UNITED STATES FISH AND WILDLIFE SERVICE

ENVIRONMENTAL ACTION STATEMENT

Within the spirit and intent of the Council on Environmental Quality's regulations for implementing the National Environmental Policy Act (NEPA), and other statutes, orders, and policies that protect fish and wildlife resources, I have established the following administrative record and determined that the proposed Habitat Management Plan for Cahaba River National Wildlife Refuge in Bibb County, Alabama:

Check One:

_____ is a categorical exclusion as provided by 516 DM 2, Appendix 1 and 516 DM 6, Appendix 1, Section 1.4 A (4). No further NEPA documentation will therefore be made.

___X___ is found not to have significant environmental effects as determined by the attached Environmental Assessment and Finding of No Significant Impact.

_____ is found to have significant effects and, therefore, further consideration of this action will require a notice of intent to be published in the Federal Register announcing the decision to prepare an EIS.

_____ is not approved because of unacceptable environmental damage, or violation of Fish and Wildlife Service mandates, policy, regulations, or procedures.

_____ is an emergency action within the context of 40 CFR 1 506.1 1. Only those actions necessary to control the immediate impacts of the emergency will be taken. Other related actions remain subject to NEPA review.

Other Supporting Documents:

Endangered Species Act, Section 7 Consultation, 2007

Signature Approval:

(1) Originator	5/9/07 Date	(2) Regional Environmental Coordinator	05/23/07 Date
(3) Regional Chief, NWRS, Southeast Region	5/30/07 Date	(4) Regional Director, Southeast Region	5/27/07 Date

CAHABA RIVER
NATIONAL WILDLIFE REFUGE

HABITAT MANAGEMENT PLAN

(1) Refuge Manager Mountain Longleaf NWR	5/9/07 Date	(2) Refuge Supervisor Area 2	5/14/07 Date
(3) Resource Management	5/18/07 Date	(4) Chief - Division of Refuges Southeast Region	5/30/07 Date

May 2007

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1.0 Introduction

1.1 Planning Process

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

The statutory authority for conducting habitat management planning on National Wildlife Refuges is derived from the National Wildlife Refuge System Administration Act of 1966 (Refuge Administration Act), as amended by the National Wildlife Refuge Improvement Act of 1997 (Refuge Improvement Act), 16 U.S.C. 668dd - 668ee. Section 4(a)(3) of the Refuge Improvement Act states: "With respect to the System, it is the policy of the United States that -- (A) each refuge shall be managed to fulfill the mission of the System, as well as the specific purposes for which that refuge was established ..." and Section 4(a)(4) states: "In administering the System, the Secretary shall monitor the status and trends of fish, wildlife, and plants in each refuge." The Refuge Improvement Act provides the Service the authority to establish policies, regulations, and guidelines governing habitat management planning within the System. The Ecological Integrity Provision of the Act further requires refuges to “ensure that the biological integrity, diversity and environmental health of the System are maintained”. Subsequent Integrity Policy established that, in accordance with Refuge Purpose, the highest measure of biological integrity, diversity, and environmental health can be achieved through restoration and management of the historic landscape cover.

An HMP is a step-down management plan of the Refuge Comprehensive Conservation Plan (CCP). The CCP describes the desired future conditions of a refuge or planning unit and provides long-range guidance and management direction to achieve the purpose(s) of the refuge; helps fulfill the mission of the System; maintains and, where appropriate, restores the biological integrity, diversity, and environmental health of each refuge and the System; helps achieve the goals of the National Wilderness Preservation System, if appropriate; and meets other mandates. A CCP has not been accomplished for Cahaba River National Wildlife Refuge and will not be completed for several years. At the time of CCP preparation, the HMP will be reexamined and appropriate information will be incorporated into the CCP.

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

1.2 Cahaba River National Wildlife Refuge

The establishment of Cahaba River National Wildlife Refuge was approved through a Congressional Act in 2002 to: (1) conserve, enhance, and restore the native aquatic and terrestrial community characteristics of the Cahaba River; (2) to conserve, enhance, and restore habitat to maintain and assist in the recovery of animals and plants that are listed as threatened or endangered species; (3) to ensure that hunting, fishing, wildlife observation, wildlife photography, and environmental education and interpretation are the priority general public uses of the refuge when providing opportunities for compatible fish- and wildlife-oriented recreation; and (4) to encourage the use of volunteers and to facilitate partnerships among the Service, local communities, conservation organizations, and other non-federal entities when promoting public awareness of the refuge's resources and those of the National Wildlife Refuge System. This notice was published under the authority of the Cahaba River National Wildlife Refuge Act, Public Law 106-331, and the National Wildlife Refuge System Administration Act of 1996, as amended (16 U.S.C., 668dd-668ee).

On September 25, 2002 the Service established the refuge and acquired initial refuge lands. In partnership with The Nature Conservancy (TNC), the Service began acquiring land for the Cahaba River National Wildlife Refuge in September 2002 (Figure 1). In February 2004, the Regional Director (Southeast Region) of the U.S. Fish and Wildlife Service (Service) authorized the expansion of the acquisition boundaries of the refuge to include an additional 340 acres of property at the confluence of the Cahaba and Little Cahaba Rivers. This expansion will allow us to better manage the refuge, further protect the Cahaba River, and also provide greater protection to several species of plants that are known from nowhere else in the world. In 2006, P.L. 109-363 authorized the further expansion of the acquisition boundaries of the Refuge by an additional 3,600 acres. By May 1, 2007, 3,414 acres had been acquired within the 7,300-acre approved acquisition area (Figure 2).

Establishment of a new National Wildlife Refuge along the Cahaba River was widely supported by both environmental organizations and local communities in the region. The Nature Conservancy took a lead in the preservation of native communities on and along the Cahaba and Little Cahaba Rivers by establishing three preserves (Pratt’s Ferry, Bibb County Glades and Barton’s Beach) totaling over 600 acres. Further legislative planning efforts were taken to gain support and provide environmental documentation for refuge establishment (Allen 2000) and later for possible expansion (Oberholster 2003) of a new refuge. Today, the Cahaba River NWR is managed from the refuge headquarters in Anniston, Alabama. The unstaffed Cahaba River NWR relies heavily on the resources of local agencies and cooperative partners to accomplish stewardship goals. Major partners on the refuge include; The Cahaba River Society (environmental education), The Nature Conservancy (habitat management), Bibb County (enforcement and facility improvement), Alabama Department of Conservation and Natural Resources (cooperative hunting and fishing, enforcement), and the City of West Blocton (enforcement). A “Friends Group” is currently being formed by the local community and will provide a

refuge advocacy voice and a base for volunteer support in accomplishing future refuge programs

1.3 Refuge Vision

The **Refuge Vision** broadly reflects the reason for establishing the refuge, based on both legislated and planning purposes and objectives. The vision statement is as follows:

"Cahaba River National Wildlife Refuge will be managed to conserve, enhance and restore the native aquatic and terrestrial community, along with providing educators, research scientists, and the public with a broad range of opportunities to appreciate and enjoy a biologically diverse and disappearing southern landscape."

Based on Service Biological Integrity Policy, refuge management programs will be directed at maintaining and restoring the natural landscape to those biological communities that existed during the presettlement period. The Refuge Vision fully supports Service Biological Integrity Policy and the congressionally mandated purpose for establishing the refuge - "to conserve, enhance and restore the native aquatic and terrestrial community characteristic of the Cahaba River".

1.4 Biodiversity

The biologically diverse Cahaba River is Alabama's longest free-flowing river with a watershed of 1,870 square miles. The 190 mile long river extends from its source near Trussville in St. Clair County south to the Alabama River. Researchers have described the river as the most icthyologically diverse free-flowing river of its size in North America (Mayden 1989). Of the 131 fish species found in the Cahaba, 18 are found nowhere else except the Mobile River drainage area. With 118 snail species in the Mobile River basin, the Cahaba is also recognized as containing the most diverse snail population in the world. In addition, 43 mussel species historically existed in the Cahaba, which exceeds the number found in all of Europe. The river also shelters the largest known stand of the imperiled shoals lily (*Hymenocallis coronaria*) in the world.

Adjacent uplands also contribute to regional biodiversity. Bibb County has long been identified as containing the most significant diversity of rare plant species of any county in the temperate Southeast (Allison 2003). This can largely be attributed to its location at the juncture of three physiographic provinces, the rural character of the county, and the existence of multiple outcrops of Ketona Dolomite. The dolomite outcroppings contain high concentrations of magnesium carbonate, which supports a unique glade community. A wide array of rare plants can be found on these glades, including eight plants found nowhere else in the world. A total of 76 rare plants have been documented from this unique corner of Alabama.

A study of over 2,000 watersheds across the continental United States selected the Cahaba River as one of eight national biodiversity "Freshwater Hotspots" deserving high priority conservation protection (Master et al. 1998). The recently completed

Cumberlands and Southern Ridge and Valley Ecoregion Biodiversity Plan (TNC 2003) provides further documentation on the river basin's contribution to regional biodiversity. The study provides a portfolio of priority conservation areas of high biodiversity within the two physiographic provinces. A total of 262 areas were identified across the region for protection of aquatic and terrestrial conservation targets. Forty-four of these areas were ultimately selected as high priority action sites. The "Upper Cahaba River", to include the entire river's length within the refuge, was selected as one of these aquatic high priority action sites. "Bibb County Glades", located on adjacent uplands, were designated a terrestrial high priority action site. While Ketona Glades are not located on the refuge, they are found adjacent to refuge boundaries and within the proposed refuge expansion area. The presence of both aquatic and terrestrial high priority action sites along the Cahaba River further documents the significance of refuge lands as a biodiversity hotspot.

The Alabama Department of Conservation and Natural Resources (ADCNR 2005) recently completed a comprehensive wildlife conservation strategy planning process on the status of Alabama wildlife and the concerns, recommendations and conservation framework for protecting these diverse populations. The planning process adopted the former TNC (2003) conservation areas (Upper Cahaba River and Bibb County Glades) with the recommendation they serve as a "blueprint" for biodiversity conservation. The planning process further considered expansion of the Cahaba River NWR as one of the highest priority actions within the Cahaba River Basin.

The impact of increased urbanization, along with associated mining and industrial industries in the upper Cahaba River Basin, have degraded water quality and threaten the future of these diverse biological communities (ADCNR 2005). The environmental organization, American Rivers (1990), selected the Cahaba River as one of the ten most endangered rivers in North America in 1990. Recognizing the importance of protecting this unique natural environment, government agencies, conservation organizations and citizen groups have worked together to improve water quality and protect the river's rare and endemic aquatic species and natural communities. The Cahaba River Society was created in 1989 and has been instrumental in coordinating and leading water quality improvement projects. The group participates in citizen advisory committee for stormwater management, basin-wide water quality planning, promotion of habitat conservation, environmental education and advising Jefferson County on a $30 million commitment to develop greenways.

1.5 Habitat Management Plan

The HMP contains a description of the proposed management program as follows:

Section 1 – Introduction

Provides an overview and introduction to plan purposes

Section 2 – Environmental Setting and Background

Provides a review of site history and a description of physical setting along with regional and local ecological issues

Section 3 – Resources of Concern

Provides a description of refuge natural communities and ecological significance, to include endangered and exotic species.

Section 4 – Habitat Goals and Objectives

Provides a overview of refuge management goals, strategy and the formulation of management objectives.

Section 5 – Habitat Management Strategies

Provides a description of management goals and specific objectives proposed for accomplishing goals.

Section 6 – Management Strategy Documents

Provides a description of resources needed to accomplish management goals along with management constraints and regulatory compliance.

2.0 Environmental Setting and Background

2.1 Location

The refuge is located near the town of West Blocton in Bibb County, Alabama. The City of Birmingham is located 30 miles to the northeast, while Montgomery is 65 miles to the southeast (Figure 1). The 3,414 acre refuge was legislatively established on September 25, 2002 on former private and commercial timberlands bordering the Cahaba River (Figure 2). Approximately 3 miles of the Cahaba River flow through the refuge. The Cahaba River (below mean-low water) is considered "state waters" and owned by the State of Alabama. In February 2004, the refuge acquisition boundaries were expanded to include 340 acres to the south along the Cahaba and Little Cahaba Rivers.

The Service has established Ecosystem Units using the U.S. Geological Survey's Hydrologic Unit Map as the foundation for managing and organizing its staff resources and program capabilities. The refuge is located in the central portion of Central Gulf Watersheds and is included within the Cumberlands and Southern Ridge and Valley Ecoregion Biodiversity Plan (TNC 2003)

2.2 Management Units

Management units (Figure 3) were delineated to facilitate and prioritize resource and prescribed burning programs on the refuge. Internal unit boundaries are along roads and streams, while external refuge boundaries currently lack established roads or firebreaks.

2.3 Physical Features

2.3.1 Geology

The coal beds of the Cahaba coal field are contained within the Pottsville Formation of lower Pennsylvanian age (QORE, Inc 2004). The Pottsville Formation is reported to be locally more than 8,000 feet thick and divided into three large scale assemblages known as magnafacies. Each magnafacies is described as a measure, a term which describes a characteristic series of beds consistent throughout an area. These magnafacies are described as the Quartzarenite Measures (Oldest, bottom), the Mudstone Measures (middle) and the Conglomerate Measures (youngest, top). Coal mining on the refuge took place within the Conglomerate Measures.

The Conglomerate Measures comprise the upper 2,500 feet of the Pottsville Formation. These measures contain abundant lithoclasts (contained rock pieces within conglomerate beds) of chert, granite, basalt, gneiss, schist, and volcanics.

Coal mining on the northern part of the refuge occurred in the Thompson Coal Bed. Specifically, Thompson coal lies atop the Straven Conglomerate, a significant and widespread marker bed within the lower portion of the Conglomerate Measures.

Typically, Thompson coal is two to three feet thick, but has been reported up to five feet thick.

2.3.2 Topography

The refuge is characterized by rolling hills with steep ravines along the river and tributary streams. Topography ranges from 220 feet (asl) along the river to 560 feet (asl) on some hilltops (Figure 2). Topography has been altered due to historic strip-mining on northern portions of the refuge.

2.3.3 Hydrology

The refuge is located within the 1,870 square mile Cahaba River watershed, approximately 15 miles north of the Fall Line. About three miles of the Cahaba River flows through the center of the refuge. Additional tributary streams on the refuge include Little Ugly and Caffee Creeks. Portions of the Little Cahaba River flow through and along the southern refuge boundary. Big Ugly Creek is just north of the refuge, while Pratt Creek is near the southern refuge boundary.

2.3.4 Soils

The Natural Resources Conservation Service is in the process of mapping Bibb County soils, but has not initiated efforts within refuge boundaries (Langlinais 2006). Preliminary mapping adjacent to the refuge however provides a general understanding of refuge soil series and possible management constraints.

Ridgetops – The Nauvoo Series is suspected to cover most refuge hills and ridge-tops. These deep, well-drained, moderately permeable soils formed in loamy residuum weathered from sandstone or imbedded sandstone and shale. Slopes range from two to 35 percent. Typically, these soils are used for growing cotton, corn, soybeans, small grains, hay and pasture.

Gentle Slopes – Most refuge side-slopes and choppy ridge-tops are probably covered by Townley and Nauvoo Series soils. Townley soils are moderately deep, well drained, slowly permeable soils formed in clayey residuum weathered from shale or interbedded sandstone and shale. Slopes range from two to 45 percent with medium to rapid runoff of surface waters. Regionally, most of these soils are in forest, with some used for growing cotton, corn, hay and pasture.

Steep Slopes – Steep slopes on the refuge can be expected to contain Gorgas, Montevallo and Rock Outcrop Series. The Gorgas Series consists of shallow, well drained, moderately rapid permeable soils that formed in sandstone residuum with slopes ranging from two to 45 percent. The Montevallo Series consists of shallow, well-drained, moderately permeable soils that formed in residuum from siltstone or silty shale on slopes ranging from two to 60 percent. These lands are typically maintained in forest, with occasional uses for pasture or cultivated crops.

Floodplains – Sterrett Series can be found along flood plains and low stream terraces, while Bloomingdale Series is common on flood plains and depressions in the broken Ridge and Valley landscape. The Sterrett Series consists of deep, somewhat poorly drained, moderately permeable soils that formed in loamy fluvial sediments deposited from sandstone and shale residuum. These soils are usually saturated with water in winter and early spring, and may flood for brief periods from December through March. Typically, these lands have been cleared and are used as pasture. The Bloomingdale Series consists of very deep, poorly drained soils that formed in mixed alluvium from shale and limestone. Typically, these lands are used for hay, pasture, and where drained, for row crops.

2.4 History of Refuge Lands

Systematic cultural or historic resource surveys have not been accomplished on the refuge. In addition, the State Historic Preservation Office (SHPO) currently has no sites recorded within refuge boundaries.

Should previously unrecorded cultural resources be encountered during refuge management activities, all activities will cease at that specific location and reasonable efforts will be taken to avoid or minimize damage to the site. The Office of the Regional Archaeologist will be immediately notified and advised of the nature of the discovery.

Should human remains be encountered during refuge management activities or permitted activities, all actions will cease at that specific location. The Refuge Manager, the Regional Archaeologist, and the Refuge Law Enforcement Officer will be contacted immediately. The SHPO, the County Medical Examiner, and the pertinent tribes will be notified pursuant to the provisions of the Native American Grave Protection and Repatriation Act.

2.4.1 Prehistoric Land Use (Native American to 1814)

The refuge is located within lands formerly part of the Creek Indian Nation. While the Creeks primarily settled along the Coosa and Tallapoosa Rivers to the east, scattered communities existed along the Cahaba, remote from the center of Creek culture. Because Choctaw lands were located a short distance west of the Cahaba River, permanent Creek settlements tended to exist along the east bank of the Cahaba, or on lands to the east. Lands west of the river provided a buffer between the two tribes and were primarily used for hunting. Typically, Native Americans cleared small openings in the woodlands to cultivate crops in and around village sites (Ellison 1984).

The Treaty of Fort Jackson in 1814 forced the cessation of all Creek lands west of the Coosa, and required Indians inhabiting the region to move east of the Coosa River.

2.4.2 Historical Land Use (1814-2002)

Following the Treaty of Fort Jackson in 1814, American settlers began moving into the area, first using the small agricultural clearings of the recently departed Creeks. Cahaba County was established in 1818 and later renamed Bibb County in 1820. Early settlement (1820s) in northern Bibb County occurred along Caffee Creek west of the refuge and along the Little Cahaba River and Mahan Creek to the southeast. Throughout the 19th Century, most inhabitants of the area lived on small, isolated farms seldom traveling outside the county.

By the 1830s, small ironworks were established across the county, with some of the larger along the Little Cahaba River and Mahan Creek east of the refuge. The Civil War further stimulated the development of ironworks across the county. The largest of these iron furnaces was the Brierfield Iron Works along Mahan Creek southeast of the refuge. Following the war, the county's furnaces were increasingly in competition with the larger Birmingham coke-fueled plants. By the early 1890s, the iron industry had all but disappeared from the county.

Coal mining was another industry stimulated by the Civil War. During the war, the Thompsons mined coal for the Condederate government using slave labor. The coal seam mined by the Thompsons is within refuge boundaries and was eventually developed as the Piper mines in later years. By the 1880s prospectors had come to northern Bibb County searching for coal to fuel the burgeoning iron and steel mills in the new City of Birmingham. The Town of Blocton soon became the center of mining across northern Bibb County. By 1890, seven mines and a coke oven operated in the Blocton area. In all probability, local forests supplied support timbers for the numerous mines in the area. Both Mohr (1901) and Harper (1942) comment that significant quantities of local timber went into mining the Cahaba coal fields. Mohr (1901) estimates that half a cubic foot of timber was required to mine every ton of coal. Two of the most prosperous communities were the twin towns of Piper and Coleanor. The towns were established in 1901 along the northeastern edge of the refuge. Piper mines and a portion of the town-site were within current refuge boundaries. The two towns eventually reached a population of 2,500, including 500 mine employees. Today, the mines are abandoned and the town-site has disappeared.

Only the vestiges of former mining remain within the refuge. All represent safety and/or environmental issues for natural communities and visitors to the refuge. Three abandoned underground mines, dating from 1900 to 1930, historically existed within the refuge. Between 1930 and 1960, and again in the 1980s, further attempts were made to surface mine the coal seam. Today, the refuge still contains remnants of these activities, which include a gob pile, two ponds, an abandoned tipple and one sediment basin.

The lumber industry in northern Bibb County was stimulated by the coming of the Alabama and Chattanooga Railroad, later to become the Southern Railway. By the 1870s, several sawmills were in operation in northern Bibb County. One of the larger timber operators in Bibb County was W.E. Belcher. Belcher constructed his first sawmill

during the timber boom in 1906. By 1918 he was operating four sawmills in the local area (Ellison 1984). The only remaining second-growth longleaf forests on the refuge were part of the former Belcher holdings. In recent years, most of the refuge was owned by industrial timber companies that established extensive loblolly pine plantations.

2.4.3 Refuge (2003-Present)

Today, 3,414 acres of the region have been protected within the Cahaba River National Wildlife Refuge. The refuge is currently unstaffed and managed from refuge headquarters in Anniston, Alabama. Most of the refuge is closed to motorized vehicles and open to foot traffic only. The exception is a two mile section of River Road extending from County Road 24 south to the mouth of Caffee Creek. The upper half of this road has been graveled along with drainage improvements, while the southern section remains unimproved road of "chert and dirt" material, but accessible to two-wheel drive vehicles. A canoe launching facility with ADA accessibility was recently constructed south of County Road 24 along River Road. Additionally, a 1.3 mile interpretive trail with ADA access is currently being constructed east of the river along the former Piper railroad bed. This trail will provide interpretation of the former mining area and provide views along the river

3.0 Resources of Concern

3.1 Refuge Natural Communities

3.1.1 Terrestrial Communities

Refuge natural communities are far different from those that existed on the historical landscape. Over the past 50 years much of the region has been converted from longleaf pine forest to loblolly pine plantations. Fire, which was part of natural and anthropogenic processes in this fire dependant ecosystem, has also disappeared from the landscape. The effects of replacing the original upland forests with a long rotation forest crop, and the elimination of fire have dramatically altered refuge natural communities. These landuse changes, along with soil disturbance and the subsequent spread of invasive species, have added to the impact, further altering refuge uplands. Within this landscape, however, there remains isolated habitats (e.g. steep slopes) or residual seed banks (e.g. Georgia aster) that retain some of the original more natural characteristics of the presettlement landscape. Approximately 60 percent of the refuge is currently in pine plantations and clear-cuts, 30 percent is hardwood and hardwood-mixed pine forest, 5 percent is natural longleaf pine forest and 5 percent consists of aquatic river environments.

Tracts formerly in private individual ownership, rather than industrial timberlands, are in the best ecological condition. Although fire suppressed, these lands contain remnants of the original forest that covered the region. In particular, uplands east of Hargrove Shoals along the southern portion of the refuge contain second growth stands of mountain longleaf pine (Section 16). These lands were owned by the Belcher Family prior to creation of the refuge.

The refuge is composed of upland ridges and slopes that support a variety of natural community types. The formation of these communities was influenced by elevation, slope, aspect and soils. In addition to geographic and physical factors, the introduction of fire has the ability to structurally change the composition of many of these natural communities. Most of today's natural communities reflect the absence of fire, and the successional trend to fire sensitive species and community types.

Refuge natural communities are classified in accordance with the system developed by NatureServe and The Nature Conservancy (TNC) in cooperation with state, federal, and academic partners. This classification is a modified version of the UNESCO vegetation classification system (UNESCO 1973). The national classification has been developed to present a consistent framework for conserving and stewarding biodiversity. As such, communities become extremely important conservation targets in areas where species patterns and ecological processes are poorly understood. Plant communities can also be used as a coarse filter approach in planning the conservation of biological diversity. Descriptions of plant associations with ecosystem information can be useful in developing management regimes that maintain biodiversity across the landscape by incorporating relatively large-scale ecosystem process models during the planning

process. Ecosystem transition models can be used in the restoration of degraded natural communities. The spatial arrangement of plant communities on the landscape can be used to interpret gaps in the landscape picture where plant communities are no longer extant. With this information it may be possible to conserve much of the natural diversity of an area through strategic conservation planning and stewardship.

Refuge community descriptions are consistent with The Nature Conservancy ecoregion planning (TNC 2003) and Alabama's Comprehensive Wildlife Conservation Strategy planning processes (ADNR 2005). The State plan identifies key habitats existing on the refuge that are important for protecting Alabama wildlife; mesic hardwood forest, dry hardwood forest, floodplain forest, dry longleaf pine forest, cliffs and rockhouses, artificial habitats, and caves and mines.

Alabama's plan includes both caves and mines, while the TNC plan restricts their planning process only to caves. Although the State plan acknowledges that environmental conditions are absent for most cave-dwelling species in mines, they believe abandoned mines are exploited by more mobile species, such as bats and some reptiles and amphibians. Regional studies in the United States have documented that up to 70 percent of abandoned mines are utilized by bats (Tuttle and Taylor 1994). Mine openings are not known on the refuge, but potential exists for the former Hargrove shaft, as well as, possible ventilation shafts for other mines. Should mines openings eventually be located on the refuge, they will be monitored for possible bat use according to procedures provides by Tuttle and Taylor (1994). If bats are found to be utilizing this habitat, management programs will be formulated based on site conditions and requirements.

Inclusion of artificial habitat in the State's planning process (ADNR 2005) seems to reflect the potential for restoration and the possible degradation of nearby more natural systems. Lands within the former Piper mining area would fall under this classification, and will eventually be restored to native forest cover, probably longleaf pine. Environmental contaminants associated with historic mining operations however create additional issues that must be considered in restoration planning (Goal 12).

Currently, a total of eleven natural plant associations are recognized on the refuge (Figure 6). The greatest proportion of the refuge is characterized by a complex of vegetation contained within the "Forest Plantations" type, while in contrast, the "Cahaba Lily-Water Willow" association is one of the smallest and globally rarest on the refuge. Refuge plant associations were characterized by the Alabama Natural Heritage Program (Schotz 2007).

3.1.2 Mountain Longleaf Pine Forest Region

Longleaf pine forests originally covered 92 million acres across the southeastern United States. These forests stretched from southeastern Virginia to Texas and have been referred to as the keystone of the southeastern landscape. Today, less than 3 million acres remain and the forest is recognized as a critically endangered ecosystem with loss of over 98 percent of its original range. Additionally, longleaf pine forest in its original fire

maintained condition has been recognized as perhaps the rarest community type in the southeastern United States (Noss et al. 1995).

The Mountain Longleaf Pine Forest Type is a loosely defined geographical extension of the southern longleaf pine forest. While the boundaries of this forest type are poorly defined, most observers agree that the Blue Ridge, Ridge and Valley and Cumberland Plateau sites are within the mountain region (Varner et al. 2003). Some observers also include the Piedmont as part of this forest type. Although longleaf pine forests once reached from Virginia to Texas, only in northeast Alabama and northwest Georgia did or do they extent beyond the Piedmont and Coastal Plain into more upland regions. Of all the longleaf pine forests, mountain longleaf is the most imperiled, comprising only about two percent of longleaf's total remnant acreage.

Longleaf pine is a key tree species in a complex fire-dependant ecosystem long native to the Southeast. These forests primarily owe their existence to lightning related wildfires, which were augmented by Native American practices of burning the forest. The former presettlement forest is believed to have evolved through lightning fires that occurred from May through July (Brown and Smith 2000) at an interval of two to eight years (Outcalt 2000).

The refuge is located near the southern edge of the Ridge and Valley, less than 10 miles north of the Fall Line. Mohr (1901) described the region as the "Lower Hill Country" and botanically regarded the area as a subdivision of the more northern mountain region. Harper (1942) placed the refuge within his "Coal Basin Region". He considered longleaf pine common within the Cahaba coal fields (Harper 1928). Although he found it scattered along the sandstone ridges (Harper 1942) in the coal fields, both loblolly and shortleaf pines are also described as common trees in the region (Harper 1913). Because the landscape is highly dissected with ridges and ravines, he believed that fire was less frequent in these forests. More recently, Griffith et al. (2001) placed the refuge within the Southern Sandstone Ridges Sub-Ecoregion of the Ridge and Valley.

Today, we loosely group refuge longleaf pine forests into what is commonly termed the "Mountain Longleaf Pine Region". While our understanding of the original forest can only be hypothesized from early observations and the highly altered refuge forests of today, we can speculate on their former composition and distribution. Higher ridges and the most xeric sites probably were covered by pure stands of longleaf pine. Xeric-mesic slopes and ridges may have contained a more mixed cover of longleaf and shortleaf pines, along with upland oaks and hickories. Ravines and more protected environments may have been dominated by deciduous trees and loblolly pine. The frequency of fire no doubt also affected forest composition. Without fire, the canopy closes, and fire sensitive hardwoods gain an advantage and eventually replace aging longleaf pines. More mesic forest associations eventually dominate a landscape formerly covered by xeric open forests of longleaf pine, shortleaf pine and upland hardwoods. The somewhat more natural second-growth forests on the refuge's Belcher tract provide an indication of what longleaf forests may have resembled.

