D'Arbonne National Wildlife Refuge

Habitat Management Plan

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Southeast Region

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1.0 INTRODUCTION

Throughout the century of its existence, the National Wildlife Refuge System has established a reputation as premier ground for the refinement of habitat management techniques. Ever since the establishment of Pelican Island national Wildlife Refuge in 1903, refuge employees have taken pride in developing the latest tools for wildlife conservation with limited resources. Some of the first examples of rocket nets and airboats, equipment now considered essential for wildlife management, were developed by refuge employees. The first prescribed fire on refuge lands was conducted in 1927 at a time when the benefits of this natural process were not well recognized and most federal agencies still considered fire to have "no place in any forest" (USFS 2004).

As the discipline of wildlife management evolved, largely through the efforts of Aldo Leopold with his publication of *Game Management* in 1933, it was recognized that a greater emphasis needed to be placed on making decisions that are based on the best science of the day, while retaining some of the artful intuition that comes from years of field experience. Sound wildlife and habitat management will always involve the skillful integration of science and art in disciplines as diverse as biology and sociology.

Habitat is defined as simply "the physical and biological surroundings of an organism" (Bolen and Robinson 1995). It includes all of the natural components of an ecosystem that are essential for survival including food, cover, and water. The processes that shaped features in northern Louisiana, including D'Arbonne National Wildlife Refuge, are complex and dynamic. This Habitat Management Plan was developed to provide a clear, science-based outline for managing the Refuge in this challenging environment. To this end, a Habitat Management Plan was developed as a first step in closing the gap between the needs of Refuge wildlife and the knowledge of its stewards.

1.1 Planning Process

Habitat Management Plans (HMP) are dynamic working documents that provide refuge managers a decision making process; guidance for the management of refuge habitat; and long-term vision, continuity, and consistency for habitat management on refuge lands. Each plan incorporates the role of refuge habitat in international, national, regional, tribal, State, ecosystem, and refuge goals and objectives; guides analysis and selection of specific habitat management strategies to achieve those habitat goals and objectives; and utilizes key data, scientific literature, expert opinion, and staff expertise.

The statutory authority for conducting habitat management planning on National Wildlife Refuges is derived from the National Wildlife Refuge System Administration Act of 1966 (Refuge Administration Act), as amended by the National Wildlife Refuge Improvement Act of 1997 (Refuge Improvement Act), 16

U.S.C. 668dd - 668ee. Section 4(a)(3) of the Refuge Improvement Act states: "With respect to the System, it is the policy of the United States that each refuge shall be managed to fulfill the mission of the System, as well as the specific purposes for which that refuge was established ..." and Section 4(a)(4) states: "In administering the System, the Secretary shall monitor the status and trends of fish, wildlife, and plants in each refuge." The Refuge Improvement Act provides the Service the authority to establish policies, regulations, and guidelines governing habitat management planning within the System (Service Manual 620 FW 1).

An HMP is a step-down management plan of the Refuge Comprehensive Conservation Plan (CCP). The CCP describes the desired future conditions of a refuge or planning unit and provides long-range guidance and management direction to achieve the purpose(s) of the refuge; helps fulfill the mission of the System; maintains and, where appropriate, restores the biological integrity, diversity, and environmental health of each refuge and the System; helps achieve the goals of the National Wilderness Preservation System, if appropriate; and meets other mandates. The CCP for D'Arbonne National Wildlife Refuge (NWR) was finalized in 2006 (USFWS 2006).

HMPs comply with all applicable laws, regulations, and policies governing the management of National Wildlife Refuge System. The lifespan of an HMP is 15 years and parallels that of refuge CCPs. HMPs are reviewed every 5 years utilizing peer review recommendations, as appropriate, in the HMP revision process or when initiating refuge CCPs. Annual Habitat Work Plans (AHWP) will contain management specifics and are prepared annually.

1.2 Refuge Purposes

The purposes of a national wildlife refuge, as established by Congress or the Executive Branch, are the barometer by which all actions on that designated public land are measured. Habitat management, public use, and all other programs are conducted as required to fulfill the established purposes of the refuge.

D'Arbonne National Wildlife Refuge was established as mitigation for a large U.S. Army Corps of Engineers navigation project on the Ouachita River. Its legislative purpose is 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*) under the authority of the Fish and Wildlife Coordination Act.

In addition to the specific purposes that were established for each refuge, Congress passed the National Wildlife Refuge System Improvement Act in 1997. This legislation provides clear guidance for the mission of the Refuge System and prioritizes wildlife-dependent public uses. The Act states that each Refuge will:

- Fulfill the mission of the National Wildlife Refuge System;
- Fulfill the individual purposes of each refuge;
- Consider the needs of wildlife first;
- Fulfill requirements of comprehensive conservation plans that are prepared for each unit of the Refuge System
- Maintain the biological integrity, diversity, and environmental health of the Refuge System; and
- Recognize that wildlife-dependent recreation activities, including hunting, fishing, wildlife observation, wildlife photography, and environmental education and interpretation are legitimate and priority public uses; and allow refuge managers authority to determine compatible public uses.

1.3 Refuge Vision

The Refuge vision was developed for the Comprehensive Conservation Plan for D'Arbonne NWR (USFWS 2006).

D'Arbonne National Wildlife Refuge will be managed for the conservation, enhancement, and restoration of bottomland hardwood forests and important, associated upland habitats as an integral component of the Lower Mississippi River Ecosystem. These habitats will support a variety of migratory birds, species of special concern, and other associated wildlife and plants. The public will be able to enjoy opportunities for wildlife-dependent recreation, while learning about and gaining appreciation of nature. Present and future generations will benefit from partnerships with others in wildlife conservation efforts.

1.4 Relationship to Other Plans

A Comprehensive Conservation Plan (CCP) was finalized for D'Arbonne NWR in 2006, which includes goals and objectives for Refuge management over a 15-year period (USFWS 2006). The Biological Review Report was instrumental in the development of the CCP (USFWS 2004). The purpose of the Habitat Management Plan is to provide more specific guidance that will facilitate the selection of prescriptions for implementing the goals and objectives of the CCP. In order to maintain consistent strategies for managing wildlife and habitats on the Refuge, several other planning documents were also used in the development of this Plan.

Refuge endangered species with approved Recovery Plans include the red-cockaded woodpecker (USFWS 2003). Whenever possible, priority actions identified in recovery plans were incorporated into goals, objectives and strategies of the Habitat Management Plan. The RCW Recovery Plan set the population goal for D'Arbonne NWR as five family groups. The refuge's population is not designated as a primary core, secondary core or support population. D'Arbonne NWR is listed as an "Important Support" population, the lowest designation given in the Recovery Plan, because of its extremely small size and its lack of potential for growth.

Other plans incorporated into the Habitat Management Plan include the North American Waterfowl Management Plan, Bird Conservation Plan for the West Gulf Coastal Plain (Rich *et al.* 2004), U.S. Shorebird Conservation Plan for the Lower Mississippi/Western Gulf Coast (Elliott and McKnight 2000), the Southeast United States Waterbird Conservation Plan (Hunter *et al.* 2006) and Louisiana Comprehensive Wildlife Conservation Strategy (Lester *et al.* 2005) as follows:

North American Waterfowl Management Plan (NAWMP)

Working under the direction of the NAWMP, the Lower Mississippi Joint Venture (LMVJV) strives to provide habitat for over-wintering waterfowl in the Mississippi Alluvial Valley (MAV) and West Gulf Coastal Plain (WGCP) Bird Conservation Region. As such, the LMVJV assumes that the availability of foraging habitat is the most important factor affecting the number of dabbling ducks that can be accommodated during winter. Diving duck habitat is not thought to be limiting in WGCP. Based on a step-down process, the LMVJV established habitat objectives that link continental waterfowl populations to on-the-ground habitat objectives. Habitat objectives are apportioned among three categories: public managed, private managed, and natural flooding within each state (in the LMVJV administrative boundaries) (USFWS 2004). By doing so, each National Wildlife Refuge (e.g., D'Arbonne NWR) is responsible for contributing to some portion of the habitat objectives. This step-down process has been completed for the Mississippi Alluvial Valley and is nearing completion for the West Gulf Coastal Plain. That is, foraging habitat objectives have not been finalized nor allocated within the WGCP portion of Louisiana, in which D'Arbonne NWR is located. When finalized, these objectives should be used as a guide in developing management objectives for individual refuges. However, D'Arbonne NWR was originally included in the Mississippi Alluvial Valley step-down and allocation process, receiving a habitat objective of 563 acres (1,060,129 duck-use days) of moist-soil habitat, which the refuge is providing.

Bird Conservation Plan for the West Gulf Coastal Plain

The West Gulf Coastal Plain includes D'Arbonne NWR because it reaches to the northwestern most portion of the Mississippi Alluvial Basin. This section of the region is primarily mixed pine/hardwood types with bottomland hardwood forest species in the more mesic areas and on slopes. These forests are of high conservation priority for conserving the natural communities and the bird populations within these habitats. The primary threats to these forests include reservoir construction; stream modifications; destructive timber harvesting practices; and conversion to pine plantations, pastures, and other land uses (Neal, http://www.lmvjv.org/wgcp). This Plan will define conservation strategies to foster support for the West Gulf Coastal Plain priorities. At this time, step-down objectives have not been finalized for the

WGCP. Habitats found on D'Arbonne NWR and associated bird species that are considered a priority in the West Gulf Coastal Plain include:

1) Loblolly/Shortleaf Pine: Henslow's sparrow, Bachman's sparrow, American kestrel, Le Conte's sparrow, chuck-will's-widow, hooded warbler, brown-headed nuthatch, prairie warbler, scissor-tailed flycatcher, red-cockaded woodpecker, and eastern wood-pewee.

2) Bottomland Hardwood Forest: Swainson's warbler, American woodcock, red-headed woodpecker, Eastern wood-pewee, Acadian flycatcher, white-eyed vireo, wood thrush, yellow-throated warbler, cerulean warbler, prothonotary warbler, Kentucky warbler, hooded warbler, and orchard oriole.

U.S. Shorebird Conservation Plan for the Lower Mississippi/Western Gulf Coast

The U.S. Shorebird Conservation Plan is a partnership effort throughout the United States to ensure that stable and self-sustaining populations of shorebird species are restored and protected. The plan was developed by a wide range of agencies, organizations, and shorebird experts for separate regions of the country, and identifies conservation goals, critical habitat conservation needs, key research needs, and proposed education and outreach programs to increase awareness of shorebirds and the threats they face. This plan recommends that public lands provide as much fall shorebird habitat as possible to meet the goal of 520 ha (1,285 acres) of fall habitat in Louisiana. Although step-down objectives have not been created for the WGCP, the following species are considered high priority for the region: piping plover, American golden-plover, marbled godwit, ruddy turnstone, red knot, sanderling, buff-breasted sandpiper, American woodcock, and Wilson's phalarope.

Southeast United States Regional Waterbird Conservation Plan.

This plan provides a framework for the conservation and management of waterbirds in the Southeast that are not covered by either the North American Waterfowl Management Plan or the U.S. Shorebird Conservation Plan. Threats to waterbird populations include destruction of inland and coastal wetlands, introduced predators and invasive species, pollutants, mortality from fisheries and industries, disturbance, and conflicts arising from abundant species. Particularly important habitats include pelagic areas, marshes, forested wetlands, and barrier and sea island complexes. The West Gulf Coastal Plain is considered to have "high responsibility and interest" for king rails, little blue herons and great blue herons. Step-down population objectives have been set in the WGCP for king rails and little blue herons:

2,000 breeding pairs of little blue herons for Louisiana and 1,000 pairs of king rails.

Little to no habitat exists on D'Arbonne NWR for king rails. Callback surveys have been conducted in the past in the Beanfield for breeding king rails but none were detected. Researchers from Louisiana State University attempted catching migrating and/or wintering king rails on the refuge with no success. Little blue herons are found on the refuge during the breeding season. A cattle egret rookery in 2009 was found a couple of days before rising flood waters topped the nests with eggs. Although it was not verified that little blue herons had nests, they were seen mixed in with the cattle egret rookery.

Louisiana Comprehensive Wildlife Conservation Strategy

The Louisiana Department of Wildlife and Fisheries (LDWF) is a critical partner in the effort to implement conservation strategies. In 2005, LDWF published the Louisiana Comprehensive Wildlife Conservation Strategy as required by Congress in association with federal funding. This Strategy is a "blueprint for guiding LDWF in the development of management actions for Louisiana's fish and wildlife species with emphasis on species of conservation concern and associated habitat they depend upon" (Lester *et al.* 2005). The state plan identifies all vegetation communities in the state along with species of concern and threats that are associated with each community. D'Arbonne NWR would contain the Mixed Hardwood-Loblolly Forest, Bottomland Hardwood Forest and Cypress Swamp communities listed in the state plan.

This Habitat Management Plan also incorporates the recommendations of other approved station plans including the Fire Management Plan (USFWS 2001) and the Wildlife and Habitat Biological Review Report (USFWS 2004). Prescribed fire strategies detailed in this Plan will be incorporated into the next revision of the Fire Management Plan.

2.0 ENVIRONMENTAL SETTING AND BACKGROUND

2.1 Location

D'Arbonne National Wildlife Refuge is in northeast Louisiana, 23 miles south of the Arkansas border and 2.5 miles north of West Monroe, Louisiana. The refuge encompasses 17,421 acres, with 9,535 acres in Union Parish and 7,886 acres in Ouachita Parish. Its southern boundary is at the edge of suburban sprawl of the city of West Monroe and expands north approximately 8 miles, following just west of Highway 143. D'Arbonne NWR is administered with four other national wildlife refuges by the North Louisiana Refuges Complex (Figure 1).

2.2 Management Units

The refuge is delineated into 25 management units (Figure 2) delineated into manageable blocks of habitat that have the same habitat management objectives. The habitat type, size, soil type, current condition and past management history for each unit is described in Table 1.

2.3 Physical Features

2.3.1 Climate

Temperatures normally range between 20°F to 70°F during winter and 70°F to 95°F during the summer. The average annual growing season is 237 days. Mean annual precipitation is 49.6 inches. Thirty percent of the total occurs in the wettest months of February through April, and 15.7 percent in the driest months of August through October. Snowfall and ice storms are uncommon occurrences.

2.3.2 Topography and Hydrology

The refuge is part of the Bayou D'Arbonne watershed. The central physical feature of the refuge is the Bayou D'Arbonne and includes an extensive system of bayous, sloughs, and lakes separated by woodlands and cleared bottomlands. At the point where the bayou flows into the refuge on its northern boundary, the bottom of the main channel is 38.5 feet above MSL. The bayou travels a 13.2-mile course through the refuge and the channel bottom gradually decreases in elevation until it is 35.5 feet above MSL at a point one mile below the southern boundary. The Corp of Engineers manipulates the Ouachita River to minimize flooding while maintaining navigable river stages. Permanent pool level is 52 feet MSL and results from backwater flooding from Columbia Lock and Dam No.19 on the Ouachita River (about 30 miles below the refuge) with a possible 30-foot rise/fall per year depending on

Table 1. Description of 25 Management Units on D'Arbonne NWR.

Management Unit	Size (ac)	Soil Type	Habitat Type	Current Condition	Treatment History
1A	529	Ora, Sacul, Guyton	Loblolly Pine Flatwood	30% mature, old loblolly-shortleaf pine; 30% mature loblolly pine-hardwood; 30% mature loblolly pine	Herbicide to kill hardwoods in mid-1980s on 326 ac; 331 acres of pine and hardwood pulpwood 1987; 34 ac slash pine 1981; 173ac pine pulpwood 1990; 232 ac pine hardwood sawtimber 1987. Burned in winter on ave. every 3 yrs. from 1979-2000. Burned growing season on ave. every 3 yrs from 2001-present.
1B	816	Litro, Groom	Bottomland Hardwood	60% overcup oak-water hickory; 10% baldcypress-water tupelo; 30% willow oak-sweetgum	38 ac pulpwood 1983; 176 ac sawtimber 1990; 178 ac sawtimber 1999; 151 ac sawtimber 2007
1C	162	Frizzell, Guyton, Ora	Upland Hardwood	100% swamp chestnut oak-cherrybark oak	166 ac herbicide to kill hardwoods in 1984; 170 ac sawtimber sale in mid-1990s.
1D	174	Frizzell, Groom, Ora	Loblolly Pine Flatwood	70% 25 yr. old loblolly pine; 30% mature loblolly pine-hardwood	20 ac herbicide to kill hardwoods in 1990; 54 ac pine pulpwood 1980; 14 ac seed tree pine regen 1983; 74 ac pine pulpwood 1987; 20 ac seed tree pine regen 1987; 42 ac hardwood sawtimber 1991; Burned in winter on ave. every 3 yrs. from 1985-1994.
2B	774	Alligator, Guyton, Leaf	Bottomland Hardwood	50% 15 yr. old sweetgum-willow oak; 30% mature sweetgum-willow oak; 20% old, overcup oak-water hickory	263 ac sawtimber 1992; 180 ac pulpwood 1993; 204 ac pulpwood 1995
3A	127	Mahan, Groom	Upland Hardwood	100% loblolly pine-hardwood	10 ac pine pulpwood 1981; 22 ac pine pulpwood 1985; 5 ac pine pulpwood 1992; 127 ac pine sawtimber 2002; Burned in winter on ave. every 3 yrs. from 1988-1993
3B	1232	Groom, Litro	Bottomland Hardwood	50% mature willow oak-sweetgum; 50% mature overcup oak-water hickory	636 ac pulpwood 1993; 277 ac pulpwood 1996
4A	190	Frizzel, Groom	Loblolly Pine Flatwood	40% 22 yr. old loblolly pine; 60% mature loblolly pine-hardwood	77 ac herbicide to kill hardwoods 1991; 81 ac seed tree pine regen 1987; 150 ac pine hardwood sawtimber & pulpwood 2007; Burned once in winter between 1989-2000.
4B	993	Alligator, Groom, Litro, Guyton	Bottomland Hardwood	60% 12 yr. old willow oak-sweetgum; 5% mature overcup oak-water hickory; 35% mature willow oak-sweetgum	18 ac sawtimber 1991; 487 ac sawtimber & pulpwood 1993; 160 ac regen cut 1993

4C	791	Frizzell, Groom, Leaf, Guyton, Muskogee, Ruston	Loblolly Pine Flatwood	70% mature loblolly pine-hardwood; 30% loblolly pine	228 ac herbicide to kill hardwoods 1988; 90 ac seed tree pine regen 1986; 94 ac pine pulpwood 1982; 105 ac pre-commercial pine thinning 1986; 237 ac pine & hardwood pulpwood 1986; 311 ac pine sawtimber & pulpwood 1991; 31 ac hardwood sawtimber 1994; 251 ac hardwood sawtimber 1992; 291 ac pine & hardwood sawtimber 2007; burned in winter on ave. every 3 yrs. from 1982-2000; burned in growing season on ave. every 3 yrs. from 2001-present
5A	174	Cadeville, Ruston, Groom, Guyton, Darley	Upland Hardwood	100% loblolly pine-hardwood	49 ac pine pulpwood 1981; 50 ac pine pulpwood 1985; 164 ac pine sawtimber 2003; Burned in winter on ave. every 3 yrs. from 1988-1993
5B	1315	Litro, Groom	Bottomland Hardwood	60% willow oak-sweetgum 40% overcup oak-water hickory	66 ac pulpwood 1988; 155 ac pulpwood 1997; 440 ac pulpwood 2000; 396 ac sawtimber 2005
6B	1366	Perry, Alligator, Leaf	Bottomland Hardwood	60% willow oak-sweetgum; 30% overcup oak-water hickory	107 ac pulpwood 1994; 173 ac pulpwood 1997; 803 ac pulpwood 1999; 108 ac sawtimber 2001; 128 ac sawtimber 2006
7A	397	Darley, Sacul, Leaf, Frizzell, Guyton	Upland Hardwood	100% loblolly pine-hardwood	74 ac pine pulpwood 1982; 10 ac pine pulpwood 1986; 115 ac pine sawtimber 2003; Burned in winter on ave. every 3 yrs. from 1988-1993
7B	643	Litro, Groom	Bottomland Hardwood	80% sweetgum-willow oak; 15% overcup oak-water hickory; 5% baldcypress-water tupelo	5 ac pulpwood 1992; 268 ac pulpwood 2001; 38 ac sawtimber 2005
8A	23	Kirvin, Guyton	Upland Hardwood	100% loblolly pine-hardwood	None
8B	1479	Perry, Portland, Guyton, Alligator	Bottomland Hardwood	50% overcup oak-water hickory; 50% willow oak-sweetgum	None
9A	136	Groom, Frizzell	Upland Hardwood	100% loblolly pine-hardwood	171 ac hardwood sawtimber & pulpwood 1999
9B	1196	Litro, Groom	Bottomland Hardwood	60% willow oak-sweetgum; 30% overcup oak-water hickory; 10% baldcypress-water tupelo	146 ac sawtimber 1998; 45 ac pulpwood 1998; 144 ac sawtimber 2002
10A	31	Kirvin, Ruston	Upland Hardwood	100% loblolly pine-hardwood	None

10B	1037	Alligator, Guyton, Litro, Kirvin	Bottomland Hardwood	35% willow oak-sweetgum; 35% overcup oak-water hickory; 25% baldcypress-water tupelo	None
11A	537	Litro	Moist Soil	Moist soil vegetation with some water control capability; can pump and hold water; can pull water off but only when Bayou D'Arbonne is not flooded	Mowed every 3 years
11B	1117	Alligator, Litro	Bottomland Hardwood	65% overcup oak-water hickory; 35% willow oak-sweetgum	None
11C	150	Litro	Moist Soil	Moist soil vegetation without water control capability	Mowed every 3 years

annual rains (Figure 3). The permanent pool is comprised of Bayou D'Arbonne, Eagle Lake, Jones Lake, Wolf Brake, Lake Drain Slough, Long Slough, Bayou Choudrant, and Cross Bayou, for a total of 2,532 acres of permanent open water on the refuge. The Corps has the right to permanently flood those lands lying below 65 feet above MSL and to flood on a seasonal basis any land lying between 65 feet above MSL and 70 feet above MSL. Average seasonal flooding is at 65-70 feet MSL in the growing season (March to November). Duration of growing season flooding varies from one to five months. Flooding may begin as early as November but in some years may not occur until January or February. Floodwaters may persist until July, but usually recede in June. Thus the flood season is basically January through June. The maximum recorded water level is 82 feet MSL. Water levels of Bayou D'Arbonne are measured indirectly through the Monroe Gauge reading of the Ouachita River collected by the Corps of Engineers. The highest elevation on the refuge is approximately 172 ft above MSL (Figure 4).

2.3.3 Soils

The following is a listing and description of the soil series and association occurring on the refuge (Figure 5) according to the U.S Department of Agriculture, Soil Conservation Service as described in the *Soil Survey of Ouachita Parish, Louisiana* (1974) and the *Soil Survey of Union Parish, Louisiana* (1997).

1). Alligator Series

Alligator clay, frequently flooded (Af) This is a poorly drained, clayey soil subject to frequent flooding, and it occurs in low-lying, broad depressional areas. The profile of this soil is typical of the Alligator Series. The surface layer is dark grayish-brown clay about 8 inches thick. Underlying layers are gray or gray and reddish-brown clay. The soils is low in natural fertility and very strongly acid. Surface runoff is slow to very slow, with the permeability rate very slow.

Alligator clay has a moderately high potential productivity for all the bottomland hardwood species found on the refuge up to site index 80. Use of heavy equipment on this soil is severely limited because of wetness which reduces the ability of the soil to support such equipment. There is also severe seedling mortality caused by exorbitant flood waters.

2). Frizzell Series

Frizzell silt loam, 0 to 1 percent slopes (FrA). This is a somewhat poorly drained, silty soil found on level, broad terraces which can be flooded on occasion for short periods after heavy rainstorms. The surface layer is a brown silt loam with light brownish gray mottling in the upper portion. The lower part is a gray and brown silty clay loam or silt loam. The soil is low in natural fertility and very strongly acid. It has slow permeability and runoff.

Frizzell silt loam, 1 to 3 percent slopes (FrB). Again, typical of the Frizzell Series, this is a poorly drained, silty soil and it is found on terraces. The surface layer is a silt loam that is grayish-brown to yellowish-brown. The subsoil is also a silt loam, but is yellowish-brown mottled with gray and brown. This soil is also low in fertility. It is medium to very strongly acid. Permeability is slow, with runoff medium, and the available water capacity is high.

Both of the above Frizzell silt loams have a high potential productivity for hardwoods and loblolly pine up to site index 90. Use of heavy equipment on these soils is only moderately limited because of excess water.

3). Guyton Series

Guyton-Rosebloom complex, frequently flooded (Gy). This soil is found in long, narrow areas on the flood plains of streams. Guyton silt loam and Rosebloom silt loam are intermingled—with Guyton silt loam generally occupying the higher elevations. Guyton silt loam is poorly drained and the surface layer is grayish-brown silt loam or very fine sandy loam about 6 inches thick. The subsurface layer is a light brownish-gray silt loam approximately 17 inches thick, and the subsoils is a gray silty clay loam. The soils characteristically have slow surface runoff, very slow permeability, high available water capacity, low natural fertility, and they are medium to strongly acid.

Rosebloom soils are poorly drained and have a gray to grayish-brown silt loam surface layer about 8 inches thick, and a gray silt loam to silty clay loam subsoil. Just as the Guyton soils, Rosebloom soils have slow surface runoff, slow permeability, low natural fertility, and high available water capacity. The soils are medium to very strongly acid.

