assessment workshop report. Captive Breeding Specialist Group, International Union for Conservation of Nature. Apple Valley, MN.
- Moore, F.R. and D.A. Aborn. 2000. Mechanisms of en route habitat selection: how do migrants make habitat decisions during stopover? *Studies in Avian Biology* 20:34-42.
- Moorman, T.E., and P.N. Gray. 1994. Mottled Duck. In *The Birds of North America*, No. 81 (A. Poole and F. Gill, eds.), Philadelphia, PA and The Academy of Natural Sciences; Washington, D.C.: The American Ornithologists' Union.
- Moulton, D.W., T.E. Dahl, and D.M. Dall. 1997. Texas Coastal Wetlands. *Status Trends*, Mid 1950s to early 1990s. 79 pp.

- National Marine Protected Areas Center (NMPAC). 2009. National Marine Protected Areas Center Strategic Plan 2010 – 2015. Available at: <http://www.mpa.gov>.
- North American Bird Conservation Initiative, U.S. Committee. 2009. The State of the Birds, United States of America, 2009. U.S. Department of Interior. Washington, D.C. 36 pp.
- Nemec, K. 1995. The diamondback terrapin. Public outreach handout. U.S. Fish and Wildlife Service. Clear Lake, Texas. 2 pp.
- Oberholser, H.C., E.B. Kincaid, Jr. 1974. The Bird Life of Texas. University of Austin Press. Austin, TX. 1100 pp.
- Omernik, J.M., S.S. Chapman, R.A. Lillie, and R.T. Dumke. 2000. Ecoregions of Wisconsin. Transactions of the Wisconsin Academy of Sciences, Arts, and Letters 88:77-103.
- Page, Gary W., Lynne E. Stenzel, G. W. Page, J. S. Warriner, J. C. Warriner and P. W. Paton. 2009. Snowy Plover (*Charadrius nivosus*), The Birds of North America Online (A. Poole, Ed.). Ithaca: Cornell Lab of Ornithology; Retrieved from the Birds of North America Online: <http://bna.birds.cornell.edu/bna/species/154> doi:10.2173/bna.154
- Paul, R.T. 1991. Status report – *Egretta rufescens* (Gmelin) Reddish Egret. U.S. Fish and Wildlife Service, Houston, TX. 73 pp.
- Peters, K.A., R.A. Lancia, and J.A. Gerwin. 2005. Research notes. Swainson's warbler habitat selection in a managed bottomland hardwood forest. Journal of Wildlife Management 69 (1):409-417.
- Pilchek, T. 2001. Personal Communication. Texas Parks and Wildlife, Private Lands Biologist.
- Post, W. 1974. Functional analysis of space related behavior in the seaside sparrow. Ecology 55:564-575.
- Post, W. and J.S. Greenlaw. 2009. Seaside sparrow (*Ammodramus maritimus*), The birds of North America online. (A. Poole, ed.), Ithaca: Cornell Lab of Ornithology. Retrieved from the birds of North America online: <http://bna.birds.cornell.edu/bna/species/127doi:10.2173/bna.127>.
- Rich, T.D., C.J. Beardmore, H. Berlanga, P.J. Blancher, M.S. W. Bradstreet, G.S. Butcher, D.W. Demarest, E.H. Dunn, W.C. Hunter, E.E. Iñigo-Elias, J.A. Kennedy, A.M. Martell, A.O. Panjabi, D.N. Pashley, K.V. Rosenberg, C.M. Rustay, J.S. Wendt and T.C. Will. 2004. Partners in Flight North American Landbird Conservation Plan.

- Cornell Lab of Ornithology. Ithaca, NY. Partners in Flight website: http://www.partnersinflight.org/cont_plan/. Accessed March 2005.
- Ricketts, T.H., E. Dinerstein, D.M. Olsen, C.J. Loucks, W. Eichbaum, D.DellaSala, K. Kavanagh, P. Hedao, P.T. Hurley, K.M. Carney, R. Abell, and S. Walters. 1999. Terrestrial ecoregions of North America. Island Press, Washington, D.C., USA.
- Ricklis, R.A. 1997. The Karankawa Indians; ecological study of cultural tradition and change. Austin, TX. University of Texas Press. 231 pp.
- Robbins, C.S. 1983. Distribution and migration of seaside sparrow. In T.L. Quay, J.B. Funderburg, Jr., D.S. Lee, E.F. Potter, and C.S. Robbins, eds. *The Seaside Sparrow, its Biology and Management*. Occas. Paps. North Carolina Biol. Surv. Raleigh, NC. USA. pp. 31-40.
- Robbins, M.B. and B.C. Dale. 1999. Sprague's Pipit (*Anthus spragueii*), The Birds of North America Online (A. Poole, Ed.). Ithaca: Cornell Lab of Ornithology; Retrieved from the Birds of North America Online: <http://bna.birds.cornell.edu/bna/species/439> doi:10.2173/bna.439
- Rush, S., E. Soehren, M. Woodrey, C. Graydon, and R. Cooper. 2009. Occupancy of Select Marsh Birds within Northern Gulf of Mexico Tidal Marsh: Current Estimates and Projected Change. *Wetlands*, 29(3):798-808.
- Ryder, R.A., and D.E. Manry. 1994. White-faced Ibis (*Plegadis chihi*). In *The Birds of North America*, No. 130 (A. Poole and F. Gill, eds.). Philadelphia, PA. The Academy of Natural Sciences; Washington, D.C. The American Ornithologists' Union.
- Salwasser, H., S.P. Mealey and K. Johnson. 1984. Wildlife population viability: a question of risk. *Transactions of the North American Wildlife and Natural Resource Conference* 49.
- Shields, M. 2002. Brown Pelican (*Pelecanus occidentalis*). In *The Birds of North America*, No. 609 (A. Poole and F. Gill, eds.). The Birds of North America, Inc., Philadelphia, PA.
- Smeins, F.E., D.D. Diamond, and W. Hanselka. 1991. Coastal prairie, in *Ecosystems of the world, natural grasslands*. R.T. Coupland (Editor), Amsterdam: Elsevier Press.
- Speer, R. 1995. Spring shorebird use at Brazoria National Wildlife Refuge Complex, Texas. Progress report available from U.S. Fish and Wildlife Service, Texas Mid-Coast NWRC. 22 pp.

- Sprigg, W.A. and T. Hinkley. 2000. *Preparing for a Changing Climate: The Potential of Climate Variability and Change – Southwest*. A Report of the Southwest Regional Assessment Group. Institute for the Study of Planet Earth, Tucson, AZ. Available at: <http://www.ispe.arizona.edu/research/swassess/report.html>.
- Stahlecker, D.A. 1992. Using national wetlands inventory maps to quantify whooping crane stopover habitat in Oklahoma. *Proc. N. Am. Crane Workshop* 6:62-68.
- Stauffer, D.F. and L.B. Best. 1980. Habitat selection by birds of riparian communities: evaluating effects of habitat alterations. *Journal of Wildlife Management*. 44:1-15.
- Stephen, W.J.D. 1979. Whooping crane sightings in Prairie Provinces 1977 and 1978. *Blue Jay* 37:163-168.
- Stewart, R.E. 1975. *Breeding birds of North Dakota*. Harrison Smith, Lund Press. Minneapolis, MN. 295 pp.
- Stutzenbaker, C.D. 1988. *The Mottled Duck: its life history, ecology and management*. Texas Parks and Wildlife Department, Austin, TX. 209 pp.
- Tassone, J.F. 1981. *Utility of hardwood leave strips for breeding birds in Virginia's central Piedmont*. M.S. Thesis. Virginia Polytech. Inst and State Univ., Blacksburg, Virginia. 83 pp.
- Texas Comptroller of Public Accounts, 2009. *Texas In Focus: Gulf Coast Region*. 66 pp.
- Texas Comptroller of Public Accounts, 2010. *Texas In Focus: Gulf Coast Region*. 70 pp.
- Texas Parks and Wildlife Department. 2005. *Texas Wildlife Action Plan*. Austin: Texas. 1100 pp.
- Texas Parks and Wildlife Department – *Wildlife Fact Sheet*. Available at: www.tpwd.state.tx.us/huntwild/wild/species.
- The Nature Conservancy. 2002. *The Gulf Coast Prairies and Marshes Ecoregional Conservation Plan*. Gulf Coast Prairies and Marshes Ecoregional Planning Team, The Nature Conservancy, San Antonio, TX, USA. 27 pp.
- Thatcher, B.S., D.G. Krementz and M.S. Woodrey. 2006. Henslow's Sparrow winter survival estimates and response to prescribed burning. *Journal of Wildlife Management* 70(1):198-206.
- Twedt, D., and S. Somershoe. 2009. Bird Response to Prescribed Silvicultural Treatments in Bottomland Hardwood Forests. *Journal of Wildlife Management* 73(7):1140–1150.

- Twilley, R. et al. 2001. Confronting climate change in the Gulf Coast Region: Prospects for Sustaining our Ecological Heritage: A report of the Union of Concerned Scientists and the Ecological Society of America. UCS Publications, Cambridge, MA.
- UNEP. 2008. Summary of protection by Country and Territory on January 31, 2008 (XLS). World Database on Protected Areas. Available at: <http://www.unep.org>.
- U.S. Department of Agriculture. 2007. United States Department of Agriculture Ag Census Report. National Agricultural Statistic Service: questions and answers. Available at: http://www.agcensus.usda.gov/Publications/2007/Full_Report/CenV1US1.txt.
- U.S. Environmental Protection Agency. AirCompare Report. Available at: <http://www.epa.gov>.
- U.S. Department of Energy, Office of Science. 1999. Carbon Sequestration Research and Development. 26 pp.
- U.S. Department of the Interior. 2006. Wetland Status of the Texas Gulf Coast. U.S. Geological Survey, National Wetlands Research Center: Lafayette, LA. Available at: <http://www.nwrc.usgs.gov/factshts/019-00.pdf>.
- U.S. Fish and Wildlife Service. 1956. Memo dated May 17, 1956.
- U.S. Fish and Wildlife Service. 1956. Memo dated July 20, 1956, from George E. Barclay Regional Supervisor, Branch of Wildlife Refuges, to John C. Gatlin, Regional Director, Region 2. Albuquerque, NM.
- U.S. Fish and Wildlife Service. 1963. Biological Reconnaissance Report. San Bernard National Wildlife Refuge. May 6, 1963.
- U.S. Fish and Wildlife Service. 1963. Memo dated October 21, 1963.
- U.S. Fish and Wildlife Service. 1965. Biological Reconnaissance Report. Brazoria National Wildlife Refuge. April 1965.
- U.S. Fish and Wildlife Service. 1965. Proposal to Migratory Bird Conservation Commission.
- U.S. Fish and Wildlife Service. 1981. Final Environmental Impact Statement for the Proposed Acquisition of Big Boggy Marsh, Matagorda, Texas.
- U.S. Fish and Wildlife Service. 1981. Memo to Senator John G. Tower.
- U.S. Fish and Wildlife Service. 1982. Mottled duck nesting investigation, San Bernard National Wildlife Refuge. 25 pp.

Appendix K: References

- U.S. Fish and Wildlife Service. 1994. Whooping Crane Recovery Plan. Albuquerque, NM. 92 pp.
- U.S. Fish and Wildlife Service. 1997. Final Proposed Austin's Woods Conservation Plan, Land Protection Compliance Document and Conceptual Management Plan - Austin's Woods Units of the Brazoria national Wildlife Refuge Complex. Southwest Region, Albuquerque, NM. April 1997.
- U.S. Fish and Wildlife Service. 2001. Endangered and threatened wildlife and plants; final determination of critical habitat for wintering piping plovers. Final Rule. Federal Register 66(132) 50 CFR Part 17.
- U.S. Fish and Wildlife Service. 2006. National Survey – 15 Year Trend Information. Available at: http://wsfrprograms.fws.gov/subpages/NationalSurvey/15_year_trend.htm. Accessed April 2011.
- U.S. Fish and Wildlife Service. 2006. Strategic Habitat Conservation: Final Report of the National Ecological Assessment Team. Arlington, VA. 45 pp.
- U.S. Fish and Wildlife Service. 2009. Texas Mid-coast Refuge Complex: Trends and Predicted Sea Level Rise Impacts to Coastal Wetlands. Southwest Region, Albuquerque, NM. 37 pp.
- U.S. Fish and Wildlife Service. 2009b. Texas Mid-Coast Refuge Complex, Brazoria and Matagorda Counties, TX, Endangered Wildlife and Plants; Permits, Sacramento, Delevan, Colusa, and Sutter National Wildlife Refuges, Glenn, Colusa, and Sutter Counties, CA. 74 Federal Register 119 (23 June 2009) 29714-5.
- U.S. Fish and Wildlife Service. 2010. Rising to the Challenge: Strategic Plan for Responding to Accelerating Climate Change. U.S. Fish and Wildlife Service, Arlington, VA.
- U.S. Fish and Wildlife Service. Piping Plover Critical Habitat: questions and answers. Available at: <http://www.fws.gov/plover/q&a.html>.
- U.S. Fish and Wildlife Service. United States Fish and Wildlife Service. Available at: http://wsfrprograms.fws.gov/subpages/NationalSurvey/15_year_trend.htm. Accessed April 2011.
- U.S. General Accounting Office. 2001. GAO-02-64R Wildlife Refuge Oil and Gas Activity. Available at: <http://www.gao.gov/search?q=oil+andgas+refuge>.
- U.S. Geological Survey. 1973. Report 163. Texas Department Water Resources. 40 pp.
- U.S. Geological Survey. 2001. A Primer on Water Quality. Available at:

<http://pubs.usgs.gov/fs/fs-027-01/>.