3.1.3 Natural Community Descriptions

Natural communities are assemblages of species that occur together in space and time. These groups of plants and animals are found in recurring patterns that can be classified and described by their dominant physical and biological features. As with most vegetation classifications, the boundary between natural communities is often an integration of different species, floral groups and physical features. For these reasons, no single natural community description will precisely match plant associations of adjacent areas. The location and configuration of refuge natural communities are provided on Figure 6. Natural community mapping and characterization were accomplished by the Alabama Natural Heritage Program (Schotz 2007).

Each community is placed in one of four soil moisture classes (dry-mesic, mesic, wet-mesic and hydric), a classification devised by the United States Department of Agriculture. Because all parts of the refuge receive similar average annual rainfall, the differences in soil moisture are due to the ability of the soils to retain their complement of precipitation. Moisture variances are functions of slope, soil texture, porosity, and vegetation cover. For example, if all other factors are equal a site of modest slope retains its moisture more tenaciously than one of greater slope. Additionally, on a given gradient, the lower portions of the slope stay wetter than points farther upslope because of downward percolation. Among environmental forces, soil moisture, whatever its governing factors, has a particularly strong influence on the vegetation that occupies a given site. So powerful, in fact, is the selecting influence of moisture that, as a rule, different species of plants inhabit xeric, mesic, and hydric sites. Since the steepness of a slope is usually the critical factor in determining soil moisture at a given refuge location, one can expect that most of the refuge's dry-mesic communities will be found on ridgetops and upper slopes and mesic conditions on the middle and lower slopes.

3.1.3.1 Dry-mesic Communities

Interior Longleaf Pine Woodland – (synonyms: montane longleaf pine forest). This woodland system is distinguished from other interior systems in having longleaf pine, an indicator of fire, as a dominant species. It is commonly referred to as the mountain longleaf pine forest type and was previously discussed under "Mountain Longleaf Pine Forest Region". In addition to Alabama, examples are also present in Georgia and North Carolina, occupying rolling to somewhat mountainous terrain north of the Fall Line. While commonly considered forest, the "woodland" classification actually refers to open stands of trees forming a 25-60 percent canopy cover. This community is often viewed as a transition between forest and savannah.

With a higher fire frequency in presettlement forests, the canopy is believed to have been more open with a high diversity of forbs and grasses in the ground cover. Present day forests, however, are closed canopy stands characterized by a dense growth of trees and shrubs in the understory, often excluding most herbaceous plants. Further, the alteration of fire regimes, combined with widespread logging, has significantly altered

environmental conditions and our understanding of the original vegetation cover. While longleaf pine was certainly more prominent in the original fire maintained forests, other pines and oaks were probably also present. While the dynamics of this system are strongly influenced by fire, fires likely occurred at frequencies lower than in the Coastal Plain. Low intensity fires would kill only a few individual plants in the fire-adapted community. Due to fire exclusion, the reproduction of longleaf pine has largely been eliminated and replaced with hardwood species that are tolerant to fire and have the ability to sprout. As such, the reintroduction of fire will only gradually restore this system to its original structure and composition. One association is known from the refuge; four others have been described, all of which have a more easterly distribution.

- *Pinus palustris – Pinus echinata* – (*Pinus virginiana*) / *Quercus marilandica* (*Quercus prinus*) / *Vaccinium pallidum* Woodland [Longleaf Pine – Shortleaf Pine – (Virginia Pine) / Blackjack Oak – (Chestnut Oak) / Lowbush Blueberry Woodland]

Historically, this association may have occupied a significant portion of the refuge, but is now limited to remnants along the highest, and most inaccessible ridges. Refuge communities (Figure 6) that include planted pine forest (both loblolly and longleaf) and native longleaf pine woodlands likely represent the historical distribution of longleaf pine on the refuge. Remaining refuge longleaf stands are generally in poor condition with little resemblance to their former stature or composition. The single exception to this generalization includes a mosaic of second-growth natural longleaf pine stands on lands referred to as the Belcher Tract (Section 16). These scattered second-growth stands range to 40 years in age and provide the best example of longleaf pine woodlands on the refuge.

The canopy, in addition to longleaf and shortleaf pines, often includes (presumably due to a reduction of historical fire regimes) loblolly pine (*Pinus taeda*), Virginia pine, and various combinations of oaks and other hardwoods, including chestnut oak, blackjack oak, white oak (*Quercus. alba*), southern red oak (*Q. falcata*), scarlet oak (*Q. coccinea*), mockernut hickory (*Carya alba*), and sourwood (*Oxydendrum arboreum*). While fire is the driving force that maintains this system, the presence of steep slopes and rocky conditions, particularly west of the Cahaba River, may have also allowed the regeneration of longleaf pine, even with infrequent fire events. In the absence of recurring fire, a wide number of trees and shrubs have also become established in the understory, resulting in the decline of the herb layer. Additional species commonly encountered in this association include blackgum (*Nyssa sylvatica*), flowering dogwood (*Cornus florida*), southern sugar maple (*Acer barbatum*), red maple (*A. rubrum*), mountain laurel (*Kalmia latifolia*), tree sparkleberry (*Vaccinium arboreum*), horse sugar (*Symplocos tinctoria*), and witch hazel (*Hamamelis virginiana*). Lowbush blueberry is locally abundant in the ground layer. The herbaceous component, although sparse, is exemplified by a rich diversity of species, the more noteworthy being bracken fern (*Pteridium aquilinum* var. *pseudocaudatum*), little bluestem (*Schizachyrium scoparium*), panic-grass (*Dichanthelium commutatum*), goat's-rue (*Tephrosia virginiana*), flowering spurge (*Euphorbia corollata*), wild bergamot (*Monarda fistulosa*), whorled tickseed (*Coreopsis*

major), grass-leaf golden aster (*Pityopsis graminifolia*), and sweet goldenrod (*Solidago odora* var. *odora*). These perennials benefit directly from the effects of growing season fire and the open forest canopy.

Rare species present: Georgia aster (*Symphyotrichum georgianum*).

3.1.3.2 Mesic Communities

Upland Mixed Forest – (synonyms: pine-oak-hickory forest, southern mixed hardwoods). Upland mixed forests are found throughout Alabama, ranging from nearly subtropical forest in the south to a cool temperate flora further to the north. In addition, the composition and abundance of species, as well as, the structure and dynamics of these forests, are affected by disturbance regimes that vary over space and time. Most recently, anthropogenic disturbance (e.g. commercial forestry and mining) has complimented natural disturbance regimes (e.g. fire exclusion) further modifying ecological processes. Much of the refuge that originally was xeric longleaf pine woodlands or xeric-mesic upland mixed forest is successionally evolving into more mesic forest. Many oaks and hickories benefit from occasional fire and, as with longleaf pine, will also be replaced by more fire-sensitive species over time. Hence, the distribution and combination of species and natural communities have significantly changed and continues to change since presettlement times. Given the above conditions, three associations are presently recognized from the refuge.

- *Quercus prinus – Carya* spp. – *Quercus velutina* / *Vaccinium arboreum* / *Iris verna* var. *smalliana* Forest [Chestnut Oak – Hickory – Black Oak / Tree Sparkleberry / Dwarf Vernal Iris Forest]

This association occupies well-drained sites throughout central Alabama, typically occurring on middle to high slopes and ridges. It is common throughout refuge uplands, constituting the prominent forest type along many slopes. On xeric fire-excluded longleaf pine sites, this forest association may represent a first step in succession to a more mesic forest association. It, however, should be recognized that many trees in this forest also benefit from fire to some degree. The canopy is primarily chestnut oak, with white oak, southern red oak, post oak (*Quercus stellata*), and mockernut hickory as codominants in many stands. Although of secondary importance, the following are also characteristic trees listed in the approximate order of abundance; shortleaf pine, beech (*Fagus grandifolia*), loblolly pine , black oak , tuliptree (*Liriodendron tulipifera*), sweetgum (*Liquidambar styraciflua*), pignut hickory (*Carya glabra*), red oak (*Quercus rubra*), and water oak (*Quercus nigra*). Understory woody vegetation is usually uniform in distribution, with no particular species assuming dominance. In addition to younger individuals of previously described canopy species, characteristic shrubs and trees include sourwood, flowering dogwood, tree sparkleberry , lowbush blueberry , oakleaf hydrangea (*Hydrangea quercifolia*), mountain laurel, hoary azalea (*Rhododendron canescens*), dwarf pawpaw (*Asimina parviflora*), and red buckeye (*Aesculus pavia*).

Typical vines include muscadine grape (*Vitis rotundifolia*), briers (*Smilax glauca* and *S. rotundifolia*), and poison ivy (*Toxicodendron radicans*).

Rare species present: smooth veiny peavine (*Lathyrus venosus*), Wherry's phlox (*Phlox pulchra*).

- *Quercus alba – Fagus grandifolia* / *Hydrangea quercifolia – Viburnum acerifolium* / *Carex picta – Polystichum acrostichoides* Forest
  [White Oak – Beech / Oakleaf Hydrangea – Mapleleaf Viburnum / Painted Sedge – Christmas Fern Forest]

While present throughout the mountain region of north Alabama, this association is less common in the central part of the State. It is rather rare on the refuge, confined only to the steep, rocky, north- to east-facing slopes overlooking Caffee Creek and along an unnamed, west flowing tirbitary on the refuge's northern boundary. Fire may enter this more mesic forest association, but probably burns at low intensity or becomes extinguished, minimizing any fire related effects. The canopy is characterized by varying degrees of codominance by white oak, beech, and tuliptree, with each species attaining prominence on occasion. Seldom absent from the canopy and of secondary importance are loblolly pine, sweetgum , white basswood (*Tilia americana* var. *heterophylla*), chestnut oak, southern red oak, water oak, and mockernut hickory. The subcanopy is relatively diverse, containing smaller canopy species along with blackgum , sourwood, bigleaf magnolia (*Magnolia macrophylla*), Florida maple, red maple, hop hornbeam (*Ostrya virginiana*), flowering dogwood, and American holly (*Ilex opaca*). Mountain laurel can be found in the shrub layer, often establishing nearly impenetrable stands. Additional shrubs include horse sugar, hoary azalea, silky camellia , oakleaf hydrangea, witch hazel , Elliott's blueberry (*Vaccinium elliottii*), dwarf pawpaw , and strawberry-bush (*Euonymus americanus*). Herbs are generally sparse, with Christmas fern , marginal wood fern (*Dryopteris marginalis*), painted sedge , heartleaf ginger (*Hexastylis arifolia* var. *arifolia*), round-lobed hepatica (*Anemone americana*), partridgeberry (*Mitchella repens*) and bluestem goldenrod (*Solidago caesia*).

Rare species present: silky camellia (*Stewartia malacodendron*) and slender bunchflower (*Melanthium latifolium*).

- *Quercus hemisphaerica – Quercus* (*falcata*, *nigra*) / *Ilex opaca – Vaccinium arboreum* / *Cnidoscolus stimulosus* Forest [Upland Laurel Oak – Oak (Southern Red, Water) / American Holly – Tree Sparkleberry / Tread-Softly Forest]

Primarily confined to the Gulf Coastal Plain, this association assumes a sporadic distribution along its northern range in central Alabama. The occurrence of this community on refuge is restricted to relatively level areas along the west side of the Cahaba River and Caffee Creek, where alluvial deposition has influenced and defined the plant life. The prominence of upland laurel oak , water oak , and loblolly pine in the canopy layers distinguish this association from others on the refuge. Similarly, a suite of secondary species are also represented the canopy and subcanopy, further indicating an

affiliation with the Gulf Coast region. Some of the characteristic trees include shortleaf pine , tuliptree , white oak , sand post oak (*Quercus margarettiae*), and hop hornbeam . The shrub component includes typical species such as sweetleaf , American holly , tree sparkleberry , and flowering dogwood , as well as, titi (*Cyrilla racemiflora*), a component of wetlands along the Gulf Coast. Herbs, which are few and sparse, include tread-softly , dwarf iris , longleaf spikegrass (*Chasmanthium sessiliflorum*), and giant cane (*Arundinaria gigantea* var. *gigantea*).

Rare species present: spring coralroot (*Corallorhiza wisteriana*).

Forest Plantations – (synonyms: planted forest, pine plantation). Planted pine plantations have been established on upland areas throughout the refuge. Loblolly pine plantations were planted prior to refuge establishment by commercial timber companies. Longleaf pine plantations were planted in 2004-2005 in an effort to reestablish a presettlement forest cover. Both plantation types were established on clear-cuts and form even-aged stands of varying ages. Historically, most of these lands were likely covered by longleaf pine forest.

♦ *Pinus taeda* Planted Forest [Loblolly Pine Planted Forest]

Even-aged loblolly pine plantations were planted on uplands, both east and west of the river, prior to refuge establishment. Plantations appear to range in age from 10 to 50 years, and all exhibit similar structural and compositional features. Loblolly pine occupies a dominant position in the canopy, with occasional hardwood associates such as tuliptree, sweetgum, mockernut hickory, and southern red oak. Subcanopy, shrub and the ground cover are highly dependent on the age and density of the loblolly pine canopy. Younger and/or more open stands contain a richer cover of plants. The subcanopy and shrub layers are comprised of early successional deciduous species, which includes the previously-mentioned hardwood species, as well as, flowering dogwood, sourwood, blackgum, persimmon (*Diospyros virginiana*), and oakleaf hydrangea. If open to sunlight, the greatest diversity is found in the herbaceous layer, which is dominated by grass (Poaceae), composite (Asteraceae), and legume (Fabaceae) families. Typical grasses include little bluestem, beardgrasses (*Andropogon* spp.), switchgrass (*Panicum virgatum*), panic-grasses (*Dichanthelium* spp.), and Indian grass (*Sorghastrum nutans*). Composites commonly include bushy aster (*Symphyotrichum dumosum*), late purple aster (*S. patens var. patens*), silvery aster (*S. concolor*), white-topped aster (*Sericocarpus tortifolius*), whorled tickseed, roundleaf thoroughwort (*Eupatorium rotundifolium*), golden- asters , and sweet goldenrod. Characteristic legumes include goat's-rue, pencil flower (*Stylosanthes biflora*), tick-trefoils (*Desmodium* spp.), and butterfly pea (*Centrosema virginiana*). Other conspicuous species include bracken fern , Adam's needle (*Yucca flaccida*), common cinquefoil (*Potentilla simplex*), mountain mints (*Pycnanthemum* spp.), and hairy phlox (*Phlox amoena*). The presence and diversity of herbaceous species in plantations is a good indicator for selecting suitable sites for longleaf pine restoration.

♦ *Pinus palustris* Planted Forest [Longleaf Pine Planted Forest]

Longleaf pine plantations represent the first stage in restoring refuge loblolly pine plantations to their historic forest cover. Restoration goals are to establish the Southeastern Interior Longleaf Pine Woodland System on sites that potentially were covered by longleaf pine during the presettlement period. This ecological forest system and component association were discussed in previous sections.

Approximately 200 acres of loblolly pine plantations were clear-cut immediately prior to refuge establishment in 2002. The area was replanted with longleaf pine seedlings (550 seedlings/acre) during 2004-2005. Near-term management tasks for restoration involve monitoring seedling survival and reintroducing a continuing fire regime. This management phase is estimated to take 30 years, and primarily involves stewardship of even-aged plantations and formation of a fire dependent ground cover. At 30 years, long-term management tasks begin with cone production and seedling establishment, and continues toward formation of a fire maintained mature forest at about 150 years. Long-term objectives involve adjusting seasonal burning frequency to maximize species richness, protecting adequate seedling recruitment, and slowly moving even-aged stands into a multiple aged forest. It should be recognized that natural mature longleaf pine woodlands typically contain a patchwork of overlapping even-aged stands that regenerate in small forest openings. Researchers believe that small gap openings and single tree mortality are critical for successful regeneration (Hermann 1993; Platt et al. 1988).

3.1.3.3 Wet-mesic Communities

Bottomland and Floodplain Forests – (synonyms: bottomland hardwoods, river bottoms, seasonally flooded basins or flats, second bottom, levee forest, river terrace).

Southern floodplain forests have undergone significant reduction and alteration throughout the United States. Many have been and are continually being converted to farmland, industrial parks, or are modified by urban and suburban expansion. Other bottomlands are managed for timber production or as recreational areas in ways that reduce their viability as natural wetland habitats.

Floodplain forests exist wherever streams or rivers flood beyond their channels. In the southeastern United States, these forests are broadly classified into three general categories, bottomland forests, floodplain forests, and deepwater alluvial swamps, each defined by the frequency and timing of annual flooding. Floodplain ecosystems are highly variable in size, ranging from broad alluvial valleys several miles wide to more narrow strips of stream-bank vegetation.

A former more widespread component of floodplain forests is believed to have been dominated by giant cane. Canebrakes in the Southeast have been identified as a critically endangered ecosystem with loss of more than 98 percent of their former range (Noss et al. 1995). They existed within forest openings and as an understory component of

floodplain forest, and as broad cane thickets without forest overstory. Canebrakes are successional communities and may have originated following abandonment of aboriginal agricultural fields or following catastrophic natural disturbances (NatureServe 2006). They are believed to have been maintained in part by fires set by Native Americans. Giant cane is a common refuge species within floodplain forests along the Cahaba River and tributary streams . The historic distribution of this community type on the refuge is unknown, but the presence of fire-dependant longleaf pine forests on adjacent uplands suggests that cane was far more widespread during the presettlement period. The absence of fire and the spread of exotic Chinese privet in temporarily flooded forests have reduced cane, as well as, the potential for restoration through fire. Efforts will be taken to encourage the spread and reintroduction of cane through ecosystem fire and experimental reintroduction programs.

Three wet-mesic associations occur along the river or tributary streams on the refuge. They occupy only a small percentage of total refuge lands.

- *Fagus grandifolia – Quercus alba* / *Kalmia latifolia – Rhododendron canescens – Symplocos tinctoria* Forest [Beech – White Oak / Mountain Laurel – Hoary Azalea – Horse Sugar Forest]

This association is confined to small stream floodplains that empty into either side of the Cahaba River. The most accessible example occurs along Little Ugly Creek where it parallels River Trace Road, south of County Road 24. Larger, higher quality examples occupy more remote sections of the refuge. Elevated a few feet above the streambed, this community experiences sporadic flooding of a minimal duration. Deep alluvial soils coupled with occasional flooding support a strikingly different flora in relation to the hardwood dominated associations of adjacent upland systems. The most characteristic trademark of this small floodplain is the prominence of beech and white oak. Although both species are well distinguished in the canopy, several hardwood species of similar height are also present in decreasing order of abundance; tuliptree, sweetgum, red maple, pignut hickory, and water oak. The understory contains not only smaller individuals of the previously mentioned canopy species, but also a variety of low growing trees and shrubs, such as Florida maple, American hornbeam (*Carpinus caroliniana*), horse sugar, witch hazel, hoary azalea, and an occasional common silverbell (*Halesia tetraptera* var. *tetraptera*) and mountain laurel. The herbaceous component is generally sparse and of moderate diversity, with the following representative species; Christmas fern, giant cane, longleaf spikegrass, cuneate trillium (*Trillium cuneatum*), rue anemone (*Thalictrum thalictroides*), heartleaf ginger, blue phlox (*phlox divaricata*), bloodroot (*Sanguinaria canadensis*), partridgeberry, beechdrops (*Epifagus virginiana*), and blue-stem goldenrod. Llanas are frequent, often climbing into the tops of the tallest trees and include muscadine grape, Virginia creeper (*Parthenocissus quinquefolia*), and cross-vine (*Bignonia capreolata*). Examples of this vegetation type have also been documented to the south in the Oakmulgee District of the Talladega National Forest.

- *Liquidambar styraciflua – Quercus* (*laurifolia, nigra*) – (*Pinustaeda*)/*Arundinaria gigantea* var. *gigantea* / *Carex abscondita* Forest [Sweetgum – (Laurel Oak, Water Oak) – (Loblolly Pine) / Giant Cane / Thicket Sedge Forest]

This forest community can be found on a poorly drained to moderately well-drained ridge and swale complex along the west side of the Cahaba River near the refuge's southern boundary. While annual flooding typifies this community, the forest is a successional phase resulting from human or natural intervention and disturbance. Eventually, an oak dominated climax forest would be expected to successionaly evolve on the site. Sweetgum and loblolly pine are the primary canopy species, with secondary species including water oak, red maple, sugarberry (*Celtis laevigata*), and American elm (*Ulmus americana*). With the exception of loblolly pine, the understory contains the above canopy species along with trees, shrubs, and vines, such as American hornbeam, Florida maple, box elder (*Acer negundo*), pawpaw (*Asimina triloba*), Chinese privet (*Ligustrum sinense*), poison ivy, Virginia creeper, and Japanese honeysuckle (*Lonicera japonica*). Chinese privet and Japanese honeysuckle are highly invasive exotic plants that occupy a significant proportion of the community. Because these exotic plants are so pervasive in the forest, native herbaceous plants are now poorly represented. Some of the more common plants include giant cane, cuneate trillium, wild garlic (*Allium canadense*), wood sedge (*Carex digitalis*), and blue violet (*Viola affinis*).

- *Liquidambar styraciflua – Liriodendron tulipifera* / *Onoclea sensibilis* Forest [Sweetgum – Tuliptree / Sensitive Fern Forest]

This association assumes a sporadic distribution throughout the southeastern United States, where it occupies somewhat poorly drained sites along brownwater rivers. On the refuge, it's confined to bottomlands along the Cahaba River, particularly along the western side of the river. The canopy is often characterized by sweetgum, tuliptree, and water oak, with loblolly pine and white oak of secondary importance. Sycamore (*Platanus occidentalis*) occasionally serves as a canopy species closest to the river's edge. The subcanopy, although well represented, is generally patchy, attaining its greatest development in forest openings. With the exception of loblolly pine, the subcanopy contains the above-mentioned species along with Florida maple, American hornbeam, winged elm (*Ulmus alata*), black cherry (*Prunus serotina*), and pignut hickory. Chinese privet, an exotic invasive shrub, is prevalent throughout the community, creating nearly monotypic stands, often to the exclusion of native shrubs and herbaceous plants. The ground cover, though generally sparse, is characterized by flora typical of regional bottomlands, with common species including sensitive fern (*Onoclea sensibilis*), Christmas fern, longleaf spikegrass, giant cane, cuneate trillium, and wild garlic.

3.1.3.4 Hydric Communities

- *Andropogon gerardii – Panicum virgatum – Baptisia australis* Herbaceous Vegetation [Big Bluestem – Switchgrass – Wild Blue Indigo Herbaceous Vegetation]

Souring by Cahaba River has created and maintained this boulder- and cobble-strewn substrate, which is vegetated with grasses and forbs along with scattered low growing trees and shrubs. Soils are classified as rapidly drained Psamments and are generally restricted to the narrow interstices of tightly packed boulders, or to small crevices in bedrock exposures. Big bluestem, little bluestem, and switchgrass are the principal vegetation cover, with total vegetation cover nearing 40 % of the ground's surface. Less common herbs include Indian grass, broomsedge (*Andropogon virginicus*), gama grass (*Tripsacum dactyloides*), two-flowered melic grass (*Melica mutica*), wild potato vine (*Ipomoea pandurata*), virgin's bower (*Clematis virginiana*), axil-flower (*Mecardonia acuminata*), blue sage (*Salvia azurea*), butterfly-weed (*Asclepias tuberosa*), and poison ivy. Though of lesser significance, woody species also serve to distinguish this association, most of which are stunted and contorted, bearing testimony to the ecological importance and abrasive force of flooding. Typical small trees and shrubs include river birch (*Betula nigra*), black willow (*Salix nigra*), Carolina willow (*Salix caroliniana*), green ash (*Fraxinus pennsylvanica*), and buttonbush (*Cephalanthus occidentalis*). Pepper-vine (*Ampelopsis arborea*) and cross-vine are common vines, often trailing along the ground surface.

This naturally occurring early successional community requires extreme environmental conditions to maintain a suitable substrate. Flash floods that actively scour the floodplain, keeping vegetation open, are necessary. This association is rare and poorly understood at the present time. Further research is needed to compare the refuge scour community with others recorded around the country. In the end, there be sufficient documentation and justification for naming the refuge community as an entirely new association.

Rare species present: maidenbush (*Leptopus phyllanthoides*) and Elliott's fan-petal (*Sida elliottii*).

- *Hymenocallis coronaria – Justicia americana* Herbaceous Vegetation [Cahaba Lily – Water-willow Herbaceous Vegetation]

Scattered along the Cahaba River are series of rocky shoals characterized by a prominence of Cahaba lily and water-willow. Less conspicuous plants include soft rush (*Juncus effusus* var. *solutus*), lizard's-tail (*Saururus cernuus*), and sensitive fern (*Onoclea sensibilis*). Three of these shoals (Upper, Caffee Creek and Hargrove) are located on the refuge (Figure 6). While the lilies are the most conspicuous plant of the shoals, the shallow rapids and aquatic environment provide critical habitat for a variety of rare fish and mollusks (Tables 1).

From a national perspective, this association is recognized as one of the most vulnerable and endangered ecological systems in North America. Never very common, rocky-shoal spiderlilly is restricted to Fall Line shoals, extending from central Alabama, through Georgia, to the vicinity of Columbia, South Carolina. Apart from water quality concerns, many occurrences are now forever submerged beneath hydroelectric dams and reservoirs, or have been destroyed by navigation projects. Approximately 200 acres of shoal's lilies are estimated to remain in the world (NatureServe 2006).

Rare species present: Cahaba lily (*Hymenocallis coronaria*).

- Roadsides

Roadsides are floristically and structurally similar to successional fields, but typically support a greater plant diversity. Because roads are frequently associated with human habitation, both past and present, roadside plant communities often feature species that have escaped from or persist after cultivation. Examples on the refuge include Chinese wisteria (*Wisteria sinensis*), Rose-of-Sharon (*Hibiscus syriacus*), and Formosa firethorn (*Pyracantha koidzumii*). The high disturbance associated with roadsides also provides suitable habitat for a diverse array of native and exotics weeds. New introductions are likely to first appear along roads, which can provide far-reaching connections between seed source and suitable dispersal habitat. Examples of common native roadside flora include Canada goldenrod (*Solidago canadensis*), bitterweed (*Helenium amarum*), ragweed (*Ambrosia artemisiifolia*), and dog fennel (*Eupatorium capillaceum*). Exotics frequently encountered include tall fescue (*Festuca arundinacea*), Nepal grass (*Microstegium vimineum*), Chinese bush-clover (*Lespedeza cuneata*), and Brazilian vervain (*Verbena brasiliensis*). Roadside communities also reflect the plant communities that immediately surround them. Thus, roadsides associated with longleaf pine forests often feature such species as little bluestem, goat's-rue (*Tephrosia virginiana*), woodland sunflower (*Helianthus divaricatus*), and grass-leaf golden-aster.

3.1.4 Aquatic Communities

The Cahaba River provides important habitat for a diverse assemblage of plants and animals and is sought out by canoeists, fisherman and others for its scenic quality. The Cahaba River supplies a large portion of Birmingham's drinking water supply, and also receives domestic and industrial wastewaters. Water quality degradation and the physical alteration of the river environment represent significant challenges for the survival of aquatic biota. The Cahaba River was selected by *American Rivers* in 1990 as one of the 10 most endangered rivers in the United States (American Rivers 1990).

The Cahaba River flows for nearly 190 miles through a variety of settings in central Alabama, draining approximately 1870 square miles and eventually joining the Alabama River near Selma. The upper half of the Cahaba River flows through the Valley and Ridge Physiographic province with its characteristic rocky shoals of limestone, sandstone, shale and dolomite. After the Cahaba River crosses the Fall Line into the

Coastal Plain physiographic province, its winding waters slow as they flow across a mostly gravel and sand substrate.

The refuge contains significant aquatic resources, including three miles of the Cahaba River as well as several tributary streams, including the Little Cahaba River, Caffee Creek and Little Ugly Creek. The refuge lies near the midpoint of the Cahaba River, approximately 95 river miles from both its headwaters and from its confluence with the Alabama River near Selma. The watershed area upstream of the refuge is approximately 650 sq miles. The Cahaba River, as it flows through the refuge, varies from 125 to 250 feet in width with a water depth from a few inches in the shoals to nearly ten feet in pools. Several small islands are scattered along the course, but the dominant features in the channel are the flat bedrock shoals (Figure 6).

