Appendix A. Environmental Assessment

Ozark Plateau National Wildlife Refuge Comprehensive Conservation Plan

Caving equipment at Ozark Plateau NWR. (Credit: Richard Stark, 2009)

Prepared by

Sarah Catchot
U.S. Fish and Wildlife Service Region 2, Division of Planning
Albuquerque, NM

Steve Hensley
Ozark Plateau National Wildlife Refuge
Tulsa, OK

Shea Hammond
Ozark Plateau National Wildlife Refuge
Colcord, OK

Richard Stark
Oklahoma Ecological Services Field Office
Tulsa, OK

APPENDIX A: ENVIRONMENTAL ASSESSMENT (EA)

CHAPTER 1: INTRODUCTION AND SCOPING ISSUES OF EA A-1

1.1 Introduction A-1

1.1 Location A-1
Figure A-1. Ozark Plateau NWR within proximity to urban and tribal populations. A-3

1.3 Background A-4

1.4 Purpose A-5

1.5 Need for Action A-7

1.6 Decision to be Made A-7

1.7 Regulatory Compliance A-8

1.8 Stakeholder Involvement and Issues Identified A-9
Table A-1. Location, Attendance, and Dates of Public Scoping Meetings. A-9
1.8.1 Landscape-level Issues A-10
Figure A-2. Cave management coordination opportunities at the landscape-level. A-14
1.8.2 Habitat Management Issues A-15
1.8.3 Wildlife Management Issues A-17
1.8.4 Public Use Opportunities Issues A-22
1.8.5 Cultural Resources Issues A-24
1.8.6 Facilities & Infrastructure Issues A-24
Table A-2. Refuge Boundary Assessment A-27
1.8.7 Refuge Administration Issues A-27

CHAPTER 2: MANAGEMENT ALTERNATIVES OF EA A-27

2.1 Formulation of Alternatives A-27

2.2 Alternatives Considered But Dismissed From Detailed Analysis A-28

2.3 Alternative A – No Action (Current Management) A-30
2.3.1 Current Landscape-level Management A-30
Table A-3. Species surveys completed on Ozark Plateau NWR until 2012. ..... A-32
2.3.2 Current Habitat Management A-35
2.3.3 Current Wildlife Management A-37
2.3.4 Current Public Use Management A-39
2.3.5 Current Cultural Resource Management A-40
2.3.6 Current Facilities & Infrastructure Management A-41
Table A-4. 2012 Refuge Boundary Assessment A-42
2.3.7 Current Refuge Administration A-42

2.4 Alternative B – Proposed Action (Proposed Future Management) **A-44**
2.4.1 Proposed Landscape-level Management A-44
2.4.2 Proposed Habitat Management A-48
2.4.3 Proposed Wildlife Management A-51
2.4.4 Proposed Public Use Management A-54
2.4.5 Proposed Cultural Resource Management A-57
2.4.6 Proposed Facilities & Infrastructure Management A-57
Figure A-2. Current and proposed infrastructure and trails on Looney Unit. A-59
Figure A-3. Zoomed-in view of MMLERC and surrounding current and proposed infrastructure. A-60
2.4.7 Proposed Refuge Administration A-62

2.5 Comparison of Alternatives **A-64**
Table A-5. Summary of Management Alternatives. A-64

CHAPTER 3: AFFECTED ENVIRONMENT OF EA **A-71**

CHAPTER 4: ENVIRONMENTAL CONSEQUENCES AND BENEFITS OF EA **A-71**

4.1 Definition of Terms **A-73**

4.2 Analysis of Impacts to Resource(s) **A-74**

4.2.1 Impacts to Physical Environment **A-74**
4.2.1.1 Climate Change A-74
Table A-6. CO2 Emissions from work-travel in FY2011. ..... A-75
4.2.1.2 Impacts on Air Quality A-79
4.2.1.3 Impacts on Water Quality and Quantity A-81
4.2.1.4 Impacts on Soils A-84

4.2.2 Impacts to Biological Environment **A-88**
4.2.2.1 Impacts on Subterranean Cave Habitat A-88
4.2.2.2 Impacts on Forest and Riparian Habitats A-91
4.2.2.3 Impacts on Wildlife: Cave Species (T&E, Species of Concern, and Non-T&E) A-99
4.2.2.4 Impacts on Wildlife: Resident or Migratory Species A-102

4.2.3 Impacts to the Human Environment **A-106**
4.2.3.1 Impacts to Cultural Resources A-106
4.2.3.2 Impacts on Local Population and/or Economy A-107
4.2.3.3 Impacts on Aesthetic and/or Visual Resources A-108
4.2.3.4 Impacts on Public Use Opportunities and/or Access A-109

4.3 Assessment of Cumulative Impacts **A-110**

4.3.1 Cumulative Impacts to Physical Resources **A-111**
4.3.1.1 Cumulative Impacts of and to Climate Change A-111
4.3.1.2 Cumulative Impacts to Air Quality A-112
4.3.1.3 Cumulative Impacts to Water Quality and Quantity A-113
4.3.1.4 Cumulative Impacts to Soils A-114

4.3.2 Cumulative Impacts to Biological Resources A-115
4.3.2.1 Cumulative Impacts to Vegetation/Habitats..... A-115
4.3.2.2 Cumulative Impacts to Wildlife..... A-116

4.3.3 Cumulative Impacts to the Socio-Economic Environment A-118
4.3.3.1 Cumulative Impacts to Cultural Resources..... A-118
4.3.3.2 Cumulative Impacts to Local Population/Economy..... A-118
4.3.3.3 Cumulative Impacts to Aesthetic/Visual Resources..... A-118
4.3.3.4 Cumulative Impacts to Public Use Opportunities/Access A-119

4.4 Comparison of Resource Impacts by Alternative A-120
Table A-7. Summary of Impacts by Environmental and Social Resources..... A-120

4.5 Short-Term Uses versus Long-Term Productivity A-125

4.6 Irreversible and Irretrievable Commitment of Resources..... A-125

4.7 Environmental Justice..... A-125

4.8 Indian Trust Assets..... A-126

CHAPTER 5: EA CONSULTATION, COORDINATION, AND DOCUMENT PREPARATION A-127

5.1 Document prepared by: A-127

5.2 Agencies and individuals consulted in the preparation of this document: A-127

5.3 References A-127

Chapter 1: Introduction and Scoping Issues of EA

1.1 Introduction

The United States Fish and Wildlife Service (Service) proposes to implement a Comprehensive Conservation Plan (CCP) for the Ozark Plateau National Wildlife Refuge (NWR), which will guide Refuge management direction for the next 15 years. This CCP includes a clear vision, goals, and objectives that will help the Refuge achieve its purposes of establishment. This Environmental Assessment (EA) is being prepared to evaluate the effects associated with this proposal and complies with the National Environmental Policy Act (NEPA) in accordance with Council on Environmental Quality regulations (40 CFR 1500-1509) and Department of the Interior (516 DM 8) and Service (550 FW 3) policies (see Section 1.7 for a list of additional regulations that this EA complies with). NEPA requires examination of the effects of proposed actions on the natural and human environment. In the following chapters, we describe two alternatives for future Refuge management, the environmental consequences of each alternative, and our proposed management direction. Each alternative was designed to contain a reasonable combination of fish and wildlife habitat prescriptions and wildlife-dependent recreational opportunities consistent with the Refuge System Improvement Act and specific Refuge purposes.

The environmental benefits and consequences of each alternative are described below and form the basis for selection of the proposed action (Alternative B). This Environmental Assessment was designed to cover NEPA compliance for the environmental benefits and consequences for most future management actions and current facilities on the Ozark Plateau National Wildlife Refuge. However, some future actions that are not described site-specifically or in sufficient detail below may require further NEPA documentation.

1.1 Location

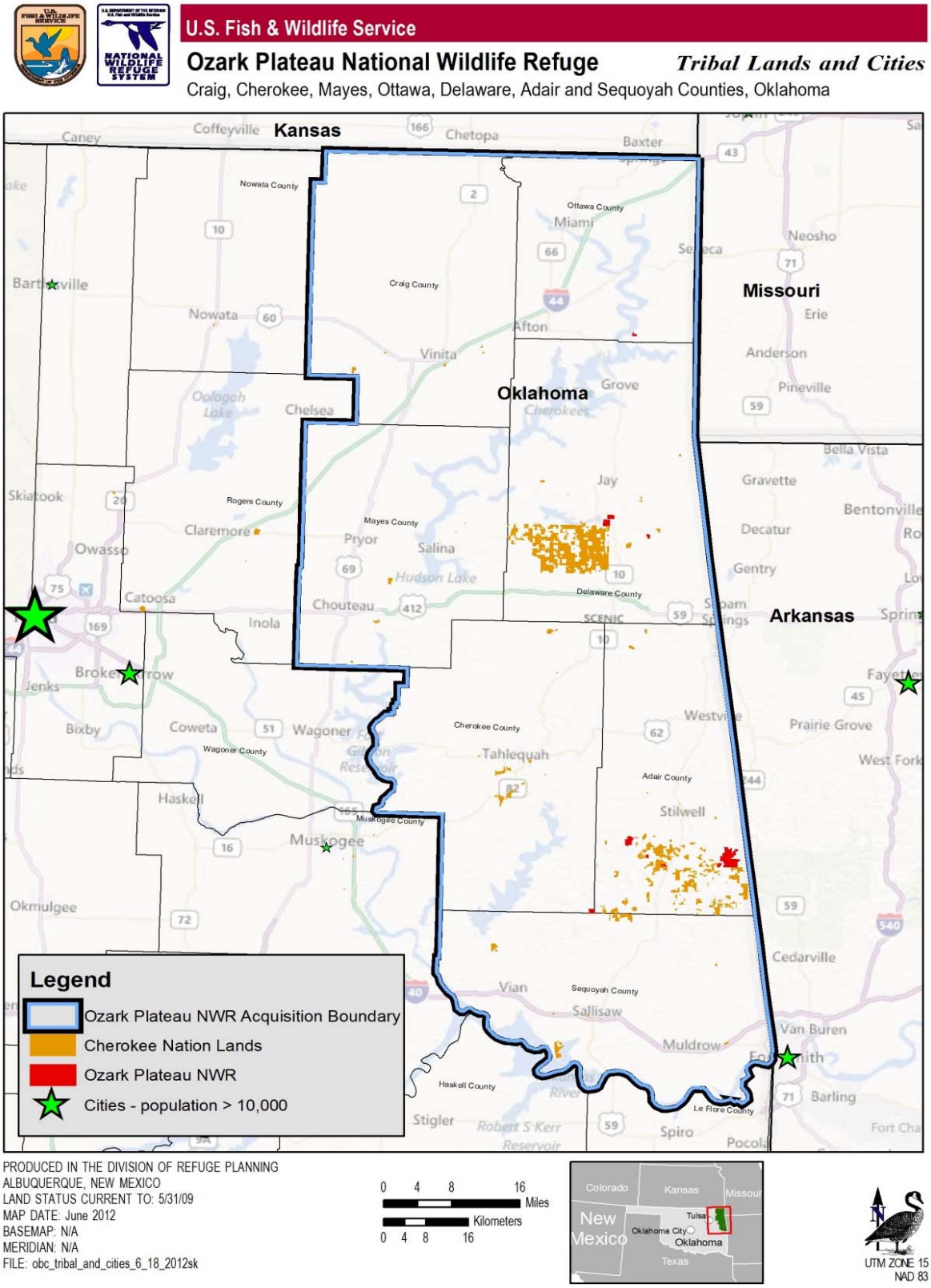
Ozark Plateau NWR lies in northeastern Oklahoma, within an approved seven-county acquisition boundary of up to 15,000 acres of land within Sequoyah, Adair, Cherokee, Mayes, Delaware, Craig, and Ottawa Counties. There are currently nine units managed by the Refuge within this boundary including the Beck (Krause), Boy Scout, Gittin Down Mountain, Lake Eucha, Liver, Mary and Murray Looney (Looney), Mutt Potter (Potter), Sally Bull Hollow, and Varmint Units; however, as lands are acquired over the lifetime of this CCP, the number of management units will increase. (See Chapter 1 of the CCP, Figure 1-1, for *Map of Ozark Plateau NWR Management Units and Acquisition Boundary*).

The seven-county area is located within Bailey's Oak-Hickory Forest Ecoregion in eastern Oklahoma along the southwest edge of Omernik's Ozark Plateau and Boston Mountains near the Arkansas border (Bailey, 1989) (Omernik, 1987). The area is in a region of karst topography, eroded to form steep hills, incised valleys, and prominent bluffs. Much of the drainage is underground resulting in a number of caves and springs. In addition, the clear rocky bottom streams, ground water recharge areas, wetlands, and large continuous stands of oak-hickory forest, support a diverse array of vertebrate and invertebrate species that not only are endemic to the Ozark Plateau, but are sometimes unique to each cave or spring because of their isolation from one another. Because cave and spring ecosystems often develop their own endemic species complements, it is possible that numerous undescribed and uncatalogued fauna may exist in the recently discovered, or yet undiscovered, caves. For example, three new species of insects have recently been identified from one Refuge cave. These caves also provide habitat for three federally listed endangered bat species and one threatened cavefish species. The forested areas surrounding the caves are also important for bat foraging as well as for breeding and migrating Neotropical birds that need unfragmented tracts of forest to support their basic needs for food, water, and cover.

Typical topography of the Ozark Plateau NWR.
(Credit: Shea Hammond)

According to the 2010 Census Bureau, the seven-county acquisition boundary area has a total population of 241,684 people (61,794 or 26% of which are Native American), and accounts for 6.4% of Oklahoma's total population. Within 20 miles of Mayes County lies the city of Tulsa, Oklahoma, which has the largest population in the surrounding area of approximately 600,000 (Census Bureau, 2010).

Figure A-1. Ozark Plateau NWR within proximity to urban and tribal populations.



1.3 Background

Ozark Plateau NWR was established April 1, 1986 by a joint effort of a number of partners including private landowners, private conservation and caving organizations, universities, tribes, and state and federal conservation agencies primarily to protect and recover federally listed cave species. Over the past 20 years, these partners have been instrumental in developing and managing the Refuge. Ozark Plateau NWR is a prime example of the need to implement Strategic Habitat Conservation on a landscape level in order to achieve the Refuge's purpose(s) of establishment (see Section 1.4).

Ozark Plateau NWR presently consists of nine management units, totaling 4,093 acres, in four counties in the Ozarks of eastern Oklahoma near the borders of four states (Arkansas, Kansas, Missouri, and Oklahoma) and four Service Regions (2, 3, 4, and 6). Political boundaries mean little to the trust fish and wildlife resources that Ozark Plateau NWR was established to protect and manage, so it is extremely important that the Refuge operate on a landscape-level across state and regional boundaries.

On February 9, 2005, the Service approved the Ozark Plateau NWR's NEPA and planning documents including an Environmental Assessment, Land Protection Plan, and Conceptual Management Plan to expand the Refuge. The Refuge was approved to acquire additional land or easements from willing sellers and donors, of up to 15,000 acres in Adair, Delaware, Ottawa, Cherokee, Craig, Mayes, and Sequoyah Counties, Oklahoma.

The area encompasses the known distribution of the federally listed endangered Ozark big-eared bat (*Corynorhinus townsendii ingens*), gray bat (*Myotis grisescens*), and threatened Ozark cavefish (*Amblyopsis rosae*) and a portion of the endangered Indiana bat (*Myotis sodalis*) range in eastern Oklahoma and the Service's Southwest Region (Region 2). In addition, two federal species of concern - Oklahoma cave crayfish (*Cambarus tartarus*) and Delaware County cave crayfish (*Cambarus subterraneus*) - use caves in the area. Essential caves, movement corridors, and foraging habitat for the bats and ground water recharge areas supplying water to the aquifers used by the cavefish and cave crayfish are found in the Ozark Plateau NWR's seven counties approved acquisition area as well as across nearby State and Service regional boundaries. This is reflected in Ozark Plateau NWR's project goals of implementing a landscape approach for protection of habitats for a number of Service trust resources and the natural biological diversity in the Ozarks.

Existing Refuge units and the approved acquisition area occurs within the known range of American burying beetle (*Nicrophorus americanus*), a federally listed endangered species. Surveys specifically targeting this species on the Refuge have not occurred. However, the results of all presence/absence surveys conducted in close proximity to existing Refuge units (i.e., within 5 miles) have been negative and suggest that occurrence on the Refuge also is unlikely.

The American burying beetle likely does not occur on Refuge tracts or occurs in very low abundance due to the rocky soils and karst topography (i.e., thin soils over bedrock) of these areas.

Bald eagles (*Haliaeetus leucocephalus*) now have been delisted from federally endangered due to recovery and are found on the Refuge in northeastern Oklahoma because of the abundant rivers and reservoirs. The longnose darter (*Percina nasuta*), a federal species of concern, is found in one stream in the area (Lee Creek). Other federal species of concern found in the area include the eastern small-footed bat (*Myotis leibii*), the southeastern big-eared bat (*Corynorhinus rafinesquii*), the southeastern bat (*Myotis austroriparius*), the bat cave isopod (*Caecidotea macropoda*), the Bowman's cave amphipod (*Stygobromus bowmani*), the Ozark cave amphipod (*Stygobromus ozarkensis*), and Ozark chinquapin (*Castanea pumila var. ozarkensis*).

1.4 Purpose

The purpose of developing the CCP for Ozark Plateau National Wildlife Refuge is not only to comply with the Refuge Improvement Act of 1997, but to have a well-developed plan that will guide management so that the Refuge can best achieve its purpose(s) of establishment, vision, and goals (see below) as well as contribute to the mission of the National Wildlife Refuge System (see Chapter 1, Section 1.3.1) ; adhere to relevant Service policies and mandates (see Chapter 1, Section 1.3.2.1); address key conservation and public issues (see Chapter 2, Section 2.3); and incorporate sound principles of fish and wildlife science.

Ozark Plateau NWR Purpose(s) of Establishment:

- Assure the continuing existence, and aid in recovery of federally listed endangered and threatened Ozark cave species;
- Reduce the need for future listing of species of concern in the Ozarks;
- Protect large continuous stands of Ozark forest essential to migratory interior forest birds; and
- Provide important environmental educational opportunities identifying the need for protecting fish and wildlife and other karst resources of the Ozarks.

Ozark Plateau NWR Vision:
(See page *i* of the CCP).

Ozark Plateau NWR Goals:

Goal 1: Landscape-level Context

Collaborate with multiple partners to implement Strategic Habitat Conservation on a landscape-level in order to prevent extinction and recover federally listed threatened and endangered Ozark cave species as well as prevent the need for listing other Ozark species of concern.

Goal 2: Wildlife Habitat & Population Management

Protect, enhance, conserve and restore Ozark natural caves, springs, streams, aquifers, wetlands, watersheds, forests, and groundwater recharge areas to prevent extinction and recover federally listed cave species as well as prevent the need for listing other native species including migratory birds and other species of concern in the Ozarks to promote natural species diversity on a landscape-level.

Goal 3: Visitor Services

Provide safe, high quality, compatible, wildlife dependent use opportunities for visitors, students, and nearby residents, to give them an understanding of the importance and value of Ozark cave, spring, aquifer, stream, wetland, watershed, groundwater recharge areas, and forest wildlife habitat conservation efforts.

Goal 4. Refuge Infrastructure & Administration

Provide administrative support and appropriate facilities required to ensure that Refuge goals and objectives are met through effective landscape conservation management of Ozark habitats, fish and wildlife, and visitor services and for the primary purpose of preventing extinction and recovering federally listed threatened and endangered Ozark cave species.

As NEPA requires, this CCP/EA evaluates reasonable management alternatives and describes their anticipatable impacts on the physical, biological, socioeconomic, cultural, and environments in the project area. We designed each alternative with the potential to be fully developed into a Final CCP.

Developing a CCP is vital for the future management of every national wildlife refuge. The purpose of this CCP is to provide strategic management direction for the next 15 years by:

- providing a clear statement of desired future conditions for habitat, wildlife, visitor services, staffing, and facilities;
- providing state agencies, refuge neighbors, visitors, and partners with a clear understanding for the reasons for management actions;
- ensuring Refuge management reflects the policies and goals of the Refuge System and legal mandates;

- ensuring the compatibility of current and future public use;
- providing long-term continuity and direction for Refuge management; and,
- providing direction for staffing, operations, maintenance, and annual budget requests

The purpose of the EA is to evaluate current issues, determine management alternatives that will address these issues, and understand the benefits and/or consequences of each action in order for management to make wise and informed decisions. The Refuge is considering the proposed action because it best achieves the Refuge's purposes, vision and goals; contributes to the mission of the National Wildlife Refuge System; is consistent with principles of sound fish and wildlife management; and addresses relevant mandates as well as major issues during public scoping. The proposed management direction is well laid-out through a set of goals, objectives, and strategies in Chapter 4 of the CCP.

1.5 Need for Action

There are several reasons why we need this CCP. Foremost, the action is needed to satisfy the legislative mandates of the National Wildlife Refuge System Improvement Act of 1997, which requires the preparation of a CCP for all national wildlife refuges in the United States. More importantly, long-term management direction does not currently exist for the Refuge. Management is now guided by various general policies, short-term, program-specific plans or other outdated plans that do not reflect current conditions, present management issues, or recent scientific knowledge. The development of this CCP is important because it gives the Refuge an opportunity to take a comprehensive look at challenges and solutions to all its management actions including working with partners on a landscape-level, habitat management, wildlife management, visitor services and uses, infrastructure, and staffing and funding needs. In order to successfully implement Strategic Habitat Conservation to benefit Ozark habitats, wildlife including various threatened and endangered cave species, and local communities, Ozark Plateau NWR needs a Comprehensive Conservation Plan to guide present and future efforts in the right direction.

1.6 Decision to be Made

The Regional Director for the Southwest Region (Region 2 of the U.S. Fish and Wildlife Service) will make two decisions based on this EA: (1) select which alternative the Refuge will implement, and (2) determine if the selected alternative is a major federal action significantly affecting the quality of the human environment, thus requiring preparation of an Environmental Impact Statement (EIS), or whether implementation of the Proposed Action can proceed. The planning team has recommended Alternative B to the Regional Director. Assuming no significant impact is found, the Final CCP will include a Finding of No Significant Impact (FONSI) statement explaining why the selected alternative will not have a significant effect on

the quality of the human environment. This determination takes into consideration the Service and Refuge System mission, the purpose(s) for which the Refuge was established, and other legal mandates. Once the FONSI is signed, the CCP will be implemented, monitored annually, and revised when necessary.

1.7 Regulatory Compliance

National wildlife refuges are guided by the mission and goals of the National Wildlife Refuge System (NWRS), the purposes of an individual refuge, Service policy, and laws and international treaties. Relevant guidance includes the National Wildlife Refuge System Administration Act of 1966, as amended by the National Wildlife Refuge System Improvement Act of 1997, Refuge Recreation Act of 1962, and selected portions of the Code of Federal Regulations and Fish and Wildlife Service Manual.

The CCP's overriding consideration is to carry out the purpose for which the Refuge was established (see Section 1.4). Refuge purposes are stated in the laws that established the Refuge and provided the funds for acquisition. Fish and wildlife management is the first priority in refuge management, and the Service allows and encourages public use (wildlife-dependent recreation) as long as it is compatible with, or does not detract from, Refuge purposes.

This EA was prepared by the Service and represents compliance with applicable Federal statutes, regulations, Executive Orders, and other compliance documents. Appendix G of the CCP contains a list of the key laws, orders and regulations that provide a framework for the proposed action.

Further, this EA reflects compliance with applicable State of Oklahoma and local regulations, statutes, policies, and standards for conserving the environment and environmental resources such as water and air quality, endangered plants and animals, and cultural resources. An ESA Section 7 Consultation would be completed for inclusion in the CCP (see Appendix F).

Comprehensive Conservation Plans include a review of the appropriateness and compatibility of existing refuge uses and of any planned future public uses. If a use is determined to be an 'Appropriate Refuge Use' by a refuge manager, it is then taken through the 'Compatibility Determination' process. Compatibility determinations (CDs) have been completed for the following activities and are provided in Appendix B of the CCP. For more information on Appropriate Refuge Uses and Compatibility Determinations, including a list of currently approved CDs, see Chapter 5, Section 5.3.2 of the CCP.

1.8 Stakeholder Involvement and Issues Identified

In accordance with Service guidelines and NEPA recommendations, public involvement has been a crucial factor throughout the development of the Draft CCP and EA. The formal planning process began with the scoping period, which involves a thorough assessment of issues, concerns, opinions, thoughts, ideas, concepts, and visions for the Refuge.

Formal scoping began with publication of a notice of intent to prepare a CCP and EA, which was published in the Federal Register on June 19, 1998 (Volume 63, Number 118, pp. 33693-33694). After *Planning Update #1* (a newsletter and issues workbook) was published in November 2009, three public open house scoping meetings were held in December 2009, as advertised in the update and local newspapers (see Table A-1). The first meeting was held in the central part of the Refuge boundary expansion area, in Tahlequah, Oklahoma, at the Cherokee Nation Tribal Headquarters building, from 6:30 to 8:00pm on December 1st. The second meeting was held the following evening near the southern units of the Refuge in Stilwell, from 6:30 to 8:00pm. The third meeting was held near the northern units in Jay at the Delaware County Library also from 6:30 to 8:00pm on December 8th. Comments were accepted through January 4, 2010.

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

Community Center	Attendance	Meeting Date
Tahlequah: Tribal Headquarters, Cherokee Nation of Oklahoma	17	Tuesday, December 1, 2009
Stilwell: Senior Center	9	Thursday, December 3, 2009
Jay: Delaware County Library	9	Tuesday, December 8, 2009

The *Planning Update #1* was also sent to the Oklahoma Department of Wildlife Conservation (ODWC) as well as seven Native American Tribes on October 27, 2009. Both the State and all affected tribes were invited to meet one-on-one with the Refuge. After attending one of the three public open house meetings, the Cherokee Nation Environmental Protection Commission indicated a desire to meet bilaterally with the Planning Team and a meeting was held at the Cherokee Nation Headquarters and Administration complex on March 3, 2010 to review issues and preliminary alternatives concerning the tribe's perspective. The following day, the core planning team met with ODWC staff at the Porter Office in Oklahoma on March 4, 2010, also to review issues and preliminary alternatives concerning the State's perspective.

Collectively, all stakeholders expressed a wide range of issues, concerns, and opportunities during the planning process, and the alternative selected for analysis reflect all of the issues, concerns, and opportunities expressed by the planning participants. These issues and concerns provided the basis for developing the Refuge's management direction and played a role in

determining desired conditions for the Refuge. The following issues, concerns, and opportunities were consolidated into the following broad categories: landscape-level, habitat management, wildlife management, public use opportunities, cultural resources, facilities & infrastructure, and administration. These issues are also explained in Chapter 2 of the CCP.

Issues identified during Scoping

1.8.1 Landscape-level Issues

Ozark Habitat Loss & Fragmentation
Some timber harvesting in the region involves the clearing of forested areas and converts them to cattle and other agricultural uses, resulting in the loss of mature tree forests, increasing understory growth, increasing water runoff, and decreasing groundwater recharge. Mining operations near the Refuge remove trees and reduce habitat for bat foraging and other species. Current and projected agricultural uses on the landscape result in a patchwork mosaic of open rangelands, further fragmenting the Ozark forests. The region is also experiencing increasing road and right-of-way construction and other infrastructure development.

The construction of reservoirs over the years has resulted in the loss of some Ozark caves and riparian forests in the ecoregion. Some caves near the reservoirs are flooded periodically, depending on rainfall and lake levels because of hydropower generation and flood control operations, making them inaccessible and uninhabitable by bats. Land acquisition could prevent similar negative effects from occurring in the future.

Ozark habitat loss and fragmentation due to development and encroachment was the primary concern among the public, the State, tribal members, and Refuge staff during scoping. Many suggested that maintaining or improving relationships with surrounding landowners and tribes could help counteract this issue - through communication and agreements to cooperatively perform sustainable land management practices for habitat and wildlife conservation in the Ozarks. The State also recommended that the Refuge look into acquiring as much land as possible (in fee title, easements, or other means) before land prices increase again.

Climate Change
Data provided by Climate Wizard (www.climatewizard.org, accessed June 2010) indicates that within the area of the Refuge the temperature is expected to warm by about 5 degrees F, while moisture is anticipated to decrease between now and 2050. Changes in climate in and around caves may affect their suitability for different bat species (Newson et al., 2009). Changes in temperature and rainfall patterns may affect both the timing and the availability of insect prey for bats (Newson et al., 2009). It has also been observed on the Refuge that there are temporal variations on migration and birthing of Ozark big-eared bats and gray bats, however, more literature is needed to document this. Warmer and drier conditions may affect surface and

groundwater availability, fire regimes, and shift hardwood forests north and produce more woodland savannah conditions within the Refuge acquisition area. Because of the unprecedented scope of affected landscapes, the Service must work together with other private landowner partners, local state, tribal, and federal governments, and Landscape Conservation Cooperatives (LCCs) to develop landscape-level strategies for understanding and responding to climate change impacts.

The Refuge and the public would like to know more about how climate change is affecting the Ozark Plateau's habitats and species (currently and in the future). Monitoring climate change in relation to habitat and wildlife changes could be useful so that the Refuge may best adapt management appropriately for the benefit of Ozark resources.

Surface and Groundwater Quality & Quantity

In the northern part of the Refuge acquisition area, abandoned lead and zinc mines including the Tri-State Superfund Site (the former Tar Creek Superfund Site expanded to include areas in Oklahoma, Missouri, and Kansas), have contaminated surface and groundwater resources. Increasing deforestation and conversion to urban and agricultural land uses in the region is also increasing the volume of water run-off and decreasing the capability of the watershed to filter this run-off. Unfiltered water contains a higher volume of both contaminants and nutrients, such as nitrogen, phosphorus, metals, pesticides, pharmaceuticals, and plasticizers.

Habitat degradation and pollution due to these agricultural and mining activities and development pose serious risks not only to the groundwater quality but are primary threats to aquatic cave fauna such as the threatened Ozark cavefish (Crunkilton, 1984; Culver et al, 2000; Graening and Brown, 2003; USFWS, 2010). The karst environments (i.e.an area of limestone that is marked by caves, sinkholes, springs, and other features and that has special drainage characteristics due to limestone's greater solubility) in which the cavefish occur, are highly vulnerable to groundwater pollution. Contaminated surface water can enter the groundwater systems rapidly in karst areas as it passes through sinkholes and cracks and crevices in the ground surface, losing streams (i.e. a stream with a bed that allows water to flow directly to the groundwater system), or fractured limestone under thin layers of permeable soils. These karst features provide for only minimal natural filtration processes. Once underground, the subterranean network of caves and conduits also allow for additional rapid water movement. Groundwater in karst areas can travel as quickly as a few thousand feet to over a mile per day. Degradation of sensitive, underground habitats used by the cavefish can, therefore, occur rapidly. These characteristics of karst ecosystems make the underground environment relatively fragile and highly susceptible to disturbances (Green et al. 2006).

In addition, the quantity of surface and groundwater of the aquifer surrounding the Refuge is being affected by agriculture and increasing urbanization. These wet karst environments that

provide habitat for cavefish and cave crayfish dwell in the same groundwater tapped by wells for local water supply. Spavinaw Creek Basin provides the water supply for the City of Tulsa. Impervious surfaces and man-made drainage systems are preventing surface water to seep through the ground and recharge the aquifer in the natural manner that it used to. There has also been an increase in water consumption due to an increasing population in growing urban areas nearby. These contributing factors are lowering surface and groundwater levels, which consequently affect subterranean and aquatic habitats and their respective species on the Refuge and surrounding areas.

The public, the State, tribal members, and the Refuge expressed high concerns regarding the degradation of surface and groundwater quality. One representative of the Seneca-Cayuga Tribe of Oklahoma stated that the "tribe's livelihood is tied to Grand Lake and that water quality and maintaining healthy wetlands is crucial to their former reservation lands".

White-nose Syndrome

Conservation organizations, the State of Oklahoma, Tribal Nations, the Refuge, and other federal agencies are extremely concerned with White-nose syndrome (WNS), a disease caused by the fungus *Geomyces destructans*, which is responsible for unprecedented mortality in cave-hibernating bats in the northeastern and central U.S and eastern Canada (Lorch et al, 2011). This previously unknown disease has spread very rapidly since its discovery in January 2007, and poses a considerable threat to cave-hibernating bats throughout North America. More than 5 million hibernating bats have died since 2007 (Froschauer, 2012). Biologists with state and federal agencies and organizations across the country are still trying to figure out how to minimize the spread and impacts of the disease and recover impacted populations. To date, seven bat species are known to be affected by the disease: the little brown bat *M. lucifugus*, eastern small-footed bat *M. leibii*, Indiana bat *M. sodalis*, northern long-eared bat *M. septentrionalis*, big brown bat *Eptesicus fuscus*, grat bat *M. grisescens*, and the tri-colored bat *Perimyotis subflavus*. Four of these species, the northern long-eared, big brown, gray, and tri-colored bat occur on the Refuge. Although the fungus *Geomyces destructans* was found on a cave *myotis* in northwestern Oklahoma in 2010, the disease WNS has not yet been documented on the Refuge. However, scientists predict that WNS will continue to spread, making it even more critical to address the issue in the future management direction.

Wind Energy Farms

The Refuge is concerned about the impacts of wind energy farms on migration routes because they cause mortality in migratory bird and bat species due to direct strikes and barotrauma from turbine blades (Johnson et al, 2002). Energy farms also increase habitat fragmentation with the construction of large fields of turbine towers and the networks of connecting power line infrastructure. These wind energy farms could be placed astride bat and bird migration corridors.

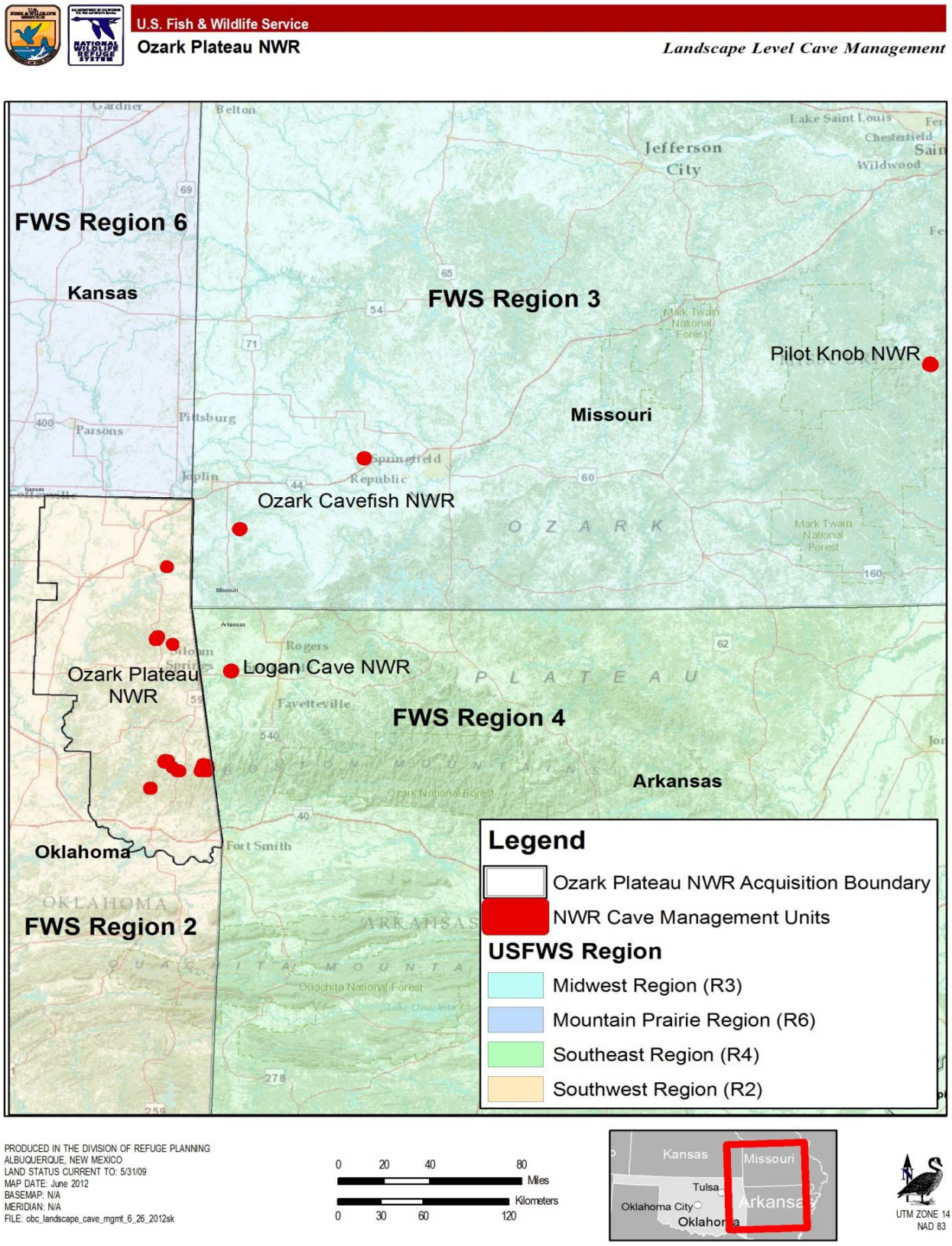
Knowledge of specific migratory routes would be beneficial during early planning stages of development projects in order to minimize the impacts to migratory species.

Coordinate Beyond Service Regional Boundaries to More Effectively Manage Federally Listed Cave Species on a Landscape Level

Ozark Plateau NWR has a unique conservation location because the Refuge lies in northeast Oklahoma amidst surrounding state borders of Missouri, Arkansas, and Kansas, which correspond to the Service Regions 2, 3, 4, and 6 (see Figure A-2). The distribution of the federally listed threatened and endangered Ozark cave species (Ozark big-eared bat, gray bat, Indiana bat, and Ozark cavefish) that Ozark Plateau NWR was established to protect and recover, cross several State and Service regional boundaries. Steps have been made within its own Region (2) to implement Strategic Habitat Conservation. Aside from building and maintaining strong partnerships across the landscape-level with various landowners, conservation organizations, cities, universities, state, tribal and other federal agencies, in 2005, Ozark Plateau NWR was authorized to expand its acquisition area from about 3,000 acres up to 15,000 acres in seven counties in northeast Oklahoma of Service Region 2. These partnerships and acquisition of land and conservation easements from willing sellers has lead the Refuge one step further in accomplishing conservation objectives. However, to fully implement the recovery tasks of protecting essential habitat as identified in the recovery plans for the Ozark big-eared bat (1995), gray bat (1982), Indiana bat (2009), Ozark cavefish (2010), and Ozark cave crayfish (1986), it will be necessary to expand beyond the approved acquisition area or develop new acquisition areas across State and Service regional boundaries into Arkansas, Missouri, and Kansas.

