HABITAT MANAGEMENT PLAN FOR

Pond Creek National Wildlife Refuge

Sevier County, Arkansas

USFWS Photo by Gary Tucker

Southeast Region

Pond Creek National Wildlife Refuge

Habitat Management Plan

U.S. Department of the Interior
Fish and Wildlife Service
Southeast Region

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CHAPTER I. INTRODUCTION

Throughout the century of its existence, the National Wildlife Refuge System (Refuge System) has established a reputation as premier ground for the refinement of habitat management techniques. 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. 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 can be defined as simply "the physical and biological surroundings of an organism" (Bolen and Robinson 1995). Habitat includes all of the natural components of an ecosystem that are essential for survival, including food, cover, and water. The processes that shaped habitat features in southern Arkansas, including Pond Creek National Wildlife Refuge (NWR), are complex and dynamic. This Habitat Management Plan was developed to provide a clear, science-based outline for managing the Pond Creek NWR 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.

A. PLANNING PROCESS

Habitat Management Plans (HMPs) 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 HMP 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 (Administration Act), as amended by the National Wildlife Refuge System Improvement Act of 1997 (Improvement Act), 16 U.S.C. 668dd - 668ee. Section 4(a)(3) of the 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 Improvement Act provides the Service the authority to establish policies, regulations, and guidelines governing habitat management planning within the Refuge System (Service Manual 620 FW 1).

An HMP is a step-down management plan of a refuge's 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 Refuge System; maintains and, where appropriate, restores the biological integrity, diversity, and environmental health of each refuge and the Refuge System; helps achieve the goals of the National Wilderness Preservation System, if appropriate; and meets other mandates. The CCP for Pond Creek NWR was finalized in 1999 (USFWS 1999).

HMPs comply with all applicable laws, regulations, and policies governing the management of the 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. Habitat Work Plans are prepared annually to guide implementation and assessment of specific management prescriptions to meet habitat objectives established in the HMP.

B. 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.

Pond Creek NWR was established under the authority of the Emergency Wetlands Resources Act of 1986, which calls for

> *"...the conservation of the wetlands of the Nation in order to maintain the public benefits they provide and to help fulfill international treaty obligations contained in various migratory bird treaties and conventions...."(16 U.S.C. 3901 (b), 1100 Stat. 3583).*

The Omnibus Parks and Public Lands Act of 1996, which authorized the transfer of land from Weyerhaeuser Company to the Service, requires that a CCP:

> *"...recognize the important public purposes served by non-consumptive activities, other recreational activities, and wildlife-related public use, including hunting, fishing, and trapping."*

Furthermore, a CCP

> *"...shall permit, to the maximum extent practicable, compatible uses to the extent that they are consistent with sound wildlife management, and in accordance with the National Wildlife Refuge System Administration Act of 1966 (16 U.S.C. 668dd-668ee) and other applicable laws."*

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

- Fulfill the mission of the 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.

C. REFUGE VISION

The Pond Creek NWR vision was developed for the CCP (USFWS 1999).

> *Pond Creek National Wildlife Refuge is a model refuge that protects and manages biological diversity for the enjoyment and benefit of present and future generations.*

D. RELATIONSHIP TO OTHER PLANS

A CCP was finalized for Pond Creek NWR in 1999, which includes goals and objectives for refuge management over a 15-year period (USFWS 1999). A "pulse check" of the biological review and CCP was completed in 2009 (USFWS 2009). The purpose of this refuge "pulse-check" was to assess progress made by the refuge related to CCP objectives and HMP strategies, and to identify additional management needs and priorities that have arisen since these plans were developed. The purpose of this HMP 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 HMP.

Refuge endangered species with approved recovery plans include the following:

During 2004, a rare plant known as Pale Green Orchid (*Plantara flava*) was discovered on the refuge by refuge volunteer, David Arbour, while he was conducting migratory bird point count surveys. The plant's status in Arkansas is considered threatened, but it is recognized as being stable throughout its range in other parts of the country. This was the first known recording of this plant in Sevier County.

The Pondberry is an endangered shrub that is documented on Pond Creek NWR and is likely present in one large, wet depression area located on the west side of the refuge. Remarkably, five other species of concern are known to exist around the refuge. The leopard darter (threatened) has been documented in the Cossatot River north of the refuge, near Gillham Lake. The Ouachita rock pocket book mussel (endangered) and Rabbitsfoot have been found in the Little River and is considered to occur in the refuge. The pink mucket pearly mussel (endangered) is thought to be in the Little River system. Historical ranges of the American burying beetle (endangered) and scaleshell (endangered) include this part of southwest Arkansas. The interior least tern also uses areas within the refuge. The Refuge is within the historical range of long-eared bats (candidate). Whenever possible, priority actions identified in recovery plans were incorporated into goals, objectives, and strategies of this HMP.

Other plans incorporated into this HMP 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 North American Waterbird Conservation Plan (Kushlan *et al.* 2002), and Arkansas Comprehensive Wildlife Conservation Strategy (Anderson 2006) as follows:

NORTH AMERICAN WATERFOWL MANAGEMENT PLAN (NAWMP)

Working under the direction of the NAWMP, the Lower Mississippi Valley Joint Venture (LMVJV) strives to provide habitat for 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. Within the MAV, ten management units were delineated for Arkansas. One of these units is the Red River-Sulphur River-Little River Unit in southwest Arkansas, which encompasses the refuge area. Although waterfowl populations for this region are low compared to those in the more extensive wetland and river systems of the MAV of eastern Arkansas, the numbers of waterfowl that use the area are adequate to provide a base from which to build larger populations through wetland protection and enhancement. Foraging habitat objectives have not been finalized nor allocated within the WGCP portion of Arkansas, in which Pond Creek NWR is located. When finalized, these objectives should be used as a guide in developing management objectives for individual refuges.

BIRD CONSERVATION PLAN FOR THE WGCP

The WGCP includes Pond Creek NWR because it reaches to the northwestern most portion of the Mississippi Alluvial Basin. This section of the region is primarily hardwood forest. 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; some destructive timber harvesting practices; and conversion to pine plantations, pastures, and other land uses (Neal, http://www.partnersinflight.org/bcps/pl_42sum.htm). This HMP will define conservation strategies to foster support for the WGCP priorities. However, at this time, step-down objectives have not been finalized for the WGCP. Habitats found on Pond Creek NWR and associated bird species that are considered a priority in the WGCP include:

- 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 Arkansas (http://www.shorebirdplan.org/wp-content/uploads/2013/01/MAVWGC1.pdf). 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 WGCP is considered an important region 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: 4,000 breeding pairs of little blue herons for Arkansas and 1,000 pairs of king rails (http://www.pwrc.usgs.gov/nacwcp/pdfs/regional/seusplanfinal906.pdf).

Little to no habitat exists on Pond Creek NWR for king rails. Little blue herons are found on the refuge during the breeding season.

ARKANSAS WILDLIFE ACTION PLAN

The Arkansas Game and Fish Commission (AGFC) is a state-partnering agency with the Service. The AGFC plays an important role in keeping "The Natural State" true to its name. Over the past 100 years, the AGFC has overseen the protection, conservation, and preservation of many species of fish and wildlife in Arkansas. This is done through habitat management, fish stocking, hunting and fishing regulations, and a host of other programs conducive to helping Arkansas' wildlife flourish. The AGFC also manages over 280,000 acres of state-owned natural areas and wildlife management areas.

The state's participation and contribution throughout this planning process provides for ongoing opportunities and open dialogue to improve the ecological health and diversity of fish and wildlife. A vital part of the planning process is the integration of common mission objectives, where appropriate.

In 2006, the AGFC published the Arkansas Wildlife Action Plan (AWAP), which is built upon a strong foundation of game and nongame conservation. The AWAP exceeds any other conservation effort written for the state in scope and direction, and provides a venue for the most innovative collaboration conducted in the state thus far. The main focus of the AWAP is to "develop a living planning tool, rather than a static funding document, that could be useful to professional partners, citizen conservationists and land managers" (Anderson 2006). The AWAP describes seven ecoregions, 396 species of greatest conservation need (SGCN), 43 terrestrial habitats, and 18 "ecobasins." Within each ecoregion, the SGCN, habitats, problems facing species, and actions are described. This HMP for Pond Creek NWR was developed with the cooperation of the AGFC and incorporates many elements of the AWAP.

This HMP also incorporates the recommendations of other approved refuge plans including the Forest Management Plan (USFWS 2003) and the Wildlife and Habitat Biological Review Report (USFWS 2009).

CHAPTER II. ENVIRONMENTAL SETTING AND BACKGROUND

A. LOCATION

Pond Creek NWR is located in Sevier County, Arkansas, approximately 55 miles north of the city of Texarkana and 142 miles southwest of Little Rock, the Arkansas state capital (Figure 1). It protects the largest remaining tract of hardwoods along the Little River, and extends west from U.S. Highway 71 almost to the Oklahoma state line. Pond Creek bisects the refuge and flows from the northwest to the southeast where it intersects the Cossatot River just upstream from the confluence of the Cossatot/Little Rivers.

B. MANAGEMENT UNITS

Pond Creek NWR consists of 26,879 acres in fee-title ownership. The refuge also administers public use activities on approximately 1,470 acres through various lease agreements, which gives the Service limited management authority on these properties. The refuge has been separated into eight management units, ranging in size from 2,217 to 4,752 acres (Tables 1 and 2). Management unit boundaries are established along geographic features that can be easily identified on the ground (i.e., streams, roads, and trails). Each management unit is subdivided into compartments to allow feasible entry (Figure 2). Compartment evaluations will follow a 15-year cycle. The compartments were inventoried in 2000/2001 and further divided into stands.

During 1999, a forest inventory was conducted on the pine plantations greater than 26 years of age. The purpose(s) of this inventory was not only to identify volumes and size classes but also to determine stocking rates of advanced hardwood regeneration present in the understory of these plantations. An inventory of the native forest communities was conducted in 2000/2001, with assistance of refuge staff from throughout the MAV. Sampling intensity was one percent of the total land area and was conducted on a systematic line/plot grid using 1/5-acre plots. In addition to standard forest inventory data, additional parameters were measured at each plot (e.g., heights, vertical position, stem crown widths, densities, and percent plant material occupancy) at upper-, mid-, and lower-level strata to assist in describing forest bird habitat conditions. These additional parameters corresponded, in part, to standard bird point count vegetative sampling techniques and were developed with extensive consultation/coordination of leading forest-dwelling landbird scientists in the Southeast. These inventories, along with vegetative data collected at over 40 point count locations on the refuge forest, provide the base line habitat information presented in this document.

C. PHYSICAL FEATURES

C-1. CLIMATE

The refuge is located in the humid subtropical zone. The climate is controlled by two principal air masses such as warm, moist air from the Gulf of Mexico, which generally dominates in the spring and summer, and cooler, drier air from the Central Plains in the winter (Stroud and Hansen 1981). Extended hot, sultry summers and moderately cool winters are normal. The summers typically have 85 days with highs greater than 90 degrees Fahrenheit. The winters are marked by brief cold periods with little snow. Average winter highs are in the mid-50s and average summer highs

Figure 1. Vicinity map of Pond Creek NWR

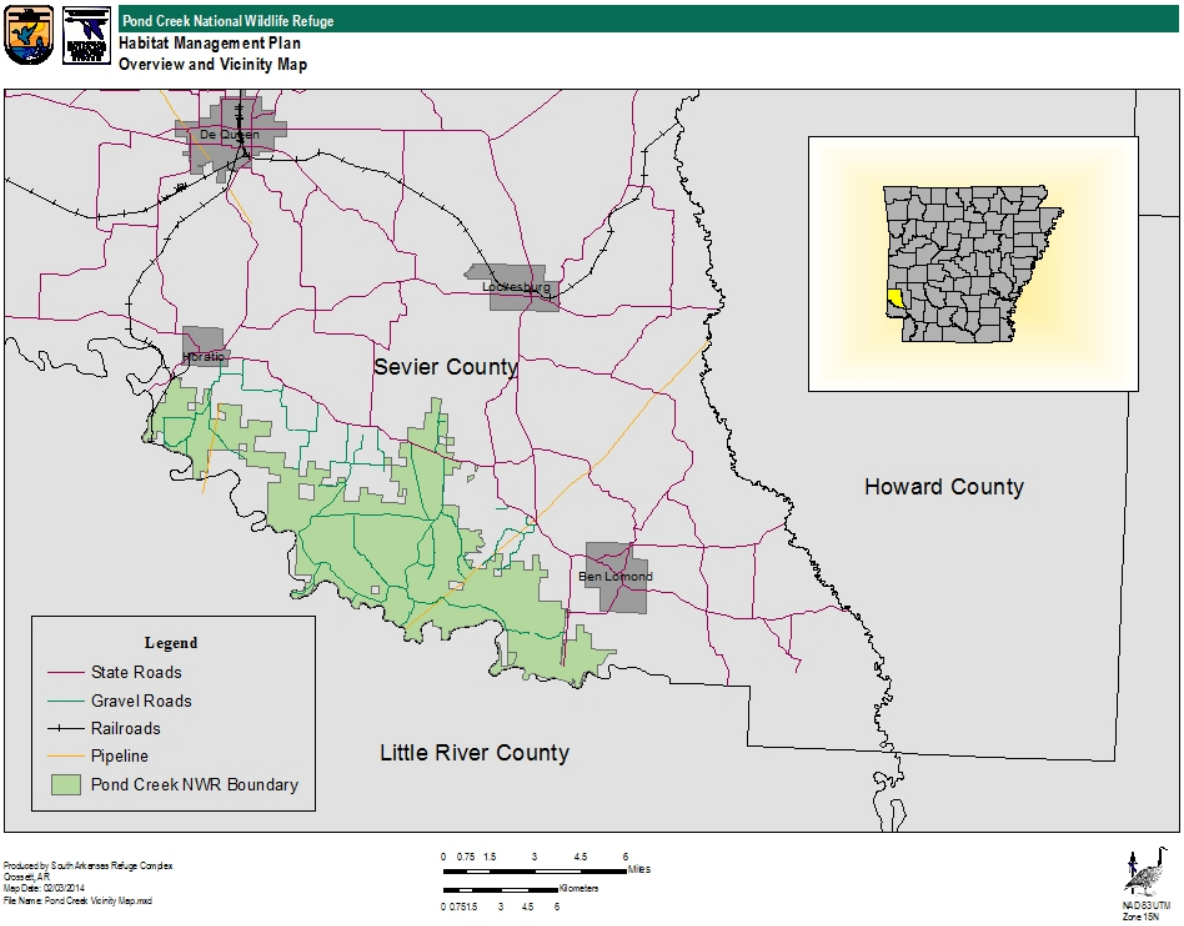
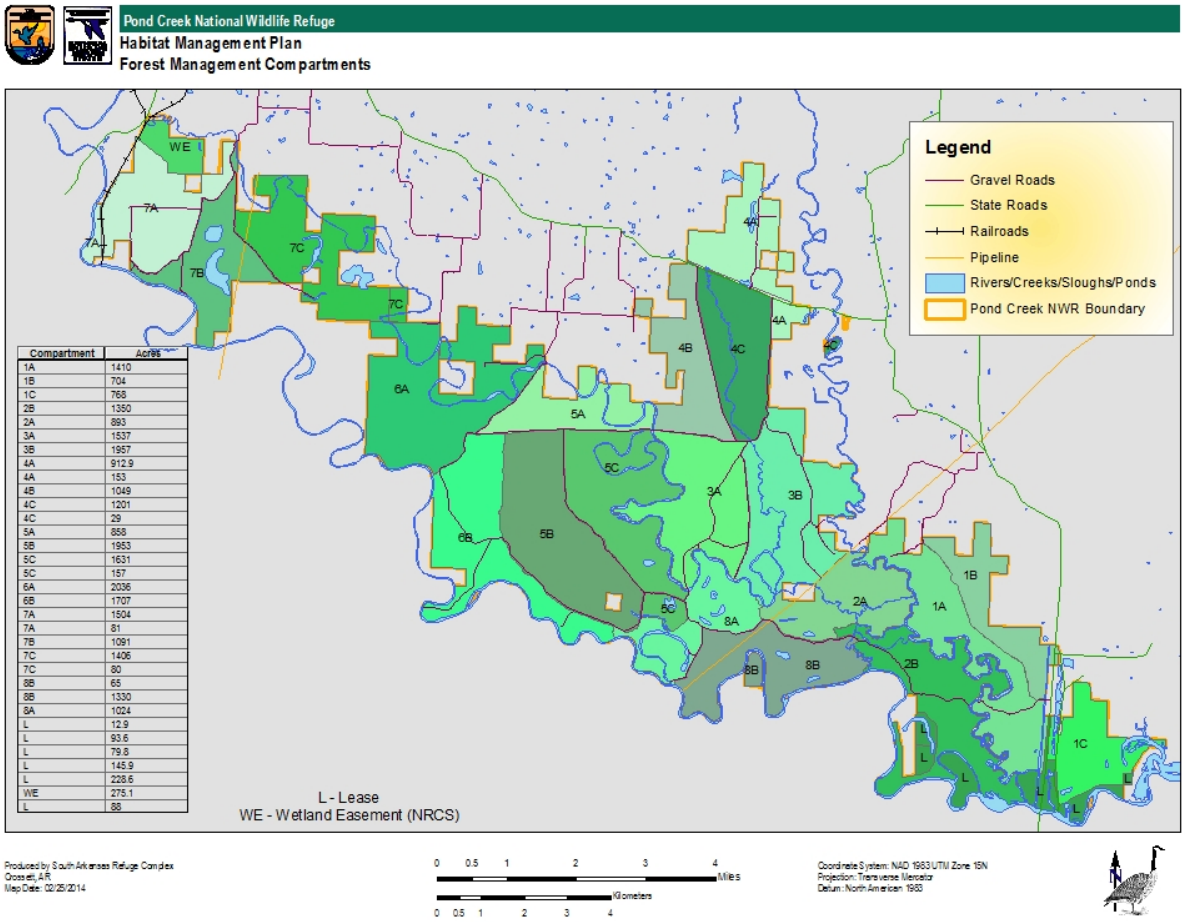