Boulder-strewn Caffee Creek is the largest tributary stream flowing through the refuge and averages 25 feet wide and less than a foot in depth. The southern boundary of the refuge contains a short stretch of the Little Cahaba River. The Little Cahaba River drains nearly 265 square miles with an average width of 50 to 75 feet. The Little Cahaba River flows through the Cahaba Valley district of the Valley and Ridge province whose bedrock is comprised of early Paleozoic limestone and dolomite.

The biological richness and significance of the Cahaba River cannot be overstated. Historically, 131 fish, 43 freshwater mussels, 20 snails, 24 crayfish and 146 caddisflies have been recorded from the river. The aquatic animals are not only diverse but nationally and globally significant.

Rare and declining species known from the Cahaba River and listed under the federal Endangered Species Act include 5 fish, 3 snails and 11 mussels. The overall diversity and abundance of the Cahaba Rives fauna has declined over recent years. At least 15 mussels and 5 fish may have been extirpated from the system due to declines in habitat, water quality and connectivity with other populations.

The greatest threat to Cahaba River biotic communities is through water quality degradation. The primary force shaping water quality conditions appears to be rapid urbanization and commercial development in Jefferson, Shelby and St Clair Counties, north and upstream of the refuge. Multiple water quality surveys have found high levels of nitrogen and phosphorus, heavy metals, low dissolved oxygen, organic enrichment, siltation, and chemical spills in the upper basin. There are at least 103 industrial discharge permits in the Cahaba Basin, releasing a variety of toxic metals, chemicals and other substances. There are six municipal wastewater treatment plants in the upper basin with a combined discharge of 19 million gallons a day.

While water quality degradation represents a significant threat to the Cahaba River aquatic system, the longterm and gradual alteration of the river's physical environment may have even greater irreversible effects on the aquatic ecosystem. Species have evolved and adapted to the varied environment of a free flowing river. As man alters stream flows, channel structure and riparian zones, many species disappear from

temperature fluctuations, sediment transport, variable dissolved oxygen and pH, substrate degradation, water depth and variable stream velocity.

Impacts and alterations to the Mobile Basin riverine environment responsible for the decline or loss of native aquatic species have been documented for species recovery plans (USFWS 2000). Typically, those species disappearing are adapted to free-flowing water habitat and depend on habitat stability and water quality. Specific impacts within the Mobile River Basin include:

- Dams – Impoundments result in burial of substrates, accumulation of fine sediments, reduced flow velocities, changes in current patterns, and changes in water quality. They form barriers to the movement of many species of fishes, mussels, snails, insects and crustaceans, fragmenting populations and eliminating genetic interchange.
- Channelization – The straightening, deepening, and/or enlarging of stream and river channels accelerates erosion, alters water depth, and reduces habitat diversity, substrate stability and riparian canopy. Past channelization often causes headcutting and further loss of aquatic habitats. The long-term effect of channelization is the continuing geomorphic response of river channels in previously channelized systems.
- Dredging – Navigation and gravel dredging physically destroys benthic organisms and their habitat, and may eliminate habitat and prey for fishes and turtles. Dredging can also initiate or perpetuate upstream channel instability and erosion. In-channel dredging spoil disposal can cover benthic species and their habitats and/or contribute to temporary downstream turbidity. Gravel mining dredging can destroy high quality gravel armored river bottoms critical to many imperiled species.
- Mining – Both active and historic coal mining has taken place along the Cahaba River. The abandoned Piper Mine is located on the refuge with mining residues directly adjacent to and in the river. Surface water runoff from coal mining results in acidification, mineralization and sedimentation.
- Pollution – Inadequately treated effluent from industrial and sewage treatment plants can eliminate or reduce the density and diversity of riverine species. Nonpoint source pollution is particularly difficult to control and represents a major challenge for the future. Nonpoint source pollution originates as general surface water runoff from construction, agriculture, silviculture, and urbanization.

3.1.5 Biota

Refuge biota are provided in the accompanying tables and figures; mollusks (Table 2), fish (Table 3), reptiles and amphibians (Table 4), birds (Figure 4) and mammals (Table 5). Plants and animals that have been identified through the Alabama Natural Heritage Program (NatureServe 2006), Alabama's Comprehensive Wildlife Conservation Strategy Plan (ADCNR 2005), Alabama's Nongame Species Regulation and/or the Federal Endangered Species Act are considered "Species of Conservation Concern" within the

HMP (Table 1, Figure 4). Where available, information on population status and refuge collection locations is provided for all "Species of Concern".

NatureServe (2006) maintains national and state conservation rankings of more than 65,000 plants and animals across the United States. Local state heritage programs provide the conservation status rankings at a local level. Those species assigned a state assessment value between 1 and 4 are included on Table 1.

- S1 – Critically Imperiled
- S2 - Imperiled
- S3 – Vulnerable to Extirpation or Extinction
- S4 – Apparently Secure

Alabama has established a comprehensive planning strategy for conserving the State's wildlife (ADCNR 2005). As a foundation for developing strategies, 314 aquatic and terrestrial wildlife species were identified as the greatest conservation concern. Plant species were not included in this evaluation process. Wildlife selected for the "Greatest Conservation Need (GCN)" were included on the table using the following selection criteria:

- Priority1/Highest Conservation Concern – Critically Imperiled and at risk of extinction/extirpation.
- Priority 2/High Conservation Concern - Imperiled

Species classified as endangered, threatened or as candidates for listing through the Endangered Species Act were also considered "Species of Concern" and discussed in greater detail in Section 3.2.

Dams, dredging and channel modifications have altered the aquatic river ecosystem, degrading biodiversity values throughout the Mobile River Basin. Anadromous (e.g. American shad) and catadromous (e.g. American eel) fish have difficulty navigating downstream dams (e.g. Millers Ferry and Claiborne). In addition, resident species (e.g. rainbow snake) that subsist on migratory species now unable to reach refuge waters also decline in numbers. As species sensitive to water quality changes, sedimentation or the loss of specialized river environments disappear, biodiversity and the stability of the entire river ecosystem come into jeopardy. With efforts in recent years to improve water quality and, where possible, rectify past alterations to the river environment, the Cahaba River represents the best opportunity in Alabama for improving biodiversity values and restoring declining or extirpated species.

3.1.5.1 Plants

The distribution and composition of species in refuge natural communities was discussed in Section 3.1.3. Eleven plant associations are currently recognized on the refuge. Each association contains a distinct community structure of different plant species.

Typically, those associations least disturbed and/or of rarest occurrence have the greatest potential to support rare or uncommon species (e.g. Cahaba Lily – Water-willow Herbaceous Vegetation). Much of the refuge, however, has been severely altered through past mining and industrial forest practices, and contains associations created by man or heavily impacted through his actions (e.g. Planted Loblolly Pine Forest). Some communities are more natural and mature, but have been severly altered by invasive/exotic plants (Sweetgum – Tuliptree / Sensitive Fern Forest). The significance and implications of invasive plants are discussed in Section 3.3.

Refuge surveys for rare plants were completed by the Alabama Natural Heritage Program (Schotz 2007). Twelve plant species considered critically imperiled, imperiled or vulnerable (NatureServe 2006) were found on the refuge during the survey (Table 1, Figure 4). Georgia aster (Candidate Species) was the only federally listed plant species.

A rare plant and natural community survey (Schotz 2007) provides baseline information for protecting and managing plants and animals considered "Species of Concern". Populations of these species will be identified according to the ecological community or specialized habitat in which they are found. In some situations, this may include the entire plant association (e.g. Cahaba Lily – Water Willow Herbaceous Vegetation). In other cases, isolated areas or specialized habitats along certain roadways (*Phlox Pulchra*) or undisturbed rocky slopes (*Lathyrus venus*) will be delineated as containing significant resources. Collectively, these areas will be designated as "Significant Biological Areas". It is important to consider the community as the basis for management and protection. It is the biological integrity and structure of these habitats that allow rare species to exist on the landscape. Management requirements and constraints needed to preserve the integrity of these habitats, along with management constraints and restrictions for operational programs, will be provided for each rare community location designated as a "Significant Biological Area" (Goal 8).

A number of additional plant species recorded by Alabama Natural Heritage Program (Schotz 2007) were formally monitored through the NatureServe Program, but have recently been taken off the list. These species include soapwort gentian (*Gentiana saponaria*), striped gentian (*Gentiana villosa*), southern twayblade (*Listera australis*), pinesap (*Monotropa hypopithys*) and ginseng (*Panax quinquefolius*).

3.1.5.2 Freshwater Mussels and Snails

Freshwater mollusks are one of the most imperiled groups of organisms in the world. Over half of all known or presumed aquatic animal extinctions in the United States since European settlement have been freshwater mussels and snails unique to the Mobile Basin (USFWS 2000). Only 75 percent of snail species and 71 percent of the mussels historically occurring in Alabama are still alive today. Only 17 percent of the snails and 21 percent of mussels in present-day state environs can be considered secure. The remainder are imperiled to various degrees, ranging from relict populations no longer reproducing to widespread species suffering from declining population levels (Mirarchi et al. 2004).

With 118 snail species in the Mobile River basin, the Cahaba River is recognized as containing the most diverse snail population in the world. In addition, 42 mussel species historically existed in the Cahaba, which exceeds the number found in all of Europe. The Cahaba River is Alabama's longest free-flowing river, which is largely responsible for the basin's rich mollusk fauna. The prominence of shoals along the upper river reaches and lack of significant development along much of the river further enhance the river's species richness. The refuge is located within the most species rich section of the river (Paul Johnson, personal communications). At the same time, rampant development of Jefferson and Shelby Counties, and decades of coal mining have degraded river water quality and hydrologic flows that continue to place stress on present-day populations.

A list of freshwater snails and mussels documented on the refuge or collected from nearby adjacent sections of the river is provided on Table 2. Eight mussels and 11 snails are designated "Species of Concern (Table 1). During a recent HMP scoping meeting with regional aquatic ecologists, the delicate spike was considered the most significant mussel population on the refuge (Garland 2006). Two mussels (fine-lined pocketbook and triangular kidneyshell) and three snails (round rocksnail, flat pebblesnail and cylindrical lioplax) are federally listed as endangered or threatened, and are discussed in further detail in Section 3.2. For refuge management planning, the river and associated stream mouths will be considered a single "Significant Biological Area".

A review of historical records from the refuge and adjacent waters can be found on Table 6 (Paul Johnson, personal communications). This is a conservative estimate of species formerly recorded from the refuge area. Because many historical collections fail to provide a specific collection site location (e.g. Cahaba River, Bibb County, etc.), there were a number of additional species that could not be definitively attributed to the refuge.

3.1.5.3 Fish

Alabama's rivers and streams are inhabited by one of the richest fish faunas in North America, numbering around 300 freshwater species (Mirarchi et al. 2004). Continuing development within the state, however, has placed stress on many of these populations, particularly those fish that depend on a free-flowing river system. Navigational and hydrological dams have inhibited upstream migration of fish. Maintenance dredging has eliminated sand and gravel bars important for spawning and has blocked block many stream mouths. Pulse releases from hydroelectric dams have adversely altered tailwater habitat and water quality conditions, and sediments and eutrophication have adversely impacted fish populations throughout the state. Continued industrial growth and urban development can be expected to place further stress on these populations in future years.

As Alabama's longest free-flowing river, the Cahaba has escaped some of these impacts. Water quality degradation, sedimentation and hydrologic modification of stream flows, however, continue to place stress on fish populations. Exotic fish species currently are not considered a significant environmental problem in the refuge area (Garland 2006).

A list of fish species potentially occurring in refuge waters is provided on Table 3. "Species of Concern" documented on the refuge can be found on Table 1 (rock darter, Cahaba shiner, skygazer shiner and goldline darter). Only the Cahaba shiner and goldline darter are federally endangered or threatened species. The two federally listed fish are discussed in further detail in Section 3.2.

3.1.5.4 Reptiles and Amphibians

Alabama reptiles and amphibians total 154 species, which include 30 frogs, 43 salamanders, 12 lizards, 40 snakes, 28 turtles, and the alligator (Mirarchi et al. 2004). The Ridge and Valley Physiographic Province is somewhat unique in that this region seems to support a higher percentage of Coastal Plain species than other regions north of the Fall Line (Mount 1975). Potential reptiles and amphibians that may inhabit the refuge are provided on Table 4.

There were no documented reptiles and amphibians on the refuge that are considered "Species of Concern" (Table 2) or federally listed as threatened or endangered. This likely reflects a lack of survey information in the local region.

3.1.5.5 Birds

Alabama provides critical nesting, wintering, and migratory habitats for a large number of birds. A total of 420 species have been documented in the state. Of this total, 178 are known to nest with 158 regularly nesting in the state. Additionally, 174 species regularly winter, and 80 species migrate through Alabama (Mirarchi 2004).

The refuge is located along the north-south flowing Cahaba River, and provides inviting habitat for both resident and migrating species. The presence of both aquatic and upland habitats on the refuge further increases the diversity of birds that can be expected on the refuge. A checklist of birds that potentially nest or migrate through the refuge is provided on Figure 4.

The Alabama Breeding Bird Atlas project is systematically documenting breeding birds according to USGS Topographic Quadrangles in the state (AOS 2006). To date, 84 birds have been recorded during late May and June within the West Blocton East Topographic Quadrangle. Birds recorded for the Breeding Bird Atlas that are designated as "Species of Concern" include Mississippi kite, bald eagle, Cooper's hawk, Kentucky warbler, wood thrush and Swainson's warbler (Table 1). The bald eagle is the only federally threatened species. Currently, there is no specific refuge habitat critical to the survival of these species. Should bald eagles nest in the future, sensitive nesting habitat could be designated as a "Significant Biological Area.

The Service has completed a "Hunting Plan" for the Cahaba River NWR (USFWS 2004). The plan authorizes the following birds for possible regulated hunting in coordination with State seasons; northern bobwhite and wild turkey. Hunting on the refuge is currently cooperatively administered with the Alabama Department of Conservation and Natural

Resources, Division of Wildlife and Freshwater Fisheries, Cahaba River Wildlife Management Area (WMA).

Turkey populations, in particular, have increased in Alabama during recent years. Northern bobwhite are less common and primarily occur around forest openings and in young open pine plantations. Northern bobwhite populations declined 65.8 percent in the Southeast from 1980 to 1999, while declines in breeding numbers averaged almost 4 percent per year from 1982 to 1999 (Dimmick et al 2003). In Alabama, northern bobwhite numbers are believed to have declined by as much as 85 percent since 1980 (USDA, Forest Service 2004). Research has indicated that regional population declines may be related to differential nest predation for both turkey and northern bobwhite (Simberloff 1993). Forested edge, habitat fragmentation and disturbed landscapes support a wide variety of predators that prey on nests. Refuge management objectives involving longleaf pine restoration are expected to increase forest interior and reduce edge habitat, potentially improving habitat suitability for both species.

Mourning doves, while not included in the Hunting Plan, are commonly found around young pine plantations and along road edges on the refuge. Although continuous forest would not be expected to support large dove populations, open stands of longleaf pine with an herbaceous ground cover, would be expected to provide better habitat than fire suppressed woodlands and closed canopy pine plantations currently on much of the refuge.

According to the Partners in Flight (PIF) Executive Summary for the Southern Ridge and Valley Bird Conservation Plan (Demarest 2006), the greatest conservation issue in this region is conversion of hardwood and mixed pine/hardwood forest to monocultures of loblolly pine, urbanization, and agriculture. A large percentage of natural vegetation in the region has been cleared, and mature forest and the birds dependant on mature forest are less secure here than in any other physiographic area in the Southern Appalachians. The long-term health of priority bird populations is considered dependent on maintenance and management of remnant forest, as well as, aggressive restoration efforts. The executive summary recommends at least eight upland hardwood forest patches greater than 4,000 hectares be sustained and that the number of such patches in the 4,000 to 40,000 hectare range be increased. More than 80 percent of the mixed mesophytic hardwood acreage within these patches should be managed for long rotation or old growth. All existing longleaf habitat should be actively and appropriately managed with fire, and current acreage should be increased where possible. Restoration of refuge uplands to the original cover of longleaf pine and associated pines and upland hardwoods is consistent with PIF goals and objectives

3.1.5.6 Mammals

Alabama has viable breeding populations of 60 native and exotic mammal species (Mirarchi et al. 2006). Species potentially inhabiting refuge communities are provided on Table 5.

The Eastern fox squirrel is the only mammal believed to inhabit the refuge that is currently considered a "Species of Concern" (Table 1). The gray bat is included on tables as potential visitor, and likely forages along the river and larger tributary streams on the refuge.

The Service has completed a "Hunting Plan" for the Cahaba River NWR (USFWS 2004). The plan authorizes the following mammals for possible regulated hunting in coordination with State seasons; squirrel, rabbit, opossum, raccoon, coyote, bobcat, white-tailed deer, and feral hog. Hunting on the refuge currently cooperatively administered with the Cahaba River WMA. Deer is the most popular species hunted on the refuge and has been restricted to bow hunting to date. While feral hogs have not been observed on the refuge, they are found outside refuge boundaries and represent a threat to native species should they be released or move onto the refuge.

3.2 Federally Listed Species

Recovery plans have only been prepared for the blue shiner (USFWS 1995) and the Cahaba shiner (USFWS 1992). Remaining federally listed aquatic species are treated through an ecosystem recovery approach (USFWS 2000; USFWS 2005).

The Mobile Basin Recovery Plan (USFWS 2000) represents the sole recovery plan for 22 aquatic species in the basin. An addendum document was later prepared to treat six snails in greater detail (USFWS 2005). Both plans were developed to compliment earlier individual recovery plans. While delisting was considered a recovery objective for the goldline darter, mussels were considered imperiled to the degree that delisting was unrealistic, and prevention of extinction and further decline were set as recovery objectives. Specific actions needed include:

- Protect habitat integrity and quality
- Consider options for river and stream mitigation strategies that give high priority to avoidance and restoration.
- Promote voluntary stewardship to reduce nonpoint pollution from private landuse.
- Encourage and support community based watershed stewardship planning and action.
- Develop and implement public education programs and materials defining ecosystem management and watershed stewardship responsibilities.
- Conduct basic research on endemic aquatic species and apply the results of this research toward management and protection
- Develop and implement technology for maintaining and propagating endemic species in captivity.
- Reintroduce aquatic species into restored habitats, as appropriate.
- Monitor listed species population levels and distribution and review ecosystem management strategy.
- Coordinate ecosystem management actions and species recovery efforts.

Recent recovery planning (USFWS 2005) for six snails in the Mobile Basin provides specific recovery needs for the three snails documented from the refuge (flat pebblesnail, cylindrical lioplax and round rocksnail). The immediate recovery objective for the cylindrical lioplax and flat pebblesnail is reclassification from endangered to threatened. The eventual recovery objective for all three snails is to restore the species to viable self-sustaining levels so that they no longer require protection of the Endangered Species Act. The recovery plan provides five criteria or factors that will be considered for downlisting or delisting snail species:

- The present or threatened destruction, modification or curtailment of its habitat or range;
- overutilization for commercial, recreational, scientific or educational purposes;
- the threat of disease or predation, particularly the presence of the introduced black carp;
- the inadequacy of existing regulatory mechanisms, particularly sensitivity of snails to certain pollutants; and
- other natural or manmade factors affecting its continued existence, particularly that of catastrophic events.

Eleven species classified as federally endangered, threatened or as candidates for federal listing have been documented on the refuge, in the immediate vicinity or are highly suspected to inhabit refuge communities. These eleven species are described in greater detail within the following section. An additional three species have been identified by Ecological Services as potentially occurring on the refuge; orange-nacre mucket mussel (*Lampsilis perovalis*), Mohr's Barbara buttons (*Marshallia mohrii*) and Georgia rockcress (*Arabis georgiana*). These three species are not discussed in detail and are not believed to occur on the refuge at the present time. They however represent potential species that could move onto the refuge or occur at some future time. Both Georgia rockcress and Mohr's Barbara buttons have been found short distances south and southwest of the refuge (Figure 4).

Gray Bat (*Myotis grisecens*) – Endangered – With few exceptions, the gray bat is restricted to caves for roosting. Available roosting opportunities on the refuge are rare to nonexistent, but the bat likely forages along the river and larger refuge tributary streams. It often travels up to 30 miles from roosting caves to forage during the night.

Bald Eagle (*Haliaeetus leucocephalus*)- Threatened – Bald eagles are found throughout Alabama along major lake and river systems. Due to devastating effects of DDT, the breeding population disappeared from the state in the 1960s. However, with the banning of DDT and intensive restoration efforts in following years, the eagle has made a spectacular recovery with 47 statewide confirmed nests in 2003 (Alabama Nongame Program 2006). Although fish comprise the major part of their diet, small animals such as rats, rabbits, opossums, raccoon, snakes and turtles are also eaten. They usually nest in large trees near water. While confirmed nesting has not been documented along the Cahaba River (Hudson, personal communications), eagles have recently been observed

by refuge personnel and others (AOS 2006) during the spring. It is highly probable that eagles are or in the future will nest along the river on the refuge.

Blue shiner (*Cyprinella caerulea*) – Threatened – The Blue shiner historically inhabited the Cahaba River above the Fall Line. It was last collected in 1971 and now believed to be extirpated from the Cahaba River. Disappearance of this fish from the river is attributed to deteriorating water quality (e.g. nutrification and low dissolved oxygen). As a requirement for delisting, the Recovery Plan (USFWS 1995) specifies at least one adequately protected population exist in the Cahaba River. Additional surveys and possible reintroduction are considered preliminary steps in achieving this objective.

Cahaba Shiner (*Notropis cahabae*) – Endangered – The Cahaba shiner is restricted to the main stem of the Cahaba River and Locust Fork. The shiner historically occurred in 76 miles of the Cahaba River, extending from Helena, Shelby County in the north to Centerville, Bibb County in the south. Currently, it is only found in 15 miles of the river from Centerville upstream to the Piper Bridge (Mirarchi et al. 2004). Five separate collection sites have been recorded on the refuge (Figure 4). Habitat is associated with shoal macro-habitats in quiet backwaters below or adjacent to riffles and runs over clean sand and gravel substrates. The shiner is usually only associated with smaller tributaries during periods of high water where individuals move into the mouths of creeks and streams. The largest and most concentrated collection of Cahaba Shiner's to date was made in the mouth of refuge tributary streams (B.R. Kuhajda, personal communications, February 15, 2006). The reproductive period extends from May to July with fish maturing at one year of age and possibly spawning the second year. Adults are believed to feed on small crustaceans, aquatic insect larvae, and perhaps some vegetation (Mirarchi et al. 2004). The Cahaba shiner is threatened by high nutrient loads, point and nonpoint source pollution, siltation and strip-mining activities (NatureServie 2006).

The Recovery Plan (USFWS 1992) considers degraded water quality as the greatest adverse impact to the Cahaba shiner. Reclassification of the shiner to threatened status will be considered achievable;

- when numbers allow the capture of at least five per hour with a 12 foot seine in suitable habitat throughout the 76 miles of historic range;
- populations are documented to be viable over ten years; and
- the Cahaba River drainage is protected from water quality degradation.

Goldline Darter (*Percina aurolineata*) – Threatened – The goldline darter can be found in the middle portion of the Cahaba River and two of its tributaries, Little Cahaba River and Schultz Creek. It has been extirpated from upper regions of the Cahaba, and currently is known from Blue Girth Creek upriver to just north of Marvel. Two collection sites have been recorded within central portions of the refuge (Figure 4). The darter occurs in swift to moderate current over a substrate of cobble or small boulders interspersed with sand, gravel and pebbles. Riffles often have vegetation on rocks and a border of water willow. It is a benthic feeder taking insects and possibly other macroinvertebrates from rocks. The darter is believed to spawn from late March to early

June, and buries its eggs in fine sands or gravel in eddies downstream and between rocks (Mirarchi et al. 2004). Current threats to the goldline darter primarily involve excessive nutrient loads and siltation (NatureServe 2004).

The recovery objective for the darter is delisting with the following criteria (USFWS 2000):

- known populations are shown to be stable or increasing for a period of at least five years;
- a demonstrated trend in water quality improvement in the reach of the Cahaba River occupied by this fish; and
- community developed watershed plans are implemented to protect and monitor water and habitat quality in all occupied watersheds.

Fine-lined Pocketbook (*Lampsilis altilis*) – Threatened – An endemic mussel found in the Coosa, Tallapoosa and Cahaba River systems. It persists in low numbers at several sites in the Coosa and Tallapoosa River systems, but is extremely rare in the Cahaba River (Mirarchi et al. 2004). A single dead shell was collected from Caffee Creek Shoals during a recent refuge mussel survey (Hartfield 2004). Preferred habitat includes a variety of substrates from clean sand and gravel riffles to depositional areas along stream margins. Females reportedly release glochidia in March with primary hosts including redeye, spotted and largemouth bass and marginal hosts including green sunfish. Physical modification of river substrate and water quality degradation constitutes threats to the mussel's future. Recommendations for recovery include the need to consider augmentation of existing populations and possible reintroduction into areas where the mussel has been extirpated (Mirarchi et al. 2004).

Recovery of the fine-lined pocketbook to the point of delisting is unlikely in the near future (USFWS 2000). Recovery objectives are:

- to prevent the continued decline of the species by locating, protecting, and restoring stream drainages with extant populations; and
- to restore stream habitats to a degree that would allow expansion and/or reintroduction.

Triangular Kidneyshell (*Ptychobranchus greeni*) – Endangered – An endemic mussel found in the Black Warrior, Cahaba and Coosa River systems. Healthy populations remain in the Bankhead National Forest, with small isolated populations found in the Locust Fork, Cahaba River and upper Coosa River (Mirarchi et al. 2004). The mussel has not been collected on the refuge, but has been found both above and below the refuge, increasing the probability of eventually being discovered on the refuge (Hartfield 2004). Preferred habitat includes riffle habitats with gravel and sand substrate in medium to large streams. A long-term brooder that releases glochidia in March, with the Warrior, Tuskaloosa , and black-banded darters, and the Mobile logperch as primary hosts. The mussel is vulnerable to extirpation because of localized distribution and rarity of

remaining populations. Recommendations for recovery include possible augmentation and/or reintroduction (Mirarchi et al. 2004).

Recovery of the triangular kidneyshell to the point of downlisting to threatened is unlikely in the near future (USFWS 2000). The immediate recovery objective is to prevent extinction by relocating, protecting and restoring stream drainages with extant populations.

Round Rocksnail (*Leptoxis ampla*) – Threatened – An endemic snail historically found throughout the Coosa and Cahaba River systems. Within the Cahaba River system, the snail is currently only known from river shoals in Bibb and Shelby counties, Shade and Sixmile Creeks, and the Little Cahaba River (Mirarchi et al. 2004). Within the refuge, the snail is considered the most abundant shoal's snail and was collected from both Hargrove and Caffee Creek Shoals (Hartfield 2004). It has also been found just south of the refuge along the Little Cahaba River (Daphne Field Office Maps). Preferred substrate is gravel, cobble and boulders at depths of less than one meter along the river channel and larger tributaries. Little is known concerning life history, but females are believed to lay eggs from March to mid-May with individuals living about two years. The rapid decline of this mussel in the Cahaba River is attributed to sedimentation, sediment toxicity and poor water quality. Recommendations for recovery include possible augmentation and/or reintroduction (Mirarchi et al. 2004).

The recovery plan (USFWS 2005) establishes the following criteria for delisting this snail:

- a minimum of three natural or re-established populations have been shown to be persistent for a period of ten years; and
- there are no apparent or immediate threats to the populations.

Flat Pebblesnail (*Lepyrium showalteri*) – Endangered – An endemic snail that historically occurred in both the Coosa and Cahaba River systems. Presently know from shoals along the Cahaba River in Shelby and Bibb Counties, and from the Little Cahaba River south of the refuge. An augmentation/reintroduction population (400-500 snails) was released at Upper shoals on the refuge in 2005 (Paul Johnson, personal communications). Additionally, the flat pebblesnail was recently rediscovered at Hargrove Shoals in 2004 (Paul Freeman, personal communications). Very little is known concerning life history of this rare snail, but preferred habitat includes smooth stones in the rapid current of small to large rivers. Within the Cahaba River, the decline of this snail is attributed to sedimentation and water pollution. Recommendations for recovery include possible augmentation and/or reintroduction (Mirarchi et al. 2004).

