U.S. Fish & Wildlife Service

Little Sandy National Wildlife Refuge

Draft

Comprehensive Conservation Plan and Environmental Assessment

January 2017

Vision Statement

Little Sandy National Wildlife Refuge (NWR or Refuge) will preserve, restore, and enhance the ecological integrity of the Oak Woods and Prairies and Piney Woods bottomland forests, oxbow lakes, and shrub swamps within the Upper West Gulf Coastal Plain ecoregion of east Texas. The Refuge will also serve as a resilient source of evolving habitats and ecosystem processes, even as structure and composition are altered due to climate change. The Refuge will continue to provide quality habitats for a variety of native plants and wildlife; with emphasis on migratory birds and threatened and endangered species, for the benefit of present and future generations.

American Alligator by David Weaver

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1.0 INTRODUCTION

The Little Sandy NWR was established as a permanent, non-development easement to protect bottomland hardwood habitat located along the Sabine River in East Texas. This document is a draft Comprehensive Conservation Plan (CCP) designed to guide management of the Refuge for the next fifteen years. The CCP provides a description of the desired future conditions and long-range guidance to accomplish the purposes for which the Refuge was established. The CCP and accompanying Environmental Assessment (EA) address U.S. Fish and Wildlife Service (Service) legal mandates, policies, goals, and National Environmental Policy Act (NEPA) compliance. The EA presents a range of alternatives for habitat and wildlife management, visitor services, and facilities management that consider issues and opportunities on the Refuge. It also identifies, describes, and compares the consequences (or impacts) of implementing management alternatives (including current management) on the physical, biological, and socio-economic 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, a brief overview of the Refuge including its establishment, authorizing legislation, and description of its 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, Refuge Resources and Current Management, explains the landscape setting; physical, biological, and socio-economic environment; and the current management programs on the Refuge. 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 tools the Refuge 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). The CCP will enhance the management of Little Sandy NWR by:

- providing a clear statement of direction for the future management of the Refuge;
- providing long-term continuity in Refuge management;
- communicating the Service's management priorities for the Refuge to their partners, neighbors, visitors, and the general public;
- providing an opportunity for the public to help shape the future management of the Refuge;
- ensuring that management programs on the Refuge are consistent with the mandates of the Refuge System and the purposes for which the Refuge was established;

- ensuring that the management of the Refuge is consistent with Federal, State, and local plans; and
- providing a basis for budget requests to support the Refuge'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 Refuge manager and 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 Refuge contributes to the overall mission of the Refuge System, fulfills the purposes designated for the Refuge, and uses the best available science for adaptive management.

The goals established for the Refuge, include the following:

- Habitat Conservation and Protection: To conserve and preserve the ecological integrity and natural diversity of bottomland hardwood habitats and associated wetlands for migrating waterfowl, other migrating birds, native species, threatened and endangered species, and other species of concern.
- Wildlife Management: To protect and maintain the existing diversity of wildlife (waterfowl, other migratory birds, and resident fish and wildlife) that are dependent on bottomland hardwood habitat.

By preparing this CCP, documenting our goals and objectives, and involving our partners and the public in the process, we can gain a better understanding of the issues-from all sides. Sustaining the nation's fish and wildlife resources is a task that can be accomplished only through the combined efforts of governments, businesses, and private citizens. This CCP will help explain how Little Sandy NWR fits into the larger landscape and our role in protecting our natural resources for present and future generations.

1.2 Refuge Overview: History of Establishment, Acquisition and Management

Early Days at Little Sandy (Pre-establishment History)

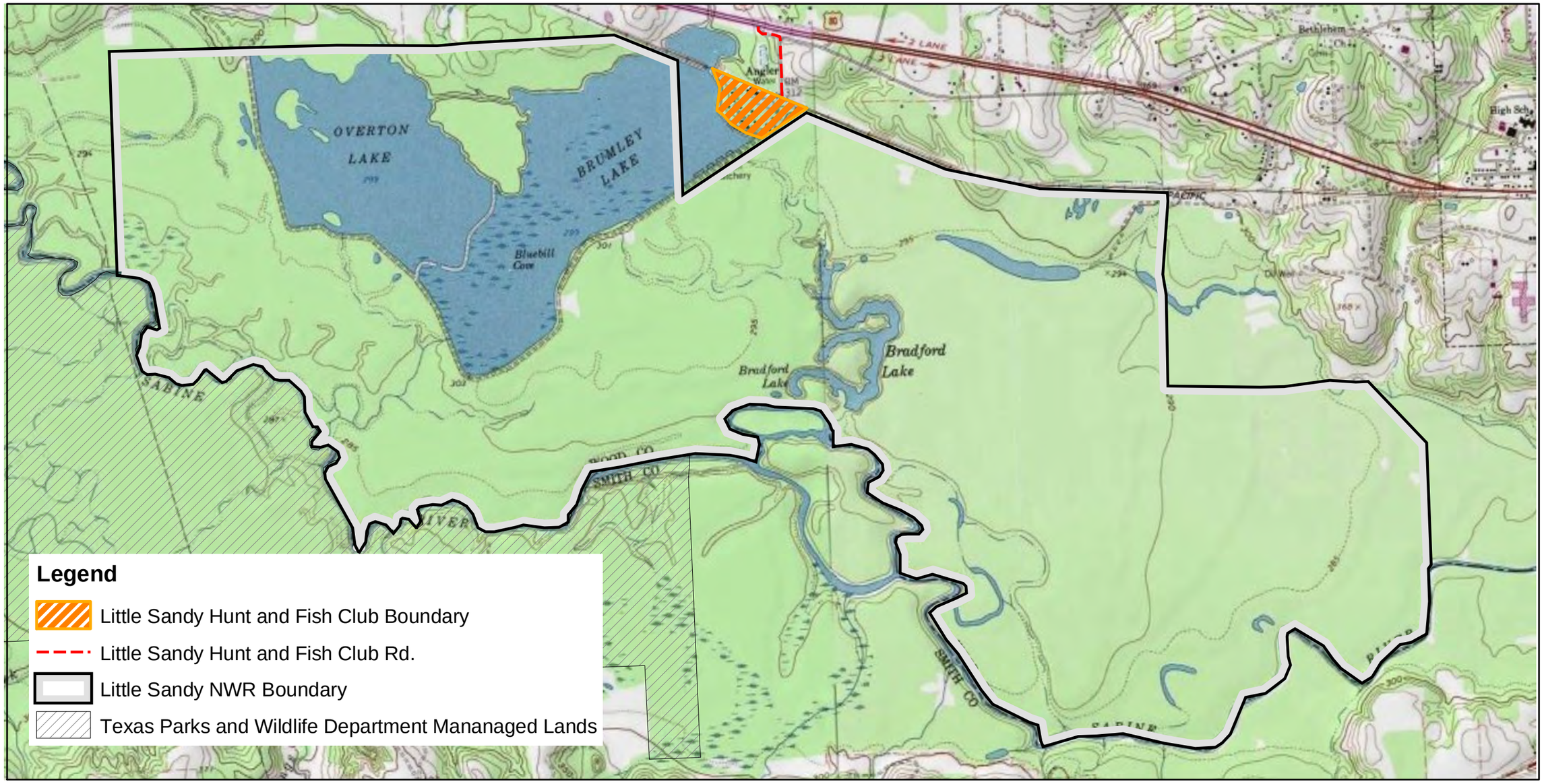
Beginning in 1898, a group of Dallas sportsmen began looking for a site where they could establish a club devoted to squirrel hunting, duck hunting, and fishing. Traveling on the Texas & Pacific Railroad, they reached a high quality eastern deciduous forest approximately 80 miles east of Dallas. The original 3,009-acre tract, which forms the nucleus of the club, was purchased in 1906 and incorporated as Little Sandy Hunting and Fishing Club (LSHFC or club) on April 17, 1907. The club was named after Little Sandy Creek, which originates from springs in the Eocene sand outcrops of eastern Wood County. The club property included the land between the Texas & Pacific tracks and the north bank of the Sabine River. LSHFC has been privately owned since 1906 and has continually operated as a private, membership based sporting club, which includes game hunting such as whitetail deer, wild feral hog, and waterfowl, as well as sport fishing.

U.S. Fish & Wildlife Service

Little Sandy National Wildlife Refuge

Smith and Wood Counties, Texas

Refuge Boundary Map



PRODUCED IN THE DIVISION OF REFUGE PLANNING
ALBUQUERQUE, NEW MEXICO
LAND STATUS CURRENT TO: 03302010
MAP DATE: 08232010
BASEMAP: US topo maps, ESRI, USGS
and © 2007 National Geographic Society
MERIDIAN: N/A
FILE: lsd_refuge_boundary_map_3_8.23.10_smk.pdf

0 0.25 0.5 1 Miles

0 0.3 0.6 1.2 Kilometers

UTM ZONE 14
NAD 83

The first clubhouse was constructed in 1907 and originally consisted of a two-story structure that eventually served as the club keeper's residence. The original clubhouse was a small, one room, wood-framed cottage that lacked indoor plumbing and eventually the house proved to be insufficient as the club began expanding in membership. The original house was expanded and increased the total living area of the facility to 7,000 square feet.

Little Sandy has two major modified oxbow lakes. One of the first projects completed by the LSHFC was the expansion of Brumley Lake. Brumley Lake is considered to be a natural, oxbow lake and it is speculated that it was once a part of the Sabine River. Brumley Lake was modified and enlarged between 1908 and 1911.

The following description from Shannon's history of the Club gives a very good flavor of the issues the membership faced in the early 1900s (Shannon 1992). In describing the expansion project Shannon writes:

"In 1908, the members of Little Sandy wanted to have a larger lake than what was sold to them. One must imagine the difficulty these new members encountered, having to hike up to one mile from their campground, through the partially wooded bottomlands, to get to their favorite fishing hole. Bothered by the inconvenience, the members decided to bring the lake to them."

If the founding members had gotten their wish, Brumley Lake, as we know it today, would have been quite a bit bigger. The original plan was to construct a levee approximately 250 feet eastward from the current, east levee. However, during construction it was soon determined that this levee was being built on grounds of "quicksand" and the members decided to bring the levee in closer to the club grounds and build it where the lake currently sits today. This lake project turned out to be a major task, over two years in the making. The work was primarily done with manual labor, several teams of mules pulling scrapers (acting as bulldozers) and plenty of dynamite to clear out any unnecessary trees and other obstacles. The project was completed in 1911, and the lake soon after filled with help from Little Sandy Creek and rainfall. In 1922, the levee for the lake was raised an additional two feet to place Brumley Lake at or near its current depth.

During the late 1940s it was believed that developing additional lakes by flooding bottomland would greatly improve the duck hunting on the main lakes. The club members believed the development of Overton Lake, an existing oxbow lake, would provide new areas for ducks to feed and roost. At the end of each duck season, the lake was drained in order to preserve the highly effective forested areas that remained after the lake had been built. With the construction of the additional lake, Little Sandy enjoyed great success with its duck hunting opportunities. In 1957, Brumley Lake and Overton Lake were joined via a narrow channel in the levee that separated them. Eventually, a fisheries brood pond was created to the north of Brumley Lake, on the north side of the nearby railroad tracks, and was subsequently stocked with crappie fingerlings.

Little Sandy NWR is believed to be one of the last remaining old-growth bottomland forests in Texas. By known records and personal accounts, the club has not harvested timber in the river basin since their ownership/charter in 1907 (except in lake basins during construction).

However, several scattered rich pine stumps were found in the northwest portion of the Refuge. These stumps show evidence of a smooth top about 18 to 24 inches above ground. This resembles modern chainsaw activity and not higher crosscut saw cuts (36 inches tall). Chainsaws did not become available until around the 1930s and would likely not widely been used until the later 1930s to early 1940s. This coincides with the oil leases the club encountered started in 1935 and continued into the 1940s. It is likely the earthen mounds in this area are related to these activities as well. Other presences of oil well sites are located on the far northeastern boundary of the Refuge. These are likely the last activities conducted in 1982. The Union Pacific (formerly Missouri Pacific, formerly Texas & Pacific) Railroad lies along the northern boundary of the Refuge easement and has frequent train traffic (Shannon 1992). No other harvesting disturbances have been observed throughout the area that is now the Refuge.

Refuge Establishment

The LSHFC was identified by Dan Lay, a retired biologist with Texas Parks and Wildlife Department (TPWD) as the highest quality bottomland hardwood forest of 57 sites identified under a contract with the Service. Based on this assessment of the area's biological values, Jim Neal and Ernest Jemison, both staff wildlife biologists of the Service, met with the LSHFC manager, Bill Martin, on April 2, 1985 and conducted a biological reconnaissance of the bottomland forest. In May 1985, the *Texas Bottomland Hardwood Concept Plan: Category 3* was completed. This plan identified the Middle Sabine Bottom, which included the LSHFC, as one of fourteen Priority 1 sites, for conserving the highest quality bottomland hardwood habitat in the area.

On October 31, 1985, Ron Cathey, Club President, and Irion Worsham, Club Attorney, met with Jim Neal and Ken Ystesund of the Service to discuss the possibility of conveying a conservation easement on the club to the Service. On December 4, 1985, the Regional Director of the Service' Southwest Region, Mike Spear, the Assistant Regional Director for Refuges and Realty, Ellis Klett, and Migratory Birds Biologist Jim Neal and several other staffers toured the club to verify its significance.

A draft Environmental Assessment proposing to accept the donation of a conservation easement on 3,802 acres of the club to the Service was published in July, 1986. A public hearing was held in Tyler, Texas to receive written and oral comments on the proposal to accept the easement. A total of 46 people, including several club members, supported the donation of the easement to the Service; 24 opposed the granting of the easement. The final Environmental Assessment and Decision Document were published on December 12, 1986 and supported the acceptance of the easement. The easement was accepted by the Service shortly thereafter.

Since this 3,802 acre easement was donated to the Service, no funding for the acquisition was required. Conditions of the easement include maintaining the use of the site as a hunting club by the LSHFC into perpetuity. With bottomland hardwoods, oxbow lakes, and planera swamps, that exemplify the east Texas ecosystem, the mission of the Refuge is to promote complete preservation of possibly the best remnant old growth bottomland hardwood in Texas, thus protecting, enhancing, and preserving wildlife dependent on this habitat. Approximately 80 percent of breeding birds that frequent the Refuge are dependent on the bottomland hardwoods for nesting.

Based on the 1990 court case Sabine River Authority v. U.S. Department of Interior, No. 90-4761, there was not universal support for the process by which Little Sandy NWR was established. The Sabine River Authority and the Texas Water Conservation Association were concerned about the donation because the Federal government's acquisition of this land foreclosed the State of Texas from taking the property by means of eminent domain. They had given serious consideration to use of the land for the Waters Bluff Reservoir, a $158 million, 45,000-acre project along the Sabine River in Smith, Upshur, and Wood counties.
Their plans for the construction of the reservoir, aimed at satisfying the anticipated need for additional water over the next forty years, were still in the preliminary stages since they had obtained none of the necessary federal and state permits, had secured no funding, and had not yet entered into any firm contracts for the 300 thousand plus acre feet of water that the reservoir would generate each year. The Sabine River Authority and the Texas Water Conservation Association filed suit in the Eastern District of Texas alleging that the Service had failed to comply with the procedural requirements of NEPA by not preparing an Environmental Impact Statement (EIS) in connection with its acquisition of the Little Sandy non-development easement. They alleged the easement was interfering with their long-term plan to take the property by eminent domain, construct the Waters Bluff Reservoir, and thus insure that the state's water supply would not be placed in jeopardy in the calendar year 2030. Invoking NEPA, they asserted that the Service's acquisition of the easement constituted a "major federal action significantly affecting the quality of the human environment," 42 U.S.C. § 4332(2)(C), thereby necessitating the preparation of an EIS.

> In a comprehensive opinion [745 F. Supp. 388 (E.D.Tex.1990)], the district court dismissed their claims by way of summary judgment. The court reasoned that the Service had prepared an adequate EA and had issued a Finding of No Significant Impact (FONSI) as a precursor to acquiring the easement. Concluding that there was no corresponding change in the physical environment due to the acquisition of the non-development easement, the district court held that the Service's decision to forego an EIS was not arbitrary and capricious. Id. at 392-97. It dismissed the lawsuit and an appeal to the U.S. Court of Appeals, Fifth Circuit, followed who subsequently affirmed the lower court’s decision. Once again, the Sabine River Authority appealed and attempted to take their case to the U.S. Supreme Court. However, the Court did not place it on their agenda, thereby affirming the decision by the U.S. Court of Appeals, Fifth Circuit.

1.2.1 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.

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 then 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 Little Sandy NWR include:

- Migratory Bird Conservation Act (16 U.S.C. 712d) also established that the Refuge is: *"for use as an inviolate sanctuary ...for any other management purposes, ...for migratory birds"* which utilize the area during the spring and fall migration.

1.3 Planning Context

The Little Sandy NWR is part of a national system of more than 565 Refuges. The Service places an emphasis on managing individual Refuges in a manner that reflects the Refuge System mission. As a result, the CCP must contribute to meeting the overall system mission and goals.

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 resource 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, 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

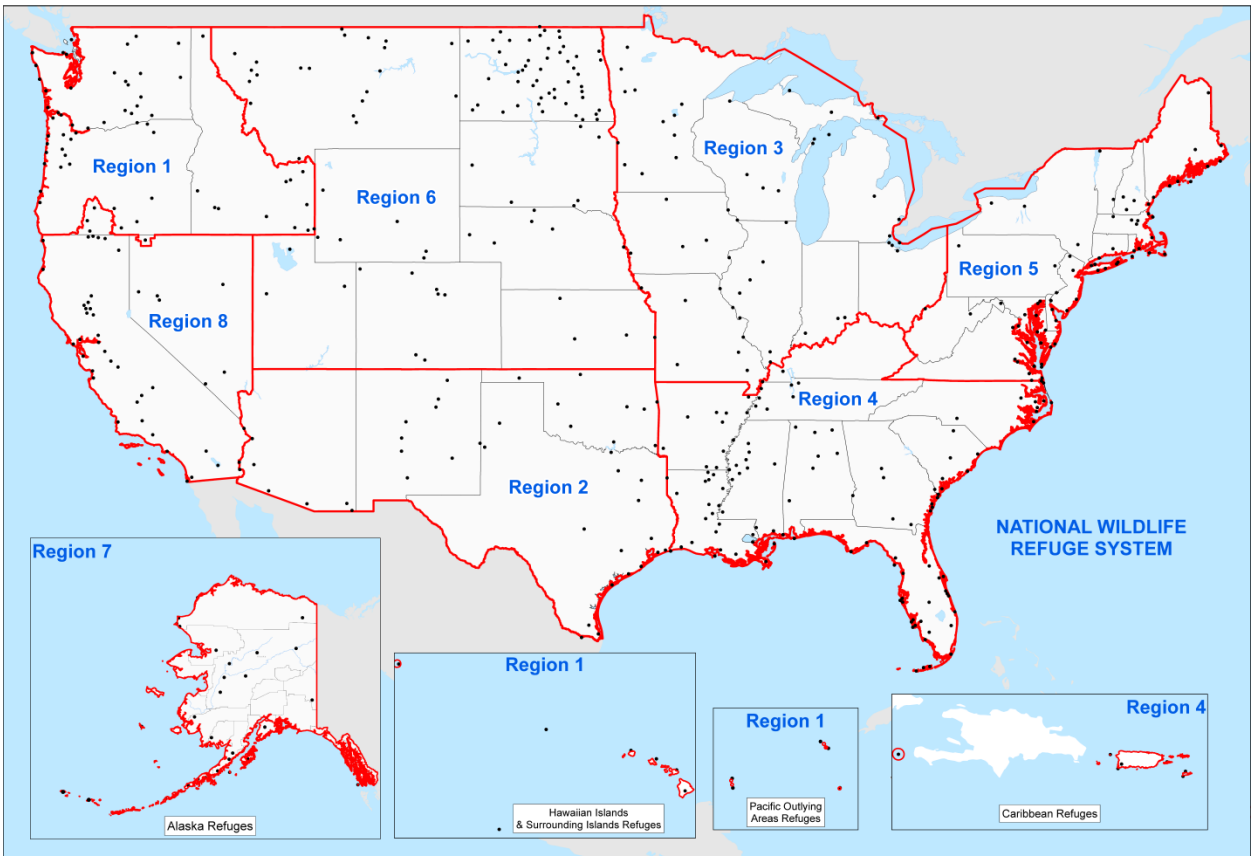
The NWRS is the only existing system of federally owned lands managed chiefly for the conservation of wildlife. Founded in 1903 by President Theodore Roosevelt with the designation of Pelican Island as a Refuge for brown pelicans, the Refuge System consists of over 150 million acres in 565 Refuges and 37 wetland management districts in all 50 states and U.S. territories. 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 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.



The National Wildlife Refuge System

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 Refuge is guided by the mission and goals of the Refuge System, Service Policy, Federal laws and executive orders, and international treaties. A complete list of the laws, policies, treaties and executive orders that pertain to the conservation and protection of natural and cultural resources on national wildlife Refuges is provided in Appendix A. Key laws and policies directly related to comprehensive conservation planning are discussed below.

National Wildlife Refuge System Administration Act of 1966

The National Wildlife Refuge System Administration Act, 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.

National Wildlife Refuge System Improvement Act of 1997

The 1997 National Wildlife Refuge System Improvement Act 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 Refuge 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 with 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
- 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; required 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, including 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 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-dependent 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).

There are no public uses on Little Sandy NWR. The Service holds a perpetual non-development conservation easement, but the land remains in private ownership. Activities conducted by the LSHFC are not subject to the Appropriate Use Policy.

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 on Refuge lands when they are compatible; however, Little Sandy NWR remains in private ownership and is closed to the public in accordance with the conservation easement. The compatibility policy is not applicable in this situation (see section 5.2.2).

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 Level Context

1.3.3.1. Climate Change

Department of the Interior Secretarial Order 3226, signed 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. 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). The last ten years have been the warmest decade on record, during which global sea level has risen about 20 centimeters (7.87 inches). 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 *"Carbon Sequestration Research and Development"* 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 CCP would conserve or restore land and habitat, and would thus retain existing carbon sequestration on the Refuge. 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 acting as a biological "scrubber" of atmospheric CO2. The Department of Energy 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).

The Service's strategic approach to climate change will emphasize three strategies that are often used to describe responses to climate change - Adaptation, Mitigation, and Education. *Adaptation* is an adjustment in natural or human systems in response to actual or expected climatic stimuli or their effects, which moderates harm or exploits beneficial opportunities. It refers to the management actions we take to reduce the impacts of climate change – reactive and anticipatory. *Mitigation* is human intervention to reduce the sources or enhance the sinks of greenhouse gases. It involves the Service "carbon footprint" by using less energy, consuming fewer materials, and altering land management practices, such as water pumping and feed/production. Mitigation is also achieved through terrestrial carbon sequestration. *Education* is helping people learn and discover, thereby creating awareness and empathy, and ultimately leading to changes in human behavior. It is a fundamental conservation tool and a public service responsibility. In the context of climate change, education means helping Service employees, our national and international partners, and constituencies (e.g. the public, Congress) understand that climate change is real and happening now; it threatens fish and wildlife resources we have come to value; and each of us can do something meaningful to reduce these threats.

Climate change could have a number of possible effects on the Refuge in addition to a general temperature increase, including: desertification, 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 grounds and stop over habitat for ducks and other waterfowl, loss of some species along with the introduction of new species, and significantly increases 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. Also, implementation of all strategies will emphasize energy conservation and/or use of alternative energy sources when feasible.

Managers and resource specialists working on the Refuge need to be aware of the possibility of change due to global warming. When feasible, documenting long-term vegetation, species, and hydrologic changes should become a part of research and monitoring programs on the Refuge. Adjustments in Refuge management direction may be necessary over the course of time to adapt to a changing climate.

1.3.3.2 National Conservation Plans and Initiatives

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

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. The plan is implemented through a dynamic action plan that details specific steps the Service will take during the next five years. 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, such as wildlife food production. Mitigation is also achieved through biological carbon sequestration, the process in which CO_2 from the atmosphere is taken up by plants through photosynthesis and stored as carbon in tree trunks, branches and roots. Engagement involves reaching out to Service employees; local, national and international partners in the public and private sectors; key constituencies and stakeholders; and everyday 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 way, the Service, its partners, and stakeholders will increase our understanding of global climate change impacts and use our combined expertise and creativity to help wildlife resources adapt in a climate-changed world.

2002 Waterbird Conservation for the Americas: the North American Waterbird Conservation Plan) / "Virtual" Version 2 (2007)

This plan provides a continental-scale framework for the conservation and management of 210 species of waterbirds, including seabirds, coastal waterbirds, wading birds, and marshbirds utilizing 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.

2012 North American Waterfowl Management Plan

The North American Waterfowl Management Plan (NAWMP) seeks to restore waterfowl populations in Canada, the U.S., and Mexico to levels recorded in the 1970s. The international partnership has worked to identify priority habitats for waterfowl and has established goals and objectives for waterfowl populations and habitats. The purpose of the NAWMP is to achieve waterfowl conservation (through habitat protection, restoration and enhancement) while maintaining or enhancing the associated ecological values in harmony with human needs (Esslinger and Wilson 2002). Regional partnerships, called joint ventures, are the implementing mechanisms of the NAWMP. There are 18 habitat based and three species based joint ventures in the U.S. today. Cumulatively, they have conserved 17.3 million acres of habitat for waterfowl and migratory birds. The Little Sandy NWR occurs within the Lower Mississippi Valley Joint Venture (LMVJV).

The LMVJV focuses on the Mississippi Alluvial Valley (MAV) and the West Gulf Coastal Plain (WGCP) Bird Conservation Regions (BCR); Little Sandy NWR occurs in the latter and covers most of east Texas. The mission of the LMVJV is to "ensure the conservation actions and programs of joint venture partners reflect reforestation and forest management prescriptions and practices that sustain populations of priority birds and other forest-dependent wildlife in concert with sustainable forestry." There are two goals of the LMVJV: 1) conserve and restore the ability of the MAV and WGCP to sustain birds of national and international conservation

concern; and 2) maintain and restore the wetland functions and values associated with forested floodplains. In addressing these goals, information on forest restoration and management is integral to the progressive refinement of Joint Venture goals and objectives.

Partners In Flight Landbird Conservation Plan 2016 Revision for Canada and Continental United States)

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. 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.

The North American Landbird Conservation Plan (2004) summarizes the conservation status of landbirds across North American, illustrating broad patterns based on comprehensive, biologically-based species assessment. The plan identifies species most in need of attention at the continental scale, recognizing the additional species will need attention in each region and outlines ways in which continental scale issues and objectives relate to regional conservation efforts. The plan identifies 100 landbird species that warrant inclusion on the Partners In Flight Watch List due to a combination of threats to their habitats, declining populations, small population sizes, or limited distributions. Of these, 28 species require immediate action to protect small remaining populations, and 44 are in need of management to reverse long-term declines.

The 2016 Landbird Conservation Plan documents widespread declines in populations of many of the 448 species of landbirds in the U.S. and Canada—a foreboding indicator that the health of ecosystems upon which we all depend is being degraded. Although much progress over the past 20 years has been made, the daunting task of conserving several hundred landbird species across vast and varied landscapes under diverse ownership requires unprecedented levels of cooperation among the public, private, and industrial sectors. The 2016 revision is intended to: 1) refine and update the relative vulnerability assessment of 448 species on North American landbirds; 2) Preserve new scientific assessments and tools to integrate into range-wide and full life-cycle conservation implementation; and 3) To deliver recommendations to advance high priority landbird conservation actions over the next 10 years.

Little Sandy NWR occurs within the PIF Physiographic Area #42, the WGCP which covers northwest Louisiana, southwest Arkansas, easternmost Texas, and the southeast corner of Oklahoma. In general, uplands are dominated by pines and bottomland hardwood forests. The pine is originally longleaf in the southern portion and shortleaf with a significant hardwood element in the northern portion. The southern edge of the physiographic area occurs where trees become less dominant and the grasslands of the Coastal Prairies begin. The West Gulf Coastal Plain extends east to the Mississippi Alluvial Valley and north to edge of the Ouachita highlands.

Drier climate and changing soils to the west mark the edge of the distribution of pine in eastern Texas and the beginnings of the Oaks and Prairies physiographic area.

Priority bird populations for this Physiographic area include: for pine forests and associated grasslands – red-cockaded woodpecker, Bewick's wren, Henslow's sparrow, Bachman's sparrow, American kestrel, brown-headed nuthatch, Chuck-will's-widow, scissor-tailed flycatcher, and prairie warbler; for hardwood forests – swallow-tailed kite, Swainson's warbler, Kentucky warbler, Prothonotary warbler, worm-eating warbler, hooded warbler, and white-eyed vireo. A majority of these species have potential habitat at the Refuge and are further discussed in Sections 3 of this document. Additional information on PIF and species priorities for the area can also be found at http://www.partnersinflight.org/bcps/pl_42sum.htm

U. S. Shorebird Conservation Plan (Brown et al 2001)
This conservation plan 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 conservation plan is to restore and maintain shorebird populations throughout the western hemisphere through an international partnership.

1.3.3.3 Regional Plans and Initiatives

2000 North American Bird Conservation Initiative: Bird Conservation Region Descriptions
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 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. BCRs are part of the NABCI. There are 67 BCRs identified, 35 of which fall entirely or partially within the United States.

Little Sandy NWR is located within BCR 25 (West Gulf Coast Plain/Ouachitas). Pines dominate this area, largely shortleaf pine in the north, including the Ouachita Mountains, and longleaf pine in the south. This westernmost part of the eastern U.S. forest also includes hardwood-dominated bottomlands along the Arkansas River and other drainages. Red-cockaded woodpecker is the highest priority bird in pine habitat, which is also inhabited by Bachman's sparrow and brown-headed nuthatch. Conversion of the native pine forests to industrial loblolly plantations provides some bird habitat but is less useful for the highest priority species. The river and stream bottoms provide habitat used by Swainson's warbler and a great rookery with large numbers of nesting herons and egrets. Bottomland hardwoods and associated wetlands support substantial wintering populations of a number of waterfowl species—principally mallards, and breeding and wintering wood ducks—and are a primary migration corridor for significant numbers of other dabbling ducks. The primary threats to bottomland hardwood wetlands in the region are from reservoirs and timber harvest and subsequent conversion to pine plantation, pasture, and other land uses.

The West Gulf Coastal Plain, as described above, is the focus of a new and innovative initiative that seeks to conserve natural communities and the bird populations within these habitats. The WGCP BCR lies almost completely within the Lower Mississippi Valley Joint Venture as does the Mississippi Alluvial Valley BCR. The WGCP BCR poses new challenges and opportunities that were not present in the LMVJV BCR; the LMVJV exists presently as a non-forested landscape while the WGCP is largely forested, albeit much changed since pre-settlement. The LMVJV and WGCP have embraced the "all bird - all habitat" approach to bird conservation that is incorporated in the NABCI. The purpose of NABCI is to ensure the long-term viability of bird populations by promoting bird conservation initiatives, such as the LMVJV and WGCP. This occurs by "delivering the full spectrum of bird conservation through regionally based, biologically driven, landscape oriented partnerships."

Over 130 species nest in the West Gulf Coastal Plain physiographic area. Widespread and representative species include the northern cardinal, cattle egret, mourning dove, pine warbler, and indigo bunting. The red-cockaded woodpecker is the highest priority species in the WGCP and occurs in open, park-like pine savannahs. Other high priority species that nest in this habitat type include Bachman's sparrow and brown-headed nuthatch. Le Conte's sparrow winters in this same habitat type. Several priority species use pine forests and other upland communities including the northern bobwhite, eastern wood-pewee, and the red-headed woodpecker. Pine savannahs are a conservation priority because of all the bird species supported in these habitats. These savannahs are continually threatened by conversion to pine plantations and the lack of prescribed burning and the suppression of naturally-caused fires.

Bottomland hardwood forests and cypress/tupelo swamps support priority species including swallow-tailed kites; Swainson's warbler, Cerulean, and Prothonotary warblers, white-eyed vireo, yellow-billed cuckoo, and red-headed woodpeckers, especially in the winter. Bottomland forests also support substantial populations of waterfowl species including the wood duck and mallard. The primary threats to these forests of high conservation priority include reservoir construction; stream modifications; destructive timber harvesting practices; and conversion to pine plantations, pastures, and other land uses.

Additional information on the BCRs can be found at http://www.nabci-us.org/

U.S. Fish and Wildlife Texas Bottomland Hardwood Concept Plan (1985)

The Texas Bottomlands Hardwood Preservation Plan outlines how the Service, with the support of other agencies and groups, propose to preserve bottomland hardwood habitat and associated wildlife resources. The river and stream system of Texas and the southeastern U.S. have long been recognized as the "life blood" of the region. These water bodies and their habitats shelter a variety of wildlife and plant species and the overflow bottoms and their associated wetlands provide other benefits such as flood and pollution control.

In 1985, the Service completed a Final Concept Plan for the Texas Bottomland Hardwood Program. The purpose of this Plan was to identify and seek methods of preserving as much of the remaining bottomland habitats of east Texas as possible. While a large portion of the rivers and streams of eastern Texas are important to waterfowl, the specific sites identified in this concept plan are vital for maintaining populations of mallards and wood ducks. A total of 62

bottomland areas, of widely varying quality, were identified within the area of ecological consideration, which includes a 65 county area in eastern Texas. The sites were placed in six priority categories: (1) Priority 1 – excellent quality bottomlands of high value to the key waterfowl species; (2) Priority 2 – good quality bottomlands with moderate waterfowl benefits; (3) Priority 3 – excellent quality bottomlands with minor waterfowl benefits because of small size, lack of management potential, other factors; (4) Priority 4 – moderate quality bottomlands with minor waterfowl benefits; (5) Priority 5 – sites eliminated from further study because of poor quality and/or no waterfowl benefits; and (6) Priority 6 – sites recommended for future study.

The Texas Bottomland Hardwood Program seeks to preserve as many bottomland hardwood sites as possible and is dependent on the active involvement of TPWD, local governments, private conservation groups, and the Service. A variety of tools including leases, perpetual easements, fee acquisition, purchase of wildlife mitigation lands, and wildlife extension efforts have be utilized to protect these areas. The Little Sandy NWR was identified (as part of the Middle Sabine Bottom) as a Priority 1 site. The TPWD acquired a portion of the remainder of the Middle Sabine Bottom Priority 1 unit and operates it as the Old Sabine Bottom Wildlife Management Area. It is contiguous to the Little Sandy NWR; the two areas preserve one of the largest intact bottomland hardwood forests remaining in Texas. To date, the Service has established four Refuges (Little Sandy NWR in 1986, Trinity River NWR in 1994, Caddo Lake NWR in 2000, and Neches River NWR in 2006) in areas that were identified as Priority 1 sites within the Texas Bottomlands Hardwood Concept Plan.

1.3.3.4 State and Local Plans and Initiatives

In administering the Refuge System, the Service will ensure that the CCP complements State and local efforts to conserve fish and wildlife and their habitats. 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.

The Nature Conservancy (TNC) Middle Sabine River Bottom Ecoregional Plan
The Middle Sabine River Bottom Ecosystem is an approximately 13,798-acre area along the Middle Sabine River between Smith and Wood Counties in Texas. The northern boundary is parallel to U.S. Highway 80 and the Old Sabine River Channel on the South. It is bounded by State Highway 14 to the east and Lake Fork Creek to the west.

Bottomland hardwoods of this ecosystem and to a greater extent the entire physiographic region that includes eastern Texas as well as southeastern Oklahoma, represent one of the most important wintering areas for the mallard in the Central Flyway, and are the principal Central Flyway breeding habitat for the wood duck. It is now recognized that bottomland wetlands of the southeastern U.S. are critical to wintering mallards and wood ducks. Recent studies have proven the value of quality wetland habitat in wintering areas for ensuring successful

reproduction on the breeding grounds. Seasonally flooded bottomland hardwoods are utilized extensively as resting and feeding areas for these and other waterfowl species.

Texas Conservation Action Plan / Texas Comprehensive Wildlife Conservation Strategy

The 2005 Texas Comprehensive Wildlife Conservation Strategy (updated in 2012 as the Texas Wildlife Action Plan) is required to assess the condition of the state's wildlife and habitats, identify the limiting factors, and outline the actions that are needed for long term conservation. The plan 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 conservation strategy focuses on the steps needed to protect, restore, and enhance habitat types.

As part of the State Wildlife Grant Program, the Texas Wildlife Conservation Strategy was completed by Texas Parks and Wildlife Department (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. This plan provides detailed species status, habitat information, conservation issues, and conservation actions needed in the state's 10 major ecoregions. Little Sandy NWR occurs within the West Gulf Coast Plain Ecoregion, also known as the Pineywoods Ecoregion. The TPWD has identified 22 rare plant species and 27 endemics; there are also several reptile and waterfowl species of concern that have habitat within this ecoregion and there is evidence that the Louisiana black bear is attempting to naturally recolonize the area.

Relevant strategies of this CCP and associated step-down management plans will take into account many of the specific conservation actions in the State's plan.

Land and Water Resources Conservation and Recreation Plan

The 2010 Land and Water Resources Conservation and Recreation Plan was written to guide TPWD in conserving the state's natural and historic heritage and in providing public access to the outdoors. Major goals of this plan include: 1) improving access to the outdoors; 2) conserving, managing, operating, and promoting agency sites for recreational opportunities, biodiversity, and the cultural heritage of Texas; 3) assisting landowners in managing their lands for sustainable wildlife habitat consistent with their goals; 4) increasing participation in hunting, fishing, boating and outdoor recreation; 5) enhancing the quality of hunting, fishing, boating and outdoor recreation; 6) improving science, data collection and information dissemination to make informed management decisions; 7) maintaining or improving water quality and quantity to support the needs of fish, wildlife and recreation; and 8) continuously improving TPWD business management systems, business practices, and work culture.

According to the plan, *"…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.."* It recommends that *"...many beach areas and mud flats need additional protection"* and incorporates many relevant strategies, such as monitoring species status and trends, restoring coastal prairie, provide public outreach, protecting cultural and historical resources, maintaining and developing new partnerships, and managing invasive species.

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 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 Service 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. As such, the Service will ensure this CCP complements the State of Texas' efforts to conserve fish and wildlife and their habitats, and to increase support for the Refuge System and participation from conservation partners and the public.

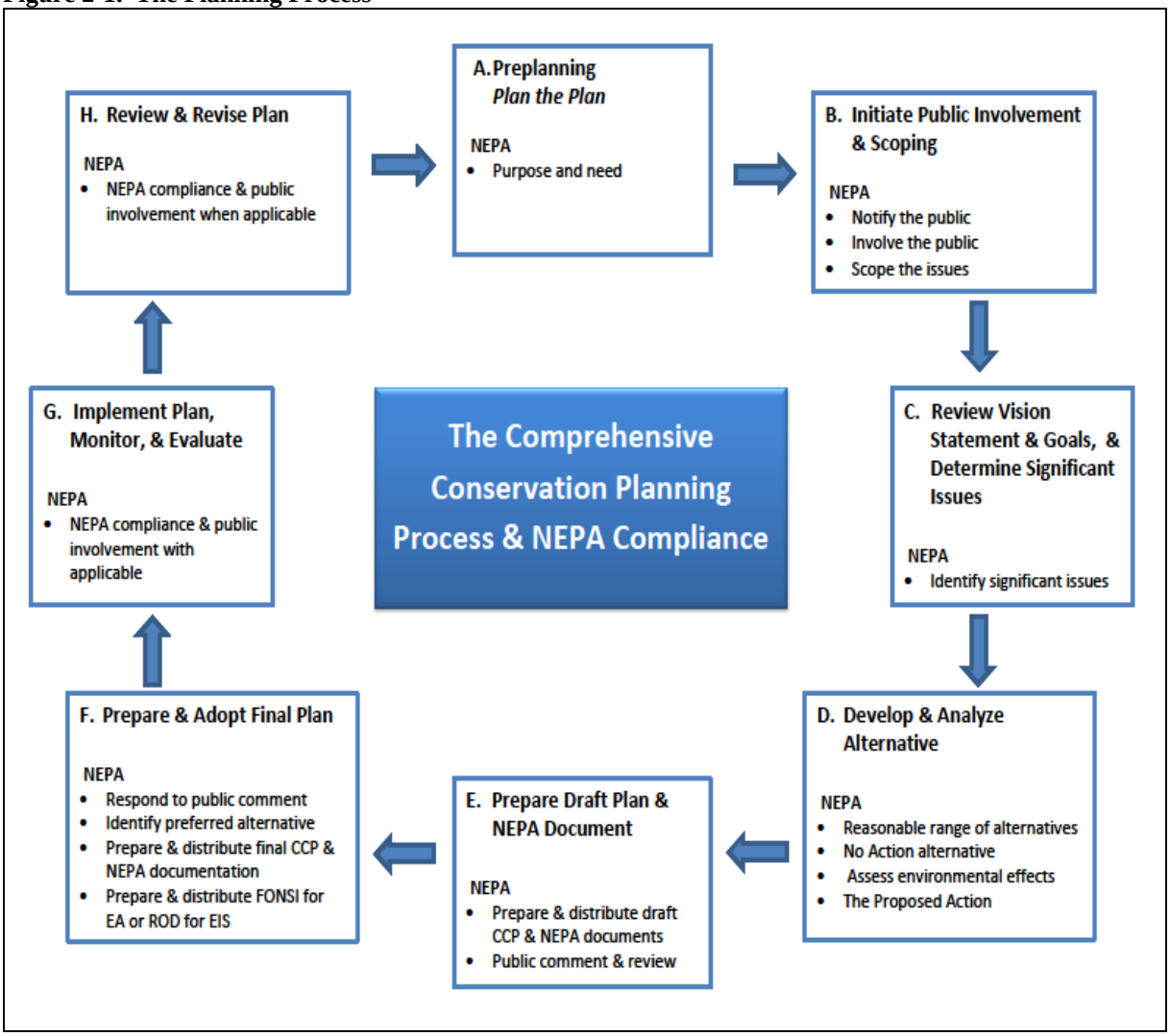
This plan recognizes that both the Service and the TPWD have authorities and responsibilities for management of fish and wildlife species on the Refuge. The State's participation and contributions throughout this planning process have provided ongoing opportunities and open dialogue to improve the ecological 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.

Brumley Lake by David Weaver

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 Refuge. Figure 2-1 shows the steps in the CCP planning process in a linear cycle. The following sections (2.1.1-2.1.8) provide additional detail on individual steps in the planning process.

Figure 2-1. The Planning Process



2.1 Preplanning

Prior to formally initiating the development of this CCP, the following tasks were completed to support planning activities:

- Established an interdisciplinary interagency planning team for the development of the CCP
- Identified Refuge purpose, history, and establishing authority as well as partnership agreements
- Identified all relevant laws, regulations, and policies that would have to be considered and that would contribute towards the development of the CCP
- Identified purpose and need for the CCP to make sure all issues are adequately addressed
- 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 a thorough assessment of issues, concerns, opinions, thoughts, ideas, concepts, and visions for the Refuge. Formal scoping began with publication of a Notice of Intent to prepare a CCP and EA, which was published in the *Federal Register* on August 16, 2007 (Volume 72, Number 158, pp. 46095-46097).

A public meeting for scoping was announced through a planning update mailing and a public notice. The meeting was held on September 9, 2009 at Jarvis College in Hawkins, Texas; four individuals attended. The feedback received at the conclusion of the public involvement period identified the following concerns in Table 2-1.

Table 2-1 List of concerns identified by stakeholder.

Table 2.3. Concerns Grouped by Category and Listed by Stakeholder				
Concern	**General Public**	**State of Texas**	**Federal Agencies**	**USFWS**
Habitat Management				
Climate Change			X	
Land Acquisition		X		X
Flora Inventory	X	X		
Prescribed Burning				X
Water Body Management	X	X		X
Invasive Species Management (Flora)	X	X		X
Wildlife Management				
Fauna Inventory	X	X		X
Nuisance and Invasive Species Management (Fauna)		X		

2.3 Determine Issues

To determine the significant issues to be addressed in the CCP, the planning team reviewed the concerns identified by the public along with management concerns identified by Refuge staff and TPWD.

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

Planning issues were identified for consideration during the development of this CCP. Scoping identified a number of issues reflecting problems, opportunities, or points of discussion that the CCP addresses in a variety of ways. The complete set of written comments received is available from the Service's Southwest Regional Office in Albuquerque, New Mexico.

The issues, concerns, and opportunities expressed during the first phase of planning have been summarized under the headings of Habitat Management and Wildlife Management.

Habitat Management

There are several irreplaceable and unique forest communities on the Refuge. Much of the bottomland hardwood habitat has been undisturbed for over 100 years, which has allowed the forest to climax to a true old growth forest. There is a desire to preserve and learn from this unique area and continue to protect some of the highest quality migratory waterfowl habitat in the bottomlands of eastern Texas and Oklahoma.

Climate Change

The Service has concerns regarding the effect climate change may have on the Refuge System. The Service acknowledges that climate change has the potential to alter the distribution of habitat types in Texas and the rest of the world; as habitats change, the wildlife species that inhabit those habitats will also change. Although the Refuge can do little to resolve this issue, it can recognize when change is occurring, document changing conditions through data collection, and adapt management to reflect changes in hydrology and plant communities. Concerns regarding climate change suggest the need to develop baseline data on Refuge habitat resources so that the Refuge can appropriately respond to changing conditions.

Land Acquisition

Currently, the Refuge is unable to acquire additional lands because the land acquisition boundary coincides with the existing Refuge boundary. High value wildlife habitat (old growth bottomland hardwoods) exists in areas surrounding the Refuge and there has been interest in recent years from landowners to sell bottomland hardwood habitat and upland lands to the Service. The Service and TPWD are interested in preserving additional bottomland hardwood areas. If this is to be accomplished through potential expansion of the Refuge, the Service must participate in a landscape-level planning effort. This Land Protection Decision Package would outline priority efforts suitable to meet the mission of the Refuge System.

Flora Inventory

While an initial habitat assessment and an ecological community characterization was completed upon the acceptance of the Refuge into the Refuge System, no detailed floral inventory of the Little Sandy NWR has been completed. The Refuge, the TPWD and one public commenter believe that completing a floral inventory of the Refuge is critical for establishing a floral baseline, determining long and short term ecological integrity, habitat diversity and tracking the effects of climate change.

Prescribed Burning

The southern yellow pine ecosystem in the uplands habitat evolved with periodic fires, either from lightning strikes, or the practice of Native Americans. Fires would spread across vast areas, driven by an abundance of highly flammable ground fuels such as pine needles and grass. In the absence of periodic fires, the grass community disappears and is replaced by shade tolerant hardwoods. The loss of this pine savannah type habitat has led to the decline of many fauna species that were once associated with it.

Wildfire potential on Little Sandy NWR is currently moderate due to heavy fuel loading along the railroad. There is currently no prescribed fire program on the Refuge. The Refuge staff believes that establishing a prescribed burning program on approximately 200 acres of uplands

habitat would mimic the natural fire ecology in the Refuge described above and, upon implementation, will contribute to a healthy upland environment.

Water Body Management

Currently, water management on Brumley and Overton Lakes is conducted by the LSHFC with technical advice available from agency experts with the Service. To date, the hunting and recreational desires of the hunt club have taken priority over habitat quality in terms of water body management practices. Both lakes had different objectives when they were constructed by the LSHFC. Brumley Lake contains a portion of an oxbow lake that was present before the construction of the levee and was designed and built for fishing activities with waterfowl hunting a secondary consideration. Overton Lake was constructed with an emphasis on waterfowl hunting. Infrastructure to manage water levels on both lakes independently was placed at the time of construction and the water supplies for the two lakes originate from different sources. This allows for the lakes to be managed jointly or as two separate units.

Brumley and Overton Lakes currently experience eutrophic conditions in which the water carries high amounts of nutrients and wide swings of dissolved oxygen. By manipulating the water level in the lakes, a more natural habitat and associated aquatic vegetation regime could be achieved simplifying the process to control the spread of invasive flora species. The Service believes that conducting periodic draw downs and flooding events on the lakes would promote migratory bird usage and improve fisheries potential; however, the Service does not have management authority of these lakes. Under the terms of the easement, the Service can only provide management advice. Any changes in water management would need to be accepted and approved by the LSHFC.

Continued collaboration with the LSHFC is needed to eventually determine the best management practices for the Refuge that would balance hunting and recreational use with the promotion of a natural vegetation regime, migratory bird usage and improved fisheries.

Wildlfie Management

Invasive Species Management (Flora)

There are several invasive species on the Refuge such as Chinese tallow, Chinese privet, silktree, Chinaberry, Nandina and Japanese honeysuckle. These plant species out-compete native plant species, reduce the quality and potential of habitat and clog waterways. There have been limited efforts to actively control or monitor the invasive species on the Refuge. It is critical that invasive species encroachment is controlled before native habitats are displaced and the unique old growth hardwood forests on the Refuge are detrimentally impacted. It is believed that a lack of ecologically based water body management is contributing to the presence and spread of invasive flora species in the Refuge. The Service believes that proper water body management could help streamline the battle on invasive flora species on the Refuge. Since this is not currently a management option for the LSHFC, for the reasons described above, mechanical and chemical removal as a secondary means to control invasive species encroachment would assist in limiting, but not ultimately resolving, the spread of invasive species.

Fauna Inventory
No comprehensive fauna inventory has been completed for the Refuge. Baseline data is critical for determining long and short-term ecological integrity, habitat diversity and tracking the effects of climate change. From 2008 to 2011, monthly aerial bird inventories were completed by the Refuge from October to February. Neotropical migratory bird point counts were initiated in the spring of 2008 and are conducted annually. Since a complete fauna inventory of the Refuge paired with updated bird point monitoring and collecting biological data from harvested fauna by the LSHFC, would establish baseline data. This would allow the Refuge to successfully orient future wildlife management programs toward species that are present on the Refuge as well as enable the Refuge staff to track potential impacts of climate change.

Invasive Species Management (Fauna)
Feral hogs occur throughout the Refuge and surrounding region. It is widely known that this species is very destructive to native habitats and detrimental to native species. Currently, population control is limited to the occasional taking of a hog by a club member; however, there is no active management by the LSHFC or the Refuge in controlling this invasive species. The Refuge staff and TPWD believe that active management (hunting and trapping) of feral hogs is necessary to restrict their movements, prevent further expansion on the Refuge, and limit subsequent resource destruction.

Nuisance Species Management (Fauna)
Beavers occur throughout the bottomland hardwood expanses of the Refuge and surrounding areas. While beavers can be an important component of a healthy ecosystem, they can be destructive to infrastructure. An increased beaver population has altered the area's hydrology by building additional dams and ponds, inundating the bottomland forests for prolonged periods. During the winter months, they construct dams which plug water control structures. In the spring, these dams prevent water from flowing freely through the drainage system and inundate trails and bottomland hardwood forests. The LSHFC staff currently removes beaver dams from culverts and small drains to restore proper water flows. The staff and the TPWD believe that continued dam removal in combination with beaver trapping efforts, would improve water flow during the spring and summer months promoting healthy bottomland hardwood habitats.

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 Refuge purposes or that were outside the Service's ability to implement. The environmental consequences of the alternatives were analyzed and the results are presented in Section 4 of the EA found in Appendix B. These alternatives meet the Refuge's purposes and goals and comply with the Service and Refuge System mission.

2.5 Prepare Draft Plan and EA

The draft CCP, EA and Draft Forest Management Plan (FMP) were prepared concurrently. This Draft CCP/EA/ FMP will be submitted to TPWD for a 30 day review period and then will go to the general public for a 30 day public review and comment period.

2.6 Prepare and Adopt Final CCP

Comments received on this draft CCP/EA will be incorporated where appropriate and may result in modifications to the proposed action or selection of another alternative. The alternative that is ultimately selected will be the basis for the final CCP. The final CCP will include an appendix with a response to comments received during the public review and will be adopted as current management after the decision document is signed (see the EA in Appendix B).

2.7 Implement Plan, Monitor, and Evaluate

The final CCP will become the basis for guiding management over the coming 15-year period. It will guide the development of more detailed step-down management plans for specific resource areas and will underpin the annual budgeting process for Refuge operations and maintenance (Chapter 5). Most importantly, it lays out the general approach to managing habitat, wildlife, and people at the Refuge 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 progress is being made toward meeting goals. Monitoring also detects new problems, issues, or opportunities that should be addressed. The Refuge is using an adaptive management approach, which means that information gained from ongoing monitoring is used to evaluate and, as needed, to modify Refuge objectives.

2.8 Review and Revise CCP

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

3.0 Refuge Resources and Current Management

The Refuge consists of a 3,802-acre perpetual conservation easement on the LSHFC. This chapter provides a description of the Refuge resources and their management. 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 more effectively achieve the Refuge System mission of conserving fish and wildlife, the Refuge took a landscape-scale approach to identifying resources and issues. The Refuge 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 Refuge is located (Map 3-1. Landscape Setting).

3.1.1 Central Flyway

Bird migration is the seasonal movement of birds between summer nesting habitat in Canada and the northern United States and wintering habitat in the southern United States, 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).

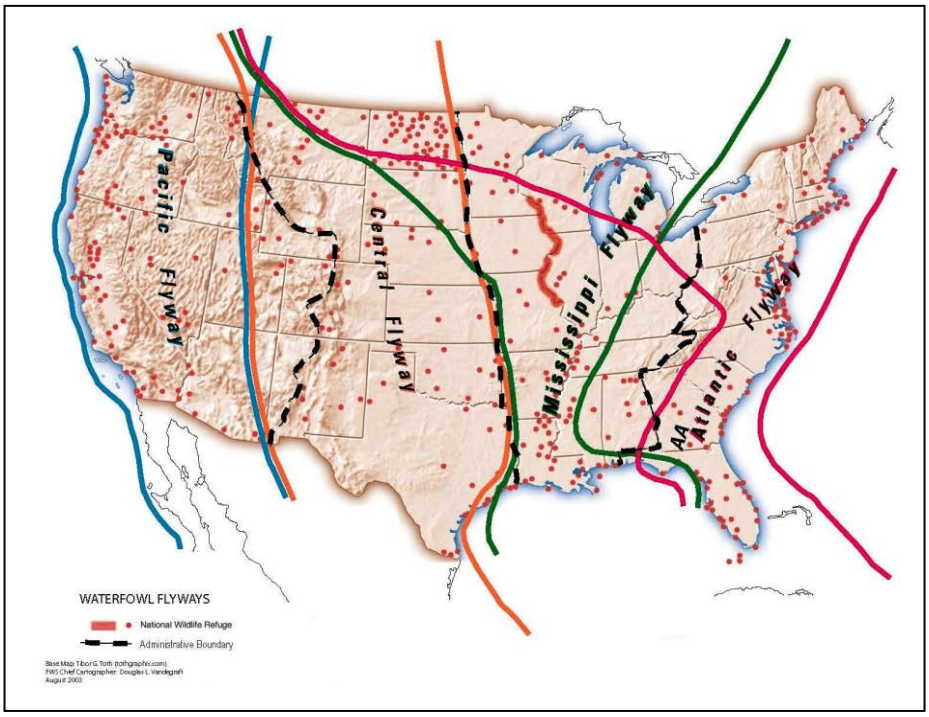


Figure 3-1Central Flyway

PRODUCED IN THE DIVISION OF REFUGE PLANNING
ALBUQUERQUE, NEW MEXICO
LAND STATUS CURRENT TO: 5/31/09
MAP DATE: August, 2010
BASEMAP: N/A
MERIDIAN: N/A
FILE: LS_landscape_setting_8.18.10_smk.pdf

0 175 350 700 Miles

0 185 370 740 Kilometers

UTM ZONE 13
NAD 83

It is along these four flyways that tens of millions of migrating birds travel seasonally. The Service established national wildlife Refuges along these flyways to provide resting and nesting habitat for migrating birds.

Little Sandy NWR is located within the Central Flyway which spans the Canadian Northwest Territory, two Canadian provinces (Alberta and Saskatchewan), numerous countries in Central and South America, and ten U.S. states: Montana, North Dakota, South Dakota, Wyoming, Nebraska, Colorado, Kansas, New Mexico, Oklahoma, and Texas.

3.1.2 Strategic Habitat Conservation and the Gulf Coast Plain and Ozarks Landscape Conservation Cooperative

Strategic Habitat Conservation
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 decisions, 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 these elements—biological planning, conservation design, delivery, monitoring, and research-in an ongoing process that changes and evolves.

- **Biological planning** involves identifying priority trust resources, determining population objectives, assessing the current status of populations, identifying threats and limiting factors, and using models to describe the relationship of populations to habitat and other limiting factors.
- **Conservation design** uses the results of biological planning to develop decision support tools, including maps and models, to guide management. It also identifies priority geographic areas for conservation and determines population-based objectives for habitat or other limiting factors based on these tools.
- **Conservation delivery** involves implementing conservation actions through programs and partnerships that are guided by decision support tools and targeted to achieve specific biological results.
- **Monitoring** collects data to evaluate the effectiveness of conservation actions in reaching biological outcomes and to provide feedback to future planning and delivery.
- **Research** tests assumptions in biological planning and conservation design that have the greatest impact on management decisions and provides feedback to future planning.