The Guyton-Rosebloom complex has a high potential productivity for many southern hardwoods and pine up to site index 90. There is moderate to severe seedling mortality because of excess water. There is also severe equipment limitations on this soil because of wetness; logging should be conducted under dry conditions only.

4). Kirvin Series

Kirvis-Ruston association, rolling (Kr). Kirvin soils are found on sloping areas of upland sites. The surface layer is a dark yellowish-brown fine sandy loam about 13 inches thick, and the subsoil is red sandy clay which is underlain by red, brown, and gray clayey material. These soils are well drained, moderately slowly permeable, low in natural fertility, and moderate in available water capacity. They are medium to very strongly acid. These soils are found on slopes having a 5 to 30 percent grade, most commonly more than 8 percent.

Ruston soils are on narrow ridge crests and upper slopes. The surface layer is a

brown find sandy loam about 12 inches thick, and the subsoil is yellowish-red to red sandy clay loam. These soils are well drained, moderately permeable, low in natural fertility, moderate in available water capacity, strongly acid, and they are found on slopes ranging from 5 to 15 percent.

Kirvin and Ora soils have a moderately high potential productivity for loblolly pine, shortleaf pine, and southern hardwoods, with a potential site index as high as 80. there are no serious limitations for seedling or use of heavy equipment.

Ruston soils have a high potential productivity and are best suited to southern pines, where a potential site index of 90 may be realized. There are no serous limitations for seedlings or equipment use on these soils.

Cadeville soils have moderately high potential productivity and are best suited to southern pines with a potential site index of 80. There is a slight to moderate erosion hazard and moderate equipment limitations on account of a clay subsoil.

5). Leaf Series

Leaf silt loam, occasionally flooded (Le). This poorly drained soil is located on terraces adjacent to the floodplain of Bayou D'Arbonne. It is level and subject to occasional deep flooding during winter and spring. The surface layer is a gray or dark-brown silt loam about 6 inches thick, and the subsoil is a gray firm clay or silty clay that has a few brown mottles. There are small areas of silty clay loam and Alligator clay included with this soil in mapping.

This soil is low in fertility, strongly acid to very strongly acid, and is very slow in permeability and surface runoff. There is a moderate capacity of available water.

This soil has a high potential productivity and is well suited to southern pine and hardwoods; the potential site index is 90. There is moderate to severe seedling mortality because of excess water, and there are severe equipment limitations besides. This soil is also suitable for rice and soybeans where flooding is not too severe.

6). Muskogee Series

Muskogee silt loam, 3 to 5 percent slopes (MuC). This soil is found on gently sloping terraces and is moderately well drained. A very dark grayish-brown silt loam approximately 3 inches thick makes up the surface layer. The subsoil is composed of a yellowish-brown to strong-brown silt loam underlain by gray clayey layers.

This soil has medium natural fertility and is strongly acid to very strongly acid. The soil has slow permeability and medium runoff. There is also a high available water capacity.

This soil series has a moderately high potential productivity and is best suited for southern hardwoods and pines with a high potential site index of 80. There are no serious limitations for seedlings or equipment usage.

7). Perry Series

Perry clay, frequently flooded (Pc). This is a level or depressional, poorly drained, clayey soil that is subject to frequent flooding by backwater in winter and late in spring of most years.

The surface layer is a dark-gray clay, and the subsoil is gray clay underlain at a depth of 20 to 30 inches by reddish-brown clay. This soil is often intermingled with Alligator and Portland soils.

Perry clay has a moderately low natural fertility and is slightly acid to very strongly acid in the upper 20 inches. Permeability and runoff are slow and available water capacity is moderate.

This soil has a moderately high potential productivity and is best suited to southern bottomland hardwoods; potential site index is 80 for most hardwoods, except cottonwood which is 90. Poor trafficability severely limits equipment use, and severe seedling mortality is liable because of excess water.

8). Portland Series

Portland silt loam (Po). This soil is found in the bottomland in long, moderately wide areas at intermediate elevations. The surface layer consists of a brown silt loam about 8 inches thick, and the subsoil is reddish-brown silty clay or clay about 24 inches thick. The soil is moderately low in natural fertility and is medium acid to very strongly acid. Permeability and surface runoff are slow. Available water capacity is moderate.

This soil has a high potential productivity and best suited for southern bottomland hardwoods. The potential site index for most hardwoods is 90, except cottonwood which is 100. Excess water causes severe equipment limitations and moderate seedling mortality. The soil is also well suited for cultivated crops and pasture.

9). Ruston Series

Ruston fine sandy loam, 3 to 8 percent slopes (RsD). This soil is found on the upland portions of the refuge and is a well drained, loamy, gently sloping to moderately sloping soil. The surface layer is brown fine sandy loam about 6 inches thick, and the subsoil is a red to yellowish-red sandy clay loam. Natural fertility is low and the soil is medium to very strongly acid. Permeability, surface runoff, and available water capacity are moderate. Most of the area of

this soil is in pine, but it is also suitable for cultivated crops.

This soil has a high potential productivity and is best suited to southern pines. There are no serious limitations on equipment use or seedling survival.

10) Ora Series

Ora fine sandy loam, 1 to 5 % (Or). This soil is found on the upland portions of the refuge and is a well drained, loamy, gently sloping to moderately sloping soil. It is found on ridgetops on high terraces. The surface layer is dark grayish brown fine sandy loam about 4 inches thick. Fertility is low. It has high levels of exchangeable aluminum that are potentially toxic to crops. The available water capacity is low to moderate. Water runs off at a medium rate.

This soil is well suited for woodlands, loblolly pine production, pastureland and homesites.

Ora fine sandy loam, 5 to 12% slopes (OS). This soil is found on strongly sloping and moderately well drained uplands. The Surface layer is dark grayish brown fine sandy loam about 5 inches thick. The soil has low fertility, due to aluminum levels, has a low to moderate water capacity and quick water runoff.

This soil is well suited for woodlands and loblolly pine production. It is poorly suited for cultivated crops because of slopes and erosion.

11) Litro Series

Litro clay, frequently flooded (LT). This soil is nearly level and poorly drained in backswamp areas on the floodplain of the Ouachita River. It is subject to frequent overflow from the river. The Surface layer is dark gray, mottled clay about 6 inches thick. It is low in fertility, permeability, and the water capacity is moderate to high. Floodwaters typically are 5 to 15 feet deep, but can exceed 20 feet in some areas and is frequently flooded for brief to long periods between November and July.

This soil is used almost entirely as woodland, especially hardwoods.

12) Groom Series

Groom silt loam, occasionally flooded (Gm). This soil is level, poorly drained and found on broad flats on low stream terraces adjacent to the floodplain of the Ouachita River. The surface layer is grayish brown silt loam about 3 inches thick. It has low fertility, slow water runoff, and a high water capacity.

This soil is used mainly as woodland and in some areas, pastureland.

Groom silty clay loam, frequently flooded (GO). This soil is similar to the

Groom (Gm) silt loam in fertility, water capacity and run off. The surface layer is grayish brown silty clay loam about 6 inches thick. This soil is frequently flooded for long periods by overflow from streams at depths of less than 5 feet.

This soil is used mainly as woodland.

13) Sacul Series

Sacul very fine sandy loam, 1 to 5 percent slopes (Sa). This soil is moderately well drained, gently sloping, and is found on convex ridgetops on uplands. The surface layer is dark brown very fine sandy loam about 3 inches thick. It has low fertility and low permeability. Water capacity is moderate to high.

This soil is used mainly as woodland, pastureland or homesites.

Sacul very fine sandy loam, 5 to 12 percent slopes (SB). This soil is strongly sloping, moderately well drained and found on slopes in uplands. The surface layer is dark grayish brown very fine sandy loam about 4 inches thick. It has low fertility, slow permeability, and a rapid rate of water runoff.

This soil is moderately well suited for woodland.

14) Darley Series

Darley gravelly fine sandy loam, 5 to 12 percent slopes (DM). This soil is strongly sloping, well drained on upland slopes. The surface layer is dark brown gravelly fine sandy loam about 4 inches thick. It has medium fertility, rapid water runoff, and moderate to high water capacity. Hazard of erosion is severe.

This soil is used mainly as woodland and some pastureland.

Darley gravelly fine sandy loam, 12 to 30 percent slopes (DO). This soil is moderately steep, well drained and found on side slopes of uplands. The surface layer is dark brown gravelly fine sandy loam about 3 inches thick. It has low fertility, high water capacity, rapid run off and easily erodes.

It is used mainly as woodland.

15) Mahan Series

Mahan fine sandy loam, 5 to 12 percent slopes (MH). This soil is strongly sloping, well drained, and found on slopes of uplands. The surface layer is dark brown fine sandy loam about 3 inches thick. It has medium fertility, moderate permeability, and a rapid rate of water runoff.

This soil is well suited for woodland and high potential for loblolly pine production.

16) Cadeville Series

Cadeville fine sandy loam, 5 to 20 percent slopes (CdE). This soil is moderately well drained, acidic and found on steep slopes. The surface layer is brown or grayish-brown fine sandy loam about 5 inches thick. It has low fertility, rapid runoff, and moderate water capacity.

This soil is used mainly for woodlands and pasture.

2.3.4 Geomorphology

D'Arbonne NWR is located within the West Gulf Coastal Plain (WGCP) which extends from south-central and southwestern Arkansas over to the extreme southeastern portion of Oklahoma and down into eastern Texas east to parts of northeastern Louisiana.

The refuge is a convoluted system of bayous, sloughs, and lakes separated by upland mix of pine and hardwood woodlands and bottomland hardwood forests. Bayou D'Arbonne meanders through a 2- to 4-mile-wide floodplain characterized by alluvial soils deposited during the last 11,000 years. The first bottom area is subject to annual flooding by stream overflow or backwater. In the center of the eastern side of the refuge an alluvial terrace, only slightly older than the adjacent floodplain, gradually rises to an elevation of 90 feet above mean sea level (MSL). The east-central part of the refuge is an alluvial terrace or second bottom. The second bottoms are also subject to flooding but only during extremely high flooding which occurs on rare occasions. A bluff along the southern boundary of the refuge marks the edge of another alluvial terrace, which rises to 130 feet above MSL. This terrace was formed during the Pleistocene epoch, some 11,000 – 2,000,000 years ago.

The uplands on the eastern side of the Refuge occur on Pleistocene terraces that were laid down 100,000 to 12,000 years ago. (Saucier 1994). All terraces are flat and are riverine deposits. Saline soils have been laid down on top of these terraces in some places much more recently. The only real beachfronts are the true uplands with sandy soils which are not located on the Refuge. Saucier (1994) distinguished several terraces, the ones located in this area being: the Deweyville terrace which is broken down into a Lake Monroe Deposit in some places, the Prairie Terrace, and the Intermediate Terrace. The Deweyville/Lake Monroe Terrace have different levels (1,2,3). For example, the lowest terrace is the Lake Monroe 1, then the Lake Monroe 2, which is highest. Intermediate Terrace is higher than the Prairie Terrace which is higher than the Deweyville/Lake Monroe Terrace.

2.4 History of Refuge Lands

The purpose of habitat management is often to restore an area to the historical

conditions that were present before the land was substantially altered by European settlement. Most habitat loss in northern Louisiana occurred within the last 100 years when development, especially in the past 40 years, increased. There are other human effects on the environment that are less conspicuous than development but can result in severe degradation of habitat. For example, alterations to the natural hydrology, such as levees, channelization of rivers, locks and dams, etc, have severe negative effects on bottomland hardwood systems and other wetlands. Fire suppression in a fire-adapted plant community can cause a succession of habitat types that eventually leads to the exclusion of wildlife that depend on the ecosystem for their survival. Lands managed for timber are harvested at an early age. When the forest in not allowed to mature, the ecosystem does not function naturally. Although these factors do not cause the dramatic die-off of animals that can be readily observed, the subsequent gradual downward trend in wildlife reproduction can result in the extirpation of a species from its native range.

In order to define objectives for habitat management on the Refuge, a substantial effort was made to determine the historical condition of Refuge lands and their surrounding areas. Historical literature, aerial photographs, General Land Office surveys, and consultations with botanical ecologists were used during the development of this Plan.

2.4.1 Cultural and Refuge Land History

Between 10,000 BC and 1700 AD, Native Americans inhabited northeastern Louisiana. At least three sites on or adjacent to refuge lands were used as villages or burial grounds. One of these sites, a burial ground, was established during the period of 1500 – 250 BC. By the 1700s, the region around the lower Bayou D'Arbonne was inhabited by the Ouachita Indians, an agricultural people of Caddo cultural-linguistic group. French explorers, hunters, and trappers traveled through the areas. Accompanying one of the early explorers was a Canadian named Jean D'Herbanne. The name of the Bayou is presumably an alteration of the spelling of his name. From 1785-1803 a Spanish military post was established 6.5 miles southeast of the refuge. A small settlement developed around it. Two land grants made during this period included portions of what now is refuge land. After the United States acquired Louisiana, American settlers established farms in the uplands around the lower D'Arbonne throughout the first half of the 19th century. By the late 1800s, steamboats plied the D'Arbonne to transport cotton and other Union Parish farm production to market. In 1883, the construction of a railroad from Monroe to Ruston, Louisiana, began the demise of steamboats on the Bayou D'Arbonne by providing a more economical means of transportation. Congress authorized a minimum 6.5 foot slack-water channel on the Ouachita River through a system of locks and dams in 1902. This was completed in 1925. At this point in history, the first extensive timber harvest just occurred in the lower D'Arbonne bottomlands. In 1955, 1,000 acres of bottomland on the western side of the refuge were cleared and planted in baldcypress, sweetgum and water tupelo. The latter two species did not survive. Congress again altered the hydrology of the refuge and surrounding lands when in 1957, it authorized the construction of the Columbia

Lock and Dam on the Ouachita River, which began in 1964. During the late 1950's the last areas of cultivated upland on the west side of the refuge were abandoned. In 1967, the baldcypress plantation plus 1,000 acres of adjacent bottomland forest were cleared and planted in soybeans. Part of the Bayou Choudrant in the southwestern part of the refuge was channelized to improve drainage to facilitate timber operations. After two or three years of crop failures due to flooding the farming operation was abandoned. On December 31, 1970 Congress passed the River and Harbor Act of 1970. This authorized the purchase of land for National Wildlife Refuges in the area affected by the Ouachita Navigation Channel Project. In 1972, the level of the permanent pool behind the Columbian Lock and Dam was increased to 51 feet above MSL and the lock and dam construction was completed. That same year the Service recommended to the Corps the land to be purchased for D'Arbonne NWR, and in 1975, D'Arbonne NWR was established (Table 2).

2.4.2 Pre-European Settlement Conditions

Bottomlands

Bottomlands in northern Louisiana consist of bottomland hardwood forest, baldcypress/tupelo swamps, sloughs, shrub-scrub wetlands, forested and emergent lakes, ponds, rivers and bayous. Because rivers, bayous and lakes are not generally managed, this section will focus on bottomland hardwood forests. These forests are forested wetlands that are found along rivers and streams. The extent of impact on bottomland forests by Native Americans is disputed. Early explorers, such as DeSoto, reported extensive tracts of forest with cleared fields and villages dispersed unevenly in the Lower Mississippi Alluvial Valley (King *et al.* 2005). Generally the first terrace was cleared for agriculture by natives, but the backswamps were left untouched. Although Native Americans had altered the forest somewhat, many European explorers, such as Bartram and Nuttall, described the area as having vast tracts of pristine, untouched forest.

Bottomland hardwood forest composition is driven by hydrology. Very slight changes in elevation result in different plant communities. Prior to Europeans making drastic alterations to the hydrology of these forests in an effort to drain them, these forests were intact, pristine wildernesses.

Researchers have studied General Land Office surveys in an attempt to characterize bottomland hardwood forests before European settlement. Ouchley *et al.* (2000) found that oaks were not the dominant species during presettlement times on nearby Bayou Cocodrie NWR. Rather, sweetgum made up the largest amount of basal area, was the dominant species, and had the second largest trees, next to baldcypress. In another study, Ouchley *et al.* (1999) synthesized three studies from the early 1900s by U.S. Forest Service employees describing these forests in Louisiana. Two of these early reports were conducted within 60 miles of D'Arbonne NWR where Tensas NWR is located. Results showed that bottomland forests during the early 1900s had 75 to 150 trees per acre. Sweetgum was the dominant species but there was a high tree diversity present including 25 other

species. Sweetgum lived longer (up to 350 years), was larger in diameter and was taller than the oaks present. Ouchley *et al.* (1999) described these old-growth forests in Louisiana as being diverse in species, size and age with 2-3 trees per acre being extremely large. They also found that small gaps created by single trees falling were distributed across the landscape causing a mosaic of different age and size classed trees.

Uplands

Bragg (2003) analyzed General Land Office surveys from 1818-1855 in Ashley Co., Arkansas which is just north of the refuge. He found that pine was often underrepresented in the GLO records by surveyors probably because their large size was not favored as a witness tree. The surveyors often described the forests as open pine with grassy understories that were subject to flooding. Several surveyors descriptions included observations of areas burned over by fire. The pine flatwoods adjacent to the Ouachita River were extensive and the largest pine recorded in the GLO record was a Loblolly Pine with a dbh of 72 inches (Bragg 2003).

Catastrophic events, such as tornadoes, created openings where loblolly pine would come into a disturbed area. If that area burned regularly, then the loblolly overtook the hardwoods or if it burned frequently and intensely, shortleaf pine would overtake the loblolly. The land could stay in this state for a few hundred years, but eventually hardwoods would succeed. Hardwood trees would then remain in the stand until another catastrophe occurred causing disturbance which allowed loblolly to reestablish. If fire was frequent, loblolly would stay dominant and keep reestablishing itself. However lower, wetter areas would not have burned as frequently allowing hardwoods to establish. Therefore, these uplands contained both hardwoods and pine; but, the hardwoods were not regularly distributed but grew in patches where fire had not occurred. These forests were dynamic, changing spatially and temporally across the landscape due to the influence of disturbance, mostly fire (Tom Foti, *pers. comm.,* Ark. Nat. Heritage, USFWS 2004).

The "History of Louisiana" was written by Le Page Du Pratz in the early 1720s and is one of the best references to what Native Americans were doing at that time. He explored the Red, Ouachita, Mississippi, and St. Francis Rivers using Native American guides. He described the Ouachita River just south of the Ouachita Mountains as a vast prairie with trees only along the streams. He states that natives would set the forest on fire in the autumn and that during summer the forest was too rank with grass to travel through. Natives burned the forest into November which is a little later than natural fires, which occurred in September and October.

2.4.3 Current Conditions and Habitat Types

The refuge is situated on the western edge of the Mississippi River Delta. In this region, hydrology plays a very important role in determining the composition and character of floodplain plant communities because each species has a different level

of tolerance to flooding. D'Arbonne NWR is predominately mature bottomland hardwood forest. The typical gradient of forest species relative to flooding in response to elevation is seen in Figures 3, 4 and 6. As one moves from permanent water up and out of the terraces to uplands, it turns from a baldcypress/tupelo, to overcup oak-water hickory, to willow oak, to upland pine-hardwood forest.

The refuge currently consists of 2,121 acres of permanent water, 10,595 acres of bottomland forest, 3,000 acres of upland forest, and 1,480 acres of cleared bottomland (Figure 6).

2.4.3.1 Bottomlands

Unlike the bottomland hardwood forest of the past, the refuge's bottoms have been altered severely by man. As described in the refuge history, past owners harvested timber on the refuge regularly and extensively. Most timber operations that occurred would be considered high-grading today. In many cases, the forest was clearcut, leaving no virgin timber on the refuge.

Another dramatic effect on the refuge's bottomland hardwoods was the construction of the Columbia Lock & Dam on the Ouachita River. This increased the level of Bayou D'Arbonne by seven feet. The dam also causes backwater flooding more frequently and for longer periods during the growing season. Willow oaks have been declining on the refuge since the late 1980s. The Stoneville Research Unit of the U.S. Forest Service began studying the willow oak die-off on the refuge in 1997. They believe that hydrology and poor soils are causing the die-off. Since 1992, the refuge has heavily thinned these areas to accelerate the advancement of hardwood regeneration to replace the dying trees.

The hydrology of the area suppresses understory growth and the forest is often inundated during the growing season. Closed canopy conditions also contribute to the lack of growth in the understory. Budget and staff constraints have also caused timber cutting rotations to fall behind; thus, creating many acres of bottoms needing sunlight to reach the ground. Vertical diversity within a bottomland hardwood forest is critical for providing wildlife cover and food. The term vertical diversity refers to the structure of the forest, indicating that plants are present at all vertical levels, including ground level, understory, mid-story and canopy. A thick understory provides deer browse and cover, nesting substrate for songbirds, cover for young fish during spring flooding, and thermal cover for wintering waterfowl. Woodcock and Swainson's warbler also prefer thick understories with limited ground cover.

Bottomland hardwoods account for the majority of refuge land cover and can be classified into four primary habitat types: 1) Baldcypress-Water Tupelo; 2) Overcup Oak-Water Hickory; 3) Sweetgum-Willow Oak; and 4) Swamp Chestnut Oak-Cherrybark Oak (Figure 6). An additional habitat type in the bottoms on the refuge is the Open Field/Beanfield area, which had been cleared of bottomland hardwood forest prior to refuge establishment.

Baldcypress-Water Tupelo

Baldcypress and water tupelo together make up the majority of stocking in this forest type, which occurs in swamps, deep sloughs, and very low, poorly drained flats. The sites are always very wet, and surface water stands well into or throughout the growing season. Soils are generally mucks, clays, or fine sand. Common trees associated with this type are black willow, water locust, overcup oak, green ash, and persimmon. Among the shrub species are swamp privet, buttonbush, and planertree. Woody vines include red vine. A variety of herbaceous plants will be commonly seen and take the form of flotants, emergents, and submergents. Frequently, a variety of mosses and lichens adorn the exposed tree trunks, and the crowns may be draped with Spanish moss.

Overcup Oak- Water Hickory

This type usually occurs in low, poorly drained flats and sloughs with tight clay or silty clay soils. These sites are the lowest within the first bottoms and are subject to late spring inundations. Overcup oak and water hickory together constitute the majority. Associates include willow oak, Nuttall oak, cedar elm, green ash, and water locust. Minor associates include black willow, persimmon, and sweetgum. Common shrub species include swamp privet, hawthorn, buttonbush, planertree, and possumhaw. Woody vine species often associated include redvine, peppervine, trumpet-creeper, dewberry, and possibly greenbrier. Panicums, asters, annual grasses, and cocklebur may occur in openings within the stand.

Sweetgum-Willow Oak

The low ridges in the broad slackwater areas of the first bottom are typically occupied by this forest type. Willow oak and sweetgum comprise the largest proportion of the stocking in stands of this type. There are extensive areas of this type on the poorly drained willow oak flats on the refuge. These stands are strongly dominated by willow oak because of the heavy clay soils. Sweetgum often forms only a minor proportion of the stocking. A major associate on higher clay ridges and flats is nuttall oak, which may represent 30 - 50 percent of the composition. Other trees associated with this forest type are sugarberry, green ash, overcup oak, water oak, water hickory, cedar elm, persimmon, and sometimes baldcypress. Common shrubs include swamp privet, American snowbell, possumhaw, hawthorn, and dull-leaf indigo. Woody vines occasionally present are greenbrier, peppervine, and redvine.

Moist Soil

Prior to refuge acquisition, 1,026 acres of bottomland hardwoods were cleared for agriculture. This area is composed of three units: 1) 374-acre moist-soil impoundment with some water control; 2) 420 acres of moist soil habitat with no water control; and 3) 240 acres that are young bottomland hardwood forest. The entire area provides a short window of exceptional waterfowl habitat and then flooding occurs making it too deep for waterfowl

foraging. The moist-soil impoundment is at 55 feet above MSL and is flooded naturally from rainwater and when Bayou D'Arbonne overflows its banks. Three structures are in place to draw water off during the spring after the bayou is at pool stage. Water can be pumped from permanent water south of the impoundment. The moist soil areas are mowed every 3 years to maintain vigorous herbaceous habitat for waterfowl foraging. The areas of young forest have had mowing discontinued to allow woody vegetation to establish. Species in this area consists of persimmon, willow oak, overcup oak, buttonbush, and baldcypress.

2.4.3.2 Pine-Hardwood Uplands

The upland forest on the refuge currently is composed loblolly pine flatwoods and upland hardwoods. Habitat types range from almost pure pine stands to almost pure hardwood stands and everything in between.

The west side of the refuge contains 800 acres of upland hardwood forest. In the early 2000s, the Service removed a large percentage of the pine trees on the western side to favor upland hardwood species. Many of the pine trees removed were slash pine, a species not native to northern Louisiana. This area currently has a great deal of hardwood regeneration that is five to six years old.

The eastern side of the refuge is comprised of approximately 1,200 acres of upland forest consisting of almost pure hardwood stands and pure pine and every combination thereof. Most of these uplands are a mix of loblolly pine and hardwoods, with a small percentage of shortleaf pine on the north end of the refuge. Areas that have been heavily managed for red-cockaded woodpeckers in the past have little hardwoods present. The burning program during the past decade has increased the herbaceous, grassy understory in some areas and has limited hardwood understory and mid-story.

Portions of the refuge that consist mostly of upland hardwoods are few. Upland hardwood forests are rare today and greatly diminished from their historic distribution in north Louisiana. Unfortunately little attention seems to be given to their decline (mostly due to the focus on bottomland hardwood forested wetlands) even though upland hardwood forests in Louisiana are threatened (Lester *et al.* 2005). Conversion of hardwood forest into pine plantations by commercial timber companies is the number one threat (Lester *et al.* 2005). For these reasons upland hardwood forest will be retained and promoted as much as possible on D'Arbonne NWR.