Currently, Logan Cave NWR in northwest Arkansas protects an important federally listed gray bat, Ozark cavefish, and Ozark cave crayfish cave and is managed as a satellite of Holla Bend NWR, in Region 4 of the Service. Similarly, Cavefish NWR in southwest Missouri was established to protect the federally listed Ozark cavefish and Pilot Knob NWR in south central Missouri was established to protect an important federally listed Indiana bat hibernaculum; both are managed as satellites of Mingo NWR in Region 3 of the Service. Management of these satellite cave refuges is challenging due to a lack of dedicated staff and funding as well as unique wildlife and habitat needs. Consequently, over a number of years there has been a cooperative effort among Holla Bend NWR, Mingo NWR, and Ozark Plateau NWR to work together to plan and implement Strategic Habitat Conservation cave and karst management practices on a landscape level on and surrounding these refuges. This cooperation has been beneficial for accomplishing some recovery tasks for Ozark federally listed cave species through adaptive management; however no formal management agreement is currently in place to ensure that it continues.

Figure A-2. Cave management coordination opportunities at the landscape-level.



Because Ozark Plateau NWR's authorized purpose is to prevent extinction of federally listed Ozark cave species, help assure their recovery, prevent the need for listing additional species, and because the Refuge has dedicated funds and staff with experience in cave and karst management, it would be most effective for Ozark Plateau NWR to manage Logan Cave, Cavefish, and Pilot Knob NWRs as additional management units across state and regional boundaries. However, Strategic Habitat Conservation could also be accomplished across state and regional borders by establishing refuges similar to Ozark Plateau NWR in Regions 3 and 4. Details on management logistics on such a large landscape scale regarding staffing and funding may initially be bureaucratically challenging, however, coordination efforts across these Service Regions should prove more effective at protecting and recovering Ozark cave wildlife species.

1.8.2 Habitat Management Issues

Degradation of Cave, Stream, and Forest Habitat

Early descriptions of the Ozark region of Oklahoma described the presence of grass-covered savannahs and open woodlands with an abundant understory of grasses, wildflowers, and other herbaceous plants (Heikens, 1999). However, since European settlement, suppression of the natural fire regime has led to overcrowded forest conditions. In addition, many fragments of forest were cut for commercial logging. As a result, today's remaining forest areas mostly consist of exceedingly high densities of even-aged stands with an excessive fuel load and a lack of well-developed understory. Current conditions not only lead to unnatural and uncontrollable wildfires, but they are also not ideal for native vegetation and wildlife to thrive as they once had. Forest habitat restoration measures (such as prescribed fire, thinning, native planting, etc.) that mimic the historic fire regime and maintain a natural mosaic of plant communities representative of the ecosystem will reduce the risk of unplanned, high-intensity wildfires while also supporting a greater diversity of native flora and fauna. Ozark big-eared bats and gray bats depend on an open, regenerating, mature forest condition (e.g., basal area of 50-60 sq. ft.) as important flight corridors and foraging habitat. Large continuous stands of mature Ozark forest are also essential to interior forest nesting migratory birds such as tanagers, warblers, and flycatchers that must nest some distance from an edge. The forest also plays an important role in preventing degradation of water quality in caves used by the Ozark cavefish and other rare aquatic cave fauna such as the Oklahoma cave crayfish.

Degradation of habitat and water quality has been identified as a major threat to aquatic cave species (USFWS Cavefish 5-year Review, 2010). Conventional agriculture run-off and increasing urban development result in decreased quantity of surface and groundwater of the aquifer as well as contaminated surface water, which freely enters groundwater with limited natural filtration in areas of karst topography such as in the Ozarks, adversely affecting cavefish, cave crayfish, and other species. (See also 1.8.1 *Surface and Groundwater Quality & Quantity*).

Human disturbance and vandalism are the leading factors in the degradation of cave habitats and decline in bat populations. In recent years, people have vandalized cave gates, destroyed and removed cave formations, modified passageways, littered, graffitied, and damaged the caves with smoke from fires. The Refuge routinely repairs cave gates about three or four times per year due to vandalism and unauthorized entry. Disturbance of hibernating bats causes the loss of critical fat stores and increases the probability of starvation during winter, while disturbance at maternity roosts can result in a loss of young (Tuttle, 1979). Protection of caves from human disturbance and destruction are identified as the most important recovery need of the three federally listed cave species known to occur on the Refuge (USFWS Ozark big-eared Bat Recovery Plan, 1995 ; USFWS Gray Bat Recovery Plan, 1982 ; USFWS Ozark Cavefish Recovery Plan, 1989).

Similarly to Ozark habitat loss and fragmentation, degradation of cave, stream, and forest habitat were some of the highest concerns that the public, the State, and tribal members had during scoping. One member of the public commented that the most important role of the Refuge is to protect these habitats.

Lack of Detailed, Scientific Cave Habitat Data

The State and the Refuge would like to know more information on cave, and forest/surface habitat requirements and feeding/foraging ecology of federally-listed bats, cavefish, and other cave-dwelling organisms (see 1.8.3 Wildlife Management Issues). Cherokee Nation members expressed that caves and the land they are located on are very valuable resources to the tribe and suggest that the Refuge coordinate with them to continue mapping caves.

Invasive Flora

Non-native invasive plants alter natural habitat conditions, which consequently affect native wildlife species. Evaluation of invasive and exotic plants that are detrimental to native flora and fauna species and maintenance of natural biodiversity is very important to the Refuge for the overall health and function of natural ecosystems within the Ozarks. Some non-native invasive species that may outcompete and displace native plants within hardwood forests and/or riparian areas of the Refuge include: Sericea lespedeza, tall fescue, Chinese privet, Japanese honeysuckle, Johnson grass, kudzu, beefsteak plant, Nepalese browntop, mimosa trees, among others. A vegetation survey from 2003 found that 8.7% of all plant species occurring on the Sally Bull Hollow Unit of the Refuge were non-native flora (Hayes). A new survey is needed to reassess how this has changed as well a baseline assessment of non-native species occurring on all other Refuge Units. These invasive plant species may have some effect on bats' prey, including moths and other insects; however, no research has been done on this. Songbirds and migratory birds depend on native plants, shrubs, and trees for nesting, perching, and hosting a multitude of insects for prey. Consequently, non-native invasive flora also affects bird niches. In addition,

exotic tree pathogens are affecting native Ozark chinquapin and flowering dogwood, which may also be altering forest structure and diversity.

Invasive flora was an issue that the public and the State felt should be addressed.

Fire Management

As mentioned above, early descriptions of the Ozark regions of Oklahoma described the presence of grass-covered savannahs and open woodlands with an abundant understory of grasses, wildflowers, and other herbaceous plants (Heikens, 1999). However, since settlement, loss of the natural fire regime has resulted in overcrowded forest conditions. This has left remaining forested areas in an over-abundance of uneven age stands of oak-hickory and oak-hickory-pine forest. Ozark big-eared bats and gray bats depend on an open, regenerating, mature forest condition (e.g., basal area of 50-60 sq. ft.) as important flight corridors and foraging habitat. Therefore, mimicking the natural fire regime would benefit these species as well as migratory interior forest nesting birds. The Refuge currently has a Fire Management Plan; however only for two of its nine management units.

The public, the State, and Tribal Nations expressed that they would like to see more well-managed prescribed burns used as a management tool in the forested areas on the Refuge. The State and Tribal Nations want to coordinate with the Refuge to do a number of controlled burns simultaneously.

1.8.3 Wildlife Management Issues

Threatened and Endangered (T&E) Species and Species of Concern

The Refuge was established to prevent the extinction and recovery of federally-listed Ozark cave species, which include the Ozark big-eared bat (*Corynorhinus townsendii ingens*), gray bat (*Myotis grisescens*), Indiana bat (*Myotis sodalis*), and Ozark cavefish (*Amblyopsis rosea*). The Refuge also currently protects nine species of concern to prevent the need for future listing. There are nine species of concern on the Refuge, including the Oklahoma cave crayfish (*Cambarus tartar*) and Delaware County cave crayfish (*Cambarus subterraneus*). Currently, there is little known about these Ozark cave species: their habitat requirements, genetics, effects of climate change, and how WNS will affect entire cave ecosystems. The Refuge would like to address scientific knowledge gaps regarding forest, surface, and cave habitat requirements and breeding ecology of cave species occurring on the landscape level to better assess and manage for their needs. The State is also concerned with insufficient knowledge regarding these species.

Ozark Big-eared Bat & Gray Bat

The Ozark big-eared bat is endemic to the Ozark Highlands and Boston Mountains Ecoregions (Omernik, 1987) where it occurs in oak-hickory hardwood forests (Clark, 1991; Leslie and Clark, 2002; and U.S. Fish and Wildlife Service, 1995). The Ozark Highlands Ecoregion is

under considerable development pressure and is one of the fastest growing areas in the country due to relatively inexpensive land prices and the aesthetics of the area. For example, the human population of Washington and Benton County, Arkansas, and Adair and Cherokee Counties, Oklahoma, increased 39.0 percent, 59.0 percent, 14.2 percent, and 24.9 percent, respectively, from 1990 to 2000. Over the same period, the human population within the states of Oklahoma and Arkansas, and within the United States increased by only 9.7 percent, 13.7 percent, and 13.2 percent respectively (U.S. Census Bureau, 2001). The Oklahoma Department of Commerce (ODOC) projects the human population of Adair and Cherokee counties, Oklahoma, to grow by about 35 percent over the next 23 years (ODOC, 2002).

Vandalism and unauthorized human activity at maternity roosts and hibernacula still occur even at gated and signed caves, prohibiting entry. Therefore, human disturbance remain a serious threat. The disparity between summer and winter counts indicates there likely are more caves of importance to the Ozark big-eared bat of which the bat conservation community is not yet aware. A prerequisite to protecting these sites is knowledge of their location, so the need to continue search efforts for unknown Ozark big-eared bat caves continues. Current and future human population growth and development within the Ozark big-eared bat's range will result in the loss and fragmentation of foraging habitat. In addition to protecting the caves used by the Ozark big-eared bat, it will become increasingly important to protect and restore foraging habitat around these caves as development pressures increase in the future (Leslie and Clark, 2002; Wethington et al., 1996).

Degradation of foraging habitat, protective flight corridors, and food resources also presents a major threat to the gray bat. Gray bats feed primarily on aquatic insects in riparian areas and over rivers, streams, and other water bodies. Gray bats also utilize forested areas for protection from predators such as screech owls as they travel between caves and foraging sites. Deforestation of wooded tracts and riparian zones in the vicinity of maternity caves (gray bats are known to forage up to 12 km from a summer cave) due to development and agricultural activities negatively impacts gray bats by reducing available foraging habitat and the wooded flight corridors that provide protection from predators (LaVal et al., 1977; USFWS, 1982). Practices that result in increased pollution, turbidity and siltation in waterways over which gray bats forage, such as development and agricultural activities and the clearing of woody riparian zones, can be detrimental by reducing the local abundance of important prey, especially species sensitive to aquatic pollution such as mayflies, caddisflies, and stoneflies (Tuttle, 1979; USWFS, 1982). In addition, natural flooding and impoundment of waterways has resulted in temporary impacts to some caves and the complete submersion and loss of other important cave sites (Barbour and Davis, 1969; LaVal et al., 1977; Tuttle, 1979). Natural and man-made flooding remains a threat at some gray bat sites.

Although additional essential caves have been discovered and protected since the time of listing the Ozark big-eared bat and gray bat, not all known caves have been afforded some form of protection (e.g., a cave gate/grill, signs, fee-title purchase, conservation easement, landowner agreements, etc).

Climate change could have a significant impact on all temperate region bats, including the Ozark big-eared bat and gray bat species. Projected changes in climate could impact bats by adversely affecting their food supply and the internal roosting temperature of caves (Bogan, 2003). The Ozark big-eared bat preys on a wide diversity of moth species, but most of the moth species are dependent upon woody forest plants as a host. Climate change may affect the Ozark big-eared bat by impacting plant resources which could alter the timing and abundance of moth prey. Ozark big-eared bats have specific cave microclimate requirements. Only those caves with appropriate microclimates are used as maternity roosts and hibernacula. Changes in the internal roosting temperature of caves may change the suitability of certain caves. Changes in food resources and cave microclimates may affect hibernation periods, and the birth and survival of pups.

The fungus associated with WNS recently has been found (Spring 2010) in close proximity to the range of the Ozark big-eared bat (northwestern Oklahoma and Missouri). WNS threatens to spread to the range of the Ozark big-eared bat in the near future. Should WNS move into the range of the Ozark big-eared bat, the potential impact could be severe due to the high mortality rate of affected bats to date, and the small population size and limited distribution of the Ozark big-eared bat. Subsequently, the fungus associated with WNS was in fact documented on gray bats in Missouri (spring 2010). Mortality attributable to WNS has not occurred in any gray bat populations to date. However, the discovery of the fungus on gray bats is cause for concern. A large percentage of the gray gat population hibernates in a limited number of caves. Mortality rates reported from hibernacula in the northeastern United States are unprecedented (e.g., 90% mortality in affected caves and over 1,000,000 bats estimated to have died due to WNS). Therefore, should gray bats develop WNS, disease transmission could occur rapidly and the resulting impacts could be severe.

Ozark Cavefish

The construction of impoundments historically may have impacted the Ozark cavefish (Graening et al. 2009). Several caves within the Spavinaw Creek Basin of Oklahoma, the current range of the cavefish in Oklahoma, were completely inundated by the construction of Lake Eucha (Looney, 1972). Several impoundments constructed in Arkansas and Missouri on the White River inundated extensive cave systems that occur within the range of the cavefish (Graening et al., 2009).

Habitat degradation and pollution due to agricultural activities and development currently are considered primary threats to the Ozark cavefish. The karst environments (i.e., a landscape underlain with limestone that is marked by caves, sinkholes, springs, and other features and has special drainage characteristics due to the greater solubility of limestone) in which the cavefish occur are highly vulnerable to groundwater pollution. Water enters the groundwater systems rapidly in karst areas as it passes through sinkholes and cracks and crevices in the ground surface, losing streams (i.e., a stream with a bed that allows water to flow directly to the groundwater system), or fractured limestone under thin layers of permeable soils. Groundwater in karst areas can travel as quickly as a few thousand feet to over a mile per day. Degradation of sensitive, underground habitats used by the cavefish can, therefore, occur rapidly. These characteristics of karst ecosystems make the underground environment relatively fragile and highly susceptible to disturbances.

Agriculture is considered the primary threat within the recharge zone (i.e., areas involved with input of water into the cave system) of 17 out of 35 active sites (David Kampwerth, Service Recovery lead, pers. comm.). Various agricultural activities can threaten groundwater quality (Aley and Aley, 1997). Chemicals and fertilizers that are applied on agricultural lands can rapidly infiltrate groundwater and cave systems during rain events due to the karst topography of the Ozark Highlands. As forested areas are harvested or lands are converted from forest to pasture, valuable canopy cover for ground temperature regulation and soil moisture retention is lost. In 1968, 59% of the Logan Cave recharge zone was forested. By 1987 the amount of forested land was about 43%, representing a 17% decrease (David Kampwerth, Service Recovery lead, pers. comm.).

Confined animal feeding operations (CAFOs) also are believed to pose a threat (Aley and Aley, 1999). Metals and other contaminants pass through poultry and other livestock and can reach groundwater through land application of wastes. Aley and Aley (1999) identified CAFOs as the greatest threat within the recharge area of Long's, McGee's, and Engelbrecht Caves in Oklahoma. CAFOs also are believed to be a threat to the water quality of Cave Springs Cave and Logan Cave in Arkansas (Graening and Brown, 2003). The 11 square mile recharge zone of Logan Cave alone contains approximately 50 hog and poultry facilities (Aley and Aley, 1987).

Urbanization and development are considered primary threats within the recharge areas of 17 cavefish caves (David Kampwerth, Service Recovery lead, pers. comm.). As development and associated impervious surfaces (e.g., roads, parking lots, etc.) increase, areas that otherwise would allow natural infiltration and percolation are lost or significantly diminished. Increased groundwater withdrawals for home, community, and agricultural use also can deplete groundwater and limits available habitat.

Unauthorized human entry also continues to be a threat at protected sites and at sites with no protection measures in place. Gates/fences have been vandalized with evidence of recent human access. Use at ungated caves is occurring based on evidence such as new paint, foot prints, and writing found during biannual monitoring surveys. Human entry causes increased turbidity decreasing cavefish sensory ability. Unauthorized human entry also increases the potential for direct trampling of individuals, and can interrupt feeding and breeding behaviors.

Migratory and Resident Bird Species

Maintaining continuous stands for interior forest Neotropical nesting birds continues to be a concern for the Refuge, primarily due to the loss of Ozark habitat and fragmentation as discussed in habitat issues (see Section 1.8.2). The Refuge implements the protection and management recommendations of the Central Hardwood Bird Conservation Region (www.partnersinflight.org). The Refuge is located on the western edge of the Ozarks Ecoregion and near the eastern edge of the Tallgrass Prairie Ecoregion, resulting in a "crossover" of eastern and western bird species found on the Refuge.

The public and organizations suggested that the Refuge establish a continuing monitoring program to keep track of migratory and resident bird population trends and changes.

Resident Non-T&E Species

Non-T&E bat species are found on the Refuge but the Refuge is just beginning to collect information on these species. With WNS as a threat, this information could be valuable in identifying the impacts to non-T&E bat species and assist in efforts to address WNS. Also, the Refuge is concerned about collecting information on other cave species, especially with the threat of WNS potentially resulting in a large decline of bat species that provide a major energy source for a number of cave fauna.

Invasive Fauna Species and Pest Management

The Refuge is concerned about the increasing number of feral hogs, an exotic fauna species that has been found to forage in oak-hickory or oak-hickory-pine forest on and around the Refuge. Feral hogs compete with native wildlife and destroy habitat used by native species. In addition, they damage riparian habitat and reduce bank stabilization in bottomlands. Feral hogs are currently found on the Sally Bull Hollow Unit in Adair County and moving north toward Delaware and Ottawa Counties, within the Refuge's acquisition area as well as near where four units of the Refuge. Feral hog hunting occurs year round on private, State and Tribal lands, however, currently, the Refuge does not allow any hunting. The Refuge would like to permit hunting of nuisance feral hogs, pending the development of a Hunt Plan (after Sally Bull Hollow Unit has been surveyed and marked) and/or an Integrated Pest Management Plan. In addition, the Refuge recognizes that feral cats prey on bats and migratory birds. Feral cats are currently found on most Refuge units, although the Refuge does not currently document feral cat occurrences. The Refuge is also concerned about the hothouse millipede, another exotic species

abundantly occurring on the Refuge. Hothouse millipede may compete with native cave species as consumers of limited energy sources within caves. This species should be studied further to assess its impacts on cave species. Introduced predatory fish in Ozark streams, such as trout, compete with native fish and may also compete with and forage on cavefish and cave crayfish and other precious aquatic species. The State is also concerned with invasive exotic animal species on and around the Refuge.

1.8.4 Public Use Opportunities Issues

Hunting

Currently, the Refuge does not allow hunting. Prior to opening up any Refuge land units for hunting, the Refuge would need to survey and mark the appropriate boundaries. During scoping, members of the public and ODWC expressed interest in having the Refuge open up hunting of Oklahoma state game species (including deer, turkey, squirrels, quail, and rabbits), in accordance with State regulations. The ODWC requested specifically that the Refuge explore hunting opportunities on the Sally Bull Hollow Unit because it is adjacent to state-managed hunting area, Ozark Plateau Wildlife Management Area, and that they have consistent regulations. They also suggested that wildlife observation and photography not be permitted during hunting season on that Unit. ODWC is interested in the recent (2010) increase in black bears in Northeastern Oklahoma (since the public also has an interest in hunting them) and suggested that if any black bears occur on the Refuge in the future, that they be documented.

Fishing

The Refuge does not currently have any land units with fishing opportunities. Nevertheless, there is a conservation agreement with the City of Tulsa and ODWC to co-manage the Eucha Unit (approximately 130 acres) of Ozark Plateau NWR, in which the City and State manage recreational fishing on the upper end of Lake Eucha/Spavinaw Creek, while the Refuge manages the Unit's cave resources.

Environmental Education

Increased urbanization in northwest Arkansas and in northeast Oklahoma is having detrimental effects on the Ozark ecoregion. Most people are not conscious of their direct impacts to the environment, and how those, in turn, affect their own lands, water, and resources that they depend on. Many people from these areas are also unaware of the large and delicate cave (subterranean) ecosystems, groundwater aquifers, and native wildlife species that lie underneath their feet as well as how they are connected to Ozark springs, streams, and forests, and other karst resources. Environmental education (EE) programs on Ozark Plateau NWR are crucial in order for both urban and rural people of this region to have an opportunity to experience a connection to and understand the importance of their local ecosystems, and be able to pass on that knowledge to future generations.

In addition, during scoping, the public and members of Tribal Nations expressed a high level of interest in having more EE programs on the Refuge. Specifically, tribes would like to be more involved in sharing native knowledge through environmental education and interpretation programs on the Refuge including trapping, survival skills, identification and medicinal uses of culturally significant trees, plants, and wildlife in relation to various Tribal Nations in the four-states area. The Cherokee Nation specifically requested that traditional foods (or native foods) are served at the MMLERC in environmental education programs, especially those catered to tribal youth.

Interpretation

As described above, increased urbanization in northwest Arkansas and in northeastern Oklahoma is having detrimental effects on natural resources of Ozark ecoregion. Most people are not conscious of their direct impacts to the environment, and how those, in turn, affect their own lands, water, and resources that they depend on. In addition, many people from these increasing urban areas do not get many opportunities to connect to nature and are also unaware of the large and delicate caves and groundwater aquifers (subterranean) ecosystems and native wildlife species that lie underneath their feet. Interpretation programs on Ozark Plateau NWR are crucial in order for both urban and rural people of this region to have an opportunity to experience a connection to and get a sense of the importance of their local Ozark ecosystems, and be able to share that experience with future generations.

Various Native American Nations would like to be more involved in sharing native knowledge through both environmental education and interpretation programs on the Refuge including trapping, survival skills, identification and medicinal uses of culturally significant trees, plants, and wildlife in relation to various Tribal Nations in the four-states area. The Cherokee Nation specifically requested that Ozark Plateau NWR install interpretive plant placards next to culturally-significant “Cherokee plants”, both in English and in the Cherokee language.

Wildlife Observation & Photography

During scoping there were no publicly-expressed opinions regarding wildlife observation and photography on Ozark Plateau NWR. However, the Refuge would like to offer more opportunities for this wildlife-dependent use by providing more nature trails and possibly having some photography blinds in appropriate areas.

Wood Harvesting

In order for the Refuge to manage for a healthy forest for wildlife needs, some thinning and fuel reduction actions must be conducted, such as after ice or wind storms and forest management. The Refuge does not have the staffing or funding available to perform these necessary management activities including the removal of downed-trees.

ATV Use
The State was concerned about enforcing laws regarding illegal use of ATVs on State-managed lands and on Refuge lands. The Refuge is also concerned about illegal ATV use; at present it has not become a problem but potentially could in the future.

Public Outreach
The public commented that Ozark Plateau NWR does not provide much information regarding their Refuge. However, now that the Mary & Murray Looney Education & Research Center (MMLERC) is being renovated, the Refuge will do much to improve outreach efforts.

1.8.5 Cultural Resources Issues

Historical Sites
There are several historical sites on Ozark Plateau NWR. For example, there is a wagon trail between Sallisaw and Tahlequah, which runs through the Potter Unit, as evidenced by old bridge abutments. This trail was main thoroughfare for local travelers, prior to the development of roads and highways. Crystal Cave on the Potter Unit was a commercial cave used for local dances in the 1920s. There is an old rock dam on the Potter Unit that was constructed to provide swimming opportunities dating back to pre-1916. In addition, cabins and infrastructure on the Mary & Murray Looney Unit have historical significance to the caving community in the Ozarks because they were used by many caving experts to explore the first private cave preserve, January-Stansberry Cave, which was later donated to the Refuge (Graening, 2011).

Archeological and Paleontological Sites
Short-faced bear, tapir, and dire wolf remains have been discovered in or around Refuge caves. Arrowheads, spear points, grinding stones, and other Native American tools probably used by the Caddo and Osage Tribes during pre-settlement times and/or by tribes after they were relocated to Oklahoma, have been found on and near the Refuge. With the help of its partners, the Refuge would like to learn more about these known sites and discover additional historical, archeological, and/or paleontological sites to better understand the history of the land and its people and animals.

1.8.6 Facilities & Infrastructure Issues

Mary & Murray Looney Education & Resource Center (MMLERC)
The current MMLERC and its associated facilities need improvement. Originally, this cabin was used as a private summer resort in the early 1950s. Due to the cabin's antiquity, the design is inefficient, the building materials have deteriorated, and standards have subsequently changed overtime. The Mary & Murray Looney cabin had been abandoned for at least 10 years prior to Refuge restoration efforts. During this time, the interior and exterior of the building and the surrounding grounds have deteriorated. Initial renovation has already taken place inside the

main MMLERC building, through a Maintenance Action Project, so that it functions adequately for the Refuge Headquarters, housing for staff, volunteers, and/or guests, along with hosting multiple EE programs. Additional restoration, however, is still required to make the building more energy-efficient, water conservation-friendly, more accessible to handicap visitors, more secure, as well as to ensure adequacy of plumbing and electrical systems. The MMLERC's concrete grounds and walkways must also be repaired for safety. And lastly, the pavilion structure needs to be renovated in order for it to be utilized as part of the MMLERC.

Access Roads

To get to the MMLERC, there is a MMLERC public access drive, which is currently 0.25-miles, unpaved and unimproved (dirt/rock), with a gate. There is an unpaved parking area (power cut easement), between the entry gate and MMLERC, for approximately 10 vehicles. Excess parking is available near the maintenance shop, next to the Guess House (150 yards). However, many people that access these roads drive up on the side of the road over vegetation, also causing soil to erode, in order to have two cars pass one another. In addition, road and parking area surfaces need to be improved with gravel to allow for a better established parking area, which will prevent visitors from parking in the grass, on the side of the road, and will help control soil erosion. In addition, Refuge staff needs a wider access road to the Beck Unit shop in turn-around area for Staff vehicles and trailers.

Nature Trails and Overlooks

Hiking trails are not adequate for the current number of people visiting the Refuge for EE and interpretation programs, let alone the amount of those anticipated in the future. Establishing more trails will make it safer for people to walk and will prevent damage to soils and vegetation. The trail from MMLERC to the pavilion is a paved path that has deteriorated and needs to be repaved. The path from the parking area to the MMLERC also needs to be an improved gravel walkway, approximately 3-feet wide, designed for heavy foot traffic. The remaining trails will be "primitive". Creating and maintaining "primitive" trails will provide a basic pathway within its natural surroundings, without involving much heavy trail construction or maintenance.

In addition, establishing overlook areas and photography blinds will provide additional opportunities for visitors to connect with nature.

Public Use Signs and Interpretive Displays

The Refuge does not currently have any public signs posted, except for at the entrances of caves stating that they are closed to the public. The Refuge does not post any public signs that are not deemed absolutely necessary in order to maintain discretion of their unit locations and to keep cave locations confidential (as required by the Federal Cave Resources Protection Act). Nevertheless, signage on the Refuge will need to be improved throughout the lifetime of this CCP as needed, especially to accommodate the increase of EE programs at the MMLERC.

Many visitors get lost when visiting the Refuge and signage could help orient them. However, the Refuge does not want to post these signs until the MMLERC is completely secured (alarm system, permanent staffing, safes, etc.). Other interpretive signage on Refuge nature trails could also provide a higher quality experience for EE and/or interpretation programs.

Refuge Headquarters Site

Currently, there are three full-time Refuge staff members, one Wounded Warrior, one Student Conservation Association (SCA) intern, and one part-time Student Career Experience Program (SCEP) student. Refuge Headquarters is currently located at the MMLERC, which provides only one office and the facility is primarily used for EE and interpretation programs. Due to limitations on office space at these headquarters, each of these staff members works out of either the Oklahoma Ecological Services Field Office in Tulsa, the MMLERC (Refuge), and/or Sequoyah NWR. Due to the lack of a centralized Headquarters space, management coordination challenging. This situation also increases staff travel time, decreasing actual work time. In anticipation of land acquisition in the near future, a centralized Refuge headquarters would help accommodate the potential increase in staff.

Maintenance Shops and Service Buildings

Current maintenance facilities are inadequate. The Refuge needs additional maintenance facilities in order to store and maintain Refuge vehicles, supplies, and equipment used for management operations. In addition, it is important that the Refuge have adequate decontamination sites for caving equipment in accordance with the Service's WNS decontamination guidance.

Refuge Housing

The MMLERC only provides one bedroom used by volunteers, researchers, interns, educators, Refuge staff, and other guests. There is also a house on the Mary & Murray Looney Unit formerly owned by Guess family known as the "Guess House" that provides housing for the one Refuge staff member through a rental agreement. In addition, there are small cabins on private lands near the Potter Unit that may be available on a limited basis for Refuge volunteers, researchers, interns, educators, and Refuge staff. However, use of these would require landowner notification and may not always be vacant. The Refuge would like to provide more housing opportunities for the current number and future increase of volunteers and partners. Additional housing to accommodate an increase in Refuge staff will also be needed.

Boundaries

The Refuge must identify and mark their boundaries in order to know their physical limitations between adjacent private, tribal, or public lands for performing management activities. Currently, there are over 36 miles of unit boundaries with a total of over 4 miles of fencing and 11 gates that are maintained and repaired by Refuge staff. Only two of the Refuge Units have

been completely surveyed and marked. The table below (Table A-2) shows an assessment of current Refuge boundary needs and infrastructure to maintain.

Table A-2. Refuge Boundary Assessment

Refuge Unit	Boundary	Surveyed?	Marked?	Fencing?	Gates?
Looney	>1.37 mi.	X	X	X	2
Liver	3.14 mi.	X	X	-	1
Potter	3.09 mi.	X	X	-	1
Sally Bull Hollow	15.42 mi.	-	-	-	4
Gittin Down Mountain	3.87 mi.	-	-	-	-
Varmint	1.24 mi.	-	-	-	-
Boy Scout	1.93 mi.	-	-	-	1
Beck	2.99 mi.	-	-	X	3
Eucha	2.51 mi.	-	-	-	-

1.8.7 Refuge Administration Issues

Funding and Staffing

Tribal members and Refuge staff agree that a lack of staffing and funding is one of the Refuge's primary issues.

Volunteers/Friends Program

Currently, the Refuge does not have an official Friends group established. An official Friends group could play a major role in outreach, land acquisition, environmental education and interpretation programs, wildlife monitoring, informing and involving the community, as well as fundraising for Refuge projects.

Chapter 2: Management Alternatives of EA

2.1 Formulation of Alternatives

Alternatives are different approaches or combinations of management actions designed to achieve a refuge's purposes and vision, the goals identified in the CCP, the goals of the Refuge System, and the mission of the Service. Based on the issues, concerns and opportunities heard from the public, the State, Tribal Nations, and other agencies during the scoping process, the Planning Team developed two alternative management scenarios that could be used at Ozark Plateau NWR.

This EA considers these two alternatives in detail (see sections 2.3 and 2.4), which cover a practical and reasonable range of management possibilities that address all of the issues stated in Section 1.8. In addition, three other alternatives were considered but eliminated from detailed analysis for the reasons listed below (see section 2.2). The proposed alternative (Alternative B) represents a different approach or management scenario from current management (Alternative A) to address public concerns and improve management for the future protection, restoration, and management of the Refuge fish, wildlife, plants, habitats, and other resources, as well as compatible wildlife-dependent recreation. Refuge staff assessed the biological conditions of Refuge habitats and analyzed the external relationships affecting each Refuge Unit. This information contributed to the development of Refuge goals and, in turn, helped formulate the alternatives, summarized in Table A-5. Alternatives will be examined in six broad issue categories:

- **Landscape-level:** How will the Refuge contribute to addressing landscape-level conservation-related issues in the Ozarks?
- **Habitat Management:** How will the Refuge manage habitats to ensure the protection of trust resources?
- **Wildlife Management:** How will the Refuge manage wildlife to ensure the protection of trust resources?
- **Public Use Management:** How will the Refuge manage wildlife-dependent public use opportunities and public use access to ensure the protection of fish, wildlife, and their habitats?
- **Cultural Resource Management:** How will the Refuge manage cultural and historical resources to ensure the preservation of ancient and recent history and culture?
- **Facilities & Infrastructure Management:** How will the Refuge provide infrastructure and related developments while ensuring the protection of trust resources?

2.2 Alternatives Considered But Dismissed From Detailed Analysis

During the public scoping period, many alternative actions for managing the Refuge were suggested. The majority of these suggestions were consistent with Refuge purposes and the mission of the Refuge System and were incorporated into the action alternative. Other actions were found to be infeasible for the reasons described below.

Fishing

The U.S. Fish & Wildlife Service requires that we consider each of the “Big 6” wildlife-dependent recreational uses, including fishing. However, the Refuge does not currently have any fishing opportunities nor proposes to consider this use because a) most of the Refuge must remain closed to the public to ensure the protection and conservation of fragile cave resources and b) the Refuge does not have any good fishing locations to provide. Nevertheless, there is a

conservation agreement with the City of Tulsa and ODWC to co-manage the Eucha Unit (approximately 130 acres), in which the City and State manage recreational fishing on the upper end of Lake Eucha/Spavinaw Creek, while the Refuge manages the Eucha Unit's cave resources.

Prohibit all Service Staff and Biologists from Cave Entry

There was a suggestion from internal Service staff that Refuge staff and cave biologists be prohibited to enter caves on the Refuge as long as WNS poses a threat to Refuge bat species. However, in order to identify whether WNS is affecting sites on the Refuge, to learn more about the disease, and to contribute to research regarding prevention of and recovery from WNS, it is essential for biologists and Refuge staff to continue monitoring caves and bat species for traces of the fungus, *Geomyces destructans*. The Refuge follows strict decontamination procedures (recommended by the WNS National Plan) of cave gear and equipment, which does not allow for the potential of humans to spread the fungus. These procedures will be taken by all Refuge staff and other scientific researchers who cooperate on scientific monitoring of cave habitat and fauna on and off Refuge. The Refuge follows guidance regarding all WNS monitoring and cave-related management activities in the most recent version(s) of the White Nose Syndrome National Plan (http://www.Service.gov/whitenosesyndrome/pdf/WNSnationalplanMay2011.pdf).

Management Activities across State and Regional Borders

In section 2.4.7 *Proposed Refuge Administration*, Ozark Plateau NWR proposes to coordinate to improve management of other "cave resource refuges" across State and Service regional boundaries, as well as expand their acquisition boundary into these areas to ensure successful Strategic Habitat Conservation. This is discussed in further detail in Alternative B below. This action sparked many ideas for more specific management activities throughout the landscape on these satellite refuges (Logan Cave NWR; Holla Bend NWR; Pilot Knob NWR; new acquisition areas within Service Region 3, 4, and 6, etc.) including:

- Refuge would partner with Service Region 3 and the State of Missouri to establish an expanded acquisition boundary in Southern Missouri's Ozark ecoregion
- Increase the monitoring programs for T&E and other species throughout species' ranges, across Service Regional boundaries and state lines, to achieve a more integrated ecoregional approach to data collection and management
- Expand EE opportunities to include school groups programs by permit only at Logan Cave NWR
- Establish an additional EE Center on new acquisitions on or near Logan Cave, Cave Fish, or Pilot Knob NWRs. The site would be acquired in an already-developed area, near the cave resources but not co-located with the caves.
- Expand wildlife observation opportunities with an observation deck at Logan Cave NWR
- Establish a 1-mile wildlife observation nature trail around the Pilot Knob NWR

Although these actions have great intentions and potential, it is not necessary to further analyze them at this time until an official management agreement has been made between these Service regional boundaries (Region 2, 3, 4 and 6) regarding management of cave resources.

Alternatives Analyzed in Detail

2.3 Alternative A – No Action (Current Management)

This alternative is the baseline for comparison with Alternative B (the Proposed Action or Proposed Future Management) because it describes how the Refuge currently manages for its fish & wildlife resources.

2.3.1 Current Landscape-level Management

Ozark Habitat Loss & Fragmentation

Land and Conservation Easement Acquisition from Willing Sellers and Conservation Agreements

The Refuge would continue current management to address habitat loss and fragmentation by acquiring land and conservation easements from willing sellers (up to 15,000 acres) and entering into conservation agreements with private landowners, conservation organizations, state, Tribal Nations, and other federal agencies. The Refuge would not build or permit the construction of any new roads or infrastructure on Refuge lands except for Refuge operation purposes and would continue its practices of maintaining and restoring forested habitat as resources allow. Conservation agreements with the Cherokee Nation, City of Tulsa, and private landowners would continue to preserve forested and/or cave habitats.

Partnerships

Partnerships would continue to be an important part of the Refuge's actions to acquire, manage, and conserve lands, inventory and monitor, conduct research, assist in protecting and restoring habitat, share information about resources, conduct environmental education, and reduce Ozark habitat loss and fragmentation. The Refuge would continue working with landowners adjacent to and near the Refuge, private businesses, citizen science groups/projects, nongovernmental organizations (NGOs) (including The Nature Conservancy [TNC], Land Legacy, Tulsa Regional Oklahoma Grotto, Central Oklahoma Grotto, Arbuckle Mountain Grotto, National Speleological Society [NSS], Bat Conservation International [BCI], Ozark Tracker Society [OTS], Blue Skywater Society, Boy Scouts of America [BSA], Girl Scouts of America [GSA], Missouri Chimney Safety Council, Audubon Society, Wild Turkey Federation, Ducks Unlimited, Student Conservation Association [SCA], Wildlife Society, American Fisheries Society, Southeastern Bat Diversity Network, Western Bat Working Group, Wildlife Federation, Northwestern Arkansas Beekeepers' Association), universities (including Oklahoma State University [OSU], University of Oklahoma [OU], Northeastern State University [NSU], Rogers State University

[RSU], University of Arkansas [UA], Southwest Missouri State University, University of Missouri, Southeastern Oklahoma State University, University of Central Oklahoma, Tulsa University), cities (Tulsa, Stilwell, Tahlequah, Jay, Colcord), counties (County Commissions for Adair, Delaware, Ottawa, Cherokee, Sequoyah, Mayes, Craig Counties), State agencies (including the Oklahoma Department of Wildlife Conservation [ODWC], Department of Environmental Quality [DEQ], Oklahoma Conservation Commission, Oklahoma Water Resources Board, Oklahoma Scenic Rivers Commission, Oklahoma State Parks, Oklahoma State Forestry Services, Oklahoma Natural Heritage Inventory, Grand River Dam Authority [GRDA], Arkansas Game and Fish Commission, Arkansas Natural Heritage Inventory, Missouri Department of Conservation), Tribal Nations (Caddo, Cherokee, Eastern Shawnee, Miami, Modoc, Osage, Quapaw, Seneca-Cayuga, and Wyandotte), and other Federal agencies (including the U.S. Forest Service, Natural Resource Conservation Service [NRCS], National Park Service [NPS], U.S. Army Corps of Engineers, Bureau of Land Management [BLM], United States Geological Survey [USGS], Environmental Protection Agency [EPA]).

Restoration

The Refuge would continue to restore 70 acres of agricultural land to forested habitat at the Beck Unit (see *Invasive Flora* below). Additionally, the Refuge would maintain approximately 3,977 existing acres of forested habitat.