Figure 2. Habitat management compartments on Pond Creek NWR



Compartment	Acres
1A	1410
1B	704
1C	768
2B	1350
2A	893
3A	1537
3B	1957
4A	912.9
4A	153
4B	1049
4C	1201
4C	29
5A	858
5B	1953
5C	1631
5C	157
6A	2036
6B	1707
7A	1504
7A	81
7B	1091
7C	1406
7C	80
8B	65
8B	1330
8A	1024
L	12.9
L	93.6
L	79.8
L	145.9
L	228.6
WE	275.1
L	88

Table 1. Management unit summary, Pond Creek NWR

Compartment	Native Forest	Pine Plantation	Beaver Ponds	Perm. Water	R.O.W.[1]	Roads	Total Acres
1	2,672	N/A	182	21	0	7	2,882
2	2,168	N/A	28	21	6	20	2,243
3	3,159	256	11	18	5	45	3,494
4	2,334	934	14	13	0	49	3,344
5	3,963	406	184	6	0	40	4,599
6	3,317	37	341	12	0	36	3,743
7	3,870	N/A	227	8	16	39	4,160
8	2,317	N/A	25	42	12	18	2,414
Total	**23,800**	**1,633**	**1,012**	**141**	**39**	**254**	**26,879**

*only fee title land is included in this table

Table 2. Pond Creek NWR elevations and forest cover types

Compartment ID	Acres	Elevation	Highest basal area present in the overstory and midstory
1 A	1,410	260'-280'	Sweetgum, Water Oak, Willow Oak, Pine, Hickory
1 B	704	270'-280'	Sweetgum, Water Oak, Willow Oak, Pine, Hickory
1 C	768	260'-270'	Sweetgum, Pine, Hickory, Water Oak, Elm
2 A	893	265'-280'	Sweetgum, Water Oak, Elm, American Holly
2 B	1,350	270'-280'	Sweetgum, Water Oak, Hickory, Willow Oak
3 A	1,537	275'-285'	Willow Oak, Sweetgum, Cherrybark, Hickory, Water Oak, White Oak
3 B	1,957	275'-285'	Sweetgum, Water Oak, Willow Oak, Overcup Oak, American Holly
4 A	1,065	285'-310'	Sweetgum, Willow Oak, Hickory, Cherrybark Oak, Pine, Overcup Oak
4 B	1,049	280'-305'	Willow Oak, Sweetgum, Pine
4 C	1,230	280'-290'	Sweetgum, Willow Oak, Hickory, Water Oak
5 A	858	280'-300'	Sweetgum, Water Oak, Willow Oak
5 B	1,953	280'-290'	Sweetgum, Hickory, Water Oak, Willow Oak, Post Oak
5 C	1,788	275'-290'	Willow Oak, Sweetgum, Water Oak, White Oak, Hickory, Post Oak

Compartment ID	Acres	Elevation	Highest basal area present in the overstory and midstory
6 A	2,036	270'-350'	Sweetgum, Willow Oak, Hickory, Water Oak, Nuttall Oak, Pine
6 B	1,707	270'-290'	Hickory, Sweetgum, Willow Oak, Nuttall Oak, Cherrybark Oak
7 A	1,585	290'-305'	Cherrybark Oak, Hickory, Sweetgum, Willow Oak, Water Oak
7 B	1,091	290'-305'	Willow Oak, Water Oak, Overcup Oak, Nuttall Oak, Hickory, Sweetgum
7 C	1,484	285'-300'	Willow Oak, Sweetgum, Water Oak, Hickory, Overcup, Blackgum
8 A	1,024	265'-285'	Willow Oak, Sweetgum, Hickory, Water Oak, Hackberry, Cherrybark Oak
8 B	1,390	265'-280'	Willow Oak, Sweetgum, Water Oak, Hickory
majority of acreage below 275' MSL			
majority of acreage above 285' MSL			

are in the low 90s. The mean January low does not fall below freezing. This leads to a relatively long growing season of 220 days (Skiles n.d.).

Average annual precipitation is 50 inches. Rainfall is well distributed throughout the year, ranging from 3-4 inches per month from June through November, and 4-6 inches per month from December through May (Smith 1989). The average annual runoff in the watershed is 18-20 inches, with most of it occurring from December to April. Evaporation exceeds precipitation in the summer months (Skiles n.d.). These climatic values play an important role in influencing the area's hydrologic regime, which subsequently shapes ecosystem processes and functions.

C-2. TOPOGRAPHY AND HYDROLOGY

Physiographically, the refuge is located on the upper West Gulf Coastal Plain under the Bailey ecoregion classification system (USDA Forest Service Publication 1995). Much of the geology is recent (Holocene and Pleistocene) alluvium derived from Coastal Plain Cretaceous parent material and outwash from the Ouachita Mountains, including extensive calcareous deposits in association with the usual noncalcareous material typical of the Coastal Plain. This alluvium, which forms the channels of the Cossatot and Little Rivers and associated terraces and meander scars, has been sorted, reworked, and deposited many times by riverine processes. The rest of the area located between the Little and Cossatot Rivers contains Upper Cretaceous Woodbine and Tokio formations formed by silt and clay deposition into shallow ocean water 135 million years ago (U.S. Geological Survey 1996).

This forested wetland has a relatively narrow topographic relief, with a difference of only 30 feet between the lowest point at the mouth of the Cossatot River (elevation 260 feet above mean sea level), and the furthest point 7 miles upstream on Pond Creek. Although relatively flat, this topography is complex with numerous stream and river channels, small tributaries and depressions, old river meanders and oxbow lakes, multiple river terraces in various stages of erosion and deposition, and adjacent poorly drained flats. The subtle but complex topography has a dramatic effect on the biotic communities that have evolved here.

C-3. SOILS

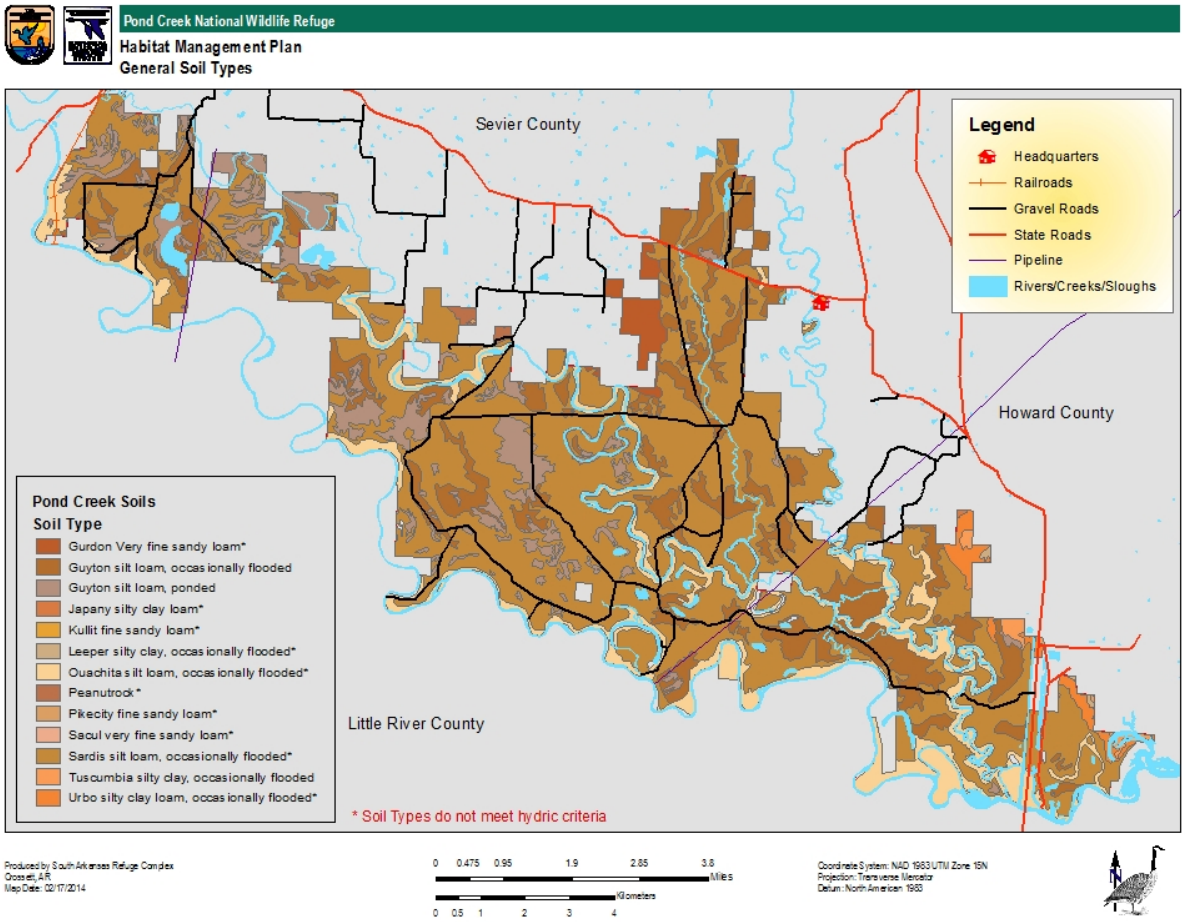
Soils provide further evidence of the complexity of the Pond Creek system (Figure 3). A combination of hydric and non-hydric soils, from two broad series of soil groups.

The Guyton-Sardis soil series group consists of deep, usually level, poorly drained loams and silty loams formed from alluvium on floodplains and terraces. These soils are often sorted by particle size, creating clay lenses and perched water tables, as well as restricted areas of well-drained deep sands. This series group is also associated with more recent alluvium and riverine deposits (U.S. Soil Conservation Service 1984).

The Smithdale-Sacul-Savanna-Saffel soil series group contains deep, moderately well drained, and well drained loamy soils formed in loamy and clayey deposits from marine sediments. These soils date from older Cretaceous age sediments with some input of clay size particles during recent (Holocene) flood events (U.S. Soil Conservation Service 1974, 1984).

Both groups of soils are rich and fertile and support a diverse native forest cover. They are subject to a low erosion hazard and have high capability to recover after disturbance.

Figure 3. Pond Creek NWR soil types.



C-4. GEOMORPHOLOGY

The refuge is located on the floodplain and overflow bottoms formed at the junction of the Little and Cossatot Rivers upstream from Millwood Lake. Generally, the Little River forms the southern boundary of the refuge and the Cossatot River forms the eastern boundary.

The refuge's northern boundary follows the Woodbine escarpment, a relatively low rise that separates the bottoms from the uplands. Pond Creek runs through the middle of the refuge, with approximately half of its watershed within the refuge and many of its south-flowing tributaries reaching into the uplands directly north. Open water covers about 2 percent of the refuge. Virtually all of the refuge (elevation below 290 feet) is part of the Millwood Lake flood pool, with the flowage easement held by the U. S. Army Corps of Engineers.

From its headwaters in the Ouachita Mountains, the Little River system drains a 3,450-square-mile watershed in southeast Oklahoma and southwest Arkansas (U.S. Geological Survey 1978). The Little River and its tributaries support a high-quality, biologically diverse system, with portions of the river in Arkansas and Oklahoma designated "wild and scenic," "high-quality water," "ecologicallysensitive waterbody," and "outstanding resource water." Many of the Little River's tributaries, including the Cossatot River, have similar designations. Within the refuge, the State of Arkansas has designated the Little River as an "Ecologically Sensitive Waterbody" (Arkansas Department of Pollution Control and Ecology 1991; Oklahoma Water Resources Board 1991).

Historically, before the construction of man-made dams and artificial impoundments in the Little River watershed, the area's annual hydrologic cycle reflected the natural effects of seasonal rainfall patterns, runoff from the Ouachita Mountains, localized heavy rains, and a flat topographic profile. Generally, low flows on the Little and Cossatot Rivers, combined with high rates of evapotranspiration, caused the bottoms to dry out from June through November. Localized heavy rains could cause parts of the bottoms to flood temporarily at any time. Flooding of low areas would begin in December with high water levels reached in February and March. This flooding was prolonged and deep in areas directly adjacent to Pond Creek and the often extensive isolated depressions and low bottoms; it was shallow and temporary in the higher bottoms and terraces. The system's abundant sloughs, oxbows, beaver ponds, and shrub swamps held water throughout the year in all but the driest times. Although probably infrequent, these extremely dry periods dried out a significant percentage of the small streams and depressions which were required for the successful reproduction of many otherwise water-tolerant plants.

Hence, before the dams were built, the wetlands of the refuge were an extremely dynamic system with the hydrology over short and long periods shaping the biota in a spatially and temporally diverse manner. Precipitation in conjunction with the flat topography and small channels quickly exceeded the short-term capacity of the system to carry away rainfall. The relatively shallow depressions in the bottoms were the first to be inundated by fall rains, and this slowed down the evapotranspiration rates and consequently increased runoff. Runoff from the upper mountainous watershed filled the main river channels and caused back flooding in Pond Creek and its tributaries, as well as the lower bottoms. As the season proceeded, the flooded areas expanded and connected, affecting larger and larger areas. Actual overbank flooding of the Little and Cossatot Rivers, however, does not appear to have been an annual occurrence, and many higher terraces were seldom flooded. If any overbank flooding did occur, it was caused by the subsequent runoff of heavy winter rains in the Ouachita Mountains. Drying out took place in reverse order; the first areas flooded were thus the last to dry in a complex interaction between the main stem rivers and their tributaries and distributaries.

These hydrologic changes are a complexity laid on an already complex ecosystem. Different parts of the refuge are now adapting in different ways to the various impacts. The highest peaks of flooding have been reduced; the high bottoms and terraces are no longer flooding; and the drying out of the lowest areas is being prevented. Much of the refuge today appears to be wetter longer than it was historically, and the forest cover is changing in response to this hydrologic change (The Nature Conservancy 1995). Ponding by beavers also appears to be more extensive than it was historically, according to the experience of local people.

The refuge is located in the high recharge area of the Quaternary aquifer of the Red River Basin. This is the single most important aquifer in the three counties surrounding the refuge. Most municipal use is drawn from this aquifer, as well as rural and agricultural use to the south of the Little River in Little River County. The well closest to the refuge is at Wilton, where 20,000 gallons are withdrawn per day. Recharge to the aquifer is from precipitation and seasonal high-river flows. Well water levels have remained stable through the 1980s, and no significant problems exist with current uses. Although the groundwater is hard and needs treatment for municipal use, no degradation in quality has occurred. Relatively small amounts of water are withdrawn from localized aquifers in various Cretaceous geologic formations to the north (at Horatio, Lockesburg, and Ben Lomond) for rural and municipal use. The discharge from these aquifers provides base flow for the south-flowing tributaries of Pond Creek. The water levels in these aquifers are also essentially stable and no degradation in quality has occurred (U.S. Department of Agriculture 1987). There is no known current impact from groundwater withdrawals on the Pond Creek Bottoms ecosystem. Large increases in withdrawals are not anticipated due to the lack of irrigated agriculture. The refuge is important for the role it plays in protecting a significant portion of the Quaternary aquifer recharge area.

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

D. CULTURAL AND REFUGE LAND HISTORY

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 southern Arkansas 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 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 is 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 HMP.

Unlike other portions of Arkansas, Sevier and Little River Counties have received little attention from archaeologists and historians. Information on prehistoric and early historic Native American cultures is drawn from immediately adjacent areas, such as the Great Bend, the Ouachita Valley, and Little River regions of southwest Arkansas, northwest Louisiana, and eastern Oklahoma, where a number of archaeological investigations have occurred. Documentation of the historic land use of the refuge seems to be limited to 19th and early 20th Century farmsteads and logging.

Between 9000-8000 B.C., the region's boreal forests were in transition to ones dominated by deciduous species. By 8000 B.C., the MAV was covered by cypress-gum forests with mixed hardwoods along the valley margins.

D-1. PRE-EUROPEAN SETTLEMENT CONDITIONS

A thorough analysis of pre-settlement vegetation is not available for this section of Arkansas; however, the community composition appears to have been maintained albeit with a younger structure.

Bottomlands in southern Arkansas consist of bottomland hardwood forests, baldcypress/tupelo swamps, sloughs, scrub/shrub wetlands, lakes, ponds, rivers, and bayous. Because rivers, bayous, and lakes are not generally managed, this section will focus on hardwood forests. These forests are 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 LMAV (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.

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, they were intact, pristine wilderness areas.

D-2. SALT INDUSTRY

Like the Caddos earlier, production of salt fueled the early frontier economy in Sevier County. Use of Salt Lake or Salt Slough, located in the western portion of the county and the Rolling Fork River, may have begun as early as the 1810s with the arrival of Joseph McKean. By the 1830s, a handful of individuals operated salt works at sites leased from the territorial government. Salt works were operated by Greene Orr at Rolling Fork Lick, later known as the Hamilton Salt Works, Robert Hamilton at Salt Lake Works, and John Clark and Benjamin Patton as partners of works on both the Saline and Rolling Fork Rivers. The salt works declined in economic importance after the 1860s due to the construction of the railroad, cheaper salt production in the east, and lack of access to navigable streams. By the early 20th Century, the works were abandoned (Johnson 1994).

D-3. LOGGING INDUSTRY

The post-Civil War industrial development in the Midwest and the north spurred the need for many of the untapped natural resources, such as timber, coal, and iron of the South. Investors purchased substantial tracts of land and constructed their own mills and company towns (Jeter et al. 1989). DeQueen's 1900 census documented the importance of the logging industry in Sevier County. A number of residents was listed as loggers (timber men, haulers, and lumbermen); laborers in the saw, planning, and stave mills; sanders; saw filers; tie makers; administrative staff of the mills; and timber

inspectors. Other important pursuits included brick manufacture, the railroad, agriculture, black smithing, and mercantile (DeQueen 1987).