Loblolly Pine

Loblolly pine forest type can be found on almost all soil types above 70 feet in elevation in the general locale of the refuge. It is found mostly on sites with abundant soil moisture, which also promotes the development of rich undergrowth. This forest type is dominated by loblolly pine as the overstory with sweetgum associated, as well as shortleaf pine, southern red oak, and post oak. On moderately

to poorly drained sites, common associates include red maple, blackgum, and water oak. Midstory trees include flowering dogwood, American holly, black cherry, hawthorn, eastern hophornbeam, sassafras, and red mulberry. Common woody vines include Carolina jessamine, Alabama supplejack, greenbrier, grape, Japanese honeysuckle, and blackberry. Among the shrubs associated with this type are American beautyberry and *Viburnum spp.*

Loblolly Pine/Hardwood

Hardwoods are predominant in this type with loblolly pine making up at least 20 percent of the stocking. On wet sites, loblolly pine is associated with sweetbay, blackgum, sweetgum, water oak, willow oak, red maple, and American elm. Species associated on drier sites are southern red oak, white oak, post oak, hickory, shortleaf pine, and persimmon. Generally, many of the same shrub, vine, and herb species found with the loblolly pine type are also common associates in stands of the loblolly pine/hardwood type.

Loblolly-Shortleaf Pine

Loblolly pine and shortleaf pine together comprise a majority of the stocking. This type is usually found on sites higher and drier than those where loblolly pine alone prevails, because shortleaf pine does not tolerate very wet soils and loblolly pine is less thrifty on dry, thin soil. Common overstory associates are sweetgum, blackgum, southern red oak, post oak, white oak, and mockernut hickory. Tree species in the midstory include flowering dogwood, persimmon, eastern redcedar, and hawthorn. Shrub species commonly associated with this type are American beautyberry, red buckeye, rusty blackhaw, and sumac. Among the common species of woody vines are greenbrier, Carolina jessamine, blackberry, Japanese honeysuckle, and poison ivy.

Swamp Chestnut Oak- Cherrybark Oak

This forest type occurs on the best, most mature, fine sandy loam soils on the highest of the first bottom ridges and hammocks, and on the second bottoms or terraces down from the ridges. Species composition of this habitat type varies widely, though cherrybark oak will most likely be much more common than swamp chestnut oak. Many other species contribute to a well-stocked stand: white oak, post oak, sweetgum, blackgum, hickory, willow oak, water oak, southern red oak, winged elm, sassafras, delta post oak, slippery elm, shumard oak, black oak, black cherry, white ash, green ash, red maple, and loblolly and shortleaf pines. Common midstory plants include: eastern redbud, flowering dogwood, American holly, red mulberry, American hornbeam, eastern hophornbeam, and witch-hazel. Shrub species usually include red buckeye, devil's walkingstick, sweetleaf, and *Virburnum spp.* Often included in this habitat type are grape vines, Alabama supplejack, Carolina jessamine, trumpet creeper, and greenbrier.

Invasives

Until recently, invasive plants have not been a large problem on the refuge. As a routine part of general forest management, foresters eliminated scattered clumps of Chinese privet, mimosa, tree-of-heaven, etc. Two species that have moved northward into this area and are of primary concern are Chinese tallow (*Sapium sebiferum*) and Japanese climbing fern (*Lygodium japonicum*). Japanese climbing fern is well established on the refuge and may be beyond the point of control, much less eradication. This invasive fern can increase in cover to form mats, smothering shrubs and trees (Miller 2003). The second problem species, Chinese tallow tree, is increasing exponentially and is an imminent threat to wetland and upland habitats. This species causes large-scale ecosystem disruption by replacing native vegetation, which reduces native species diversity, which in turn has a negative impact on wildlife. Tallow can quickly become the dominant plant in disturbed areas and invade bottomland forests, such that it earned a spot on the "America's Least Wanted-The Dirty Dozen" list of The Nature Conservancy (Flack and Furlow 1996). Other invasive plants that have been found on the refuge include princess tree and chinaberry.

2.4.4 Habitat Changes from Historic to Current Conditions

Prior to the acquisition of the land by the Corps, the land was held by 55 different landowners. More than 80 percent of the refuge was owned or controlled by four corporations which managed the land for timber production. Many landowners probably used what is called a "selective" cutting method which is essentially exploitation cutting or high grading. The market condition was the main controlling factor that dictated how the timber was cut.

At the time of acquisition, T.L. James and Company, Inc. had a surface lease from D'Arbonne Company for 10,615 acres of predominantly bottomland hardwood forest land on what is now the refuge. This represented almost 61 percent of the total refuge area. T.L. James assumed control of the land in 1953 from the D'Arbonne Company which owned the land back to 1923. There were other owners of this land all the way back to 1901, including several forest-product companies. Prior to 1953, a local sawmill owner leased the property for almost 15 years and cut timber as it was needed and when ground conditions would allow. When the sawmill owner realized that his lease on the property was about to expire, he cut most of the merchantable timber remaining. He left some large trees in the sloughs and brakes because wet ground conditions prevented his access. The timber in these areas was cut later by T.L. James. During the period from the early 1900s to the late 1960s, there was no market for hardwood pulpwood, and for this reason, when hardwood stands were cut, only sawlogs were removed. Scarcely any but cull and low-grade hardwood sawtimber and pulpwood-sized trees were left standing following such operations.

When the management of T.L. James deduced that its land was to be part of the refuge, they proceeded to cut all the merchantable timber that could be harvested. The last period of cutting for this company was from 1968 to 1970. Volumes as high as 50 cords per acre were harvested during clearcutting operations, with the average age of the trees being about 35.

Olinkraft Incorporated had owned 2,643 acres of pine and bottomland forest, representing about 15 percent of the refuge. Olinkraft acquired this land around 1955 in a merger with Frost Lumber Industries which had owned the land back to about 1900. Olinkraft managed the land using what was said to have been a selection system which created uneven-aged conditions in both the pine and the bottomland hardwood stands. However, this method was probably not a true selection system since there was no market for hardwood pulpwood. Olinkraft relied strictly on natural regeneration to reforest the cut areas. Cutting in the hardwood stands was sporadic because the hardwood market was not dependable.

During the acquisition process the Service and Olinkraft came to an agreement on how much of the remaining timber could be harvested from the land. Olinkraft had already clearcut at least 250 acres before the accord was reached. According to the terms of the agreement, pine sawtimber was to be marked so that 50 percent of the volume could be harvested; no trees below 14 inches in diameter at breast height could be cut; one third of the stems would be taken from pine pulpwood stands, leaving the better quality trees; all hardwood trees would be left.

The Pennzoil Producing Company owned 545 acres of pine and bottomland hardwood forest, representing 3 percent of the refuge. This land was acquired by Pennzoil in the late 1930s. Most of the land supported only marginal stands because the timber had been partially cut in the early 1930s. Pennzoil cut the remaining pine and hardwood timber in the late 1940s and early 1950s. At that time the hardwood sawtimber sold for about $20 per thousand board feet. After tha period of cutting, no more timber was harvested from this land until the Service owned it. Plantations were established along Holland's Bluff Rd in 1949, 1950, and 1957. Both loblolly and slash pine seedlings were planted; however, the overall performance of the slash pine was poor because of a high incidence of fufiform rust (*Cronartium quercuum* [Berk.]). Furthermore, slash pine is not native to this area. Pennzoil also experimented with prescribed fire in the pine stands.

Prior to the time the aforementioned corporations were entitled the land, much of it was either leased or owned by other forest-product companies back to and possibly before 1900. Historical information on the area which is now the refuge before this time is not readily available. However, it is generally known that the early 1800s was a period of settlement by pioneers, and the latter part of the century was a period of reconstruction and industrial development. Steer (1948) indicated that Louisiana's lumber production went from the lowest in the South in 1869 to the greatest in the nation in 1914. It is evident that the forest resources of Louisiana were much exploited during this area. Sawmills would spring up where timber was in great abundance, then move on after the timber had been exhausted from an area. It was this period of exploitation which led to the cutting of the last virgin timber on the refuge between 1912 and 1925.

Since refuge establishment, the Service has modified its management objectives in the upland pines several times. During the 1980s, management chemically treated

and girdled large expanses of upland hardwood trees for the purpose of enhancing endangered red-cockaded woodpecker (RCW) habitat. In an attempt to follow to the letter the RCW management guidelines at that time, the Service attempted to convert the upland pine-hardwood forest into a pure pine forest. They were unsuccessful in some places and successful in others. The result is a mix of upland habitat types ranging from pure pine to pure hardwoods and everything in between. In the past, the refuge conducted prescribed burns in the upland forests to benefit red-cockaded woodpeckers. Until the 2000s, most of these burns were dormant season burns and really only accomplished stump sprouting hardwood species. Due to the recommendations of the RCW Recovery Plan that growing season fires benefit RCWs more than dormant (USFWS 2004), the refuge started burning during the early growing season in the past several years. A more herbaceous understory has developed in some upland pine stands as a result of the change in burning seasons.

Since the acquisition of the refuge by the Service, no farming has been conducted. The 1,000 acres which was cleared from bottomland hardwood forest and planted in soybeans has been dubbed the "beanfield". It presently is comprised of moist soil plants and regeneration areas of bottomland hardwoods.

The surrounding landscape is of course changed within northern Louisiana. Development and population spread from West Monroe south of the refuge has caused habitat conversion from forests to residential neighborhoods and businesses. Another recent trend is conversion of bottomland hardwood forest to pine plantation. Timber companies accomplish this by raising the site slightly with machinery which alters the hydrology of the area forever. However, the refuge itself is more forested now than before it was purchased by the Service. Off-site slash pine has been cut to allow loblolly pine and upland hardwoods to grow instead. The installation of the Columbia Lock & Dam on the Ouachita River in the 1970s has changed the flooding regime substantially. Flooding occurs later into the growing season, for longer duration and greater depth. It is thought this change in hydrology is the cause of willow oak die-off in the refuge bottomlands. The Service has extensively cut the dying willow oak to release regeneration with the hopes that the young oaks will be more tolerant to the new flood regime. If not, the sites will naturally evolve into an overcup oak/water hickory forest.

As mentioned earlier, invasive plant species are present on the refuge, especially in the upland communities, that would not have been present or as well established in the past.

In the future, the effects of global climate change will gradually increase at D'Arbonne NWR over the next 100 years. Within the 15 year time-frame of this plan, smaller impacts may be seen. According to the report "Global Climate Change Impacts in the United States" (2009), it is expected there will be higher temperatures, less rainfall, particularly in winter and spring, increased storm intensity and frequency, and more drought throughout the Southeast. It is anticipated that temperatures will increase by at least 4.5°F by 2080 and fire

severity will increase 10 to 30 percent within the next 50 years. Within the next 15 years, increasing impacts of higher temperatures will likely cause the spread of invasive species and small changes to native plant and animal distributions. Migratory birds will probably breed and winter a little further north. More southern, tropical species, (i.e. black-bellied whistling ducks, wood storks, etc.) will extend their ranges into Louisiana. Invasive species such as *Salivinia*, water hyacinth, tallowtree, etc. will become more established and extend their ranges further north. The source of these impacts are difficult to isolate as caused either in part or in fully by global climate change, but are anticipated nevertheless. This plan addresses these short-term anticipated impacts of invasive species and community shifts through habitat management objectives. Impacts including increased drought, fire severity, and storm intensity cannot be influenced by the scope of this plan.

Table 2. Historical timeline of D'Arbonne National Wildlife Refuge establishment

Before 10,000 BC-1700 AD Native Americans inhabited northeastern Louisiana. At least three sites on or adjacent to refuge land were used as villages or burial grounds. One of these sites, a burial ground, was established during the period 1500-250 BC.	*Late 1950s* The last areas of cultivated upland on the west side of the refuge were abandoned.
1700-1785 The region around lower Bayou D'Arbonne was inhabited by the Ouachita Indians, an agricultural people of the Caddo cultural-linguistic group. French explorers, hunters, and trappers traveled the area. One of the early explorers was a Canadian named Jean D'Herbanne. The name of the Bayou is presumably an alteration of his name.	*1964* Construction began on the Columbia Lock and Dam.
1785-1803 A Spanish military post was established 6.5 miles southeast of the refuge. A small settlement developed and two land grants during this period included part of what is now refuge.	*1966-1967* The baldcypress plantation plus 1,000 acres of bottomland forests were cleared and planted in soybeans. After 2-3 years of crop failures due to flooding, farming was abandoned.
1803-mid-1800s The United States acquired Louisiana. American settlers established farms in the upland areas near Bayou D'Arbonne	*1967* Part of the Bayou Choudrant in the southwestern part of the refuge was channelized to improve drainage. This was done to facilitate timber operations.
Mid-late 1800s Steamboats ran Bayou D'Arbonne to transport cotton and Union Parish farm products to market.	*December 31, 1970* Congress passed the Rivers and Harbors Act. This authorized the purchase of land for national wildlife refuges in the area affected by the Ouachita Navigation Channel Project.
1883 The construction of a railroad from Monroe to Ruston, Louisiana, began the demise of steamboats on Bayou D'Arbonne.	*April 5, 1972* Following a field investigation, the Fish and Wildlife Service recommended to the Corp of Engineers the land to be purchased for D'Arbonne Refuge.
1902 Congress authorized a minimum 6.5-foot slack-water channel on the Ouachita River through a system of locks and dams.	*June 1972* The level of the permanent pool behind the Columbia Lock and Dam was increased to 51 feet above MSL by the Corps.
1912-1925 The first extensive timber harvest occurred in the D'Arbonne bottomlands, which would include the majority of bottomland habitat of the refuge today.	September 6, 1972 A public meeting was held in West Monroe concerning acquisition of lands for the refuge. The attitude of those present was mixed, but strong opposition was not evident.
1925 The system of locks and dams providing a 6.5-foot slack-water channel on the Ouachita River was completed.	*November 20, 1972* The Columbia Lock and Dam were completed.
1950 Congress authorized construction necessary to increase the depth of the Ouachita Navigation Channel to nine feet.	*May 19, 1975* D'Arbonne Refuge was established under an Interim Management Permit with the Department of the Army.
1954-1955 Approximately 1,000 acres of bottomland on the west side of the refuge were cleared and planted in baldcypress, sweetgum, and water tupelo, of which the latter two did not survive.	July, 1975 The level of the permanent pool behind the Columbia Lock and Dam was increased to 52 feet above MSL.
1957 The Columbia Lock and Dam were authorized by Congress as a result of a study of the Ouachita Navigation Channel Project.	December 31, 1981 The Service received fee title to D'Arbonne Refuge from the Corps of Engineers.

2.5 Maps

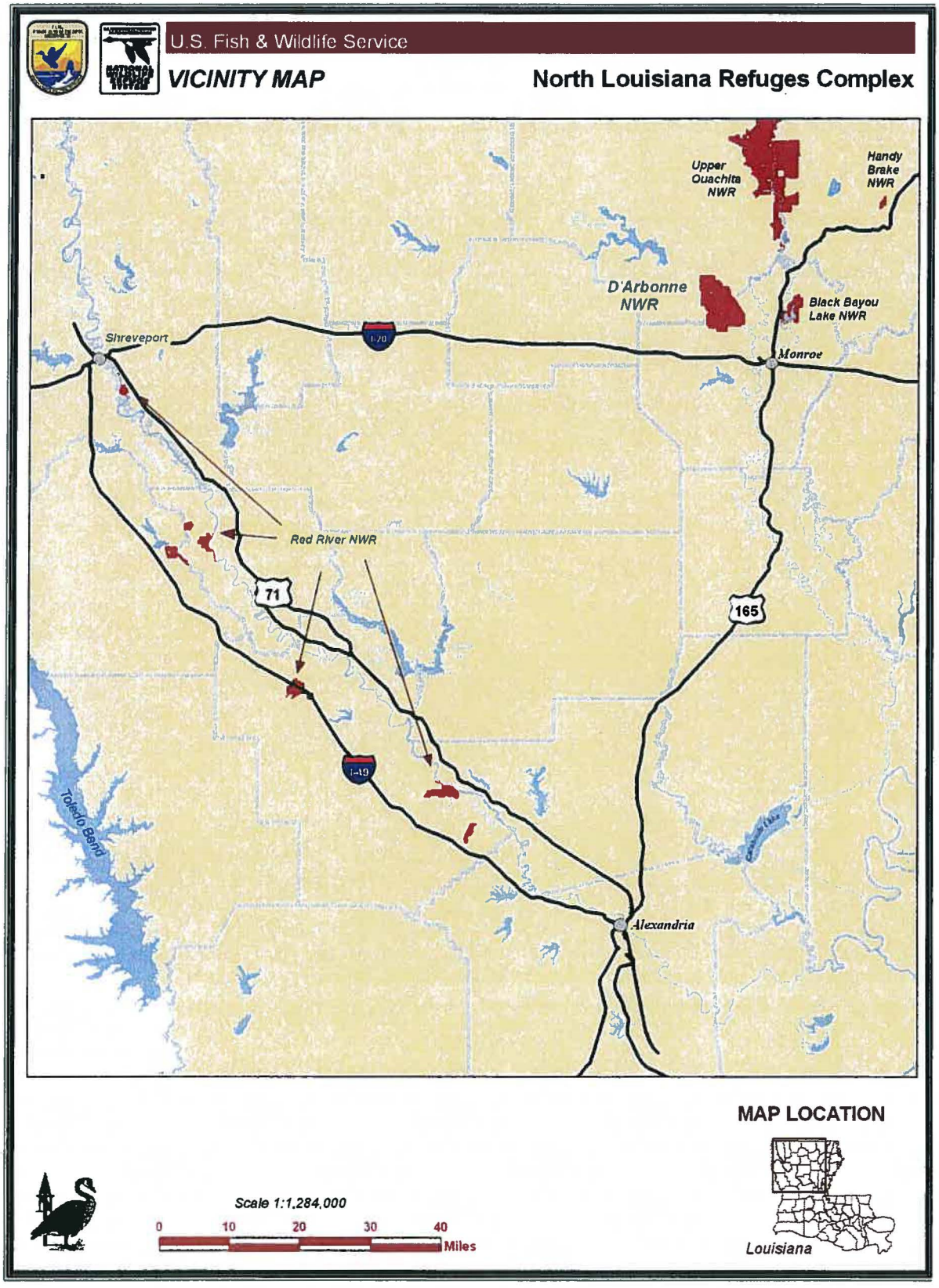

Figure 1. North Louisiana Refuges Complex.

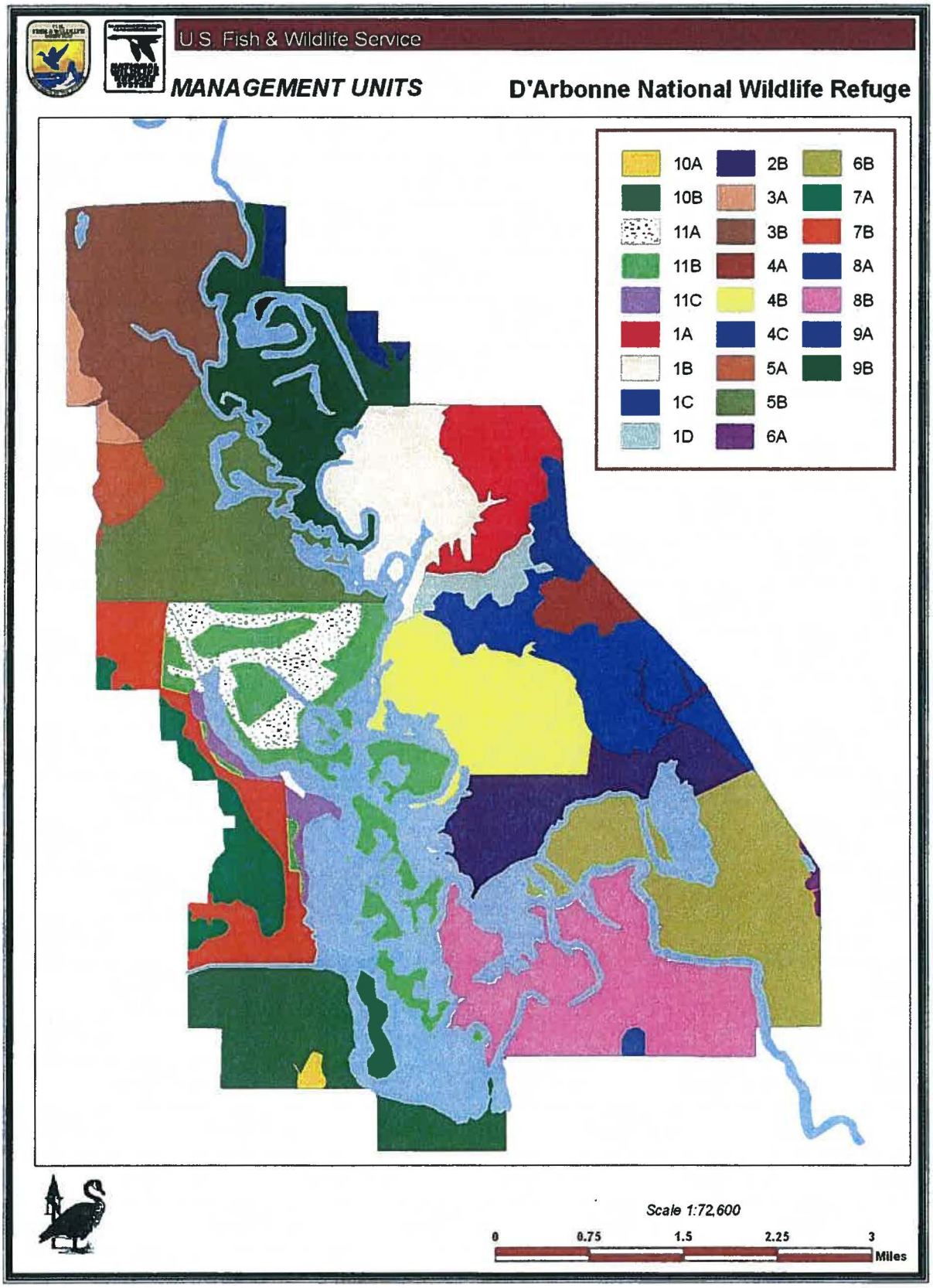

Figure 2. Twenty-five management units of D'Arbonne NWR.

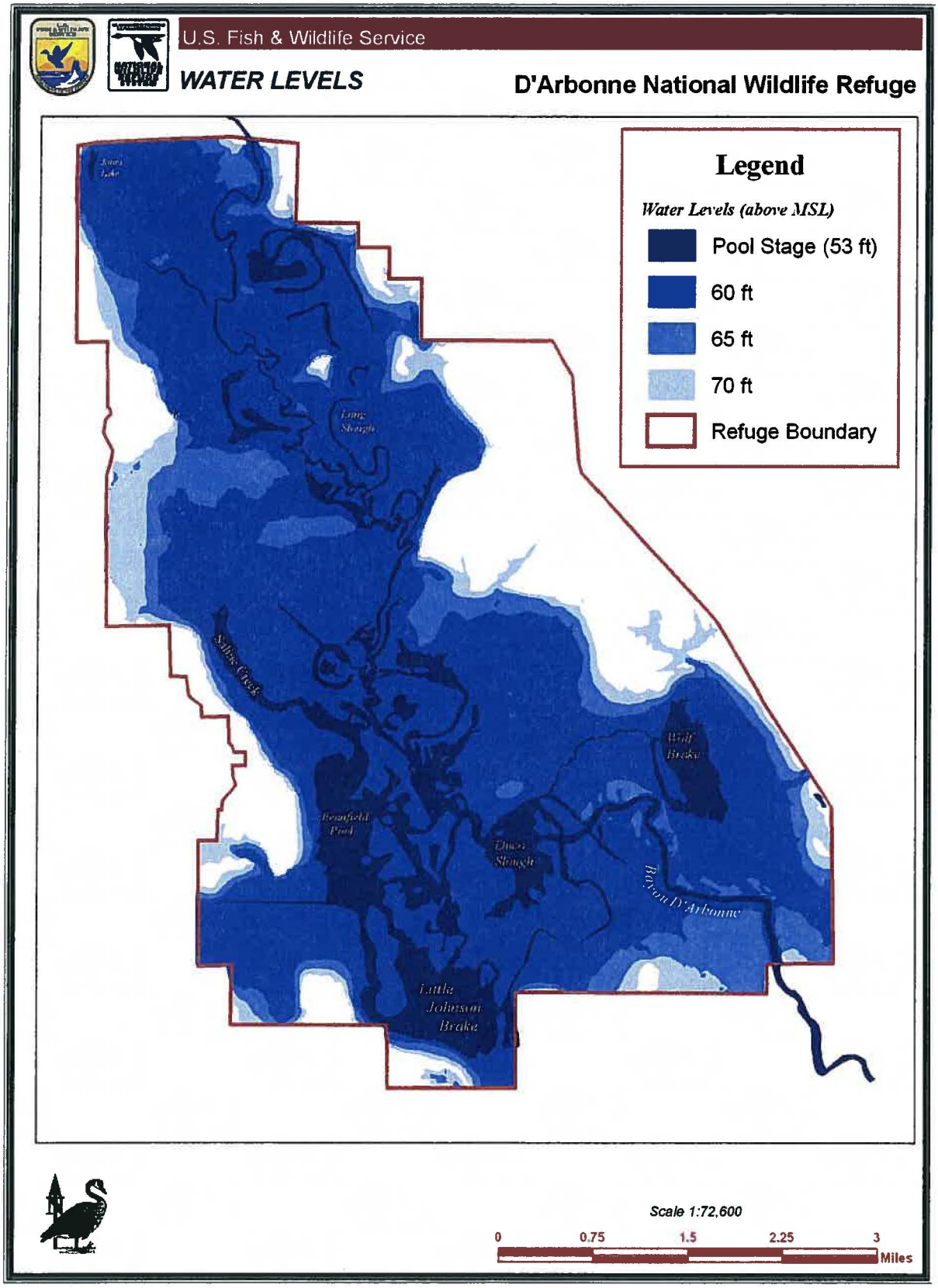

Figure 3. Extent of flooding at different water levels on D'Arbonne NWR.