- U.S. North American Bird Conservation Initiative Committee. 2000. North American Bird Conservation Initiative: Bird Conservation Region Descriptions. U.S. Fish and Wildlife Service, Division of Bird Habitat Conservation: Arlington, VA.
- Webb, J.W. 1997. Columbia Bottomlands avifauna habitat inventory: Phase II. Gulf Coast Bird Observatory, Lake Jackson, Texas. 24 pp.
- Werler, J. E., and J. R. Dixon. 2000. Texas snakes: identification, distribution, and natural history. Austin, TX: University of Texas Press. 437 pp.
- White, W.A., and Paine, J.G. 1992. Wetland plant communities, Galveston Bay System: Galveston Bay National Estuary Program, Publication GBNEP-16. 124 pp.
- Wilson, B.C., and C.G. Esslinger. 2002. North American Waterfowl Management Plan, Gulf Coast Joint Venture: Texas Mid-Coast Initiative. North American Waterfowl Management Plan, Albuquerque, NM. 28 pp.
- Yosef, R. 1996. Loggerhead Shrike (*Lanius ludovicianus*). In The Birds of North America, No. 231 (A. Poole and F. Gill, eds.). The Birds of North America, Inc., Philadelphia, PA.

[This page intentionally left blank.]

Appendix L. Service Response to Public Comment

This appendix summarizes the comments that were received on the Draft Comprehensive Conservation Plan and Environmental Assessment (CCP/EA) for Texas Mid-coast National Wildlife Refuge Complex. The Draft CCP/EA was released for public review and comment from August 15, 2012 to September 20, 2012. The public was notified of the release of the Draft CCP and EA with a Notice of Availability in the *Federal Register* on August 15, 2012 (Volume 77, Number 158, pp. 49011-49015) and again on August 21, 2012 (Volume 77, Number 162, pp. 50523-50526) because the incorrect comment period end date was published in the first notice. Notification was also provided through local media outlets (local newspapers, radio station, and television) and public notices that were posted at all refuge offices.

The document was made available to approximately 170 individuals, organizations, elected officials, and local, state, and federal agencies; and an electronic copy was made available on the Service's website. An open house was held during the comment period (on August 29, 2012) at the Complex headquarters, providing the public with an opportunity to discuss the plan with Service staff. Despite being heavily advertised, only eight individuals attended this event; no comments were submitted at the open house meeting. The Service received a total of four written comments (three via email and one letter from the Houston Regional Group of the Sierra Club). The comments received and the Service's responses are as follows.

E-mail Comment 1 (associated with Brazosport Birders):

I found a few mistakes:

3.6.1.4 Partnerships page 3-93

Add Brazosport Birders (we provided open house volunteers for Brazoria National Wildlife Refuge for over 20 years and provide volunteers still for different projects, including keeping the bird checklist up to date).

Page 3-65

Caption under photo should read Gulf Coast Bird Observatory, not Gulf Coast Observatory.

5.6.1.7 Gulf Coast Bird Observatory

Remove "Participate in Texas Birding Classic". We are no longer associated with the Classic.

I have also contacted Jennifer about adding a section about utilizing the refuges for the Christmas Bird Counts of Brazoria, Brazos Bend, Freeport, and San Bernard.

Response:

Thank you for your comments. Corrections to the identified sections were made as suggested.

E-mail Comment 2 (associated with Friends of Brazoria Wildlife Refuges):

What a wonderful set of documents you have created with the TMCNWRCCP and EA plans! Their scope is truly impressive and encompassing, and they will be a valued reference resource for understanding the path of managing our refuges over the next 15 years. I am sure that I and

other members of the Friends board of directors will be wearing pages out as we frequently use these documents to organize our part of support for the Texas Mid-coast NWRs.

After ten hours of reading, I admit that I reverted to scanning the documents, pausing to read in detail those areas where I am engaged or find of particular interest. I only found two typos: Page 2-10: Columbia should be Columbia. southern most should be southern-most.

I was personally pleased to see three of my photos used in the CCP document: Page 3-82, Seining; Page 3-83 Crabbing; and Page 3-127 Pond Life.

Table 3-12 is missing the Dow Woods Bayou Loop Trail.

I am a student of climate, and so paid particular attention to these sections. On the future trajectory of climate impacts, we disagree. In looking at your climate assumptions, I am reminded of a quote attributed by Daniel Patrick Moynihan, to paraphrase, "You are entitled to your own opinion, but you are not entitled to your own facts."

To wit: Page 1-15: "The U.N. Intergovernmental Panel on Climate Change (IPCC) reports that direct temperature measurements at weather stations worldwide suggest that the surface of Earth has warmed, on average, 34°F in the last 100 years (IPCC, 2007). Data for the Southwest show an increase in temperature of 34°F to 35°F during the past century and project an increase in temperature of 40.1°F to 43°F in the future." That's +18.9 °C rising to +23.9 °C! The peak of the last interglacial (Eemian) briefly rose to 5 °C above today, so your claim to an ~ 20 °C rise in 100 years is incredible! So your temperature numbers are incorrect and did not come from the IPCC. The 2007 IPCC TR4, section 3.1, "...surface temperatures have increased by about 0.74 °C over the past hundred years (between 1906 and 2005)...", i.e. = 1.35 °F. The computer models used by the IPCC project an energy imbalance of 3.7 W/m² for a doubling of CO₂, which yields a temperature gain of between 1.5 °C and 4.5 °C, with the most common estimates being around +2.5-3.0 °C.

Page 1-15: "The last ten years have been the warmest decade on record, during which global sea level has risen about 8 inches."

The 2007 IPCC TR4, FAQ 5.1, "Estimates for the 20th century show that global average sea level rose at a rate of about 1.7 mm per year." = 6.7 inches for those 100 years as opposed to your misstated 8 inches in ten years. Houston & Dean, 2007 provide updated numbers through 2010 and show no acceleration in SLR. Another source, report a 3.2 mm/yr SLR in the last decade = 1.3 inches; see http://sealevel.colorado.edu/current/sl_noib_global_sm.jpg .

Since there is nothing the Complex can do to mitigate the warming of the globe, and since adaptive measures will be taken in the management of our refuges to SLR, your climate sections are really a case of no harm, no foul. In the process, we can rejoice that the increase of CO₂ is fertilizing plant growth.

Response:

Thank you for your comments and support.

The typographical errors identified on page 2-10 were corrected as suggested and the Bayou Loop Trail was added to Table 3-12.

According to Service policy, the pictures taken by refuge volunteers belong to the Service, so photo credit is shown as USFWS; however, we acknowledge that the photos shown on pages 3-82 (Seining), 3-83 (Crabbing), and 3-127 (Pond Life) were taken by refuge volunteer, Marty Cornell. We appreciate the assistance and support provided by all of our volunteers.

Thank you for pointing out the errors presented in the second paragraph of section 1.3.3.1 (Climate Change). The incorrect numbers were mistakenly included in the second paragraph of that section; it has have been corrected as follows.

“The U.N. Intergovernmental Panel on Climate Change (IPCC) reports that direct temperature measurements at weather stations world-wide suggest that the surface of Earth has warmed, on average, 1.0 °C (1.8 °F) in the last 100 years (IPCC 2007). Data for the Southwest show an increase in temperature between 1.1°C (2 °F) to 1.7°C (3.1 °F) during the past century and project an increase in temperature of 4.5°C (8.1 °F) to 6.1°C (11 °F) in the future (Sprigg and Hinky 2000). Estimates for the 20th century show that global average sea level rose at a rate of about 1.7 mm per year, which equals 17.0 centimeters (6.7 inches) for those 100 years. The increase of carbon dioxide (CO₂) within the earth’s atmosphere has been linked to the gradual rise in surface temperature commonly referred to as global warming. The IPCC also concludes that substantial increases in global average temperatures will cause major changes in ecosystem structure and function, species’ ecological interactions, and species’ geographical ranges. These projected changes have enormous implications for management of fish, wildlife, and their habitats around the world. “

Email comment 3:

While Defenders of Wildlife is not able to submit detailed comment on the draft CCP, they would like the Refuge to refer to criteria developed in the Defenders of Wildlife fact sheet “Climate Change and National Wildlife Refuge Planning” to ensure that climate change is comprehensively considered and addressed.

Response 6: The Refuge reviewed the Defenders of Wildlife fact sheet and using best available data, integrated climate change throughout the CCP. For more information, please refer to the following sections of the CCP:

- Section 1.1, Purpose and Need for the CCP
- Section 1.3.3.1, Climate Change
- Section 1.3.3.2, Strategic Habitat Conservation and Gulf Coast Prairie Landscape Conservation Cooperative
- Section 1.3.3.3, National Conservation Plans and Initiatives
- Section 2.3.1, Ecoregion Issues
- Section 3.3.1.5, Estimated Future Habitat Conditions due to Climate Change
- Section 3.3.1.6, Concerns Regarding Refuge Habitat
- Section 3.3.2.9, Concerns Regarding Wildlife Populations

- Section 3.6.5.4, Concerns Regarding Special Management Areas
- Chapter 4, Ecoregional Objective 1
- Appendix I, Land Protection Plan for Austin's Woods

The following comments were received from the Sierra Club:

Note: The following sentence was included at the end of each comment within the commentors letter. "The public must have this information so that it can review, comment on, and understand all the environmental impacts of the CCP." In an attempt to streamline this appendix, this sentence has been removed from each comment listed below; we do not feel it is helpful to repeatedly mention this sentence throughout this appendix. Otherwise, the comments are shown verbatim, followed by the Service response.

Comment 1:

Page 1-16, 1.3.3.2 Strategic Habitat Conservation and Gulf Coast Prairie Landscape Conservation Cooperative, are targets and goals the same thing? If not how do they relate to each other? Please be specific.

Response: Targets and goals are the same in this situation. In section 1.3.3.2, under the five key principles of SHCs we have changed "setting targets" to "setting goals" to avoid confusion.

Comment 2:

Page 2-5, Table 2-3, Addressing the Issues Raised During Scoping, Issues that are outside the scope of this Plan, urbanization and development, stream channelization, and reintroduction of species are listed as outside the scope of the CCP. However, depending on the exact set of circumstance these three issues may be appropriately found inside the scope of the CCP.

For instance, if urbanization and development affects the Complex, like is noted with wildland-urban interface and fire or other affects on the Complex then this issue should be addressed in this CCP. In addition, there are drainage districts that want to claim an easement through federal property to dredge a natural channel deeper and wider and which alter the hydrology beyond the Complex and affects the hydrology on the Complex. In addition, an easement that the FWS has on Cedar Lake Creek has been the focus of a management controversy between the landowner and the drainage district.

Further, the CCP talks about the reintroduction of species both endangered and other species (American Bison). Reintroduction of species should in the Complex be covered in the CCP.

Response:

Thank you. In response to your comment, we reviewed the table and particularly the issues outside of the scope of this CCP. We moved urbanization and development in to the category of addressed by the CCP. This decision is based on the inclusion of the Land Protection Plan in Appendix I. By providing a conservation alternative to a land owner interested in selling their land, the Service does address this issue. However the Complex has no authority with regards to stream channelization outside of the refuge boundaries. Within the boundaries of the refuge,

including conservation easements, the Complex would address any request for bank clearing and channelization through the Appropriate Use and Compatibility Policies. The Complex does not have enough information regarding plans or impacts to fully evaluate reintroduction of any species at this time. The Complex has not been identified for the reintroduction of any endangered species other than as a possibility to be evaluated. If the Service chooses to do so in the future, planning, including additional NEPA will need to be completed.