The recovery plan (USFWS 2005) established the following criteria for reclassification to threatened status:

- the existing population has been shown to be stable or increasing over a period of ten years;

- there are no apparent or immediate threats to the listed population;
- a captive population has been established at an appropriate facility, and the species has been successfully propagated; and
- a minimum of two additional populations have been established within historic range

Cylindrical Lioplax (*Lioplax cyclostomaformis*) – Endangered – An endemic snail that historically occurred throughout the Mobile River Basin. Currently, the snail appears extant in only 15 miles of the Cahaba River above the Fall Line in Bibb and Shelby counties (Mirarchi et al. 2004). Within the refuge, the snail was considered uncommon and collected from Hargrove and Caffee Creek Shoals during recent mussel surveys (Hartfield 2004). The snail requires unusual and specialized substrate of mud beneath large rocks located in rapid shoal's current. Little is known concerning life history, with life spans reported from three to 11 years. Degraded water quality and modification of river flows are credited with the disappearance of this snail. Recommendations for recovery include possible reintroduction (Mirarchi et al. 2004)

The recovery plan (USFWS 2005) criteria for reclassification of cylindrical lioplax to threatened status are the same as those provided for flat pebblesnail.

Georgia Aster (*Symphyotrichum georgianum*) – Candidate – Georgia aster is a showy flowering plant restricted to the Piedmont and Ridge and Valley physiographic provinces from Alabama to North Carolina. In Alabama, the plant is represented by 34 occurrences in seven counties, primarily in the central portion of state. Within the refuge, the aster is widespread along road openings in the Belcher Tract and along the margins of recently planted longleaf pine restoration sites. Openings through the forest created by a continuing fire regime appear needed to maintain this species. With implementation of a prescribed burning program and longleaf pine restoration that opens the forest floor to sunlight, this plant should benefit and increase in the future.

3.3 Exotic Species

The spread of non-native or exotic species represents one of the most serious threats to biodiversity, undermining the ecological integrity of native habitats and pushing rare species to the edge of extinction. Often, introduced species lack predators for control or simply out-compete native species. Once established, many exotic species are virtually impossible to eradicate. They have been implicated in the decline of nearly half the imperiled species in the United States (Defenders of Wildlife 2006).

Historical landuse on refuge lands has ranged from mining and commercial forestry to, in some areas, municipal development (e.g. Piper). These activities have eradicated or heavily disturbed native plant and animal communities in the area. Disturbance and the imbalance of naturally evolved ecological communities is often a primary mechanism for the spread of opportunistic invasive species. While human disturbance on the refuge has been reduced, established exotic species remain a legacy for future resource managers.

All exist and, in many cases, are expanding at the expense of less competitive native species.

Feral hogs have not been documented on the refuge, but are known from nearby areas, particularly south of the refuge. Hogs represent a serious potential impact to natural communities and in particular longleaf pine regeneration.

The recently completed Natural Community and Rare Plant Survey (Schotz 2007) identified several significant exotic plant infestations on the refuge (Figure 7). This mapping effort should not be considered inclusive of all plant infestations, but representative of some of the more heavily impacted lands.

While there are numerous exotic or nonnative invasive species on the refuge, serious environmental harm is usually associated with a select few. The following species represent some of the more ecologically harmful exotic plants and animals that can be found on the refuge. When possible or feasible, eradication or control will concentrate on these species. Additional species, particularly invasive plants, can be found on the refuge and may also require control efforts in the future.

Asian Clam (*Corbicula fluminea*) – The exotic Asian clam can be found in freshwaters throughout the United States. Ecologically, this species can alter benthic substrates and compete with native mussel species for food and space. The clam seems well adapted to disturbed ecosystems and often out-competes more sensitive native mussels. It is more tolerant of polluted environments than most native species, is hermaphroditic and capable of self fertilization, and the glochidia go through a planktonic stage rather than a host specific parasitic phase. The Asian clam was ubiquitous during recent surveys (Hartfield 2004), being the only mollusk that was collected at all sampling locations.

Control or elimination of the Asian clam from the Cahaba River is technically not realistic. Resource managers, however, can minimize adverse consequences on native species by assuring water quality, hydrologic flows and the physical river substrate are protected and improved. The ability of native mussels to effectively compete against the Asian clam is dependant on ensuring healthy populations and suitable habitat.

Brown-headed Cowbird (*Molothrus ater*) – While several nonnative birds (eg. European starling, house sparrow, etc.) are known to nest on or near the refuge, potential adverse effects to native birds primarily involve the brown-headed cowbird (Figure 5). The cowbird is a brood parasite that deposits its eggs in the nests of smaller birds. The cowbird nestlings then typically out-compete their smaller nest mates. During historic times, the cowbird was restricted to the open prairies of the Midwest. As lands were cleared for farms and pastures, the bird moved east to the new more open landscape. Many native eastern birds have never developed strategies for dealing with brood parasitism. Common hosts of the brown-headed cowbird are yellow warblers, song sparrows, red-eyed vireos, chipping sparrows, eastern phoebes, eastern towhees, ovenbirds and common yellowthroats (Cornell Laboratory 1999).

The best approach for reducing cowbirds is by minimizing or eliminating forest openings. Unfragmented or continuous forest is less appealing to cowbirds. Resource management objectives on the refuge that involve restoring longleaf pine and associated hardwood communities to an unfragmented landscape should minimize habitat availability for the cowbird in future years.

Chinese Privet (*Ligustrum sinense*) - Exotic privet can form dense shrub thickets in a wide range of habitats, including floodplain forests, woodlands, and upland fields. They out-compete native vegetation eventually forming dense shrub monocultures. They are fast growing, extremely adaptable, thrive in both shade and sun, rapidly spread and produce copious fruit. They have no known biological controls in North America. Once established, privet is extremely difficult to eradicate. Within the refuge, privet can be found in both upland pine plantations and woodlots, and within bottomlands along streams and the river. The most serious infestations, however, occur in low bottomlands and wetlands. Extensive areas along the river and in low cleared areas have been transformed into a shrub monoculture (Figure 7).

While eradication is difficult, control methods that provide some degree of effectiveness include mowing and cutting, seedling removal, herbicide application and burning. While herbicides have proved somewhat effective as a control measure, they require a broad foliar application with nonselective herbicides. This eliminates beneficial plants and, possibly, animals along with the privet. The most appropriate herbicide control method that minimizes or localizes these effects is a combination of manual cutting and the application of basal herbicide. This is a rather labor intensive approach and should be used in low wet floodplain areas where the problem is most serious. Uplands and transitional areas should be evaluated at a later date after a prescribed burning program is well established. There is some indication that repeated burning over an extended period of time may eventually control privet. Realistically, low floodplains and wet areas with a heavy privet cover will never reach soil moisture or fuel requirements for carrying fire. These areas represent a long-term problem and intensive control should focus on these lands.

Kudzu (*Pueraria montana*) – Kudzu is often characterized as the largest nonwoody weed problem of forest management in the South. It typically occurs in open, disturbed areas such as abandoned fields, roadsides, and forest edges. The vine, however, spreads more rapidly in open areas, and is slowed as kudzu encounters the shade of a forest edge. Although kudzu typically occurs in disturbed habitats, it can invade forest edges, enveloping, suppressing, and eventually killing mature trees. Fire does not seem to be an avenue for controlling Kudzu. In fact, there is some speculation that fire actually promotes seed germination (USFS 2006).

Kudzu is difficult to eradicate once established. In fact, eradication becomes increasingly difficult with increasing age of the infestation. Generally, elimination of the vine requires frequent defoliation by a single or multiple methods. Mechanical removal, grazing or mowing can be effective if root crowns are accessible. Herbicides can also be effective, but generally require repeated applications to regrowth in successive years

(Miller 2003). Kudzu is found at a number of locations on the refuge. Most infestations are located within the former Piper town-site or mining area.

Mimosa (*Albizia julibrissin*) – Mimosa grows in a variety of soil types, produces a large seed crop, and readily resprouts. It quickly takes advantage of disturbed areas or reseeds from nearby infestations. While the tree prefers full sunlight and is often seen along roadsides, it can tolerate partial shade environments. It often becomes a serious problem along riparian areas, where it becomes established along scoured shores and seeds are easily transported in water (SE-EPPC 2004). The seeds remain viable for more than five years (PCA 2004).

Mimosa can be controlled through a variety of mechanical (cutting, girdling and hand-pulling) and chemical (foliar spray and basal bark) treatments. While the tree can be found in a variety of habitats on the refuge, it is most common along the Cahaba River (Figure 7).

Japanese Honeysuckle (Lonicera japonica) – Japanes honeysuckle is an exotic trailing or climbing woody vine that spreads by seeds, underground rhizomes and aboveground runners. The vine invades fields, forest edges and openings, disturbed woods and floodplains. While it prefers open sunlight, the vine is adapted to growing in conditions receiving as little as 25 percent light. It has few enemies in North America and is difficult to control once established. The vine is common throughout the refuge, particularly within disturbed environments and longleaf pine restoration areas. Longleaf restoration involving timber removal and replanting represent a potential for further spreading the vine on refuge uplands.

The implementation of a recurring prescribed fire program represents the best option for eventually controlling and reducing Japanese honeysuckle on the refuge. While the short-term use of fire may have minimal impact on the vine, recurring longterm prescribed burning may eventually control the species. The application of seasonal biennial burning over a 23 year period in a south Alabama study eventually eliminated the vine entirely in most treatments (USFS 2006). Control on the refuge will therefore consider fire as a primary longterm treatment for all areas within proposed prescribed burning prescriptions.

Chinese Lespedeza (Lespedeza cuneata) - Chinese lespedeza is an aggressive legume introduced from Asia to provide livestock forage, reclaim eroded slopes, and as a seed source for wildlife food plots and and roadside planting. The plant is both flood and drought tolerant, and is rarely bothered by insects or disease. The seeds remain viable for up to 20 years and control is extremely diffucult once the plant becomes established. Chinese lespedeza is widespread across the refuge, particularly along roadsides and within the former Piper townsite. The species, however, is also present to a lesser degree within longleaf pine restoration areas. Fire by itself does not control the plant and can even stimulate further spread. Chinese lespedeza, together with bicolor lespedeza (Lespedeza bicolor), are two exotics that will be monitored during the course of longleaf pine restoration programs.

Control of the plant on the refuge will be extremely difficult and may be nearly impossible in well established infestations. Prescribed burning actually provides an avenue for further spreading the plant, particularly on recently opened lands being replanted to longleaf pine. Minimizing plowed firebreaks and soil disturbing management activities will be the first line of defense for controlling/managing exotic lespedezas. Where serious concern for spread exists, prescribed burning will attempt to target the late summer period and possibly follow-up with herbicide treatments. Late season burning seems to reduce mature plants, remove that year's seed and decrease seedling survival.

4.0 Habitat Management Goals

The establishment of Cahaba River NWR was approved through congressional legislation in 2002 to:

- **conserve, enhance and restore the native aquatic and terrestrial community characteristic of the Cahaba River;**

- **conserve, enhance and restore habitat to maintain and assist in the recovery of animals and plants listed under the Endangered Species Act of 1973;**

- **provide opportunities for compatible fish- and wildlife-oriented recreation, and ensure priority public uses of hunting, fishing, wildlife observation and photography, and environmental education and interpretation are given priority consideration; and**

- **encourage the use of volunteers and to facilitate partnerships among the United States Fish and Wildlife Service, local communities, conservation organizations, and other non-Federal entities to promote public awareness of the resources of the Cahaba River National Wildlife Refuge and the National Wildlife Refuge System and public participation in the conservation of those resources.**

The biological diversity and rarity of aquatic biota were primary reasons for selecting these lands as a new National Wildlife Refuge. To meet these purposes, **management goals** and subsequent **management objectives** are directed at conserving, enhancing and restoring refuge aquatic and terrestrial native communities. All goals and objectives are designed and evaluated according to their ecological benefit in reestablishing or enhancing native communities that existed on refuge lands prior to European settlement. In many situations, this objective involves reestablishing a fire regime on upland habitats, and replanting or enhancing the former longleaf pine ecosystem that historically dominated the landscape. Where protective or mitigative measures are considered necessary to ensure the survival of a species or community type, they are identified and incorporated into management strategy.

The **Refuge Vision** broadly reflects the reason for establishing the refuge, based on both legislated and planning purposes and objectives. The vision statement is as follows:

"Cahaba River National Wildlife Refuge will be managed to conserve, enhance and restore the native aquatic and terrestrial community, along with providing educators, research scientists, and the public with a broad range of opportunities to appreciate and enjoy a biologically diverse and disappearing southern landscape."

The following **management goals** were designed to meet refuge establishment purposes and define general targets in support of the Refuge Vision.

- **GOAL 1 – Participate in regional and cooperative efforts for water quality improvement and ecological restoration of the Cahaba River aquatic system;**

- **GOAL 2 - Protect, restore and enhance the Cahaba River aquatic environment adjacent to the refuge**

- **GOAL 3 - Provide an ecosystem management strategy for uplands that restores and maintains the mosaic cover of native pine and hardwood forests;**

- **GOAL 4 – Reestablish a recurring fire regime through prescribed burning to approximate conditions occurring in presettlement forests;**

- **GOAL 5 – Restore the longleaf pine and associated upland communities, where possible, to a condition that can be maintained through prescribed burning;**

- **GOAL 6 - Manage wetland, streamside and hardwood forests as a component of the mountain longleaf pine ecosystem;**

- **GOAL 7 – Manage the refuge as part of the regional landscape, while minimizing forest fragmentation and disturbed edge habitat within the refuge boundaries;**

- **GOAL 8 - Inventory, protect and manage rare, endangered, threatened and sensitive species and natural communities;**

- **GOAL 9 - Inventory and control exotic and invasive species;**

- **GOAL 10 – Maintain and restore native wildlife associated with longleaf pine and other refuge upland natural communities.**

- **GOAL 11 – Maintain an adequate firebreak system that fulfills management and public use needs, while minimizing adverse ecological effects on the natural landscape.**

- **GOAL 12 – Restore altered habitats and highly disturbed landscape associated with the former Piper mine complex.**

5.0 Habitat Management Strategies and Objectives

Management objectives are incremental steps or specific tasks for achieving management goals. Objectives should be viewed through adaptive management, and modified, added or eliminated as new information becomes available. Management objectives that are particularly critical and should be implemented in the immediate future are termed **primary objectives**. Those objectives in which additional information is needed before implementation of specific management efforts are termed **secondary objectives**. Secondary objectives are not necessarily of less ecological importance, but require additional information or completion of a **primary objective** before programs are initiated.

Strategies provide definable techniques and approaches for meeting management goals and achieving management objectives. They are discussed under **supporting rationale** as the probable approach for reaching objectives. Future information and site specific conditions may necessitate modifying techniques and strategy. It is critical again that managers view strategy through an adaptive management approach, and take advantage of lessons learned and new information as it becomes available.

While **management objectives** can be formulated at the present time, specific techniques or **strategies** in accomplishing objectives may have to be modified due to site specific or changing conditions.

Specific prescriptions for meeting **management goals** and accomplishing **management objectives** will be selected in the Annual Habitat Work Plan (AHWP). The HMP however provides a range of options with the most probable strategy described in detail. Costs associated with accomplishing **management objectives** are provided on Table 7.
A probable schedule for implementing and accomplishing objectives is provided on Table 8. The HMP provides a 15-year management scenario. Costs, where possible, will be developed according to management year (e.g. Year 1, Year 2, etc.) The accomplishment of annual management objectives is heavily dependent on annual funding and adequate staffing.

GOAL 1

Participate in regional and cooperative efforts for water quality improvement and ecological restoration of the Cahaba River aquatic system.

The Cahaba River Basin covers 1818 square miles within the State of Alabama. About 185 miles of streams in the basin have impaired water quality and fail to currently support their designated uses. Most of these water quality impairments exist above the Fall Line and can be attributed to urban and industrial development in the Birmingham metropolitan area (ADCNR 2005). Located south of Birmingham, the refuge is the direct recipient of much of this degraded water quality and sedimentation. With degraded water quality and altered stream environments, refuge biota suffer with those unable to adapt to changing conditions becoming endangered, threatened or totally disappearing from the river.

Characterization of Cahaba River water quality by the U.S. Environmental Protection Agency (Howard et al. 2002) documented the following problems in the basin:

- Excessive sedimentation and nutrient enrichment are affecting watershed biology;
- A decline in pollution-sensitive fish species with a concomitant increase in pollution-tolerant fish species;
- A prominence of the filamentous green algae *Cladophora*, which is often associated with nutrient enrichment and nuisance conditions;
- Total phosphorus and total nitrogen ranged from 12 to 960 ppb and 230 to 21,094 ppb, respectively (12 ppb TP and 230 ppb TN considered adequate);
- Excessive sediments have degraded and altered benthic community and species diversity in portions of the river;
- Dramatic increase in “disturbed land” in the basin since 1990; and
- High incidence of NPDES permit violations for nutrient or nutrient related parameters over the last several years

The refuge, on an individual basis, can have little direct effect for improving water quality in the Cahaba River. It forms less than three-tenths of one percent of all river basin land. Benefits to refuge biota and the river in general can only be accomplished through region-wide efforts that improve water quality of the river and associated basin streams. With eventual water quality improvements, those species adapted to specialized habitats and a diverse aquatic community will be more able to compete and survive in the healthy environment.

Management objectives will focus on establishing partnerships or participation as a stakeholder in regional efforts for Cahaba River water quality improvement. While several existing examples are provided as management objectives, additional opportunities are expected to evolve and come to the public’s attention with changing

attitudes, new issues and over time. As new opportunities are presented, refuge managers will consider Service participation according possible benefits to refuge natural communities and aquatic biota.

Primary Objective 1 – Participate as stakeholder on regional water quality improvement efforts within the upper Cahaba Basin, with at least annual coordination meetings with major participants.

Supporting Rationale

Participate as stakeholder with groups working on regional water quality improvement within the Cahaba River Basin. The most significant adverse impact to refuge aquatic communities is attributable to upstream water quality degradation. Major groups associated with this effort include The Nature Conservancy, Cahaba River Authority, Clean Water Partnership, Bibb County Wildflower Society, Storm Water Management Authority and Cahaba River Society.

Using the The Nature Conservancy and the Cahaba River Society as a gateway, refuge staff will monitor ongoing efforts and programs in the region. Service personnel will attend public and planning meetings, and participate as a stakeholder in programs that have potential for improving water quality and decreasing sediment loads in the Cahaba River. The Service will provide verbal and documented support to groups on existing effects to refuge biota, particularly adverse impacts on federally listed species, from continuing deteriorated water quality and sediment.

Coordination meetings with the Cahaba River Society and/or The Nature Conservancy will be held at least once annually concerning status of existing programs and the possibility of new efforts in the coming year.

Primary Objective 2 – Establish partnerships with the Alabama Aquatic Biodiversity Center in conserving and restoring sensitive aquatic species, with at least one annual coordination meeting

Supporting Rationale

The Alabama Aquatic Biodiversity Center (AABC) was recently established at Marion, Alabama, 35 miles south of the refuge. The 36 acre complex has a staff of nine employees. The mission of the AABC is to promote the conservation and restoration of freshwater species in Alabama waters. Because some of the most endangered groups exist in the Mobile River Basin, the center will first target these species. A strategy of establishing partnerships, particularly with federal agencies, is considered by the State as the most effective approach in accomplishing conservation goals.

The proximity of the refuge to the center, along with the presence of rare species and critical habitats within the refuge, provides opportunities for both the Service and AABC to accomplish mission goals from cooperative partnerships. Refuge staff will maintain

ongoing communications with the center, seeking opportunities to further research and restoration of sensitive and rare species on the refuge. All programs involving federally listed species will also be coordinated through Ecological Services.

Coordination meetings will be held with AABC staff at least once annually concerning the status of ongoing programs and the possibility of new efforts in refuge waters.

Primary Objective 3 – Ensure water quality of refuge tributary streams through partnerships with adjacent land owners, and coordinate possible support and expertise at least once annually.

Supporting Rationale

Refuge tributary streams (Caffee Creek, Little Ugly Creek and unnamed tributary streams) provide critical escape habitat for fish during sediment and contaminant episodes along the river's main stem. Maintaining and protecting water quality in these streams may be more critical, in the near term, than water quality improvement efforts along the river. For example, the largest collection of Cahaba shiners ever made occurred in the mouth of tributary streams on the refuge (Kuhajda, personal communications). Protecting and improving water quality of these streams and avoiding catastrophic contaminate loading upstream would assure these areas remain available as escape habitat should adverse events occur along the Cahaba River.

Individual streams will be reviewed through aerial photography, and adjacent landuses and landownership will be determined. Landowners adjacent to high value streams will be contacted as part of a community outreach program. Should landowner activities be found to represent a threat to stream water quality, efforts will be made to find funding and expertise to remedy the situation. A partnership will be established with these neighbors to educate them on the importance of their lands in protecting and conserving sensitive aquatic species on the refuge and along the river.

Individual landowners along priority refuge tributary streams will be contacted at least annually and offered support in remediating, restoring and/or protecting streamside habitat from actions that contribute contaminants or degrade water quality.

Primary Objective 4 – Establish cooperative programs and partnerships with the University of Alabama for lands along the western refuge boundary, and meet at least once annually on the status of these programs and the possibility of new partnerships.

Supporting Rationale

Lands bordering the west refuge boundary are owned by the University of Alabama. This rather isolated part of the refuge lacks a boundary road or firebreak, with much of the adjacent university land showing evidence of recent timber harvest. The proximity of

university land to the refuge offers a variety of opportunities for cooperative agreements and partnerships with the University of Alabama. Examples of subject areas for further consideration include cooperative burning programs, cooperative natural resource management programs, and research and educational partnerships. Further research and educational possibilities exist for the establishment of a research facility and access through the refuge for aquatic field programs.

The University of Alabama managers will be contacted at least annually concerning the status of existing cooperative efforts and the possibility of additional partnerships in the future.

GOAL 2

Protect, restore and enhance the Cahaba River aquatic environment adjacent to the refuge

While long-term improvement of refuge biotic communities is highly dependent on regional water quality improvement, there are refuge management activities that will contribute to enhancing and protecting the local and, to a lesser extent, regional aquatic environment. The location of three shoal areas within refuge boundaries establishes critical habitat directly adjacent to refuge boundaries. Protecting these natural communities is particularly important for the maintenance of populations and establishing areas for future recovery and augmentation efforts.

Primary Objective 1 – Restore, where feasible, the river hydrological environment that existed during the presettlement period, and summarize existing and proposed projects in the annual refuge report.

Supporting Rationale

Hydrological modifications and river scouring have altered the Cahaba River sediment environment from the presettlement period. Many organisms that were adapted to this environment have disappeared from the river or have been relegated to relict habitat scattered along the river. Potential exists for restoring isolated areas of restored habitat using engineered weirs or other structures to trap river sediments. Restored habitat, if successful, could then serve as possible augmentation sites for restoring disappearing organisms.

The possibility of constructing sediment traps or other structures to restore habitat will be coordinated annually with Ecological Services, Alabama Aquatic Biodiversity Center and other research organizations. Suitable locations on the refuge could provide opportunities to test various approaches and techniques in reestablishing unconsolidated sediments within the river. If these approaches prove successful, they could then be implemented on a wider level along other segments of the river.

Primary Objective 2 – Manage River Road as a refuge access road, while minimizing erosion/sedimentation and the contribution of contaminants into the river, and summarize the status of road conditions and recommended improvements in the annual refuge plan.

Supporting Rationale

River Road extends south from County Road 24 along the Cahaba River for approximately two miles. This refuge road historically provided recreational access to visitors along the river. Prior to refuge establishment, this unimproved dirt road was subject to flooding and washouts from unrestricted use. Portions of the road provided

direct vehicle access onto the riverbank and into the river itself. A primitive road/trail continued south fording Caffee Creek and eventually terminating near Pratt Creek south of the refuge. With establishment of the refuge, preliminary efforts were made to reduce erosion and resulting sedimentation from the road. The northern mile of road was graveled, culverts were installed, and a parking and canoe launching facility were constructed. Access south from Caffee Creek was blocked and gated to restrict use to foot travel.

Road conditions will continue to be monitored, and additional requirements for minimizing or reducing erosion will be described in the annual plan.

Primary Objective 3 – Provide emergency spill response at the Piper Bridge, and review capabilities and equipment condition annually.

Supporting Rationale

County Road 24 is a major vehicle access route across Bibb County. The potential consequences of a chemical or contaminate spill from the Piper Bridge into the Cahaba River could have devastating effects to sensitive and rare aquatic biota in the river. The ability for emergency responders to quickly access required equipment could be critical to minimizing adverse impacts to the aquatic system. Construction and maintenance of a spill containment box at the bridge would place equipment readily available to responders. Coordination efforts with local responders would be necessary to ensure a spill plan was in place should an event occur.

The spill box would be equipped, maintained and condition checked by refuge personnel. A cooperate agreement would be established with local responders to ensure access in advent of a spill along the bridge. The condition of the box, equipment requirements and usage would be reviewed in the annual plan.

Primary Objective 4 – Evaluate the need to establish a USGS monitoring station on the refuge, with additional annual review.

Supporting Rationale

The closest USGS monitoring station to the refuge is located at Centerville, about 10 miles to the south. As restoration efforts and research increase on the refuge, the need may arise to maintain more accurate local flow data for the river. This may become particularly useful should augmentation and reintroduction projects for listed species be developed. The potential also exists to actually modify USGS data collection to meet specific requirements of restoration. Historically, a USGS monitoring station was located at the Piper Bridge, but is now closed.

The need to reopen the monitoring station will be reviewed on an annual basis and the status will be provided in the annual plan.

GOAL 3

Provide an ecosystem management strategy for uplands that restores and maintains the mosaic cover of native pine and hardwood forest.

Service Biological Integrity Policy directs management programs to reestablish and maintain the natural landscape that existed on the refuge during presettlement times. While anthropogenic activities (mining and industrial forestry) and fire exclusion have obscured our understanding of these communities, historical descriptions and remnant less disturbed forest tracts provide an indication of what these forests may have resembled (Section 3.1.3.1).

The Belcher Tract (Section 16) is located in the southeast portion of the refuge and provides a good example of natural second-growth longleaf pine forest. This tract was harvested 30 plus years ago and allowed to regenerate a second naturally seeded forest. While fire exclusion no doubt affected forest development and structure, the stand does represent a good example of natural species distribution for the region. Typically, longleaf pine occurs along ridgetops and upper slopes with hardwoods and other pines transitioning in along lower slopes and streams. It is apparent from both historical descriptions and existing communities that natural forest cover existed as a mosaic of forest types with soil, slope, aspect, and moisture all influencing vegetation cover. Longleaf pine exists as a component of this mosaic, most commonly occurring and adapted to ridges and south to southwesterly drying slopes. This entire mosaic of community types existed and evolved through a landscape of recurring fires. It is therefore critical that management strategies consider fire as the primary mechanism that has and is responsible for maintaining this historic forest cover.

While vegetation community and longleaf pine mapping are critical to restoring refuge forests, management programs can proceed prior to acquiring detailed stand information. Dormant season prescribed burns should first be used to reduce fuel loads within burn and management units that contain stands of longleaf pine. Once fuel loads have been reduced and are consistent throughout the unit, growing season burns can be applied to the units for hardwood control. The reintroduction of fire is the most critical element in all longleaf pine restoration and maintenance programs.

Primary Objective 1 – Within two years, map vegetation cover types on refuge to establish community structure and limitations for future prescribed burning.

<u>Supporting Rationale</u>

Refuge communities were described and characterized in Section 3.1.3. They were classified as dry-mesic (one association), mesic (five associations), wet-mesic (three associations) and hydric (two associations). Community type provides important information concerning fuel loading, sensitivity or adaptation to fire, and priority and need for future burning. This information is critical for establishing a refuge-wide prescribed burning program.

General community mapping will be accomplished through outside contracts with the Alabama Natural Heritage Program. The entire refuge (3,414 acres) will be mapped according to the above community designations.

Secondary Objective 2 – Within five years, designate stand condition within existing longleaf pine and loblolly plantations for restoration prescriptions. .

Supporting Rationale

Longleaf pine forest exists in a variety of stand conditions. Most variation is related to fire exclusion and hardwood encroachment. Many former longleaf pine sites have been planted in even aged commercial loblolly plantations.

Forest associations identified under Primary Objective 1 as longleaf pine or loblolly pine plantation will be further defined according to stand condition; (1) fire maintained, (2) midstory and/or hardwood encroachment, (3) longleaf pine stocking, and (4) the presence of off-site pines. In some situations, "encroachment" and "poor stocking" may apply to the same forest area.