D-4. FIRE MANAGEMENT

Historically, wildfires occurred on Pond Creek NWR sporadically and under specific conditions. However, the hardwood dominated forest communities within Pond Creek NWR are not fire-dependent systems.

Prescribed fire is a cost effective tool that can be used to alter vegetation composition and structure, serve as an agent of disturbance to promote early successional species and reduce hazardous fuel accumulations. 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.

Prescribed fire may be used on Pond Creek NWR for multiple reasons including but not limited to moist soil unit management, control of less desirable woody species, promotion of herbaceous ground cover, hazardous fuel reduction and site preparation for reforestation efforts.

Wildfire potential on Pond Creek NWR is currently very high due to flammable mid and understory species, low crown heights, stressed or dying trees, disease or insect attacks which are often associated with off-site plantations. When coupled with seasonal conditions these may contribute to high fire danger.

FWS and Arkansas State Forestry Commission have a cooperative agreement which generally states, each agency may respond to, or assist with fire suppression on adjacent lands. Arkansas Forestry Commission resources are the closest forestry fire fighting resources available to protect Pond Creek NWR. A copy of the agreement can be found in the South Arkansas Fire Management Plan (USFWS 2010)

Federal suppression resources are allocated based on considerations for human safety, actual and potential fire behavior, fire occurrence threat, values to be protected and expected suppression cost. During periods of high fire danger (prolonged drought or high fire occurrence) resources are shared/ transferred/temporarily reassigned to affected areas like what happened in the severity packages implemented on Pond Creek in 1999, 2010 and 2011.

Arson was listed as the source of ignition for several wildfires that occurred on Pond Creek in 1999. One grew to 210 acres (140 FWS, 70 private). It burned through 10 year old pine plantation when the KBDI was 750 out of 800 (very dry).

E. CURRENT CONDITIONS AND HABITAT TYPES

Today, the hydrologic regime on Pond Creek NWR has changed. Flood control dams on the Little River and its main tributaries, in both upper and lower watersheds, have altered the high and low flows of the river with cascading impacts on the duration, timing, and depth of flooding in the bottoms. Landscape changes in the watershed–primarily from the conversion of forests and grasslands to pine plantations and pastures–could also be impacting the ecosystem. Although historical hydrological data for the ecosystem are lacking, some impacts can be projected. Local knowledge combined with historical accounts of the area, along with changes in the current forest cover, reflect the altered hydrologic regime and will become more evident over time (The Nature Conservancy 1995).

The dams and artificial impoundments in the upper watershed are intended for flood control (Alan Smith, pers. comm. 1997). During times of high runoff, they store water; during times of low water, they release it. The effects on the forested wetlands of the refuge include a reduction in peak flooding with a longer duration of moderate and low flooding and drying out periods. The Millwood Lake pool, below the refuge, extends the duration of low and moderate flooding on the refuge by causing backwater flooding when the lake's water levels are high, thus extending the time it takes the bottoms to drain and dry out. Although never used, the U.S. Army Corps of Engineers' flood easement could store water in the refuge during severe floods for extended periods of time. The effects of the land-use changes are much harder to analyze, but they appear to be working in the opposite direction of the dams, with land clearing increasing runoff and short-term peak flows.

Silvicultural practices on the refuge prior to acquisition have resulted in a younger forest, with 25-30 percent in an early successional stage and/or young pine plantation. An extensive elevated road and drainage network, which was constructed to support these silvicultural activities, now modifies and restricts the local water flow patterns. These changes have greatly favored the life cycle and population growth of beaver, resulting in a large increase in beaver density, beaver pond formation, and subsequent destruction of timber.

Pond Creek NWR is an extensive wetland complex comprised of forested overflow bottoms and riparian forests of the Little River, the Cossatot River, Bridge Creek, and Pond Creek. The refuge is approximately 95 percent forested, with small areas of open water, shrub swamps, beaver ponds, open marsh, and roads. The refuge is a very fertile area with a high site index, fast tree growth, and a unique ability to recover quickly from natural disturbance. The diverse plant communities reflect the small elevation changes, complex soils, and natural hydrological changes throughout the refuge.

The forested matrix contains mostly natural second- and third-growth hardwood forests, with inclusions of loblolly pine communities on high terraces, stringers of riparian forests along the Little and Cossatot Rivers, cypress swamps and cypress-lined oxbow lakes, buttonbush shrub swamps, open sedge marshes, and young pine plantations (Table 2). The canopy trees in this matrix forest are 50-70 years old, with scattered patches of much older trees (The Nature Conservancy 1995; Arkansas Natural Heritage Commission 1991).

Most of the area is a contiguous forest of hardwoods, pine-hardwoods, and pine plantations. Weyerhaeuser Company converted about 6,000 acres of hardwoods to pine plantations from 1977 through 1987. Since 2004, in an effort to restore hardwood habitat, the refuge has harvested approximately 4,000 acres of plantation pine. The natural regeneration throughout these plantations was sufficient to convert these areas back to hardwood-dominated stands. Approximately 2,000 acres remain to be harvested and efforts are underway for a timber-for-land exchange.

Since completion of the CCP, the refuge has acquired a 275-acre tract known as the Ward tract. This land was divided into 128 acres of Wetlands Reserve Program (WRP) afforestation, 52.3 acres of moist-soil units, and 94.7 acres of existing hardwood habitat. The use of fire could potentially be considered in conjunction with management of moist soils, as well as in some other refuge habitats.

E-1. NATIVE HARDWOOD FORESTS

Pond Creek NWR is a fertile area with a high site index, fast tree growth, and quick recovery from disturbance (Arkansas Natural Heritage Commission 1991). The forest community includes an abundance of oaks (water - *Quercus nigra,* willow - *Quercus phellos,* overcup - *Quercus lyrata,* Nuttall

- *Quercus texana*, cherrybark - *Quercus pagoda*, cow - *Quercus prinus*, white - *Quercus alba*, Shumard - *Quercus shumardii*, delta post - *Quercus similis*) and hickories (water - *Carya aquatica*, pecan - *Carya illinoensis*, shellbark - *Carya laciniosa*, bitternut - *Carya cordiformis*, mockernut - *Carya tomentosa*). Other species present include bald cypress (*Taxodium distichum)*, loblolly pine (*Pinus taeda)*, American holly (*Ilex opaca)*, river birch (*Betula nigra)*, red and silver maple (*Acer rubrum* and *A. saccharinum*), sweetgum (*Liquidambar styraciflua)*, sycamore (*Platanus occidentalis)*, blackgum (*Nyssa sylvatica)*, sugarberry (*Celtis laevigata)*, American elm *(Ulmus americana)*, and green ash (*Fraxinus pennsylvanica)*. The understory includes small trees and shrubs such as swamp and rough leaf dogwood (*Cornus alternifolia* and *C. drummondii*), American holly (*Ilex opaca*), buttonbush *(Cephalanthus occidentalis),* pawpaw (*Asimina triloba)*, hornbeam (*Carpinus* spp.) and switchcane *(Arundinaria gigantea)*. These forests also contain a heavy vine component that adds substantially to the vegetative diversity (The Nature Conservancy 1996). Due to the diversity of the forested communities at Pond Creek NWR, it is difficult to identify and virtually impossible to accurately map Society of American Forester's stand types on the refuge. Table 2 identifies the top species in each forest management compartment according to basal area present in the overstory and midstory.

The forests in this area have been selectively harvested since settlement, except perhaps for a few isolated stands of hardwoods and cypress-lined lakes which appear uncut. The hardwood forests have retained their species diversity but appear relatively even-aged without some of the structure found in old-growth forests. Very large trees, apparently ancient culls, and small stands of old growth are scattered throughout the bottoms mostly in the wettest and least accessible areas. The stands present along some stream systems, apparently placed in stream side management zones by the previous owner, exhibit less disturbance than most of the forest proper. The most impacted forest communities were found on the drier sites and areas easier to drain (The Nature Conservancy 1995). Prior to settlement, it is likely that willow, water and cherrybark oaks along with some composition of loblolly pine on the stream terraces were the dominant trees across much of the refuge. Obviously, wetter site species such as Nuttall oak, overcup oak and cypress occurred along and in the stream courses, oxbow lakes and low elevation sites. A thorough analysis of pre-settlement vegetation is not available for this section of Arkansas; however, the community composition appears at least partially intact albeit with a younger structure and a higher than normal defect rate. Locally, recent silvicultural practices in the area have resulted in a much younger forest, with 25-30 percent in early successional stages.

Southern forested wetlands have always been subject to natural disturbance. Weather phenomena, especially wind storms, ice storms, and severe drought, cause short-term permutations through the creation of gaps and episodic reproductive events. Flooding, even severe events, is probably not a major negative force due to the diffusing and buffering effects a large forested wetland has on floods and the fact that most species occurring in a flood plain are water tolerant to some degree. The natural meandering of river channels does cause disturbance by removing land from one bank, and depositing it on the other.

The area around Pond Creek NWR is rural with forests occurring on roughly 70 percent of Sevier County. The remainder of the county has 26 percent of the total land area in small family farms devoted to livestock and/or hay production with only four (4) percent of the total land area under crop production (U.S. Dept. of Agriculture, 1992). Commercial forest industry is the largest landowner and owns 49 percent of all county forested acreage. Non-industrial private land owners, other corporations and the U.S. Government own 34, 13 and four (4) percent, respectively, of the forest lands in this county (USDA, Forest Service, 1995). Virtually all of the forest industry ownership and significant amounts of the remaining forested ownership have been converted to short rotation loblolly pine plantations.

E-2. MOIST-SOIL

Hemi-marsh and native vegetation management provide broad cover and optimal food resources, resulting in the best habitat management outcomes for migrating, staging and wintering waterfowl. Areas managed to create shallow water levels, native emergent patches, and a hemi-marsh condition provide habitat conditions for waterfowl use throughout the fall migrating and wintering periods to sustain the annual life cycle requirements of waterfowl (Bookhout et al. 1989). The emergent plant component is a 50:50 mix of emergent stands and open water and consists of a wide diversity of native vegetation such as stands of annual moist-soil plants, such as wild millet, panic grasses, sedges, sprangletop, smartweeds, spikerushes, and beggarsticks. Managing native vegetation in the form of moist-soil crops has more benefits for waterfowl than managing agricultural crops.

Although managed areas may deviate from the historic natural conditions in a wetland area, they constitute a management option that is consistent with the Biological Integrity, Diversity, and Environmental Health (BIDEH) policy. Effectively managed moist-soil areas can contribute to diversity on the local scale, and can contribute to landscape-scale conservation of species, which concentrate during migration and winter. Water level manipulation is intended to mimic natural hydrological regimes in a controlled and enhanced manner to maximize plant production. Periodic drawdowns may also alleviate stress to the bottomland hardwood forest during the growing season.

E-3. INVASIVE SPECIES

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

Undoubtedly, the most serious non-native species problem is being caused by the high feral swine population on the refuge. Refuge staff indicated that the hog population is still increasing, despite efforts by staff and several volunteers to shoot all hogs seen on the refuge. Current staffing and funding levels make it impossible control the hogs.

The Biological Review (2009) emphasized the known and suspected impacts of the resident feral swine population on Pond Creek NWR and recent growth of the feral swine population on the refuge and adjacent private lands. Feral swine have an extremely high reproductive potential. A sow can become sexually mature at 6 months old, and can have two litters per year with each litter averaging 4 to 6 piglets; however, litters of 13 have been documented.

Feral swine carry serious diseases, some of which are transmissible to domestic livestock, wildlife, and humans. Feral swine compete with many species of wildlife for food and cover. Hogs can negatively impact wildlife, water sources, native plant species, levees, fragile native habitat such as marshes, and reforested trees, including rare or endangered plants and animals. Damage also occurs in the form of predation of livestock, deer fawns, ground-nesting birds and their eggs, and alligator eggs.

Adequate feral hog population control is expensive and intensive. Effective control programs should utilize all practical methods, which for Pond Creek NWR include shooting by refuge staff and trapping by

refuge staff or agency partners. Given funding, refuge staff could implement updated trap designs. Some land managers involved in feral swine control have had success applying small ear transmitters to hogs and releasing them so they can track the single hog to a group of hogs; the concept is called “Judas Pig” and may have potential application to Pond Creek NWR.

The feral hog problem extends beyond the borders of Pond Creek NWR and adequate control will not occur by focusing solely on the refuge. Therefore, refuge managers should consider partnering with any and all parties who have a stake in feral hog control. Potential partners may include adjacent landowners, Arkansas Game and Fish Commission, USDA Wildlife Services, and the U.S. Army Corps of Engineers.

Much scientific literature exists that documents adverse impacts by feral swine to habitat productivity and reproduction of most native wildlife (Lipscomb 1989; Belden 1972; Belden and Pelton 1976; Scott 1973; Yarrow 1987; Jacobi 1980; Baron 1980; Lacki and Lancia 1986; Willy 1987). Being omnivorous, feral swine utilize virtually every component of the habitat resulting in direct competition with native wildlife, reductions in carrying capacities, and adverse impacts to reproduction/recruitment. In addition, existing documentation indicates feral swine serve as a source for many diseases that impact wildlife as well as domestic livestock and swine. A partial list of these diseases include black plague (Clark et al. 1983), bovine tuberculosis (Nettles et al. 1989), brucellosis (Becker et al. 1978), coccidiosis (Greiner et al. 1982), foot and mouth disease (Pech and Hone 1988), hog cholera (Nettles et al. 1989), Leptospirosis (Clark et al. 1983), parvo (New et al. 1994), pseudorabies (Clark et al. 1983), swine fever (Dahle and Leiss 1992), and Trichinosis (Nettles et al. 1989).

Invasive species that are known to occur within the hardwood forest on the refuge and potentially need control are Chinese privet, Chinese tallow, and Japanese honeysuckle. All of these species have difficulty surviving within the hardwood forests of the refuge that are subject to late spring flooding. However, there are locations where these species may impact hardwood management activities, such as reforestation and underplanting. When Chinese privet and Japanese honeysuckle are present they usually are very invasive and dominate the understory. Known invasive aquatic plants that occur in moist-soil habitats on the refuge and potentially need control are alligatorweed, parrotfeather, and purple loosestrife.

F. HABITAT CHANGES FROM HISTORIC TO CURRENT CONDITIONS

In the first quarter of the 19th Century, there was a shift from hunting-herding to small scale farming. Public land surveys in 1815 opened up large tracts of potentially arable land in Arkansas. The farmsteads were typically small, ranging from 5-20 acres. Primary crops were cotton and corn. Agricultural fields and pastures irregularly arranged and followed topographic features and zones of fertile agricultural soils (Jeter et al. 1989).

Sevier County was established in 1828. Cotton was the primary staple and economic basis for the county through much of its early history. During this time, steamboats operated up the Cossatot, and Little Rivers, ferrying cotton to market. When the cultivation of cotton waned in the early 1900s, logging of the area became important.

The forests in this area have been selectively harvested since settlement, except perhaps for a few isolated stands of hardwoods and cypress-lined lakes which appear uncut. The hardwood forests have retained their species diversity but appear relatively even-aged without some of the structure found in old-growth forests. Very large trees, apparently ancient culls, and small stands of old growth are scattered throughout the bottoms mostly in the wettest and least accessible areas. The stands present along some stream systems, apparently placed in stream side management zones by the

previous owner, exhibit less disturbance than most of the forest proper. The most impacted forest communities were found on the drier sites and areas easier to drain (The Nature Conservancy 1995). Locally, recent silvicultural practices in the area have resulted in a much younger forest, with 25-30 percent in early successional stages.

The area around Pond Creek NWR is rural with forests occurring on roughly 70 percent of Sevier County. The remainder of the county has 26 percent of the total land area in small family farms devoted to livestock and/or hay production with only four (4) percent of the total land area under crop production (U.S. Dept. of Agriculture 1992). The commercial forest industry is the largest landowner and owns 49 percent of all county forested acreage. Non-industrial private landowners, other corporations and the U.S. Government own 34, 13, and 4 percent, respectively, of the forest lands in this county (USDA Forest Service 1995). Virtually all of the forest industry ownership and significant amounts of the remaining forested ownership have been converted to short rotation loblolly pine plantations.

G. CHANGES ASSOCIATED WITH GLOBAL CLIMATE CHANGE

The Intergovernmental Panel on Climate Change (IPCC) has concluded that "warming of the climate system is unequivocal (Metz et al. 2005)." Global climate change poses risks not only to human health but also to terrestrial and aquatic ecosystems. The abundance and distribution of wildlife and fish will change, particularly affecting those species already "at risk." Important economic resources such as agriculture, forestry, and water resources also can be affected. Warmer temperatures, more severe droughts and floods, and sea level rise will have a wide range of impacts. All these stresses, added to existing stresses on resources caused by other influences such as population growth, land-use changes, and pollution, pose a significant challenge for fish and wildlife conservation.

According to NOAA and NASA data, the Earth's average surface temperature has increased by about 1.2 to 1.4ºF since 1900. Some climate models, based on emissions of greenhouse gases, primarily carbon dioxide, methane, and nitrous oxide, predict that average surface temperatures could increase from 2.5 to 10.4ºF by the end of the 21st century. The frequency of extremely hot summer days is expected to increase, along with this general warming trend. Increases in atmospheric CO2 are attributed largely to human activities, which have grown rapidly since the 1940's. The burning of fossil fuels adds 5.6 billion tons of carbon, (and deforestation contributes another 0.4 to 2.5 billion tons of carbon) to the atmosphere each year.

The effects of climate change and global warming will be changes in weather/rainfall patterns, decreases in snow and ice cover, rising sea levels, and stressed ecosystems. For the Southeastern U.S. this could mean extreme precipitation events; greater likelihood of warmer/dryer summers and wetter/reduced winter cold; and, alterations of ecosystems and habitats due to these changes in weather patterns. For Pond Creek NWR, warmer conditions would favor increased densities of vegetation and wetter conditions would favor trees and vegetation that are better adapted to these conditions. If conditions become drier, the current range and density of forests would be reduced and replaced by grasslands and the probability of wildfires would increase.