Comment 3:

Page 2-9, Erosion, FWS should mention the Gulf Intracoastal Waterway (GIWW) now since later in the CCP (page 8-85, "The GIWW is a major source of erosion, leading to saltwater intrusion and the subsequent degradation of freshwater marshes. This project affects all three refuges in the Complex"; page 3-5, "... and the Gulf Intracoastal Waterway has had significant impacts on coastal marshes"; page 3-45, "Erosion along the edges of the GIWW has been significant since it was first dredged ... However acres of marsh are lost annually as vessel wakes, tides, and wind driven wave-action erode fine marsh sediments along exposed shorelines"; and page 3-49, "The GIWW is now three to four times wider than when originally dredged. This equates to a direct loss of marsh habitat as well as opening up channels into once isolated wetlands.") FWS identifies the GIWW as one of the major reasons for erosion on the Complex. The Sierra Club believes that stopping this erosion on all three refuges should be one of the number one priorities of the Complex.

Response:

Thank you for your comment. We have added the GIWW to the erosion issue statement on page 2-9 as suggested. The Service has no control over the use or maintenance of the GIWW; the erosion problems identified in the CCP are outside of our management authority. The Service will continue use best management practices and address/minimize potential erosion for management actions on refuge lands.

Comment 4:

Page 2-9, Land Management and Other Land Use Practices, the CCP states "in addition ... is solely determined by the Water Development Boards." What boards is FWS referring to? Please be specific.

Response:

Thank you for your comment. The last sentence of the Land Management and Other Land Use Practices issue statement on page 2-9 was clarified; Water Development Boards was changed to River Authorities.

Comment 5:

Page 3-8, Marine Environments, the CCP mentions "Gulf sturgeon". The FWS should state how the Gulf Sturgeon is doing and whether management of the Complex can assist in the recovery of this vanishing fish.

Response:

Thank you for your comment. The Gulf sturgeon only occurs in the eastern region of the northern Gulf of Mexico. It has never been known to occur in the western subregion (south of

Galveston Bay) of the northern Gulf of Mexico. The Complex does not play a role in the recovery of this species since it is outside of the none or historical range of the Gulf Sturgeon.

Comment 6:

Page 3-31, Environmental Contaminants, FWS does not mention in the CCP Hoskins Mounds and the controversy about contaminants on this 2,500 acre in-holding that Chevron is required by deed to give to the FWS. The Sierra Club is very concerned that the FWS never even mentions Hoskins Mounds as a viable acquisition and why it has refused to accept this donation. It is the Sierra Club's understanding that there are no contaminant issues left at Hoskins Mound but that the FWS regional office is afraid that there might be hidden contaminant issues. Chevron has conducted its due diligence and cleaned up the area and FWS must accept the donation of this key in-holding. The CCP must talk about Hoskins Mound and its status. The acquisition of Hoskins Mound should be a goal of this CCP.

Response:

Thank you for your comment. No change has been made in response to your comment; this section reviews environmental contaminant or sources of potential contamination that could affect the refuge. Other than from the oil and gas operations, the Complex does not consider the Hoskins Mound in-holding a potential for contamination. The Complex shares your concerns regarding the future of this substantial in-holding. This property being completely surrounded by the refuge as well as the unique habitat resources, does make it a priority for acquisition. The Service has completed a baseline study on the property, which should aid in moving forward with acquisition, if in the future, Chevron Texaco chose to dispose of this property.

Comment 7:

Page 3-48, 3.3.1.5 Estimated Future Habitat Conditions due to Climate Change, the Sierra Club appreciates that the FWS has provided a detailed discussion about the potential impacts of climate change on the Complex. What does "would function at a level 24 of long-term productivity" mean?

Response:

Thank you for your comment. The phrase reference above was an editorial error. That sentence, which is toward the end of the third paragraph in section 3.3.1.5 has been clarified. It now reads as "...would function at a level where productivity would offset predicted losses."

Comment 8:

Page 3-52, Habitat Fragmentation, the CCP states "... these rights-of-way ... enable the transport and introduction of invasive species, direct take of wildlife, and alteration of adjacent habitats increase light reaching the canopy floor alters species composition." It is important that the FWS talk about how these impacts will be reduced. The same is true for livestock grazing which can introduce non-native invasive plant species. What does FWS plan to do to combat this impact due to ROWs and livestock grazing? Be specific.

Response:

Thank you for your comment. The Service considers each request for right-of-way or other permits on a case-by-case basis and stipulations are included in the permit to avoid and minimized impacts. For clarification, the following sentence was added to the Habitat

Fragmentation paragraph on page 3-52.

“Due to these policies no new pipeline right-of-ways have been constructed through bottomland habitats that have been acquired by the Service.”

Comment 9:

Page 3-57, Smalltooth Sawfish, the Sierra Club urges the FWS to do everything it can to assist in the recovery, including reintroduction, of the Smalltooth Sawfish into Texas waters at the Complex and other coastal habitats.

Response:

Thank you for your comment. As explained in our response to comment #2, reintroductions of threatened and endangered species on the Complex are not planned at this time and are outside the scope of this CCP.

Comment 10:

Page 3-67, 3.3.2.2 Focal/Representative Species, FWS should state how the focal species it will use were chosen over other species. The public should be given more information. For instance, the U.S. Forest Service provided a public comment period on its proposal to change its indicator species.

Response:

Thank you for your comment. Information was added to the introductory paragraph of section 3.3.2.2, to help clarify the selection of focal species. The selection was made through an evaluation of the ecological significance, management significance, policy mandates and our effect this species through management actions as outlined in the Strategic Habitat Conservation Technical Implementation Guide. This list should be considered flexible but the current species helped to guide the goals, objectives and strategies found in the CCP.

Comment 11:

Page 3-93, 3.6.1.4 Partnerships, the Sierra Club should be listed as a partner.

Response:

Thank you for your comment. The Sierra Club was added to section 3.6.1.4 as requested.

Comment 12:

Page 3-93, 3.6.1.6 Law Enforcement and Resource Protection, the Sierra Club supports the addition of at least three additional law enforcement positions so that the very sprawled-out Complex can be covered fully.

Response:

The Service appreciates your support for additional law enforcement personnel. Table 5-2 identifies personnel needed beyond current levels to implement our proposed action identified in the CCP.

Comment 13:

Page 3-104, Haying, the CCP should show where "prescribed fire cannot be implemented due

to an expansion of WUI areas" and how many acres and linear feet these areas cover.

Response:

The following verbal description was added to this section. "Two units, Halls Bayou near Santa Fe, Texas and Fire Hall Units near Demi John are currently hayed." It is impractical to provide a map for these units since they are so small (they would not show up clearly on a refuge map) and further development is continually occurring around the refuges. The Service evaluates the need for haying in WUI areas on a case-by-case basis.

Comment 14:

Page 3-110, Dune and Beach, the CCP states "The Complex is extremely concerned about the beach resources, where unlimited access is contrary to refuge purposes." The Sierra Club supports fencing off the San Bernard Beach and dunes so that motorized vehicles cannot access this area and providing regular patrols to catch those who illegally drive here. A public education program is also needed for this issue

Response:

In response to your comment, we have added the following text to the Dune and Beach section. "San Bernard NWR is currently working with the Texas General Land Office to further protect the San Bernard Beach. Bollards were installed in 2011 to notify the public that the upper beach is part of Refuge and limit access. The Service needs to continue to educate the public on the importance of beach resources." Fencing is impractical; the high tide would constantly throw debris into it, making maintenance difficult (if not impossible).

Comment 15:

Page 3-111, Feral Hog, the Sierra Club supports an aerial hunting program to reduce feral hog numbers on the Complex.

Response:

Thank you for your support of our feral hog management program.

Comment 16:

Page 3-123, Fishing, the CCP states"... encourage anglers to collect and discard excess and old fishing line, hooks, and sinkers, since wildlife are known to die after ingesting this debris." The Sierra Club supports education but also strong enforcement to catch those who trash out the Complex and create death traps for wildlife.

Response:

Thank you for your support. The Service will continue ongoing education and enforcement efforts.

Comment 17:

Page 3-133, Waterways, Brazoria NWR, Christmas Bay is mentioned here in the CCP. However, in the rest of the CCP not a word is said about the importance of Christmas Bay, how it has been designated a Coastal Preserve, and what FWS is going to do in the CCP to protect Christmas Bay, its seagrass beds, and other natural resources from

degradation.

Response:

Thank you for your comment. We have added information on the Coastal Preserve Program under sections 1.3.3.5 and 3.1.4 of the CCP.

Comment 18:

Page 3-136, 3.6.5.2 Research Natural Areas (RNA), the CCP mentions Christmas Point Research Natural Area but says nothing about where it is located, what is there, and why it is a RNA.

Response:

Thank you for your comment. The records concerning the Christmas Point RNA are sparse. Our files contain a Natural Area Information Form and a map and indicate that it was established August, 1973, but there is no detail about why it was established.

Comment 19:

Page 4-1, 4.1 Ecoregional Goal, instead of saying "To contribute to conservation efforts" say "To implement conservation efforts".

Under Objective 1 – Managing Landscapes, instead of saying "habitat shifts in an attempt to enable best management practices" say "habitat shifts to implement best management practices".

Page 4-2, 4.1 Ecoregional Goal, the citation for Donnelly, 2009, is not found in the references on pages B-97 and B-98 or K-1 through K-13. Please include this study with the references.

Page 4-2, 4.1 Ecoregional Goal, the Houston Sierra Club should be included as a partner.

Page 4-3, Strategies, 10., the five year timeframe for modeling Columbia Bottomlands response to climate change should be changed to three years. If this habitat is as important and in danger of vanishing as the FWS states in the CCP it needs attention sooner, not later.

Objective 2 – Conservation of Columbia Bottomland Ecosystem, instead of acquiring 1,000-2,500 acres/year the Sierra Club suggests that the acquisition of 2,500-5,000 acres/year be the goal. If this habitat is as important and in danger of vanishing as the FWS states in the CCP it needs attention sooner, not later.

Response:

Thank you for your comments. Changes to the Ecoregion Goal (pages 4-1 and 4-2), Objective 1- Managing Landscapes, and the Strategy on page 4-3, were made as suggested.

In response to your comment about the “Donnelly 2009” citation, we have made appropriate corrections within the text and Appendix K. Donnelly, the Service employee who authored the paper was incorrectly listed in the citation. The citation should have been shown as USFWS

2009, which was included in the EA references (pages B-97 and B-98), but was inadvertently left out the Appendix K of the Draft CCP.

In response to your comment about Objective 2 – Conservation of Columbia Bottomland Ecosystem, no changes to the document we made. The objective of acquiring 1,000-2,500 acres/year was established based on the past 15 years of acquisition. Although during 2012, more than 10,000 acres were conserved in one year. This year aside, the average has been 1,400 acres/year. Based on the complexity and limitations of putting together traditional and non-traditional funding, it is unlikely that this will change in the foreseeable future. A goal of 2,500-5,000 is unrealistic based on past experience.

Comment 20:

Page 4-4, Habitat Management Goal, Objective 1 – Bottomland Hardwood Forests, here FWS states that old growth is 80+ years but on page 3-6 and in other places in the CCP FWS states that old growth is 50 to 100 years old. Which statement is correct? FWS must be consistent. The Sierra Club's viewpoint is that 50 year old trees are not old growth.

Response:

A change was made on page 3-6 to make it consistent with this section, which states that old growth is 80+ years.

Comment 21:

Page 4-5, Objective 1 – Bottomland Hardwood Forests, Strategies, 10., the FWS throughout this CCP talks about step-down plans. FWS does not say how these plans provide for public participation and input. The Sierra Club requests that this issue be addressed. For instance, the Sierra Club wants to participate and provide public input on the Habitat Management Plan. How is this done?

In addition, FWS should prioritize land acquisition so that additional Brazoria Palm habitat is acquired.

Response:

Thank you for your interest in our planning process. It is the responsibility of the Refuge Manager to ensure that all environmental compliance requirements are completed before project or plan implementation. The level of NEPA compliance (Categorical Exclusion, EA or EIS) and associated public involvement necessary is determined when planning is initiated. The public will be notified about future opportunities for public involvement for projects and step-down plans as appropriate.

The Service agrees that the acquisition of additional Brazoria palm habitat is a priority and has taken advantage of every opportunity to purchase Brazoria palm habitat when it has been available from a willing seller.

Comment 22:

Page 4-5, Objective 2– Coastal Prairie, less than 1% of the 9 million acres of coastal prairie means that less than 9,000 acres exist. However FWS states that within Texas 250,000 acres

exist. Which figure is correct? The public must have this information so that it can review, comment on, and understand all the environmental impacts of the CCP.

Under the photo on page 4-5, of a lightning caused wildfire near Cedar Lake Creek the word "consumed" is used. FWS knows that prairie is not consumed by wildfire. Prairie is restored, rejuvenated, or simply functions better naturally due to wildfire. One of FWS purposes is to educate the public. By using the word "consumed" the FWS undermines environmental education with alarmist hype instead of scientific explanation. Remove the word "consumed" and use a more appropriate and accurate term.