(1) "Fire maintained" areas include those longleaf pine stands that can be maintained in high quality condition through seasonal prescribed burning. These forests, should they exist on the refuge, represent high quality longleaf pine stands, and generally provide the benchmark for restoration efforts. (2) "Midstory and/or hardwood encroachment" occurs in fire-suppressed stands where fire alone will not restore forest structure. These areas may require additional mechanical or chemical treatments to reduce competition. Areas classified as (3) "poor stocking" represent stands where existing longleaf pine stocking is below that needed to produce an adequate number of cone bearing trees at some future time. These areas may require supplemental hand planting to reestablish an adequate overstory as a future seed source. The last classification, (4) "off-site pine presence" includes planted or naturally seeded loblolly pine stands. These areas may require mechanical or chemical treatment, or possibly timber sales and replanting with longleaf pine.

Stand condition will be determined by refuge staff from mapping accomplished by the Alabama Natural Heritage Program.

GOAL 4

Reestablish a recurring fire regime through prescribed burning to approximate conditions occurring in presettlement forests.

Longleaf pine associations are fire-dependent communities that slowly evolve into more mesic hardwood communities without fire. The frequency of fire within these forests during the historic period, however, is difficult to estimate. While the forests no doubt evolved through lightning generated wildfire, presettlement forests also experienced burning by Native Americans and then by early settlers. Reference is often made to annual burning of the woods by Native Americans (Mann 1970), which in all probability is a far higher frequency then naturally occurred. By the time early botanists described the forests, the natural sequence of fire had changed, along with the structure of many forests. Harper (1913) believed the highly dissected landscape in the Southern Ridge and Valley facilitated a less frequent fire regime then occurred in more continuous forest regions. A conservative estimate of natural fire frequency for the local area might fall between three and five years. This, however, assumes a condition of long-term maintenance and does not reflect fire-suppressed conditions existing in today's refuge forests. To reestablish structural conditions needed for fire maintenance, initial fire frequency must be shortened and rely on growing season burns to restore forest conditions. Once restored to an open forest with a fire dependant herbaceous layer, fire frequency and seasonality may be adjusted to reflect a less frequent fire regime.

The existence of fire suppressed longleaf pine forest on the refuge creates an additional concern that must be integrated into management strategy. Prescribed burning in the Southeast has revealed that fire suppressed mature longleaf pine containing high fuel loads can be harmed through the reintroduction of fire (Zutter et al. 2002). Heavy litter accumulation around the base of trees in fire-excluded stands allows feeder roots to penetrate into the rich organic layer. These roots are subject to lethal heating related to the duration of combustion and the downward heat pulse, and not necessarily by fireline intensity (Brown and Smith 2000). Fires burning into this deep organic layer can consume the feeder roots and affectively girdle the tree from intense and prolonged heat. It is therefore important to reduce fuel loads within areas that have not burned in recent years before implementing growing season or hot dormant season burns. Mortality is often not immediate, but can occur as a "lag effect" with trees slowly dying over the following two years. Because few mature longleaf pine stands, other than on the Belcher tract, exist on the refuge, this concern is relegated to isolated areas. Within fire units containing mature fire-suppressed longleaf pine, a series of three consecutive dormant season burns over a nine year period will be planned prior to considering growing season burns. A slow transition to growing season prescribed burning is considered an appropriate planning measure to ensure minimal harm to existing forest stands.

After reducing fuel loads through dormant season burns, a sequence of growing season prescribed burns will be scheduled at varying intervals. It is only through growing season burns that encroaching hardwoods, shrubs, and particularly oaks can be reduced or eliminated (Robertus et al. 1993). Preliminary studies have indicated that hardwoods are

most effectively controlled by fire during the early part of the growing season (Streng et al. 1993). Prescribed burning during mid and late growing season tends to be slightly less effective. Where the opportunity exists and the primary objective is hardwood control, prescribed burning will therefore be scheduled early in the season (April-early June). Once burn units are considered restored, a maintenance burning schedule with seasonal variability will be established.

While fire is critical to long-term longleaf pine restoration, canopy cover must also be considered in planning efforts. Longleaf pine forests are often referred to as woodlands or savannah, and not as a forest. This nomenclature differentiation is related to the original fire maintained old-growth forest system, which contained a canopy cover between 25 and 60 percent (Section 3.1.3.1). This open canopy facilitates the establishment of a diverse fire adapted herbaceous layer, and permits sunlight to reach the shade-intolerant longleaf pine seedlings on the forest floor. One of the greatest obstacles to restoration often occurs when the native ground cover is successionally lost and the forest lacks sufficient herbaceous cover to carry light intensity fires (Brown and Smith 2000). On the nearby Talladega National Forest, repeated growing season burns failed to meet restoration objectives because of this dense canopy cover (USDA Forest Service 2004). It is therefore critical that pine and hardwood control open the longleaf pine canopy to ensure long-term restoration success. All stands failing to meet longleaf pine canopy criteria or experiencing significant hardwood encroachment should therefore also be considered for treatment under Goal 5.

Effectiveness of prescribed burns will be measured through long-term monitoring programs. A Fuel and Fire Effects Monitoring Plan will be prepared in support of the Refuge Fire Management Plan. The monitoring plan will track structural and compositional changes from fire over time. Success will be determined according to structural changes (reduction of shrub hardwood component) and the increase of fire dependant herbaceous species (indicator species). Photo monitoring plots will provide a refuge-wide system for monitoring structural changes.

The following objectives provide an overall planning approach that involves three consecutive dormant season (winter) burns, followed by restoration burns (growing season) and eventually long-term maintenance (seasonal variation) burns. This is a planning approach and assumes some component of longleaf pine in the burn unit. A slow transition to establish consistent fuel loads using cool dormant season burns is considered appropriate planning to minimize harm to mature longleaf pine forest. Should conditions or objectives warrant deviating from this approach, each burn will then be evaluated on an individual basis. For example, a burn unit containing predominately loblolly commercial pine plantations may be more appropriately managed through growing season burns that open the forest and establish a grass-herbaceous cover open to the sunlight.

The following management objectives use three-year burning cycles to describe program goals. Actual burning intervals however will depend on site conditions and individual restoration objectives. Some areas may be burned on shorter cycles (e.g. two-year frequency) in the early stages of restoration, while intervals on other areas may be

extended to longer cycles (e.g. maximize seed catch and/or seedling survival). Managers should view three-year burning intervals as an average for planning purposes, and adjust individual strategies to meet restoration and maintenance requirements.

Primary Objective 1 – Conduct dormant season prescribed burns annually within burn units described in Refuge Fire Management Plan until fuel loads are reduced allowing growing season burns.

Supporting Rationale

Dormant season burns are necessary to reduce fuel loads and to establish consistent fuel loading within individual burn units or at a larger scale. Current fuel loads vary according to species composition and former land-use, and are not consistent throughout the refuge. Before seasonal growing season burns can be initiated, it is critical to eliminate high fuel loading within isolated fire suppressed stands.

The Refuge Fire Management Plan (FMP) will be developed to support HMP goals and objectives. While tentative burn units have been established in the HMP (Figure 3), annual acreages for scheduled burning were estimated by placing the refuge on a three year burn cycle. At least 1000 acres ($25/acre) will be burned annually, with dormant season burns taking place during the first few years.

It should be recognized that burn units contain a mosaic of community types and not all areas within the units will burn. The actual acres burned will therefore be less than the total scheduled acreage.

Secondary Objective 1 – Within three years after completing dormant season burns, conduct early growing season prescribed burns annually within burn units described in Refuge Fire Management Plan.

Supporting Rationale

After dormant season burns have been completed and consistent fuel loads established (Goal 4 – Primary Objective 1), growing season burns will be accomplished on units containing longleaf pine.

Early growing season burns will initially be scheduled at three year intervals, but will depend on the accumulation of an adequate fuel load. Once adequate hardwood control is accomplished and a satisfactory herbaceous cover exists, the unit will be considered restored and maintenance burning will be implemented (Goal 4 - Secondary Objective 2). At that time, seasonality of burning will be varied at three year intervals. Restoration success will be measured and determined according to procedures in Goal 4, Primary Objective 1.

Secondary Objective 2 – Establish maintenance prescribed burning on a three year cycle on burn units where monitoring plant form and species composition indicates stands have been restored to high quality.

Supporting Rationale

Once burn units are considered restored with suitable herbaceous and hardwood forest structure, a maintenance burning schedule will be established. This schedule will provide seasonality of burning with three-year intervals anticipated. Monitoring of plant form and species will continue and provide information concerning the need and frequency for growing season burning.

The sequence of maintenance burning follows completion of Goal 4 - Primary Objective 1 and Goal 4 - Secondary Objective 1. Initiation of the maintenance burning schedule is based on successful restoration through dormant and growing season burns. Additional intervals of growing season burns may be required to reach the point where burn units are classified restored and ready for maintenance. Costs and specific tasks for this objective are not provided in the plan. It is highly improbable that the maintenance phase will be achieved during the 15-year span of the HMP (Table 8). The objective is provided only as a target objective in out years.

GOAL 5

Restore longleaf pine and associated upland communities, where possible, to a condition that can be maintained through prescribed burning.

Stands once dominated by longleaf pine or containing longleaf pine as a component can be found at scattered locations across the refuge. In many situations, these forests represent long-term fire exclusion with resulting hardwood encroachment and/or poor stocking. The ability of managers to restore these areas depends to some degree on the intensity and frequency of prescribed burning. Some fire-suppressed forests however will require additional restoration efforts to establish a high quality longleaf pine forest. The selection of appropriate techniques depends to a large extent on merchantability of existing plantation timber and/or the integrity of the existing herbaceous ground layer. Techniques for structural restoration include herbicides, tree felling, timber harvest, girdling, drum chopping, hydro-ax, brush cutter, machine and hand planting.

While fire is critical to long-term longleaf pine restoration, canopy cover must also be considered in planning efforts. Longleaf pine forests are often referred to as woodlands or savannah, and not as a forest. This nomenclature differentiation is related to the original fire maintained old-growth forest system, which contained a canopy cover between 25 and 60 percent. This open canopy facilitates the establishment of a diverse fire adapted herbaceous layer, and permits sunlight to reach the shade-intolerant longleaf pine seedlings on the forest floor. One of the greatest obstacles to restoration often occurs when the native ground cover is successionally lost and the forest lacks sufficient herbaceous cover to carry light intensity fires (Brown and Smith 2000). On the nearby Talladega National Forest repeated growing season burns failed to meet restoration objectives because of this dense canopy cover (USDA Forest Service 2004). It is therefore critical that midstory and hardwood control also open the longleaf pine canopy to facilitate the establishment of an herbaceous ground cover.

Restoration efforts will be accomplished through three approaches; control of hardwood-pine encroachment in longleaf pine stands, removal of off-site trees on disturbed areas, and replanting understocked longleaf pine stands. These situations were evaluated and identified for Goal 3 –Primary Objective 2. Several years of prescribed burning will provide additional information concerning those areas that cannot be restored through prescribed burning, or fail to exhibit adequate seedling recruitment.

Secondary Objective 1 - Within five years of determining longleaf pine stand condition, schedule and reduce hardwoods and unwanted pines on at least 20 acres annually within longleaf pine stands that cannot be controlled through prescribed burning, with the objective of establishing a 25-60 percent canopy cover.

<u>Supporting Rationale</u>

Longleaf pine stands exhibiting an advance degree of hardwood and loblolly pine encroachment that cannot be restored singularly through prescribed fire, will require structural restoration. This condition may require midstory control to the selective

removal of overstory trees. Techniques include mechanical removal, girdling or chemical injection, to the selective harvest of unwanted hardwoods and pines. Selective timber harvest (thinning) contracts may have to consider larger acreages to maximize economical benefits and entice outside contractors to bid on proposed timber sales,

Longleaf pine canopy cover should range from 25-60 percent (NatureServe 2006) after removal of undesirable midstory and overstory trees. Research has demonstrated that seed dispersal distance within mature forest is greater than in second-growth stands (Grace et al. 2004). Greater dispersal distances may be attributed to a more open savannah forest that exposes crowns to winds that carry seeds further from the tree. Most seeds were found to disperse from 10-75 m (or more) of the tree. An increased dispersal distance in mature forest can be expected to reduce inbreeding and increase genetic diversity of populations. .

A critical factor in selecting the appropriate control technique must consider minimizing soil and ground disturbance within areas with prior minimal disturbance. Maintaining the existing herbaceous ground layer is critical to the long-term success of restoration. Disturbance of this soil layer also opens the forest to weedy annuals and exotics.

Mechanical or chemical control of competing hardwoods will be scheduled for 50 acres annually. Mechanical control is considered the probable method ($100/acre-tree felling).

Secondary Objective 2 – Within five years of mapping loblolly pine plantations, schedule and remove at least 20 acres annually of timber, replanting the areas with longleaf pine seedlings, no more than 600 trees/acre.

Supporting Rationale

Restoration will be accomplished on planted loblolly pine plantations that are common throughout the refuge. Where feasible, timber harvest contracts will be considered as the removal technique. If undesirable trees have no commercial value, mechanical removal, girdling or chemical injection will be considered possible options. In some situations chemical site preparation followed by a prescribed burn may be needed to control shrubs and competing herbaceous vegetation prior to seedling planting. The seedlings will be planted by contract or volunteers.

Merchantable plantations will be harvested through timber sales. Requirements for site preparation and replanting of longleaf pine or other desired species may be included in the timber sale contract. Timber harvest contracts may have to consider larger acreages to maximize economic benefits and entice outside contractors to bid on proposed timber sales,

Planted longleaf pine will be treated and managed as an even aged plantation during the first years (~30 years) of management. Aggressive prescribed burning and maintaining open seedling/tree stands will encourage the establishment/development of a fire dependant ground cover. As trees exert dominance and mature, the stand will transition into an all aged stand and management will consider opening gaps and thinning trees.

Planting density should be less than 600 trees/acre, with survival between 100-300 trees/acre.

Individual projects are estimated at 20 acres with a three year completion timeline (tree removal, prescribed burning and seedling planting). Requirements involve purchase and hand-planting of seedlings. Prescribed burn requirements would be coordinated with the ongoing refuge burn program. Total cost of individual 20 acre restoration projects are estimated at $350/acre or $5000 for each project. This cost could be eliminated or reduced if included within a timber sale contract.

GOAL 6

Manage wetland, streamside and hardwood forests as a component of the mountain longleaf pine ecosystem.

The refuge is comprised of a mosaic of natural communities with longleaf pine representing one cover type. Community associations on the refuge include dry-mesic (one association), mesic (five associations), wet-mesic (three associations) and hydric (two associations). While longleaf pine is clearly a fire dependent forest type, other refuge communities are not commonly viewed as fire adapted. While this may or may not be true, it is recognized that fire was responsible for the prominence of longleaf pine forests on refuge uplands, and all refuge communities have persisted and evolved in a fire environment. Research in the Southeast strongly suggests that at least upland hardwoods, particularly oaks and hickories, may also depend on fire to maintain structure and species composition (Section 3.1.3.1). In most situations, fuel loads within these communities are minimal or soil is damp, inhibiting fire or minimizing intensity.

Primary Objective 1 – After prescribed burns are completed, monitor condition and changes in all forest types using at least four photo monitoring plots per burn unit with photos taken annually.

Supporting Rationale

While adverse effects to refuge forest communities from prescribed fire are not anticipated, care will be taken to assess this situation through continuing research and observations. Both, positive and negative effects of fire will be monitored, and should protection measures be considered necessary for prescribed burning, annual burn plans will be modified to include mitigation or avoidance measures.

The effects of fire on community types will be monitored through photo plots and observations. Many of these communities exist within burn units and require ongoing monitoring to assess long-term management implications. Photo plots will be established as each individual prescribed burn is scheduled.

GOAL 7

Manage the refuge as part of the regional landscape, while minimizing forest fragmentation and disturbed edge habitat within the refuge boundaries.

The refuge represents a minor part (3,414 acres) of a much larger regional landscape. Much of the uplands southwest of Birmingham (Bibb, Perry, and southwest Shelby) remain in forest. Ownership ranges from private individuals and industrial forestry to federal, state and nongovernmental organizations. Particularly significant are the Talladega National Forest (12 miles south and southwest), and The Nature Conservancy lands (scattered south of refuge). Viewed in a regional context, the refuge has the potential to contribute to the viability of a much larger regional landscape ecosystem.

Partners in Flight (PIF) conservation goals provide an example of benefits of viewing the refuge as a regional landscape unit. The executive summary for the Ridge and Valley Bird Conservation Plan (Demarest 2006) recommends that eight upland forest patches (10,000-100,000 acres) be maintained within the physiographic province for the benefit of birds dependent on mature forest. While the refuge alone can never accomplish this goal, working together with regional partners greatly increases chances for success.

Alabama's Comprehensive Wildlife Conservation Strategy planning process further supports regional approaches in their statewide conservation actions (ADNR 2005): "ADCNR and other land management agencies (e.g. U.S. Fish and Wildlife Service) should use a landscape management approach to enhance greatest conservation need (GCN) species and their habitats".

Within the refuge, management strategies can be used to maximize habitat values for natural communities occurring on the refuge. Forested edge, openings and disturbances to forest cover and soils are responsible for modifying habitat conditions favorable to species associated with early successional or disturbed habitats. As the regional landscape becomes more fragmented and disturbed, habitat conditions provided by forest interior become rarer. Many of the plants and animals dependent on forest interior also decline. Many species associated with disturbance, particularly plants, are exotic and highly invasive, further threatening ecosystem integrity.

Research in Alabama (Soehren 1995) has demonstrated that forest fragmentation strongly affects the total number of neotropical migratory birds and in particular the number of low nesting birds. Further research on the relationship of fragment size to nest predation (Hill et al 1996; Keyser et al. 1998) concluded that reduced forest size increases predation on ground nests and that nest clustering increases predation of ground nests by large predators. These results suggest a causal link between increased predation rate, fragment size, and the observed abandonment of small forest fragments by neotropical migrant songbirds.

Forest edge and ecotonal areas also have the potential to adversely effect game populations, such as turkey and northern bobwhite. Research has indicated that regional population declines are often related to differential nest predation (Simberloff 1993).

Forested edge, habitat fragmentation and disturbed landscapes support a wide variety of predators that prey on nests. Management objectives involving longleaf pine forest restoration are expected to increase forest interior and reduce edge habitat, potentially improving habitat suitability for important game species.

Recent research in the Southeast (Buehler and Miles 2004) has further investigated the importance of small maintained forest openings in contributing to fragmentation and declining avian populations. This study focused on the role of wildlife food plots and small openings to breeding bird populations. The study concluded that effects are variable and depend greatly on the landscape in which the forest is located. In a landscape surrounded by farms, disturbance and early successional habitat, adverse effects are likely. Recommendations for relatively intact forests within a developed landscape include "avoiding the creation of new openings and allowing existing openings to regenerate to forest". Additional recommendations in another similar landscape involve, "Creation of new openings, including extensive daylighting of forest roads, should be conducted only in areas that already possess openings to avoid negative effects on areas with high-quality habitats for forest interior birds".

Management objectives are intended to maximize forest interior and minimize openings, firebreaks and other disturbances within intact forest. Generally, when an activity requires opening or clearing forest cover, an attempt will be made to place this disturbance in peripheral areas that minimize intrusion. An opening or disturbance to forest cover will be defined as an activity that opens the forest canopy creating edge or ecotonal habitat. Firebreaks that are narrow and maintain a closed canopy cover are not necessarily fragmentary. Forest canopy opening through longleaf pine restoration programs follow natural process that historically existed in the region's forests. Native species have evolved and adapted to surviving in this community type and, therefore, benefit from the reestablishment of historic forest conditions.

Primary Objective 1 – Within two years, conduct a coordination meeting with regional partners to establish a cooperative working group that integrates landscape strategies along the Cahaba River and adjacent forested uplands.

Supporting Rationale

The working group is anticipated to include U.S. Forest Service, U.S. Fish and Wildlife Service, Alabama Division of Wildlife and Freshwater Fisheries, The Nature Conservancy, and other group/agencies managing and protecting lands in the region. Individual agency/organization information and goals would be exchanged and integrated into cooperative objectives that would maximize benefits region-wide. It is anticipated that the working group would meet at least annually to share information and review goals.

Primary Objective 2 – Within two years, review forest openings for fragmentation, and abandon or restore, where possible, at least 5 acres annually of small openings that can be returned to a continuous forest cover.

Supporting Rationale

A variety of past landuses are responsible for opening the forest canopy (coal strip-mining, logging roads and loading decks, coal-bed methane well sites, etc). Nonessential openings will be restored according to their size and requirements. Small openings will be allowed to revert to forest through natural succession. Larger openings will be considered for restoration though seedling replanting. Seedling type will be selected according to habitat suitability.

The objective of maximizing forest interior, and minimizing edge and disturbed habitat will benefit many neotropical birds and game species. This approach is consistent with Service Biological Integrity Policy for the National Wildlife Refuge System.

Forest openings will be recorded on maps and reviewed according to appropriate restoration needs. Some areas may be designated for restoration by seeding from adjacent communities and allowed to proceed through natural succession. Other larger areas may possibly require seedling planting. This may be accomplished through planting by Service personnel, volunteers or outside contracts. Approximately 20 acres ($250/acre) have been scheduled annually. Procedures for contract replanting are provided under Goal 5.

Primary Objective 3 - Within two years, initiate biotic inventories with a minimum of five annual point counts for nesting birds, both east and west of the river, in both the upland forest and transitional communities (minimum of 10 point counts).

Supporting Rationale

Biotic inventories will be accomplished through qualitative observations of flora and fauna on the refuge. Point counts for nesting birds however will provide a measurable approach for evaluating the forest community's ability to support forest interior birds and game species in both upland hardwoods and longleaf pine communities. Areas supporting sensitive species may be used as models in managing or restoring other forests on the refuge.

Point counts will be established in selected stands to measure changes in bird populations over the course of management programs that increase forest interior and restore historic longleaf pine woodlands. Support will be solicited from local universities, and standard point counts will be established before, during and after prescribed burning efforts to measure long-term effects of restoration and burning. An effort will be made to accomplish at least one survey every three year management cycle for habitats of biological concern.

GOAL 8

Inventory, protect and manage rare, endangered, threatened and sensitive species and natural communities.

Rare, uncommon or declining species on the refuge are considered "Species of Concern". A list and summary of designated "Species of Concern" are provided on Table 1 and Figure 4. The table provides an overview of those species currently tracked through the NatureServe Program (2006), Alabama's Nongame Species Regulation, Alabama's Comprehensive Wildlife Strategy Plan (ADCNR 2005) and the Federal Endangered Species Act. Forty-seven species are included on the table (Mammals-2, birds-6, fish-5, mussels-9, snails-11, insects-2, plants-12). Those species designated as federally endangered, threatened or candidates for federal listing are further discussed in Section 3.2. Federally listed or candidate species documented or highly suspected to be on the refuge or immediately adjacent include the gray bat, bald eagle, blue shiner, Cahaba shiner, goldline darter, fine-lined pocketbook, triangular kidneyshell, round rocksnail, flat pebblesnail, cylindrical lioplax, Georgia aster, Georgia rockcress, orange-nacre-musket and Mohr's Barbara buttons.

"Species of Concern" populations will be identified according to the ecological community or specialized habitat in which they are found. In some situations, this may include the entire community association (e.g. Cahaba Lily – Water Willow Herbaceous Vegetation). In other cases, isolated areas or specialized habitats along certain roadways (*Phlox Pulchra*) or undisturbed rocky slopes (*Lathyrus venus*) will be delineated as containing significant resources. Collectively, these habitats will be designated as "Significant Biological Areas". It is important to consider the community as the basis for management and protection. It is the biological integrity and structure of these specialized habitats that allow rare species to exist on the landscape. Management requirements and constraints needed to preserve the integrity of these habitats, along with management constraints and restrictions for operational programs, will be provided for each rare community location.

Because the Cahaba River provides unique habitat for a wide range of mussels, snails and fish, along with a highly unique community association (Cahaba Lily-Water Willow Herbaceous Vegetation), the entire river and associated stream mouths will be designated as a single "Significant Biological Area". Within the river, however, additional core areas containing highly specialized or unique habitat (e.g. shoals) may be selectively identified for more focused protection and management. Upland terrestrial communities also contain a variety of birds, mammals and plants considered "Species of Concern" (Table 1, Figure 4). These species tend to be found along protected slopes that have received few past disturbances, as residual fire-dependent species from presettlement longleaf pine forests, or on areas that seem to have calcareous rock near the ground's surface. As these specialized habitats within communities associations are identified, additional "Significant Biological Areas" will be delineated and incorporated into refuge management operation and protection.

Primary Objective 1 - Within two years, seek funding for inventories of rare, endangered, threatened, and sensitive species and communities within the refuge, and prepare an annual report on the status of populations, management requirements and new species discovered during the year.

Supporting Rationale

Research and inventories will be encouraged with academic institutions, researchers, organizations, agencies and volunteers. Research results will be incorporated into refuge inventory lists and records, and used to characterize and manage refuge lands. Any new findings will be provided in an annual report.

Because of the potential for new discoveries within the Cahaba River, inventories will be strongly encouraged within aquatic communities. In particular, inventory deficiencies have been noted for refuge tributary streams (snails, invertebrates and fish), particularly along Caffee Creek (Garland 2006).

Current surveys on the refuge are characterizing plant communities and identifying rare plants. Early findings of these surveys have been incorporated into the HMP, but additional species and rare community types are anticipated in the final report (Schotz 2007).

Primary Objective 2 – When significant ecological communities are discovered on the refuge that merit designation as a "Significant Biological Area", these communities will mapped and status, along with management/protection requirements provided and reviewed in annual reports.

Supporting Rationale

"Significant Biological Areas" have not been designated on the refuge at the present time. Their designation will depend on the presence of rare species, unique or sensitive habitat identified through research, inventories or management programs on the refuge. The location, status and management/protection needs will be provided in annual plans.

Sensitive and unique biological areas designated as "Significant Biological Areas" will be monitored to determine the effects of prescribed burning, longleaf pine restoration, visitation and other management activities. Photo documentation will provide the basis for monitoring and reviewing changes and alterations to "Significant Biological Areas". Mitigative measures will be implemented should adverse impacts be discovered.

Primary Objective 3 – Participate in the recovery of endangered, threatened, candidate and rare species on the refuge with at least annual coordination with Ecological Services.

Supporting Rationale

The refuge comprises one of the few federally owned lands along the Cahaba River with the primary mission of managing lands for the benefit of wildlife. It is also located within the historically richest biological section of the Cahaba River (Paul Johnson, personal communications). The refuge provides an ideal location and stable future environment for recovery efforts initiated under the Endangered Species Act.

Refuge staff will work closely with Ecological Services in establishing and monitoring recovery efforts on the refuge. While the relationship is anticipated to involve continual coordination, issues and potential opportunities will be discussed at least on an annual basis.

GOAL 9

Inventory and control exotic and invasive species.

The spread of exotic species, particularly invasive plants, represents one of the greatest threats to ecological communities and refuge biodiversity. Historical use of refuge lands ranges from intensive strip-mining to widespread industrial plantation forestry. These landuses have introduced and spread exotic plants throughout the refuge. A review of exotic species documented on the refuge along with a strategy for control was provided in Section 3.3. Proposed strategies focus on mapping and control of those species presenting the greatest threat to refuge ecological systems.

Seven exotic species are considered the primary target of refuge management and concern (Asian clam, brown-headed-cowbird, Chinese privet, kudzu, mimosa, Japanese honeysuckle and Chinese lespedeza). Direct control of the two animal species, Asian clam and brown-headed cowbird, is not considered technically feasible. Resource managers can minimize adverse effects from the Asian clam to native species through assuring water quality, hydrologic flows and the physical river substrate are protected and improved. The ability of native mussels to effectively compete against the Asian clam is best achieved through ensuring a healthy population and suitable habitat. The brown-headed cowbird thrives in a disturbed open landscape, and should effectively be controlled through proposed upland forest restoration that maximizes forest interior and minimizes forest edge. Adequate control and elimination of Japanese honeysuckle can best be handled through a long-term prescribed fire program. Chinese lespedza, on the other hand, is extremely difficult to eliminate and tolerates fire. Careful monitoring of lespedeza populations and minimizing soil disturbance is the best approach for preventing further spread. Populations should be monitored and an action plan may eventually need to be developed should the plant represent a threat to native plant communities at some future time.

Direct control of exotic species will focus on the three most highly invasive plants on the refuge (Chinese privet, kudzu and mimosa). Most Chinese privet and mimosa exist along low areas bordering the Cahaba River and tributary streams (Figure 7). Kudzu is fairly isolated to uplands on the northern portion of the refuge. While other exotic plants are also pervasive on the refuge (Section 3.3), existing threats and potential harm to surrounding habitats is considered less serious. In addition, fire represents a factor that may influence the status of some exotic plants. While species such as Chinese privet may actually be effectively controlled through recurring fires on uplands, species such as exotic lespedezas may become a greater threat and spread into newly restored open forest. All exotic plants will be closely monitored for their response to fire and should fire increase the spread of certain species, additional control measures may have to be formulated.