Climate Change

Monitoring

The Refuge staff and university partners would continue monitoring baseline cave microclimates with temperature and humidity loggers, which record data every fifteen minutes or every hour, everyday, year-round. The loggers are located in one Refuge cave and one cave managed jointly with TNC.

Service staff and university partners would also continue monitoring the known maternity colonies and hibernacula annually. Two techniques would be used to estimate colony size at these caves. The technique used at the maternity sites consists of conducting an exit count as the bats emerge from the cave at night to forage using night vision optics, thermal videography, and infrared videography. For most gray bat maternity sites, guano pile measurements are taken in the fall or winter to estimate colony size. Acoustic monitoring would also be used to gain insight on use of Refuge tracts and caves by bat species. The technique used at hibernacula consists of entering the cave and counting the bats. Monitoring bat population sizes on private, state and tribal lands provides baseline information for understanding how climate change is affecting populations.

The Refuge would continue contracting with universities and NGOs to monitor mammals, birds, herpetofauna, fish, cave invertebrates, terrestrial insects, and vegetation. The following table shows surveys that have been completed until 2012 on the Refuge Units listed below:

Table A-3. Species surveys completed on Ozark Plateau NWR until 2012.

Species Survey	*Management Unit Surveyed*
Mammals	• Sally Bull Hollow
Birds	• Sally Bull Hollow • Mary & Murray Looney • Eucha • Beck • Potter
Herpetofauna	• Sally Bull Hollow
Fish	• Sally Bull Hollow
Cave invertebrates	• Sally Bull Hollow • Eucha • Beck • Gittin Down Mountain • Liver • Varmint • Mary & Murray Looney • Potter • Boy Scout
Terrestrial insects	• Sally Bull Hollow • Mary & Murray Looney
Vegetation	• Sally Bull Hollow • Gittin Down Mountain • Liver • Mary & Murray Looney

Green Infrastructure

The Refuge would continue installing and maintaining energy-efficient appliances and an efficient heating and cooling system (stove, refrigerator, dishwasher, hot water heater, washer and dryer) at the MMLERC. Water filtration systems would also be maintained at the MMLERC and Guess House, thereby reducing the need to bring bottled water onto the Refuge.

Carbon Sequestration

The Refuge manages 3,977 acres of oak-hickory and oak-hickory-pine forest. The protection and management of these forested areas enhances carbon sequestration.

Surface and Ground Water Quality & Quantity

Land and Conservation Easements Acquisition from Willing Sellers

The Refuge would continue to acquire land and conservation easements from willing sellers to protect the land from development. In the past 25 years, the Refuge has purchased 3,572.35 acres in fee, 162 acres of conservation easements, manages 359 acre of conservation agreements, anticipates purchasing about 400 acres in the next few years, and is approved to acquire up to 15,000 acres from willing sellers in the future. Once acquired, the Refuge would implement appropriate forest management practices to control water run-off such as burning to control invasive species and thin the forest (see 2.3.2 *Fire Management*), planting native species, controlling unauthorized grazing, and monitoring the health of the forest and effects of management practices on wildlife species. The Refuge would continue these forest management practices on its existing 4,093.35 acres (and new areas acquired) of oak-hickory forest, grasslands, and riparian areas within recharge zones.

Groundwater Mapping

The Service and NGOs would continue to work with private landowners, universities, Tribal Nations, USGS, and Service Regional Hydrologist, Inventorying & Monitoring (I&M), and Contaminants personnel to map groundwater recharge areas within the acquisition area, in and around all Refuge units, including private lands, specifically used for locations where Ozark cavefish, cave crayfish, and other important aquatic cave organisms are present. The Refuge would continue to identify all landowners in determined and potential recharge zones and seek permission to perform delineation process, which consists of using fluorescent-dye tracing to determine recharge areas, general directions of groundwater flow, and minimum and maximum groundwater travel times in days and miles from losing streams as a result of dye tracing.

Monitoring

The Refuge would continue to partner with universities, Oklahoma DEQ, Oklahoma Water Resources Board, USGS, and EPA to monitor surface and ground water quality (amount of pesticides, nitrates, phosphates, pharmaceuticals, and heavy metals) on and around all units on the Refuge. Water sampling has taken place on the Looney Unit among others.

The Refuge would also continue to partner with local municipalities and water authorities to share information about water levels affecting the Refuge. The Refuge would continue to coordinate surface water quality monitoring in Spavinaw Creek with the City of Tulsa and the State of Oklahoma. Spavinaw Creek is a water supply source for the City of Tulsa. The Refuge and the City would continue to share this monitoring data.

Partnerships

The Refuge would continue to work with adjacent and nearby landowners (private, NGO, state, tribal, and federal) to implement conservation agreements, assist with wildlife management through the Partners for Fish and Wildlife program and Section 6 of the Endangered Species

Act, and provide technical assistance. These partnerships will continue to help improve habitat quality on adjacent or nearby lands and also will prevent and minimize habitat loss and fragmentation in the Ozarks.

White-nose Syndrome (WNS)

WNS National Plan

The Refuge would continue to implement the actions and standards in the current WNS National Plan (http://www.Service.gov/whitenosesyndrome/pdf/WNSnationalplanMay2011.pdf), as it is updated. At this time, the actions include controlling access to caves for only WNS research and monitoring needs, decontaminating process of all cave gear, and monitoring T&E and non-T&E bats to establish baseline data on Refuge and neighboring private-land caves.

Monitoring

The Refuge would continue to partner with universities, caving organizations and other NGOs, state agencies, Tribal Nations, USGS, and other federal agencies to monitor for WNS on- and off- Refuge. The Refuge would continue to coordinate with other agencies and wildlife health organizations to identify preventative measures and investigate potential captive holding facilities.

Public Outreach

The Refuge would also continue public outreach regarding WNS by visiting schools and leading educational or interpretive discussions about the topic- discussing the issue with local landowners and organizations, producing exhibits, and including information on WNS in EE programs held at the Refuge.

Cave Access Control

The Refuge would continue to post signs prohibiting public entry in all Refuge caves, construct and maintain cave gates to control access to caves, and receive on-call law enforcement (LE) support from Sequoyah NWR.

Wind Energy Farms

Monitoring and Research

The Refuge would continue to monitor baseline bird and bat populations in caves and on bat routes using mobile acoustic monitoring to identify high risk areas and locate areas that would minimize impacts for development projects such as wind energy farms.

2.3.2 Current Habitat Management

Degradation of Cave, Stream, and Forest Habitat

Cave Protection

The Refuge would continue its current activities with caving organizations and other volunteers to build, maintain, and repair approximately 50 cave gates on- and off-Refuge. The Refuge would continue to post signs prohibiting entry at cave locations and would continue its policy of maintaining confidentiality of cave locations. LE officers stationed at Sequoyah NWR and a Zone Officer at Washita NWR would continue to provide "on-call" response to investigate cave gate vandalism and consult on effective monitoring actions. The Refuge would continue to partner with local residents, TNC, GRDA, and State/Tribal Game Wardens to monitor for unauthorized entry to caves and report any sightings or violations to the Refuge staff. The Refuge staff would also continue to remove trash and graffiti from caves.

Fire Management

See *Fire Management* category below.

Boundaries

The Refuge would continue to survey and mark Refuge boundaries, as funding becomes available.

Partnerships

The Refuge would continue to consult with adjacent and nearby landowners about any illegal grazing issues and remove any illegal dump materials.

Lack of Detailed, Scientific Cave Habitat Data

Research and Monitoring

The Refuge would continue contributing its research efforts on the Ozark Subterranean Biodiversity Project, similar projects, and other cave fauna bio-inventories in collaboration with TNC and other NGOs, universities, state agencies, Tribal Nations, USFS, and NPS on all Refuge units and surrounding private lands. Additionally, the Refuge would continue annual monitoring surveys of bat hibernacula and maternity sites, as well as cavefish and cave crayfish surveys. The technique used at the maternity sites consists of conducting an exit count as the bats emerge from the cave at night to forage using night vision optics, thermal videography, and infrared videography. For most gray bat maternity sites, guano pile measurements are taken in the fall or winter to estimate colony size. Acoustic monitoring would also be used to gain insight on use of Refuge tracts and caves by bat species. The technique used at the hibernacula consists of entering the cave and counting the bats. The Refuge would also continue searching for additional cave locations and cave mapping efforts on known caves with Refuge staff, cavers, NSS and other partners. Cave mapping would also continue to inform the Refuge staff of overlying landowners and help to identify outreach efforts.

Invasive Flora

Fire Management

See *Fire Management* category below.

Herbicide Treatment

The Refuge does not currently use chemical treatments for invasive flora.

Mechanical Treatment

The Refuge would continue to remove invasive plants with handtools, chainsaws, and by mowing approximately 10 acres total approximately one time per year on the Krause, Looney, Sally Bull Hollow, and Eucha Units.

Partnerships

The Refuge would continue working in partnership with the City of Tulsa and Land Legacy for challenge cost-share for invasive plant control using handtools or mechanical treatment, plantings, and prescribed burning (see *Fire Management* below). The Refuge would also continue partnerships through agreements with private landowners for prescribed burns by Service personnel on approximately 50 acres per year. The Refuge would continue its vegetation inventory in partnership with OSU to monitor native and invasive plants.

Fire Management

Ozark Plateau NWR enhances its Fire Management Program through assistance provided by Service personnel of the Oklahoma/North-Texas Fire Management District (remotely located at Wichita Mountains Wildlife Refuge).

Wildfire Management

The Refuge typically experiences frequent, small-scale wildfires that normally range from a few acres to approximately 500 acres per year. Management would respond to a wildland fire on Refuge lands based on objectives established in the applicable Habitat Management Plan (HMP) or Fire Management Plans (FMP). A wildfire may be concurrently managed for more than one objective. Response to wildland fire would be based on ecological, social, and legal consequences of the fire. Responses to wildland fire would be coordinated with all affected agencies/tribes/cooperators regardless of the jurisdiction at the ignition point. The appropriate response to wildland fire would be dictated by:

- the circumstances under which a fire occurs;
- the likely consequences to firefighter/public safety and welfare; and
- the natural/cultural resource values to be protected

Initial response decisions and actions may include a management or initial decision to postpone taking action on the ground based on conditions, safety, and/or competing priorities. Initial

response to human-caused wildfires would be to suppress the fire at the lowest cost with the fewest negative consequences with respect to firefighter and public safety. Unplanned natural ignitions would be managed to achieve HMP and FMP objectives when risk is within acceptable limits. Wildland Fire Decision Support System has tools available to assist in these decision processes, 1) organizational needs assessment, 2) complexity analysis. Objectives established in applicable HMP and FMPs would direct strategy/tactics selected in response to wildland fires on federal land.

The Refuge would continue receiving wildfire suppression assistance from local fire departments, the Oklahoma Department of Agriculture, Food and Forestry – Oklahoma Forestry Services, Tribal Nations, and Service personnel and other federal agency personnel. The Refuge would pursue funding to implement 1) FireWise activities 2) coordination/training with adjacent volunteer fire departments and 3) community wildfire protection plan (CWPP-e) actions and fuel treatments.

Prescribed Fire Management

The Refuge would continue to implement their FMPs on the Looney and Sally Bull Hollow Units. Treatment goals for forest management are to maintain open understory, reduce fuel loads, and foster mature oak-hickory or oak-hickory-pine overstory, while increasing understory diversity through prescribed fire. Prescribed fire is planned on a 3 to 5 year rotation. Although actual acres treated per year will vary due to units selected for treatment and treatment boundaries, an annual average of approximately 400 acres per year is treated during the rotation cycle. Currently, the Refuge does not have a FMP to perform prescribed fire management on other Refuge units.

Monitoring

All projects would be monitored to determine if treatment objectives were met and to document weather, fire behavior, fuels information, and smoke dispersion. Evaluation reports would be completed and maintained in the project file and accomplishment reports (namely, FMIS and NFPORS), as per agency requirements.

2.3.3 Current Wildlife Management

Threatened and Endangered (T&E) Species and Species of Concern

Monitoring and Research

The Refuge would continue contributing research efforts on the Ozark Subterranean Biodiversity Project, similar projects, and other cave fauna bio-inventories in collaboration with TNC and other NGOs, universities, state agencies, Tribal Nations, U.S. Forest Service, and NPS on all Refuge units and surrounding private lands.

Additionally, the Refuge would continue annual monitoring surveys of bat hibernacula and maternity sites, as well as cavefish and cave crayfish surveys. The technique used at the maternity sites consists of conducting an exit count as the bats emerge from the cave at night to forage using night vision optics, thermal videography, and infrared videography. For most gray bat maternity sites, guano pile measurements are taken in the fall or winter to estimate colony size. The technique used at the hibernacula consists of entering the cave and counting the bats. Radio telemetry and acoustic monitoring surveys would also be continued to gain insight on migration and movement corridors bat species utilize.

Partnerships
The Refuge would continue to partner with private landowners, NSS, TNC, the City of Tulsa, universities, GRDA, ODWC, and tribal governments to conduct monitoring and surveys on T&E species on- and off- Refuge. The Refuge would also continue partnering with OSU to perform genetic research on bat species to identify genetic diversity and gather information related to WNS.

Fire Management
See *Fire Management* above in 2.3.2 Current Habitat Management.

Migratory and Resident Bird Species
The Refuge would continue to conduct bird point counts during the spring and other migration seasons to monitor bird population and establish data trends over time. The Refuge would continue to use prescribed fire to promote ideal nesting/foraging habitat in Ozark forests for bird species (see *Fire Management* above in 2.3.2 Current Habitat Management). The Refuge would continue the policies of limited public use activities and maintaining continuous forest habitats to favor interior forest species.

Resident Non-T&E Species
Monitoring
The Refuge would continue to conduct mobile acoustic monitoring once or twice a month from the spring through fall from roadways and videography of cave entrances during the spring and summer to determine non-T&E bat population counts and habitat preferences. Collecting this information would allow the Refuge to continue assessing population declines due to WNS and habitat loss, focus conservation efforts on specific habitat types, and fulfill the Refuge's mission of preventing the listing of species.

Bioinventories
The Refuge would also continue approximately one bio-inventory in 2 or 3 caves every 5 years, determined by volunteers and other partners to monitor other cave species.

Invasive Fauna Species and Pest Management
As is currently, the Refuge would not manage for invasive fauna species or pests.

2.3.4 Current Public Use Management

Hunting
As is currently, the Refuge would not allow hunting.

Environmental Education (EE)
The Refuge would continue managing high quality, EE programs on the Looney Unit and at the MMLERC, by permit only. These programs would continue to be limited to 10-20 people, 2 or 3 times per month in the spring and fall, 1 or 2 times per month in the summer, and approximately once per month in the winter. These EE programs would be primarily "place-based" on Refuge resources- including on-site, field-based classes and experiences in Ozark forests, streams, riparian areas, and karst environments on the Looney Unit and/or on nearby private lands in cooperation with local residents.

EE programs would be hosted, sponsored, and lead in cooperation with multiple partners including: BCI, Blue Thumb, BSA, Campfire USA, Land Legacy, NSS, OTS, Tulsa Audubon Society, TNC, several universities and approximately 1,000 hours of volunteer time.

The Refuge would continue to coordinate Refuge-based collegiate-level classes and field trips, with the following universities: OSU, OU, RSU, NSU, UA, University of Southern Mississippi, University of Missouri, Missouri State University, John Brown University. As part of overnight EE programs, NGOs and university groups of approximately 30 people (50 maximum) would also continue "primitive" overnight camping in the designated area, by permit only, occurring approximately 12 weekends per year. Local K-12 school classes would continue to conduct site visits to the Looney Unit and MMLERC for resource education programs. In addition, the Refuge would continue to coordinate with tribal entities to provide tribal-hosted EE programs from a Native American cultural perspective in their Native language and in English to share information regarding cultural and natural resources, local ethno-botanical knowledge, and healthy living and cooking using native/natural edible plants.

Interpretation
The Refuge would continue to manage interpretive programs regarding cave and karst resources for approximately 25 people per month on-site at the Looney Unit and MMLERC, and five to several hundred people per month off-site at schools and events.

On-site interpretation programs would continue to be conducted in coordination with local residents, BCI, Blue Thumb, BSA, Campfire USA, Land Legacy, NSS, OTS, Tulsa Audubon Society, TNC, OSU, John Brown University, RSU, NSU, UA, and OU on the Looney Unit and

at the MMLERC. On-site programs (aside from introductory interpretive discussions for most EE groups that visit the Refuge) are primarily for school and youth groups, civic organizations, naturalists/scientists, university faculty and students, Tribal groups, Service staff, and other agency staff, and may include short interpretive hikes on primitive trails and discussions that interpret natural and cultural information regarding the Ozark ecoregion, karst ecosystem, geology, water resources, Native American cultural resources and paleo resources, federally listed T&E species, especially about bats and other cave species, species of concern, game and nongame species, migratory birds (including bird language), and cave technology demonstrations (Anabat acoustic detectors, real-time infrared and thermal videography, night vision, etc.). Refuge staff would also conduct visits to local K-12 schools, especially in October to make presentations on bats, usually during the Halloween season. In addition, Refuge staff would also continue hosting information booths and making presentations at public shows, such as the Illinois River Festival and the Wildlife Expo in central Oklahoma.

Wildlife Observation & Photography

The Refuge would continue to provide wildlife observation and photography opportunities by permit only on the Looney Unit, in conjunction with interpretive and/or EE programs, to view and/or photograph Ozark Plateau NWR's diverse habitats including Refuge forests, streams, and cave exteriors as well as wildlife including resident and migrating birds, mammals, fish, insects and butterflies, etc. There would be no opportunities for unescorted, unpermitted wildlife observation and photography.

Wood Harvesting

As is currently, the Refuge would not permit wood harvesting by the public.

Public Outreach

The Refuge would continue to maintain a Service website with limited information. Confidentiality would continue to be maintained to protect Refuge resources. As is currently, no pamphlets or fliers about the Refuge would be available.

2.3.5 Current Cultural Resource Management

Historical Sites

As is currently, the Refuge would protect historical sites by keeping areas confidential and limiting public access. The Refuge would continue partnering with SHPO and appropriate tribes to preserve these sites.

Archeological and Paleontological Sites

As is currently, four known archeological sites on Sally Bull Hollow, Potter, and Looney Units and short-faced bear and tapir remains on Gittin Down Mountain Unit would be kept confidential and public access to these sites would be limited. The Refuge would continue partnering with

SHPO, Sam Noble Museum archeologists and paleontologists (University of Oklahoma), and Tribal Nations to preserve archeological and paleontological sites.

2.3.6 Current Facilities & Infrastructure Management

Mary & Murray Looney Education & Research Center (MMLERC)
The Refuge would continue to operate and maintain the MMLERC, a 1,200 square feet, semi-renovated cabin with one meeting room, one office, 2 bathrooms, one sleeping room, and a kitchen. The MMLERC is ADA-accessible from the parking lot into the cabin. Adjacent to the MMLERC, there is an unrenovated outdoor pavilion consisting of 300 square feet enclosed studio space and a 200 square feet outdoor patio.

Access Roads
As is currently, the Refuge would continue to use and maintain a 0.25-mile, unpaved and unimproved (dirt/rock) access road to the MMLERC, with a gate. The Refuge would also utilize and maintain an unpaved parking area (power cut easement), between the entry gate and MMLERC, for approximately 10 vehicles near the MMLERC. Excess parking would also be available near the maintenance shop, next to the Guess House (150 yards). Refuge staff would also utilize a very narrow access road to the Beck Unit maintenance shop, which currently does not have a turn-around area.

Nature Trails and Overlooks
Currently, the Refuge would utilize and maintain a few trails around the Refuge including a deteriorating path from the MMLERC to the pavilion, a small path from the parking area to the MMLERC, one 1/4-mile trail from MMLERC to Spavinaw Creek, 1/8-mile trail from MMLERC to the old garden area at top of hill, 150-yards trail from Guess House to the MMLERC, and 1/4-mile trails near the Guess House on the Looney Unit. As is currently, there would be no established overlook areas.

Public Use Signs and Interpretive Displays
As is currently, the Refuge would continue to neither post public use signs for any Refuge units, except for outside of caves stating that they are closed to the public, nor interpretive displays at the MMLERC/Looney Unit.

Refuge Headquarters Site
The Refuge would continue to operate Refuge Headquarters at the MMLERC, which provides only one office and is primarily used for EE and interpretation programs. Therefore, Refuge staff would continue to work out of non-centralized office spaces including the Oklahoma Ecological Services (ES) Field Office in Tulsa, the MMLERC (Refuge), and/or Sequoyah NWR.

Boundaries

As is currently, there are over 36 miles of unit boundaries with a total of over 4 miles of fencing and 11 gates that would be maintained and repaired by Refuge staff. Only two of the Refuge units have been completely surveyed and marked. The following table (Table A-4) shows an assessment of current Refuge boundary needs and infrastructure to maintain.

Table A-4. 2012 Refuge Boundary Assessment

Refuge Unit	Boundary	Surveyed?	Marked?	Fencing?	Gates?
Looney	>1.37 mi.	X	X	X	2
Liver	3.14 mi.	X	X	-	1
Potter	unknown	(partial)	(partial)	-	1
Sally Bull Hollow	15.42 mi.	-	-	-	4
Gittin Down Mountain	3.87 mi.	-	-	-	-
Varmint	1.24 mi.	-	-	-	-
Boy Scout	1.93 mi.	-	-	-	1
Beck	2.99 mi.	-	-	X	3
Eucha	2.51 mi.	-	-	-	-

Maintenance Shops and Service Buildings

The Refuge would utilize and maintain two maintenance shops and one storage building: Beck Unit Shop: 50’ x 30’ metal building on concrete pad for cave gate construction and storage; Looney Unit: 50 x 30 metal building on concrete pad for all other maintenance, containing a WNS decontamination site; and Guess House metal storage building: 30' x 20'.

Refuge Housing

The Refuge would continue to provide Refuge housing for Refuge staff at the Guess House, located on the Looney Unit and one bedroom for volunteers, researchers, interns, educators, Refuge staff, and other guests at the MMLERC cabin. In addition, the Refuge would currently maintain an agreement with Leslie Krause, in which, after he resides and maintains Krause House on the Beck Unit, the house reverts to the Refuge (via donation) at termination of agreement.

2.3.7 Current Refuge Administration

Funding and Staffing

The Refuge would continue to receive funding and staffing for operations, infrastructure and maintenance, through the Department of the Interior budget approved by Congress, and allocated to the Refuge by the Southwest Regional Office of the U.S. Fish & Wildlife Service. Refuge staff would continue to seek additional funding elsewhere such as applying for grants and

working with NGOs in order to implement all current and future management activities and educational programs.

Volunteers/Friends Program

The Refuge does not have an official Friends group established. However, the Refuge would continue provide volunteer opportunities for:

- informal Friends support from NSS local chapters (cavers)
- 2 part-time, resident volunteers at Guess House (Looney Unit) for management activities such as: mowing, building/property maintenance, security, visitor coordination at MMLERC (20 hours per week by agreement).
- 1 part-time, resident volunteer at Krause House (Beck Unit) for management activities such as: mowing, maintaining fences, assisting with cave gate construction, cleaning up trash/litter, ice damage recovery and cleanup, and maintaining security at Beck Unit (approximately 10-20 hours per week on a volunteer basis).
- Approximately 25 individuals as part-time, non-resident volunteers and approximately 10 to 15 organizations that maintain a habitual relationship with the Refuge to offer volunteer services and labor from a number of individuals (several hundred) for management activities such as: cave mapping, cave gate construction/repair/maintenance, EE, invasive plant removal, trail maintenance, litter and trash cleanup, cabin renovation and maintenance, chimney repair, 2010 Ozark Summit administration and support, research and citizen science, and wildlife inventorying and monitoring (approximately 5,000 to 10,000 person hours total per year).

Coordinate Beyond Service Regional Boundaries to More Effectively Manage Federally Listed Cave Species on a Landscape Level

Ozark Plateau NWR would continue to be managed by dedicated staff for the purpose(s) listed below:

- Assure the continuing existence, and aid in recovery of federally listed endangered and threatened Ozark cave species
- Reduce the need for future listing of species of concern in the Ozarks
- Protect large continuous stands of Ozark forest essential to migratory interior forest birds
- Provide important environmental educational opportunities identifying the need for protecting fish and wildlife and other karst resources of the Ozarks.

Meanwhile, other nearby cave resource satellite refuges including Logan Cave NWR, Cave Fish NWR, and Pilot Knob NWR would continue to be managed by staff from refuges that primarily manage habitats other than caves. Ozark Plateau NWR staff, with its experience and expertise in karst management, would continue to cooperate with Hollow Bend NWR staff to assist in

developing management plans and activities for Logan Cave NWR. The Ozark Plateau NWR Refuge staff would also continue working closely with Cave Fish and Pilot Know NWRs (managed out of Mingo NWR) in Missouri. However, there would be no current management agreement to ensure that this continues.

2.4 Alternative B – Proposed Action (Proposed Future Management)

2.4.1 Proposed Landscape-level Management

Ozark Habitat Loss & Fragmentation

Land and Conservation Easements Acquisition from Willing Sellers and Conservation Agreements

The Refuge would continue those actions identified in Alternative A, plus the Refuge would partner with Service Regions 2, 3, 4 and 6 to establish an expanded acquisition boundary in the Ozark ecoregion.

Partnerships

The Refuge would continue actions described in Alternative A, plus the Refuge would increase collaboration and partnerships at a landscape-level on public and private lands, crossing state and regional boundaries, with private landowners, conservation organizations, universities, state agencies, Tribal Nations, and other federal agencies.

Restoration

Same as Alternative A, plus the Refuge would maintain, conserve, and/or restore up to 15,000 acres of acquired lands to natural forest habitat (see 2.4.2 Proposed Habitat Management).

Climate Change

Monitoring

The Refuge would continue the same management in Alternative A, plus it would implement long-term monitoring of habitat and wildlife to better understand the impacts of climate change. Monitors would consist of fixed, solar-powered acoustic monitoring stations (Anabat) at cave locations. The Refuge would partner with universities to determine the best locations for monitoring. The Refuge would also expand its data loggers program to collect air temperature, humidity, light, cave rock temperature, groundwater elevation, and cave stream temperature data at cave, surface and groundwater locations on each unit every hour everyday year-round.

In addition, the Refuge would identify bat, bird, and other wildlife species migration routes/corridors utilizing various methods (i.e., conduct acoustic route monitoring, banding, tagging, and using radio transmitters, radar technology, and other technology). Then it would use GIS to delineate high risk areas based on identification of migration corridors to understand how climate change is affecting migratory routes on a landscape-level.

The Refuge would install permanent weather stations at the Looney, Boy Scout, and Sally Bull Hollow Units, and any appropriate new areas acquired to establish baseline climate information and measure trends over time. The weather stations would be approximately 4 feet by 4 feet on a concrete pad with a five feet tall box to house the instruments and gauges.

Green Infrastructure

Same as Alternative A, plus the Refuge would install solar panels on the MMLERC, Guess House, or near previously disturbed, infrastructure areas on the Looney Unit and potentially on any newly acquired or developed buildings, if amount of sun and location is appropriate, to offset carbon and rely mostly on alternative energy sources.

In the case that the Refuge establishes a new Refuge Headquarters/Visitor Center site (see 2.4.6 Proposed Facilities & Infrastructure Management: *Refuge Headquarters*) it would also install solar panels on the roof of the new building or where amount of sun is appropriate. The Refuge would install solar panels on some new buildings developed or acquired as a part of new Refuge units, if appropriate.

The Refuge would install and/or maintain energy efficient heating and cooling systems and appliances on Refuge buildings such as geothermal heating and cooling system, proper insulation in the walls, ceilings, and subfloors, double-pane windows, energy-efficient stove, refrigerator, dishwasher, on-demand hot water, and washer and dryer in all (utilized) Refuge buildings, including the new Headquarters site. The Refuge would also refit buildings with rain collection equipment to capture rainwater for irrigation purposes. A water filtration system would also be installed and maintained at the MMLERC and all other Refuge buildings to utilize local water resources and reduce carbon emissions and waste associated with bottled water.

Carbon Sequestration

The Refuge would continue protecting and managing up to 15,000 acres of mostly forested lands, enhancing carbon sequestration. The Refuge would either acquire lands that already have large, continuous stands of native oak-hickory forests and preserve them or it could restore native oak-hickory forests on lands that were previously used for agricultural purposes or deforested.

Restoration would involve prescribed fire, mowing, tilling, and thinning with chainsaws and tractors if necessary, to initially remove non-native vegetation followed by planting native oak and hickory trees (moderately stocked with an herbaceous understory) to provide continuous stands of oak-hickory forest for the benefit of migratory birds and foraging habitat for bats (see also 2.4.2 Proposed Habitat Management). This would include restoration of 50 acres of improved pasture lands on the Beck Unit back to native forest habitat by mowing existing Bermuda grass and fescue in the spring for three consecutive years, and replanting area with

moderately stocked native oak-hickory trees and grasses after successful eradication of non-native invasive species.

Surface and Groundwater Quality & Quantity

Land and Conservation Easements Acquisition from Willing Sellers

Same as Alternative A.

Groundwater Mapping

Same as Alternative A, plus work with Service Water Resources Division to create groundwater level contour maps to map water wells on or surrounding the Refuge.

Monitoring

The Refuge would continue management actions in Alternative A, plus the Refuge staff would work with USGS and local universities to implement a permanent water quality and quantity monitoring program, instead of the current opportunistic water sampling.

To implement a permanent water quality monitoring program, the Refuge would install small water quality measurement devices (semi-permeable water sampling devices and other automated water quantity and quality sampling devices), submerge them in cave and surface streams, leave them for one month, send monitoring results to a laboratory for analysis, record data, and schedule this procedure to re-occur every 5 years in wells, streams, such as Spavinaw Creek, and caves, including January-Stansberry, Duncan Field, Crystal, Boy Scout Cave, and any other new caves acquired, to measure contaminant levels and how they affect cavefish. In addition, the Refuge would implement the same permanent water quality program off-refuge at the Twin, McGee, Long's, Jailhouse caves and other appropriate cave discoveries.

The Refuge would also implement a long-term water quantity monitoring program, consisting of installing water quantity devices permanently, to record data constantly, reviewing results every two years to establish baseline data on water levels and identify trends in water levels in wells on or surrounding the Refuge, as well as January-Stansberry, Duncan Field, Crystal, Twin, other new caves acquired, and any other important caves within the landscape-level.

Partnerships

Same as Alternative A, plus pursue partnerships with commercial firms and businesses within the ecoregion.

White-nose Syndrome (WNS)

WNS National Plan

As in Alternative A, the Refuge would continue to implement actions from the WNS National Plan, as it is updated.

Monitoring
Same as Alternative A plus the Refuge would coordinate and partner with universities to implement a permanent monitoring program in forests and caves to determine which bat species are being affected by WNS. The Refuge would also partner with laboratories in Oklahoma and Arkansas, NSS, and with ES, to track movement and occurrence data of WNS for each bat species, search for bat mortality in caves, collect data on soil and cave substrate samples, and search for physical signs of WNS-effected bats. The Refuge would deposit data in a central WNS research warehouse. The Refuge would continue cave access monitoring and construction of cave gates to control access to caves and prevent the potential spread of the fungus, *Geomyces destructans*, by unauthorized people. The Refuge would coordinate more closely with Tribal Nations, State agencies, and caving organizations to search on- and off-Refuge caves for affected or deceased bats and to collect data on soil and air samples. In addition, the Refuge would continue conducting genetic sampling to identify which populations are genetically isolated, by comparing nuclear and mitochondrial DNA among bats from essential maternity caves.

The Refuge would also collaborate with multiple landscape-level partners to identify migration corridors of bat, bird or other wildlife species by utilizing various methods (i.e., conduct acoustic route monitoring, banding, tagging, and using radio transmitters, radar technology, and other technology) and use GIS to delineate high risk areas based on identification of migration corridors to help track movement of WNS on a landscape-level.

Public Outreach
Same as Alternative A.

Cave Access Control
Same as Alternative A, but the Refuge would increase law enforcement (LE) presence and monitoring of caves by Refuge staff and a LE Officer based out of Sequoyah NWR, who would dedicate part of his/her time to working for Ozark Plateau NWR to include routine visits once every month or variable by season based on bats' use of the caves.

Additionally, the Refuge would investigate the feasibility and necessity of installing motion- and light-activated alarms inside all essential maternity and hibernacula caves, and do so when and where deemed feasible. The alarms would notify Refuge staff and LE of any intruders and would record occurrences.

Wind Energy Farms
Monitoring and Research
The Refuge would continue actions in Alternative A, plus would conduct research projects with local universities, energy companies, USGS, and other partners to identify corridors and routes for bat migration by utilizing various methods (i.e., conduct acoustic route monitoring, banding,

tagging, and using radio transmitters, radar technology, and other technology). It would also use GIS to delineate high risk areas based on identification of migration corridors. It would also quantify impacts and investigate potential mitigation measures. The Refuge would work with ES to develop a resource map to demonstrate range of bat habitat, focusing on sensitive areas, migration routes, and population densities.

2.4.2 Proposed Habitat Management

Degradation of Cave, Stream, and Forest Habitat

Cave Protection

The Refuge would continue actions described in Alternative A, but the LE officer based at Sequoyah NWR would increase LE presence and monitoring of caves with routine visits once every month or variable by season based on bats' use of the cave. Additionally, the LE officer would monitor to prevent illegal timber harvesting on all Refuge units. Similar to those actions described for WNS, the Refuge would install and develop alarm systems and/or infrared video cameras at essential maternity and hibernacula caves (approximately 14 caves), on- and off-Refuge to deter and detect cave vandalism.

In addition, the Refuge would increase cave protection efforts by searching for new caves to protect. This would be accomplished first by partnering with local cavers, NSS, universities, Tribal Nations, USGS, Service I&M, and other organizations or agencies to map full subterranean extent of known caves to identify all surface cave entrances (which may lead to other unidentified caves), and then "ridge walking" areas that are conducive to cave formation on- and of-Refuge to identify unknown cave sites. This includes walking along faults, contacts, depressions, springs, sinking streams and/or other appropriate geological areas which may lead to potential cave locations. Utilizing technology such as satellite and aerial imagery (to look for features indicative of having a cave opening), thermal imagery (to locate potential hot or cold zones), radio telemetry (track bats to unknown roost sites), and others would also help the Refuge to locate and protect important cave habitats.

Fire Management

See *Fire Management* category below.

Boundaries

Same as Alternative A.

Partnerships

The Refuge would increase participation with Partners for Fish and Wildlife Program to assist adjoining and nearby landowners with wildlife and cave and forest management on private lands with more on-the-ground time discussions with landowners and educating them on the importance of caves and surrounding resources. The Refuge would also work with ODWC and

ES to increase Section 6 of Endangered Species Act funding for cave gating projects, controlled burns, fencing, wetlands restorations, invasive species removal and planting of native species on tribal, state-owned, and private lands. The Refuge would also increase partnerships by going to meetings, working on joint projects, and contracting through cost-share or joint funding to assist them with their projects.

Lack of Detailed, Scientific Cave Habitat Data

Research and Monitoring

The Refuge would continue actions described in Alternative A, plus it would work with universities and other partners to develop a habitat suitability index model for cave species which would determine optimum cave habitat requirements for species such as Ozark big-eared bats, gray bats, Ozark cavefish, Oklahoma cave crayfish, Delaware County cave crayfish and other federally listed species and species of concern as needed. The Refuge would employ the best adaptive management practices according to the requirements discerned out of the model(s). In addition, the Refuge would research effects of prescribed fire/thinning on cave habitats and impacts to Ozark big-eared and gray bats. The Refuge would also implement a monitoring program for non-listed cave species to establish baseline information, including the use of acoustic equipment/monitors, surveys conducted by Refuge staff and partners, and macro-invertebrate and other cave fauna sampling.

Also see 2.4.1 Proposed Landscape-level Management: *Climate Change: Monitoring*.

Invasive Flora

Monitoring

The Refuge would work with partners such as landowners, NGOs, universities, state agencies, Tribal Nations, and federal agencies to identify, document, and monitor all plant species (native and non-native) occurring on the all units of the Refuge. The Refuge would continue to reassess changes in vegetation throughout the lifetime of this CCP in order to identify which non-native flora species are causing the greatest (negative) impact to T&E species, species of concern, and/or representative species. If deemed necessary, the Refuge would develop an Integrated Pest Management Plan to further address the issue.

Fire Management

See *Fire Management* category below.

Herbicide Treatment

The Refuge would rather refrain from using chemicals in management activities, however, in the event that invasive non-native species become uncontrollable and hazardous to the health of the habitat's ecosystem, the Refuge would use herbicides to spot-treat invasive flora species including: Japanese honeysuckle; sericea lespedeza; Chinese privet; shrubby lespedeza; tall

fescue; yellow sweetclover; puncturevine; stinkgrass; shepherd's-purse; watercress; fivestamen tamarisk; barnyardgrass; curly dock; field bindweed; Johnson grass; mimosa; tall fescue; Russian-olive; ground ivy; red clover; hairy vetch and others that become a threat to important native plant and/or fauna species. The Refuge would apply one to three applications per year of Garlon 3A, (made of LI-700 , Methylated seed oil, MSO , Fighter-F 10, Ethanol, Triethylamine, and EDTA), on problematic areas of newly acquired lands or existing Refuge Units between the months of March through November. Applications to a cut stump would be done by hand or backpack using 50% solution and applications for ground spot treatment would only be 2% solution. The Refuge would employ best management practices during planning and application of all herbicide use including: application at wind speeds less than 10 mph (but not inversion conditions) - must follow label; calibrate application equipment; field scouting/monitoring before pesticide application; pesticide application buffers around sensitive areas; use lowest effective application rate; and vegetative buffers. The Refuge would not apply chemical herbicides in sensitive groundwater recharge areas or above karst topography that is conducive to filtrating into fragile cave habitat.

Mechanical Treatment

The Refuge would continue actions described in Alternative A, plus the Refuge would increase mechanical removal of problematic non-native invasives to include all Refuge Units on approximately 50 acres per year for the first 5 years, then decreasing each year as non-native invasives are controlled to approximately 10 acres per year in a continuous maintenance regimen.

Partnerships

The Refuge would continue actions described in Alternative A, plus would increase the number of agreements with surrounding private landowners for prescribed fire to include burning up to approximately 1/3 of the total Refuge adjoining lands (see *Fire Management* below).

Fire Management

Wildfire Management

The Refuge would continue actions described in Alternative A, plus the Refuge would address wildfire policy and management in a Refuge-wide FMP. Additionally, the Refuge would increase funding available to support the Wildland-Urban Interface Program.

Prescribed Fire

The Refuge would continue actions described in Alternative A for the Looney and Sally Bull Hollow Units, plus the Refuge would develop a FMP for all Refuge Units, including burn plans and a training program for Refuge staff, to increase the use of prescribed fire to 1/3 of the Refuge's total acreage per year including future acquired lands (approximately 1,300 acres in 2012), in 3 to 5 year rotations.

The Refuge would increase communication and build relationships with surrounding private landowners to increase the number of agreements for prescribed fire to include burning up to 1/3 of the total Refuge adjoining lands on a 3 to 5 year rotation. The Refuge would partner with private contractors, local fire departments, OSU, the Oklahoma State Forestry Division, tribal entities, NPS, Forest Service, etc. to assist in prescribed burns efforts.