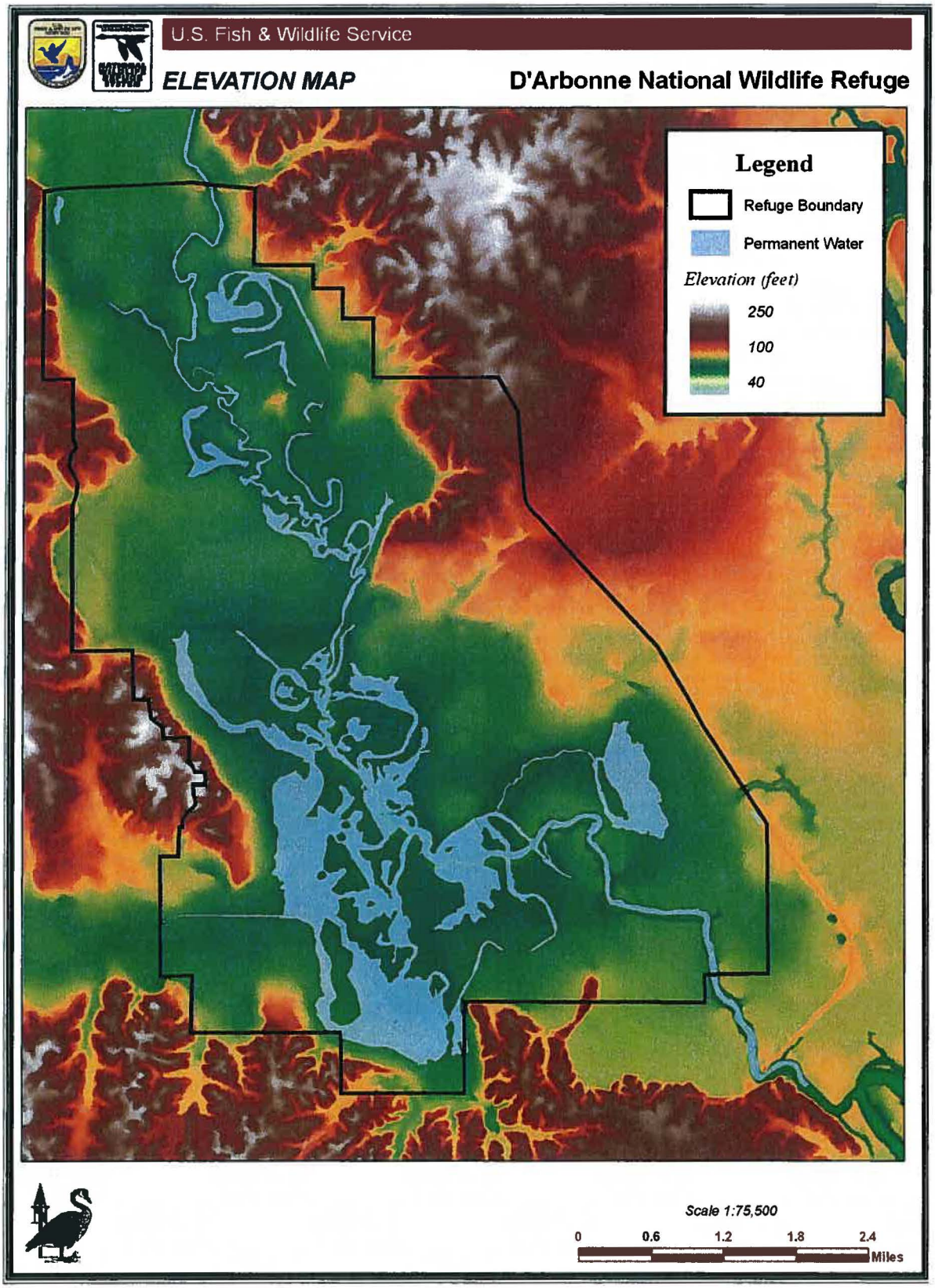

Figure 4. Elevation levels at D'Arbonne NWR.

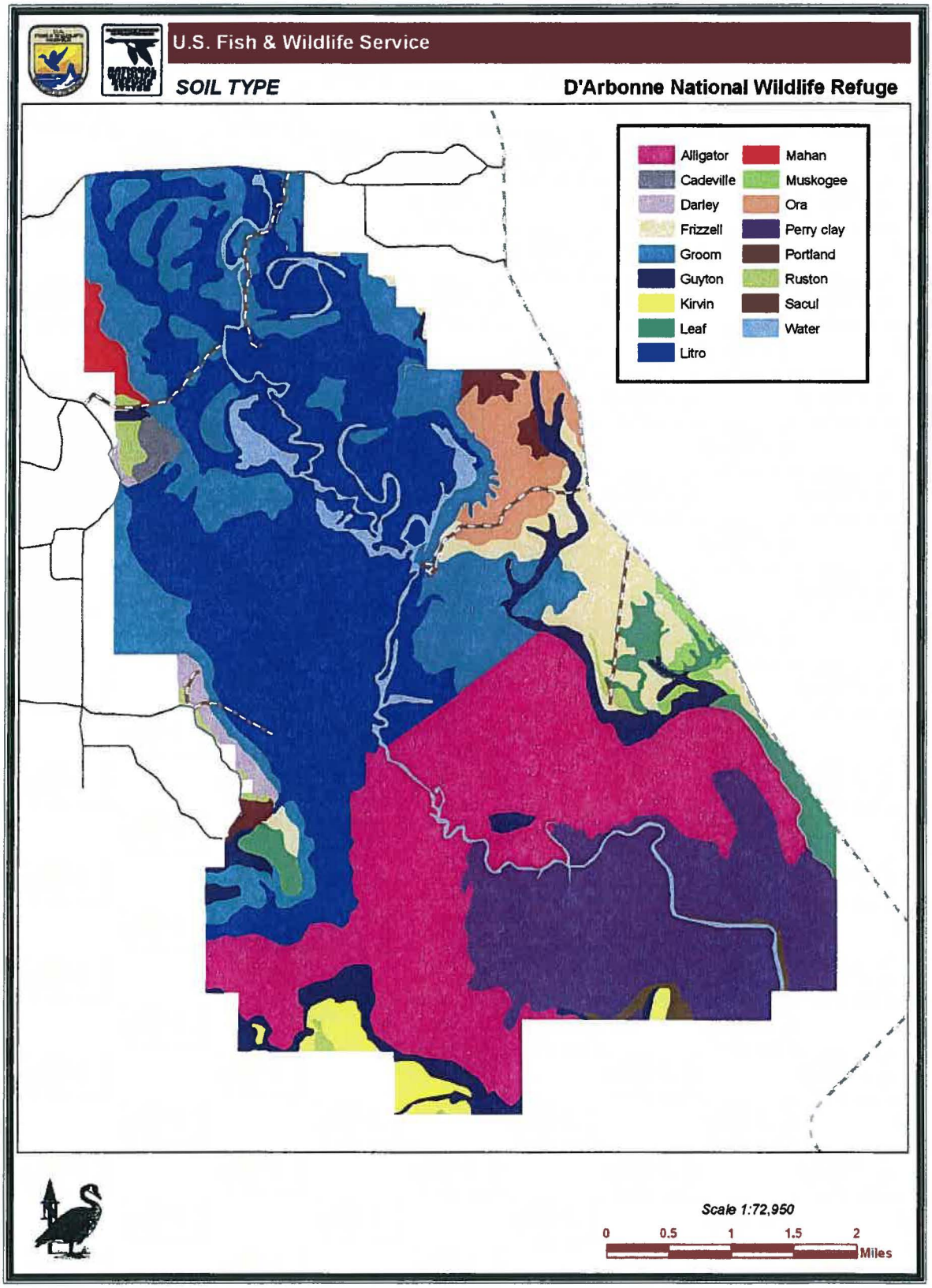

Figure 5. Soil types present on D'Arbonne NWR.

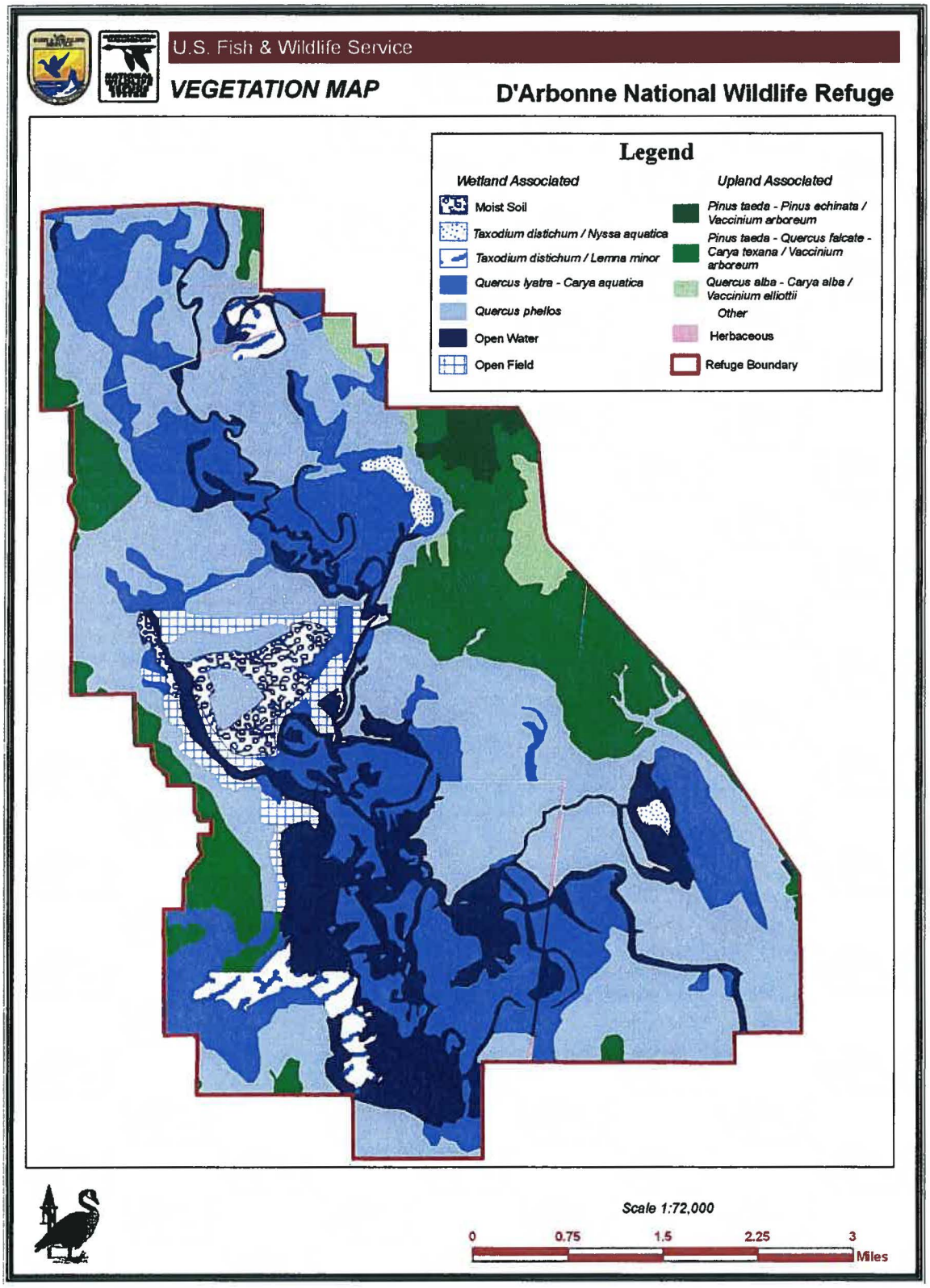

Figure 6. Vegetation types on D'Arbonne NWR.

3.0 RESOURCES OF CONCERN

3.1 Identification of Refuge Resources of Concern

Priorities associated with wildlife and habitat management for the NWRS are determined through directives, policies, and legal mandates. Resources of concern include species, species groups, and/or communities that support refuge purposes as well as FWS trust resource responsibilities (including threatened and endangered species and migratory birds). Resources of concern are also native species and natural, functional communities such as those found under historic conditions that are to be maintained and, where appropriate, restored on a refuge (601 FW 3.10B[1]).

Resources of concern for D'Arbonne NWR were selected after taking into account the conservation needs identified within international, national, regional, or ecosystem goals/plans; state fish and wildlife conservation plans; recovery plans for threatened and endangered species; and previously approved refuge resource management plans as identified in the Comprehensive Conservation Planning Process policy [602 FW 3.4C[1][e]) as well as Section 1.3 of this HMP. The specie/communities selected as resources of concern from these plans support the following NWRS mandates:

- Support refuge purposes and the NWRS mission;
- conserve biological integrity, diversity, and environmental health (giving special consideration to rare, declining or unique natural communities, species, and ecological processes within the refuge boundary and the West Gulf Coastal Plain); and
- fulfill FWS trust resource responsibilities (see Section 1.2)

Resources of concern identified for D'Arbonne NWR include:

- Wintering waterfowl and breeding wood ducks
- Forest interior songbirds
- Rafinesque's big-eared and southeastern bats
- Upland hardwood forest
- Red-cockaded woodpeckers

3.1.1 Wintering Waterfowl

D'Arbonne NWR is located in the Mississippi Flyway, which is a critical ecoregion for migrating and wintering dabbling ducks, wood ducks, and geese in North America (Reinecke et al. 1989), as well as southern breeding populations of wood ducks. Until step-down objectives for the WGCP become established, D'Arbonne NWR was given the MAV step-down objective of 536 acres of moist soil by the LMVJV (USFWS 2004). The refuge attracts tens of thousands of mallards, teal, gadwall and wood ducks during the winter. Waterfowl utilize not only the moist soil habitat but also the bottomland hardwood forest on the refuge. Davis *et al.* (2008) found that female mallards spent the majority of their time in bottomland

hardwood forest, much more so than in moist soil habitat, on nearby Upper Ouachita NWR, underscoring the importance of these forests to wintering waterfowl.

3.1.2 Breeding Wood Ducks

Wood ducks are year round residents in the forest lands of the United States, including D'Arbonne NWR. Although wood duck numbers declined to drastically low numbers in the early 20th century due to market hunting, liberal hunting seasons, and habitat loss, today wood duck populations appear stable (Dugger and Fredrickson 2001). However, our grasp on the population status of this species is shaky. Population estimates are inaccurate due to aerial surveys being ineffective in forested habitats. Wood ducks rank high among species harvested in the Mississippi flyway and are popular with hunters, especially when other waterfowl species are not present in large numbers (Dugger and Fredrickson 2001).

Because wood ducks depend upon forested wetlands for breeding and wintering habitat (Dugger and Fredrickson 2001), D'Arbonne NWR has the opportunity to provide excellent habitat for breeding wood ducks. The Wildlife and Habitat Review (USFWS 2004) for D'Arbonne NWR suggests wood ducks are an important resource of the refuge.

3.1.3 Forest Interior Songbirds of Bottomland Hardwoods

Due to the loss of approximately 80% of the bottomland hardwoods in the Lower Mississippi River Alluvial Valley (Tiner 1984), D'Arbonne NWR can play an important role in providing bottomland hardwood habitat for forest interior songbirds. Over 10,000 acres of such habitat in a largely forested landscape are available on the refuge. The LMVJV (2007) considers forest interior songbirds that utilize bottomland hardwood forests a priority resource, particularly Kentucky, Swainson's and cerulean warblers. Priority Partners in Flight species in the WGCP are listed in Section 1.4.

3.1.4 Rafinesque's Big-eared Bat and Southeastern Bat

Bottomland hardwood systems seem to be important to Rafinesque's big-eared bat (Clark 1990; Clark *et al.* 1998; Cochran 1999) and southeastern bats (Cochran 1999; Hoffman 1999) as both roosting and foraging habitat. Due to the loss of approximately 80% of the bottomland hardwoods in the Lower Mississippi River Alluvial Valley (Tiner 1984), both bat species have probably been negatively affected. Declines in numbers of southeastern bats (Harvey *et al.*,1999) might be due to the loss of bottomland hardwood forests, and Rafinesque's big-eared bats populations might be declining in Arkansas (Cochran 1999). Both species are designated federal species of concern (Martin *et al.* 2002) and southeastern bats are a state species of concern (Lester *et al.* 2005).

Again, the opportunity exists for D'Arbonne NWR with its extensive bottomland hardwood forest to provide important habitat for these two species of bats. Furthermore, known roost locations have been found on the refuge for both species (Gooding and Langford 2004).

3.1.5 Upland Hardwood Forest

Upland hardwood forests in Louisiana are a threatened community, given an S3/S4 rank (Lester *et al.* 2005). The primary threat to these forests is conversion to pine plantation. Little focus has been given to this declining community due to it not being a wetland habitat in an area where wetlands are given primary attention. Timber companies and private landowners have been stripping away upland hardwoods in favor of the more profitable loblolly pine. Pine monocultures lack the species and structural diversity of an upland hardwood forest.

D'Arbonne NWR still has small remnants of intact mature upland hardwood forest. The refuge has the opportunity to provide this declining habitat type that may in the future be gone.

3.1.6 Red-cockaded Woodpecker

Red-cockaded woodpeckers, a federally endangered species, are found on the east side of the refuge in small numbers. They were chosen as a resource of concern because of their conservation status and they are a trust species. Currently, there are three active groups on the refuge. The RCW Recovery Plan has a goal of five groups listed for D'Arbonne NWR (USFWS 2003). Five clusters are and have always been managed for RCW habitat on the refuge. Over the past 10 years, the number of active family groups has fluctuated from one to four.

3.2 Habitat Requirements of Resources of Concern

3.2.1 Wintering Waterfowl

North American waterfowl have seasonally dynamic life-cycle needs that are fulfilled by use of a diversity of habitats and foods throughout their annual range, which, for most species, is continental in scale in contrast to resident wildlife. Indeed, habitat (*both* its quantity and quality) is the primary template for ecological strategies of waterfowl (and all wildlife) and a critical determinant of their survival and productivity. Hence, sustaining viable and harvestable populations of waterfowl depends on conservation and management of habitats throughout the Flyways of North America. Concerning wintering habitat, dabbling ducks need a diversity of wetlands including the following: (1) flooded crop land, (2) natural wetlands, and (3) refuge (i.e., sanctuary) (Reinecke *et al.* 1989).

Two natural wetland habitats that ducks have used historically in the Mississippi Delta are bottomland hardwood forests and moist-soil habitats (i.e., early successional grass-sedge and other herbaceous vegetated wetlands). These natural

wetlands are critical foraging and resting habitats. Both hardwood bottomlands and moist-soil habitats are rich in high-energy natural seeds (e.g., acorns in oak bottomlands; grass-sedge seeds, roots, tubers, etc. in moist-soil areas) and aquatic invertebrates (Kaminski *et al.* 2003, Heitmeyer 1988, 2006). Indeed, wintering waterfowl satisfied their nutritional and other physiological needs in these wetlands before large-scale conversion of the MAV to agriculture.

Several species of waterfowl heavily utilize flooded forested habitat in winter for resting and foraging for acorns, other fruits, various seeds, and invertebrates. Wood ducks seek these habitats almost exclusive of other habitats. Mallards, gadwall, and wigeon all utilize flooded forested habitat as one of the complex of preferred habitats (Fredrickson and Heitmeyer 1988). These areas are vital to waterfowl for pair bonding, loafing, sanctuary, thermal cover and feeding (Reinecke *et al.* 1989). Ducks like openings in the woods to allow them easy access. Small groups of trees (3-5) that dominate canopy coverage can be removed to provide the openings that ducks prefer for landing (USFWS 2004).

The high seed production of moist-soil plants and their value as waterfowl foods have been known since at least the 1940s (Low and Bellrose 1944). However, managing seasonally flooded herbaceous wetland impoundments or "moist-soil units" only became a widely accepted practice after many years of research in southeastern Missouri (Fredrickson and Taylor 1982, Fredrickson 1996). Today, more than 20,000 acres of moist-soil habitat are managed in more than 300 impoundments on state and federal lands in the LMV (LMVJV Water Management Tracking System).

Although geese sometimes use moist-soil impoundments and eat shoots of germinating plants, rhizomes, roots, or tubers, the primary emphasis of moist-soil management is to produce seeds that will provide food for ducks. Most research has focused on estimating seed production and studies have shown that, under intensive management, species of barnyard grass (*Echinochloa* spp.), sprangletop (*Leptochloa* spp.), flatsedge (*Cyperus* spp.), smartweed (*Polygonum* spp.) and panicum (*Panicum* spp.) can produce more than a 1,000 lbs/ac of seed (Fredrickson and Taylor 1982). However, we know far less about production that might be occurring under current conditions in the Lower Mississippi Valley. Reinecke *et al.* (1989) suggested an average of 450 kg/ha (400 lb/ac) of seed might be reasonable because of site and staff limitations. More recently, the LMVJV Waterfowl Working Group used available moist-soil seed estimates of nearly 500 pounds per acre reported by Kross (2006) to increase the value of this habitat to 1,883 DUDs per acre. Regardless of the quantity of seed produced, moist-soil impoundments are highly recommended as a means of diversifying habitat (Fredrickson and Taylor 1982, Reinecke *et al.* 1989) and supplying food with nutrients not generally available in agricultural grains.

The remaining essential component of waterfowl wintering habitat complex is sanctuary. Waterfowl need sanctuary from human disturbance. Winter is an important season in the life of waterfowl. It is a biological preparatory period

during which many ducks and geese pair and perform other life functions (e.g., females of some species [e.g., mallard] undergo a prebasic molt to acquire their breeding-season plumage) in readiness for reproduction. Disturbance-free habitat enables some species of waterfowl to prepare biologically for spring migration and reproduction (Reinecke *et al.* 1989, Strickland and Tullos 2009). Disturbance can interrupt resting and feeding bouts resulting in a loss of energy and lowering of body weight (Henry 1980; Heitmeyer and Raveling 1988; Kahl 1991). Paulus (1984) found in Louisiana that increased foraging time by gadwalls was insufficient to counterbalance disturbance factors.

3.2.2 Breeding wood ducks

Preferred habitats include forested wetlands, wooded and shrub swamps, tree-lined rivers, streams, sloughs and beaver ponds. Wood ducks seek food in the form of acorns, other soft and hard mast, weed seeds and invertebrates found in shallow flooded timber, shrub swamps and along stream banks. They loaf and roost in more secluded areas and dense shrub swamps (Dugger and Fredrickson 2001).

Wood ducks are cavity nesters, seeking cavities in trees within a mile of water. Brood survival is higher in situations where nests are close to water. Due to the loss of forested wetlands and competition for nest sites from a host of other species, natural cavities are the primary limiting factor to reproduction. Nest boxes are commonly used to supplement natural cavities and increase local production of wood ducks. Box programs are not an end to all nesting problems. They require time to clean and repair at least annually. Production can be increased by more frequent checks and cleaning of boxes, but this must be weighed with other time constraints.

Recent guidelines, entitled "Increasing Wood Duck Productivity: Guidelines for Management and Banding, USFWS Lands (Southeast Region) 2003 (update)" by the Division of Migratory Birds, provide direction for the use of Wood Duck nest box programs on refuges. Boxes should be placed in, or adjacent to, good brood habitat in areas where they are not subject to flooding. It is critical that boxes have functional predator guards and are checked and repaired annually; otherwise, boxes are considered traps for the hen and her clutch. Conical predator guards should be maintained on all of the boxes to more effectively keep rat snakes from climbing into the boxes. Some reports indicate that, if rat snakes learn there is a meal of eggs in the nest box, it becomes very difficult to exclude them from the boxes. If boxes cannot be properly maintained, they should be boarded up until sufficient effort can be put toward operating an effective nest box program. Cleaning the boxes after the initial peak of nesting (about mid-April) will significantly improve annual production if competition for nest sites increase.

Adequate brood habitat can seriously affect duckling survival and reproductive success. McGilvrey (1968) described preferred brood habitat as 30 to 50% shrubs, 40 to 70% herbaceous emergents and 25% open water. Overhead cover within 1 to 2 feet of the water surface is vital for wood duck broods. Optimum habitat should

have 75% cover and 25% open water, with a minimum of 1/3 cover to 2/3's open water. Placement of boxes in or adjacent to good brood cover will significantly improve duckling survival to flight age.

Wood ducks depend heavily on acorns during winter, even up to 75% of their diet (Dugger and Fredrickson 2001). During the spring, an increase in animal foods can be seen in both sexes. Aquatic insects become an important part of the egg-laying female's diet (Dugger and Fredrickson 2001).