Landscape Conservation Cooperatives
To ensure that science entities are strategically placed, the Service and US 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 Little Sandy NWR is located within the Gulf Coastal Plains and Ozarks Landscape Conservation Cooperative (GCPOLCC). This LCC will facilitate conservation planning and design across a highly diverse region in southeastern North America. It extends 180 million acres from the mountain tops of the Ozark, Boston and Ouachita ranges, to the pine savannah and prairies of the West and East Coastal Plains, and down into the swamps, bayous and alluvial bottomlands of the Mississippi Alluvial Valley. The Mississippi River bisects the region. State owned lands are an important component of the GCPOLCC area and many contribute habitats necessary to support priority species. The majority of the GCPOLCC area is under private ownership. Incentives that encourage private landowners to manage their lands in ways that contribute to wildlife habitat values, and providing tools that help strategically target those incentives, are important considerations of the GCPOLCC.

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).

Little Sandy NWR is located with the Upper West Gulf Coastal Plain ecoregion as identified by TNC (Gould et. al. 1960) and covers approximately 7,100 square miles. It includes portions of southwest Arkansas, southeast Oklahoma, northeast Texas and western Louisiana. Given the large size of this ecoregion, a great diversity of habitats and species is expected.

3.1.3.1 Terrestrial Description

According to TNC's ecoregional assessment catalogue, Little Sandy NWR exists within the Middle Sabine River Bottom Ecosystem, which is an approximately 13,798-acre area along the Middle Sabine River between Smith and Wood Counties in Texas. The northern boundary is parallel to U.S. Highway 80 and the Old Sabine River Channel is along the southern boundary. It is bounded by State Highway 14 to the east and Lake Fork Creek to the west.

Bottomland hardwoods of this ecosystem, and to a greater extent the entire physiographic region that includes eastern Texas as well as southeastern Oklahoma, represent one of the most important wintering areas for the mallard in the Central Flyway, and are the principal Central Flyway breeding habitat for the wood duck. It is now recognized that bottomland wetlands of the southeastern U.S. are critical to wintering mallards and wood ducks. Recent studies have proven the value of quality wetland habitat in wintering areas for ensuring successful reproduction on the breeding grounds. Seasonally flooded bottomland hardwoods are utilized extensively as resting and feeding areas for these and other waterfowl species.

In addition, bottomland forests support abundant populations of white-tailed deer, squirrels, eastern wild turkeys, raccoons and other furbearers. These wildlife species are directly dependent on food produced by a diversity of bottomland plant species. Bottomlands of Texas also support a number of species of special concern including the bald eagle and American alligator. Goals for this Ecosystem were considered over the larger physiographic region and are documented the Service's East Texas Ecosystem Plan.

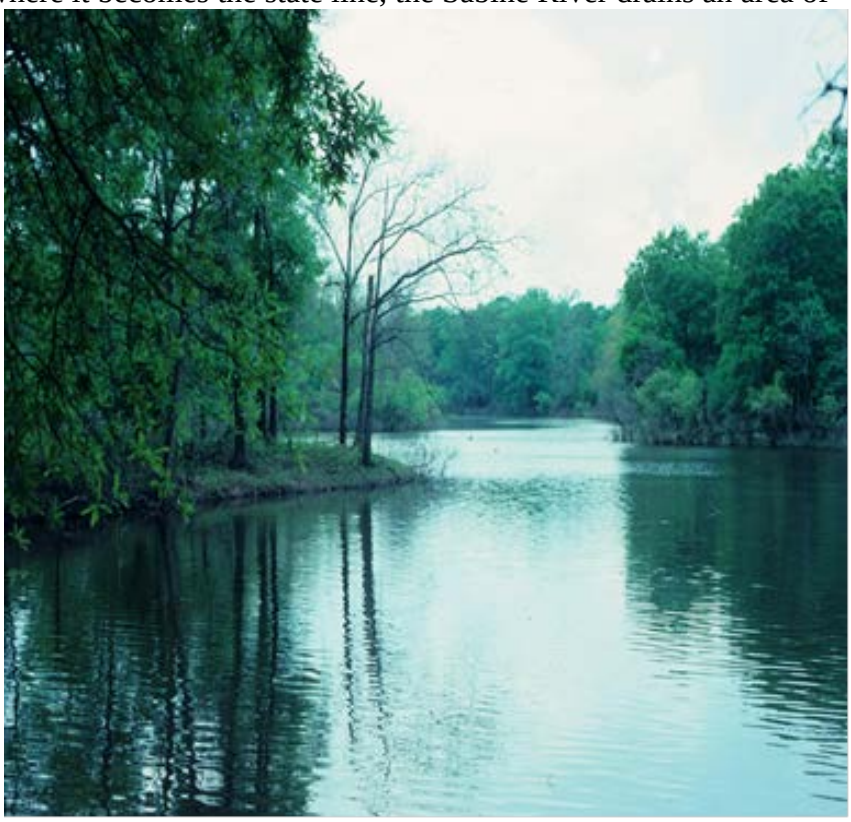
The Refuge is located along the convergence of the TPWD's Post Oak Savannah/Blackland Prairies and Pineywoods wildlife management districts, which encompass 58 counties from the Red River south to Grimes, Brazos, Burleson and Milam Counties and east to the Texas-Louisiana border. The western 13 counties, or portions thereof, fall within the Blackland Prairie Ecoregion, 18 counties fall within the Post Oak Savannah Ecoregion, and the remaining counties east of Wood County fall within the Pineywoods district.

3.1.3.2 Aquatic Description

The Refuge is located within the Sabine River Basin which is relatively long and narrow, with a length of approximately 300 miles and a maximum width of approximately 48 miles. It is roughly crescent-shaped, extending in a general southeasterly direction for a distance of some 165 miles from its source in Hunt County, Texas, to the Texas-Louisiana border in the vicinity of Logansport, Louisiana, thence in a southerly direction to Sabine Lake and the Gulf of Mexico. The Sabine River Basin is bounded on the north and northeast by the Red River Basin, on the east by the Calcasieu River Basin, on the west by the Neches River Basin, and on the northwest by the Trinity River Basin.

Land surface elevations along the watershed divide vary from a few feet above sea level near the coast to approximately 700 feet above mean sea level at the headwaters. The slope of the valley is fairly uniform from the coast to the vicinity of Mineola, Texas, from where it progressively increases to the headwaters. The headwaters of the Sabine River originate at river mile 579.4 (watershed divide) in northwestern Hunt County, from where the River flows southeasterly

through the City of Greenville for a distance of approximately 60 miles to join Caddo Creek and the South Fork within Lake Tawakoni. From Iron Bridge Dam, which forms Lake Tawakoni, the River flows a distance of about 250 channel miles across Texas to the boundary between Texas and Louisiana near the town of Logansport, Louisiana, then southerly along the state line through Toledo Bend Reservoir for a distance of about 265 miles to Sabine Lake, and thence into the Gulf of Mexico. At the point where it becomes the state line, the Sabine River drains an area of approximately 4,846 square miles. The lower Basin or state line portion has a contributing area of some 4,910 square miles, of which approximately 2,550 square miles lie within Texas and 2,360 square miles lie within Louisiana. The total area of the watershed is 9,756 square miles of which some 76 percent lies within the boundaries of Texas.



Sabine River NWRS

The Sabine River is an alluvial river, which originates to the northwest of the Refuge in Hunt County and is joined by the South Fork at the intersection of Hunt, Van Zandt, and Rains counties.

Presently, surface runoff is the major water source for the Sabine River. The Sabine River eventually drains into Sabine Lake and then the Gulf of Mexico with a total drainage basin area of 9,756 square miles (TDWR 1984). Hydrological data for the Sabine River south of Mineola, from U.S. Geological Survey Station #08018500 located upstream of the Refuge, indicates that the average discharge at the station is 845 cubic feet per second (daily statistic for water years 1968 through 2011, based on USGS information) with extremes of 76,000 cubic feet per second (high) and zero flow (low) (USGS 2001). The drainage area at the Mineola station is believed to be approximately 1357 square miles.

The flow of water in bottomlands, over-bank flooding, and the depositional and erosional processes resulting from river flows are responsible, in part, for modern southeastern floodplain landforms, soils, and forest cover. The dynamic fluctuations of rivers and streams in the southeast relate directly to high flows from winter and spring rains and low flows with high evapo-transpiration rates in late summer and fall (Wharton and Brison 1979).

3.1.4 Protected Areas in the Upper West Gulf Coastal Plain 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 these values are passed 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 United States, over 10,480 protected areas, including state level protected areas, account for 27 percent of the land area (UNEP 2008). Within the Upper West Gulf Coastal Plain (UWGCP) Ecoregion there are 156 federal, state or privately owned/managed conservation and recreation units including the Little Sandy NWR. These protected areas consist of approximately 5.5 percent of the entire UWGCP Ecoregion. Appendix D identifies State and Federal conservation lands within the UWGCP Ecoregion. These protected areas total 1,408,910 acres of the entire UWGCP Ecoregion and are shown on Map 3-2 (Ecoregion Map).

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 Sabine River Ecosystem is working with partners to identify key conservation corridors and crucial habitats is needed to conserve the habitat and wildlife species that depend on it.

Bottomland hardwood forests are some of the most endangered and productive wetland ecosystems in the southeastern United States. Over 90 percent of these forests in Texas have been converted to other uses, thereby eliminating a tremendous amount of wildlife habitat in the eastern portion of the state. The Middle Sabine Bottoms, which includes the Refuge, was identified as one of 14 priority one bottomland hardwood sites for protection in the Service's 1985 Texas Bottomland Hardwood Concept Plan. This same area has also been identified as a priority bird conservation area within the West Gulf Coastal Plain Bird Conservation Region, a part of the Lower Mississippi Valley Joint Venture. Little Sandy was rated as the highest priority site for conservation in an earlier study.

Little Sandy NWR includes 3,802 acres of old growth, perhaps virgin, bottomland hardwood forest. It is believed that the forest was essentially undisturbed when the LSHFC was founded in 1907. The directors of the club have allowed no significant timber harvesting since it was founded. As such, the Refuge is the largest extant acreage of old growth bottomlands in the West Gulf Coastal Plain.

After the LSHFC received protection as a national wildlife Refuge, other sites in the immediate vicinity were also preserved. These include the Old Sabine Bottoms Wildlife Management Area

(5,726 acres managed by Texas Parks and Wildlife Department and immediately south of LSNWR), the Mineola Nature Preserve (2,960 acres managed by the City of Mineola), the Burleson Wetland Partners (2,650 acre Forest Legacy property and wetland mitigation bank), and two other small mitigation banks (approximately 500 acres). The immediate landscape includes over 15,500 acres of habitat devoted to conservation purposes, yet only limited analysis of the composition and community structure of these forests has been completed.

Other priorities in the surrounding landscape include: the deep sand herbaceous and upland hardwood communities located on Sparta Sands outcroppings and marsh communities within the Sparta Sands. Little remains of these community types and almost none are preserved in conservation ownerships. The band of sand communities occupies an area from just east of Hawkins south to Tyler and west nearly to Mineola.

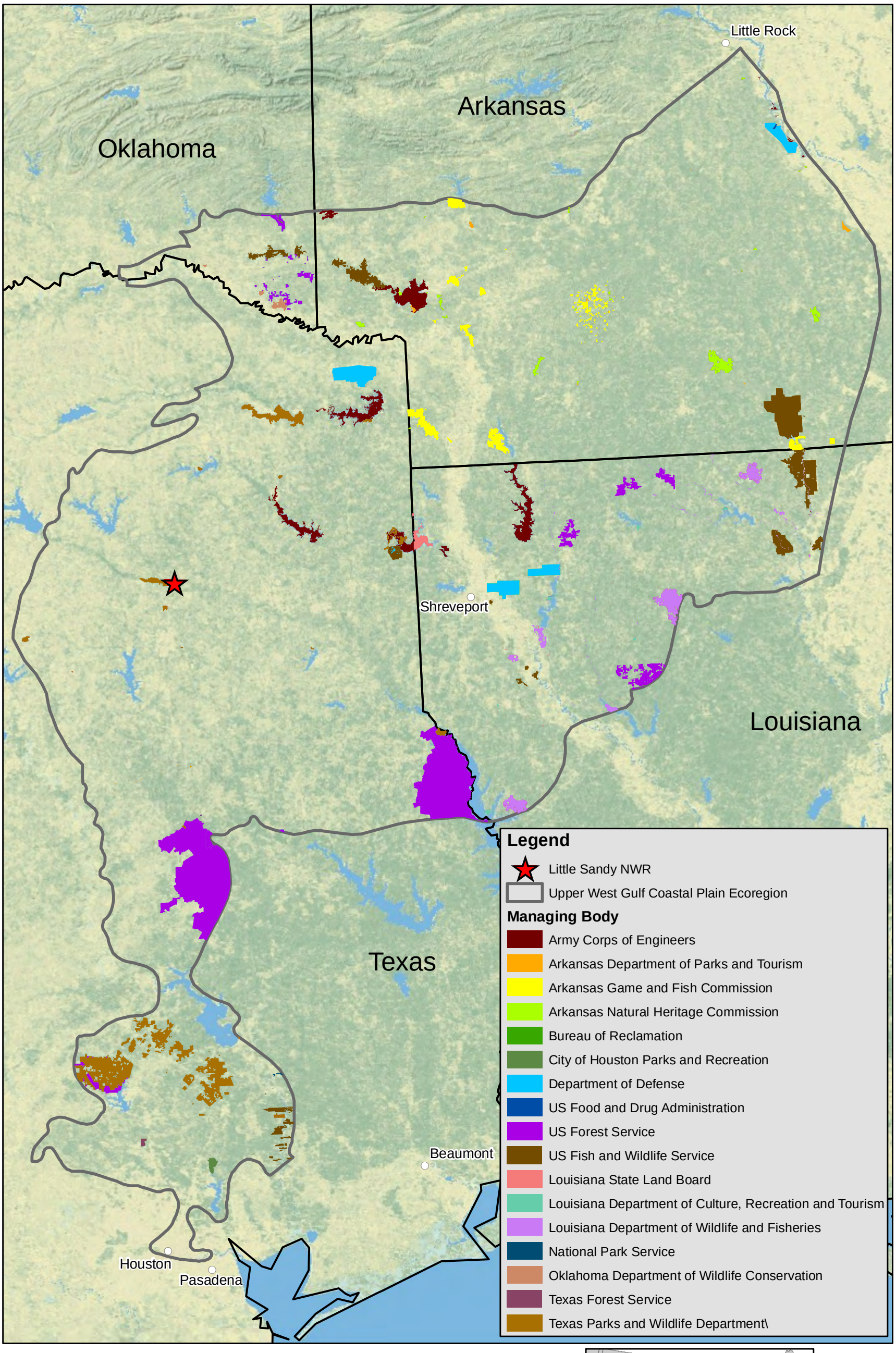
Sabine River: NWRS

U.S. Fish & Wildlife Service

Little Sandy National Wildlife Refuge

Wood County, Texas

Upper West Gulf Coastal Plain Ecoregion Map



PRODUCED IN THE DIVISION OF REFUGE PLANNING
ALBUQUERQUE, NEW MEXICO
LAND STATUS CURRENT TO: 5/31/09
MAP DATE: April, 2011
BASEMAP: N/A
MERIDIAN: N/A
FILE: lsd_upper_west_gulf_coastal_land_4.28.11_shl

0 20 40 80 Miles

0 20 40 80 Kilometers

UTM ZONE 15
NAD 83

3.1.6 Refuge Location

The Refuge is located in Wood County, Texas approximately three miles west of Hawkins, Texas and 20 miles north of Tyler, Texas.

3.1.7 Surrounding Land Uses

The area around Little Sandy NWR is rural with forests occurring on roughly 31 percent of Wood County. The remaining area consists of pasture and hay land (53 percent), cropland (eight percent), water areas (six percent) and urban and built-up areas (two percent) (U.S. Department of Agriculture 2007).

The Refuge is bordered on the south by the Sabine River (which is the Smith County line), on the north by a Missouri Pacific Railroad line, and to the west and east by private property. The area immediately surrounding the Refuge is generally forested, with a small pastures adjoining the Refuge on the northwest corner. Highway 80 lies north of the Refuge generally within a half mile of the Refuge boundary. Three miles east on Highway 80 is the town of Hawkins. Small family farms, which typically consist of pastures, home sites and relatively narrow strips of riparian vegetation along secondary stream courses, scatter the county surrounding the Refuge. Much of the bottomland forest on the Sabine River is still forested including the Old Sabine River Channel which allows the basin to widen up-stream of the Refuge. Several large blocks of forest are located in the Sabine Basin that includes Old Sabine Bottoms WMA (5,158 acres), Mineola Nature Preserve (2,900 acres) and several wetland restoration projects.

3.2 Physical Environment

The Refuge lies within the WGCP physiographic area and has a relatively narrow topographic relief overall. Although relatively flat, this topography is complex with numerous stream channels, depressions and a few poorly drained flats. There is a difference of 60 feet between the lower points along the banks of the Sabine River on the southeast boundary (elevation 270-280 feet above mean sea level), and the highest point near the northeast boundary along the railroad (330 feet above mean sea level). Approximately 30 percent of the Refuge is below the 290-foot contour, which includes Bradford Lake; this area is primary bottomland hardwoods and is likely to flood. Approximately 31 percent of the Refuge exists between the 290 to 295 foot contours; this would be where much of the break begins between the primary and secondary bottomland hardwoods, with a flood occurrence ranging between annually to every several years. Beaver Lake located near the eastern boundary lies in this elevation range. Between the 295 to 300 foot contour there is approximately 32 percent of the Refuge with half of this elevation level containing Overton and Brumley Lake. The forested portion of this elevation range consists of both bottomland hardwoods and upland hardwood stands with both shortleaf and loblolly pines dominating several of the upland ridges.

3.2.1 Climate

According to Larkin and Bomar (1983), this region of northeast Texas occupies a subtropical-humid climate caused by the predominant onshore flow of tropical maritime air from the Gulf of Mexico. This onshore flow is modified by a lateral decrease in moisture content from east to west across the state and by intermittent seasonal intrusions of continental air. 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.

Temperatures within this region are fairly uniform, with pleasant summers and mild winters and annual average temperatures range from 64°F to 70°F. Temperatures in January range from an average low of 32° F to an average high of 54°F and in July from 71° to 95°F. The average annual precipitation measures 43 inches, and the growing season averages 246 days a year (Handbook of Texas Online, http://www.tshaonline.org/handbook/online/articles/hcw15). 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).

The Refuge is located within the East Texas Climate Division, according to the USDA National Agriculture Statistics Service, Texas Climate Divisions Map. The East Texas division is located in the northeastern-most part of the State of Texas; Wood County, where Little Sandy NWR is located, is one of 43 counties located within this division.

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 man-made 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 EPA has provided a scale called the Air Quality Index (AQI) for rating air quality. The AQI scale is based on the National Ambient Air Quality Standards (NAAQS) and is described in the Code of Federal Regulations (CFR), Part 58. As of June 28, 2012 the AQI for the region associated with the Refuge was reported by TCEQ air monitoring sites and private air monitoring

networks to be "Moderate", due to the proximity of Tyler, Texas (http://www.tceq.state.tx.us/cgi-bin/compliance/monops/aqi_map.pl#interpret).

The ambient air quality of the more rural areas of east Texas and Wood County is typically higher quality than the monitoring sites mentioned above. Within the boundaries of the Refuge ambient air quality does not vary considerably. The Little Sandy NWR in Texas has not recorded ambient criteria pollutant concentrations that approach the maximum concentration permitted by the NAAQS (EPA).

3.2.3 Water Resources

Little Sandy NWR is located in the Sabine River watershed. Open water and oxbow lakes cover around 17 percent of the Refuge. Overton Lake (built in 1949) and Brumley Lakes together entail approximately 597 acres. Beaver Lake is approximately 20 acres and is an oxbow lake. Bradford Lake is approximately 32 acres and was built in 1978 (Shannon 1992). The Sabine River forms the southern boundary of the Refuge along with much of the southern boundary of Wood County. The river flows from a westerly direction to an easterly heading along Wood County's southern boundary. Little Sandy Creek flows from the north into Brumley Lake. The creek flows from southward on to Bradford Lake and then on into the Sabine River. Jim Ned Creek flows into Overton Lake and out in a southwestward direction into the Sabine River.

Aquifers and Groundwater
Nearly all the water used in Wood County, in northeast Texas, is supplied from ground-water sources. The principal aquifers are the Carrizo-Wilcox and the Sparta-Queen City. Wells drilled to these aquifers have historically furnished as much as 700 gallons per minute and, while the water is generally fresh, there is an excessive concentration of iron. The occurrence of excessive iron follows a somewhat predictable pattern, so that with discriminate well construction and pumping rates, water relatively free of iron can be recovered from both aquifers. The low pH and high iron content of the water and the low permeability of the sand in the aquifers may limit large-scale development of ground water in the county (TDWR 1984).

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, with climate, and with the types of soils and rocks through which water moves. Water quality is also affected by human activities including, but not limited to, urban and industrial development, farming, mining, combustion of fossil fuels, and stream-channel alteration (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. Water bodies that do not meet one or more applicable water quality standards and those that are threatened for a designated use by one or more pollutants are listed on each state's 303(d) list. The 303(d) list includes waters impaired by both point and non-point source pollution. Point source pollution occurs when contaminants enter the water body 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.

Little Sandy NWR does not contain any impaired water bodies that are currently listed on the State of Texas' 303(d) list.

3.2.4 Geology and Soil Resources

Geology

The Refuge lies within the Gulf Coastal Plains Physiographic Province. Each province or landscape reflects a unified geological history of depositional and erosional processes and each physiographic province is distinguished by characteristic geologic structure, rock and soil types, vegetation, and climate. 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. The Gulf Coastal Plains are further divided into three sub-provinces referred to as the Coastal Prairies, the Interior Coastal Plains, and the Blackland Prairies. The sub-regions specifically associated with the Refuge and the surrounding ecological communities are the Blackland Prairies and Interior Coastal Plains.

The Interior Coastal Plains comprise alternating belts of resistant un-cemented sands among weaker shale that erode into long, sandy ridges. At least two major down-to-the-coast fault systems trend nearly parallel to the coastline. Clusters of faults also concentrate over salt domes in East Texas. The region is characterized by pine and hardwood forests and numerous permanent streams. West and south, tree density continuously declines, pines disappear in Central Texas, and chaparral brush and sparse grasses dominate between the cities of San Antonio and Laredo. On the Blackland Prairies of the innermost Gulf Coastal Plains, chalks and marls weather to deep, black, fertile clay soils, in contrast with the thin red and tan sandy and clay soils of the Interior Gulf Coastal Plains. The blacklands have a gentle undulating surface, often cleared of most natural vegetation and cultivated for crops.

During the Mesozoic Era, broad limestone shelves were periodically buried by coastal plains and deltaic deposits as the Texas continental margin gradually shifted southeastward into the Gulf of Mexico. In the East Texas Basin, deeply buried salt deposits moved upward forming salt ridges and domes, providing a variety of folded structures and traps for oil and gas. Major delta's fed by these rivers spread the early Cenozoic coastline more than 100 miles seaward into the Gulf of Mexico. Among the effects of this major increase in sediment volume moving into the Gulf of Mexico, was renewed upward migration of thick Mesozoic marine salt and the formation of additional salt domes in the coastal plain area near the city of Houston and South Texas. Additionally, rapid deposition of deltaic sands over older marine mud resulted in a mechanically unstable sediment column, leading to displacement of the sediments by growth faults (large, curved faults that form during sediment accumulation and continue to grow with increasing depth of burial). Linear zones of growth faults of various ages extend from northeastern Mexico into Louisiana and compose traps for large oil and gas fields in offshore Texas (Hentz 2007). Young deltaic sands, silts, and clays erode to nearly flat grasslands that form almost imperceptible slopes to the southeast. Trees are uncommon except locally along streams and in oak mottes, growing on coarser underlying sediments of ancient streams. Minor steeper slopes,

from one foot to as much as nine feet high, result from subsidence of deltaic sediments along faults.

At the Refuge, the geological substrate is formed by two fundamentally different groups:

- Surficial, recent (Quaternary System) alluvium in the Sabine River Valley; and
- Eocene Series (Tertiary System) strata of the Claiborne group, Queen City Formation. The Queen City Formation consists of inter-bedded fine sand and clay Quaternary period materials (less than three million years in age) composed of sandstone, rock and unconsolidated sand. Modern river deposits (such as those of the Sabine) of sand, gravel, and clay cover older Tertiary materials. Modern floodplains are shaped by flows and sediments carried by the river which are essential to maintenance of the floodplain ecosystem.

Soils

East Texas largely has undulating to rolling soils with loamy or sandy surface layers and reddish, mottled, clayey subsoil of the Bowie-Kirvin-Troup soil association (Godfery et al. 1973). The soils at the Refuge are primarily under forested lands. There are seven soil types mapped for the Refuge (see Map 3-3). These are listed below by their type, topography association and common tree species occurrence (U.S. Department of Agriculture 1998).

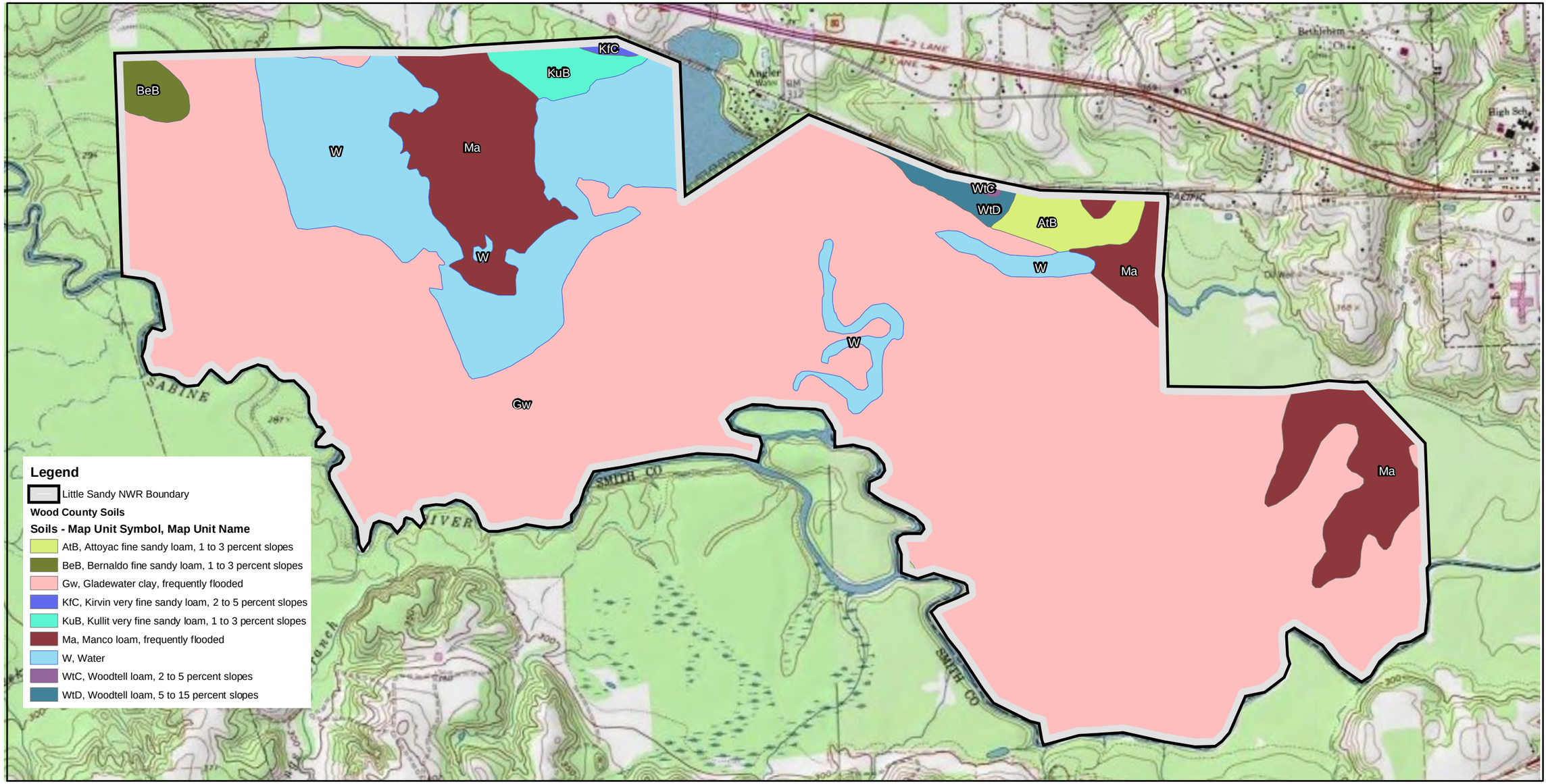
- Gladewater clay - 0 to 1 percent slopes, frequently flooded, very deep nearly level, somewhat poorly drained soil is on wide flood plains of Sabine River, 10 to 5,000 acres in size, water and willow oak;
- Manco loam - 0 to 1 percent slopes, frequently flooded, very deep, nearly level somewhat poorly drained soils is on flood plains of major creeks, 5 to 2,000 acres in size- sweetgum, water and willow oak;
- Bienville loamy fine sand - 1 to 3 percent slopes, low stream terraces adjacent to flood plains along Sabine River, 10 to 200 acres in size and irregularly shaped, loblolly and shortleaf pine, sweetgum, southern red oak;
- Kullit very fine sandy loam, - 1 to 3 percent slopes, very deep, very gently sloping, moderately well drained soil is on broad areas, slopes and heads of drainage ways on uplands, 10 to 200 acres in size and irregularly shaped, loblolly pine, southern red and white oak, sweetgum;
- Attoyac fine sandy loam - 1 to 3 percent slopes, very deep, very gently sloping, well drained soils on stream terraces, 10 to 200 acres in size and irregularly shaped, - shortleaf and loblolly pine;

U.S. Fish & Wildlife Service

Little Sandy National Wildlife Refuge

Wood County, Texas

Natural Resource Conservation Service - Soils



PRODUCED IN THE DIVISION OF REFUGE PLANNING
ALBUQUERQUE, NEW MEXICO
LAND STATUS CURRENT TO: 03302010
MAP DATE: 03302010
BASEMAP: US topo maps, ESRI, USGS
and © 2007 National Geographic Society
MERIDIAN: N/A
FILE: lsd_soils_8.19.10_smk.pdf

0 0.25 0.5 1 Miles

0 0.25 0.5 1 Kilometers

UTM ZONE 14
NAD 83

- Woodtell loam - 5 to 15 percent slopes, soils are deep to stratified shale and loamy materials, strongly sloping to moderately steep, well-drained soil on side slopes above drainage ways on uplands, 20 to 500 acres in size and irregularly shaped, loblolly and shortleaf pine;
- Kirvin very fine sandy loam - 2 to 5 percent slopes, deep to stratified sandstone and shale, gently sloping, well drained soils on broad, convex ridge tops on uplands, 10 to 400 acres in size and irregularly shaped, loblolly and shortleaf pine;

The above soils are shown from ascending to descending acreage order with Gladewater clay soil type cover roughly 3/4 (2,830 acres) of the Refuge and widely located along the Sabine River. Manco loam soil type is located east of Beaver Lake and between Overton and Brumley Lakes. It is the second largest soil type found on the Refuge at roughly eight (8) percent (289 acres). The other remaining soil types are located along the northern boundary of the Refuge and form the upland transition into the pineywoods. The USDA soil survey includes soil types for acreage in Overton and Brumley Lakes that have different species composition than listed above due to hydrology changes in regards to flooding regimes.

3.2.5 Mineral Resources

The Refuge lies at the periphery of the East Texas Embayment. In Wood County, the distal coastal barrier production is restricted to the Paulxy extension of the large, multi-reservoir Hawkins and Pine Mills fields (Caughey 1977). Major oil fields occur in Wood County immediately north and east of the Refuge, on the eastern edge of the Refuge, and to the south of the Refuge in Smith County. Some recent drilling activity has occurred on the Refuge and in the Sabine River bottom of Smith County directly opposite the Refuge.

A major lignite deposit is located within a narrow band of the Wilcox geological group, which extends through the extreme northwestern corner of Smith County and through western Wood County. The nearest lignite mining occurs west and southwest of Athens in Henderson County, approximately 45 miles southeast of the Refuge, and southeast of Sulphur Springs, approximately 45 miles northwest of the Refuge.

The principal mineral resources of Smith and Wood County include kaolinite, industrial sand, and limonite (iron ore) (Garner et al. 1979). Sand is the only known potential mineral resource on the Refuge.

Oil and Gas Occurrences and Potential
The Service does not own mineral interest underlying the lands within the Refuge and must provide reasonable access to mineral owners to explore and develop their mineral interests. The LSHFC owns all mineral rights on the Refuge. It is the policy of the club not to engage in oil/natural gas exploration/extraction activities on the easement area. In 1980, the club leased an area near Beaver Lake for the production of crude oil to Exxon Corporation. The one well that was drilled did not produce any oil/gas products. Approximately two years later, another well was permitted and drilled by Exxon Corporation approximately one half mile south of the initial well site. It was also a "dry hole". In 1998, the club permitted seismic exploration on the southwest section of the Refuge by Canada Western Oil and Gas Company using helicopter seismic methods. The club agreed to the exploration and production of oil/gas, if the drilling and

production activities were completed outside the boundary of the club property (horizontal drilling from adjacent lands). Canada Western Oil and Gas Company did not pursue drilling activities for oil/gas. There are no oil/gas activities occurring at Little Sandy NWR at this time.

Oil and gas activities are allowed to take place on Refuges for a number of reasons. On the majority of Refuges, oil or 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).

Under the National Wildlife Refuge System Administration Act of 1966, as amended, the Service is responsible for regulating all activities on Refuges. The Act requires the Service 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 the Refuge. Nevertheless, the activities of private mineral owners on Refuges are subject to a variety of legal restrictions, including Service regulations. A variety of 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.

3.3 Biological Environment

This section describes the biological environment in which the Little Sandy NWR is found. It includes a description of the present, historical, and potential future condition of terrestrial and aquatic habitat types found on the Refuge, 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 Refuge. The section concludes with a short discussion about the Service's concerns pertaining to the biological environment.

3.3.1 Habitat Types

The most important aspect of the Refuge is its old growth bottomland forest ecosystem that has not seen timber harvesting in over 100 years. The only significant hydrological alterations have occurred around the current lakes. These alterations generally entail levee development and construction to improve fishing and waterfowl hunting opportunities. The levee construction on the four lakes increased size and depth of the lakes, providing greater area for both fish and waterfowl usage.

The Refuge is approximately 82 percent (approximately 3,097 acres) forested with small areas of open water, shrub swamps, beaver ponds and four lakes ranging in size from 19.7 acres (Beaver) to 315 acres (Brumley). No commercial timber harvesting has occurred in the forest communities at Little Sandy NWR for over 100 years. During the construction of Overton Lake (1949), the timber was removed and paid for the construction of the lake (Shannon 1992). During the construction of Bradford Lake (1978), it is likely that some trees were removed to form the lake. During the forest inventory in 2006 the lake was dry except for the three-foot wide channel. Several stumps were seen in the basin of the lake.

Currently, much of the bottomland forest is late stand succession with large over-story trees dying creating up to 1/4 acre gaps in the forest canopy and allowing sunlight to reach the forest floor which is refer to as “gap dynamics”. Numerous seedlings and native herbaceous vegetation quickly carpet these openings. Shrub swamps (dominated by water elm (*Planera aquatic* thickets) meander throughout several low lying area on the Refuge providing a dense low canopy layer. The bottomlands support overcup oak, bottomland post oak, green ash, water hickory, cedar elm and several red oaks (willow and water). Along the upland ridges, often referred to as the pineywoods, shortleaf and loblolly pine tower above a mixed upland hardwood forest where red oaks (southern red and water), hickories, white oaks and sweetgum arae among the most common species. See the draft Forest Habitat Management Plan (Appendix F) for further details.

The cypress knee sedge and panicled indigobush are two plants classified by the state of Texas as Species of Greatest Conservation Need (SGCN) that could be present on the refuge within suitable habitat. The cypress knee sedge is a clump-forming sedge found growing on baldcypress stumps, buttonbush, or in shallow water in swamps and wet swales in bottomland hardwood forest. The plant is listed as critically imperiled in the state of Texas. The panicled indigobush is a shrub that is found growing in wet floodplain forest and seeps. The plant is listed as imperiled in the state of Texas. To support scientific knowledge, state listed species, SGCN, and vegetative communities should be reported to the Texas Natural Diversity Database (TXNDD) at http://tpwd.texas.gov/txndd.

For this document, the Refuge used the National Vegetation Classification System (NVCS), as discussed below, to describe habitat types at the ecological system level (see Map 3-4).

3.3.1.1 Terrestrial Vegetation Classes

<u>East-Central Texas Plains Post Oak Savanna and Woodland</u>
This system is primarily found within eastern Texas, lying in a broad band west of the Upper West Gulf Coastal Plain and Gulf Coast Prairies and Marshes ecoregions, ranging from Live Oak and Atascosa counties in the south and trending in a northeasterly band to the Red River along the Oklahoma-Texas border. It exhibits some floristic and physiognomic variation across this northeast-southwest gradient. Its range is roughly co-incident with (parts of) the "East Central Texas Plains" (Level III Ecoregion 33) of EPA (Griffith et al. 2004). It is distinguished from the surrounding prairie by the higher density of trees and diversity of woody species. The system differs from the floristically similar Crosstimbers Oak Forest and Woodland (CES205.682) in that it generally occurs on Tertiary (primarily Eocene) geologic formations on the East-Central

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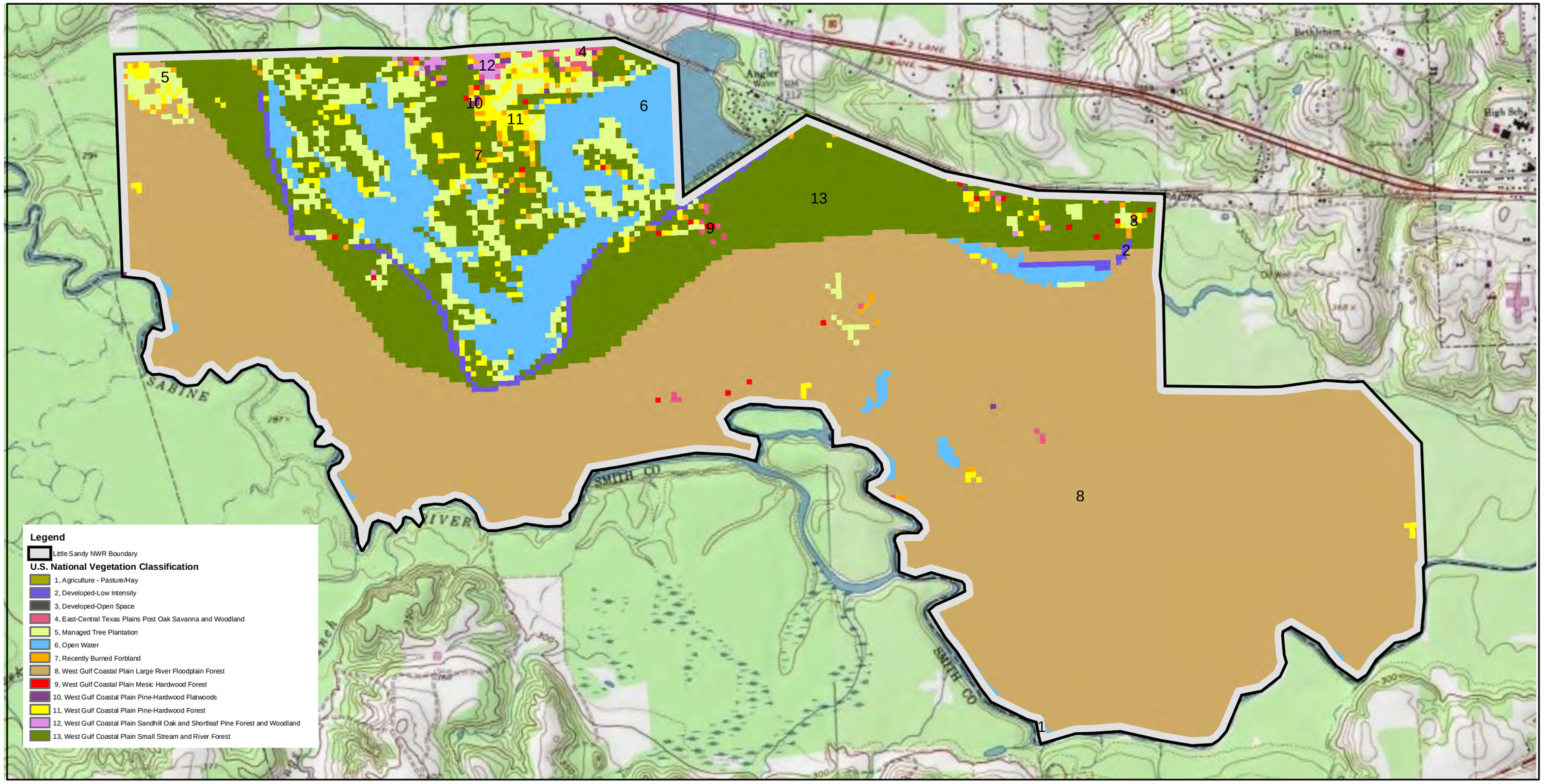
Little Sandy National Wildlife Refuge

Wood County, Texas

U.S. National Vegetation Classification



PRODUCED IN THE DIVISION OF REFUGE PLANNING
ALBUQUERQUE, NEW MEXICO
LAND STATUS CURRENT TO: 03302010
MAP DATE: 08232010
BASEMAP: US topo maps, ESRI, USGS
and © 2007 National Geographic Society
MERIDIAN: N/A
FILE: lsd_usnvc_8.23.10_smk.pdf

0 0.15 0.3 0.6 Miles

0 0.3 0.6 1.2 Kilometers

UTM ZONE 14
NAD 83

Texas Plains, while the related Crosstimbers ecological system occupies Cretaceous and older formations of the interior plains (Natureserve, 2009).

West Gulf Coastal Plain Large River Floodplain Forest

This system represents a geographic subset of the Southern Floodplain Forest found west of the Mississippi River. Examples may be found along large rivers of the West Gulf Coastal Plain and Upper West Gulf Coastal Plain, especially the Trinity, Neches, Sabine, and others. 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. 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 (Natureserve, 2009).

West Gulf Coastal Plain Mesic Hardwood Forest

This ecological system is found in limited upland areas (especially ravines and side-slopes) of the Gulf Coastal Plain west of the Mississippi River. These areas are topographically isolated from historically fire-prone, pine-dominated uplands in eastern Texas, western Louisiana, and southern Arkansas. Sites are often found along slopes above perennial streams in the region. These sites have moderate to high fertility and moisture retention. Soils can be quite variable, ranging from coarse to loamy in surface texture. Most are acidic in surface reactions and less commonly circum-neutral. Vegetation indicators are mesic hardwoods such as American beech, white oak, and American holly, although scattered, large-diameter pines (most often Loblolly pine) are also often present. Spring-blooming herbaceous species are typical in the understory of most examples (Natureserve 2009).

West Gulf Coastal Plain Pine-Hardwood Flatwoods

This ecological system represents predominantly mesic to dry flatwoods of limited areas of inland portions of the West Gulf Coastal Plain. These areas are usually found on Pleistocene high terraces that are located above current floodplains. Hydrology is controlled by local rainfall events and not overbank flooding. Soils are fine-textured, and hardpans may be present in the subsurface. The limited permeability of these soils contributes to shallowly perched water tables during portions of the year when precipitation is greatest and evapotranspiration is lowest. Soil moisture fluctuates widely throughout the growing season, from saturated to very dry, a condition sometimes referred to elsewhere as xerohydric. Saturation occurs not from overbank flooding but typically whenever precipitation events occur. Local topography is a complex of ridges and swales, often in close proximity to one another. Ridges tend to be much drier than swales, which may hold water for varying periods of time. Within both ridges and swales, there is vegetation variability relating to soil texture and moisture and disturbance history. The driest ridges support Loblolly pine and post oak; more mesic ridges have Loblolly pine with white oak and species such as common sweetleaf and southern arrowwood. Fire may have been an important natural process in some examples of this system (Natureserve, 2009).

West Gulf Coastal Plain Pine-Hardwoods Forest

This West Gulf Coastal Plain ecological system consists of forests and woodlands dominated by Loblolly pine and/or shortleaf pine in combination with a host of dry to dry-mesic site hardwood species. This type was the historical matrix (dominant vegetation type) for large portions of the Upper West Gulf Coastal Plain (TNC ecoregion 40) where it replaced longleaf pine-dominated vegetation. In this region of southern Arkansas, northwestern Louisiana, and parts of eastern Texas, this type was historically present on nearly all uplands in the region except on the most edaphically limited sites (droughty sands, calcareous clays, and shallow soil barrens/rock outcrops). Such sites are underlain by loamy to fine-textured soils of variable depths. These are upland sites on ridgetops and adjacent side-slopes, with moderate fertility and moisture retention. This type was also present in more limited areas of the West Gulf Coastal Plain (TNC ecoregion

41), where it was confined more typically to side slopes and other locations not dominated by longleaf pine. There are no known local endemic or globally rare plant species, and overall this system may have supported relatively low levels of vascular plant species diversity. This system has undergone major transformations since European settlement of the region (Natureserve, 2009).

West Gulf Coastal Plain Sandhill Oak and Shortleaf Pine Forest and Woodland

This ecological system occurs west of the Mississippi River primarily outside the natural range of longleaf pine and less commonly within. Like other sandhill systems of the Gulf and Atlantic coastal plains, this type is found on uplands underlain with deep, coarse sandy soils. These sites are typified by low fertility and moisture retention, which contribute to open tree canopies with usually <60 percent canopy closure. Sparse understory vegetation and abundant patches of bare soil are indicative of this system. Vegetation indicators are species tolerant of droughty sites, especially bluejack oak and Arkansas oak, but also blackjack oak and post oak. Longleaf pine is absent (or perhaps at low frequency within its range); shortleaf pine is usually present.

Floating Vegetation by David Weaver

This system supports a large concentration of vascular plant endemics, near endemics, and a number of plant species with high fidelity to sandhills in the region. Elsewhere in the Atlantic and Gulf coastal plains, including most of the adjacent ecoregion (41), these site conditions are closely associated with longleaf pine (Natureserve, 2009).

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 vegetation 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. Areas impacted by beaver impoundments are also included in this system (Natureserve, 2009).

3.3.1.2 Aquatic Vegetation Classes

Wetland community types can vary significantly on Little Sandy NWR and range between the following three categories:

- Fresh water marshes dominated by smartweeds, arrowheads, cattails and giant cutgrass or southern wild rice found at the edges of the impoundments.
- Aquatic beds of the impoundments dominated by
- water lilies, lotus, spatterdock, and big floating heart.
- Bogs dominated by lizard tail, arrow-arum, arrowheads, and cinnamon fern.

3.3.1.3 Natural Disturbance Processes

Natural disturbances on a landscape scale (10,000-100,000 acres) occur at a relatively constant rate of one (1) percent a year across many different forest types. Disturbance adds greatly to the structure of forested communities across the landscape. Early explorers reported land conditions of open forests of large trees. In the Refuge, these relatively small-scale and temporally constant disturbances are discontinuously distributed across an already complex forested mosaic. Forested ecosystems with intact natural processes do not proceed to a static climax condition or even a dynamic equilibrium; they exist in a fundamental state of dis-equilibrium and change.

As mentioned previously, much of the Refuge has not been silviculturally modified in over 100 years. At this phase in stand succession, numerous events have contributed in the development of the forest. On April 09, 1919 a cyclone (tornado) passed west of the Refuge with a northeast bearing. It crossed Wood County and several others in east Texas. The destruction described was in local papers and firsthand accounts were horrific as it occurred in the predawn hours. High wind, duration flooding, wildfire, insect/disease and tornado all have a part in forest stand development. Over the past 100 years, these events have been the only active force altering the Refuge landscape along with time itself.

Wildfire potential on Little Sandy NWR is currently moderate due to heavy fuel loading along the railroad. It is likely that the upland ridges burned during the steam engine era due to the association with coal and wood embers and sparks emitted from the smoke stack. Later many steam trains were converted to oil burning to prevent the embers starting spot fires. A lightning strike in 2005 started a fire in the bottoms along a grassy beaver kill area about ½ mile south of

Beaver Lake (drought in 2005 and 2006). It burned itself out that day or the next day due to rain and change in fuel source according to a club worker. Staff estimated the wildfire to have burned approximately 15 to 20 acres of both forest and the snag-filled beaver area. It did not burn intense enough to kill any over-story trees but did clean the understory and woody debris in several locations. Grasses had already reclaimed the beaver killed area by spring 2006 and vines, ferns and legumes were found in the forest floor. Fire has a role in many ecosystems and depending on the circumstances should be considered as a tool to maintain forest systems. With the habitat at Little Sandy NWR, prescribed fire does not readily promote management in old growth systems. The downed woody debris, snags and hollow trees (possible den sites) would be consumed which are a key component in old growth ecosystems. As in many mature bottomland hardwood forests, generally prescribed fire is not used due to the low intensity and cleaning effect under desired fire parameters. High intensity prescribed fires in bottomland hardwood forest are usually implemented to clean logging debris (site preparation). They are rarely conducted in mature bottomland forest due to likelihood of harming residual trees.

The southern yellow pine ecosystem evolved with periodic fires, either from lightning strikes, or the practice of Native Americans. Fires would spread across vast areas, driven by an abundance of highly flammable ground fuels such as pine needles and grass, and lack of man-made barriers such as highways and lakes. In the absence of periodic fires, the grass community disappears and is replaced by shade tolerant hardwoods. The loss of this pine savannah type habitat has led to the decline of many fauna species that were once associated with it. Examples include red-cockaded woodpecker, Louisiana pine snake, northern bobwhite quail, eastern wild turkey, and Bachman's sparrow (Texas Parks and Wildlife 2007, website).

At Little Sandy NWR, many of the pineywood ridges are generally small and would be of minimum to moderate value on a landscape level if prescribed fire was implemented. The habitat benefit to new wildlife would provide small niche needed for many species that have declined as previously mentioned.

The most recent natural event to impact Little Sandy NWR occurred on April 29, 2016. A long-track, multi-vortex tornado, with EF-2 wind speeds, touched down near Lindale, Texas and traveled northeast through Smith, Wood, and Upshur counties. The tornado passed through a portion of the Refuge which caused damage to the bottomland hardwood forest. A significant portion of the Refuge had trees snapped and uprooted from the strong winds. The LSHFC had a number of its facilities and structures damaged from the strong winds and falling trees. Service staff will be conducting a forest inventory to assess the damages from the tornado on the bottomland hardwood forest protected by the Refuge. Blow downs are expected to contribute to age and size class diversity of hardwoods within the bottomland hardwood forest which will benefit a variety of wildlife.

3.3.1.4 Historical Habitat Description

In the early 1800s as settlers arrived in East Texas, the landscape was forested with a variety of both pine and hardwood species. Pines, for the most part, dominated the uplands while hardwoods were abundant in the bottomlands. The common pine species were shortleaf, loblolly and longleaf (longleaf is typically found further south and east in Texas). Although some overlap of pine species did occur, each species was generally restricted to a specific geographical

area. Bottomland habitats along rivers, swamps and associated drainage were interspersed through the area.

The shortleaf pine forest type was located in the northern and western half of the pineywoods which would include the eastern portion of Wood County. This area was generally bordered by the Red River to the north, the Louisiana border to the east, Hopkins County to the west, and Angelina and Houston Counties to the south. North of the Sabine River, from Longview, Texas through Cass and Bowie Counties, the shortleaf pine formed compact forests.

Since the first railroads were cut through this area, the harvest of the shortleaf timber began earlier than that of the other pine timber. For the most part, very little reforestation of these harvested areas occurred and hardwood began to occupy many of the sites with some shortleaf regenerating successfully. Many sites were cleared for cultivation and grazing (Texas Park and Wildlife website).

Rich, fertile bottomland forest along rivers and drainages included oak, ash, hickory, gum, elm and cottonwood tree species. These hardwood trees grew very large with early accounts of oaks, ashes, and hickories up to diameters of six, four and three feet, respectively. Settlers not only commercially harvested the bottomland forest but also cleared the forest for settlement and agricultural production in the nutrient rich soils.

Due to the demand for lumber and the abundant timber resource of east Texas in the late 1800's through the early 1900s, much of Texas' old growth-forests had been harvested by 1915 (Texas Environmental Profiles website). By 1940, much of the upland area north of the Refuge was cleared and cultivated for crops such as cotton.

Little Sandy NWR is believed to be one of the last remaining old-growth bottomland forest in Texas. By known records and personal accounts, the club has not harvested in the river basin since their ownership/charter in 1907 (except in lake basins during construction). However, during the timber inventory in 2006 by Refuge staff, several scattered rich pine stumps were found in the northwest portion of the Refuge. These stumps show evidence of a smooth top, indicating chainsaw activity, about 18 to 24 inches above ground. Chainsaws did not become available until around the 1930s and were likely not widely been used until the later 1930s to early 1940s which coincides with the oil leases the club allowed during those years. It is likely the earthen mounds also found in this area are related to these activities as well. Other evidence of oil well sites are located on the far northeastern boundary of the Refuge and are likely the last activities conducted in 1982. Union Pacific Railroad (formerly Missouri Pacific, formerly Texas & Pacific) lies along the northern boundary of the Refuge easement and has frequent train traffic. No other harvesting disturbances were observed throughout the Refuge by staff. On occasion, removal of fallen trees from the ATV trails is necessary to permit access on the Refuge.

3.3.1.5 Estimated Conditions due to Climate Change

The information on climate change and its positive or negative impacts are still largely unknown. The earth's climate is predicted to change because human activities are altering the chemical composition of the atmosphere through the buildup of greenhouse gases. There most likely will

be increases in temperature and changes in precipitation, soil moisture, and sea level, which could have adverse effects on many ecosystems (EPA 1997). Trees and forests are adapted to specific climate conditions, and as climate warms, forests will change. These changes could include changes in species, geographic range, and health and productivity. These changes could also be accelerated by other stresses such as fire, pests, and diseases. With changes in climate, the extent and density of forested areas in east Texas could change little or decline by 50-70 percent (EPA 1997).

Projecting impacts of climate change on biodiversity is a challenge for scientists and decision-makers (Powledge 2008). Rising temperatures are leading to increased demand for water and energy. In parts of the region, this will constrain development, stress natural resources, and increase competition for water. Significant climate-related challenges are expected to involve 1) resolving increasing competition among land, water, and energy resources; 2) developing and maintaining sustainable agricultural systems; 3) conserving vibrant and diverse ecological systems; and 4) enhancing the resilience of the region's people to the impacts of climate extremes. These growing challenges will unfold against a changing backdrop that includes a growing urban population and declining rural population, new economic factors that drive incentives for crop and energy production, advances in technology, and shifting policies such as those related to farm and energy subsidies (Melillo 2014).

3.3.2 Wildlife

Bottomland hardwood ecosystems are very productive habitats for a wide array of fish and wildlife species. The Refuge and the surrounding area are no exception. Since no complete biotic inventory has been completed on Little Sandy NWR, the wildlife descriptions in this section are based on species found in similar habitats in the area.

3.3.2.1 Priority Species

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. Proposed species means any species of fish, wildlife, or plant that is proposed in the *Federal Register* to be listed under section 4 of the ESA. The only federally-listed species known to occur in Wood County are the Least Tern (endangered), Piping Plover and Red Knot (threatened) and the Louisiana Pine Snake (candidate); however, these species are not known to occur on the Refuge.

The state of Texas has identified a number of species as State Listed Species and Species of Greatest Conservation Need (SGCN) from Wood County, Texas. The species of special concern for the adjacent Old Sabine Bottom Wildlife Management Area and Little Sandy National Wildlife Refuge can be found in Appendix E.

Other Species of Concern

Bald Eagle

The bald eagle was listed as endangered on March 11, 1967, as a result of population declines due to pesticide-induced reproductive failure, loss of riparian habitat, and human disturbances, such as shooting, poisoning, and trapping. On August 11, 1995, the bald eagle was down-listed from endangered to threatened status in the majority of the contiguous U.S., due to nationwide recovery efforts. In 1999, the Bald Eagle was proposed for delisting and in 2007 the bald eagle was, in fact, formally delisted (USFWS 1999). The bald eagle is a very rare nesting species in east Texas and uncommon on the Texas coast. These birds characteristically nest in Texas along bottomlands and wooded lake shores. A pair of bald eagles has consistently nested on the Refuge from 2009 along Brumley Lake. With the spring of 2016, tornado on the Refuge, the nest was disturbed and as of June, no observations have been made of the pair since damage from the tornado.

Southeastern Myotis Bat

The southeastern myotis bat is recognized as a SGCN in the state of Texas. The bi-colored bat has russet, dark gray and black wooly fur with whitish tips. The skull is domed with a sagittal crest. Caves, mines, bridges, human habitations, culverts, and tree hollows provide the southeastern myotis mat shelter for roosting. The preferred shelter consists of oak-hickory to mixed conifer hardwood forests often near lakes and streams (TPWD website). The southeastern myotis bat is found in the pineywoods of eastern Texas and has been documented as roosting at the Refuge.

Rafinesques' Big-eared Bat

The Rafinesques' big-eared bat is listed as threatened by the state of Texas. It is a medium-sized bat with long rabbit-like ears (27-33 mm). It has large facial glands protruding from each side of its snout. Its fur is grayish brown above and conspicuously bicolored underneath; each individual hair has a dark brown base and whitish tip. Its long toe hairs extend past the claws. Their diet consists of mostly moths. But Rafinesques'a big-eared bat will consume mosquitoes, beetles and flies as well. Predators that feed on the bat include snakes, raccoons, opossums, and cats. They roost in cave entrances, hollow trees, and abandoned buildings and under bridges in the forests of the southeastern United States. The westernmost portion of their range includes the pine forests of east Texas. They have been recorded roosting at Little Sandy (TPWD website).