Monitoring
The Refuge would research the effects of prescribed fire and midstory thinning on forest and cave habitats and how they impact T&E and representative species such as Ozark big-eared and gray bats. The Refuge would employ the best adaptive management practices according to results of these studies.

2.4.3 Proposed Wildlife Management

Threatened and Endangered (T&E) Species and Species of Concern
Monitoring and Research
The Refuge would continue actions described in Alternative A, plus the Refuge would establish permanent, stationary acoustic monitors, both inside and outside of caves, on all units determined necessary to record bat calls and identify which bat species use which caves and at what season/time(s) of the year.

The Refuge would establish a permanent acoustic survey program on designated routes, instead of the current temporary (2-year) program, in order to learn more about foraging ecology and roost sites outside of caves. This program would include utilizing radio tracking, a permanent mobile and stationary acoustic survey program, transects, insect surveys, guano dissection, vegetation surveys, and other methods on and around the Refuge to determine listed and non-listed foraging bat species presence and distribution, roost tree sites, foraging habitat preferences, habitat conditions that affect foraging ecology, and monitor these trends overtime. The Refuge would also work closely with Service I&M to create a database documenting these results and would use data to guide adaptive management to best maintain and/or restore forest habitat and other bat foraging habitats.

As mentioned in 2.4.2 Proposed Habitat Management: *Lack of Detailed Scientific Cave Habitat Data*, the Refuge would work with partners to develop a habitat suitability index model to determine optimum forest and cave habitat requirements for Ozark big-eared bats, gray bats, Ozark cavefish, Oklahoma cave crayfish, Delaware County cave crayfish and other federally listed species and species of concern as needed, and employ the best adaptive management practices to meet these requirements.

The Refuge would continue partnering with OSU and other scientific organizations to perform genetic research on- and off- Refuge of bat, crayfish, cavefish, and other cave species in order to

identify undetermined cave species, determine population dynamics, identify genetic diversity, etc., by comparing nuclear and mitochondrial DNA samples.

The Refuge would install permanent cameras in the January-Stansberry Cave and/or other appropriate caves to monitor bat activity to provide additional scientific information (i.e., seasonal use of the caves by the bats, observe bat behavior, etc.) and monitor human disturbance. In addition, these cameras could provide online web-streaming during the maternity season for interpretation purposes twenty-four hours per day.

Fire Management
See *Fire Management* above in 2.4.2 Proposed Habitat Management.

Migratory and Resident Bird Species
The Refuge would continue actions described in Alternative A, plus the Refuge would work with landowners, bird conservation organizations, state agencies, Tribal Nations, and federal agencies to identify migratory bird species occurring near or on the Refuge during the spring and fall (compile a species list). The Refuge would also conduct seasonal nesting studies and MAPS banding of birds once a month for six months each year on the Refuge in cooperation with partners, such as the Audubon Society and universities, to gather additional data on migration corridors, paths, origins and destinations, as well as population data trends. The Refuge would implement recommendations from the Partners in Flight Plan and coordinate with them on migratory bird conservation management including research such as identify the quantity, quality and spatial configuration of available habitat, link habitat condition and population response, and anticipate future habitat conditions, in order to set and achieve population objectives for priority landbirds of the Central Hardwood Bird Conservation Region.

Also, the Refuge would increase the use of prescribed fire, as described in 2.4.2 Proposed Habitat Management: *Fire Management*, from 400 acres per year to 1/3 of the Refuge's total acreage per year (approximately 1,300 acres total in 2012) to improve Refuge habitats to support bird species.

Also see 2.4.1 Landscape-level Management: *Ozark Habitat Loss & Fragmentation* and 2.4.2 Habitat Management: *Degradation of Cave, Stream and Forest Habitat*.

Resident Non-T&E Species
Monitoring
The Refuge would continue actions described in Alternative A, plus the Refuge would establish permanent, stationary acoustic monitors, both inside and outside of caves, on all units determined necessary to record bat calls and identify which bat species use which caves and at what time(s) of the year. The Refuge would also establish a permanent mobile acoustic survey program on

designated routes, instead of the current temporary, 2-year program, in order to learn more about foraging ecology and roost sites outside of caves. This program would include utilizing radio tracking, a permanent mobile and stationary acoustic survey program, transects, insect surveys, guano dissection, vegetation surveys, and other methods on and around the Refuge to determine listed and non-listed foraging bat species presence and distribution, roost tree sites, foraging habitat preferences, habitat conditions that affect foraging ecology, and monitor these trends overtime. The Refuge would also work closely with Service I&M to create a database documenting these results and would use data to guide adaptive management to best maintain and/or restore forest habitat and other bat foraging habitats.

The Refuge would perform annual monitoring count surveys of all non-T&E cavefish and mark recapture of cave crayfish to understand population trends.

In addition, the Refuge would work with cooperative landowners, NGOs, universities, state agencies, Tribal Nations, USGS, Service I&M and other federal agencies to continue monitoring and conducting surveys of invertebrates, herpetofauna, fish, birds, and mammals to identify and document all wildlife species occurring on all units of the Refuge, potential acquisition areas, and with cooperating adjacent and nearby landowners (compile a species list). The Refuge would continue partnering with OSU, other universities, and other scientific organizations to perform genetic research on- and off- Refuge of bat, crayfish, cavefish, and other cave species to identify undetermined cave species, determine population dynamics, identify genetic diversity and isolation, etc.

Bioinventories

The Refuge would continue actions described in Alternative A, plus the Refuge would establish a scheduled monitoring program in which specific caves (approximately 5 caves per year) would be inventoried on a five-year rotation by the Refuge to monitor cave resources.

Invasive Fauna Species and Pest Management

Monitoring

The Refuge would work with partners such as landowners, NGOs, universities, state agencies, Tribal Nations, and federal agencies to identify, document, and monitor all species (native and non-native) occurring on the all units of the Refuge. The Refuge would perform studies in cooperation with partners to identify which non-native wildlife species are causing the greatest (negative) impact to native flora, wildlife T&E species, species of concern, and/or representative species. If deemed necessary, the Refuge would develop an Integrated Pest Management Plan (step-down plan) to further address specific management for invasive species (flora and fauna).\

Feral Hogs
The Refuge would conduct a feral hog population study and, if deemed necessary, Refuge staff would consider partnering with adjoining landowners to sterilize and/or shoot and/or trap feral hogs found on and around the Refuge in an Integrated Pest Management Plan.

Feral Cats
The Refuge would conduct a feral cat population survey and, if deemed necessary, Refuge staff would consider partnering with adjoining landowners to sterilize and/or shoot and/or trap feral cats found on and around the Refuge in an Integrated Pest Management Plan.

Hothouse Millipede
The Refuge would conduct research with partners to determine Hothouse millepede population occurrence, impacts on cave resources, and if necessary, potential eradication strategies in an Integrated Pest Management Plan.

2.4.4 Proposed Public Use Management

Hunting
In this alternative, the Refuge would develop a Hunt Plan, in accordance with 605 FW 2.9, to allow walk-in only, open access hunting according to State regulations, on the Sally Bull Hollow Unit of the Refuge, adjacent to the State wildlife management area (WMA), called Ozark Plateau WMA, managed by ODWC. Hunting regulations would be coordinated with ODWC and would ideally be identical to those of Ozark Plateau WMA. The Refuge would inventory and monitor federally listed endangered cave species on the Sally Bull Hollow Unit to identify whether this public use causes any adverse effects, and would coordinate with the ODWC to modify hunting regulations, if necessary. The Refuge would also evaluate the feasibility of allowing hunting on other areas of the Refuge as lands are acquired (such as in the case of acquiring migratory waterfowl habitat, etc.).

Environmental Education (EE)
The Refuge would continue to conduct EE programs on the Looney Unit, by permit only, in cooperation with multiple local partners, plus the Refuge would provide more EE opportunities and programs. It would increase EE visitation to 50-100 people per week, with 3-4 visits per week in spring, fall, and summer, and approx. 10-20 per week with 1-2 visits per week in winter. The Refuge would continue to seek funding, write grants, oversee contracting, and do all that is necessary to provide funding to its partnering NGOs in order to provide all current and future EE programming and staffing needs. If needed, the Refuge would also develop a Visitor Services Plan (step-down plan) to further develop facilitation and management of visitor services opportunities, including EE.

When staffing and funding are available, the Refuge would engage in the planning, development, leadership, and evaluation of EE programs in order to determine effectiveness of current programs and better design future EE programs regarding Ozark Plateau NWR resources. This would also include developing curriculum and workbook documents in conjunction with EE partners for current and future EE programs.

The Refuge would also expand its EE programs for after- and home-school student programs and create a Teacher Continuing Education and General Education Credits program. It would also collaborate with master gardeners and master naturalists to lead EE hands-on gardening programs on growing traditional foods and herbs (seeds provided by Cherokee Nation) in raised garden beds and landscape design using native plants (aesthetically-pleasing landscape, while also benefitting native wildlife such as birds and pollinators). MMLERC would be utilized as a quarterly training and meeting site for the local master gardeners.

In addition, Refuge staff would develop curricula and conduct training for Service and other partner agencies staffs on effective EE methods based on "coyote mentoring" techniques (Young, et. al., 2010) to effectively accomplish national goals associated with Connecting People with Nature (CPWN) and Youth in the Great Outdoors (YGO), using the Ozark resources as a vehicle and example. Coordinate curricula with Region 2 Regional Office Division of Visitor Services and NCTC. Training would be Refuge-based due to the proximity of four states, four Service regions, the Ozark ecoregion common to all four states/regions, and other unique landscapes and facilities.

The Refuge would improve the MMLERC cabin and Looney Unit access roads and trails associated with EE (see 2.4.6 Proposed Facilities & Infrastructure Management).

Interpretation

The Refuge would continue actions in Alternative A, plus the Refuge would create new interpretive programs to include permaculture gardening in collaboration with the Tribal Nations and master gardeners, and it would also showcase Refuge use of sustainable/green technologies. The Refuge would engage in the planning, development, leadership, and evaluation of interpretive programs in order to determine effectiveness of current programs and better design future programs regarding Ozark Plateau NWR resources, when funding and staffing are available. If needed, the Refuge would also develop a Visitor Services Plan (step-down plan) to further develop facilitation and management of visitor services opportunities, including interpretation.

In accordance with the contemporary WNS National Response Plans in effect at the time, the Refuge would resume limited interpretive programs within caves, by permit and/or under escort by Refuge staff. The Refuge would update its website(s) and create a flier/brochure advertising visitor services opportunities, including EE and interpretation programs at MMLERC/Looney

Unit, with contact information. Lastly, the Refuge would stream a live video of bat activity within caves on the web as an opportunity to engage in off-site interpretation.

The Refuge would improve the MMLERC cabin and Looney Unit access roads and trails associated with interpretation programs (see 2.4.6 Proposed Facilities & Infrastructure Management).

Wildlife Observation & Photography

The Refuge would continue actions in Alternative A, however, once Sally Bull Hollow Unit is surveyed and marked, the Refuge would also allow wildlife observation at Sally Bull Hollow Unit with walk-in access only at all times of the year aside from hunting season. Sally Bull Hollow Unit is adjacent to the State-managed Ozark Plateau WMA, which allows wildlife observation with walk-in access as well. The Refuge would also explore additional opportunities for wildlife observation and photography as lands are acquired. The Refuge would continue to prohibit wildlife observation and photography from within caves, in accordance with the current WNS National Plan.

The Refuge would install photography blinds and three primitive overlook areas in appropriate areas that would cause minimal to no disturbance to vegetation and/or wildlife adjacent to Looney Unit primitive trails and potentially on other acquired lands, if appropriate, as stopping points for wildlife observation and photography and/or for EE and interpretation programs. (Also see 2.4.6 Proposed Facilities & Infrastructure Management: *Nature Trails and Overlooks* and *Public Signs and Interpretive Displays*).

Wood Harvesting

Wood harvesting would only be permitted if Refuge forest and wildlife management needs dictate, such as after ice or wind storms, selective thinning by the Refuge, and for fuel reduction. In the event that the Refuge would need additional assistance in removal of downed-trees or fallen wood for wildlife and forest management needs, the Refuge would contact interested landowners, NGO partners, NRCS, ODWC, and other state and federal agencies, as well as Tribal Nations, to notify the public of wood harvesting opportunities. For interested individuals, a special use permit would be issued. The public would not be permitted to cut down any live or dead-standing trees, however, they would be permitted to cut and harvest using chain saws, axes, or other handtools, to remove downed-trees and haul away with trucks, trailers and 4WD vehicles on designated Refuge roads only. If necessary, the Refuge would contract for the removal and use of excess wood.

Public Outreach

The Refuge would create a flier/brochure to advertise visitor services opportunities and update Refuge websites (http://www.Service.gov/southwest/refuges/oklahoma/Ozark/ and

http://www.Service.gov/refuges/profiles/recEdMore.cfm?ID=21645) to inform the public of current programs and recreational opportunities, including contact information (while cave locations continue to remain confidential). The Refuge would also work with dedicated volunteers to establish an official Friends group, which would increase public outreach efforts.

2.4.5 Proposed Cultural Resource Management

Historical Sites

The Refuge would continue actions in Alternative A, plus it would increase LE (from Sequoyah NWR) to provide better security to known sites.

Archeological and Paleontological Sites

The Refuge would continue actions in Alternative A, plus it would increase LE (from Sequoyah NWR) to provide better security to known sites.

2.4.6 Proposed Facilities & Infrastructure Management

Mary & Murray Looney Education & Resource Center (MMLERC)

The Refuge would remodel and renovate the MMLERC to make the building safe, more energy-efficient, conserve water, make ADA-accessible, more secure, as well as to ensure adequacy of plumbing and electrical systems. Actions under this alternative would include: Renovate the roof; Insulate the basement and attic; Renovate the cabin exterior (replace logs and grout, seal the exterior, paint exterior trim, and repair the retaining wall behind the cabin); Renovate flooring of porch and ensure porch railing meets safety standards; Renovate flooring of porch and ensure porch railing meets safety standards; Renovate front door to be ADA-accessible; Renovate one bathroom in the EE center to include an accessible entrance and shower; Install monitored alarm system in cabin; Replace plumbing system, if necessary; Replace electrical system, if necessary; Replace propane gas lines, if necessary; Install energy-efficient exterior storm windows; Maintain water filter for drinking water to reduce energy and waste associated with bottled water; Install rainwater collection system for irrigation purposes; Collaborate with master gardeners and master naturalists to build raised garden beds and to re-landscape with native plants around the MMLERC, using permaculture methods; Install solar panels on area with the most sunlight on the Looney Unit, to offset carbon and rely mostly on alternative energy sources; Use energy-efficient heating and cooling system and appliances (geothermal heating and cooling system, insulation, double pane windows, stove, refrigerator, dishwasher, on-demand hot water, washer and dryer) on all Refuge buildings; Maintain energy-efficient heating and cooling air duct systems and appliances; Install audio/visual technology (i.e. ceiling-mounted projector, etc.) for modern methods of teaching EE programs (i.e., power points, etc.); and remove small cabin building (but retain existing fireplace) adjacent to MMLERC and replace with a 800 sq. ft. outdoor pavilion studio space (partially open, partially covered), that would also bridge the stream in a previously-disturbed site.

Access Roads

The Refuge would continue to maintain current access roads and parking areas, plus it would work with Refuge personnel to improve its roads and parking areas including: Widen the MMLERC access drive by 2 feet and improve with gravel, including parking area; Improve road with gravel from county road to maintenance shop (next to Guess House) on the Looney Unit; Improve parking area surfaces with gravel at both the overflow parking, near maintenance shop, and parking on top of MMLERC road; Improve 0.3 miles of gravel road on the Beck Unit for Refuge management access; and improve and/or maintain roads on newly acquired lands, where necessary.

Nature Trails and Overlooks

The Refuge would establish a 0.25-mile mostly primitive trail to connect the MMLERC pavilion/Spavinaw Creek trail to the maintenance shop trail (move old concrete, some boulders). The Refuge would build a new 2-mile primitive trail (no clearing or removing of trees or large shrubs, however some boulders may need to be removed and some small creek-crossing bridges may need to be built) around the perimeter of the Mary & Murray Looney Unit to connect to the MMLERC-Pavilion-Spavinaw Creek trail, the maintenance shop trail, and the parking area trail. The Refuge would repave the 0.1-mile concrete path from the MMLERC cabin to the pavilion. The Refuge would improve the 0.25-mile trail with gravel from the Looney maintenance shop to the MMLERC. Also the Refuge would improve the 0.1 mile primitive trail with gravel from the parking/camping area on top of the hill down to the MMLERC to ensure safety. (See Figures A-2 and A-3).

The Refuge would install photography blinds and three primitive overlook areas in appropriate areas that would cause minimal to no disturbance to vegetation or wildlife adjacent to Looney Unit primitive trails and potentially on other acquired lands, if appropriate, as stopping points for wildlife observation and photography and/or for EE and interpretation programs.

Figure A-2. Current and proposed infrastructure and trails on Looney Unit.

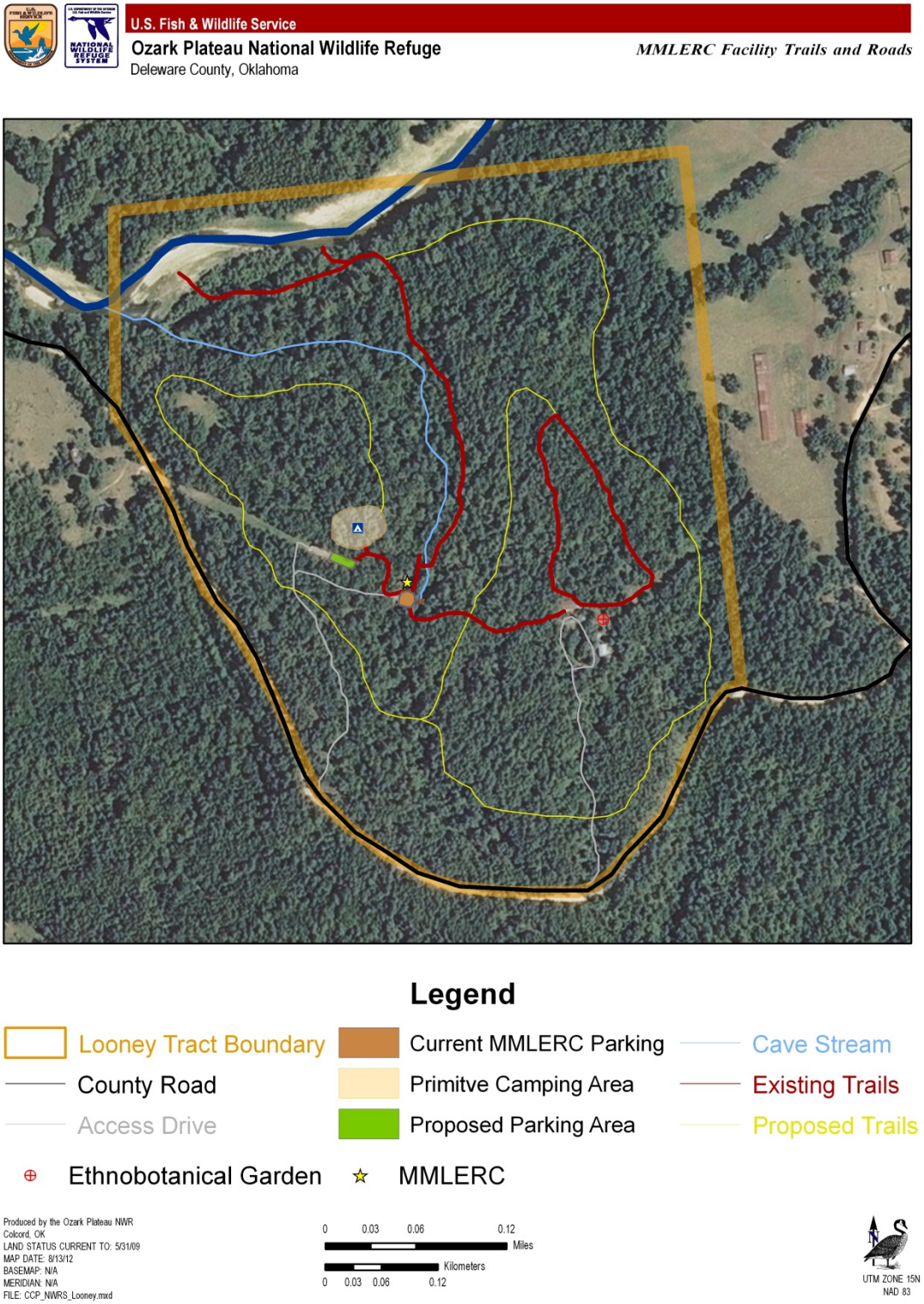
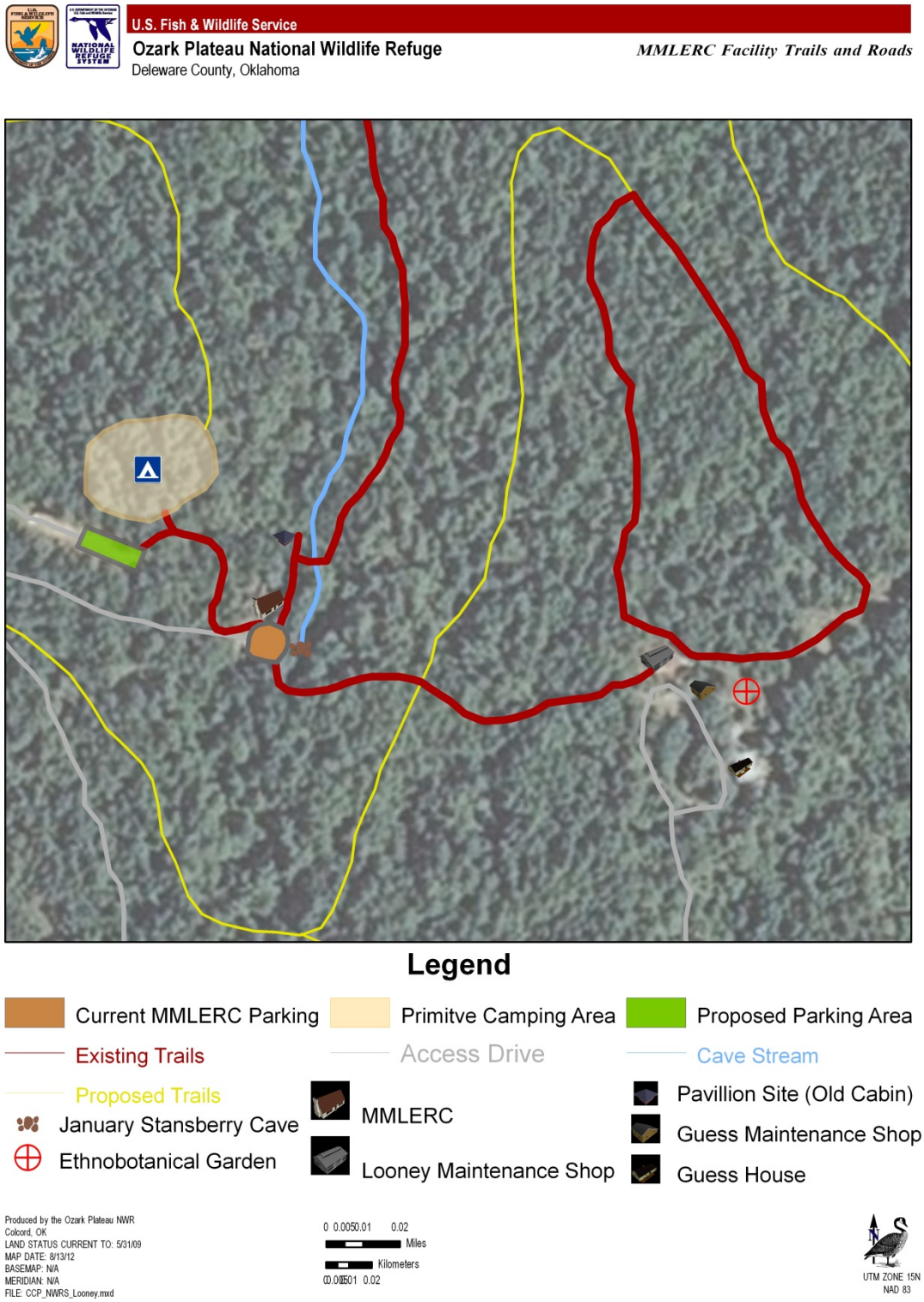


Figure A-3. Zoomed-in view of MMLERC and surrounding current and proposed infrastructure.



Public Use Signs and Interpretive Displays

The Refuge would construct and post a sign at the MMLERC to say "Mary & Murray Looney Education & Research Center". The Refuge would construct a directional MMLERC sign at the county road entrance, only once MMLERC is sufficiently secure. The Refuge would establish a Refuge Headquarters sign, once the new Refuge Headquarters is built/established. The Refuge would continue to maintain resources confidentiality by not posting public use signs at all other Unit entrances and/or on public access roadways. The Refuge would install signs at all cave entrances to prohibit public entry and also to inform them about WNS. Lastly, the Refuge would install limited interpretive signage on the nature trail at the Looney Unit.

Refuge Headquarters/Visitor Center Site

The Refuge would acquire up to 15,000 acres of land and conservation easements from willing sellers within the approved acquisition boundary and utilize an acquired building(s), if appropriate, that could be retrofitted for a new, centralized, Headquarters site/Visitor Center. This building would be remodeled/retrofitted with adequate office and administrative space for anticipated staffing in a centralized location. This building would also be retrofitted to be as "green" as possible, using energy efficient upgrades and water conservation technologies.

In the case that the Refuge does not acquire any appropriate buildings for a Refuge Headquarters/Visitor Center site, the Refuge would build a new Headquarters/Visitor Center site on appropriate areas of newly acquired lands near the Looney Unit. In this event, the Refuge would design a sustainable Headquarters building (energy-efficient and using sustainable materials) and construct it only in previously disturbed habitat, not to exceed 5,000 square-feet to provide adequate office and administrative space for anticipated staffing within the lifetime of this CCP.

Boundaries

The Refuge would continue to contract surveyors to survey all unsurveyed unit boundaries on the Refuge (see Table A-2 in section 1.8.6). The Refuge would install permanent boundary markers (standard metal post and sign) on all unit boundaries that are marked. The Refuge would maintain and repair existing gates, fencing and markers. In addition, the Refuge would construct a new road gate on the access road at the Beck Unit for access to the Krause House and on the MMLERC access road.

Maintenance Shops and Service Buildings

The Refuge would continue maintaining maintenance facilities and supplies, as specified in Alternative A, plus it would build an additional maintenance shop (50'x100' metal building/concrete pad) at new Headquarters site. The Refuge would construct an additional decontamination and storage facility/structure at the new Headquarters location to decontaminate caving equipment in accordance with the Service's WNS decontamination guidance

(http://www.Service.gov/WhiteNoseSyndrome/index.html). The Refuge would construct a separate ventilated building located next to maintenance shop at new Headquarters site for hazardous materials storage. The Refuge would outfit these facilities with appropriate maintenance equipment, heat, insulation, electricity, appropriate plumbing, lighting, etc. The Refuge would construct a new fueling station for Refuge vehicles and equipment at new Headquarters location. Lastly, the Refuge would reconstruct existing pole barn on the Beck Unit, near the Krause House.

Refuge Housing

The Refuge would continue to maintain all Refuge housing as described in Alternative A, plus once the new Headquarters is established, it would convert existing Refuge office to a second guest room at the MMLERC for volunteers, researchers, interns, educators, and/or Refuge staff. The Refuge would also construct and/or purchase two new residences (one staff, one volunteer/student) adjacent to the new Headquarters building location. In addition, the Refuge would construct two RV pads for volunteers at the new Headquarters site, to include utilities as well as an additional RV pad for a volunteer on the Looney Unit, adjacent to the maintenance shop next to the Guess house, to include utilities. The Refuge would include facilities for volunteers (lounge, kitchen, showers, etc.) in the site plan for the new Headquarters facility. Once the residence agreement with Leslie Krause is terminated (via donation), the Refuge would renovate Krause residence to use for staff/volunteer/student housing.

2.4.7 Proposed Refuge Administration

Funding and Staffing

Same as Alternative A.

Volunteers/Friends Program

The Refuge would maintain partnerships and volunteers as described in Alternative A, plus the Refuge would coordinate with unofficial Friends group and/or dedicated volunteer members, current partners, and other members in the community to encourage the formation of an organized and official Friends Group. The Refuge would also perform outreach to local landowners, organizations, schools, universities, and Tribal Nations to increase part-time, non-resident volunteers to approximately 10,000 to 20,000 person hours per year. The Refuge would educate Friends and other volunteers on current issues and solutions regarding karst and cave management and other Refuge resources. The Refuge would also train Friends and other volunteers to perform their job/role in a safe, quality, and efficient manner to include citizen science, EE, interpretation, outreach, cave management and cave rescue and perform other actions as needed.

Coordinate Beyond Service Regional Boundaries to More Effectively Manage Federally Listed Cave Species on a Landscape Level

The Refuge would coordinate with the State of Arkansas and Service Region 4 to manage Logan Cave NWR as a unit of Ozark Plateau NWR or in cooperation with Ozark Plateau NWR. The Refuge would coordinate with the State of Missouri and Service Region 3 to manage Cavefish NWR and Pilot Knob NWR as units of Ozark Plateau NWR or in cooperation with Ozark Plateau NWR. The Refuge would coordinate with the State of Kansas and Service Region 6 for Ozark Plateau NWR to cooperatively manage federally listed Ozark cave species. In addition, the Refuge would establish new acquisition areas within the landscape-level of Oklahoma, Arkansas, Missouri, and Kansas and Service Regions, 2, 3, 4, and 6 to include a larger range of all federally listed Ozark cave species (such as the Ozark big-eared bat, etc.) as addressed by the recovery tasks presented in their recovery plans.

2.5 Comparison of Alternatives

Table A-5. Summary of Management Alternatives.

Issue	Alternative A: Current Management	Alternative B: Proposed Future Management
Landscape-level Management How will the Refuge contribute to addressing landscape-level conservation-related issues in the Ozarks?		
Ozark Habitat Loss & Fragmentation	Acquire land from willing sellers or enter into agreements for conservation easements; maintain strong landscape-level partnerships; maintain 4,000 acres of forested habitat; restore 70 acres of agricultural land to forested habitat at Beck Unit; refrain from developing new roads or infrastructure.	Alternative (Alt) A + partner with the FWS southwestern, midwestern, southeastern and mountain-prairie regions to expand acquisition boundaries in the Ozark ecoregion; maintain, conserve, and restore up to 15,000 acres of acquired lands to native forest habitat.
Climate Change	Monitor baseline data on cave microclimate changes; use energy-efficient heating/cooling system and water filtration system on Looney facility.	Alt A + implement long-term Anabat monitoring stations to monitor climate change impacts to bat species; expand data loggers for climate info; install weather stations; install solar panels on Refuge facilities; sequester carbon by restoring up to 15,000 acres of acquired lands to native forest habitat.
Surface and Groundwater Quality & Quantity	Survey groundwater recharge areas; acquire land and conservation easements from willing sellers to restore forest and control run-off; partner with adjacent and nearby landowners; sample water quality.	Alt A + partner with U. S. Geological Services (USGS) and local universities to implement a permanent water quality and quantity monitoring program.
White-nose Syndrome (WNS)	Implement actions in WNS National Plan; close caves to the public; partner to monitor for WNS on and off Refuge; take preventative measures in decontamination of staff caving gear; public outreach; gain Law Enforcement (LE) support from Sequoyah NWR.	Alt A + coordinate/partner to implement permanent monitoring program to monitor species at risk, track movement and occurrence of WNS, and search for physical signs in Ozark ecoregion; develop a Refuge-specific WNS contingency plan; identify migration corridors; increase LE support; investigate feasibility of installing alarms inside caves.
Wind Energy Farms	Monitor baseline data of bird/bat populations affected by wind turbines and determine locations to minimize impacts.	Alt A + identify bat migration corridors; use GIS to delineate high-risk areas; quantify impacts; investigate mitigation measures.

Issue	Alternative A: Current Management	Alternative B: Proposed Future Management
Habitat Management How will the Refuge manage habitats to ensure the protection of trust resources?		
Degradation of Cave, Stream, and Forest Habitat	Build and repair cave gates on- and off- Refuge; post signs prohibiting entry of caves; maintain confidentiality of cave locations; gain LE support "on call" from Sequoyah NWR; partner with landowners; survey and mark boundaries; implement fire management plans for Looney and Sally Bull Hollow Units.	Alt A + increase LE presence; install alarm systems and infrared cameras at caves; search for unknown caves with partners; outreach to landowners.
Lack of Detailed, Scientific Cave Habitat Data	Perform cave bio-inventories; survey bat hibernacula and maternity sites; survey cavefish and cave crayfish; map subterranean extent of caves.	Alt A + partner to develop habitat suitability indexes for cave species; research effects of prescribed burning/thinning on cave habitats and wildlife; implement acoustic monitor program for non-listed species; survey macroinvertebrates and other cave fauna.
Invasive Flora	Remove with handtools, chainsaws, and mow on 10 acres; partner for burns and invasive control; inventory vegetation with Oklahoma State University; (see *Fire Management*, below).	Alt A + work with partners to identify, document, and monitor all plant species occurring on the Refuge; assess changes in vegetation overtime; use mechanical treatments and if necessary, use herbicide spot-treatment a maximum of one to three applications per year, March – November (see *Fire Management*, below).
Fire Management	Coordinate response to all wildfires based on ecological, social, and legal consequences of fire; implement Fire Management Plans for Looney and Sally Bull Hollow Units, including prescribed burns of 400 acres/year every 3-5 years.	Alt A + develop a Refuge-wide Fire Management Plan to increase use of prescribed fire to 1/3 of Refuge's total acreage/year every 3-5 years; establish agreements with landowners to increase use of prescribed fire surrounding the Refuge; monitor effects of prescribed fire and midstory thinning on habitats and species.

Issue	Alternative A: Current Management	Alternative B: Proposed Future Management
Wildlife Management How will the Refuge manage wildlife to ensure the protection of trust resources?		
Threatened and Endangered (T&E) Species and Species of Concern	Continue annual bio-inventorying research of cave fauna; monitor surveys of bat populations, activity, guano measurements, and cavefish/crayfish counts; monitor emergence/foraging/migration of bat species using radio telemetry, infrared video, and thermal imaging; partner with universities for genetic research.	Alt A + establish permanent, stationary acoustic monitors in and around caves on all Units; establish permanent acoustic survey program on designated routes; develop a habitat suitability index model for T&E cave species; increase genetic research; install permanent cameras in caves; increase prescribed fires to all Units (see *Fire Management*).
Migratory and Resident Bird Species	Conduct bird counts during migration seasons; use prescribed fire on Looney and Sally Bull Hollow Units; enforce limited public use.	Alt A + identify all migratory bird species occurring on or near the Refuge (spring and fall); conduct seasonal nesting studies and MAPS banding of birds monthly for 6 months each year; increase prescribed fires to all Units (see *Fire Management*).
Resident Non-T&E Species	Conduct mobile acoustic monitoring once or twice a month from spring through fall from roadways and cave entrances; perform bio-inventories in 2-3 caves every 5 years.	Alt A + establish permanent, stationary acoustic monitors in and around caves on all Units; establish permanent acoustic survey program on designated routes; perform annual count surveys of non-listed cavefish and mark recapture of cave crayfish; survey all wildlife species occurring on Refuge; increase genetic research of cave species; install permanent cameras in caves; increase prescribed fires to all Units (see *Fire Management*).
Invasive Fauna Species and Pest Management	No management for invasive fauna species and/or pests.	Partner to identify, document, and monitor all species occurring on the Refuge; conduct a feral hog, feral cat, and hothouse millipede survey; research eradication strategies; if necessary, develop an Integrated Pest Management Plan.
Public Use Management How will the Refuge manage wildlife-dependent public use opportunities and public use access to ensure the protection of fish, wildlife, and their habitats?		
Hunting	No hunting permitted.	Develop a Hunt Plan to allow walk-in only, open access hunting on the Sally Bull Hollow Unit, adjacent to the State-managed Ozark Plateau Wildlife Management Area.

Issue	Alternative A: Current Management	Alternative B: Proposed Future Management
Environmental Education (EE)	Partner to offer place-based EE programs on the Looney Unit and at the Mary & Murray Looney Education & Research Center (MMLERC), by permit only, limited to 10-20 people, 2-3 times per month in spring and fall, 1-2 times per month in summer and 1 per month in winter.	Alt A + increase visitation to 50-100 people per week, 3-4 times per week in spring, summer, and fall and 10-20 people per week, 1-2 times per week in winter; expand programs to include after- and home- school, teacher continuing education, gardening program, tribal-lead; train other FWS and partner agencies effective EE methods; if necessary, develop a Visitor Services Plan.
Interpretation	Partner to conduct interpretation programs on the Looney Unit and MMLERC, by permit only, for approximately 25 people per month on-site and to 5 to 100s of people per month off-site.	Alt A + offer interpretive programs to include permaculture gardening, showcase Refuge use of sustainable/green technologies; if necessary, develop a Visitor Services Plan.
Wildlife Observation & Photography	Provide opportunities by permit only on the Looney Unit, in conjunction with interpretive and/or EE programs.	Alt A + allow walk-in access of wildlife observation and photography on Sally Bull Hollow Unit, aside from hunting season; explore additional opportunities on acquired lands; prohibit use in caves; install photography blinds and 3 primitive overlook areas on Looney Unit trails and potentially newly acquired lands.
Wood Harvesting	Prohibit wood harvesting by the public.	Permit wood harvesting by the public of downed-trees as Refuge forest and wildlife management needs dictate.
Public Outreach	Maintain confidentiality to protect Refuge resources (no pamphlets/fliers available).	Create a flier/brochure to advertise Visitor Services opportunities and update Refuge websites to include contact info; work with volunteers to establish an official Friends group to assist with public outreach.
Cultural & Historical Resources Management How will the Refuge manage cultural and historical resources to ensure the preservation of ancient and recent history and culture?		
Historical Sites	Keep sites confidential; partner with SHPO to preserve sites.	Alt A + increase LE from Sequoyah NWR to secure known sites; partner to preserve and perform studies on known sites and newly discovered sites.
Archeological and Paleontological Sites	Keep sites confidential; partner with SHPO, Sam Noble Museum archeologists and paleontologists to preserve sites.	Alt A + increase LE from Sequoyah NWR to secure known sites; partner to preserve and survey known sites and newly discovered sites.