A recent study of the effects of climate change on Eastern U.S. bird species concluded that as many as 78 bird species could decrease by at least 25 percent while as many as 33 species could increase in abundance by at least 25 percent due to climate and habitat changes (Matthews et al. 2004). In short, global warming could increase storm intensity, negatively change ecologically important plant species, alter the spread of invasive species, increase drought-induced fires, and further imperil already threatened and endangered species.

CHAPTER III. RESOURCES OF CONCERN

Priorities associated with wildlife and habitat management for the Refuge System 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 Service 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 Pond Creek 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)). The species/communities selected as resources of concern from these plans support the following Service mandates:

- Support refuge purposes and the Refuge System 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 Service trust resource responsibilities.

Resources of concern identified for Pond Creek NWR include:

- Wintering waterfowl
- Breeding wood ducks
- Forest interior songbirds
- Rafinesque's big-eared bat

A. WINTERING WATERFOWL

A-1. SIGNIFICANCE

The Mississippi Alluvial Valley (MAV) is one of the six highest priority habitat regions identified in the NAWMP as requiring special attention and conservation action (Yaich 1990). Within the MAV, ten management units were delineated for Arkansas. One of these units is the Red River-Sulphur River-Little River Unit in southwest Arkansas, which encompasses the refuge area. Although waterfowl populations for this region are low compared to those in the more extensive wetland and river systems of the MAV of eastern Arkansas, the numbers of waterfowl that use the area are adequate to provide a base from which to build larger populations through wetland protection and enhancement. Waterfowl, primarily mallards, gadwall, and wood ducks, have traditionally used the seasonally flooded wetland habitats of the refuge. Other species of lesser occurrence include wigeon and green-winged teal.

A-2. IDENTIFICATION OF HABITAT REQUIREMENTS

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 bottomlands, (2) natural wetlands, and (3) refuge (i.e., sanctuary) (Reinecke et al. 1989).

Two natural wetland habitats that ducks have used historically in the MAV 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. On Pond Creek NWR, both hardwood forests and moist-soil habitat exists. Hardwood forests are rich in high-energy natural seeds (e.g., acorns in oak hardwood forests) 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). Waterfowl generally occur in those elevations falling within the 5-year floodplain (generally < 275' MSL). This area experiences annual overbank flooding and contains oxbow lakes, sloughs, beaver ponds, and drains, all routinely providing habitat for wintering waterfowl. This area is exclusively forested with mixed species floodplain hardwoods. This same general area has excellent potential for nongame bird utilization and, in fact, currently receives heavy use from this species group. Resident wildlife values are also high, due in part to a high mast producing component in the various stands. Mast producing tree and shrub species will be favored in all management actions within the limits of compositions set in other parts of this plan. Approximately 3,800 - 4,000 acres falls within this elevation range.

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. The only area currently closed to waterfowl hunting is the WRP acquisition. The moist-soil units on this WRP tract should remain closed and act as the sanctuary area for the refuge.

A-3. POTENTIAL REFUGE CONTRIBUTION TO HABITAT NEEDS

The moist soil impoundments and seasonally-flooded hardwoods within Pond Creek NWR provide the excellent food, cover and undisturbed refuge necessary for wintering waterfowl. Many species of migratory waterfowl, particularly mallards, may utilize refuge habitats from early fall through spring, therefore, a variety of food resources are required to meet the needs throughout this period. Pond Creek NWR can provide an abundance of foods in the form of moist soil seeds in fall, acorns in fall

and winter, macroinvertebrates in late winter and spring, and aquatic invertebrates in spring. The loss of approximately 80% of the original bottomland hardwoods within the MAV (Forsythe and Gard 1980), highlight the importance of the remaining forested wetlands like those at Pond Creek NWR.

B. BREEDING WOOD DUCKS

B-1. SIGNIFICANCE

Wood ducks are year-round residents in the forest lands of the United States, including Pond Creek 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 uncertain. 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).

B-2. IDENTIFICATION OF HABITAT REQUIREMENTS

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 tend to be the primary limiting factor to reproduction. Natural cavities suitable for wood duck nesting are limited at Pond Creek NWR, due to the predominance of young forest structure. 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 increases.

Adequate brood habitat can seriously affect duckling survival and reproductive success. McGilvrey (1968) described preferred brood habitat as 30 to 50 percent shrubs, 40 to 70 percent herbaceous

emergents, and 25 percent open water. Overhead cover within 1 to 2 feet of the water surface is vital for wood duck broods. Optimum habitat should have 75 percent cover and 25 percent 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 percent of their diet (Dugger and Fredrickson 2001). Research has demonstrated that wood ducks feed on a variety of acorn species, and acorn selection by wood ducks is primarily driven by availability. However, in general, most food habit studies indicate that wood ducks prefer cherrybark oak, water oak, Nuttall oak, and willow oak (Bellrose and Holm 1994, pages 407-412). In a study of acorn selection by captive, wild-strain female wood ducks (Barras et al. 1996) found that willow oak acorns were much preferred over cherrybark and Nuttall oak acorns, presumably because of its smaller size and thinner seed coat. 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).

B-3. POTENTIAL REFUGE CONTRIBUTION TO HABITAT NEEDS

Because the refuge is mostly comprised of forested wetlands, it has the opportunity to provide excellent habitat for breeding wood ducks. The Biological Review (USFWS 2009) for Pond Creek NWR suggests wood ducks are an important resource of the refuge. Flooded beaver ponds and sloughs provide excellent nesting and brood-rearing habitat for resident wood ducks.

C. FOREST INTERIOR SONGBIRDS

C-1. SIGNIFICANCE

Pond Creek NWR can play an important role in providing hardwood habitat for forest interior songbirds. Many species of neotropical migratory songbirds are experiencing long-term declines as a result of widespread habitat loss and fragmentation. Bottomland hardwood forests and riparian woodlands have been identified as a top habitat conservation priority throughout the Southeast (Hunter et al. 1992). Conservation and management of the critical hardwood forests on the refuge will enhance the breeding, wintering, and transitional habitats for many species of migratory and resident songbirds.

Avifauna analysis was completed by refuge staff and Service/non-Service bird biologists and researchers during the CCP planning process. This analysis, based upon West Gulf Coastal Plain Partners in Flight Bird Conservation Plan (BCP) criteria, was conducted in order to establish tentative non-game migratory bird suites and indicator species for each suite (USFWS 1998). Other analysis conducted for this area was performed by LMVJV's West Gulf Coastal Plain Landbird Working Group. The indicator species identified by the LMVJV (e.g., highest score by habitat component) is as follows: understory - Swainson's warbler and Kentucky warbler; mid-story - prothonotary warbler; overstory/canopy - swallow-tailed kites and cerulean warbler. These individual species were selected to serve as indicator or representative species for these specific elements or layers of the forest structure.

However, the Biological Review (2009) determined that an uncertainty exists as to the appropriateness to list swallow-tailed kites and cerulean warblers as indicator species in mature, dominant hardwood forests on Pond Creek NWR, since these two species are not known to currently breed in this area.

Lastly, Arkansas Audubon has identified sixty-two species of birds classified as Arkansas Birds of Conservation Interest (ABCI). This classification is assigned due to continued downward trends in population and/or continued loss of habitat. Many of these ABCI species utilize the wetland forest communities of Pond Creek NWR at various times of the year and include black- and yellow-crowned night herons, wood stork, hooded merganser, American woodcock, northern harrier, sharp-shinned hawk, Cooper's hawk, red-headed woodpecker, loggerhead shrike, wood thrush, prothonotary warbler, Swainson's warbler, and worm eating warbler.

C-2. IDENTIFICATION OF HABITAT REQUIREMENTS

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 midstory 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 percent in bottomland hardwood forests where selective timber harvests 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 canopydwelling and forest interior songbirds (Pashley and Barrow 1993) when forests 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 Pond Creek NWR; however, Acadian flycatchers and prothonotary warblers are detected during landbird surveys at much higher rates (USFWS unpub. data). Some of 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. 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, and waterfowl) into the desired forest guidelines for bottomland hardwood forests. These guidelines recommend a reduction in canopy cover, retention of snags and den trees, and an 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, such as 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.

The presence of internal stand structures, both horizontal and vertical along with the spatial arrangement within the stand, is a critical habitat component for virtually all priority species for this refuge. There are many components that influence the management of the forest canopy for the priority wildlife species. These requirements become a detailed list of what the forest canopy layers

should be. The optimum habitat conditions in general are found when basal areas are 60 to 90 square feet per acre. The overstory, during leaf out, with 100 percent being total area covered by leaf area, should be between 60 to 80 percent occupied. Approximately 5 to 15 percent of the stand needs to have emergent crowns. Average crown diameters for dominant/co-dominant stems should be 45 feet or greater. Indicator species targeted by these stand conditions are swallow-tailed kite, cerulean warbler, northern parula, and yellow-throated warbler. During leaf out, mid-story should be between 20 to 50 percent occupied by vegetation. Vines can be considered in this estimation. Mid-story starts at 10 feet and proceeds to the overstory. Birds that are targeted as indicator species utilizing the mid-story include prothonotary warbler, yellow-billed cuckoo, and the Acadian flycatcher. The understory is 3 to 10 feet in height and targets Swainson's, Kentucky, and hooded warblers as indicator species. Ground cover is the most variable component and is dependent on the percentages in the three canopy layers and water amounts. Ground cover ranges from less than 3 feet in height, with the foliage percentages around 20 to 50 percent of the total space available. Two birds that serve as indicator species for this layer are the American woodcock and the Swainson's warbler. Around 70 percent of stands needs vines present in all three canopy layers. Cane thickets should be present on 20 percent of the plots, if the site is appropriate for cane (Hamel and Twedt 2000). All four canopy layer percentages are by ocular estimation.

In management units 2B, 3A, 3B, 5C, 6A, 8A, and 8B, within the 275-285' MSL range forest-dwelling non-game migratory birds will receive highest priority consideration. These sites are forested with mixed species hardwoods, an occasional scattered loblolly pine stem or small clump of pines, a highly diverse mid-story, and a heavy vine component. This elevation range has the highest forest vegetative diversity, with many stands routinely having 30+ species present. These sites are generally transition areas moving upslope to high terraces or off-refuge upland escarpments. Unfortunately, it's within this area that most of the conversion to loblolly pine monoculture occurred. Of the 12,800 - 13,000 acres within this elevation range, an estimated 2,000 acres (+) is now in pine plantations. Extensive stands of switch cane occur within this elevation class which provides exceptional quality habitat for species such as Swainson's warbler. Resident wildlife values are also high within this area and will be given consideration in all management actions.

The highest elevation sites (>285' MSL), units 4A, 4B, 4C, 6A, 7A, 7B, and 7C, occur along stream terraces, abandoned stream meanders, and upland escarpments. This community typically is above the 25-year floodplain and rarely floods. It generally exhibits a small native loblolly pine component throughout its limits and generally has a high American holly component. Acreage in this elevation range is roughly 9,600 - 9,800 acres (+). However, it frequently occurs in narrow ridge top terraces that literally run for miles paralleling stream courses throughout the refuge. Due to the juxtaposition of this community to not only open water systems but also extensive stands of floodplain hardwood forest, it is important to many species of migratory non-game birds and resident wildlife.

C-3. POTENTIAL REFUGE CONTRIBUTION TO HABITAT NEEDS

Widespread habitat loss and fragmentation has caused the decline of many species of neotropical migratory songbirds and highlights the importance of the existing hardwood and riparian forests of Pond Creek NWR. Many species of forest-interior songbirds can be supported at Pond Creek NWR because of the diverse horizontal habitat structure created by variation in wetness gradients and elevation. Furthermore, current and future habitat management will ensure the vertical habitat structure necessary to support forest interior songbirds. Pond Creek NWR has very high potential to provide habitat for canopy-dwelling, shrub-level, and ground-dwelling and nesting birds including many high-priority bird species.

D. RAFINESQUE'S BIG-EARED BAT

D-1. SIGNIFICANCE

Bottomland hardwood systems seem to be important to Rafinesque's big-eared bat (Clark 1990; Clark et al. 1998; Cochran 1999) as both roosting and foraging habitat. Due to the loss of approximately 80 percent of the bottomland hardwoods in the MAV (Tiner 1984), this species has probably been negatively affected. The Rafinesque's big-eared bat populations might be declining in Arkansas (Cochran 1999). This species is a designated federal species of concern (Martin et al. 2002) throughout most of its range. Little is known about species biology and habitat, although it is clearly recognized as a species associated with bottomland hardwood habitats of the southeastern United States. This species is known to use trees with large cavities in wetland habitats for roosting, particularly tupelo and bald cypress in areas where trees of this species and size are found in concentration. Conversion of hardwood habitats and historic removal of large trees within forested habitat contribute to the concern for the species within Arkansas and throughout the range. Rafinesque's big-eared bats also use man-made structures such as abandoned houses, barns, and cisterns for roosting, and this plasticity may allow extended habitat use in areas where trees with large cavities suitable for roosting are limited. Pond Creek NWR likely provides significant habitat for this species within a largely altered landscape and contributes towards the conservation of this species.

D-2. IDENTIFICATION OF HABITAT REQUIREMENTS

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

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 (Table 3).

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

Species	***Attribute***	***Reference***
	Stand Density	
Baldcypress	≥ 2.5 cm d.b.h. target 593 live trees /ha	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	90-150 cm	Sargent 1965, Harlow and Harrar 1969
Tupelo	63-122 cm	Martin and Smith 1991, Sargent 1965
	Stand basal area	
Baldcypress	7.7 m^2/ha	Hall and Penfound 1939
Tupelo	6.7 m^2/ha	
	Height	
Baldcypress	30.5-36.6 m	Harlow and Harrar 1969
Tupelo	24.4-27.4 m	Harlow and Harrar 1969
	Need several standing snags and downed logs of baldcypress and tupelo	Martin and Smith 1991

D-3. POTENTIAL REFUGE CONTRIBUTION TO HABITAT NEEDS

The mature cypress-tupelo swamps and hardwood and riparian forests of Pond Creek NWR can provide suitable roosting and foraging habitat for Rafinesque's big-eared bats. Roosting sites may become more abundant as these wetland forests mature and trees reach the size and condition necessary to provide suitable roost cavities. As with the other resources of concern listed above, the loss of hardwood forests in the Southeast increases the importance of all remaining wetland forests like those found at Pond Creek NWR.

CHAPTER IV. HABITAT MANAGEMENT GOALS AND OBJECTIVES

For habitats that require active management, goals and objectives were developed in the refuge's CCP, which are expanded upon or combined in this HMP 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 Chapter IV. The habitat management compartments are referenced in Figure 2 and Table 2.

A. HABITAT MANAGEMENT CCP GOAL

Restore and maintain diverse native riparian forested habitats designed to achieve refuge purposes and wildlife population objectives.

A-1. NATIVE HARDWOOD HABITAT MANAGEMENT OBJECTIVE (CCP GOAL 1, OBJECITIVE 1, 2)

Implement adaptive management to maintain 35-50 percent of 25,535 acres of hardwood forests at any given time at a basal area of 60-70 ft^2/acre, for a canopy cover between 60-70 percent, 25-40 percent midstory cover, 25-40 percent understory cover, and 20-50 percent ground cover, with regeneration of hard mast producing species (e.g., oaks and hickories) present on 30-50 percent of inventory plots (LMVJV 2007) for a diversity of wildlife species, particularly waterfowl, wading birds, and migratory forest-dwelling land-birds.

Resources of Concern: Wintering waterfowl; breeding wood ducks; forest interior songbirds; and Rafinesque's big-eared bat.

Rationale: This objective will achieve a diverse forest with a thick understory, well-developed midstory, and plenty of canopy dominants to produce hard and soft mast, and to provide snags and regeneration. Forest interior songbirds benefit from the vertical structure provided. Wintering waterfowl and wood ducks benefit from the mast produced. Bats will be provided foraging and roost habitat.

Adaptive Management Monitoring Elements

Habitat Response Variables	Probable Methods
▪ Percent herbaceous cover (desirable/non-desireable) ▪ Forest overstory structure ▪ Area (acres) in condition ▪ Hardwood regeneration within target treated areas	▪ Herbaceous cover plots (x samples/season) ▪ Forest cruise/inventory sampling (traditional parameters, e.g., BA, overstory CC, stocking) ▪ GIS stand maps and harvest records ▪ Regeneration sample plots
Wildlife Response Variables	**Probable Methods**
▪ Wintering waterfowl use ▪ Forest breeding birds (species composition and abundance) ▪ Breeding wood ducks ▪ Rafinesque's big-eared bat	▪ Waterfowl Counts (bi-weekly Sept 15-Apr 01) ▪ Breeding landbird survey (point counts) ▪ Cavity tree surveys (wood ducks and bats)

A-2. REFORESTATION HABITAT MANAGEMENT OBJECTIVE (CCP GOAL 1, OBJECTIVE 3)

In units 3A, 3B, 4A, 4B, 4C, 5B, 5C, and 6A, restore approximately 2,000 acres of pine plantations into hardwood forests through sound silvicultural practice as outlined in 2003 Forest Management Plan and Environmental Assessment. Conversion to hardwood forests would occur through a combination of planting of hardwoods and natural regeneration based upon existing regeneration prior to harvest (Table 4).

Resources of Concern: Breeding wood ducks; forest interior songbirds.

Rationale: Most of the area is a contiguous forest of native hardwoods, pine-hardwoods, and pine plantations. The Weyerhaeuser Company converted about 6,000 acres of hardwoods to pine plantations 20 to 40 years ago. Since 2004, the refuge has harvested approximately 4,000 acres of plantation pine, with about 2,000 acres remaining to be harvested. Natural regeneration of hardwood species was abundant enough in each of the plantation cuts so that no reforestation was necessary to convert these areas back to hardwood-dominated stands. One of the most striking features of the refuge's hardwood forests is the diversity of tree species.