While exotics constitute varying degrees of threat to native communities, their presence and spread is consistently associated with soil disturbance and, in some situations, fire exclusion. It therefore becomes critical to consider the eventual impact of soil

disturbance on all proposed management and refuge activities. Once the physical soil environment is altered, it becomes extremely difficult to reestablish native plant communities. Many of these same native plant communities are also needed for maintaining a contiguous flammable fuel load for the prescribed burning.

Primary Objective 1 – Within three years, initiate herbicide control of kudzu and treat at least 2 acres annually.

Supporting Rationale

Kudzu infestations can be found on the northern part of the refuge, primarily in and around the former Piper mine and community. Because kudzu is rather narrowly restricted on the refuge, this invasive exotic is a prime candidate for eradication within refuge boundaries. Treatment acreage should be adjusted to apply herbicide to the entire infestation in a single year.

Multiple applications of herbicide over several years will be required to totally eliminate this exotic. For planning, annual treatment costs were set at $1000/acre.

Primary Objective 2 – Within three years, initiate herbicide control of Chinese privet treat at least 5 acres annually.

Supporting Rationale

Chinese privet can be found throughout most river and streamside communities on the refuge. To a lesser extent, it also occurs on disturbed upland habitats throughout the refuge. This invasive shrub probably represents the most significant existing impact to natural communities on the refuge. It forms a monotypic shrub layer throughout many wet-mesic forests on the refuge.

While effective control can be achieved through a variety of control techniques (mowing, seedling removal, and herbicides), most methods require a nonselective removal of all plants and associated animals in the community. To minimize incidental harm from privet control, treatment on wet-mesic communities will use manual cutting and the application of a basal herbicide to the stem cut. Because fire may effectively control privet on uplands, control measures on uplands will be postponed until monitoring determines the effectiveness of fire in controlling this exotic. It is highly improbable that privet can ever be totally eliminated from the refuge. Efforts will be taken to prioritize areas for intense treatment. Efforts will be concentrated within the highest prioritized infestation that represents a reasonable chance of eliminating.

For planning, treatment costs were set at $1000/acre.

Primary Objective 3 – Within three years, initiate herbicide control of mimosa.

Supporting Rationale

Mimosa can be found in disturbed habitats throughout the refuge. It represents a serious problem in disturbed areas open to sunlight along the Cahaba River. The seeds remain viable for more than five years, making eradication of mimosa a long-term project.

Because mimosa occurs singularly or in small infestations, the primary technique for control of trees on the refuge will involve tree felling and herbicide application to stumps, or stem injection. For resprouts, seedlings and younger individuals, a selective foliar herbicide spray will be applied. Control of mimosa on uplands will be postponed until monitoring results indicate the effectiveness of fire for controlling this exotic plant.

Treatment costs for mimosa include selective injection of scattered trees along one-fourth mile of shore line or roadway, and are estimated as comparable to kudzu at $500/acre for 20 acres.

GOAL 10

Maintain and restore native wildlife associated with longleaf pine and other refuge upland natural communities.

Longleaf pine ecosystem restoration will occur in existing longleaf stands and restorable forests that contain a significant component of longleaf pine. Prescribed burning and woody understory reduction are expected to increase herbaceous cover and low growing shrubs. In most situations, a more open forest and a low shrub and herbaceous cover will increase available forage for species such as turkey and deer. Generally, the nutrient quality can be expected to also improve with prescribed burning. Turkeys, in particular, may benefit from increased herbaceous cover.

Because mountain longleaf pine occurs as part of the overall forest mosaic, forest cover diversity will remain. Hardwoods have and will always occur on slopes, stream bottoms, northerly slopes and ravines. These areas will support and enhance the overall habitat quality of the entire mountain longleaf pine ecosystem. The fire maintained longleaf pine forest will provide suitable habitat for species such as the eastern fox squirrel and Bachman's sparrow, which have dramatically declined in numbers due to regional habitat loss.

The increase in herbaceous ground cover is also expected to enhance habitat quality for bobwhite, a game species that has all but disappeared from many regions of the Southeast. With an increase in reforestation and the decrease of farms and fire in the Southeast, bobwhite numbers have dramatically decreased in recent years. The implementation of a prescribed burning program and more open forests should provide habitat conditions more favorable for northern bobwhite.

Primary Objective 1 – Continue a hunting program on the refuge that provides recreational opportunities and maintains game species at sustainable population levels.

Supporting Rationale

The Service has completed a hunting plan (USFWS 2004) and opened the refuge for hunting in cooperation with the Alabama Department of Conservation and Natural Resources. The refuge is included within the administrative regulations governing the Cahaba River Wildlife Management Area.

Maintaining game populations through an active hunting program not only provides recreational opportunities, but also is important in maintaining a stable ecosystem. Deer in particular have few natural population controls and can impact community structure through over-browsing. In many situations, over-browsing will selectively impact the most palatable plants to the greatest extent. Resulting community structure can then become skewed to favor plants less preferred as browse. While the overall significance of over-browsing on longleaf pine community structure is unclear, the maintenance of a

stable game population is considered desirable in establishing and restoring existing forest systems on the refuge.

Primary Objective 2 – Within two years, contact and encourage cooperative programs with academic institutions and nongovernmental organizations to educate, monitor, and establish habitat improvement projects for native wildlife within high quality longleaf pine forests on the Refuge.

Supporting Rationale

Prescribed burning within longleaf pine stands is expected to slowly modify forest understory structure favoring herbaceous plant species. The reestablishment of a native ecosystem once predominate in the region is expected to open opportunities for cooperative and educational demonstration projects. In addition, the biological diversity and unique environment of the Cahaba River provides similar opportunities for projects that could be enjoyed by refuge visitors.

Interested groups, agencies and organizations will be invited to partner in showcasing areas for native wildlife and aquatic species. Over time, these areas will be considered demonstration projects and used for future research and education purposes.

GOAL 11

Maintain an adequate road/trail (firebreak) system that fulfills management and public use needs, while minimizing adverse ecological effects on the natural landscape.

Firebreaks create ecotonal edge, soil disturbances and pathways for invasive plants and animals. On slopes and ridges, firebreaks become highly susceptible to erosion, resulting in sedimentation onto lower slopes and wetlands.

Existing firebreaks on the refuge were initially created for access and logging. The resulting firebreak configuration includes varying widths and degree of roadside disturbance. Many will eventually be abandoned, reclaimed and restored to native forest cover.

Primary Objective 1 – Within two years, review existing refuge roads/trails (firebreaks) for fragmentation, erosion, sedimentation and need, and restore nonessential firebreaks, where possible, to a continuous forest cover, and implement erosion protective measures annually on at least five miles of essential firebreaks to meet Alabama Best Management Practices.

Supporting Rationale

Firebreaks width, where possible, will be reduced to a single blade width. Unmaintained margins will be allowed to reseed from adjacent forest cover. Firebreaks considered nonessential to fire management will be recorded on maps, gated, posted as closed and allowed to revert to a forest cover. Many of these firebreaks are not essential to prescribed burning and represent a significant erosion and sedimentation problem. They fail to meet Alabama's Best Management Practices for forest roads, and therefore fail to comply with the Clean Water Act in regards to nonpoint source pollutants (AFC 1993).

Operating procedures for maintaining essential firebreaks will establish policy for equipment operators to minimize firebreak width. Firebreaks will continually be reviewed to determine need and possibility for closure. Currently, 19 miles of roads/trails exist on the refuge. Essential firebreaks will be maintained to minimize erosion and sedimentation, and meet Alabama Best Management Practices for forest roads (AFC 1993). Those essential firebreaks that create erosion potential will be remediated, closed and gated to the public, and available only for fire and management activities. Costs associated with achieving this objective primarily involve annual maintenance of firebreaks and construction of gates.

GOAL 12

Restore altered habitats and highly disturbed landscape associated with the former Piper mine complex.

The former Piper Mine is located on the refuge and was intermittently mined from the mid-1800s to the late 1900s. Mining techniques involved both subsurface mining and strip mining operations. Today, the site remains unreclaimed with strip-mine headwall, mine pit, gob pile (abandoned mine waste) and settling ponds exposed to natural weathering processes. Vegetation is scattered and indicative of highly disturbed soils and exotic invasives. Surface water runoff from the site can be expected to degrade water quality and transport coal fines into the Cahaba River.

Coal mining has a long history of impacting aquatic ecosystems, and has been identified as a significant factor contributing to the decline of freshwater mussels in Alabama (USFWS 2000). Drainage from mines has been associated with a variety of acute and chronic effects to aquatic life and the degradation of aquatic ecosystems (Tuttle 1998). Impacts may result from acid generation of exposed mine rock and the mobilization of acid-soluble metals. The occurrence of an orange precipitate in refuge streams receiving drainage from one coal pile suggests acid generation and mobilization is occurring on the refuge (Tuttle et al. 2004). Aquatic ecosystem impacts may also result from the enrichment of metal and trace elements in aquatic sediments of impacted streams. Coal from the Warrior Coal Fields in Alabama, which include portions of the Cahaba River Basin, has been recognized nationwide as having high metal and trace element concentrations (Goldhaber et al. 2000). Metal concentrations in sediments in mine-impacted streams in Alabama are also documented as elevated (Goldhaber et al. 2001). In addition, coals are also recognized as a source of polycyclic aromatic hydrocarbons (PAH) in aquatic systems.

The restoration of this highly disturbed and altered landscape will take place through three consecutive tasks or phases; environmental characterization, planning and ecological restoration.

Primary Objective 1 – Formulate and implement a water quality/environmental characterization program on the historic Piper coal mining complex to identify potential environmental threats.

Supporting Rationale

Coal wastes can generate significant levels of contamination through natural weathering processes. Before physical restoration is initiated, existing contaminated surface runoff, along with potential further contributions from exposing buried material, must be identified and evaluated. Future restoration design plans can then include mitigative measures to minimize or reduce environmental concerns should they be revealed through environmental characterization. The refuge, in conjunction with Ecological Services, has prepared a water quality characterization plan for the former Piper mining complex

(Tuttle et al. 2004). This plan or a similar plan will provide the basis for characterizing the mine complex environment. The following objectives were considered necessary for identifying environmental constraints:

- characterize the chemical quality (e.g. trace elements and PAH composition) of coal-mine waste rock;
- characterize the quality (e.g. water quality parameters and trace element composition) of drainage emerging from coal water rock;
- characterize sediment quality (e.g. trace element and PAH concentrations) in streams receiving drainage from mined areas and coal waste rock;
- characterize chemical composition (e.g. trace element and PAH concentrations) of coal fines in mine process ponds; and
- conduct a screening-level risk assessment to better ascertain constituents of concern and the relative degree of risk to aquatic life, wildlife and refuge habitat quality.

Secondary Objective 1 – Prepare a plan to restore the Piper mine complex to a natural landscape native to the region.

Supporting Rationale

A restoration plan will be developed that integrates environmental constraints (Primary Objective 1) with an overall objective to establish a native landscape across the reclaimed mine complex. The plan should restore stream drainage patterns, re-contour steep slopes and headwalls, and remove or bury mine wastes (gob pile).

Three management strategies have been provided for possible consideration (Tuttle et al 2004).

- If contaminant hazards are insignificant, efforts to stabilize and reclaim coal wastes can proceed utilizing refuge staff and resources.
- If potential benefits of removing coal wastes and associated contaminant concerns outweigh potential detriments of disturbance, wastes could be removed through outsides contracts or a remining agreement.
- If corrective measures are warranted and removal is not economical, the Service can petition OSM (Office of Surface Mining) and ASCM (Abandoned Mine Land Reclamation Program) to reclaim coal waste features and replant a native forest cover.

Careful consideration will be given to selecting a native forest cover to stabilize reclaimed lands. It is anticipated that longleaf pine, native to upland ridges on the refuge, is the most appropriate forest cover to replant.

Secondary Objective 2 – Restore Piper mine complex to a native forest cover.

Supporting Rationale

Physical restoration of the Piper mine complex will depend on the results of environmental characterization (Primary Objective 1) and the selected planning approach (Secondary Objective 1). The overall objective is to reduce/eliminate environmental contamination and reestablish a native landscape.

6.0 Management Strategy Resources and Constraints

6.1 Necessary Resources

Fiscal resources necessary to successfully meet management goals and accomplish management objectives are provided on Table 7. To fully implement the goals and meet objectives as outlined in the Habitat Management Plan will require an estimated $417,000 for first year and $324,000 for recurring need. Approximately 80 percent of the recurring need represents salaries for a biologist, forester/prescribed fire specialist, maintenance worker, and manager that would be attributable to meeting these goals and objectives. The ratio of contract versus Service accomplished tasks is provided separately on the table. Where possible, estimates for outside contracts are based on local costs, which are provided in Section 5.0.

Cahaba River NWR is currently unstaffed with a minimal maintenance budget. Implementation of this Habitat Management Plan will be accomplished incrementally as time and budgets are available. Reclamation of the abandoned Piper Mine will be accomplished through abandoned mine and water quality improvement funding available through the State of Alabama Abandoned Mine Lands programs and Office of Surface Mining programs.

6.2 Management Constraints

Proposed strategy and costs must be formulated and selected according to future effects of prescribed burning, and then applied through adaptive management to meet ever changing conditions in refuge forests. The ability of fire to restore longleaf pine forests is dependent on a wide range of variables that include fire intensity, fire frequency, environmental conditions as well as the physical parameters of refuge lands. The benefits of fire will differ according to location and stand, and will, no doubt, require prescription modifications as restoration progresses. A flexible adaptive management approach will be critical to the long-term success of longleaf pine restoration

A second constraint of refuge management involves the cost and ability of managers to apply prescribed fire as a longleaf pine restorations technique. Fire is a fundamental requirement of any longleaf pine restoration program, and critical to successfully restoring refuge lands. The lack of a fire management staff on the refuge or at nearby refuges constitutes a significant constraint in meeting fire management goals. Both scheduling problems and increased costs will create difficulties in accomplishing management objectives.

6.3 Regulatory Compliance

All management activities will be accomplished according to regulatory requirements and guidelines. The draft HMP will be reviewed according to regulatory requirements of the National Environmental Policy Act (NEPA), and comments and concerns will be considered in revising the final document. As part of the NEPA review process, the draft plan will be provided to Ecological Services for review under Section 7 of the Endangered Species Act. Any changes or specific details provided in future AHMPs will be separately coordinated according to Section 7 requirements.

Systematic cultural or historic resource surveys have not been accomplished on the refuge and the State Historic Preservation Office (SHPO) has not recorded any sites within refuge boundaries. Should unrecorded cultural resources be encountered during refuge management activities, all activities will cease at that specific location and reasonable efforts will be taken to avoid or minimize damage to the site. The Office of the Regional Archaeologist will be immediately notified and advised of the nature of the discovery. Should human remains be encountered during refuge management activities or permitted activities, all actions will cease at that specific location. The Refuge Manager, the Regional Archaeologist, and the Refuge Law Enforcement Officer will be contacted immediately. The SHPO, the County Medical Examiner, and the pertinent tribes will be notified pursuant to the provisions of the Native American Grave Protection and Repatriation Act.

Service Compatibility Determinations are only required for management activities that generate revenue or are traded for goods or services. Timber sales are the only anticipated management activity that meets this criteria. Timber sales represent an option for eliminating designated tree species prior to longleaf pine restoration. A Compatibility Determination will be prepared prior to any timber sales to ensure the proposal is compatible with the purposes for which the refuge was established and the mission of the National Wildlife Refuge System.

7.0 Figures

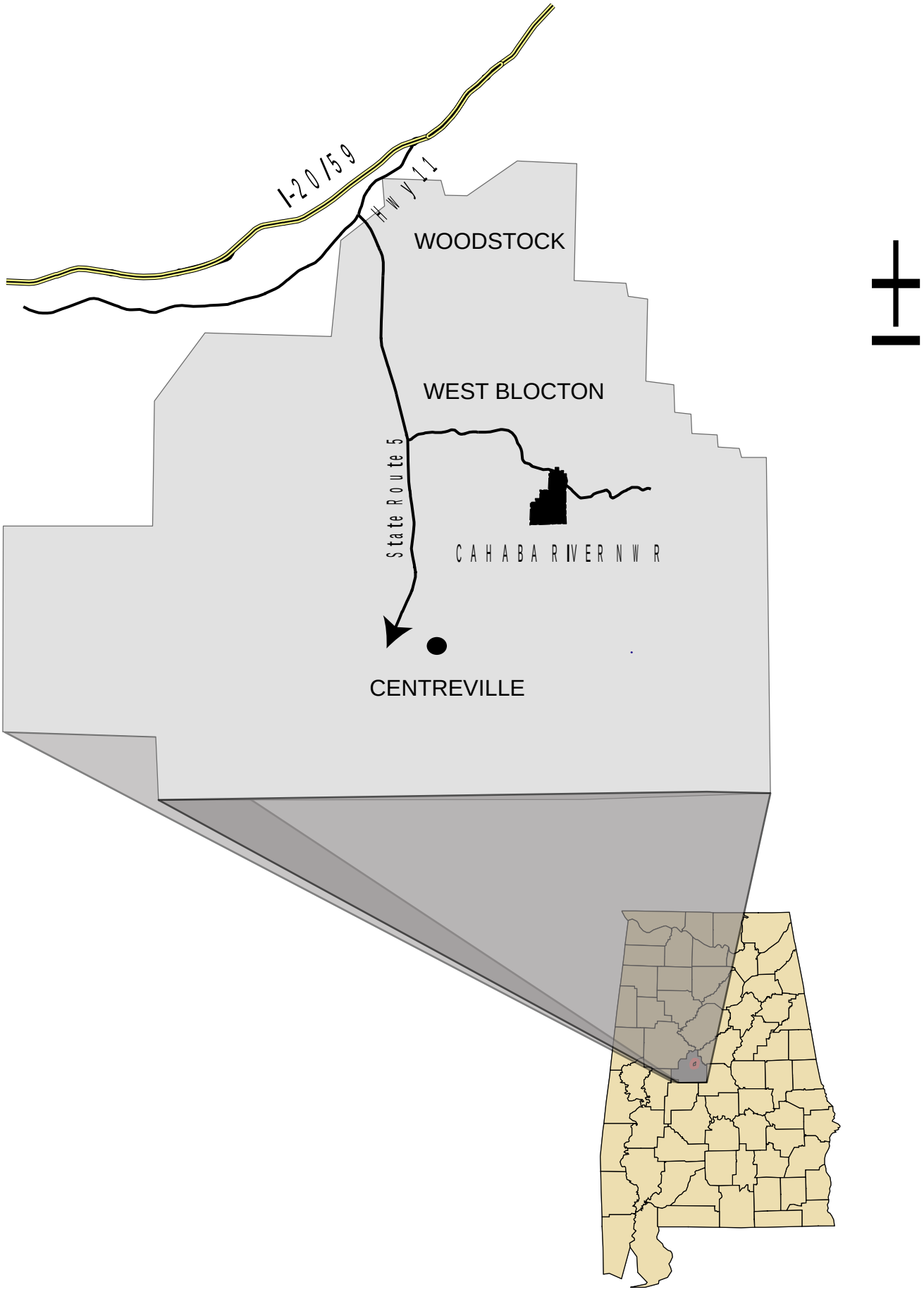


FIG. 1 CAHABA RIVER NATIONAL WILDLIFE REFUGE LOCATION

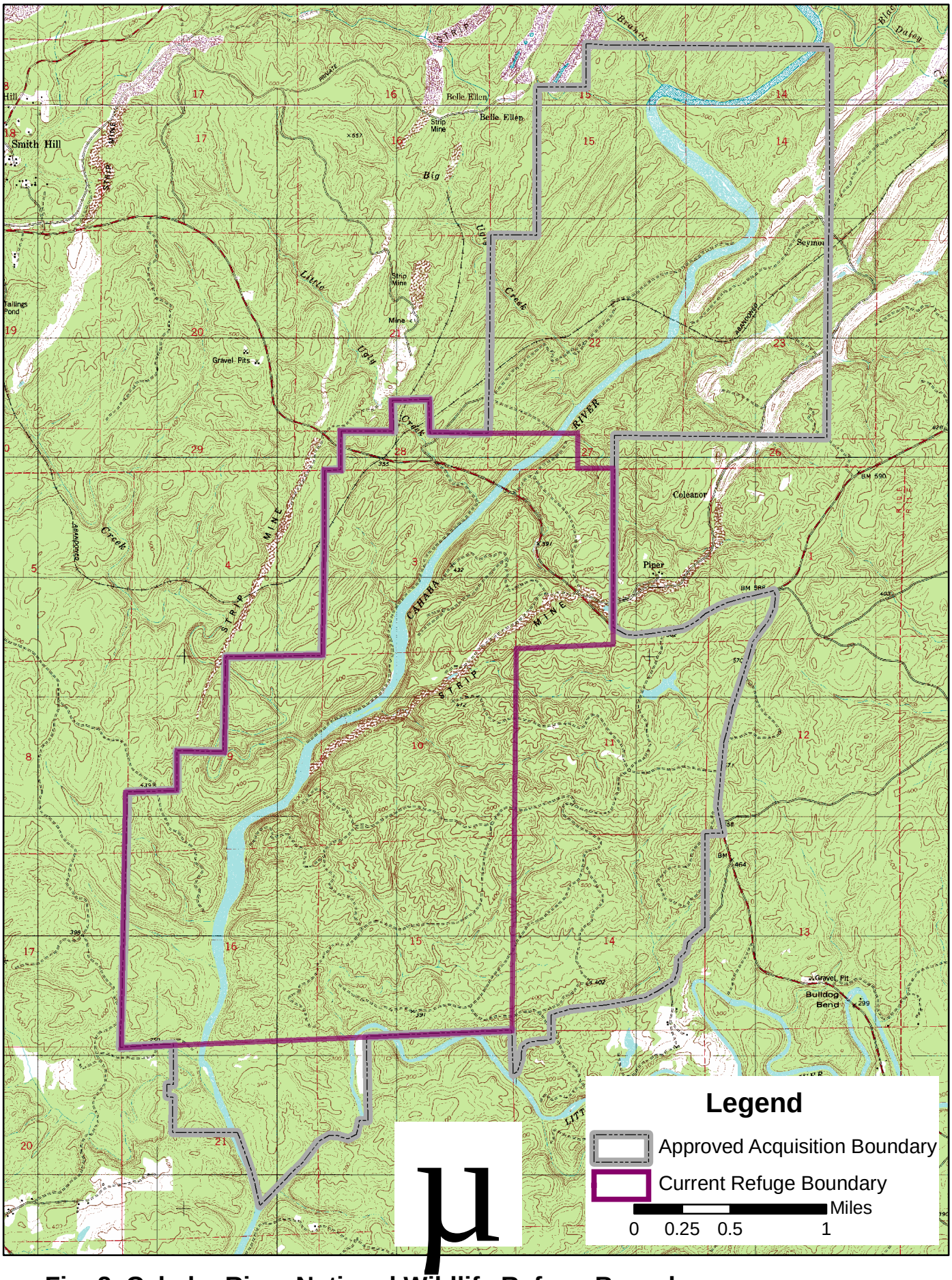


Fig. 2 Cahaba River National Wildlife Refuge Boundary

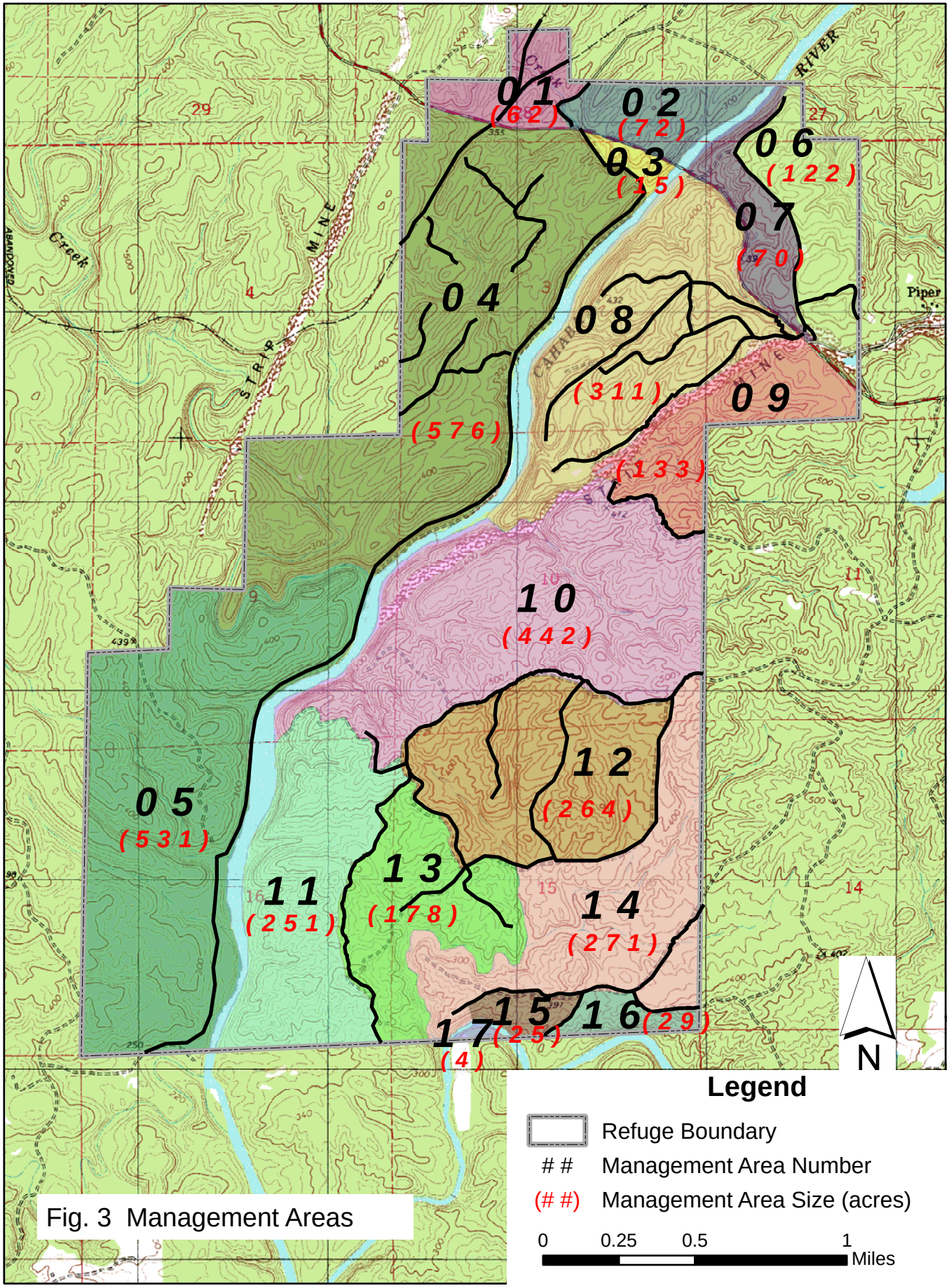


Fig. 3 Management Areas

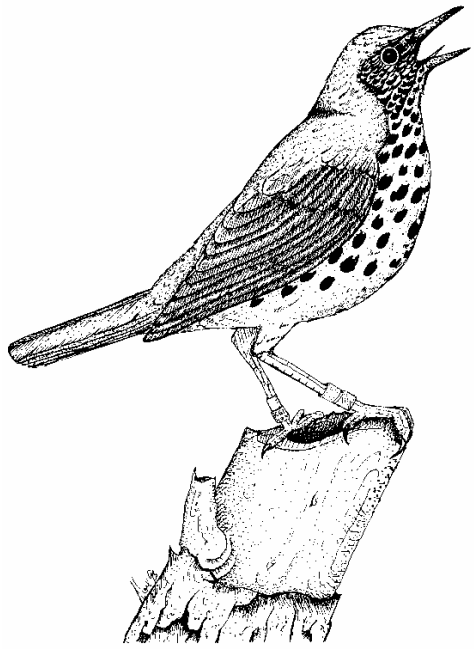
Figure 4

The Figure showing a map of the locations of species of concern has been withheld from the public version of this document.