Page 4-6, Strategies, the Sierra Club is very disappointed that FWS does not have a conservation strategy for native coastal tallgrass prairie. There is a need for more acquisition of coastal tallgrass prairie so that can it be restored and additional habitat provided for the reintroduction of species like American Bison, Attwater's Prairie Chicken, and others.

The Sierra Club supports a strategy with a goal of a certain number of acres acquired and restored each year to coastal tallgrass prairie. This acquisition will is needed since the climate change section of the CCP states plainly that a lot of coastal tallgrass prairie may become marsh habitat as sea level rise occurs. The Sierra Club wants to participate via public input on the Habitat Management Plan.

Response:

Clarification has been added to the rationale under objective 2. Both figures are correct based on the literature citations we have provided. The 1 percent of 9 million acres represents the total unaltered (never plowed; never touched) coastal prairie that is remaining. The 250,000 acres of coastal prairie in Texas includes lands with native prairie species that have been managed and/or restored.

Under the photo on page 4-5, "consumed" was changed to "burned" as suggested.

The following strategies were added:

13. Acquire prairie and former prairie habitat associated with Columbia Bottomland Forest Ecosystem.
14. Restore fallow fields and non-native pasture to native prairie habitat.

Comment 23:

Page 4-8, Objective 3 – Wetlands, Strategies, 3., the FWS should state clearly how it will "Protect refuge shorelines and dunes from human disturbance to maintain the natural function of these areas." The Sierra Club wants to participate in public input on the Habitat Management Plan.

Response:

Thank you for your comments. Clarification was added to strategy number 3, which now reads "Protect refuge shorelines and dunes from human disturbance to maintain the natural function of these areas by restricting vehicle traffic above high tide lines." Another strategy was also added. It is listed as strategy number 4 and states that the refuge will "Work with GLO to limit access to San Bernard Beach."

Comment 24:

Page 4-9, Objective 1 -Waterfowl, Strategies, 3., the Sierra Club supports making recovery of the Mottled Duck one of the top priorities for the CCP. The Sierra Club supports, at a minimum, at least 2,000 acres of restored Mottled Duck nesting habitat for the CCP.

Page 4-9, Strategies, 4., the FWS should provide an estimate of the increase in acres of Wolfweed and Sargent wetlands that it will occur due to the CCP. The public must have this information so that it can review, comment on, and understand all the environmental impacts of the CCP.

Page 4-9, Strategies, 1., the Sierra Club supports acquisition of water rights so that the Complex will have long-term access to water.

Response:

Thank you for your comments. Mottled duck recovery is one of the Complex's top priorities; however, due to past prairie restoration efforts, prairie habitat (nesting habitat) is not the limiting factor. Targeting brooding habitat near prairie habitat, as stated in Objective 1, will be the most effective way to enhance mottled duck production.

We have edited Strategy 4, on page 4-9, to indicate that managed wetlands at San Bernard would be increased by 400 acres. We have also added the following strategy under Objective 1, which is shown as strategy 7, "Continue research programs on mottled ducks including brood and molter banding programs."

The Service also shares your concerns about water rights and will continue to pursue opportunities to purchase water rights from willing sellers as they become available.

Comment 25:

Page 4-10, Objective 2 – Forest birds, Strategies, 2., the Sierra Club supports the reintroduction of Eastern Wild Turkey to the Complex. However, the Sierra Club urges FWS to understand the failure of reintroduction of Eastern Wild Turkey in the National Forests of Texas and especially Sam Houston National Forest so that it does not repeat costly failures.

Page 4-10, Strategies, 5., the Sierra Club recommends that a forest bird habitat monitoring protocol not just be developed but also implemented in this strategy.

Response:

Thank you for your comments. As stated in the strategy, the Service will evaluate the potential for reintroduction. During this evaluation, the Service will utilize the best available science during planning and implementation to ensure the best chance of success.

Strategy 5, under objective 2 (Forest Birds) has been edited as suggested. It now reads as following, "Within one year, develop and implement a forest bird habitat monitoring protocol such as a modified James and Schugart vegetation sample."

Comment 26:

Page 4-12, Objective 3 – Grassland and Secretive March Birds, Strategies, 3. and 7., the Sierra Club is *very* concerned about using non-native invasive species, cows, to conduct habitat management. It would be far better to spend money on how American Bison can be introduced to the coastal tallgrass prairie, not salt marsh, so that one native grazing species would be integrated back into its native habitat.

The Sierra Club is *very* concerned about FWS ineptness with regard to the Hoskins Mound donation (about 2,500 acres) that Chevron has offered. The Sierra Club finds it ridiculous that the FWS regional office cannot get to a final resolution about this valuable in-holding so that Chevron can donate the land to the Complex. Things have gotten so bad that Chevron does not want to talk to FWS because it has not been able to make a determination about contaminants and the work that Chevron has done to remove contaminants from the site. Further delay is not acceptable. FWS must move on this issue now. This situation has been sitting on the *stove* for over five years. It is time to fish or cut bait. Don't throw this once in a lifetime opportunity away.

Response:

Thank you for your comments. Although grazing by domestic cattle is being presented in this plan, an additional grazing implementation plan still needs to be prepared. This plan will identify goals and objectives for grazing as well as implementation strategies and the specific impacts of this implementation as well as a monitoring program to ensure habitat and wildlife benefits are occurring from this management activity. It is anticipated that implementation of grazing on the Complex will not be a “typical” program and that by implementing light intensity; cool season grazing will benefit the prairie as well as the wildlife it supports. Although bison are a viable option, the ability to move domestic cattle on and off the refuge to meet the objectives of the grazing program increases the likelihood of meeting the objectives of the program including invasive species control and increasing diversity.

We agree that Hoskins Mound would be a valuable addition to the refuge; however, we take exception to being characterized as inept in regard to acquiring this inholding. There are certain requirements that the Service has to complete before accepting any parcel of land. One of these is that it must have a contaminant evaluation. During the initial evaluation in 2005, the Service had questions regarding contamination of soils and ground water due to the presence of elemental sulfur in the surface soils. The Service has not pursued the Hoskins Mound tract more vigorously in recent years due to limited staffing and because there have been no imminent threats to the parcel and the current owners re-evaluated their landholdings and chose to hold on to the parcel for now. In addition, there have been other acquisition priorities. With the available (limited) funding and staff, our priority on the Complex has been the acquisition of bottomland hardwood forest in accordance with the Austin's Woods Plan. The Service will pursue acquisition of inholdings (including Hoskins Mound) in the future, as funds and manpower allow.

Comment 27:

Page 4-12, Objective 4– Colonial Waterbird Colonies, Strategies, 2. And 7., how many new islets for nesting birds will be created and where.

Response:

This question cannot be answered at this time; the size and placement will be determined based on the amount of dredge spoil generated.

Comment 28:

Page 4-14, Objective 5 – Shorebirds, Strategies, 6., the Sierra Club supports the protection of beach habitat in San Bernard NWR. How will vehicle access be restricted?

Page 4-14, Strategies, 4., 10 years is too long for development of a shorebird monitoring protocol. A more reasonable time is 3-5 years. The FWS must tell the public why development and implementation of a shorebird monitoring protocol takes so long.

Response:

Thank you for your support. See response to comment #14 for methods used to restrict vehicle access.

Strategy 6 on page 4-14 was changed to “Protect four miles of beach habitat of San Bernard NWR by restricting vehicle access above mean high tide, establishing education programs and regular law enforcement patrols.”

Strategy 4 on page 4-14 was changed to “Continue shorebird monitoring protocol that was established in 2011.”

Comment 29:

Page 4-15, Objective 6 – Reptiles and Amphibians, Strategies, 6., since Texas Parks and Wildlife Department already has a way to survey American Alligators the Sierra Club does not understand why FWS needs five more years to implement a monitoring protocol.

Response:

Thank you for your comment. No change was made. The State’s alligator monitoring flights only monitor a portion of the refuge and are not a good indication of total population. We do not feel that they are an adequate means of assessing Complex-wide alligator populations.

Comment 30:

Page 4-16, Objective 7 – Mammals, Strategies, 3., the Sierra Club supports reducing feral hog populations all over the Complex.

Page 4-16, Strategies 6., the Sierra Club supports monitoring bat habitat and populations.

Response:

Thank you for your support.

Comment 31:

Page 4-17, Objective 1 – Visitation, Strategies, 9., people are not customers. They are owners of the NWR System. There is a difference. Treat the people as owners and not customers.

If the FWS proposes to charge people, the owners, an entrance fee of \$3/person to visit the people's San Bernard and Brazoria NWRs, then FWS must discuss in detail why this fee is needed, what it will pay for, how it will affect those who have little money but visit the Complex or would like to visit the Complex, and how it affects those who do not want to pay to have access to their property.

A fee is not charged at Trinity River NWR, Anahuac NWR, Texas Point NWR, and McFaddin NWR. What makes the Complex different from these? The Sierra Club is opposed, in most cases, to entrance fees for lands that the public owns. What are the impacts that the entrance fee will have on the public? The National Environmental Policy Act (NEPA) requires that the FWS adequately address this issue in the EA. But FWS says not one word about this proposal's impacts on the public. The Sierra Club opposes this entrance fee.

Response:

Thank you for your comment. We have reconsidered the practicality of charging an entrance fee. Since there is no consistent way to implement this proposal, we have decided to remove it from consideration. All references to an entrance fee in the CCP have been removed and it has been dropped from Alternative B in the EA.

Comment 32:

Page 4-20, Objective 4 – Interpretation, Strategies, 11., what does TMC mean?

Response:

TMC is the acronym we commonly use for Texas Mid-coast NWR Complex. We have changed this to Complex, which is the term consistently used throughout the CCP.

Comment 33:

Page 4-22, Objective 6 – Fishing, Strategies, 4., FWS states "allowing non- motorized access along the beach to the San Bernard River." Bicycles are non- motorized vehicles but should not be allowed because they can cause damage to dune and beach habitats.

Response:

Thank you for your comment. We disagree that bicycles should not be allowed. Based on past experience, we do not anticipate any adverse effects from the limited bicycle use that may occur.

Comment 34:

Page 4-24, Objective 8 – Outreach, Strategies, 3., five years is a lot of time for development of portable interpretive displays. Three years is a more reasonable timeframe.

Page 4-24, Strategies, 5., eight years is a long time to develop outreach tools. Three years is a more reasonable timeframe.

Response:

Thank you for your comment. Strategies 3 and 5 under Objective 8 provide timeframes that we feel are reasonable based on expected staffing levels and Complex priorities. It would not be realistic to expect these strategies to be implemented in shorter timeframes.

Comment 35:

Page 4-25, Objective 9 – Law Enforcement and Visitor Safety, the Sierra Club supports a strategy that requires the hiring of at least 3 additional law enforcement officers so that there are at least 5 law enforcement-officers at the Complex. The Complex is far too large in number of acres, linear feet of boundary, and distance between refuges for two law enforcement officers.

Response:

The Service appreciates the Sierra Club’s support for hiring additional law enforcement offices; however, the current law enforcement deployment model does not allow expansion of law enforcement numbers at this time. Table 5-2 of the CCP identifies additional personnel beyond current levels to implement the CCP.

Comment 36:

Page 4-27, Objective 11 – Cultural Resources, Strategies, 5., 10 years is far too long for the development of exhibits about historical connections between people and the land. Five years is a more reasonable timeframe.

Response:

Thank you for your input. We maintain that 10 years is a reasonable timeframe for this activity. The only historical site on the Complex that is accessible has already been interpreted and we will continue to assess the need for interpretive material as additional sites are identified.

Comment 37:

Page 4-29, Objective 4, Strategies, 1., the public must have the opportunity to participate and comment on any EA, special use permit, and other documents that deal with oil/gas activities on the Complex.

Response:

This is already common practice for the Complex. Every EA for oil and gas activities goes out for a 30-day public comment period.

Comment 38:

Page 5-3, Table 5-2, Additional Personnel Needs Beyond Current Levels, the Sierra Club supports adding all of these positions to the Complex as well as 3 additional law enforcement personnel.

Response:

Thank you for your input. See response to comment #35.

Comment 39:

Page 5-11, 5.2.2 Compatibility, the Sierra Club has concerns about Mosquito Control, Livestock Grazing, Cooperative Farming, and Bicycling on the Complex. There is no way that Mosquito Control can be thought of as being compatible. Aerial use of poisons on the Complex affects fish and wildlife and vegetation resources. Livestock Grazing using non-native cows is not good for native coastal tallgrass prairie. If FWS desires that a native grazer of coastal tallgrass prairie (not salt grass or wet soils) be present then reintroduction

of American Bison should be pursued. Bicycling on open roads is fine and the Sierra Club supports this type of bicycle use. The Sierra Club however, does not support mountain bike use on hiking trails and on closed roads at Hudson Woods. The Sierra Club prefers that cooperative farming be phased out and the FWS begin the restoration to coastal tallgrass prairie of long-term heavily farmed lands. This will result in fewer waterfowl but if prairie potholes and other features are restored then there will be less impacts on waterfowl. Positive impacts include the provision of more habitat for grassland species of birds which have been declining significantly in the past 20 years.