Issue	Alternative A: Current Management	Alternative B: Proposed Future Management
Facilities & Infrastructure Management How will the Refuge provide infrastructure and related developments while ensuring the protection of trust resources?		
Mary & Murray Looney Education & Research Center (MMLERC)	Operate and maintain MMLERC (1200 sq. ft.) facility; maintain ADA accessibility.	Alt A + renovate roof; insulate basement and attic; renovate cabin exterior; renovate porch; renovate front door to be ADA-accessible; renovate one bathroom to be ADA-accessible; install monitored alarm system; replace plumbing system; replace electrical system; replace propane gas lines; install energy-efficient windows; maintain water filter; install rainwater collection system; build raised garden beds and re-landscape with native plants; install solar panels; use energy-efficient heating and cooling system and appliances; install A/V technology; remove small cabin adjacent to MMLERC and replace with a 800 sq. ft. outdoor pavilion studio space and bridge.
Access Roads	Maintain a 0.25-mile, unpaved and unimproved access road to the MMLERC, with a gate; maintain an unpaved parking area for approximately 10 vehicles; excess parking near the maintenance shop.	Alt A + improve roads and parking areas including: widen MMLERC access drive/parking area by 2 feet and improve with gravel; improve road with gravel from county road to maintenance shop; improve parking area surfaces with gravel; improve 0.3 miles of gravel road on Beck Unit; improve and/or maintain roads on newly acquired lands, if necessary.
Nature Trails and Overlooks	Utilize and maintain trails around the Refuge including: deteriorating path from the MMLERC to the pavilion, small path from the parking area to the MMLERC, 1/4-mile trail from MMLERC to Spavinaw Creek, 1/8-mile trail from MMLERC to the old garden area at top of hill, 150-yards trail from Guess house to the MMLERC, and 1/4-mile trails near the Guess house; no established overlook areas.	Alt A + Establish a 0.25-mile primitive trail to connect the MMLERC trail to maintenance shop trail; build a 2-mile primitive trail around the perimeter of the Looney Unit; repave the 0.1-mile concrete path from the MMLERC cabin to the pavilion; improve the 0.25-mile trail with gravel from the Looney maintenance shop to the MMLERC; improve the 0.1 mile primitive trail with gravel from the parking/camping area on top of the hill down to the MMLERC.

Issue	Alternative A: Current Management	Alternative B: Proposed Future Management
Public Use Signs and Interpretive Displays	No public use signs or interpretive signs posted on any Refuge units, except for outside of caves stating that they are closed to the public.	Construct and post a sign for the MMLERC and new HQ site; install directional MMLERC sign at the county road entrance; install signs at all cave entrances to prohibit public entry and also to inform them about White-nose Syndrome (WNS); install limited interpretive signage on Looney Unit.
Refuge Headquarters (HQ) Site	No centralized HQ site – each staff member works out of the Oklahoma ES Office in Tulsa, the MMLERC (Refuge), and/or Sequoyah NWR.	Acquire up to 15,000 acres of land and conservation easements from willing sellers within the approved acquisition boundary and utilize an acquired building(s), if appropriate, for new centralized HQ site; or build a new HQ site on centralized acquired site.
Boundaries	Maintain and repair 60 miles of Unit boundaries with a total of over 4 miles of fencing and 11 gates.	Alt A + Contract surveyors to survey and mark all un-surveyed/un-marked Unit boundaries on the Refuge; maintain new markers.
Maintenance Shops and Service Buildings	Utilize and maintain three maintenance shops: Beck Unit Shop: 50’ x 30’ metal building on concrete pad, Looney Unit: 50’ x 30’ metal building on concrete pad, and Guess House Shop.	Alt A + build an additional 50’x100’ metal building on concrete pad maintenance shop at new HQ site; construct additional decontamination and storage facility at new HQ, with ventilation building; outfit facilities; construct a fueling station for Refuge vehicles and equipment at new HQ; reconstruct existing pole barn on the Beck Unit.
Refuge Housing	Provide Refuge housing for Refuge staff at the Guess House and one bedroom for staff, volunteers, guests, etc. at the MMLERC cabin (Looney Unit); maintain agreement with Leslie Krause.	Alt A + once HQ is established, convert existing Refuge office to a second guest room at the MMLERC; new HQ plan would include kitchen/bath facilities; construct two RV pads at the new HQ site; construct RV pad on the Looney Unit; when agreement with Leslie Krause is terminated (donation), renovate Krause residence for Refuge housing.

Issue	Alternative A: Current Management	Alternative B: Proposed Future Management
Administration Management How will the Refuge administer its management to ensure the protection of trust resources?		
Funding and Staffing	Receive funding and staffing for operations, infrastructure and maintenance, determined by Congress and allocated to refuges by the Southwest Regional Office of the U.S. Fish & Wildlife Service; seek additional funding such as applying for grants and working with NGOs in order to leverage funds to implement management activities and educational programs.	Same as Alt A.
Volunteers/Friends Program	No official Friends group established (support from National Speleological Society local chapters); approximately 5,000 to 10,000 volunteer hours total per year.	Alt A + coordinate with unofficial Friends group and/or dedicated volunteer members to encourage formation of official Friends Group; perform outreach to increase part-time, non-resident volunteers to approximately 10,000 to 20,000 volunteer hours per year; educate and train volunteers.
Coordinate Beyond FWS Regional Boundaries to More Effectively Manage Federally Listed Cave Species on a Landscape Level	No management agreement in place to coordinate across FWS regional boundaries to manage cave habitat and species.	Coordinate with the state of Arkansas and FWS Region 4 to manage or co-manage Logan Cave NWR as a Unit of Ozark Plateau NWR; coordinate with the state of Missouri and FWS Region 3 to manage or co-manage Cavefish NWR and Pilot Knob NWR as Units of Ozark Plateau NWR; coordinate with the state of Kansas and FWS Region 6 for Ozark Plateau NWR to cooperate management of federally listed Ozark cave species; expand and establish new acquisition areas within the Ozark landscape across multiple state and regional boundaries.

Chapter 3: Affected Environment of EA

Please reference Chapter 3 of the CCP for a description of Refuge resources.

Chapter 4: Environmental Consequences and Benefits of EA

This chapter describes the environmental consequences we predict from implementing the management alternatives presented in Chapter 3. Where detailed information is available, we present a scientific and analytic comparison between alternatives and their anticipated consequences, which we describe as "impacts" or "effects". In the absence of detailed information, we make comparisons based on our professional judgment and experience. We specifically predict the effects of implementing the management actions and strategies for each of the alternatives.

Our discussion focuses on the impacts associated with the goals and issues identified in Chapter 1 – Purpose of and Need for Action. Direct, indirect, short-term, beneficial and adverse effects likely to occur over the 15-year life span of the CCP are discussed. Beyond the 15-year planning horizon, we give a more speculative description of the direct, indirect, and cumulative effects. At the end of this chapter, Table A-7 summarizes the effects predicted for each alternative and allows for a side-by-side comparison. This chapter identifies the irreversible and irretrievable commitment of resources from our proposed actions. The relationship between short-term uses of the environment and long-term productivity of proposed actions, their cumulative effects, and the relationship to environmental justice are also described.

As required by Council on Environmental Quality and Service regulations implementing the NEPA, we assessed the importance of the effects of the CCP alternatives based on their context and intensity. The context of the impacts ranges from local and site-specific to regional and broad-scale. For example, direct impacts to soils at a parking lot construction location would be highly localized or impacts on gray bat species would directly affect their populations in the Ozarks and indirectly affect their populations in the larger context of their limited range and distribution. Although Refuge lands comprise a small percentage of these larger ecosystem or regional contexts, each alternative was developed to contribute towards conservation goals in these large geographic landscapes.

We evaluated the intensity of impacts based on the anticipated degree of resource change from current conditions, the frequency and duration of the effect, the sensitivity of the resource to such an effect or the natural resiliency of the resource to recover from such an effect, and the potential for implementing effective preventative or mitigation measures to reduce the effect. Duration of effects vary from those that would occur only once for a brief period of time during the 15-year planning horizon, for example, the effects of construction to install solar panels, to those that

would occur every day during a given season of the year, such as the effects of a group of 20 people visiting the Looney Unit for an environmental education program.

There are certain types of actions identified in Chapter 3 that do not require additional NEPA analysis because they are "categorically excluded" (516 DM 2.3(A)) from further analysis or review. Categorical exclusions are classes of actions which do not individually or cumulatively have a significant effect on the human environment. These categorically excluded actions include, but are not limited to, the following actions, as listed in 516 DM 8.5A:

- Environmental education and interpretative programs (unless major construction is involved, or a significant increase in visitation is expected)
- Research, resource inventories, and other resource information collection activities
- Operations and maintenance of existing infrastructure and facilities, including renovation (unless major renovation is involved)
- Routine, recurring management activities and improvements
- Small construction projects (e.g. fences, cave gates, small stream projects, trail maintenance, development of access for routine management purposes)
- Minor vegetation plantings
- Reintroducing native plants and animals within their historic or established range
- Minor changes in amounts or types of public use
- Issuance of new or revised management plans when only minor changes are planned
- Law enforcement activities

However, these categorically excluded actions will be briefly mentioned in the effects analysis to justify why they are negligible for further discussion. All other actions (current and proposed) described in the two alternatives of this CCP's EA will be analyzed in detail below.

Actions that are not categorically excluded and that will require additional NEPA analysis beyond this Final CCP/EA are:

- Use of prescribed fire on 1/3 of total Refuge lands (in a step-down, Refuge-wide FMP)
- Permit hunting on the Sally Bull Hollow Unit (in a step-down Hunt Plan)
- Construct or build a new Refuge Headquarters/Visitor Center facility that is outside of the parameters and mitigation measures described in effects analysis below

This chapter is organized by major resource heading. Under each heading we discuss the resource context and describe how the management actions may affect the environment either beneficially or adversely. An analysis of the effects of management actions on the physical environment has been conducted for air quality, water quality/quantity, and soils. Analysis of the effects of management actions on the biological environment was conducted for vegetation/habitat, cave wildlife, including species of special concern (e.g., threatened and endangered species) and other wildlife occurring on the Refuge. Although all plant, animal, and

fish species on the Refuge are important, many species are not expected to experience any adverse impacts – as a result of implementing the alternatives. For that reason, not all Refuge species are discussed in this chapter. An analysis of the effects of management actions on the socio-economic environment was also conducted for cultural resources, local populations and economy, public use opportunities, aesthetic/visual resources, public use opportunities and access.

4.1 Definition of Terms

Effects

- *Direct effects* are the impacts that would be caused by the alternative at the same time and place as the action.
- *Indirect effects* are impacts that occur later in time or distance from the triggering action.
- *Cumulative effects* (definition provided in section 4.6)

Impact Type

- *Adverse impacts* are those resulting from management actions that degrade the quality and/or quantity of identified refuge resources or recreational opportunities.
- *Beneficial impacts* are those resulting from management actions that maintain or enhance the quality and/or quality of identified refuge resources or recreational opportunities.

Duration of Impacts

- *Short-term impacts* affect identified refuge resources or recreational opportunities; they occur during implementation of the management action but last no longer.
- *Medium-term impacts* affect identified refuge resources or recreational opportunities that occur during implementation of the management action; they are expected to persist for some time into the future though not throughout the life of the CCP.
- *Long-term impacts* affect identified refuge resources or recreation opportunities; they occur during implementation of the management action and are expected to persist throughout the life of the CCP and possible longer.

Intensity of Impact

- *Negligible impacts* result from management actions that cannot be reasonably expected to affect identified refuge resources or recreational opportunities at the identified scale.
- *Minor impacts* result from a specified management action that can be reasonably expected to have detectable though limited effect on identified refuge resources or recreation opportunities at the identified scale.
- *Moderate impacts* result from a specified management action that can be reasonably expected to have apparent and detectable effects on identified refuge resources or recreation opportunities at the identified scale.

- *Major impacts* result from a specified management action that can be reasonably expected to have readily apparent and substantial effects on identified refuge resources and recreation opportunities at the identified scale.

Scale of Impact

- *Site-specific effects* are those impacts that occur solely within the project area.
- *Local effects* are those impacts that can be reasonably expected to have detectable effects within and immediately surrounding the project area.
- *Refuge-wide effects* are those impacts that can be reasonably expected to have noticeable effects across the entire Refuge landscape.

4.2 Analysis of Impacts to Resource(s)

4.2.1 Impacts to Physical Environment

4.2.1.1 Climate Change

Alternative A - Current Management (No Action Alternative):
Over the long term, such as the next 50 years, climate change is likely to have drastic effects on the Refuge's flora, fauna, and public use. Over the 15-year planning horizon of this CCP, these effects may be more subtle and incremental. Data provided by Climate Wizard (www.climatewizard.org, accessed June 2010) indicates that within the area of the Refuge the temperature is expected to warm by about 5 degrees F, while moisture is anticipated to decrease between now and 2050. Changes in climate in and around caves may affect their suitability for different bat species (Newson et al., 2009). Changes in temperature and rainfall patterns may affect both the timing and the availability of insect prey for bats (Newson et al., 2009). It has been observed on the Refuge that there are temporal variations on migration and birthing of Ozark big-eared bats and gray bats, however, more literature is needed to document this. Warmer and drier conditions may affect surface and groundwater availability, fire regimes, and shift hardwood forests north and produce more woodland savannah conditions within the Refuge acquisition area.

Adverse Impacts (Alternative A)
In this alternative, the Refuge contributes to climate change by emitting approximately 19.28 metric tons of CO_2 in the atmosphere per year from driving up to four government vehicles to individual offices and to access its nine land management units (see Table A-6 below). Since the Refuge Headquarters is currently at the MMLERC, which provides one office space, Refuge staff must drive from either Tulsa (approx. 80 miles) or Sequoyah NWR (approx. 100 miles) to frequently meet at the Looney Unit.

Table A-6. CO2 Emissions from work-travel in FY2011.

	Miles/gallon	Miles driven/year	Metric tons of CO_2
2008 Chevy Trailblazer	17.6	7,300	5.18
2010 Ford Explorer	17.6	9,700	4.83
2009 Chevy Silverado 2500	14.8	12,171	7.21
2005 Trailblazer	23	5,400	2.06

Total CO_2 emissions/year = 19.28

Wildfires of approximately 500 acres per year on all Refuge units and on average 100 acres per year of prescribed fire on the Sally Bull Hollow Unit and Looney Units, would contribute to some CO_2 emissions in the atmosphere, therefore contributing to climate change in the short-term. However, there are long-term beneficial impacts to climate change regarding fire management (see below).

The Refuge would continue restoring up to 50 acres of non-native grasses from an old pasture on the Beck Unit to native oak-hickory forest by planting native hardwood species to offer benefits to wildlife, such as oaks. Mowing and/or weed wacking of non-native grasses with handheld mechanical equipment may be done first to allow for an area feasible for planting native seeds. These mechanical devices may emit C02 in the atmosphere. However, this is a temporary action that lasts a few days out of the year and would not continue once some native hardwood trees become established.

Groups of 10-20 people come to the Refuge for EE programs approximately 2-3 times per month in the spring and fall, 1 or 2 times per month in summer and one per month in the winter driving primarily from Tulsa, Joplin, Fayetteville, and Tahlequah (45 – 80 mile range to Looney Unit), which also contributes (via CO2 car emissions) to climate change. There are also a few participants that come from TN, TX, MO, KS, OK, MS and AR. However, the Refuge mitigates the amount of individual car emissions by encouraging groups to carpool and arranges for vans or buses to transport larger groups in from local schools and organizations.

Beneficial Impacts (Alternative A)

Monitoring cave species and other wildlife species on some Refuge units as well as baseline cave microclimates with temperature and humidity loggers in two Refuge caves would assist with understanding more about climate change and how it is affecting Refuge habitats and wildlife. The Refuge also works together with other federal, state, tribal and local governments, LCCs, and private landowner partners, to develop landscape-level strategies for understanding and responding to climate change impacts.

Fire management research indicates that fire can be used in hardwood stands to re-establish and release oak-hickory regeneration (http://www.forestencyclopedia.net/p/p157). Overall, the prescribed fires on the Sally Bull Hollow and Looney Units would contribute to an overall increase in carbon sequestration due to healthier, regenerating forests, reducing the amount of CO_2 in the atmosphere in the long-term despite the emissions created from the short duration of the burn(s) itself.

According to the U.S. Forest Service, large-diameter, long-lived, leafy hardwood species are twice as effective at sequestering carbon as conifers (Manley, 2009). In addition, the annual carbon sequestration of an old mature oak can be matched only by several newly planted oaks (Manley, 2009). Since the Refuge currently manages 3,977 acres (of 4,093 total Refuge acres) of mostly mature oak-hickory forest, the amount of carbon these forests sequester is very important for mitigating climate change.

EE and interpretation programs would help to increase several hundred people's appreciation of nature and understanding of the importance of their local resources. This may influence them to make better environmental decisions, which would help mitigate climate change.

In addition, the Refuge maintains energy-efficient appliances including a stove, refrigerator, dishwasher, hot water heater, and washer and dryer, and uses a water filtration system to tap into the local water resources to mitigate the need to purchase bottled water. In the U.S. alone 1.5 million barrels of oil are consumed in making bottles solely for bottled water (sierraclub.org). In addition, it also requires the use of fossil fuels in its transport and packaging producing tremendous waste (Arnold, 2006). Therefore, the Refuge is helping to mitigate climate change through utilization and maintenance of green infrastructure/appliances.

<u>Alternative B-- Proposed Future Management (Proposed Action)</u>:
As described in Alternative A, climate change is likely to have drastic effects on the Refuge's flora, fauna, and public use over the next 50 years. Over the 15-year planning horizon of this CCP, these effects may be more subtle and incremental. Data provided by Climate Wizard (www.climatewizard.org, accessed June 2010) indicates that within the area of the Refuge the temperature is expected to warm by about 5 degrees F, while moisture is anticipated to decrease between now and 2050. Changes in climate in and around caves may affect their suitability for different bat species (Newson et al., 2009). Changes in temperature and rainfall patterns may affect both the timing and the availability of insect prey for bats (Newson et al., 2009). It has been observed on the Refuge that there are temporal variations on migration and birthing of Ozark big-eared bats and gray bats, however, more literature is needed to document this. Warmer and drier conditions may affect surface and groundwater availability, fire regimes, and shift hardwood forests north and produce more woodland savannah conditions within the Refuge acquisition area.

Adverse Impacts (Alternative B)
The effects of Alternative B are expected to be the same as Alternative A, however, until the Refuge establishes a centralized Headquarters/Visitor Center site and Refuge housing, the Refuge is expected to contribute more gas emissions due to an increase in staff and staff vehicles, although this figure is unknown since it would depend on where staff would live in proximity to the Refuge and where their office(s) would be located. The Refuge would mitigate this increase in gas emissions by carpooling whenever possible to perform management activities at the various units.

Wildfires of approximately 500 acres per year on all Refuge Units and an increase of prescribed burns to approximately 1/3 of the Refuge's lands (existing and as they are acquired) on 3-5 year rotations is expected to increase CO_2 emissions in the atmosphere, therefore contributing a short-term impact to climate change. However, there are long-term beneficial impacts to climate change regarding the outcome of this fire management tool (see below).

The Refuge would continue restoring habitats on newly acquired lands of non-native vegetation to native oak-hickory forest by planting moderately-stocked native hardwood species to offer benefits to wildlife, such as oaks. Mowing and/or weed whacking of non-native grasses with handheld mechanical equipment may be done first to allow for an area feasible for planting native seeds. These mechanical devices may emit $C0_2$ in the atmosphere. However, this is a temporary action and once native trees become established, they would offset the machinery's emission output in the long-term.

An increase in visitation for EE and interpretation programs (by 40-80 people per week in spring, summer, and fall and by 10-20 per week in the winter) driving primarily from Tulsa, Joplin, Fayetteville, Tahlequah (45– 80 mile range to Looney Unit), will also contribute to short-term impacts (via CO2 car emissions) to climate change. There may be a few participants that come from TN, TX, MO, KS, OK, MS and AR. However, the Refuge would continue to mitigate the amount of individual car emissions by encouraging groups to carpool and arrange for vans or buses to transport larger groups in from local schools and organizations.

Beneficial Impacts (Alternative B)
In this Alternative, the Refuge plans to staff employees at a centralized (new) Headquarters site near the Looney Unit, as opposed to the current commute of 80-100 miles. In addition, the Refuge proposes to provide more Refuge housing for employees, volunteers, educators, etc., which would deter staff from having to commute from cities that are 45-80 miles away. In the long-term, this may actually reduce the amount of gas emissions that Refuge staff currently contributes in Alternative A.

In addition to working with landscape-level partners to address climate change, in this Alternative, the Refuge would implement a more permanent long-term monitoring program of habitat and wildlife to better understand the impacts of climate change. This program, comparing wildlife identification, location, and seasonality with climate information including air temperature, humidity, light, cave rock temperature, groundwater elevation, and cave stream temperature data, would contribute to greater scientific knowledge regarding how climate change is affecting Ozark habitats and wildlife and would also give management better insight as to how to adapt management according to these changes.

As described in Alternative A, fire management research indicates that fire can be used in hardwood stands to re-establish and release oak-hickory regeneration (http://www.forestencyclopedia.net/p/p157). Overall, the prescribed fires that the Refuge proposes in this Alternative would contribute to an overall increase in carbon sequestration due to restoration and promotion of up to 15,000 acres of healthy, regenerating forests, which scientists from the Association for Fire Ecology argue is the key to reducing net carbon emissions and preparing forests for the effects of climate change (Straub, 2012). In the long-term, prescribed burns to enhance old-growth oak-hickory forest would sequester more carbon in the atmosphere than it would produce from the prescribed burns.

According to the U.S. Forest Service, large-diameter, long-lived, leafy hardwood species are twice as effective at sequestering carbon as conifers (Manley, 2009). In addition, the annual carbon sequestration of an old mature oak can be matched only by several newly planted oaks (Manley, 2009). In Alternative B, the Refuge would attempt to acquire up to 15,000 acres of lands with cave and karst resources and made up of mostly mature oak-hickory forest. This would be a substantial additional amount of mature oak trees that would play an important role at sequestering carbon in terms of climate change.

In this Alternative, increasing EE and interpretation opportunities may also increase several hundred to thousands of people's appreciation of nature and understanding of the importance of their local resources. In addition, the Refuge proposes to discuss climate change as a talking point for both EE and interpretation programs. This may influence people to make better environmental decisions, which would help mitigate climate change.

Lastly, the Refuge would install solar panels on the MMLERC, Guess House, or near previously disturbed, infrastructure areas on the Looney Unit and potentially on any newly acquired or developed buildings, if amount of sun and location is appropriate, to offset carbon and rely mostly on alternative energy sources. The Refuge would also continue to install proper insulation and energy-efficient appliances such as a stove, refrigerator, dishwasher, hot water heater, and washer and dryer, in all Refuge buildings and at the new Headquarters site. It would also conserve and reuse water by installing a rain collection system to the outside of the building

for irrigation purposes. In addition, it would continue installing a water filtration system to tap into the local water resources at each Refuge building, including the new Refuge Headquarters site to mitigate the need to purchase bottled water. In the U.S. alone 1.5 million barrels of oil are consumed in making bottles solely for bottled water (sierraclub.org). In addition, it also requires the use of fossil fuels in its transport and packaging producing tremendous waste (Arnold, 2006). Therefore, the Refuge is helping to mitigate climate change through these simple green infrastructural upgrades and maintenance.

4.2.1.2 Impacts on Air Quality

Alternative A—Current Management (No Action Alternative):
Under Alternative A, Refuge activities affecting air quality would continue to include prescribed fire, construction and maintenance of roads, and emissions from vehicle exhaust. The Refuge would continue to coordinate with the Service's Denver Air Quality Branch to ensure appropriate and consistent air quality monitoring.

Adverse Impacts (Alternative A)
Prescribed fire would have minor adverse impacts that are short-term in duration at the local scale due to smoke from burning vegetation. Prescribed fires could produce smoke that could drift into residential communities and cause breathing and eye irritation and inconvenience during times of unpredicted inversions. There are also short-term adverse impacts on visibility, which is in conflict with the Class 1 Airshed designation.

Dust and emissions produced by equipment and vehicle operation associated with mowing non-native vegetation, maintenance, and construction would be minor. Performing work during times of low to no wind would abate blowing dust. Furthermore, most construction occurs as maintenance to already existing facilities or infrastructure that is small scale and localized.

Fugitive dust can cause impacts including visibility impairment, respiratory problems, or eye irritation. Construction and maintenance occurs Refuge-wide and could cause fugitive dust. Refuge dirt roads would continue to be maintained up to twice per year. Trail maintenance would occur on the Looney and Beck Units periodically. Under Alternative A, new facility construction is limited and would not create more than a negligible adverse impact on air quality. Fugitive dust would typically be negligible.

Cave gate construction creates short-term minor impacts that last 5-6 days total. Welding the frame is done from the outside on the surface using a long lead wire, creating some smoke. Cave gate construction activities may also create dust due to drilling and create temporary residential fumes from the rust-free primer paint.

Beneficial Impacts (Alternative A)
The Refuge currently manages 3,977 acres (of 4,093 total Refuge acres) of mature oak-hickory forest, which benefit air quality because the trees:

- Help to settle out, trap and hold particle pollutants (dust, ash, pollen and smoke) that can damage human lungs.
- Absorb CO_2 and other dangerous gasses and, in turn, replenish the atmosphere with oxygen.
- Produce enough oxygen on each acre for 18 people every day.
- Absorb enough CO_2 on each acre, over a year's time, to equal the amount you produce when you drive your car 26,000 miles. Trees remove gaseous pollutants by absorbing them through the pores in the leaf surface. Particulates are trapped and filtered by leaves, stems and twigs, and washed to the ground by rainfall.

(www.dnr.state.md.us)

Alternative B-- Proposed Future Management (Proposed Action):
Adverse Impacts (Alternative B)
Prescribed fire would have the same minor adverse impacts as described in Alternative A, that are short-term in duration at the local scale due to smoke from burning vegetation.

In addition, due to the short-term construction associated with renovations of an acquired buildings for a new Headquarters site or developing a new Headquarters site on previously disturbed acquired land, MMLERC renovations, MMLERC access drive improvements (add gravel and widen by 2 feet), parking area surface improvements with gravel, and 0.3 miles of gravel improvements on Beck Unit road as well as any necessary improvements to access roads on acquired lands, it would cause minor to moderate short-term impacts to air quality from dust and emissions produced by equipment and vehicle operation. These construction and maintenance activities would also cause minor incidents of fugitive dust. Fugitive dust could cause impacts including visibility impairment, respiratory problems, or eye irritation.

Dust and emissions produced by equipment and vehicle operation associated with mowing non-native vegetation, maintenance, and construction would be minor. Performing work during times of low to no wind would abate blowing dust. Furthermore, most construction occurs as maintenance to already existing facilities or infrastructure that is small scale and localized.

As described in Alternative A, cave gate construction would continue in this Alternative and creates short-term minor impacts that last 5-6 days total. Welding the frame is done from the outside on the surface using a long lead wire, creating some smoke. Cave gate construction activities may also create dust due to drilling and create temporary residential fumes from the rust-free primer paint.

Beneficial Impacts (Alternative B)
The Refuge proposes to acquire up to 15,000 acres of, at minimum, 80% mature oak-hickory forest which would benefit air quality because the trees would:

- Help to settle out, trap and hold particle pollutants (dust, ash, pollen and smoke) that can damage human lungs.
- Absorb CO_2 and other dangerous gasses and, in turn, replenish the atmosphere with oxygen.
- Produce enough oxygen for people and wildlife to breathe.
- Absorb enough CO_2 on each acre, over a year's time, to equal the amount one produces driving a standard car over 20,000 miles. Trees remove gaseous pollutants by absorbing them through the pores in the leaf surface. Particulates are trapped and filtered by leaves, stems and twigs, and washed to the ground by rainfall.

(www.dnr.state.md.us)

4.2.1.3 Impacts on Water Quality and Quantity

Alternative A—Current Management (No Action Alternative):
Adverse Impacts (Alternative A)
In Alternative A, the Refuge causes minimal adverse impacts to water quality and quantity.

All wildland fires, both prescribed fires (approximately 100 acres/year) and wildfires (approximately 500 acres/year), can adversely affect water quality by burning protective vegetative cover, thereby exposing soils to wind and water erosion. Especially on slopes, these soils can then be transported with runoff to waterbodies, including streams, marshes, ponds, and lakes, where they at first occur as suspended sediments, causing turbidity (muddy or cloudy water). High levels of turbidity are not only aesthetically unattractive, but may reduce the amount of light penetrating to lower depths, which inhibits the growth of submerged aquatic plants. In turn, this may affect aquatic organisms which are dependent on aquatic plants, such as fish and shellfish. High turbidity levels may also reduce the ability of fish gills to absorb dissolved oxygen. Later, when suspended sediments settle on the bottom of the waterbody in a process called sedimentation; these deposited sediments may cover and smother benthic (bottom-dwelling) organisms, both plants and animals. However, the Refuge's proposed short-term prescribed burns would have only minor impacts to water resources.

To a limited extent, use of trails may result in soil compaction, erosion, trampling of vegetation, and production of litter or human waste. Areas surrounding public use facilities can also contribute to the problems of erosion, suspended sediments, turbidity, and sedimentation. This may cause minor impacts to water quality. In addition, annual monitoring of cave fauna would cause turbidity in the water of wet caves, which may disrupt wildlife temporarily.

Maintenance to facilities or the use of roads and trails could cause soil disturbance, or materials from these sites (such as leaked equipment fluids) could get washed away during a storm event. However, the amount of work to facilities under this Alternative would be small and activity would be temporary making any associated adverse effects negligible to minor, short-term, and localized to widespread, depending on whether the runoff traveled to land or moving water.

During cave gate construction, the Refuge works within 50-100 feet within the cave recession, disrupting soil from human foot traffic, which temporarily causes turbidity. Finally, the Refuge paints the gates with a rust-proof primer, which may cause discharge of small quantities of liquids containing waxy distillate, soap, water, particles, and mineral oil into cave water, however, the small amount of this should have a minor to negligible impact to water quality.

Beneficial Impacts (Alternative A)
Direct and indirect impacts of Alternative A would primarily benefit water quality and quantity.

The Refuge has acquired a total of 4,093 acres of lands in which they manage to protect cave, karst, forest, groundwater, as well as surfacewater resources. Maintaining and restoring 3,977 of these acres of large stands of healthy forest provides natural infiltration and percolation, reducing the amount of sediment, pesticides, and nutrients that might otherwise enter water bodies from surface run-off. In addition, the Refuge partners with adjacent and nearby landowners to implement conservation agreements to maintain or restore forest and aquatic habitats and encourage sustainable grazing methods, which overall benefit water quality and quantity.

In this Alternative, the Refuge surveys groundwater recharge areas in order to gain more information regarding point-source pollution and identify sensitive areas to protect. The Refuge also samples ground- and surface-water quality and shares information with local municipalities and water authorities regarding how water quality affects the Refuge.

<u>Alternative B—Proposed Future Management (Proposed Action)</u>:
Adverse Impacts (Alternative B)
As well as in Alternative A, actions in Alternative B would cause minimal adverse impacts to water quality and quantity.

As described in Alternative A, all wildland fires, including the proposed amount of 1/3 of Refuge lands and adjacent lands with cooperating landowners of prescribed fires and wildfires (approximately 500 acres/year), can adversely affect water quality by burning protective vegetative cover, thereby exposing soils to wind and water erosion. Especially on slopes, these soils can then be transported with runoff to waterbodies, including streams, marshes, ponds, and lakes, where they at first occur as suspended sediments, causing turbidity (muddy or cloudy water). High levels of turbidity are not only aesthetically unattractive, but may reduce the

amount of light penetrating to lower depths, which inhibits the growth of submerged aquatic plants. In turn, this may affect aquatic organisms which are dependent on aquatic plants, such as fish and shellfish. High turbidity levels may also reduce the ability of fish gills to absorb dissolved oxygen. Later, when suspended sediments settle on the bottom of the waterbody in a process called sedimentation; these deposited sediments may cover and smother benthic (bottom-dwelling) organisms, both plants and animals. However, fire management within this proposed alternative would only have short-term, minor impacts to water resources. The benefits to fire management would outweigh these adverse effects (see *Beneficial Impacts* below).

To a limited extent, use of trails may result in soil compaction, erosion, trampling of vegetation, and production of litter or human waste. Areas surrounding public use facilities can also contribute to the problems of erosion, suspended sediments, turbidity, and sedimentation. This may cause minor impacts to water quality. In addition, annual monitoring of cave fauna would cause turbidity in the water of wet caves, which may disrupt wildlife temporarily.

Under this Alternative, the Refuge would re-construct a water crossing for single-file pedestrians to cross the stream by the MMLERC from the newly renovated outdoor pavilion studio space to the primitive trail on the other side. Construction itself would likely consist of a small crew working on either side of the stream (stream is less than 5 feet wide). Concrete anchor points (2x4') or wood posts would be placed on either side, however this should not disrupt aquatic habitat because it will be placed in a previously disturbed area.

Construction of new facilities such as a new Headquarters/Visitor Center site, three Refuge housing RV pads, additional maintenance shops and decontamination facilities, as well as maintenance to existing facilities or the use of roads and trails will cause minor to moderate soil disturbance, and materials from these sites (such as leaked equipment fluids) may get washed away during a storm event. However, construction would be short-term and localized to the site, making any associated adverse effects negligible to minor, short-term, and localized to widespread, depending on whether the runoff traveled to land or moving water.

As described in Alternative A, during cave gate construction, the Refuge works within 50-100 feet within the cave recession, disrupting soils due to human foot traffic, which temporarily causes turbidity in cave streams. Finally, the Refuge paints the gates with a rust-proof primer, which may cause discharge of small quantities of liquids containing waxy distillate, soap, water, particles, and mineral oil into cave water, however, the small amount of this should not have a minor impact to water quality.

Beneficial Impacts (Alternative B)

Direct and indirect impacts of Alternative A would primarily benefit water quality and quantity.

The Refuge would acquire up to 15,000 acres of lands in which they manage to protect cave, karst, forest, groundwater, as well as surfacewater resources. Maintaining and restoring 50-100% of total acquired lands as large stands of healthy forest will provide natural infiltration and percolation, reducing the amount of sediment, pesticides, and nutrients that might otherwise enter water bodies from surface run-off. In addition, the Refuge would continue implementing Strategic Habitat Conservation regarding water protection by continuing its groundwater mapping efforts in order to identify sensitive areas that would be of high-priority potential land acquisition areas for the benefit of cave and aquatic species.

The Refuge would continue to partner with adjacent and nearby landowners to implement conservation agreements to maintain or restore forest and aquatic habitats and encourage sustainable grazing methods, which overall benefit water quality and quantity.

In this Alternative, the Refuge would increase monitoring of water quantity and quality by implementing a permanent water quality and quantity monitoring program, instead of the current opportunistic water sampling. This would ensure current and accurate information that could help the Refuge better understand and analyze water quantity and quality trends in relation to cavefish and cave crayfish population levels.

Under this Alternative, reconstruction of an old water-crossing that would cross the stream by the MMLERC from the newly renovated outdoor pavilion studio space to the primitive trail on the other side would mitigate disturbance to stream water and habitat in the long-term.

4.2.1.4 Impacts on Soils

<u>Alternative A—Current Management (No Action Alternative)</u>:
Adverse Impacts (Alternative A)
The Refuge would continue to apply fire according to a naturally-occurring fire regime. The primary objective is to return fire at a historic fire frequency. Research has found that this historic fire return interval was at least every five years (Stambaugh et al. 2009). As noted above, both prescribed and wildland fires, affect soils in several ways. A number of factors influence just how prescribed fire affects soils, including fire intensity, ambient temperature, vegetation type, and soil moisture (Wells et al., 1979). Low-intensity prescribed fires have few, if any, adverse effects on soil properties; in some cases such fires may improve soil properties. Repeated burning over a long period may affect levels of available phosphorus, exchangeable calcium, and organic matter content of mineral soil. While fire volatilizes nitrogen, causing losses of this nutrient, these losses are often offset by increased activity of nitrogen-fixing soil microorganisms after fires. Calcium and phosphorus may be lost from the upper soil layer but tend to be partially retained in lower mineral soil horizons. Moderate-intensity prescribed burns have little, if any, adverse effect on soil erosion even on relatively steep slopes (Brender and Cooper, 1968; Cushwa et al., 1971; Goebel et al., 1967). Alternatively, prescribed burns

conducted when soils and fuel loads are too dry can cause severe damage to soils. The Refuge would mitigate this by burning during state season of burn, and by considering weather variables in planning burns and fire safety. High-intensity prescribed fires have a short-term negative impact on nutrient status from volatilization of nitrogen and sulfur, plus some cation loss from ash convection. Such effects tend to be short-term after moderate-intensity fires, but recovery is not as rapid after severe fires (Stanturf, no date). Virtually all prescribed fires on the Refuge would be moderate-intensity.

In addition, the Refuge would continue restoring up to 50 acres of non-native grasses from an old pasture on the Beck Unit to native oak-hickory forest by planting native hardwood species to offer benefits to wildlife, such as oaks. Planting new hardwoods would be done by seedling primarily in the fall. A hole large enough to plant seed and bury it at least a few inches below the soil's surface (to keep out predation by birds, rodents, and insects) would be made (by hand or mechanically), disrupting soil layers within the planting area (Wittwer et al, OSU). Overall, re-establishment of these native species will improve the soil quality overtime, since it will mitigate the need for heavy equipment to continue mowing the area (as was done before the land was donated to the Refuge to maintain pasture), which would compact the soil, reducing the ability of soil to absorb and hold water and the ability of roots to penetrate through the soil (see more in *Beneficial Impacts*). However, this is a temporary action that lasts one to two weeks out of the year and may not continue once some native hardwood trees become established.

Maintenance activities would have localized, negligible to minor adverse impacts on soils by exposing them through removing vegetation, and by erosion. These effects would range from short-term. Short-term effects would occur during and immediately after maintenance activities. The amount of work to facilities under this Alternative would be small and activity would be temporary making any associated adverse effects negligible to minor, short-term, and localized to widespread depending on the potential for storms and erosion.

Service staff, expert cavers, and scientists that enter caves throughout the year (primarily winter during bat hibernaculum) perform cave fauna monitoring that may have short-term minor impacts to the soil within caves, including compaction, disturbance and may also cause turbidity in the water of wet caves, which may disrupt or scare wildlife temporarily.

EE and interpretation programs that include hiking around the Looney Unit on designated primitive trails and off-trail would result in some disturbance to soils. However, trail maintenance would occur periodically to reduce potential for erosion. In addition, a few of these programs include overnight camping in a designated primitive camping area (approximately one weekend per month). These impacts have little potential of leading to extensive soil erosion or degradation. Visitor access typically occurs by individuals or groups that participate in recreational activities for short durations. The Refuge would continue to allow public access by

appointment only on the Looney Unit and MMLERC, where the facility exists specifically to accommodate the use while reducing resource impacts. The use of trails may result in soil compaction, erosion, and minor trampling of vegetation. These impacts have little potential of leading to extensive soil erosion or degradation.

Cave gate construction creates short-term minor to moderate impacts to the soils that last 5-6 days total. Construction happens in phases, beginning with initial measuring. This mostly creates disturbance to soils by foot trampling at the mouth of the cave. Then, a gate frame is installed, which may include minor adjustments such as knocking out small pieces of rock with a sledgehammer in order to place steel frame. Cave gate construction activities may create dust or displace soil and/or rock in cave mouth area, which may pollute cave water sources temporarily.