Adaptive Management Monitoring Elements

Habitat Response Variables	Probable Methods
▪ Percent herbaceous cover (desirable/non-desireable) ▪ Forest overstory structure ▪ Area (acres) in condition ▪ Hardwood regeneration within target treated areas	▪ Herbaceous cover plots (x samples/season) ▪ Forest cruise/inventory sampling (traditional parameters, e.g., BA, overstory CC, stocking) ▪ GIS stand maps & harvest records ▪ Regeneration sample plots
Wildlife Response Variables	**Probable Methods**
▪ Forest breeding birds (species composition and abundance) ▪ Breeding wood ducks	▪ Breeding landbird survey (point counts) ▪ Cavity tree surveys (wood ducks)

Table 4. Species list for planting of pine plantation cuts at Pond Creek NWR

Cherrybark Oak	*Quercus pagoda*
Water Oak	*Quercus nigra*
Willow Oak	*Quercus phellos*
White Oak	*Quercus alba*
Post Oak	*Quercus stellata*
Nuttall Oak	*Quercus nuttallii*
Overcup Oak	*Quercus lyrata*
American Elm	*Ulmus americana*

Sweetgum	*Liquidambar styraciflua*
Blackgum	*Nyssa sylvatica*
Red Maple	*Acer rubrum*
Sugarberry	*Celtis laevigata*
Sycamore	*Platanus occidentalis*
Bald Cypress	*Taxodium distichum*
Persimmon	*Diospyros virginiana*
Green Ash	*Fraxinus pennsylvanica*
Water Hickory	*Carya aquatic*
Mockernut Hickory	*Carya tomentosa*
Bitternut Hickory	*Carya cordiformis*

A-3. MOIST-SOIL HABITAT MANAGEMENT OBJECTIVE (CCP GOAL 1, OBJECTIVE 4)

Use adaptive management on the existing 52 acres of moist-soil habitat units 1, 2, and 3, to promote desirable vegetation through a combination of water manipulation, mechanical, chemical, and/or fire treatments for shorebirds and wintering waterfowl. Within 2 years, create a 200-acre, semi-permanent wetland unit to provide feeding and resting areas for wintering waterfowl.

Resources of Concern: Wintering waterfowl

Rationale: Moist-soil management will be directed towards managing for preferred foods by varying flooding and de-watering of units. Soil moisture, soil temperature, rainfall, drought, existing vegetation, and management objectives will determine exact prescription. Drawdowns will occur from early March to mid- or late-summer depending on the moist-soil plants the refuge manager is trying to promote.

Adaptive Management Monitoring Elements

Habitat Response Variables	**Probable Methods**
▪ Percent herbaceous cover (desirable/non-desireable)	▪ Herbaceous cover plots (x samples/season)
Wildlife Response Variables	**Probable Methods**
▪ Wintering waterfowl use	▪ Waterfowl Counts (bi-weekly Sept 15-Apr 01)

A-4. GREENTREE RESERVOIR HABITAT MANAGEMENT OBJECTIVE (CCP GOAL 1, OBJECTIVE 1, 2)

Within 2 years, create and manage two greentree reservoir (GTR) units in Compartments 6A (86 acres) and 7B (311 acres), with levees and water control structures to provide feeding areas for wintering waterfowl (Figures 4 and 5). Depth, duration, and timing of flooding will vary annually, and

will include years of no flooding. Utilize adaptive management approach to GTR management that provides high-quality waterfowl habitat and ensures continued health and regeneration of the existing forest.

Resources of Concern: Wintering waterfowl; breeding wood ducks

Rationale: Since the 1930s forested areas throughout the MAV and WGCPO have been leveed and then flooded to make foods such as acorns and other seeds and invertebrates available to waterfowl. Forested wetlands are the most beneficial to waterfowl when adequate water, food and cover are available. Flooding occurs during the dormant season coinciding with the waterfowl migration. A GTR creates a more dependable habitat for waterfowl during the fall and winter. The key to maintaining the productivity of the GTR is to mimic natural water regimes. Adaptive management guidelines also include: (1) No flooding prior to November 30; (2) flood to depths between 6 and 18 inches; (3) gradual drawdowns of the GTR should be complete by March; (4) GTR will remain dry one year in 3 or 5; and (5) alter the depth/duration/timing of flooding and drawdown each year. If negative impacts to the forest are detected due to flooding, water management in the GTR should cease immediately.

Adaptive Management Monitoring Elements

Habitat Response Variables	**Probable Methods**
▪ Percent herbaceous cover (desirable/non-desireable) ▪ Forest overstory structure ▪ Area (acres) in condition ▪ Hardwood regeneration within target treated areas	▪ Herbaceous cover plots (x samples/season) ▪ Forest cruise/inventory sampling (traditional parameters, e.g., BA, overstory CC, stocking) ▪ GIS stand maps and harvest records ▪ Regeneration sample plots
Wildlife Response Variables	**Probable Methods**
▪ Wintering waterfowl use	▪ Waterfowl Counts (bi-weekly Sept 15-Apr 01)

Figure 4. Proposed GTR on Pond Creek NWR in compartment 6A

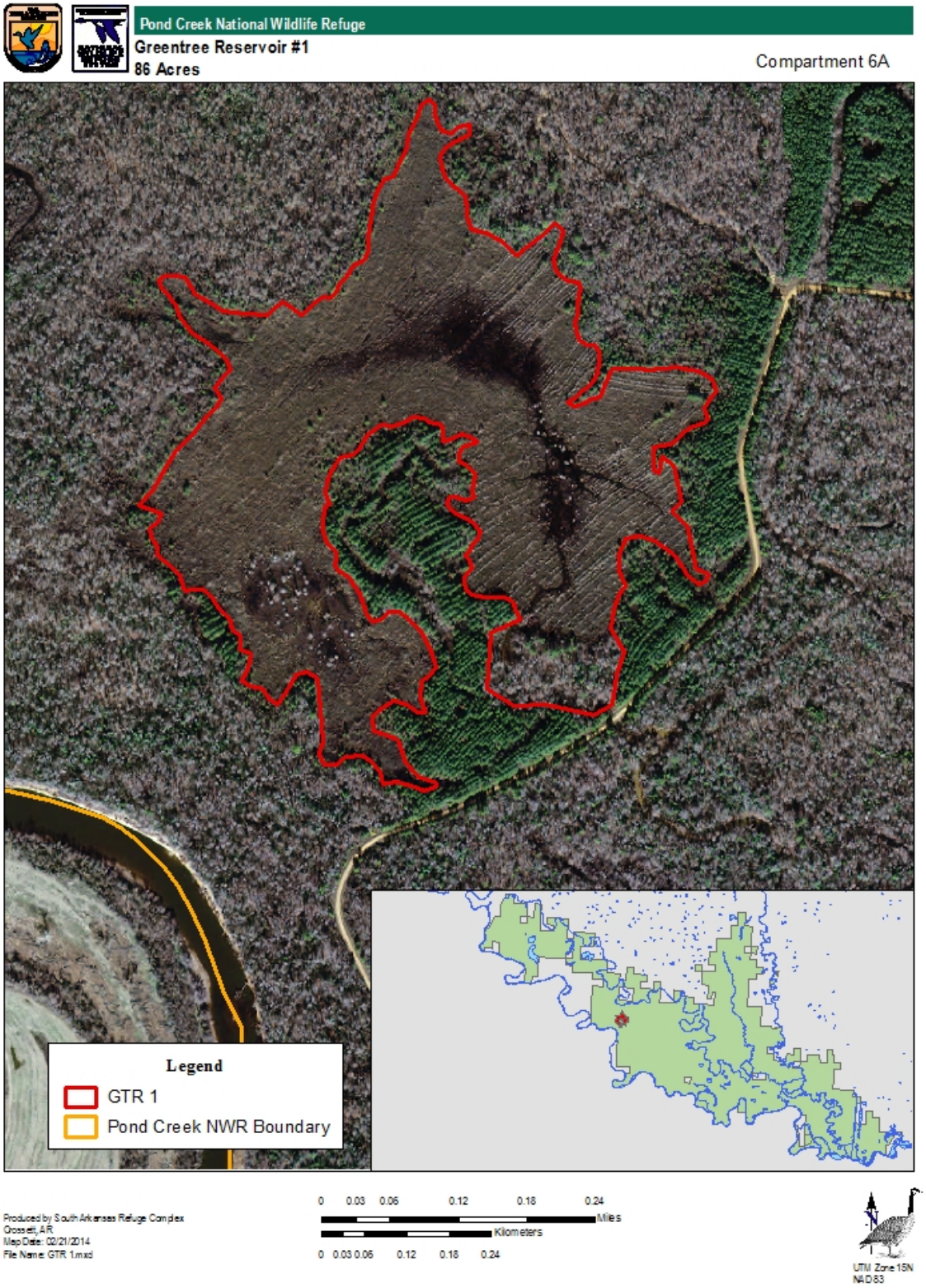
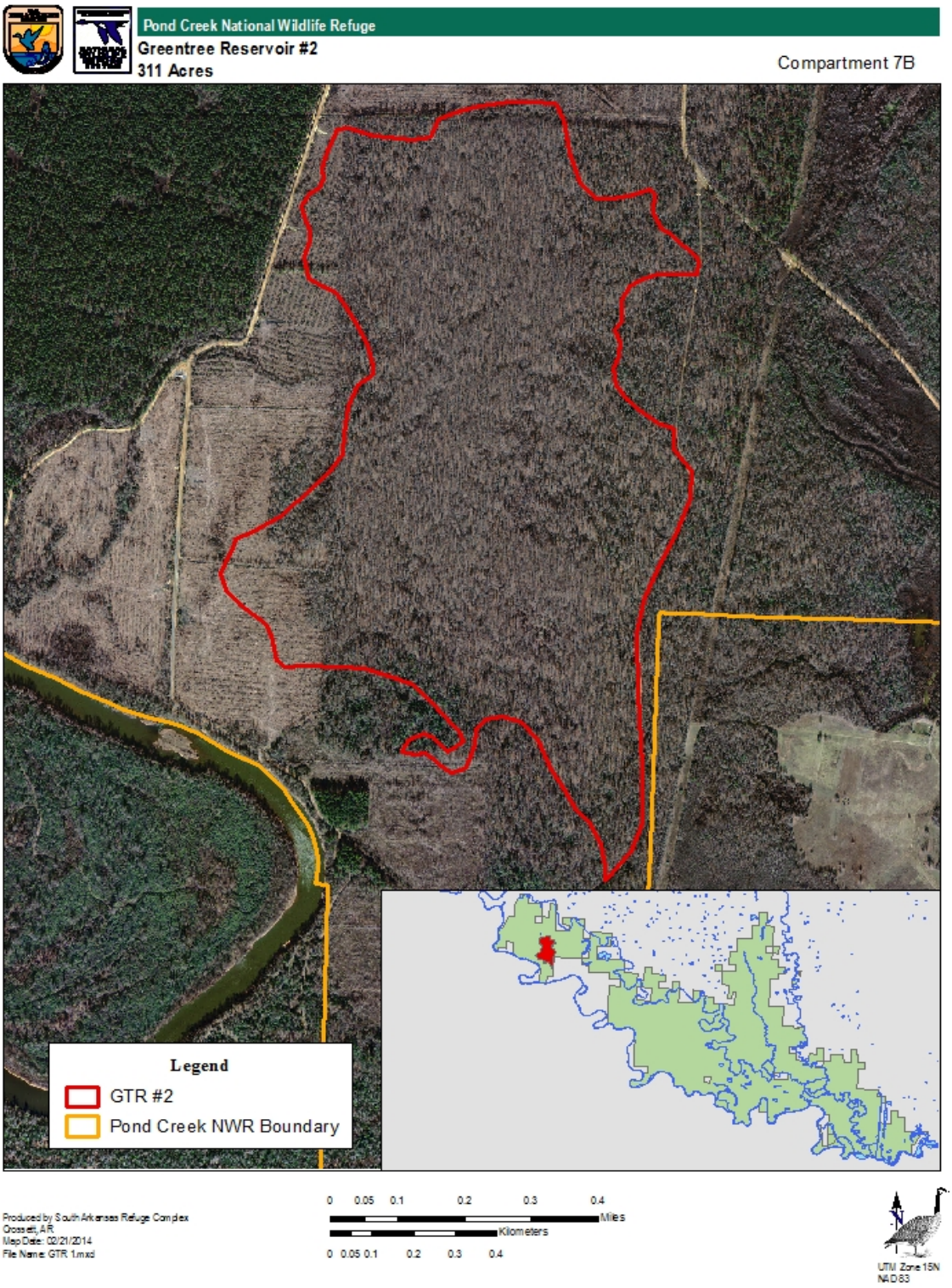


Figure 5. Proposed GTR on Pond Creek NWR in compartment 7B



CHAPTER V. HABITAT MANAGEMENT STRATEGIES

ADAPTIVE MANAGEMENT

USFWS advocates improving habitat management through adaptive management (http://www.fws.gov/policy/620fw1.html). The Service defines adaptive management as "the rigorous application of management, research, and monitoring to gain information and experience necessary to assess and modify management activities. A process that uses feedback from refuge research and monitoring and evaluation of management actions to support or modify objectives and strategies at all planning levels." As such, it is imperative that the impact of forest and wetland management decisions be evaluated with regard to habitat conditions and wildlife response.

A. FOREST HABITAT MANAGEMENT STRATEGIES

POTENTIAL STRATEGIES

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

The purposes of the forest habitat management strategies are to establish and maintain the desired forest conditions specified in the objectives (LMVJV 2007). 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.

A combination of silvicultural methods will be utilized to meet the uneven-aged forest management objectives described in the refuge's CCP and this HMP for hardwood forests. For a complete listing of silvicultural practices that can be utilized on the refuge refer to the 2003 Forest Management Plan, EA and FONSI.

Commercial Timber Harvest Strategies

Commercial timber harvest is the most economical method to manage forest to meet habitat objectives of the refuge. The cost to the refuge associated with non-commercial treatments is much higher than commercial treatments in terms of manpower and funding. However, there are conditions where commercial operations are not feasible and/or cannot meet refuge objectives.

Depending on the existing stand condition and desired outcome there are harvest strategies that can be utilized to meet the forest management objectives described in the refuge CCP/HMP for hardwood forest. The silvicultural methods are:

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.

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.

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.

Patchcuts – Patchcuts are small clearcuts that vary in size from 1 to 7 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.

No Cut – This method would be equivalent to passive management. Areas under this management would be left to grow without silvicultural manipulations.

Salvaging – Insects, diseases and weather are natural forces that affect and alter forest composition and help increase wildlife habitat diversity. Insect and disease management activities would concentrate on major outbreaks that may destroy valuable wildlife habitat and outbreaks that may occur in high public use areas. Normally scattered lightning struck trees, scattered wind thrown trees, or scattered dead diseased trees are protected as snags and are not salvaged unless posing a safety risk. Large groups of damaged trees (i.e. wind thrown, ice/storm damaged and other physically damaged trees) may be salvaged, if it is determined that these trees present a potential for disease outbreaks and a fire or safety.

There are a few threatened and endangered species considerations for forest management at Pond Creek NWR. The refuge is in the range of the proposed endangered Long-eared bat and could provide summer brood-rearing habitat. In the summer months the Long-eared bats use trees with exfoliating bark and snags as maternal colonies. Timber management will have to consider that for treatments undertaken during the summer brooding months a survey of the treatment area may be warranted. Wintertime logging would not directly affect the bats, but this is generally not a feasible option because of flooding and wet soil conditions. Treatments should retain some trees with exfoliating bark and all snags. If snags are underrepresented then any of the harvest strategies above should also include snag creation (herbicide or girdling) as part of a prescription.

Cavity tree retention for breeding wood duck is important within the hardwood forests that are near good brood habitat. Efforts should be made during timber harvest activities to leave tree species that are more prone to cavity formation. Desirable tree species that are prone to cavity formation include bald-cypress, blackgum, sycamore, and beech.

Non-commercial Forest Stand Improvement Strategies

When commercial harvest is not feasible or will not meet a specific habitat objective, forest stand improvement (FSI) work can be an option. FSI practices can produce similar results as the commercial silvicultural methods listed above (i.e., thinning to patchcuts) without the removal of logs.

However, the costs to the refuge in funds and staff time are much greater. FSI work will likely only be done on a relatively small scale and/or when commercial timber harvest is not a feasible option. FSI is typically used to remove undesirable tree species, allow the canopy spread of existing desirable trees, prepare a site for natural seeding, and releasing underplanted seedlings. The development of snags and course dead wood are a few of the positive wildlife benefits of non-commercial FSI practices.

Basically, FSI involves the killing of some or all the trees within a given area. There are several commonly used techniques, each with advantages and disadvantages. Some techniques employ the use of herbicides, while others do not. If herbicides are used, treatments follow the Service Guidelines.

Treatments that do not involve the use of herbicide are felling and girdling. Felling is simply taking the tree to the ground using a chainsaw. This technique results in an immediate removal, releasing the desired trees, similar to commercial harvest. However, felling can be very time consuming and is more dangerous to refuge staff than any of the other techniques. Obviously, this technique does not produce snags. Depending on the tree species and age, stump sprouting can be a problem.

Girdling is cutting to a depth of approximately one inch completely around the tree. If this is done with an ax the bark should be completely removed in a notch that is 2-4 inches in width. Using a chainsaw there should be two cuts 2-4 inches apart that at least 1 inch deep and completely encircle the tree. Girdling is much safer than felling but is still fairly time consuming. Depending on the tree species and age, stump sprouting can be a problem. Snags will be produced by this method.

There are five different techniques that can be used in forestry applications of herbicides. The desired outcome of the management action and target vegetation will determine which method will be most efficient and effective. The techniques are as follows:

Hack and squirt method (Frill Girdle) uses hatchets, machetes, or similar devices to make downward angle frill or cut at proper spacing, following label recommendations. Cuts should penetrate through the bark into cambium tissue layer, producing a cupping effect to hold herbicide. Spray a measured quantity into cuts using a squirt bottle or a low pressure straight stream sprayer. This technique is not recommended for use during heavy sap flow in spring. Hack and squirt is generally used to control trees with a greater than 5 DBH (Jackson and Finley 2007).