3.2.3 Forest Interior Songbirds

Priority species such as Swainson's, hooded and Kentucky warblers and white-eyed vireos require dense understory growth (Rich *et al.* 2004), that is often associated with tree fall gaps (Pashley and Barrow 1993), in forests with large block sizes (> 5,200 acres) in a largely forested landscape (>60%) (LMVJV 2007). Timber thinning can increase canopy gaps, thereby increasing understory and misstory growth (Robinson and Robinson 1999). Thatcher (2007) found that most Partners in Flight priority species had higher densities in thinned hardwood forest than unthinned. Heltzel and Leberg (2006) also found that Swainson's, Kentucky and hooded warblers increased by 200% in bottomland hardwood forest where selective timber harvest had occurred. However, this study also showed that Acadian flycatcher and prothonotary warbler declined in abundance in harvested stands. Timber harvest can have negative effects on canopy dwelling and forest interior songbirds (Pashley and Barrow 1993) when forest are fragmented. Nest parasitism by brown-headed cowbirds and predation can occur at higher rates in fragmented forests (Brittingham and Temple 1983). Norris *et al.* (2009) found that individual selection and group selection harvests benefitted most avian species in a bottomland hardwood forest in Louisiana.

Both Acadian flycatchers and tree fall gap species such as the Kentucky, Swainson's, and hooded warblers utilize D'Arbonne NWR; however, Acadian flycatchers and prothonotary warblers are detected during landbird surveys at much higher rates (USFWS *unpub. data*). The refuge is currently in a mid-successional, closed canopy condition which causes a very sparse understory. Because most bottomland hardwood forests are in this condition (LMVJV 2007), the refuge should work to provide a more structurally diverse forest. However, even with heavy timber thinnings, the local flooding regime suppresses understory growth to some extent and will always be a management constraint.

The management challenge, of course, is to provide the correct balance of closed canopy forest and harvested stands that allow for denser understory growth. Fortunately, the LMVJV (2007) has already incorporated the different needs of forest interior songbirds along with other priority wildlife species (i.e. bears, bats, waterfowl) into the desired forest guidelines for bottomland hardwood forests. These guidelines recommend reduction in canopy cover, retention of snags and den trees and increase in understory vegetation. Twedt and Somershoe (2008) conducted a study on nearby Tensas River NWR to test the effects of selective harvesting that followed the LMVJV guidelines on priority forest birds. They found that the priority species Eastern wood-

pewee, Kentucky warbler, orchard oriole, red-headed woodpecker, white-eyed vireo, hooded warbler and Swainson's warbler were present in higher densities in thinned stands than unthinned. There was not a significant difference in densities of prothonotary warblers between the two treatments. Densities of Acadian flycatchers were less in treated stands than in untreated; however, they were present in treated stands and overall remained one of the most abundant species in the forest.

Forest interior songbirds partially conflict in habitat needs with wintering waterfowl. The management of moist soil for waterfowl in a forested landscape could increase the brood parasitism rate by brown-headed cowbirds and predation rate of songbirds by fragmenting forests (Brittingham and Temple 1983, Robinson *et al.* 1995). The biological review (USFWS 2004) suggested monitoring the amount of forest within a 75,000-acre landscape centered on the refuge. If the amount of forest declined below 75%, the review team recommended studying the productivity of priority bird species to determine if the moist soil management is having a deleterious effect. Currently, the landscape is 80% forested; therefore, no avian productivity research has been initiated.

3.2.4 Rafinesque's Big-eared Bat and Southeastern Bat

All 44 roost trees of both bat species on the refuge were found in water tupelo (*Nyssa aquatica*) (Gooding and Langford 2004). Water tupelos apparently are important roost trees for these species (Mirowsky and Horner 1997, Clark *et al.* 1998; Cochran 1999, Hoffman 1999; Hofmann et al. 1999, Rice 2009), although they have been found to utilize other tree species such as black gum (*Nyssa sylvatica*) (Mirowsky and Horner 1997), swamp tupelo (*Nyssa nigra*) (Hobson 1998), baldcypress (*Taxodium distichum*) (Clark 1990), water hickory (*Carya aquatica*) (Hoffman 1999), American beech (*Fagus grandifolia*) (Mirowsky and Horner 1997), sycamore (*Platanus occidentalis*) (Clark 1990), and others. Due to the importance of water tupelo, experimental plots of tupelo have been planted in the beanfield area in 2005 with little survival due to extended flooding and red vine invasion.

Large diameter trees with large interior cavities within mature bottomland hardwood forests have been found to be important to both bat species (Gooding and Langford 2004, Rice 2009). Management should be directed towards retention of large snags, promotion and regeneration of baldcypress/tupelo stands (Table 3), and management for mature bottomland hardwood forests (LMVJV 2007). During the Biological Review, it was made mention that fire could possibly be the agent that produced basal cavities in the water tupelo stand on the refuge (USFWS 2004). Fire may have been the cause; however, *Nyssa* species tend to develop heart rot and form cavities (Burns and Honkala 1990, Mirowsky and Horner 1997). One would also expect if fire was the agent that the direction of the cavity openings would be similar; however, the aspect of 44 bat roost cavities was not found to be significantly different from random (Gooding and Langford 2004). No young tupelo stands exist on the refuge to manage experimentally with fire.

Table 3. Baldcypress and tupelo old-growth attributes (modified from Devall 1998)

Species	*Attribute*	*Reference*
	Stand Density	
Baldcypress	≥ 1 in d.b.h. target 240 live trees /ac	Hall and Penfound 1939
Tupelo	> 10 cm d.b.h. target 7-12 live trees/ha	Martin and Smith 1991
	d.b.h. of largest trees	
Baldcypress	35- 60 in	Sargent 1965, Harlow and Harrar 1969
Tupelo	25- 48 in	Martin and Smith 1991, Sargent 1965
	Stand basal area	
Baldcypress	33.5 ft^2/ac	Hall and Penfound 1939
Tupelo	30 ft^2/ac	
	Height	
Baldcypress	100-120 ft	Harlow and Harrar 1969
Tupelo	80-90 ft	Harlow and Harrar 1969
	Need several standing snags and downed logs of baldcypress and tupelo	Martin and Smith 1991

3.2.5 Upland Hardwood Forest

Upland hardwood forest in this Plan is used to describe those habitats that are not subject to flooding where pine is not the dominant overstory species. Lester *et al.* (2005) describe this type of community as a hardwood slope forest. These forests were estimated to have occupied 100,000 to 500,000 acres historically with only 25-50% remaining today (Smith 1993).

In hardwood slope forest, canopy dominants are American beech (*Fagus grandifolia*), water oak (*Quercus nigra*), white oak (*Q. alba*), swamp chestnut oak (*Q. michauxii*), sweetgum (*Liquidambar styraciflua*), mockernut hickory (*Carya tomentosa*), cherrybark oak (*Q. pagodifolia*), black gum (*Nyssa sylvatica*) and southern red oak (*Q. falcata*). Understory and midstory associates include silverbell (*Halesia dipteral*), bigleaf snowbell (*Styrax grandifolia*), sweetleaf (*Symplocos tinctoria*), flowering dogwood (*Cornus florida*), black cherry (*Prunus serotina*), ironwood (*Carpinus aroliniana*), holly (*Ilex americana*), Elliott's blueberry

(*Vaccinium elliottii*), hoary azalea (*thododendron canescens*), witch hazel (*Hamammelis virgini*), huckleberry (*Vaccinium arboretum*), eastern hophornbeam (*Ostrya virginiana*), and service-berry (*Amelanchier arborea*). Herbaceous plants found in this community type include broad beech-fern (*Phegopteris hexagonoptera*), Christmas fern (*Polystichum acrostichoides*), jack-in-the-pulpit (*Arisaema spp.*), violets (*Viola spp.*), and may-apple (*Podophyllum peltatum*).

The primary threat to this community is invasion by invasive species, particularly Chinese tallowtree, Chinese privet and Japanese climbing fern. On private lands, conversion to pine plantation is another major problem. However, on the refuge, focus should be on promoting biological integrity, environmental health and diversity by selectively thinning the forest to maintain a high diversity of native plant species and by controlling invasive species.

3.2.6 Red-cockaded Woodpecker/Loblolly Pine Flatwoods

The red-cockaded woodpecker (RCW) is confined to old pine stands in the southeastern United States. This species evolved in a fire-maintained ecosystem and consequently prefers open, park-like pine stands with little or no hardwood midstory and herbaceous groundcover (USFWS 2003). These woodpeckers excavate only live pine trees that are 75 years or older and usually have been infected with heartwood fungus. Habitat loss from development and fire suppression are the primary cause of their endangerment (USFWS 2003). In north Louisiana where longleaf pine does not grow, red-cockaded woodpeckers historically existed in loblolly pine flatwoods and shortleaf pine forests.

After researching General Land Office records, reviewing soil and geological maps, and consulting with botanist Tom Foti of the Arkansas Natural Heritage Program, it was determined that loblolly pine flatwoods are the habitat type that exists on the east side of the refuge where the red-cockaded woodpeckers clusters are present. Mr. Foti explained that catastrophic events, such as tornadoes, created openings where loblolly pine would come into a disturbed area. If that area burned regularly, then the loblolly overtook the hardwoods or if it burned frequently and intensely, shortleaf pine would overtake the loblolly. The land could stay in this state for a few hundred years, but eventually hardwoods would succeed. Hardwood trees would then remain in the stand until another catastrophe occurred causing disturbance which allowed loblolly to reestablish. If fire was frequent, loblolly would stay dominant and keep reestablishing itself. However lower, wetter areas would not have burned as frequently allowing hardwoods to establish. Therefore, these flatwoods contained both hardwoods and pine; but, the hardwoods were not regularly distributed but grew in patches where fire had not occurred. These flatwoods were dynamic, changing spatially and temporally across the landscape due to the influence of disturbance, mostly fire (Tom Foti, *pers. comm.,* Ark. Nat. Heritage, USFWS 2004).

Objectives were then established in the CCP (USFWS 2006) to manage the loblolly flatwoods as close to historic conditions as possible, with emphasis on allowing

prescribed fire to burn in a patchy way as opposed to ensuring a 100% burn across a unit. After consulting with Ecological Services, it was determined that red-cockaded woodpeckers could be managed within these objectives without violating RCW Recovery Plan guidelines. Good quality foraging habitat for red-cockaded woodpeckers is defined in the RCW Recovery Plan (USFWS 2004) as the following:

- $\geq$ 18 stems/acre of pines that are $\geq$ 60 years in age and 14 in. dbh. Minimum basal area of these pines is 20 ft^2/acre.
- Basal area of pines 10-14 in. dbh is between 0 and 40 ft^2/acre
- Basal area of pines < 10 in. dbh is < 10ft^2/ac *and* < 20 stems/acre.
- Basal area of all pines $\geq$ 10 in. dbh is at least 40 ft^2/acre
- Sparse to no hardwood midstory greater than 7-ft in height.
- Canopy hardwoods are less than 30% of the canopy trees.
- Groundcover is of fire-tolerant, herbaceous plants that cover > 40% of the ground and are dense enough to carry a growing season fire every 5 years.
- All of the above habitat is within 0.5 miles of the center of the cluster and preferably, 50% within 0.25 miles of the cluster center
- Foraging habitat is not separated by more than 200 ft of non-foraging areas which include hardwood forest, pine forests < 30 years of age, cleared lands, clear cuts, bodies of water, rights of way and roadways.

Historic characteristics of loblolly pine flatwoods would have met RCW Recovery Plan guidelines. This inherently makes sense due to the long-time presence of red-cockaded woodpeckers in north Louisiana and their evolution with fire-maintained ecosystems.

4.0 HABITAT MANAGEMENT GOALS and OBJECTIVES

For habitats that require active management, goals and objectives were developed in the Refuge CCP, which are expanded upon or combined in this Plan to fulfill the refuge purposes. A habitat management goal is a broad, qualitative statement that is derived from the established purposes and vision for the refuge. Goals and objectives pertain to resources of concern identified in Section 3.0.

4.1 Bottomland Hardwood Habitat Goal

Restore, enhance, and maintain healthy, deciduous bottomland habitat to support a natural diversity of plant and animal species and foster the ecological integrity of the Lower Mississippi River Ecosystem.

- *Objective 4.1.1:*
  In Management Units1B, 2B, 3B, 4B, 5B,6B, 7B, 8B, 9B, 10B, and 11B, implement adaptive management to maintain 35-50% of 11,000 acres of bottomland hardwood forest at any given time at a basal area of 60-90 ft^2/acre, for a canopy cover between 60-80 percent, 30-60 percent mid-story cover, 30-40 percent understory cover, and 20-50 percent ground cover, with regeneration of hard mast producing species (e.g., oaks and water hickory) present on 30-50 percent of inventory plots (LMVJV 2007).

  Resource of Concern: Forest interior songbirds, wintering waterfowl and breeding wood ducks, bats

- *Objective 4.1.2:*
  In Management Units1B, 2B, 3B, 4B, 5B, 6B, 7B, 8B, 9B, 10B, and 11B, Where regeneration is highly likely, maintain < 60 percent canopy cover on 5-10 percent of the bottomland hardwood forest to allow regeneration of shade intolerant trees (e.g., sweetgum, nuttall oak, and willow oak), and leave 4 to 6 super-emergent trees per acre as a seed source (LMVJV 2007).

  Resource of Concern: Forest interior songbirds, wintering waterfowl and breeding wood ducks, bats

- *Objective 4.1.3:*
  In Management Units1B, 2B, 3B, 4B, 5B,6B, 7B, 8B, 9B, 10B, and 11B, Maintain 2 to 4 logs/acre to provide coarse woody debris, 4 to 6 cavity trees >4" in dbh per acre, and 1 to 4 large den trees or "unsound cull" trees per 10 acres in bottomland hardwood forest to increase habitat for resident wildlife, such as amphibians, reptiles, bats, bears, and cavity-nesting birds (LMVJV 2007).

Resource of Concern: Forest interior songbirds, wintering waterfowl and breeding wood ducks, bats

- *Objective 4.1.4:*
  In Management Units1B, 2B, 3B, 4B, 5B,6B, 7B, 8B, 9B, 10B, and 11B, retain and enhance all baldcypress and water tupelo stands towards old-growth attributes and in mixed hardwood bottomland habitat favor baldcypress and tupelo (Table 3).

  Resource of Concern: bats

- *Objective 4.1.5:*
  Each year, starting in mid-August, flood Management Unit 11A gradually to < 18" (Fredrickson 1991) and draw down in April/May (both treatments to the extent natural hydrology will allow) to provide wintering waterfowl habitat.

  Resources of concern: wintering waterfowl

- *Objective 4.1.6:*
  Maintain and enhance Management Units 11A and 11C with a grass/sedge composition of 70-80 percent cover (e.g., sprangletop, panicum, millet, toothcup, smartweed, and Carex spp.), and keep non-desirables (e.g., coffeeweed and cocklebur) to less than 20 percent to support foraging habitat for wintering waterfowl (Strader and Stinson 2005).

  Resources of Concern: wintering waterfowl

- *Objective 4.1.7:*
  Maintain 5,887 acres (33 percent) of refuge as waterfowl sanctuary and use adaptive management for yearly regulations, delineations, and modifications.

  Resources of Concern: wintering waterfowl

4.2 Upland Pine-Hardwood Habitat Goal

Enhance and maintain a mixed coniferous and deciduous habitat that historically occurred on the uplands of the West Gulf Coastal Plain for indigenous migratory birds, species of concern, and other associated wildlife.

- *Objective 4.2.1:*
  In Management Unit 1A , maintain 364 acres with a 50:50 ratio of loblolly to shortleaf pine with the shortleaf on the ridges and slopes and loblolly on the toe of the ridge; with up to 15 to 30 percent of the overstory stem count in hardwoods of white oak, southern red oak, post oak, sweetgum, and mockernut

hickory; with pine basal area of 60-70 square feet, hardwood basal area of 10 square feet for a total of 70 square feet ± 10 square feet; and with an understory of >70% herbaceous cover with fire-maintained plant species, such as big bluestem, little bluestem, and switchgrass.

Resources of Concern: Red-cockaded woodpecker/loblolly pine flatwoods

- *Objective 4.2.2:*
  In Management Units 1D and 4A, maintain 780 acres with 90:10 ratio of loblolly to shortleaf pine with hardwood species comprising 25 to 30 percent of the overstory stem count within red-cockaded woodpecker foraging habitat. Outside of this foraging habitat, hardwood species would comprise 35 percent of the total basal area. Pine basal area will be 70 square feet, hardwood basal area will be 20 square feet, and total basal area will be 90 square feet ± 10 square feet; with an understory that is >50% herbaceous with fire-maintained plant species in drier areas, and patches of wet areas that include more hardwood regeneration.

  Resources of Concern: Red-cockaded woodpecker/loblolly pine flatwoods

- *Objective 4.2.3:*
  In Management Unit 4C, maintain 529 acres with 90:10 ratio of loblolly pine to shortleaf pine with hardwoods comprising no more than 30 percent of the overstory stem count within red-cockaded woodpecker foraging habitat. Hardwoods would comprise 35 to 50 percent of the total basal area of this foraging habitat. Hardwood species include white oak, post oak, southern red oak, sweetgum, water oak, and willow oak. Target basal area for pine will be 80 square feet, 20 square feet for hardwoods, and a total basal area of 100 square feet ± 10 square feet; with an understory that is >40% herbaceous with patches of wetter areas that include woodier shrub species.

  Resources of Concern: Red-cockaded woodpecker/loblolly pine flatwoods

- *Objective 4.2.4:*
  In Management Units 1C, 3A, 5A, 7A, 8A, 9A, and 10A, maintain 723 acres with 50:50 ratio of loblolly pine to shortleaf pine with pine comprising 20-40 square feet and hardwoods comprising 80-120 square feet of the total basal area; hardwoods should have a high species diversity, including sweetgum, blackgum, swamp chestnut oak, water oak, cherrybark oak, southern red oak, post oak, white oak, mockernut hickory; with midstory species including flowering dogwood, persimmon, eastern hophornbeam, ironwood, and hawthorne; with total basal area for pine and hardwoods at 120 square feet ± 10 square feet; and with an understory that includes more woody shrub and vine species, such as American

beautyberry, serviceberry, red buckeye, rusty blackhaw, sumac, Carolina Jessamine, blackberry, and poison ivy.

Resources of Concern: Upland hardwood forest

4.3 Species of Special Concern Goal

Contribute to the long-term protection and recovery of threatened, endangered, and species of special concern populations in D'Arbonne Refuge and the Lower Mississippi River Ecosystem.

- *Objective 4.3.1*

  In Management Units1A and 4C, provide minimum nesting habitat for red-cockaded woodpeckers by maintaining 10 acres of habitat around each cluster site according to red-cockaded woodpecker guidelines (minimum basal area for pines ≥ 60 years in age and ≥ 14" in dbh at 20 feet/acre; canopy hardwoods < 30 percent of number of canopy trees; no or sparse hardwood midstory; and > 40 percent of ground and midstory plants are native bunchgrasses and native, fire-tolerant, fire-dependent herbs). Provide minimum foraging habitat that consists of at least 125 acres of pine ≥ 30 years in age with 40-80 square feet of basal area and canopy hardwoods < 30 percent of overstory stem count (USFWS 2004).

  Resources of Concern: Red-cockaded woodpecker

5.0 HABITAT MANAGEMENT STRATEGIES

5.1 Moist Soil Management Strategies

5.1.1 Potential Strategies

Preferred moist-soil plants for foraging waterfowl are typically heavy seed producing annuals, such as wild millets, smartweeds, sprangletop, other grasses and sedges. Soil disturbance and moisture are critical for the production of these desirable plants. Failure to disturb the soil (i.e. disking) will allow the invasion of perennials, both herbaceous and woody, that out-compete annual plants and greatly reduce waterfowl food production. Therefore, it is critical that the moist-soil areas be maintained using whatever means available if the refuge is to meet its waterfowl foraging objectives (Strader and Stinson 2005).

Through much trial and error, it has long ago been established that mowing is by far the best way to accomplish the vegetation species and cover objectives for moist soil habitat (Annual Narratives 1977-2008). Soil disturbance has been difficult to accomplish due to hydrology, and when conducted, has often been deleterious. The beanfield area almost never dries sufficiently to disk. In extremely dry summers, when disking was accomplished, the soil temperatures were high causing the germination of undesirable plants, such as *Sesbania* and cocklebur, result (Strader and Stinson 2005). In contrast, mowing every three years has been found to be the best technique for setting back perennials and woody vegetation such as buttonbush and red vine without causing the germination of undesirables. Prescribed fire has been used in the past to set back woody vegetation but has never been successful. The fuels have never been dry enough to carry fire sufficiently (Section 5.3). Chemical control of red-vine has been shown to be somewhat effective (Section 5.2).

Moist-soil habitat management generally requires active management of soil and hydrology to promote productive and diverse stands of moist-soil plants. Management actions include draw down timing and duration, mowing, disking or chemicals to keep units in early successional stages (Strader and Stinson 2005). These actions are used to maximize waterfowl food production and usage. Desirable moist-soil vegetation at D'Arbonne NWR consists mostly of *Leptochloa*, *Echinochloa*, toothcup, and some *Cyperus* species, which germinate during late summer drawdowns. Moist-soil management at D'Arbonne is constrained by backwater flooding of Bayou D'Arbonne. When the bayou rises, backwater will eventually top the levee in the beanfield flooding the entire unit. Due to the local hydrological regime, the impoundment often cannot be drained until June or July.

Regarding flooding, the impoundment should be flooded from late August through early September to provide water for migrating blue-winged teal, pintail, and shorebirds and drawndown should be conducted no later than April 15th (Strader and Stinson 2005). Ideal depths for foraging dabbling ducks are less than 12 inches; if water depths exceed 18 inches, food will be out of reach (Strader and Stinson 2005).

5.1.2 Management Strategy Prescription

To meet Objectives 4.1.5 and 4.1.6 in Management Units 11A and 11C for wintering waterfowl, the following strategies will be used to manage moist soil habitat:

- Every 3 years mow impoundment (when sufficiently dry to drive tractor) to reduce succession by woody plants
- Annually, place boards in water control structures in August-October to hold water or if not sufficient rainfall, pump water to achieve < 18 inches depth.
- If bayou is low enough to permit, begin drawdown in April/May
- Monitor vegetation growth for percent cover of undesirable plants. If undesirables exceed 20% cover, manipulate vegetation through mechanical (mowing) or chemical (Section 5.2) means.
- Maintain records by date for water management actions, water elevations, vegetation and wildlife response.
- Use sampling techniques in Strader and Stinson (2005) to determine percent cover of plant species and seed production to determine if management actions need to be changed to meet objectives.

5.2 Chemical Management Strategies

5.2.1 Potential Strategies

The presence of exotics and invasive plant species can alter the function of ecosystems due to the loss of wildlife habitat, displacement of native species, change in carrying capacity from reducing native forage production, lower plant diversity, and increase soil erosion and soil sedimentation. These negative effects decrease the biological integrity, diversity and environmental health of the refuge; and therefore, require a management strategy that will control, and if possible, eradicate the exotic species.

Two invasive species are on the verge of significantly impacting the biological integrity of the refuge: Chinese tallow tree and Japanese climbing fern. Tallow tree is a small, fast-growing tree with high reproductive capability. The tree grows in a variety of habitats, is extremely invasive, and can form monoculture stands quickly. Japanese climbing fern is a fast-growing woody vine that can completely shroud everything in its path. It has the ability to kill trees directly by blocking sunlight and adds extra mass to trees acting as a sail, which causes uprooting during high winds. This species is a relatively new invader in the United States, and is now becoming widespread throughout Louisiana and the southeast. This fern is fairly dense in the uplands on the refuge and does not respond well to control methods. Both the tallow and climbing fern will not be eradicated from the refuge, but extensive measures should be made to control their spread. Other invasive species that the refuge has good opportunity to control with conventional methods are Chinese mimosa, royal palownia, Chinese privet, and chinaberry. All of these species have been found in both the uplands and bottomlands on the refuge.

Invasive plant control is a legal and common management action for many national wildlife refuges, but is labor intensive and costly. Significant resources should be focused on determining the extent of each invasive species on the refuge and to controlling their spread. Successful control requires careful planning, implementation, and monitoring.

Chemical pesticides will be used primarily to supplement, rather than as a substitute for, practical damage control measures of other types. Whenever a chemical is needed, the most narrowly specific pesticide available for the target organism in question should be chosen, unless considerations of persistence or other hazards would preclude that choice (7 RM 14). All chemicals will be approved through the Pesticide Use Proposal process and will follow Integrated Pest Management Policy (569 FW 1).

The refuge has aggressively been treating exotic plants in the past few years. The mechanical removal of exotic trees has shown to be very ineffective due to stump sprouting and in the case of climbing fern, promoting its spread by machinery. Monitoring efforts have shown some chemicals to be more effective than others. The Global Species Invasive Database (http://www.issg.org/database/species/ecology.asp?si=999&fr=1&sts=sss&lang=EN) recommends using Rodeo for treatment of climbing fern, reporting an efficacy of 95% compared to 0% for Garlon 3A, Garlon 4, and Pathfinder II. The refuge has been using this technique for two growing seasons and has been seeing a 95% efficacy. Element 4 has been 97% effective against Chinese tallowtree using proper applications.

Management of the moist soil habitat in Management Units 11A and 11C may require the use of chemicals periodically to control undesirable vegetation, such as red vine, buttonbush, *Sesbania,* etc.

Although these chemicals have proven to be effective, the refuge is always striving for better methods. If over time, these chemicals are shown through monitoring to lose their efficacy, other chemicals will be tried through the adaptive management process.