Beneficial Impacts (Alternative A)
The Refuge has acquired 4,081 acres of lands in which it manages to protect cave, karst, forest, groundwater, as well as surfacewater resources. Maintaining and restoring 3,977 acres of native, large stands of healthy forest and their root systems in addition to multiple watershed areas without farming, grazing, or using chemical pesticides, increases soil health and quality, including its organic matter, water holding capacity, soil organisms, soil structure, infiltration capacity, and nutrients (NRCS; USDA Soils, 2012). In addition, the Refuge partners with adjacent and nearby landowners to implement conservation agreements to maintain or restore forest and aquatic habitats and encourage sustainable grazing methods, which overall benefit soil quality.

Restoring 50 acres on the Beck Unit of non-native pasturelands to native trees and native vegetation will increase the soil quality, once established. These native plants and wildflowers are adapted to local soil pH, nutrient levels, soil moisture and weather conditions so they do not require chemical inputs, irrigation, or other inputs that may deplete soil quality in order to thrive (NRCS; USDA Soil Health Fact Sheet 5, 2011). These plants evolved with native soil fungi, bacteria and invertebrates and help maintain a healthy soil ecosystem (NRCS; USDA Soil Health Fact Sheet 5, 2011). Furthermore, the Refuge would not need to apply excess water or nutrients, which may degrade local surface and subsurface water quality in order to maintain these native plant populations.

<u>Alternative B--Proposed Action</u>:
Adverse Impacts (Alternative B)
The Refuge would continue to apply fire according to a naturally-occurring fire regime of burning approximately 1/3 of Refuge lands, including newly acquired lands and on adjacent lands with cooperating landowners in a 3-5 year rotation. The primary objective is to return fire at a historic fire frequency. Research has found that this historic fire return interval was at least every five years (Stambaugh et al. 2009). As noted above, low-intensity prescribed fires have

few, if any, adverse effects on soil properties. Alternatively, prescribed burns conducted when soils and fuel loads are too dry can cause severe damage to soils. The Refuge would mitigate this by burning during state season of burn, and by considering weather variables in planning burns and fire safety. High-intensity prescribed fires have a short-term negative impact on nutrient status from volatilization of nitrogen and sulfur, plus some cation loss from ash convection. Such effects tend to be short-term after moderate-intensity fires, but recovery is not as rapid after severe fires (Stanturf, no date). Virtually all prescribed fires on the Refuge would be moderate-intensity. At Ozark Plateau NWR, the fire program is such that prescribed fires would be conducted at such a frequency as to avoid the accumulation of fuels that might result in hot fires and severe damage to soils.

As described above, the Refuge would continue restoring lands of non-native grasses from old pasture lands (50 acres on the Beck Unit) and any other acquired lands with these conditions to native oak-hickory forest by planting native hardwood species to offer benefits to wildlife, such as oaks. Planting new hardwoods may involve using machinery such as a Bobcat Auger with 36” tapered tree bit to drill holes for planting. Drilling would disrupt soil layers and root systems and may damage soil organisms within the 20-40” holes. However, overall re-establishment of these native species will improve the soil quality overtime, since it will mitigate the need for heavy equipment to continue mowing the area (which would compact the soil, reducing the ability of soil to absorb and hold water and the ability of roots to penetrate through the soil) (see more in *Beneficial Impacts*). However, this is a temporary action that lasts one to two weeks out of the year until native hardwood forest has become established.

Construction of new facilities such as a new Headquarters/Visitor Center site, three Refuge housing RV pads, additional maintenance shops and decontamination facilities, as well as maintenance to existing facilities or the use of roads and trails will cause minor to moderate soil disturbance, or materials from these sites (such as leaked equipment fluids) could get washed away during a storm event. However, construction would be short-term and localized to the site, making any associated adverse effects negligible to minor, short-term, and localized to widespread, depending on whether the runoff traveled to land or moving water.

An increase in visitation for EE and interpretation programs (by 40-80 people per week in spring, summer, and fall and by 10-20 per week in the winter) using designated primitive trails and/or wandering off-trail would result in an increase to disturbance to soils. However, the Refuge proposes to construct additional primitive trails in order to mitigate soil disruption to areas where visitors would walk without an established trail. Building and/or improving 2.52 miles of trails would also disrupt top soil and foot traffic using these trails would create soil compaction, minor erosion and trampling of vegetation. The Refuge would perform trail maintenance every spring and fall to reduce the potential for erosion. In addition, a few of these programs include overnight camping in a designated primitive camping area (up to three weekends per month).

These impacts have a low potential of leading to extensive soil erosion or degradation. Visitor access typically occurs by individuals or groups that participate in recreational activities for short durations. The Refuge would continue to allow public access by appointment only on the Looney Unit and MMLERC/outdoor pavilion, where the facilities would exist specifically to accommodate the use while reducing resource impacts.

Beneficial Impacts (Alternative B)
In this Alternative, the Refuge proposes to acquire up to 15,000 acres of lands in which it would manage to protect cave, karst, forest, groundwater, as well as surfacewater resources. Maintaining and restoring up to 15,000 acres of native, large stands of healthy forest (protection and prescribed burns) and their root systems in addition to multiple watersheds without farming, grazing, or using chemical pesticides to treat invasive species, will increase soil health and quality, including its organic matter, water holding capacity, soil organisms, soil structure, infiltration capacity, and nutrients (NRCS Soils, 2012). In addition, the Refuge would increase partnerships with adjacent and nearby landowners to implement conservation agreements to maintain or restore forest and aquatic habitats and encourage sustainable grazing methods, which overall benefit soil quality.

In addition, the Refuge would continue restoring up to 50 acres of non-native grasses from an old pasture on the Beck Unit to native oak-hickory forest by planting native hardwood species to offer benefits to wildlife, such as oaks. Planting new hardwoods may involve using machinery such as a Bobcat Auger with 36” tapered tree bit to drill holes for planting. Drilling would disrupt soil layers and root systems and may damage soil organisms within the 20-40” holes. However, overall re-establishment of these native species will improve the soil quality overtime, since it will mitigate the need for heavy equipment to continue mowing the area (which would compact the soil, reducing the ability of soil to absorb and hold water and the ability of roots to penetrate through the soil) (see more in *Beneficial Impacts*). This is a temporary action that lasts one to two weeks out of the year until native hardwood forest has become established.

4.2.2 Impacts to Biological Environment

4.2.2.1 Impacts on Subterranean Cave Habitat

<u>Alternative A—Current Management (No Action Alternative)</u>:
Adverse Impacts (Alternative A)
Current monitoring is done by Service staff, cave experts, and scientists, enter caves (where appropriate) throughout the Refuge and on adjacent and nearby neighboring lands (only by agreement with landowner) to perform annual bat hibernacula counts, cavefish and cave crayfish counts, and bio-inventorying of cave fauna. These visits contribute short-term minor impacts to cave habitats including additional noise in the caves, light pollution, soil compaction, soil disturbance and cause turbidity in the water of wet caves, which may disrupt or scare wildlife

temporarily. However, the Refuge only permits a necessary and minimal amount of experts to enter caves for essential cave monitoring and management activities. In addition, staff or partners that extract limited bat guano samples for scientific monitoring purposes may slightly reduce nutritional sources for all other cave-dwelling organisms; however, this amount is so small relative to the total amount of guano within the caves, that the overall impact is negligible.

Because caves are in remote locations, maintaining a LE presence and/or security is difficult. Therefore, illegal entry by the public may take place. In these incidents, cave species are disturbed and trash, graffiti, and vandalism may take place, which affects the quality of cave habitat for its respective species. The Refuge takes measures to avoid this by posting interpretive signs prohibiting entry, constructing cave gates to control access, and patrolling the areas as often as possible.

Cave gate construction creates short-term moderate impacts that last 5-6 days total. The Refuge schedules cave gate construction outside of maternity and hibernacula season when bats are not present or will be least impacted. Construction happens in phases, beginning with initial measuring. This mostly creates disturbance to soils by foot trampling at the mouth of the cave. Then a gate frame is installed, which may include minor adjustments such as knocking out small pieces of rock with a sledgehammer in order to place steel frame. This will re-adjust cave rock formation and create minor noise. Next, the Refuge and staff take large pieces of steel (to fit the length and/or width of the cave) and drill them with a large hand drill into cave wall, which directly impacts that particular section of cave rock and contributes to minor noise due to drilling. Welding the frame is done with the welder outside on the surface using a long lead wire, creating some smoke. The Refuge then attaches final steel bars. This semi-final phase creates moderate to severe noise from hammering, banging, and welding (humans need earplugs). Lastly, the Refuge paints the gates with a rust-proof primer, which may create fumes and cause discharge of small quantities of liquids containing waxy distillate, soap, water, particles, and mineral oil, however, the amount of this should not have a minor to negligible impact to water quality. Cave gate construction activities may create dust or displace soil in cave mouth area, which may pollute cave water sources temporarily.

According to a study for the 1999 *National Cave and Karst Management Symposium*, cave gates, if not designed properly, may restrict the natural airflow in and out of the caves (Roebuck et. al., 1999). There is less than 1% pressure loss for low velocity airflow for typical cave gate materials at solidity ratios of 60% or less (Roebuck et. al., 1999). Research on cave gates on Refuge caves and other nearby caves has shown that biological implications on endemic cave fauna are minimal (Martin et. al., 2006). The Refuge chooses its location carefully for installing cave gates so as to minimize impacts on air flow and continues to seek materials and designs that allow for natural air flow. In addition, the Refuge only designs and constructs “bat-friendly” gates with horizontal bars, enough distance apart, to allow for all bat species and even small

mammals to pass between bars with ease (White & Seginak, 1987). The majority of bat gates are built approximately 50-100 feet recessed into the caves so that bats are more tempted to utilize the cave. Again, the benefits to having cave gates to ensure protection for fragile cave habitats and wildlife outweigh these adverse impacts.

Beneficial Impacts (Alternative A)
Monitoring of groundwater quality in caves for traces of pesticides nitrates, phosphates, pharmaceuticals, and heavy metals helps the Refuge assess the quality of habitat for cave dwellers such as Oklahoma cave crayfish, and Delaware County cave crayfish. Groundwater mapping also allows the Refuge to identify any point-source pollution area that is affecting specific Refuge cave locations, which helps the Refuge prioritize communication with landowners as well as land acquisition areas with important recharge zones.

The Refuge prohibits public entry of the caves, so as not to disturb the fragile habitat and wildlife within and also to avoid the potential of humans to spread of WNS. The Refuge takes precautions before entering caves to make sure that all their caving equipment and gear is decontaminated prior to entry, as per the WNS National Plan guidelines (http://www.Service.gov/WhiteNoseSyndrome/pdf/WNSnationalplanMay2011.pdf). This ensures that staff and partners also avoid spreading WNS from cave to cave. In addition and as stated above, the Refuge builds, maintains, and repairs “bat-friendly” cave gates on- and off-Refuge which mitigate illegal entry and disturbance to the environment immensely. The Refuge also partners with landowners to identify cave entry violations. An LE officer is “on-call” from Sequoyah NWR. Furthermore, all EE and interpretation programs discuss the importance of cave ecosystems as well as the importance of preventing disturbance to cave habitats and wildlife. This may influence people to think twice about entering caves on and/or off the Refuge in order to protect endangered species.

<u>Alternative B--Proposed Future Management (Proposed Action)</u>:
Adverse Impacts (Alternative B)
The Refuge would have the same adverse impacts as described in Alternative A. However, in this Alternative, installing climate data loggers and fixed, solar-powered acoustic monitoring stations (Anabat) at cave locations would have little to no adverse effects on cave habitats or Refuge wildlife.

Installing cameras and alarms inside maternity/hibernacula caves may have short-term adverse impacts such as drilling in cave rock for attachment of equipment, and would also create temporary noise from the drill and light pollution from headlamps. In addition, installation of permanent acoustic monitors (of approximately the size of a human hand) in and around caves would have minor aesthetic and spatial impacts to cave habitat. Installation of these devices

would occur only during the appropriate season that would cause the least amount of disturbance possible to wildlife, especially bat species.

Beneficial Impacts (Alternative B)
The Refuge proposes to acquire up to 15,000 acres of land and will implement Strategic Habitat Conservation efforts to locate and acquire additional caves, springs, aquifers, groundwater recharge areas, and forested foraging areas that host an array of biodiversity of cave and surface fauna, including cave T&E species or species of concern on a landscape-level.

In addition, the Refuge proposes to coordinate beyond its own acquisition and Service regional boundaries to more effectively manage and protect subterranean and surface habitats for federally listed cave species on the landscape-level, such coordinating management efforts with Logan Cave NWR (Region 4), Cavefish NWR and Pilot Knob NWR (Region 3), and Region 6.

Monitoring activities proposed in this alternative will provide many benefits by increasing knowledge for Refuge staff and the academic and scientific community such as identifying cave habitat suitability requirements for Ozark big-eared bats, gray bats, Ozark cavefish, and cave crayfish, and other T&E and/or species of concern.

The Refuge will continue to control public entry of the caves, so as not to disturb wildlife that use the cave and other cave resources and also to avoid the potential of humans to spread of WNS. The Refuge takes precautions before entering caves to make sure that all their caving equipment and gear is decontaminated prior to entry, as per the WNS National Plan guidelines (http://www.Service.gov/WhiteNoseSyndrome/pdf/WNSnationalplanMay2011.pdf). This ensures that staff and partners also avoid spreading WNS from cave to cave. In addition the Refuge would continue to build, repair, and maintain cave gates, where and when appropriate, increase law enforcement presence around caves to monitor cave entry (once every month or especially during high bat activity seasons), and install alarm systems and infrared cameras at maternity and hibernacula caves, which would help reduce and prevent illegal entry. An increase in EE and interpretation programs would also increase the amount of people learning and discussing the importance of cave ecosystems as well as the importance of preventing disturbance to cave habitats and wildlife. This may influence people to think twice about entering caves on and/or off the Refuge.

4.2.2.2 Impacts on Forest and Riparian Habitats

<u>Alternative A—Current Management (No Action Alternative)</u>:
Under Alternative A, management activities for bottomland and upland hardwood forests would continue. Current management includes maintaining and protecting approximately 3,977 acres of forest on all Refuge Units and restoring 50 acres of native prairie on the Beck Unit back to historical forest conditions. Pre-settlement conditions are described as moderately stocked, open

woodlands and mature Oak-hickory forest, with an abundant understory of grasses, wildflowers, and herbaceous plants (Heikens, 1999).

Adverse Impacts (Alternative A)

The Refuge uses prescribed fire (approximately 300-500 acres every 3-5 years) on the Looney and Sally Bull Hollow Units and allows naturally-occurring wildfires to burn (as long as they do not pose a threat to infrastructure) to restore these forest areas to the desired conditions described above. Low-intensity prescribed fires have few adverse effects on Ozark forest habitat because it mainly plays a healthy role for the bottom- and up-land forest ecosystems. While the fires may cause short-term disturbance and/or changes to soil, water, and/or air quality (as described in those resource categories above), overall it has negligible adverse effects on the forest habitat, except that the prescribed burning program will have a visible impact on vegetation and the land. Immediately after a fire much of the land will be blackened. There will be few grasses or understory forbs remaining and most of the brush will be scorched. Trees may be scorched and scarred thereafter. Some of the less fire resistant trees will show signs of wilting and may succumb. After one season of regrowth, most signs of prescribed burning will be difficult to detect without close examination, except tree scarring. The Refuge uses firebreaks including existing roads, trails and/or water bodies such as streams. Road and trail firebreaks would be maintained, when necessary, for use in containing wildland fires and future prescribed burns. Because of wet ground conditions or patchy fuels, there are often areas within the burn unit that are untouched by fire, resulting in a patchy, mosaic burn. Some visitors find recently burned areas of the forest to be aesthetically unpleasing. On the other hand, prescribed fire can actually enhance the appearance of the area even within a few days. For example, after a spring burn, the enriched soil will promote rapid growth of green sprouts, native grasses and forbs will begin within a few days to a couple of weeks (see more in *beneficial impacts* below). The threat to biodiversity from lack of fire in many forest types outweighs the potential advantages of fire suppression (Noss, 2001).

In addition, the Refuge would continue restoring up to 50 acres of non-native grasses from an old pasture on the Beck Unit to native oak-hickory forest by planting native hardwood species to offer benefits to wildlife, such as oaks. Mowing and/or weed wacking of non-native grasses with handheld mechanical equipment may be done first to allow for an area feasible for planting native seeds. These mechanical devices cause temporary moderate to high levels of noise, create short-term dust and pollen spores, and may emit C02 in the atmosphere. However, this is a temporary action that lasts a few days out of the year and would not continue once some native hardwood trees become established. The noise would disturb wildlife within the habitat; however, it would not be a long-enough period to deter wildlife from living or utilizing the area. Planting new hardwoods would be done by seedling primarily in the fall. A hole large enough to plant the seed and bury it at least a few inches below the soil's surface (to keep out predation by birds, rodents, and insects) would be made (by hand or mechanically), disrupting soil layers

within the planting area (Wittwer et al, OSU). In addition, seedlings would need to be watered until they have been established to at least one- to two-feet high. However, re-establishment of these native species will improve the soil quality and should not affect water tables since their root systems should be adapted to the area's groundwater levels and to the natural amount of rainfall that northeast Oklahoma precipitates annually.

In addition, trail maintenance is performed on less than one-mile total of trails supporting limited public use (by appointment only) through bottomland hardwood forests, which result in minor, site-specific impacts since these trails are primarily "primitive", meaning there has been no major construction or removal of well-established or important native vegetation or boulders to create them.

The MMLERC and its adjoining dirt parking lot and primitive trails occupy land surface area of this forest. However, Refuge infrastructure represents a very small fraction of the total area of bottomland forest and the impacts to habitat quality are minor to negligible.

Beneficial Impacts (Alternative A)
Currently, approximately 97% of Refuge lands are upland and bottomland hardwood forest habitat, which is very important to conserve, protect, and manage within the Ozarks landscape since the habitat is disappearing due to extensive urban, suburban, industrial, and agricultural development. In addition, this forest is very important foraging habitat for the endangered Ozark big-eared bat (*Corynorhinus townsendii ingens*) and the associated streams and riparian habitat within it are also important foraging habitat for endangered species, gray bat (*Myotis grisescens*).

Historically, oak-hickory forests had an understory fire regime (Van Lear and Waldrop 1989). Native Americans burned these forests frequently to promote grasses and attract game, among other reasons. Oaks and hickories were favored by these frequent fire regimes, because they both have adaptations that make them resistant to fire, such as thick bark (http://www.forestencyclopedia.net/p/p157). U.S. Forest Service describes that after many years of fire exclusion, an ecosystem needs periodic fire or it becomes unhealthy. Trees become stressed by overcrowding; fire-dependent species disappear; and flammable fuels build up and become hazardous. The Refuge plans to carefully plan its prescribed burns to mimic these natural fire regimes of fires occurring every three to five years under the appropriate conditions to benefit its forest habitat by giving it sufficient recovery time for existing plant communities and time for new plants to establish. These burns only occur on a small portion of Refuge lands, however the benefit to the forest ecosystem is great including reducing hazardous fuels, preventing woody encroachment, protecting human communities from extreme fires; minimizing the spread of pest insects and disease; removing non-native invasive species that threaten species native to an ecosystem; opening up understory for ideal foraging habitat for Ozark big-eared bats; recycling nutrients back to the soil; and promoting the growth of native trees, wildflowers,

and other plants, which can also be aesthetically pleasing (http://www.fs.fed.us/fire/management/rx.html) (Bidwell et al, 2003).

Restoring approximately 70 acres on the Beck Unit of non-native pasturelands to native trees and native vegetation will increase the soil quality, and provide better habitat for native wildlife species, once established. These native plants and wildflowers are adapted to local soil pH, nutrient levels, soil moisture, and weather conditions. Therefore, once established, in order to maintain these native plant populations, the Refuge will not need to apply excess water or chemical nutrients, which would degrade local surface and subsurface water quality.

Alternative B—Proposed Future Management (Proposed Action Alternative):
The Refuge would continue to implement actions as stated in Alternative A, plus it would acquire at least 80% of forested-lands, or up to 10,907 acres, ideally, of mature oak-hickory and pine forest habitat. The Refuge proposes to protect, maintain and/or restore acquired habitats to pre-settlement conditions - described as moderately stocked, open woodlands and mature oak-hickory forest, with an abundant understory of grasses, wildflowers, and herbaceous plants (Heikens, 1999).

Adverse Impacts (Alternative B)
The Refuge proposes to increase the use of prescribed fire (approximately 1/3 of Refuge lands every 3-5 years) to all Refuge Units to restore these forest areas to the desired conditions described above. Low-intensity prescribed fires have few adverse effects on Ozark forest habitat because they mainly play a healthy role for the bottomland forest ecosystem. While prescribed fire may cause short-term disturbance and/or changes to soil, water, and/or air quality (as described in those resource categories above), overall it has negligible adverse effects on the forest habitat, except that the prescribed burning program will have a visible impact on vegetation and the land. Immediately after a fire much of the land will be blackened. There will be few grasses or understory forbs remaining and most of the brush will be scorched. Trees may be scorched and scarred thereafter. Some of the less fire resistant trees will show signs of wilting and may succumb. After one season of regrowth, most signs of prescribed burning will be difficult to detect without close examination, except tree scarring. The Refuge uses firebreaks including existing roads, trails and/or water bodies such as streams. Road and trail firebreaks would be maintained, when necessary, for use in containing wildland fires and future prescribed burns. Because of wet ground conditions or patchy fuels, there are often areas within the burn unit that are untouched by fire, resulting in a patchy, mosaic burn. Some visitors find recently burned areas of the forest to be aesthetically unpleasing. On the other hand, prescribed fire can actually enhance the appearance of the area even within a few days. For example, after a spring burn, the enriched soil will promote rapid growth of green sprouts, native grasses and forbs will begin within a few days to a couple of weeks (see more in *beneficial impacts* below). The threat

to biodiversity from lack of fire in many forest types outweighs the potential advantages of fire suppression (Noss, 2001).

In the event that a portion of these acquired lands are old pasture-lands, farm fields, or other lands that require intense restoration from invasive plant species, the Refuge would first attempt using mechanical treatments, such as mowing (see Alternative A) and if necessary, would also apply spot-herbicide treatment, to initiate the restoration process. Herbicides can efficiently and effectively suppress or kill unwanted plants and the Service uses them in such a manner as to minimize adverse effects on non-target resources. An herbicide suppresses or kills plants by decreasing their growth, seed production, and competitiveness (USFWS, 2009b). The Refuge must weigh the benefits of herbicides in controlling invasive plants against the potential for exposure and impacts to human health, non-target organisms, and the environment. The federal and state governments regulate herbicides to ensure that they do not pose unreasonable risks. The EPA requires extensive test data from herbicide producers to show that their products are safe to use. EPA scientists and analysts carefully review these data to determine whether to register (license) an herbicide and whether certain restrictions on use are needed (USFWS, 2009b). EPA evaluates both exposure and toxicity to determine the risk associated with use of a given herbicide. Applications and subsequent movement may expose people, non-target flora and fauna, water, and soil directly or indirectly to herbicides; the Refuge can minimize or avoid this exposure by following proper instructions and labels. For wildlife and humans, herbicides may enter the body through the skin, by swallowing, and by breathing. Once the Refuge applies herbicides, the many biotic (living) and abiotic (non-living) processes that affect the fate of herbicides in the environment further influence the potential for exposure. Herbicide use on national wildlife refuges must comply with the Federal Insecticide, Fungicide, and Rodenticide Act (FIFRA) and other federal laws and authorities. The use of herbicides and other pesticides on refuges is governed by the U.S. Department of Interior Integrated Pest Management Policy (517 DM 1), the Service Pest Management Policy and Responsibilities (30 AM 12), and the Service Refuge Manual (7 RM 14). Refuge staff must complete a Pesticide Use Proposal (PUP) whenever we use a pesticide or herbicide on a refuge, including applications by staff, volunteers, contractors, or in association with a right-of-way easement or Special Use Permit. Individuals with duties related to plant management and knowledge and experience with herbicides typically complete and submit the PUP. An online PUPS database enables staff to complete and submit PUPS electronically at https://systems.Service.gov/PUPS/. Depending on the pesticide and other conditions listed in the PUP, the PUP may need Regional Office review and approval, and under some circumstances, the Regional Office may need to submit the PUP for Washington Office (WO) review and approval. PUPS that are part of an approved integrated pest management plan may receive five-year approvals. The Director periodically issues specific guidance that includes details about PUP approval authority and which herbicides and application scenarios require review beyond the field station.

Refuge managers or the project leader ensures that:

- Pest management decisions are consistent with all applicable policies, laws, and regulations.
- Anyone applying pesticides, releasing biological control agents, and conducting other Integrated Pest Management (IPM) activities has the appropriate training and equipment necessary to protect their safety and health.
- We apply pesticides only after the appropriate reviewer approves the PUP.
- We establish threshold levels of damage or pest populations according to Service or field station goals and objectives and applicable laws.
- Staff store, handle, and dispose of pesticides and pesticide containers in accordance with the label and in a manner that safeguards human, fish, and wildlife health and prevents soil and water contamination.
- Submit annual reports documenting pesticide use and efficacy into the online PUPS database (USFWS, 2009b).

The Refuge would rather refrain from using chemicals in management activities because of the potential of contaminating groundwater aquifers used by the federally listed threatened Ozark cavefish, species of concern cave crayfish, other subterranean aquatic species, and forage species fed upon by federally listed endangered Ozark big-eared bats and gray bats. However, in the event that invasive non-native species become uncontrollable and threaten the health of the ecosystem, the Refuge would use limited herbicides to spot-treat invasive flora species including: Japanese honeysuckle; sericea lespedeza; Chinese privet; shrubby lespedeza; tall fescue; yellow sweetclover; puncturevine; stinkgrass; shepherd's-purse; watercress; fivestamen tamarisk; barnyardgrass; curly dock; field bindweed; Johnson grass; mimosa; tall fescue; Russian-olive; ground ivy; red clover; hairy vetch and others that become a threat to important native plant and/or fauna species within the habitat. Once the PUP is approved, the Refuge proposes to apply one to three applications per year of Garlon 3A (made of LI-700 , Methylated seed oil, MSO , Fighter-F 10, Ethanol, Triethylamine, and EDTA), between the months of March through November. Applications to a cut stump would be done by hand or backpack using 50% solution and applications for ground spot treatment would only be 2% solution. The Refuge would employ best management practices during planning and application of all herbicide use including: application at wind speeds less than 10 mph (but not inversion conditions) - must follow label; calibrate application equipment; field scouting/monitoring before pesticide application; pesticide application buffers around sensitive areas; use lowest effective application rate; and vegetative buffers. The Refuge would not apply chemical herbicides in sensitive groundwater recharge areas or above karst topography that is conducive to filtrating into fragile cave habitat.

Trail-building of 2.25 miles of primitive trails and maintenance of less than one-mile of primitive trails would support limited public use (by appointment only) through Ozark forests, and would

result in minor, site-specific impacts. Since these trails are primarily "primitive", there would be no major construction or removal of well-established native vegetation or large boulders in order to create and/or maintain them. This would be done primarily using hand tools and occasionally using mechanical tools.

Weather stations, each consisting of a 4 feet tall by 4 feet wide concrete pad with a five feet tall box to house instruments and gauges, would be installed as permanent structures at the Looney, Boy Scout, and Sally Bull Hollow Units as well as any appropriate acquired land areas. The Refuge would choose the location for this structure carefully, so that no important native vegetation or large rocks would need to be removed for the installation. In addition, these would be placed near Refuge access roads to avoid vehicle disturbance within any protected habitat area. In addition, weather stations would adversely affect the aesthetics of this habitat, since it will appear as man-made structure amidst predominately wild forest habitat. However, the Refuge will mitigate this by choosing locations carefully so as to somewhat "camouflage" the stations from human and/or wildlife visibility.

In this Alternative, Ozark Plateau NWR proposes hunting on the Sally Bull Hollow Unit, by walk-in access only, and to be limited to state seasons and regulations. Hunting activities on the Refuge will be 1) consistent with resource objectives of the Refuge and 2) supported by yearly State harvest estimates indicating that target species support a harvestable surplus. Allowing this public use on the Refuge will increase foot traffic (hunting would only be accessed by foot), which may cause minor long-term impacts to the habitat, such as trampling of vegetation.

Photography blinds and three primitive overlook areas on the Looney Unit trails and potentially newly acquired lands would be established, primarily within upland forest habitats. In order to protect the habitat, these would be placed carefully so as not to remove any native vegetation, trees, or large rocks. In addition, these would not require heavy construction equipment and would be constructed by hand in areas with great views or nature-viewing opportunities for visitors. The impacts would mostly be negligible to the forest habitat, however, it would increase groups stopping around it and may cause some additional trampling of vegetation or soil.

In this alternative, the Refuge proposes to allow wood harvesting by the public, only in the events that there are wind or ice storms or to reduce fuel accumulation in the forests. During these events, there would be an increase in public use of these areas, which may trample vegetation and temporarily compact soils. In addition, loud noise occurring from the use of chainsaws and other mechanical equipment may disturb wildlife.

Construction due to the building and/or restoring of a new Headquarters site and building of could disturb animals in the short-medium term that it persists. The Refuge would not construct

a new building on any site that would damage critical habitat for any native wildlife species; instead, Refuge staff would identify a building site that had been previously disturbed (i.e. old pasturelands, etc.). The construction of two RV pads, adjacent to existing or future acquired buildings on the other hand, may have minor impacts to habitat by removing vegetation and/or boulders.

Beneficial Impacts (Alternative B)

The Refuge proposes to acquire up to 15,000 acres of lands throughout the lifetime of this CCP. The Refuge ideally would acquire at least 80% of those as mature oak-hickory forest habitat (including cave habitats). Restoring habitat on and surrounding the Refuge to conditions that promote a more open, and regenerating, mature forest condition (*e.g.*, basal area of 50-60 sq. ft.) is expected to provide an enhanced foraging environment and abundant food source for the endangered species, Ozark big-eared bat (*Corynorhinus townsendii ingens*), and protect important flight corridors for gray bats (*Myotis grisescens*). Another purpose of Ozark Plateau NWR is to protect large continuous stands of mature Ozark forest essential to interior forest nesting migratory birds such as tanagers, warblers, and flycatchers that must nest some distance from an edge. The forest also plays an important role in preventing degradation of water quality in caves used by the Ozark cavefish and other rare aquatic cave fauna such as the Oklahoma cave crayfish. Large stands of healthy forest also provide natural infiltration and percolation, reducing the amount of sediment, pesticides, and nutrients that might otherwise enter water bodies from surface run-off.

As described in Alternative A, historically, oak-hickory forests had an understory fire regime (Van Lear and Waldrop 1989). Native Americans burned these forests frequently to promote grasses and attract game, among other reasons. Oaks and hickories were favored by these frequent fire regimes, because they both have adaptations that make them resistant to fire, such as thick bark (http://www.forestencyclopedia.net/p/p157). U.S. Forest Service describes that after many years of fire exclusion, an ecosystem needs periodic fire or it becomes unhealthy. Trees become stressed by overcrowding; fire-dependent species disappear; and flammable fuels build up and become hazardous. The Refuge would carefully plan its prescribed burns to mimic these natural fire regimes of fires occurring every three to five years under the appropriate conditions to benefit its forest habitat by giving it sufficient recovery time for existing plant communities and time for new plants to establish. Increasing the amount of prescribed burns to up to 1/3 of total Refuge lands, will greatly reduce hazardous fuels; prevent woody encroachment; protect human communities from extreme fires; minimize the spread of pest insects and disease; remove non-native invasive species that threaten species native to an ecosystem; open up understory for ideal foraging habitat for T&E species, Ozark big-eared bat; provide ideal nesting and breeding conditions for resident and migratory birds; recycle nutrients back to the soil; and promote the growth of native trees, wildflowers, and other plants, which can

also be aesthetically pleasing to the human eye (http://www.fs.fed.us/fire/management/rx.html) (Bidwell et al, 2003).

Aside from using fire as a management tool, wood harvesting would aid in a reduction of fuel loads, which is important in order to mitigate hot-burning wildfires (which could destroy old-growth trees). Wood harvesting of downed trees and excessive fuel loads would also assist the Refuge at attaining the forest conditions necessary for restoration such as moderately stocked mature oak-hickory-pine with an open understory in order to provide suitable habitat for its bat, resident, and migratory wildlife species.

Restoring future acquired lands from non-native invasive flora species to native trees and native vegetation will increase the soil quality, and provide better habitat for native wildlife species, once established. These native plants and wildflowers are adapted to local soil pH, nutrient levels, soil moisture, and weather conditions. Therefore, once established, in order to maintain these native plant populations, the Refuge will not need to apply excess water or chemical nutrients, which would degrade local surface and subsurface water quality.

4.2.2.3 Impacts on Wildlife: Cave Species (T&E, Species of Concern, and Non-T&E)

Alternative A—Current Management (No Action):

Adverse Impacts (Alternative A)

Using florescent dye-tracing methods to map groundwater recharge areas within the acquisition may affect the pH levels of the water quality, which may also influence a short-term impact to Ozark cavefish and cave crayfish and other aquatic cave organisms. However, a 2011 study by researchers, Rowinski and Chrzanowski, revealed that if used properly, Rhodamine B and Rhodamine WT (commonly used fluorescent dyes for hydrological research), are low enough concentrations that exert almost no toxic impact on small aquatic organisms.

Because caves are in remote locations, maintaining a LE presence and/or security is difficult. Because of this, illegal entry by the public may take place. In these incidents, cave species are disturbed and trash, graffiti, and vandalism may take place, which affects the quality of cave habitat for its respective species. The Refuge takes measures to avoid this by posting signs prohibiting entry, constructing cave gates to control access, and patrolling the areas as often as possible.

Monitoring efforts performed within caves may temporarily disturb cave wildlife. Refuge staff and other cave experts enter wet caves with decontaminated waders and gear, disrupting bottom-soil and water flow, while causing turbidity, which may pollute the quality of the water (affecting cavefish or cave crayfish's quality of breathing) or scare wildlife temporarily. In addition, cavers must go in using headlamps and light can bother cave wildlife, which is accustomed to complete darkness. However, monitoring activities in each cave only last a few

days out of the year and have minor to negligible long-term impacts on cave fauna. In addition, Refuge staff employs best management practices so as to least disturb the species, such as whispering in the caves while the bats are hibernating.

Beneficial Impacts (Alternative A)
Monitoring cave species and other wildlife species on some Refuge Units as well as baseline cave microclimates with temperature and humidity loggers in two Refuge caves would provide more understanding about climate change and how it is affecting Refuge habitats and wildlife. Other monitoring activities in this Alternative benefit the scientific community by providing baseline information to begin studying trends. This information can help guide management to meet cave fauna needs.

The Refuge controls public entry of the caves, so as not to disturb the fragile habitat and wildlife within and also to avoid the potential of humans to spread WNS. The Refuge takes precautions before entering caves to make sure that all their caving equipment and gear is decontaminated prior to entry, as per the WNS National Plan guidelines (http://www.Service.gov/WhiteNoseSyndrome/pdf/WNSnationalplanMay2011.pdf). This ensures that staff and partners also avoid spreading WNS from cave to cave. In addition and as stated above, the Refuge builds, maintains, and repairs "bat-friendly" cave gates on- and off-Refuge which mitigate illegal entry and disturbance to cave species immensely.

All EE and interpretation programs highlight the important role of bat species in supporting cave ecosystems. These discussions may influence people to appreciate rather than fear bats as well as understand the need to protect fragile cave habitat.

<u>Alternative B—Proposed Future Management (Proposed Action)</u>:
Adverse Impacts (Alternative B)
Impacts to monitoring cave fauna would be the same as described in Alternative A.

The Refuge also proposes to use herbicide spot-treatment of Garlon 3A (described in detail in 4.2.2.2 Impacts on Forest and Riparian Habitats), only if necessary, on future acquired lands that may require intensive restoration of non-native invasive flora. Non-target species sensitive to herbicide application of Garlon 3A include: amphibians, crustaceans, fish, fish-eating birds, honeybees, mammals, native lepidopterans, native pollinating insects, passerines, reptiles, and waterfowl. If the Refuge deems that it is necessary to use minimal herbicide spot treatments on non-native invasive flora of future acquired lands for habitat restoration, the Refuge will take all precautions necessary such as follow label guidelines and implement best management practices to eliminate drift, exposure, or any harm to non-target species and T&E species.

When cave wildlife species are handled for genetic sampling (DNA samples), levels of stress hormones may increase, which can temporarily lead to a depression of immune functions. However, when possible, the Refuge will use "non-invasive sampling" as the primary method used to gather genetic material such as: hair, feces, saliva, feathers, urine, etc. so as to reduce or mitigate any disturbance to wildlife, especially T&E species (Waits & Paetkau, 2005).

Beneficial Impacts (Alternative B)
The Refuge proposes to acquire up to 15,000 acres of lands throughout the lifetime of this CCP, focusing acquisition priorities on providing and protecting cave habitat for T&E cave species and species of concern.

In addition, acquiring and protecting/restoring up to 15,000 acres of forested habitat (removal of non-native species, prescribed burns, planting native trees, and wood harvesting downed trees to reduce fuel loads) on and surrounding the Refuge to conditions that promote a more open, and regenerating, mature forest condition (*e.g.*, basal area of 50-60 sq. ft.) is expected to provide an enhanced foraging environment and abundant food source for the endangered species, Ozark big-eared bat (*Corynorhinus townsendii ingens*), and protect important flight corridors for gray bats (*Myotis grisescens*). The forest also plays an important role in preventing degradation of water quality in ground water aquifers used by the Ozark cavefish and other rare aquatic cave fauna such as the Oklahoma cave crayfish.

In addition, the Refuge proposes to coordinate beyond its own acquisition and Service regional boundaries to more effectively manage and protect cave habitats for federally listed cave species on the landscape-level, such as coordinate management efforts with Logan Cave NWR (Region 4), Cavefish NWR and Pilot Knob NWR (Region 3), as well as coordinate management efforts with Region 6. This would promote stronger support for these species to assure continuing existence and recovery from being threatened, endangered, or a species of concern.

In this alternative, an increase in LE support by Refuge staff and a LE Officer based out of Sequoyah NWR to monitor cave entry once every month or by high bat activity seasons could prevent cave vandalism, which would ensure cave species protection from disturbance to their cave habitat and/or physical disturbance/harm.

Monitoring activities proposed in this alternative will provide many benefits by increasing knowledge for Refuge staff and the scientific community such as identifying cave habitat suitability requirements for Ozark big-eared bats, gray bats, Ozark cavefish, and cave crayfish, and other T&E and/or species of concern. Monitoring cave species and other wildlife species on and around Refuge Units as well as baseline cave microclimates with temperature and humidity loggers in two Refuge caves would assist with understanding more about climate change and how it is affecting Refuge habitats and wildlife. Identifying bat migration corridors will help to

identify high risk areas to mitigate wind energy farm projects and it will also give useful insight of how WNS is anticipated to spread. Genetic sampling of bat, crayfish, cavefish, and other cave species would help to identify which cave species populations are genetically isolated, identify undetermined cave species, and determine population dynamics by comparing nuclear and mitochondrial DNA, and which could also contribute to WNS research. Other monitoring activities in this Proposed Action Alternative benefit Refuge staff and the scientific community by addressing gaps in scientific information that could provide more insight for improvements in cave, karst, forest, and water resource management.