Stem injection method uses a hypo-hatchet or lance-type tree injector, calibrated to deliver the proper amount of herbicide with each blow. Following label recommendations penetrate through the bark into the living cambium layer at properly spaced intervals. This technique is not recommended for use during heavy sap flow in spring. Stem injection is generally used to control individual trees greater than 5 inches in diameter (Jackson and Finley 2007).

Cut stump method uses water-soluble herbicide mixtures by spraying or painting the cambial layer of freshly cut stumps. If using an oil-soluble mixture, treatments can be applied to stumps up to 1 month following cutting. In this case, spray the sides of the stump to the root collar and the cambium area around the entire circumference of the cut surface until thoroughly wet. Cut stump treatment prevents resprouting of hardwoods (Jackson and Finley 2007).

Basal spraying method uses a low-pressure backpack sprayer to thoroughly wet the lower 12 to 15 inches of the stem completely around tree including the root collar area. Basal bark treatments use an oil carrier so that the herbicide will adhere to the stem and penetrate the bark. This technique is

generally used to control thin-barked trees when they are less than 6 inches in basal diameter (Jackson and Finley 2007).

Foliar spray method uses aerial or ground spray equipment, such as a helicopter, skidder, backpack sprayer, or mist blower to spray the foliage of targeted plants. Use a sprayer to mist spray herbicides evenly over plant foliage. Mechanical air-blast sprayer can treat understory vegetation up to 20 feet in height. Foliar spraying is used to control many woody plants, herbaceous weeds, grasses, and vines (Jackson and Finley 2007). Aerial application during the growing season will, in most case, result in stand replacement. There is a possibility of using a dormant season aerial application of a systemic herbicide to control Chinese privet.

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. The herbicides planned to be used will first be submitted through the PUP approval process.

Reforestation

Reforestation may be a management option for open lands that are taken out of moist-soil or agriculture production. This habitat change could occur for many reasons, including the field becoming unproductive or a management need for more forested habitat in a particular location. A combination of reforestation methods can also be utilized to meet the forest management objectives described in the refuge CCP/HMP for hardwood forest. The methods are planting bare root seedlings, containerized seedlings, and direct seeding.

Bare root seedlings are seedlings without any planting media attached to the roots. The best time to plant a seedling is while the plant is dormant, which generally occurs from December through March, but seedlings that are kept refrigerated can be planted into May. Seedlings can be planted either by hand or with machinery, and should be planted with the root collar at least one inch below the surface of the ground. Seedlings should be planted on a 10 x 10 spacing (435 trees per acre). Containerized seedlings are seedling with planting media attached to the roots. The main advantage is that the planting season can be extended to almost all months except for the hottest and driest. Disadvantages include the higher cost per seedling and the increased planting time.

Direct seeding is the process of applying seed directly into the soil. This is typically done with a modified agricultural grain planter. Selected agricultural fields and site prepped clearcuts can be direct seeded. Generally, direct seeding has a larger planting window. Fall sowing is required for white oak, swamp chestnut oak, and overcup oak as these species germinate in the fall. Red oak acorns are best sown in late winter to early spring. Acorns can be sown at a depth of two to six inches below ground surface, with an ideal planting depth of two to three inches. An individual seedling is not considered to be established until it reaches ten years of age, and only one of four sprouts will live to this threshold. Thus, planting rates should be four times the desired stocking rate.

Herbicide Treatment for Invasive Plant Control

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 increased soil erosion and soil sedimentation. These negative effects decrease the biological integrity, diversity, and environmental health of the refuge, requiring a management strategy that will control, and if possible, eradicate the exotic species.

There are no major problems at present on the refuge involving non-native plants. Invasive plant control is a legal and important issue 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).

Invasive species that are known to occur within the hardwood forests on the refuge and potentially need control are Chinese privet and Japanese honeysuckle. Both of these species have difficulty surviving within the hardwood forests of the refuge that are subject to late spring flooding. However, there are locations where these species may impact hardwood management activities, such as reforestation and underplanting. When Chinese privet and Japanese honeysuckle are present they usually are very invasive and dominate the understory. When a forest management prescription calls for the replacement of the overstory with advanced regeneration or underplantings these species will need to be controlled, if present.

The only feasible methods of control of these highly invasive species involve the use of herbicide. Hack-and-squirt and cut stump herbicide treatment methods have been successful in killing privet. Foliar spraying is also an efficient means of control on privet seedlings. Foliar applications are required for the control of honeysuckle. Controlling either of these plants by the means addressed in very labor intensive and can only be done on a relatively small scale. One option for larger-scale treatments is a dormant season aerial application of glyphosate herbicide. This aerial application technique has been tested by the Georgia Forestry Commission and has shown promising results in controlling privet with little to no damage to overstory trees (Johnson et al. 2010).

Water Management

The water management strategies for hardwood forests should first focus on preserving the vigor and productivity of the forest. Water management that emulates natural flood regimes is desirable to protect tree health and provide more diverse habitats for wildlife (Fredrickson and Butema 1992). Growing season flooding will stress and eventually lead to mortality of most tree species. Thus, the flooding of hardwoods should be delayed until the trees enter dormancy. The water management schedules for a given stand should be different among years to mimic the variations that occur naturally. Water level adjustments should be gradual and slow to prevent overtopping food resources. Drawdowns should also be slow to reduce the loss on nutrients that have accumulated in algae and other floating aquatic plants.

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 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. The refuge should improve hydrology, where practical, by blocking ditches and canal constructed to drain some pine plantations.

The refuge roads also impact hydrology. The refuge staff needs to continue its efforts on improving hydrology by replacing or adding culverts, deepening roadside ditches, and closing some unessential roads to vehicular traffic.

A long-term monitoring program is needed to detect changes to the forest composition caused by hydrologic changes or other stressors.

Prescribed Fire

Prescribed fire is a cost effective tool that can be used to alter vegetation composition and structure, serve as an agent of disturbance to promote early successional species and reduce hazardous fuel accumulations. 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.

Prescribed fire may be used on Pond Creek NWR for multiple reasons including but not limited to moist soil unit management, control of less desirable woody species, promotion of herbaceous ground cover, hazardous fuel reduction and site preparation for reforestation efforts.

Nuisance Animal Control

Beavers have the potential to significantly adversely affect 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 that beavers, on average, damaged $164/acre (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 have not been in demand; therefore, little trapping is conducted, causing beaver numbers to be high (Hill 1982).

Methods to control beavers include trapping and shooting by Service employees, through interagency agreements with USDA-APHIS, and trapping by the public. To minimize habitat loss, removing beaver dams manually, with heavy equipment or by explosives is done by Service or APHIS employees. Dams that are small enough to remove by hand or are located in a culvert or water control structure will be removed manually. If a dam is so large it cannot be removed manually, it can either be removed by machinery or explosives. Explosives are used only by certified employees of the Service or APHIS and all state and local laws are followed.

Ongoing efforts to control feral hogs on the refuge should continue and expand where practical. Effective control programs should utilize all practical methods including shooting by refuge staff and trapping by refuge staff or agency partners. Refuge staff should consider using the radio-telemetry/Judas pig method to further control feral pigs on Pond Creek NWR.

The feral hog problem extends beyond the borders of Pond Creek NWR and adequate control will not occur by focusing solely on the refuge. Therefore, refuge managers should consider partnering with any and all parties who have a stake in feral hog control. Potential partners may include adjacent landowners, Arkansas Game and Fish Commission, USDA Wildlife Services, and the U.S. Army Corps of Engineers.

SELECTED MANAGEMENT STRATEGIES AND UNIT PRESCRIPTIONS

To meet Objectives A-1, A-2, and A-3 in compartments 1A-8B for wintering waterfowl, breeding wood ducks, bats, and forest interior songbirds within native hardwood forests, the following forest management strategies as outlined in the 2003 Forest Management Plan 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 specified parameters.
- Harvest 1- to 7-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 the objectives (LMVJV 2007), 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.
- Control invasive plant species through herbicidical or mechanical treatments. Continue feral hog eradication efforts. Inventory and map the native hardwood forest prior to silvicultural treatment.
- Following the forest inventory, develop prescriptions and implement management of hardwood stands to increase red oak and other hard mast producer component using commercial or non-commercial silvicultural practices.
- Commercial harvest is preferred over non-commercial techniques if refuge objectives can be met and the harvest is feasible.
- Patchcuts and group selection will be used to encourage regeneration of shade intolerant oaks on sites oaks are largely absent. Thinning and single-tree selection methods will be used when desirable tree species are present to release these species and improve crown development.
- Prior to conducting timber harvest activities consult with the FWS Ecological Services office in Conway, Arkansas as to potential impacts to the endangered species.
- Recognize importance of natural cavities and retention of larger, older trees to improve natural cavity formation (see Regional Guidelines regarding wood duck management). Retain cavity trees and snags in locations near good wood duck brood habitat. Also retain some individual trees of species that are susceptible to cavity formation. Small diameter snags and cavity trees should also be retained of other species, such as prothonotary warbler and great-creasted flycatcher.
- When stand replacement is the objective to increase the red oak component, incorporate the underplanting of oaks and other desirable tree seedlings within the stands that have little to no oak advanced regeneration. Prior to underplanting the seedlings remove 50 percent of the stand basal area (at least 50 percent of the canopy cover) through commercial timber harvest or FSI techniques. Once the underplanted seedlings are established enough to regenerate the new stand utilize patchcut harvest method to release the desired trees.
- When commercial harvest is not feasible or will not meet refuge objectives, utilize FSI methods to manage a stand. For employee safety and efficiency reasons the methods most commonly used will be hack-and-squirt and basal bark herbicide treatments. Herbicide label and PUP guidelines will be strictly followed.

- During forest inventory operations GPS and map all locations of invasive plants.
- Conduct control efforts to reduce the competition of Chinese privet and Japanese honeysuckle on desired vegetation in locations where active management actions are planned (Johnson et al. 2010). Cut-stump, hack-and-squirt, and foliar applications of herbicides will be the techniques used.
- If any open hardwoods (i.e., agriculture, moist-soil) are abandoned consider reforestation with native hardwood seedlings. Species to be planted should naturally occur in the area.
- Where possible, the water management schedule for hardwood habitat should mimic natural flood regimes. Always delay flood-up until after the trees have entered dormancy. All water level adjustments (flood-up and drawdown) should be slow and gradual. Vary the timing of flood-up and drawdown from year to year within an impoundment. Consider varying water levels within a year to further mimic natural flooding. At least every fifth year, do not intentionally flood impoundments that are predominantly hardwood habitat.
- GPS areas of infestation by exotics. Once areas of concern are identified, research and utilize most effective means of control.
- If current process becomes ineffective, use adaptive management process to find more efficient ways of treating invasive plant species.

To meet Objectives A-1, A-2, and A-3 on the Refuge for wintering waterfowl, breeding wood ducks, and forest breeding birds, the following strategies will be used to control nuisance animal damage in 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.
- If funding is available, contract with USDA-APHIS, utilize staff, or public trapping to control beavers and to remove beaver dams.
- The beaver population control methods are trapping and shooting.
- Beaver dam removal will be accomplished using the following means: removal by hand, use of heavy equipment, or by using explosives. Explosives will only be used by certified personnel and will follow all federal, state, and local laws. Currently, Service employees are the only personnel using explosives.
- If feral hogs are found on the refuge, immediate action to eradicate the individuals should occur.

B. MOIST-SOIL MANAGEMENT STRATEGIES

POTENTIAL STRATEGIES

Preferred moist-soil plants for foraging waterfowl are typically heavy seed producing annuals, such as wild millets, smartweeds, sprangletop, and 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).

Since completion of the CCP, the refuge has acquired a 275-acre WRP tract that provides the opportunity to manage two moist-soil impoundments totaling approximately 52 acres.

Prescribed fire could be used in conjunction with management of moist soils, as well as in some other refuge habitats.

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 water management, and mechanical and chemical management to keep units in early successional stages (Strader and Stinson 2005). These actions are used to maximize waterfowl food production and usage.

Water Management

General

Desirable moist-soil vegetation at Pond Creek NWR consists mostly of *Leptochloa*, *Echinochloa*, toothcup, and some *Cyperus* species, which germinate during late summer draw-downs. Moist-soil management at Pond Creek NWR could perhaps be constrained by backwater flooding of Millwood Lake Pool. When the lake rises, backwater will eventually top the levee. Due to the local hydrological regime, the impoundment often cannot be drained until June or July.

Regarding flooding, the impoundments should be flooded from late August through early September to provide water for migrating blue-winged teal, pintail, and shorebirds, and a draw-down should be conducted no later than April 15 (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).

Water Management Techniques for Moist-Soil Production

Drawdown and flood-up schedules play a significant role in determining the plant community, seed production, and wildlife use of a specific moist-soil unit. The specific water management techniques are: 1) season of drawdown; 2) speed of the drawdown; 3) variation of drawdowns for plant diversity; and 4) timing of flood-up.

Season of Drawdown

The time of year that a drawdown occurs has a great impact on the species of plants that germinate and eventually dominate the plant community. The growing season has been divided into three periods that typically result in somewhat differing plant communities. These periods are early season, mid-season, and late season. These periods are generally defined by changes in weather variables, such as temperature and rainfall. However, it should be understood that unusual weather patterns, such as drought, flooding, and abnormal temperatures, can greatly alter the expected plant community.

Early season drawdowns at the latitude of Pond Creek NWR starting in April. The expected desired plant community may contain Pennsylvania smartweed, nodding smartweed (*P. lapathifolium*), beggarticks, and spike rush. Undesirable plants that are promoted by an early season drawdown include aster and black willow. Early season drawdowns coincide with spring shorebird migration and provide excellent mudflat habitat.

Mid-season drawdowns occur in May and June, typically producing stands of greater plant diversity than the other drawdown periods. Barnyardgrass, millet, yellow-nut sedge, nodding smartweed, beggarticks, tooth-cup, redroot flatsedge, and red sprangletop are the common desirable moist-soil

plants. Problem plants that also respond to mid-season drawdowns are black willow and cocklebur. Due to the frequency of uncontrolled spring flooding, moist-soil plant communities produced by mid-season drawdowns occur more often on the refuge than early drawdowns.

Late season drawdowns (July and August) should be used with caution and on a limited basis. They are typically used to meet objectives (i.e., fall shorebirds and early goose browse) other than moist-soil habitat. Seed production can be much lower and there is a greater risk of undesirable plants dominating the plant community. However, late season drawdowns are a good management tool that will be used under specific conditions. The desirable plants that respond to late drawdowns are yellow-nut sedge, teal grass, and tooth-cup. Sesbania and/or cocklebur, which are undesirable, can dominate a stand. Late drawdowns also promote the growth of alligatorweed by keeping the impoundment flooded later. This also limits the control of this species, since most herbicides have proven to be ineffective on alligatorweed when it is in water.

Speed of the Drawdown

Fast drawdowns are completed within a matter of days to a few weeks, depending on the size of the impoundment. These are typically done in the early spring or following uncontrolled flood events with a primary purpose of drying agriculture fields. For moist-soil management purposes fast drawdowns should only occur during the early season period when rainfall and lower temperatures will maintain soil moisture high enough to promote the germination of desirable plants. A disadvantage of utilizing this type of drawdown is that mudflat habitat availability for shorebirds is completely lost in this short time frame.

Slow drawdowns are staggered over a longer period of up to a month, according to the size of the impoundment. This is the technique of choice for moist-soil management in southern latitudes. The advantages of slow drawdowns include; extended habitat availability and foraging times for migrant waterbirds, elevated soil moisture which promotes desirable annual seed producers, decreased probability of germination of undesirable species, gradually decreasing water depths that benefit many species of wildlife, and potentially higher yields of annual moist-soil plants. One disadvantage of using a slow drawdown is the potential to have exposed mud flats during the period when black willow is scattering seeds, which can result in a large acreage of young willows.

Variation of Drawdown Strategies for Plant Diversity

It is important to utilize all the drawdown techniques addressed above in order to produce a diversity of moist-soil plant communities throughout the refuge. This should occur within the same year by staggering the drawdown schedules between impoundments as much as possible. This can also be accomplished within an impoundment by stair-stepping the drawdown to occur across multiple periods. Of course, variation is easier planned than accomplished. The greatest constraint is the probability of an uncontrolled flood, with funding for a prolonged pumping period being another problem.

Timing of Flood-up

The flood-up of moist-soil habitats will begin as early as August within some impoundments. Irrigation of established moist-soil plants during the dry summer can enhance seed production. This water also provides habitat for early migrating blue-winged teal, rails and bitterns, which begin arriving in early August. Care should be taken to not overtop the vegetation during the growing season.

Once the plants have matured the fall flood-up should occur as the moist-soil food resources are depleted and will be in increments that do not exceed six inches. Efforts should be made to provide newly flooded moist-soil habitat throughout the fall migration and wintering period. However, the flooding of moist-soil may vary depending on water availability, waterfowl usage, and weather patterns.

Mechanical

Disking

Maintenance of good seed production in moist-soil requires a periodic soil disturbance. Disking is one of the most viable options available to managers as physical manipulation of the soil is necessary to set back succession, control undesirable plant communities, and rejuvenate moist-soil units that are producing low yields. Manipulations are required as seed producing annuals are replaced by perennial plants, which could occur every three to ten years.

Proper disking technique is also important, as many factors determine the outcome of this manipulation. Most often, more than one pass over a unit is required as the soil may initially be left in clods and clumps. If the soil is left in this condition, plant communities will develop that are less than desirable due to the micro-environments created as the soil dries unevenly. By making additional disking passes over the unit, the clumps and clods are broken down into a more homogenous seed bed, which creates conditions that are more conducive to the germination of desired annual seed producers. The use of a cultipacker can also aid in providing a good seed bed.