Wood Stork

The wood stork is a listed as threatened by the state of Texas. It is a migrant colonial waterbird that utilizes swamps and other wetlands in east Texas during late summer. Near the point of extinction, the wood stork was listed as endangered in 1984. The wood stork stands approximately three feet tall with a wingspan reaching up to six feet. The wood stork was a former nester in southeast Texas swamps and wood storks have been reported at the Refuge in late summer.

Migratory Bird Species of Concern

The 1988 amendment to the Fish and Wildlife Conservation Act mandates the Service to "identify species, subspecies, and populations of all migratory nongame birds that, without additional conservation actions, are likely to become candidates for listing under the Endangered

Species Act (ESA) of 1973." Birds of Conservation Concern 2008 (BCC 2008) is the most recent effort to carry out this mandate. The overall goal is to accurately identify the migratory and non-migratory bird species (beyond those already designated as federally threatened or endangered) that represent our highest conservation priorities. The following lists species which may occur or have a historical range that potentially exist on the Refuge that are of conservation concern (IpaC Trust Resources Report).

American Kestrel	Hudsonian Godwit	Painted Bunting
Bald Eagle	Kentucky Warbler	Prothotary Warbler
Bell's Vireo	Le Conte's Sparrow	Red-headed Woodpecker
Bewick's Wren	Least Bittern	Rusty Blackbird
Bown-headed Nuthatch	Lesser Yellowlegs	Short-eared Owl
Dickcissel	Little Blue Heron	Sprague's Pipit
Fox Sparrow	Loggerhead Shrike	Swainson's Warbler
Harris's Sparrow	Louisiana Waterthrush	Wood Thrush
Henslow's Sparrow	Orchard Oriole	Worm Eating Warbler

3.3.2.2 Focal/Representative Species

The Migratory Bird Program Strategic Plan 2004-2014 identified 139 focal species or populations whose numbers needed to be increased to improve the number 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. Focal species are selected based on the knowledge that factors limiting their populations are sensitive to landscape-scale characteristics and that by addressing the needs of these focal species, other priority species within a guild are expected to benefit. In addition, an appropriate set of focal species includes consideration for the specifics of the respective ecoregion, availability of data and information, and programmatic obligations, as defined in the Strategic Habitat Conservation Report (USFWS 2006). Focal species are those species and their associated habitats that are generally included in CCP objectives and strategies for which protection, management, research, and monitoring efforts will be focused and for which management and protection efforts are necessary to sustain them.

There is not an exhaustive list of species known to occur on the Refuge; however, what is known is species that occupy and use habitats similar to those what Little Sandy NWR provides. While it is possible to provide species that the Refuge either is within their historical range or provides habitat types that identified species typically inhabit and potentially exist on the Refuge.

3.3.2.3 Birds

The Refuge is located within the Central Flyway (see Section 3.1.1.), a route traveled annually by numerous species of waterfowl and other migratory birds, moving between tropical wintering and U.S. nesting areas. Birds constitute the largest group of vertebrate species occurring on the Refuge and populations vary according to seasonal migrations.

Waterfowl

One of the most important values of bottomland hardwoods and associated wetlands is to waterfowl species. A total of 38 species of waterfowl are known to occupy the Refuge. Primary emphasis of the proposed Bottomland Hardwood Protection Program is perpetuation of waterfowl resources dependent on east Texas bottomlands (USFWS 1986). In the process of preserving bottomlands for waterfowl, a large number of other wildlife species are preserved. Bottomlands of eastern Texas contain important wintering habitat for various waterfowl species including the mallard, and producing and rearing habitat for the wood duck. Historically, the area has played a key role in sustaining continental and Central Flyway waterfowl populations. East Texas and southeastern Oklahoma bottomlands represent the only significant breeding habitat of the wood duck and perhaps the most important wintering area of the mallard in the Central Flyway.

Bottomland Hardwoods: NWRS

The Service has acknowledged importance of these east Texas floodplain forests along with adjacent Oklahoma bottomlands and the Mississippi River floodplain. The entire area is within the Lower

Mississippi Valley Joint Venture. The region is of primary importance to both the mallard and wood duck.

The mallard has the most extensive breeding range of any duck in North America, extending from the shores of the Bering Sea through the northern one-third of the United States (Bellrose 1976).

Mallards migrate along a number of corridors from their breeding grounds to wintering areas. Approximately 1.5 million birds migrate along the Missouri River to rice producing areas of Arkansas and into western Louisiana and eastern Oklahoma and Texas (Bellrose 1976). A significant number of mallards winter in the bottomlands of east Texas, but their numbers vary considerably from year to year.

The wood duck regularly breeds in forested wetlands from southern Canada to the Gulf of Mexico. The Lower Mississippi River delta and east Texas are among the most important wood duck production areas. The interior migratory pattern extends throughout the south from the Carolinas to eastern Texas. During the middle 1980s, more than 900,000 wood ducks of the interior population wintered in Alabama, Mississippi, Arkansas, Louisiana, and Texas. Wood ducks consistently utilize natural wetlands for wintering and breeding habitat.

One of the primary migration corridors for dabbling ducks is through eastern Texas. This corridor is utilized by almost three million dabbling ducks (Bellrose 1980). Principal species migrating through and to a lesser extent, wintering in east Texas, besides mallards and wood ducks, include the green-winged teal, blue-winged teal, northern pintail, northern shoveler, gadwall, and American widgeon. The area also is of importance as a migratory route and wintering area for diving ducks such as ring-necked ducks and lesser scaups.

A significant hunting resource is available in the general area. TPWD surveyed waterfowl population data for the Pineywoods and Post Oak Savannah region of Texas (which includes the Middle Sabine bottoms) from 1997 thru 2005 and revealed that an estimated average of 844,729 ducks wintered in the Oaks and Prairies and 10,559 used the Pineywoods. Approximately 700 ducks are harvested on the Refuge annually, primarily mallards, gadwalls, and ring-necked ducks. Wood ducks are generally not as commonly hunted (since they are found more commonly in the bottomlands and not the lakes where the majority of the hunting occurs), but are numerous on the Refuge. Two major roosts for wood ducks exist on the Refuge.

Other Migratory Birds

A total of 273 species of birds occur in bottomland forests and associated wetlands in eastern Texas. Included in this list are 38 waterfowl species; 29 species of colonial waterbirds (i.e., herons, gulls, terns); 20 hawks, vultures and owls; 37 rails and shorebirds; eight woodpeckers; 130 passerine birds; and 11 miscellaneous species. A total of 101 species are known or believed to breed in eastern Texas (USFWS 1986).

A significant colonial waterbird colony is located on the two impoundments on the Refuge, Overton and Brumley Lakes. The colony supports populations of anhinga, great blue heron,

little blue heron, snowy egret, cattle egret, great egret, and white ibis. Additionally, the black crowned night heron nests in the bottomlands.

Land Birds
There are 122 species of land birds that have been recorded at Little Sandy NWR, at least forty-six species of which nest on the Refuge. The most common groups of birds found at the Refuge include hawks and owls, woodpeckers, flycatchers, vireos, warblers, and sparrows and finches. Several of the more important high priority species found in bottomland hardwood forests at Refuge as identified by PIF for the West Gulf Coastal Plain BCR include the white-eyed vireo, prothonotary warbler, Swainson's warbler, Kentucky warbler, and hooded warbler. A pair of bald eagles has consistently nested on the Refuge since 2009.

Waterbirds
The Refuge serves as a critical rookery for water birds for east Texas with vast tracks of nests along the lakes. Twenty nine species of water birds are found at least seasonally at Little Sandy NWR; at least 13 of these species nest on the area. A significant colonial waterbird colony is located on the two impoundments on the Refuge, Overton and Brumley Lakes and in the dead trees along the oxbow at Switch Cane slough. The colony at Overton and Brumley supports extensive populations of anhinga, great blue heron, little blue heron, snowy egret, cattle egret, great egret, and white ibis. Additionally, black crowned night heron nest in the bottomlands.

Shorebirds
Only six species of shorebirds have been documented on the Refuge, including killdeer, spotted sandpiper, least sandpiper, willet, woodcock and common snipe. None of these species are known to breed at the Refuge. Very little habitat for shorebirds occur on the Refuge. The best times for significant shorebird numbers is during the late summer and early fall during periods of drought or when the lakes have been drawn down.

3.3.2.4 Mammals

A total of 45 mammal species have been recorded in bottomlands and associated wetlands of east Texas. Included are 11 species of bats, 15 species of rodents (including squirrels), 11 species of carnivores, and eight other species.

Important game species that occur on the Refuge include swamp rabbit, gray squirrel, and white-tailed deer, which are rather abundant at LSHFC.

Principal furbearers that occur (or potentially occur) on the Refuge are raccoon, mink, opossum, gray fox, bobcat, coyote, striped skunk, nutria, river otter, and beaver (Schmidley, 1983 & 1984). Raccoon, nutria, mink, otter, and beaver all prefer aquatic and wetland habitats and are all rather common on the Refuge.

3.3.2.5 Reptiles

A total of 54 species of reptiles are known to occur in bottomland hardwoods and associated wetland habitats in east Texas. This list includes 17 turtles; one crocodilian, the American alligator; eight lizards; and 28 snakes (USFWS 1985).

Characteristic species of the east Texas floodplains include the common snapping turtle, alligator snapping turtle, red-eared slider, the soft-shell turtles, the water snakes, western mud snake, rat snake, cottonmouth, copperhead, and timber rattlesnake. The alligator snapping turtle and timber rattlesnake are state-listed threatened species which occur on the refuge.

3.3.2.6 Amphibians

A total of 31 species of amphibians are known to occur in bottomland hardwoods and associated wetland habitats in east Texas. This list includes 11 salamanders; and 20 toads and frogs (USFWS 1985).

Amphibian species thought to be common in the Refuge area include the mole salamander, smallmouth salamander, lesser siren, tree frogs, bullfrog and southern leopard frog. No threatened or endangered amphibian species are known to occur. However, recent research findings indicate that amphibian populations, particularly frogs, are undergoing significant population declines throughout the world. Also in the United States, alarming numbers of frogs of various species are being observed with deformities such as abnormal organs, feet, and toes.

3.3.2.7 Fish

A total of 116 species of fish occur within east Texas. Many of these fish utilize bottomlands during seasonal inundation of the floodplain. The fish species that most commonly use the floodplain during periods of overflow flooding include the bow-fin, American eel, red-fin pickerel, chain pickerel, yellow bull-head, topminnows, mosquito fish, sunfish, flier, and swamp darter (Wharton et al. 1982). Many of these species are believed to occur in the Sabine River and its tributaries, but no work to document fish species on the Refuge has yet been undertaken. The Paddlefish, Ironcolor shiner, Creek chubsucker, Western sand darter, and Orangebell Darter are identified as SGCN by the state of Texas, and have historical ranges within the Sabine River basin.

3.3.2.8 Invertebrates

There are a myriad of invertebrate species of rivers, creeks and floodplains within east Texas. Invertebrates serve as food for a number of vertebrates already discussed including the mallard and wood duck. A number of invertebrate species that are dependent on floodplain habitats are of economic importance to man, most notably the crawfish.

Freshwater mussels are important components of aquatic ecosystems, and are one of the most imperiled faunal groups in the United States. There are 50 mussel species known to occur in the state of Texas. The Texas heelsplitter and Texas Pigtoe are two State threatened species that have been recorded in the Sabine River Watershed near the refuge. Mussels require good water

quality, stable stream channels, and free-flowing water. Habitat degradation is recognized as one of the major causes for decline in mussel populations. Habitat preservation and restoration is an effective method to increasing mussel populations and diversity. The habitat conservation and management implemented on the bottomland hardwood forest of the refuge, will improve water quality by holding back sediment and filtering pollutants, and will slow down flood flows and minimize erosion, which will support mussel populations. No known mussel surveys have been conducted on the Refuge but suitable habitat exists in and around the Refuge.

3.4 Socioeconomic Environment

This section describes the socioeconomic environment of the communities near the Little Sandy NWR. It includes a discussion of nearby human populations and economies; the archeological, cultural, and historical resources associated with the Refuge. There is no public access to the Refuge and no Service-owned administrative facilities.

3.4.1 Population

Texas is the second most populated state in the country and was estimated to have a population of 25,145,561 in the 2010 U.S. Census. The entire state of Texas is projected to have a population of over 28 million people by 2025. The Little Sandy NWR is located in the Upper East Texas Region, which covers a 23-county area that stretches from Arkansas and Louisiana to the fringe of the Dallas-Fort Worth Metroplex, which has an estimated population of 6,526,548 (2011 U.S. Census, https://www.tsl.state.tx.us/ref/abouttx/census.html). Figure 3-1 shows the population trend in the Upper East Texas Region from 2001-2012. Table 3-1 shows similar trajectory into the year 2030.

The Refuge is located in Wood County, Texas, which has a population of 41,964 (U.S. Census 2010). Of this population, approximately 84.9 percent are Non-Hispanic Whites, 4.6 percent are Non-Hispanic African Americans, and other Non-Hispanic races, including Native Americans and Asian Americans, together contribute approximately two percent to the county's population. The remaining 8.5 percent of the population are Hispanic (Texas Association of Counties; see http://www.county.org/resources/countydata/products/Pop2010.html. The Refuge is located approximately three miles west of the town of Hawkins, Texas, population 8,406. Several small towns are within 25 miles of the Refuge including Tyler, Lindale, and Mineola, Texas. Dallas, Texas is within 100 miles of the Refuge.

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 to wildlife habitat, and trends in real estate markets. The projected population growth for Wood County and Smith County, which borders the Refuge to the south, is shown in Table 3-1 and remain on the same trajectory as in Figure 3-2.

Table 3-1. Population projections for Wood and Smith County, 2010-2030

	2010	2015	2020	2025	2030
Wood County	41,155	43,209	44,913	46,075	47,025
Smith County	199,948	200,943	209,525	217,504	225,370

Source: Texas Office of the State Demographer

3.4.2 Economy

The Refuge serves as a conservation easement for a private hunting and fishing club. There are no other economic uses on the Refuge.

3.4.2.1 Regional Economic Profile

Texas is a vast and diverse state, with numerous economic bases and strengths. The state's Comptroller's Office tracks this economy and provides regional outlooks for 12 different regions throughout Texas. The Little Sandy NWR is located in the Upper East Texas region stretches from the serene expanses of the pine forests bordering Arkansas and Louisiana to the energetic eastern edge of Dallas-Fort Worth Metroplex. This diverse landscape provides for a variety industries in the region. The region's economy is expected to grow at a steady rate. Agriculture has traditionally anchored the Upper East Texas economy. Agricultural enterprises such as horticulture, timber and the dairy industry have remained robust, which activities such as food processing and food distribution have evolved to support them. The most competitive jobs in the region are centered in the specialty trade contractor, oil and gas, mining, general and refrigerated warehousing and storage, civilian federal government and telephone call center industries. The Upper East Texas region has abundant natural resources, including 30 lakes and reservoirs, two major and two minor aquifers and some of Texas' largest oil, natural gas and coal reserves, all of which should help to sustain strong economic growth. Economic expansion is also supported by a geography and infrastructure conducive to interstate trade. The region's transportation system, include two major interstate highways, hundreds of miles of rail and two commercial airports, helps support economic activity in the area. Figure 3-2 displays the projected employment growth in the Upper East Texas region for various industries.

In Wood County, the agriculture and tourism industries are particularly important. The livelihood of many people in the county depends on the production of timber, forage for livestock, and cultivated crops. The oil and gas industry is also important to the economy and provides many jobs. Water, fish, and wildlife are also important natural resources in Wood County. Thousands of people each year are attracted to Wood County by its history, lakes and annual events.

Nature tourism is another industry that is particularly important to the region's economy. Nature tourism is defined as "discretionary travel to natural areas that conserve the environment, 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.

Table 3-2. Estimated Percentage Change from 2012-2017

	Tyler MSA	Upper East Tx	Texas	US
Jobs	11.69%	11.18%	12.32%	7.59%
Outputs (RGP)	26.19%	24.82%	25.60%	18.59
Estimated Absolute Change from 2012-2017				
Jobs	15,700	58,300	1,839,500	10,080,400
Outputs (RGP)	2.247 Billion	$8.9 Billion	$315.140 Billion	$2,499.522 Billion

Source: Perryman Short-Term Economic Forecast 2012-2017

3.4.2.2 Economic Significance of the Refuge

Little Sandy NWR contributes little to a regional economy that has been relatively stable since 2002. Because Refuge staff is shared with other Refuges and stationed elsewhere, there is no property rental or ownership in the county by Service personnel. Further, little to no retail trade in the form of services or equipment rental and purchases, combined with the Refuge being closed to the public, result in a relatively minor contribution to the local economy.

3.5 Archeological, Cultural and Historical Resources

The Sabine River Basin has been a site for human habitation for over 12,000 years. The Clovis Culture was the beginning of southeastern Native American Development in the Sabine River Basin. The peak of Native American habitation was in the early Caddoan Period around 700 AD. The early Caddoan period was identified by the construction of large mounds that were later abandoned during the 14th Century. The first English settlers came to the area in the 16th Century and found several tribes along the Sabine River (TSHA 2001).

The archeological, cultural, and historical resources within the Refuge are currently unknown. The lack of identification of these resources is due to the absence of systematic research within the Refuge. However, site information and data from research conducted in the Sabine River Basin would indicate a high probability that significant historic resources exist within the easement area.

In 1975, Southern Methodist University discovered a prehistoric Caddoan site in the Upper Sabine River basin in Wood County during the Lake Fork Reservoir survey. The site was observed to contain prehistoric remnants from a Caddoan settlement (Pertula 1981). As a result, Caddoan and other historic sites are potentially present at the Refuge. Further research is necessary to determine the presence of these resources at the Refuge.

No known archeological sites have been identified on Little Sandy NWR. Just north of the Refuge, the LSHFC has numerous structures that may be historically significant. Between the

railroad tracts (north of club area) to the highway in the present open field was a saw mill that cut much of the lumber used to build many of the early structures at LSHFC. The saw mill is no longer there. Another structure of historical significance at the club would be the old Angler concrete water tank located by the railroad. This was used during the stream engine locomotive era. The tank is over 90 years old (Shannon 1992). On the Refuge a few oil well sites still exist. On the northwest portion of the Refuge several large holes are present with the spoil near each hole. Trees have grown on top of the spoil sites. Evidence of oil well exploration that started in 1935 and continued through the 1940's is evident on the Refuge and in the Club area (Shannon 1992).

There are no known National Register of Historic Places (NRHP) on the Refuge. Since a complete inventory has not been completed for the Refuge, locations of any archeological, cultural and historical resources, should they exist, are protected and preserved and may be mandated by federal law and Service policy.

3.6 Current Management and Administration

Little Sandy NWR consist of 3,802 acres of a perpetual conservation easement that was donated by the LSFHC to the Service for maintenance of wildlife habitat.

A conservation easement is a non-possessory property interest that an entity has in land owned by another entitling the holder of the interest to limited use or enjoyment of the other's land. Conservation easements used by the Service run with the land and are binding on all future owners of the subject land. As such, the Service has the right to periodically monitor the easement and to enforce the terms of an easement should the owner be in violation of the terms.

As part of establishing the conservation easement, easement restrictions get recorded at the courthouse via a deed of conservation easement and future landowners would be required to abide by those restrictions. The restrictions, however, usually lower the market value of the underlying fee ownership. The landowner may sell or donate a perpetual (forever) conservation easement to the Service and may receive income and estate tax benefits from the donation. The landowner still pays property taxes on the land, but does not have to allow public access to the land, unless he or she grants permission. The federal government would make no Refuge revenue sharing payment to the county for conservation easements it holds.

Under the terms of the easement between the Service and LSHFC (see Appendix C), the Club:

(1) retains the right to control access to the land;
(2) may use the land for hunting and fishing; and
(3) may derive income from the extraction of oil and natural gas resources.

The Club may not:
(1) alter the current topography or vegetative cover through timber harvest or other means;
(2) drain any wetlands on the site;

(3) construct any roads, trails, buildings, fences, or other structures without the permission of the Service;
(4) apply insecticides, herbicides, or other chemicals (except to control vegetation in lakes) without the consent of the Service; and
(5) grant additional easements, right-of-way, or similar interests (except for extracting oil and gas resources) on the land without the written concurrence.

The Service has the right of ingress and egress in, over, and across the property for the purpose of administration of the easement and inspection of the property, but only through their authorized representatives. The Service agrees to use and protect its rights for protection and maintenance of wildlife and wildlife habitat as a unit of the Refuge System.

3.6.1 Administration

3.6.1.1 Administrative Facilities

The Service does not own or administer any facilities on the Refuge.

The LSHFC owns an additional 145 acres adjacent to the Refuge easement, where they maintain a clubhouse, numerous lodges, boathouses, docks and other recreational improvements that are used by club members.

3.6.1.2 Partnerships

The Refuge partners with TPWD on wildlife surveys, breeding bird census data, and other plant and animal inventories. The Refuge also partners with Stephen F. Austin State University on bat, bird, alligator, and plant research. The Service also partners with LSHFC on coordination and all management aspects of the Refuge. These types of partnerships play a critical role in current management and will continue to play a major role as goals, objectives and strategies are implemented on the Refuge.

3.6.2 Habitat Management

Forest Management
There is no active management of the bottomland hardwood forests on the Refuge, except for limited invasive species control.

The Refuge has been separated into six management units or compartments which range in size from 115 to 887 acres (see map 3-2). Compartment boundaries are established along geographic features that can be easily identified on the ground (i.e. streams, roads, trails, etc). Additional information can be found in the Forest Habitat Management Plan in Appendix F.

Flora Inventory
An initial habitat assessment of the Refuge was completed by Refuge staff when Little Sandy was added to the Refuge System and an additional ecological community characterization survey was conducted by the U.S. Geological Survey's National Wetland Research Center. Data collections are being used to provide baseline flora information on the Refuge; however, such databases are limited in scope and detail. An additional floral inventory was conducted in 2011-2012 and it presently being analyzed. Present activities are primarily limited to the identification of invasive flora species, when reported, and confirming their existence on the Refuge.

Water Body Management
The Refuge considered management action focused on water level management of Brumley and Overton Lakes; however, the LSHFC has repeatedly held the position that it does not desire the water levels to be managed for any purpose other than to maximize the viability of sport fishing and waterfowl hunting opportunities and do not believe that the Refuge's recommendations described previously would accomplish that. The LSHFC has reserved sole responsibility for

water level management; the Refuge will not pursue this issue without further collaboration between the Service and the LSHFC. As such, water level management on Brumley and Overton Lakes will continue to be the responsibility of the LSHFC with the Refuge continuing to act as a consultant to the club for ecologically-sound water management practices.

Invasive Species Management (Flora)
There are several invasive species known to be present on the Refuge: Chinese tallow, Chinese privet, silktree, Chinaberry, Nandina and Japanese honeysuckle. In the past, invasive species management on the Refuge consisted only of confirming their presence when club members report a possible sign of their existence. In recent years, (2011 and into 2012) some funding has been approved for limited invasive species control. The primary target species for this funding is Chinese tallow and privet.

Chinese tallow is rapidly encroaching on openings on the forest floor. By use of GPS and mapping software, the Refuge staff should be able to detect infestations and maintain records of herbicide applications that treat infestations. Treatments would consist of the use of herbicides (Garlon 3A and Garlon 4) from a pressurized spray rig. During these treatments, the Refuge staff will monitor treated areas and detect new infestations. Treatments will take place during the late summer and early fall to allow maximum root intake of herbicides. Basal applications where the cambium has been severed would be the preferred treatment (i.e., “cut stump” application). During the winter months, which are usually wet, the Refuge staff will remove small seedlings which were identified during chemical treatment that can be pulled from the ground by hand.

3.6.3 Wildlife Management

Fauna Inventory
Annual aerial waterfowl surveys were conducted between October and February on a monthly basis by the Region 2 pilot and a Refuge staff member. In addition, annual bird point counts are conducted with assistance from Region 2 migratory bird biologist, TPWD biologist and Refuge staff each spring, usually in May and June.

Nuisance and Invasive Species Management (Fauna)
The Refuge staff assists with beaver management activities. The LSHFC staff identifies and removes beaver dams throughout the year from culverts and small drains to promote drainage to allow for trail utilization and to reduce timber loss. The number of beavers trapped annually by the club is generally low (five to ten individuals per year).

In addition, feral hog activity is present throughout the Refuge. Their presence and activity disrupts approximately 3,000 acres of native bottomland hardwood habitat; the vast majority of the Refuge’s total acreage. Presently, hunt club members may take hogs during other hunting activities, but these circumstances are opportunistic and relatively rare. Hogs are most often taken when they are around and/or causing damage to the various club residences and facilities. No Refuge management program currently exists for feral hog control.

3.6.4 Visitor Services and Infrastructure

The Refuge is closed to public entry due to private ownership by the LSHFC. Therefore, the Refuge does not offer any wildlife-dependent recreation opportunities, public use access, or public use facilities.

3.6.5 Special Management Areas

There are no special management areas (i.e., wilderness areas, research natural areas, or other administrative designations) on the Refuge.

3.6.5.1 Wilderness Review

The Service is required to conduct a wilderness review for each Refuge as part of the comprehensive conservation planning process. For a Refuge to be considered for wilderness designation, all or part of the Refuge must: be affected primarily by the forces of nature, with the human imprint substantially unnoticed; have outstanding opportunities for solitude or primitive and unconfined type of recreation; have at least 5,000 contiguous acres or be sufficient in size to make practical its preservation and appropriate management, at the time of review; and be a road less island.

The Little Sandy NWR contains 3,834 acres. The Service holds a perpetual non-development conservation easement on Little Sandy NWR. The Service has considered the potential for designating wilderness areas on the Refuge. It has been determined that Little Sandy NWR does not meet the criteria for a wilderness designation since it is less than 5,000 acres in size, it is closed to the public, and it is entirely privately owned and operated as a hunting and fishing club.

3.6.6 Land Protection and Acquisition

Currently, there is no land acquisition program on Little Sandy NWR; there is no approved PPP or LPP to facilitate expansion of the Refuge beyond the 10% of the approved land base authorized by the conservation easement. This CCP identifies the need for a separate planning process to develop a Landscape Conservation Design.

The LCD process facilitates collaborative, landscape scale conservation. It integrates societal values and multi-sector interests with the best available interdisciplinary science to assess landscape conditions, vulnerabilities, risks and opportunities to achieve desired outcomes. The Refuge System engages in LCD in order to ensure that we adequately address Service trust resources and System priorities and work with our partners to better understand our role in conservation throughout the larger landscape. This enables us to use the LCD to inform the development of our comprehensive conservation plans, land protection plans and step down management plans.

Little Sandy NWR remains a high priority for conservation of bottomland hardwood forest. Bottomland hardwood forests are some of the most endangered and productive wetland ecosystems in the southeastern U.S. Over 90 percent of these forests in Texas have been converted to other uses, thereby eliminating a tremendous amount of wildlife habitat in the

eastern portion of the state. The Middle Sabine Bottoms, which includes the LSNWR, was identified as one of 14 priority one bottomland hardwood sites for protection in the Service's 1985 Texas Bottomland Hardwood Concept Plan. This same area has also been identified as a priority bird conservation area within the West Gulf Coastal Plain Bird Conservation Region, a part of the Lower Mississippi Valley Joint Venture. Little Sandy was rated as the highest priority site for conservation in an earlier study.

Other sites in the immediate vicinity have recently been preserved, contributing to conservation and protection at the larger landscape level. These including the Old Sabine Bottoms Wildlife Management Area (5,726 acres managed by Texas Parks and Wildlife Department and immediately south of LSNWR), the Mineola Nature Preserve (2,960 acres managed by the City of Mineola), the Burleson Wetland Partners (2,650 acre Forest Legacy property and wetland mitigation bank), and two other small mitigation banks (approximately 500 acres). The immediate landscape includes over 15,500 acres of habitat devoted to conservation purposes.

Other conservation priorities in the surrounding landscape include: the deep sand herbaceous and upland hardwood communities located on Sparta Sand outcroppings and marsh communities within the Sparta Sands. Little remains of these community types and almost none are preserved in conservation ownerships. The band of sand communities occurs from just east of Hawkins south to Tyler and west nearly to Mineola.

Through the LCD process, the Services' role in the Middle Sabine River Basin will be focused on conservation and preservation of the most pristine bottomland hardwood forests in Texas. LCD efforts will continue to describe the role of each conservation partner and jointly improve habitat conditions throughout the ecoregion. If there are opportunities for expansion of the Little Sandy NWR, a Land Protection Decision Package would be completed to allow for the Service to pursue additional conservation easements or fee acquisition in the Middle Sabine Basin in the future.

3.6.7 Cultural Resource Management

No cultural resources have been identified on the Refuge. The Service's Regional Archaeological Officer will be provided opportunities to review all management activities and location maps for review/coordination with pertinent authorities prior to implementing any habitat actions (excluding monitor/inventory) to assure protection of potential sites. The Service will comply with the National Historic Preservation Act prior to the initiation of any ground disturbing actions that may potentially affect any documented cultural resources.

4.0 Management Direction: Goals, Objectives, and Strategies

The Service manages fish and wildlife habitats considering the needs of all resources in decision-making. 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 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.

This chapter describes the management focus for this Refuge and sets out the associated objectives and strategies that the Refuge believes are necessary to achieve the identified goals. However, the Service is limited by the conditions of the conservation easement. Many of the objectives and strategies identified in the CCP can only be accomplished with the cooperation of the LSHFC.

The objectives and strategies in this chapter are intended to guide future management and are expected to be implemented during the 15-year term of this CCP. However, the Service acknowledges that the future remains uncertain. Understanding ecological interactions on the Refuge, anticipating the effects of a changing climate, recognizing that there are gaps in available data, and anticipating changes the capacity of the Service to make future management planning difficult and complex. For this reason, the Refuge will use this chapter as a guide for achievement of overall goals and 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 approach 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 Refuge will use adaptive management and implement strategic habitat conservation throughout the lifetime of this CCP.

4.1 Habitat Goal

To acquire, conserve, restore, enhance and preserve the ecological integrity and natural diversity of one of the last remaining old-growth bottomland hardwood forests in Texas and associated wetlands for migratory birds by implementing appropriate management programs to benefit native species, threatened and endangered species, and other species of concern.

Objective 1: Within seven years of the CCP's approval, support a partnership-driven planning effort to produce a Landscape Conservation Design (LCD) to target and prioritize land acquisition to enhance connectivity and conserve bottomland hardwood forest habitat within the Sabine River Basin.

Rationale:
Landscape-level protection is a high priority for Little Sandy NWR and surrounding areas. Approximately 18,000 acres are protected by other agencies in the immediate vicinity of the Refuge; however, no land protection plan has been prepared to link the individual sites. There are numerous sites, such as an old growth forest adjacent to the Refuge, that are considered high priority to the Service, TPWD, TNC, The Conservation Fund, and The City of Mineola that should be considered as part of land protection planning. There are also Wetland Reserve Program tracts with conservation easements held by the NRCS and the Burleson Ranch protected with funds from the Forest Legacy Program of the U.S. Forest Service and Texas Forest Service.

A Land Protection Planning Process would enable the Service to acquire surrounding properties from willing sellers that promote strategic habitat conservation. Potential for habitat restoration would be a consideration for prioritizing available properties. An expanded Refuge acquisition boundary would provide for the protection of additional pristine bottomland hardwood forests.

Strategies:

1. Work with the conservation community to complete a Landscape Conservation Design (LCD) and Land Protection Planning Process to assess the potential for acquiring additional lands.

Objective 2: Based on several comprehensive baseline Refuge-wide inventories and surveys that have been conducted, it would be beneficial to develop a biological Inventory and Monitoring plan (IMP) for the Refuge. Development of an IMP would help identify new and current inventories and surveys in a consistent manner throughout the ecoregion.

Rationale:
Since the Refuge and surrounding Sabine River Basin provide some of the most pristine bottomland hardwood forest in Texas, conservation should be focused on growing conservation efforts in the region with a basic understanding of the population trends of associated wildlife species. The old growth characteristics of LSNWR should be monitored for long-term observations in regards to natural community development and changes in wildlife use. Little Sandy NWR is arguably the highest quality bottomland hardwood site in the West Gulf Coastal Plain and one of the highest quality sites in the southern United States. Very little of the Club has been modified since the site was purchased in 1907, and the majority of the 3,802 acres is high quality pristine bottomland hardwood forest habitat.

In 2006, a Refuge-wide forest inventory was conducted by staff to assess forest conditions. This data set was used to prepare the Forest Habitat Management Plan for Little Sandy NWR. In 2008, the USGS, National Wetland Research Center began a study to determine the composition and structure of old-growth bottomland hardwood forests that makes up the LSNWR. The study was initiated by Dr. Susan C. Carr, from the University of Wisconsin and completed in 2012. This study looked at both flora and soils. Since 2008, bird point counts have been conducted annually to assess forest breeding bird usage. Aerial waterfowl surveys were conducted from 2008 to 2011. Studies have been conducted on the American Alligator and bats on Little Sandy

NWR. The data collected will be used to inform and direct strategic habitat conservation efforts on the Refuge.

Strategies:

1. Develop an IMP to prioritize needed surveys and inventories to support Refuge priorities.
2. Conduct a forest inventory and assessment every two years for one compartment with the entire Refuge inventoried in a 12 year period.
3. Inventory all infrastructure, buildings, roads, water bodies, campsites, piers, feeders, hunting improvements (blinds, stands, etc), trails, infrastructure, etc. (abiotic resources) within 2 years of completion of the CCP, and implement best management practices to minimize their potential impacts to wildlife resources.
4. Develop partnerships with other entities, such as the US Geological Survey, TPWD, University of Texas at Tyler, and Stephen F. Austin State University to develop and support science needs within the bottomland hardwood forest habitat in the Sabine River Basin.

Objective 3: Continue to implement invasive species detection, treatment and monitoring to reduce and/or eliminate their encroachment.

Rationale:

There are several invasive plant species on the Refuge: Chinese tallow, Japanese/Chinese privet, silktree, Chinaberry, Nandina and Japanese honeysuckle are known to be present. Since 2011, Chinese tallow has been treated on the Refuge. Annual records for this species are compiled and entered in database for monitoring. The Refuge has received several annual invasive species grants since 2011 for invasive species control.

A Fire Management Plan will provide a management strategy to treat invasive plant species on the Refuge on upland sites. Prescribed fire would be utilized to retard and prevent the further encroachment of invasive species. Japanese honeysuckle and Japanese/Chinese privet are two species that are effectively controlled by prescribed fire.

Aquatic invasive species can be treated by de-watering and implementing mechanical treatment, herbicide and/or prescribed fire.

Strategies:

1. Through the use of forest inventories and in combination with geospatial software and LIDAR, invasive floral species will be inventoried, mapped, and monitored in response to implemented control efforts.
2. Use a combination of prescribed fire, chemical treatment and mechanical removal of invasive flora species.
3. Utilize new and improved biological treatments to control invasive species.
4. Implement a Fire Management program that will promote the use of prescribed burning to control invasive plant species.

Objective 4: Continue to work with the LSHFC and our partners (TPWD, USGS, etc.) to ensure conservation efforts on the landscape are strategic, accountable, and adaptive actions driven by sound science and biological principles.

Floating vegetation and rookery by David Weaver

Rationale:
Brumley and Overton Lakes are tremendous wetland resources that provide fisheries and waterfowl hunting opportunities. Collaborating with the state of Texas as well as with the LSHFC will help establish biologically sound management practices to support resource management goals. The implementation of a water management strategy will support long range management goals identified for the wetland units on the Refuge.

Strategies:

1. With representatives from other state and federal agencies, sponsor a workshop on the role of proper water management on recreation, habitat and wildlife resources.
2. Collaborate with TPWD on opportunities to cooperatively assist the LSHFC, as well as other landowners with bottomland hardwood habitat in the east Texas region, in conserving and managing the biodiversity on their lands.
3. Continue to coordinate and implement resource management priorities with the LSHFC to promote the ecological integrity of the bottomland hardwood forest and associated habits on the Refuge.

Objective 5: Continue to advance the terms and conditions of the conservation easement, which were established to support habitat conservation efforts at the Refuge and between the Service and the LSHFC.

Rationale:
The conservation easement between the Service and the LSHFC outlines the roles and responsibilities of each party in their efforts to support resource management at the Refuge. The conservation easement contains prohibitions or stipulations against various types of development including drainage of any wetlands occurring and recurring due to natural causes, construction of structures or roads, application of chemicals, alteration of the current topography or vegetation cover and concession of additional easements or rights-of-way.

The coordinated effort between the Service and LSHFC in the development of this CCP, will promote a stronger relationship in establishing and implementing the future direction of resource management on the Refuge.

Strategies:

1. During bird point counts, forest inventories and other habitat programs; Refuge staff will assess and monitor the Refuge for compliance with the terms and conditions of the conservation easement.

2. Service representatives along with LSHFC representatives will meet annually to discuss compliance with the restrictions and limitations imposed by the conservation easement authorizing the Little Sandy NWR.

4.2 Wildlife Goal

To protect, maintain and enhance the existing diversity of waterfowl, other migratory birds, and native fish and wildlife species dependent on bottomland hardwood habitat.

Objective 1: Continue to conduct ongoing surveys and inventories established for the Refuge. Within 2 years of the CCP's approval, develop and establish an IMP to prioritize surveys and inventories to direct future management decisions.

Rationale:
There have been a number of surveys and inventories conducted on the Refuge (bird point counts, waterfowl counts, etc.) to establish baseline data for the Refuge. Through strategic habitat conservation efforts, the future resource needs of wildlife on the Refuge can be prioritized and addressed to meet established goals and objectives identified for the Refuge.

Strategies:
1. Continue conducting annual bird point counts and the collection of biological data from harvested fauna (biotic resources).
2. Collect biological data (sex, age, weight, etc.) from all native wildlife (deer, waterfowl, etc.) taken during club hunting activities and track the annual take of invasive feral hogs (*Sus scrofa*) and other invasive species that are controlled through management. This would provide critical baseline data for wildlife management programs on the Refuge (biotic resources).

3. Initiate inventories for mammals, birds, reptiles and amphibians, fish, and invertebrates (biotic resources).

Objective 2: Within one year of the CCP's approval, develop a feral hog management plan that would reduce/eliminate the damaging effects of feral hogs on native wildlife populations and the Refuge habitat.

Nesting Egrets by David Weaver

Rationale:
An integrated approach to control the population of feral hogs will reduce competition with indigenous wildlife species for food, water, cover or space; reduce the damages to sensitive ecosystems and habitats; and minimize disease threats to wildlife, domestic livestock and humans.

Strategies:

1. Consult with the landowner to develop feral hog hunting and trapping programs on the Refuge. Feral hogs will be shot or trapped anytime on Refuge lands by Service staff. The club members may shoot feral hogs in accordance with state law and/or as their rules allow. If feral hogs are taken after daylight hours, the local state game warden needs to be notified and approve the activity. There is no limit on the number of feral hogs that may be taken. The Service will work with the LSHFC in the use of birth control toxicants or repellents if they become registered for use in the State of Texas.

2. Deprive feral hog populations of sanctuary areas on the Refuge by initiating hunting and trapping programs. Feral hogs will be live-trapped or hunted with dogs on the Refuge by members of the general public through Special Use Permit (SUP) only. In order to be considered as a permittee to live-trap or hunt feral hogs with dogs on the Refuge, applicants must adhere to the special conditions and restrictions outlined in the SUP. All feral hogs captured become the property of the permittee and must be killed prior to leaving the Refuge. There shall be no bag or possession limit on the number of feral hogs taken. The Refuge Manager will have the authority to take action on behalf of the government to amend or modify the conditions and requirements of the SUP when deemed necessary. Failure by the permittee to follow all of the special conditions and restrictions outlined in the SUP will result in immediate cancellation of the permit.

3. Partner and collaborate with adjacent landowners to expand feral hog management to areas outside of the Refuge boundary.

Objective 3: Continue to implement and develop a strategic nuisance species management program which would maintain beaver numbers at a level where beaver dam construction is limited to areas that do not adversely impact the bottomland hardwood ecosystem. Areas impacted by beaver activity will be monitored and numbers addressed in the late spring or summer to promote tree health.

Rationale: The active beaver population has impacted several drainages on the Refuge through the construction of dams. Over time, these dams can negatively degrade flood-prone bottomland hardwood forest. Properly managed, these flooded impoundments can be quite productive for wintering waterfowl. Prolonged inundation of these bottomland forests by beaver dams generally result in stressing or killing flooded trees. In addition, beaver have become a recognized nuisance species to surrounding landowners in the river basin. Ongoing activities such beaver dam removal and population control by trapping has occurred to promote forest health. Nutria would be included in this program so that the population on the lakes could be addressed as needed.

Strategies:

1. Consult with the landowner to develop beaver and nutria control mechanisms and programs on the Refuge.
2. Conduct beaver control through trapping and shooting activities.
3. Deprive beaver populations of habitat by dewatering flooded timber areas in the spring.

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5.0 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

5.1.1 Personnel

Little Sandy NWR is a part of a Complex of four Refuges: Little River, Caddo Lake, Little Sandy and Neches River NWRs. In fiscal year 2016, Little Sandy NWR had two Service staff members based out of Caddo Lake assigned to work on the Refuge. Both staff members conducted bird point surveys and worked with invasive species and contributed four weeks of their time annually to Little Sandy NWR.

In addition to Service staff having access to the Refuge, the LSHFC currently has a membership of 84 stockholders; each stockholder has their own family and friends who are able to visit the Refuge. The club is governed by a Board of Directors, which reports to all the members of the club. In addition, the management of the club is the responsibility of several committees, including the Grounds, Hunting, and Fishing committees. These committees, with the approval of the Board and members, direct the operations of the club, which are carried out by the Club Manager and his staff. There are several employees of the LSHFC that are routinely on the property with a full time care taker.

5.1.1.2 Additional Personnel Needs

The following table identifies staff needed, beyond current levels, to fully implement the management direction presented in this plan. Continuous efforts to establish efficiencies with limited staff and resources will be established throughout the Complex to insure that appropriate management levels are represented at Little Sandy NWR.

Table 5-1. Additional Personnel Needs

Refuge Maintenance	Engineering Equipment Operator	WG-5716	8	FT Permanent
Wildlife and Habitat	Biologist Technician	GS-486	5	Part time/seasonal
Wildlife and Habitat	Wildlife Biologist	GS-401	7/9	FT Permanent

5.1.2 Budget

5.1.2.1 Existing Budget

Table 5-2 reflects the funds needed to maintain current programs in the short-term as well as out-year estimates assuming full implementation of this CCP. 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. The Refuge was not provided a base operational budget in fiscal year 2016 and no additional funds necessary to operate Refuge programs were received. In FY16 a line item funding of $9,080 for tallow control along with $1,450 for feral hog control were allocated for the Refuge.

Table 5-2. Existing Budget

Refuge Base Operational Budget	$0	$612,476.00
Annual Maintenance	$0	$0
Fire Operations	$0	$0
Tallow/Feral Hog Control	$10,530.00	$
Total Budget	**$10,530.00**	**$612,476.00**

Refuge Operational Needs System(RONS)

The RONS is the mechanism that the Refuge uses to justify needed funds and personnel for new programs and projects necessary to meet legal mandates, Refuge plans, and departmental and Service directives. The needs identified in the Refuge's RONS database date back to 01/2010. There are 5 projects totaling $ 612,476.00 and 2.5 staff positions. Additional RONS projects will be submitted for potential funding in order to achieve the management direction identified in this plan.

Service Asset Maintenance Management System (SAMMS)

The SAMMS is a database the Refuge uses to document and justify significant maintenance projects and equipment replacement. The Refuge's SAMMS project list currently has one project identified for a total of $155,000. Additional SAMMS projects will be submitted for funding in order to achieve the management direction identified in this plan.

5.1.2.2 Additional Budget Needs

Table 5-3 identifies budget needs, beyond current levels, to fully implement the management direction presented in this plan.

Table 5-3. Additional Budget Needs

Refuge Base Operational Budget	$300,000.00
Annual Maintenance	$10,000.00
Fire Operations	$10,000.00
Feral Hog/Tallow Control	$20,000.00
Total Additional Budget Needed	**$340,000.00**

5.2 Appropriate Refuge Uses and Compatibility

5.2.1 Appropriate Refuge Uses

There are no public or other uses on the Refuge that the Service has jurisdiction over. The Service holds a perpetual non-development conservation easement, but the land remains in

private ownership. Activities conducted by the LSHFC are not subject to the Appropriate Use Policy.

5.2.2 Compatibility

The Service's Compatibility Policy (603 FW 2) provides guidelines for determining if a use proposed on a national wildlife Refuge is compatible with the purposes for which the Refuge was established and the mission of the Refuge system. It also identifies exceptions from when a compatibility determination is required (603 FW 2, section 2.10 B). "The most common exceptions to compatibility involve property rights that are not vested in the Federal Government, such as reserved rights to explore and develop minerals or oil and gas beneath a Refuge. In some cases, exceptions may include water rights, easements, or navigable waters."

As mentioned in section 1.3.2.1, there are no public or Refuge management economic activities on the Little Sandy NWR. The Refuge remains in private ownership and is closed to the public in accordance with the conservation easement. The compatibility policy is not applicable in this situation.

5.3 Intra-service Section 7 (Endangered Species Act Consultation)

The Service has conducted an Intra-Service Section 7 consultation for the implementation of CCP objectives and strategies with the Arlington Ecological Services Field Office (see Appendix D).

5.4 Step-Down Management Plans

Implementation of this CCP will be accomplished, in part, through various step-down management plans (see sections 5.4.2). 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 plan.

5.4.1 Current Step-Down Plans

<u>Forest Habitat Management Plan</u>

A Forest Habitat Management (FMP) plan was initiated in 2009 and included in this CCP (Appendix F). This plan will guide the forest inventory as well as assess the current and desired habitat condition, within each compartment throughout the Refuge.

5.4.2 Future Step-Down Plans

The following list of step-down management plans that will be drafted to guide management of specific Refuge programs:

Fire Management Plan

The fire plan will address prescribed fire activities, if any, on approximately 200 acres of the upland portions of the Refuge in order to mimic natural fire ecology. A fire plan would also address invasive species encroachment and be utilized as a management tool to treat invasive species. This plan will also address wildfire response activities.

Feral Hog and Beaver Management Plan

The feral hog and beaver plan will provide guidance on population assessment and control measures for both species.

Beaver activity occurs throughout the bottomland hardwood areas of the Refuge and surrounding areas. The LSHFC staff removes beaver dams from culverts and small drains to restore drainage; however, the number of beaver trapped by club staff is low. During the winter months, beavers assist in flooding bottomland hardwood forest timber by plugging water control structures with debris; however, the opposite is true in the spring and summer months when water needs to flow freely throughout the drainage system. Beaver trapping and dam removal by either staff or contractors would permit enhanced maintenance of productive bottomland hardwood habitat.

Feral hog activity is present throughout the Refuge and surrounding region. Since 2013, the Refuge has received grants designated to control invasive species and have assisted in the control of feral hogs. These grants have funded the constructing of traps and the purchase of bait. These traps have been maintained and supervised by staff of LSHFC.

Invasive Species Management Plan

An invasive species plan will direct the Refuge and club staff in monitoring and treatment of invasive flora species throughout the Refuge and provide guidance on monitoring and treatment through the use of herbicides and mechanical tree removal. There are several invasive species on the Refuge; Chinese tallow, Chinese privet, silktree, Chinaberry, Nandina and Japanese honeysuckle are all known to be present. Since 2011, Chinese tallow trees have been treated and monitored on the Refuge.

Preliminary Project Proposal and Land Protection Plan

Prior to acceptance into the Refuge System, a final EA and Decision Document for Little Sandy NWR was developed and subsequently published on December 12, 1986; this document supported the acceptance of the easement. The easement was therefore accepted by Regional Director, Mike Spear, shortly thereafter. Since then, no additional land protection planning efforts have been conducted on the Refuge.

A Land Protection Planning Process would provide opportunities for the Service to acquire surrounding properties that promote strategic habitat conservation. Desired habitat conditions would be considerations for available properties. The acquisition boundary would provide an area of interest for surrounding and buffering the current Refuge boundary.

Landscape Level protection is a high priority for Little Sandy NWR and surrounding areas. At least 18,000 acres are protected by other agencies in the immediate vicinity of the Refuge; however, no land protection plan has been prepared to link the individual sites. There are numerous sites, such as an old growth forest adjacent to the Refuge, that are considered high priority to the Service, TPWD, The Nature Conservancy, The Conservation Fund, and The City of Mineola that should be considered as part in a land protection plan.

Since a Land Protection Planning process has not been initiated on the Refuge, the Service has not attempted to acquire adjacent fee title lands even though surrounding landowners have expressed interest in selling their lands.

5.5 Refuge Projects

The following list of Refuge projects have been identified as needed to fulfill the goals and objectives identified in Chapter 4: Management Direction.

5.5.1 Existing Projects

5.5.1.1 Habitat Management Projects

In 2008, a study was initiated to provide a Description of Old-Growth Characteristics of Bottomland Hardwood Forests at Little Sandy NWR (Appendix G).

The study involved the development of a detailed floristic description of the old-growth bottomland hardwood forests using existing data collected by the USGS, National Wetland Research Center. The study was completed in 2012 by Dr. Susan C. Carr, from the University of Wisconsin. The objective of the project was to determine the composition and structure of old-growth bottomland hardwood forests that make up the bulk of Little Sandy NWR. The quantitative old-growth description includes the relative abundance and frequencies of component woody species, the composition of understory vegetation, and forest characteristics related to snags and downed trees. The project was completed in 2 phases.

<u>Phase I</u>
This part of the study involved the development of a detailed description of the forests of Little Sandy NWR based on existing field data collected in the fall of 2007-2008 by Bob Keeland of the USGS, National Wetland Research Center, Lafayette, Louisiana. Phase I involved the analysis of existing USGS vegetation data, and produced quantitative descriptions of vegetation composition, relative abundance, and forest structure. This portion of the study began in fall 2010 with the acquisition, management, and quality control of the existing field data. Further work will involve development of a GIS database, evaluation of the existing dataset relative to

the study goals, and preliminary analysis leading to a description of old-growth characteristics of Little Sandy NWR forests. The Phase I portion of the study was completed in 2011.

Phase II
This part of the study was to develop a model of vegetation and environmental relationships. Specifically, patterns in community composition and forest structure would be related to edaphic and topographic landscape features. This phase of the study was contingent on analysis of the existing USGS dataset (Phase I) to determine additional field and digital data needs for the Phase II project.

Lastly, the incorporation of specific soil descriptors in their model of environmental-vegetation variation was accomplished. For this, soil samples from a subset of vegetation plots at Little Sandy NWR to tie soils to physiographic features of the floodplain were collected. Soil analysis included quantification of texture (percent sand, silt, clay), organic matter, pH, electrical conductivity, and macronutrients (nitrate-nitrogen, phosphorus, calcium, magnesium, and sulfur), and micronutrients (iron, zinc, manganese, and copper). Site specific soil metrics provide quantitative and continuous explanatory variables for our correlative model of vegetation variation.

The report can be found in Appendix G.

5.5.2 Future Projects

5.5.2.1 Habitat Management Projects

Little Sandy NWR Vegetation Inventory
The LSNWR provides a unique bottomland hardwood forest community and one of the most pristine old growth forests in the state of Texas. The relationship between flora and fauna should be monitored for long-term observational data on old-growth development and changes in wildlife use. Little Sandy NWR is arguably the highest quality bottomland hardwood site in the West Gulf Coastal Plain and one of the highest quality sites in the southern United States. Very little of the club has been modified since the site was purchased in 1907, and the majority of the 3,802 acres may never have been cut. This is one of the few locations that an intact, old-growth site can be studied in the southeastern united states.

Because of the desire to participate in adaptive responses as described in Goal 4, a thorough understanding of the current flora conditions of Little Sandy NWR is necessary. This project would involve a Refuge-wide survey of the Refuges wildlife resources using various methods including historical imagery and tabular data, LiDAR, existing maps and records, contemporary ortho-rectified imagery, ground truthing, and on-screen digitizing to establish a decision-based research and monitoring program for the Refuge.

Invasive Flora Species Control

There are a number of invasive species on the Refuge: Chinese tallow, Chinese privet, silktree, Chinaberry, Nandina and Japanese honeysuckle are known to be present. Since 2011, Chinese tallow trees have been treated and monitored on the Refuge.

This project will involve the identification of pockets of invasive plant species and the use of appropriate herbicides to control these invasive species. It also will compare the vegetation and avian communities of old-growth bottomland forests of Little Sandy NWR with the adjacent younger forests of Old Sabine Bottoms Wildlife Management Area. In a cooperative project between TPWD and the Service funded primarily by TPWD, Stephen F. Austin State University will analyze the avian communities and describe the bottomland hardwood forest communities at Old Sabine Bottoms and contrast those communities with the old-growth communities of Little Sandy NWR. This study also will use data developed by Dr. Susan C. Carr based on the field studies of the USGS, National Wetland Research Center.

5.5.2.2 Wildlife Management Projects

Little Sandy NWR Wildlife Survey
Little Sandy NWR has conducted two flora inventories: a forest condition assessment and a USGS inventory of flora. Since a major portion of the Refuge is undisturbed, the Refuge serves as an ideal study site to establish a baseline inventory of fauna that is representative of bottomland hardwood habitat. Because of its relative pristine nature, any potential impact from climate change, both positive and negative, can be adequately assessed, independent of other influences.

Forest Dwelling Landbirds
Refuge staff continues to conduct annual bird point counts (18 points) on the Refuge that were initiated in 2008 and will work with the Inventory and Monitoring staff to ensure that regional protocols are being followed to maximize the use of existing and future data sets.

Bats
The Refuge staff completed annual mobile acoustical bat monitoring surveys in 2014 and 2015 to establish a baseline inventory of bat species in and around the Refuge. Future surveys are planned to determine population trends and species diversity present on the Refuge.

Waterfowl
Monthly (October – March) aerial waterfowl surveys were conducted on the Refuge to provide an index of the waterfowl species utilizing the Refuge. The surveys were negated in 2011.

Because of the desire to participate in adaptive management, a thorough understanding of the current fauna of Little Sandy NWR is necessary. This project would involve a Refuge-wide survey of wildlife resources, using various methods including historical imagery and tabular data, existing maps and records, contemporary ortho-rectified imagery, ground truthing, and on-screen digitizing; develop and establish a decision-based research and monitoring program.

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 participation by the LSHFC and the State of Texas as well as neighboring landowners. 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.

These partnerships supports achievement of Habitat Goal 1, Objective 3 as identified in Chapter 4: Management Direction.

5.7 Monitoring and Evaluation

Monitoring and evaluating helps track the progress of implementing the CCP. The results of monitoring show how objectives are being achieved and measure progress towards accomplishing goals. Proposed monitoring and evaluation plans will be refined as various step-down management plans are drafted or revised.

The Refuge will conduct implementation status monitoring of the CCP to evaluate the efficiency and effectiveness. The goals of Refuge monitoring are:

- To evaluate, document, and report on the progress of the Goals, objectives and strategies of the CCP,
- Determine how well the Plan meets its stated goals, and,
- Determine if the Plan's purpose and direction remain appropriate.

Table 5.8 displays proposed monitoring and evaluation projects for fish, wildlife and their habitats. These proposed monitoring techniques will be refined as various step-down management plans are drafted or revised.

5.8 Plan Amendment and Revision

Periodic review and change of this CCP will be necessary. As knowledge of Refuge resources, user groups, and use evolves, changes in management may be identified. Fish and wildlife populations, adjacent land users, and other management considerations may change in time. Challenges also may be encountered 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 objectives and strategies identified to reach goals can be adjusted as needed.

This CCP will be informally reviewed by Refuge staff while preparing annual work plans. It may also be reviewed during routine inspections or programmatic evaluations. Results of the

reviews may indicate a need to modify the CCP. The monitoring and evaluation of objectives is an integral part of the CCP, and management activities may be modified if desired results are not achieved. If minor changes are required, the project leader will determine the level of public involvement and associated NEPA documentation. This CCP will be formally revised at least every 15 years.