Response:

Thank you for your input, but we disagree with your position. The scope of these activities is limited and they will be implemented to meet specific management objectives, as described in Appendix C. Each of these activities has been thoroughly evaluated and they have been determined to be compatible, which means that they do not materially detract from the purpose(s) of the refuge(s).

Comment 40:

Pages 5-12 through 5-14, 5.4.1 Current Step-Down Plans and 5.4.2 Future Step-Down Plans, the Sierra Club urges FWS to provide a public participation and input period for these plans. The public, as owners of the NWRs, should have the right to provide review and comment on these plans. In particular the Sierra Club requests the opportunity to participate in the development of the Oil and Gas Management Plan.

Response:

Appropriate levels of NEPA compliance will be completed for each of the proposed step-down plans. If an EA is found to be warranted, public involvement will be requested.

Comment 41:

Page 5-15, Moist-Soil Management, the Sierra Club supports acquisition of additional water rights so that even during dry periods or droughts the Complex is able to maintain the three refuges for wildlife habitat.

Response:

Thank you for your support. The Service will continue to pursue opportunities to purchase water rights from willing sellers as they become available.

Comment 42:

Pages 5-18 and 5-19, 5.5.2.1 Biological Management Projects, the Sierra Club supports these restoration plans. In particular, the Sierra Club understands that trespass cattle have been allowed to degrade part of the Slop Bowl because no fence has installed to keep them out. It is time to stop this trespass so that this incompatible and illegal use no longer affects fish and wildlife values on Brazoria NWR.

The Sierra Club is very supportive of projects that address erosion control and bank stabilization due to GIWW impacts and turkey reintroduction into the Columbia Bottomlands.

Response:

Thank you for your support.

Comment 43:

Pages 5-23 and 5-24, 5.6 Partnerships and 5.6.1.2 Austin Woods Conservation project: A Partnership Project, the Houston Sierra Club should be listed as a partner.

Response:

Thank you for your input; however, we did not change the list in sections 5.6 and 5.6.1.2. Not all partners are listed, only those primary partners that contributed funds and manpower.

Comment 44:

Page B-7, 1.8.1 Ecoregion Issues, the Sierra Club supports the Complex in taking a landscape-scale approach to management.

Response:

Thank you for your support.

Comment 45:

Page B-8, Disturbance, if increased air traffic and boat use are important issues with regard to disturbance of wildlife the CCP should discuss these issues in detail and state how the environmental impacts will be minimized. The Sierra Club does not see the discussion of these issues or mitigation for these issues.

Response:

Thank you for your comment. We feel that disturbance has been adequately discussed in the CCP and analyzed in the EA. Ecoregion issues, such as disturbance, which result in impacts to wildlife and habitat outside of the Complex are outside our control.

Comment 46:

Page B-13, Entrance Fees, FWS states that members of the public were split about entrance fees. On pages B-42 and B-50, FWS proposes in Proposed Alternative B that a \$3 entrance fee be charged.

There is zero discussion about this decision. The Trinity River NWR, Anahuac NWR, Texas Point, and McFaddin NWR have no entrance fees. Anahuac proposed an entrance fee about five years ago and then withdrew that proposal.

The Sierra Club supports entrance fees for National Parks and for special services like campgrounds and developed facilities. However, entrance fees raise serious questions about free public access, social equity, and the potential to transform recreational management of public land from public service orientation to commercial enterprise. This may drive FWS to provide services for those who pay and who want more expensive and more environmentally damaging activities versus those who cannot pay and participate in less environmentally degrading activities like hiking and nature study.

The Sierra Club requests that FWS withdraw this entrance fee proposal. If this does not occur then FWS must provide a detailed discussion and analysis about the impacts the fee can have on the public who own NWRs but would not have access to them unless they pay a second time (people already pay taxes every April 15th to support the professional management of public lands). The U.S. Congress often chooses to subsidize extractive industrial use of our public lands like oil/gas drilling, grazing, etc. while charging fees for low-impact recreational activities. Families should not have to pick-up this additional tab for industry every time they want to use their NWRs.

The Sierra Club is also concerned about the fiscal and financial inequity that working class and poor people must assume with an entrance fee. Three dollars may not seem like much to some but for many, particularly in these depressed times, that is money that could decide for one of the owner's of the NWRs that they cannot afford and will result in their being turned away from the natural beauty that they own and so they cannot fish, hike, enjoy nature study and environmental education.

When the Sierra Club takes people to the Complex it tells visitors that they own NWRs and they can come back any time they want and enjoy them. The Sierra Club also tells people that they have a responsibility to take care of NWRs. To build a constituency FWS should not charge the owners of NWRs (public lands) money to see and enjoy what they already own.

Enclosed is a study as printed in the Journal of Leisure Research entitled, "Do User Fees Exclude Low-income People from Resource-based Recreation?". This study states, in part, "Since fees do have a significant negative impact on participation by low-income people, how should public agencies respond? Of the usual justifications given for fees, many are little more than attempts to rationalize excluded users, avoiding any moral issues involved. For example, many managers focus on agency welfare, turning excluded users into little more than an accounting problem. Similarly, a focus on resource protection or economic efficiency can support fee programs with little consideration of which visitors get excluded. The currently popular "customer" orientation can accomplish a similar result. Since low-income people are less likely to participate in many forms of resource-based recreation, they can simply be defined as "not our customers." Each of these strategies is in full play in recreation management and research; what is missing is a sense of public need or mission."

"These caveats aside, visitor exclusion highlights a critical problem in recreation policy – the problem of public purpose. In general, for the public sector to be involved in an activity, there needs to be a public purpose for it – some public need that must be fulfilled, some public goal that must be accomplished. This is certainly true for public lands, and it is this public purpose that must drive policy."

"Thus, the key question with regard to fees becomes: How do fees enhance or detract from an agency's ability to fulfill its missions? ... Our data clearly suggest that fees have had a negative impact on participation for nearly half of low- income households ... If low-income people are, in fact, excluded from public parks and recreation areas, then serious policy questions are raised about the very purpose of public recreation ... However, when agencies begin to

act like entrepreneurs seeking self-funding through fees, and low-income people are excluded, the public purpose- the very reason for public ownership- is defeated ... Our results suggest that fees undercut this mission: they are a major step in the gentrification of recreational resources. When the parks are reserved for the comfortably well-off, will they continue to be publicly necessary?"

The Sierra Club urges FWS to abandon this ill-thought-out idea. The Sierra Club supports on pages B-36 and B-46 no entrance fee but an emphasis on voluntary contributions.

Response:

Thank you for your comments. As we stated in our response to comment #31 we have reconsidered the practicality of charging an entrance fee. This proposal was not well thought out and we have decided to withdraw its consideration from the CCP and EA. The section on Entrance Fees (now found on pages B-43 and B-51) have been changed to indicate that voluntary contributions would be accepted and donation boxes would be added to public use area under Alternative B. Alternative C would be the same as Alternative B.

Comment 47:

Page B-14, 1.8.6 Addressing Issues in the CCP and EA, FWS states that certain issues are outside the scope of the CCP but were considered in developing it. The Sierra Club disagrees. The issues mentioned are not outside the scope of the CCP.

For instance, Fragmentation disrupts the landscape-scale ecoregion, ecosystems and refuges; Commercialization is part of what an entrance fee will introduce into the Complex and oil/gas operations represent commercialization inside the Complex; Urbanization is already affecting the Complex by reducing the opportunities to buy Columbia Bottomlands and other ecosystem lands and create more of a urban-wildland emphasis which the Complex has stated has led to more mowing on the boundaries; Prairie/Habitat Conversion is a landscape-scale problem that flows onto the Complex particularly since there are few natural wild seed sources left; Residential Development affects the Complex like Urbanization; Incompatible Forestry and Livestock Production Practices help destroy prairie and Columbia Bottomland Ecosystems, reduce the number of tracts that are suitable for purchase, and creates an avenue for invasive species to move onto the Complex; and finally Stream Channelization alters hydrology on the Complex even if done outside its boundaries. All of these issues are important to discuss and are not outside the scope of the CCP. Mitigation against these intrusive outside, and sometimes inside forces, must be addressed in the CCP.

Response:

Thank you for your comments. Additional clarification about how issues were address was incorporated into section 1.8.6 of the EA.

Comment 48:

Page B -16, 2.2 Alternatives Considered but Dismissed from Detailed Analysis, the Sierra Club disagrees that elimination of the farming program and buying mineral rights should be dismissed from analysis. For the farming program, reduction or elimination ensures that FWS focuses on its core duties, which is ecosystem restoration (wetlands and prairies).

As mentioned in the CCP a lot of coastal tallgrass prairie restoration is needed on the Complex. A reduction in waterfowl numbers would occur if farming were eliminated but an increase in coastal tallgrass prairie dependent bird and other species would occur and the creation of prairie potholes will reduce the impacts of reductions. So there would be a trade-off and this does "contribute to the objectives and goals outlines in the plan".

Once coastal tallgrass prairie restoration is underway the costs and work required for farming will no longer be required. The management of coastal tallgrass prairies is more within the traditional FWS focus than farming and can be accomplished. In addition, by farming to increase population densities of waterfowl FWS inadvertently crowds birds together so that if disease occurs it can spread quicker and to a greater number of individuals.

With the buying of mineral rights the FWS has simply dismissed the idea with nothing more than a statement that "this is infeasible" and that it would take more staff and budget to do. Where is the documentation to support these assertions? How much time does FWS spend currently working on oil/gas issues and thus could save if over time mineral rights could be acquired? How much would this cost? What do mineral rights sell for? Where is the analysis that supports these statements? The Sierra Club understands that buying mineral rights is not easy but over the long-term it means that the Complex can more precisely operate for fish and wildlife benefits than its present attempts to minimize interference with and the need to mitigate for damages caused by oil/gas exploration, drilling, and production (including transportation).

Response:

Thank you for your comments. The Service considers farming an essential part of management and the current farming program does not interfere with or limit our habitat restoration efforts.

During the land acquisition process, the Service inquires if there are any oil and gas minerals associated with the property and whether or not the landowner is interested in selling them. For those that are willing to sell the Service will acquire those interests. Unfortunately, the majorities of oil and gas mineral interests have been separated from the surface interest and are held by other entities.

Response:

The Service understands the Sierra Club's concerns about the aerial use of herbicides and takes all necessary measure to minimize potential impacts. The following clarification was added to the paragraph to describe what the Service does to minimize potential impacts from the aerial application of herbicides. "The Complex utilizes drift retardant to minimize drift; spraying is only conducted in areas where there are no sensitive resources (i.e., species that could be adversely impacted) and where private lands would not be impacted."

Comment 53:

Page B-28, Farming Program, FWS should define "Rent equivalents" so the public understands what this term means.

Response:

A description of what constitutes a “rent equivalent” was provided within description of the Farming Program on page B-27 of the CCP. To further clarify and reiterate, the paragraph now reads as follows. “A Cooperative Farming Agreement is prepared annually and identifies field and crops planted as well as compensation to the government, which could include direct payment, crops left in field, or rent equivalents. Rent equivalents may include discing in non-farmed marshes; purchase of herbicide used to spray invasive trees and brush on irrigation laterals and/or track-hoe or excavator work on irrigation laterals. Additional rent equivalents include maintenance of feeder ditches, pipes, and water control structures and water credits purchased by farmer to be used by the refuge as duck or shorebird water following harvest.”

Comment 54:

Page B-29, Water Purchases, the Sierra Club supports the FWS in an aggressive acquisition program for water rights or the purchase of water so that fish, wildlife, and ecosystem needs are met.

Response:

Thank you for your support. The Service will continue to pursue the purchase of water rights from willing sellers when they are available.

Comment 55:

Pages B-37 through B-43, Alternative B – (Proposed Action) and B-69, the Sierra Club does not support this alternative because it requires an entrance fee, allows bicycling in Hudson Woods and on other gated roads and hiking trails, focuses too much emphasis on farming, does not address erosion and marsh issues due to the GIWW sufficiently, and re-introduces livestock grazing.

Nowhere in the CCP/EA does FWS state that livestock grazing can be harmful to Complex ecosystems. Livestock grazing is responsible for the introduction of non-native invasive plant species into coastal tallgrass prairies and other habitats. Local ranchers are pressuring FWS to open up the Complex to unlimited livestock grazing (notice the phrase used on page B-39, “acreage to be grazed determined annually” – an open checkbook of a phrase if ever there was one) because non-grazed Complex prairies have recovered from livestock grazing that those local ranchers have supported. There is no need for livestock grazing. Reduction of phragmites cane can be accomplished in other ways (herbicides, mowing, mechanical removal, burning, etc.) and does not require livestock grazing.