5.2.2 Management Strategy Prescription

To meet all objectives in all Management Units for all resources of concern, the following strategies will be used to control exotic plants:

- GPS new areas of infestation by exotics annually.
- Treat new or re-sprouted Japanese climbing fern with a foliar spray of Rodeo or other approved chemical once per year from May-October.
- Treat Chinese tallowtree, mimosa, chinaberry, royal palownia, Chinese privet, and other woody exotics once per year anytime except during leaf-out with 20% Element 4 with surfactant to trees > 8 in. dbh by cut-spray application. Treat trees < 8 in. dbh but taller than 5 ft, with basal spray

application 12-18 in. from ground. Treat trees shorter than 5 ft with a foliar spray of 5% glyphosate.

- If current process becomes ineffective, use adaptive management process to find more efficient ways of treating invasives.

To meet Objective 4.1.6 in Management Units 11A and 11C for wintering waterfowl, the following strategies will be used to control undesirable vegetation in moist soil habitat:

- When red vine covers greater than 20% of management unit, treat with RoundUp after disking in late fall.
- When *Sesbania* covers greater than 20% of management unit, treat with 0.5 qts/acre of Blazer before plants flower and/or reach 3 ft in height.
- Other undesirable plants such as cocklebur and buttonbush are to be treated with 2-4D when coverage exceeds 20% of management unit.

5.3 Prescribed Fire Management Strategies

5.3.1 Potential Strategies

Prescribed burns can be applied in multiple ways by varying the season and intensity of the burn. The intensity of the burn can be manipulated by using flanking, backing or head fires. Other variables that can affect the results of a burn include weather, fuel loads, fuel type, and fuel moisture.

Use of prescribed fire is the most cost-effective method of controlling mid-story hardwoods. To comply with the guidelines for management of red-cockaded woodpeckers, succession of pine stands toward a climax condition must be interrupted (USFWS 2004). If this action is not taken, habitat for this endangered species will deteriorate and eventually disappear. Moderate to high intensity early growing season burns on a 3 to 5 year cycle tend to control small diameter hardwoods, increase the amount of grasses, and promote other vegetative growth by increasing the amount of sunlight that reaches the forest floor (USFWS 2004). Annual growing season burns will significantly reduce or eliminate hardwoods over time and tend to promote the production of grasses. The RCW Recovery Plan calls for growing season burns to maintain RCW habitat. Dormant season fires are acceptable to reduce hazardous fuels when re-introducing fire and then growing season fires implemented thereafter (USFWS 2004).

Prescribed fire will be used in a way that mimics the natural wildfire fire as much as possible. As stated in Section 3.2.6, fires would not have burned as frequently in lower, wetter areas allowing hardwoods to establish. Therefore, these flatwoods contained both hardwoods and pine; but, the hardwoods were not regularly distributed but grew in patches where fire had not occurred. These flatwoods were dynamic, changing spatially and temporally across the landscape due to the influence of disturbance, mostly fire (Tom Foti, *pers. comm.,* Ark. Nat. Heritage, USFWS 2004). On D'Arbonne NWR, prescribed fires will be applied to create a mosaic pattern. To mimic the patchiness of wet and drier areas based on soil and

soil moisture, the loblolly pine flatwoods have been divided into three elevation categories that basically coincide with geomorphology. Elevation dictates how wet the areas are and thus, how often they would have burned historically. Also, while timber types have been altered by man over the past two hundred years, elevation has been unchanged (USFWS 2006). Fire management will be applied according to protocols established in the Fire Management Plan (2001).

5.3.2 Management Strategy Prescription

To meet Objectives 4.2.1, 4.2.2, 4.2.3, and 4.3.1 in Management Units 1A, 1D, 4A, and 4C for red-cockaded woodpeckers, the following strategies will be used:

- Unit 1A should be burned every 1-3 years during the growing season using backing and flanking fires to allow slow, low intensity burns. The fire should be allowed to burn patchy without efforts made to re-light areas not burned. RCW trees should be raked around and backfired to prevent trees burning.

- Units 1D and 4A should be burned every 2-5 years during the growing season using backing and flanking fires. The fire should be allowed to burn patchy without efforts made to re-light areas not burned. RCW trees should be raked around and backfired to prevent trees burning.

- Unit 4C should be burned every 3-6 years during the growing season using backing and flanking fires. The fire should be allowed to burn patchy without efforts made to re-light areas not burned. RCW trees should be raked around and backfired to prevent trees burning.

- In those stands within a management unit that need more hardwood species and coverage and will not conflict with red-cockaded woodpecker foraging habitat management, dormant season burns will be used until hardwoods are established and can better withstand fire.

- In those stands within a management unit that need fire re-introduced, dormant season burns will be used until fuel loads have been decreased enough to allow for growing season fire.

5.4 Beaver Management Strategies

5.4.1 Potential Strategies

Beavers have the potential to significantly adversely affect bottomland hardwood forests by damming sloughs and brakes (Mahadev *et al.* 1993). Forests inundated into the growing season quickly show signs of stress and trees eventually die. Beavers also kill trees by girdling and felling. One study in Mississippi showed beavers on average damaged $164/ac (1985 values) of timber by girdling and felling (Bullock and Arner 1985).

Historically, beaver numbers were controlled by trapping for the demanding fur trade. In the 1980s, annual harvests exceeded 1 million beaver pelts across the nation (Hill 1982). Recently due to cultural and societal changes, furs are not in demand and therefore, little trapping is conducted causing beaver numbers to be high (Hill 1982).

Methods for control include removing beaver dams manually, with heavy equipment or by explosives, trapping and shooting by Service employees, and recreational trapping by the public.

5.4.2 Management Strategy Prescription

To meet Objectives 4.1.1, 4.1.2, 4.1.3, and 4.1.4 in Management Units 1B, 2B, 3B, 4B, 5B, 6B, 7B, 8B, 9B, 10B, and 11B for bats and forest interior songbirds, the following strategies will be used to control beaver damage in bottomland hardwood forest:

- When water recedes in spring/summer, inspect refuge for areas where water is not draining, including all areas known to have beaver dams in the past
- GPS locations of all beaver dams for future reference
- Determine best method for removal of located dams and remove immediately.
- During winter when refuge is flooded, remove beavers
- If time permits, set traps for beavers

5.5 Forest Management Strategies

5.5.1 Potential Strategies

In this section, the methods and procedures for implementing strategies to harvest timber are specified. This Plan now incorporates what was formerly considered the Forest Management Plan.

The purpose of the forest habitat management strategy is to establish and maintain the desired forest conditions specified in the objectives (Section 4.0). Both commercial and non-commercial silvicultural treatments can be utilized to produce the desired forest conditions. Commercial timber harvest operations are more economical and will be used to meet the forested habitat objectives of the refuge. The cost to the refuge associated with non-commercial treatments is higher than commercial treatments in terms of manpower and funding. However, non-commercial treatments will be used when commercial operations cannot meet refuge objectives and sufficient funding is available. Forest management strategy details associated specifically with administration of commercial application of timber removal are addressed in Section 7.0.

A combination of silvicultural methods will be utilized to meet the uneven-aged forest management objectives described in the refuge CCP/HMP for bottomland hardwood forest. The silvicultural methods are:

1. Thinning - Intermediate cuttings that are aimed primarily at controlling the growth of stands by manipulating stand density. The objective of thinning on the refuge will be to open the forest canopy, release trees from competition, improve regeneration, and improve species composition within a stand.

2. Single-Tree Selection - Removal of a single mature individual tree or small clumps of several such trees. Openings created with this method are generally about ¼ acre in size. This is an uneven-aged silvicultural method that will allow for the development of a new age class of trees within the forest structure. This method favors the regeneration and development of plant species with higher shade tolerances.

3. Group-Selection - Removal of trees from a stand in groups to create openings in the forest canopy. These openings are generally about ½ acre in size. The increased size of the openings will encourage the regeneration of more shade intolerant plant species such as sweetgum, red oaks, pecan, green ash, etc.

4. Patchcuts - Patchcuts are small clearcuts that vary in size from 1 to 3 acres. Dependent upon the shape of the patchcuts, forest openings of this size will eliminate the effects of shading throughout most of the opening. This will benefit the regeneration of even the most shade intolerant plant species. A few cavity trees may be left within each patchcut to provide perches and nest locations for some bird species. Patchcuts will provide small areas of even-aged forest scattered across an uneven-aged forested landscape that will benefit many species that need even-aged stand conditions to regenerate successfully such as sweetgum, red oaks, cottonwood, sycamore, pecan, etc.

A combination of silvicultural methods will be utilized to meet the even-aged and uneven-aged forest management objectives described in the refuge CCP/HMP for upland hardwood and pine flatwood forest. The silvicultural methods to be used are:

1. Thinning - Intermediate cuttings that are aimed primarily at controlling the growth of stands by manipulating stand density. The objective of thinning on the refuge will be to open the forest canopy, release trees from competition, improve regeneration, and improve species composition within a stand.

2. Single-Tree Selection - Removal of a single mature individual tree or small clumps of several such trees. Openings created with this method are generally about ¼ acre in size. This is an uneven-aged silvicultural method

that will allow for the development of a new age class of trees within the forest structure. This method favors the regeneration and development of plant species with higher shade tolerances.

3. Shelterwood – The shelterwood methods will be used to regenerate pine stands, mainly for the perpetuation of red-cockaded woodpecker habitat. It is reliable in ensuring sufficient seed production and dispersal and uniform stocking of reproduction. Using this even-aged method, the pine stand would be thinned to within 25-40 square feet of basal area per acre up to 10 years prior to the final cutting. The selection of those trees to be left as seed trees depends on the existing species composition and the past seed productivity of the individual trees. As a rule, trees with a large number of cones have been good producers in the past. Two to three pine seed trees per acre will be left after the final cutting to provide nest sites and snags for future and additional seed for regeneration if needed.

The hydrology on the refuge greatly affects the vegetation type, structure and wildlife communities present. The natural flooding regime occurs anywhere from November to July, but generally the refuge is flooded to some extent between January and June. The bottomland hardwood forest on the refuge is limited in vertical structure and tree diversity due to flooding. Water present on stands late into the growing season restricts understory growth and the number of species that can tolerate such wet conditions. Management activities are limited to late summer and autumn when soils are drier. On occasion flooding can occur during late summer due to hurricane rains, which can and often will shut down timber harvesting operations. It is very possible and even likely that the order of entry schedule will become back logged due to those years when unusually high water precludes timber harvests.

5.5.2 Management Strategy Prescription

To meet all objectives on all units, the forester will cruise management units according to the entry schedule (Section 7.1) to access conditions and a site and time specific forestry prescription will be written.

To meet Objective 4.2.4 in Management Units 1C, 3A, 5A, 7A, 8A, 9A, and 10A for Upland Hardwood Forest, the following forest management strategies will be used:

- Determine present composition and canopy cover of pines and hardwoods, and percent cover and composition of understory cover, and thin accordingly to meet parameters specified in Objective 4.2.4.

To meet Objective 4.2.1, 4.2.2, and 4.2.3 in Management Units 1A, 4C, 1D, and 4A for red-cockaded woodpeckers, the following forest management strategies will be used:

- Determine present composition and canopy cover of pines and hardwoods,

and percent cover and composition of understory cover, and thin accordingly to meet parameters specified in Objective 4.2.1, 4.2.2, and 4.2.3.

To meet Objectives 4.2.1, 4.2.2, 4.2.3, and 4.3.1 in Management Units 1A and 4C for red-cockaded woodpeckers, the following forest management strategies will be used:

- Pine will be thinned in red-cockaded woodpecker clusters and foraging habitat to meet parameters specified in Objective 4.3.1.
- Timber management for RCW nesting and foraging habitat will be even-aged.
- Rotations intervals will be 100 years.
- Regeneration areas will be 25 acres or less with a minimum of 6-10 pines/acre retained.
- Regeneration cuts (seed-tree or shelterwood) will be placed and timed in such a way to ensure an even distribution of age classes across the landscape. This will guarantee the presence of old pine stands in perpetuity.

To meet Objectives 4.1.1, 4.1.2, 4.1.3, and 4.1.4 in Management Units 1B, 2B, 3B, 4B, 5B, 6B, 7B, 8B, 9B, 10B, and 11B for wintering waterfowl, breeding wood ducks, bats, and forest interior songbirds within bottomland hardwood forests, the following forest management strategies will be used:

- Harvest 1- to 3-acre patches on 5 to 10 percent of stand leaving 4 to 6 large trees per acre within the small clearcuts (LMVJV 2007).
- Thin bottomland hardwood forest to meet parameters specified in Objectives 4.1.1, 4.1.2, and 4.1.3 by reducing basal area by 40 to 50 percent with variable rate of removal throughout management units to allow significant sunlight penetration to the understory (LMVJV 2007).
- No timber removal or management in pure baldcypress and water tupelo stands.
- Favor cypress in spots of regeneration in the willow oak die-off area.
- Conduct light thinning of small (14") cypress trees when mixed in hardwood stands to create larger (24") trees, and select thinning of hardwoods to release cypress to grow to old, large trees.

- Continue trying to establish 2 to 4, 2-acre experimental aforestation plots of cypress/tupelo stands where possible to promote this rare, old-growth habitat.

5.6 Waterfowl Sanctuary Management Strategies

5.6.1 Potential Strategies

Sanctuary can be applied to waterfowl habitat in different ways. Sanctuary can mean that no public use is permitted in waterfowl habitat at any time or that no

waterfowl hunting can occur but other public uses are permitted. Some refuges limit waterfowl hunting to only a certain number of days per week to limit disturbance to ducks. The size or percentage of waterfowl habitat that is sanctuary varies also. Sanctuary can be in moist soil habitat and/or in flooded bottomland hardwood forest. Strickland and Tullos (2009) recommend 20-25% of waterfowl habitat be in sanctuary to reduce disturbance. Sanctuary should be available in all habitat types, including moist soil, agriculture and bottomland hardwood forest (USFWS 2004).

Thirty-three percent of the refuge is currently not open to waterfowl hunting. However, other public uses are not prohibited in the sanctuary. All of the moist soil habitat and 10% of the bottomland hardwood forest is within this sanctuary. Refuge personnel in the past have seen little disturbance to waterfowl within the sanctuary. The water level keeps most of the public out of the sanctuary area during the winter.

5.6.2 Management Strategy Prescription

To meet Objective 4.1.7 in Management Units 11A, 11B, 11C, 4B, 7A, 7B, and a portion of 2B and 6B for wintering waterfowl, the following management strategies will be used:

- Keep sanctuary boundary posted and continue to enforce no waterfowl hunting in the sanctuary.

6.0 LITERATURE CITED

Bolen, E.G. and W.L. Robinson. 1995. Wildlife Ecology and management. Prentice Hall, Inc. 620 pp.

Bragg, D. 2003. Natural Presettlement Features of the Ashley County, Arkansas Area. American Midland Naturalist 149(1):1-20.

Brittingham, M.C. and S.A. Temple. 1983. Have cowbirds caused forest songbirds to decline? BioScience 33:31-35.

Bullock, J.F and D.H. Arner. 1985. Beaver damage to non-impounded timber in Mississippi. Southern Journal of Applied Forestry 9: 137-140.

Burns, R. M., and B. H. Honkala, technical coordinators. 1990. Silvics of North America: 1. Conifers; 2. Hardwoods. Agriculture Handbook 654, volume 2. United States Department of Agriculture, Forest Service, Washington, D.C.

Checkett, J.M., R.D. Drobney, M.J. Petrie, and D.A. Graber. 2002. True metabolizable energy of moist-soil seeds. Wildl. Soc. Bull. 30:1113-1119.

Clark, M.K. 1990. Roosting ecology of the eastern big-eared, *Plecotus rafinesquii*, in North Carolina. M.S. Thesis. N.C. State Univ., 110 pp.

Clark, M. K., A. Black, and M. Kiser. 1998. Draft report C7745.11: roosting and foraging activities of *Corynorhinus rafinesquii* and *Myotis austroriparius* within the Francis Beidler Forest, South Carolina. North Carolina State Museum of Natural Sciences, Raleigh.

Cochran, S.M. 1999. Roosting and habitat use by Rafinesque's big-eared bat and other species in a bottomland hardwood forest ecosystem. M.S. Thesis. Arkansas State Univ., 50 pp.

Davis, B.E, A.D. Afton, and R.R. Cox. 2008. Habitat Use by Female Mallards in the Lower Mississippi Alluvial Valley. Journal of Wildlife Management 73(5): 701-709.

Devall, M.S. 1998. An interim old-growth definition for cypress-tupelo communities in the Southeast. Gen. Tech. Rep. SRS-19. Asheville, NC:U.S. Department of Agriculture, Forest Service, Southern Research Station. 13 pp.

Dugger, K.M. and L.H. Fredrickson. 2001. Life history and habitat needs of the wood duck. Pages 53-59 in K.D. Nelms editor. Wetland Management for Waterfowl Handbook.

Elliott, L. and K. McKnight, editors. 2000. The U.S. shorebird conservation plan: Lower Mississippi/ Western Gulf Coast regional shorebird plan. Manomet Center for Conservation Sciences. http://www.Manomet.org/USSCP/files.htm

Flack, S. and E. Furlow. 1996. America's least wanted "purple plague," "green cancer" and 10 other ruthless environmental thugs. Nature Conservancy Magazine. Vol. 46, No. 6 November/December.

Fredrickson, L.H. 1991. Strategies for water level manipulations in moist-soil systems. USFWS Fish & Wildlife Leaflet 13.

Fredrickson, L.H. 1996. Moist-soil management, 30 years of field experimentation. International Waterfowl Symposium 7:168-177.

Fredrickson, L.H. and M.E. Heitmeyer. 1988. Waterfowl use of forested wetlands of the southern United States: an overview. Pages 307-323 in M.W. Weller, editor. Waterfowl in winter. University Minnesota Press, Minnesota, USA.

Fredrickson, L.H., and T.S. Taylor. 1982. Management of seasonally flooded impoundments for wildlife. USFWS Resource Pub. 148.

Global Climate Change Impacts in the United States, Thomas R. Karl, Jerry M. Melillo, and Thomas C. Peterson, (eds.). Cambridge University Press, 2009.

Gooding and Langford. 2004. Characteristics of tree roosts of Rafinesque's big-eared bat and southeastern bat in northeastern Louisiana. The Southwestern Naturalist 49(1): 61-67.

Heitmeyer, M.E. 1988. Body composition of female mallards in winter in relation to annual cycle events. Condor 90:669-680.

Heitmeyer, M.E. 2006. The importance of winter floods to mallards in the Mississippi Alluvial Valley. Journal of Wildlife Management 70:101-110.

Heitmeyer, M.E., and D.G. Raveling. 1988. Winter resource use by three species of dabbling ducks in California. Dept. Wildlife and Fisheries Biology, Univ. of Calif., Davis. Final Report to Delta Waterfowl and Wetlands Research Center, Portage La Prairie, Manitoba, Canada, 200 pp.

Henry, W.G. 1980. Populations and behavior of black brant as Humbolt Bay, California. M.S. Thesis, Humboldt State Univ., Arcata, 111 pp.

Hall, T.F., and W.T. Penfound. 1939. A phytosociological study of a cypress-gum swamp in southeastern Louisiana. Am Midl. Nat. 21(2):378-395.

Harlow, W.M., and E.S. Harrar. 1969. Textbook of dendrology. McGraw-Hill, New York. 510pp.

Harvey, M.J., J.S. Altenbach, and T.L. Best. 1999. Bats of the United States. Arkansas Game & Fish Commission and U.S. Fish & Wildlife Service, 64 pp.

Heltzel, J.M. and P.L. Leberg. 2006. Effects of selective logging on breeding bird communities in bottomland hardwood forests in Louisiana. Journal of Wildlife Management 70(5): 1416-1424.

Hill, E.P. 1982. Beaver. Pages 256-281 in J.A. Chapman and G.A. Fledhamer, editors. Wild mammals of North America: biology, management and economics. Johns Hopkins University Press, Baltimore, Maryland, USA.

Hoffman, V.E. 1999. Roosting and relative abundance of the southeastern myotis, (*Myotis austroriparius*), in a bottomland hardwood forest. M.S. thesis, Arkansas State University, Jonesboro.

Hoffman,V..E., J.E. Gardner, J. K. Krejca, and J.D. Garner. 1999. Summer records and a maternity roost of the southeastern myotis (*Myotis austroriparius*) in Illinois. Illinois State Academy of Science 92:95–107.

Hunter, W.C., W. Golder, S. Melvin, and J. Wheeler. 2006. Southeast United States Regional Waterbird Conservation Plan. U.S. Fish & Wildlife Service, Southeast Region, Atlanta, 131 pp.

Kahl, R. 1991. Boating disturbance of canvasbacks during migration at Lake Poygan, Wisconsin. Wild. Soc. Bull. 19:242-248

Kaminski, R.M. J.B. Davis, H.W. Essig, P.D. Gerard, and K.J. Reinecke. 2003. J. Wildl. Manage. 67:542-550.

King, S.L, J.P. Shepard, K. Ouchley, J.A. Neal, and K. Ouchley. 2005. Ecology and management of bottomland hardwood systems: the state of our understanding. L.H. Fredrickson, S.L. King and R.M. Kaminski, editors. University of Missouri-Columbia. Gaylord memorial Laboratory Special Publication No. 10. Puxico.

Kross, J. 2006. Conservation of waste rice and stimates of moist-soil seed abundance for wintering waterfowl in the Mississippi Alluvial Valley. Thesis, Mississippi State University, Mississippi State, MS. 56 pp.

Lester, G.D., S.G. Sorensen, P.L. Faulkner, C.S. Reid, and I.E. Maxit. 2005. Louisiana Comprehensive Wildlife Conservation Strategy. Louisiana Department of Wildlife and Fisheries. Baton Rouge, LA, 455 pp.

Low, J.B., and F.C. Bellrose, Jr. 1944. The seed and vegetative yield of waterfowl food plants in the Illinois River Valley. Journal of Wildlife Management 8:7-22.

LMVJV Forest Resource Conservation Working Group. 2007. Restoration, management, and monitoring of forest resources in the Mississippi Alluvial Valley: recommendations for enhancing wildlife habitat. Edited by R. Wilson, K. Ribbeck, S. King, and D. Twedt, 88 pp.

McGilvrey, F.B. 1968. A guide to wood duck production habitat requirements. U.S. Fish and Wildlife Service. Research Publication 60, 32 pp.

Mahadev, G.B., R.G. Huffaker, and S.M. Lenhart. 1993. Controlling forest damage by dispersive beaver populations: centralized optimal management strategy. Ecological Applications 3(3): 518-530.

Martin, D.L., and L.M. Smith. 1991. A survey and description of the natural plant communities of the Kisatchie National Forest Winn and Kisatchie Districts. Louisiana Dep. Wildl. And Fish., Baton Rouge. 372 pp.

Martin, C. D., W. A. Mitchell, and M. S. Wolters. 2002. Eastern cave- and crevice-dwelling bats potentially impacted by USACE Reservoir Operations. EMRRP Technical Notes Collection (ERDC TN EMRRP-SI-34). United States Army Engineer Research and Development Center, Vicksburg, Mississippi.

Miller, J.H. 2003. Nonnative invasive plants of southern forests: a field guide for identification and control. Gen. Tech. Rep. SRS-62. Asheville, NC: U.S. Department of Agriculture, Forest Service, Southern Research Station, 93 pp.

Mirowsky, K., and P. Horner. 1997. Roosting ecology of two rare vespertilionid bats, the southeastern myotis and Rafinesque's big-eared bat in east Texas. 1996 Annual Report (20 June 1997), Texas Parks and Wildlife Department, Resource Protection Division, Austin.

Ouchley, K., W.C. Barrow, K. Ouchley, and R.B. Hamilton. 1999. Characteristics of old-growth bottomland hardwood forests of the Lower Mississippi River Alluvial Valley in Louisiana. Forest Management and Ecology.

Ouchley, K., R.B. Hamilton, W.C. Barrow, and K. Ouchley. 2000. Historic and Present-Day Forest Conditions: Implications for Bottomland Hardwood Forest Restoration. Ecological Restoration Vol. 18, no. 1, pp. 21-25.

Pashley, D.N. and W.C. Barrow 1993. Effects of land use practices on Neotropical migratory birds in bottomland hardwood forests. Pages 315-320 in D.M. Finch and P.W. Stangel, editors. Status and management of Neotropical

migratory birds. U.S. Forest Service General Technical Report RM-229, Washington, D.C., USA.

Paulus, S.L. 1984. Activity budgets of nonbreeding gadwalls in Louisiana. Journal of Wildlife Management 48:371-380.

Reinecke, K.J., R.M. Kaminski, D.J. Moorhead, J.D. Hodges, and J.R. Nassar. 1989. Mississippi Alluvial Valley. Pp.203-247 in Habitat management for migrating and wintering waterfowl in North America, eds. L.M Smith, R.L. Pederson, and R.M. Kaminski. 1989. Texas Tech University Press. 560 pp.

Rice, C.L. 2009. Roosting ecology of *Corynorhinus rafinesquii* (Rafinesque's big-eared bat) and *Myotis austroriparius* (southeastern myotis) in tree cavities found in a northeastern Louisiana bottomland hardwood forest streambed. M.S. Thesis, University of Louisiana, Monroe, Louisiana 124 pp.

Rich, T. D., C. J. Beardmore, H. Berlanga, P. J. Blancher, M. S. W. Bradstreet, G. S. Butcher, D. W. Demarest, E. H. Dunn, W. C. Hunter, E. E. Iñigo-Elias, J. A. Kennedy, A. M. Martell, A. O. Panjabi, D. N. Pashley, K. V. Rosenberg, C. M. Rustay, J. S. Wendt, T. C. Will. 2004. Partners in Flight North American Landbird Conservation Plan. Cornell Lab of Ornithology. Ithaca, NY. Partners in Flight website. http://www.partnersinflight.org/cont_plan/ (VERSION: March 2005).