Objective Number	Effectiveness Measures	Monitoring Techniques	Reliability	Time Factors	Cost Factors*	Personnel	Link to regional monitoring
Habitat Objectives							
Initiate Proceedings to Complete and Approve an LCD, LPP and PPP	Support partnership driven planning efforts to produce a Land Protection Planning Process	NA	NA	Seven years from the date of CCP approval	$$	Refuge Staff, RO	NA
Complete and Approve a Fire Management Plan	Completion and approval of a Refuge Fire Management Plan	NA	NA	Two years from the date of CCP approval	$	Refuge Staff, Fire Staff	NA
Partnerships	Meet and collaborate with existing partners	NA	NA	Quarterly	$	Refuge Staff	NA
Enforce Conditions of the Conservation Easement	Conduct Refuge inspections for violations of negative covenants	Visual comparison	NA	Annual	$$	Refuge Staff	NA
Refuge Habitat Survey	Completion of a Refuge-wide survey of wildlife resources	NA	NA	Five years from the date of CCP approval	$$$	Refuge Staff, Partners	NA
Invasive Fauna Species	During Refuge habitat survey, identify areas with exiting, or prone to, invasive flora	NA	NA	Five years from the date of CCP approval	$$$	Refuge Staff, Partners	NA
Wildlife Objectives							
Hog Eradication	Completion and approval of a strategic feral hog pest plan	NA	NA	One year from the date of CCP approval	$	Refuge Staff	NA

Nuisance Species	Completion and approval of a strategic nuisance species management program	NA	NA	Two years from the date of CCP approval	$	Refuge Staff	NA
Refuge Habitat Survey	Completion of a Refuge-wide survey of wildlife resources	NA	NA	Five years from the date of CCP approval	$$$	Refuge Staff, Partners	NA
Climate Change Objectives							
Combine Refuge Habitat and Wildlife Surveys	Combine both habitat and wildlife inventories to develop a comprehensive baseline of Refuge resources	NA	NA	One year from the respective completion of habitat and wildlife surveys	$ $ $	Refuge Staff, Partners, RO	NA

Table 5-4 Biological inventory and monitoring

*Cost factors are highly dependent on budget any given year.

$ - Refuge can accomplish with existing funding
$$ - Some addition funding needed
$$$ - Significant funding needed

Terminology

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: physical evidence or place of past human activity.

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.

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: Landscape dominated by trees. For impacts analysis in CCPs, we assume most 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 [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-jursdictional 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, pubic 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*).

Un-fragmented 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
ARPA	Archeological Resources Protection Act
BCR	Bird Conservation Region
CAP	Contaminant Assessment Process
CCP	Comprehensive Conservation Plan
CD	Compatibility Determinations
CPCI	Coastal Prairie Conservation Initiative
CO_2	Carbon dioxide
DEEP	Discovery Environmental Education Program
EA	Environmental Assessment
EE	Environmental Education
EIS	Environmental Impact Statement
EPA	Environmental Protection Agency
EQIP	Environmental Quality Incentives Program
EO	Executive Order
ESA	Endangered Species Act
FM	Farm-to-Market (State secondary road)
FONSI	Finding of No Significant Impact
FR	Federal Register
FRWC	Fossil Rim Wildlife Center
FTE	Full-time equivalent
GIS	Geographic Information System
GCP&M	Gulf Coast Prairies and Marshes
GLO	General Land Office
GS	General Schedule (pay rate schedule for certain Federal positions)
IPCC	International Panel on Climate Change
IUCN	International Union for Conservation of Nature
KPC	Katy Prairie Conservancy

lbs.	Pounds
LCC	Landscape Conservation Cooperative
LCRA	Lower Colorado River Authority
LEED	Leadership in Energy and Environmental Design
MOU	Memorandum of Understanding (Agreements)
MOU	Memorandum of Understanding (Agreements)
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
NO_2	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
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)
WGCP	West Gulf Coastal Plain
WWF	World Wildlife Fund

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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, rulemaking, 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 (pump-outs), 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**

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)(l) 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.

Appendix B. Environmental Assessment

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) and incorporated Forest management Plan (FMP) for the Little Sandy National Wildlife Refuge (NWR), which would guide management on the Refuge for the next 15 years. This Environmental Assessment (EA) is being prepared to evaluate the effects associated with this proposal and 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 that this EA complies with). NEPA requires examination of the effects of proposed actions on the natural and human environment. In the following chapters, we describe two alternatives for future Refuge management, the environmental consequences of each alternative, and our proposed management direction.

The environmental consequences of each alternative are described below and form the basis for selection of the proposed action. This EA was designed to cover the environmental consequences of management actions discussed herein.

1.2 Location

Little Sandy NWR is situated in Wood County, Texas within the flood plain and overflow bottoms of the Sabine River and is made up of 3,802 acres of bottomland hardwoods, oxbow lakes and shrub swamp habitats. The Refuge is approximately 7 miles south of the small community of Hawkins, Texas, which is 80 miles east of Dallas, Texas.

1.3 Background

Beginning in 1898, several farsighted sportsmen began traveling east from Dallas seeking land for a hunting and fishing club. Specifically, the gentlemen were looking for big woods where they could establish a club devoted to squirrel hunting, duck hunting, and fishing. Traveling on the Texas & Pacific Railroad, they reached a great eastern deciduous forest approximately 80 miles east of Dallas. The original 3,009-acre tract, which forms the nucleus of the club, was purchased in 1906 and incorporated as Little Sandy Hunting and Fishing Club (LSHFC) on April 17, 1907. The club was named after Little Sandy Creek, which reaches from springs in the Eocene sand outcrops of eastern Wood County. The club property included the land between the Texas & Pacific tracks and the north bank of the Sabine River. Little Sandy NWR has two major

man-made lakes that are modified oxbow lakes near the amenities. Brumley Lake was modified and enlarged between 1908 and 1911. In 1922, the levee for the Lake was raised an additional two feet to place Brumley Lake at or near its current depth. Overton Lake, the other major lake, was constructed in 1949 and - was formed from an existing oxbow lake.

The first clubhouse, known as the Men's Clubhouse, was constructed in 1907 and remained the cornerstone of LSHFC until 1980. Since then, 37 other administrative and residential facilities have been constructed on approximately 10 acres on the upland portion adjacent to the Refuge. In addition to these structures, another 50 or so boathouses and subsequent docks were developed on the northeastern corner of Brumley Lake. These developed areas were retained by the LSHFC and are not part of the Refuge easement.

LSHFC currently has a membership of 84, each member owning one share of stock. A Board of Directors governs the Club, which reports to all the members of the Club. In addition, the management of the Club is the responsibility of several committees, including the Grounds, Hunting, and Fishing committees. These committees, with the approval of the Board and members, direct the operations of the Club, which are carried out by the Club Manager and his staff.

In December of 1986, the Service accepted a permanent, non-development conservation easement donation of 3,802 acres of land owned by the LSHFC to become part of the National Wildlife Refuge System. There was no funding required for the conservation easement and conditions of the easement including maintaining the use of the site as a hunting club by the LSHFC into perpetuity. This non-development easement prohibits the conversion of these lands to other land practices such as timber harvest or alteration of wetlands notwithstanding specific authorization by Congress.

Not everyone agreed with the process by which Little Sandy NWR was established, and the Sabine River Authority (Sabine River Authority, et al. v. US Department of Interior, No. 90-4761) filed a lawsuit in 1987 against the Department of Interior. The Sabine River Authority and the Texas Water Conservation Association had plans to construct the Waters Bluff Reservoir, a $158 million, forty-five thousand acre project along the Sabine River in Smith, Upshur, and Wood Counties. The project would construct a reservoir, aimed at satisfying the anticipated needs for additional water over the next forty years. The project was still in the preliminary stages, and none of the federal and state permits had been obtained, no funding had been secured, and no contract had been finalized for the 300 thousand acre feet of water that the reservoir would generate each year. The property owned by the LSHFC was located within the project area and the Service negotiated a conservation easement on the property, establishing the Little Sandy NWR, which stopped the State of Texas from taking the property by means of eminent domain.

The lawsuit was filed in the Eastern District of Texas alleging that the Service had failed to comply with the procedural requirements of NEPA by not preparing an Environmental Impact Statement (an "EIS") in connection with its acquisition of the Little Sandy non-development easement. They alleged that the easement was interfering with their long-term plan to take the property by eminent domain, construct the Waters Bluff Reservoir, and thus insure that the

state's water supply would not be placed in jeopardy in the calendar year 2030. Invoking NEPA, they asserted that the Service's acquisition of the easement constituted a "major federal action significantly affecting the quality of the human environment," 42 U.S.C. § 4332(2)(C), thereby necessitating the preparation of an EIS.

In a comprehensive opinion, 745 F. Supp. 388 (E.D.Tex.1990), the district court dismissed their claims by way of summary judgment. The court reasoned that the Service had prepared an adequate Environmental Assessment (the "EA") and had issued a "Finding of No Significant Impact" ("FONSI") as a precursor to acquiring the easement. Concluding that there was no corresponding change in the physical environment flowing from the acquisition of the non-development easement, the district court held that the Fish and Wildlife Service's decision to forego an EIS was not arbitrary and capricious. Id. at 392-97. It dismissed the lawsuit, and an appeal to the United States Court of Appeals, Fifth Circuit followed who subsequently affirmed the lower court's decision. Once again, the Sabine River Authority appealed and attempted to take their case to the U.S. Supreme Court; however, the Court did not place it on their agenda, thereby affirming the decision by the United States Court of Appeals, Fifth Circuit.

It is understood and agreed by the parties that this easement imposes no limitations or restrictions on the fee simple title of the LSHFC, other than those set forth within the conservation easement. The LSHFC retains the right to control use of, and access to, the land and may continue to use the land and water for hunting, fishing, oil and gas exploration, drilling and production, and for any other purpose consistent with the intent of this agreement to maintain the land and water as wildlife habitat, subject to the following restrictions and limitations.

The LSHFC shall not (except in connection with exercising and enjoying the rights reserved to it generally and specifically listed above):

1. Permit or authorize any use that will alter the current topography or vegetative cover, in either a temporary or permanent manner, through the transfer of pertinent surface or subsurface rights, including timber rights, or by any other means without the written concurrence of the U.S. Fish and Wildlife Service.

2. Drain or permit the drainage of any wetlands presently occurring or recurring due to natural causes through the transfer of appurtenant water rights or by any other means, except for the purpose of operating "greentree reservoirs", consisting of flooding certain portions of the area concerned for not more than five months per year.

3. Construct or permit the construction of any roads, trails, buildings, fences, or other structures, in, on or across the land except as the outer boundary, without the specific written concurrence of the U.S. Fish and Wildlife Service; except that the LSHFC may erect and maintain permanent or temporary hunting blinds for waterfowl or game animals and roads that reach them.

4. Apply or permit the application of insecticide, herbicide, or other chemical to the surface, vegetation, or atmosphere of the land or water covered hereby, without the written concurrence of the U.S. Fish and Wildlife Service, except the LSHFC may use herbicides or other chemical to eliminate or control vegetation in its lakes.

5. Grant additional easements, rights-of-way, or other similar interests in the aforesaid land without the written concurrence of the Service except such rights-of-way, permits, easements, or leases as are necessary for the development of mineral interests held by LSHFC.

With bottomland hardwoods, oxbow lakes, and planera swamps that exemplify the east Texas ecosystem, the mission of the Refuge is to promote complete preservation of possibly the best remnant old growth bottomland hardwood in Texas, thus protecting, enhancing, and preserving wildlife dependent on this habitat. Many of the breeding birds that frequent the Refuge are dependent on the bottomland hardwoods for nesting. The birds that frequent the Refuge are reliant on deep tracts of bottomland hardwoods like those located on the Refuge.

The Refuge was established under the authority of the:

- Migratory Bird Conservation Act (16 U.S.C. 712d) also established that the Refuge is: *"for use as an inviolate sanctuary, ...for any other management purposes, ...for migratory birds"* which utilize the area during the spring and fall migration.

Little Sandy NWR is a part of a Complex of four Refuges: Little River, Caddo Lake, Little Sandy and Neches River National Wildlife Refuges. The only permanent staff in this Complex is assigned to Little River, Caddo Lake, and Neches River NWRs. As such, there are no staff permanently assigned to Little Sandy NWR; however, staff from Little River, Caddo Lake NWR and Neches River NWRS will work at Little Sandy NWR.

1.4 Purpose of Action

The purpose of the proposed action is to specify a management direction for Little Sandy NWR over the next 15 years. The purpose of the EA is to:

- select a management direction for the Refuge that best achieves the Refuge's purposes, vision, and goals;
- contribute to the mission of the National Wildlife Refuge System;
- be 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 this draft CCP.

1.5 Need for Action

The action is needed because adequate long-term management direction does not currently exist for the Refuge. 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 that each Refuge is managed to fulfill the mission of the National Wildlife Refuge System and the purposes for which the individual Refuge was established.

1.6 Decision to be Made

The Regional Director for the Southwest Region (Region 2 of the U.S. Fish and Wildlife 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 implementation of the Proposed Action can proceed.

The Refuge's proposed action is Alternative B. If 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 Refuge was established, and other legal mandates. Once the FONSI is signed, the CCP will be implemented, monitored and evaluated 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 purposes 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, 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 purpose for which the Refuge was established. Refuge purposes are stated in the laws that established the Refuge and provided the funds for acquisition. 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.

This EA was prepared by the Service and represents compliance with applicable Federal statutes, regulations, Executive Orders, and other compliance documents. Appendix A of the CCP 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.

1.8 Scoping/Public Involvement and Issues Identified

The formal planning process begins with the scoping period, which involves a thorough assessment of issues, concerns, opinions, thoughts, ideas, concepts, and visions for the Refuge. Formal scoping began with publication of a Notice of Intent to prepare a CCP and EA, which was published in the *Federal Register* on August 16, 2007 (Volume 72, Number 158, pp. 46095-46097). One public meeting was held in Hawkins, Texas at Jarvis College on September 9, 2009. The meeting was announced through a planning update mailing and a public notice; four individuals attended.

In addition, the Service provided a news release and sent out 118 letters and emails to potential interested parties announcing the initial scoping period for development of this EA. During the scoping period the Service received 6 response letters or emails with comments that were considered as part of this analysis. The lack of public response is believed to be a result of the Refuge being a conservation easement and not accessible to the general public.

The feedback that was provided during the public scoping period identified concerns from a limited number of stakeholders. The issues and concerns provided the basis for developing the Refuge's management direction and played a role in determining desired conditions for the Refuge. The issues for the Refuge to address are divided into two categories: Habitat and Wildlife.

1.8.1 Habitat Management

Climate Change
The Service believes that there are concerns regarding the effect climate change may have on the Refuge System. The Service acknowledges that climate change has the potential to alter the distribution of habitat types in Texas and the rest of the world; as habitats change, the wildlife species that inhabit those habitats will also change. Although the Refuge can do little to resolve this issue, it can recognize when change is occurring, document changing conditions through data collection, and adapt management to reflect changes in hydrology and plant communities. Concerns regarding climate change also indicate the need to develop baseline data on Refuge habitat resources so that the Refuge can appropriately respond to changing conditions.

Land Acquisition
Currently, the Refuge boundary is comprised of 3,802 acres, but high value wildlife habitat (old growth bottomland hardwoods) exists in areas surrounding the Refuge. These including the Old Sabine Bottoms Wildlife Management Area (5,726 acres managed by Texas Parks and Wildlife Department and immediately south of LSNWR), the Mineola Nature Preserve (2,960 acres managed by the City of Mineola), the Burleson Wetland Partners (2,650 acre Forest Legacy property and wetland mitigation bank), and two other small mitigation banks (approximately 500 acres). The immediate landscape includes over 15,500 acres of habitat devoted to conservation

purposes. In recent years, there has been interest from landowners to sell bottomland hardwood habitat and uplands to the Service. The development of a Landscape Conservation Design (LCD), for the Sabine River Watershed is needed to prioritize future land acquisition planning efforts (fee title, donations, conservation easements, etc.) to address the sustainability of bottomland and upland habitats for trust resource species. The LCD will insure, future planning for Refuge expansion and land conservation, are consistent with the goals and objectives of the overall larger natural resource partnership within the watershed. This assessment is the first step toward the development of a Land Protection Plan, that would enhance and promote conservation efforts of wildlife habitats in this area of Texas.

Flora Inventory

An initial habitat assessment ecological community characterization was completed upon the acceptance of the Refuge into the Refuge System. In 2008, the USGS, National Wetland Research Center began a flora survey for LSNWR completed in 2012 by Dr. Susan C. Carr, a private consultant. The Refuge has identified that the continued monitoring of the Refuge habitat is critical for monitoring changes, determining long and short term ecological integrity, determining habitat diversity, and tracking the effects of climate change,

Prescribed Burning

The southern yellow pine ecosystem in the uplands habitat evolved with periodic fires, from either lightning strikes, or the practice of Native Americans. Fires would spread across vast areas, driven by an abundance of highly flammable ground fuels such as pine needles and grass, and lack of fabricated barriers such as highways and lakes. In the absence of periodic fires, the grass community disappears and replaced by shade tolerant hardwoods. The loss of this pine savannah type habitat has led to the decline of many fauna species that were once associated with it.

There is currently no prescribed fire program on the Refuge. The Refuge staff believes that establishing a prescribed burning program within the suitable fire regime habitats identified on the Refuge would contribute to a healthy upland environment. The Refuge will develop a Fire Management Plan to implement prescribed fire on the Refuge to meet resource goals and objectives.

Water Body Management

The LSHFC currently has the ability to manage water levels through water control structures on Brumley and Overton Lakes. Both lakes had different objectives when they were constructed by the LSHFC. Brumley Lake contains a portion of an oxbow lake that was present before the construction of the levee and was designed and built for fishing activities with waterfowl hunting a secondary consideration.

Overton Lake was constructed with an emphasis on waterfowl hunting. The water supply for each lake originates from different sources. The water control structures were strategically installed so that the lakes could be managed together or as separate units.

Brumley and Overton Lakes currently experience eutrophic conditions in which the water carries high amounts of nutrients and wide swings of dissolved oxygen are present. By manipulating the

water level in the lakes, a more natural habitat and associated aquatic vegetation regime could be established to control the spread of invasive flora species. Conducting periodic draw downs and flooding events on the lakes would promote migratory bird usage and improve fisheries capabilities. These management practices could be used under this alternative with the existing water control mechanisms should the LSHFC agree.

The LSHFC retains ultimate control of water management within the Refuge. The Service and LSHFC will continue to coordinate and collaborate on best management practices that promote sustainable hunting, fishing and other recreational activities within the watershed. Water management is critical to support healthy vegetation, support waterfowl and other wetland-dependent wildlife and promote a healthy fisheries resource.

Invasive Species Management (Flora)
Little Sandy NWR is infested with several invasive plant species (Chinese tallow, Chinese privet, Silk tree, Chinaberry, Japanes honeysuckle, and Nandina), which can negatively impact the native habitat and wildlife species on the Refuge. Invasive plant species can affect the natural landscape by displacing native vegetation and reducing the quality of the habitat for native wildlife species. To address invasive species on Little Sandy NWR, funding has been allocated annually since 2011 to treat areas of infestation on the Refuge. The funding has been utilized to purchase herbicide and treat the known areas infested on the Refuge. A thorough assessment of the Refuge is needed to identify and map the areas on the Refuge impacted by invasive species. This assessment will identify target areas for treatment and will establish a baseline for comparison for future treatments.

The Refuge staff and the State of Texas are deeply concerned about the spread of invasive species into Brumley and Overton Lakes, and feels that proper water body management would reduce and or eliminate invasive species from entering and spreading in these aquatic systems. The Refuge will work with LSHFC to assess and monitor the water bodies to detect invasive species. Early detection will assist in limiting the spread of invasive species and will promote effective control measures.

1.8.2 Wildlife Management

Fauna Inventory
To date, no comprehensive fauna inventory has been completed for the Refuge. The Refuge, along with TPWD, believes that there is a need to establish baseline data and that such data is critical for determining long and short term ecological integrity, habitat diversity and tracking the effects of climate change. The Refuge staff completed monthly aerial waterfowl surveys from 2008-2011. The surveys were scheduled to be completed October through March, but the lack of staff limited the number of surveys completed annually. The data provided the Refuge with a snapshot of waterfowl presence, but was not collected consistently to determine an accurate index of waterfowl use on the Refuge.

The Refuge staff began conducting bird point count surveys on the Refuge in 2008 and continues on an annual basis. Refuge staff implemented the forest breeding bird monitoring program in accordance with the guidelines and protocol established by the Lower Mississippi Valley Joint

Venture. Refuge staff conducted mobile acoustical bat surveys in 2014 and 2015. The survey was implemented to establish baseline inventory of bat species at the Refuge and contribute to a landscape- level understanding of bat population trends and habitat associations. A complete fauna inventory of the Refuge paired with the bird point monitoring, and collecting biological data from harvested fauna by the LSHFC would establish baseline data. This would allow the Refuge to successfully orient future wildlife management programs toward species that are present on the Refuge as well as enable the Refuge staff to track potential impacts of climate change.

Nuisance and Invasive Species Management (Fauna)
Beaver activity occurs throughout the bottomland hardwood areas of the Refuge and surrounding areas. While beavers can be an important component of a healthy ecosystem, they can also cause problems to Refuge infrastructure. During the winter months, the dam constructing activities of beavers can cause flooding in bottomland hardwood forest, which can promote wetland habitat for waterfowl and other wetland-dependent species, however, the opposite is true in the spring and summer months when permanent flooding can stress and ultimately kill trees. Permitting beaver activities that cause serious destruction of native bottomland hardwood trees is counterproductive to the Refuge's efforts to preserve and restore the bottomland hardwood forest. Standing water on access trails and bottomland hardwood trees during this time-frame is debilitating to both. The LSHFC staff currently removes beaver dams from culverts and small drains to restore drainage, but the number of beaver trapped by club staff is low. As such, beaver activities continue to restrict the flow of water through water control structures. The Refuge staff and the TPWD believe that continued dam removal in combination with additional beaver trapping would maintain the beaver populations at a manageable level to ensure no long-term negative impacts occur within the bottomland hardwood forest of the Refuge.

Feral hog activity is present throughout the Refuge and surrounding region and their presence is widely noted by habitat destruction resulting from their foraging for food, which subsequently impacts the habitat, threatens native wildlife species, and degrades water quality.

In 2012, feral hogs became increasingly observable on the Refuge, and their damaging effects from rooting could be observed throughout the forest floor. In an effort to control and eliminate the feral hog population, the Refuge received appropriated funds (invasive species funding) in 2013 that was directed to implement a feral hog trapping program with assistance from the LSHFC. The Refuge worked with the LSHFC to install traps that would be used to begin removing feral hogs from the Refuge. The use of trapping and shooting by the club members continues to be the management strategy implemented to remove feral hogs from the Refuge. The damaging effects to native wildlife and the environment from feral hogs require continual implementation of a control program. The Refuge will continue to work with the LSHFC to implement a feral hog management program to reduce/eliminate the feral hog population and the damaging effects to the environment caused by this invasive species.

2.0 DESCRIPTION OF ALTERNATIVES

Alternatives are different approaches or combinations of management actions designed to achieve a Refuge's purposes and vision, the goals identified in the plan, the goals of the Refuge System, and the mission of the Service. Based on the issues, concerns, and opportunities at Little Sandy NWR, the Service and the LSHFC will need to work collaboratively within the parameters and stipulations of the conservation easement, to establish a management direction that addresses the resource needs of the Refuge in balance with the goals and objectives of LSHFC. The continued coordination will ensure the best management alternative is implemented that is acceptable to both the Refuge and the LSHFC.

This EA considers two alternatives in detail (see section 2.4), which cover a reasonable range of alternatives. 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. 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.

2.1 Alternatives Analyzed in Detail

The following alternatives were developed to comply with NEPA and to provide ways to address a number of issues, concerns, and opportunities that were 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 alternatives respond to issues or concerns identified during the planning process.

Comparison of Alternatives		
Issue Topic	**Alternative A: No Action Alternative (Current Management)**	**Alternative B: Proposed Action**
Habitat Management		
Climate Change	The Service has limited activities at Little Sandy NWR; as such, the Refuge attempts to limit carbon footprints by consolidating trips from Caddo Lake NWR; what few trips are made to the Refuge are offset by the conservation of the bottomland hardwood habitat found on the Refuge. There are no Service facilities present on the Refuge; therefore, there is no effort to utilize green products commonly associated with such facilities.	The Refuge would establish a baseline dataset for Refuge resources. To do so, the Refuge would use technologies including historical imagery and tabular data, existing maps and records, LiDAR, contemporary ortho-rectified imagery, ground-truthing and on-screen digitizing. This baseline dataset would enable the Refuge to develop a decision-based research and monitoring program to track potential impacts from climate change on the Refuge. There would be no Service development of facilities on the Refuge.
Land Acquisition	The Service would work within the 10% rule which allows Refuge expansion to occur up to 10% of the total Refuge establishment acres within the Refuge or up to 1 mile of the existing Refuge boundary. This includes fee acquisition and conservation easements from willing sellers or donors.	The Refuge will participate in a partnership driven Land Protection Planning process that would guide land acquisition efforts and provide the opportunity to acquire any adjacent lands from willing sellers. Both bottomland and upland tracts would be considered in the plan.
Flora Inventory	An initial habitat assessment of the Refuge was completed by Refuge staff when Little Sandy was incepted into the Refuge system and an additional ecological community characterization survey was conducted by the U.S. Geological Survey's National Wetland Research Center. Current inventory activities are limited to identification and confirmation of invasive flora species when Little Sandy Hunting and Fishing Club (LSHFC) members report them.	Same as Alternative A plus the development of a comprehensive species list for the Refuge would be beneficial for determining ecological integrity and habitat diversity as well as providing a baseline dataset from which any changes to habitat as a result of climate change and management activities can be tracked.

Comparison of Alternatives		
Issue Topic	**Alternative A: No Action Alternative (Current Management)**	**Alternative B: Proposed Action**
Prescribed Burning	There is currently no prescribed fire plan or program on Little Sandy NWR. A Fire program would mimic natural fire ecology and be beneficial to upland habitat.	The completion and implementation of a step-down fire management plan would be focused on mimicking natural fire ecology on the upland portions of the Refuge, controlling invasive flora species, reducing fuel loads from wildfires and promote pine savanna habitat.
Invasive Species Management (Flora)	Limited management activities are present in the form of chemical (Garlon 3A and Garlon4) treatments when identified by LSHFC members. In 2011 and 2012, limited funding was available to treat Chinese tallow and privet.	Same as Alternative A plus increased efforts to locate, map, treat, and monitor these, as well as other invasive species, which may be present on the Refuge. In addition, some stumps may be cut and sprayed to minimize spread of invasive species. This can be conducted in conjunction with the Flora Inventory as described above. Prescribed burning can also be used to treat with the production of a fire management plan.
Water Body Management	Brumley and Overton Lake levels managed by LSHFC for recreation and hunting purposes; the Refuge serves in an advisory function only.	Same as Alternative A.
Wildlife Management		
Fauna Inventory	Annual aerial waterfowl surveys were conducted between October and March, from 2008 – 2011, on a monthly basis by the Region 2 pilot and a Refuge staff member. Aerial surveys were halted in 2011 when the Region no longer had a plane. In addition, annual bird point counts are conducted with assistance from Region 2 migratory bird biologist, Texas Parks and Wildlife biologist and Refuge staff each spring in May and June.	Same as Alternative A, plus expand current wildlife monitoring on the Refuge and coordinate with the Division of Biological Sciences. This alternative would also provide an opportunity to utilize LiDAR to monitor changes in habitat throughout the Refuge. The alternative includes; expansion of bird points and monitoring to meet Service standards, continuation of on the ground waterfowl surveys and the collection of biological data from fauna harvested by the LSHFC.

Comparison of Alternatives		
Issue Topic	**Alternative A: No Action Alternative (Current Management)**	**Alternative B: Proposed Action**
Nuisance and Invasive Species Management (Fauna)	The LSHFC staff identifies and removes beaver dams throughout the year from culverts and small drains to promote drainage and maintain trails. Hunt club members may take hogs during other hunting activities, but these circumstances are opportunistic and relatively rare; there have been coordinated trapping efforts between the Service and LSHFC since 2013.	Under this alternative, the Refuge will develop step down management plans focused on nuisance and invasive species management. Step Down Plans would be initiated for an Invasive Species Management Plan, a Feral Hog and Beaver Management Plan. Step Down Management Plans may initiate management practices for nuisance species (beaver, nutria), such as dam removal and trapping, reducing the negative impacts to existing infrastructure. Additionally, the Refuge will utilize their own staff or contract services to conduct hunting and trapping of feral hogs.
Refuge Base Operational Budget	$0	$612,476.00
Annual Maintenance	$0	$0
Fire Operations	$0	$0
Tallow/Forest Inventory	$18,884.00	$18,884
Total Budget	**$18,884.00**	**$631,360.00**
Staff Requirements	0 FTE	2.0 FTE

2.2 Alternative A: No Action Alternative (Current Management)

Under the No Action Alternative, the Refuge would continue as an easement refuge with no public use activities. Bottomland hardwood forests would continue to be protected. Service staff would continue to serve as a consultant role for LSHFC activities and management objectives.

2.2.1 Habitat Management

Climate Change
There is currently no management activity being conducted on Little Sandy NWR in regards to climate change. The Service has limited activities at Little Sandy NWR; as such, the Refuge attempts to limit carbon footprints by consolidating trips from staff from other Refuges in the Complex. What few trips are made to the Refuge are offset by the conservation of the bottomland hardwood habitat found on the Refuge. Further, since the Service does not have any facilities on the Refuge, there is no effort needed to utilize green products generally associated with increasing the energy efficiency of such facilities. Greenhouse gases, especially carbon dioxide (CO_2) are increasing in the atmosphere, which have been linked to climate change. The bottomland hardwood forest protected at Little Sandy NWR can store large amounts of carbon, a process known as carbon sequestration, which can slow or reverse the accumulation of CO_2 in the atmosphere. Ensuring proper forest management will promote carbon sequestration while providing for wildlife and recreation.

Land Acquisition
The Service would work within the 10% rule which allows Refuge expansion to occur up to 10% of the total Refuge establishment acres within the Refuge or up to 1 mile of the existing Refuge boundary. This includes fee acquisition and conservation easements from willing sellers or donors.

Flora Inventory
An initial habitat assessment of the Refuge was completed by Refuge staff when Little Sandy was added to the Refuge System and an additional ecological community characterization survey was conducted by the U.S. Geological Survey's National Wetland Research Center. Data collections are being used to provide baseline flora information on the Refuge; however, such databases are limited in scope and detail. Since that time, little flora inventory activities have taken place on Little Sandy NWR and is primarily limited to the identification of invasive flora species.

Prescribed Burning
While it is acknowledged that such a program would mimic natural fire ecology and be beneficial to upland habitat, there is currently no prescribed fire plan or program on Little Sandy NWR.

Invasive Species Management (Flora)
There are several invasive species known to be present on the Refuge: Chinese tallowtree, Chinese privet, Silktree, Chinaberry, Japanese honeysuckle, and Nandina. The Refuge was allocated funding in 2011 to treat invasive plant species. The funding has been utilized to purchase herbicide and treat the known areas infested on the Refuge. A thorough assessment of the Refuge is needed to identify and map the areas on the Refuge impacted by invasive species. This assessment will identify target areas for treatment and will establish a baseline for comparison for future

The primary target species for this funding is Chinese tallow and privet. Tallow is rapidly encroaching on openings on the forest floor. Little Sandy has the largest acreage (approximately 3,000 acres) of old growth bottomland hardwood forest in the state of Texas and in the West Gulf Coastal Plain. By use of GPS and mapping software, the Refuge staff should be able to detect infestations and maintain records of herbicide applications that treat infestations. Treatments would consist of the use of herbicides (Garlon 3A and Garlon 4) from a pressurized spray rig. During these treatments, the Refuge staff will monitor treated areas and detect new infestations.

Treatments will take place during the late summer and early fall to allow maximum root intake of herbicides. Basal applications where the cambium has been severed would be the preferred treatment (i.e., “cut stump” application). During the winter months, which are usually wet, the Refuge staff will remove small seedlings which were identified during chemical treatment that can be pulled from the ground by hand. Since both alternatives involve the use of pesticides, some impacts will be the same between each alternative.

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 (U.S. Fish and Wildlife Service, 2009).

The benefits of herbicides in controlling invasive plants must be weighed against the potential for exposure and impacts to human health, non-target organisms, and the environment. The U.S. Environmental Protection Agency (EPA) requires extensive test data from herbicide producers to show that their products can be used safely. 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, 2009). More information about EPA registration and re-registration of chemicals can be found at: http://www.epa.gov/pesticides/.

EPA evaluates both exposure and toxicity to determine the risk associated with the use of a given herbicide. People, non-target flora and fauna, water, and soil may all be exposed directly or indirectly to herbicides during applications and subsequent movement; this exposure can be minimized or avoided by following proper instructions and labels. For wildlife and humans, herbicides may enter the body through the skin, by swallowing, and by breathing. Once herbicides have been applied, the potential for exposure is further influenced by the many biotic (living) and abiotic (non-living) processes that affect the fate of herbicides in the environment.

Herbicide use on national wildlife Refuges must be in compliance 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).

Service policies and Refuge Manual state that Refuges 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 herbicides will be used to meet invasive plant management objectives, then the least hazardous, most effective herbicides will be used to meet those objectives (USFWS, 2009).

Refuge staff must complete a Pesticide Use Proposal (PUP) whenever a pesticide is used on a Refuge, including applications by staff, volunteers, contractors, or in association with a right-of-way easement or a Special Use Permit. The PUPs are usually completed and submitted by individuals with duties related to plant management and knowledge and experience with herbicides. Depending on the type of pesticide and conditions listed in the PUP, the Project Leader may review and approve the PUP or it may require review and approval by the Regional Office or even the Washington Office (WO). The National Integrated Pest Management Coordinator works with a national team to determine the appropriate level of review and approval that each pesticide requires. PUP reviewers examine each PUP for compliance with regulations to ensure that employees use the most specific and effective pesticides with the least risk to manage the target pests.

As outlined in 569 FW 1.9 J, Refuge Managers or Project Leaders must ensure that:

- Pest management decisions are consistent with all applicable policies, laws, and regulations.
- Integrated Pest Management (IPM) plans are developed and include strategies consistent with resource management goals and objectives;
- IPM practices are promoted to land owners and others whose pesticide use may affect Service lands and resources;
- Anyone applying pesticides, releasing biological control agents, and conducting other Integrated Pest Management (IPM) activities has the appropriate training and equipment necessary to protect their safety and health;
- Pesticides are applied only after the Regional IS Coordinator approves the PUP;
- Threshold levels of damage for pest populations are established according to Service or field station goals and objectives and applicable laws;
- Staff must verify that damage levels for pest populations exceed threshold levels at potential treatment sites prior to treatment;

- After treatment, staff determines whether the pest management action achieved the desired results and whether there were any unanticipated or non-target impacts;
- 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, 2009).

In addition to Service policy, the approved PUPs include measures to minimize environmental impacts through the following best management practices:

- Calibrate application equipment;
- Application must be in accordance with chemical label;
- Field scouting/monitoring before pesticide application;
- Use pesticide application buffers around sensitive areas ;
- Use lowest effective application rate;
- Herbicides will not be applied within 100 feet of wetlands;
- Foliar applications will not be made if wind speeds are in excess of 10 mph;
- Pesticides will not be applied after a moderate/heavy rain or if significant rainfall is forecast within 6 hours.

Overall, during their use across both alternatives, pesticides are expected to produce minor, short-term adverse impacts but localized to the site of application. Once the invasive species are treated and subsequently eradicated, there is expected to be moderate, long-term beneficial impacts to the Refuge as a whole since the spread of invasive species will then be controlled. More specific impacts to the physical, biological and human environments are discussed in upcoming sections.

Water Body Management

The LSHFC has reserved sole responsibility of water level management on Brumley and Overton Lakes, and their primary management focus is to maximize the viability of sport fishing and waterfowl hunting opportunities on these bodies of water. As such, water level management on Brumley and Overton Lakes will continue to be the responsibility of the LSHFC with the Refuge continuing to act as a consultant to the club for ecologically-sound water management practices.

2.2.2 Wildlife Management

Fauna Inventory
Annual aerial waterfowl surveys were conducted between October and March from 2008 through 2011 on a monthly basis by the Region 2 pilot and a Refuge staff member. In addition, annual bird point counts were initiated in 2008 and continue annually by Refuge staff, and assistance from Texas Parks and Wildlife biologist. Refuge staff implemented the forest breeding bird monitoring program in accordance with the guidelines and protocol established by the Lower Mississippi Valley Joint Venture.

Nuisance and Invasive Species Management (Fauna)
The LSHFC staff identifies and removes beaver dams throughout the year from culverts and small drains to promote drainage to allow for trail utilization and to deter timber loss. The club actively engages in the removal of beaver dams and beavers when the actively impacts infrastructure and the bottomland hardwood forest habitat. The Refuge staff does not currently participate in beaver management activities.
In addition, feral hog activity is present throughout the Refuge. Their presence and activity disrupts approximately 3,000 acres of native bottomland hardwood habitat which affects the vast majority of the Refuge's size. Presently, hunt club members may take feral hogs during other hunting activities, but these circumstances are opportunistic and relatively rare. The circumstances surrounding the club taking of feral hogs most often revolves around the hogs being present around and damaging the various club residences and facilities. The Refuge worked with the LSHFC to install traps that would be used to begin removing feral hogs from the Refuge. The use of trapping and shooting by the club members continues to be the management strategy implemented to remove feral hogs from the Refuge. The Refuge will develop a feral hog management plan to identify strategies to control the feral hog population on the Refuge.

2. 3 Alternative B: Proposed Action Alternative

This alternative would provide for a proactive approach to making concerted strategic decisions through the consideration and analysis of the best available science for management of the Refuge. This alternative is based on input received from the public, partners and Service staff.

Alternative B represents actions that would best achieve the Refuge's purposes, vision and goals and would contribute to the Refuge System mission. This proposed action, along with associated goals, objectives and strategies, comprises the CCP for Little Sandy NWR. It considers Refuge lands in context with other adjacent lands at the ecosystem level rather than as disjunctive, independent and unrelated units. This alternative also stresses the use of adaptive resource management based upon observation and the most current scientific knowledge.

2.3.1 Habitat Management

Climate Change
Under the proposed action, the Refuge would implement adaptive strategies to monitor Refuge resources. To do so, the Refuge would use technologies including historical imagery and tabular data, existing maps and records, contemporary ortho-rectified imagery, ground-truthing and on-screen digitizing. This baseline dataset would enable the Refuge to develop a decision-based research and monitoring program to track potential impacts from climate change on the Refuge.

Since the Service does not have any facilities nor is planning to construct facilities on the Refuge, there is no effort needed to utilize green products generally associated with increasing the energy efficiency of such facilities.

Land Acquisition
The Refuge would work with partners in the development of an LCD in a separate planning effort focused on the Middle Sabine River Basin and determining the role of the Refuge throughout the larger landscape. Based on the outcome of the LCD, the development of a PPP and LPP as a step-down management plan would guide land acquisition efforts and provide the opportunity to acquire any adjacent lands from willing sellers. Alternative B would initiate an assessment for the development of a PPP and a LPP upon the conclusion of the LCD. This assessment is the first step toward the development of an LPP, the completion of which would enhance and promote conservation efforts of wildlife habitat throughout the Middle Sabine River Basin.

Flora Inventory
A complete plant inventory, along with LiDAR (Light Detection and Ranging) a remote sensing method to examine the surface of the landscape, would provide a method for creating a three-dimensional topographical aerial map or the Refuge showing both surface terrain elements and man-made structures. Since the bottomland hardwood habitat found at Little Sandy NWR is largely untouched, this information will be used to represent the ideal bottomland hardwoods habitat and can be compared to the surrounding areas to determine impacts to similar habitat outside of the Refuge boundary that have not experienced the same amount of protection from timber harvest and livestock grazing. Several agencies (federal, state and county), colleges and universities, and private organizations/individuals may participate and subsequently benefit from this inventory in future management approaches throughout bottomland hardwood forests.

Prescribed Burning
There is currently no prescribed fire program or activities at the Refuge. The completion and implementation of a step-down fire management plan would be focused on mimicking natural fire ecology on approximately 200 acres of habitat on the upland portions of the Refuge on the areas adjacent to the railroad and the northern Refuge boundary. This would provide a small niche on the landscape for fire dependent species that could utilize the small-burned areas. The plan could also address the response of wildfire occurrence from the railway or other events as well as reduce fuel loads to decrease the chances of rapid spreading wildfires. The plan can also address the advantages of promoting small pockets of pine savanna habitat for the benefit of associated wildlife species as well as describe how prescribed fire can be used as a tool to control invasive species.

Invasive Species Management (Flora)
Chinese tallow and Chinese/Japanese privet would continue to be treated with both mechanical and chemical means described in Alternative A to control the infestations on the Refuge; however, Alternative B involves increased efforts to locate, map, treat, and monitor these, as well as other invasive species, which may be present on the Refuge. The resulting database from the Flora Inventory described above would greatly assist in this. A step-down monitoring and treatment program would be developed using Refuge staff and club members/staff to locate and record invasive encroachment. Treatments would continue as in current management with the addition of other methods identified in a step down management plan.

2.3.2 Wildlife Habitat

Fauna Inventory
This alternative would expand current wildlife monitoring on the Refuge by working with the Division of Biological Sciences on implementing scientific approaches to address resource issues on the Refuge. Alternative B would also establish the baseline fauna inventory for the Refuge. The alternative includes; expansion of bird point counts and surveys as well as monitoring, collection of biological data from harvested fauna, and development of an Inventory and Monitoring Plan. The collection of biological data from all wildlife taken during club hunting activities and invasive species control management would provide critical baseline data for wildlife management programs on the Refuge. This alternative also would include the initiation of inventories for mammals, birds, reptiles and amphibians, fish, and invertebrates. Under this alternative state agencies would provide input into survey methods and may participate in data collection.

Nuisance and Invasive Species Management (Fauna)
Under this alternative, the Refuge will develop a step down management plan focused on nuisance and invasive fauna species management. This plan will focus on the Refuge beaver removal and dewatering of flooded timber and trails. Management practices such as dam removal and beaver trapping will reduce the negative impacts to bottomland hardwood habitats. By reducing beaver numbers and dewatering the flooded timber in the spring in a timely manner, the Refuge can maintain productive habitat. The current level of beaver infestation will need to be assessed to determine the scope of implementation for this alternative. After the initial treatment, a monitoring program will be used to determine the extent of management practices available for the following session.

As a part of this step down management plan, the Refuge will utilize their own staff or contract out in order to conduct hunting and trapping of feral hogs to reduce the negative impacts. Feral hog populations have a wide range and generally utilize areas where there is little hunting or trapping pressure. The Refuge will have to maintain a proactive hunting and trapping program to keep the feral hog population from growing and expanding across the landscape. Close coordination with the State will help maximize management practices to control feral hog populations in and around the Refuge. The current level of hog infestation will need to be assessed to determine the scope of the hog population and the type of practices to be utilized.

3.0 AFFECTED ENVIRONMENT

For information regarding the affected environment, see Chapter 3 of the CCP.

4.0 ENVIRONMENTAL CONSEQUENCES

This chapter analyzes and discusses the potential environmental effects or consequences that can reasonably expected by the implementation of the alternatives described in Chapter 2.0 of this EA. An analysis of the effects of management actions has been conducted on the physical environment (air quality, water quality, and soils); biological environment (vegetation and wildlife); and socioeconomic environment (cultural resources, socioeconomic features including public use/recreation, and visual and aesthetic resource). The direct, indirect, and cumulative impacts of each alternative are considered.

4.1 Definition of Terms

A list of definition used in used in this analysis is provided below:

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 quality 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 possible longer.

Intensity of Impact
Negligible impacts result from management actions that cannot be reasonably expected to affect identified Refuge resources or recreational opportunities at the identified scale.

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.

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.

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.

Site-specific effects are those impacts that occur solely within the project area.

Local effects are those impacts that can be reasonably expected to have detectable effects within and immediately surrounding the project area.

Refuge-wide effects are those impacts that can be reasonably expected to have noticeable effects across the entire Refuge landscape.

4.2 Physical Environment

4.2.1 Impacts on Air Quality

Alternative A: No Action Alternative
The current management activities of Little Sandy NWR are expected to have negligible impacts on air quality in or around the Refuge.

There is the potential for spray drift resulting from chemical control of invasive species. Currently, chemical use is limited to spot-treatment on invasive species and therefore, adverse impacts to air quality are minor, short-term and limited to the site of application. Not spraying during periods of high winds provides adequate mitigation efforts and limits these impacts to air quality.

Alternative B: Proposed Action
The proposed action may result in some short-term negative impacts at a local scale as a result of the mechanical and chemical treatments of invasive species (i.e., stump cutting and spraying to remove Chinese tallow). Minor short-term impacts to air quality at the site scale would result

from dust and emissions produced by the equipment necessary for mechanical and chemical treatments; these emissions would be undetectable after the project is completed.

In addition, the use of prescribed fire in uplands habitat would result in moderate short-term adverse impacts at a local scale through the additional aerial particulates typical of a burn program on wildlife Refuges. The negative impact of a prescribed fire program is limited to specifically the time periods on which burning would take place; once the burning is completed, any negative impact is eliminated. Mitigation measures can minimize these local impacts by limiting burning times to periods of low winds, high humidity and cool temperatures.

As with Alternative A, there is the potential for spray drift resulting from chemical control of invasive species. Chemical use will still be completed by spot-treatment on invasive species and therefore, adverse impacts to air quality are minor, short-term and limited to the site of application. Continued adherence to not spraying during periods of high winds provides adequate mitigation efforts and limits these impacts site specific and minor.

The effects of Alternative B would be slighter greater than under Alternative A; however, they are still expected to be site specific, minor and of short duration.

4.2.2 Impacts on Water Quality and Quantity

Alternative A--No Action Alternative
Current water management on Little Sandy NWR consists of the Little Sandy Hunting and Fishing Club (LSHFC) semi-permanently retaining water in Brumley and Overton Lakes for recreational purposes based on the Clubs allocated water rights. This practice can result in a higher quality of water leaving the Refuge than entering since pollutants and particulates are permitted to drop out of suspension, collecting in the soils underlying the lakes.

The Refuge has approval for the use of Garlon 3A and Garlon 4 and has current Pesticide Use Proposals (PUPs) on file for each of these chemicals. Herbicides have the potential of leaching into and polluting groundwater and getting flushed 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. The use of these herbicides may decrease the water quality during their use; however, this impact is expected to be minor, short-term given the extent of Brumley and Overton Lakes, the amount of water they hold collectively, and the area impacted by chemicals. The adverse effect that these chemicals may have on the water quality is anticipated to be minor because impacts would be limited to the specific site of application and measures would be taken to minimize impacts. The application of herbicides on the Refuge will be in accordance with the manufactures uses and restrictions.

Alternative B: Proposed Action
Alternative B also proposes a slightly increased use of chemical and mechanical means to control invasive species, but also includes prescribed fire to control invasive species and mimic natural processes. The Refuge has been approved for the use of Garlon 3A and Garlon 4 and has current approved PUPs on file. Herbicides have the potential of leaching into and polluting groundwater

and getting flushed 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. The use of these herbicides may decrease the water quality during their use; however, this impact is expected to be minor, short-term given the extent of Brumley and Overton Lakes, the amount of water they hold collectively, and the area impacted by chemicals. The adverse effect that these chemicals may have on the water quality is anticipated to be minor because impacts would be limited to the specific site of application and measures would be taken to minimize impacts.

As with the use of chemicals, mechanical removal of invasive species would be expected to produce a minor adverse impact on water quality and wildlife during the dry periods when equipment can be used to treat invasive species. Any plan to use mechanical controls will be reviewed and carefully timed to avoid any adverse impacts to wildlife. Oil, gasoline and emissions from machinery have the potential to enter the groundwater supply; however, given the minimal use of mechanical invasive species control, little, if any, impact is expected.

Prescribed fire does have the potential for longer term affects to Refuge water quality. Once the management of prescribed fire is conducted, the upland habitats will have less vegetative ground cover. As such, during periods of extensive rain, erosional processes may begin to take effect, increasing the amounts of particulates in the surface water of the Refuge, subsequently decreasing the water quality. That said, since water management practices are expected to remain the same, the additional particulates, if they do reach Brumley or Overton Lakes, will be permitted to drop out of suspension prior to heading downstream. While the short term effects of prescribed burning may be relatively high and site-specific, indications are that the long term adverse effects on water quality are negligible.

4.2.3 Impacts on Soils

Alternative A--No Action Alternative

Alternative A can result in short to medium term adverse effects due to soil disturbance along the 22.2 miles of all-terrain vehicle trails used by LSHFC members' that are on the Refuge and by the rooting activity of feral hogs. The trails used by club members serve to provide access for hunting and other recreation, and travel is permitted along the existing trails. The trail use by club members has been very consistent over time, should the hog population on the Refuge continue to grow, the level of soil disturbance would increase. The potential of increased adverse impacts on Refuge soils is possible should the feral hog population continue to go unchecked. Extensive rooting of soils, forest litter, and grasslands can cause serious erosion of riparian areas, which leads to siltation, lower water quality, and sometimes fish kills. Rooting may also disrupt native plants and change the plant and animal community.

Alternative B--Proposed Action

Under Alternative B, implementation of proposed management activities could potentially impacts soils. The proposed management tools, which include chemical and mechanical removal of invasive flora, prescribed fire and feral hog eradication, would be designed to control invasive species and mimic natural processes.

Soil can be degraded by the misuse or over use of pesticides. Timing of application is one of the most important management factors that can be adjusted to reduce impacts to the soil, as well as the proper disposal of pesticides. The Service will use the lowest impact method of treatment, spot spraying with a backpack-style sprayer, so that soil disturbance will be at a minimum. Chemicals that are not leeched out through ground water can remain and pollute the soil; depending on the chemicals used, the short to long term effects of the chemical deposits may vary but negative impacts will be minimized by only conducting spot spraying.

Minimal and temporary soil disturbance is also likely to exist due to removal of feral hogs by trampling soil to set up traps, trapping hogs and providing access to maintain traps. Trapping locations can be relocated regularly to minimize long term disturbances to any single site. Controlling the population of feral hogs on the Refuge should have a short to medium range beneficial effect on soil disturbance at the local scale because reducing the population limits the amount of damage caused by rooting and other non-desirable feeding techniques of hogs. Rooting often causes soil disturbances which results in many cases of disturbing native vegetation and often depositing seeds of non-native invasive species changing the natural dynamics of bottomland hardwood forests. Some short term adverse impacts are expected at the treatment sites due to the placement of traps and/or the equipment needed to remove hogs. As the hog population of the Refuge is reduced, there should be a corresponding decrease in the amount of adverse soil disturbance which results in a long term beneficial impact at the Refuge scale.

While the ultimate goal is habitat restoration, potential soil disturbance is possible. Stump cutting, spraying and prescribed fire could establish short term, minor impacts on soils.

Lastly, some adverse impacts are also expected with prescribed fire management. Prescribed fire results in temporary loss of ground cover and tree canopy; however, soils are not heavily impacted due to their porous nature and quick rejuvenation of plants after fires limit the moderate short term adverse impacts at the site specific scale. Potential adverse impacts from erosion may be experienced should a period of heavy rainfall occur prior to the establishment of plants. As such, there is some potential for minor adverse impacts to the site following prescribed fire activities; however, this can be mitigated by using prescribed fire during periods of the year that have historically low rainfall as well as using soil restoration technique's following treatments.

4.3 Biological Environment

4.3.1 Impacts on Habitat

Alternative A: No Action Alternative
The Refuge conducts limited habitat management activities. The Refuge has recently acquired previously described funding for invasive flora control; however, no other habitat management activities exist beyond monitoring. The current management implemented by the Refuge and the LSHFC has provided limited impact on future control and expansion of invasive species.

Alternative A would continue to limit habitat management activities. Under this Alternative, there would continue to be minimal habitat management activities to address invasive floral species and feral hog populations. This Alternative would not provide the necessary habitat management techniques to remove invasive floral species and feral hogs that can negatively impact the habitat if not managed and removed.

Alternative B: Proposed Action
This alternative is expected to have moderate beneficial, long term effects on a Refuge wide scale. Alternatively, there are very few expected short term adverse effects due to project disturbance; however, post project, Alternative B would result in long term beneficial effects and would be a significant increase in benefits over Alternative A.

This alternative would incorporate invasive species control measures on fauna (feral hogs) and flora (Chinese tallow, Chinese privet, Silk tree, Chinaberry, Japanese honeysuckle, and Nandina). Treatments of fauna species will eliminate the disruption to soils and invasion of bottomland hardwood habitat. Such measures would cause minor short term adverse impacts at a site specific scale during chemical and mechanical removal. Treatments in this respect are virtually simultaneous and would continue until the desired species is removed, which may require repetitive treatments. The methods used in this process are not expected to negatively impact habitats on any scale and are limited to just the site of application; impacts on native flora will be minimal because treatments are conducted through spot-spraying. Once treatment is completed and the invasive species removed, beneficial long-term impacts at the Refuge scale are expected.

4.4 Impacts on Wildlife

Alternative A: No Action Alternative
Under Alternative A, the existing habitat conditions supporting native wildlife species could be negatively impacted if invasive floral species and feral hog populations are left uncontrolled. Invasive species can have adverse impacts at the local scale by degrading the habitat and displacing native wildlife species.

Alternative B: Proposed Action
There would be some site specific short-term adverse impacts on small mammals, birds, and other wildlife due to habitat loss and displacement during project implementation, specifically as

it pertains to invasive flora management actions; however, similar habitat is abundant in the area and no loss of species diversity or abundance is anticipated. Any disturbance or displacement of wildlife species will be temporary and their population numbers will respond positively as the habitat improves.

The possible short-term decline in certain species, in particular beaver due to nuisance control measures, is anticipated but this decline is not expected to affect the viability of beaver populations in the area. Beaver populations are resilient and the use of trapping and shooting will maintain population levels that do not negatively impact the bottomland hardwood forest habitat from dam building and flooding.

4.4.1 Impacts on Threatened and Endangered Species and Special Status Species

Alternative A: No Action Alternative
Federally listed species known to occur in Wood County include the least tern, piping plover, red knot and a candidate species the Louisiana pine snake. Under the No Action Alternative, the existing habitat conditions would be maintained, no additional activities would occur and the current amount of disturbance potential would remain constant. Under the no action alternative, there would be no impact to Threatened and Endangered Species.

Alternative B: Proposed Action
No known federally listed species currently occupy the Refuge. Under Alternative B, the existing habitat conditions would be altered slightly but all activities would be initiated to promote habitat conditions, minimizing invasive species and initiating step down management plans to promote desirable bottomland hardwood forests. Under this alternative, habitat conditions would be improved and maintained promoting life history requirements of listed species if they are found to occur on the Refuge. Under this alternative there would no impact to Threatened and Endangered Species.

4.5 Human Environment

4.5.1 Impacts on Cultural Resources

Alternative A: No Action Alternative
There are no known cultural resources on Little Sandy NWR. Under current management, the Refuge and the LSHFC do not implement any ground disturbing activities; therefore, no direct or indirect impacts to cultural resources are expected.

Alternative B: Proposed Action
Under the Proposed Action Alternative, there could be adverse impacts to cultural resources if any archeological sites are found within the project area where mechanical and chemical treatments and ground disturbance is going to occur during invasive species management. Since no cultural inventory has been completed for the Refuge, locations of any cultural resources,

should they exist, are not known at this time. Should cultural resources be located on the Refuge, their protection and preservation is mandated through federal law and Service policy; therefore, any ground disruptive work will cease should cultural resources be located until those resources are protected, salvaged or mitigated.

4.5.2 Impacts on Socioeconomics

Alternative A: No Action Alternative
The economic and social condition of the area would remain the same. The Refuge is not open to the public, because the Conservation Easement conveyed to the Service for the property specifically states that such property shall not be opened to the public. Since there are no current major management actions on the Refuge, no revenue is being generated for the local economy other than that generated by the LSHFC members.

Alternative B: Proposed Action
The proposed action would have short to long term beneficial impacts on the local economy through potential equipment and materials purchases. Should the Refuge decide to utilize contractor support for nuisance and invasive species control, local sources, if available, would be able to compete for those contracts. Further, equipment and chemical purchases for flora invasive species control would be sought through the local economy, adding to the beneficial impacts to the local economy.

4.5.3 Impacts on Aesthetic and Visual Resources

Alternative A: No Action Alternative
There would be no change to the existing visual landscape. Feral hog activity would continue some minor short term adverse impacts at the site scales and, if left unchecked, may develop into major long term adverse impacts at the Refuge scale.

Alternative B: Proposed Action
Eradication of feral hogs will eliminate the ground disturbance around the hunt club thereby resulting in long term beneficial impacts at the sites normally affected by feral hog activity. Further, invasive flora management through mechanical and chemical means will hamper expansion of invasive species. The combination of these management actions described in Alternative B; however, would result in negligible observable change to the existing visual landscape at the local and Refuge scales.

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.

The Refuge is not aware of any past, present or future planned local, state or federal actions that would result in additional adverse impact(s) when added to the Refuge's proposed action as outlined in Alternative B. The overall adverse direct and indirect effects of the proposed action on air, water, soil, habitat and wildlife resources are expected to be minor and short-term. The benefits to long-term ecosystem health that Alternative B will accomplish far outweigh any of the short-term adverse impacts discussed in this document and are deemed to be overall beneficial in the long term.

There are no roads on the Refuge other than the gated primary access point to the hunt club and is not open to the public.

There are few established all-terrain vehicle trails on the Refuge and the trails that do exist are used by the hunt club members and staff for hunting and fishing purposes. None of the trails on the Refuge are open to the public. On occasion, removals of fallen trees from the trails are performed to permit access on the Refuge.

Little Sandy Hunting and Fishing Club has been privately owned since 1906 and has continually operated as a private, membership based sporting club, which includes game hunting such as whitetail deer, feral hogs, and waterfowl, as well as sport fishing. In 1986, a perpetual non-development easement was donated to the Service by the Club; however, the Refuge is currently closed to public entry due to private ownership by the club. Guests are allowed with invitation and approval of the Club. Professional interest in the Refuge is high and growing as little habitat of this caliber is left in Texas and the WGCP. It likely to become a popular destination for invited outdoor enthusiasts to view old growth forest and the diversity in wildlife species.