If a grazing animal must be reintroduced then it needs to be a native species, like the American Bison, and it needs to be introduced into coastal tallgrass prairie and not in wet soil salt marshes where a lot of rutting, trampling, and other damage is done due to livestock grazing. The introduction of a small American Bison herd would instantly bring attention to the Complex unlike anything else and the Sierra Club believes people would come out just to see them. Then environmental education could easily be accomplished for adults and children and an explanation about wildlife management techniques could be introduced.

The Sierra Club is concerned about the inconsistency of the CCP with regard to mountain

bikes. On the one hand the CCP states that bicycles are welcome on open roads. On the other hand, on pages B-43 and B-50, the CCP states that roads that are not open and specific trails now will be open to mountain bikes. The Sierra Club does not support allowing mountain bikes to go through the wet and moist habitats and closed roads of Hudson Woods. This will create rutting of soil, erosion of soil, trampling of vegetation, introduce non-native invasive plant species, and because there are always some people who do not follow the rules, will result in user created trails.

There are also safety and trail conflicts between those who seek a quiet, wilderness experience and those who want to buzz through areas on mountain bikes where exertion is an important part of the ride. The Sierra Club sees where the use of mountain bikes on the Dow Woods trail makes sense because it is a hard surface. However, using earthen surfaces results in modifying the environment and creates an incentive to go faster. There is no analysis about expanding the use of mountain bikes to more units, including Columbia Bottomlands habitats, there is no discussion about environmental impacts (including disturbance to wildlife), there is no discussion about user conflicts and safety, and there is no discussion about what limits, mitigation, monitoring, and law enforcement will be required to ensure that damage is not done.

Response:

Thank you for your comments. The Service has selected Alternative B because it best meets the Complex's vision for the future, the purpose for which the Refuges were established, and the habitat, wildlife, and visitor services goals identified in the CCP.

The Sierra Club's opinion that "Local ranchers are pressuring the Service to open the Complex to unlimited livestock grazing..." is misinformed and incorrect. The Service proposes to use limited grazing for specific management purposes, including control of invasive species and increasing natural diversity created historically from the interaction of both grazing and fire as recurring disturbance. The implementation of the program at this time includes only seasonal grazing, where cattle are removed from the refuge during the growing season to allow recovery. Additional comments on grazing were addressed in responses to comment number 80. In regard to comments on entrance fees, farming, bicycling, and wilderness, please see responses to comment number 31 (for entrance fees); 48 and 79 (for farming); 78 (for bicycling), and 82 (for wilderness).

Comment 56:

Pages B-43 through B-47, Alternative C, of all the three alternatives the Sierra Club prefers this alternative because it is the most environmentally protective alternative. Alternative C does not have an entrance fee, addresses GIWW erosion and marsh habitat restoration more completely, increases restoration efforts due to climate change more, looks at purchasing water rights and will purchase water when available, will reduce farming by 500 acres, would restore 500 acres to coastal prairie, would provide for more feral hog control, would address exotic ants more aggressively, and would emphasize voluntary contributions to the Complex.

The Sierra Club recommends changing Alternative C in the following ways to make it even more environmentally protective:

1. Allow mountain bikes only on open roads except for the Dow Woods hard surface trail.
2. Require that there be an acquisition program for coastal tallgrass prairie.
3. Require that the Hoskins Mound donation by Chevron is accepted.
4. Prioritize GIWW erosion and marsh restoration for all three refuges as one of highest priorities and seek a national consensus for mitigation with the Corps and other interested parties.
5. Provide more sites for climate change monitoring than the four planned (at least 10 should be implemented including some on Big Boggy NWR).

6. Page B-44 and pages 1-1 through 1-22, Draft Land Protection Plan Austin's Woods San Bernard National Wildlife Refuge Brazoria, Fort Bend, Matagorda, and Wharton Counties, Texas, conduct a study about the 10% goal for Columbia Bottomlands protection to determine whether this is scientifically valid under today's changing environment. The Sierra Club favors the protection of 150,000 to 200,000 acres as being more sustainable with multiple landscape linkages between the three rivers to allow for movement of organisms and as mitigation for habitat fragmentation.

A larger area saved makes sense when looking at how the original habitat has been destroyed and the remainder fragmented. Of the original 700,000 acres only 150,000 acres may remain (most in degraded condition that needs restoration). This is only 21.43% of the original total so barely one-fifth of the original acreage is left today. Saving 10% means only 70,000 acres are protected. Saving 150,000 to 200,000 acres means 21.43% to 28.57% of the original acreage is saved.

The addition of multiple habitat bridges between the three rivers, the Colorado, San Bernard, and Brazos, will add additional sustainability for the land acquisition effort. Larger, connected, preserves have been shown to fight better the loss of species from an area. Larger and better connected units will become more crucial in the future as more habitat is developed and further fragmented around the protected acres. A larger, more connected, Columbia Bottomlands is necessary and a study about this issue would guide FWS on the precise acreage that should be acquired, restored, and protected. If the study indicates that protection of sufficient acreage is still not enough so that the Columbia Bottomlands program is totally sustainable then additional mitigation measures are necessary to minimize further impacts on this ecosystem and should be proposed and implemented in the CCP.

7. Add an education program about non-native invasive plant and animal species like Chinese Tallow and Feral Hogs. The education program would be supplemented by partnerships with nearby and adjacent landowners to remove these species and if possible restore natural replacement species.

8. Implement a comprehensive program to educate people about and provide barriers for beach and dune ecosystems near Cedar Lakes so that the area is biologically and ecologically protected.

Response:

Thank you for your input. Alternative C was not selected for a number of reasons determined by the EA (Appendix B). The suggested changes provided above have been addressed in our responses to other comments within this appendix (see # __) as they relate to Alternative B and we see no reason to modify Alternative C.

Comment 57:

Pages B-53 through B-54, 4.1 Definition of Terms and page 8-63, the CCP unfortunately has not resulted in FWS implementing a recent court ruling about assessment of impacts and the methodology used. United States District Judge John D. Bates stated, in part, in *Sierra Club v. Mainella* the following:

"Because NPS's impairment analysis served as its NEPA analysis, the flaws in the impairment analysis also apply to the environmental assessment. Those shortcomings are, first, NPS's lack of explanation as to how it reached its conclusions, typically simply describing the impacts followed by a conclusion that the impact was not an impairment or, in the case of NEPA, that it was not "significant"; and second, the use of the descriptors "negligible", "minor", "moderate", and "major" that are largely undefined or are defined in a manner that includes few objective bounds ... nowhere explained the basis for its conclusion that potentially "moderate" impacts could not be significant under NEPA ... There is no basis in the administrative record for accepting NPS's conclusion that even a "minor" impact is not significant under NEPA, because there are no determinate criteria offered for distinguishing a "minor" impact from a "moderate" or "major" impact other than NPS's conclusory say-so ... the seeping regulations still require the agency to explain why they {dismissed issues} will not have a significant effect on the human environment ... Thus, the EA must provide a realistic evaluation of the total impacts and cannot isolate a proposed project, viewing it in a vacuum ... In short, NPS's three findings of no significant impact are, the court concludes, arbitrary and capricious for many of the same reasons as are the impairment determinations. In each decision, NPS has failed to take a "hard look" at impacts on the Preserve from adjacent surface activities, as evidenced by the lack of explanations supporting its conclusions and, in particular, its methodology of describing impacts using conclusory labels and then setting forth a bare conclusion without explanation as to the significance of an impact. NPS also failed to provide an adequate cumulative impacts analysis that included the other oil and gas operations in the Gore Baygall Unit ... However, NPS's ultimate conclusions that the drilling activities would not result in impairment of park resources and values under the Organic Act, or a significant impact on the human environment under NEPA, are not supported by reasoned explanations, and hence are arbitrary and capricious and an abuse of discretion."

FWS has not quantified in the CCP assessment, analysis, and evaluation all the environmental impacts. The methodology used has the "conclusory statements" that Judge Bates ruled against. Judge Bates stated in his decision that the descriptors "negligible", "minor", "moderate", and "major" are largely undefined or are defined in a manner that includes few objective bounds. These descriptors have been used by FWS but are largely undefined and with few objective bounds. FWS has failed to take the "hard look" that Judge Bates stated must be done. Some of the conclusory statements that are used which are not defined

include:

1. cannot be reasonably expected
2. impacts are so small
3. can be reasonably expected
4. limited effect
5. affect a small area
6. have apparent and detectable effects
7. would be readily apparent
8. relatively large area
9. not extreme or excessive
10. readily apparent and substantial effects
11. would be readily apparent
12. would substantially change
13. immediately surrounding
14. to any appreciable degree (a new term that is not found under the definitions of environmental impacts found on pages 8-53 through 8-55 but is found on page 8-63)

All of these conclusory and undefined words and phrases leave the public in a quandary about what the environmental impacts are, what their intensity is, and how different alternatives can be compared and differentiated. The public and decision-makers need this information clearly stated and transparently presented so that it can be reviewed, commented on, and understood in relation to the environmental impacts of the alternatives. The FWS has not implemented Judge Bates' ruling in a convincing and complete manner. The Sierra Club objects that FWS ignores Judge Bates' decision.

FWS has failed to take the "hard look" that Judge Bates requires it to do. The public must have this information so that it can review, comment on, and understand all the environmental impacts of the CCP.

For an EA/EIS, dictionary usage of words or phrases will not suffice to provide the public with a clear picture of what the intensity, significance, and context of environmental impacts are. An all qualitative assessment, analysis, and evaluation of environmental impacts is not sufficient to deal with the clearly articulated CEQ requirements in Section 1502.14, that the EA/EIS "should present the environmental impacts of the proposal and the alternatives in comparative form, thus sharply defining the issues and providing a clear basis for choice among options by the decision-maker and the public".

Quantitative assessment, analysis, and evaluation are necessary to ensure that alternatives and environmental impacts are clearly defined and shown in the EA/EIS. As stated in the CEQ NEPA implementing regulations, Section 1500.1(b), Purpose, "NEPA procedures must insure that environmental information is available to public officials and citizens ... The information must be of high quality. Accurate scientific analysis ... are essential to implementing NEPA".

As stated in Section 1501.2(b), "Identify environmental effects and values in adequate

detail so they can be compared to economic and technical analyses."

As stated in Section 1502.8, "which will be based upon the analysis and supporting data from the natural and social sciences and the environmental design arts."

As stated in Section 1502.18(b), about the Appendix, "Normally consist of material which substantiates any analysis fundamental to the impact statement".

As stated in Section 1502.24, "Agencies shall insure the professional integrity, of the discussions and analyses ... They shall identify any methodologies used and shall make explicit reference by footnote to the scientific and other sources relied upon for conclusions in the statement."

FWS has mostly relied for analysis for this CCP on "best professional judgment". "Best professional judgment" is where a group of people, using their experience, decide what is important. This level of assessment, analyses, and evaluation for environmental impacts and alternatives is an insufficient foundation upon which to base an EA/EIS.

The qualitative description of phrases used to describe environmental impacts or the protectiveness of an alternative do not provide the public with the degree of comparison required by the CEQ's mandatory NEPA implementing regulations. These regulations state, in Section 1502.14, Alternatives including the proposed action, that, "This section is the heart of the EIS ... it should present the environmental impacts of the proposal and the alternatives in comparative form, thus sharply defining the issues and providing a clear basis for choice among options by the decision-maker and the public ... Devote substantial treatment to each alternative in detail ... so that reviewers may evaluate their comparative merits."

The CEQ also states, in Section 1502.16 and (d), Environmental consequences, that, "This section forms the scientific and analytic basis for the comparisons ... The environmental effects of alternatives including the proposed action the comparisons under Section 1502.14 will be based on this discussion."

FWS has not clearly compared and made apparent the distinctiveness of each alternative and its impacts or protectiveness. This is not accomplished when phrases like "readily apparent" are used instead of quantitative information or more detailed and clear descriptions of qualitative information. The Sierra Club requests that FWS clarify and detail clearly the comparative differences between each alternative and define clearly what the words or phrases used mean.

The use of "best professional judgment" is not a substitute when quantitative information is available to show what impacts are or could be. This is the concern that the Sierra Club if FWS develops and uses a methodology that is based on "best professional judgment" but the public is not told what phrases mean.

Response:

Thank you, but we disagree with your comments.

The language used in this analysis is typical of CCPs throughout the county. It is accepted and appropriate for this type of plan-level NEPA document. Contrary to your repeated assertion that the terminology is not defined and “The public must have this information so that it can review, comment on, and understand all the environmental impacts of the CCP” the general public has apparently had no concerns with our management activities or analysis, which is evident by the general lack comments provided by public.