Disking can occur during the period of spring to early fall. Disking in the months of April, May, and June are typically aimed at producing annual grasses in that calendar year. Disking in July, August, and September targets invertebrate production and late germinating species for that season, and annual grasses the following growing season. Caution should be taken when disking during the late season without the planting of millets, buckwheat or winter wheat, as it is very conducive to the germination of undesirable plants.

Caution should also be used in deciding what areas are suitable to be disk. There are many areas on the refuge that will never dry sufficiently to support equipment. Other means to set back succession will be required on these sites. Options for inaccessible locations include aerial application of herbicides and deep flooding through the growing season. Locations that contain alligatorweed should not be disked unless the site has been treated with herbicide prior to disking. Disking has been found to spread alligatorweed, since this plant easily spreads from cuttings.

Mowing

Moist-soil units are typically comprised of desirable and undesirable plant species. Undesirable plants are defined as those species which have either an established monoculture or have begun to interfere with the production of seed or tuber producers at a specified level (greater than 50 percent of the moist-soil area). These species often include broadleaves such as cocklebur, which are particularly susceptible to mowing with a rotary mower, and can be successfully controlled when clipped below the meristem after reaching a height of 12 inches or more. Removal of the overstory allows sunlight to reach the ground, which promotes and releases the grass species that are growing underneath the broadleaf canopy.

The greatest benefit derived from mowing occurs after the dominant overstory plants have become well developed, and are effectively stopping sunlight from reaching the ground. This technique

should be applied during the months of June through September. Mowing applied in June or July will result in an improved annual grass and broadleaf community, while mowing in August and September will provide a coarse substrate for invertebrate production after flooding.

Prescribed Fire

Prescribed fire is a cost effective tool that can be used to alter vegetation composition and structure, serve as an agent of disturbance to promote early successional species within Pond Creek NWRs moist-soil units. 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.

Herbicide Treatment

The presence of 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 invasive species.

Known invasive aquatic plants that occur in moist-soil habitats on the refuge and potentially need control are alligatorweed, parrotfeather, and purple loosestrife. 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.

Management of the moist-soil habitat in management units 1-3 may require the periodic use of chemicals to control undesirable vegetation, such as red vine, buttonbush, and *Sesbania*.
Native plants can also be very invasive in moist-soil units. The species with the greatest impact on moist-soil management on the refuge are knot grass, black willow, silver maple, bald cypress, cocklebur, and aster. Where mechanical means are not feasible, such as in wet ground, herbicides provide an effective management tool to control invasive native plants.

Herbicides will be used primarily to supplement, rather than as a substitute for, control measures of other types. Whenever an herbicide 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 herbicides will be approved through the Pesticide Use Proposal process and will follow Integrated Pest Management Policy (569 FW 1). Herbicide use will meet all State and Federal permitting regulations.

Herbicide applications can be made using various application means. Spot treatments can be done using handheld or vehicle mounted sprayers. Tractor or ATV mounted boom sprayers can be used to cover larger areas. Aerial application with helicopters is commonly used in locations that are inaccessible with ground equipment.

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 used through the adaptive management process.

SELECTED MANAGEMENT STRATEGIES AND UNIT PRESCRIPTIONS

To meet Objective A-4 in Management Units 1, 2, and 3 for wintering waterfowl, the following strategies will be used to manage moist-soil habitat:

- To the extent feasible, conduct a slow one foot drawdown around July 1 to increase the production of invertebrates and wetland plant foods for shorebirds and waterfowl.
- Conduct drawdown and reflooding schedules to maximize seed yields of annual moist-soil plants and develop structural diversity and mudflat habitats for shorebirds and waterfowl every three years.
- Water levels are raised slowly in the fall (November 1)(not to exceed 0.10 msl/day) to provide a continuous supply of food resources.
- Utilize mowing, disking, control burns, or chemically treat impoundments to reduce succession by woody plants.
- Annually, place boards in water control structures in October to hold water, to achieve < 18 inches depth.
- Monitor vegetation growth for percent cover of undesirable plants. If undesirables exceed 20 percent cover, manipulate vegetation through mechanical (mowing), prescribed fire, or chemical means.
- Maintain records by date for water management actions, water elevations, vegetation, and wildlife response.
- Determine if management actions for plant species and seed production need to be changed to meet objectives by using sampling techniques in Strader and Stinson (2005).
- Control invasive and noxious plant and animal species to include using approved herbicides, mechanical removal, beaver dam removal, and lethal removal of feral hogs, nutria, and beavers.
- Each individual unit should be burned every 3 years or as necessary during the growing season, using backing and flanking fires.
- GPS areas of infestation by exotics.
- Once areas of concern are identified, research and utilize most effective means of control.
- Treat with appropriate chemical when undesirable plant coverage (e.g., *Sesbania*, cocklebur, willow, or buttonbush) exceeds 20 percent of management unit.
- Collect coordinates of all beaver dams for future reference.
- Determine best method for removal of located dams and remove immediately.

C. GREENTREE RESEVOIR MANAGEMENT STRATEGIES

POTENTIAL STRATEGIES

Strategies for managing the GTRs fall into two categories - vegetation manipulation and water level management. Options for treating the forest vegetation in the GTRs are similar to those for the other non-GTR forests on the refuge. Manipulation of forest vegetation could be accomplished as described above for the actively managed portions of the refuge, following the guidelines set forth in LMVJV Forest Resource Conservation Working Group (2007). Alternatively, silvicultural manipulation of the GTRs could be deferred, and managers could attempt to mimic a natural flooding regime by use of the water control structures. Theoretically, this would, over time, move the GTRs towards conditions described in LMVJV Forest Resource Conservation Working Group (2007), although the timeline would be unpredictable, since it would depend on stochastic events like storms. Further,

because the functional area of the GTRs is only about 300-350 acres, depending on chance events to create succession in forest vegetation (e.g., blowdown from a tornado or hurricane) may take decades or longer.

Water level management in the GTRs will be achieved as precipitation is collected and/or water is collected from floodwater as the Little River floods its banks. Removal of the water, of course, depends on gravity flow, and therefore upon water levels downstream of the water control structure. However, most years the refuge is dry enough to allow drainage of the GTRs on schedule.

Because of concerns that annual flooding might exacerbate the decline of oaks and other desirable species in the GTRs, managers might choose a regime in which one year in two or three the GTRs are left dry. Balancing this regime with the needs of wood ducks and other resources of concern would then be a matter of adaptive management, with careful monitoring of water levels and use by waterfowl. Variables subject to modification based on the results of monitoring would be water level (which also controls areal extent of flooding), date of flooding, date of drainage, and frequency (i.e., annual, biennial, 2 of 3 years, etc.). In an effort to mimic natural flooding, managers should alter the depth, duration, and timing of flooding within and among years within the GTRs.

SELECTED MANAGEMENT STRATEGIES AND UNIT PRESCRIPTION

To meet the GTR objective in compartments 6A and 7B for wintering waterfowl and breeding wood ducks, the following strategies will be used:

- Target frequency for flooding the GTR will be two years out of three or less. This frequency will be subject to change based on the results of monitoring of forest vegetation and wildlife use.
- Flooding will start as early as November 1 and removed by March 1. Flooding will be staggered. The GTR water levels will be fluctuating throughout the season may even be dry several times a season. Dates of flooding will be subject to change based on the results of monitoring of forest vegetation and wildlife use.
- Forest vegetation in the GTR will be manipulated as described above. Flooding may be deferred to allow for timber harvest, or to allow the development of understory plants and/or forest regeneration in openings.
- If negative impacts to forest health are detected, water management should cease immediately.

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APPENDICES

APPENDIX A. THE COMMERCIAL SALE OF TIMBER

EXECUTION OF TIMBER HARVEST

A habitat and timber inventory will be conducted for each compartment prior to any timber harvest. The inventory may be conducted using fixed plot or point sampling techniques. The following data will be collected during each compartment cruise:

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

Volume tables for each compartment will be expressed in 2-inch diameter classes for both sawtimber and pulpwood. Doyle volume tables will be used for both pine and hardwood volumes for both sawtimber and pulpwood products.

Treatment prescriptions will contain the following information:

- Compartment map;
- Stand map designating various timber stands within the compartment;
- Description of compartment including vegetation profile, soil types, hydrology, and other physiological features;
- Timber data including tree species composition, sawtimber, and pulpwood volumes, stocking, age, condition, and basal area.
- 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, and wildlife tracks).
- Composition of woody plant regeneration;
- Prescription of silvicultural treatment to be conducted in the compartment;
- Description of desired results;
- Map of treatment area; and
- 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. Marking trees to be removed or to be

retained with two spots of paint will allow the contractor to determine which trees are designated for removal during timber harvest and help the forester identify the stumps of marked trees during administration of the logging contract. In certain situations, the operator select method of harvest can be utilized in order to meet habitat objectives.

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. The refuge forester will be responsible for staying informed as to the details of the local markets surrounding the refuge in order to satisfy these conditions.

Timber harvest operations can occur anytime of the year except from April through June. By restricting harvest activities to this time period, disturbance of bird nesting and breeding activities of most bird species should be minimized (*Chuck Hunter, USFWS, per. comm.*). Logging will also be restricted to dry periods of the year to keep soil disturbance and damage to residual vegetation at a minimum.

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. 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, 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.

Monitoring

Upon completion of prescribed timber harvest operations, a sub-set of treatment areas will be monitored at 1, 5, 10, and 15 years post-harvest. This monitoring will evaluate vegetative response, and help refuge staff to determine if the desired results of the compartment prescription have been met or if changes need to be made to forest management prescriptions.

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-, and 30-meter resolution satellite images. Shapefiles, 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 HMP, GIS shapefile layers 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 concerning natural and scenic rivers, all forest management operations on the refuge will leave a 200-foot buffer along the banks of the Cossatot and Little Rivers. Logging is generally restricted to the summer and early fall, which are generally the driest times of the year, to reduce soil compaction and erosion potential. However, if dry weather persists and it is agreeable between the refuge forester and the refuge manager logging can be authorized to take place outside of the normal time period. 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.

Archaeological and Cultural Resources

As stated before in this document, there are 14 identified cultural resource sites on Pond Creek NWR. Consisting exclusively of Native American sites, these areas are located on refuge maps and will have full protection as provided by the Archaeological Resources Protection Act. There are no National Register sites present.

When a compartment comes under consideration for treatment, known archaeological sites and cultural resources that are identified in or near the treatment area will be noted and a list sent to the Service's regional archaeologist. Review of the sites and resources will be performed by this person and clearance obtained from the State Historic Preservation Office. Upon completion of all clearances, treatment will be implemented with an appropriate buffer established around the perimeter of the site.

It is possible that forest management activities on the refuge could disturb archaeological sites. In the event this happens, the logging operation will cease and the regional Archaeologist will be contacted.

Aesthetics

Aesthetics are important concerns for forest habitat managers. Thousands of visitors use the refuge every year for hunting, fishing, wildlife observation, or other compatible wildlife-dependent recreation. In application of all forest habitat treatments, consideration must be given to the fact that these habitats are to be managed "for the benefit of present and future generations of Americans" (National Wildlife Refuge System Improvement Act of 1997). While the intentions of this management plan are to fulfill this obligation, it must be realized that some silvicultural treatments may not readily appeal to some visitors. Therefore, buffer strips will be established along watercourses and some major roadways. Silvicultural applications will be minimized in these areas to provide an aesthetically pleasing forest to visitors. Buffer strips along roads will not be implemented during conversion of pine plantations.

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 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.

Insects and Diseases

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, over-maturity, 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 USDA Forest Service, State and Private Forestry Division in Pineville, Louisiana, for advice 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.

APPENDIX B. 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, etc., is a common practice in forest management. Forest management on Pond Creek 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.

APPENDIX C. ADMINISTRATION OF SALES

CONDITIONS APPLICABLE TO TIMBER HARVESTING PERMITS

- Except where specifically authorized by a special use permit, all regulations governing activities on national wildlife refuges in general and specific public use regulations for Pond Creek NWR (including littering, possession and use of firearms, and protection of wildlife) apply.

- All logging will be within the boundaries specified (see attached map) and coordinated with the refuge forester or his designee.

- Trees larger than or equal to 16 inches in diameter (dbh) shall be cut so as to leave a stump not more than 6 inches above the root collar. Trees less than 16 inches in diameter (dbh) shall be cut so as to leave a stump not more than 6 inches in height on the side adjacent to the highest ground. Stump heights will be measured on the side adjacent to the highest ground. Trees are painted at eye level and at stump; ground level paint spot must be visible after tree has been cut. All marked trees must be cut. In the event any marked trees are not cut by permittee, refuge personnel will have the trees cut and will withhold from the permittee's performance guarantee a sufficient amount to cover the cost incurred.

- Logging will not be permitted when the ground is wet and subject to rutting or severe soil compaction. The permittee and his employees will do all in their power to prevent rutting and erosion. Permittee will be required to fill any ruts made as a result of his operation.

- Only marked or designated trees shall be cut, unless otherwise agreed on by both parties. Utmost care shall be exercised to protect all other trees and vegetation from damage. Additional trees marked by refuge personnel for roads or loading sites will be paid for at bid price. The penalty for excessive skinning or other damages may be assessed at $5.00 per inch of stump diameter. Additional damages may be assessed and merchandising methods adjusted (i.e. skidding lengths) based on the severity of the damage. Penalties will be assessed for cutting unmarked hardwood trees at $5.00 per inch of stump diameter up to 22 inches and $10.00 per inch of stump diameter for 22 inch and larger stumps. Penalties will be assessed for cutting unmarked pine trees at $5.00 per inch of stump diameter up to 14 inches and $10.00 per inch of stump diameter for 14 inch and larger stumps.

- Trees will be de-limbed and topped at the point of felling, unless special conditions are permitted.

- If excessive skidding damage occurs, skidding lengths can be shortened by refuge forester.

- No loading sites will be permitted within 300 feet of public roads or near ATV trails open to the public. A refuge forester must approve the location of all loading sites and temporary roads.

- Trees and tops cut shall not be left hanging or supported by any other living or dead tree or brush. Any tree that becomes lodged when cut shall be immediately rendered unlodged and felled flush to the ground. All tree tops and other logging debris will be removed from roads, roadside ditches, trails, firebreaks, fields, streams, and drainages immediately after felling.

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

- Vehicles and other equipment will be operated in a safe manner at all times. Both refuge personnel and the visiting public use the refuge roads. The speed limit on refuge roads is 35 miles per hour unless posted otherwise.

- Each bidder will submit with his bid, or have on file in the refuge office, a current statement demonstrating his financial ability and the ownership or control of necessary equipment to carry out the operation on the basis herein specified. To properly construct and/or maintain roads will require the use of a crawler tractor and road grader.

- The permittee and his/her employees will be reasonably prudent in preventing and suppressing forest fires. Permittee shall be liable for all fire suppression costs resulting from his operations.

- The permittee shall protect all known (identified on the ground) archaeological sites against disturbance, destruction, or damage during harvesting operations. If, during the course of the harvest activity, the permittee notices illegal excavation or archaeological resources removal activities, this information shall be immediately provided to the refuge manager.

- If previously unrecorded cultural resources or human remains be discovered on Service land, thinning activities at that site will be immediately halted. There can only be minimal soil disturbance within these areas.

- If, during the course of the harvest activity, the permittee deliberately damages a recorded site, the permittee will be responsible for the resultant site damage assessment and mitigation.

- The normal operating season on this sale will be June 15 through November 15. Any operations outside the normal season must be approved in advance by the refuge forester. For safety reasons and to minimize conflict, the permittee will cease logging operations during refuge deer gun quota hunts.

- A pre-entry conference between the refuge forester (or designee) and the successful bidder representative will be required before beginning logging operations to ensure understanding of the permit conditions and thus avoid serious conflicts.

- The refuge manager or his/her designee (e.g., administrative forester) shall have the authority to stop timber harvesting operations anytime justifiable reasons develop.

- Loggers are required to implement Arkansas Best Management Practice guidelines.

- Clean-up of oil, hydraulic fluid, and other contaminants as a result of the logging operation is the responsibility of the permittee.

- The permittee will remove plugs, dams, and bridges constructed by the permittee upon completion of the contract.

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

- Maintenance of all roads on Pond Creek used in the logging operation will be the responsibility of the permittee. These roads must be maintained to pre-harvest condition or to the standards described under these permit conditions.

- Use the old travel way as much as possible to minimize stump and root wad removal and refilling.

- Maintain a maximum 20-foot-wide road bed.

- If necessary, place “B” stone in drainages to facilitate crossing, but at a level that will not impede water flow.

- If necessary, place pit-run gravel to firm up the roadbed and in conjunction with culvert placement.

- If necessary, disc and grade to fill in ruts after completion of the sale or by November 15 of each year whichever is first.

- V-ditch and crown haul roads (no blading out of haul roads). Also, utilize lead-off ditches for drainage where appropriate.

- Grade all access roads as necessary to maintain a reasonably smooth road surface.

CONTROL RECORDS

The following process will be adhered to before application of any silvicultural treatments. First, stands will be inventoried in a uniform manner to evaluate habitat conditions as they apply to the objectives of the refuge. Next, inventory data will be evaluated and a determination made as to the best course of action to accomplish the habitat objectives. Finally, Regional Office approval will be necessary before any treatment is applied to the stand. All original documents pertaining to the stand treatments (i.e., inventory data, prescriptions, approvals, volumes removed, and contracts) will be kept in the refuge office files.

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 invitations, 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 management unit folder for each individual management unit, thus keeping all information pertaining to a management unit within a single file.

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 Pond Creek NWR CCP, Pond Creek NWR HMP, and management unit prescriptions.

Small sales (estimated receipts less than $2,500) will be negotiated as authorized by 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 high 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 and 3). Bid invitations will contain the following information:

- A formal bid information form containing sales information will be given to the bidder to fill out, sign, and return to the refuge.
- Maps giving general sales location information and detailing all sales units.
- General conditions applicable to harvest of forest products.
- Special conditions applicable to the timber sale.
- Certificate of Independent Price Determination.
- Equal Employment Opportunity Clause (Form 3-176).
- Information on dates when prospective bidders can evaluate sales areas before bid opening.