4.6.1 Cumulative Impacts to the Physical Environment

4.6.1.1 Air Quality

Similar activities that can affect air quality (such as prescribed burning and invasive species control) as described in the proposed action exist on surrounding properties. In addition, farming activities in the area as well as roadway construction and maintenance activities are conducted in the area that can influence air quality. The presence of the Refuge and its desire to participate in the proposed action is not expected to adversely impact the air quality of the surrounding area given the relatively insignificant amount of prescribed fire and chemical spraying when compared to other activities in the area which impact air quality on a much larger scale.

4.6.1.2 Water Quality and Quantity

An increasing population in the region, along with greater urban, industrial, and agricultural development would all tend to increase the extent of adverse effects on water quality in and around the Refuge by increasing discharges from point and non-point sources of water pollutants and contaminants. In addition, as the area grows and develops, there will be an increased demand for water, and water table drawdown could be a potential problem in the area. The desire for the LSHFC to detain water in Brumley and Overton Lakes during periods of low water yield could adversely impact downstream neighbors; however, historical precedent exists and the LSHFC has been participating in such detainment since the development of the water control structures and no known water quantity issues exist.

4.6.1 Soils

On-Refuge cumulative effects on soils would result from several factors, including ground disturbances resulting from invasive species (flora and fauna) treatment and prescribed fire activities. Continuous use of chemical compounds used in the treatment of invasive flora species would mean that residues of a number of pesticides could continue to occur in soils; however, proper selection of pesticides with short half-lives and the use of best management practices will minimize this impact.

The disturbances to soils during the mechanical treatment of invasive species (both flora and fauna) are different in nature when compared to the impacts of chemical use. The mechanical removal of invasive flora species consists of simply pulling seedlings by hand and involves no machinery other than potentially an all-terrain vehicle used for access. Limiting all-terrain

vehicle use to existing trails will mitigate these effects on soils. In addition, there will be soil disturbances that will result at the immediate locations where traps are constructed, which are expected to be negligible, particularly when compared to the soil disturbances that can result should the feral hog population be allowed to grow unchecked.

Overall, the effects on soils resulting from the proposed action are minor, short term impacts at the site scale during treatments but these treatments promote moderate long term beneficial impacts at the Refuge scale.

4.6.2 Cumulative Impacts to the Biological Environment

4.6.2.1 Habitats

The Refuge is surrounded by a mix of private agricultural lands, rural housing developments and some commercial activity. The increased potential for continued rural residential development further increases the potential for habitat fragmentation and may create pest management problems. In addition, increased urbanization has the potential to dramatically reduce or inhibit Refuge habitat management activities. As one of the best examples of the bottomland hardwood habitats known to exist; the non-development easement that consists of the Refuge ensures that this habitat will be conserved. The management activities described in the proposed action is designed specifically to provide long term beneficial impacts to bottomland hardwood habitat. While the Refuge is relatively small in relation to surrounding acreages, preservation of this rare habitat is invaluable. The Refuge will participate in a partnership driven process to develop a LCD within the Sabine River Watershed, which will combine geospatial data with biological information that can be used to identify locations throughout the landscape where conservation and restoration efforts are most beneficial. This will eventually lead to the completion of a PPP and LPP to strategize on prioritizing the most efficient areas to grow the Refuge.

4.6.2.2 Wildlife

Some Refuge management activities, such as invasive species removal (flora and fauna) and prescribed fire, temporarily impact wildlife on a short term basis, and is limited only to times of that activity; however, given the very small and limited scope of such activities compared to the size of the Refuge, there is ample habitat available. Wildlife is expected to return following the cessation of these activities limiting the amount of disturbances to the time of treatments with minimal impacts. The overall effect following these treatment activities is designed to produce long term beneficial impacts to habitats that wildlife depend on for survival.

Cumulative Impacts		
Environmental Resource	**Alternative A No Action Alternative (Current Management)**	**Alternative B Proposed Action**
Air Quality	*Fauna Inventory* *Invasive Species Management (Flora)* Potential minor, short-term and limited to the site of application.	Same as Alternative A plus: *Invasive Species Management (Flora)* Short-term adverse impacts on local scale due to dust and emissions from equipment; potential minor, short-term and limited to the site of application impacts coming from possible spray drift. *Prescribed Burning* Moderate short-term adverse impacts at a local scale resulting from aerial particulates.
Water Quality and Quantity	*Water body Management* Some beneficial impacts resulting from water detainment in Brumley and Overton Lakes which allows pollutants and particulates to drop out of suspension prior to the water travelling downstream; potential short- to medium-term adverse impacts to water quantity to downstream neighbors due to the detainment of water during periods of low yield. *Invasive Species Management (Flora)* Minor short-term adverse impacts at the site or local scales.	Same as Alternative A plus: *Invasive Species Management (Flora)* Slight increase minor short-term adverse impacts at the site or local scales. *Prescribed Burning* Potential of short- to medium term adverse impact water quality at the site of application if completed during periods of high rainfall, due to runoff.

Cumulative Impacts		
Environmental Resource	**Alternative A No Action Alternative (Current Management)**	**Alternative B Proposed Action**
Soils	*Nuisance and Invasive Species Management (Fauna)* Short to medium term adverse effects due to soil disturbance by feral hog activity. The potential of increased adverse impacts on Refuge soils is possible with uncontrolled rooting and other disruptive behaviors by hogs should the feral hog population continue to go relatively unchecked.	Same as Alternative A plus: *Invasive Species Management (Flora)* Minor short-term adverse impact at the site scale. *Nuisance and Invasive Species Management (Fauna)* Anticipated short term, moderate and site specific adverse impacts outweigh the long term benefits of limiting the feral hog population by reducing the amounts of rooting and other disruptive invasive seed dispersals methods utilized by feral hogs. *Prescribed Burning* Some minor short-term adverse impacts in the way of erosion may be experienced should periods of heavy rainfall occur prior to the rejuvenation of plants.
Habitat	*Nuisance and Invasive Species Management (Fauna)* Minor short term adverse effects due to project disturbance at the site specific scale.	Same as Alternative A plus: *Nuisance and Invasive Species Management (Fauna)* Minor short term adverse effects due to project disturbance at the site; however, post project results in major long term beneficial effects by reducing invasice species encroachment and rooting behaviors exhibited by wild hogs.

Cumulative Impacts		
Environmental Resource	**Alternative A No Action Alternative (Current Management)**	**Alternative B Proposed Action**
Wildlife	*Nuisance and Invasive Species Management (Fauna)* Failure to limit the feral hog population may result in some moderate short- and medium term adverse impacts at the local scale due to native species being displaced over time from to habitat disturbances caused by feral hog activity.	*Nuisance and Invasive Species Management (Fauna)* There are expected short-term adverse impacts on small mammals, birds, and other wildlife due to habitat loss and displacement during project implementation; however, similar habitat is abundant in the area and no loss of species diversity or abundance is anticipated. Some short term decline in certain species (beaver) is expected due population control methods.
Threatened and Endangered Species	No Federally listed species currently occupy the Refuge, so there would be no impact to Threatened and Endangered Species.	Same as Alternative A
Cultural Resources	There are no known cultural resources on Little Sandy NWR. Under current management, the Refuge and the LSHFC do not implement any ground disturbing activities; therefore, no direct or indirect impacts to cultural resources are expected.	*Invasive Species Management (Flora)* If any cultural resources are discovered during treatments, they will be completely avoided. Avoidance practices will eliminate any effects on cultural resources not documented on the refuge.
Socioeconomics	Since the Refuge staff does not participate in any current management actions, no amount of revenue is being generated for the local economy. Travel and visitation to the refuge by Club members may have a small beneficial impact on the local economy.	Short to long term positive impacts are expected through equipment and material purchases as well as potential contract assignees as well as the potential of growing the refuge and allowing public use activities on new Refuge parcels.

Cumulative Impacts		
Environmental Resource	**Alternative A No Action Alternative (Current Management)**	**Alternative B Proposed Action**
Aesthetic and Visual Resources	*Nuisance and Invasive Species Management (Fauna)* Feral hog activity would continue some minor short-term adverse impacts at the site specific scale and, if left unchecked could continue to change the dynamics of bottomland hardwood forest.	*Nuisance and Invasive Species Management (Fauna)* Short to long term positive impacts as feral hog populations are reduced. *Invasive Species Management (Flora)* Negligible observable change.

4.7 Cumulative Impacts to the Human Environment

4.7.1 Cultural Resources

There has been no survey to determine if there are cultural resource sites on the Refuge. Since there are no known cultural resource sites identified, impacts from mechanical and chemical treatments and ground disturbance occurring during invasive species management and fire activities cannot be determined at this time. Should cultural resources be located on the Refuge, their protection and preservation is mandated by Federal law and Service policy; therefore, any ground disruptive work will cease should cultural resources be located until those resources are protected, salvaged or mitigated.

4.7.2 Socioeconomics

Historically, management activities for invasive species and prescribed fire have been limited in size and scope and therefore the beneficial impacts have been relatively minor. The proposed action broadens management activities for invasive species and prescribed fire on the Refuge, which requires substantial increases in funding to implement and personnel to accomplish. The increase in funding expended to implement these management activities will be distributed throughout the local commercial and services market, which is expected to be a beneficial impact to the local community.

There are no expected impacts on any scale to the local socioeconomics as a result of the management action described in the proposed action.

4.7.3 Aesthetic and Visual Resources

Overall, the aesthetic and visual resources will be improved, albeit slightly, upon implementation of the proposed action. Removal of invasive flora and fauna species will ensure that the bottomland hardwood habitat is restored and protected for future generations to observe and enjoy. The removal of feral hogs will result in less ground disturbances that negatively impact the aesthetics of the bottomland hardwood forest.

Prescribed fire provides a contrast to the landscape, which may be visualized as positive or negative depending on personal opinion. Prescribed fire is implemented to mimic natural ecological processes, and the short-term negative impacts it may have in an aesthetic sense will be necessary to achieve long-term benefits to the habitat.

4.7.4 Unavoidable Effects

Under Alternative B, there will be some unavoidable impacts as described below. These impacts are expected to be minor and/or short-term in duration; however, the Refuge would attempt to minimize these impacts wherever possible. The following sections describe the measures the Refuge would employ to mitigate and minimize the potential impacts that could result from implementation of the proposed action.

4.7.5 Water Quality and Use of Herbicides

As previously discussed, prolonged herbicide use for invasive species (flora) control could result in a slight decrease in water quality. Through the proper selection and application of herbicides, a minor impact on the environment is expected due to the limited size and scope of treatments.

4.7.6 Wildlife Disturbance

Disturbance to wildlife is an unavoidable consequence of any management program, regardless of the activity involved. As discussed, this disturbance is expected to be very minimal with little to no impact on wildlife.

4.7.7 Vegetation Disturbance

Some negative disturbances in native flora as a result in invasive species (flora) control due to the nature of chemical and mechanical treatments used; however, because of the spot-spraying techniques and hand-removal of seedlings limits treatment application specifically to the invasive species needing removal, any collateral loss of native flora species is acceptable. Further, once invasive species are removed, native species are no longer displaced which will allow for longer term beneficial impacts to habitat.

4.*7.8* 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 time frame, 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. Implementation of the proposed action would require the irretrievable commitment of fossil fuels (diesel and gasoline), oils, and lubricants used by heavy equipment and vehicles. Also, management actions in this document will require a commitment of funds that would be unavailable for use on other Service projects. The Proposed Action would result in some temporary disturbances to some wildlife. The Service would implement best management practices to minimize potential impacts.

4.8 Environmental Justice

Executive Order 12898 (Federal Actions to Address Environmental Justice in Minority and Low-Income Populations; February 11, 1994) was designed to focus the attention of Federal Agencies 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 directed federal agencies to develop environmental justice strategies to aid in identifying and addressing disproportionately high and adverse human health and environmental effects of their programs,

policies, and activities on minority and low-income populations. The order is intended 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 related to human health and the environment.

Any identified environmental and socioeconomic effects from management alternatives would not be localized nor primarily placed on any identified minority and/or low-income population component. Overall, the identified minority and/or low-income populations would not be disproportionately affected compared to other segments of the general population in the area. Additionally, persons of all races and income levels are invited to participate in the scoping process and provide comments and input into the plan. Therefore, implementation of the preferred alternative would be in compliance with EO 12898.

4.9 Indian Trust Assets

No Indian Trust Assets have been identified in or around the Little Sandy NWR. There are no reservations or ceded lands present. Since no specific tribe is known to have special interests within the refuge boundaries, no Native American tribe was specifically consulted on the proposed action but all Native American tribes are welcomed to submit comments on the proposed action. Although no specific tribe was consulted, any potential impacts to any cultural or historical resources would be evaluated before any type of ground disturbing activity could take place. No impacts are anticipated on any Indian Trust Assets, cultural or historical resources as a result from implementation of either alternative described in the EA.

5.0 Consultation, Coordination and Document Preparation

Document prepared by Refuge Staff, Little Sandy National Wildlife Refuge, U.S. Fish and Wildlife Service, Hawkins, Texas. A complete list of preparers and consulting entities can be found in Appendix J of the CCP.

Easement

Active Rookery by David Weaver

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CONVEYANCE OF CONSERVATION EASEMENT 041163

This conservation easement, made this 2nd day of February, 1987, by and between the Little Sandy Hunting and Fishing Club (the Club), a nonprofit corporation of the State of Texas, and the United States of America, acting by and through the U.S. Fish and Wildlife Service (FWS) as the authorized representative of the Secretary of the Interior,

Witnesseth

WHEREAS the Secretary of the Interior is authorized to acquire interests in land and water for the protection and maintenance of wildlife and wildlife habitat, and

WHEREAS the land described below has been determined to have significant value to wildlife in its present condition, and

WHEREAS the Club is the fee title owner of the land described below,

1. Now; therefore, the Club does hereby give, grant, bargain, and convey unto the United States of America forever, as an absolute and unconditional gift, commencing with the acceptance of this indenture by the Secretary of the Interior or his authorized representative, an easement for the maintenance of the land described below as wildlife habitat, in perpetuity (including the right of access thereto by authorized representatives of the United States) namely;

3,802± acres of land, more or less, in Wood County, Texas, lying adjacent to and along the Sabine River and being more particularly described in "Exhibit A", attached hereto and by reference made a part of this agreement; subject, however, to all existing rights-of-way and easements; all outstanding mineral rights; the rights of the United States of America and third parties under patents of record; the rights of third parties under oil and gas leases of record; and the hunting, fishing, and oil and gas rights and titles of the Club, including all incomes derived therefrom, which are hereby excepted and reserved to the Club; and, provided further, such grantee may not assign this easement, or any interest therein or right thereunder, without the written approval of the Club.

2. The Club for itself, and for its successors and assigns, and any other person claiming under it, convenants and agrees that it will cooperate in the preservation of the aforesaid land and water as wildlife habitat to the extent and subject to the provisions herein set forth.

3. It is understood and agreed by the parties that this easement imposes no limitations or restrictions on the fee simple title of the Club, other than those set forth herein. The Club retains the right to control use of and access to the land and may continue to use the land and water for hunting,

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fishing and oil and gas exploration, drilling and production; and for any other purpose consistent with the intent of this agreement to maintain the land and water as wildlife habitat, subject to the restrictions and limitations herein set forth.

4. The Club shall not (except in connection with exercising and enjoying the rights reserved to it generally and specifically in paragraph 3 above):

(1) Permit or authorize any use that will alter the current topography or vegetative cover, in either a temporary or permanent manner, through the transfer of pertinent surface or subsurface rights, including timber rights, or by any other means without the written concurrence of FWS.

(2) Drain or permit the drainage of any wetlands presently occurring or recurring due to natural causes through the transfer of appurtenant water rights or by any other means, except for the purpose of operating "greentree reservoirs", consisting of flooding certain portions of the area concerned for not more than five months per year.

(3) Construct or permit the construction of any roads, trails, buildings, fences, or other structures in, on, or across the land except at the outer boundary, without the specific written concurrence of FWS; except that the Club may erect and maintain permanent or temporary hunting blinds for waterfowl or game animals and roads to reach them.

(4) Apply or permit the application of insecticide, herbicide, or other chemical to the surface, vegetation, or atmosphere of the land or water covered hereby, without the written concurrence of FWS, except the Club may use herbicides or other chemicals to eliminate or control vegetation in its lakes.

(5) Grant additional easements, rights-of-way, or other similar interests in the aforesaid land without the written concurrence of FWS except such rights-of-way, permits, easements, or leases as are necessary for the development of mineral interests held by the Club.

5. FWS shall have the right of ingress and egress in, over, and across the aforesaid property for the purpose of administration of the easement and inspection of the property, but only through their authorized representatives. It is specifically understood that such property shall not be opened to the public or to anyone except such representatives. Notice will be given to the Club prior to the entrance upon the property by authorized representatives of FWS except in emergency situations or instances where the Club has nobody available.

6. FWS agrees to use and protect its rights herein granted in the promotion of the protection and maintenance of wildlife and wildlife habitat as a unit of the National Wildlife Refuge System.

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fishing and oil and gas exploration, drilling and production; and for any other purpose consistent with the intent of this agreement to maintain the land and water as wildlife habitat, subject to the restrictions and limitations herein set forth.

4. The Club shall not (except in connection with exercising and enjoying the rights reserved to it generally and specifically in paragraph 3 above):

(1) Permit or authorize any use that will alter the current topography or vegetative cover, in either a temporary or permanent manner, through the transfer of pertinent surface or subsurface rights, including timber rights, or by any other means without the written concurrence of FWS.

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6. FWS agrees to use and protect its rights herein granted in the promotion of the protection and maintenance of wildlife and wildlife habitat as a unit of the National Wildlife Refuge System.

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ACKNOWLEDGMENT

THE STATE OF TEXAS)
)
COUNTY OF DALLAS)

BEFORE ME, the undersigned, a Notary Public in and for said County and State, on this day personally appeared RONALD R. CATHEY, known to me to be the person and officer whose name is subscribed to the foregoing instrument and acknowledged to me that the same was the act of the said Little Sandy Hunting and Fishing Club, a nonprofit corporation, and that he executed the same as the act of such nonprofit corporation for the purposes and consideration therein expressed, and in the capacity therein stated.

GIVEN UNDER MY HAND AND SEAL OF OFFICE this the 2nd day of Feb. A.D. 1987.

Linda Moralli
Notary Public in and for the
State of Texas

My Commission Expires:
November 2, 1989

State of N. Mex.)
)
County of Bernalillo)

BEFORE ME, the undersigned, a Notary Public in and for said County and State, on this day personnally appeared Michael J. Spear, known to me to be the person and officer whose name is subscribed to the foregoing instrument and acknowledged to me that the same was the act of the United States of America, acting by and through the U.S. Fish and Wildlife Service, Department of the Interior, and that he executed the same as the act of such government agency for the purposes and consideration therein expressed, and in the capacity therein stated.

GIVEN UNDER MY HAND AND SEAL OF OFFICE this the 6th day of February A.D. 1987.

Patricia J. Dalla
Notary Public

My Commission Expires:
July 30, 1989

OFFICIAL SEAL
PATRICIA J. DALLA
NOTARY PUBLIC - NEW MEXICO
My Commission Expires 7/30/89

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ACKNOWLEDGMENT

THE STATE OF TEXAS)
)
COUNTY OF DALLAS)

BEFORE ME, the undersigned, a Notary Public in and for said County and State, on this day personally appeared RONALD R. CATHEY, known to me to be the person and officer whose name is subscribed to the foregoing instrument and acknowledged to me that the same was the act of the said Little Sandy Hunting and Fishing Club, a nonprofit corporation, and that he executed the same as the act of such nonprofit corporation for the purposes and consideration therein expressed, and in the capacity therein stated.

GIVEN UNDER MY HAND AND SEAL OF OFFICE this the 2nd day of Feb. A.D. 1987.

Linda Moralli
Notary Public in and for the
State of Texas

My Commission Expires:
November 2, 1989

State of N. Mex.)
)
County of Bernalillo)

BEFORE ME, the undersigned, a Notary Public in and for said County and State, on this day personnally appeared Michael J. Spear, known to me to be the person and officer whose name is subscribed to the foregoing instrument and acknowledged to me that the same was the act of the United States of America, acting by and through the U.S. Fish and Wildlife Service, Department of the Interior, and that he executed the same as the act of such government agency for the purposes and consideration therein expressed, and in the capacity therein stated.

GIVEN UNDER MY HAND AND SEAL OF OFFICE this the 6th day of February A.D. 1987.

Patricia J. Dalla
Notary Public

My Commission Expires:
July 30, 1989

OFFICIAL SEAL
PATRICIA J. DALLA
NOTARY PUBLIC - NEW MEXICO
My Commission Expires 7/30/89

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THENCE in a Southerly direction with an occupational fence line and East boundary line of the above referenced Tract 3 as follows: South 00° 31' 32" East, a distance of 128.88 feet to a point for corner; South 05° 52' 01" West, a distance of 1,344.11 feet to a point for corner; South 07° 00' 27" East, a distance of 385.17 feet to a point for corner; South 01° 10' 18" East, a distance of 1,106.03 feet to a point for corner and South 01° 10' 45" West, a distance of 567.75 feet to a point for corner;

THENCE in an Easterly direction with an occupational fence line as follows: South 87° 04' 09" East, a distance of 1,712.75 feet to a point for corner; South 89° 03' 54" East, a distance of 431.53 feet to a point for corner; North 84° 01' 38" East, a distance of 828.03 feet to a point for corner; South 83° 53' 50" East, a distance of 475.24 feet to a point for corner and North 89° 33' 10" East, a distance of 215.19 feet to a point for corner, said point for corner being at or near the Southeast corner of the above referenced Edward Wideman Survey and the Southwest corner of the Geo. Brewer Survey, Abstract 41;

THENCE South 41° 30' 15" East, a distance of 1,522.27 feet with an occupational fence line and common boundary line between the above referenced Henry Woodland Survey and the J. E. Trevathan Survey, Abstract 587, to a point for corner, said point for corner being at or near the Northwest corner of the Walter Corley Survey, Abstract 730 and the Southwest corner of said Trevathan Survey;

THENCE South 00° 04' 22" West, a distance of 2,200.83 feet with the most Easterly occupational fence line and boundary line of the above referenced Henry Woodland Survey and the West boundary line of the above referenced Walter Corley Survey, to a point on the North high bank of the Sabine River for corner, said point for corner being 2.00 feet South of a 20" Elm tree with blazes on 4 sides in said fence line;

THENCE in a general Westerly direction with the meanders of the North high bank of the Sabine River, not the gradient boundary, as follows:

S39°08'09"W	88.27
S00°20'52"E	610.63
S07°47'30"W	570.07
S62°16'35"W	297.35
S80°35'45"W	214.77
S49°45'14"W	480.88
S34°07'58"W	308.24
S59°00'59"W	186.32
N52°58'22"W	449.22
N39°24'28"W	206.24
N33°34'34"W	316.23
N57°02'02"W	619.80
S62°21'53"W	187.91
S12°31'58"W	80.17
S01°42'39"E	371.24
S12°37'12"E	148.55
S24°59'21"W	253.34
S54°32'15"W	424.61

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S80°29'31"W	377.52
S25°14'33"W	731.91
S43°21'38"W	206.07
S57°41'46"W	136.01
S89°00'00"W	364.30
N78°00'43"W	563.57
N75°03'03"W	774.37
S87°32'40"W	477.79
N89°44'38"W	346.80
S76°13'44"W	640.25
N18°28'17"W	76.78
N07°39'37"W	315.41
N71°25'46"W	184.72
N61°37'05"W	735.18
N35°23'50"W	321.43
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back to the place of beginning and containing 3,880.935 acres of land before subtracting the amount of acreage contained in the following described parcel which is reserved and excepted from the land covered by this easement, namely:

That particular tract described as follows:

Beginning at a point on the south right-of-way line of said railroad which is 400 feet westerly of the west end of the railroad trestle over Little Sandy Creek;

Thence southerly on a straight course, which passes 25 feet to the west of the most southwesterly of the four old brood ponds along Brumley Lake levee, to the southeast line of said levee;

Thence northeasterly on a straight course, which passes 500 feet southeast of the Larry Ferguson house, in the developed area of Little Sandy Hunting and Fishing Club, to the northerly line of the above described tract;

Thence westerly along such line to the place of beginning.

SIGNED FOR IDENTIFICATION:

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Table 3.1.4. Upper West Gulf Coastal Plain Ecoregion State and Federally Managed Lands				
Unit Name	**Managing Body**	**Primary Purpose**	**State**	**Acres**
Davy Crockett National Forest	U.S. Forest Service	Wildlife Conservation	TX	241,379.95
Sabine National Forest	U.S. Forest Service	Wildlife Conservation	TX	199,710.12
Sam Houston National Forest Wildlife Management Area	Texas Parks and Wildlife Department	Wildlife Conservation	TX	159,194.40
Felsenthal National Wildlife Refuge	U.S. Fish and Wildlife Service	Wildlife Conservation	AR	65,439.56
Kisatchie National Forest	U.S. Forest Service	Wildlife Conservation	LA	58,052.53
Upper Ouachita National Wildlife Refuge	U.S. Fish and Wildlife Service	Wildlife Conservation	LA	46,520.06
Millwood Lake	Army Corps of Engineers	Public Use	AR	35,861.52
Red River Army Depot/Lone Star Army Ammunition Plant	Department of Defense	Military	TX	35,648.43
Bodcau Wildlife Management Area	Army Corps of Engineers	Public Use	LA	33,334.03
Wright Patman Lake	Army Corps of Engineers	Public Use	TX	29,469.40
Pond Creek National Wildlife Refuge	U.S. Fish and Wildlife Service	Wildlife Conservation	AR	27,375.71
Jackson Bienville Wildlife Management Area	Louisiana Department of Wildlife and Fisheries	Wildlife Conservation	LA	24,795.62
White Oak Creek Wildlife Management Area	Texas Parks and Wildlife Department	Wildlife Conservation	TX	24,766.23
Barksdale Air Force Base	Department of Defense	Military	LA	22,399.03
Ouachita Wildlife Management Area; McCurtain Unit	U.S. Forest Service	Wildlife Conservation	OK	20,673.31
Lake O' The Pines	Army Corps of Engineers	Public Use	TX	20,462.93

Table 3.1.4. Upper West Gulf Coastal Plain Ecoregion State and Federally Managed Lands				
Unit Name	**Managing Body**	**Primary Purpose**	**State**	**Acres**
Pine Bluff Arsenal	Department of Defense	Military	AR	19,343.04
Poison Spring Wildlife Management Area	Arkansas Game and Fish Commission	Public Use	AR	18,670.75
Sulphur River Wildlife Management Area	Arkansas Game and Fish Commission	Wildlife Conservation	AR	18,146.96
D'Arbonne National Wildlife Refuge	U.S. Fish and Wildlife Service	Wildlife Conservation	LA	17,623.73
Moro Big Pine Natural Area-Wildlife Management Area	Arkansas Natural Heritage Commission	Wildlife Conservation	AR	15,910.98
Louisiana Ordnance Plant	Department of Defense	Military	LA	15,694.87
Trinity River National Wildlife Refuge	U.S. Fish and Wildlife Service	Wildlife Conservation	TX	15,410.42
Lafayette County Wildlife Management Area	Arkansas Game and Fish Commission	Public Use	AR	14,692.24
Little River National Wildlife Refuge	U.S. Fish and Wildlife Service	Wildlife Conservation	OK	13,675.20
Sabine Wildlife Management Area	Louisiana Department of Wildlife and Fisheries	Wildlife Conservation	LA	13,214.69
Union Wildlife Management Area	Louisiana Department of Wildlife and Fisheries	Wildlife Conservation	LA	12,302.04
State Lands	Louisiana State Land Board	Public Use	LA	11,227.35
Caddo Lake	Army Corps of Engineers	Public Use	TX	11,036.87
Lake Greeson Wildlife Management Area	Arkansas Game and Fish Commission	Public Use	AR	7,875.21
Caddo Lake National Wildlife Refuge	U.S. Fish and Wildlife Service	Wildlife Conservation	TX	7,641.90
Sam Houston National Forest	US Forest Service	Public Use	TX	7,338.14

Table 3.1.4. Upper West Gulf Coastal Plain Ecoregion State and Federally Managed Lands				
Unit Name	**Managing Body**	**Primary Purpose**	**State**	**Acres**
Beryl Anthony Lower Ouachita Wildlife Management Area	Arkansas Game and Fish Commission	Public Use	AR	7,126.09
Loggy Bayou Wildlife Management Area	Louisiana Department of Wildlife and Fisheries	Wildlife Conservation	LA	6,573.81
Dr. Lester Sitzes III Bois D'Arc Wildlife Management Area	Arkansas Game and Fish Commission	Wildlife Conservation	AR	5,886.15
Old Sabine Bottom Wildlife Management Area	Texas Parks and Wildlife Department	Wildlife Conservation	TX	5,858.82
Red Slough Wildlife Management Area	Oklahoma Department of Wildlife Conservation	Wildlife Conservation	OK	5,600.09
Caddo Lake Wildlife Management Area	Texas Parks and Wildlife Department	Wildlife Conservation	TX	5,519.45
Big Slough Wilderness	U.S. Forest Service	Wildlife Conservation	TX	5,261.63
Lake Houston Wilderness Park	City of Houston Parks and Recreation	Wildlife Conservation	TX	4,970.31
Rick Evans Grandview Prairie Conservation Education Center	Arkansas Game and Fish Commission	Public Use	AR	4,903.77
Black Bayou Lake National Wildlife Refuge	U.S. Fish and Wildlife Service	Wildlife Conservation	LA	4,495.21
Red River National Wildlife Refuge	U.S. Fish and Wildlife Service	Wildlife Conservation	LA	4,426.90
Warren Prairie Natural Area	Arkansas Natural Heritage Commission	Wildlife Conservation	AR	4,253.41
Dequeen Lake	Army Corps of Engineers	Public Use	AR	4,234.49
Little Lake Creek Wilderness	U.S. Forest Service	Wildlife Conservation	TX	3,933.33
Little Sandy National Wildlife Refuge	**US Fish and Wildlife Service**	**Wildlife Conservation**	**TX**	**3,833.66**

Table 3.1.4. Upper West Gulf Coastal Plain Ecoregion State and Federally Managed Lands				
Unit Name	**Managing Body**	**Primary Purpose**	**State**	**Acres**
Falcon Bottoms Natural Area	Arkansas Natural Heritage Commission	Wildlife Conservation	AR	3,233.50
Northwest Louisiana Game And Fish Preserve	Louisiana Department of Wildlife and Fisheries	Public Use	LA	3,010.12
North Toledo Bend Wildlife Management Area	Texas Parks and Wildlife Department	Wildlife Conservation	TX	2,737.40
Bayou L'Outre Natural and Scenic River	Louisiana Department of Wildlife and Fisheries	Wildlife Conservation	LA	2,580.92
Saline Bayou National Wild And Scenic River	U.S. Forest Service	Public Use	LA	2,276.81
Bayou Pierre Wildlife Management Area	Louisiana Department of Wildlife and Fisheries	Wildlife Conservation	LA	2,269.56
Huntsville State Park	Texas Parks and Wildlife Department	Public Use	TX	2,216.90
Nacatoch Ravines Natural Area	Arkansas Natural Heritage Commission	Wildlife Conservation	AR	2,125.77
Hope Upland Wildlife Management Area	Arkansas Game and Fish Commission	Wildlife Conservation	AR	2,111.30
Soda Lake Wildlife Management Area	Army Corps of Engineers	Public Use	LA	2,042.65
Cane Creek State Park	Arkansas Department of Parks and Tourism	Public Use	AR	2,027.06
Palmetto Flats Natural Area	Arkansas Natural Heritage Commission	Wildlife Conservation	AR	1,851.81
Davis Hill State Park	Texas Parks and Wildlife Department	Wildlife Conservation	TX	1,816.22
W G Jones State Forest	Texas Forest Commission	Wildlife Conservation	TX	1,706.08
Pine Bluff Project Office	Army Corps of Engineers	Public Use	AR	1,671.32
Crossett Experimental Forest Wildlife Management Area	Arkansas Game and Fish Commission	Wildlife Conservation	AR	1,661.60

Table 3.1.4. Upper West Gulf Coastal Plain Ecoregion State and Federally Managed Lands				
Unit Name	**Managing Body**	**Primary Purpose**	**State**	**Acres**
Purtis Creek State Park	Texas Parks and Wildlife Department	Wildlife Conservation	TX	1,565.06
Atlanta State Park	Texas Parks and Wildlife Department	Wildlife Conservation	TX	1,225.47
Ouachita River Natural and Scenic River	Louisiana Department of Wildlife and Fisheries	Wildlife Conservation	LA	1,058.96
North Toledo Bend State Park	Louisiana Department of Culture, Recreation and Tourism	Public Use	LA	1,049.95
Brushy Creek State Park	Army Corps of Engineers	Public Use	TX	1,031.64
Dorcheat Bayou Natural and Scenic River	Louisiana Department of Wildlife and Fisheries	Wildlife Conservation	LA	1,010.95
Corney Bayou Natural and Scenic River	Louisiana Department of Wildlife and Fisheries	Wildlife Conservation	LA	1,000.55
Tyler State Park	Texas Parks and Wildlife Department	Public Use	TX	973.30
Crater of Diamonds State Park	Arkansas Department of Parks and Tourism	Public Use	AR	936.92
Grassy Slough Wildlife Management Area	Oklahoma Department of Wildlife Conservation	Wildlife Conservation	OK	907.90
Millwood State Park	Arkansas Department of Parks and Tourism	Public Use	AR	866.09
Lake Bistineau State Park	Louisiana Department of Culture, Recreation and Tourism	Wildlife Conservation	LA	849.62
Middle Fork of Bayou D'Arbonne Natural and Scenic River	Louisiana Department of Wildlife and Fisheries	Wildlife Conservation	LA	848.84
Division Of State Lands	Louisiana Office of State Lands	Public Use	LA	839.41

Table 3.1.4. Upper West Gulf Coastal Plain Ecoregion State and Federally Managed Lands				
Unit Name	**Managing Body**	**Primary Purpose**	**State**	**Acres**
Caddo Lake National Wildlife Refuge (not yet cleaned)	Department of Defense	Military	TX	769.53
Black Lake Bayou Natural and Scenic River	Louisiana Department of Wildlife and Fisheries	Wildlife Conservation	LA	725.55
Lake D'Arbonne State Park	Louisiana Department of Culture, Recreation and Tourism	Wildlife Conservation	LA	706.61
Poison Springs State Forest Sand Barren & Oak-Pine Forest Preserve	Arkansas Natural Heritage Commission	Public Use	AR	705.10
Lake Bob Sandlin State Park	Texas Parks and Wildlife Department	Public Use	TX	651.38
Lake Claiborne State Park	Louisiana Department of Culture, Recreation and Tourism	Public Use	LA	623.96
Big Thicket National Preserve	National Park Service	Wildlife Conservation	TX	609.86
Daingerfield State Park	Texas Parks and Wildlife Department	Public use	TX	608.13
Ozan Wildlife Management Area	Arkansas Game and Fish Commission	Wildlife Conservation	AR	577.41
White Cliffs Natural Area	Arkansas Natural Heritage Commission	Wildlife Conservation	AR	574.77
Little River Wildlife Management Area	Arkansas Game and Fish Commission	Wildlife Conservation	AR	564.75
Spring Bank Wildlife Management Area	Arkansas Game and Fish Commission	Wildlife Conservation	AR	562.58
Angelina National Forest	U.S. Forest Service	Wildlife Conservation	TX	516.99
National Center For Toxicological Research	U.S. Food and Drug Administration	Wildlife Conservation	AR	492.53
Terre Noire Natural Area	Arkansas Natural Heritage Commission	Wildlife Conservation	AR	480.14

Table 3.1.4. Upper West Gulf Coastal Plain Ecoregion State and Federally Managed Lands				
Unit Name	**Managing Body**	**Primary Purpose**	**State**	**Acres**
Caddo Lake State Park	Texas Parks and Wildlife Department	Public Use	TX	464.28
Bayou D'Arbonne Natural and Scenic River	Louisiana Department of Wildlife and Fisheries	Wildlife Conservation	LA	436.59
Mountain Fork River Reach	Bureau of Reclamation	Public Use	OK	432.05
Whitegrass Flats Wildlife Management Area	Oklahoma Department of Wildlife Conservation	Wildlife Conservation	OK	407.52
Kingsland Prairie Natural Area	Arkansas Natural Heritage Commission	Wildlife Conservation	AR	394.64
State Lands	Louisiana Department of Natural Resources	Public Use	LA	345.36
Mission Tejas State Park	Texas Parks and Wildlife Department	Cultural	TX	342.75
Big Cypress Natural Area	Louisiana Department of Culture, Recreation and Tourism	Public Use	LA	332.72
Lorance Creek Natural Area	Arkansas Natural Heritage Commission	Wildlife Conservation	AR	301.04
Texas State Railroad	American Heritage Railways	Cultural	TX	295.83
Bayou Bartholomew Natural and Scenic River	Louisiana Department of Wildlife and Fisheries	Wildlife Conservation	LA	273.58
White Oak Lake State Park	Arkansas Department of Parks and Tourism	Public Use	AR	265.56
State Trust Land	Oklahoma State Land Board	Public Use	OK	239.05
Martin Creek Lake State Park	Texas Parks and Wildlife Department	Public Use	TX	238.33
Pine Ridge Park	Army Corps of Engineers	Public Use	AR	235.77
Miller County Sandhills Natural Area	Arkansas Natural Heritage Commission	Wildlife Conservation	AR	218.72

Table 3.1.4. Upper West Gulf Coastal Plain Ecoregion State and Federally Managed Lands				
Unit Name	**Managing Body**	**Primary Purpose**	**State**	**Acres**
Arkansas Oak Natural Area	Arkansas Natural Heritage Commission	Wildlife Conservation	AR	201.03
Logoly Natural Area	Arkansas Natural Heritage Commission	Wildlife Conservation	AR	196.32
Mansfield State Historic Site	Louisiana Department of Culture, Recreation and Tourism	Cultural	LA	176.84
Taylor Woodlands Natural Area	Arkansas Natural Heritage Commission	Wildlife Conservation	AR	145.85
Saline Bayou Natural and Scenic River	Louisiana Department of Wildlife and Fisheries	Wildlife Conservation	LA	144.57
Byrd Lake Natural Area	Arkansas Natural Heritage Commission	Wildlife Conservation	AR	143.57
Paraloma Park	Army Corps of Engineers	Public Use	AR	141.33
Texas State Railroad/Rusk Depot	American Heritage Railways	Cultura	TX	140.96
Logoly State Park	Arkansas Department of Parks and Tourism	Public Use	AR	140.08
Russell Sage Wildlife Management Area	Louisiana Department of Wildlife and Fisheries	Wildlife Conservation	LA	128.45
Blevins Wildlife Management Area	Arkansas Game and Fish Commission	Wildlife Conservation	AR	127.61
Moro Bay State Park	Arkansas Department of Parks and Tourism	Public Use	AR	117.81
Stone Road Glade Natural Area	Arkansas Natural Heritage Commission	Wildlife Conservation	AR	108.23
Texas Freshwater Fisheries Center State Fish Hatchery	Texas Parks and Wildlife Department	Public Use	TX	105.31
Lake Livingston State Park	Texas Parks and Wildlife Department	Public Use	TX	104.69
East Texas Ecological Education Center	Texas Parks and Wildlife Department	Public Use	TX	85.59

Table 3.1.4. Upper West Gulf Coastal Plain Ecoregion State and Federally Managed Lands				
Unit Name	**Managing Body**	**Primary Purpose**	**State**	**Acres**
The Nature Center Wildlife Management Area	Texas Parks and Wildlife Department	Wildlife Conservation	TX	85.29
Poison Springs State Park	Arkansas Department of Parks and Tourism	Public Use	AR	84.40
Moro Creek Bottoms Natural Area	Arkansas Natural Heritage Commission	Wildlife Conservation	AR	80.80
Ada Interstate 20 Rest Area	Louisiana Department of Transportation	Public Use	LA	75.12
Caddoan Mounds State Historical Site	Texas Historical Commission	Cultural	TX	70.42
Saratoga Blackland Prairie Natural Area	Arkansas Natural Heritage Commission	Wildlife Conservation	AR	66.35
Texas State Railroad/Palestine Depot	American Heritage Railways	Cultural	TX	61.29
Beard's Bluff Park	Army Corps of Engineers	Public Use	AR	58.70
Coffee Prairie Natural Area	Arkansas Natural Heritage Commission	Wildlife Conservation	AR	55.41
Fillmore Interstate 20 Rest Area	Louisiana Department of Transportation	Public Use	LA	52.39
I-20 Rest Area	Louisiana Department of Transportation	Public Use	LA	51.97
Jenkins Ferry State Park	Arkansas Department of Parks and Tourism	Cultural	AR	40.71
Monroe Fish Hatchery/District 2 Headquarters	Louisiana Department of Wildlife and Fisheries	Public Use	LA	39.41
Cottonshed Landing Use Area	Army Corps of Engineers	Wildlife Conservation	AR	34.71
Neches River National Wildlife Refuge	U.S. Fish and Wildlife Service	Wildlife Conservation	TX	31.30
River Run Park	Army Corps of Engineers	Public Use	AR	27.19
White Cliffs Park	Army Corps of Engineers	Public Use	AR	23.61

Table 3.1.4. Upper West Gulf Coastal Plain Ecoregion State and Federally Managed Lands				
Unit Name	**Managing Body**	**Primary Purpose**	**State**	**Acres**
Oak Grove Use Area	Army Corps of Engineers	Public Use	AR	21.76
Saratoga Landing Use Area	Army Corps of Engineers	Public Use	AR	19.64
Mccloy Park	Arkansas Department of Transportation	Public Use	AR	13.04
Rebel State Historic Site	Louisiana Department of Culture, Recreation and Tourism	Cultural	LA	11.53
Department Of Transportation Area	Louisiana Department of Transportation	Public Use	LA	7.24
Marks' Mills State Park	Arkansas Department of Parks and Tourism	Cultural	AR	6.21
Louisiana State Exhibit Museum	Louisiana Department of State	Public Use	LA	6.15
Lake Greeson	Army Corps of Engineers	Public Use	AR	5.12
Starr Family Home State Historic Site	Texas Historical Commission	Cultural	TX	3.81
Louisiana State Oil and Gas Museum	Louisiana Department of State	Public Use	LA	1.98
Wayside Park	Arkansas Department of Transportation	Public Use	AR	1.30
Highway 1 Dotd Roadside Park	Louisiana Department of Transportation	Public Use	LA	1.14
Beard's Lake Use Area	Army Corps of Engineers	Public Use	AR	1.06
Linville Roadside Park	Louisiana Department of Transportation	Public Use	LA	0.76
Old Washington Historic State Park	Arkansas Department of Parks and Tourism	Cultural	AR	0.57
TOTAL				**1,408,909.77**

SPECIES OF SPECIAL CONCERN FOR OLD SABINE BOTTOM WILDLIFE MANAGEMENT AREA AND LITTLE SANDY NATIONAL WILDLIFE REFUGE

Mammals

Rafinesque's big-eared bat (*Corynorhinus rafinesquii*)*
Southeastern myotis (*Myotis austroriparius*)*+
Louisiana black bear (*Ursus americanus luteolus*) # +
Plains spotted skunk (*Spilogale pautorius interrupta*) +

Birds

Peregrine falcon (*Falco peregrinus*) +
Bald Eagle (*Haliaeetus leucocephalus*) +
Wood stork (*Mycteria americana*) *+
White-faced ibis (*Plegadis chihi*) *
Bachmans's sparrow (*Aimophila aestivalis*)
Henslow's sparrow (*Ammodramus henslowii*) +
Swallow-tailed Kite (*Elanoides forficatus*)
Swainson's Warbler (*Limnothlysis swainsonii*) *
Kentucky Warbler (*Oporornis formosus*)
Prothonotary Warbler (*Protonotaria citrea*) *
Worm-eating Warbler (*Helmitheros vermivorus*)
Hooded Warbler (*Wilsonia pusilla*)
Bell's Vireo (*Vireo bellii*)
White-eyed Vireo (*Vireo griseus*) *
Yellow-billed Cuckoo (*Coccyzus americanus*) *

Reptiles

Alligator snapping turtles (*Macroclemys temminckii*) *+
Texas horned lizard (*Phrynosoma cornutum*) +
Northern scarlet snake (*Cemphora coccinea copei*) +
Louisiana pine snake (*Pituophis melanoleucus ruthveni*) +
Canebrake or timber rattlesnake (*Crotalis horridus atricaudatus*) *+
Texas garter snake (*Thamnophis sirtalis annectens*)
Sabine Map Turtle (*Gratemys ouachitensis sabinensis*)

Amphibians

None

Fish

Shovelnose sturgeon (*Scaphirynchus platorynchus*)
Paddlefish (*Polydon spathula*) *+
Taillight shiner (*Notropis maculata*)
Ironcolor shiner (*Notropis chalybaeus*) +
Bluehead shiner (*Pteronotropis hubbsi*)
Creek chubsucker (*Erimyzon oblongus*) +
Blackside darter (*Percina maculata*)
Orangebelly darter (*Etheostoma radiosum*) +
Western sand darter (*Ammocrypta clara*) +

Mollusks

Creeper "squawfoot" (*Strophitus undulates*)
Fawnsfoot (*Truncilla donaciformis*)
Little spectaclecase (*Villosa lienosa*)
Louisiana pigtoe (*Pleurobema riddellii*) +
Pistolgrip (*Tritogonia verrucosa*)
Rock pocketbook (*Arcidens confragosus*)
Sandbank pocketbook (*Lampsilis satura*) +
Southern hickorynut (*Obovaria jacksoniana*) +
Texas heelsplitter (*Potamilus amphichaenus*) +
Texas pigtoe (*Fusconaia askewi*) +
Wabash pigtoe (*Fusconaia flava*)
Wartyback (*Quadrula nodulata*)

Plants

Cypress knee sedge (*Carex decomposita*) +
Panicled indigobush (*Amorpha paniculata*) +

Federally listed threatened or endangered species
+State listed rare, threatened, or endangered species for Wood County
* Known to occur on Little Sandy National Wildlife Refuge

DRAFT FOREST HABITAT MANAGEMENT PLAN

LITTLE SANDY NATIONAL WILDLIFE REFUGE

HAWKINS, TEXAS

Prepared by: _____ _____

John Stephens Date

Forester

Caddo Lake National Wildlife Refuge

Karnack, TX

Submitted by: _____ _____

David Weaver Date

Project Leader

Little River National Wildlife Refuge Complex

Broken Bow, OK

Concurrence by: _____ _____

Raye Nilius Date

Refuge Supervisor, OK/TX

Region 2, Albuquerque, NM

Approved by: _____ _____

Aaron Archibeque Date

Regional Chief

Region 2, Albuquerque, NM

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I. Introduction

A. Scope of Plan

This Interim Forest Habitat Management Plan (IFHMP) has been prepared for Little Sandy National Wildlife Refuge (NWR) in northeastern Texas, also known as the Little Sandy Hunting and Fishing Club (LSHFC). The purpose for the plan is to identify the forest habitat needs for the Refuge and identify the management actions that will be implemented to achieve Refuge wildlife objectives. The life span of the FHMP will be 15 years (2016-2031). Presently, the Service has a perpetual, non-development easement on 3,802 acres of the LSHFC. There is approximately 3,097.1 acres of forested land inside the easement Refuge and the remainder of the easement is permanent water in lakes. There is an additional 145 acres of the club that are excluded from the easement. The exclusion area contains a clubhouse, numerous lodges and recreational improvements that are used by the club members.

B. Legal Mandates

As part of the U.S. Fish and Wildlife Service, 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). This act requires, in general, that Refuges restore and maintain the biological integrity, diversity and environmental health necessary to achieve this mission and the purposes established for each Refuge. Sound natural resource management practices are called for to provide optimum wildlife habitats and create an environment where compatible public use will be encouraged.

Little Sandy NWR's official purpose states that the Refuge

> *"...shall be administered by him [Secretary of the Interior] directly or in accordance with cooperative agreements... and in accordance with such rules and regulations for the conservation, maintenance, and management of wildlife , resources thereof, and its habitat thereon.."* 16 U.S.C. 664 (Fish and Wildlife Coordination Act of 1934.)

Little Sandy NWR was established for:

- The preservation of wintering and breeding habitat for migratory waterfowl of the Central Flyway.
- The preservation of habitat for birds utilizing the area during the spring and fall migration.
- To perpetuate forest succession of one of Texas' largest old-growth bottomland hardwood forest.

The Refuge meets the Service mandate for the conservation of declining wetlands habitats, including bottomland hardwood forests, and the restoration and enhancement of biodiversity of wetland and upland habitats which have both been designated as priorities by the Land Acquisition Committee of the East Texas Ecosystem (ETXECO).

C. Relationship to other plans

The Final Environmental Assessment and Decision Document for Little Sandy Hunting and Fishing Club Easement, completed in 1986, identify the significance of maintaining the approximate 3,000 acres of bottomland hardwoods. This site is significantly unique because of the size, location and past management which renders this habitat priceless due to forest structure and age. This establishment of this IFHMP will provide habitat assessment of the forest conditions according to current Service guidelines used in the West Gulf Coastal Plain (WGCP) and Mississippi Alluvial Valley (MAV). This

will allow habitat monitoring to be conducted over time, assessing and documenting change. Currently, the Comprehensive Conservation Plan for Little Sandy NWR is being reviewed for public review. The EADD established the following purposes for the Refuge as a guide to its present and future habitat management direction:

- Preservation of wintering and breeding habitat for migratory waterfowl of the Central Flyway, as well as habitat for birds utilizing the area during spring and fall migration.
- Permanently protection of the bottomland hardwoods and the waterfowl species of these wetlands.

A strong concern for declining habitat for non-game forest dwelling birds is shared throughout agencies and organizations that are involved in management of bottomland hardwood and other forest communities. This plan will involve management actions that assess vegetation parameters, including a habitat evaluation system that will capture changes in wildlife habitat parameters.

Located in the WGCP, Little Sandy NWR is a component of forested lands needed to achieve the objectives of the North American Waterfowl Management Plan (NAWMP), Partners-In-Flight Plan for Landbirds, United States Shorebird Conservation Plan, Waterbird Conservation for the Americas and it also is located within the West Gulf Coastal Plain Bird Conservation Region and the Lower Mississippi Valley Joint Venture, a component of the North American Bird Conservation Initiative (NABCI). This plan identified the need for additional acquisition of public lands in this area for migratory bird management. The Refuge not only contains habitat for waterfowl, but also for migratory non-game forest land birds, waterbirds and shorebirds. Developing and implementing a Refuge habitat assessment program designed to improve and maintain high quality migratory bird habitat directly contributes to the achievement of NAWMP objectives.

The Refuge is part of the Service's ETXECO which covers parts of two states (70 Texas counties and 5 Louisiana parishes) and includes portions of two Service Regions. The Refuge is located just north of the Sabine River that flows into the Gulf of Mexico. The ecosystem plan, revised in 2003, states: "The vision of the ETXECO Team is the efficient and effective management of Federal trust fish and wildlife resources of the ecosystem to conserve and restore biodiversity for the benefit of the people." This plan establishes several major objectives including "Conserve and Restore Focus Habitats" (specific strategies developed for several plant communities, including wetlands and bottomland hardwood forests) and "Focus Species Conservation and Restoration" (specific strategies for migratory birds and listed species). Habitat management designed to restore and maintain diversity of the floodplain hardwood systems contained on Little Sandy NWR directly supports the objectives of the ETXECO Plan.

II. Background

Native Americans settled in northeastern Texas and northwestern Louisiana around 12,000 years ago during the Paleo-Indian Period and existed as mobile hunters-gatherers and foragers (Perttula and Nelson 1999, Cliff et al. 1996). Beginning about 1,200 years ago in what is sometimes referred to as the Early Ceramic Period, the art of ceramics was established, and the sophisticated culture of the Caddo tribe occupied portions of the four states. The Caddos were traders, horticulturist and hunters that lived in grass and cane covered huts housed in dispersed villages. At the time of sustained European contact with the Caddos in the late 1600's, several thousand people lived around the Red River and central east Texas (Perttula and Nelson 1999). The first permanent Euro-American settlers to the area and the site were cotton planters, and the majority of the land grantees can be classified culturally as Anglo-Americans (Cliff et al. 1966).

During the mid-1800's, east Texas was being settled with cattle production and farming providing much of the area's commerce. As the turn of the century neared, hunting and fishing clubs were established for business men and others to retreat from the big cities and recreate at these clubs. Dallas Hunting and Fishing Club established in 1885 and is only 10 miles south of downtown Dallas. This was prior to the era of automobiles with horse and buggies or trains as the primary means of transportation. Some felt that 10 miles away from Dallas which was thriving and growing was too close and a club further away with good access would be preferred. The only way to get to LSHFC in the early days was by train which took about two and half hours from Dallas. The train initial stopped at Hawkins, Texas and the members had to ride back to the Club through meadows in buggies. An agreement in 1914 allowed a water tank to be built that provided water for the steam engines and also permitted the members to board and disembark at the Club at a rail site designated as Angler, Texas (Shannon 1992).

A. Inventory and description of Refuge habitats

The forested ecosystems of the Little Sandy NWR are a complex and diverse networks of plants and animals created and maintained by a history of periodic flooding in the bottomland systems. Due to long term Club ownership since the 1907, the bottomland system has had little to no harvesting activities. Today, the Refuge easement consist of a mosaic of bottomland hardwood forests and mature mixed hardwood-pine forests with gap succession dynamics occurring as large dominant overstory trees die. This promotes numerous early, light seeded, successional communities to become established in these gap areas. With time and current protection, the Refuge should retain much of the old growth characteristics, including a diverse assemblage of plants and animals.

1. Location:

Little Sandy NWR is located in Wood County, Texas, approximately 20 miles north of Tyler, TX and three miles west of Hawkins, TX. The Refuge is border on the south by the Sabine River and the Smith County line, north by a Missouri Pacific Railroad line, and west and east by private property. The Refuge consists of one of the few old growth bottomland hardwood forests in Texas and the West Gulf Coastal Plain.

2. Management units:

Little Sandy NWR consist of 3,802 acres of a donated perpetual easement from the LSFHC. The Refuge has been separated into six management units or compartments which range in size from 115 to 887 acres (see map pp 49). Compartment boundaries are established along geographic features that can be easily identified on the ground (i.e. streams, roads, trails, etc.). Compartment evaluations will follow a six year schedule. The compartments were inventoried in 2006 and later divided into stands. Table 1 (pp 5) and map (pp 48) provides existing land use by compartment on Little Sandy NWR. In mapping the Refuge boundary the acreage derived was five acres less the actual easement allotment and is considered only for management purposes.

Table 1. Area Summary Table, Little Sandy NWR

Compartment	Forest	Wetland Habitat	Perm. Water	Total Acres

1	115.6		0	115.6
2	527.4		0	527.4
3	734.2	36.1	0	770.3
4	243.1	23.8	0	266.9
5	840.9	33.2	0	874.1
6	542.8		0	542.8
Co. line - riverbank			54.7	54.7
4 lakes			645.4	645.4
Total	**3004**	**93.1**	**700.1**	**3797.2**

An inventory of the native forest communities was conducted in 2006 by the Service staff. Sampling intensity was around 2.5 percent of the total land area and was conducted on a systemic grid cruise using a 10 factor prism and 1/5 acre plots. In addition to standard forest inventory data, additional parameters were measured at each plot (e.g. heights, vertical position, stem crown widths, densities, percent plant material occupancy, etc.) at upper, mid and lower level strata to assist in describing forest bird habitat conditions. These additional parameters corresponded, in part, to standard bird point count vegetative sampling techniques and were developed with extensive consultation/coordination of leading bird scientists in the Southeast Region. Appendix A provides a copy of the data sheets developed and utilized in this effort. This inventory provides the base line habitat information presented in this document.

3. Physical or geographic setting:

The Refuge lies within the WGCP physiographic area and has a relatively narrow topographic relief overall. Although relatively flat, the topography is complex with numerous stream channels, depressions and a few poorly drained flats. There is a difference of 60 feet between the lower points along the banks of Sabine River on the southeast boundary (elevation 270-280 feet above mean sea level (msl)), and the highest point near the northeast boundary along the railroad (330 feet msl). Around 30 percent of the Refuge is below the 290' contour, including Bradford Lake. This area should largely be considered bottomland hardwoods and likely to flood. Approximately 31% of the Refuge lies between the 290 to 295' contour, where much of the break begins between the primary and secondary bottomland hardwoods with flooding occurrence from annually to every several years. Beaver Lake, located near the eastern boundary, lies in this elevation range. Around 32% of the Refuge lies between the 295 to 300' contour with half of this elevation level containing Overton and Brumley Lake. The forested portion of this elevation range consists of both bottomland hardwoods and upland hardwood stands with both shortleaf and loblolly pine dominating several of the upland ridges.

Wood County is hot in summer but cool in winter, when an occasional surge of cold air causes a sharp drop in otherwise mild temperatures. Rainfall is uniformly distributed throughout the year, reaching a slight peak in spring. Snowfalls are infrequent.

In winter, the average temperature is 45 degrees F and the average daily minimum temperature is 33 degrees F. The lowest temperature on record, which occurred on December 30, 1983, is 1 degree F. In summer, the average temperature is 80 degrees F and the daily average maximum temperature is 92 degrees F. The highest recorded temperature, which occurred on July 16, 1978, is 107 degrees F. The growing season averages 246 days a year.