It is the Complex’s opinion that all CEQ requirements have been addressed in this EA. The purpose of the EA is not only to provide information to the public and the decision-maker, but also to determine if there are significant impacts resulting from an action, thereby determining if an EIS is necessary. It is the opinion of the Service that the terminology provided in section 4.1 has been adequately defined and supports the analysis, which concludes that the proposed action (implementation of the CCP) would not result in significant impacts.

Comment 58:

Page B-55, Climate Change, FWS states "... there should be little or no net change in the quantity of carbon sequestered at the Complex from any of the proposed management alternatives." There is no analysis that demonstrates this is true. Where is the documentation that provides a comparison between the alternatives?

The Sierra Club appreciates that the Secretary of the Interior, in Secretarial Order No. 3285 and 3289 has determined that climate change is a critical issue to focus on and deal with. The Sierra Club is also pleased that FWS released on September 21, 2001 “Rising to the Challenge” Strategic Plan for Responding to Accelerating Climate Change. The Sierra Club appreciates the attempt to provide a picture of what impacts climate change may have on the Complex. However, the FWS must do more in a site specific manner.

As FWS has documented in the CCP climate change will alter existing ecosystems; make it more difficult for plants and animals to adapt successfully to these changed ecosystems; and make it more difficult for FWS to manage the Complex for the species, landscape, and ecosystems that these refuges were originally acquired for.

FWS should prepare and include in the CCP a climate change ecological resilience and resistance plan (CCERRP). The CCERRP would assess, analyze, evaluate, and prioritize the biological and ecological elements in the Complex and the effects that climate change has had and will have on these elements. The CCERRP would assist plants, animals, and ecosystems in adapting to climate change and would require monitoring of changes and mitigation measure effectiveness. The CCERRP would be based on:

1. Protection of existing functioning ecosystems in the Complex.
2. Reduction of stressors on ecosystems in the Complex.
3. Restoration of natural functioning ecological processes in the Complex.
4. Use of natural recovery in the Complex, in most instances.

5. Acquisition of buffers and corridors to expand and ensure connectivity of ecosystems in the Complex.
6. Intervention to manipulate (manage) ecosystems in the Complex only as a last resort.
7. Reduction of climate change gases from the Complex.

Some but not all of these elements are found within the CCP. The CCP must be revised so that all of these elements are addressed. One way that FWS can reduce climate change gases is if it requires that oil/gas activities provide CO₂ reductions via the integration of energy saving programs during exploration, drilling, and production operations.

Response:

The sentence that states “Overall , there should be little or no net change in the quantity of carbon sequestered at the Complex from any proposed management alternatives” is incorrect and has been removed. Clarification/analysis has been added to section 4.3.1. The Complex has addressed climate changes issues and considered energy saving methods to the extent possible in the CCP and EA (see response to Email comment #3). Not all elements listed above can be address at this time. The Complex has not yet received guidance on stepping down the objectives of the Service’s national climate change adaptation plan to the site-specific level. Many of the objectives and topics discussed above (including the CCERRP) are beyond the Complex’s current capacity.

Comment 59:

Pages B-57 through B-59, Herbicide Application, FWS states "The federal and state governments regulate herbicides to ensure that they do not pose unreasonable risks. The EPA requires extensive test data from herbicide producers to show that their products are safe to use. EPA scientist and analysts carefully review these data to determine whether to register (license) an herbicide and whether certain restrictions on use are needed."

Enclosed are a series of fact sheets that demonstrate that EPA registration of pesticides does not ensure that pesticides are safe to use. This includes the use of "inert ingredients" that may not be benign, whether pesticides are safe to use, the problem with aerial use of pesticides due to drift, and do pesticides create a health risk. FWS should be careful when using stock phrases about the safety of pesticides and the EPA process that is used to register them.

Response:

Thank you for your comments. The sentence that said “The EPA requires extensive test data from herbicide produces to show their products are safe to use” has been changed to “The EPA requires extensive test data from herbicide producers prior to licensing and determining restriction on use.”

The Service shares your concerns of herbicide drift and utilizes a variety of tools to maximize limited funding and resources on the war against invasive flora throughout the refuge. In Section 4.2 of the EA under Impacts from Herbicide Application” the Refuge evaluates existing and

potential impacts of the use of herbicides and identifies the guidelines and requirements needed in order to utilize herbicide application. In addition to these guidelines and requirements and Service policy, the refuge also identifies additional mitigation measures used to minimize impacts from the use of herbicides.

Comment 60:

Page 8-59, Petroleum Development Impacts, FWS rates the environmental impacts of petroleum development as "adverse, long-term, site-specific, and of negligible to minor intensity." The Sierra Club vigorously disagrees with FWS. When looking at impacts of petroleum development all impacts from exploration, drilling, and production (including transportation) must be assessed. With dozens of pipelines cross-crossing the Complex (essentially as roads), well pads, roads to well pads, truck traffic, etc., how can these overall impacts be anything, except major? The Sierra Club requests a copy of the FWS analysis that was done to come up with the impact rating.

Response:

Thank you for your comments. Based on the amount of petroleum development over the last 10 years and our ability to work with exploration companies to limit the impact of operations, the evaluation of impacts being adverse, long-term, site specific, and of negligible to minor intensity is accurate. Over the past ten years, only five wells have been requested and permitted. Of these, one has never been drilled, two did not make production quantity and were never developed and the site restored and two wells were developed. In addition, 5 previous wells have been plugged and the site restored. The Service requires the preparation of a detailed Environmental Assessment and Operations Plan prior to permitting oil and gas operations. Within this plan, requirements to protect refuge resources from undue harm are stipulated and all efforts to minimize the impact on refuge resources are made. Seismic operations cause the greatest amount of impact, primarily because they occur across the landscape rather than at a specific site. Even with these operations, all efforts are made to minimize impacts including allowing only smaller, lightweight, maneuverable drillers into bottomlands so the trees are not removed during operations.

Comment 61:

Page B-61, Fishing, FWS states "Trash is the single greatest impact on the refuges associated with this use." It is much worse than trash. Some of the "trash" left is toxic, like lead, some of the "trash" wraps around wildlife or is swallowed by wildlife and kills it, like monofilament line, some of the "trash" may acclimatize species to associate humans with food (Alligators and gulls), like bait used or food scraps left. So the problem is much bigger than trash.

Response:

Thank you for your comments. This Fishing section was edited to include the impacts of trash on wildlife resources as well as included our efforts to control trash and the impacts of trash. The following information was added to the end of the second paragraph.

“Trash left from fishing activities can be harmful to wildlife. Monofilament line can entangle wildlife or be ingested. Ingested lead sinkers can cause lead poisoning and food scraps are not healthy for wildlife. In an effort to control trash, the refuge has installed monofilament recycling

containers at fishing areas. Trash is removed from fishing areas on a weekly basis. Fishing areas are shut down if trash gets out of hand.”

Comment 62:

Page B-62, Other Common Effects, there is no analysis about the impacts that noise, transportation, waste management, etc. has on the Complex, its wildlife, and visitors. All that is provided is a statement that there are "negligible or at most minor effects". What is this statement based upon? Where is the analysis and documentation that backs up this assertion?

Response:

Thank you for your comment. This section is intended to document the impacts that the Service's actions have on resources, not the impacts that outside actions have on the Complex.

Comment 63:

Pages B-63 through B-64, 4.3.1 Impacts on Air Quality, this assessment is incomplete. The air pollution that is generated by oil/gas development, vehicles of the staff and visitors, and boats of staff and visitors and its impacts on the Complex is not provided.

Response:

Thank you for your comments. We feel that impacts to air quality have been accurately and completely assessed. While we may not have specifically listed every activity that could have negligible impacts to air quality, we clearly mention that “Management actions and activities associated with Alternative A....” This includes public uses.

Comment 64:

Pages B-64 through B-66, 4.3.2 Impacts on Water Resources, the analysis is not complete because it does not include water pollution generated on the Complex from oil/gas development and sewage from staff and visitors.

Response:

Thank you for your comment. We believe that sections 4.3.2 and 4.2 (as referenced) adequately address the impacts of refuge activities, including oil and gas activities, on water resources. Impacts from sewage from staff and visitors were not mentioned because we do not feel that this is an issue. The vault septic systems placed throughout the Complex effectively eliminate potential water pollution.

Comment 65:

Page B -77, 4.4.4 Impacts on Resident, Native Wildlife, Alternative C, FWS should also state that this alternative will restore 500 acres to coastal tallgrass prairie which will benefit native wildlife.

Response:

Thank you for your comment. The change, as suggested, was incorporated into this section.

Comment 66:

Page B-78, 4.4.5 Impacts on Threatened and Endangered Species, Alternative C, FWS should

state that this alternative will restore 500 acres to native tallgrass prairie which will benefit threatened and endangered species. Therefore, Alternative C has more beneficial impacts than Alternative B.

Response:

Thank you for your comment. The change, as suggested, was incorporated into this section. The conclusion was changed to “slightly more beneficial than” instead of “same as” Alternative B.

Comment 67:

Pages B-78 and B-79, 4.5.1 Impacts on Local Population and or Economy, FWS should state that buying land will benefit the economy and local landowners. FWS ignores the Alternative B economic impacts on people who will have to pay an entrance fee.

Response:

Thank you for your comment. The following statement was added to the end of the second paragraph under the Alternative B analysis. “The Service’s land acquisition benefits the economy by sustaining land values at current and rising levels. In addition, funds generated from land sales are available for other economic benefits to the landowner.”

The proposal to charge entrance fees was withdrawn from consideration, so further analysis is not necessary.

Comment 68:

Pages B-79 and B-80, 4.5.2 Impacts on Aesthetic and Visual Resources, FWS fails to acknowledge the erosion control infrastructure that currently exists at the GIWW and the proposed additional GIWW infrastructure (pages B-65 and B-66).

Response:

Thank you for your comments. In response to you comments, the following changes to section 4.5.2 were made. Under Alternative A, the following sentence was added “Existing erosion control structures, including revetment geotubes and oyster reef domes, can detract from aesthetics.” Under Alternative B, the following sentence was added “Increased erosion control would further detract from aesthetics along the GIWW.”

Comment 69:

Page B-82, 4.5.3 Impacts on Public Use Opportunities, Alternative B – Proposed Action, FWS ignores the impacts that an entrance fee will have on low-income people and others who either cannot or do not want to pay a fee. FWS ignores the idea that these lands are owned by the public and that requiring people to pay to see and enjoy their public lands when they have already paid income taxes is not fair or appropriate.

FWS also ignores the potential impacts that can occur by opening hiking trails or closed roads in Hudson Woods to mountain bikes.

Response:

Thank you for your comments. The proposal to charge entrance fees was withdrawn from consideration, so further analysis is not necessary.

The following paragraph, concerning the impacts of mountain bike use, was added under Alternative B. "Alternative B would allow bicycles on the trails a Hudson Woods. This would increase opportunities for visitors to access remote areas along Oyster Creek. Based on current levels of bicycle use on other areas of the refuge conflicts between users are not anticipated."

Comment 70:

Pages B-83 through B-92, 4.6 Assessment of Cumulative Impacts, FWS fails to assess and show cumulative impacts are required by Council on Environmental Quality NEPA regulations.

FWS fails to name specific cumulative actions that may have cumulative effects on the Complex. For instance, under air quality, recently DOW in Freeport announced that it would expand its facilities to take advantage of the availability of natural gas. Freeport LNG is currently undergoing a Federal Energy Regulatory Commission (FERC) NEPA process so that it can export natural gas.

There is no discussion about any specific residential, industrial, commercial projects (cumulative actions) and their potential affects and intensity of those affects on the Complex. There is no discussion about oil/gas development (exploration, drilling, and production (including transportation) offsite and what cumulative impacts this has had both on and off the Complex. There is no discussion of cumulative actions, like DOW seeking off-site reservoirs, and what cumulative impacts this may have both on and off the Complex. There is no discussion of cumulative actions that may have cumulative impacts on water quality both in and out of the Complex. Texas Commission on Environmental Quality (TCEQ) permits could be listed including those recently granted and those currently being sought.

FWS gets the cumulative actions and impacts analysis wrong by stating repeatedly that "the impacts from proposed management activities (all alternatives) would not be cumulatively significant." It is not just the cumulative actions and impacts on the Complex that must be analyzed but cumulative actions and impacts off the Complex that must be analyzed and then added to those cumulative actions and impacts that affect the Complex. In other words NEPA requires that all cumulative actions and impacts, whether on or off the Complex, be assessed including all past, present, and future foreseeable actions.