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 $500 bid guarantee must accompany all bids received through the formal bid process. 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 Federal Government. When the successful bidder is named, all unsuccessful bidders' deposits will be immediately returned. The successful bidder's deposit will be returned when a performance guarantee is submitted. The performance guarantee is a deposit of 10 percent of the estimated value of the sale up to a maximum of $20,000 and must be received before any activities proceed. Depending on the size of the sale or potential for damage, more than 10 percent of the appraised value may be justified as a deposit; the amount of the deposit will be stipulated in the bid invitation. The performance guarantee will be retained by the Federal Government in a holding account to cover any damages caused by the successful bidder, their agents, employees, or their producers. The balance of the deposit will be refunded to the successful bidder when the sale is completed.

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

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 Service's Regional Director signs the special use permit.

PAYMENT FOR FOREST PRODUCTS AND ADMINISTRATION OF RECEIPTS

In the case of lump sum sales, the successful bidder (hereafter referred to as the permittee) will have 10 days after receipt of the harvesting permit to make total payment, or in the event of a consumer scale sale (pay as cut), the performance guarantee will be considered as prepayment for the first operating period and after each subsequent operating period, payment will be made to the Federal Government in the amount indicated by actual scale tickets for that period. In no case will harvesting operations begin prior to payment. The purpose of an advance payment is to encourage the permittee to begin harvesting operations as quickly as possible and is Department policy. All payments will be in the form of a cashier's check payable to U.S. Fish and Wildlife Service.

In some cases, such as salvage sales, where speed is essential and volumes are difficult to determine, timber products may be sold by mill scale. That is, the products will be sold according to the volume of products delivered to a mill, as scaled by that mill. In mill scale sales, payment will be made according to the units scaled at a negotiated price per unit. Payments will be made on a time schedule specified on the special use permit. All payments will be accompanied by mill scale tickets or other documentation confirming the volume of forest products removed from the refuge.

Refuges are authorized to enter into Timber for Land Exchanges. In this process, land within the approved 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 U.S.C. 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. The refuge manager identifies areas within the approved acquisition boundary for acquisition.

2. The 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 (Area Supervisor and Division of Realty).

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

5. If the landowner is willing to sell, Division of 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 sale bid forms 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. The Division of Realty advises the landowner that the third party will intercede to acquire the subject property on the Service's behalf.

10. The Division of Realty obtains an exchange agreement with the third party. The agreement identifies and states the price of the subject property and 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.

APPENDIX D. EXHIBITS

EXHIBIT 1: POND CREEK NWR TIMBER SALE 20XX-XX

SPECIAL CONDITIONS APPLICABLE TO TIMBER HARVESTING

Before commencing logging operations, the refuge forester and 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, will lessen the chance of public disagreement with refuge forest management philosophy.

1. Except where specifically authorized by a special use permit, all regulations governing activities on national wildlife refuges in general and specific public use regulations for Pond Creek NWR (including littering, possession and use of firearms, and protection of wildlife) apply.

2. All logging will be within the boundaries specified (see attached map) and coordinated with the refuge forester or his designee.

3. Trees larger than or equal to 16 inches in diameter at breast height (dbh) shall be cut so as to leave a stump not more than 6 inches above the root collar. Trees less than 16 inches in dbh shall be cut so as to leave a stump not more than 6 inches in height on the side adjacent to the highest ground. Stump heights will be measured on the side adjacent to the highest ground. Trees are painted at eye level and at stump; ground level paint spot must be visible after tree has been cut. All marked trees must be cut. In the event any marked trees are not cut by permittee, refuge personnel will have the trees cut and will withhold from the permittee's performance guarantee a sufficient amount to cover the cost incurred.

4. Logging will not be permitted when the ground is wet and subject to rutting or severe soil compaction. The permittee and his employees will do all in their power to prevent rutting and erosion. Permittee will be required to fill any ruts made as a result of his operation.

5. Only marked or designated trees shall be cut, unless otherwise agreed on by both parties. Utmost care shall be exercised to protect all other trees and vegetation from damage. Additional trees marked by refuge personnel for roads or loading sites will be paid for at bid price. The penalty for excessive skinning or other damages may be assessed at $5.00 per inch of stump diameter. Additional damages may be assessed and merchandising methods adjusted (i.e. skidding lengths) based on the severity of the damage. Penalties will be assessed for cutting unmarked hardwood trees at $5.00 per inch of stump diameter up to 22 inches and $10.00 per inch of stump diameter for 22 inch and larger stumps. Penalties will be assessed for cutting unmarked pine trees at $5.00 per inch of stump diameter up to 14 inches and $10.00 per inch of stump diameter for 14 inch and larger stumps.

6. Trees will be delimbed and topped at the point of felling, unless special conditions are permitted.

7. If excessive skidding damage occurs, skidding lengths can be shortened by refuge forester.

8. No loading sites will be permitted within 300 feet of public roads or near ATV trails open to the public. A refuge forester must approve the location of all loading sites and temporary roads.

9. Trees and tops cut shall not be left hanging or supported by any other living or dead tree or brush. Any tree that becomes lodged when cut shall be immediately rendered unlodged and felled flush to the ground. All tree tops and other logging debris will be removed from roads, roadside ditches, trails, firebreaks, fields, streams, and drainages immediately after felling.

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

11. Vehicles and other equipment will be operated in a safe manner at all times. Both refuge personnel and the visiting public use the refuge roads. The speed limit on refuge roads is 35 miles per hour unless posted otherwise.

12. Each bidder will submit with his bid, or have on file in the refuge office, a current statement demonstrating his financial ability and the ownership or control of necessary equipment to carry out the operation on the basis herein specified. To properly construct and/or maintain, roads will require the use of a crawler tractor and road grader.

13. The permittee and his/her employees will be reasonably prudent in preventing and suppressing forest fires. Permittee shall be liable for all fire suppression cost resulting from his operations.

14. The permittee shall protect all known (identified on the ground) archaeological sites against disturbance, destruction, or damage during harvesting operations. If, during the course of the harvest activity, the permittee notices illegal excavation or archaeological resources removal activities, this information shall be immediately provided to the refuge manager.

15. All known archaeological sites will be identified on the ground by refuge personnel placing a wooden stake at the center and flagging the perimeter with pink or pink/black ribbon. If unrecorded cultural resources or human remains are discovered on Service land, thinning activities will be immediately halted. There can only be minimal soil disturbance within these areas.

16. If, during the course of the harvest activity, the permittee deliberately damages a recorded site, the permittee will be responsible for the resultant site damage assessment and mitigation.

17. The normal operating season on this sale will be June 15 through

18. November 15. Any operations outside the normal season must be approved in advance by the refuge forester. For safety reasons and to minimize conflict, the permittee will cease logging operations during the refuge's deer gun quota hunts.

19. A pre-entry conference between the refuge forester (or designee) and the successful bidder representative will be required before beginning logging operations to ensure understanding of the permit conditions and thus avoid serious conflicts.

20. The refuge manager or his/her designee (i.e., administrative forester) shall have the authority to stop timber harvesting operations at anytime justifiable reasons develop.

21. Loggers are required to implement Arkansas Best Management Practices (BMPs) guidelines.

22. Clean up of oil, hydraulic fluid, and other contaminants as a result of the logging operation is the responsibility of the permittee.

23. The permittee will remove plugs, dams, and bridges constructed by the permittee upon completion of the contract.

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

25. Maintenance of all roads on Pond Creek NWR used in the logging operation will be the responsibility of the permittee. These roads must be maintained to pre-harvest condition or to the standards described under these permit conditions.

General constraints and specifications for haul route improvement are as follows:

- Use the old travel way as much as possible to minimize stump and rootwad removal and refilling.
- Maintain a maximum 20-foot-wide road bed.
- If necessary, place “B” stone in drainages to facilitate crossing, but at a level that will not impede water flow.
- If necessary, place pit-run gravel as necessary to firm up the road bed and in conjunction with culvert placement.
- If necessary, disc and grade to fill in ruts after completion of the sale or by November 15 of each year, or whichever is first.
- V-ditch and crown haul roads (no blading out of haul roads). Also, utilize lead-off ditches for drainage where appropriate.
- Grade all access roads as necessary to maintain a reasonably smooth road surface.

EXHIBIT 2: LUMP SUM BID FORM

BID FORM

Pond Creek NWR Timber Sale 20xx-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: _____

_____

_____

_____

EXHIBIT 3: BID INVITATION

South Arkansas National Wildlife Refuge Complex
Pond Creek National Wildlife Refuge
1958 Central Road
Lockesburg, AR 71846

Phone: 870-289-2126
FAX: 870-289-2127
Cell: 870-784-3520
[Date]

Pond Creek National Wildlife Refuge
Compartment x
Timber Sale 20x-xx

BID INVITATION

Sale Number PC-XX-X Compartment XX Product Multiple

Formal sealed bids will be received in the temporary office of the Refuge Manager of the Pond Creek National Wildlife Refuge (NWR), Lockesburg, AR, until **1:00 p.m., Month/Day Year for**. Formal sealed bids will be opened at this time. This bid includes the sale of hardwood pulpwood and low quality sawtimber contained in an area of marked trees (see attached map) in Compartment XX of Pond Creek NWR, located in Sevier, AR. The boundaries for the sale are the XXXXX River and XXXX Lake to the North, the XXXX River to the East, XXXX Slough to the South and a yellow ATV trail to the West. The sale area is in parts of sections X,X,X & X of Township ??S, Range ??W.

This sale is a consumer scale sale or "pay as you cut" sale. Payment will be based on certified weight scale tickets with a copy provided to this office with payment. All bids will be by the ton on each individual product class: hardwood sawtimber and hardwood pulpwood. The successful bidder will be determined by the highest total value of the sale based on the sum of the value of the two product classes. (Determined by the Fish and Wildlife Services estimated tonnage per product class, times the bid price.) The bidder is responsible for determining volumes from which to base his/her bid.

All bids must be securely sealed in a suitable envelope and plainly marked "Timber Bid, PC-XX-X; C-XX" on the outside of the envelope.

The sale area is located on approximately XXX acres. This sale consists of low quality hardwood sawtimber and hardwood pulpwood marked at eye level and at the stump with blue paint. All stems marked with **blue paint** are to be cut and removed.

A show me trip will be conducted by staff on Month/Day/Year. The staff and potential bidders will meet at Pond Creek National Wildlife Refuge OFFICE at 10:00 a.m. and then travel to the sale. The sale location is shown on the attached map. Additional information may be obtained at the Refuge

Office. With this bid invitation "in hand", an ATV can be used to examine the sale area until Month/Day/Year after notification of Pond Creek NWR office (870-xxx-xxxx). **Questions concerning this sale should be directed to the refuge forester at 870-xxx-xxxx (cell).**

Operations must be completed in the most expeditious time possible. The sale will expire on Month/Day /Year. (At the discretion of the Refuge Manager, an extension may be granted for extended wet weather or other uncontrollable circumstances.)

Each bidder will submit with his bid, a bid guarantee in the amount of $500.00 payable to the U.S. FISH AND WILDLIFE SERVICE IN THE FORM OF A CERTIFIED CHECK. The deposits of the unsuccessful bidders will be returned after a determination has been made regarding the bidder who will be awarded the permit.

The bid guarantee of the successful bidder will be retained by the Government and applied to the PERFORMANCE GUARANTEE which will be **$15,000** to cover any damages or claims the Government may have against the permittee as a result of this operation under the terms and conditions of the permit-agreement and to serve as a perpetual advanced payment for timber.

Payment of the performance guarantee will be in the form of a CERTIFIED CHECK due within ten (10) days of purchaser's receipt of the timber sale permit. Upon satisfactory completion of the timber operation, the performance guarantee will be returned.

Timber will be paid for every two weeks by company check. The value of the timber will be based on actual scale tickets provided with the payments. Weather and logging conditions permitting, START HARVEST OPERATIONS WITHIN THIRTY (30) DAYS of the bid opening.

A copy of applicable special harvesting conditions and map is attached to this bid invitation.

A sample copy of the permit agreement is available from the refuge manager at the Pond Creek NWR office located at 1958 Central Road, Lockesburg, AR 71846.

The right to reject any or all bids hereunder is reserved.

Bid: For sale number PC-XX-X, C-XX

Item 1: Hardwood Sawtimber $_____per ton
Item 2: Hardwood Pulpwood $_____per ton

_____ _____
Submitted by (Company or Organization) Name of Bidder

_____ _____

Address	Signature
City, State, Zip	Date
Accepted by: Administrative Forester, South Arkansas Refuges Complex	Date

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 offeror 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 offer furnished with the bid or proposal includes 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.

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 September 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 September 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.

APPENDIX E: 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.

Preferred Action and Alternatives. The preferred action is the approval and implementation of this Habitat Management Plan (HMP) for Pond Creek National Wildlife Refuge (NWR). This HMP is a step-down management plan providing the refuge manager with specific guidance for implementing goals, objectives, and strategies identified in the Pond Creek NWR Comprehensive Conservation Plan (CCP) (1999).

The CCP is the preferred alternative among three alternatives considered in the Environmental Assessment (EA) (Draft CCP and EA 1999). In the CCP, the preferred action is: to restore and maintain diverse habitats designed to achieve the refuge purpose and wildlife population objectives; to maintain viable, diverse populations of native flora and fauna consistent with sound biological principles; to protect the area's wetlands and resource values through land protection strategies; and to develop and implement a quality wildlife-dependent recreation and environmental education program that leads to enjoyable recreational experiences and a greater understanding and appreciation of fish and wildlife resources (Pond Creek NWR CCP 1999).

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 Pond Creek NWR CCP and accompanying Environmental Assessment (1999). These include:

- A-1. Native Hardwood Habitat Management Objective (CCP Goal 1, Objective 1, 2)

  Implement adaptive management to maintain 35-50 percent of 25,535 acres of hardwood forests 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 midstory cover, 30-40 percent understory cover, and 20-50 percent ground cover, with regeneration of hard mast producing species (e.g., oaks and hickories) present on 30-50 percent of inventory plots (LMVJV 2007) for a diversity of wildlife species, particularly waterfowl, wading birds, and migratory forest-dwelling land-birds.

- A-2. Reforestation Habitat Management Objective (CCP Goal 1, Objective 3)

  In units 3A, 3B, 4A, 4B, 4C, 5B, 5C, and 6A, restore approximately 2,000 acres of pine plantations into hardwood forests through sound silvicultural practice as outlined in 2003 Forest Management Plan and Environmental Assessment. Conversion to hardwood forests would occur through a combination of planting of hardwoods and natural regeneration based upon existing regeneration prior to harvest (Table 4).

Forest Habitat Management Strategies (HMP, Chapter V)

- A-3. Moist-Soil Habitat Management Objective (CCP Goal 1, Objective 4)

  Use adaptive management on the existing 52 acres of moist-soil habitat units 1, 2, and 3, to promote desirable vegetation through a combination of water manipulation, mechanical, chemical, and/or fire treatments for shorebirds and wintering waterfowl. Within 2 years, create a 200-acre, semi-permanent wetland unit to provide feeding and resting areas for wintering waterfowl.

Moist-Soil Management Strategies (HMP, Chapter V)

- A-4. Greentree Reservoir Habitat Management Objective (CCP Goal 1, Objective 1, 2)

  Within 2 years, create and manage two greentree reservoir (GTR) units in Compartments 6A (86 acres) and 7B (311 acres), with levees and water control structures to provide feeding areas for wintering waterfowl (Figures 4 and 5). Depth, duration, and timing of flooding will vary annually, and will include years of no flooding. Utilize adaptive management approach to GTR management that provides high-quality waterfowl habitat and ensures continued health and regeneration of the existing forest.

Greentree Reservoir Management Strategies (HMP, Chapter V)

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"* applicable to implementation of the preferred action.

Consistent with Categorical Exclusion (516 DM 6, Appendix 1, Section 1.4 B (10)), this 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 this 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 is not likely to adversely affect the:

Bald Eagle - Wintering bald eagles are frequently seen along the Little and Cossatot Rivers and the upper portion of Millwood Lake;

American Alligator - Alligators are common in the lakes, streams and sloughs of the refuge;

Rafinesque's big-eared bat – May use the large hollow trees on the refuge for roosting and breeding;

Rabbitsfoot mussel - occurs in the Little and Cossatot Rivers; and

Alligator snapping turtle - May occur in the refuge's wetlands and stream systems.

(A Section 7 Intra-Service Consultation was signed on June 2, 1999, and included in the CCP for Pond Creek NWR.)

Other Items to include that should be listed and can be found in the EAS accompanying the final CCP:

- Executive Orders 11988/11990 - July 1999

- Floodplain Management and Protection of Wetlands, July 1999

Public Involvement/Interagency Coordination. This HMP is a step-down of the approved CCP for Pond Creek NWR. The development and approval of the CCP included appropriate NEPA documentation and public involvement. An Environmental Assessment was developed (Draft CCP/EA 1999), which proposed and addressed management alternatives and environmental consequences. Public involvement included a public meeting on June 26, 1997, at the Horatio Elementary School, Horatio, Arkansas, concerning the future management of Pond Creek NWR. A total of 56 participants were divided into six groups and facilitators recorded their comments on flip charts, according to pre-determined categories (e.g., hunting, fishing). The comments were then summarized for all participants. 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. 1998. Pond Creek National Wildlife Refuge, Fire Management Plan.

U.S. Fish and Wildlife Service. 2003. Pond Creek National Wildlife Refuge, Forest Management Plan.

U.S. Fish and Wildlife Service. 1999. Pond Creek National Wildlife Refuge, Comprehensive Conservation Plan.

U.S. Fish and Wildlife Service. 1999. Pond Creek National Wildlife Refuge, Environmental Assessment for the Draft Comprehensive Conservation Plan.

_____ _____
Refuge Manager Date

_____ _____
Regional Refuge NEPA Coordinator Date

_____ _____
Regional Chief, Southeast Region Date

Pond Creek National Wildlife Refuge

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