Robinson , W.D. and S.K. Robinson. 1999. Effects of selective logging in forest bird populations in a fragmented landscape. Conservation Biology 13: 58-66.

Robinson, S.K., F.R. Thompson, T.M. Donovan, D.R. Whitehead, and J. Faaborg. 1995. Regional forest fragmentation and the nesting success of migratory birds. Science 267:1987-1990.

Sargent, C.S. 1965. Manual of the trees of North America. Dover Publ., Inc., New York.

Saucier, R.L. 1994. Geomorphology and quaternary geologic history of the Lower Mississippi Valley, Vol I (report), Vol II (map folio), U.S. Army Engineer Waterways Experiment Station, Vicksburg MS.

Smith, L.M. 1993. Estimated presettlement and current acres of natural plant communities in Louisiana. Louisiana Natural Heritage Program, Louisiana Department of Wildlife and Fisheries, Baton Rouge, LA.

Strader, R.W., and P.H. Stinson. 2005. Moist Soil Guidelines for the U.S. Fish and Wildlife Service, Southeast Region. Division of Migratory Birds, U.S. Fish and Wildlife Service. Jackson, MS. 17 pp plus appendices.

Strickland, B.K and A. Tullos. 2009. Waterfowl Habitat Management Handbook for the Lower Mississippi River Valley. Mississippi State University, Mississippi, 31 pp.

Thatcher, B.S. 2007. Evaluation of forest management to improve breeding habitat for songbirds in oak hickory forests at Tennessee National Wildlife Refuge. Ph.D. Dissertation, University of Tennessee, Knoxville, Tennessee, 256 pp.

Tiner, R. W., Jr. 1984. Wetlands of the United States: current status and recent trends. United States Fish and Wildlife Service, National Wetland Inventory Washington, D.C.

Twedt, D.J. and S.G. Somershoe. 2008. Bird response to prescribed silvicultural treatments in bottomland hardwood forests. Journal of Wildlife Management 73(7): 1140-1150.

U.S. Department of Agriculture. 1974. Soil Survey of Ouachita Parish, Louisiana. Soil Conservation Service and Louisiana Agricultural Experiment Station, 80 pp.

U.S. Department of Agriculture. 1997. Soil Survey of Union Parish, Louisiana. Natural Resources Conservation Service and Louisiana Agricultural Experiment Station, 201 pp.

U.S. Fish and Wildlife Service. 2001. North Louisiana Refuges Complex Fire Management Plan. Farmerville, LA 65 pp.

U.S. Fish and Wildlife Service. 2003. Recovery plan for the red-cockaded woodpecker (*Picoides borealis*): second revision. U.S. Fish and Wildlife Service, Atlanta, GA. 296 pp.

U.S. Fish and Wildlife Service. 2004. D'Arbonne National Wildlife Refuge Biological Review Report. U.S. Fish and Wildlife Service. Atlanta, GA 50 pp.

U.S. Fish and Wildlife Service. 2006. D'Arbonne National Wildlife Refuge Comprehensive Conservation Plan. Atlanta, GA 196 pp.

U.S. Forest Service (USFS). 2004. Final Environmental Impact Statement for the Revised land and Resource Plan, National Forests in Alabama. U.S. Department of Agriculture. Atlanta, GA 510 pp.

7.0 APPENDIX A: THE COMMERCIAL SALE OF TIMBER

7.1 Execution of Timber Harvest

7.1.1 Cruising and Marking Timber

Each management unit is assigned a year of entry. The year of entry is assigned to distribute forest management activities across the refuge throughout the duration of this habitat management plan. Following the Order of Entry (Table 3), a habitat and timber cruise will be conducted for each compartment. The cruise may be conducted using fixed plot and point sampling techniques. Most cruise sampling will be done using a fixed radius plot of $1/5^{th}$ acre for saw timber, $1/20^{th}$ acre plots for pulpwood, and $1/100^{th}$ acre plots for regeneration and herbaceous ground cover. Point samples utilizing 10, 15, or 20 factor prisms may be used at various times for collecting timber volumes. The following data will be collected during each compartment cruise:

1. Timber volumes including basal area for sawtimber and pulpwood
2. Species composition of woody vegetation
3. Tree ages
4. Canopy conditions
5. Presence of vines, Spanish moss, and switchcane
6. Herbaceous ground cover
7. Number and size of den, cavity, and cull trees per acre
8. Tree and shrub species regeneration
9. Species composition of each canopy layer (overstory, midstory, understory, and ground cover)
10. Presence of woody debris

Volume tables for each compartment will be expressed in 2-inch diameter classes for both sawtimber and pulpwood. Doyle form class 80 will be used to express volume sawtimber (MBF) and pulpwood (cords) volumes for pine. Doyle form class 76 will be used to express volume sawtimber (MBF) and pulpwood (cords) volumes for bottomland hardwoods. The exception will be green ash and water tupelo volumes, which will utilize Doyle form class 70.

Table 3. Order of Entry 2009-2023

Year to Enter	Compartment	Acres*
2009	Compartment 2	1,259.6
2010	Compartment 3	1,343.7
2011	Compartment 4	1,593.9
2012	Compartment 5	1,497.0

2013	Compartment 6	1,329.6
2014	Compartment 7	1,073.7
2015	Compartment 8	1,527.8
2016	Compartment 9	1,301.7
2017	Compartment 10	1,105.0
2018	Compartment 11	1,699.9
2019	Compartment 1	1,597.4
2020	Allow for Backlog/Revisits	
2021	Allow for Backlog/Revisits	
2022	Evaluate additional acreages added to Refuge during HMP	
2023	Write new CCP and HMP	

* Acreage values expressed in this table are GIS acreage estimates.

Treatment prescriptions will contain the following information:

1. Compartment map
2. Stand map designating various timber stands within the compartment
3. Description of compartment including vegetation profile, soil types, hydrology, and other physiological features
4. Timber data including tree species composition, sawtimber and pulpwood volumes, stocking, age, condition, and basal area.
5. Wildlife habitat parameters including plant composition of overstory and understory; number of cavity and den trees; presence of vines, Spanish moss, and switchcane; number of dead snags; presence of woody debris; and evidence of wildlife activity (e.g. bird nests, browsing of plants, wildlife tracks, etc.)
6. Composition of woody plant regeneration
7. Prescription of silvicultural treatment to be conducted in the compartment
8. Description of desired results
9. Map of Treatment Area
10. Timber data for the Treatment Area showing what is to be removed during treatment

After the Prescription is written, it will be submitted to the Regional Office for approval. Copies of Prescriptions and all other information will be kept on file in the refuge office.

To determine which trees are designated for removal, the forester will follow sound silvicultural procedures prescribed in the compartment prescription. As the forester determines which trees are to be removed, paint will be applied at breast height and

at the base of trees to be removed. These two marks allow for the contractor to distinguish which trees are designated for removal during logging operations and help the forester identify the stumps of marked trees during administration of the logging contract.

Timber marking is very subjective and varies from one timber marker to another. Though the compartment prescription gives the timber marker guidelines to follow, each individual timber marker has a different opinion on how to reach the desired results of the compartment prescription. To ensure forest diversity and avoid bias, more than one person should be involved with the timber marking of treatment areas on the refuge.

During the timber marking activities, many factors are considered before selecting a tree for removal. These include species composition of the compartment, tree health and vigor, present regeneration, potential regeneration, canopy structure, number of cavities within the area, habitat value of the tree, mast production, and objectives of the compartment prescription. The compartment prescription designates how much timber volume or basal area to remove during a treatment, but the application of the prescription occurs during timber marking.

The timber sale must satisfy certain conditions to be operable by a contractor. For present market conditions, the following guidelines apply to timber sales open to formal competitive bidding; adjustments may be necessary if significant changes in the economy occur. Total sale volumes could be less in the case of a negotiated sale; however, the average volumes per acre would remain essentially unchanged.

Pine saw timber must have a minimum DBH of 11.0 inches and a minimum merchantable length of 12 feet. The upper limit of merchantability is defined as:

1. A minimum top diameter inside bark of 7.0 inches, or

2. The point in the upper stem at which excessive taper occurs. Excessive taper is generally associated with these limits:

    a. A stem defect
    b. A limiting whorl. A limiting whorl is branches, at least 1 inch in diameter, radiating from 3 or more faces and situated within a 6-inch vertical span, where the sum of their diameters equals or exceeds ½ of the outside stem diameter at the point of occurrence. The term "branch" shall mean live branches or dead branches that still show remnants of branch endings
    c. If a usable 8-foot or longer section occurs above either (a) or (b), take the merchantable height to the top of this section. A usable section is one not having the characteristics of (a) or (b) and not limited by diameter.
    d. Occasionally, there may be two limiters with a usable 8-foot or longer section above them. If the two limiters occur within a

vertical 4-foot span, take the merchantable height to the top of the next usable section. Otherwise, measure to the first limiter.

Hardwood saw timber must have a minimum DBH of 11.0 inches and minimum merchantable length of 12 feet. The diameter of swell-butted species, such as baldcypress and water tupelo, shall be measured 1-½ feet above swell, when the swell is more than 3 feet high, instead of at DBH.

The upper limit of merchantability is defined as:

1. A minimum top diameter inside bark of 8 inches, or
2. The point at which the tree breaks into forks containing no merchantable saw logs, or
3. One or more live limbs occurring within a vertical span of 1 foot, whose sum of diameter equals or exceeds 1/3 of the stem diameter outside the bark at that point, or
4. A stem deformity

Pine pulpwood must have a minimum DBH of 5.0 inches and a minimum merchantable length of 10 feet. The upper limit of merchantability is defined as:

1. A minimum top diameter inside bark of 3.0 inches, or
2. That point at which stem deformity prevents utilization. If at least a full 5-foot usable section occurs above this point, take the merchantable height to the top of this section. A usable section is one that is reasonable straight and sound and whose small-end diameter equals or exceeds 3.0 inches inside bark.

Hardwood pulpwood must have a minimum DBH of 7 inches and minimum merchantable length of 10 feet. The upper limit of merchantability is defined as:

1. A minimum top diameter inside bark (DIB) of 4.0 inches, or
2. That point at which stem deformity prevents utilization. If at least a full 5-foot section occurs above this point, take the merchantable height to the top of this section. A usable section is one that is reasonably straight and sound and whose small end diameter equals or exceeds 4.0 inches diameter inside bark.

Trees that fork immediately above DBH will be measured below the swell resulting from the double stem. The longest utilizable stem shall be measured for the merchantable height. Trees that fork below DBH shall be considered as two

separate trees, and the diameters shall be measured or estimated 3 ½ feet above the fork.

Timber harvest operations can occur anytime of the year. By limiting harvest activities April through June, disturbance of bird nesting and breeding activities of most bird species should be minimized. Logging will also be restricted to dry periods of the year to keep soil disturbance and damage to residual vegetation at a minimum.

7.1.2 Logging Operations

Permanent roads for commercial timber harvest operations will be limited to existing roads only. This will help reduce fragmentation of the habitat and limit disturbance to soil and plants throughout the refuge. Road edges that receive direct sunlight may provide substantial amounts of soft mast (fruit), where otherwise closed canopy forests make this important food source rare (Perry et al, 1999). Edge habitats along roads may be important for reasons stated above, but should still be limited because of concerns of increased predation and parasitism of bird nests (Robinson et al. 1995), and effects of roads on amphibian movements (Gibbs 1998, deMaynadier and Hunter 2000).

Logging operations will be allowed to use skidders, crawler tractors, and wheeled tractors to skid logs to loading areas where they are loaded onto trucks. Tree-length skidding will be allowed, but the trees must have the tops and all limbs removed before skidding. Removal of tops and limbs will reduce chances of damage to residual trees. If possible, harvest should be conducted outside of breeding season for birds (April-June), but management can be conducted during this period if necessary. Other special conditions and/or restrictions, as determined by refuge staff, may be stated in the Timber Sale Bid Invitation (Exhibit 3) and Special Use Permit awarded to the highest bidder for the Timber Sale Bid.

In order to confirm harvest procedures and address any questions, a pre-entry conference will be held between the Refuge Manager and/or Refuge Forester, Permittee, and the logging contractor, if different than the Permittee. The Permittee is to notify the Refuge when harvesting operations begin and are completed.

Close inspection and supervision of all timber sales is necessary to ensure that harvesting operations meet the conditions of the Special Use Permit and refuge objectives. Frequent inspections of harvesting operations will ensure that only designated trees are cut, and problems are rectified before becoming major issues. Timber harvesting operations may be suspended or restricted any time that continued operation might cause excessive damage to the forest stands, soil, wildlife habitat, or cultural resources. Reasons for suspension or restriction may include, but are not limited to: periods of high wildfire potential, insects or disease hazard, times when harvesting may interfere with essential refuge operations, during periods of heavy rains or wet conditions which may cause rutting and erosion of soils, when harvesting operations present a safety hazard, or when

harvest operations reveal new or may damage existing cultural resources. Furthermore, operations may be suspended or terminated if the Permittee violates the conditions of the Special Use Permit.

When harvesting is complete, the Refuge Forester or designated Refuge Staff will inspect the site for compliance with all requirements of the contract. If any deficiencies are found, the Permittee will be notified and given reasonable time to achieve compliance. If full compliance is achieved, the Permittee's performance deposit will be returned in full. If not, an amount to mitigate damages will be deducted from the performance deposit and the remaining amount returned.

7.1.3 Monitoring

Upon completion of prescribed timber harvest operations, each treatment area will be monitored the next year and every 5 years after to see if desired results of the compartment prescription have been met. Monitoring will consist of the forester walking through the treated area and taking basal area measurements at several points. This will help the refuge staff to determine what changes, if any, may be needed for future forest management prescriptions.

To monitor the impact of timber management activities on migratory birds, a bird-monitoring program has been developed in cooperation with the Lower Mississippi Valley Joint Venture office. The information gathered from the bird-monitoring system assists in identifying the impacts of timber harvest on bird populations, as well as other wildlife species, before and after treatment. This information will help adapt timber management activities to the needs of the many plant and animal species utilizing the forested habitat of the refuge.

A Geographical Information System (GIS) and Global Positioning System (GPS) database is currently being developed on the refuge. The current refuge GIS database consists of various image files including Digital Orthophoto Quarter Quads (DOQQ's), Digital Raster Graphs (DRG's) of USGS topographic quad maps, and 10- 15- 30-meter resolution satellite images. Feature classes, from a variety of different state and federal agencies provide mapping layers for federal and state highways, local roads, parish boundary lines, powerline and pipeline rights-of-way, reforestation projects on private and public lands, public land boundaries, and various other layers providing information about the area surrounding the refuge.

For this plan, GIS data have been developed on a local scale to reflect the refuge management activities. To enhance the development of a GIS database that is specific to the refuge, GPS technology has and will continue to be used to establish compartment boundaries, maps, cruise lines, treatment area maps and boundaries, monitoring programs, logging access routes, areas of special concern, refuge roads, beaver activity, cultural resources, forest cover types, map reforestation areas, and all other management activities related to the refuge.

To ensure the refuge is in compliance with the Forestry Best Management Practices (FBMP) manual regulations (http://www.ldaf.state.la.us/portal/Portals/0/FOR/for%20mgmt/BMP.pdf) concerning Natural and Scenic Rivers, all forest management operations on the refuge will leave a 200-foot buffer along the banks of Bayou D'Arbonne. Logging is restricted to the summer and early fall, which are generally the driest times of the year, to reduce soil compaction and erosion potential. Logging access roads will be limited to existing woods roads left over from previous ownership whenever possible. New road construction will be kept to a minimum and must be approved by the refuge manager.

The 200-foot buffer along major waterways and permanent water areas will help keep logging debris out of water channels. These buffer areas will also serve as filtration strips to reduce sediment loads that may be caused by logging activities. Treetops and other logging debris will be kept out of brakes and swales to minimize any impacts that logging activities may have on drainage. The number of crossings through swales and brakes will be kept at a minimum to prevent damage to the natural drainage of water. These crossings will be maintained and any structures, such as culverts, will be removed as soon as logging activities are completed.

7.1.4 Archeological and Cultural Resources

The Archeological Resources Protection Act of 1979 obligated the refuges to protect all sites of archeological and historical significance. In 1982, a cultural resources reconnaissance of the refuge was conducted by the Research Institute of Northeast Louisiana University (Heartfield and Price 1982). It was primarily a survey of planned construction sites on the refuge. As a result of the survey, six prehistoric sites were identified. Two of the sites were largely destroyed; four sites needed further investigation to determine eligibility for inclusion on the National Register of Historic Places. It is very likely that more prehistoric sites exist on the refuge especially on deposits of Pleistocene age. Since the survey was conducted, artifacts have been found by members of the refuge staff on four additional sites on or adjacent to the refuge.

It is possible that forest management activities on the refuge could disturb some unknown archeological site. Thus to minimize the chance of such disturbances the following actions will be taken:

1. All forest management prescriptions will be submitted to the Regional Archeologist for approval prior to the start of any logging activities.
2. Logging will be limited to dry soil conditions, thus limiting soil disturbance and erosion.
3. Limit new road construction to reduce the chance of disturbance.
4. Cease logging operations and flag any suspected archeological sites that may be discovered during logging operations

5. Contact the Regional Archeologist if any suspected archeological sites are discovered and follow instructions given by the Regional Archeologist to protect the site until a thorough investigation of the site can be conducted.

7.1.5 Aesthetics

Aesthetic values fall under the category of wildlife observation, which is one of the six priority public uses of refuges designated in the National Wildlife Refuge System Improvement Act of 1997. Although aesthetic values vary from person to person, forest management activities will use the following guidelines to ensure that wildlife observation opportunities for the public are not impeded:

1. Keep logging loader sets at least 100-feet away from designated hiking trails.
2. Maintain a 200-foot buffer along the boundary of all major waterways where logging will not be allowed. Road construction, loader sets, and skidding of logs will also be prohibited within this buffer. All logging debris will be removed from within the buffer boundary.
3. Keep logging slash piles away from designated hiking trails.
4. Limit height of slash piles to less than 4 feet in logging areas and loader sets, unless otherwise directed for wildlife habitat improvement purposes.
5. Ensure all logging access roads are maintained and free of litter and debris while logging activities are in progress.

7.1.6 Forest Openings

Forest openings on the refuge will be managed as temporary openings. These are openings created during logging operations either as patchcuts or loader sets. The patchcuts, 1-3 acres in size, are designated during timber marking to develop temporary openings in the forest canopy large enough to encourage the development of shade intolerant plant species. Loader sets are areas opened up by the logging contractor for the loading of forest products onto trucks. Loader sets usually range in size from ¼ to ½ acre in size and soil disturbance is greater in these areas than any other areas within the timber sale. In an effort to lessen the risk of soil erosion during wet periods in loader sets, these areas may be planted with winter grasses to serve as a temporary vegetative cover until normal vegetation has a chance to reclaim the site. Rotation of timber harvest areas between the forest compartments will allow for temporary openings to be created throughout the refuge on a continual basis to replace older forest openings as they close up.

7.1.7 Insect and Disease

Insects and diseases that may affect the forested habitat on the refuge can be most effectively controlled by promoting stand conditions favoring healthy vigorous trees. Trees stressed by overstocking, flooding, drought, overmaturity, fire, etc., have an increased susceptibility to insects and diseases. Forest management activities such as thinnings and group selection cuts will help promote tree health

and vigor by reducing competition and stocking as well as maintaining tree species diversity.

Most of the disease and insect damage found on the refuge presently is limited to individual trees or small groups and should not pose a threat to the health of the forest. The presence of tree diseases and insects is a normal occurrence in the forest. Many neotropical bird species forage on insects that damage trees, while other wildlife species forage on the conks and other fruiting bodies of various diseases. Portions of trees damaged by insects and diseases may eventually develop into cavities available for wildlife use.

Upon entry into a compartment, insect and disease damage will be evaluated and taken into consideration as part of the compartment cruise. In situations where insect and/or disease conditions are considered severe, the refuge forester will try to identify the problem and consult with the Forest Health Unit of The United States Forest Service Southern Region State and Private Forestry Division in Pineville, Louisiana for advise on how to effectively control the problem.

In the event of extensive disease or insect infestation, the refuge manager or forester may request an expedited treatment. This request must be approved at the Regional level and should eliminate most of the formal prescription approval process, though sound biological and silvicultural principals will still apply. The formal bidding process for such treatments may be scaled back in order to expedite the treatment.

7.1.8 Timber Salvage and Unscheduled Harvesting

Salvaging damaged timber, dead, or down trees following natural events such as ice storms, tornadoes, disease/insect outbreaks, windstorms, wildfires and etc. is a common practice in forest management. Forest management on D'Arbonne NWR will only consider salvaging timber to reduce fire hazards or prevent the likelihood of insect or disease outbreaks. These natural events usually provide wildlife species with many habitat needs such as snags for cavities, new denning locations, diversifying the canopy structure, increased plant diversity on the forest floor, etc. Unscheduled harvesting may need to occur to prevent the loss of timber due to outbreaks of insects or disease. If an outbreak of insects or diseases should occur, it may be necessary to enter into a compartment ahead of the entry cycle to stop or slow the outbreak.

7.1.9 Threatened and Endangered Species

The refuge currently has the endangered red-cockaded woodpecker on the east side in the upland pine forests. The threatened Louisiana black bear is a transient on the refuge. An Intra-service Section 7 Consultation will be conducted for any timber operation that may negatively affect either species.

7.2 Administration of Sales

7.2.1 Conditions Applicable to Timber Harvesting Permits

1. A pre-entry conference between the Refuge Forester and the designated Permittee representative will be a requirement before the purchaser starts logging operations. The purpose of the pre-entry conference is to ensure that the purchaser completely understands what is expected of him, thus avoid misunderstanding or serious conflict.

2. If requested, satisfactory scale tickets for timber products shall be submitted to the Refuge Forester.

3. Bottomland hardwood species will be cut so as to leave a stump not more than 18 inches high for sawtimber and pulpwood. Upland hardwood stump height shall not exceed 18 inches for sawtimber and 12 inches for pulpwood. Stump height for pine shall not exceed 12 inches for sawtimber and 6 inches for pulpwood-sized trees. All stump heights are measured at the side adjacent to the highest ground. In the case of swell-butted species or trees with metal objects in the butt, stumps may be higher.

4. Whole tree skidding in sawtimber sales is prohibited, unless special conditions are permitted.

5. Ground level paint spots must remain visible after the tree has been cut. All marked trees are to be cut, unless otherwise approved by the Refuge Forester.

6. Trees and tops shall not be left hanging or supported by any other tree and shall be pulled down immediately after felling.

7. Tops and logging debris shall be pulled back 20 feet from public roads and lopped within 150 feet.

8. All roads, right-of-ways, fields, openings, streams, and firebreaks must be kept clear of tops and debris. Permittee shall also repair all damage to same resulting from operations conducted under this permit.

9. Littering in any manner is a violation of the Code of Federal Regulations. The entire work area shall be kept free of litter at all times. Repairs and cleanup work will be accomplished to the satisfaction of the Refuge Manager and/or Refuge Forester.

10. Additional trees removed to prepare loading sites will be paid for at bid prices. Unmarked trees, which are cut or injured through carelessness, shall be paid for at **double** the bid price.

11. The Permittee will remove temporary plugs, dams, and bridges, constructed by the Permittee, upon completion of the contract. There are areas on the refuge where temporary plugs or dams in an intermittent stream would not be allowed. These areas will be indicated on sale maps.

12. Loading sets will be determined cooperatively between the Refuge Forester and Permittee.

13. Ownership of all products remaining on a sale area will revert to the U.S. Government upon termination of the permit.

14. Logging within the area of red-cockaded woodpecker clusters (200 feet from the nearest cavity tree) will be limited to August through February. Cluster areas will be indicated on sale area maps when appropriate.

15. The Refuge Manager and/or Forester shall have authority to temporarily close down all or any part of the harvest operation during a period of high fire danger, wet ground conditions, or for any other reason deemed necessary. An equal amount of additional time will be granted to the Permittee.

16. The U. S. Government accepts no responsibility to provide right-of-way over private lands for materials sold under this contract.

17. The Permittee and his employees will do all within their power to prevent and suppress wild fires.

18. The decision of the Refuge Manager shall be final in the interpretation of the regulations and provisions governing the sale, cutting, and removal of the timber covered by this permit.

19. When a timber sale area is adjacent to private land, all logging debris will be pulled back onto the refuge to avoid damage to private property.

20. Permittee and his employees shall not build fires on the refuge.

7.2.2 Control Records

The primary purpose of records is to show progress made in fulfilling the habitat management plan objectives. These records include but are not limited to: compartment prescriptions, compartment geographical information system (GIS) maps, sale area GIS maps, timber sale contracts and special use permits, compartment timber volume tables, order of entry plan and progress reports, non-commercial treatments, wildlife information gathered by compartment, and data collected from bird counts conducted throughout the length of the HMP.

7.2.3 Sale Folders

A sale folder will be prepared and maintained for each individual timber sale. The folder shall contain copies of all data collected for the sale. This includes tally sheets, volume estimates, maps, bid invitation, Special Use Permits, payment records, correspondence with permittee, sale compliance inspection notes, copies of deposit checks, payment transmittal forms, etc. The sale folder shall be kept in a separate folder within the compartment folder for each individual compartment, thus keeping all information pertaining to a compartment within a single file.