4.2.2.4 Impacts on Wildlife: Resident or Migratory Species

Alternative A--No Action Alternative:

Adverse Impacts (Alternative A)

The Refuge would continue restoring up to 50 acres of non-native grasses from an old pasture on the Beck Unit to native oak-hickory forest by planting native hardwood species to offer benefits to wildlife, such as oaks. Mowing and/or weed whacking of non-native grasses with handheld mechanical equipment may be done first to allow for an area feasible for planting native seeds. This is a temporary action that lasts a few days out of the year and would not continue once some native hardwood trees become established. During this short period, these mechanical devices cause moderate to high levels of noise, which may disturb and/or deter wildlife within 50 feet of use, such as deer, birds, and/or other small mammals temporarily, however, it is not anticipated to have any long-term adverse impacts.

Prescribed burns on the Looney and Sally Bull Hollow Units (approximately 400 acres every 3-5 years) would have minor adverse impacts to wildlife (see *Beneficial Impacts* below). During spring burns, some birds may lose their nests, but if the prescribed burn is early enough in the breeding season, the majority of these animals will re-nest. These prescribed burns could result in the mortality of some individuals, although this is unlikely. However, overall this will benefit the native species population levels by creating and maintaining highly productive native habitat.

Beneficial Impacts (Alternative A)

One of the purposes of Ozark Plateau NWR's establishment is to protect large continuous stands of mature Ozark forest essential to interior forest nesting migratory birds such as tanagers, warblers, and flycatchers that require nesting some distance from an edge. The Refuge is currently managing 3,977 acres of this type of habitat and plans to continue acquiring more habitat critical for these birds.

The majority of the prescribed fires will take place in early spring prior to the hatching and birthing periods for most species (i.e. deer fawns, song bird broods, etc.) and in late fall when the young animals have matured enough to avoid the fire. Prior to European settlement and wildfire suppression, fires played a major role in shaping the historic landscapes of the region and the

Refuge's native plant and animal communities. Animals and plants associated with these fire dependent habitat types have evolved with fire and, through time, developed adaptations to endure fire's effects. The immediate impact of fire on animals is generally less severe, as both vertebrates and invertebrates have shown to be fairly successful at avoiding fire. Many small mammal species, amphibians, reptiles, and invertebrates will survive burns by retreating into underground burrows or by going under water until the burn passes through. Healthy large mammals and birds have the ability to escape. Also, prescribed fires tend to burn in a mosaic fashion leaving some areas unburned and providing refugia for wildlife species. Changes in the plant community following a fire have benefits on the animal communities that inhabit these ecosystems. The long-term survival of wildlife species depends on the health of the plant community, which is enhanced by intermittent prescribed burns in a fire-dependent ecosystem. Fire programs also create a diverse mosaic of habitat conditions that support a biodiversity of native wildlife species.

Monitoring cave species and other wildlife species and surrounding Refuge Units as well as baseline cave microclimates with temperature and humidity loggers in Refuge caves would assist with understanding more about climate change and how it is affecting Refuge habitats and wildlife.

Other monitoring activities in this Alternative benefit Refuge staff and the scientific community by providing baseline information to begin studying trends. This information can help guide management to meet resident and migratory species' needs.

The Refuge controls public entry of the caves, so as not to disturb the fragile habitat and wildlife within and also to avoid the potential of humans to spread of WNS. The Refuge takes precautions before entering caves to make sure that all their caving equipment and gear is decontaminated prior to entry, as per the WNS National Plan guidelines (http://www.Service.gov/WhiteNoseSyndrome/pdf/WNSnationalplanMay2011.pdf). This ensures that staff and partners also avoid spreading WNS from cave to cave. In addition and as stated above, the Refuge builds, maintains, and repairs "bat-friendly" cave gates on- and off-Refuge which mitigate illegal entry and disturbance to cave species immensely.

All EE and interpretation programs highlight the important role of bat species in supporting cave ecosystems. These discussions may influence people to appreciate rather than fear bats as well as understand the need to protect fragile cave ecosystems.

<u>Alternative B--Proposed Action</u>:

Adverse Impacts (Alternative B)

In the event that a portion of these acquired lands are old pasture-lands, farm fields, or other lands that require intense restoration from invasive plant species, the Refuge would first attempt

using mechanical treatments, such as mowing (see impacts in Alternative A) and if necessary, would also apply spot-herbicide treatment, to initiate the restoration process. In these cases, the Refuge proposes to use herbicide spot-treatment of Garlon 3A (described in detail in 4.2.2.2 Impacts on Forest and Riparian Habitats), once to three times per year March – November. Non-target species sensitive to herbicide application of Garlon 3A include: amphibians, crustaceans, fish, fish-eating birds, honeybees, mammals, native lepidopterans, native pollinating insects, passerines, reptiles, and waterfowl. If the Refuge deems that it is required to use herbicide spot treatments on non-native invasive flora of future acquired lands for habitat restoration, the Refuge will take all precautions necessary such as follow label guidelines and implement best management practices to eliminate drift, exposure, or any harm to non-target species and T&E species.

In this alternative, the Refuge proposes to allow wood harvesting by the public, only in the events that there are wind or ice storms or to reduce fuel accumulation in the forests. Loud noise occurring from the use of chainsaws and other mechanical equipment may disturb wildlife, such as birds and small mammals, but only temporarily.

In this Alternative, Ozark Plateau NWR proposes to develop a Hunt Plan to allow hunting on the Sally Bull Hollow Unit. Hunting activities on the Refuge will be 1) consistent with resource objectives of the Refuge and 2) supported by yearly state harvest estimates indicating that target species support a harvestable surplus. According to ODWC monitoring and regulations, there would be no negative impacts on game abundance and distribution if the Refuge implements a Hunt Plan, under Alternatives B. However, allowing this public use on the Refuge will increase human foot traffic (hunting would only be accessed by foot). In addition, gun shots may temporarily startle wildlife, such as birds for the short duration of the shot.

Increasing EE opportunities at the Looney Unit for approximately 50-100 people per week, with 3-4 visits per week in spring, fall, and summer, and approximately 10-20 people per week with 1-2 visits per week in winter will increase the number of humans within the boundary of the Looney Unit. A greater number of groups per week may disturb wildlife species even if only when passing through/by. However, most species within the area are accustomed to humans and will not be affected by their presence. Large groups of school children may cause medium to loud levels of noise that can disturb birds and mammals. The Refuge will encourage large groups of children to listen carefully to the sounds of the forest around them to mitigate the noise level.

Construction due to the building and/or restoring of a new Headquarters site, MMLERC renovations, installation of solar panels, construction of raised garden beds, construction of RV pads, and/or renovations to other Refuge housing could disturb animals in the short to medium term that the renovation persists. Most disturbance would be due to noise from drilling,

hammering, banging, and mechanical equipment involved. During construction, wildlife such as birds, may choose a location that is within a safe distance from the noise and work. However, these species would be expected to return once construction is complete. The Refuge would not construct a new building on any site that would damage critical habitat for any native wildlife species; Refuge staff would identify building sites that had been previously disturbed (i.e. old pasturelands, etc.).

Banding of bird species once a month for six months each year on the Refuge may temporarily stress the species being handled. In addition, it may disturb the bird's flight balance or perching accuracy for a very short-term, until the band is adapted to by the bird. The Refuge will make sure to employ best management practices when banding birds such as those recommended by USGS, including handle each bird carefully, gently, quietly, with respect, and in minimum time; capture and process only as many birds as you can safely handle; close traps or nets when predators are in the area; do not band in inclement weather; frequently assess the condition of traps and nets and repair them quickly; properly train and supervise students; check nets as frequently as conditions dictate; check traps as often as recommended for each trap type; properly close all traps and nets at the end of banding; do not leave traps or nets set and untended; and use the correct band size and banding pliers for each bird; treat any bird injuries humanely (http://www.pwrc.usgs.gov/bbl/resources/ethics.cfm).

In this Alternative, the Refuge proposes to conduct studies to identify, document, and monitor all non-native wildlife species occurring on the Refuge, such as feral hog, feral cat, and hothouse millipede. The Refuge will evaluate the impacts of these species on cave, stream, riparian, forest, bottomland, and upland forest communities and if necessary, investigate methods for control and/or eradication. Hunting, trapping, or sterilizing any invasive fauna species would have a negative impact on its own population, by reducing breeding potential. However, these actions would greatly benefit native habitat and give native resident or migratory species a better chance to compete.

Beneficial Impacts (Alternative B)

The Refuge would continue the policies of limited public use activities to minimize disturbance to resident and migratory birds and other wildlife on Refuge lands. This ensures that wildlife have an authentic "refuge"- a sanctuary from human noise, distraction, and disturbance.

One of the purposes of Ozark Plateau NWR's establishment is to protect large continuous stands of mature Ozark forest essential to interior forest nesting migratory birds such as tanagers, warblers, and flycatchers that require nesting some distance from an edge. The Refuge is proposing to acquire a minimum of 80% forest habitat of its remaining 10,907 acreage, which would provide critical habitat for these birds, especially in anticipation of increased development within the area.

Monitoring activities proposed in this alternative will provide many benefits by increasing knowledge of Refuge staff and the scientific community such as identifying migration corridors of bat, bird, and other wildlife species; conducting species surveys of invertebrates, herpatofauna, fish, birds, and mammals to identify and document all wildlife species occurring on all units of the Refuge, potential acquisition areas, and with cooperating adjacent and nearby landowners, including surveys regarding non-native fauna species and their impacts to native species; conduct seasonal nesting studies as well as MAPS banding of birds once a month for six months each year on the Refuge to gather additional data on migration corridors, paths, origins and destinations, as well as population data trends; identify the quantity, quality and spatial configuration of available habitat, link habitat condition and population response, and anticipate future habitat conditions, in order to set and achieve population objectives for priority landbirds of the Central Hardwood Bird Conservation Region.

Collaborating with master gardeners and master naturalists to create raised vegetable/herb gardens and plant a native flower, plant, and herb permaculture-design garden around the MMLERC will benefit wildlife, especially for important pollinators including bees, butterflies, and hummingbirds.

4.2.3 Impacts to the Human Environment

4.2.3.1 Impacts to Cultural Resources

Alternative A—Current Management (No Action Alternative):
Under this alternative, there are no anticipated direct or indirect adverse impacts to cultural resources, as current conditions would be maintained, and no ground disturbance would occur.

Beneficial Impacts (Alternative A)
Cultural, historical, and/or archeological known sites would be kept confidential from the public to ensure preservation and protection.

Alternative B—Proposed Future Management (Proposed Action):
Adverse Impacts (Alternative B)
Under the Proposed Action Alternative, if there are any adverse impacts to cultural resources, it would only be accidental such as if any cultural, historical, and/or archaeological sites are found where mechanical treatment for forest restoration already occurs or when construction of a new Headquarters site and RV pads for Refuge housing takes place. However, the Refuge would survey these areas first in early planning stages to ensure that construction of infrastructure and/or disturbance to the land does not occur where valuable natural or cultural resources are present.

Beneficial Impacts (Alternative B)
Same as Alternative A, plus, if cultural, historical, and/or archaeological sites are discovered, the Refuge would coordinate with universities, Sam Noble Museum of National History archeologists and paleontologists, Tribal Nations, and SHPO to survey the area, study its historical context and significance, and preserve the site.

4.2.3.2 Impacts on Local Population and/or Economy

Alternative A--No Action Alternative:
Beneficial Impacts (Alternative A)
The economic and social condition of the area would remain the same in this Alternative. The presence and operation of the Refuge provides economic benefits to the surrounding communities within an 80 mile radius by bringing in groups of 10-20 people for EE and interpretation programs approximately 2-3 times per month in the spring and fall, 1 or 2 times per month in summer and one per month in the winter driving primarily from Tulsa, Joplin, Fayetteville, Tahlequah (45 mile – 80 mile range to Looney Unit), which contributes to generating revenue for the local economy (i.e., stopping at local restaurants and shops). There are a few participants that come from TN, TX, MO, KS, OK, MS and AR, which also bring more revenue into the State of Oklahoma. In addition, much of the Refuge's annual budget is invested in equipment and supplies- purchased primarily from local businesses, and is also spent on contracts for local labor to accomplish Refuge projects. The Refuge provides full-time employment for 2 individuals, part-time employment for 2 individuals, as well as student employment and paid-internship opportunities for people that live in nearby communities.

Alternative B--Proposed Action:
Beneficial Impacts (Alternative B)
The economic and social condition of the area would improve in this Alternative. The presence and operation of the Refuge would provide economic benefits to the surrounding communities within an 80 mile radius by bringing in additional groups of 50-100 people for EE and interpretation programs approximately 3-4 times per week in the spring, summer and fall, and approximately 10-20 people, 1 or 2 times per week in winter, driving primarily from Tulsa, Joplin, Fayetteville, Tahlequah (45 mile – 80 mile range to Looney Unit), which contributes to generating revenue for the local economy (e.g., stopping at local restaurants and shops). There may be a few participants that come from TN, TX, MO, KS, OK, MS and AR, which would also bring more revenue into the State of Oklahoma. In addition, much of the Refuge's annual budget is invested in equipment and supplies purchased from local businesses and is sometimes spent on contracts for local labor to accomplish Refuge projects. In this Alternative, the Refuge would provide full-time employment for over 9 individuals, in addition to many student employment and paid-internship opportunities. The Refuge would also provide housing for as many of these individuals as possible.

4.2.3.3 Impacts on Aesthetic and/or Visual Resources

Alternative A--No Action Alternative:
The visual landscape of Ozark Plateau NWR would primarily remain the same in this No Action Alternative.

Adverse Impacts (Alternative A)
Cave gates would remain on caves where federally listed species reside inside. Wildland fires (wildfire and/or prescribed fires) would blacken the land immediately after occurrence. There would be few grasses or understory forbs remaining and most of the brush would be scorched. Trees may be scorched and scarred thereafter. Some of the less fire resistant trees will show signs of wilting and may succumb. After one season of regrowth, most signs of prescribed burning will be difficult to detect without close examination, except tree scarring. Because of wet ground conditions or patchy fuels, there are often areas within the burn unit that are untouched by fire, resulting in a patchy, mosaic burn. Some visitors find recently burned areas of the forest to be aesthetically unpleasing.

Beneficial Impacts (Alternative A)
After only a few days to one year, wildland fires can enhance the appearance of the area. For example, after a spring burn, the enriched soil will promote rapid growth of lush green sprouts, native grasses, wildflowers, and forbs.

Alternative B-- Proposed Future Management (Proposed Action):
Adverse and beneficial impacts on aesthetic and/or visual resources would be the same as described in Alternative A plus:

Adverse Impacts (Alternative B)
Weather stations would adversely affect the aesthetics of this habitat, since they will appear as man-made structures amidst predominately wild forest habitat. However, the Refuge will mitigate this by choosing locations carefully so as to somewhat “camouflage” the stations from human visibility.

Beneficial Impacts (Alternative B)
Photography blinds would be constructed so as to blend in with the natural habitat (for example: made of local wood sources), and would enhance visitors’ ability to observe authentic wildlife behavior, without scaring wildlife away. Areas designated as primitive overlooks will also increase the opportunities for people to appreciate the beauty of various habitats and vista points of the Ozark Plateau NWR. Wood harvesting of accumulated fuel loads due to ice/wind storms or over-stocked areas of forest habitat will increase the aesthetics of these areas by allowing for grasses, wildflowers, and other vegetation to grow as an open understory to a moderately-stocked mature oak-hickory and pine forest of large trees. Establishment of 2.25 miles of new

primitive trails will give visitors better access to viewing and appreciating the splendor of Ozark Plateau forests, rocks and cave exteriors, and flowing streams.

4.2.3.4 Impacts on Public Use Opportunities and/or Access

Alternative A--No Action Alternative:

Adverse Impacts (Alternative A)

Ozark Plateau NWR has not promoted public use of the Refuge because of the sensitivity to human disturbance of the federally listed T&E cave species the Refuge was established to protect. Many people from the surrounding communities do not know about any public use opportunities that Ozark Plateau NWR has to offer (website is not updated frequently enough, there are no fliers/brochures, etc.). Many locals and ODWC have expressed that they would like hunting to be allowed on the Refuge, however, the Refuge currently does not allow hunting.

Beneficial Impacts (Alternative A)

The Refuge provides EE, interpretation, wildlife photography and observation opportunities to engage the public from surrounding communities to connect to nature and understand the importance of Ozark natural resources, including cave, karst, water, and forest. This benefits groups of 10-20 people, 2-3 times per month in the spring and fall, 1 or 2 times per month in summer and one per month in the winter. There are even some participants that come from TN, TX, MO, KS, OK, MS and AR. Not only are these programs engaging and satisfying (based on feedback) for visitors, they most likely will influence people to make “greener” decisions. This is concluded based on various research including one study that found that measures of environmental consciousness are closely linked to environmentally-responsible purchasing behavior (Schlegelmilch, 1996).

Alternative B--Proposed Action:

Impacts would be the same as those described in Alternative A. In addition:

Adverse Impacts (Alternative B)

An increase in visitation for EE and interpretation programs would increase the traffic along the access road. In addition, group sizes would be larger, therefore less personal. Hunting opportunities on the Sally Bull Hollow Unit may expose caves to the public, which could increase the potential for vandalism. There would be a temporary increase of vehicle traffic on Refuge roads close to wood harvest pile areas.

Beneficial Impacts (Alternative B)

In this alternative, the Refuge would provide more EE, interpretation, wildlife photography and observation opportunities and allow and hunting to engage the public from surrounding communities to connect to nature and understand the importance of Ozark natural resources, including cave, karst, water, and forest. In addition, programs would improve community

support of the Refuge as well as benefit all kinds of people from elders to young children to local Native American populations. The additional gardening program should teach people the skills and knowledge they need to know on how to grow their own vegetable, herb, and native plant (pollinator) garden in their backyard.

Trail-building of 2.25 miles of primitive trails and maintenance of current and future trails would support limited public use through bottomland hardwood forests, allowing visitors to get exercise while accessing new areas of the Refuge. This may increase the visitors' appreciation for not only the work the U.S. Fish & Wildlife Service does, but also for the environment in general.

Allowing for more public use opportunities, such as hunting and wood harvesting, will improve relationships with the public/local landowners, Tribal Nations, and the State. It will also heighten awareness of what Ozark Plateau NWR's purposes are. Support from people on all levels is needed to benefit the lands and species in the long-term and to establish future conservationists.

4.3 Assessment of Cumulative Impacts

A cumulative impact is defined as an impact on the environment that results from the incremental impact of the Proposed Action when added to other past, present, and reasonably foreseeable future action regardless of what agency (federal or nonfederal) or person undertakes such other actions. Cumulative impacts can result from individually minor but collectively significant actions taking place over a period of time (40 CFR 1508.7).

Cumulative impacts are the overall, net effects on a resource that arise from multiple actions, initiated by Ozark Plateau NWR and beyond the Refuge boundary by private landowners, businesses, industries, cities, universities/researchers, the State, and/or Tribal Nations. Impacts caused by all of these stakeholders can "accumulate" spatially, when different actions affect different areas of the same resource. They can also accumulate over the course of time, from actions in the past, the present, and the future. Occasionally, different actions counterbalance one another, partially cancelling out each other's effects on a resource. But more typically, multiple effects add up, with each additional action contributing an incremental impact on the resource.

As stated in the Service Manual (550 FW 1 and 2), in an EA, a cumulative impact assessment should be conducted if it is determined necessary through scoping to make a determination of significance of the proposed action. When a cumulative effects analysis is included in an EA, the analysis need only be sufficient for the decision maker to reach a conclusion on the significance of the impact in order to determine if the preparation of an EIS is required.

This section addresses the potential cumulative effects for all the alternatives and is intended to consider the activities on the Refuge in the context of other actions on a larger spatial and temporal scale. The impacts of past and present actions that have taken place on Ozark Plateau NWR are reflected in the current resource conditions (Affected Environment) as described in Chapter 3 of the Final CCP. The impacts of proposed future actions (for all alternatives) are discussed in earlier parts of this EA. The Service also considered past, present and future planned actions on other State, Federal and private lands surrounding the Refuge. Based on this analysis, the Service has concluded that proposed Refuge management actions (for both alternatives) when added to other past, present or future proposed actions would not result in significant cumulative impacts, as summarized below. The benefits to habitat, wildlife, and public use opportunities that the proposed actions would achieve greatly outweigh any of the adverse impacts discussed in this document.

4.3.1 Cumulative Impacts to Physical Resources

4.3.1.1 Cumulative Impacts of and to Climate Change

In the past 1,000 years, studies have shown that climate change is occurring primarily due to worldwide human activities that increase CO_2 in the atmosphere, causing the greenhouse effect (Crowley, 2000). This is expected to impact ecosystems in a variety of ways. These impacts may include: species range shifts, species extinctions, phenological changes, and increases in primary productivity.

Growing global corporation, Wal-Mart, has its corporate headquarters located only 40 miles from the Ozark Plateau NWR in Bentonville, Arkansas. Wal-Mart accounts for much of the urbanized growth in the surrounding area due to jobs and expansion. In Wal-Mart's 2010 Global Sustainability Report, the corporation reported to emit over 20 million metric tons of CO_2 in 2008, and that their "company's absolute GHG footprint continues to rise as [they] expand". In addition, Tulsa, Oklahoma (located 80 miles from the Looney Unit) boomed to a population of 72,000 by 1920, earning the city title, "Oil Capital of the World" (Tulsa Historical Society, 2010). The period of the 1950's and 60's saw Tulsa expand its physical limits. Small towns that had once been suburbs of the city were annexed as the city limits expanded to the south and east with additional roads, vehicles, large footprint homes, etc. (Tulsa Historical Society, 2010), further contributing to global greenhouse gas emissions.

The Refuge may be a minor contributor to climate change; however, the potential to acquire up to 15,000 acres of mature forest will account as an important carbon offset on the landscape-level through carbon sequestration. In addition, the Template for Assessing Climate Change Impacts and Management Options (TACCIMO) study suggests that prescribed burning could reduce CO_2 and other emissions from fires in dry forest types by 52-68%. This equates to overall fire emission reduction in the western U.S. of 18-25%, and as much as 35% at the state level

(http://www.forestthreats.org/). Therefore, the Refuge benefits climate change within the context of cumulative impacts. As the Refuge begins experiencing greater effects from climate change, the need for adaptive management will increase. More scientific data on when and where these changes may occur (the Refuge will be establishing an inventorying and monitoring program specifically to begin monitoring for this) along with what they may entail is necessary before determining how to counteract or adapt to them.

4.3.1.2 Cumulative Impacts to Air Quality

Surrounding city growth, the aerial spraying of croplands and invasive plants, and hot wildfires can contribute adversely to air quality. Spraying of croplands for pests and weeds has occurred and continues to occur regularly on croplands within the seven counties of the Refuge acquisition area, however, the Refuge does not have nor propose a farming program. The Refuge does not treat invasive plants through aerial spraying, but there are many farm fields surrounding the Refuge that may use aerial application of herbicides, which can result in an immediate and temporary air quality impact.

Oil refineries and gas companies make up for the majority of the State of Oklahoma's contributions to emissions that decrease air quality (Oklahoma Department of Environmental Quality, 2010). In addition, Oklahoma coal mines produced 2.0 million tons of coal in 2006, (0.2% of the U.S. total) (sourcewatch.org). In November 2010, a report produced by the Sierra Club attributed as many as 64 days with harmful levels of smog in Oklahoma to Texas' coal-fired power plants (sourcewatch.org). Grand River Dam Authority, located within the Refuge acquisition area of Mayes County, produces approximately 65.8% from coal and 34.2% from hydroelectricity (Energy Information Administration, 2008). Northeastern Station, a coal power plant only 30 miles from the Refuge acquisition boundary of Mayes County, which encompasses more than 40 square miles, five towns, and an entire watershed in far northeastern Oklahoma, creates toxic dust from over 75 million tons of chat piles (mining waste) of abandoned lead and zinc mines, which are especially hazardous to children under six years of age, causing lifelong impaired neurological development problems (Hughes, et. al., 2012). Furthermore, the miscarriage rate in the Tri-State Superfund Site area is 24%, compared to the national average of 10% (Sheiback, et al, 1982) due to large amounts of mine waste.

Projects on the Refuge that result in effects to air quality would be about the same over time, with minimal differences based on conditions (i.e. prescribed burning regimen, etc.). Restoring up to 15,000 acres of forest could improve the air considerably for the region. Beyond the Refuge, air quality impacts would remain about the same or decrease air quality in the foreseeable future, pending extreme population growth and subsequent heightened impacts to air quality from pollution.

4.3.1.3 Cumulative Impacts to Water Quality and Quantity

Some past, present, and reasonable foreseeable future Refuge activities; construction, herbicide spraying, and 15,000 acres of forest management affect water quality. In the Proposed Action, the Refuge proposes to restore up to 15,000 acres of forest, which includes mature trees that provide natural infiltration and percolation, reducing the amount of sediment, pesticides, and nutrients that might otherwise enter the groundwater from surface run-off. This would provide a beneficial cumulative impact to water resources and those that rely on these in surrounding communities. On the other hand, if the Refuge is compelled to use herbicide spot-treatment to control problematic invasive species, it may have negligible to minor cumulative impacts to water quality for lands downstream, depending on the duration and extent of the use in the future.

Water quality and quantity is also affected by adjacent and nearby landowners due to management decisions of grazing and the method and use of chemical fertilizers, insecticides, and herbicides. In a 1983 study on cattle grazing impacts to water quality, it found that bacteria densities in stream water are significantly higher when there is a high concentration and amount of cattle near the water source (Howard, 1983). Furthermore, Delaware County has some of the most severe numbers of “factory farms” in the United States, also known as “confined animal feeding operations” (CAFOs) (factoryfarmmap.org). CAFOs pollute surface and groundwater sources due to the mass amount of chicken and hog waste that is created- which seeps into local aquifers (foodandwaterwatch.org). Even though this is not taking place directly on the Refuge, it cumulatively impacts the water quality of surrounding areas, eventually making its way to Refuge water resources. This cumulatively impacts wildlife species including native fish of freshwater creeks and streams and even T&E species, such as the Ozark cavefish and Delaware County cave crayfish.

In 2010, the Environmental Integrity Project, the Sierra Club, and Earthjustice reported that Oklahoma, along with 34 states, had significant groundwater contamination from coal ash that is not currently regulated by the Environmental Protection Agency (EPA), including the Northeastern Station coal plant, only 30 miles from the Refuge acquisition boundary of Mayes County (sourcewatch.org). In addition, abandoned lead and zinc mines from the Tri-State Superfund Site have contaminated surface and groundwater resources in the northern part of the Refuge acquisition area.

Nearby fracking operations (a.k.a., hydraulic fracturing or industrial gas drilling) in northeast Oklahoma and northwestern Arkansas continue to be a threat to the water resources in the area (earthjustice.org). The *Scientific American* published an article on fracking stating, “records from disparate corners of the United States, [including Oklahoma], show that wells drilled to bury this waste deep beneath the ground have repeatedly leaked, sending dangerous chemicals and waste gurgling to the surface or, on occasion, seeping into shallow aquifers that store a

significant portion of the nation's drinking water (Lustgarten and ProPublica, 2012). "In 10 to 100 years we are going to find out that most of our groundwater is polluted", stated Mario Salazar, an engineer who worked for 25 years as a technical expert with the EPA's underground injection program in Washington (Lustgarten and ProPublica, 2012).

Grand River Dam Authority's (GRDA) hydroelectric dams may continue to affect the water levels and flows on important maternity cave sites near the Refuge, unless the Service and Federal Energy Regulatory Commission come to a management agreement. Beaver Dam Cave is a Refuge cave monitoring site and major gray bat maternity cave (5,000 - 20,000 bats) on private land in the Grand Lake flood pool. It is an alternate site for the major gray bat maternity colony (5,000 - 30,000 bats) using Twin Cave owned by TNC, that the Refuge helps manage. Operation of Grand River Dam Authority's hydropower project at Pensacola Dam on Grand Lake in cooperation with the U.S. Army Corps of Engineers' flood control operation of Grand Lake has increased the frequency of flooding (about once every five years) of Beaver Dam Cave, which has drowned bats in the past. During renewal of GRDA's Federal Energy Regulatory Commission Hydropower License, they consulted with the Oklahoma ES Field Office through Section 7 of the Endangered Species Act and a Biological Opinion was prepared indicating the effects and resulting in GRDA being required to help with and fund management of Beaver Dam Cave, Twin Cave and Jail Cave (another cave in the basin used by gray bats in the past).

The Department of Environmental Quality of Oklahoma, the City of Tulsa, and Indian Nations Council of Governments (INCOG) produced a Watershed Restoration Action Strategy in 1999 for the Eucha/Spavinaw watershed, which lies within the acquisition boundary of the Refuge and directly impacts the Refuge's water resources and wildlife. In this document the main sources identified that contribute to water pollution include: poultry litter/production; cattle/hog livestock; poor private septic systems; municipal permitted point sources dischargers; background nutrient sources; commercial fertilizer use; and soil erosion (City of Tulsa and INCOG, 1999). This Strategy outlines a cumulatively beneficial action plan; however, it may be outdated and should be revisited/updated.

4.3.1.4 Cumulative Impacts to Soils

Maintaining continuous stands of mature oak-hickory forest on up to 15,000 acres of Refuge will benefit surrounding lands and communities because it will stabilize the soil and reduce the potential for erosion. Many adjacent lands, however, are currently used for crop production, ranching or commercial development. Development, ranching and agriculture could cause cumulative effects of soil erosion, including more soil particulates travelling in the air from wind, tillage, and removal of native vegetation. In addition, development and monocultures could cause soil to erode into water sources on and around the Refuge. Continuous use of chemical compounds on or around the Refuge would mean that residues of a number of pesticides would continue to occur in soils throughout the lifetime of the CCP. The Refuge

would only use minimal herbicide spot-treatment, if necessary, on invasive flora of newly acquired lands in order to restore the land to native forest or other native habitat, which should not negatively impact the soils cumulatively. The Refuge would also collaborate with landowners adjacent to and near the Refuge to assist in conservation efforts by promoting sustainable land management practices.

4.3.2 Cumulative Impacts to Biological Resources

4.3.2.1 Cumulative Impacts to Vegetation/Habitats

The Refuge is surrounded by private agricultural lands and nearby developing urban centers, which have cumulative impacts for the habitat(s) within the seven county acquisition area of the Refuge. Some timber harvesting in the region has involved the clearing of forested areas, converting them to cattle and other agricultural uses. This results in the loss of mature tree forests, while increasing understory growth, increasing water runoff, and decreasing groundwater recharge. Mining operations near the Refuge remove trees and reduce habitat for bat foraging and other species. Current and projected agricultural uses on the landscape result in a patchwork mosaic of open rangelands, further fragmenting the Ozark forests. The region is also experiencing increasing road and right-of-way construction and other infrastructure development.

In a northeastern Oklahoma study, Bidwell et al. (2010) showed that caves and species within the caves were exposed to contaminants including pesticides, antibiotics and other pharmaceuticals, fragrances, and other plasticizers. Potential sources of water contaminants include sewage lagoons, municipal and industrial wastewater treatment outflows, septic systems, mining operations, fracking operations, runoff from landfills, confined animal feeding operations, roads, and agriculture occurring off-Refuge (Aley, 1990; 1999).

Earthquakes can greatly affect wildlife habitat on and surrounding the Refuge, especially cave habitat, due to the fragile karst formations. The Oklahoma Geological Survey released a study in 2011 examining whether the fracking activities in Oklahoma related to several series of earthquakes in Garvin County, Oklahoma in 2011. They conclude that “the strong spatial and temporal correlations to the hydraulic fracturing in Picket Unit B Well 4-18 certainly suggest that the earthquakes observed in the Eola Field could have possibly been triggered by this activity” (Holland, 2011).

In addition, increased urbanization has the potential to dramatically reduce or inhibit Refuge habitat management activities. As more homes surround the Refuge, prescribed burning becomes more expensive and more difficult to conduct safely.

City, State, Tribal, and Federal lands and other conservation areas adjacent to the Refuge would benefit from the protection of habitat and mitigate future development on that particular area.

Cumulatively, the Refuge contributes many beneficial impacts to habitat(s) within the seven county acquisition area and landscape-level. Within the lifetime of this CCP, the Refuge proposes to acquire and protect up to 15,000 acres of cave and forest habitat within Craig, Ottawa, Mayes, Delaware, Cherokee, Adair, and Sequoyah Counties to address Ozark habitat loss and fragmentation on a landscape-scale. Although the Refuge's contribution may be relatively small in acreage in the grander scale within these county's boundaries, preservation and restoration of this rare habitat in this region is invaluable. Furthermore, in Alternative B, the Refuge proposes to coordinate beyond the Service southwest (Region 2) regional boundary to more effectively manage federally listed Ozark cave species on a landscape-level by cooperating with Services Region 3 and 4 in managing Logan Cave, Cavefish, and Pilot Knob NWRs, as well as expanding cave habitat acquisition areas within four surrounding regions (Region 2, 3, 4, and 6 in Oklahoma, Arkansas, Missouri, and Kansas), which could extremely benefit federally listed species in a cumulative context.

Lastly, preserving and studying the uniqueness of subterranean habitats and life forms they host provides an important source of information for the advancement of scientific knowledge because caves and aquifers are unique evolutionary "laboratories" for the study of natural selection and adaptation (Graening, et. al, 2011). Caves also have unique ecosystems for ecological studies since habitat variables are stable, photosynthetic inputs are absent, amount of species is low, gene pool is restricted, and natural replication is plentiful (Culver, 1982). Refuge habitat management and inventorying and monitoring activities contribute beneficially, cumulatively, to the advancement of science.

4.3.2.2 Cumulative Impacts to Wildlife

Regionally, the Refuge anticipates increased habitat loss and fragmentation to occur in the coming 15 years from the general, long-term increase in population and development within and surrounding the seven county acquisition area. In general, such habitat loss and fragmentation would be detrimental to populations of many species of resident, native wildlife. Specifically, there is a potential for future development of wind energy farms on nearby migration corridors, which cause mortality in migratory bird and bat species due to direct strikes and barotrauma from turbine blades (Johnson et al, 2002). The Refuge would take an active role in participating in various wildlife migration corridor identification research projects on- and off- Refuge, which could be useful insight for planners to mitigate, for example, wind energy projects in wildlife migration high-risk areas.

Furthermore, the Refuge will mitigate habitat loss by acquiring up to 15,000 acres of beneficial habitat to native resident species, including cave species within these seven counties. Also, in

cooperation with private landowners, state, Tribal Nations, and other federal agencies, the Refuge can help to influence a conservation need within the Ozarks via education and partnerships, especially in order to protect and recover T&E cave species. A cooperative conservation movement would benefit T&E, species of concern, and non-T&E species alike, if all partners work to provide quality native habitat(s) for wildlife foraging, resting, breeding, nesting, roosting, hunting, etc. Additionally, in Alternative B, the Refuge proposes to coordinate beyond the Service Southwest (Region 2) regional boundary to more effectively manage federally listed Ozark cave species on a landscape level by cooperating with Regions 3 and 4 in or co-managing Logan Cave, Cavefish, and Pilot Knob NWRs, which lie outside of Ozark Plateau NWR's Region 2, as well as expanding cave habitat acquisition areas within the four surrounding Service regions: 2, 3, 4, and 6.

The disease, WNS, caused by the fungus *Geomyces destructans*, is responsible for unprecedented mortality in cave-hibernating bats in the northeastern and central U.S and eastern Canada (Lorch et al, 2011). This previously unknown disease has spread very rapidly since its discovery in January 2007, and poses a considerable threat to cave-hibernating bats throughout North America. More than 5 million hibernating bats have died since 2007 (Froschauer, 2012). Even though the Refuge has not had any WNS occurrences to date, it anticipates that the disease will spread to the Ozark Plateau area. If in fact, WNS does occur on or surrounding the Refuge, it could be catastrophic for bat populations. Not only does WNS threaten to decrease bat populations, but it also would affect insect populations that bats prey on, as well as cave species, including Ozark cavefish and Delaware County, which depend on bats to bring in sources of energy (via guano deposits) from the exterior of caves. Refuge staff, in addition to biologists with state and federal agencies and organizations across the country, are still trying to figure out how to minimize the spread and impacts of the disease and recover impacted populations. To date, seven bat species are known to be affected by the disease: gray bat (*Myotis grisecens*), the little brown bat (*M. lucifugus*), eastern small-footed bat (*M. leibii*), Indiana bat (*M. sodalist*), northern long-eared bat (*M. septentrionalis*), big brown bat (*Eptesicus fuscus*), and the tri-colored bat (*Perimyotis subflavus*). Four of these species, (gray, the northern long-eared, big brown, and tri-colored bats) occur on the Refuge. It is likely that WNS will affect bat populations on and around the Refuge within the lifetime of the CCP. It is difficult to predict which populations will be affected and the scale of impact to these populations and dependent cave species. The Refuge contributes to WNS research in both alternatives, and follows emerging news and research in order to be informed and prepared for occurrence adaptive management strategies. The Refuge will pull all resources it can to prevent WNS from occurring and/or mitigate the spread of WNS to all bat species, especially to T&E bat species and bat species of concern. Hopefully, Refuge mitigations, prevention methods, and adaptive management strategies will cumulatively benefit bat populations susceptible to the disease; however it may be extremely challenging to control.

4.3.3 Cumulative Impacts to the Socio-Economic Environment

4.3.3.1 Cumulative Impacts to Cultural Resources

No external factors have been identified that would contribute adversely to cumulative effects on the Refuge's cultural resources. At the close of the planning period, it is anticipated that the condition of the Refuge's cultural resources would remain intact and protected and society's knowledge and appreciation of them would be somewhat better than at present.

4.3.3.2 Cumulative Impacts to Local Population/Economy

The Refuge will have minor cumulative impacts on the local economy, because it provides very few public use opportunities in order to best conserve and protect cave and karst habitat for T&E cave species. Nonetheless, the public opportunities it does provide, especially those proposed in Alternative B, provide some cumulative economic benefits to the surrounding communities within approximately an 80 mile radius by generating revenue for the local economy (e.g., visitors stopping at local restaurants and shops). Some participants may come from TN, TX, MO, KS, OK, MS and AR, which also bring more revenue into the State of Oklahoma. In addition, much of the Refuge's annual budget is invested in equipment and supplies purchased primarily from local businesses, and are often spent on contracts for local labor to accomplish Refuge projects. The Refuge would also provide full-time employment for up to 9 people within the next 15 years, in addition to providing multiple local student research opportunities and paid-internships. Furthermore, a 2012 peer-reviewed national study by the U.S. Fish & Wildlife Service showed that homeowners owning a home near a national wildlife refuge increases the home value and supports the surrounding community's tax base.

4.3.3.3 Cumulative Impacts to Aesthetic/Visual Resources

The Refuge's management would enhance the scenic resources on a landscape-level, by protecting up to 15,000 acres of at least 80% mature oak-hickory-pine forest and cave habitat within Craig, Ottawa, Delaware, Mayes, Cherokee, Adair, and Sequoyah Counties of Oklahoma, adding to cumulative beneficial impacts on visual landscape. However, pushing in the opposite direction are growth trends in the area. Adding vehicles and commercial and industrial development would raise emissions of air pollutants that tend to compromise visibility and aesthetics of the landscape. Moreover, development outside the Refuge's boundaries, such as the recent construction of a wind farm to the east, will gradually fill the formerly rural landscape with a number of structures that many visitors might regard as unsightly clutter. On balance, it seems more likely that these adverse factors will predominate. To conclude, the Refuge's natural landscape character would become even more important in the future.