Figure 5

A Checklist for

The Birds of Cahaba River National Wildlife Refuge



1st Edition
February 2007

WELCOME TO CAHABA RIVER NATIONAL WILDLIFE REFUGE

This checklist is a general guide to bird abundance in Cahaba River National Wildlife Refuge

The seasonal occurrence, relative abundance, and breeding status of birds in their suitable habitat are coded as follows:

SEASONS

s – Spring (Mar – May) **F** – Fall (Aug – Nov)
S – Summer (Jun – Jul) **W** – Winter (Dec – Feb)

RELATIVE ABUNDANCE

a – abundant	Numerous and widespread
c – common	Likely to be present and observed
f – fairly common	Occurs annually
u – uncommon	Present, but not certain to be observed
o – occasional	Occurs only a few times during a season, or restricted in distribution
r – rare	Not observed every year
x – accidental	Exceptionally observed outside of its typical geographic range

NESTING

***** – Confirmed or suspected to nest on refuge

				s	S	F	W
GEESE – SWANS – DUCKS (13)							
			Snow Goose	-	-	-	r
			Canada Goose	o	o	o	o
			Wood Duck *	u	u	u	u
			Gadwall	-	-	-	o
			American Wigeon	-	-	-	o
			American Black Duck	-	-	-	o
			Mallard	u	-	u	u
			Blue-winged Teal	u	-	u	-
			Northern Shoveler	u	-	u	u
			Northern Pintail	-	-	-	o
			Green-winged Teal	-	-	-	u
			Ring-necked Duck	u	-	u	u
			Hooded Merganser	u	o	u	u
GAMEBIRDS (2)							
			Wild Turkey *	u	u	u	u
			Northern Bobwhite *	f	f	f	f
LOONS – GREBES (1)							
			Pied-billed Grebe	o	o	o	o
PELICANS – CORMORANTS (1)							
			Double-crested Cormorant	o	-	o	o
HERONS – IBISES – VULTURES (6)							
			Great Blue Heron	c	f	c	c
			Great Egret	o	o	o	o
			Green Heron *	u	u	u	-
			Yellow-crowned Night-Heron	u	u	u	-
			Black Vulture	f	u	f	f
			Turkey Vulture *	f	f	f	f
HAWKS – FALCONS (10)							
			Osprey	u	o	u	-
			Mississippi Kite	-	r	r	-
			Bald Eagle	r	r	r	r
			Northern Harrier	o	-	r	o
			Sharp-shinned Hawk*	u	r	u	u
			Cooper's Hawk *	u	o	u	u
			Red-shouldered Hawk *	u	u	u	u
			Broad-winged Hawk *	f	f	f	-
			Red-tailed Hawk *	c	f	c	c
			American Kestrel	u	o	u	u
PLOVERS – SANDPIPERS (5)							
			Killdeer *	f	f	f	f
			Spotted Sandpiper	o	-	o	-
			Least Sandpiper	o	-	o	-
			Wilson's Snipe	o	-	o	o
			American Woodcock	o	-	o	o
GULLS – TERNS – SKIMMER (4)							
			Ring-billed Gull	r	-	r	r
			Herring Gull	r	-	r	r
			Caspian Tern	r	-	r	-
			Forster's Tern	o	-	o	-

				s	S	F	W
DOVES – CUCKOOS (4)							
			Rock Pigeon	u	u	u	u
			Mourning Dove *	a	c	a	a
			Black-billed Cuckoo	r	-	r	-
			Yellow-billed Cuckoo *	c	c	c	-
OWLS (3)							
			Eastern Screech-Owl *	u	u	u	u
			Great Horned Owl *	u	u	u	u
			Barred Owl *	u	u	u	u
GOATSUCKERS (3)							
			Common Nighthawk	c	o	c	-
			Chuck-will's-widow*	u	u	u	-
			Whip-poor-will	o	o	o	-
SWIFT – HUMMINGBIRD – KINGFISHER (3)							
			Chimney Swift *	f	f	c	-
			Ruby-throated Hummingbird *	f	f	c	-
			Belted Kingfisher *	f	u	f	f
WOODPECKERS (7)							
			Red-headed Woodpecker *	u	u	u	u
			Red-bellied Woodpecker *	c	c	c	c
			Yellow-bellied Sapsucker	f	-	f	f
			Downy Woodpecker *	c	c	c	c
			Hairy Woodpecker *	f	u	f	f
			Northern Flicker *	f	f	f	f
			Pileated Woodpecker *	f	f	f	f
FLYCATCHERS (10)							
			Olive-sided Flycatcher	r	-	r	-
			Eastern Wood-Pewee *	f	f	f	-
			Yellow-bellied Flycatcher	r	-	r	-
			Acadian Flycatcher *	f	f	u	-
			Alder Flycatcher	r	-	r	-
			Willow Flycatcher	r	-	r	-
			Least Flycatcher	r	-	r	-
			Eastern Phoebe *	f	f	f	u
			Great Crested Flycatcher *	f	f	f	-
			Eastern Kingbird *	c	f	c	-
SHRIKE – VIREOS (6)							
			Loggerhead Shrike*	r	r	r	r
			White-eyed Vireo *	c	f	c	-
			Yellow-throated Vireo *	f	f	f	-
			Blue-headed Vireo	u	r	u	r
			Philadelphia Vireo	u	-	u	-
			Red-eyed Vireo *	c	f	c	-
JAY – CROWS – RAVEN (3)							
			Blue Jay *	a	a	a	a
			American Crow *	a	a	a	a
			Fish Crow	u	u	u	u
LARK – SWALLOWS (6)							
			Purple Martin	c	f	u	-
			Tree Swallow	u	-	u	-
			Northern Rough-winged Swallow *	f	f	f	-
			Bank Swallow	u	-	u	-

				s	S	F	W
LARK – SWALLOWS (cont)							
			Cliff Swallow*	u	r	u	-
			Barn Swallow *	c	f	c	-
TITMICE – NUTHATCHES – CREEPER – WRENS (9)							
			Carolina Chickadee *	a	a	a	c
			Tufted Titmouse *	a	a	a	c
			Red-breasted Nuthatch	o	-	u	f
			White-breasted Nuthatch *	c	c	c	c
			Brown-headed Nuthatch *	f	f	f	f
			Carolina Wren *	a	a	a	a
			House Wren	f	-	c	r
			Winter Wren	u	-	u	f
			Sedge Wren	o	-	o	-
KINGLETS – GNATCATCHER – THRUSHES – MIMIDS (13)							
			Golden-crowned Kinglet	u	-	u	f
			Ruby-crowned Kinglet	c	-	c	c
			Blue-gray Gnatcatcher *	c	c	c	r
			Eastern Bluebird *	f	f	f	f
			Veery	u	-	u	-
			Gray-cheeked Thrush	u	-	u	-
			Swainson's Thrush	f	-	f	-
			Hermit Thrush	u	-	u	f
			Wood Thrush *	c	f	c	-
			American Robin *	c	f	c	c
			Gray Catbird *	f	f	c	r
			Northern Mockingbird *	c	c	c	c
			Brown Thrasher *	c	c	c	c
STARLING – PIPIT – WAXWING (2)							
			European Starling *	c	c	c	c
			Cedar Waxwing	u	-	u	f
WOOD WARBLERS (37)							
			Blue-winged Warbler	f	u	f	-
			Golden-winged Warbler	u	-	f	-
			Tennessee Warbler	c	-	c	-
			Orange-crowned Warbler	u	-	f	r
			Nashville Warbler	u	-	u	-
			Northern Parula *	c	c	c	-
			Yellow Warbler	u	-	u	-
			Chestnut-sided Warbler	f	-	f	-
			Magnolia Warbler	f	-	c	-
			Cape May Warbler	u	-	u	-
			Black-throated Blue Warbler*	r	-	r	-
			Yellow-rumped Warbler	c	-	f	a
			Black-throated Green Warbler	f	u	f	-
			Blackburnian Warbler	f	-	u	-
			Yellow-throated Warbler *	f	c	f	-
			Pine Warbler *	c	c	c	c
			Prairie Warbler *	f	f	c	-
			Palm Warbler	f	-	f	o
			Bay-breasted Warbler	f	-	u	-
			Blackpoll Warbler	f	-	-	-
			Cerulean Warbler	u	-	u	-

				s	S	F	W
WOOD WARBLERS (cont.)							
			Black-and-white Warbler *	f	f	c	-
			American Redstart *	c	f	c	-
			Prothonotary Warbler *	f	u	u	-
			Worm-eating Warbler *	f	f	f	-
			Swainson's Warbler *	u	o	o	-
			Ovenbird	f	U	f	-
			Northern Waterthrush	f	-	f	-
			Louisiana Waterthrush *	c	f	u	-
			Kentucky Warbler *	f	f	f	-
			Connecticut Warbler	r	-	r	-
			Mourning Warbler	r	-	r	-
			Common Yellowthroat *	f	f	c	-
			Hooded Warbler *	f	f	f	-
			Wilson's Warbler	u	-	u	-
			Canada Warbler	u	-	u	-
			Yellow-breasted Chat *	f	f	f	-
TANAGERS – SPARROWS – GROSBEAKS (18)							
			Summer Tanager *	c	c	c	-
			Scarlet Tanager*	f	o	f	-
			Eastern Towhee *	c	c	c	c
			Chipping Sparrow *	f	u	f	f
			Field Sparrow *	f	f	f	f
			Vesper Sparrow	o	-	o	o
			Savannah Sparrow	u	-	u	u
			Fox Sparrow	u	-	u	u
			Song Sparrow	f	-	f	c
			Lincoln's Sparrow	r	-	r	r
			Swamp Sparrow	u	-	u	u
			White-throated Sparrow	f	-	f	c
			White-crowned Sparrow	o	-	o	o
			Dark-eyed Junco	f	-	f	c
			Northern Cardinal *	a	a	a	a
			Rose-breasted Grosbeak	f	-	f	-
			Blue Grosbeak *	f	f	c	-
			Indigo Bunting *	c	a	c	-
BLACKBIRDS – ORIOLES (7)							
			Red-winged Blackbird *	c	c	c	c
			Eastern Meadowlark *	c	f	c	c
			Rusty Blackbird	u	-	u	u
			Common Grackle *	c	c	c	c
			Brown-headed Cowbird *	c	c	c	c
			Orchard Oriole *	c	f	c	-
			Baltimore Oriole	o	-	o	-
FINCHES – WEAVER FINCH (5)							
			Purple Finch	u	-	u	u
			House Finch *	c	c	c	c
			Pine Siskin	o	-	o	u
			American Goldfinch *	f	f	f	c
			House Sparrow*	u	u	u	u

NOTES

Location _____

Date _____ Time _____

Observer(s) _____

_____

RARE SPECIES / HIGH NUMBERS

Species _____

Number _____ Age _____ Sex _____

Distance from bird _____ Duration _____

Habitat _____

Optical Equipment _____

Weather _____ Wind _____

Bird-sun orientation _____

Head & Neck _____

Eyes & Lores _____

Upper & Lower Mandibles _____

Legs & Feet _____

Upperparts _____

Tail _____

Wings _____

Vocalizations _____

Behavior _____

_____

_____

Additional Comments _____

_____

_____

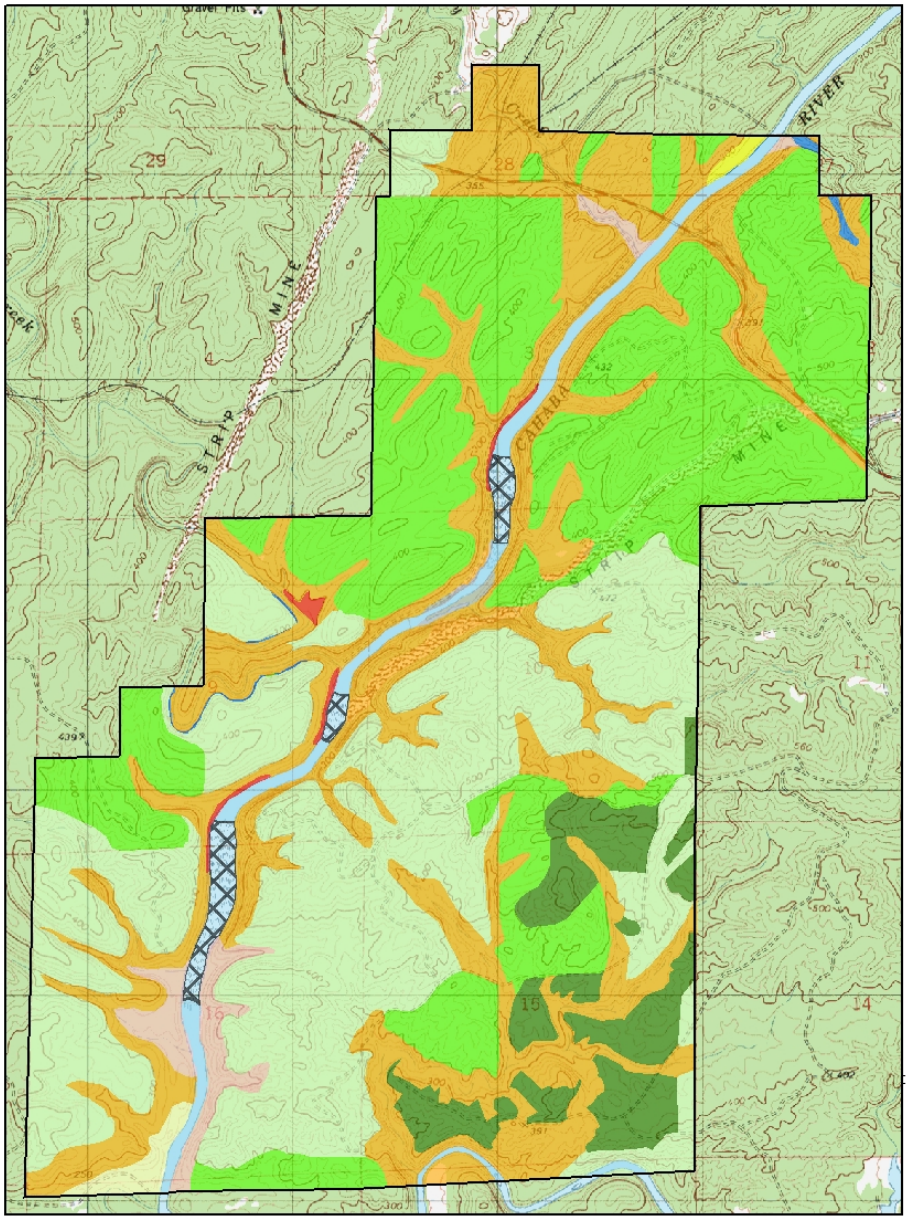
_____

Please share your rare or unusual findings with our members by e-mailing your information to:

cahabariver@fws.gov

FIGURE 6

Vegetation Key to Natural Communities of the Cahaba River National Wildlife Refuge



Natural Community

- *Quercus prinus* - *Carya* spp. - *Quercus velutina* / *Vaccinium arboreum* / *Iris verna* var. *smalliana* Forest
- *Quercus alba* - *Fagus grandifolia* / *Hydrangea quercifolia* - *Viburnum acerifolium* / *Carex picta* - *Polystichum acrostichoides* Forest
- *Quercus hemisphaerica* - *Quercus* (*falcata, nigra*) / *Ilex opaca* - *Vaccinium arboreum* / *Cnidoscolus stimulosus* Forest
- *Pinus palustris* - *Pinus echinata* - (*Pinus virginiana*) / *Quercus marilandica* - (*Quercus prinus*) / *Vaccinium pallidum* Woodland
- *Pinus taeda* Planted Forest
- *Pinus palustris* Planted Forest
- *Fagus grandifolia* - *Quercus alba* / *Kalmia latifolia* - *Rhododendron canescens* - *Symplocos tinctoria* Forest
- *Liquidambar styraciflua* - *Quercus* (*laurifolia, nigra*) - (*Pinus taeda*) / *Arundinaria gigantea* var. *gigantea* / *Carex abscondita* Forest
- *Liquidambar styraciflua* - *Liriodendron tulipifera* / *Onoclea sensibilis* Forest
- *Hymenocallis coronaria* - *Justicia americana* Herbaceous Vegetation
- *Andropogon gerardii* - *Panicum virgatum* - *Baptisia australis* Herbaceous Vegetation
- Water

Map prepared by Al Schotz (2007), Alabama Natural Heritage Program, Auburn University

8.0 Tables

TABLE 1

Species of Conservation Concern
Cahaba River NWR

Common Name	Scientific Name	Status			Refuge Location
		Federal	State	TNC	
Mammals					
Gray Bat	*Myotis grisescens*	E	SP, P1	S2	Suspected to forage along the river and larger tributary streams
Eastern Fox Squirrel	*Sciurus niger*			S3	Highly Suspected - Mature longleaf and shortleaf pine forests in the Belcher Tract
Birds					
Mississippi Kite	*Ictinia mississippiensis*			S3	Recorded for Breeding Bird Atlas on or just east of the refuge (AOS 2006)
Bald Eagle	*Haliaeetus leucocephalus*	T	SP	S3	Observed during breeding season for Breeding Bird Atlas on or just west of refuge (AOS 2006), Pair observed by refuge staff along river during summer 2006.

Common Name	Scientific Name	Status			Refuge Location
		Federal	State	TNC	
Cooper's Hawk	*Accipiter cooperii*		SP	S3	Recorded for Breeding Bird Atlas on or just east of refuge (AOS 2006)
Swainson's Warbler	*Limnothlypis swainsonii*		P2	S3	Recently fledged young were recorded for the Breeding Bird Atlas on or just NE of the refuge (AOS 2006)
Kentucky Warbler	*Oporornis formosus*		P2		Seen, heard or recently fledged young recorded for the Breeding Bird Atlas throughout West Blocton East Quad (AOS 2006)
Wood Thrush	*Hylocichla mustelina*		P2		Seen, heard or territorial behavior recorded for Breeding Bird Atlas throughout West Blocton East Quad (AOS 2006)
Fish					
Blue Shiner	*Cyprinella caerulea*	T	SP, P2	S1	Probably extirpated from Cahaba River, but establishment of a viable population in the river a requirement in Recovery Plan (USFWS 1995) for delisting.
Rock Darter	*Etheostoma rupestre*			S4	Common in Cahaba and Black Warrior river systems (NatureServe 2006) and recorded as a single population in the central portion of the refuge (ANHP 2006).

Common Name	Scientific Name	Status			Refuge Location
		Federal	State	TNC	
Cahaba shiner	*Notropis cahabae*	E	SP	S2	Cahaba endemic (NatureServe 2006) and recorded as five populations on refuge (ANHP 2006)
Skygazer Shiner	*Notropis uranoscopus*			S2	Alabama endemic recorded on southern portion of refuge (ANHP 2006) and recognized as more common downstream (NatureServe 2006)
Goldline Darter	Percina aurolineata	T	SP, P1	S1	Rare and local in Cahaba River (NatureServe 2006) with two collection sites in the central portion of the refuge (ANHP 2006 and USFWS, Daphne field Office)
Mussels					
Delecate Spike	Elliptio arctata			S2	Widespread but uncommon in Mobile River Basin (Mirarchi 2004) and collected at Caffee Creek Shoals during recent refuge survey (Hartfield 2004)
Gulf Pigtoe	*Fusconaia cerina*			S4	Widespread Mobile River Basin endemic (Mirarchi 2004) with dead/live shells collected at Upper and Caffee Creek Shoals during recent refuge survey (Hartfield 2004)

Common Name	Scientific Name	Status			Refuge Location
		Federal	State	TNC	
Fine-lined Pocketbook	*Lampsilis altilis*	T	P2	S2	Rapidly declining mussel (Nature Serve 2006) with a single fresh dead shell collected at Caffee Creek Shoals during recent refuge survey (Hartfield 2004)
Southern Pocketbook	*Lampsilis ornata*			S4	Relatively abundant and widespread within Mobile River Basin (NatureServe 2006) with collections at Upper and Caffee Creek Shoals during recent refuge survey (Hartfield 2004)
Alabama Heelsplitter	*Lasmigona complanata alabamensis*			S3	Endemic to Mobile River Basin (Mirarchi 2004) with a single mussel collected at Upper Shoals during recent refuge survey (Hartfield 2004)
Triangular Kidneyshell	*Ptychobranchus greeni*	E	SP, P1	S1	Rapidly declining mussel (NatureServe 2006) that has not been collected on the refuge, but has been found in previous surveys both north and south of the refuge (Hartfield 2004)
Pistolgrip	*Tritogonia verrucosa*			S4	Fairly common in Mobile River Basin (Mirarchi 2004) with a few dead shells collected at Upper Shoals during recent refuge survey (Harfield 2004)

Common Name	Scientific Name	Status			Refuge Location
		Federal	State	TNC	
Little Spectaclecase	*Villosa lienosa*			S4	Although not collected during recent refuge surveys, this mussel has been collected from the Cahaba in the past (Hartfield 2004). Considered common in Alabama (Mirarchi 2004)
Southern Rainbow	*Villosa vibex*			S4	Common in Alabama (Mirarchi 2004) with collections at Upper Shoals during recent refuge survey (Hartfield 2004)
Snails					
Ample Elimia	*Elimia ampla*		P2	S1	Cahaba River endemic found between Centerville and Booth Ford, Shelby County (NatureServe 2006) and recorded as two populations on the refuge (ANHP 2006) and at Upper Shoals in recent refuge survey (Hartfield 2004)
Cahaba Pebblesnail	*Clappia cahabensis*		P1	S1	Presumed extinct and rediscovered on the refuge in 2005 (NatureServe 2006)
Lilyshoals Elimia	*Elimia annettae*		P2	S1	Cahaba River endemic found between Lily Shoals and Pratt's Ferry (NatureServe 2006) and recorded on the refuge as a single population by ANHP (2006) and at Upper and Caffee Shoals (Harfield 2004) in a recent refuge survey

Common Name	Scientific Name	Status			Refuge Location
		Federal	State	TNC	
Cahaba Elimia	*Elimia cahawbensis*			S3	Endemic and common in Mobile River Basin (Mirarchi 2004), recorded by ANHP (2006) as four populations on the refuge, and collected at Caffee Creek in a recent refuge survey (Hartfield 2004)
Riffle Elimia	*Elimia clara*			S2	Endemic and common to Cahaba River (Mirarchi 2004), recorded by ANHP (2006) as two populations on the refuge, and collected at Upper and Caffee Creek Shoals in recent refuge survey (Hartfield 2004)
Compact Elimia	*Elimia showalteri*			S1	Endemic to Cahaba River (Mirarchi 2004), recorded by ANHP (2006) as three populations on the refuge, and collected at Upper and Caffee Creek Shoals in recent refuge survey (Hartfield 2004)
Puzzle Elimia	*Elimia varians*		P2	S1	Rapidly declining Cahaba River endemic found between Marvel and Centreville in Bibb County (NatureServe 2006), and recorded by ANHP (2006) as a single population at Upper Shoals
Round Rocksnail	*Leptoxis ampla*	T	SP, P2	S1	Found in Cahaba River shoals and three isolated tributary streams off refuge (NatureServe 2004), recorded by ANHP (2006) and Harfield (2004) at Upper and Caffee Creek Shoals on refuge, and

Common Name	Scientific Name	Status			Refuge Location
		Federal	State	TNC	
					collected from Little Cahaba River (USFWS, Daphne Field Office)..
Flat Pebblesnail	*Lepyrium showalteri*	E	SP, P1	S1	Known from shoals along the Cahaba River in Shelby and Bibb Counties, and along the Little Cahaba River. Reintroduced at Upper Shoals and collected from Hargrove Shoals.
Cylindrical Lioplax	*Lioplax cyclostomaformis*	E	SP, P1	S1	Currently only know from 15 miles of the Cahaba above the Fall Line (Mirarchi et al 2004) and collected from Upper and Caffee Creek Shoals during recent refuge survey (Hartfield 2004)
Smooth Hornsnail	*Pleurocera prasinata*			S1	Common endemic of Mobile River Basin (Mirarchi 2004) with collections at Upper and Caffee Creek Shoals during recent refuge surveys (Hartfield 2004)
Insects					
Caddisfly	*Cheumatopsyche ela*			S2	Collected near County Road 24 Bridge and Little Ugly Creek (Harris et al. 1991)
Caddisfly	*Hydropsyche hageni*			S2	Collected near County Road 24 Bridge and Little Ugly Creek (Harris et al. 1991)

Common Name	Scientific Name	Status			Refuge Location
		Federal	State	TNC	
Plants					
Spring Coralroot	*Corallorhiza wisteriana*			S2	Upland Laurel Oak-Oak/American Holly-Tree Sparkleberry-Tread-softly Forest Association. A saprophytic orchid
Alabama Croton	*Croton alabamensis var. alabamensis*			S3	Scattered in dry mesic and mesic communities where calcareous outcropping are on or near the surface
Shoals Spider Lily or Cahaba Lily	*Hymenocallis coronaria*			S2	Cahaba Lily-Water Willow Herbaceous Association. Less than 200 acres remains world-wide
Smooth Veiny Peavine	*Lathyrus venosus*			S1	Mesic hardwood forest communities
Maidenbush	*Leptopus phyllanthoides*	`		S2	Big Bluestem-Switchgrass-Wild Blue Indigo Herbaceous Plant Association. A woody Euphorb shrub.
Broadleaf Barbara's Buttons	*Marshallia trinervia*			S3	Wet-mesic communities along streams
Wherry's Phlox	*Phlox pulchra*			S2	Chestnut Oak-Hickory-Black Oak/Tree Sparkleberry/Dwarf Vernal Iris Forest Association. Roadsides and right-of-ways
Nevius' Stonecrop	*Sedum nevii*			S3	Mesic hardwood slopes - 1992 historic record

Common Name	Scientific Name	Status			Refuge Location
		Federal	State	TNC	
Georgia Aster	*Symphyotrichum georgianum*	C		S2	Longleaf Pine-Shortleaf Pine-(Virginia Pine)/Blackjack Oak-(Chestnut Oak)/Lowbush Blueberry Woodland Association. Widely scatter along roadsides in longleaf pine woodlands and open longleaf restoration areas.
Slender Bunchflower	*Melanthium latifolium*			S1	Beech-WhiteOak/Mountain Laurel-Hoary Azalea-Horse Sugar Forest Association. Appalachian species known in Alabama from three sites in Bibb Co.
Elliott's fan-petal	*Sida elliottii*			S2	Big Bluestem-Switchgrass-Wild Blue Indigo Herbaceous Plant Association
Silky Camellia	*Stewartia malacodendron*			S2	Beech-WhiteOak/Mountain Laurel-Hoary Azalea-Horse Sugar Forest Association.

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(2) SP=State Protected (Alabama Nongame Species Regulation, Section 220-2-.92 of the Alabama Regulations for 2003-2004 Game, Fish, and Fur Bearing Animals); P1=Species of Highest Conservation Concern, P2=Species of High Conservation Concern (Conserving Alabama's Wildlife: A Comprehensive Strategy).

(3) Nature Conservancy Heritage Ranking system - S1=Critically imperiled in Alabama because of extreme rarity or because of some factors making it especially vulnerable to extirpation from Alabama, S2=Imperiled in state because of rarity or because of some factors making it very vulnerable to extirpation from Alabama, S3=Rare or uncommon in Alabama, S4=Demonstrably secure in Alabama and essentially ineradicable under present conditions.