7.2.4 Bid Invitations

Commercial timber sales are the most practical method available for creating and maintaining desired forest habitat conditions. All timber sales will be conducted in accordance with the requirements listed in the Refuge Manual, and the guidelines and specifications detailed in the D'Arbonne NWR CCP, D'Arbonne NWR Habitat Management Plan, and compartment prescriptions.

Small sales (estimated receipts less than $2,500) will be negotiated as authorized by U. S. Fish and Wildlife Service policies. The Refuge Forester will make a reasonable effort to obtain at least three bids from potential buyers. These bids will be documented and a permit will be issued to the successful bidder.

Larger timber sales (estimated receipts more than $2,500) will be conducted through a formal bid procedure. Invitations to bid will be prepared and administered by refuge personnel. Formal bid invitations will be mailed to all prospective bidders (Exhibit 2). Bid invitations will contain the following information:

1. A Formal Bid Information Form containing sales and estimated volume information.
2. A bid form, which the bidder fills out, signs, and returns to the refuge.
3. Maps giving general sales location information and detailing all sales units.
4. General conditions applicable to harvest of forest products.
5. Special conditions applicable to the timber sale.
6. Certificate of Independent Price Determination.
7. Equal Employment Opportunity Clause (Form 3-176).
8. Information on dates when prospective bidders can evaluate sales areas before bid opening.

7.2.5 Bids and Performance Deposits

For all bid sales, a bid opening date and time will be set to occur at the refuge headquarters. All bids received prior to the opening time will be kept, unopened and locked in the Refuge Cashier's safe until the specified opening time. Any bids received after the specified opening time will not be accepted. The refuge retains

the right to reject any and all bids, particularly those that are incomplete or otherwise unacceptable.

A deposit of $5,000 to $10,000 in the form of a cashier's check or money order made out to the U. S. Fish and Wildlife Service, must accompany all bids received through the formal bid process. The deposit amount will reflect the size of the sale and potential for damage. The amount of the deposit will be stipulated in the bid invitation. This deposit is to ensure the sincerity of the bidder's intention to purchase the offered sale at the bid price. In the event the successful bidder chooses not to purchase the offered timber, the bid deposit will be forfeited to the government. When the successful bidder is named, all unsuccessful bidders' deposits will be immediately returned. The successful bidder's deposit will then become his performance guarantee deposit and will be retained by the government as such. Before the completion of the operation, the successful buyer will repair any and all damages caused by his operation. The performance guarantee deposit may be used to cover any un-repaired damages caused by the successful bidder, their agents, employees, or their contractors. The balance of the deposit will be refunded to the successful bidder when the sale and all related repairs are completed.

Small sales through the negotiated process will also require a performance guarantee deposit to be received by the government prior to any timber harvest.

7.2.6 Special Use Permit

Upon selection of a successful bidder by the Refuge Manager or designated representative, a Special Use Permit will be issued containing information relevant to the timber sale, such as terms of payment, authorized activities, General and Special Conditions, and location map. The Refuge Manager or designated representative, upon receipt of payment, signs the Permit, if the value is within their warranted authority. If the value is above that amount, an authorized representative of the Regional Director signs the Special Use Permit.

7.2.7 Payment for Forest Products and Administration of Receipts

The permittee will have 10 business days after notification of award of bidding to make total or partial payment (according to what is specified in the Special Use Permit). Under no circumstances will harvest operations begin prior to receipt of payment. The purpose of an advance payment is to encourage the permittee to begin harvesting operations as quickly as possible. All payments will be in the form of a cashier's check or money order payable to the U. S. Fish and Wildlife Service.

For pay-as-cut sales, the buyer shall provide weekly scale totals and/or scale tickets along with a weekly payment. All receipts for forest products along with proper documentation will be forwarded the same day received to the Fish and Wildlife Service Finance Center. Any receipts, that cannot be processed the same day received, will be stored in the Refuge Cashier's safe until processing can be

completed. Presently, receipts for the sale of products of the land are deposited into the Revenue Sharing account at the Finance Center. Other arrangements can only be made in accordance with policy, regulations, and laws.

Refuges are authorized to enter into Timber for Land Exchanges. In this process, land within the approved Refuge Acquisition Boundary may be purchased indirectly through exchange of normal timber sale volumes. Requirements for timber for land exchange sales are as follows:

1. Authority, which allows the Service to exchange timber for lands: National Wildlife Refuge System Administration Act of 1966 (16 USC 668dd-ee).

2. Lands acquired must be located within the approved refuge acquisition boundary. No Preliminary Project Proposal or any other studies are required. The merit of the acquisition is a judgment call by the Refuge Manager.

3. Forest management plans are followed, and no deviation from planned schedules should be considered. No additional timber harvest is considered for the sole purpose of acquiring land.

4. The land is conveyed to the United States in exchange for refuge timber or other refuge products. The timber is transferred via Special Use Permit, much the same as a timber sale. If timing requires the timber to be harvested prior to closing on the land, the permittee can make a performance deposit equal to the value of the deed. That deposit is refunded upon completion of the deed transfer.

5. The Service receives compensation for the timber when the third party acquires the subject property and conveys it to the United States.

6. The value of the land to be acquired, and the timber exchanged should be approximately equal or the value of the timber higher than the land. Any excess value of the timber can be made as a payment to the Service for the difference.

7. The Division of Realty will be responsible for land appraisals, title insurance, reimbursement of relocation costs, and recording fees resulting from the conveyance of the property to the United States. These miscellaneous costs will be paid from Division of Realty funds.

A sequence of steps for a hypothetical timber for land exchange is as follows:

1. Refuge Manager identifies areas within the approved refuge acquisition boundary for acquisition.

2. Refuge Manager and Division of Realty determine if landowner(s) are willing sellers.

3. If seller is willing to sell, the Refuge Manager notifies the Regional Office (District Manager and Division of Realty).

4. Division of Realty contacts the landowner, orders the appraisal, and makes an offer to the landowner.

5. If the landowner is willing to sell, Realty advises the Refuge Manager.

6. The Refuge Manager and refuge staff shall determine which upcoming timber sales, awaiting the timber sale bid process, to use in the exchange.

7. Timber Sales bids are sent out with a description of the responsibilities of the winning bidder pertaining to the timber for land exchange. This gives the bidders an opportunity to determine if they are willing to participate in the timber for land exchange. This also ensures that bidding for the timber is competitive.

8. The Refuge Manager selects the winning bidder following the normal timber sale bid process. The winning bidder is now referred to as the third party.

9. Division of Realty advises the landowner that the third party will intercede to acquire the subject property on the Service's behalf.

10. Division of Realty obtains an exchange agreement with the third party. The agreement (1) identifies and states the price of the subject property and (2) stipulates the volume and value of timber involved in the refuge's timber sale.

11. The third party acquires the subject property at the appraised value.

12. The third party conveys the subject property to the United States via a warranty deed. A Special Use Permit is issued by the Refuge Manager, which specifies the requirements that must be followed by the third party while cutting on the refuge. The Special Use Permit becomes part of the closing documents.

13. The third party completes logging operation within the specified time frame, as detailed in the Special Use Permit.

7.3 Exhibit 1: Upper Ouachita NWR Timber Sale 200x-xx

SPECIAL CONDITIONS APPLICABLE TO TIMBER HARVESTING

Before starting logging operations, the refuge forester, the permit holder and his logging contractor will discuss the following special conditions. The goal of the following conditions is to protect the refuge forest from unnecessary damage. If the forest is logged carefully, it will look like a job well done which will in turn lessen the chance of public disagreement with refuge forest management philosophy.

1. All timber marked with two spots of blue paint will be cut, except as otherwise agreed by both parties. The permit holder is subject to paying $700 per MBF for leave pine saw timber trees which are cut or excessively damaged through carelessness. The penalty for cut or excessively damaged hardwood leave trees will be $500 per MBF on saw timber and $25 per cord on pulpwood-sized trees.

2. Trees are to be cut so as to leave a stump not more than 12 inches high. In the case of swell-butted trees or trees with metal objects in the butt, stumps may be higher. The lowest practicable stumps that can be left are preferred on all trees.

3. Trees and tops shall not be left hanging or supported by any other living or dead tree and shall be pulled down immediately after felling. This applies especially to pines to lessen the chance for pine beetles.

4. Access roads for the removal of trees shall be coordinated with the refuge forester. See compartment 2 map for present road locations. Roads, rights-of-way, and stream beds must be routinely kept clear of tops and logging debris. The permit holder shall provide and install any necessary culverts in the sale area. Roads will be maintained regularly. To avoid excessive damage following heavy rains, loggers should be prepared to stop all hauling for at least one day. Excessive or extended rains may result in overly wet ground conditions that would prevent logging for an undetermined period of time. The refuge forester expects close cooperation from all logging crews. At the completion of sale, roads will be left in at least as good as original condition. Location of additional roads must be pre-approved by the refuge forester. Leave trees cannot be removed for access or loading sets without prior approval from the refuge forester. The permit holder shall promptly repair all damage resulting from operations conducted under this permit to the refuge forester's satisfaction.

5. There are a significant number of leave trees which can be protected by careful logging activity. Logging will be restricted to ground conditions dry enough to minimize rutting. Besides being unsightly, rutting will often damage the root systems of leave trees. Soft spots (springs, wet creek bottoms, etc.) will be avoided whenever possible. The majority of the area has ample room for skidding between leave trees without damaging leave trees. Skinning butts and damaging roots of all leave trees will be avoided as much as practicable. Whole tree skidding will be allowed where minimal damage to leave trees would be expected. Skidding of

hardwoods with large crowns – potentially more damaging to leave trees – will be strictly controlled where excessive damage to leave trees is likely to occur. In general, hardwoods or pines with large crowns will be lopped prior to skidding.

6. The entire work area shall be kept free of litter at all times. Petroleum products must be properly disposed of and may not be dumped on the ground. **Note: The logger agrees to remove soil contaminated by petroleum product spills from the refuge when directed by the refuge forester.**

7. The refuge forester shall have the authority to temporarily close down all or part of the operation during a period of high fire danger or wet ground conditions. An equal amount of additional time will be given to the permit holder when necessary.

8. Should the permit holder's logging operation expose any archaeological or cultural resources, the logger will immediately cease operations in that area and notify the U.S. Fish and Wildlife Service.

9. Logging contractors will do all in their power to prevent and suppress forest fires, and will be held liable for damages and suppression costs resulting from logging contractor-caused fires, except as may otherwise be allowed under State or Federal laws.

10. Failure by the permit holder to meet any applicable conditions may result in penalties levied against the performance bond. The decision of the Deputy Project Leader shall be final in interpreting regulations and provisions governing the sale, cutting, and removal of forest products under this permit.

7.4 Exhibit 2: Bid Form

BID FORM

D'Arbonne NWR Timber Sale 200x-xx

The following is my bid for the stumpage offered in this invitation.

Lump sum bid for compartment x **$**_____

Reminder: Don't forget to include the $10,000 good faith deposit with your bid. Without the good faith deposit, the bid will have to be automatically rejected.

I have inspected the sale area and trees designated for removal. If I am adjudged the successful bidder, I agree to accept the terms and special conditions of the permit-agreement. I also agree to give at least two weeks' notice of my desire to move on site to start cutting. However, entry onto the area with logging equipment will <u>not</u> be allowed until the ground is sufficiently dried out as determined by the refuge forester.

Name of Firm:

_____

Address:

_____

_____Zip Code: _____

Signature of Bidder: _____Date: _____

Telephone:

_____

Comments:

_____

7.5 Exhibit 3: Bid Invitation

North Louisiana Refuge Complex
11372 Highway 143
Farmerville, LA 71241
Telephone: 318-726-4222
FAX: 318-726-4667
[Date]

D'Arbonne National Wildlife Refuge
Compartment x
Timber Sale 200x-xx

BID INVITATION

The purpose of this sale is to thin the forested area in a portion of compartment x to promote general forest health and understory/midstory development for wildlife.

To locate the sale area, see maps (Figures x and x). All trees to be cut were marked with blue paint. This will be a general thinning of [insert whether it is for pine or hardwood pulpwood or sawtimber] products on +/- xx acres. [Pine or hardwood] saw timber estimates are xxx MBF and [pine or hardwood] pulpwood estimate is xx cords (not including top wood). Close merchandising of timber products could cause the pine saw timber volume to be greater than the estimate.

NOTE: Much of the sale area has flat woods which are very wet much of the year because of a high water table. Dry ground conditions will be necessary to support logging equipment and log trucks.

A permit will be issued for cutting until [insert date]. Unusually wet summers and falls may allow for an extension. The extension, if granted, would be at the discretion of the Deputy Project Leader and Refuge Forester.

Prospective buyers can contact Refuge Forester [insert forester's name] at the above phone number if they want to arrange a visit to the sale area. There is a parking lot on the western edge of the sale area. **ATV access will be allowed in the sale area for timber inspection purposes only.** Otherwise, buyers are free to go look at the timber unescorted.

Formal sealed bids will be accepted at the refuge office until 3:00 p.m., [date], for the sale of the marked timber. Bids will be opened at 3:05 p.m., [same date] at the refuge office which is located 2.5 miles south of Rocky Branch, Louisiana on HWY 143. The U.S. Fish and Wildlife Service (Service) reserves the right to reject any and all bids. The refuge may take up to five (5) working days before determining whether any of the bids will be accepted.

Each bidder will submit with their bid a CERTIFIED OR CASHIER'S CHECK in the amount of $10,000 made payable to the U.S. Fish and Wildlife Service as a good faith deposit. The successful bidder's deposit will be retained by the Service and may be forfeited to the government if that bidder fails to accept and agree to execute the Special Use Permit agreement. After the permit agreement is finalized, the deposit will be retained by the Service as a performance guarantee to cover any damages or claims the Service may have against the permit holder as a result of the logging operation. The balance will be returned to the permit holder upon satisfactory completion of the operation. In the past most operators have been refunded the entire bond. The Special Use Permit will be issued as a sale document to the buyer. The Service does not issue "timber deeds." All subsequent payments will also be made to the U.S. Fish and Wildlife Service.

Note: The successful bidder will be required to hold 10 percent of the lump sum in reserve for road repairs required by the refuge. The refuge forester will determine where repairs will be done. The timber buyer will pay for road repairs with this set aside money when notified by the refuge forester. As soon as the permit holder is notified that no more of the set aside funds are required for road repairs, the permit holder will be required to promptly submit payment to the U.S. Fish and Wildlife Service for the remaining set aside funds.

Bids mailed or hand delivered must be securely sealed in an envelope plainly marked:

"Bid: D'Arbonne NWR Timber Sale 200x-xx"

If you have any questions about this packet, feel free to call [forester's name] (318-726-4222 ext 25) for additional information. If you're not planning on submitting a bid, a negative reply would be greatly appreciated.

7.6 Exhibit 4: Certificate of Independent Price Determination

U.S. DEPARTMENT OF THE INTERIOR
Fish and Wildlife Service

CERTIFICATE OF INDEPENDENT PRICE DETERMINATION
(101-45.4926 Fed. Prop. Mgt. Reg.)

(a) By submission of this bid proposal, each bidder or offerer certifies, and in the case of a joint bid or proposal each party thereto certifies as to its own organization, that is in connection with this sale:

(1) The prices in this bid proposal have been arrived at independently, without consultation, communication, or agreement, for the purpose of restricting competition, as to any matter relating to such prices, with any other bidder or offeror or with any competitor;

(2) Unless otherwise required by law, the prices which have been quoted in this bid or proposal have not been knowingly disclosed by the bidder or offeror and will not knowingly be disclosed by the bidder or offeror prior to opening, in the case of a bid, or prior to award, in the case of a proposal, directly or indirectly to any other bidder or offeror or to any competitor; and

(3) No attempt has been made or will be made by the bidder or offeror to induce any other person or firm to submit or not to submit a bid or proposal for the purpose of restricting competition.

(b) Each person signing this bid or proposal certifies that:

(1) He is the person in the bidder' s or offeror' s organization responsible within that organization for the decision as to the prices being bid or offered herein and that he has not participated, and will not participate, in any action contrary to (a) (1) through (a) (3), above; or

(2) (i) He is not the person in the bidder' s or offeror' s organization responsible within that organization for the decision as to the prices being bid or offered herein but that he has been authorized in writing to act as agent for the persons responsible for such decision in certifying that such persons have not participated, and will not participate, in any action contrary to (a) (1) through (a) (3), above, and as their agent does hereby so certify; and

(ii) He has not participated, and will not participate, in any action contrary to (a) (1) through (a) (3), above.

(c) This certification is not applicable to a foreign bidder or offeror submitting a bid or proposal for a contract, which requires performance or delivery outside the United States, its possessions, and Puerto Rico.

(d) A bid or proposal will not be considered for award where (a) (1), (a) (3), or (b), above, has been deleted or modified. Where (a) (2), above, has been deleted or modified, the bid or proposal will not be considered for award unless the bidder or offeror furnishes with the bid or proposal a signed statement which sets forth in detail the circumstance of the disclosure and the head of the agency, or his designee, determines that such disclosure was not made for the purpose of restricting competition.

7.7 Exhibit 5: Equal Employment Opportunity Clause

"During the performance of this contract, the contractor agrees as follows:

"(1) The contractor will not discriminate against any employee or applicant for employment because of race, color, religion, sex, or national origin. The contractor will take affirmative action to ensure that applicants are employed, and that employees are treated during employment, without regard to their race, color, religion, sex or national origin. Such action shall include, but not be limited to the following: employment, upgrading, demotion, or transfer; recruitment or recruitment advertising; layoff or termination; rates of pay or other forms of compensation; and selection for training, including apprenticeship. The contractor agrees to post in conspicuous places, available to employees and applicants for employment, notices to be provided by the contracting officer setting forth the provisions of this nondiscrimination clause.

"(2) The contractor will, in all solicitations or advancements for employees placed by or on behalf of the contractor, state that all qualified applicants will receive consideration for employment without regard to race, color, religion, sex or national origin.

"(3) The contractor will send to each labor union or representative of workers with which he has a collective bargaining agreement or other contract or understanding, a notice, to be provided by the agency contracting officer, advising the labor union or workers' representative of the contractor's commitments under Section 202 of Executive Order No. 11246 of September 24, 1965, and shall post copies of the notice in conspicuous places available to employees and applicants for employment.

"(4) The contractor will comply with all provisions of Executive Order No. 11246 of Sept. 24, 1965, and of the rules, regulations, and relevant orders of the Secretary of Labor.

"(5) The contractor will furnish all information and reports required by Executive Order No. 11246 of September 24, 1965, and by the rules, regulations, and orders of the Secretary of Labor, or pursuant thereto, and will permit access to his books, records, and accounts by the contracting agency and the Secretary of Labor for purposes of investigation to ascertain compliance with such rules, regulations, and orders.

"(6) In the event of the contractor's noncompliance with the nondiscrimination clauses of this contract or with any of such rules, regulations, or orders, this contract may be cancelled, terminated, or suspended in whole or in part and the contractor may be declared ineligible for further Government contracts in accordance with procedures authorized in Executive Order No. 11246 of Sept.

24, 1965, and such other sanctions may be imposed and remedies invoked as provided in Executive Order No. 11246 of September 24, 1965, or by rule, regulation, or order of the Secretary of Labor, or as otherwise provided by law.

8.0 APPENDIX B: ENVIRONMENTAL ACTION STATEMENT

U. S. FISH AND WILDLIFE SERVICE

ENVIRONMENTAL ACTION STATEMENT FOR CATEGORICAL EXCLUSION

Within the spirit and intent of the Council on Environmental Quality's regulations for implementing the National Environmental Policy Act (NEPA), and other statutes, orders, and policies that protect fish and wildlife resources, I have established the following administrative record and determined that the following proposed action is categorically excluded from NEPA documentation requirements consistent with 40 CFR 1508.4, 516 DM 2.3A, 516 DM 2 Appendix 1, and 516 DM 6 Appendix 1.4.

Proposed Action and Alternatives. The proposed action is the approval and implementation of the Habitat Management Plan (HMP) for D'Arbonne National Wildlife Refuge (NWR). This plan is a step-down management plan providing the refuge manager with specific guidance for implementing goals, objectives, and strategies identified in the D'Arbonne NWR Comprehensive Conservation Plan (CCP) (2006).

The proposed CCP action was the preferred alternative among three alternatives considered in the Environmental Assessment (EA) (Draft CCP and EA 2006). In the CCP, the proposed action was to manage the refuge *"based on sound science for the conservation of a structurally and species diverse bottomland hardwood habitat for migratory birds and resident wildlife. Upland habitat will be allowed to function and respond to processes mimicking the natural fire regime and disturbances to benefit migratory birds, red-cockaded woodpeckers and resident wildlife. A focused effort will be directed toward reducing invasive species, which are threatening the biological integrity of the refuge. Wintering waterfowl habitat will be maintained as important foraging habitat in the moist soil and forested wetlands."* (D'Arbonne NWR CCP 2006).

The CCP has defined goals, objectives and strategies to achieve the stated action. The actions further detailed in the HMP have been identified, addressed, and authorized by the D'Arbonne NWR CCP and accompanying Environmental Assessment (2006). These include:

- Forest Management Strategy: Selectively thin upland and bottomland forests to achieve desired forest conditions stated in CCP objectives (CCP pages 64,66-69, 72,74-75)
- Moist soil Management Strategy: Manipulate water levels and vegetative cover in moist soil habitat to provide wintering waterfowl habitat as stated in CCP objectives (CCP pages 69

and 71)
- Fire Management Strategy: Implement prescribed burning to upland pine habitat in a way that mimics historic and natural fire regime to achieve desired habitat conditions stated in CCP objectives (CCP pages 72, 74-75)
- Chemical Management Strategy: Use approved chemicals according to label specifications and Pesticide Use Proposals to control invasive plant species (CCP pages 69, 71, 76)
- Waterfowl Sanctuary Strategy: Maintain no hunting areas for wintering waterfowl to rest in bottomland hardwood forest and moist soil habitat according to CCP objective (CCP page 54)
- Beaver Management Strategy: Control beaver damage to allow for healthy bottomland hardwood forests according to CCP objective (CCP pages 48, 66)

Categorical Exclusion(s). Categorical Exclusion Department Manual 516 DM 6, Appendix 1 Section 1.4 B (10), which states *"the issuance of new or revised site, unit, or activity-specific management plans for public use, land use, or other management activities when only minor changes are planned. Examples could include an amended public use plan or fire management plan.",* is applicable to implementation to the proposed action.

Consistent with Categorical Exclusion (516 DM 6, Appendix 1 Section 1.4 B (10)) the HMP is a step-down management plan which provides guidance for implementation of the general goals, objectives, and strategies established in the CCP, serving to further refine those components of the CPP specific to habitat management. This HMP does not trigger an Exception to the Categorical Exclusions listed in 516 DM 2 Appendix 2.

Minor changes or refinements to the CCP in this activity-specific management plan include:
- Habitat management objectives are further refined by providing numerical parameter values that more clearly define the originating objective statement.
- Habitat management objectives are restated so as to combine appropriate objectives or split complicated objectives to provide improved clarity in the context of the HMP.
- Specific habitat management guidance, strategies, and implementation schedules to meet the CCP goals and objectives are included (e.g. location, timing, frequency, and intensity of application).
- All details are consistent with the CCP and serve to provide the further detail necessary to guide the refuge in application of the intended strategies for the purpose of meeting the habitat objectives.

Permits/Approvals. Endangered Species Act, Intra-Service Section 7 Consultation was conducted during the CCP process. The determination was a concurrence that the CCP may affect, but is not likely to adversely

affect the endangered red-cockaded woodpecker (signed January 23, 2006 within CCP).
Other Items to include that should be listed and can be found in the EAS accompanying the final ccp:

- Executive Orders 11988/11990 - May 31, 2006
- Floodplain Management and Protection of Wetlands, May 31, 2006
- Form DI-711, Intergovernmental Notice of Proposed Action, March 29, 2006
- National Historic Preservation Act, Protection of Cultural Resources, March 29, 2006

Public Involvement/Interagency Coordination. The proposed HMP is a step-down of the approved CCP for D'Arbonne NWR. The development and approval of the CCP included appropriate NEPA documentation and public involvement. An Environmental Assessment was developed (Draft CCP and EA 2006) which proposed and addressed management alternatives and environmental consequences. Public involvement included public notification (Notice of Intent: Federal Register Vol. 69, No. 51, March 16, 2004 and Notice of Availability: Federal Register Vol. 71, No. 69, April 11, 2006) and news releases (*Bastrop Daily Enterprise*, *Ruston Leader*, Farmerville *Gazette*, Monroe *The News-star*, KEDM 90.3FM, KJLO 104 FM, KNOE 102 FM), public scoping (public meetings June 8, 2004, Rocky Branch, LA and May 2, 2006 D'Arbonne NWR Headquarters) and public review (30-day availability period: April 11, 2006-May 11, 2006). No one attended the public meetings. Written comments were submitted by one member of the general public and two organizations. No comments were submitted by other federal agencies. Refer to CCP for specific comments and Service response.

Supporting Documents. Supporting documents for this determination include relevant office file material and the following key references:

U.S. Fish and Wildlife Service. 2001. D'Arbonne National Wildlife Refuge, Fire Management Plan.
U.S. Fish and Wildlife Service. 1983. D'Arbonne National Wildlife Refuge, Forest Management Plan.
U.S. Fish and Wildlife Service. 2006. D'Arbonne National Wildlife Refuge, Comprehensive Conservation Plan.
U.S. Fish and Wildlife Service. 2006. D'Arbonne National Wildlife Refuge, Environmental Assessment for the Draft Comprehensive Conservation Plan.

Project Leader

3-2-10
date