4.3.3.4 Cumulative Impacts to Public Use Opportunities/Access

According to the U.S. Census Bureau, the total population in Oklahoma is projected to grow by about 13.4% by the year 2030 (U.S. Census Bureau, 2012). In all likelihood, the rising local and state populations, along with increased development, will drive an increase in the demand for outdoor recreation and public use opportunities, such as hiking and hunting, on undeveloped, public lands in Oklahoma, including Ozark Plateau NWR. The Refuge would benefit surrounding communities by providing a natural space for people to reconnect with nature and learn about their local environmental resources and wildlife. As proposed in Alternative B, the Refuge would increase EE programs on the Looney Unit and allow hunting on the 2,280 acre, Sally Bull Hollow Unit, which would accommodate the projected increase in population and desire for accessing natural public use areas. In addition, it would enhance EE opportunities for tribal youth by collaborating with nearby tribes to provide Native American–led and –designed programs. These should cumulatively benefit tribal communities by enhancing opportunities for cultural preservation and environmental awareness. According to renowned author and journalist, Richard Louv, providing more programs and opportunities for children to have experiences in the outdoors has a great beneficial impact on “everything from a positive effect on the attention span to stress reduction to creativity, cognitive development, and their sense of wonder and connection to the earth” (von Zastrow, 2008). Cumulatively, increasing public use opportunities on the Refuge will enhance outdoor experiences, environmental consciousness, and may improve the wellbeing of surrounding community members.

4.4 Comparison of Resource Impacts by Alternative

KEY:
(-) = *adverse impact*
(+) = *beneficial impact*

Table A-7. Summary of Impacts by Environmental and Social Resources.

Environmental Resource	Impacts of Alternative A: No Action	Impacts of Alternative B: Proposed Action
Impacts to Climate Change	(-) moderate, long-term impacts due to CO_2 emissions (+) moderate long-term impacts due to carbon sequestration of 4,000 acres of forest (+) minor long-term impacts due to environmental education (+) minor impacts due to maintenance of energy-efficient appliances and water filter	(-) minor to moderate impacts due to CO_2 emissions (+) minor impacts due to climate monitoring (+) moderate impacts due to carbon sequestration of acquiring up to 15,000 acres of forest habitat (+) minor impacts due to environmental education (+) minor impacts due to use of energy-efficient retrofits, appliances, and water conservation (+) minor to moderate impacts due to use of renewable energy source (solar panels)
Impacts to Air Quality	(-) short-term minor impacts due to prescribed burns and wildfires, dust, welding, and emissions (+) long-term minor impacts of managing 4,000 acres of forest- producing oxygen and cleaning air	(-) short-term minor impacts due to prescribed burns and wildfires, dust, welding, and emissions (+) long-term moderate impacts of maintaining and restoring up to 15,000 acres of forest- producing oxygen and cleaning air
Impacts to Water Quality and Quantity	(-) minor localized impacts due to soil erosion, turbidity caused by human traffic in caves, soil compaction, and leaked fluids from maintenance (+) minor to moderate impacts due to managing and protecting approximately 4,000 acres of forest, groundwater aquifers and surfacewater resources	(-) minor localized impacts due to soil erosion, turbidity caused by human traffic in caves, soil compaction, and leaked fluids from construction/maintenance (-) minor to moderate short- to medium-term impacts on water quality due to use of herbicide spot treatment (+) moderate impacts due to protection of up to 15,000 acres of forest, groundwater aquifers and surfacewater (+) minor impacts due to increasing knowledge of water quantity/quality in permanent I&M program

Environmental Resource	Impacts of Alternative A: No Action	Impacts of Alternative B: Proposed Action
Impacts to Soils	(-) negligible to minor short-term impacts due to prescribed burns (-) minor short-term localized impacts due to invasive species removal and native tree planting (-) minor to moderate soil disturbance due to compaction and erosion of visitor use of trails and roads and cave gate construction (+) moderate impacts of maintaining and restoring 4,000 acres of mature stands of native trees	(-) negligible to minor short-term impacts due to prescribed burns (-) minor short-term localized impacts due to invasive species removal and native tree planting (-) minor to moderate soil disturbance due to compaction and erosion of visitor use of trails and roads, cave gate construction, and facility construction (+) moderate impacts of maintaining and restoring up to 15,000 acres of mature stands of native trees

Environmental Resource	Impacts of Alternative A: No Action	Impacts of Alternative B: Proposed Action
Impacts on Habitat	(-) minor, short-term, localized impacts due to human disturbance of cave habitats due to scientific monitoring and cave gate construction (-) minor to moderate localized impacts due to illegal cave entry and vandalism within caves (-) minor impacts due to cave gates restricting air flow within habitat (-) minor short-term impacts due to prescribed burns on two Refuge units (+) moderate impacts due to protection and restoration of 4,000 acres of forest, cave, and riparian habitats (+) minor to moderate impacts due to monitoring cave habitat quality, cave mapping, and groundwater delineation (+) minor impacts due to controlled cave entry (+) minor impacts on forest habitat due to prescribed burns	(-) minor, short-term, localized impacts to human disturbance of cave habitats due to scientific monitoring and cave gate construction (-) minor to moderate localized impacts due to illegal cave entry and vandalism within caves (-) minor impacts due to cave gates restricting air flow within habitat (-) minor, short-term impacts due to installation of cameras, alarms, climate data loggers and acoustic monitors (-) minor short-term impacts due to prescribed burns on 1/3 of total Refuge lands (-) minor impacts due to vegetation removal for trails (+) moderate impacts due to protection and restoration of up to 15,000 acres of forest, cave, and riparian habitats (+) moderate to highly beneficial impacts due to coordination efforts of expanding acquisition and cave management on a landscape level (+) minor to moderate impacts due to increase of law enforcement and alarm systems to prevent and reduce vandalism of cave habitats (+) minor to moderate long-term impacts due to increase in environmental education regarding cave and karst habitats (+) minor to moderate impacts on forest habitat due to increase of prescribed burns (+) minor to moderate impacts due to evaluation and control of invasive species

Environmental Resource	Impacts of Alternative A: No Action	Impacts of Alternative B: Proposed Action
Impacts on Wildlife (T&E and non-T&E)	(-) negligible to minor short-term impacts on cavefish due to florescent dye tracing affecting pH levels (-) minor, short-term, localized impacts due to human disturbance of cave wildlife for scientific monitoring and cave gate construction (-) minor to moderate localized impacts due to illegal cave entry and vandalism within caves (+) minor to moderate impacts of increasing knowledge by I&M of Refuge wildlife species (+) minor impacts due to controlled cave entry (+) minor long-term impacts due to environmental education programs increasing awareness of importance of bat, cave, and other wildlife species	(-) negligible to minor short-term impacts on cavefish due to florescent dye tracing affecting pH levels (-) minor, short-term, localized impacts due to human disturbance of cave wildlife for scientific monitoring and cave gate construction (-) minor localized impacts due to illegal cave entry and vandalism within caves (-) minor short-term to long-term impacts on Refuge species due to use of herbicide spot treatment (+) moderate impacts due to protection and restoration of up to 15,000 acres of forest, cave, and riparian habitats for T&E/Species of Concern (+) moderate to highly beneficial impacts due to coordination efforts of expanding acquisition and cave management on a landscape level for T&E/Species of Concern (+) minor to moderate impacts due to increase of law enforcement and alarm systems to prevent and reduce vandalism of cave habitats and species (+) moderate impacts of increasing knowledge by enhancing I&M of Refuge wildlife species (+) minor impacts due to controlled cave entry (+) minor long-term impacts due to environmental education programs increasing awareness of importance of bat, cave, and other wildlife species (+) minor to moderate long-term impacts due to restoration of historic fire regime (+) minor to moderate long-term impacts due to an increase of environmental education programs raising awareness of importance of bat, cave, and other wildlife species

Environmental Resource	Impacts of Alternative A: No Action	Impacts of Alternative B: Proposed Action
Impacts on Cultural Resources	(-) none anticipated (+) minor to moderate impacts by keeping cultural and historical sites protected and confidential	(-) negligible to moderate localized impacts due to the potential of discovering resources on new construction area of HQ (+) minor to moderate impacts due to the protection and preservation of newly discovered cultural/historical resource sites
Impacts on Socioeconomic Resources	(+) minor economic impacts to surrounding communities via staffing, supply purchases, and visitation	(+) minor increase to economic impacts to surrounding communities, via increase in staffing, increase in supply purchases, and anticipated increase in visitation
Impacts on Aesthetic and Visual Resources	(-) minor to moderate long-term impacts due to cave gate aesthetics (-) minor to moderate short-term impacts due to fires (+) minor to moderate long-term impacts due to fire enhancement of forest habitat and vegetation	(-) minor impacts due to weather stations (-) minor to moderate long-term impacts due to cave gate aesthetics (-) minor to moderate short-term impacts due to fires (+) minor to moderate long-term impacts due to fire enhancement of forest habitat and vegetation (+) minor impacts due to photography blind and overlook opportunities (+) minor impacts due to wood harvesting to clean up fuel loads (+) minor impacts due to establishment of trails for more wildlife-viewing opportunities
Impacts on Public Use	(-) minor impacts due to limited public use opportunities because of sensitivity of federally listed cave species (-) minor to moderate impacts due to lack of hunting opportunities on Refuge (-) minor impacts due to lack of public information regarding Refuge opportunities (+) minor to moderate impacts of EE, interpretation, wildlife photography and observation opportunities	(-) minor impacts due to limited public use opportunities on most Refuge units (-) minor impacts due to minor increase in traffic (-) minor to moderate impacts due to exposure to caves on Sally Bull Hollow and Looney Units (+) minor to moderate impacts due to proposal to allow hunting on the Sally Bull Hollow Unit (+) minor to moderate impacts of increasing EE programs and increasing awareness of local resources (+) minor impacts of increasing public outreach efforts (+) minor impacts due to adding trails for public use

4.5 Short-Term Uses versus Long-Term Productivity

The habitat protection and management actions under the proposed alternative are dedicated to maintaining the long-term productivity of Refuge habitats. The benefits of this CCP for long-term productivity far outweigh any impacts from short-term actions, such as the construction of a cave gate, installation of solar panels, or improvement of access roads and trails. While these activities would cause short-term negative impacts, the protection of habitat, increased scientific knowledge regarding cave and karst ecosystems, as well as public support gained from an enlightening outdoor experience, would produce long-term benefits on a landscape-level.

The key to protecting and ensuring the Refuge's long-term productivity is to find the threshold where public uses do not degrade or interfere with the Refuge's natural resources. The plans proposed have been carefully conceived to achieve that threshold. Therefore, implementing the proposed alternative would lead to long-term benefits for wildlife protection and land conservation that far outweigh any short-term impacts.

4.6 Irreversible and Irretrievable Commitment of Resources

Irreversible and irretrievable resource commitments are related to the use of finite resources and the effects that this use could have on future generations. Irreversible effects primarily result from the use or destruction of specific resources that cannot be replaced within a reasonable time frame, such as energy or minerals. Irretrievable resource commitments involve the loss in value of an affected resource that cannot be restored as a result of the action, such as extinction of a threatened or endangered species or the disturbance of a cultural resource.

Neither of the alternatives would result in a large commitment of nonrenewable resources. Project implementation would require the irretrievable commitment of fossil fuels (diesel and gasoline), oils, and lubricants used by vehicles and heavy equipment. However, the Refuge proposes to install and utilize solar power as a renewable energy source to provide electricity for Refuge facilities. Also, management actions in this document will require a commitment of funds that would then be unavailable for use on any other Service projects. At some point, commitment of funds to these projects would be irreversible, and once used, these funds would be irretrievable. The Proposed Action would result in some unavoidable harm or harassment to some wildlife; however, the actions proposed are merely to protect the Refuge's finite resources, not harm them. The Service would implement best management practices to minimize potential negative impacts.

4.7 Environmental Justice

Executive Order 12898 (Federal Actions to Address Environmental Justice in Minority and Low-Income Populations; February 11, 1994) was designed to focus the attention of Federal Agencies

on the environmental and human health conditions of minority and low-income populations, with the goal of achieving environmental protection for all communities. The order directed federal agencies to develop environmental justice strategies to aid in identifying and addressing disproportionately high and adverse human health and environmental effects of their programs, policies, and activities on minority and low-income populations. The order is intended to promote nondiscrimination in federal programs substantially affecting human health and the environment, and to provide minority and low income communities with access to public information and opportunities for participation in matters related to human health and the environment.

Neither alternative described in this EA will disproportionately place any adverse environmental, economic, social, or health impacts on minority and low income populations. Implementation of the proposed action is anticipated to benefit the environment and people in the surrounding communities.

4.8 Indian Trust Assets

Indian Trust Assets (ITAs) are legal interests in property held in trust by the United States for Indian Tribes or individuals. The Secretary of the Interior, acting as the trustee, holds many assets in trust. Examples of objects that may be trust assets are lands, minerals, hunting and fishing rights, and water rights. While most ITAs are on reservations, they may also be found off-reservations. The United States has an Indian trust responsibility to protect and maintain rights reserved by or granted to Indian Tribes or Indian individuals by treaties, statutes, and executive orders. These are sometimes further interpreted through court decisions and regulations. Tribal lands are lands that have been deeded to tribes or upon which tribes have a historical claim.

ITAs have been identified within and/or surrounding the seven county area approved acquisition boundary of Ozark Plateau NWR, including nearby tribal allotted lands and individually-owned tribal lands in trust by tribal members of Caddo, Cherokee, Eastern Shawnee, Miami, Modoc, Osage, Quapaw, Seneca-Cayuga, and Wyandotte Nations. The Refuge partners with many of these Tribal Nations to protect and conserve these lands, cultural resources, and essential cave habitat for important cave species. For example, under agreements with the Cherokee Nation, Ozark Plateau NWR monitors cave species populations on adjacent tribal land (ITA) and shares that information with the Tribe. Some archaeological and cultural resources have been found on the Refuge and are preserved in place by stabilizing the surrounding soils and restricting human use so as not to disturb these sites any further. No significant impacts are anticipated to affect ITAs from implementation of either Alternative described in the EA.

Chapter 5: EA Consultation, Coordination, and Document Preparation

5.1 Document prepared by:

Sarah Catchot
U.S. Fish and Wildlife Service Region 2, Division of Planning
Albuquerque, NM

Steve Hensley
Ozark Plateau National Wildlife Refuge
Tulsa, OK

Shea Hammond
Ozark Plateau National Wildlife Refuge
Colcord, OK

5.2 Agencies and individuals consulted in the preparation of this document:

Carol Torrez
NEPA Coordinator of U.S. Fish and Wildlife Service Region 2
Albuquerque, NM

Elizabeth Montgomery-Anderson
GIS Specialist of the Cherokee Nation GeoData Center
Tahlequah, OK

5.3 References

Arnold, Emily. March 8, 2006. “Bottled Water: Pouring Resources Down the Drain”. *The* Globalist.

Aley, T., and C. Aley. 1990. Hyrdogeology of Ozark cavefish caves in Oklahoma. Final Report submitted to The Nature Conservancy. Ozark Underground Laboratory, Protem, Missouri.

Aley T. J., and C. Aley. 1999. Recharge area delineation and hazard area mapping for Long and McGee’s caves in the Eucha Nature Preserve and for Twin Cave in the Twin Cave Preserve, Delaware County, Oklahoma. Contract Study to The Nature Conservancy. Ozark Underground Laboratory, Protem, Missouri.

Bidwell, J. R., C. Becker, S. Hensley, R. Stark, and M. T. Myer. 2010. Occurrence of organic wastewater and other contaminants in cave streams in northeastern Oklahoma and northwestern Arkansas. Archives of Environmental Contaminants and Toxicology 58 (2) 286-298.

Bidwell, Terrence et al. 2003. "Using Prescribed Fire in Oklahoma". Oklahoma Cooperative Extension Service, Division of Agricultural Sciences and Natural Resources, OSU, in cooperation with USDA NRCS, Oklahoma Department of Agriculture, Food and Forestry; and Oklahoma Department of Wildlife Conservation.

City of Tulsa & INCOG. 1999. "Watershed Restoration Action Strategy (WRAS) for the Eucha/Spavinaw Watershed".

Clean Air Task Force. 2004. "Death and Disease from Power Plants". Accessed 2012.

Crowley, Thomas J. 2000. "Causes of Climate Change Over the Past 1000 Years". *Science* 289, 270.

http://www.dnr.state.md.us/forests/publications/urban2.html

http://earthjustice.org/features/campaigns/fracking-across-the-united-states

Energy Information Administration. 2005; accessed April 2008. "Existing Electric Generating Units in the United States".

http://www.factoryfarmmap.org/#animal:all;county:40041;location:OK;year:2007

http://action.foodandwaterwatch.org/p/dia/action/public/?action_KEY=5232

http://www.forestthreats.org/research/tools/taccimo/library/Prescribed_Fire.pdf

http://www.Service.gov/refuges/about/pdfs/NWRSAmenityReportApril2012withCovers8.pdf

http://www.guidancebrokers.com/Tool1/office_space_square_footage_calculator.php

Heikens, A. L. 1999. Savanna, Barrens, and Glade Communities of the Ozark Plateaus Province. In eds. Anderson, R. C., J. S. Fralish, and J. M. Baskin: Savannas, Barrens, and Rock Outcrops of North America. Cambridge University Press. 470pp.

Holland, Austin A. August 2011. "Examination of Possibly Induced Seismicity from Hydraulic

Fracturing in the Eola Field, Garvin County, Oklahoma". Oklahoma Geological Survey. Open-file Report OF1--2011.

Howard, G. S. Johnson, & S. Ponce. 1983. "Cattle grazing impact on surface water quality in a Colorado front range stream". *Journal of Soil and Water Conservation*. Vol. 38 no. 2 124-128.

Hughes, Angela, Dennis Datin and David Cates. March 2012. Oklahoma Department of Environmental Quality. "Land Protection Division Tar Creek Section". http://www.deq.state.ok.us/lpdnew/TarCreekindex.html

http://www.invasivespeciesinfo.gov/unitedstates/ok.shtml

L.P. Waits and D. Paetkau. "Non-invasive Genetic Sampling Tools for Wildlife Biologists: A Review of Applications and Recommendations for Accurate Data Collection." *Journal of Wildlife Management*. 2005.

Lustgarten, Abrahm and ProPublica. June 2012. "Are Fracking Wastewater Wells Poisoning the Ground beneath Our Feet?" *Scientific American*.

Manley, Reeser. "Hardwoods better than conifers at sequestering carbon dioxide". Dec. 25, 2009. *Bangor Daily News.*

Noss, R. F. (2001), Beyond Kyoto: Forest Management in a Time of Rapid Climate Change. Conservation Biology, 15: 578–590. doi: 10.1046/j.1523-1739.2001.015003578.x

http://www.pwrc.usgs.gov/bbl/resources/ethics.cfm

http://www.sierraclub.org/committees/cac/water/bottled_water/

Roebuck B., A. Vakili, and L. Roebuck. 1999. *Cave Gate Airflow Disturbance – A Qualitative Study* for 1999 National Cave and Karst Management Symposium.

Rowinski, Pawel & Marcin Chrzanowski. Feb. 2011. "Influence of Selected Fluorescent Dyes on Small Aquatic Organisms". *Acta Geophysica* vol. 59, no. 1, pp. 91-109.

Schlegelmilch, Bodo B., Greg M. Bohlen, Adamantios Diamantopoulos, (1996) "The link between green purchasing decisions and measures of environmental consciousness", European Journal of Marketing, Vol. 30 Iss: 5, pp.35 – 55.

Sheibach, R. Bruce, Roy E. Williams, and Benjamin R. Genes. 1982. "Controlling Acid Mine Drainage from the Picher Mining District, Oklahoma, United States". *International Journal of Mine Water*, 1 (1982) 45 – 52. Granada, Spain.

http://www.sourcewatch.org/index.php?title=Oklahoma_and_coal

Straub, Noelle. Accessed June 5, 2012. "CLIMATE: Scientists Prescribe Controlled Burns To Protect Forests, Curb Emissions". http://www.ncprescribedfirecouncil.org/.

Tilman, D., P. Reich, H. Phillips, M. Menton, A. Patel, E. Vos, D. Peterson, J. Knops. 2000. Fire suppression and ecosystem carbon storage. Ecology 81:2680–2685.

Tulsa Historical Society "Learn" Online Exhibits. 2010. http://www.tulsahistory.org/learn/online-exhibits/

U.S. Census Bureau. 2010. (http://2010.census.gov/)

U.S. Census Bureau. "Population Projections by State". Accessed June 2012. http://www.census.gov/population/www/projections/statepyramid.html

USDA, Natural Resources Conservation Service (NRCS) – New Jersey. 2011. Soil Health Fact Sheet 5, Ocean County. "Corporate Lawn Converstion to Native Plants".

USDA, Natural Resources Conservation Service (NRCS) Soils. Accessed June 5, 2012. http://soils.usda.gov/sqi/concepts/soil_organic_matter/som.html

Van Lear, D.H. and T.A. Waldrop. 1989. History, use and effect of fire in the southern Appalachians. USDA Forest Service, Southeastern Forest Experiment Station, Gen. Tech. Rep. SE 54: 20 p.

Walmart Global Sustainability Report. 2010 Progress Update. Bentonville, AR. http://cdn.walmartstores.com/sites/sustainabilityreport/2010/WMT2010GlobalSustainabilityReport.pdf

White-nose Syndrome National Plan: http://www.Service.gov/WhiteNoseSyndrome/pdf/WNSnationalplanMay2011.pdf

Wittwer, R., C. Barden & S. Anderson. "Growing Oak Trees from Seed". Oklahoma Cooperative Extension Service NREM-5031. Oklahoma State University.

Zastrow, Claus von. April 2008. "'Last Child in the Woods': Our Interview with Best Selling Author Richard Louv". Public School Insights.

United States Fish and Wildlife Service
Environmental Action Statement

Within the spirit and intent of the Council on Environmental Quality's regulations for implementing the National Environmental Policy Act (NEPA), and other statutes, orders, and policies that protect fish and wildlife resources, I have established the following administrative record and determined that the action of implementing the Ozark Plateau National Wildlife Refuge Comprehensive Conservation Plan is found not to have significant environmental effects as determined by the attached *Finding of No Significant Impact* (following) and the *Comprehensive Conservation Plan and Environmental Assessment.*

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

9/12/13
Date

Jeff Haas, Project Leader
Sequoyah and Ozark Plateau National Wildlife Refuges

4/24/13
Date

Aaron Archibeque, Regional Chief
NWR System, Region 2

9/11/13
Date

Carol Torrez, NEPA Coordinator
Division of Planning, Region 2

9/10/13
Date

[This page intentionally left blank.]

FINDING OF NO SIGNIFICANT IMPACT

ENVIRONMENTAL ASSESSMENT FOR THE OZARK PLATEAU NATIONAL WILDLIFE REFUGE COMPREHENSIVE CONSERVATION PLAN U.S. FISH AND WILDLIFE SERVICE

The U.S. Fish and Wildlife Service (Service) has developed a Comprehensive Conservation Plan (CCP) and Environmental Assessment (EA) for the Ozark Plateau National Wildlife Refuge, which has an approved acquisition boundary that includes Adair, Cherokee, Craig, Delaware, Mayes, Ottawa, and Sequoyah Counties, Oklahoma. The CCP provides management direction for present and future refuge managers for the next 15 years. The Refuge took a landscape-scale approach in preparing the CCP, identifying issues and threats to the ecosystem including climate change, habitat fragmentation, degradation of cave, stream and forest habitat, wind energy farms, white-nosed syndrome, invasive species and fire management, and surface and ground water quality and quantity. The CCP describes management activities that occur on the Refuge and provides management goals, measurable objectives, and strategies designed to enhance and protect existing habitats for the benefit of wildlife. The goals and objectives shall guide management toward the Refuge's vision or the ecologically desirable outcome across the refuges. The CCP also identifies opportunities for environmental education, interpretation, public outreach, photography, wildlife observation, and other wildlife-dependent recreation opportunities; development of compatible facilities; habitat and wildlife management; and implementation of related programs.

An EA was completed to fulfill the requirements of the National Environmental Policy Act (NEPA) of 1969 and to inform the public of the possible environmental consequences of implementing the CCP for the Refuge. Two alternatives were developed and analyzed for potential impacts on the natural and human environment. Three other actions were considered but dismissed from detailed analysis, as documented in the EA. The EA was prepared to provide decision-making framework that 1) explores a reasonable range of alternatives to meet project objectives, 2) evaluates potential issues and impacts to the refuge resources and values, and 3) identifies measures to minimize the degree or extent of these impacts.

ALTERNATIVES CONSIDERED AND ANALYZED

Alternative A: Current Management (No Action Alternative)

This alternative is the baseline for comparison with the action alternatives because it does not involve change from current management programs and emphases. It represents biological management, land conservation and public use activities presently occurring and those that have occurred on the Ozark Plateau NWR since it was established. Ozark Plateau NWR would continue to: assure the continuing existence, and aid in recovery of federally listed endangered and threatened Ozark cave species; reduce the need for future listing of species of concern in the Ozarks; protect large continuous stands of Ozark forest essential to migratory interior forest nesting birds; and provide important environmental educational opportunities identifying the need for protecting fish and wildlife and other karst resources of the Ozarks.

Activities such as cave protection, fire management, forest management, threatened and endangered species and other wildlife management, research and monitoring, environmental education, interpretation, wildlife observation and photography, and public outreach would continue without any major changes. No hunting, fishing, or wood harvesting opportunities currently occur on the Refuge.

The Refuge would continue current management to address habitat loss and fragmentation by acquiring land and conservation easements from willing sellers (up to 15,000 acres) and entering into conservation agreements with private landowners, conservation organizations, state, Tribal Nations, and other federal agencies. The Refuge would not build or permit the construction of any new roads or infrastructure on Refuge lands except for Refuge operation purposes and would continue its practices of maintaining and restoring forested habitat as resources allow. Conservation agreements with the Cherokee Nation, City of Tulsa, and private landowners would continue to preserve forested and/or cave habitats.

The Refuge manages 3,977 acres of oak-hickory and oak-hickory-pine forest. The protection and management of these forested areas enhances carbon sequestration. The Refuge would continue to restore 70 acres of agricultural land to forested habitat at the Beck Unit (see *Invasive Flora* below). Additionally, the Refuge would maintain approximately 3,977 existing acres of forested habitat. Service staff and university partners would also continue monitoring the known maternity colonies and hibernacula annually. The Refuge would continue contracting with universities and NGOs to monitor mammals, birds, herpetofauna, fish, cave invertebrates, terrestrial insects, and vegetation. The Refuge would continue to implement the White-nose syndrome National Plan. Groundwater mapping efforts and monitoring would also continue.

Partnerships would continue to be an important part of the Refuge's actions to acquire, manage, and conserve lands, inventory and monitor, conduct research, assist in protecting and restoring habitat, share information about resources, conduct environmental education, and reduce Ozark habitat loss and fragmentation. The Refuge would continue working with landowners adjacent to and near the Refuge, private businesses, citizen science groups/projects, and nongovernmental organizations (NGOs) to implement conservation agreements, assist with wildlife management through the Partners for Fish and Wildlife program and Section 6 of the Endangered Species Act, and provide technical assistance. These partnerships will continue to help improve habitat quality on adjacent or nearby lands and also will prevent and minimize habitat loss and fragmentation in the Ozarks.

Alternative B: Proposed Action

The programs and activities discussed under Alternative A would continue and be enhanced. This alternative would provide for a proactive approach to making concerted strategic decisions, through the consideration and analysis of the best available science, based on the goals for management of the Refuge. This alternative was developed based on input received from the public, Oklahoma Department of Wildlife Conservation (ODWC), conservation partners, Service staff, and the professional judgment of the planning team. This alternative is based on successful pre-existing management strategies and has incorporated ecological principles that apply to Bailey's Central Interior Broadleaf Forest ecoregion province and Ozark Highlands ecoregion section.

This is the alternative that would best achieve refuge purposes, vision, and goals and would best contribute to the National Wildlife Refuge System mission. Alternative B, with associated goals, objectives, and strategies, comprises the CCP for the Ozark Plateau National Wildlife Refuge. This alternative would also stress the use of adaptive resource management based on observation and the most current scientific research. Additional inventories, monitoring, and studies would be implemented to better manage federally-listed threatened and endangered cave species, other species of concern in the Ozarks, and migratory and resident bird species; better understand the impacts of climate change; manage/control invasive species; and minimize the impacts of white-nose syndrome.

The Service would continue to work with conservation partners and increase collaboration and partnerships at a landscape-level on public and private lands, working toward maintaining the integrity of this isolated and threatened ecosystem. The Refuge would explore opportunities to expand acquisition boundaries in the Ozark ecoregion. The Refuge also would maintain, conserve, and restore up to 15,000 acres of acquired lands within the approved acquisition boundary to native forest habitat. A Fire Management Plan would be developed to increase the use of prescribed fire on up to 1/3 of the Refuge's acreage per year.

Recreational and Environmental Education opportunities would be enhanced and existing facilities improved. The Refuge would acquire and utilize/retrofit an existing building on newly acquired land as a Headquarters Site/Visitor Center or would build a new Headquarters Site/Visitor Center on appropriate areas of newly acquired lands. New maintenance shops and service buildings would be constructed, and residences for Refuge staff would be purchased or constructed. Wood harvesting by the public would only be permitted if Refuge forest and wildlife management needs dictate. In addition, the Refuge would develop a Hunt Plan to allow hunting on the Sally Bull Hollow Unit, adjacent to the State-managed Ozark Plateau Wildlife Management Area.

DECISION: THE SELECTED ALTERNATIVE

Alternative B was selected over the other alternatives because it best meets the Refuge's vision for the future, the purposes for which the refuge was established, and the habitat, wildlife, and visitor services goals identified in the CCP. This alternative is the basis for the Comprehensive Conservation Plan and describes how habitat objectives will be accomplished through a combination of management activities to encourage ecological integrity of caves, springs, streams, wetlands, watersheds, forests, and groundwater recharge areas, improve or maintain habitats for native and migratory wildlife and provide for environmental education and recreational opportunities. Future management actions will have a neutral or positive impact on the local economy and the recommendations in the CCP will ensure that refuge management is consistent with the mission of the National Wildlife Refuge System and U.S. Fish and Wildlife Service.

SUMMARY OF EFFECTS

Implementation of the Service's decision would be expected to result in environmental, social and economic effects as outlined in the CCP/EA and summarized here. The CCP describes habitat management, wildlife management, and land conservation objectives that would result in

improved habitat conditions. The proposed recreational opportunities would result in enhanced experiences for refuge visitors.

The Ozark Plateau NWR would continue to expand in accordance with the 2005 Land Protection Plan. Lands may be acquired if a willing seller or donor becomes available and acquired through fee title acquisition or conservation easement. Ozark Plateau NWR was approved to acquire additional land or easements from willing sellers and donors, up to 15,000 acres in seven counties of northeast Oklahoma. Conservation of these lands will protect valuable foraging areas and movement corridors for the federally listed endangered bats, as well as watersheds and ground water recharge areas important for maintaining surface and ground water quality for the federally listed threatened Ozark cavefish. In addition, sites will take into consideration appropriate geological formations including caves, springs, aquifers, losing and gaining streams, sinkholes, buffs and talus cracks. Expansion of the Refuge has also provided additional opportunities for various outdoor recreational activities, environmental education, interpretation, and scientific research. Conservation would allow beneficial minor to moderate and long-term effects to air, water, soil and habitats and wildlife. Restoring future acquired lands from non-native invasive flora species to native trees and native vegetation will increase the soil quality, and provide better habitat for native wildlife species, once established. These native plants and wildflowers are adapted to local soil pH, nutrient levels, soil moisture, and weather conditions.

Refuge management activities (prescribed burning, forest management, invasive species control, new construction, etc.) would result in short- and long-term negligible to moderate, both adverse and beneficial impacts to soils, air, water, habitat, and wildlife as described in the EA; however, the long-term impacts are expected to be beneficial. Restoring habitat on and surrounding the Refuge to conditions that promote a more open, and regenerating, mature forest condition (*e.g.*, basal area of 50-60 sq. ft.) is expected to provide an enhanced foraging environment and abundant food source for the endangered Ozark big-eared bat, and protect important flight corridors for endangered gray bats. Another purpose of Ozark Plateau NWR is to protect large continuous stands of Ozark forest essential to interior forest nesting migratory birds such as tanagers, warblers, and flycatchers that must nest some distance from an edge. The forest also plays an important role in preventing degradation of water quality in caves used by the threatened Ozark cavefish and other rare aquatic cave fauna such as the Oklahoma cave crayfish. Large stands of healthy forest also provide natural infiltration and percolation, reducing the amount of sediment, pesticides, and nutrients that might otherwise enter water bodies from surface run-off.

The refuge would increase some public uses and facilities in this alternative. However, any additions to public use opportunities would be small and produce only a minor effect on habitats. New facilities would remain within the already developed footprint so as to prevent habitat loss. Short-term wildlife and habitat disturbance may occur during construction of additional facilities. The public use management actions and associated facilities improvements might have a minor negative impact on habitat at the local scale but would also have a beneficial effect to public use opportunities on the widespread scale. Public use improvements will allow for increased public use and improve the quality and management of those opportunities. Allowing for more public use opportunities, such as hunting and wood harvesting, will improve relationships with the public/local landowners, Tribal Nations, and the State. It will also heighten awareness of what

Ozark Plateau NWR's purposes are. The refuge would also have beneficial impacts on the local economy through purchases, increased visitation and revenue.

Disturbance to wildlife at some level is an unavoidable consequence of any public use program, regardless of the activity involved. Obviously, some activities innately have the potential to be more disturbing than others. The management actions to be implemented have been carefully planned to avoid high levels of impact. As currently proposed, the known and anticipated levels of disturbance associated with management actions are considered minimal and well within the tolerance levels of know wildlife species and populations present in the area.

Implementing the Service's management action is not expected to have any significant adverse effects on wetlands and floodplains, pursuant to Executive Order 11990 and 11988, because there would be no development of refuge facilities within wetland or floodplain areas. There would be no adverse effect on threatened, endangered, proposed or candidate species and/or critical habitat, as documented in the intra-Service Section 7 (Endangered Species) Consultation completed with the Oklahoma Ecological Services Field Office and signed on November 15, 2012. In addition, archeological and/or historical resources would not be impacted.

The Refuge considered other past, present, or reasonably foreseeable future planned actions and no significant cumulative impacts would result from the addition of the proposed refuge management actions, as outlined in Alternative B.

PUBLIC OUTREACH, REVIEW AND COMMENT

Development of the Ozark Plateau National Wildlife Refuge CCP has been coordinated with all interested and/or affected parties.

Formal scoping began with publication of a notice of intent to prepare a comprehensive conservation plan and environmental assessment in the *Federal Register* on June 19, 1998 (63 FR 33693). The Refuge solicited public comments on issues and concerns to aid in CCP development through three open house meetings held in December 2009 at the Tribal Headquarters of the Cherokee Nation in Tahlequah, Oklahoma; the Senior Center in Stilwell, Oklahoma; and the Delaware County Library in Jay, Oklahoma. The Refuge also met on March 3, 2010, with the Cherokee Nation Environmental Protection Commission at the Cherokee Nation Headquarters to understand issues concerning the tribe and discuss potential ways to collaborate on solving issues common to the two agencies. On March 4, 2010, the Refuge met with the Oklahoma Department of Wildlife Conservation staff at the Porter Office in Oklahoma also to discuss their concerns regarding past management, future management, and issues common to both agencies. The feedback received at the conclusion of the public scoping period identified numerous concerns from a variety of stakeholders. This input was used in preparation of the Draft CCP.

The public was notified of the release of the Draft CCP and EA with a Notice of Availability published in the *Federal Register, Vol. 78, No. 27*, on February 8, 2013 ([FWS–R2–R–2012–N277] FR00001273). A postcard also was mailed to everyone on the Refuge mailing list notifying them of the Draft Plan/EA public review process. In addition, the Refuge also advertised in various media outlets (local newspapers and local and national social media sites)

and by posting fliers at local community centers and libraries. The public comment period was open for 30 days, closing on March 8, 2013. The Ozark Plateau NWR hosted three public meetings on February 25, February 26 and February 28, 2013 in the towns of Jay, Stilwell, and Tahlequah, Oklahoma. Approximately 36 participants attended these meetings. The Service received a total of 64 comments (letters, emails, and comments submitted orally and on comment forms during the public meetings). The comments were thoroughly reviewed and addressed in Appendix K (Response to Comments) of the CCP. The CCP did not change substantially based on public comment.

FINDINGS

Based on the analysis documented in the environmental assessment and with due consideration given to comments from the public and through consultation with the State of Oklahoma, it is my determination that the proposed action does not constitute a major Federal action that will have a significant effect on the quality of the human environment under the meaning of Section 102 (2) (C) of the National Environmental Policy Act of 1969 (as amended). As such, it is my conclusion that an environmental impact statement is not required for this plan and the selected alternative may be implemented as soon as practicable. This determination is based on the following factors (40 C.F.R. 1508.27), as addressed in the attached Environmental Assessment.

1. Both beneficial and adverse effects have been considered and this action will not have a significant effect on the environment (Environmental Assessment, pages A-77 – A-122).

2. The actions will not have a significant effect on public health and safety (Environmental Assessment, pages A-110 – A-114).

3. The project will not significantly affect any unique characteristics of the geographic area such as proximity to historical or cultural resources, wild and scenic rivers, or ecologically critical areas (Environmental Assessment, pages A-110 – A-111).

4. The effects on the quality of the human environment are not likely to be highly controversial (Environmental Assessment, pages A-78 – A-123).

5. The actions do not involve highly uncertain, unique, or unknown environmental risks to the human environment (Environmental Assessment, pages A-78 – A-123).

6. The actions do not establish a precedent for future actions with significant effects nor do they represent a decision in principle about a future consideration (Appendix A, Environmental Assessment).

7. There will be no cumulatively significant impacts on the environment. Cumulative impacts have been analyzed with consideration of other similar activities on adjacent lands, in past action, and in foreseeable future actions (Environmental Assessment, pages A-114 – A-123).

8. The actions will not significantly affect any site listed in, or eligible for listing in, the National Register of Historic Places, nor will they cause loss or destruction of significant

scientific, cultural, or historic resources (Environmental Assessment, pages A-110 – A-111).

9. The actions are not likely to adversely affect threatened or endangered species, or their habitats (Environmental Assessment, pages A-103 – A-106); Appendix F: Intra-Service Section 7 Consultation).

10. The actions will not lead to a violation of federal, state, or local laws imposed for the protection of the environment (Environmental Assessment, pages A-8).

Recommended: _____ 4/24/13

Jeff Haas, Project Leader — Date
Sequoyah and Ozark Plateau National Wildlife Refuges

Approved: _____ 9/12/13

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

[This page intentionally left blank.]