The total annual precipitation is about 45 inches. Of this, 22.5 inches, or 50 percent, usually falls in April through September. The heaviest 1-day rainfall during the period of record was 6.5 inches on December 3, 1982. The average seasonal snowfall is about 2 inches. The greatest snow depth at any one time during the period of record was 9 inches.

The average relative humidity in mid-afternoon is about 60 percent. Humidity is higher at night and the average at dawn is 80 percent. The sun shines 70 percent of the time in summer and 55 percent in winter. The prevailing wind is from the south. Average wind speed is highest, 13 miles per hour, in spring (U.S. Department of Agriculture 1998).

The area around Little Sandy NWR is rural with forests occurring on roughly 31 percent of Wood County. The remaining area consists of pasture and hayland (53 percent), cropland (eight percent), water areas (six percent) and urban and built-up areas (two percent) (U.S. Department of Agriculture 1998).

Hydrology

Little Sandy NWR is located in the Sabine River watershed. Open water and oxbow lakes cover around 17 percent of the Refuge. Overton (built 1949) and Brumley Lakes together occupy around 597 acres. Beaver Lake, an oxbow lake, is approximately 20 acres. Bradford Lake, a modified oxbow lake and fed by Little Sandy Creek, is approximately 32 acres and was built in 1978 (Shannon 1992). The Sabine River forms the southern boundary of the Refuge along with much of the southern boundary of Wood County. The river flows from a westerly direction eastward along Wood County south boundary. Little Sandy Creek flows from the north into Brumley Lake thence southward to Bradford Lake and then into the Sabine River. Jim Ned Creek flows into Overton Lake and then in a southwestward direction into the Sabine River.
Woods County has several lakes and reservoirs that lie upstream of the Refuge. Two closer ones are Lake Fork Reservoir (built 1980) and Hawkins Lake (built 1962). Hawkins Lake is just north of the Refuge on Little Sandy Creek while Lake Fork Reservoir is in the northeast corner of the county and drains into the Sabine River above the Refuge through Lake Fork Creek. Another large lake on the Sabine River upstream of the Refuge is Lake Tawahoni (built 1960). Toledo Bend Reservoir (built 1967) and Sabine Lake are located down river of the Refuge. These are some of the larger reservoirs located in the Sabine River Watershed (Sabine River Authority and Texas Parks Wildlife websites).

The most important aspect of the Refuge is its large, functioning forested ecosystem. Although the many direct and indirect hydrologic alterations described above have impacted the processes that maintain the Refuge's ecosystem function and plant community composition, forested uplands and wetlands are naturally dynamic and display a high resiliency to disturbance due to the nature of the processes that maintain them.

a. Historic condition

In the early 1800's as settlers arrived in East Texas, the landscape was forested with a variety of both pine and hardwood species. Pines, for the most part, dominated the uplands while hardwoods were abundant in the bottomlands. The common pine species were shortleaf, loblolly and longleaf (longleaf is typically found further south in Texas). Although some overlap of pine species did occur, each species was generally restricted to specific geographical and topographical areas. Bottomland habitats along rivers, swamps and associated drainage were interspersed through the area.

The shortleaf pine forest type was located in the northern half and western portions of the pineywoods which would include the eastern portion of Wood County. This area was generally bordered by the Red River to the north, the Louisiana border to the east, Hopkins County to the west, and Angelina and Houston Counties to the south. North of the Sabine River, from Longview, TX, through Cass and Bowie Counties, the shortleaf pine formed compact forests (Texas Park and Wildlife website).

Since the first railroads were cut through this area, the harvest of the shortleaf timber began earlier than that of the other pine timber. For the most part, very little reforestation of these harvested areas occurred and hardwood began to occupy many of the sites with some shortleaf regenerating successfully. Many sites were cleared for cultivation and grazing (Texas Park and Wildlife website).

Rich, fertile bottomland forest along rivers and drainages included oak, ash, hickory, gum and cottonwood tree species. These hardwood trees grew very large with early accounts of oaks, ashes, and hickories up to diameters of six (6), four (4) and three (3) feet, respectively. Settlers not only commercially harvested the bottomland forest but also cleared the forest for settlement and agricultural production in the nutrient rich soils (Texas Park and Wildlife website).
Due to the demand for lumber and the abundant timber resource of east Texas in the late 1800's through the early 1900's, much of Texas' old growth-forests had been harvested by 1915 (Texas Environmental Profiles website). By 1940, much of the upland area which comprises the Refuge was cleared and cultivated for crops such as cotton.

Little Sandy NWR is believed to be one of the last remaining old-growth bottomland forest in Texas. By known records and personal accounts, the club has not harvested in the river basin since their ownership/charter in 1907 (except in lake basins during construction). However, during the timber inventory in 2006 by Refuge staff, several scattered rich pine stumps were found in the northwest portion of the Refuge. (Generally takes larger pine trees to form resin stumps from the center of the tree that persist for decades due to the resin preserving them. The rich lighter pine is very ignitable if the weathered coating is removed and exposed to flame.) These stumps show evidence of a smooth top about 18 to 24 inches above ground. This resembles modern chainsaw activity and not higher crosscut saw cuts (36 inches tall). Chainsaws did not become available until around the 1930's and would likely not widely been used until the later 1930's to early 1940's. This coincides with the oil leases the Club encountered started in 1935 and continued into the 1940's. It is likely the earthen mounds in this area are related to these activities as well. An oil well site is located on the far northeastern boundary of the Refuge. These are likely the last oil and gas activities on the Club to date. Union Pacific (formerly Missouri Pacific and formerly Texas & Pacific) Railroad lies along the northern boundary of the Refuge easement and has frequent train traffic (Shannon 1992). No other harvesting disturbances were observed throughout the Refuge. On occasion, removal of fallen trees from the ATV trails is performed to permit access.

b. Current condition

Vegetation

The forests on the easement Refuge have no evidence of timber harvesting except for the oil well sites and related disturbances. Currently, much of the bottomland forest is late stand succession with the death of large overstory trees creating up to 1/4 acre gaps in the forest canopy and allowing sunlight to reach the forest floor. Numerous seedlings and native herbaceous vegetation quickly carpet these openings a process referred to as "gap dynamics". Planera swamps (water elm thickets) meander throughout several low lying area on the Refuge providing a dense low canopy layer. The bottomlands support overcup oak, bottomland post oak, green ash, water hickory, cedar elm and several red oaks (willow and water). In the uplands, often referred to as the pineywoods in east Texas, shortleaf and loblolly pine tower above a mixed upland hardwood forest with red oaks (southern red and water), hickories, white oaks and sweetgum among the most common forest species.

The forest community at Little Sandy NWR includes an abundance of oaks (water - *Quercus nigra,* willow - *Q. phellos, overcup - Q. lyrata,* southern red - *Q. falcata,* white - *Q. alba,* bottomland post - *Q. similis,* post - *Q. stellata*) and hickories (water - *Carya aquatica,* pecan - *C. illinoensis,* bitternut - *C. cordiformis,* mockernut - *C. tomentosa,* black - *C. texana*). Other species present include bald cypress *(Taxodium distichum),* boxelder *(Acer negundo),* black willow *(Salix nigra*), the introduced Chinese tallow tree *(Sapium sebiferum),* eastern red cedar *(Juniperus virginiana),* water and honey locust *(Gleditsia aquatica* and *G. triacanthos*), loblolly and shortleaf pine *(Pinus taeda and P. echinata),* red mulberry *(Morus rubra),* river birch *(Betula nigra),* red and silver maple *(Acer rubrum and A. saccharinum),* sweetgum *(Liquidambar styraciflua),* sycamore *(Platanus occidentalis*), blackgum *(Nyssa sylvatica),* sugarberry *(Celtis laevigata),* American elm *(Ulmus americana),* cedar elm *(Ulmus crassifolia),* slippery elm *(Ulmus rubra),* water elm (*Planera aquatica*), winged elm (*Ulmus alata*), persimmon *(Diospyros virginiana)* and green ash *(Fraxinus pennsylvanica).* The understory includes small trees and shrubs such as swamp and flowering dogwood *(Cornus alternifolia* and *C. florida),* American holly *(Ilex opaca),* deciduous holly *(Ilex decidua),* buttonbush *(Cephalanthus occidentalis),* swamp privet *(Forestiera acuminata),* hornbeam *(Carpinus spp.),* dwarf palmetto (*Sabal minor*) and switchcane *(Arundinaria gigantea*). This above information was compiled from 2006 forest inventory and staff observations. The USGS and Service conducted a thorough vegetation assessment for Little Sandy NWR.

In deriving a way to describe the diverse forested communities at Little Sandy NWR, the Society of American Forester's stand types were considered. Over the Refuge, numerous stand types can be readily identified: 80 Loblolly Pine - Shortleaf Pine, 81 Loblolly Pine, 82 Loblolly Pine - Hardwood, 88 Willow oak - Water oak- Diamondleaf oak, 92 Sweetgum - Willow Oak, 96 Overcup Oak - Water Hickory and 101 Baldcypress (Society of American Foresters 1980). Stand type 75 Shortleaf Pine and 76 Shortleaf Pine - Oak, which historically forested the uplands pineywoods, occurs only in small acreages and are generally mixed with loblolly pine to some extent. Overall the bottomland hardwoods on the Refuge can be depicted with three of the above SAF Types: 88 Willow oak - Water oak- Diamondleaf oak, 92 Sweetgum - Willow Oak and 96 Overcup Oak - Water Hickory. However, no diamondleaf (laurel) oak (Quercus laurifolia) were found during the 2006 forest inventory. Cherrybark oak, Nuttall oak and Shumard oak *(Quercus pagoda, Q. nuttallii* and *Q. shumardii*) were other species absent from the tally in 2006. The above three species are commonly found throughout the WGCP bottomland hardwoods. In regards to species diversity, the decision was made to utilize the top three tree species that had the highest basal area present in the overstory and mid-story to represent the stand type for any given location. Forest cover type maps are provided in the compartment summaries, pp. 50 to 67.

Soils

East Texas largely has undulating to rolling soils with loamy or sandy surface layers and a reddish, mottled, clayey subsoil of the Bowie-Kirvin-Troup soil association (Godfery et al. 1977). The soils at Little Sandy NWR are primarily under forest.

Seven soil types are mapped for the Little Sandy NWR area. Below the type, topography association and common tree species are listed (U.S. Department of Agriculture 1998).

- Gladewater clay, - 0 to 1 % slopes, frequently flooded, very deep nearly level, somewhat poorly drained soil is on wide flood plains of Sabine River, ranges 10 to 5,000 acres in size - water and willow oak;
- Manco loam, - 0 to 1 % slopes, frequently flooded, very deep, nearly level somewhat poorly drained soils is on flood plains of major creeks, 5 to 2,000 acres in size- sweetgum, water and willow oak;
- Bienville loamy fine sand, - 1 to 3 % slopes, low stream terraces adjacent to flood plains along Sabine River, 10 to 200 acres in size and irregularly shaped, - loblolly and shortleaf pine, sweetgum, southern red oak; Kullit very fine sandy loam, - 1 to 3 % slopes, very deep, very gently sloping, moderately well drained soil is on broad areas, foot slopes and heads of drainage ways on uplands, 10 to 200 acres in size and irregularly shaped - loblolly pine, southern red and white oak, sweetgum;
- Kullit very fine sandy loam, - 1 to 3 % slopes, very deep, very gently sloping, moderately well drained soil is on broad areas, foot slopes and heads of drainage ways on uplands, 10 to 200 acres in size and irregularly shaped - loblolly pine, southern red and white oak, sweetgum;
- Attoyac fine sandy loam, - 1 to 3 % slopes, very deep, very gently sloping, well drained soils on stream terraces, 10 to 200 acres in size and irregularly shaped, - shortleaf and loblolly pine;
- Woodtell loam, - 5 to 15 % slopes, soils are deep to statified shale and loamy materials, strongly sloping to moderately steep, well drained soil on side slopes above drainage ways on uplands, 20 to 500 acres in size and irregularly shaped - loblolly and shortleaf pine;
- Kirvin very fine sandy loam, - 2 to 5 % slopes, deep to stratified sandstone and shale, gently sloping, well drained soils on broad, convex ridge tops on uplands, 10 to 400 acres in size and irregularly shaped - loblolly and shortleaf pine;

The above soils are in ascending to descending acreage order with Gladewater clay soil type cover roughly 3/4 (2,830 acres) of the Refuge and widely located along the Sabine River. Manco loam soil type is located east of Beaver Lake and between Overton and Brumley Lakes. It second largest soil type found on the Refuge at roughly eight (8) percent (289 acres). The other remaining soil types are located along the northern boundary of the Refuge and form the upland escarpment into the pineywoods. The USDA soil survey includes soil types for acreage in Overton and Brumley Lakes that have different species composition than listed above due to hydrology changes in regards to flooding regimes.

Competition between native and non-native species

Silvicultural and farming activities on Little Sandy NWR never occurred on any scale according to recorded records. Open fields around the clubhouse and lodging area have provided opportunity for invasive species to encroach into the forest edge by wind and water dispersion. This leaves the forest composition to that of a more native stand stocking and not altered by harvesting programs.

The overstory through much of the bottomland hardwoods has reached the climaxed forest stage and entering into gap dynamics in numerous areas. This promotes the development of dense understory consisting of both shade tolerant and shade intolerant species at first. Usually in just several years the shade tolerant species began to undergo stress due too much direct sun which favoring the intolerant species. Favorable oak, ash, elm and gum regeneration is present in many of the gap areas. Obviously soils, size of gaps and seed source dictates species composition at any particular location. The current forest is perpetuating naturally providing irreplaceable habitat. This is referred to as climax regeneration, ultimately perfect state of nature in which all organisms are represented and all physical and biotic factors are in perpetual balance (Smith et al. 1996).

The upland escarpments on the Refuge are diverse in the species composition with micro sites (2 to 15 acres) being dominated by shortleaf and loblolly pines. Several of the micro sites are overstocked with pines promoting stem exclusion among pines. This is common in overstocked pine stand which usually produces high quality sawtimber. Over time the pines will self-thin on these sites and even promote oak and hickory encroachment into the overstory. Both shortleaf and especially loblolly pine are considered pioneer species; older stands generally have only a few stems per acre to reach longevity of 140 to 120 years of age. On the peninsula between Overton and Brumley Lakes, it appears that Ips carver beetles have killed several shortleaf and loblolly pines. This will promote the hardwood development and possibly allow some of the pine seedlings to generate and develop in the larger open areas.

In the understory immediately below the levees of Overton and Brumley Lakes to the southeast a dense undergrowth of dwarf palmetto is established. This undergrowth is practically shading the entire forest floor for several hundred yards away from the lakes. Dwarf palmetto and switch cane are found throughout much of the Sabine bottoms on the Refuge. Both palmetto and cane are dependent on sunlight and generally thrive following forest canopy disturbances.

There are several non-native species that occur on the Refuge and can usually be observed along ground that was formerly cultivated or disturbed. Along the edge of Refuge easement perhaps both Chinese and Japanese privet *(Ligustrum sinense* and *L. japonicum*) are present and encroaching into the forest understory from the clubhouse area. The most widespread invasive would be the aggressive Chinese tallow tree which can be found along the lakes and old oil well sites in the eastern portion of the Refuge. This species is rapidly gaining attention across the southeast U.S. due to the tree's hardiness and its ability to out compete native vegetation. A few isolated Chinaberry *(Melia azedarach)* trees were documented while conducting the forest inventory in 2006. At this stage in the invasive encroachment of the privet and tallow tree could be controlled by using proper herbicides applied in the late summer, before leaf fall. To ignore this issue will likely change the future understory at invaded areas. The problem will likely spread except in areas that limit the encroachment.

Fire management

Wildfire potential on Little Sandy NWR is currently moderate along the railroad due to heavy fuel loading. It is likely that the upland escarpments burned during the steam engine era due to the fires from coal and wood embers and sparks emitted from the smoke stack. Later many steam trains were converted

to oil burning to prevent the embers starting spot fires. A lightning strike in 2005 started a fire in the bottoms along a grassy beaver kill area about ½ mile south of Beaver Lake (a drought occurred in 2005 and 2006). According to a club worker, it burned itself out that day or the next day due to rain and change in fuel source. Staff estimated the wildfire to have burned around 15 to 20 acres of both forest and the snag filled beaver area. It did not burn intense enough to kill any overstory trees but did clean the understory and woody debris up in several locations. Grasses had already reclaimed the beaver killed area by spring 2006 and vines, ferns and legumes were found in the forest floor.

Fire has a role in many ecosystems and depending on the circumstances, should be considered as a tool to maintain forest systems. With the habitat at Little Sandy NWR, prescribed fire does not readily promote management in old growth systems. The down woody debris, snags and hollow trees (possible den sites) that would be consumed are a key components of old growth ecosystems. As in many mature bottomland hardwood forest, generally prescribed fire is not used due to the low intensity and cleaning effect that results under desired fire parameters. High intensity prescribed fires in bottomland hardwood forests is usually implemented to clean logging debris (site preparation). They are rarely conducted in mature bottomland forest due to likelihood of harming residual trees.

The southern yellow pine ecosystem evolved with periodic fires, either from lightning strikes, or the practice of Native Americans. Fires would spread across vast areas, driven by an abundance of highly flammable ground fuels such as pine needles and grass, and lack of man-made barriers such as highways and lakes. In the absence of periodic fires, the grass community disappears and is replaced by shade tolerant hardwoods. The loss of this pine savannah type habitat has led to the decline of many species that were once associated with it. Examples include red-cockaded woodpecker *(Picoides borealis*), Louisiana pine snake *(Pituophis melanoleucus ruthveni)*, northern bobwhite quail *(Colinus virginianus)*, eastern wild turkey *(Meleagris gallopavo slivestris)*, and Bachman's sparrow *(Aimophila aestivalis)* (Texas Parks and Wildlife website).

At Little Sandy NWR, many of the pineywoods are generally small and would be of minimum to moderate value on a landscape level if prescribed fire was implemented. The habitat benefit to new wildlife would only provide small amount of habitat needed for many species. With the history of Little Sandy NWR, implementing a prescribed fire program would alter what has been accomplished over time. Wildfire as it occurs should be safely extinguished with knowledge that this is a natural event and will continue to be a part of nature.

Forest pests and diseases

There are many forest pests that are common throughout northeast Texas. Many forest pests are present in forest communities in such small quantities that they go undetected. When conditions begin to stress forest communities, forest pests may capitalize on the situation and become a problem. Southern pine beetles, Ips beetles, and turpentine beetles are all common forest pests that usually attack stressed pine trees. Oak wood borers usually attack oak trees that are mature and possibly under stress. Oak trees are susceptible to several blights and galls that are common in east Texas and surrounding states. On a small scale, pests and diseases usually do not pose a problem but, when opportune conditions arise, they can spread and cause major habitat destruction through loss of trees.

Some of the high valued pineywoods (both habitat and economically) on the Refuge are overstocked. When the basal area of a pine dominated stand exceeds 100 square feet to the acre, it becomes very susceptible to southern pine beetle attacks. Ips beetles usually attack stressed trees, such as lightning damaged, and spread to other nearby pine trees. Black turpentine beetles are usually attracted to wounded

trees when the bark or roots are damaged. In all the above cases, lightning struck trees could very well begin an outbreak. Generally pest outbreaks, on the Refuge, will be assessed and treated accordingly to prevent habitat loss. Since no commercial timber activity has been conducted over the past 100 years, and the pine forests on Little Sandy NWR are succeeding to an oak-hickory forest due to climax succession. Late successional pine communities are becoming rare throughout the southeastern U.S. and promoting forest health is needed to preserve this habitat from preventable damage.

Historically, the southeast needed outbreaks and natural events to set stand succession back. Little Sandy NWR is a small gem on the landscape. Altering that takes nature out of its element.

4. Maps

A National Vegetation Classification System Map for the Refuge is on pp. 47. A land use map for Little Sandy NWR and surrounding area is located on pp. 48. Individual compartment maps with stand summaries and vegetative analysis follows the compartment locale map located on pp. 50 to 67.

III Resources of Concern

Fish and Wildlife

Bottomland hardwood ecosystems are very productive habitats for a wide array of fish and wildlife species. The Refuge and the surrounding area are no exception. The Refuge's abundance of high quality forested communities provides outstanding habitat for a diversity of fish and wildlife.

In general, a thorough base-line inventory of most species of wildlife in the Refuge has not been conducted. The Service's east Texas Bottomland Hardwoods Concept Plan (USFWS 1985) will be used to provided species list. Even so, omissions of certain wildlife species in this document may represent a lack of information rather than a lack of concern about those particular species.

Mammals

A total of 45 mammals species have been recorded in bottomlands and associated wetlands of east Texas. Included are 11 species of bats, 15 species of rodents, 11 species of carnivores and eight other species (USFWS, 1985).

Important game species that occur on the Refuge include swamp rabbit *(Sylvilagus aquaticus)*, gray squirrel *(Sciurus carolinensis)*, and white-tailed deer (*Odocoileus virginianus*). All three game species are abundant on the Refuge.

Principal furbearers that occur (or potientially occur) on the Refuge are raccoon, mink *(Mustela vison)*, opossum *(Didelphis virginiana)*, gray fox *(Urocyon cirereoargenteus)*, bobcat *(Felis rufus)*, coyote *(Canis latrans)*, striped skunk *(Mephitis mephitis)*, nutria *(Myocastor coypus)*, river otter *(Lutra canadensis)* and beaver *(Castor canadensis)* (Schmidley, 1983 & 1984). Raccoon, nutria, mink, otter and beaver all prefer aquatic and wetland habitats and are all rather common on-site with the possible exception of the river otter, which is present in unknown numbers in the area.

Gray and fox squirrels are both abundant, particularly where suitable mast-producing hardwoods are available. Although the habitats of these two species overlap, gray squirrels prefer deep woods with heavy mid-story vegetation, whereas fox squirrels tend to favor small woodlots and the edges of larger forested tracts. Due to their high potential recruitment rates (directly associated with availability of mast) and high natural mortality rates, it is unlikely that any long-term changes in squirrel population densities have occurred within the available forest communities.

Several species of bats are native to this region. One species of concern is the Rafinesque's big-eared bat (*Plecotus rafinesquii*). This bat is known to use large cavity trees on Little Sandy NWR for nesting and brood chambers. The southeastern myotis (*Myotis austroriparius*), an uncommon species, is also found on the Refuge. The population status of these bat species on the Refuge is unknown.

Beaver and raccoon population levels have become quite high in recent years, probably associated with depressed fur demands and a lack of natural predators. These two species are of major concern because of their potential to significantly impact ecosystem functions. An increased beaver population has altered the area's hydrology as a result of increased dams and beaver ponds, inundating the bottomland forests and keeping them flooded for prolonged periods. In addition, beaver have become a greater nuisance to private landowners in the area. The negative impacts of high raccoon populations include their effect in reducing populations of migratory and resident birds. Raccoons are usually nocturnal and feed primarily on acorns and crawfish, with fruits, a few fish, birds and snakes being a part of their diet (Caire et al., 1989). With raccoon numbers higher than previous years, many more food sources are used to support the increase in population. Raccoon predation may be adversely affecting reproduction of breeding neotropical migratory birds and turtles (Cooper and Ford 1993).

Free ranging feral hogs on the Refuge have become a concern for wildlife land management. Hogs are highly adaptable, have high reproductive capabilities, and can be found in a wide range of habitat types. When feral hogs actively compete for mast food resources, resident wildlife may enter the winter with deficient fat reserves. Deer and turkey find acorns primarily by sight while feral hogs use sight and smell to locate their food source. Feral hogs have the potential to impact ground-nesting species, particularly quail and turkeys, through nest destruction and predation (U.S. Fish & Wildlife 2000 II).

<u>Birds</u>

The diverse forest communities (pineywoods and bottomland hardwoods) of Little Sandy NWR provide outstanding habitat for an abundance of bird life. A total of 273 species of birds occur in bottomland forests and associated wetlands in eastern Texas (USFWS, 1985). Included in this list are 38 waterfowl species, 29 colonial waterbirds (i.e., herons, gulls and terns); 20 hawks, vultures and owls; 37 rails and shorebirds; eight woodpeckers; 130 passerine birds (i.e., warblers, vireos and flycatchers); and 11 miscellaneous species. A total of 101 species are known or believed to breed in eastern Texas.

A significant colonial waterbird colony is located on Brumley Lake. The colony supports populations of Anhinga *(Anhinga anhinga)*, little blue heron *(Egretta caerulea)*, snowy egret *(E. thula)*, cattle egret *(Bubulcus ibis)*, great egret *(Casmerodius albus)*, and white ibis *(Eudocimus albus)*. Black-crowned night-herons *(Nycticorax nycticorax)* and great blue heron *(Ardea herodias)* are found nesting in Overton Lake and Switch Cane Slough and will nest throughout the bottomlands. The Refuge also is of

importance to a number of raptors, woodpeckers and silvicolous bird species (USFWS, 1985). Much seasonal variation occurs in avian species composition and populations in the area because the bird use is by migratory species. Some neotropical migratory songbirds use these habitats for breeding in the spring and summer and others during migration in the spring and fall. The forested wetlands of Little Sandy NWR are also used by migrating and wintering waterfowl during the fall, winter and spring.

Waterfowl, primarily mallard (*Anas platyrhynchos*), gadwall (*Anas strepera*) and wood duck (*Aix sponsa*), have traditionally used the seasonally flooded wetland habitats of the Refuge. On larger bodies of water, northern pintail (*Anas acuta*), northern shoveler (*Anas clypeata*) and green-winged teal (*Anas crecca*) feed, rest and preen. American wigeon (*Anas americana*) also use the Refuge wetlands. Flooded beaver ponds and sloughs provide excellent nesting and brood-rearing habitat for resident wood ducks. The hooded merganser (*Lophodytes cucullatus*), another cavity nester, is an uncommon breeding species in the region, and does not occur anywhere in large concentrations. Although waterfowl populations for this region are low compared to those in the more extensive wetland and river systems of the Mississippi Alluvial Valley, the numbers of waterfowl that use the area are adequate to provide a base from which to build larger populations through wetland protection and enhancement.

Many species of neotropical migratory songbirds are experiencing long-term declines as a result of widespread habitat loss and fragmentation. Bottomland hardwood forests and riparian woodlands have been identified as a top habitat conservation priority throughout the southeast (Hunter et al., 1992). Conservation of the critical bottomland forests on the Refuge will enhance the breeding, wintering, and transitional habitats for many species of migratory and resident songbirds. Some of the more commonly occurring bird species include the Carolina chickadee (*Poecile carolinensis*), tufted titmouse (*Baeolophus bicolor*), Carolina wren (*Thryothorus ludovicianus*), prothonotary warbler (*Protonotaria citrea*), northern cardinal (*Cardinalis cardinalis*), and white-throated sparrow (*Zonotrichia albicollis*). The forested wetlands of the Refuge also are frequented by many species of wading birds, including the great blue heron, little blue heron, green heron (*Butorides virescens*), cattle egret, snowy egret, great egret, anhinga, and yellow-crowned night heron (*Nyctanassa violacea*).

Pineywoods throughout the south provide a habitat for a suite of priority species such as the red-headed woodpecker (*Melanerpes erythrocephalus*), red-cockaded woodpecker, brown-headed nuthatch (*Sitta pusilla*), pine warbler (*Dendroica pinus*) and Bachman's sparrow. Many of these species prefer late climax pine stands which are found on the Refuge.

The eastern wild turkey and northern bobwhite quail are the primary resident game birds for the area's ecosystem. Their population status is currently unknown. It is unknown how much nest and brood predation occurs to turkeys which may impact the recovery of the species on the Refuge. However, habitat components for the species are present throughout the Refuge.

<u>Reptiles and Amphibians</u>

Reptiles and amphibians require quality wetland habitat for their survival, and they may be an important indicator group of environmental well-being. The damp, forested bottomland hardwood habitat of the Refuge is conducive to an abundance and diversity of reptiles and amphibians. As with the other wildlife groups, detailed information on the species of herpetofauna found on the Refuge is lacking. A total of 54

species of reptiles and 31 species of amphibians are known to occur in bottomland hardwoods and associated wetland habitats in east Texas. This list includes 17 turtles; 1 crocodilian, the American alligator (*Alligator mississippiensis*), 8 lizards; 28 snakes; 11 salamanders; and 20 toads and frogs (USFWS, 1985).

Some reptiles thought to commonly occur on Little Sandy NWR include the common snapping turtle (*Chelydra serpentina*), alligator snapping turtle *(Macroclemys temmincki)*, Mississippi mud turtle (*Kinosternon subrubrum*), American alligator, red-eared slider *(Trachemys scripta elegans*), black rat snake (*Elaphe obsoleta obsoleta*), broad-banded water snake (*Nerodia fasciata confluens*), canebrake rattlesnake (*Crotalus horridus*) and western cottonmouth (*Agkistrodon piscivorus leucostoma*). Alligator snapping turtles, the largest of the turtle group and attaining sizes of up to 200 pounds, were once more abundant and widespread throughout the southeast. However, due to recent exploitation, their numbers have been reduced in many areas. Because of concerns about the recent population reduction Texas Parks and Wildlife Department (TPWD) prohibited all taking of alligator snapping turtles in Texas and the species is listed as threatened in the state.

Amphibian species thought to be common in the Refuge area include the mole salamander (*Ambystoma talpoideum*), smallmouth salamander (*Ambystoma texanum*), five-lined skink (*Eumeces fasciatus*), green tree frog (*Litoria caerulea*), bullfrog *(Rana catesbeiana)* and southern leopard frog (*Rana sphenocephala*). No threatened or endangered amphibian species are known to occur. However, recent research findings indicate that amphibian populations, particularly frogs, are undergoing significant population declines throughout the world. Also in the United States, alarming numbers of frogs of various species are being observed with deformities such as abnormal organs, feet, and toes.

Fish

The Refuge borders the Sabine River on the south boundary and has a diversity of aquatic species. Upstream two lakes provide sportfishing opportunities for bass, bream, catfish, and crappie. A total of 116 species of fish occur within east Texas. Many of these fish utilize bottomlands during seasonal inundation of the floodplains.

Brumley Lake has an improved boat launching spot on the club's property outside the Refuge easement. The area allows access to the Refuge easement on both Brumley and Overton Lake. There is also an improved boat ramp on Highway 14 on the Sabine River east of the Refuge.

Threatened, Endangered, and Candidate Species

There are 47 species of concern located or potentially located on the Refuge or adjacent area (see Appendix B). The Louisiana black bear (*Ursus americanus luteolus*) is the only federally listed species for Little Sandy NWR and was delisted March 10, 2016 due to recovery. The American bald eagle *(Haliaeetus leucocephalus*) is protected by two other federal laws: the Bald and Golden Eagle Protection Act and the Migratory Bird Treaty Act. Both laws prohibit killing, selling or otherwise harming eagles, their nest or eggs. Wintering populations of bald eagles occur at Little Sandy NWR where they traditionally utilize the extensive permanent water wetland communities present throughout the area. An American bald eagle nest has been present on the Refuge in Compartment 1 for several years now (since

2009). They have raised several successful eagle chicks. The nest was destroyed this year by a tornado in May 2016.

Other species exhibiting population declines and of concern to the Service partner conservation organizations include the Rafinesque's big-eared bat and alligator snapping turtle. This bat uses large hollow trees within the area for nursery/roosting sites while alligator snappers likely use permanent water wetlands throughout the year (The Nature Conservancy, 1996).

Little Sandy NWR provides habitat for a broad array of wildlife species and as discussed above, this includes many listed or candidate species and species of concern to conservation partner organizations. Habitat needs, protection and actions designed to enhance suitable habitat conditions for the species, to the extent practical, must be considered in all management activities.

Archaeological Resources

Little is known about the archaeological and cultural resources on the Refuge. Just outside of the Refuge boundary, the Little Sandy Hunting and Fishing Club (LSHFC) have several structures that may be of historical significance. In an open field between the railroad tracts (north of club area) and Highway 80 was a saw mill that cut much of the lumber used to build many of the early structures at LSHFC that is no longer there. Another structure of historical significance at the club would be the old Angler concrete water tank located by the railroad. This was used during the stream engine locomotive era. The tank is over 90 years old (Shannon 1992). However, on the Refuge the only known historic sites are a few oil well sites. On the northwest portion of the Refuge several large holes are present with spoil near each hole. Trees have grown on top of the spoil sites that are small sawlogs. Evidence of older equipment parts suggest old oil well exploration that started in 1935 and continued through the 1940's. (Shannon 1992).

A cultural resource review should be considered for the Refuge in the future to assess the sites on the Refuge and further investigate other locales of interest. Uncertain of the origin of the holes and spoil, these areas are located on Refuge maps and will be provided full protection as provided by Archaeological Resources Protection Act because they may be 50 years age. These maps are not included in plans that will receive wide distribution in order to provide protection. There is no known National Register of Historic Places (NRHP) on the Refuge.

The Service's Regional Archaeological Officer will be provided draft copies of all management prescriptions and location maps for review/coordination with pertinent authorities prior to implementing any habitat actions (excluding monitor/inventory) to assure protection of these sites. The Service will comply with the National Historic Preservation Act prior to the initiation of this plan.

A. Identify the priority species, species groups, and communities

Based upon the discussions previously presented, the priority species of consideration for this Refuge, are those classed as threatened or endangered and candidate species for listing (T& E species) and migratory birds (waterfowl, particularly mallards and wood ducks, silvicolous birds, colonial waterbirds and shorebirds). Presence in and utilization of Refuge habitats by these species and/or species groups was previously presented. Legislative mandates, purposes and specific guidance established by legislation, Refuge purposes, Agency policy and priorities and the goals/objectives set forth are detailed throughout

this plan. All habitat management actions implemented under this plan will consider the maintenance and/or establishment of suitable habitat conditions, where practical, for these species and species groups as top priority. Habitat management actions, even if conducted specifically for a single species (e.g. a T&E species) would be designed, within practical limits, to also benefit a wide diversity of wildlife and habitat.

Establishing and maintaining desirable habitat conditions for T&E species will be given top priority throughout the Refuge when/where these species occur or where specific actions might benefit offsite populations.

Waterfowl, along with migratory non-game birds, are assigned a high priority in those elevations falling within the flood plain (generally < 290' MSL). This area experiences seasonal flooding from over bank flow from the Sabine River and nearly all of Bradford Lake which provide habitat for wintering waterfowl. This area is exclusively forested with mixed species floodplain hardwoods. This same general area has excellent potential for non-game bird utilization and, in fact, currently receives heavy use from this species group. Resident wildlife values are also high, due in part to a high mast producing component in the various stands. A total of about 1,150 acres falls below this elevation range.

Within the 290-295' MSL range, forest dwelling non-game migratory birds and waterfowl (wintering and resident) will receive highest priority consideration. Beaver Lake and many of the drains that flow from Overton and Brumley Lakes are included in this elevation range. This site contains forest with mixed hardwood species and denotes the flood tolerable range for loblolly pine on the Refuge. In this range, loblolly pine generally can not endure the clay soils being saturated for long durations unless on a knoll. Stands of switch cane occur within this elevation class which provides exceptional quality habitat for species such as Swainson’s warbler. Resident wildlife values are also high within this area and will be given consideration in all management actions. About 1,164 acres lies in this elevation range.

Within the 295-300' MSL range (likely outside waterfowl use except for Overton and Brumley Lakes), the ascent from the Sabine River bottoms becomes noticeable. In this range, forest dwelling non-game migratory birds will receive the highest priority consideration. Documentation exist (photos) that this area has flooded irregularly and infrequently in the past as evident from the presence of the upland species such as shortleaf pine and southern red oak. This community typically is above the floodplain and rarely floods. It begins the pineywood and largely consists of loblolly pine with native shortleaf pine and slope hardwood species throughout much of this transitional site. About 1,219 acres lies in this elevation range with both Overton and Brumley Lake included (281 acres and 315 acres respectively, lakes summed equals 596 acres).

The remaining elevation range (> 300' MSL) consist of upland hardwoods and the pineywood communities. This site is seldom if ever flooded and contains the levees that impound Overton and Brumley Lakes. In this range, forest dwelling non-game migratory birds will receive the highest priority consideration. Acreage in this highest elevation range is approximately 236.

A unique feature on the Refuge is the old growth hardwood bottoms. Little Sandy NWR is only one of a few tracts still remaining in Texas uncut for over a hundred years. The Refuge has a heritage and legacy unlike many national wildlife Refuges in the WGCP due to the Club’s protection of the bottomlands from

timber harvesting. The forest has been allow to proceed with stand succession and would be considered in the later stages of succession.

Since the 1990's, avifauna analysis has been reviewed by Region 2 and 4 Refuge staff, Service/non-Service bird biologists and researchers for forested Refuges located in similar habitats in the WGCP. This analysis, based upon West Gulf Coastal Plain Partners in Flight Bird Conservation Plan (BCP) criteria, was conducted in order to establish tentative non-game migratory bird suites and indicator species for each suite. This analysis is presented in Appendix C for reference purposes. Other analysis conducted for this area was performed by Lower Mississippi Valley Joint Venture's West Gulf Coastal Plain Landbird Working Group. The analysis from this group is presented in Appendix D and E. The indicator species identified by BCP (e.g. highest score by habitat component) is as follows for hardwood forest: understory - Swainson's warbler and Kentucky warbler; mid-story - prothonotary warbler; overstory/canopy - swallow-tailed kites and cerulean warbler. The pine savannah forest indicator species are as follows: overstory/mid-story - red-cockaded woodpecker (RCW), overstory/canopy - American kestrel and brown-headed nuthatch, and understory - Bachman's sparrow. These individual species were selected to serve as indicator or representative species for these specific elements or layers of the forest structure. The assumption is made that, in general, if habitat requirements are established and maintained for these birds in these forest layers, the conditions present will also meet the needs of a wide array of other bird species (e.g. bird suite) that utilize this same forest structure element for their life requirements. Selection of these birds as indicator species was made by both Service and non-Service bird biologists and research scientists and represent the best state-of-the-art information/habitat requirement criteria currently available. Selection of these species and identification of optimum habitat conditions for each must be considered tentative until actual effects/response to management effort is monitored across time. Finally, selection of these species and the corresponding bird suites they represent was based upon present Refuge habitat conditions and potential conditions that should develop following application of needed silvicultural actions. It is not the intent of this plan or the Service to attempt radical changes from what is viewed as native flora and fauna compositions but rather to address specific management actions designed to produce optimum, long term habitat conditions for the priority species.

Implementing forest habitat management program for Little Sandy NWR is essential to assess and promote suitable habitat for the species listed above. This program will discuss forest management silvicultural actions, habitat monitoring and prescribed fire to achieve and maintain the habitat conditions necessary to meet priority wildlife objectives.

B. Identify habitat requirements

As stated previously, T&E species and their habitat needs will be given top priority in all management actions. The vast majority of the listed species known to be present or where the published home range includes this general area are riverine dependent and occur near river systems or permanent water areas (black bear) or in pineywood savannahs (RCW). Opportunities to reduce negative impacts and benefit the aquatic species are limited to establishment of streamside management zones (SMZ's) and adhering to Texas' Forestry Best Management Practices (BMPs). Within SMZ's, active forest management will be restricted to only essential actions addressing issues such as public safety or individual tree removal to achieve spot specific site requirements such as super dominant or emergent crown class development.

Disturbance to ground conditions will be minimized in order to assure minimal offsite sedimentation. The nearest known RCW's are located nearly 70 miles away on state owned land (Maxey 2008).

Bald eagles, formerly federally threatened, overwinter and nest on or near the Refuge where they extensively utilize the lake, river and streams. Refuge use would typically involve feeding activities by individual birds. As with the riverine species group, habitat requirements for this species is such that few opportunities exist to provide positive habitat improvements through forest management actions. Some minor improvements may result through the development of emergent stem canopies on high terraces associated with stream systems which might serve as future nest trees. Bald eagles nested on Little Sandy NWR beginning in 2009 until present (2016).

The Rafinesque's big-eared bat is known to use large, hollow trees on Little Sandy NWR for roosting and for brood/nursery chambers. Subject experts have visited the Refuge to view existing habitat conditions and provided some minimal management recommendations. These recommendations included retention of all suitable den trees (≥ 24" DBH with full length cavities - hollow trunks - throughout the entire forest) and retention of a significant old age class component (75 years old +) throughout the area for development of future den trees. Presence of adequate numbers of suitable den trees is viewed as a major limiting factor for this species range wide. Refuge staff was encouraged to protect bald cypress, sycamore and blackgum along/in stream courses since these species tend to have the best chance of developing suitable cavities. Study proposals to examine on-site habitat utilization, population status and habitat requirements for this elusive and relatively unknown species will be considered and efforts made to procure needed funding.

Louisiana black bears generally range over miles; bears home range would extend outside of the Refuge. Yet the habitat at the Refuge provides ample resources for bear use and the large, hollow trees mention above for bat roosting could also be used for bear dens if the trees' hollows are larger enough.

For forest dwelling wildlife, the size, structure and composition of forests are as important as the abundance and spatial distribution of forests within the landscape. To ensure hard mast production for consumption by Louisiana black bear and some species of waterfowl, it is important to maintain some proportion of forest stands in oaks or sweet pecan. However, for large woodpeckers, such as the ivory-billed woodpecker *(Campephilus principalis)*, large-diameter senescent trees are a key habitat component. In addition, large (>36 inch) diameter trees are important for bats and the Louisiana black bear, especially baldcypress, water tupelo, blackgum and overcup oak for den and roosting sites (Hightower et. al. 2002, Benson 2005, Cochran 1999, Hoffman 1999, Gooding and Langford 2004).

Moreover, within stand successional patterns results in a shifting mosaic of patches of various ages and sizes across the landscape. At any given point in time, a particular stand may not provide desired conditions, but at a different stage of stand succession it may be crucial for providing habitat for priority wildlife species. Ideal habitat conditions for any given species are transient, and the presence and abundance of species will vary temporally according to the successional stage of the stand and the surrounding landscape. In forested systems, the time frame necessary to achieve desired conditions within a stand for a given species may be decades. Thus strategic long, term planning is necessary to achieve forest habitat goals. The presence of internal stand structure, both horizontal and vertical along with the spatial arrangement within the stand is a critical habitat component for virtually all priority

species for this Refuge. Patchiness, also a critical habitat element for many forest birds and game species, is typically measured in terms of spatial relationships of reproduction clumps or shrub clumps, coupled with early successional stage plants, such as vines and herbaceous growth to closed canopy/more open stand conditions. These patches/holes would serve a dual function of initiating regeneration to achieve uneven-age stand conditions. Retention of 10% of existing old age class stems (75 years +) throughout each stand to deliberately create an old growth component by leaving older stems of long lived species (oaks, cypress), will provide an abundance of cavities due to high levels of naturally occurring defects within these old age classes. The forest management program developed will not focus on arbitrary parameters such as establishing a predetermined "rotation age" of the forest community for management purposes. Rather, the need for treatment or implementing a silvicultural action will be solely dependent upon wildlife habitat needs of the area - not some assigned stand age structure as a trigger for treatment.

As stated previously, Little Sandy NWR has the heritage of not being silvicultural manipulated for at least the past 100 years. Forest stand conditions impressively display the habitat parameters developed for desired forest conditions. Native species diversity is noted throughout the Refuge due to the minimum disturb over such a long span. The majority of upland forest communities at Little Sandy NWR are mature and well stocked. This provides optimum opportunity for habitat conditions to develop and maintain the late succession mixed hardwood-pine forests. In the upland portion of the Refuge, both upland hardwoods and pineywoods stands are present on small scales (5 to 20 acres) providing groups and corridors in the upland communities that will retain diversity and increase the habitat values. In bottomland hardwoods, old growth conditions extend over much of the dynamic forest. Presence of high forest tree species diversity within the constraints of what species generally occur within specific site conditions are readily detected throughout the Refuge bottoms. This condition is of natural forest diversity and provides a wide range of habitat conditions for a cadre of wildlife species. Mast producing tree species, both hard and soft mast, are present throughout the Refuge.

Original habitat parameters were developed for Pond Creek NWR and Little River NWR in 2001-2002. Since these efforts and habitat parameters were developed, several federal, state, conservation and academic entities have further developed the habitat parameters for a broader range of hardwood forests. The efforts from the agencies has produced the "General Guidelines for Hardwood Forest Management to Improve Wildlife Habitat" (Appendix F). In the mid 2000's, the Lower Mississippi Valley Joint Venture Forest Resource Conservation Working Group focused on refining the hardwood guidelines for desired forest conditions. The group consisted of a team of Service foresters and biologists from multiple Refuges programs and Regions, several state biologists and foresters, and non-Service scientists and researchers. The team developed a document titled Restoration, Management and Monitoring of Forest Resources in the Mississippi Alluvial Valley: Recommendations for Enhancing Wildlife Habitat. The Forest Resource Conservation Working Group (2007) published the document with the refined guidelines for use on federal, state and private lands outlining key characteristics for desired forest conditions for a broad and diverse cadre of wildlife species. While the document was prepared for the Mississippi Alluvial Valley, the LMVJV partnership considered the WGCP with the intent to extend into bottomland hardwoods of the WGCP. Even with this current literature, the parameters must be viewed as a beginning point, not an end point since they may be refined, modified or changed as experience, response to management actions and/or new research data is developed. Major changes in knowledge that results in

significant changes in recommended management actions should be incorporated by amendment to this plan.

The following information details a numerical range for multiple parameters at multiple layers within the bottomland hardwood forest communities. These values (and ranges of values) were developed based upon providing suggested optimum habitat conditions for the identified wildlife priorities given above, including the specific indicator forest bird species. In other words, when forest stand conditions (identified through inventory data collection activities) approximate the parameter values developed by the group, habitat conditions for the priority species and non-game bird suites utilizing that forest layer are considered to be approaching optimum conditions.

Obviously, there are many components that influence the quality of habitat provided to specific wildlife species; these components become a detailed list of what the forest canopy layers, forest floor vegetation and forest patches should be at any point in time. Of necessity, the stand components selected for use must be those that can be routinely evaluated through forest inventory data collection efforts. Current funding and staff constraints for Refuge forest management efforts limits exhaustive parameter data collection efforts across extended periods of time (years). Therefore, this effort focuses upon selecting parameters that could be easily and accurately measured by technicians, where descriptive values of the habitat present would provide a reliable “picture” of habitat conditions.

Table 2. Desired stand conditions for bottomland hardwood forest

Forest Variables[1]	Desired Stand Structure	Conditions That May Warrant Management
Primary Management Factors		
Overstory Canopy Cover	60-70%	>80 %
Midstory Cover	25-40%	<20% or >50%
Basal Area	60-70 ft^2/acre with ≥ 25% in older age classes[2]	>90 ft^2/acre or ≥ 60% in older age classes
Tree Stocking	60-70%	< 50% or > 90%
Secondary Management Factors		
Dominant Trees[3]	> 2/acre	< 1/acre
Understory Cover[4]	25-40%	< 20%
Regeneration	30-40% of area	< 20 % of area
Coarse Woody Debris (> 10 inch diameter)	≥ 200 ft^3/acre	< 100 ft^3/acre
Small Cavities (< 10 inch diameter	> 4 visible holes/acre or > 4 “snag” stems ≥ 4" dbh or ≥ 2 stems > 20" dbh	< 2 visible holes/acre or < 2 snags ≥ 4" dbh or < 1 stem ≥ 20" dbh
Den Trees/Large Cavities[5] (>10 inch diameter)	1 visible hole/10 acres or ≥ 2 stems ≥ 26" dbh (≥ 8 ft^2 BA ≥ 26" dbh)	0 visible holes/10 acres or < 1 stem ≥ 26" dbh (< 4 ft^2 BA ≥ 26" dbh)
Standing Dead and/or Stressed Trees[5]	> 6 stems/acre ≥ 10" dbh or ≥ 2 stems ≥ 20" dbh (> 4 ft2 BA ≥ 10" dbh)	< 4 stems ≥ 10" dbh/acre or < 1 stem ≥ 20" dbh (< 2 ft2 BA ≥ 10" dbh)

[1] Promotion of species and structural diversity within stands is the underlying principle of management. Management should promote vines, cane, and Spanish moss with site limitations.

[2] "Older age class" stems are those approaching biological maturity, (i.e., senescence). We do not advocate aging individual trees but use of species-site-size relationships as a practical surrogate to discern age.

[3] Dominants (a.k.a. emergents) should have stronger consideration on more diverse sites, such as ridges an first bottoms.

[4] Advanced regeneration of shade-intolerant trees in sufficient numbers (circa 400/acre) to ensure their succession to forest canopy. Areas lacking canopy (i.e., group cuts) should be restricted to < 20% of the stand area.

[5] Utilizing BA parameters allows the forest manager to maintain this variable in size classes that are most suitable for the stand instead of using specific size classes noted.

Summary

There are many components that influence the management of the forest canopy for the priority wildlife species. These requirements become a detailed list of what the forest canopy layers should be. The optimum habitat condition in general is found when basal areas are 60 to 70 square feet per acre. The **overstory,** during leaf out, with 100 percent being total area covered by leaf area, should be between 60 to 70 percent occupied. Five to 15 percent of the stand needs to have dominant (emergent) crowns. Average crown diameters for dominant/co-dominant stems should be 45 feet or greater. Indicator species targeted by these stand conditions are swallow-tailed kite, cerulean warbler, northern parula and yellow-throated warbler. During leaf out, **mid-story** should be between 25 to 40 percent occupied by vegetation. Vines can be considered in this estimation. Mid-story starts at ten (10) feet and proceeds to the overstory. Birds that are targeted as indicator species utilizing the mid-story include prothonotary warbler, yellow-billed cuckoo and Acadian flycatcher. The **understory** is three (3) - ten (10) feet in height and targets Swainson's, Kentucky and hooded warblers as indicator species. Understory leaf area should be between 25 to 40 percent occupied by vegetation. **Ground cover** is the most variable component and is dependent on the percentages in the three canopy layers and water amounts. Ground cover ranges from less than three (3) feet in height would likely contain most of the down woody debris. Two birds that serve as indicator species for this layer are the American woodcock and the Swainson's warbler. Old guidelines suggested that 70 percent of the stand should have vines present in all four canopy layers and cane thickets should be present on 20 percent of the plots if the site is appropriate for cane **(**Hamel and Twedt, 2000**)**. The refined guidelines mention that vines, cane and Spanish moss should be promoted within site limitations. All four canopy layer percentages are by ocular estimation.

The forest inventory conducted in 2006 at Little Sandy NWR provided ample information to derive the vegetation estimates that access suitability status under the earlier habitat assessment. This information was collected by Service Complex staff over a four week period. A two and half (2 ½) percent inventory was conducted on the forested portions of the Refuge. Much of Little Sandy NWR's bottomland hardwoods and upland escarpments are believed to be undisturbed silviculturally for the last 100 years and are considered old growth. Data from this assessment can be viewed in the compartment summaries of this plan.

1. Remnant habitats

There are several irreplaceable and unique forest communities on the Refuge. Much of the bottomland hardwood forest is considered and appears be undisturbed for the last 100 years which has allowed the forest to become a climax, old growth forest. It is likely that areas of the Refuge bottoms are virgin forest meaning the forest has never been harvested. Even if harvesting activities occurred in the late 1800's prior to the club's charter in 1907, the activities would have been likely single tree selection, unless clearing for fields, and allowing the forest 100 plus years to follow stand succession would generally return the forest back to the old growth state. This is the legacy of the club/Refuge and why the habitat should be considered irreplaceable and unique.

The only disturbances by man are the levees, cattle grazing and oil exploration. The levees created two new lakes and expanded both Brumley and Beaver Lakes. During the late 1800's and into the 1900's cattle drives were common and free ranging cattle was generally accepted. After the club's charter, a fence was erected allowing the club manager to run his cattle on the Refuge until 1915. The oil well exploration that happened between 1935 and 1982 generally occurred on the upland portions of the Refuge (Shannon 1992). Several low impact ATV/UTV and seasonal vehicle trails meander over the Refuge for ease of access to remote locations.

Bottomland Hardwood

The bottomland hardwood communities on the Refuge are comprised of approximately 2,945.9 acres. This community adjoins the Sabine River and extends north to the upland escarpments and levees around Overton and Brumley Lakes. Both Beaver and Brafford Lakes are nestled in this community. The west portion of the bottomland hardwoods grades northward into the upland communities which consisting primarily of shortleaf and loblolly pine and upland hardwoods and are generally knolls and ridges on the westside of the Refuge. In the central portion of the Refuge the bottomland hardwoods are intersected by several stream meanders and drains from the two leveed lakes, Overton and Brumley. Along these two lake levees, a borrow pit can be found generally parallel to the levees; usually, the water is shallow and the pits are rarely over 40 feet wide. On the eastward side and northwest corner of the Refuge the upland escarpment (mixture of pineywoods and upland hardwood-pine) can be readily apparent by the gain in elevation and change in species composition.

At the riverbank and on first ridge near the river, light seeded species such as black willow, green ash, boxelder, sugarberry and sycamore are generally found. On the back slopes descending into the floodplain from the river, the same species are found with blackgum, persimmon, water hickory and overcup oak. Elevation and hydrology has a direct impact on species composition. Other species that are commonly found throughout the bottomland hardwoods are willow oak, water oak, cedar elm, sweetgum and bottomland post oak.

Approximately 160 acres of this bottomland community is a mixture of depression and riverine wetlands which adds significant habitat value to the Refuge. Depression wetlands are found in lower areas where changes in the surface topography result in a groundwater discharge. Riverine wetlands occur along streams and rivers in floodplains that are flooded periodically but can dry during parts of the year (Brooks

1997); much of this habitat is located along the fringes and fingers of drains that are connected to the four lakes.

Pineywood and Upland Forest

The mature upland forests (approximately 151.2 acres) on the Refuge are moderate to slightly overstocked with a heavy understory and mid-story that is mostly hardwood. Smaller stands (two to 50 acres in size) of pineywood habitat can be found on knolls and ridges through the upland habitat. Fire suppression has left moderate fuel loadings in this historic fire dependent habitat. Pine savannah communities were here at the time of European settlement with reoccurring fire controlling the hardwood understory and mid-story encroachment. Likely due to the isolation and size of these pineywood habitats, wildfire do not generally occur. Even with a high traffic railway north of one site, little to no fire scarring is present.

2. Habitat size and configuration

Previous sections of this plan provide detailed information on forest habitat types, size and configuration. (Section II.A.1.&2. **Location & Management Units).**

3. Connectivity

There is little fragmentation within the Refuge forest. Bradford and Beaver Lakes both have forest surroundings and Overton and Brumley are forested on the levees except at the club house area outside the Refuge boundary. A couple of abandon oil well site exist on the far northeast portion of the Refuge.

The immediate surround area around the Refuge is generally forested with a couple of small pastures adjoining the Refuge on the northwest corner. Highway 80 lies north of the Refuge generally within a half mile of the Refuge boundary. Three miles east on Highway 80 is the town of Hawkins. Small family farms which typically consist of pastures, home sites and relatively narrow strips of riparian vegetation along secondary stream courses scatter the county surrounding the Refuge. Much of the bottomland forest up river on the Sabine is still forested including the Old Sabine River Channel which allows the basin to widen up stream of the Refuge. Several larger blocks of forest are located in the Sabine Basin that includes: Old Sabine Bottoms WMA (5,158 acres), Mineola Nature Preserve (2,900 acres) and several wetland restoration projects (Texas Parks & Wildlife and Mineola Nature Preserve websites).

4. Habitat corridors

Within the Refuge, habitat corridors are not an issue due to past management by the club/Refuge. There is no development of roads and ROWs within the Refuge. In some areas, land use changes outside the Refuge ownership have resulted in loss of connectivity with other high value habitats. A pipeline outside the western boundary flows northwest to southeast. The discussed railway forms the northeastern boundary of the Refuge. The four lakes provide corridors along with the previously mentioned depression and riverine wetlands.

5. Edge habitats

The Refuge on the whole has little traditional "edge" habitat due to the contiguous forested communities. Both Overton and Brumley Lakes provide significant edge habitat along the levees. Primary edge habitats that effect neotropical birds are those of adjacent landowners, ROW's and the lakes. Pasture land, clear-cuts and the lakes are examples of large scale open areas that create edge effect adjacent to the Refuge forest.

6. Buffer zones

Streamside management zones along the lakes and streams will be a high priority to assure no potential negative impact to water quality. Water quality preservation is important for many reasons and in this Refuge, particularly due to multiple listed species in these stream systems. Streamside management zones will be considered on all intermittent and perennial streams, rivers and lakes.

There are several small locations for rookeries on or along the lakes that are mostly forested with shrubs. SMZ's considerations should be around such areas to protect them from disturbance. Rookeries are to some extent transient and will be monitored. Nearly all rookeries sites are located in identified depression or riverine wetlands and are not considered for any alterations. A few species that may nest in these rookeries are Anhinga, little blue herons, snowy egrets, great egrets and cattle egrets.

7. Natural dynamics of the system

Work by Runkle (1991) shows that natural disturbance on a landscape scale (10,000-100,000 acres) occurs at a relatively constant rate of one (1) percent a year across many different forest types. Disturbance adds greatly to the structure of forested communities across the landscape. Early explorers reported land conditions of open forests of large trees. In the Refuge, these relatively small-scale and temporal disturbances are discontinuously distributed across an already complex forested mosaic. Forested ecosystems with intact natural processes do not proceed to a static climax condition or even a dynamic equilibrium; they exist in a fundamental state of dis-equilibrium and change.