This has not been done by the FWS in this analysis. The Sierra Club has seen cumulative impact analysis from other agencies where future foreseeable projects are named and their cumulative impacts assessed (right now the Federal Highway Administration's proposed Grand Parkway, Segment B, DEIS comment period is ongoing and the DEIS has such an analysis). FWS must do the same. FWS says little or nothing about how cumulative actions and impacts outside the Complex effect and the magnitude of the effects for bottomland hardwood forests, migratory birds, wetland and aquatic habitats, prairie habitats, resident, native wildlife (For instance, where is the discussion about road kill?), threatened and

endangered species, aesthetic and visual resources, hunting, wildlife observation and wildlife photography, environmental education, interpretation, and local population and or economy. For instance, what is the percent growth in population and the economy currently and what is predicted for the next 15 years? These are the questions, analysis, and data that must be obtained but FWS has not done the work. It must do so. The public must have this information so that it can review, comment on, and understand all the environmental impacts of the CCP.

Response:

Thanks you for your comments.

We disagree with your interpretation the adequacy of our cumulative effects analysis. We acknowledge that there are cumulative impacts occurring to resources outside of the Complex; however, our ongoing and proposed management actions do not add to those negative impacts.

The EA considers other state, federal and private actions. While we do not detail every specific action occurring around the complex, we have clearly stated that development, urbanization, and industrialization have adverse effects on area resources. We agree and acknowledge that these activities can impact the Complex; however, our responsibility under NEPA is to disclose if and how our actions incrementally add to cumulative impacts on the biological environment. We have determined that **our** impacts are not significant, when considered along with other state, federal and private actions. For instance, the City of Houston may have significant adverse impacts on air quality. However, the Complex's contribution to green house gases is insignificant, particularly when you consider the filtering effect the natural habitat (that we restore, protect, and manage) has on air quality. The existence of the Complex, with the acquisition of additional lands and restoration of degraded habitats, functionally mitigates and/or ameliorates some of the adverse effects (such as habitat loss) of activities occurring outside of the Complex.

The impacts of our management actions are not significant or additive to those resource impacts occurring outside of the Complex. It is also, not our responsibility to analyze how non-Service actions impact the Complex itself, but to look at the impacts of our management on the physical, biological and socioeconomical environment on a larger scale and disclose how our actions add to the impacts cause by other state, federal and private actions

It is the Complex's opinion that all CEQ requirements have been addressed in this EA.

Comment 71:

Page B-92, 4.7 Short-Term Uses Versus Long-Term Productivity, FWS states "would cause short-term negative impacts ... from the improved visitor experience would produce long-term benefits for the Complex's entire ecosystem." The FWS forgets to analyze the impacts of an entrance fee on public visitation and that Complex lands are owned by the public and accessible to them freely.

FWS states that "The key to protecting and ensuring the refuges' long-term productivity is to find the threshold where public uses do not degrade or interfere with the refuges' natural

resources." But FWS does not mention carrying capacity and what it is for various natural resources so that the degradation and interference mentioned does not occur.

Response:

Thank you for your comments. For clarification, this section was edited as follows.

At the end of first paragraph, "Complex's entire" was removed from the last sentence.

On the second paragraph, first two sentences were replaced with the following:

"Inventory and monitoring refuge resources is an essential part of ensuring long-term productivity. Resources are impacted by a variety of natural influences, including climate and storm events. Adding additional stressors through public use opportunities, oil and gas development, and short-term construction activities can have detrimental effects if coupled with other stressors. The Refuges ability to manage habitats, control short-term disturbance and buffer uncontrollable events will enable population sustainability. Within the limited public use areas at each refuge, it is expected that repetitive disturbance and infrastructure does impact populations. However by limiting the area of impact the refuge hopes to obtain a balance between providing opportunities for visitors and meeting the needs of wildlife."

Comment 72:

Page B-92, 4.8 Unavoidable Adverse Effects and Mitigation Measures, FWS states "The Complex expects these impacts to be minor and or short-term in duration" but then does not name them. The public must have this information so that it can review, comment on, and understand all the environmental impacts of the CCP. FWS does not mention the impacts that entrance fees will have on the public who owns the Complex and should have free access to it.

Response:

The impacts are clearly named and discussed in this section. For further clarification, the second sentence of the introductory paragraph now reads "The Complex expects the impacts described below to be minor and/or short-term in duration."

Comment 73:

Page B-93, 4.9 Irreversible and Irretrievable Commitment of Resources, FWS states "The Proposed Action would result in some unavoidable harm or harassment to some wildlife" but then does not describe or name the unavoidable harm or harassment to which wildlife species.

Response:

Thank you for your comment. The quoted sentence was deleted; it was not appropriate for this section.

Comment 74:

Pages B-93 through B-97, Table EA 4-2 Summary of Environmental Effects by Alternative,

FWS fails to state or acknowledge what the impacts are of entrance fees and allowing mountain bikes on hiking trails or closed roads.

Response:

Entrance fees were withdrawn from consideration and Table EA 4-2 was updated accordingly.

Comment 75:

Pages C-3 through C-8, Draft Compatibility Determination, Hunting, FWS states there are no long-term and cumulative impacts. However, displacement of users by hunting is a long-term and cumulative impact that should be stated and discussed.

Response:

We disagree with the statement "...displacement of users by hunting is a long-term and cumulative impact that should be stated and discussed." Hunting areas on the Complex are separate from other public use areas. Under the existing hunt program, there is no user conflict.

Comment 76:

Pages C-9 through C-13, Draft Compatibility Determination, Fishing, FWS states there are no long-term and cumulative impacts but lead sinkers and monofilament line discarded by fishing creates trash and kills wildlife and are long-term and cumulative impacts that should be stated and discussed.

Response:

The fishing CD was edited for clarification.

Comment 77:

Pages C-41 through C-44, Draft Compatibility Determination, Boating, FWS states there are no cumulative impacts but noise and visual presence by boating creates disturbance and is a long-term and cumulative impact that should be stated and discussed. FWS lumps airboats with other craft that are much less intrusive and cause less disturbance. Airboats have much greater impacts and should be analyzed separately than small motor boats (which are not defined but should be defined), canoes, and kayaks.

Response:

Thank you for your comment. The Boating CD remains unchanged. We agree that airboats are more intrusive than other boats; however, they are typically only used by hunters for access; these sportsmen have a vested interest in minimizing wildlife disturbance and we have not documented problems with use of boats to access hunting and fishing areas.

Comment 78:

Pages C-45 through C-48, Draft Compatibility Determination, Bicycling, FWS states there are no cumulative impacts but rutting, safety, illegal trails, and wildlife disturbance by mountain bikes are long-term and cumulative impacts that should be stated and discussed. FWS fails in the CCP/EA to discuss how it will monitor and enforce rules to keep people

on mountain bikes from causing illegal actions.

Response:

Thank you for your comment. The Compatibility Determination for bicycling was edited because bicycling at Hudson Woods was left off the location for the activity. Last year, San Bernard reported only 25 bicycling visits. Of these visits, the majority are children on a bicycle accompanying their parents as they walked the trail. There are only a few visitors who choose to bicycle the tour loop road or bicycle the trails as the primary mode of transportation. Based on the historical light use and there has never been outreach from bicyclist to open the trails, with this Compatibility Determination, we do not anticipate a large increase in bicyclist on the refuges. This activity could result in some deterioration of the trails with rutting but regular maintenance to ensure the trails are safe for all visitors will ensure needed repairs are made.

Comment 79:

Pages C-54 through C-57, Draft Compatibility Determination, Cooperative Farming, FWS states there are no cumulative impacts but by farming it not only keeps hundreds of acres from being restored to natural ecosystems but also creates a water pollution problem with fertilizer and pesticide use and costs money which could be used elsewhere to manage natural ecosystems. These cumulative impacts should be stated and discussed.

Response:

Thank you for your comment. The Compatibility Determination for farming has been edited and the potential of pollution from fertilizer application addressed. In 2013, the Cooperative Farmer will plant the first fields that can be classified as organically farmed. In time, we hope to convert most if not all fields to organic farming.

Comment 80:

Pages C-58 through C-62, Draft Compatibility Determination, Cooperative Grazing, FWS states there are no cumulative impacts but by livestock grazing results in trampling of vegetation, rutting of soil, and uses up important food sources that could instead be used by wildlife. In addition, the huge amount of organic manure causes water pollution problems. In addition, cattle like to rest in wet or riparian areas which causes wildlife habitat problems and the potential spread of non-native invasive plant species. These cumulative impacts should be stated and discussed. The Sierra Club opposes the reintroduction of livestock cattle into the Complex because it is not needed and has not been justified.

Response:

Thank you for your comment. Depending on the grazing pressure, grazing can be harmful to the environment. However under careful implementation that includes an annual inventory and monitoring of prairie conditions, grazing can be beneficial, increasing diversity, and providing habitat for some species that cannot be sustained in a fire alone management approach. Prior to implementing a grazing program that would utilize only cool season pasture grazing and/or high intensity – short duration grazing to target invasive species, a grazing management plan will be prepared. This plan will identify the goals and objectives for grazing as well as implementation

strategies and the specific impacts of this implementation as well as a monitoring program to ensure habitat and wildlife benefits are occurring from this management activity. Because this plan is yet to be written, the Complex cannot address specific grazing issues because efforts to eliminate adverse impacts will be addressed at that time.

Comment 81:

Pages C-63 through C-68, Draft Compatibility Determination, Pesticide Application to Control Mosquito Populations, FWS states there are no long-term and cumulative impacts but mosquito control causes pesticide drift, kills wildlife, kills wildlife foods, and poisons ecosystems. These cumulative impacts should be stated and discussed. The Sierra Club opposes mosquito control which is not compatible as wildlife management on the Complex and has not been justified.

Response:

Thank you for your comment. This Compatibility Determination does not provide an unlimited use of pesticides across the refuges. The Complex has been working with the Brazoria County Mosquito Control District to better understand population dynamics of breeding mosquitoes. This Compatibility Determination limits acreages to limited specific and identified upland areas. In addition, any spraying conducted on the refuge will have to be when populations are exceeding a threshold that without spraying, human and wildlife health are being jeopardized.

Comment 82:

Pages H-1 through H-8 and Map H-1 Wilderness Inventory Units, the part of this inventory that the Sierra Club finds totally unacceptable is page H-3, Evaluation of Outstanding Opportunities for Solitude or Primitive and Unconfined Recreation and Table H-2, Minimum Criteria Inventory. The idea that Big Pond, Dance Bayou; Linville Bayou, and other units (not all units are shown as wilderness inventory units which we do not understand) are disqualified as being potential wilderness study areas due to their lack of solitude or primitive and unconfined recreation is simply unbelievable and makes no sense.

If anything these units have provided to the Sierra Club, when we have visited them, some of the best places for solitude and primitive recreation (hiking, nature study, birding, etc.) of any of the places we have visited in Texas. When the Sierra Club visits these areas we rarely see or hear humans or any motorized vehicles. It is *very* easy to get lost in the Columbia Bottomlands and coastal prairies and marshes of Brazoria and San Bernard National Wildlife Refuges.

If FWS would make an honest attempt to assess solitude and primitive recreation in these units it is the Sierra Club's contention that this criteria would not disqualify these areas. If FWS wants to disqualify these areas due to pipelines, roads, and other human impacts, okay, the Sierra Club sees your point. But if FWS disqualifies these areas based upon solitude and primitive recreation we say that FWS is either totally naïve and ignorant about wilderness inventory assessment or has purposefully disqualified these areas inappropriately.

The Sierra Club requests that the solitude and primitive recreation criteria assessment be redone for these areas.

Response:

Thank you for your comments. The bottomland forests, especially the larger and older forests are special places. However, these areas can and are impacted by oil and gas activities, maintenance on existing pipeline, utility corridors and invasive species control. These events are irregular but cannot be avoided. Within the past year, we have worked with an exploration company completing a large 3-D seismic operation west of West Columbia. This project included operations across five existing units and one pending acquisition. For more than eight months, crews and environmental monitors were permitted to access these areas. Although we have not sold any new easements since the acquisition, we do accept the terms of numerous existing easements when each parcel is acquired. Within the past year we have worked with three companies to permit maintenance work on existing easements including; replacing pipe or sections of a pipe and replacing utility line poles. Nearly all bottomland tracts have pipeline or ROW facilities which require regular and sometimes intrusive maintenance that can interrupt solitude and the values of wilderness.

[This page intentionally left blank.]

**U.S. Fish & Wildlife Service
National Wildlife Refuge System
Division of Planning
P.O. Box 1306
Albuquerque, NM 87103
505/248-7458
www.fws.gov/southwest/**

**Texas Mid-coast National Wildlife Refuge Complex
2547 CR 316
Brazoria, TX 77422
979/964-4011**

www.fws.gov/southwest/refuges/Plan/planindex.html

Reddish egret at Brazoria National Wildlife Refuge.
© Greg Lavity

September 2013