TABLE 2

Freshwater Mussels and Snails Recorded on Cahaba River NWR (1)

Common Name	Scientific Name	Refuge Locations			
		Upper Shoals	Caffee Creek Shoals	Hargrove Shoals	Caffee Creek
Mussels					
Threeridge	*Amblema plicata*	X	X		
Delicate Spike	*Elliptio arctata*	X	X		
Elephantear	*Elliptio crassidens*	X	X	X	
Southern Pigtoe	*Fusconaia cerina*	X	X		
Fine-lined Pocketbook (2)	*Lampsilis altilis*		X		
Southern Pocketbook	*Lampsilis ornata*	X	X		
Yellow Sandshell	*Lampsilis teres*	X			
Alabama Heelsplitter	*Lasmigona alabamensis*	X			

Common Name	Scientific Name	Refuge Locations			
		Upper Shoals	Caffee Creek Shoals	Hargrove Shoals	Caffee Creek
Fragile Papershell	*Leptodea fragilis*	X			
Washboard	*Megalonaias nervosa*	X			
Threehorn Wartyback	*Obliquaria reflexa*	X			
Bleufer	*Potamilus purpuratus*	X	X	X	
Triangular Kidneyshell (2)	*Ptychobranchus greeni*	Previous Records Near Refuge			
Alabama Orb	*Quadrula asperata*	X			
Pistolgrip	*Tritogonia verrucosa*	X			
Little Spectaclecase	*Villosa lienosa*	Previous Records on Refuge			
Southern Rainbow	*Villosa vibex*	X			
Asian Clam	*Corbicula fluminea*	X	X	X	X
Snails					
Ample Elimia	*Elimia ampla*	X			
Lilyshoals Elimia	*Elimia annettae*	X	X		
Riffle Elimia	*Elimia clara*	X	X		
Cahaba Elimia	*Elimia cahawbensis*				X
Compact Elimia	*Elimia showalteri*	X	X		

Common Name	Scientific Name	Refuge Locations			
		Upper Shoals	**Caffee Creek Shoals**	**Hargrove Shoals**	**Caffee Creek**
Round Rocksnail (2)	*Leptoxis ampla*	X	X		
Flat Pebblesnail (2)	*Lepyrium showalteri*	Previous Records on Refuge			
Cylindrical Lioplax (2)	*Lioplax cyclostomaformis*	X	X		
Smooth Hornsnail	*Pleurocera prasinata*	X	X		

(1) Hartfield, E. 2004. Freshwater Mussels of Cahaba River National Wildlife Refuge. U.S. Fish and Wildlife Service, Ecological Services, Jackson, MS

(2) Federally Listed and Endangered or Threatened

TABLE 3

Fishes of
Cahaba River NWR (1)

Scientific Name	Common Name	Status			Refuge Record
		Federal(2)	Alabama(3)	TNC(4)	
Ichthyomyzon castaneus	Chestnut Lamprey			S2	
Ichthyomyzon gagei	Southern Brook Lamprey				
Lampetra aepyptera	Least Brook Lamprey				
Lepisosteus oculatus	Spotted Gar				
Lepisosteus osseus	Longnose Gar				
Amia calva	Bowfin				
Anguilla rostrata	American Eel				
Alosa alabamae	Alabama Shad		P2	S2	
Alosa chrysochloris	Skipjack Herring				
Dorosoma cepedianum	Gizzard Shad				
Dorosoma petenense	Threadfin Shad				

Scientific Name	Common Name	Status			Refuge Record
		Federal(2)	Alabama(3)	TNC(4)	
Campostoma oligolepis	Largescale Stoneroller				
Cyprinella caerulea	Blue Shiner	LT	SP, P2	S1	Possibly extirpated from Cahaba River
Cyprinella callistia	Alabama Shiner				
Cyprinella trichroistia	Tricolor Shiner				
Cyprinella venusta	Blacktail Shiner				
Cyprinus carpio	Common Carp				
Ericymba buccata	Silverjaw Minnow				
Hybopsis winchelli	Clear Chub			S3	
Luxilus chrysocephalus	Striped Shiner				
Lythrurus bellus	Pretty Shiner				
Lythrurus lirus	Mountain Shiner			S3	
Macrhybopsis aestivallis	Speckled Chub				
Macrhybopsis storeriana	Silver Chub				
Nocomis leptocephalus	Bluehead Chub				
Notemigonus crysoleucas	Golden Shiner				
Notropis ammophilus	Orangefin Shiner				

Scientific Name	Common Name	Status			Refuge Record
		Federal(2)	Alabama(3)	TNC(4)	
Notropis asperifrons	Burrhead Shiner				
Notropis atherinoides	Emerald Shiner				
Notropis cahabae	Cahaba Shiner	LE	SP, P1	S2	X
Notropis chrosomus	Rainbow Shiner				
Notropis edwardraneyi	Fluvial Shiner				
Notropis stilbius	Silverstripe Shiner				
Notropis texanus	Weed Shiner				
Notropis uranoscopus	Skygazer Shiner			S2	X
Notropis volucellus	Mimic Shiner				
Phenacobius catostomus	Riffle Minnow				
Pimephales notatus	Bluntnose Minnow				
Pimephales vigilax	Bullhead Minnow				
Semotilus atromaculatus	Creek Chub				
Carpiodes cyprinus	Quillback				
Carpiodes velifer	Highfin Carpsucker				
Erimyzon oblongus	Creek Chubsucker				
Hypentelium etowanum	Alabama Hog Sucker				

Scientific Name	Common Name	Status			Refuge Record
		Federal(2)	Alabama(3)	TNC(4)	
Minytrema melanops	Spotted Sucker				
Moxostoma carinatum	River Redhorse				
Moxostoma duquesnei	Black Redhorse				
Moxostoma erythrurum	Golden Redhorse				
Moxostoma poecilurum	Blacktail Redhorse				
Ameiurus natalis	Yellow Bullhead				
Ictalurus punctatus	Channel Catfish				
Noturus gyrinus	Tadpole Madtom				
Noturus leptacanthus	Speckled Madtom				
Noturus nocturnus	Freckled Madtom		P2	S3	
Pylodictis olivaris	Flathead Catfish				
Esox niger	Chain Pickerel				
Strongylura marina	Atlantic Needlefish				
Fundulus dispar	Northern Starhead Topminnow			S2	
Fundulus olivaceus	Blackspotted Topminnow				
Fundulus stellifer	Southern Studfish				
Gambusia affinus	Mosquitofish				

Scientific Name	Common Name	Status			Refuge Record
		Federal(2)	Alabama(3)	TNC(4)	
Labidesthes sicculus	Brook Silverside				
Cottus carolinae	Banded Sculpin				
Ambloplites ariommus	Shadow Bass				
Lepomis cyanellus	Green Sunfish				
Lepomis gulosus	Warmouth				
Lepomis macrochirus	Bluegill				
Lepomis megalotis	Longear Sunfish				
Lepomis microlophus	Redear Sunfish				
Lepomis miniatus	Redspotted Sunfish				
Micropterus coosae	Redeye Bass				
Micropterus punctulatus	Spotted Bass				
Micropterus salmoides	Largemouth Bass				
Pomoxis annularis	White Crappie				
Poxomis nigromaculatus	Black Crappie				
Ammocrypta beani	Naked Sand Darter				
Ammocrypta meridiana	Southern Sand Darter				
Crystallaria asprella	Crystal Darter			S3	

Scientific Name	Common Name	Status			Refuge Record
		Federal(2)	Alabama(3)	TNC(4)	
Etheostoma jordani	Greenbreast Darter				
Ethiostoma ramseyi	Alabama Darter				
Ethiostoma rupestre	Rock Darter			S4	X
Ethiostoma stigmaeum	Speckled Darter				
Ethiostoma whipplei	Redfin Darter				
Percina aurolineata	Goldline Darter	LT	SP, P1	S1	X
Percina brevicauda	Coal Darter		P2	S2	
Percina lenticula	Freckled Darter			S2	
Percina nigrofasciata	Blackbanded Darter				
Percina shumardi	River Darter			S3	
Percina vigil	Saddleback Darter				
Percina sp.	Mobile Logperch				
Stizostedion vitreum	Walleye				
Aplodinotus grunniens	Freshwater Drum				

(1) Mettee, M.F., P.E. O'Neil and J.M. Pierson. 1996. Fishes of Alabama and the Mobile Basin. Oxmoor House, Inc. Birmingham, AL;

Alabama Natural Heritage Program. 2006. Alabama Inventory List: the Rare, Threatened and Endangered Plants & Animals of Alabama. Privately printed by the Alabama Natural Heritage Program, 1500 East Fairview Avenue, Montgomery, AL:

Alabama Department of Conservation and Natural Resources. 2005. Conserving Alabama's Wildlife: A Comprehensive Strategy. ADCNR, Division of Wildlife and Freshwater Fisheries. Montgomery, AL.

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TABLE 4

Potential
Reptiles and Amphibians
Cahaba River NWR (1)

Scientific Name	Common Name	Status			Refuge Record
		Federal(2)	Alabama(3)	TNC(4)	
Frogs and Toads					
Bufo americanus americanus	American Toad				
Bufo quercicus	Oak Toad				
Bufo terrestris	Southern Toad				
Bufo woodhouseii	Fowler's Toad				
Acris crepitans crepitans	Northern Cricket Frog				
Acris gryllus gryllus	Southern Cricket Frog				
Hyla avivoca	Bird-voiced Treefrog				
Hyla cinerea	Green Treefrog				
Hyla crucifer crucifer	Northern Spring Peeper				

Scientific Name	Common Name	Status			Refuge Record
		Federal(2)	Alabama(3)	TNC(4)	
Hyla femoralis	Pine Woods Treefrog				
Hyla gratiosa	Barking Frog				
Hyla squirrela	Squirrel Treefrog				
Hyla versicolor	Gray Treefrog				
Pseudacris brachyphona	Mountain Chorus Frog				
Pseudacris ornata	Ornate Chorus Frog				
Pseudacris triseriata	Upland Chorus Frog				
Gastrophryne carolinensis	Narrowmouth Toad				
Scaphiopus holbrookii	Eastern Spadefoot Toad				
Rana catesbeiana	Bullfrog				
Rana clamatans	Green/Bronze Frog intergradation				
Rana pipiens sphenocephala	Southern Leopard Frog				
Salamanders					
Ambystoma maculatum	Spotted Salamander				
Ambystoma opacum	Marbled Salamander				
Ambystoma talpoideum	Mole Salamander				

Scientific Name	Common Name	Status			Refuge Record
		Federal(2)	Alabama(3)	TNC(4)	
Ambystoma tigrinum	Eastern Tiger Salamander			S3	
Desmognathus fuscus fuscus	Northern Dusky Salamander				
Desmognathus monticola	Seal Salamander		SP		
Eurycea bislineata	Two-lined Salamander				
Eurycea longicauda guttolineata	Three-lined Salamander				
Gyrinophilus porphyriticus	Spring Salamander				
Hemidactylum scutatum	Four-toed Salamander			S3	
Plethodon dorsalis dorsalis	Zigzag Salamander				
Plethodon glutinosus glutinosus	Slimy Salamander				
Pseudotriton ruber	Northern Red and Southern Red Salamander intergradation				
Necturus beyeri	Beyer's Waterdog				
Notopthalmus viridescens	Red-spotted and Central Newt intergradation				
Sirens					
Siren intermedia intermedia	Eastern Lesser Siren				
Crocodillians					

Scientific Name	Common Name	Status			Refuge Record
		Federal(2)	Alabama(3)	TNC(4)	
Alligator misissippiensis	American Alligator				
Lizards and Snakes					
Ophisaurus attenuatus longicaudus	Eastern Slender Glass Lizard				
Ophisaurus ventralis	Eastrn Glass Lizard				
Anolis carolinensis	Green Anole				
Sceloporus undulatus	Fence Lizard				
Eumeces anthracinus pluvialis	Southern Coal Skink		P2	S3	
Eumeces egregius similis	Northern Mole Skink				
Eumeces fasciatus	Five-lined Skink				
Eumeces inexpectatus	Southeastern Five-lined Skink		P2	S3	
Eumeces laticeps	Broad-headed Skink				
Scincella laterale	Ground Skink				
Cnemidophorus sexlineatus sexlineatus	Eastern Six-lined Racerunner				
Carphophis amoenus amoenus	Eastern Worm Snake				
Cemophora coccinea copei	Northern Scarlet Snake				
Coluber constrictor priapus	Southern Black Racer				

Scientific Name	Common Name	Status			Refuge Record
		Federal(2)	Alabama(3)	TNC(4)	
Diadophis punctatus	Ringneck Snake				
Elaphe guttata guttata	Corn Snake				
Elaphe obsoleta spiloides	Gray Rat Snake				
Farancia abacura	Mud Snake				
Farancia erytrogramma erytrogramma	Rainbow Snake		P2	S3	
Heterodon platyrhinos	Eastern Hognos Snake				
Heterodon simus	Southern Hognose Snake		P1	Possibly Extirpated	
Lampropeltis calligaster rhombomaculata	Mole Snake				
Lampropeltis getulus holbrooki	Speckled Kingsnake		P2	S4	
Lampropeltis getulus niger	Black Kingsnake				
Lampropeltis triangulum elapsoides	Scarlet Kingsnake				
Masticophis flagellum flagellum	Eastern Coachwhip			S3	
Natrix erythrogaster flavigaster	Yellow-bellied Water Snake				
Natrix rhombifera rhombifera	Diamond-backed Water Snake				

Scientific Name	Common Name	Status			Refuge Record
		Federal(2)	Alabama(3)	TNC(4)	
Natrix sipedon pleuralis	Midland Water Snake				
Opheodrys aestivus	Rough Green Snake				
Pituophis melanoleucus melanoleucus	Northern Pine Snake		P2	S3	
Regina rigida sinicola	Gulf Glossy Water Snake				
Regina septemvittata	Queen Snake				
Storeria dekayi wrightorum	Midland Brown Snake				
Storeria occiptomaculata occiptomaculata	Northern Red-bellied Snake				
Tantilla coronata	Southeastern Crowned Snake				
Thamnophis sauritus sauritus	Eastern Ribbon Snake				
Thamnophis sirtalis sirtalis	Eastern Garter Snake				
Virginia striatula	Rough Earth Snake				
Virginia valeriae valeriae	Eastern Smooth Earth Snake				
Micrurus fulvius fulvius	Eastern Coral Snake		P2	S3	
Agkistrodon contortrix contortrix	Southern Copperhead				
Agkistrodon piscivorus piscivorus	Eastern Cottonmouth				
Crotalus horridus	Timber Rattlesnake				

Scientific Name	Common Name	Status			Refuge Record
		Federal(2)	Alabama(3)	TNC(4)	
Sistrurus miliarius	Pigmy Rattlesnake				
Turtles					
Chelydra serpentina	Common Snapping Turtle				
Macroclemys temmincki	Alligator Snapping Turtle		SP, P2	S3	
Deirochelys reticularia reticularia	Eastern Chicken Turtle			S3	
Graptemys geographica	Map Turtle			S3	
Graptemys nigrinoda nigrinoda	Northern Black-knobbed Sawback		SP	S3	
Graptemys pulchra	Alabama Map Turtle		SP	S3	
Pseudemys concinna concinna	River Cooter				
Pseudemys scripta	Yellow-bellied/Red-eared Pond Slider intergradation				
Terrapene carolina	Eastern/Three-toed Box Turtle intergradation				
Kinosternon subrubrum subrubrum	Eastern Mud Turtle				
Sternotherus minor peltifer	Stripe-necked Musk Turtle				
Sternotherus odoratus	Common Musk Turtle				
Trionyx muticus calvatus	Gulf Coast Smooth Softshell				

Scientific Name	Common Name	Status			Refuge Record
		Federal(2)	Alabama(3)	TNC(4)	
Trionyx spiniferus asper	Gulf Coast Spiny Softshell				

(1) Mount, R.H. 1975. The Reptiles & Amphibians of Alabama. Auburn University/Agricultural Experiment Station. Auburn, AL.; Alabama Natural Heritage Program. 2006. Alabama Inventory List: the Rare, Threatened and Endangered Plants & Animals of Alabama. Privately printed by the Alabama Natural Heritage Program, 1500 East Fairview Avenue, Montgomery, AL: Alabama Department of Conservation and Natural Resources. 2005. Conserving Alabama's Wildlife: A Comprehensive Strategy.

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TABLE 5

Potential Mammals
Cahaba River NWR (1)

Common Name	Scientific Name	Status			Recorded on Refuge
		Federal (2)	Alabama (3)	NC (4)	
Virginia Opossum	*Didelphis virginiana*				
Southern Short-tailed Shrew	*Blarina carolinensis*				
Southeastern Shrew	*Sorex longirostris*				
Least Shrew	*Cryptotis parva*				
Southeastern Shrew	*Sorex longirostris*				
Eastern Mole	*Scalopus aquaticus*				
Gray Bat	*Myotis grisecens*	LE	SP, P1	S2	
Little Brown Myotis	*Myotis lucifugus*		P2	S3	
Southeastern Myotis	*Myotis austroriparius*		P2		
Northern Long-eared Bat	*Myotis septentrionalis*		P2	S2	
Indiana Bat	*Myotis sodalis*	LE	SP, P1	S2	

Common Name	Scientific Name	Status			Recorded on Refuge
		Federal (2)	Alabama (3)	NC (4)	
Eastern Red Bat	*Lasiurus borealis*				
Hoary Bat	*Lasiurus cinereus*				
Seminole Bat	*Lasiurus seminolus*				
Silver-haired Bat	*Lasionycteris noctivagans*				
Eastern Pipistrelle	*Pipistrellus subflavus*				
Big Brown Bat	*Eptesicus fuscus*				
Evening Bat	*Nycticeius humeralis*				
Rafinesque's Big-eared Bat	*Corynorhinus rafinesquii*		SP, P1	S2	
Brazilian Free-tailed Bat	*Tadarida brasiliensis*		P2	S3	
Nine-banded Armadillo	*Dayspus novemcinctus*				
Swamp Rabbit	*Sylvilagus aquaticus*				
Eastern Cottontail	*Sylvilagus floridanus*				
Eastern Chipmunk	*Tamias striatus*				
Woodchuck	*Marmota monax*				
Eastern Gray Squirrel	*Sciurus carolinensis*				
Eastern Fox Squirrel	*Sciurus niger*			S3	
Southern Flying Squirrel	*Glaucomys volans*				

Common Name	Scientific Name	Status			Recorded on Refuge
		Federal (2)	Alabama (3)	NC (4)	
American Beaver	*Castor canadensis*				
Marsh Rice Rat	*Oryzomys palustris*				
Eastern Harvest Mouse	*Reithrodontomys humulis*				
Cotton Mouse	*Peromyscus gossypinus*				
White-footed Mouse	*Peromyscus leucopus*				
Oldfield Mouse	*Peromyscus polionotus*				
Golden Mouse	*Ochrotomys nuttalli*				
Hispid Cotton Rat	*Sigmodon hispidus*				
Eastern Wood Rat	*Neotoma floridana*				
Woodland Vole	*Microtus pinetorum*				
Common Muskrat	*Ondatra zibethicus*				
Black Rat	*Rattus rattus*				
Norway Rat	*Rattus norvegicus*				
House Mouse	*Mus musculus*				
Coyote	*Canis latrans*				
Red Fox	*Vulpes vulpes*				

Common Name	Scientific Name	Status			Recorded on Refuge
		Federal (2)	Alabama (3)	NC (4)	
Common Gray Fox	*Urocyon cinereoargenteus*				
Northern Raccoon	*Procyon lotor*				
Long-tailed Weasel	*Mustela frenata*		SP, P2	S3	
American Mink	*Mustela vison*				
Northern River Otter	*Lontra canadensis*				
Eastern Spotted Skunk	*Spilogale putorius*		P2	S3	
Striped Skunk	*Mephitis mephitis*				
Eastern Spotted Skunk	*Spilogale putorius*				
Bobcat	*Lynx rufus*				
White-tailed Deer	*Odocoileus virginianus*				
Feral Swine	*Sus scrofa*				

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(2) E=Federally Listed Endangered, T=Federally Listed Threatened, C=Candidate for Federal Listing

(3) SP=State Protected (Alabama Nongame Species Regulation, Section 220-2-.92 of the Alabama Regulations for 2003-2004 Game, Fish, and Fur Bearing Animals), P1=Species of Highest Conservation Concern, P2=Species of High Conservation Concern (Conserving Alabama's Wildlife: A Comprehensive Strategy).

(4) Nature Conservancy Heritage Ranking system - S1=Critically imperiled in Alabama because of extreme rarity or because of some factors making it especially vulnerable to extirpation from Alabama, S2=Imperiled in state because of rarity or because of some factors making it very vulnerable to extirpation from Alabama, S3=Rare or uncommon in Alabama, S4=Demonstrably secure in Alabama and essentially ineradicable under present conditions,

TABLE 6

Historic Records (1)
Mussels and Snails
Cahaba River NWR

Scientific Name	Status			Collection Dates
	Federal(2)	State (3)	TNC (4)	
Snails				
Campeloma regulare				Cahaba River-1917
Lioplax cyclostomaformis	E	SP, P1	S1	Cahaba River-1916, 1917
Lepyrium showalteri	E	SP, P1	S1	Cahaba River-1916, Little Cahaba River-1916
Somatogyrus nanus			Possibly Extinct	Cahaba River-undated; Little Cahaba River-undated
Elimia ampla			S1	Cahaba River-1918, undated; Little Cahaba River-1978
Elimia annettae		P2	S1	Cahaba River-undated
Elimia cahawbensis			S3	Cahaba River-undated, 1918; Little Cahaba River-1916, 1978, undated; Unnamed Tributary Stream-1975

Scientific Name	Status			Collection Dates
	Federal(2)	State (3)	TNC (4)	
Elimia clara			S2	Cahaba River-undated
Elimia olivula			S1	Cahaba River-1918
Elimia pupoidea			Presumed Extinct	Cahaba River-1918
Elimia showalteri			S1	Cahaba River-1918, undated
Elimia varians		P2	S1	Cahaba River-1916
Elimia variata		P2	S1	Little Cahaba River-1978, undated
Leptoxis ampla	T	SP, P2		Little Cahaba River-1978
Leptoxis compacta			Presumed Extinct	Cahaba River-1916, undated
Ferrissa fragilis				Little Cahaba River-1978
Mussels				
Amblema plicata			S5	Cahaba River-1913
Ellipto arca		P1	S2	Cahaba River-1918
Ellipto arctata		P1	S2	Cahaba River-1916, 1918
Ellipto crassidens			S5	Cahaba River-1918
Epioblasma metastriata	E	Extinct/ Extirpated	Possibly Extinct	Cahaba River-1916

Scientific Name	Status			Collection Dates
	Federal(2)	State (3)	TNC (4)	
		SP		
Fusconaia cerina			S4	Cahaba River-1918
Fusconaia ebena			S5	Cahaba River-1916, 1918
Hamiota altilis	T	P2, SP	S2	Cahaba River-1916, 1918, 1935
Lampsilis ornata			S4	Cahaba River-1916
Lampsilis staminea				Cahaba River-1916, 1918
Lampsilis teres			S5	Cahaba River-1916, 1918
Leptodea fragilis			S5	Cahaba River-1916, 1918
Ligumia recta		P2	S2	Cahaba River-1918
Medionidus parvulus	E	Extinct/ Extirpated SP	Presumed Extirpated	Cahaba River-1916
Megalonaias nervosa			S5	Cahaba River-1916
Pleurobema decisum	E	P2, SP	S1	Cahaba River-1918
Pleurobema perovatum	E	P1, SP	S1	Cahaba River-1916, 1918
Pleurobema rubellum		P1	S1	Cahaba River-1916, 1918, undated
Potamilus purpuratus			S5	Cahaba River-1916, 1918
Ptychobranchus greenii	E	SP, P1	S1	Cahaba River-1915, 1916, 1918

Scientific Name	Status			Collection Dates
	Federal(2)	State (3)	TNC (4)	
Quadrula apiculata			S5	Cahaba River-1918
Quadrula asperata			S4	Cahaba River-1916
Quadrula verrucosa			S4	Cahaba River-1918
Strophitus subvexus				Cahaba River-1918
Toxolasma corvunculus		P1	S1	Cahaba River-1918
Villosa lienosa			S4	Cahaba River-1916, 1918, undated
Villosa vibex			S4	Cahaba River-1916

(1) Paul Johnson, personal communications (Interim draft of historical freshwater mussel and gastropod collections in the Cahaba River)

(2) E=Federally Listed Endangered, T=Federally Listed Threatened, C=Candidate for Federal Listing

(3) SP=State Protected (Alabama Nongame Species Regulation, Section 220-2-.92 of the Alabama Regulations for 2003-2004 Game, Fish, and Fur Bearing Animals), P1=Species of Highest Conservation Concern, P2=Species of High Conservation Concern (Conserving Alabama's Wildlife: A Comprehensive Strategy).

(4) Nature Conservancy Heritage Ranking system - S1=Critically imperiled in Alabama because of extreme rarity or because of some factors making it especially vulnerable to extirpation from Alabama, S2=Imperiled in state because of rarity or because of some factors making it very vulnerable to extirpation from Alabama, S3=Rare or uncommon in Alabama, S4=Demonstrably secure in Alabama and essentially ineradicable under present conditions, S5=Secure.

Table 7

Management Strategy Costs
Cahaba River NWR

GOAL	OBJECTIVE	COST ($)	PERCENTAGE		FREQUENCY INTERVAL
			SERVICE	CONTRACT	
G-1	P1	1,000	100		Annual
G-1	P2	2,000	100		Annual
G-1	P3	5,000	100		Annual
G-1	P4	3,000	100		Annual
G-2	P1	15,000	40	60	Annual
G-2	P2	20,000	66	34	Annual
G-2	P3 Yr1 Yr2-15	 10,000 2,000	 100 100		 One-time Annual
G-2	P4	2,000	100		Annual
G-3	P1	-	-		Ongoing
G-3	S1 Yr1 Yr2	 10,000 5,000	 100 100		 One-time One-time
G-4	P1	50,000 annual combined Goal 4	100		1,000 ac/year
G4	S1				1,000 ac/yr
G4	S2				1,000 ac yr
G-5	S1	40,000	90	10	Annual

GOAL	OBJECTIVE	COST ($)	PERCENTAGE		FREQUENCY INTERVAL
			SERVICE	CONTRACT	
G-5	S2	50,000	90	10	Annual
G-6	P1	2,000	100		Annual
G-7	P1	2,000	100		Annual
G-7	P2	16,000	100		Annual
G-7	P3	7,000	100		Annual
G-8	P1	18,000 22,000	60 80	40 20	One-time Annual
G-8	P2	10,000	100		Annual
G-8	P3	5,000	100		Annual
G-9	P1	8,000	88	12	Annual
G-9	P2	8,000	88	12	Annual
G-9	P3	4,000	100		Annual
G-10	P1	6,000	100		Annual
G-10	P2	5,000	100		Annual
G11	P1	12,000	60	40	Annual
G12	P1	27,000	25	75	Two Years
G12	S1	50,000	20	80	One-time
G12	S2	1,000,000		100	Funded by Abandoned Mine Lands Program

TABLE 8

Updated 2008

Management Accomplishment Targets
Cahaba River NWR

GOAL	OBJECTIVE	ACCOMPLISHMENT TARGET	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022
			YEAR														
			01	02	03	04	05	06	07	08	09	10	11	12	13	14	15
1-P1	Water quality Meetings	Participant/Annual	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■
1-P2	Biodiversity Center Partnership	Coordination Meeting/Annual	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■
1-P3	Adjacent Owner Partnerships	Contacts and Support/Annual	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■
1-P4	Univ of Alabama Partnership	Coordination Meeting/Annual	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■
2-P1	Restore Hydrological Environment	Establish Partnerships/Annual	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■
2-P2	River Road Environmental Control	Review of Conditions/Annual	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■
2-P3	Prepare for Highway Spills	Establish and Inspect Spill Box	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■
2-P4	USGS Monitoring Station	Status Review/ Annual	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■
3-P1	Forest Mapping	Alabama Natural Heritage Program															
3-P2	Forest Stand Condition Mapping	Prescription Map			■	■	■	■	■	■	■	■	■	■	■	■	■
4-P1	Dormant Season Prescribed Burns	Annual 2-3 year cycle	■	■	■	■	■	■	■	■	■						
4-P2	Growing Season Prescribed Burns	Annual 3 year cycle										■	■	■	■	■	■
4-P3	Maintenance Prescribed Burns	Annual															
5-S1	Forest Structure Restoration	Min. 50 ac/Annual					■	■	■	■	■	■	■	■	■	■	■
5-S2	Forest Replanting	Min. 20 ac/Annual					■	■	■	■	■	■	■	■	■	■	■

■ Implementation Year

GOAL	OBJECTIVE	ACCOMPLISHMENT TARGET	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022
			YEAR														
			01	02	03	04	05	06	07	08	09	10	11	12	13	14	15
6-P1	Prescribed Fire Monitoring	Photo Plots/Annual	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■
7-P1	Landscape Strategies	Meeting/Annual			■	■	■	■	■	■	■	■	■	■	■	■	■
7-P2	Restore Forest Openings	Min. 20 ac/Annual			■	■	■	■	■	■	■	■	■	■	■	■	■
7-P3	Biotic Monitoring	Avian Point Counts/Annual		■	■	■	■	■	■	■	■	■	■	■	■	■	■
8-P1	Biological Inventories	Report/Annual			■	■	■	■	■	■	■	■	■	■	■	■	■
8-P2	Significant Biological Communities	Report/Annual	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■
8-P3	Participate in Recovery	Report/Annual			■	■	■	■	■	■	■	■	■	■	■	■	■
9-P1	Control Kudzu	Min. 20 ac/Annual				■	■	■	■	■	■	■	■	■	■	■	■
9-P2	Control Privet	Min. 20 ac/Annual				■	■	■	■	■	■	■	■	■	■	■	■
9-P3	Control Mimosa	1/4 mile of Shoreline/Annual				■	■	■	■	■	■	■	■	■	■	■	■
10-P1	Continue Hunting Program	State Meeting/Annual	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■
10-P2	Native Wildlife Improvement	Report/Annual			■	■	■	■	■	■	■	■	■	■	■	■	■
11-P1	Firebreak Maintenance	5 Miles/Annual			■	■	■	■	■	■	■	■	■	■	■	■	■
12-P1	Environmental Characterization	Report/Annual			■	■											
12-S1	Restoration Plan	Report/Annual					■										
12-S2	Piper Mine Restoration	Report/Annual						■	■	■	■	■	■	■	■	■	■

■ Implementation Year

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