As mentioned previously, much of the Refuge has not been subjected to any silvicultural in over 100 years. At this phase in stand succession, numerous events have contributed in the development of the forest. On April 09, 1919 a cyclone (tornado) passed west of the Refuge with a northeast bearing. It crossed Wood County and several others in east Texas. The destruction described was in local papers and firsthand accounts were horrific as it occurred in the predawn hours (Hawkin Holly Lake Gazette website). Several small storms have occurred at the Refuge within the last 15 years. High wind, flooding, wildfire, insect/disease and tornado all have a part in forest stand development. Over the past 100 years these events have been the only active force altering the Refuge landscape along with time itself.

Consequently, much of the Refuge forested ecosystem is currently skewed to an older and more uneven age structure.

C. Identify Refuge habitat potential to contribute to the needs of those identified species, species groups and communities.

The Refuge has great potential for providing desirable habitat for the priority species listed previously. The size of the Refuge allows for stratification of areas that may provide habitat while other areas are cycling back to a desired condition. These areas will be small compared to the whole Refuge. The abundant habitat resources present provide habitat for migrating forest dwelling birds and wintering waterfowl.

D. Reconciling conflicting habitat needs for resources of concern.

In habitat management of forested ecosystems, the most common conflict occurs when unique habitat requirements of a specific T&E species provides less than optimum conditions for other priority species, even occasionally other T&E species. Recognizing and quantifying the level (degree) of this conflict frequently allows for modification of management actions to minimize negative impacts to another species or group of species.

In floodplain hardwood forests, most such conflict revolves around eliminating or restricting the scope of active management actions on specific areas where a sensitive species occurs. If these restrictions involve significant (percent of the total area available) and discreet limits to needed active management, overall level of conflict (e.g. trade-offs) elevates rapidly and management decisions must then be made on a continuum of least impact. At Little Sandy NWR, preceding sections have described implementing SMZ's along all major river and stream courses to minimize the potential for offsite sedimentation within water bodies. Furthermore, preceding sections detailed establishment of buffer zones (a form of SMZ's) around wet, depression areas located throughout the lower fringes of the Refuge to protect possible rookery sites. Within these protection areas, long term habitat values for migratory birds and resident wildlife may be reduced due to the inability to implement needed management actions. Beyond this instance, habitat needs of the priority species on this Refuge and the management actions detailed in preceding sections to achieve optimum habitat conditions do not result in significant conflicts. Extensive experience in floodplain forest management has revealed that, as a rule, optimum forested habitat for waterfowl (mixed species stands with a good mast producing component, large crowned dominant and co-dominant crown class stems in mid to upper size and age classes, relatively low stand basal areas to perpetuate ground and understory vegetation, etc.) virtually always provides excellent conditions for most forest land birds and resident wildlife. Little waterfowl productivity is lost by retaining culls and old age class components while such actions add significant value for forest land birds and many species of resident wildlife. Mid-story components, a significant need for one group of forest land birds, within floodplain hardwood stands are frequently composed of abundant soft fruit producing species which waterfowl and resident wildlife use readily. In general, high quality habitat at Little Sandy NWR for one group of priority species is also high quality habitat for the other priority species.In the upland communities that contain pine components, T&E species become the focus a mention previously. When in the WGCP, late succession pine stands are for the most part rare and are usually found on public or non-industrial private lands. Based on the amount of habitat present on the Refuge and adjacent areas it is unlikely that any one T&E species would thrive in the area regardless of the quality. An example would be the red-cockaded woodpecker (RCW) that uses late succession pine stands. According to Region 4 (lead on RCW) the recovery plan states that 125 acres is needed for the immediate colony and 500 acres for foraging (USFWS, 2003). Other species may not have such high acreage demands but would be limited to the smaller stands of pine.

IV. Habitat Objectives

The overall objective is to allow stand succession to continue in the (bottomland hardwoods and upland escarpment) forest communities at Little Sandy NWR. Promoting this management for the past 100 years has provided quality habitat for priority wildlife, including T&E species, migratory birds and resident wildlife.

Section III. B., **Identify habitat requirements**, presents detailed information concerning habitat requirements and specific quantified variables to achieve the desired conditions for meeting the needs of priority wildlife species. This information includes both general and specific objectives for desired conditions. The information largely was derived by mimicing old growth conditions in younger, commercial altered forest communities. (Currently, the Refuge is setting the bar for what is expected in desired forest conditions.) A decision was made to leave this information in that section since it is also directly related to habitat requirements.

The 1986 EA provides the purpose for the Refuge's establishment. The easement is to prevent destruction of wildlife habitat, which does not require active management by FWS. Little to no discussion is made in regards to active management of the Refuge. The intent for the Refuge was to perpetuate the forest habitat and protect it from destruction. Several goals from the 1986 EA stated below.

EA Goal: Permanently Protection of Bottomland Hardwood Forests and Wetlands.

EA Goal: Protection of Migratory Bird (waterfowl) Resources.

These above goals were general and used for assessment and planning in 1986. With inventory data and a larger Complex staff, forest monitoring and assessment will benefit the Service and local partners in determining habitat conditions and wildlife use. These goals, objectives and strategies are germane to the habitat management program at Little Sandy NWR as expressed in the 1986 EA.

_ The protection and preservation of the old growth bottomland hardwood forest plant community which is perhaps Texas' largest last remaining old growth forest.

***** For the life of this plan, monitor the 2,945.9 acres of bottomland forest with no intention of manipulating the habitat silvicultural. The Refuge will provide a benchmark for habitat monitoring in this region of old growth forest communities.

-Implement a monitoring program that captures migratory bird usage in the spring and summer (non-game forest dwelling birds) and in the fall and winter (wintering waterfowl). The program will describe the forest conditions in a manner that will strive to capture identifying characteristics relative to migratory bird usage.

-Bird monitoring data will be collected annually with relative plot data taken every five (5) years as 1/5 acre Continual Forest Inventory (CFI) plots.

***** Invasive plant species are encroaching into the Refuge. Monitoring and control measures need to be considered by the Service/Club to prevent spread on the Refuge.

-Implement a forest management program that results in the mapping, maintenance and monitoring of invasive plant species.

* During the life of this plan, negative impacts will be monitored and addressed to promote overall health of the bottomland hardwood communities.

-A forest health program will monitor activities such as beaver dam formation. Extensive dam formations can pose a forest health concern in the summer months by allowing water to stand on green trees. Dam removal de-waters flooded timber and reduces tree stress from long duration flooding.

-Wildfires would be considered potentially hazardous to the health of the forest and considerable measures will be implemented to protect the bottomland hardwood communities.

_ The protection and preservation of the late successional upland hardwood and pineywoods plant communities.

* For the life of this plan, 151.2 acres of upland communities will be monitored with no intention of manipulating the habitat silviculturally.

-Implement a monitoring program that captures migratory bird usage in the spring and summer (non-game forest dwelling birds). The program will describe the forest conditions in a manner that will strive to capture identifying characteristics relative to migratory bird usage.

-Bird monitoring data will be collected annually with relative plot data taken every five (5) years as 1/5 acre CFI plots.

* Invasive plant species are encroaching into the Refuge. Monitoring and control measures need to be considered by the Service/Club to prevent the spread and abundance on the Refuge.

-Implement a forest management program that results in the mapping, maintenance and monitoring of invasive plant species.

_ The development of a biological information database for use in monitoring ecosystem changes and assessing forest health Refuge wide.

*Evaluate, monitor and update the baseline forest habitat inventory conducted in 2006 for suitable habitat parameters to detect changes in habitat parameters.

-Implement a 2 ½ percent forest inventory every two years for one of the six compartments that will result in data collection of parameters such as tree conditions (i.e., dominance, vigor) and note if dead trees exist for snag and down woody debris. Development of understory, mid-story, and overstory stand

components (i.e. complex forest stand structure) will be assessed in this inventory. Every 12 years the Refuge entire Refuge would be assessed.

_ The development of the biological information database and bird usage data for distribution to the Joint Venture for analysis on the landscape level across the WGCP.

*****In summary form, provide inventory results from both monitoring programs (bird point counts and CFI plots).

-Bird monitoring data will be provided annually and CFI plot data provided every five (5) years.

A. Scientific basis/rationale for development of habitat objectives

Habitat objectives and requirements presented above and in Section III. B. are the culmination of efforts involving input from the Service and from science teams. The 1986 EA process involved multiple, full scale public meetings and incorporated information from many Service and non-Service scientists, biologists, land managers and conservation organizations. The objectives developed from this process are broad and present the best information available during the 1986 EA development. These objectives are incorporated into this document and serve as the basis/foundation for development of specific habitat requirements and management approaches for priority species. These specific habitat requirements reported in Section III. A. and III. B. above were developed by a multi-discipline, multi-Region team of Refuge managers, foresters, biologists, Service Wildlife Habitat Management Division biologists, and forest bird research scientists from multiple agencies/organizations.

B. Habitat objectives and specific EA goals

The native bottomland hardwoods are to be maintained for the benefit of wildlife. The two goals of the 1986 EA are the protection of bottomland hardwood forest and wetlands, and protection of migratory birds resources (U.S. Fish & Wildlife 1986). These goals provide/suggest the need for habitat evaluation for migratory bird usage with habitat suitability being the focus. The habitat objectives mentioned previously and along with scientific rationale support the need to monitor the forest habitats on the Refuge. The intent of this plan is not to suggest a commercial timber harvest program but rather a biologically sound approach for monitoring habitat parameters.

V. Habitat Management Strategies

A. Identify potential management strategies

Typically, commercial timber operations are considered for forest habitat management plans; however, one of the conditions of the easement is that timber harvesting would not occur on the Refuge. Generally, most forest habitats have been altered by harvesting; use of the practice allows managers the opportunity to manipulate species composition and other parameters back to desired conditions. Commercial timber harvesting at Little Sandy NWR will not be considered and all alternatives will continue to promote stand succession.

(1) ACTIVE FOREST AND MIGRATORY BIRD MONITORING AND PRESCRIBED FIRE USAGE IN THE UPLANDS - In the forested communities, monitoring habitat conditions and migratory bird usage would be conducted and the forests would continue succession just like the past 100 years. Also, this alternative includes actions by the Service staff to address upland habitats through prescribed fire treatments to restore historic forest conditions (where practical) by reducing the hardwood understory. With the return of prescribed fire, small acreages of upland pineywoods would slowly convert back to a historic pine savannah. Use of prescribed fire on the uplands would reduce fire fuel loads and wildfire intensity. Fire lines would be put in place by staff and would include use of a crawler tractor and fire plow.

(2) ACTIVE FOREST ASSESSMENT AND MIGRATORY BIRD MONITORING PROGRAM AND MONITORING AND MAINTENANCE OF INVASIVE SPECIES (PREFERRED ALTERNATIVE) - this alternative would provide a means to monitor habitat conditions and migratory bird usage in a forest that has been left to stand succession for the past 100 years. With a need to promote native species composition over invasive species, a monitoring detection program through GIS should be implemented; control/eradication of each invasive species by maintenance through Refuge staff and club employees should be initiated. Common methods would include the use of herbicides and cutting/removal from site when feasible or necessary. This alternative retains the legacy and prestige of the old growth bottomland hardwood forest that characterizes Little Sandy NWR. Generally, most habitats in the U.S. are not of this age class and have been altered by past silvicultural activities which then requires management actions to return the habitat to optimum conditions when and as feasible.

(3) NATURAL SUCCESSION (NO ACTION) - this approach provides for no active silvicultural activities and relies upon natural successional processes. No monitoring would occur, which provides no habitat assessments. Consideration of biological parameters identified for optimum wildlife habitat conditions continue to be unknown.

B. Identify constraints associated with management strategies

Potential constraints associated with strategy (1) ACTIVE FOREST AND MIGRATORY BIRD MONITORING AND PRESCRIBED FIRE USAGE IN THE UPLANDS include: (a) modest increases in staffing and funding resources to implement a prescribed fire program; (b) extensive per acre cost to promote pineywoods back to pine savannah with minimum gain due to small quantities of habitat; (c) minimal increases in staffing and funding resources to administer customary Service inventory and monitoring program.

Potential constraints associated with strategy (2) ACTIVE FOREST ASSESSMENT AND MIGRATORY BIRD MONITORING PROGRAM AND MONITORING AND MAINTENANCE OF INVASIVE SPECIES (PREFERRED ALTERNATIVE) include: (a) minimal increases in staffing and funding resources to administer customary Service inventory and monitoring program; (b) associated cost of maintenance and monitoring of invasive species such as use of herbicides.

Potential constraints associated with strategy (3) NATURAL SUCCESSION (NO ACTION) include: (a) virtually no long term habitat assessment by the Service of the Refuge; (b) failure to assess Refuge habitat and usage in regards to the Refuge wildlife goals and objectives in the 1986 EA.

C. Identify the positive and negative impacts to fish, wildlife and plants associated with management strategy

Positive impacts that directly and indirectly affect fish, wildlife and plants associated with Strategy (1) ACTIVE FOREST AND MIGRATORY BIRD MONITORING AND PRESCRIBED FIRE USAGE IN THE UPLANDS include: fire restored to promote historic upland plant communities and also promoting conditions for stand succession to continue for 3,097.1 acres over life of plan. Implementing a monitoring and assessment program for habitat and wildlife.

Negative impacts include: risk of minimal soil compaction, rutting, increased siltation and wildlife disturbance through equipment use. Negative impacts associated with equipment use will be short-term and minimized through biological planning.

Positive impacts that directly and indirectly affect fish, wildlife and plants associated with Strategy (2) ACTIVE FOREST ASSESSMENT AND MIGRATORY BIRD MONITORING PROGRAM AND MONITORING AND MAINTENANCE OF INVASIVE SPECIES (PREFERRED ALTERNATIVE) include: promoting conditions for stand succession to continue for 3,097.1 acres over life of plan. Implementing a monitoring and assessment program for habitat and wildlife. No risk of soil compaction, rutting, increased siltation and wildlife disturbance through equipment use. **Negative impacts** include: moderate risk of wildfire in the upland communities.

Positive impacts that directly and indirectly affect fish, wildlife and plants associated with Strategy (3), NATURAL SUCCESSION (NO ACTION) include: no risk of disturbance to wildlife, siltation, rutting, soil compaction or loss of forest connectivity. **Negative impacts** include: inability to assess forests habitat parameters. Moderate risk of wildfire in the upland communities.

D. Selected strategy implementation

The ACTIVE FOREST ASSESSMENT AND MIGRATORY BIRD MONITORING PROGRAM AND MONITORING AND MAINTENANCE OF INVASIVE SPECIES was selected as the preferred strategy. This strategy best meets the concerns addressed by the perpetual easement for management of habitats on Little Sandy NWR; it also addresses habitat issues identified in the 1986 EA, meets legal mandates, and will make the most significant contribution to accomplishing Refuge wildlife/habitat objectives. The strategy has only minimal potential impacts on forest and cultural resources and is economically feasible. This approach will provide for maximum habitat productivity through silvicultural monitoring and enhancement in an

acceptable time-frame. The approach also provides a means for maintenance of habitat improvements long-term.

The following management strategies, for the preferred alternative are detailed in Sections III. B. and IV. of this document and are summarized below. The overall management strategy is to provide multiple forest communities for a broad array of species that are listed in this document.

_ Implement an annual bird point count system that captures spring bird use in the forest communities on the Refuge. There are three (3) compartments on the Refuge that have upland habitat. Each Refuge compartment (if possible) should have three (3) plots (total of 18 points) with each compartment having both upland and bottomland forest plots.

_ Install and inventory 18 CFI plots in conjunction with the bird points. Tree data will be collected and recorded in relationship to plot center based on a 1/5 acre plot. These CFI plots will be inventoried and assessed every five (5) years to monitor change.

_ Conduct a Refuge forest inventory and assessment every two years for one compartment with the entire Refuge being assessed in 12 years capturing forest health and structural change. The sample intensity will be 2 ½ percent using a 10 factor BA prism on the tree inventory and a 1/5 acre plot for subjective measurements. Considerations such as presence of vines, palmetto, switch cane and down woody debris will be recorded in these plot assessments.

_ Implement of an invasive species program that monitors, maintains and treats non-native species on the on the Refuge. GIS will be used to map the encroachments. Both Refuge staff and Club members and employees will work together to locate these species. Depending on species, location and the Club's preference; herbicides, cut and remove or other ongoing methods may be used to control or treat the invasive species. Records and results of treatments will be kept. Currently, there is no Service staff stationed at Little Sandy NWR. Monitoring will be performed as staff are available and through communicates with Club members and employees.

E. Program policies and administrative control

1. Fish and Wildlife Service policy

Under 620 FW 1 1.3, of the National Wildlife Refuge Improvement Act of 1997, "each Refuge shall be managed to fulfill the mission of the System, as well as the specific purposes for which that Refuge was established." Little Sandy NWR's forest habitat management program will adhere to the approved procedures, principles, and techniques listed in 620 FW 1 and the Refuge Manual.

2. Compartment prescription

As related earlier in Section II. A. 2., **Management units**, the Refuge has been divided into six (6) compartments and will be evaluated on a 12-year cycle.

Table 3. Compartment Prescription Cycle

Year	Compartment	Acres

2017	1	115.6
2018	2	527.4
2019	3	770.3
2020	4	266.9
2021	5	874.1
2022	6	542.8
2023	1	115.6
2024	2	527.4
2025	3	770.3
2026	4	266.9
2027	5	874.1
2028	6	542.8
2029	1	115.6
2030	2	527.4
2031	3	770.3

Each stand will then be systematically inventoried with respect to Refuge habitat objectives. At a minimum, inventory designs will incorporate timber volumes, measurements of habitat structure, and measurements of stand development i.e., regeneration and stand succession (see data collection sheet, Appendix A). Timber cruise, habitat data and detailed maps will be kept on file by stand and compartment in the Refuge office. The results will be evaluated and a summary report designed by a team consisting of the Refuge Forester, Refuge Wildlife Biologist and Refuge Manager. The report will evaluate the results of the inventory and describe in detail the habitat condition of the forest.

Both vegetative and avian responses to habitat conditions will be monitored. Ocular observations and permanent bird/CFI plots will be used to evaluate avian use and habitat conditions for the stand. Vegetative analysis for bird plots will be updated every five (5) years. Bird plot monitoring, forest inventory reports and relative maps will be kept on file.

3. Archeological and cultural resource management

As stated before in this document, there are no identified cultural resource sites on Little Sandy NWR. There are no NRHP present. A cultural resource survey should be performed on the Refuge as time and budgets permit.

4. Aesthetics

Aesthetics are an important concern for forest habitat managers. Club member and visitors use the Refuge for hunting, fishing, wildlife observation, or other compatible wildlife-oriented recreation. In application of all forest habitat treatments, consideration must be given to the fact that these habitats are to be managed “for the benefit of present and future generations of Americans” (Refuge Improvement Act of 1997).

F. Policy and administration of sales

This is an easement Refuge with the land and timber being property of the Club. In the EA, there is to be no timber conducted on the property while a Refuge.

G. Scope of forest program

The forest habitat management program on Little Sandy NWR is designed to monitor and assess the forest and wildlife habitat, focusing in waterfowl and migratory forest birds. The cost to the Refuge associated with these activities, in terms of manpower and funding, should be acceptable during the life of this plan.

H. Program units – habitat management compartments

Little Sandy NWR has been divided into six (6) compartments with the compartment boundaries following distinct lines that can be easily identified in the field, i.e., streams, roads, trails, etc. Compartment evaluations will follow a two (2) year rotation with a different compartment being inventoried until all are assessed over 12 years (see Table 4). Upon inventory completion each stand will be evaluated through the prescription process to form a summary report for the Refuge.

All record of inventories, stand boundaries, etc. will be kept on file, organized by compartment, in the Refuge office.

I. Physical plant and equipment use requirements

Access to the Refuge is limited to Club member and guests which enter from Highway 80. Vehicle access from the club area is limited to unimproved trails that meander throughout the Refuge. All of the forest compartments can be accessed from these trails except for Compartment 1. ATVs are the most appropriate means of transportation on land due to low impact; a boat is needed to access Compartment 1 (peninsula between Overton and Brumley Lakes).

J. Miscellaneous equipment

There is currently no forestry equipment at Little Sandy NWR; however, the Refuge is complex into Little River National Wildlife Refuge Complex. Much of the equipment needs have been acquired but extra use and staff time will be a direct cost. Equipment needs and cost for implementing the forest management plan are listed below.

Table 4. Forest Management Program Equipment

	Item	Unit	Cost	Total Amount
1	4-Wheel Drive Pickup[1]	1	$30,000	$30,000
2	4-Wheel Drive UTV[1]	1	$10,000	$10,000
3	Trailer[1]	1	$2,000	$2,000
4	Global Positioning System Unit[1]	1	$2,000	$2,000

5	Office Computer[1]	1	$3,500	$3,500
6	42-inch Printer[1]	1	$7,000	$7,000
7	Miscellaneous		$1,000	$1,000
				$55,500

[1] Items are already acquired under complex activities (A total cost of $1,000 w/ no regards to wear on the these items).

Other equipment such as boats with outboard motors, additional trucks, trailers, all terrain vehicles (ATV's), chainsaws, and safety equipment are available from the Caddo Lake NWR. Numerous small items such as compasses, prisms, diameter tapes, increment borers, fire safety equipment, etc., are additional small items used in the forestry program.

K. Manpower and funding requirements

Little River National Wildlife Refuges Complex currently entails three Refuges: Caddo Lake, Little River, Little Sandy and Neches River. Current staffing at Caddo Lake NWR (one hour and half away) consists of a Refuge manager, two foresters, a contaminant biologist, administrative technician and heavy equipment operator. Management of the forest habitat to meet the objectives under this plan will require staff time and equipment which are already committed. The following table presents the annual staff requirements to implement forest management on Little Sandy NWR with two other Refuges with active forest habitat management plans.

Table 5. Staffing Requirements

Staff Position	Forest Staff Days
Refuge Manager	10
Forester	30
Forestry Technician	25
Refuge Biologist	25
Biological Technician	15
Equipment Operator	5
Refuge Law Enforcement Officer	5

Clerical Staff	5

The following table is a breakdown of anticipated duties for each position.

Table 6. Staff Days by Duties and Position

Staff Position	Administration	Inventories	Prescriptions	Pest Management	Miscellaneous	Total
Refuge Manager	10					10
Forester	5	10	5	5	5	30
Forestry Technician		20		5		25
Refuge Biologist	10	10	5			25
Biological Technician		10		5		15
Equipment Operator					5	5
Law Enforcement					5	5
Clerical Staff	5					5

A total of 120 annual staff days are needed to accomplish the activities in the habitat objectives. A biologist, biological technician, and forestry technician are essential staffing additions needed to fully implement forest habitat management on Little Sandy NWR and Little River National Wildlife Refuge Complex. These desired positions will be stationed at Caddo Lake NWR. The Little Sandy CCP is currently being reviewed in the Regional Office. A completion date of 2016 has been set. Annual funding needs are summarized as follows.

Table 7. Forestry Program Funding Needs

Description	Cost
Salaries	$50,000
Equipment & Maintenance	20,000
Forest Habitat Improvement	5,000
Operating Expenses	5,000
Total Annual Cost	80,000

Salary cost is prorated for all staff positions identified in the previous table. Equipment and maintenance costs include a portion of a new 4-wheel drive truck, UTV's, and other purchases of forestry supplies, including computers, etc. Operating expenses include purchase of fuel, high explosives for beaver dam removal, computers, office supplies, etc.

VI. Monitoring and Evaluation by Objective

Monitoring and evaluating the forest habitat for each of the habitat objectives on the Refuge will be performed every two years on one compartment. Every 12 years, the entire Refuge will be assessed. A two and half (2 ½) percent forest inventory cruise will be conducted on the Refuge forest. Each objective will be evaluated by the Refuge manager, forester, and wildlife biologist. During the six year window, Refuge compartments will still be monitored by ocular observations for changes. Bird point counts at 18 locations throughout the forest will be monitored annually and forest bird utilization evaluated for response to management actions implemented. These bird points will double as CFI plots which will be measured on a five (5) year interval. Actual measures on a 1/5 acre plot will be used to capture actual change at the bird points. Plot centers will be permanently marked with a t-post or similar object. Monitoring of the 18 bird point counts will also provide preliminary data for Little Sandy NWR. This data can be analyzed with other Refuges that are monitoring bird points throughout the WGCP and MAV.

VII. Annual Habitat Work Plans

Each year, bird point counts will be conducted by qualified personnel on the 18 plots. Continual Forest Inventory data will be collected on these plots every five (5) years. A Refuge inventory of 2 ½ percent will be conducted one compartment every two years to capture forest compartment changes over time.

In May, 2016, a tornado passed over the western portion of the Refuge from the southwest headed to the northeast. It impacted Compartments 2 and 3 heavily. It destroyed the American bald eagle nest in Compartment 1 – nest located on the southern tip in a loblolly pine. The developed area was where the club houses are was hit hard as well. The 2016 bird points were cancelled due to the inaccessibility and

high water. Compartments 2 and 3 will likely be inventoried together in 2017 before green up for better assessment and staff safety. If so, this will defer the 2019 inventory for Compartment 3.

Lake and Tree-Line by David Weaver

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STRUCTURE AND COMPOSITION OF OLD-GROWTH BOTTOMLAND FORESTS OF LITTLE SANDY NATIONAL WILDLIFE REFUGE, EAST TEXAS, U.S.

Final Report

Submitted by Susan C. Carr and Jim Neal
September, 2012

INTRODUCTION

Bottomland hardwood forests are among the most endangered and productive wetland ecosystems in the southeastern United States. Over 75% of bottomland forests of Texas have been converted to other uses, such as agriculture and timberlands. In addition, hydrologic alteration of east Texas rivers affect the natural composition and dynamics of bottomland forests. The Middle Sabine Bottoms, which includes what would become the Little Sandy National Wildlife Refuge (LSNWR or Refuge), was identified as a top priority bottomland hardwood protection site in the US Fish and Wildlife Service's 1985 Texas Bottomland Hardwood Concept Plan (US Fish and Wildlife Service 1985). Furthermore, LSNWR was rated as the highest priority of 57 sites identified for conservation in an earlier study by Dan Lay, a retired biologist with Texas Parks and Wildlife Department. This same area has also been identified as a priority bird conservation area within the West Gulf Coastal Plain Bird Conservation Region, a part of the Lower Mississippi Valley Joint Venture.

The Refuge is home to one of the largest tracts of intact old-growth bottomland hardwood forest in the southeastern U.S. Even among extant bottomlands hardwood forests, most have been logged at least once and no longer possess old-growth characteristics. In contrast, the forested wetlands of LSNWR have been protected from cutting since at least 1907, the year the club was formed and the property was purchased. Furthermore, there are no records of any cutting on the property prior to that date. As such, the LSNWR, at approximately 1,600 ha, represents the largest tract of intact old-growth bottomland hardwood forest in eastern Texas and the West Gulf Coastal Plain. Only the Congaree National Park in central South Carolina is known to include a larger tract of old-growth bottomland forest in the southeast U.S.

Very little information is available on the composition and structure of the old-growth bottomland forests that once covered large areas of eastern Texas. To understand the resource needs of wildlife that inhabited the area prior to settlement, we require better knowledge of the pre-settlement habitat conditions. As the largest remaining old-growth stand in the West Gulf Coastal Plain, LSNWR presents the best opportunity for building a model of wildlife habitat and natural conditions, which may be used as "reference site" information for ecological restoration of altered forests. Furthermore, as a reference site, the Refuge can serve as a useful "control" for climate change studies.

Our study objective is to describe the composition and structure of old-growth bottomland hardwood forests that make up the bulk of LSNWR. Of primary importance in a quantitative description of forest conditions is the analysis of relative abundance, frequency and cover of component species. To this end,

it is necessary to understand the size structure of specific species' populations, as well as distribution of species across the landscape. We sought to quantitatively describe forest composition and structure from two perspectives: 1) as it exists on the LSNWR bottomland tract as a whole and 2) as composition and structure varies by changes in habitat associated with micro-topography, alluvial deposition and drainage. Our results present a comprehensive and systematic coverage of the Refuge with respect to canopy and mid-story tree composition, and provides LSNWR personnel with better data on stand composition and structure.

METHODS

Study site

Little Sandy National Wildlife Refuge (LSNWR) is approximately 1,600 ha in size, and is located in Wood County, near the town of Hawkins, Texas. Most of the LSNWR tract contains an old growth bottomland hardwood forest situated in the floodplain of the middle stretches of the Sabine River. Little Sandy became a National Wildlife Refuge in 1986 when a perpetual easement was donated to the US Fish and Wildlife Service by the Little Sandy Hunting and Fishing Club, in part to protect the land from permanent inundation by the proposed Waters Bluff Reservoir. Prior to this, the land was purchased by the Little Sandy Hunting and Fishing Club in 1907 and managed since then as a members-only preserve for hunting, fishing, and outdoor recreation. It is believed that the forest was essentially undisturbed when the Club purchased the land, and the directors of the Club allowed no significant timber harvesting during the subsequent 105 years of Club ownership. As such, LSNWR is probably the largest extant acreage of old growth bottomlands in the West Gulf Coastal Plain, west of the Mississippi River, and it may represent the second largest old-growth tract in the southeastern U.S., following the Congaree National Park in South Carolina.

Field methods

We used a modified point-quarter survey method to quantify the composition and structure of LSNWR bottomland forest vegetation (Cottom and Curtis 1953, Mitchell 2007). We established a grid of systematically placed 100 m (north/south) by 200m (east/west) sample points covering the bottomland portion of LSNWR (Figure 1). Upon field inspection, sample points were rejected if they were located in open water, on the Refuge boundary or on established trails or roads. Of our initial 600+ potential sample points, we sample 564. This sample is a comprehensive and systematic coverage of the LSNWR bottomland tract and all associated plant associations.

We used a modification of the point-centered quarter method to sample woody stems of LSNWR bottomlands (Cottam and Curtis 1953, Cottam et al. 1956, Mitchell 2007). Between the fall of 2007-2008, we recorded data for Large stems (trees > 15 cm diameter at breast height (dbh)), and Small stems (> 5 cm but ≤ 15 cm dbh). At each of the 564 sample points, we identified the nearest Small and Large stems in each of four quadrants (NE, SE, SW, NW), which were located as "quarters" of a circle centered on the sample point. We identified the species of each stem and measured the stems to sample point to 10 cm accuracy. In addition, we recorded stem dbh to the nearest mm. In this manner, we collected 8 sets of measurements per point, four Large and four Small stems.

We classified each sample point as one of six habitat types in an attempt to understand how bottomland forest composition and structure varies with micro-environment. We defined "habitat types" to represent subtle but influential variations in micro-topography, drainage, and (we presume), alluvial deposition related to these features, and was subjectively based on our field observations of these landscape features. The six habitat types occur along a topographic continuum of only several feet, from the highest ridges and natural levees to lowest sloughs and oxbows. The latter habitat usually retains water throughout most of the year. The six habitat types in order from highest (and most well drained) to lowest (least drainage) are: 1) Ridges & Levees, 2) Ridges-High Flats, 3) High Flats, 4) High-Low Flats, 5) Low Flats-Sloughs, and 6) Sloughs. Some sample points were omitted due to our inability to classify them.

Numerical methods

Stem measurements were compiled for each of two datasets: Large stems and Small stems. The two datasets were analyzed separately, using identical numerical methods. Interpretations are limited to the forest component represented by each dataset (i.e. overstory trees vs. sub-canopy and midstory trees and shrubs).

For the LSNWR tract in its entirety, we calculated the relative "importance" of each species, for both the Large and Small stem datasets. A species' "importance" summarizes its dominance (size), density, and distribution. The Importance Value (IV) is the sum of three relative values: relative density, relative frequency, and relative cover (Mitchell 2007). The relative density of a species is the percentage of the total number of observations of that species (i.e., number of quarters with species X / total number quadrats) multiplied by 100. A species absolute frequency is calculated as the percentage of sample points at which the species occurs (number of sample points with species / total number sample points). Note that this represents the distribution of a species, irrespective of the number of stems per sample point. Relative frequency per species is absolute frequency / sum of all frequencies. The absolute cover of each species is expressed as basal area per hectare (BA/ha), calculated as a sum of individual BA's derived from dbh. A species' relative cover measures its dominance, and is the total BA / total BA all species. The correction factor suggested by Mitchell (2007) was used for calculations where stems were missing (fewer than 4 stems per sample). Finally, the IV for each species was calculated as the sum of the three relative values, and the sum of all IV's per dataset is 300.

We examined size class distributions of all stems in the Large and Small datasets as histograms of stem counts per dbh size class. In addition, we calculated mean dbh for each Large stem species and examined the species distributions of very large trees (> 75 cm dbh). Size class distributions of Large stems by habitat type were plotted similarly. For this, we aggregated data from the six habitat types into four groups (each representing similar patterns in forest structure). These were: 1) the Upper group (Ridges&Levees plus Ridges-High flats), 2) High Flats group (containing High Flats only), 3) Lower group (Low Flats plus Low Flat & Sloughs) and 4) Sloughs (containing Sloughs only).

The IV analysis was repeated for sub-sets of the Large and Small datasets by habitat type. In this manner, we calculated relative values per species by habitat in an attempt to identify habitat dominants and specialists. The calculations were identical to those described above. However, the number of observations per data sub-set range widely, from 108 (sloughs) to 1399 (High Flats), depending on the

prevalence of habitat type in the study area. Because IVs are summary measures of relative abundance and frequency, they are used to compare species' prevalence and specificity among habitat types.

RESULTS

A total of 2338 Large stems and 2351 Small stems were recorded from 564 LSNWR samples. There are 34 tree species in the Large dataset, ranging in stem counts from 1 to 438 (Appendix 1), and 49 species represented in the Small stem dataset, ranging in counts from 1 to 419 (Appendix 2). Recorded tree sizes ranged from 15 to 126.4 cm dbh.

Overall forest structure and composition of LS bottomlands

Large Stem Data

Six tree species comprise over 78% of total importance value (IV) in the Large stem dataset (Figure 2,3, Appendix 1). In order of decreasing IV these include: overcup oak (Quercus lyrata), willow oak (Q. phellos), cedar elm (Ulmus crassifolia), green ash (Fraxinus pennsylvanica), hackberry (Celtis laevigata) and water oak (Q. nigra). Cumulatively, they account for 75% of relative frequency, 78% of relative density, and 82% of the relative cover in the LSNWR bottomland forest (Appendix 1). Of these six species, three are oaks (Quercus spp.). Overcup and willow oak are by far the species of highest importance in the bottomlands as a whole; combined IVs of these two species account for more than one-third of the total Large stem observations (124.7 out of 300; Figure 2a). Furthermore, these oaks rank highest in relative cover, accounting for over half of the total cover at LSNWR (55.3%; Appendix 1). Not surprisingly, overcup and willow oaks have many large trees, ranking among the highest in mean tree size (mean dbh = 49.9 and 44.3 cm, respectively; Figure 4).

The third, fourth and fifth most important trees of LSNWR bottomlands are notable for their high relative frequencies and densities, more so than their presence as large trees. These species are cedar elm (*Ulmus crassifolia)*, green ash (*Fraxinus pennsylvanica)*, and hackberry (*Celtis laevigata*) and they comprise about a third of the total Large stem observations (36%, Figure 3a). However, they are under-represented in contribution to forest basal area, representing just over 18% of the relative cover. Water oak (*Q. nigra*) is the sixth most important tree species of LSNWR bottomlands (IV = 18.8). Similar to the other oaks, water oak has greater relative cover values compared to its relative frequency and density.
The remaining 28 tree species have a combined IV of just over 22%, and similarly represent 22% of total observations. Species with lower IV's include many sub-canopy forest trees such as red mulberry (*Morus rubra)*, persimmon (*Diospyros virginiana)*, American hornbeam (*Carpinus caroliniana)*, slippery elm (*Ulmus rubra)*, hawthorn (*Crateagus* spp.), and American holly (*Ilex opaca)*. In general, IV's of these species mirror relative densities and frequencies with the notable exception of sweetgum (*Liquidambar styraciflua*) and bottomland post oak (*Q. similis*). While these two species comprise 6% of the total Large stem observations, they account for over 9% of total relative cover (Appendix 1). These species have some of the largest trees at LSNWR. The mean dbh of bottomland post oak is 49.9 cm, and mean dbh of sweetgum is 43.6 cm.

Trees with dbh > 70 cm (27.5 inches, hereafter called "Big trees") comprised 5.6% of the total count of Large stems (132 of 2338). Overcup and willow oaks (*Q. lyrata* and *Q. phellos*) number 69% of these

large stems (46.2% and 22.7% respectively). Interestingly, the three species with the next highest frequencies have relatively low overall IV's (Figure 4, Appendix 1). These are water oak (*Q. nigra*), bottomland post oak (*Q. similis*), and sweetgum (*L. styraciflua*), and they represent 22% of the Big trees (29 of 132 stems) but only 13% of the total IV (41 out of 300). The remaining Big tree species include green ash (*F. pennsylvanica*) and loblolly pine (*Pinus teada*) among others. The latter species is confined to bluffs and transitional areas on the edge of the bottomland forest (J. Neal, pers. obs.). Among the 18 recorded individuals of *very* large trees (>100 cm dbh, ~40 inches), 11 are overcup oaks (*Q. lyrata*), two are loblolly pines, two water oaks, and one each of sweetgum, willow oak, and green ash.

Small stem data

Of the 47 Small stem species, 30 are saplings of tree species that are represented in the Large stem data. These stems comprise 62% of the total Small stem count, and their sum of IV's is 204 (out of 300). The remaining 17 species are either small trees or shrubs typical of bottomland sub-canopy and mid-story and are not present in the LSNWR Large stem data (see Appendix 2). These 17 species account for 38% of the total Small stem count, and their sum of IV's is 96. In general, the IV's of Small species closely mirrors their relative frequencies and densities, which is not surprising given the narrow size range for this dataset (5-15 cm dbh; Figure 3b). The exception to this pattern is deciduous holly (*Ilex decidua*), which is the most frequent of the small stem species. As a small tree of the forest mid-story, stems rarely exceeds 10 cm dbh. Deciduous holly is out-ranked in IV by cedar elm (*Ulmus crassifolia*), due to the higher relative cover of the elm.

The four species with highest small stem IV's constitute approximately two thirds of the small stem count: these are cedar elm, deciduous holly, green ash (*Fraxinus pennsylvanica*), and hackberry (*Celtis laevigata*). Similar to deciduous holly, hackberry and cedar elm are common mid-story trees, although they can attain larger statures in the sub-canopy (which is rarely observed at LSNWR). Cumulatively, the four bottomland oak species (*Q. nigra, Q. similis, Q. phellos*, and *Q. lyrata*,) comprise a scant 10% of the small stems (Figure 3b, Appendix 2), despite canopy dominance of the latter two species.

Size class distributions of dominant tree species

The size class distribution of LS tree species as a whole resembles the "reverse-J" pattern of an uneven aged forest with ample regeneration. More than 65% of Large stems are < 40 cm dbh (Figure 5a), indicating a preponderance of smaller trees and saplings. These smaller stems include saplings of canopy species in addition to forest midstory trees and larger shrubs. Fewer than 10% of the recorded trees are > 70 dbh cm.

The Small stem size class distribution indicates a similar pattern, with the majority of stems < 6 cm dbh (53% < 6 cm; Figure 5b). These Small size classes are overwhelming composed of seedling and saplings of mid-story and overstory species. Common mid-story species, such as deciduous holly and cedar elm, dominate the larger size classes of the Small stem data.

Population structure of individual canopy species shows departures from the overall forest size class distribution. Notably, the common oak species display "bell-shaped" size class patterns, with relatively fewer small stems than that of the "inverse-J" distribution (Figure 6 a-d vs. Figure 5a). This is most pronounced in the distributions of water and willow oaks, the latter being one of the top two most

important tree species. Distributions of both oak species display attenuation of stem < 40 cm dbh. Water oak stems appear depressed at the high as well as low size classes (Figure 6c). The overcup oak stem distribution has high frequency of stems in the < 20 cm dbh classes relative to other oaks. The bottomland post oak distribution is erratic, not surprising given the low stem count for this species (n=53). Sweetgum displays a size distribution similar to that of overcup oak, although total observations for this tree was rather low (n=92).

Elm stems (*Ulmus* spp.) are over-represented in smaller size classes (< 40 cm dbh; Figures 6e,f). Cedar elm has the highest IV in the small stem data, and is prominent in the 15-40 cm dbh range, although absent in size classes > 65 cm. In contrast, there are a few larger American elm trees (*U. americana*; up to 80 cm dbh), although Small stems comprise the vast majority of this tree population. Similar distributions are apparent for hackberry (*Celtis laevigata*) and green ash (*F. pennsylvanica*), suggesting ample regeneration of these species. Water elm (*Planera aquatica*) is a shrub or small tree common to sloughs which are inundated much of the year. This species typically does not attain large stature, although we recorded a few individuals > 50 cm dbh.

Forest structure by habitat type

The IVs of tree species varies across the six LSNWR habitat types. Oaks have the highest IV of each habitat, with the exception of Sloughs (where water elm supplants overcup oak in importance). Water oak is dominant in the two most well drained habitats: the Ridges and Levees and the Ridge-High Flats. Similarly, these two habitats share other highly ranked species, including sweetgum, willow oak, hackberry, and loblolly pine (see Figure 7). Although these two habitat types have roughly equal numbers of samples, the Ridge-High Flat habitat harbors more tree species.

The two well-drained habitats are similar in their composition and relative densities of Small stems. American hornbeam, deciduous holly, and hackberry are frequent in these habitats. Small stems of cedar and American elms, and sweetgum are absent from ridges and levees, although sweetgum has high IV in this habitat (Figures 7 and 8). By contrast, small elm stems are common in the Ridges-High Flats habitats (Figure 8).

The High Flats encompass the habitat of greatest extent in the study area (~ 65 % of the classified samples), and are characterized by the dominance of willow and overcup oaks (*Q. phellos* and *Q. lyrata*). The abundance and frequency of willow oak and cedar elm distinctly peaks in High Flats, relative to other habitats (Figure 10). Bottomland post oak is present in low abundance in all three well-drained habitats. Green ash, deciduous holly, and hackberry are common saplings in High Flats (Figure 11). Of the overstory oaks, only willow oak saplings are present to any extent in High Flats. Water and overcup oaks small stems are rare, despite the presence of the later as a dominant tree.

The two Low Flats habitats (High-Low Flats and Low Flats-Slough) are similar in composition and dominance of tree species. Here, overcup oak replaces willow oak as the tree of highest importance (Figure 10). Subdominant trees include green ash, willow oak and hackberry, and in the case of Low Flat-Sloughs, water elm (Figure 11). Cedar elm drops in importance in the Low Flat-Sloughs. Green ash reaches it greatest abundance in Low Flats, and is very common as Small stems in the High-Low Flats.

Several common small trees in High Flats decline in importance in Low Flats, including deciduous holly, cedar elm, and hackberry. They are replaced by obligate wetland shrub species: eastern swamp privet (*Foresteria acuminata*), button bush (*Cephalanthus occidentalis*), and small stems of water elm. Overcup oak sapling density peaks in Low Flats, suggesting increased regeneration in these wetter areas (Figure 10a).

The tree composition and structure of Slough habitats is distinctive relative to other bottomland habitat types. Water elm is by far the dominant species in the Large stem data, followed by overcup oak and green ash. Water elm and eastern swamp privet are prominent Small stem species (Figure 8c). A few of the less common trees reach their pinnacle in Sloughs, including black willow (*Salix nigra*), and honey and water locusts (*Gleditsia triacanthos* and *G. aquatica*, respectively). Sloughs also appear to be the least diverse habitats in terms of species richness, although direct comparisons between habitats are hindered by unequal sample sizes.

Forest size class structure varies across habitat types in the LSNWR bottomland forest. In general, the proportion of smaller trees increases from drier to wetter habitats, with a concurrent decrease in the proportion of mid-size trees. In the better drained habitats (including Ridges & Levees, and Ridge-High Flats), 43% of trees are < 30 cm dbh, compared to 47% and 57% in High Flats and Low Flats respectively (Figure 9). Sloughs had the high proportion of small trees, with 67% < 30 cm dbh. This likely reflects large numbers of small water elm trees common to these habitats. A concurrent decline in middle-sized trees occurs from upper to lower habitats; the proportion of stems between 30 and 70 cm dbh is as follows: 49% (Ridges & Levees, Ridge-High Flats); 44% (High Flats); 32% (Low Flats, Low Flats-Slough), and 28% (Sloughs).

DISCUSSION

Six tree species dominate the bottomland forests of LSNWR: three oak species, green ash, hackberry and cedar elm cumulatively comprise over 75% of importance value, and 5 out of the 6 Small stem species with highest IVs. In contrast, 28 tree species account for a mere quarter of the LSNWR forest compositional importance. The diversity of infrequent Small stem species is even higher. Tree species of lesser importance are typically denizens of geographically limited habitats (such as Ridges & Levees), are habitat generalists with low population abundances, or require specific environmental or biotic conditions for recruitment. Examples of the latter may include small trees with fleshy animal-dispersed fruits, such as mulberry (*Morus rubra*) and persimmon (*Diospyros viriginiana*).

Similar to the pattern of Large stem composition, the top 6 Small stem species comprised 71% of the observations, with 41 species comprising the remaining 29%. A sizable number of Small stems are not tree saplings (37% of stems). Rather, they are members of small tree and shrub species, which are relegated to the sub canopy and mid-story of forests. At LSNWR, a well-developed and diverse mid-story is an important component of old-growth bottomland forests, as these species improve wildlife habitat. Many small tree and shrub produce fleshy fruits, which are important wildlife food for songbirds, bears, and other mammals (i.e. *Morus rubra*, *Crataegus* spp, *Cornus* spp, *Nyssa sylvatica*, *Diospyros virginiana*).

Overall, the LSNWR bottomlands contain uneven-aged forests dominated by oak species. Approximately 90% of our study area contains habitats ranging from Ridges and Levees to Low Flats (omitting Sloughs), and in each of this habitats, oaks consistently rank highest in importance value reflecting the ubiquity of oak species at LSNWR. In most habitats, oak IV's are related to high relative cover in addition to high frequency, which underscores the importance of large oak trees as an old-growth forest component.

The size structure of oak populations does not resemble the overall forest structure of LSNWR bottomlands. Size class distributions of all four bottomland oak species are skewed toward larger (and presumably older) trees, with relatively fewer Small stems. Bell-shaped size class distributions may indicate relatively even-aged populations with depressed regeneration. Water oak (*Quercus nigra)* and willow oak (*Q. phellos)* have distributions with the most pronounced mid-size class peaks, and dampened small stem densities. In addition, the low occurrence of water oak saplings is apparent in the Small stem IV data, and corroborates the paucity of juvenile recruitment. Similarly, the size class distribution of overcup oak (*Q. lyrata*) is relatively bell-shaped, but it differs with a distinct peak in the 20-30 cm dbh category. This may be a result of a "pulse" in oak recruitment under specific environmental conditions, or a signature of a significant biotic phenomenon (such as acorn masting).

Oak regeneration in bottomland forests is a complex process influenced by flooding, gap formation, and seed predation and dispersal (Collins and Battaglia, 2008). Water and willow oaks in particular are shade intolerant and may require canopy gap formation for successful seedling recruitment and growth (McKnight et al. 1981). Further investigation of size classes as they relate to actual tree age is recommended, and may enhance the study of oak regeneration patterns as they relate to forest conditions and hydrology at LSNWR.

In contrast to the oaks, other tree species are apparently enjoying enhanced recruitment and growth at LSNWR. Cedar and American elms (*Ulmus crassifolia* and *U. americana*) and hackberry (*Celtis laevigata*) are trees that reach large stature (> 70 cm dbh). However, at LSNWR they are most abundant as small trees (< 40 cm dbh), and display the pronounced "reverse-J" size class distribution pattern of a population with ample regeneration. Unlike cedar elm, which appears to be a habitat specialist common to the High and Low Llats but infrequent elsewhere, American elm and hackberry are present throughout most LSNWR habitats. These habitat generalists may be colonizing the forest following modern changes in hydrology. As mentioned above, further investigation to establish age-class relationships for these populations is warranted.

Forest structure at LSNWR varies by habitat type, with discernible changes in size class distribution coincident with drainage and micro-topography. Our sample sizes range considerably by habitat type (from 108 to 1399 observations), rendering generalizations about size distributions tenuous at best. However, the relative paucity of Small stems in better drained areas (Ridges and Levees) likely reflects

the lack of juvenile recruitment of water oaks and other species specific to those micro-habitats. In general, the overall size-class patterns more closely resemble the "reverse-J" distribution of a regenerating forest in wetter habitats, as do the population structure of the dominant tree species. Further investigation may elucidate the actual age structure of forests by habitat type.

Two tree species are notable for their presence among the very large trees (> 75 cm dbh) and scarcity among Small stems. These are sweetgum (*L. styraciflua*) and bottomland post oak (*Q. similis*). Both species have intermediate importance values in the better drained habitat zones (Ridges & Levees and High Flats). In other old-growth remnants of the southeastern U.S., sweetgum forms a "supercanopy" of very large trees on ridges and high flats (i.e. the Sweetgum tract of the Delta National Forest in Mississippi). At LSNWR, sweetgum regeneration is apparent, perhaps as a "pulse" of stems in the 20-30 cm dbh size class. However, importance values of small sweetgum stems are low. Population density of bottomland post oak is low throughout (only 53 stems in the tree dataset), and of that, about 20% are very large trees (10 > 75 cm dbh). Saplings of bottomland post oak are virtually non-existent, as this species ranks near the bottom of small stem IV's.

RECOMMENDATIONS FOR FUTURE WORK

Inferences regarding LSNWR forest structure are tenuous without knowing the age-class relationships of the dominant tree populations. This information would allow us to examine the size class distribution of species and predict their age structure and regeneration dynamics. Furthermore, because we know now that dominant species and forest structure vary by drainage and micro-habitat at LSNWR, trees, that represent different micro-habitat conditions, could be aged to help better determine population dynamics of the LSNWR. In this manner, it may be possible to tease apart the influence of habitat on tree growth (i.e. site index), so that we could make better predictions about where and how recruitment of trees occurs.

The information presented here pertaining to forest structure, tree population dynamics, and compositional variation by habitat could be interpreted in the context of recent hydrological history of the Middle Sabine bottoms region, particularly if we knew more about the age class distribution of major species. For example, changes in flooding regime may affect tree regeneration in Ridge habitats, which would disproportionately affect water oaks and sweetgum, as our data suggests depressed recruitment for these species.

Additional data also exists on dead tree, vine, and herbaceous species occurrence that would add to the analysis of the old growth vegetation communities at LSNWR. A second data set at 60 randomly selected plots within each of the six habitats was collected in the fall of 2010. These plots were sampled using a more traditional plot analysis method to better describe the habitat types. In additional soil samples were collected at random sites for the original samples and all of the 60 plots from the 2010 field effort; this soils data will be used to better correlate the plant community composition with the physiographic features of the bottomlands. The analysis of all this data was beyond the scope of the present study, but will be analyzed in the future.

Finally, this information can be used as a descriptive interpretive model for “reference site” conditions of bottomland forests in the West Gulf Coastal Plain. Given its size and old-growth conditions, LSNWR represents perhaps the best reference site model in the region. Studies of nearby ecological restoration and dynamics can use these data as a model of desired forest composition and structure. Additionally, these data may be compared with other high quality bottomland forests throughout the southeast in a study of regional variation and diversity, as it relates to geomorphology and biogeography.

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TABLES AND FIGURES

Species	count	Mean DBH	Var DBH
Pinus taeda	15	52.7	592.9
Nyssa sylvatica	15	50.3	433.6
Quercus lyrata	409	49.9	602.7
Quercus similis	53	49.9	532.3
Quercus nigra	132	45.6	401.1
Quercus phellos	438	44.3	387.3
Liquidambar styraciflua	92	43.7	493.8
Carya aquatica	21	36.3	672.0
Salix nigra	16	30.4	312.5
Ulmus crassifolia	365	29.4	97.6
Fraxinus pennsylvanica	265	29.1	222.8
Diospyros virginiana	15	27.9	108.3
Celtis laevigata	208	25.2	87.8
Acer negundo	11	24.2	94.1
Ulmus americana	88	24.1	114.6
Planera aquatica	100	22.6	58.0
Morus rubra	23	20.3	28.7
Carpinus caroliniana	15	18.6	8.4

Table 1. Largest trees in LSNWR Large tree dataset (species with highest Mean DBH). Var DBH = variance, and count = number of stems measured. Shaded entries are large tree species > 50 stems.

Species	code	ridge	HF_R	HF	H_Lflat	LF_slo	slough
Quercus nigra	QUNI	**66.9**	**55.3**	13.3	16.5	8.0	20.0
Liquidambar styraciflua	LIST	**35.9**	**33.8**	12.8	18.8	16.9	0.0
Quercus phellos	QUPH	**21.2**	**29.3**	**57.5**	**22.6**	**24.8**	0.0
Celtis laevigata	CELA	**19.2**	**23.3**	**23.1**	19.6	**17.2**	17.6
Pinus taeda	PITA	**18.8**	15.7	0.0	0.0	0.0	0.0
Quercus similis	QUSI	13.1	**16.3**	17.2	0.0	6.2	4.1
Ulmus crassifolia	ULCR	5.7	10.5	**47.7**	**29.0**	11.7	6.3
Quercus lyrata	QULY	7.1	13.5	**46.8**	**73.8**	**82.9**	**58.1**

Fraxinus pennsylvanica	FRPE	13.4	14.3				
Nyssa sylvatica	NYSY	11.3	11.3	6.9	**30.5**	0.0	0.0
Planera aquatica	PLAQ	7.8	7.0	2.1	5.4	**27.8**	**102.3**
Gledetsia sp.	GLSP	0.0	0.0	1.5	0.0	0.0	**21.3**
Salix nigra	SANI	0.0	0.0	0.0	0.0	16.1	**20.3**
Gledetsia aquatica	GLAQ	0.0	0.0	1.5	3.3	8.7	15.1
Carya aquatica	CAAQ	16.6	15.8	5.6	11.1	17.0	10.2
Ulmus americana	ULAM	8.5	10.9	12.1	12.8	14.4	0.0
Diospyros virginiana	DIVI	8.0	8.0	3.1	7.2	3.7	0.0
Acer negundo	ACNE	7.5	4.4	1.6	0.0	3.6	0.0
Forestiera acuminata	FOAC	0.0	0.0	1.3	0.0	2.7	0.0
Morus rubra	MORU	10.3	7.2	3.6	5.6	0.0	0.0
Tilia caroliniana	TICA	0.0	0.0	0.0	2.6	0.0	0.0
Ulmus rubrum	ULRU	2.5	1.7	4.0	0.0	0.0	0.0
Crataegus sp.	CRSP	0.0	0.0	2.7	0.0	0.0	0.0
Ulmus alata	ULAL	2.0	2.0	2.5	0.0	0.0	0.0
Carpinus caroliniana	CACA	10.1	7.8	1.6	0.0	0.0	0.0
Ostrya virginiana	OSVI	0.0	0.0	1.2	0.0	0.0	0.0
Quercus stellata	QUST	5.3	5.3	0.0	0.0	0.0	0.0
Betula nigra	BENI	4.8	4.0	0.0	0.0	0.0	0.0
Ilex opaca	ILOP	3.9	2.4	0.0	0.0	0.0	0.0

Table 2. Tree species IVs by habitat type. Shaded cells indicate species with highest IVs for specific habitat category.

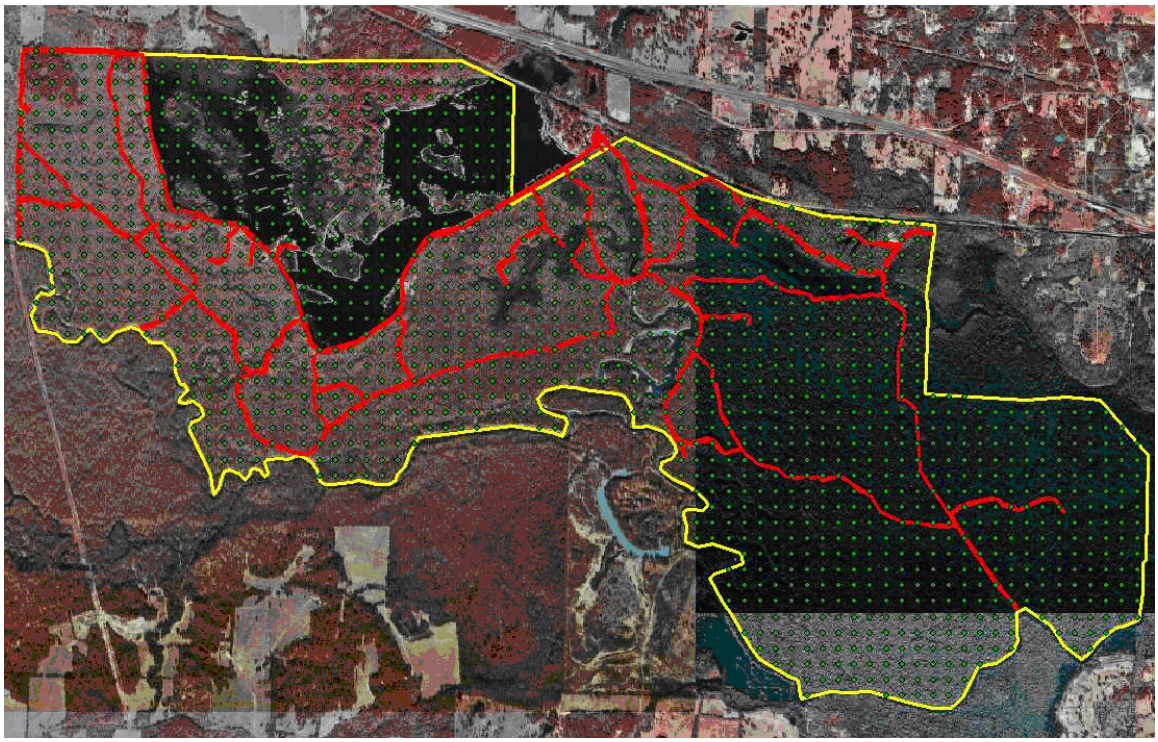

Figure 1: Aerial photo of Little Sandy National Wildlife Refuge (boundary in yellow). Points show locations of point-center quadrats (564 sample locations).

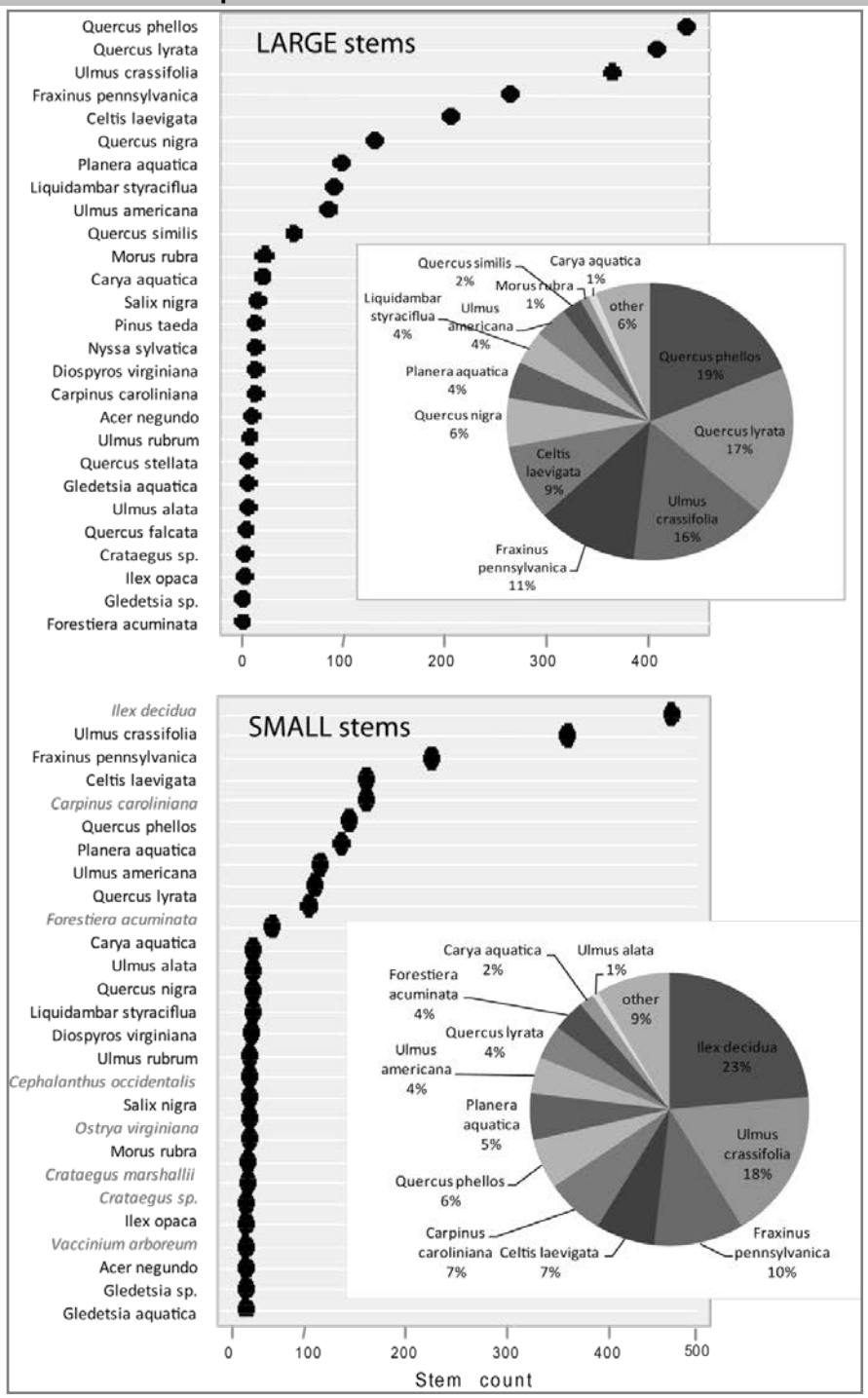

Figure 2. Frequency counts of stems in the Large and Small datasets. Small stem species in *italics* are small trees or shrubs not found in the LSNWR forest overstory. Species names in **bold** are represented in the Large stem dataset.

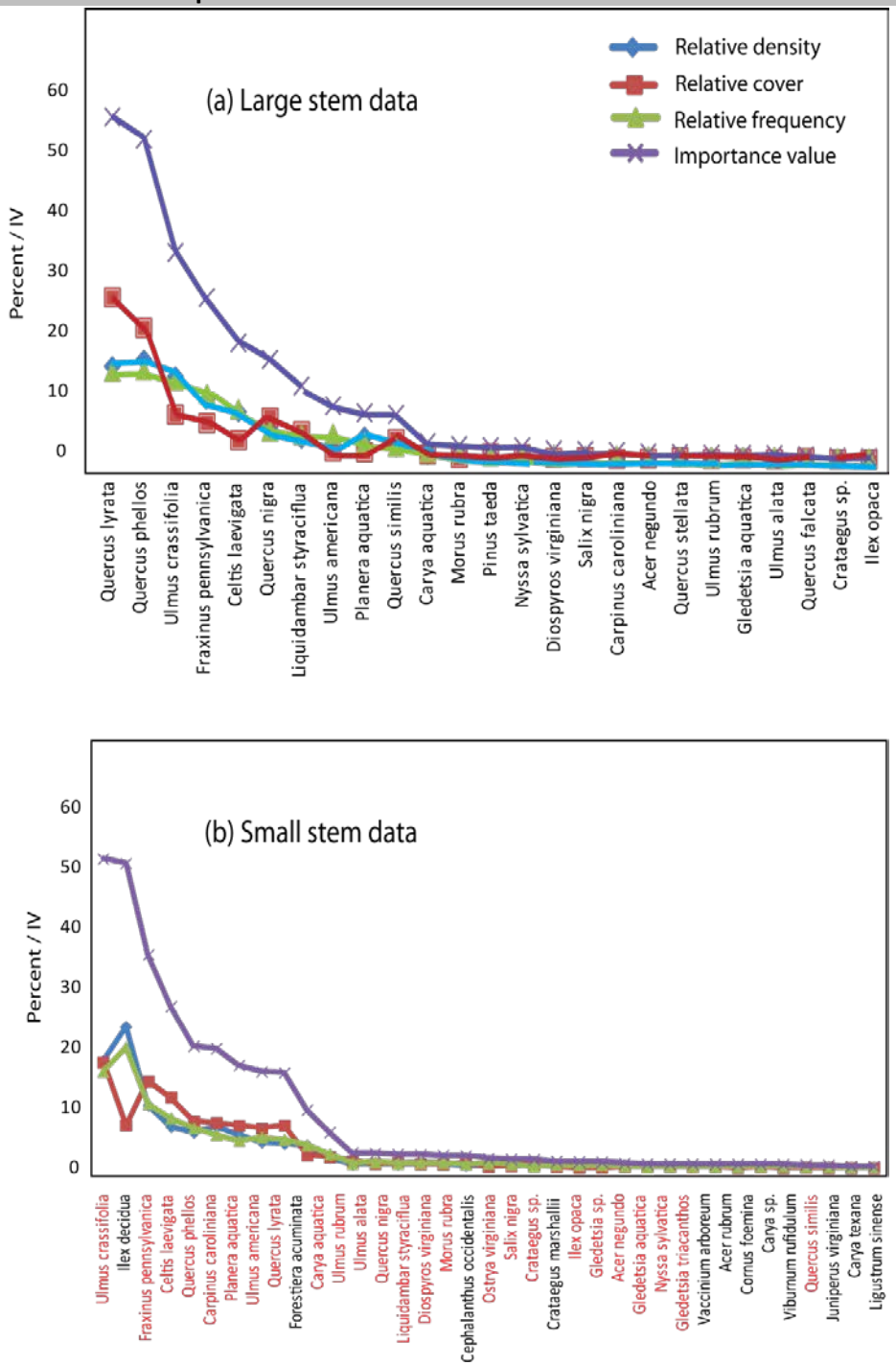

Figure 3. Woody species in order of descending Importance Value for Large stems (top plot) and Small stems (lower plot). Only species with > 3 occurrences included. Relative cover, frequency and densities (precent) also shown for each species. Names in Red type indicate small stems that are tree saplings (i.e. species is represented in the Large stem data).

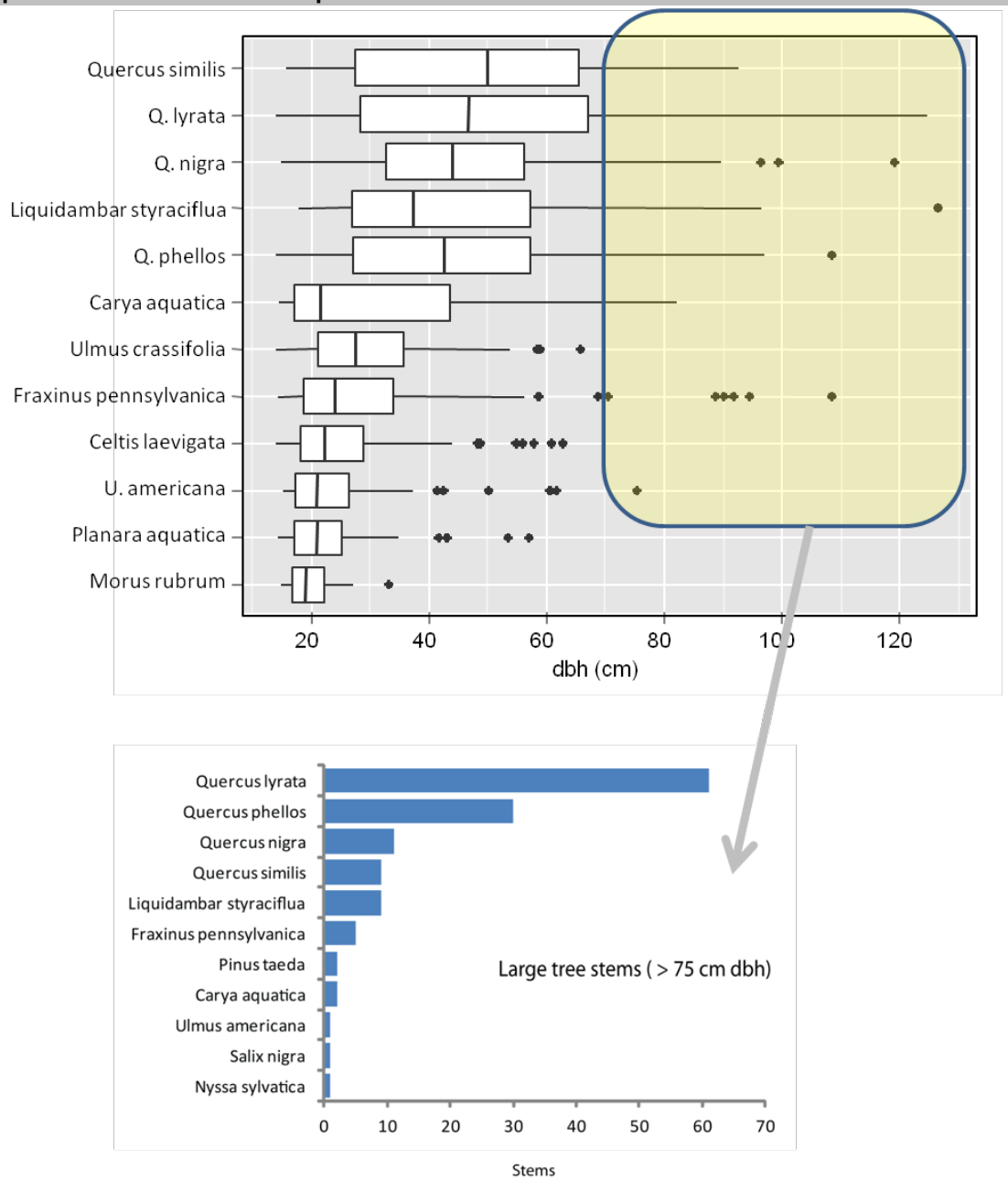

Figure 4. Distribution of DBH (mean and range indicated by boxplot) for the 12 species with highest cover (Large stem dataset; top plot). The distribution frequency of very large trees (stems > 75 cm dbh) shown in lower histogram.

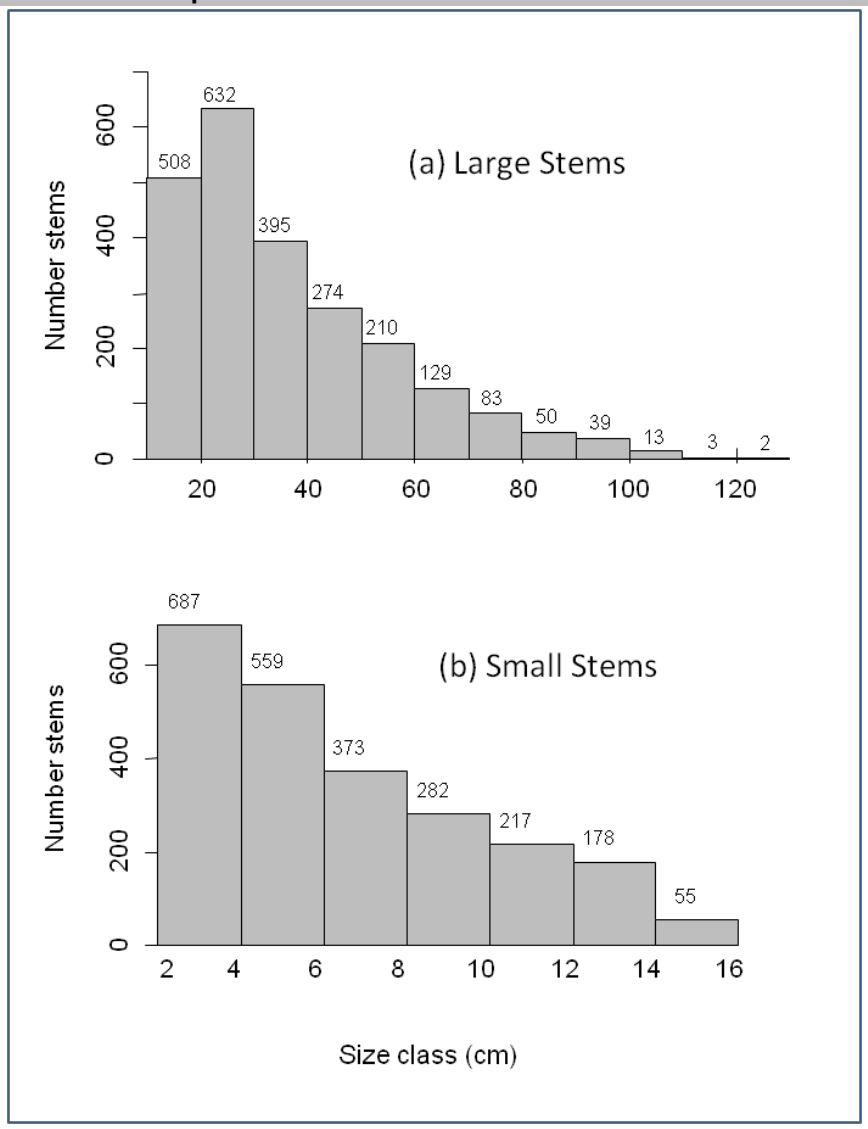

Figure 5. Size class distributions of stems by size class (dbh cm): Large stems (top plot) and small stems (bottom plot). Number of stems per size class is shown above each bar.

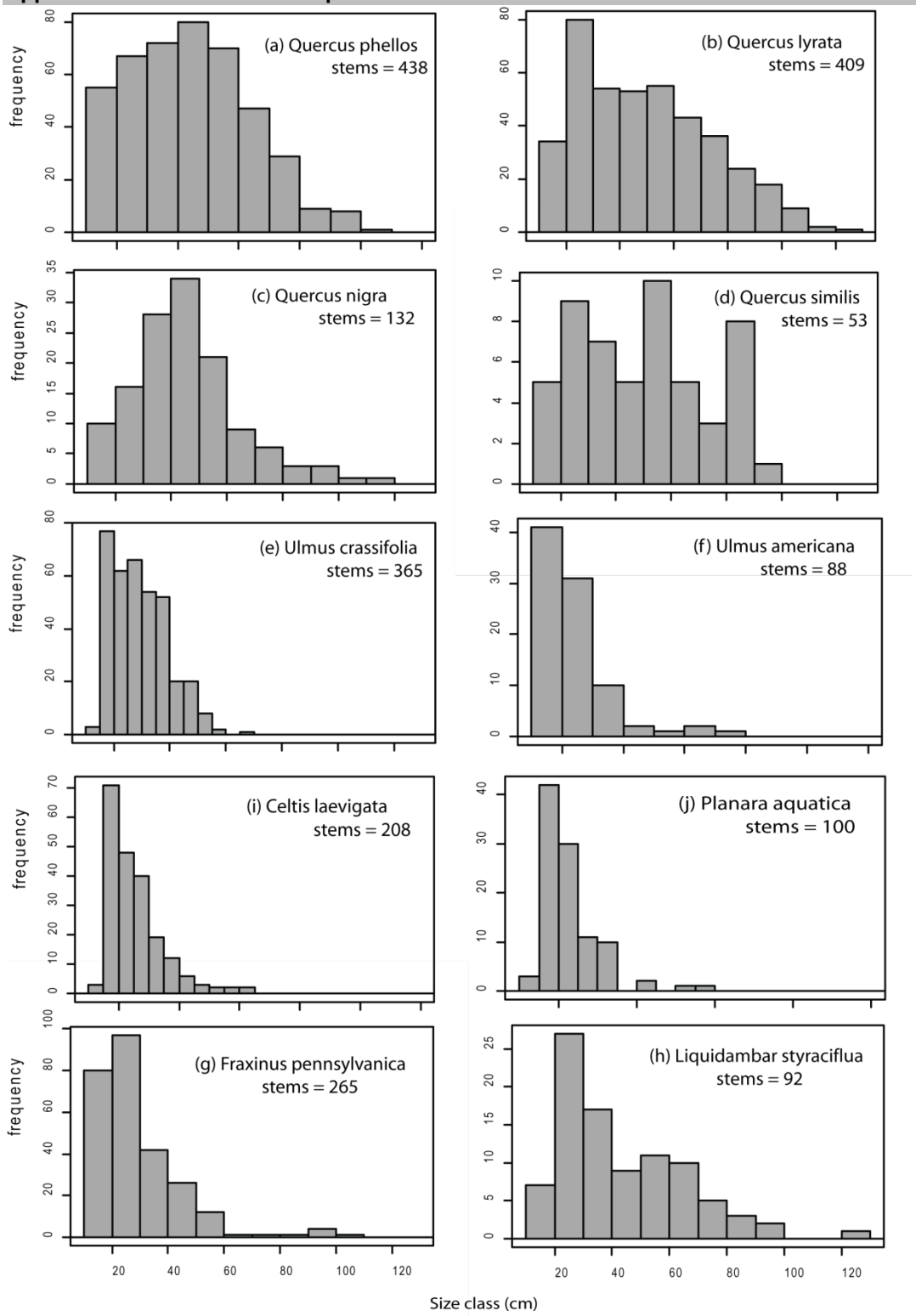

Figure 6. Size class distribution of dominant tree species (Large stem dataset). Histograms show number stems per 20 cm size class. Total number stems indicated in each plot.

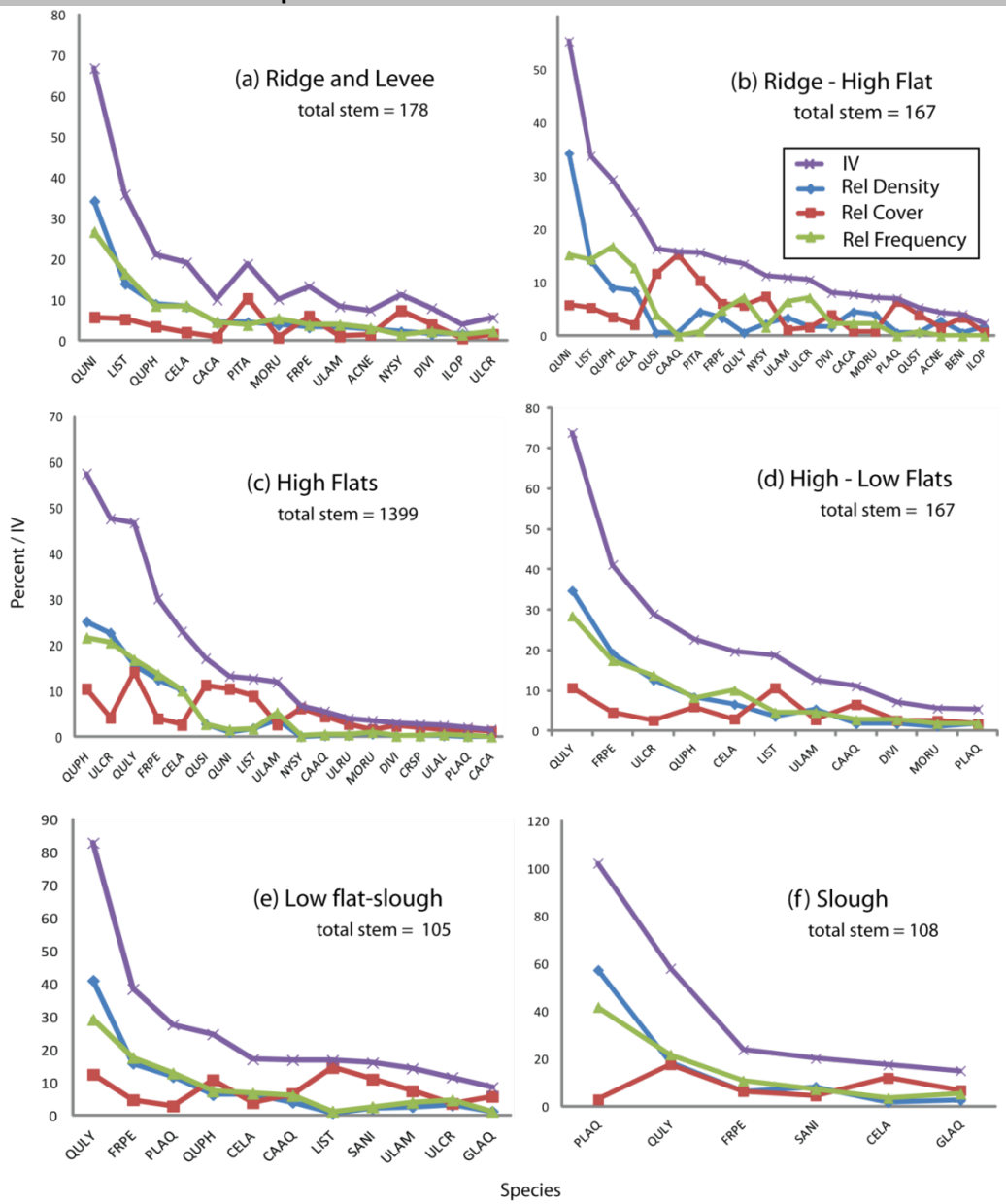

Figure 7. Importance values (IV) and relative density, frequency, and cover values for Large stem species (freq > 2) by habitat type. Species codes listed in Appendix 1.

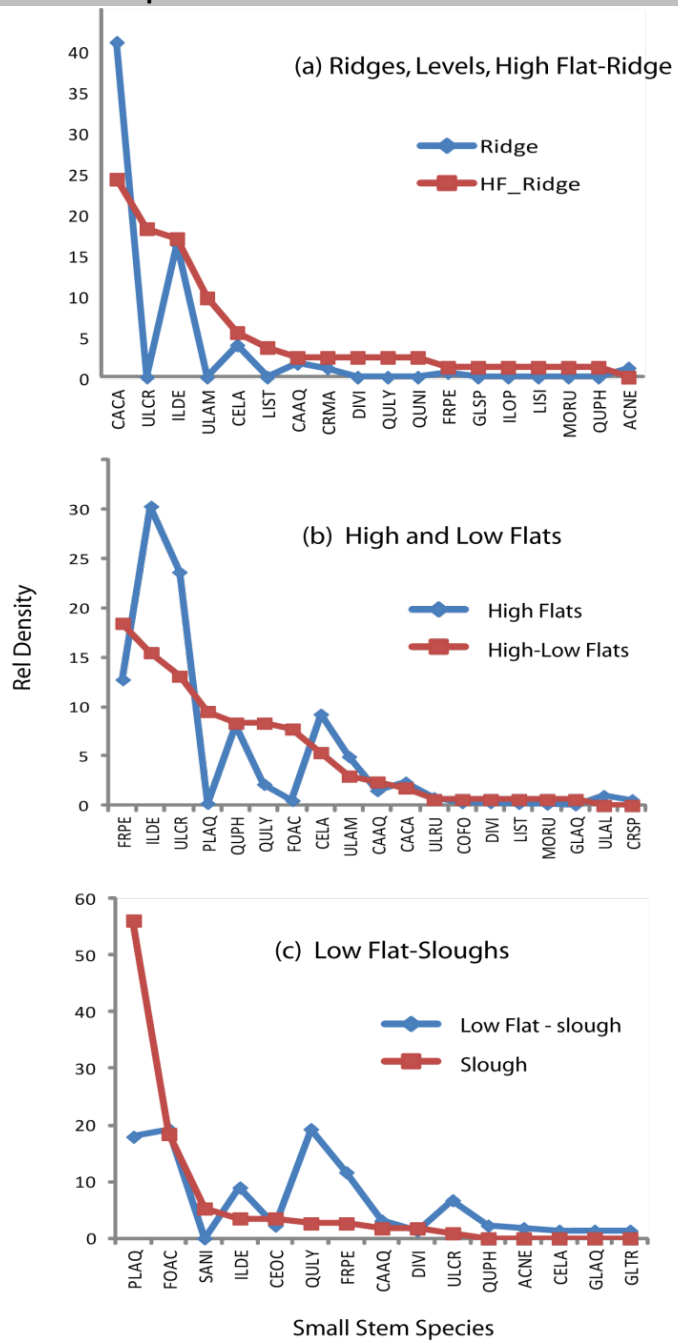

Figure 8. Relative density for Small stem species (freq > 2) by habitat type. Total stems indicates stems recorded per type. Species codes listed in Appendix 2.

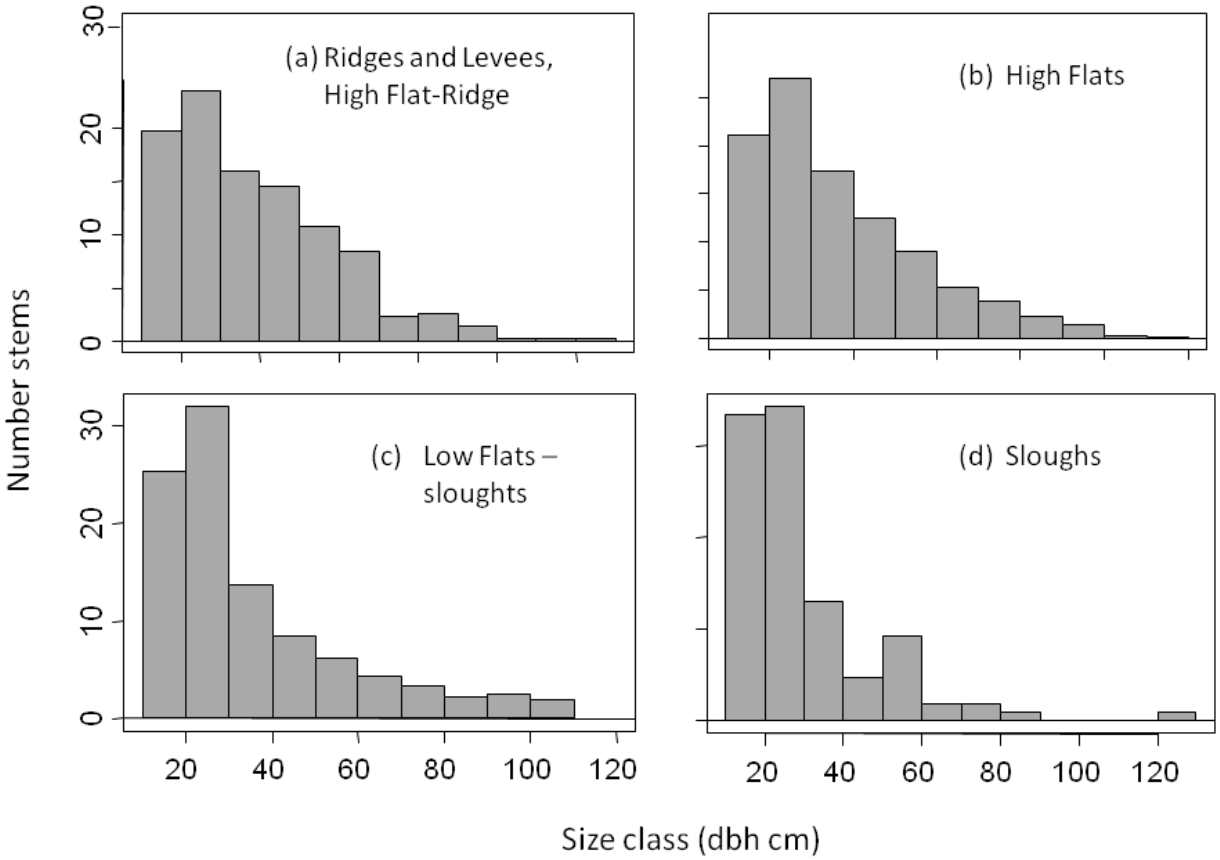

Figure 9. Size class distribution of Large stems in 4 habitat categories (see text).

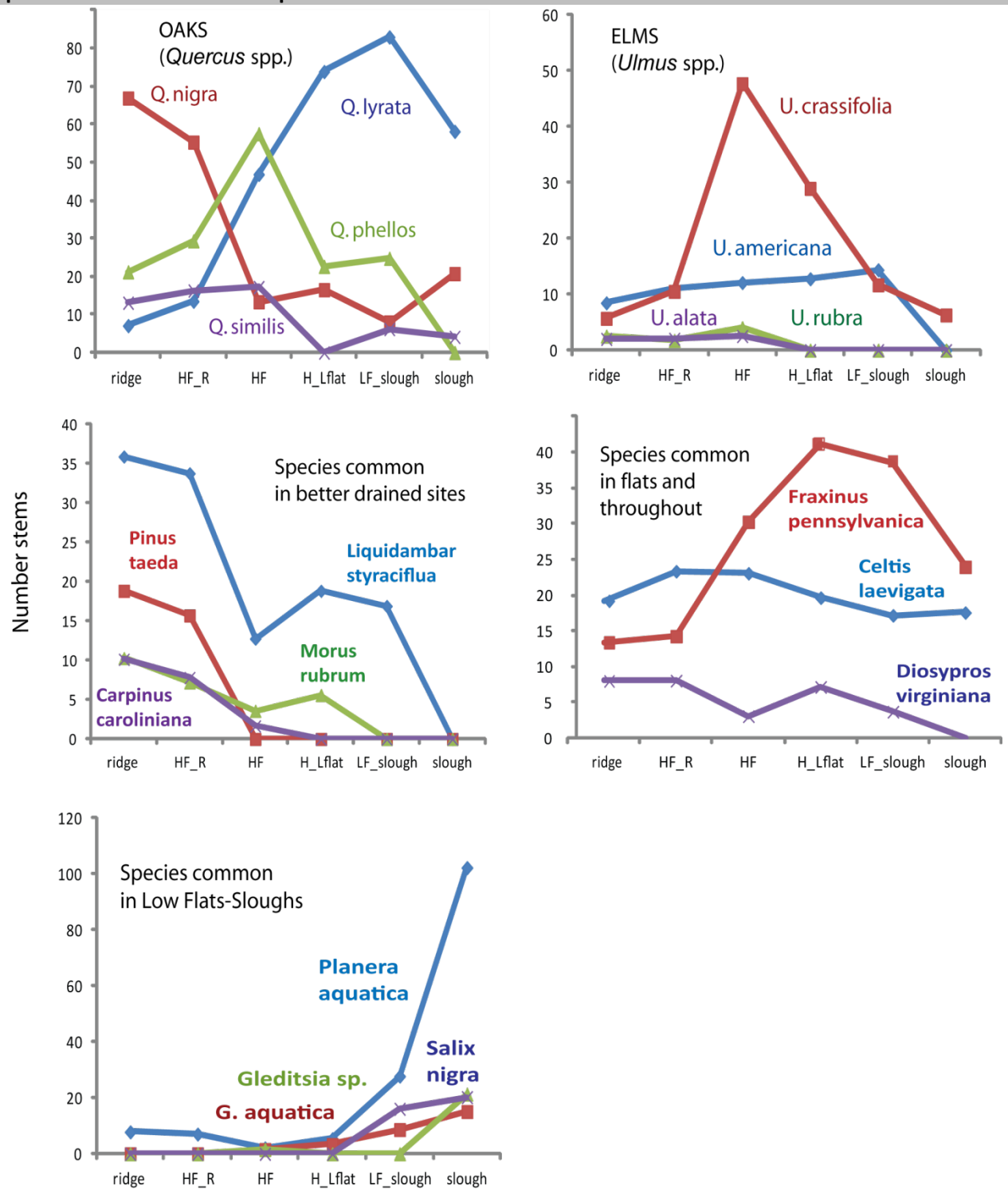

Figure 10. Large stem Species IV values by habitat type, arranged from best to least well-drained. Only species with IV > 2 shown. Top plots include Oaks (Quercus spp.) and Elms (Ulmus spp.). Habitat codes as follows: ridge = Ridge and Levee, HF_R =High Flat-Ridge, HF = High Flat, H_Lflat = High-Low Flats, LF_lough = Low Flats-Slough, and slough = Slough.

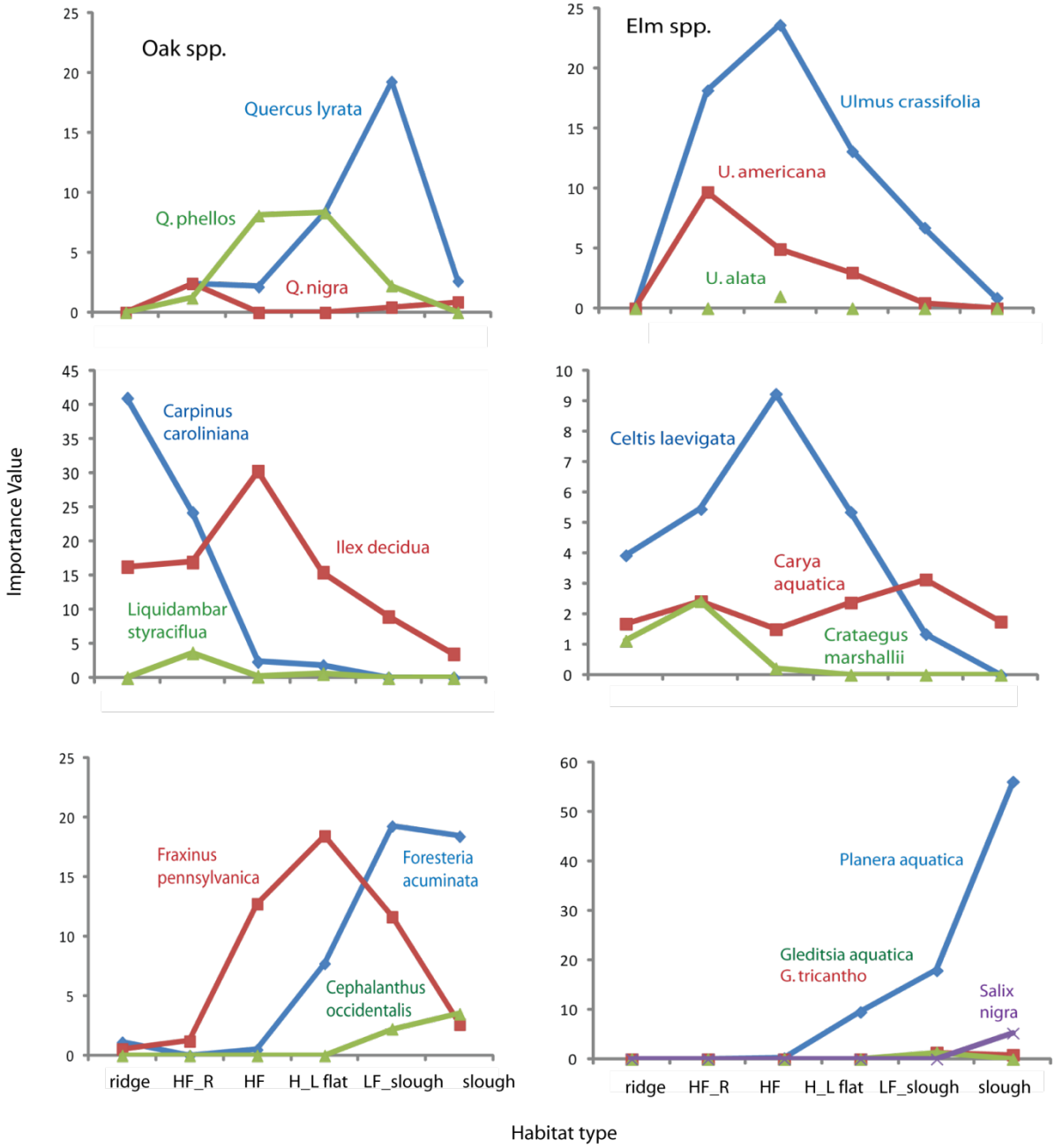

Figure 11. Small stem Relative Density values by habitat type, arranged from best to least well-drained. Habitat type codes shown in Figure 8.

APPENDICES

Species	species	count	mean BA	rel den	rel cov	rel freq	IV
Quercus lyrata	QULY	409	2429.08	17.49	30.49	16.46	64.45
Quercus phellos	QUPH	438	1841.86	18.73	24.76	16.77	60.26
Ulmus crassifolia	ULCR	365	753.39	15.61	8.44	14.84	38.90
Fraxinus pennsylvanica	FRPE	265	840.73	11.33	6.84	12.30	30.47
Celtis laevigata	CELA	208	566.31	8.90	3.62	9.44	21.95
Quercus nigra	QUNI	132	1947.91	5.65	7.89	5.28	18.82
Liquidambar styraciflua	LIST	92	1880.51	3.93	5.31	4.60	13.84
Ulmus americana	ULAM	88	545.69	3.76	1.47	4.84	10.08
Planera aquatica	PLAQ	100	444.60	4.28	1.36	3.11	8.75
Quercus similis	QUSI	53	2364.38	2.27	3.85	2.36	8.47
Carya aquatica	CAAQ	21	1535.41	0.90	0.99	1.30	3.19
Morus rubra	MORU	23	345.35	0.98	0.24	1.43	2.66
Pinus taeda	PITA	15	2612.56	0.64	1.20	0.56	2.40
Nyssa sylvatica	NYSY	15	2303.39	0.64	1.06	0.68	2.39
Diospyros virginiana	DIVI	15	691.35	0.64	0.32	0.87	1.83
Salix nigra	SANI	16	955.04	0.68	0.47	0.56	1.71
Carpinus caroliniana	CACA	15	278.23	0.64	0.13	0.75	1.52
Acer negundo	ACNE	11	526.44	0.47	0.18	0.62	1.27
Quercus stellata	QUST	8	1688.59	0.34	0.41	0.43	1.19
Ulmus rubrum	ULRU	9	488.01	0.38	0.13	0.50	1.02
Gledetsia aquatica	GLAQ	8	780.37	0.34	0.19	0.43	0.97
Ulmus alata	ULAL	8	280.76	0.34	0.07	0.50	0.91
Quercus falcata	QUFA	5	1828.95	0.21	0.28	0.25	0.74
Crataegus sp.	CRSP	4	372.96	0.17	0.05	0.25	0.47
Ilex opaca	ILOP	4	228.32	0.17	0.03	0.19	0.39
Gledetsia sp.	GLSP	2	1424.52	0.09	0.09	0.12	0.30
Forestiera acuminata	FOAC	2	221.87	0.09	0.01	0.12	0.22
Betula nigra	BENI	1	1206.87	0.04	0.04	0.06	0.14
Carya cordiformis	CACO	1	865.70	0.04	0.03	0.06	0.13
Carya sp.	CAGL	1	697.46	0.04	0.02	0.06	0.13
Carya texana	CATX	1	369.84	0.04	0.01	0.06	0.12
Tilia americana var carolinianc	TICA	1	240.53	0.04	0.01	0.06	0.11
Ostrya virginiana	OSVI	1	181.46	0.04	0.01	0.06	0.11
Ilex decidua	ILDE	1	151.75	0.04	0.00	0.06	0.11

Appendix 1. stem species ranked by IV. Count = number stems measured, meanBA = mean basal area in m/ha, relden = Relative density, relcov = Relative cover, relfreq = Relative Frequency.

Species Name	code	count	meanBA	rel den	rel cov	rel freq	IV
Ulmus crassifolia	ULCR	419	43.18	17.82	17.60	16.05	51.48
Ilex decidua	ILDE	553	13.25	23.52	7.13	20.08	50.73
Fraxinus pennsylvanica	FRPE	245	60.46	10.42	14.41	10.72	35.55
Celtis laevigata	CELA	161	74.91	6.85	11.73	8.32	26.90
Quercus phellos	QUPH	139	57.44	5.91	7.77	6.63	20.31
Carpinus caroliniana	CACA	161	48.15	6.85	7.54	5.52	19.91
Planera aquatica	PLAQ	130	55.67	5.53	7.04	4.55	17.12
Ulmus americana	ULAM	101	67.06	4.30	6.59	5.13	16.02
Quercus lyrata	QULY	95	76.54	4.04	7.07	4.74	15.86
Forestiera acuminata	FOAC	88	25.19	3.74	2.16	3.77	9.67
Carya aquatica	CAAQ	41	46.09	1.74	1.84	2.34	5.92
Ulmus rubrum	ULRU	14	85.03	0.60	1.16	0.78	2.53
Ulmus alata	ULAL	17	44.59	0.72	0.74	0.97	2.44
Quercus nigra	QUNI	15	59.58	0.64	0.87	0.78	2.29
Liquidambar styraciflua	LIST	15	47.93	0.64	0.70	0.84	2.18
Diospyros virginiana	DIVI	15	42.56	0.64	0.62	0.84	2.10
Morus rubra	MORU	10	96.31	0.43	0.94	0.65	2.01
Cephalanthus occidentalis	CEOC	12	23.80	0.51	0.28	0.78	1.57
Ostrya virginiana	OSVI	11	33.91	0.47	0.36	0.65	1.48
Salix nigra	SANI	11	56.95	0.47	0.61	0.32	1.40
Crataegus sp.	CRSP	8	35.08	0.34	0.27	0.52	1.13
Crataegus marshallii	CRMA	10	10.88	0.43	0.11	0.52	1.05
Ilex opaca	ILOP	8	15.67	0.34	0.12	0.52	0.98
Gledetsia sp.	GLSP	5	53.10	0.21	0.26	0.32	0.80
Acer negundo	ACNE	6	42.70	0.26	0.25	0.19	0.70
Gledetsia aquatica	GLAQ	5	46.06	0.21	0.22	0.26	0.70
Nyssa sylvatica	NYSY	5	41.96	0.21	0.20	0.26	0.68
Gledetsia triacanthos	GLTR	4	61.68	0.17	0.24	0.26	0.67
Vaccinium arboreum	VAAR	7	11.02	0.30	0.08	0.26	0.63
Acer rubrum	ACRU	4	49.98	0.17	0.19	0.26	0.62
Cornus foemina	COFO	5	13.36	0.21	0.06	0.32	0.60
Carya sp.	CASP	4	28.96	0.17	0.11	0.26	0.54
Viburnum rufidulum	VIRU	4	14.04	0.17	0.05	0.26	0.48
Quercus similis	QUSI	2	84.73	0.09	0.16	0.13	0.38
Juniperus virginiana	JUVI	2	73.44	0.09	0.14	0.06	0.29
Carya texana	CATX	3	11.49	0.13	0.03	0.13	0.29
Ligustrum sinense	LISI	3	8.66	0.13	0.03	0.13	0.28
Triadica sebifera	TRSE	2	20.71	0.09	0.04	0.13	0.26
Cornus drummondii	CODR	2	10.19	0.09	0.02	0.13	0.23
Pinus taeda	PITA	1	95.03	0.04	0.09	0.06	0.20
Quercus falcata	QUFA	1	51.53	0.04	0.05	0.06	0.16
Betula nigra	BENI	1	24.63	0.04	0.02	0.06	0.13
Myrica cerifera	MOCE	1	22.90	0.04	0.02	0.06	0.13
Cornus florida	COFL	1	11.95	0.04	0.01	0.06	0.12
Campsis radicans	CARA	1	8.55	0.04	0.01	0.06	0.12
Frangula caroliniana	BULY	1	8.04	0.04	0.01	0.06	0.12
Sapindus saponaria	SASA	1	7.55	0.04	0.01	0.06	0.11
Melia azedarache	MEAZ	1	7.07	0.04	0.01	0.06	0.11

Appendix 2: Small stem species, ranked by IV. Count = number stems measured, meanBA = mean basal area in m/ha, relden = Relative density, relcov = Relative cover, relfreq = Relative Frequency.

Intra-Service Section 7 Coordination

FORM RESET

Consultation No: 02ETAR00-2016-I-0841

• INTRA-SERVICE SECTION 7

BIOLOGICAL EVALUATION FORM

Originating Person: David Weaver **Date:** July 14, 2016

Intra-Service Section 7 Coordination Arlington Texas ESFO **Program:** Endangered Species

Field Office:

Project/Tract Name: ~~Little Sandy NWR - Comprehensive~~ Conservation Plan

Geographic Information:

Project Location: * Project Map Required Latitude 32.58426 Longitude -95.25533

Note: Identify Multiple Counties in Description of Proposed Action County Wood State Texas

Species/Habitat Occurrence:

Little Sandy National Wildlife Refuge (NWR) is situated in Wood County, Texas within the flood plain and overflow bottoms of the Sabine River and is made up of 3,802 acres of bottomland hardwoods, oxbow lakes and shrub swamp habitats. The Refuge is approximately 82 percent (approximately 3,097 acres) forested with small areas of open water, shrub swamps, beaver ponds and four lakes ranging in size from 19.7 acres (Beaver) to 315 acres (Brumley). Currently, much of the bottomland forest is in late stand succession with large overstory trees. Shrub swamps, dominated by water elm, meander throughout several low lying areas on the Refuge providing a dense low canopy layer. The bottomlands support overcup oak, bottomland post oak, green ash, water hickory, cedar elm and several red oaks (willow and water). Along the upland ridges, often referred to as the pineywoods, shortleaf and loblolly pine tower above a mixed upland hardwood forest where red oaks (southern red and water), hickories, white oaks and sweetgum are among the most common species.

The following species are identified as endangered, threatened, proposed, and candidate species, as well as proposed and final designated critical habitat, which may occur within the boundary of the proposed project.

Listed Endangered Species:

Least Tern (*Sterna antillarum*) - There is no critical habitat designated in the project area for this species. The Interior Least Tern is migratory, breeding along inland river systems in the United States, and found along the Canadian, Red, and Rio Grande River systems in Texas, Interior Least Terns are found utilizing bare to sparsely vegetated sand and gravel bars along rivers and reservoirs. The Interior Least Tern is known to occur, or is believed to occur, in Wood County, Texas.

Listed Threatened Species:

Piping Plover (*Charadrius melodus*) - There is no critical habitat designated in the project area for this species. This species does not require consideration because the project is not a wind energy project.

Red Knot (*Calidris canutus rufa*) - There is no critical habitat designated in the project area for this species. This species does not require consideration because the project is not a wind energy project.

Listed Candidate Species:

Louisiana Pine Snake (*Pituophis ruthveni*) - There is no critical habitat designated in the project area for this species. The Louisiana pine snake prefers sandy, well-drained soils; open pine forests, with a moderate to sparse midstory; and a herbaceous understory dominated by grasses. The Louisiana pine snake is found associated with Baird's pocket gophers. The gophers create burrows which provide habitat for

the Louisiana pine snake and they also serve as a major food source. The Louisiana pine snake is known to or is believed to occur in seven counties in Texas. These counties are located well south and east of Wood County in Texas.

Description of Proposed Action:

In December of 1986, the U.S. Fish and Wildlife Service accepted a permanent, non-development conservation easement donation of 3,802 acres of land owned by the Little Sandy Hunting and Fishing Club (LSHFC) to become the Little Sandy NWR. The conservation easement imposes no limitations or restrictions on the fee simple title of the LSHFC, other than those set forth within the conservation easement. The LSHFC retains the right to control use of, and access to, the land and may continue to use the land and water for hunting, fishing, oil and gas exploration, drilling and production, and for any other purpose consistent with the intent of the agreement to maintain the land and water as wildlife habitat. The U.S. Fish and Wildlife Service (USFWS) has developed a Comprehensive Conservation Plan (CCP), with proposed management activities, that will become the basis for guiding management of the Little Sandy NWR over the next 15 years. It will guide the development of more detailed step-down management plans for specific resource areas and will underpin the annual budgeting process for Refuge operations and maintenance. Most importantly, it lays out the general approach to managing habitat, wildlife, and people at the Refuge and will direct day-to-day decision-making and actions.

The CCP identifies the following proposed issues and actions for Little Sandy NWR.

(1) Issue Topic: Climate Change
Proposed Action: Under the proposed action, the Refuge will implement adaptive strategies to monitor Refuge resources. To do so, the Refuge will use technologies including historical imagery and tabular data, existing maps and records, contemporary ortho-rectified imagery, ground-truthing and on-screen digitizing. This baseline dataset would enable the Refuge to develop a decision-based research and monitoring program to track potential impacts from climate change on the Refuge. The data will be shared with the LSHFC to help guide their management decisions.

(2) Issue Topic: Land Acquisition
Proposed Action: The Refuge will develop a Landscape Conservation Design (LCD), along with a Land Protection Planning process, which will guide land acquisition efforts and provide the opportunity to acquire any adjacent lands from willing sellers. Bottomland hardwood forest and upland tracts will be considered in the plan.

(3) Issue Topic: Flora Inventory
Proposed Action: A complete plant inventory, along with LiDAR (Light Detection and Ranging), will provide a three-dimensional topographical aerial map or the Refuge showing both surface terrain elements and man-made structures. The bottomland hardwood habitat found at Little Sandy NWR is largely untouched, and the information will be used to represent the ideal bottomland hardwood habitat which can be compared to the surrounding areas to determine impacts to similar habitat outside of the Refuge boundary. There are several agencies (federal, state and county), as well as private organizations/individuals, which may benefit from this inventory in their management approaches.

Description of Proposed Action - *Continued*:

(4) Issue Topic: Prescribed Burning
Proposed Action: The Refuge will develop and implement a step-down fire management plan that will focus on mimicking natural fire ecology on approximately 200 acres of habitat on the upland portions of the Refuge adjacent to the railroad and northern boundary. This will provide a small niche on the landscape for fire dependent species. Prescribed burning will also support control efforts for invasive species.

(5) Issue Topic: Invasive Species Management (Flora)
Proposed Action: Chinese tallow and Chinese/Japanese privet is currently being treated on the Refuge by mechanical and chemical control methods. The Refuge will increase efforts to locate, map, treat, and monitor Chinese tallow and Chinese/Japanese privet, as well as, other invasive species (silktree, Chinaberry, Nandina and Japanese honeysuckle) that are present on the Refuge. In addition, management strategies will be implemented to minimize the spread of invasive species. This can be conducted in conjunction with the Flora Inventory as described above.

(6) Issue Topic: Water Body Management
Proposed Action: The Refuge has no direct control or management of the water bodies on Little Sandy NWR, however the Refuge will establish a baseline dataset for the aquatic resources. To do so, the Refuge will use technologies including historical imagery and tabular data, existing maps and records, LiDAR, contemporary ortho-rectified imagery, ground-truthing and on-screen digitizing. This baseline dataset will enable the Refuge to develop a decision-based research and monitoring program to track potential impacts. There will be no Service development of facilities on the Refuge. The data will be shared with the LSHFC to help guide their management decisions.

(7) Issue Topic: Fauna Inventory
Proposed Action: The action will expand current wildlife monitoring on the Refuge in coordination with the Inventory and Monitoring Division (I&M). The action will also provide an opportunity to utilize LiDAR to monitor changes in the habitat throughout the Refuge. The action includes; expansion of bird point counts, continue waterfowl surveys, and initiate inventories for mammals, birds, reptiles, amphibians, fish and invertebrates found on the Refuge. Biological data will collected from fauna (deer, waterfowl, etc.) harvested by LSHFC.

(8) Issue Topic: Nuisance and Invasive Species Management (Fauna)
Proposed Action: The Refuge will develop a step down management plan focused on the population control of nuisance and invasive fauna species. Management practices for nuisance species (beaver, nutria) will include activities such as dam removal and trapping to reduce their negative impacts to existing infrastructure. Additionally, the Refuge will utilize staff or contract services to conduct hunting and trapping efforts to remove feral hogs.

Justification of **Concurrence* Determination of Effect:

The proposed action by the U.S. Fish and Wildlife Service (USFWS) is to develop a Comprehensive Conservation Plan (CCP) for Little Sandy NWR. The CCP will identify proposed management activities for the Refuge over the next 15 years.

The Service has reviewed the identified project proposal and has identified the following determination of effect on the listed species/critical habitat of the following species.

The proposed action will have NO EFFECT on the Least Tern (Sterna antillarum), which is a listed species with no critical habitat designated. The Least Tern requires sparsely vegetated gravel and sand bars along rivers and reservoirs to support the habitat requirements needed for the species. Little Sandy NWR has little to none of that habitat type. The proposed actions outlined in the CCP will support habitat improvements and will promote management and monitoring efforts that may support Least Tern populations.

The proposed action will have NO EFFECT on the Piping Plover (Charadrius melodus). which is a listed species with no critical habitat designated. This species does not require consideration because the project proposal does not include wind energy.

The proposed action will have NO EFFECT on the Red Knot (Calidris canutus rufa), which is a listed species with no critical habitat designated. This species does not require consideration because the project proposal does not include wind energy.

The proposed action will have NO EFFECT on the Louisiana Pine Snake (Pituophis ruthveni), which is a listed candidate species with no critical habitat designated. The Louisiana pine snake is known to or is believed to occur in seven counties (Angelina, Jasper, Nacogdoches, Newton, Sabine, San Augustine and Tyler) in Texas. These counties are located well south and east of Wood County in Texas. The Louisiana pine snake is found in sandy, well-drained soils; open pine forests with a moderate to sparse midstory, and a herbaceous understory dominated by grasses. The Refuge is predominantly bottomland hardwood habitat and lacks the habitat to support the Louisiana pine snake. The proposed actions outlined in the CCP will support habitat improvements and will promote management and monitoring efforts that may support Louisiana pine snake populations.

Justification of ****Concurrence* **Determination of Effect - ***Continued*****:**

Determination of Effect - Listed Species/Critical Habitat:

☒ No effect on species/critical habitat. *Concurrence

Species: **Least Tern (*Sterna antillarum*), Piping Plover (*Charadrius melodus*),** and **Red Knot (*Calidris canutus rufa*)**

☐ May affect, is not likely to adversely affect species/critical habitat. *Concurrence

Species: _____

☐ May affect, is likely to adversely affect species/critical habitat. ***Formal Consultation Required***

Species: _____

Determination of Effect - Proposed Species/Proposed Critical Habitat:

☐ No effect on proposed species/critical habitat. *Concurrence

Species:

☐ Is not likely to jeopardize proposed species/adversely modify proposed critical habitat. *Concurrence

Species:

☐ Is likely to jeopardize proposed species/adversely modify proposed critical habitat. ***Conference Required***

Species: _____

Determination of Effect - Candidate Species:

☒ No effect on candidate species. *Concurrence

Species: **Louisiana Pine Snake (*Pituophis ruthveni*)**

☐ Is not likely to jeopardize candidate species. *Concurrence

Species: _____

☐ Is likely to jeopardize candidate species. ***Conference Required***

Species: _____

ESFO Evaluations:

Concur ☒ Non-Concur ☐

Signatures:

OMAR BOCANEGRA Digitally signed by OMAR BOCANEGRA Date: 2016.08.11 10:13:46 -05'00' — August 11, 2016

Section 7 Biologist — Date

ERIK ORSAK Digitally signed by ERIKORSAK Date: 2016.08.15 12:54:02 -05'00' — August 15, 2015

Field Supervisor or Authorized Delegate — Date

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David Weaver / USFWS

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